BOOKKEEPING AND COST ACCOUNTING FOR FACTORIES

WILLIAM KENT

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BOOKKEEPING

AND

COST ACCOUNTING

FOR FACTORIES

BY

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PREFACE

The author of this treatise was a bookkeeper and cost accountant for some years before he became an engineer, and many times during his career as an engineer and as manager of works he had occasion to install systems of bookkeeping and cost accounting and to audit books. In this way, and by reading much of the extensive literature on accounting, he has kept in touch for over forty years with the development of accounting practice. More than twenty years ago he was urged by the president of one of the largest manufacturing corporations in New England to write a book on factory cost accounting, but he was then too busy with other matters and the suggested book had to be postponed to the indefinite future. Some three years ago the suggestion was repeated at a conference of several professional accountants, who agreed that the literature on cost accounting was in a most chaotic shape and was altogether unsatisfactory.

The author then began a serious re-study of the subject, by reading many of the most recent books, both English and American (there has been a large crop of them in the last ten years), re-reading the articles on accounting that had appeared in *Engineering Magazine* and in the *Transactions* of the American Society of Mechanical Engineers during the last twenty-five years, and by visiting many factories and conferring with their managers and cost accountants. The result of the study was to confirm the statement that the word "chaos" properly describes the bulk of the literature, and the cost accounting methods in most factories. There are many good books on bookkeeping and ordinary accounting, and some useful books on certain parts of the general subject of cost accounting, but there seems to be a lack of books covering a wide field and representing the best modern practice.

The principal faults of the existing books may be listed as follows:

1. Over-conservatism. Adherence to old-fashioned theories and fallacies.
2. Over-development of red tape, leading to unnecessary clerical work.
3. Too much variety and novelty of method.
4. Vagueness and lack of detail in descriptive text.
5. Incompleteness. Partial treatment of complex subjects.

Accounting practice in factories, and that of professional accountants who are introducing their "systems" into factories, varies all the way from excellent to very poor. Some accountants are in advance of the books both in theory and in practice. Others have not yet come abreast of the modern ideas of accounting.

A few of the fallacies that are rapidly being discarded are: that interest on investment forms no part of factory cost; that business and selling expense are part of cost; and that a profit cannot arise until a thing is sold. Wrong methods of distributing burden are most common. The ratio of non-productive to productive labor is by many still considered to be an index of the efficiency of the manager. "Tying the costs to the general books" is erroneously supposed to prove the accuracy of the cost accounts. Inventories are priced and profits and losses are computed on the basis that the goods in the warehouse and stores are worth just what it cost to produce them, possibly many months earlier, although market values may have advanced or declined in the meantime. Inventories are inflated by charging to the cost of finished product the cost of keeping part of the factory idle.

The time has arrived when there is a need for a systematic treatise on cost accounting which will start the student at the beginning with the elementary principles of double entry bookkeeping and lead him through factory accounting to cost accounting, giving him not only the fundamental theory in accordance with the views of the ablest modern accountants, but also warning him against the time-worn fallacies of the older school. Such a treatise the author has undertaken to prepare.

The first three chapters treat of elementary principles, titles and definitions of accounts, and the evolution from the ordinary journal and ledger systems into the labor-saving methods of separate purchase and sales ledgers, column cash books and journals, up to the monthly column ledger, and finally to the combined journal-ledger, by means of which the troublesome trial balance is dispensed with. The Federal Trade Commission's system of accounts for retail merchants is then discussed, and it is shown how it can be improved by the use of the journal-ledger. Incidentally the Commission's views on Merchants' Selling Prices and Turnover are criticised.

Factory Accounting is then shown to be distinct from commercial bookkeeping, and the first principle stated is that in the general books of a manufacturing concern the operations of the factory should be treated as if they were those of a separate business, belonging to outside parties. Only two accounts need be kept with the factory, one for the investment in real estate and equipment, and the other, for the operations of the factory, called Manufacturing or Factory Operating account. This account is charged with all disbursements for factory operations, including purchases of material, payment of salaries, wages and expenses, together with monthly charges against the factory for its proportion of taxes, insurance, administration expense, interest on investment, and reserve for depreciation. The account is credited with the "factory cost" or "warehouse value" of all goods shipped from the factory.

In the factory books an account is opened with "Company," or "Private Ledger," which is the reverse of Factory Operating account in the general ledger. It is credited with all charges made by the Company against the factory and charged with the value of the goods shipped. No account of selling expenses is kept in the factory books.

When "Company" is credited with the values received from it, charges for the monthly total of these values are made to Factory Cash, Stores, Labor, and Burden, and in recording the factory operations these four accounts are credited and Work in Process, Worked Material, and Finished Product are debited. Numerous examples are given to show how these principles are worked out in practice.

Cost Accounting is then taken up, and the author divorces the accounting department from the cost department, having the latter determine costs by an independent method. "A new definition of Factory Cost is now needed. It is not *post-mortem* cost, what the goods cost last year, but what it now costs to reproduce them or what they will probably cost during the remainder of the current year, assuming that the factory runs at its normal rate" (page 49).

Various methods of cost finding are described, and the use of job tickets and stores-issue tickets is fully explained with examples. A long chapter is devoted to Distribution of Burden, and the errors of old methods are shown. The author considers the machine-hour rate as the basis of the best system for factories making "assembled" products, but shows how certain modifications of it may make the costs more accurate, and in the "Last Word on Burden; Standard Burden per Unit of Product" (page 81), explains a system by means of which the clerical labor of cost finding may be greatly lessened.

Other chapters treat of Depreciation, Inventory Valuation, Appraisals, "Systems" and "Red Tape," Daily and Monthly Records, Charting of Statistics, Cost of Idleness, Problems and Difficulties, Uses of Costs, Various Opinions about Costs, Classification, Symbols, Bookkeeping by Machinery. These, with the introductory chapters take up about one-half of the book. The remainder is devoted to practical cost accounting in various industries, including a blast furnace, a steel works, foundries, a hardware factory, a machine shop, a bakery, a textile mill, a woodworking shop, cost and price of coal, power plants, and printing shops. The final chapter contains examples of reports to stockholders of large corporations, numerous blank forms in addition to those given in other chapters, and a list of books on cost accounting and on scientific management.

The author here wishes to acknowledge his indebtedness to the many officers of corporations, accountants and others who have assisted him in his labors by allowing him to study their cost accounting methods. He is under especial obligations for courtesies extended by the following: Plimpton Press, Norwood, Mass.; New England Butt Co., Providence, R. I.; Yale & Towne Mfg. Co., Stamford, Conn.; Nash Engineering Co., South Norwalk, Conn.; Federal Printing Co., New York; National Meter Co., Brooklyn, N. Y.; Tabor Mfg. Co., Miller Lock Co., and Henry Disston & Sons, Philadelphia, Pa.; Ferracute Machine Co., Bridgeton, N. J.; H. H. Franklin Mfg. Co., Syracuse, N. Y.; Lodge & Shipley Co., and The Lunkenheimer Mfg. Co., Cincinnati, O.; and The Joseph & Feiss Co., Cleveland, O. He is indebted also to Mr. Gershom Smith, Manager of the Tabulating Machine Co., New York, and to Mr. Albert Walton, manufacturing accountant and industrial engineer, Philadelphia, who have kindly contributed matter which will be found under their names in the text.

Attention is called to some unusual features of the book, designed to make it convenient for readers and students, viz., the size of the page, $8\frac{1}{2}$ by 11 inches, double column, with two sizes of type, to facilitate reading and to give space for large forms and tables without using folders; the use of the wax process instead of photographic methods of reproducing forms; the substitution in the forms of clear lower case type for capitals and block letters which are often difficult to read; the very complete table of contents and index with occasional use of full-face type to call attention to the most important subjects; the index to forms and to names of authorities quoted; and the use of easily read figures in the tables, with diagonal lines for the fractions in all 6-point type.

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BOOKKEEPING AND COST ACCOUNTING FOR FACTORIES

CHAPTER I

BOOKKEEPING

ELEMENTARY PRINCIPLES

Bookkeeping is a systematic method of keeping accounts of business transactions.

Accounts are personal or non-personal:

A personal account is a record of the transactions of a business with a particular person, firm or corporation.

A non-personal account, sometimes called a "representative account," is one kept with things dealt in, such as Cash, and Merchandise, or Bills Receivable, and with expenditures for or receipts from other things than purchases and sales of the goods dealt in, for example, Expense Account; Interest Account.

The Ledger. An account is usually kept in a Ledger. The name of the account is written at the top of the page. In the ordinary form of ledger the page is divided into two sides, left and right hand, called the Debtor and Creditor (or Debit and Credit) sides, and is ruled as shown below:

Dr.				John Jones				Cr.			
1916											
Feb. 1	To Mdse.	24	17 10		Feb. 15	By Cash		11		26	35
3		25	9 25								

The meaning of these entries is that John Jones purchased merchandise on Feb. 1, $17.10 and on Feb. 3, $9.25, the details of the sale, corresponding with the bills or sales-tickets made at the time of the sale, being recorded on pages 24 and 25 of some other book, such as a Sales Book or Day Book, and that he paid the account on Feb. 15, as recorded on page 11 of a Cash Book. The words "To" and "By" are used as a matter of custom on the debit and credit sides respectively, but they are often omitted.

In this system of bookkeeping there are at least three books involved, two *books of original entry*, the Sales Book and the Cash Book, and a third book, the Ledger, into which entries are transferred or "posted" from the other books. In some lines of business, such as that of a country store, the Ledger may be a book of original entry, and it may be ruled as follows:

1916		John Jones	
Feb. 1	10 beef, 20	2	00
	30 pork, 20	6	00
	25 sugar, 7	1	75
	6 dz. eggs, 25	1	50
	2 lb. coffee, 30		60
	1 bbl. flour	5	25
		17	10
Feb. 3	1 pc. dress gds.	4	00
	1 pr. boots	5	25
		9	25
	Paid Feb. 15	26	35

In this ledger all the columns are debit columns, and there may be three or more money columns, depending on the size of the page.

The Card Ledger. The ledger may be kept on cards, which are filed alphabetically in a drawer, instead of in a book.

The Bill Files. The ledger and the sales book may even be dispensed with altogether. If a bill is delivered to John Jones each time he makes a purchase, a carbon copy of the bill may be put in a folder or envelope marked with his name, and kept in a filing case or drawer of Unpaid Bills in which the folders are arranged alphabetically. If bills are rendered monthly, a sales memorandum or sales ticket for each sale is similarly filed, and at or near the end of the month all the John Jones tickets are taken out of the folder and a type-written bill and a carbon duplicate are made from them, the duplicate being placed in the unpaid bill file while the original is sent to Jones.

Originals should be kept. The original sales tickets, or the carbon copies of the original bills delivered with the several sales, should be filed carefully and preserved for two years as a precaution in case any dispute should arise about the account.

When Jones pays his bill or bills, the duplicates are taken out of the unpaid bill file, marked paid and placed in the file of paid bills. The amount of cash received is entered in the cash book, which may be of any shape and ruling suitable to the kind and extent of the business, the following being the common form:

The Cash Book

Dr. Cash				Cash Cr.			
1916							
Feb. 13	To Balance, forward	317	96	Feb. 13	By Expense, Clerk hire	24	17
14	To Wm. Smith on acct.	50	00	14	By Mdse (Thomson's bill)	15	00
15	To John Jones in full	26	35	15	By W. Robinson & Sons	217	24
		394	31		By Balance	137	90
						394	31
Feb. 16	To Balance	137	90				

The receipts and payments of cash are usually kept on opposite pages of the book, the Dr. side (receipts) always being the left-hand page and the Cr. (payments) the right-hand page; corresponding to the Dr. and Cr. side of a ledger page. The entry "By Balance, 137.90" on the Cr. side is usually made in red ink.

Labor-saving Methods. The difference between modern bookkeeping systems and old-fashioned ones is not in the principles, which are as unchangeable as those of arithmetic, but in the use of labor-saving methods, such as card ledgers, bill files, and other "short cuts."

An example in labor saving is shown in the modern way of paying bills by checks sent by mail. Fifty years ago Jones would have written a letter in copying ink reading as follows:

New York, Feb. 14, 1866.

Messrs. Thomas Brown & Sons,
230 Washington St.,
City.

Gentlemen:

I beg to enclose my check No. 1234 on the Bank of North America for $26.35 in payment of your invoices of 1st and 3d inst. Kindly acknowledge receipt.

Yours respectfully,

JOHN JONES.

He would make a press copy of this letter in a letter book, make a note of it in the index, and enclose it in an addressed envelope. On receiving the letter Thomas Brown & Sons would mail John Jones a formal receipt together, possibly, with a courteous letter of thanks, using time, paper, ink and postage stamps.

In the year 1916 he would receive his monthly bill in a "window" envelope, his name and address being printed by an addressograph on a perforated coupon attached to the bill, which is folded so that the name and address show through the transparent paper in the "window." Here is one style of coupon:

SPECIAL NOTICE

IF THIS BILL IS PAID BY CHECK AND NO FURTHER RECEIPT REQUIRED PLEASE DETACH THIS COUPON AND MAIL WITH CHECK

Folio 1794 Date Feb 1, 1916

Name Mrs. John Jones

Address Montclair N. J. Amount 21.09

James McCreery & Co., 5 W. 34th St. N. Y.

When a concern pays a bill it is no longer customary to send a letter with the check, requesting that a receipt be returned. The check is merely enclosed with a printed coupon attached to it, something like the following:

The coupon may be dispensed with, and instead there is printed on the back of the check, at the top:

IN PAYMENT OF ACCOUNT AS PER STATEMENT OF.....191..

In some places the labor of making and mailing monthly checks is still further shortened. The customer makes a list of all his monthly bills, giving names and addresses of the creditors, and sends to his local bank a single check for the total amount. The bank lumps together all the amounts due to each creditor, and sends each a cashier's check (or a credit memorandum if the creditor is a depositor in the same bank) for the total amount due him, thus acting as a clearing house between debtors and creditors.

Single-entry Bookkeeping. The system of accounts described above is called single entry. Personal accounts only are kept in the ledger, and there is only one entry for each transaction. We "charge" or "debit" John Jones's account when he makes a purchase and credit it when he pays his account. A creditor, one from whom we purchase goods, is credited when we receive his bill or statement of account, and charged or debited when we pay him. The system is rarely used by any except very small business concerns, because it does not give all the information that the owner wishes to know about his business, such as the amount of merchandise bought or sold during any given period, the amount of bills or notes receivable or payable received, issued or outstanding, and the amount of expenses.

Double Entry. In double-entry bookkeeping, which is in almost universal use, ledger accounts are kept not only with persons, firms and corporations, but with things, such as cash, merchandise, bills payable, bills receivable, and with interest, discount and expenses of various kinds, also with the owner for his investment or net assets; and there is a profit and loss account to show gains or losses. The chief principle of double-entry bookkeeping is that for every transaction an entry is made to two or more accounts, and that the entry or entries made on the debit side of the ledger must for every transaction be equal in amount to the entry or entries made on the credit side. The ledger thus is always "in balance," provided all the posting from the journal and other books has been done and no errors have been made; that is, the sum of all the entries on the debit sides of all the accounts equals the sum of all the entries on the credit sides. The "balances" or differences between the debit and credit sides of the several accounts, when listed and summed up in a "trial balance," will also be in balance; that is, the sum of the debit balances will equal the sum of

The above check is in payment of account as shown below. Tear off at perforation before using at bank. No receipt or acknowledgment is necessary. If unsatisfactory return all papers for adjustment.

Date	Our No.	Details of Payment Made by This Remittance from Company	Amount of Charge	Less Discount	Less Freight	Other Deductions	Net
11 2	53191	Balauce of Account					516 67

Detach this statement before depositing check.

the credit balances if the "posting" has been done correctly.

The John Jones transactions shown on page 1 in single entry will appear as follows in a double-entry ledger:

(Page 26)

Dr.	Merchandise					Cr.
			Feb. 1	By John Jones	24	17 10
			3	By John Jones	25	9 25

(Page 6)

Dr.	Cash			Cr.
Feb 15	To John Jones	11	26 35	

(Page 130)

Dr.	John Jones						Cr.
Feb. 1	To Mdse.	24	17 10	Feb. 15	By Cash	11	26 35
Feb. 3	To Mdse.	25	9 25				

In order to save time and ink when there are hundreds or thousands of personal accounts, the expressions "To Mdse" and "By Cash" are often omitted.

The Journal. In the above entries the credits to merchandise account and the two charges to John Jones were posted from the Sales Book, and the debit of Cash and the credit of John Jones were posted from the Cash Book, but it is customary in double-entry bookkeeping to have another book called the Journal, which may be a book of original entry containing either all of the transactions of a business or only those which are not entered in the sales book, cash book or other book, or it may be an intermediate book between the books of original entry and the ledger, in which transactions are summarized or grouped, in order to avoid crowding the ledger with unnecessary detail. When all the transactions are entered in the Journal it is sometimes called the *Day Book* or *Blotter*. Entries in a Journal are always made in "journal form," that is, in Debtor and Creditor style, but in a Day Book they may be made in ordinary language, as below:

DAY BOOK

Tuesday, February 1, 1916		
Sold John Jones (here insert items)	17	10
Thursday, February 4, 1916		
Sold John Jones (items)	9	25
Tuesday February 15, 1916		
John Jones paid his account	26	35

JOURNAL

(Page 24)	Tuesday, February 1, 1916	Dr.		Cr	
130	John Jones Dr.	17	10		
20	To Mdse.			17	10
(Page 25)	Thursday February 3, 1916				
130	John Jones Dr.	9	25		
20	To Mdse.			9	25
(Page 32)	Tuesday February 15, 1916				
6	Cash Dr.	26	35		
130	To John Jones			26	35

These entries are posted in the ledger as already shown. As each journal entry is "posted" a figure showing the page of the ledger on which the account appears is entered in the first column of the journal.

In actual bookkeeping the expression "Dr." and "To" in the above entries and Dr. and Cr. at the tops of the columns are generally omitted.

Except in small businesses it is not customary to make a journal entry of each separate transaction, as above shown, but once a month to make group entries of transactions of a similar kind, the original entries of which are made in other books, as below:

Feb. 29

	Sundries				
	To Mdse.				X
130	John Jones	26	35		
175	Wm. Smith	46	17		
161	Thos. Robertson	93	20		
	X. The sum of all the charges to individual accounts is entered here as a credit to Merchandise account.				
	Cash To Sundries	X			
130	To John Jones			26	35
175	To Wm. Smith			30	00
161	To Thos. Robertson			85	10
	X. Enter here the sum of all the cash receipts which are credited to individuals				

The word "Sundries" means the "several accounts stated below."

In the actual practice of large concerns both of the above entries would be omitted from the journal, on account of their involving an unnecessary amount of labor. The charges to Jones and others would be entered directly from the sales book and the credit to Mdse. would be the total of the monthly entries in the sales book. So also the receipts of cash would be entered to the credit of individual accounts directly from the cash book, and the debit to Cash account would be the total cash receipts of the month.

Rules for Journalizing. Certain rules for making entries in journal form, whether they are made in the journal or in books of original entry such as the cash book or the sales book, are memorized by bookkeepers, and their careful observance is essential for correct work. Such rules are as follows:

Rule 1. When a thing is received and a thing is given for it at the time, the thing received is Dr. to the thing given.

Rule 2. When a thing is received and nothing is given for it at the time the thing received is Dr. to the party from whom it was obtained.

Rule 3. When a thing is given and nothing is received for it at the time, the party to whom it is given is Dr. to the thing given.

General Rule. The account that receives value is Dr. to the account that gives or parts with value.

Examples

Transactions	Entries
Rule 1. We buy Mdse. and pay Cash	Mdse. Dr. to Cash.
We sell Mdse. and receive a note.	Bills Receivable to Mdse.
Rule 2. We receive Cash from John Jones.	Cash Dr. to John Jones
We buy Mdse. on time from Peter James.	Mdse. Dr. to Peter James.
Rule 3. We sell Mdse. to John Jones on time.	John Jones Dr. to Mdse.
We pay Cash to Peter James.	Peter James Dr. to Cash.

Loss and Gain Accounts. While these rules are sufficient for most business transactions, such as purchases and sales, payments of cash or issue of notes for merchandise, or to settle open accounts and the like, they are scarcely sufficient without the use of some sort of bookkeeping fiction for other kinds of transactions, such as the payment of taxes, clerk hire, interest on borrowed money, the receipt of allowance for defective goods, or for changes in the value of accounts, such as may be caused by appreciation or depreciation of property, bankruptcy of debtors or other causes. To cover these cases we have another general rule to be memorized:

Loss and Gain Account

Debit for Losses Credit for Gains

Loss and Gain Account, or Profit and Loss Account as it is commonly called, is an account that represents all changes in the net assets of a concern that are due to gains or losses of any kind. Such changes are not always entered at the time they occur. An appreciation in the value of land or the depreciation in the value of a building or of machinery or goods may not appear in the books until the proprietor of the business finds it convenient or advisable to make the entry.

Discount, Interest, Taxes, Insurance, Commissions, Advertising, Clerk Hire, Freight and Cartage, Fuel, Light, Depreciation and similar expense accounts are branches or subsidiaries of the general Profit and Loss Account, and their balances (that is the difference between their debit and credit columns) are transferred to Profit and Loss Account at the end of the year or other time for closing the books. Several of these accounts, which represent the general constandly recurring expenses of the business, are commonly lumped into one account, called Expense Account. Discount and Interest is a single account representing both receipts and payments or allowances for discount or interest. Expense Account and Discount and Interest, and all losses or gains on any other account, such as Merchandise Account, are closed into Profit and Loss Account at the end of the year.

Invoice Book. An Invoice Book is a book in which all purchases of goods and all bills for expenses are recorded. In small concerns having a limited amount of transactions in each month they may be entered directly in the Journal, but in larger concerns an invoice book of some form is used, and its summarized records are entered monthly in the Ledger. It may be either a book similar to the Journal, all entries being written in it, or it may be a large bound book of blank manila leaves in which the bills are pasted monthly after being sorted and arranged in alphabetical order. A vertical letter filing case may be substituted for the book, the bills being filed in folders labeled with the names of the creditors and arranged alphabetically.

Invoice Ledger and Sales Ledger. In order to prevent the Ledger from being too bulky, when there are a great many personal accounts to be kept, the personal accounts are removed from it, putting the accounts of creditors in a separate book, called an Invoice Register, Invoice Ledger, Purchase Book, or Accounts Payable Book, and the accounts of debtors or customers in a Sales Ledger. The monthly total of the entries in the Invoice Book is entered in the General Ledger to the credit of Accounts Payable, "By Sundries," and this account is debited "To Cash" for the total monthly cash payments of invoices. The monthly total of sales shown in the Sales Book is charged in the General Ledger to the debit of Sales Account or Accounts Receivable, "To Sundries," and this account is credited monthly with the total cash receipts from sales.

Having thus described the general principles of double-entry bookkeeping we will in the next chapter illustrate their application to an ordinary commercial business.

The Trial Balance. When all the monthly entries have been posted into a double-entry ledger from the Cash Book, Journal, Sales Book, Invoice Register or other books, the ledger will be "in balance" if the entries have been made correctly, for in double entry the sum of the debit items entered must always equal the sum of the credit entries. If we make a list of all the open accounts in a ledger and sum up the totals on the debit side and on the credit side of each account these two totals will balance, but this is not often done; it is sufficient to take the balance or *differences* of the two sides of each account and write them on the Dr. or Cr. sides of the trial balance, according to whether the Dr. or Cr. sides of the account is greater. The sum of the balances on the two sides, if no error has been made, must be equal.

If the ledger is found to balance, that is, the trial balance shows that the sum of the Dr. balances equals the sum of the Cr. balances, it is generally assumed that the ledger has been properly posted and that it represents the true condition of the accounts. There are, however, possible errors which the trial balance does not reveal. They are: 1, Failure to post a journal entry, both Dr. and Cr. sides. 2, Posting an entry to a wrong account. 3, Making two errors in posting or in addition, or subtraction, or the transcribing from the ledger to the trial balance, one of which balances the other. As a possible means of finding an error of this kind, several steps may be taken.

1. Compare the balance of Cash in the Trial Balance with that in the Cash Book.

2. Compare Bills Receivable with the total of notes receivable on hand.

3. Compare Bills Payable with the balance shown in the Bill Book.

4. Compare Accounts Receivable with the total balances in the sales ledger or with the total of unpaid accounts shown in the carbon copies in the file of customer's accounts unpaid.

5. Compare Accounts Payable with the total of unpaid bills in the Invoice Register or with the total of the file of unpaid bills for purchases.

6. Compare the present month's trial balance with the one of the previous month to see if the figures of those accounts in which there have been no transactions or entries during the month (such as Real Estate, Office Furniture, Capital Stock, Bond and Mortgage) are unchanged.

If the two sides of the trial balance do not agree there is an error somewhere and it must be searched for until it is found. When the ledger has a great number of accounts this is often a long and tedious operation. The error may be in the trial balance itself; it may be found by taking a new trial balance, verifying the lead-pencil footings of the Dr. and Cr. sides of each account and the difference between them, which is entered in the trial balance. If the second trial balance shows the same figures as the first, then the postings in the ledger must be checked against the figures in the Cash Book, Journal and other books from which the postings were made, the bookkeeper or clerk calling off the figures from the several books while an assistant checks their posting in a ledger. If the error is not found in the posting, then the several books must be examined to see if the debit entries balance the credits. If the error remains undiscovered, the next step, and it is a long one, is to find if the previous month's trial balance correctly represents the difference between the lead-pencil footings of the Dr. and Cr. columns of the ledger when the trial balance was taken, then to post that trial balance in a new temporary ledger made on sheets of paper, then post in that ledger every entry of the month, first verifying the figures of the Dr. and Cr. items of each entry; then take a trial balance of the temporary ledger and compare it with the original trial balance.

One of the best ways to lessen the trial balance difficulty is to have as few accounts as possible in the general double-entry ledger, keeping the Sales Ledger and the Purchase Ledger by single entry. The accounts of a factory should be kept in a separate set of books from those of the general offices, the whole of the operations of the factory being represented in the general ledger by a single Manufacturing or Factory Operating Account.

Perhaps the best of all the ways is to adopt the Column Ledger or Combined Journal-Ledger which is its own trial balance. This is fully described later.

THE BOOKKEEPER, THE ACCOUNTANT, AND THE ENGINEER

A bookkeeper is a man skilled in the art of keeping the books of a business. A good bookkeeper is a good penman, quick at figures, rapid and accurate in making entries, posting the ledger, taking trial balances and the like.

An accountant is a man versed in the theory and practice of accounts, capable of originating a bookkeeping system and of directing the bookkeeper, and skilled in interpreting the language of bookkeeping and in making reports and drawing conclusions from the records in the books.

A cost accountant is a man who possesses not only the general knowledge and skill of an accountant, but who has in addition the special knowledge and experience necessary to originate and keep a system of accounts which will show in gross and in detail the costs of a manufacturing or other industrial or financial operation, and to make reports and draw conclusions from records of costs.

An industrial engineer is a man capable of managing an industrial enterprise, and who possesses as part of his equipment such a knowledge of cost accounting as will enable him to supervise and direct the cost accountant.

Engineers need sound knowledge of the principles of double-entry bookkeeping, if for nothing else, to enable them to exercise a close, intelligent and independent supervision of manufacturing costs.—Humphreys.

Relation between the Accountant and the Efficiency Engineer (C. E. Knoeppel and Harold Burt, *Journal of Accountancy*, Vol. 21, 1916, p. 101):

The real trouble is this: The accountant looks upon the efficiency movement as a visionary, radical and revolutionary thing, full of inconsistencies, because it seems to violate all the principles of good accounting practice. The engineer views accounting as a theoretical exposition of facts and figures which are misleading, incorrect, as well as dangerous to use, and violating all the rules of good practical management.

The accountant and the engineer can get together if each will get away from the feeling that the other does not know what he is talking about.

The accountant and the engineer should hold frequent conferences and each study the work of the other. Both should recognize that the engineer is concerned with the things that are to be accomplished while the accountant is concerned with things that have been accomplished.

A slight modification of the wording of the first of the above quotations would make it more accurate. For "the accountant," in the first line, read "some accountants of the old school," and for "the engineer" read "some half-educated engineers, who are not versed in modern accounting practice." The fact is that within the last few years industrial engineers and accountants (or a few of them at least) have got together, and each knows what the others are talking about. In many cases industrial engineers are accountants themselves and are training other accountants.

The student who wishes to learn more of the details of bookkeeping than are given in the above highly condensed treatment is advised to purchase two or three old books on the subject at a second-hand book store and get the views of different authors on the fundamental theory, then for a great variety of detailed instruction and forms, with much good advice, get a recent edition of J. H. Goodwin's Improved Bookkeeping and Business Manual, published by Mr. Goodwin at 1547 Broadway, New York City.

CHAPTER II

TITLES AND DEFINITIONS OF ACCOUNTS

Stock

When a man is in business for himself his individual account, representing the capital he has invested in the business, is commonly called "Stock." It might be called "Capital," "Owner," or "Proprietor," or the man's name might be used.

George Robertson (Partner's name)

When there are partners each partner has an account under his own name. The credit balance of each partner's account represents the amount of his interest in the business.

Capital Stock; Common Stock; Preferred Stock

In the case of a corporation the par value of the stockholders' interests is represented by an account called Capital Stock. If there are two kinds of stock there is an account for each. The credit balance of Capital Stock account (or accounts) is the par value of the stock issued or outstanding. A Stockholder's Ledger (not a part of the general books) is kept to show the number of shares that each stockholder owns. A stockholder is credited in it with the number of shares he owns and charged with the shares he parts with.

Profit and Loss Account (Loss and Gain)

To this account are transferred all the profits and losses shown in the accounts representing business transactions. If an account shows a profit (there being a balance on the credit side of it after the inventory balance has been added) the amount of that profit is transferred to the credit of Profit and Loss Account by a journal entry. If an account shows a loss, such as an expense account, the amount of that loss is charged to Profit and Loss.

Profit and Loss is Debited with *Losses*
and Credited with *Profits*.

Loss and Gain

Debit Losses Credit Gains

An item on the *left* or *debit* side of the ledger is an asset if the amount eventually will be received, is a loss if the amount eventually will not be received.

An item on the *right* or *credit* side of the ledger is a liability if the amount will eventually have to be paid; is a gain if the amount will eventually not have to be paid.—Humphreys.

There is an apparent exception to the latter statement in the fact that Capital Stock, Surplus, Proprietor's account, and usually Profit and Loss, are on the credit side of the ledger, and do not "eventually have to be paid," but this is not in reality an exception, for the amounts of these accounts represent the indebtedness of the business to its owners, and it will eventually have to be paid to them if the assets are all sold and the business wound up or "liquidated."

Surplus; Dividend

If Profit and Loss account, after all the entries have been made in it at the end of a fiscal period, shows a credit balance that is the net profit. If it shows a debit balance that is the net loss.

In either case the account may be closed in red ink To (or By) Balance, and the balance brought down.

Or in case of a business owned by a single proprietor it may be closed by a journal entry, transferring the profit to the credit side of Stock Account or the loss to the debit side of that account.

In the case of a partnership, the balance of Profit and Loss Account is to be subdivided among the several partners in accordance with the terms of the partnership agreement, and a journal entry made transferring each partner's share of the profit or the loss to his individual account.

In the case of a stock company the disposition of the balance of Profit and Loss Account depends on the decision of the directors. They may decide to leave the account open and bring the balance down, and this is generally done when the account has a debit balance, showing a loss or "Deficit" on the year's business. If there is a gain the account may be charged through a journal entry, and Dividend Account credited, with such portion of the profits as it is deemed advisable to distribute to the stockholders, another portion may be transferred to one or more Reserve accounts, such as Reserve for Bad Debts, another portion to Surplus account, representing the increased value of the business over the par value of the outstanding Capital Stock. When the dividends are paid in cash, Dividend Account is charged and Cash credited.

Merchandise Account

Merchandise Account in ordinary bookkeeping is a mixed account. We charge it with the cost of our purchases at the invoice price. If we are allowed a discount of 2 per cent for prompt cash payment we do not credit Mdse. but credit Discount. If we keep the merchandise several months before selling it we do not charge it with storage, insurance or interest on the investment, but let these expenses be hidden in the expense accounts. If we sell the goods we credit Mdse. account not with the cost of the goods sold but with their gross selling price. If we allow the purchaser a cash discount, we do not charge it against Mdse. Acct. but against Discount. When we take a balance of Mdse. Acct. we do not get the

value of our Mdse. assets, but a figure which is made up of value of the goods on hand and of the profits or losses on the goods that have been sold. In order to separate the value of the goods on hand from the profits or losses it is necessary to take an inventory.

EXAMPLE

Buy $1000 worth of goods. Allowed 2 per cent discount for prompt payment, $20. Shall we make the entry on the Cr. side of the Cash Book, By Mdse. $980, or shall we make it By Mdse. $1000 and enter on the Dr. side To Discount $20? It is customary to do the latter on the theory that we shall probably have to give a cash discount when we sell the goods, or that we may have to keep them for some months before selling them, costing us interest on the investment, storage and insurance, so that they will cost us $1000 before they are sold; also on the theory that financial accounts like Discount and Interest should be kept separate from Mdse. account, in order to have the books show how much we gain or lose by taking or giving discounts. Suppose we sell the goods, after keeping them three months, for $1100 and allow 2 per cent discount for cash. The entries then will be:

CASH

Jan. 10	To Discount	20	Jan. 10	By Mdse.	1000
April 10	To Mdse.	1100	April 10	By Discount	22

MDSE.

Jan. 10	To Cash	1000	April 10	By Cash	1100

DISCOUNT

April 10	To Cash	22	Jan. 10	By Cash	20

Increase of Cash, $98; Profit on Mdse., $100; Loss on Discount, $2. Net profit on the transaction, apparently, $98, no entries having been made of the loss due to expenses, such as interest on the use of the money, which might have been invested in goods having a more rapid turnover, and storage, insurance, cost of handling, clerical work, etc., all of which are covered in the general expense accounts, which are not apportioned to particular transactions.

Trading Account; Purchase Account; Sales Account

On account of the complex nature of Merchandise Account some accountants split it up into two or three accounts, Trading, Purchase, and Sales. One author goes so far as to say that Mdse. Acct. is obsolete and that no first-class modern bookkeeper would use it, although perhaps 99 per cent of all bookkeepers do use it. Purchase Account, or Merchandise Purchased is charged with the cost of purchased goods and credited, Sales, or Trading, being charged, at the cost price, for the goods sold, the balance showing the cost of goods remaining unsold. Sales, or Trading, is credited, Cash or Accounts Receivable being charged, with the selling price of the goods sold. When all three accounts are used Purchases is charged with the cost of goods purchased, Sales is credited with the selling price of the goods sold, and at the end of the fiscal period Trading Account is opened, charged with the cost of the goods sold, Purchases being credited, and credited with the total credit balance of Sales Account. When these entries are made the balance of Trading shows the profit or loss on the goods sold. Trading Account may also be charged with the balances of the various expense accounts connected with the handling of the goods, and charged or credited with discount and interest, and in that case the balance of the account will show the profit or loss on the whole trading business.

An example of the use of Trading Account will be found on page 25. It is doubtful if the advantages claimed for this method are sufficient to overcome the objections of increasing the number of accounts and the increased difficulty of taking trial balances.

Merchandise Returned; Sales Allowances

These items may be entered in Mdse. Account or in separate accounts as may be found most convenient. If we return goods that we have purchased and credited to the party from whom they were purchased, Mdse. being charged, we make a counter entry, charging them back to the party and crediting Mdse. If goods have been returned to us that we have charged to the party to whom they were sent, crediting Mdse., we make a counter entry crediting the party and charging Mdse. By this method the Dr. side of Mdse. contains a record not only of the goods we have purchased but also of those that have been returned to us, and the Cr. side includes both the sales of goods and the goods that we have returned. Allowances, rebates, etc., may also be included in Mdse. Acct.

EXAMPLE

Dr.	Merchandise		Cr.
To Jones, purchased from him	1000	By Jones, returned to him	100
To Brown, returned by him	200	By Brown, sold him	500
To Brown, allowed him	50	By Jones, allowance for defects	40

Dr.	Jones		Cr.
To Mdse. returned to him	100	By Mdse. bought from him	1000
To Mdse. allowance by him	40		

Dr.	Brown		Cr.
To Mdse. sold him	500	By Mdse. returned by him	200
		By Mdse. rebate allowed him	50

Or the entries may be made as follows:

Dr.	Merchandise Purchases		Cr.
To Jones	1000		

Dr.	Mdse. Sales		Cr.
		By Brown	500

Dr.	Mdse. Returned		Cr.
To Brown *	200	By Jones	100

* The entries in this account appear to read wrongly, for Mdse. was not returned to Brown and returned by Jones, nor were allowances made to Brown and by Jones, but just the opposite. The Bookkeeper, however, will read them correctly: Mdse. returned Dr. To Brown, for goods returned by him, and Mdse. Returned Cr. By Jones, for goods that we returned to Jones.

Dr.	Allowances		Cr.
To Brown.	50	By Jones	40

Dr.	Jones		Cr.
To Mdse. Returned	100	By Purchases	1000
To Allowances	40		

Dr.	Brown		Cr.
To Sales	500	By Merchandise Returned	200
		By Allowances	50

Dr.	Trading Account (entries at end of year)		Cr.
Bal. Mdse. on Hand	....		
Total Purchases	....	Total Sales	....
Total Mdse. Returned	....	Total Mdse. Returned	....
Total Allowances	....	Total Allowances	....
Profits on Mdse.	....	Bal. Invty. (red ink)	....

Still another method of making these entries is to have Mdse. Account ruled in columns, as below:

Dr.			Merchandise			Cr.
Allowances	Returns	Purchases		Sales	Returns	Allowances
		1000	Jones		100	40
50	200		Brown	500		

The Jones and Brown accounts being treated in the ordinary way. In very large concerns having hundreds or thousands of personal accounts Mdse. Account may be kept as a controlling* account in the private ledger, entries of totals of Purchases, Sales, Returns and Allowances being made in it once a month, separate ledgers being kept for each of these subdivisions. The monthly entry in the controlling account might be made in two lines, Accounts Payable and Accounts Receivable taking the place of Jones and Brown in the form shown above. These subordinate ledgers may also be further subdivided into departmental merchandise ledgers or ledgers for different classes of goods, and the general Mdse. Account in the private ledger may likewise be subdivided as desired.

* The word "control" as used by accountants does not mean control in the ordinary sense, it means rather to condense or summarize. An entry in a controlling account is a total of the entries in several subordinate or detail accounts kept in another book.

The general principle upon which these subdivisions should be made is that they shall furnish all the information that the management needs concerning the merchandising part of the business, in gross, by summaries, or in detail, with the least possible duplication of entries or cost of clerical labor.

Each transaction is recorded originally upon a piece of paper, such as an invoice of goods received, a carbon copy of a bill for goods sold, or a credit memorandum. These may be sorted and filed every day by departments or by classes of goods and alphabetically by names of debtors and creditors, and at the end of the month verified by comparing them with the monthly statements received from creditors or sent out to debtors. These statements then become original records for permanent filing and their totals are transcribed to the Invoice Register or Purchase Ledger or Departmental or Class Ledgers as the kind and extent of the business may require, and to Sales Registers or Ledgers. These books should have as many columns as may be needed to show kinds of goods, discounts, returns and allowances, and it is only the totals of these columns that need to be posted in the condensed private ledger.

Accounts Receivable; Accounts Payable

In old-fashioned double-entry bookkeeping, with a single ledger, these accounts were unknown. The personal account of each debtor and creditor was entered under his own name. There were, however, accounts called Sundry Debtors and Sundry Creditors, which were used to keep in one place entries with such debtors and creditors as were likely to have only one or two transactions with us in a year. When entries were made in them the man's name was written on the line in either the Dr. or Cr. side, whichever was needed for the first transaction with him, a sale or a purchase.

EXAMPLE

Dr.	Sundry Debtors				Cr.
Jan. 10	J. Smith	17.15	Mar. 10	Cash	17.15
Feb. 17	R. Johnson	26.40			

Sundry Creditors

Feb. 15	To Cash	46.50	Jan. 15	M. L. Ewen	46.50
			Feb. 12	P. J. Franklin	57.10

In modern bookkeeping, purchases, except cash purchases, are entered in an Invoice Register or Purchase Ledger, and the monthly total is credited to Accounts Payable in the general ledger, charging the footings of the columns headed Mdse., Expense, Supplies, etc., to these accounts. The monthly total of sales, except cash sales, is charged "Accounts Receivable to Mdse." in the General Ledger, the charges against the individual debtors being made in the Sales Register or Sales Ledger. The Dr. balance of Accounts Receivable should equal the sum of the Dr. balances of the

individual accounts in the Sales Ledger. The Cr. balance of Accounts Payable should equal the total amount that we owe on individual accounts in the Purchase Ledger.

Bills (or Notes) Receivable

Notes, Bills of Exchange, or Acceptances (accepted time drafts) in our possession and payable to us, are called Bills Receivable (or Notes Receivable). They are usually entered in the order of their receipt (or alphabetically if numerous) in a *Bill Book*.

Transactions	Journal or Cash Book Entrie
(1) We sell Mdse., $1000 to Jones on 60 day credit and and take his note due 60 days hence in settlement.	Bills Rec. 1000 To Mdse. 1000
(2) Having sold Smith $2000 Mdse. and charged his account with it, we take his interest-bearing note in settlement.	Bills Rec. 2000 To Smith 2000
(3) Instead of an interest-bearing note Smith gives us a 3-months' note for the account including interest	Bills Rec. 2030 To Smith 2000 To Interest 30
(4) Note (1) is renewed at the end of 60 days, we received a new note for the same amount and a $10 check for interest.	Cash 10 To Interest 10 No Journal entry is needed. The new note is entered on the Bill Book, and the entry of the old note is marked "renewed."
(5) Instead of (4) Jones pays $400 cash on account and $10 interest and gives us a new note for $600	Cash 410 To Bills Rec. 400 To Interest 10 In the Bill Book the entry of the old note is marked "Pd. $400 on a/c. New note for $600."
(6) We discount at Bank Note (2) after it has run two months. The Bank credits us $2020	Cash 2020 To Bills Rec. 2000 To Interest 20
(7) Note (3) is discounted 30 days before it is due. The bank credits us $2020	Cash 2020 To Bills Rec. 2030 Interest 10
(8) We draw on Brown at 30 days for the balance of his account, $1000 plus $15 interest which will then be due, and he returns the draft "Accepted."	Bills Rec. 1015 To Accts. Rec. (Brown) 1000 To Interest 15

Bills (or Notes) Payable

Transactions	Journal or Cash Book Entries
(9) We buy Mdse. $1000 on 60 days credit, and give a 60-day note in payment	Mdse. 1000 To Bills Payable 1000
(10) We owe Johnson $2000 and give him an interest-bearing note	Accts. Payable (Johnson) 2000 To Bills Payable 2000
(11) Instead of (10) we give 3-months Note with $30 interest added.	Accts. Payable 2000 To Bills Payable 2030 Interest 30
(12) The bank discounts our own note for $1000, crediting us $990	Cash Dr. 1000 To Bills Payable 1000 Cash Cr. 10 By Interest 10 (Entry on both sides of cash book)
(13) We renew note (11) giving a new 3-mos. note and a check for $30 interest	Cash Cr. By Interest 30 The new note is entered in the Bill Book and the entry of the old note is marked "Renewed."
(14) We accept Simpson's time draft on us in payment of account due him $1000 and $10 interest	Accts. Pay. (Simpson) 1000 To Bills Pay. 1010 Interest 10
(15) We pay note (10) which has 2 months' interest accrued	Bills Payable 2000 To Cash 2020 Interest 20 (Entry on Cr. side of Cash Book) By Bills Pay. 2000 By Interest 20)

If each one of the above entries represented a separate transaction the Cash Book entries would be as follows:

Dr.		Cash			Cr.
(4)	To Interest	10	(12)	By Interest	10
(5)	To Bills Rec.	400	(13)	By Interest	30
	To Interest	10	(15)	By Bills Pay.	2000
(6)	To Bills Rec.	2000	(15)	By Interest	20
	To Interest	20			
(7)	To Bills Rec.	2020			
(12)	To Bills Pay.	1000			

The Bill Book entries would be as below:

Bills Receivable

Dr.	Acct.	Cr. Acct.	Cr. Int.	Total	Dr.	Acct.		Dr. Int.
(1)	Mdse.	1000	....	1000	(5)	Cash	400	
(2)	Smith	2000	....	2000	(6)	Cash	2000	
(3)	Smith	2000	30	2030	(7)	Cash	2020	10
(8)	Brown	1000	15	1015				

Bills Payable

Dr.				Acct.	Dr. Acct.	Dr. Int.	Cr. B.Pay.
(15)	Cash	2000	(9)	By Mdse.	1000		1000
			(10)	By Johnson	2000		2000
			(11)	By Johnson	2000	30	2030
			(12)	By Cash	1000		1000
			(14)	By Simpson	1000	10	1010

The Bill Book usually contains numerous columns for Date of Note, Drawer, Endorser, Amount, when Payable, Accts. Credited (or Debited) and Remarks.

Interest Account in the General Ledger, posted monthly from the footings of the Interest Columns in the Cash Book and Bill Book would show the following:

Dr.	Interest		Cr.
Cash	60	Cash	40
Bills Rec.	10	Bills Rec.	45
Bills Pay.	40		
			85
	110		

Balancing Bills Receivable and Payable. Interest Account

It is customary to enter all bills receivable and bills payable at their face value, whether this value includes interest or not, and on balancing the books at the end of the year to bring down the balances of notes unpaid at their face values. It is also customary to make entries charging or crediting interest when interest is added on the note at the time the note is drawn, but when the note is interest-bearing to make the interest charge or credit only when the interest is paid. At the end of the year, when interest account is balanced, if there is a Dr. balance it is charged, and if there is a Cr. balance it is credited to Profit and Loss. There is a certain inaccuracy in this method, since at the time of balancing the notes may be worth something more or less than their face values, depending on whether the notes are interest-bearing and have interest accrued on them but not entered, or whether interest to a future date has been added in the face value of the note but is not yet accrued. Also Interest Account may not show the true profit or loss, for there may be interest accrued but not entered or entered but not accrued. To correct these inaccuracies by Journal entries to an Interest Adjustment Account, or to such accounts as Accrued Interest Payable, Accrued Interest Receivable, Interest not Accrued, etc., introduces a complexity in the bookkeeping that is usually considered to be more trouble than it is worth. It is better to let the inaccuracy correct itself as it does when the notes are paid, and to make a memorandum of it, if thought desirable, on the balance sheet.

Suppose that on December 1st White and Black each owes us $2000 and that we owe Gray and Green each $1000. White gives us a three-months' note, including interest, for $2030, and Black gives us an interest-bearing note for $2000. We give Gray a three-months' note for $1015, and Green a demand note, interest-bearing, for $1000. The Ledger entries are:

Bills Receivable

Dec. 1	To White	2000				
	To Interest	30	2030			
	To Black		2000			
			4030			

Bills Payable

				Dec. 1	By Gray	1000
					By Interest	15 1015
					By Green	1000
						2015

Interest

Dec. 1	To Bills Pay. (Gray)	15	By Bills Rec. (White)	30

On balancing the books we find that we own Bills Rec. $4030, that we owe Bills Pay. $2015, and that Interest shows a profit of $15. The actual present worth of White's note, however, is only $2010, $20 out of the $30 interest not having yet accrued, and the present worth of Black's note is also $2010, $10 having accrued on it, making the two notes worth $4020 instead of $4030. Our present liability on Gray's and Green's note is $1005 each, or $2010 for the two, instead of $2015. We have earned $10 interest on White's note and $10 on Black's, a total of $20, instead of $30, and $5 each has accrued on our notes to Gray and Green, a total of $10 instead of $15. Net profit on interest account $10 instead of $15. Rather than make a lot of adjustment entries in the journal and ledger, involving the opening of one or more new ledger accounts, to reconcile the book values with the present values of Bills Receivable and Bills Payable, and to show the exact profit on Interest Account, it is better to let the balances appear as they are in the accounts, and to put a footnote in the Balance Sheet showing the present values and the actual profit. A footnote should also show our contingent liability on notes that we have endorsed, and a statement of any Bills Receivable of which there is a doubt as to their being paid.

Suspense Account

If there are Bills Receivable, or Accounts Receivable, of which there is a serious doubt of their being collectible, they may be taken out of their respective accounts and charged to Suspense account until they are either paid or found to be of no value, in which latter case Suspense acct. is credited and Profit and Loss charged with them.

Various Property Accounts

All the property that a concern possesses may be subdivided in the bookkeeping system into as few or as many accounts as the owner may deem desirable. The goods he buys and sells may all be lumped into a single merchandise account, subdivided into Merchandise Purchases, Merchandise Expense, Merchandise Sales, Trading Acct., etc., or into classes of goods, as Mdse. Dept. A, Dept. B, or Wheat, Corn, Oats, etc. His factory property may be handled in one account, Factory, or divided into Land, Building, Machinery, Power Plant, etc. Store equipment may be divided into Store Fixtures, Office Fixtures, and other accounts.

In making up a scheme for subdivision of the property accounts the owner should ask himself the following questions: What do I wish to have a dollar-and-cent record of in regard to my property and the various parts into which it may be divided. Do I wish this record in gross or in greater or less detail? If I wish it in great detail, is it necessary to get it all into the shape of double-entry journal and ledger accounts? Should it all be in one ledger or in several ledgers? Will it not be well to have a private double-entry ledger with only a few controlling accounts, covering the business as a whole, and to have separate books or filing cabinets containing the details? What statistical reports, weekly, monthly or annual do I need? Can a statistical system be devised which will get the information directly from original documents, or must it all be got from the ledger?

Whatever system be devised for the subdivision of the accounts there will necessarily be a double-entry ledger to

cover the whole business, and there may be subordinate ledgers for details.

Balancing Property Accounts

In all ledger accounts representing property the method of keeping the account is the same, viz.:

1. On opening the account enter the inventory or appraisal value of the property represented by the account.

2. Debit the account with the value of all additions to the property, whether by work done on it, or by purchases for it; and with all expenses incurred on account of it which increase its value.

3. Credit it with all values returned by the property whether by sale or by transfer to other branches of the whole property.

4. At the end of the fiscal period have an inventory or appraisal of the property made, and enter the value, in red ink, on the credit side of the account By Balance (Invty.) $.....

5. Add up both sides of the account and find the difference. If the Cr. side is the larger there is a profit, if the Dr. side is the larger there is a loss. Enter the profit or loss on a memorandum of profits and losses which is to be used in making a journal entry.

6. When all the property accounts have had their profits or losses determined in this way, two journal entries are made, viz.:

Sundries To Profit and Loss

For profits on the following accounts.

(Here enter the accounts with the several amounts)

Profit and Loss To Sundries

For Losses on the following accounts.

7. Post these journal entries to the several accounts in the ledger.

8. The two sides of each property account will now be equal. Rule the account, enter the total on both sides, and bring down the balance, entering on the Dr. side To Balance (Invty.) $.....

Investments in Bonds and Stocks

If we invest any portion of our capital in bonds or stocks either because we have no immediate need of it in our active business, or because we wish to have some of our capital available for quick turning into cash in case of an emergency, the accounts of such investments are kept in the same manner as those of any other property accounts. Debit at cost what we receive, credit at the selling price what we part with or sell. At the close of the fiscal period, or at any other convenient time, take an inventory, credit Profit and Loss with gains, charge it with losses. If we borrow money, giving a note with stocks or bonds as collateral, Cash and Interest are debited and Bills Payable credited, no entry being made to Stocks and Bonds account, but in the list of stocks and bonds mark the ones used "Deposited as Collateral."

Mortgage or Bonded Indebtedness

If on beginning business we have a bond or mortgage liability, it is entered on the Cr. side of the Bond and Mortgage Account, and if we give a bond for cash or settlement of some account, Cash (or other account) is debited and Bond and Mortgage credited. When we pay cash in full or on account of bonded indebtedness, Bond and Mortgage is debited and Cash credited.

Expense Accounts

All expenditures except those for merchandise or other property are charged either to Expense account or to one or more of the several accounts into which it may be subdivided. Some of these are Rent, Insurance, Taxes, Repairs, Salaries, Freight and Express, Postage, Cleaning, Fuel, Light, Heat, Power, Salesmen's Expense, Stationery, Advertising, Traveling Expense, Charitable Subscriptions, Accidents, Legal Expense. In manufacturing concerns Factory Expense may be subdivided into a hundred or more subordinate accounts. To keep all these accounts in the usual form of double-entry ledger involves an intolerable amount of clerical work, therefore, many kinds of "short-cuts" have been designed by which all the necessary information concerning the details of the various expenditures may be obtained with a minimum expenditure of time and labor. Some of these are described elsewhere in this work.

Expense account (or any subdivision of the account) is charged with expenditures, Cash, Petty Cash, Accounts Receivable or other account being credited. In balancing the books at the end of the year Profit and Loss is debited and the expense account credited with the Dr. balance of the account, except that when any part of expense can be considered as an asset, such as unexpired taxes or insurance, or advertising paid for this year but belonging chiefly to next year's business, or the cost of a catalogue which will be useful for years to come, the amount that is estimated to be an asset is inventoried and brought down as a balance.

Advance Payments and Accrued Expenses. Insurance is usually paid in advance, sometimes for a year, sometimes for three years. The entry is Insurance Dr. to Cash (or, in the Cash Book, Cash Cr. By Insurance), the insurance being an expense. When the books are balanced at the end of a fiscal period, so much of the insurance as has not expired is an advance payment for a future expense, and is, therefore, not an expense of the period but an asset. It may be closed in the books into an account called Advanced Expenses, and show in the Balance Sheet as an asset, but it is just as well, and less troublesome not to open this new account, but to let Insurance Account remain open, crediting it and charging Expense Account with the amount of the insurance that has expired, and leaving the balance to Insurance Account, representing the amount paid in advance. In the case of insurance paid on factory buildings, equipment and stores, the amount paid is charged on the general books to Insurance, and once a month the account is credited, Factory Operating Account being charged with the monthly proportion, or one-twelfth of a year's insurance.

Taxes are usually paid at some other time in the year than

the date of closing the books. If the books are closed on June 30th and December 31st, and the taxes are paid on October 1st for the year ending December 31st, then the June balance sheet should show on the Dr. side of Accrued Taxes one-half of a year's taxes, the amount of an expense or loss that has accrued but has not been paid.

Advanced payments not belonging to the expense of the current period, but to the next fiscal period, or to other future periods, are also known as Deferred Charges.

Consignment Accounts

When we ship goods to a branch store, to an agent or to a commission house to be sold for us we open a Consignment Account, also called "Shipping" or "Adventure" account, charging it with the goods at our cost figures, and also with any expenditures we may make on account of the consignment, such as freight, insurance, etc. The consignee from time to time sends us an "Account Current" or "Account Sales" charging us with any expenditures he may have made on account of the consignment, such as drayage, storage, repacking, etc., and also with his commission on the sales he has made; and crediting us with any advances we may have made him for his expenses and with any money he has received on account of the goods he has sold. The account current contains also a statement of the goods sold and an inventory of the goods remaining on hand. On receipt of the account current we make the proper entries to the Consignment Account, charging it and crediting the agent, if we keep a personal account with him, for his disbursements, crediting it and charging him for his receipts if he has not paid them over to us. When they are paid we credit him and charge Cash. When the goods are all sold and a final account current rendered the consignment account is balanced and Profit and Loss is credited with the profit or charged with the loss on the consignment. If at the end of the year any of the goods remain unsold they are inventoried at their present value at their present location, cost plus freight, etc., less depreciation, if any, and this inventory value is brought down as a balance for next year, the entry to Profit and Loss being made as in the case of Mdse. Account.

Commission Business

When we receive goods from another party to be sold by us on commission, we receive with the goods an invoice which we file as an inventory of goods received on commission. We open an account with the consignor, charging him for any payments we may make on account of the goods, such as drayage, insurance, labor, etc., also with our commission on the goods sold, and with any remittances we may make from collections we have made from the parties to whom we have sold the goods. We render to the consignor an account sales or account current, showing the disbursements and receipts, a statement of the sales made, moneys collected and still due, inventory of goods on hand, and balance due to or by the consignor.

An Account Current or Account Sales is a formal itemized statement made by the consignee to the consignor giving all the charges and credits entered on the consignment account, and a statement of the goods remaining unsold.

Classification of Accounts—Accounting Code. In large concerns it is customary for the chief accountant to have a book in which all the titles of the accounts are listed, usually in alphabetical order, together with a description of each account and of the kind of transactions that are to be recorded on its debit and credit sides. Copies of this book, sometimes called the Accounting Code, are available for use by the bookkeepers, to enable them to preserve a uniform system of classification and method of making the journal entries for every possible kind of transaction.

SOME DEFINITIONS

Capital. Money or wealth employed in any business.

Capital, fixed: Invested in property in a permanent form (lands, buildings, machinery).

Capital, active or working: Cash, or property, or assets, that can easily be turned into cash, also raw material, work in progress, finished product in warehouse.

Capital Stock. The indebtedness of the business to its stockholders, as represented by the shares of stock issued to the stockholders, together with the shares held as "Treasury Stock" for sale or for issue in the future, for which "Treasury Stock" account is debited.

Capital stock appears on the general ledger as a liability, and it is, therefore, entered on the Cr. side of the ledger.

Capital expenditure, charges to capital. Charges to revenue, charges against income.

The word "capital" is used in two opposite senses: 1, The assets of the business, or net assets, entered on the Dr. side of the ledger; 2, the amount of capital stock, issued or held for future issue, entered on the Cr. side.

When money is spent for a new machine it may be charged to Machinery Acct. as an asset of the factory, or it may be charged to repairs or expense, if it is a new machine replacing an old one that is worn out. In the former case it is called by some writers a charge to capital or a capital expenditure, and in the latter case a charge to revenue or income.

CHAPTER III

THE EVOLUTION OF BOOKKEEPING. THE COLUMN LEDGER

The beginning of double-entry bookkeeping was the use of the Journal with its debit and credit columns, and of the Ledger with its debit and credit sides. Every transaction was entered first in the Journal and then in the Ledger. A series of transactions would appear in the Journal as follows:

Cash to Proprietor	600	600
Mdse. to Jones (purchase)	500	500
Smith to Mdse. (sale)	400	400
Sundries to Bills Payable Jones—in payment of his acct. Interest	 500 10	510
Bills Receivable to Sundries to Smith, his a/c. pd. by note to Interest on note	408	 400 8
Sundries to Bills Receivable Cash Smith's note discounted at bank Interest	 401 7	408
Bills Pay.—pd. Jones's note To Cash	510	510
Cash To Mdse. Cash sales	150	150
Expense (Payroll) To Cash	50	50

These entries would be posted into the ledger as below:

Proprietor

		By Cash	600

Cash

To Proprietor	600	By Bills Pay.	510
To Bills Rec.	401	By Expense	50
To Mdse.	150		560
	1151		

Mdse.

To Jones	500	By Smith	400
		By Cash	150

Bills Receivable

To Sundries	408	By Sundries	408

Bills Payable

To Cash	510	By Sundries	510

Interest

To Bills Pay.	10	By Bills Rec.	8
To Bills Rec.	7		

Expense

To Cash	50		

Jones

To Bills Pay.	500	By Mdse.	500

Smith

To Mdse	400	By Bills Rec.	400

The Trial Balance taken after the above Entries are posted would be as follows:

Dr.	Trial Balance		Cr.
Cash	591	Proprietor	600
Interest	9	Mdse.	50
Expense	50		
	650		650

The first modification of this system was the taking of the separate Cash transactions out of the Journal and entering them in a Cash book, the footings of the two sides being entered in the Journal at the end of the month—thus:

Dr.	Cash Book		Cr.
To Prop.	600	By Bills Pay.	510
To Mdse.	150	By Expense	50
To Bills Rec.	401		560
	1151		

Journal

Cash		
To Sundries	1151	
To Prop.		600
To Mdse.		150
To Bills Rec.		401
Sundries		
To Cash		560
Bills Pay.	510	
Expense	50	
Interest	7	
To Bills Rec.		7
Int. on Smith's note		

The Ledger then would show:

Dr. Cash			Cr.
To Sundries	1151	By Sundries	560

Bills Rec.			
To Sundries	408	By Cash	401
		By Int.	7

This modification introduced one objectionable feature, the making of an entry in two different books when a note was discounted, one in the Cash Book, for the net cash received, and the other in the Journal, for the interest charged. This objection was avoided by making an entry on the debit side of the Cash Book for the face value of the note and on the credit side for the interest; thus, Cash Dr. to Bills Rec. $408; Cr. by Interest $7, on the fiction that Cash received $408 for the note and paid $7 interest, instead of receiving the net sum of $401 with which the bank credited its customer. A similar plan was followed when discounts were allowed for prompt payment of invoices. If instead of our giving Jones a note for $500 in settlement of his account for $500, he offers to take $495 for prompt cash and we draw a check for that amount, an entry By Jones $500 is made on the credit side of the cash book and To Interest $5 on the debit side.

When the number of discount and interest transactions became large, an improvement was made in the Cash Book by adding a discount and Interest column to each side, a column crediting Discount and Interest account on the Cr. side, and one debiting that account on the Dr. side. Thus, in paying Jones's account of $500 with $495 cash the entry on the credit side of the Cash Book is

Cr.	Cash Pd.	Dr. Acct.	Cr. Dis. and Int.
By Jones	495	500	5

The $500 is posted to the debit of Jones, balancing his account, and the footing of the column headed Cr. Dis. & Int. is credited to that account, Cash being charged.

In like manner if Smith instead of giving us a note for $408 in payment of his account of $400 with interest gives us his check for $398, we making him an allowance of $2.00, the entry on the Dr. side of the Cash Book is

Cash Dr.	Cash Received	Cr. Acct.	Dis. and Int. Dr.
To Smith	398	400	2

In posting, Smith's account is credited $400, and the footing of Dis. & Int. column is debited, Cash being credited. When the Cash Book is journalized at the end of the month, the discounts being received and allowed as above stated, the entries are:

Cash		
To Sundries	1155	
To Prop.		600
To Mdse.		150
To Smith		400
To Dis. & Int. (from Jones, Cr. side of Cash Book)		5
Sundries		
To Cash		552
Jones	500	
Expense	50	
Dis. & Int. (from Smith, Dr. side of cash Bk.)	2	

Accounts Receivable. Accounts Payable

The next development, in the direction of simplifying the general Ledger, as the number of accounts increases to such an extent as to make the Ledger too bulky and the labor of balancing it too great, is to remove from it the personal accounts with debtors and creditors, putting them into a Sales Ledger or Accounts Receivable Book, and into a Purchase Ledger or Invoice Register, or Accounts Payable Book. In the general Ledger the accounts thus removed are represented by two controlling accounts, Accounts Receivable or Sundry Debtors or Trade Debtors, and Accounts Payable, or Sundry Creditors or Trade Creditors. Two new columns are added to the Cash Book, one on the Dr. side with the heading Accts. Rec'l., and the other on the Cr. side, headed Accts. Pay.

The Cash Book entries will then appear as follows:

Cash	Dr. Cash Rec.	Dr. Dis. and Int.	Cr. Acct. Rec'l.	Cr. Sundry Accts.
To Prop.	600			600
To Mdse.	150			
To Smith	398	2	400	

Cash	Cr. Cash Pd.	Cr. Dis. and Int.	Dr. Accts. Pay.	Dr. Sundry Accts.
By Jones	495	5	500	
By Expense	50			50

Smith's account in the Sales Ledger, which has been debited $400 by posting from the Sales Book, is credited $400 from

the Accts. Receivable column in the Cash Book, and Jones's account in the Purchase Ledger which has been credited $500 by posting from the Invoice Register is debited $500 from the Accts. Payable, in the Cash Book.

In journalizing and posting Cash at the end of the month, Cash is made Dr. to Accts. Receivable, and credited by Accts. Payable for the amounts of the footings of the columns so named.

If many notes are received or given two other columns are added, Bills Receivable on the Dr. side and Bills Payable on the Cr. side.

The Column Cash Book. In this way the Cash Book develops into a Column Cash Book containing from six to ten columns on each side according to the number of accounts in the General Ledger the entries to which are numerous enough to warrant their being grouped together. One column on each side will be headed Sundry Accts., to contain entries for which no place is provided in the other columns.

Dr. Cash

Name of Cr. Acct.	Cash Recd.	Dis. & Int. Dr.	Credit Accts.			
			Mdse.	Bills Rec.	Acct. Rec.	Sundry Accts.

Cash Cr.

Name of Dr. Acct.	Cash Pd.	Dis. & Int. Cr.	Debit Accts.				
			Bills Pay.	Accts. Pay.	Mdse.	Exp.	Sundry Accts.

When the column Cash Book is used it is not necessary to journalize it at the end of the month. The column footings may be posted directly into the General Ledger, the few entries in the Sundry columns being posted to their proper accounts. Another development of the Cash Book is the provision of a Petty Cash Book, also provided with several columns, to take care of a great number of small items with which it is not desired to cumber the Cash Book. The footings of the columns of the Petty Cash Book may be entered on a line above the footings in the principal Cash Book, in the proper columns, or they may be posted separately into the Ledger as may be most convenient.

The Invoice Register is also a book of several columns, the number of them depending upon the number of classes into which it is desired to subdivide the materials or other things or services purchased. For example, the headings may read Mdse., Expense Supplies, Expense Services, Repairs, Selling Expenses. The footings of the several columns may be journalized, crediting Accounts Payable for the total, or they may be directly posted into the Ledger. The Sales Book or Register of Charge Sales (made up from sales tickets) usually needs only one or two columns, and the journal entry in the general Ledger is a single one, Accounts Payable Dr. to Mdse., but if it is desired to subdivide Mdse. into several classes this may be done by means of different columns with appropriate headings. The individual entries in the Sales Book are posted to the individual accounts in the Sales Ledger.

The Bill Book. When the business involves the handling of a great number of notes or Bills Receivable and Bills Payable it is well to have a Bill Book as a book of original entry for recording these notes. Usually Bills Receivable are received only in settlement of Accounts Receivable and interest, and Bills Payable are given only in settlement of Accounts Payable and interest, so that only three columns are needed, Face of Note, Interest, and Dr. (or Cr.) Account, but a fourth column may be added for the notes given or received on any other account. Separate pages, or in large businesses separate books, are used for Bills Receivable and Payable.

THE EIGHT-COLUMN JOURNAL

The Journal is sometimes ruled with six, eight or ten money columns, half on one side and half on the other, with a wide central column for the description of the transaction; and two narrow columns for the entry of the ledger folio after posting to the ledger. The following is an example:

Dr. Cr.

Sundry Accts.	Interest & Disct.	Accts. Rec.	Mdse.	L. F.	February 28, 1917	L. F.	Mdse.	Accts. Pay.	Interest & Disct.	Sundries.
			500		Mdse. to J. Jones	✓		500		
A/c Pay 400	10			✓	T. Smith & Sons. To Bills Pay. Interest	40				Bills Pay 410
		300		✓	W. Brown. To Mdse.		300			
Bills Rec 204					Bills Rec. To C. Jackson. Interest	✓			4	A/c Rec 200

The meaning of these entries is (1) we bought Mdse. from Jones and credit him in the Invoice Register or Accounts Payable Book; the check showing that the credit has been entered. (2) We having credited Smith in the Accts. Payable Book for Mdse. purchased $400, now give him a note for $410, including $10 interest. We credit Bills Payable (the thing given) $410 and charge Accts. Payable in the Sundry Accounts Column $400, posting the amount to Smith's account in the Purchase Ledger and charge Interest (it being a loss) on the Dr. side in the Interest column. (3) We sell

Brown $300 of Mdse. on account, charging Accts. Receivable in Dr. side of the Journal, and posting the amount to Brown's account in the Sales Ledger. (4) Jackson gives us his note $204, in payment of his account $200 and $4 interest. We charge Bills Receivable (the thing received) $204, crediting Interest (a gain) on the credit side of the Journal, and Accts. Rec. in the Sundries Column on the credit side $200, crediting Jackson this amount in the Sales Ledger. The several columns are footed and the totals at the end of the month are posted into the proper accounts in the general ledger. The footings of the sundry columns are subdivided into their respective accounts, thus in the above, on the Dr. side $400 is posted to Accts. Payable and $204 to Bills Receivable.

When an account is posted into the ledger the number of the ledger page is entered in the journal in the column L.F. (ledger folio).

THE SAFEGUARD LEDGER

A form of sales ledger known as the Safeguard Ledger, which is used by many large concerns, is illustrated in Fig. 1. The size of the page is 15×12 in. and a double page contains the entries for six months. A perforated crease is made in the June column on the right-hand page to allow the folding in of a strip of the width of the name column, so as to expose the name column on the left-hand page when the July and December entries are made. By this means the names have to be written only once a year. There are 79 numbered lines to a page besides a line for footings at the bottom. The number of lines allowed to an account depends upon the number of entries that are expected to be made in a month, as determined by inspection of the old ledger. The debit balances from the old ledger are entered as shown in Column 1. In Column 2 are entered the debits, taken from the Sales Book or Sales Tickets, and the credits, whether cash, returned goods, or allowances, are entered in Column 3. After the debits and credits for the month have been posted each customer's account is balanced by adding the amount of his purchases to the old balance and subtracting the amount of his credits. The balance thus found is entered in Column 4.

2 JANUARY

	Names	Trans. from Led. A.	(1) Debit Balance	(2) Date	Book Page	Terms	Debits	(3) Date	Book Page	Credits	(4) Debit Balance	Columns for February	Date	Book Page	Credits	Trans. to	
												March					
0	S. S. Pierce Co.	235	780 37	3	204		V 125 —	2	1	V 500 —	V	April					0
1			V	21	245		V 375 —	31	3	V 790 04		May					1
2	Boston,			23	268		V 9 67					June					2
3	Mass.						509 67										3
4																	4
5																	5
6	*(Five lines or any multiple of five are allowed for each*																6
7	*account according the probable maximum number*																7
8	*of entries in a month)*																8
9																	9
10	John B. Stetson Co.	236	407 63	16	245		V 25 —			V 407 63	500 —						10
11			V	18	249		V 45 —			V 70 —							11
12	Philadelphia,			20	254		367 50										12
13	Pa.			21	260		132 50										13
14							570 00										14
78	*(80 ruled lines to a page numbered 0 to 79)*											*Crease for folding between Cols. 3 and 4 in June*					15
79																	16
	Totals		1188 00				1079 67			1767 67	500						17
																	18
																	19

Designed by Safegnard Account Company Chicago New York Boston

FIG. 1.—THE SAFEGUARD LEDGER.

Each page is footed separately, and if no error has been made in balancing the sum of Columns 1 and 2 should equal the sum of Columns 3 and 4. Instead of taking a trial balance in the old way the footings of each page are transferred to a Proof Book, which contains four columns corresponding to those of the ledger, and these columns are footed. The total of the Transferred Balance column shows the amount outstanding from customers at the time of transfer of the accounts from the old ledger; the debit column total shows the charges to all customers during the month, and it should equal the total charges in the Sales Book; the credit total should agree with the total credits to customers as shown by the Cash book and Allowance or other auxiliary books; and the debit balance total shows the amount owing by customers at the end of the month. Errors in posting are shown by the differences between the total proved footings of the columns and the proved footings of the books from which the postings were made.

The several advantages of this form of ledger over the old style ledger are fully explained in a handsome illustrated circular issued by the manufacturers, The Safeguard Account Co., New York.

THE COLUMN LEDGER, OR COMBINED JOURNAL-LEDGER

The greatest recent improvement in bookkeeping systems is the abandonment of the ordinary Journal and Ledger and the substitution for them of the "Combined Journal-Ledger," or Column Ledger. It is merely a stage in the evolution which began with the adoption of the Column Cash Book and the Column Invoice Register. It consists of a single sheet for each month's transactions, ruled with columns and horizontal lines, with the titles of the active accounts printed at the heads of the columns and at the left of the horizontal lines. Entries are made from the books of original entry by simply transcribing the column footings of these books into the Ledger. If an entry, Mdse. to Accts. Payable $3000, is to be made from the Invoice Register, it is done by once writing the amount in the Ledger column, Accts. Pay. Cr., on the line Mdse. Dr. Writing the figure once makes a double entry, charging one account and crediting another, just as a single entry on the Dr. side of the Cash Book at the same time charges Cash and credits the Account for which the cash was received. To illustrate the Column Ledger system of bookkeeping an example of handling a month's transactions, as shown in the books of original entry, by means of the ordinary Journal and Ledger and by means of the Column Ledger is given below. Other illustrations of the use of the Column Ledger will be found on pages 32 and 40.

Column Footings of Books of Original Entry

CASH BOOK

Debit Accts.		Credit Accts.						
			Mdse.	Accts. Recl.	Bills Pay.	Bills Rec.	Exp.	Int.
Cash Dr.	13,250		1200	5000	4000	3000	10	40

Credit		Debit Accts.							
		Sundries.		Mdse.	Accts. Pay.	Bills Pay.	Labor.	Exp.	Int.
Cash Cr.	11,910	Store Fix.	30	200	6500	4500	300	350	30

SALES BOOK

	Dr.		Cr.		Cr.
Accts. Recl.	5050	Mdse.	5000	Exp.	50

INVOICE REGISTER

	Cr.		Dr.		Dr.		Dr.
Accts. Pay.	3400	Mdse.	3000	Exp.	300	Repairs	100

BILL BOOK

Bills Rec. Dr.	1015	Accts. Recl. Cr.	1000	Interest Cr.	15		
Bills Pay. Cr.	1520	Accts. Pay. Dr.	1500	Int. Dr.	20		

PAY ROLL

	Cr.		Cr.		Dr.		Dr.
Labor	450			Expense	400	Mdse.	50
	Dr.						
Labor	70	Mdse. Cr.	70				

In the common system of bookkeeping these footings would be journalized at the end of the month as follows:

Cash		
To Sundries	13,250	
Mdse.		1,200
Accts. Recl.		5,000
Interest		40
Bills Pay.		4,000
Bills Rec.		3,000
Expense		10
Sundries		
To Cash		11,910
Mdse.	200	
Store Fix.	30	
Accts. Pay.	6,500	
Bills Pay.	4,500	
Labor	300	
Expense	350	
Interest	30	
Accts. Receivable	5,050	
To Sundries		
To Mdse.		5,000
To Exp. (supplies sold)		50
Sundries		3,400
To Accts. Pay.		
Mdse.	3,000	
Exp.	300	
Repairs	100	
Bills Receivable	1,015	
To Sundries		
To Accts. Recl.		1,000
To Int.		15
Sundries		
To Bills Pay.		1,520
Accts. Pay.	1,500	
Interest	20	
Sundries		
To Labor		450
Expense	400	
Mdse.	50	
Labor	70	
To Mdse.		70

The Trial Balance of the Ledger before posting the above Journal Entries may be as follows:

		Dr.			Cr.
1	Cash	1,000	9	Proprietor	10,500
2	Bills Rec.	4,000	10	Profit & Loss	1,000
3	Accts. Rec.	6,000	11	Bills Pay.	8,000
4	Mdse.	10,000	12	Accts. Pay.	7,000
5	Real Estate	5,000	13	Labor	300
6	Store Fix.	500	14	Interest	
7	Expense	300			
8	Repairs				
		26,800			26,800

After posting the above Journal Entries the Ledger will appear as below:

(1) Cash

Bal.	1,000	Sunds.	11,910
Sunds.	13,250		

(2) Bills Rec.

Bal.	4,000	By Cash	3,000
To Sunds.	1,015		

(3) Accts. Rec.

Bal.	6,000	By Cash	5,000
To Sunds.	5,050	By Bills Rec.	1,000

(4) Mdse.

Bal.	10,000	By Cash	1,200
To Cash	200	By Accts. Rec.	5,000
Accts. Pay.	3,000	By Labor	70
To Labor	50		

(5) Real Estate

Bal.	5,000		

(6) Store Fixtures

Bal.	500		
To Cash	30		

(7) Expense

Bal.	300	By Cash	10
To Cash	350	By Accts. Rec.	50
To Accts. Pay.	300		
To Labor	400		

(8) Repairs

To Accts. Pay	100		

(9) Proprietor

		Bal.	10,500

(10) Profit & Loss

		Bal.	1,000

(11) Bills Pay.

To Cash	4,500	Bal.	8,000
		By Cash	4,000
		By Sund.	1,520

(12) Accts. Pay.

To Cash	6,500	Bal.	7,000
To Bills Pay	1,500	By Sund.	3,400

(13) Labor

To Cash	300	Bal.	300
To Mdse.	70	By Sund.	450

(14) Interest

To Cash	30	By Cash	40
Bills Pay.	20	By Bills Rec.	15

After taking a trial balance of the ledger to prove the correctness of the posting, Mdse. shows a Dr. Balance of $6980, Expense a/c $1290, Repairs $100, and Interest has a credit bal. of $5.00. If the Inventory shows that Mdse. unsold has a value of $8400 and that there are Expense Assets on hand of a value of $250, viz., Supplies charged to Expense and not yet used, $50, prepaid Taxes $100, prepaid Insurance $100—entries may be made in the Journal for the Profits and Losses as follows:

Sundries To Profit & Loss			1425
Mdse.			
On hand as per inventory	8400		
Less Dr. Bal. of Acct.	6980		
		1420	
Interest, Cr. Bal. of Acct.		5	
Profit & Losa To Sundries		1140	
To Expense			
Dr. Bal. of Exp. Acct.	1290		
Less expense assets per inventory	250		
			1040
To Repairs, Dr. Bal. Acct.			100

After these entries are posted a balance sheet is made out, as follows:

1	Cash	2,340	9	Proprietor	10,500
2	Bills Rec.	2,015	10	Profit & Loss	1,285
3	Acets. Rec.	5,050	11	Bills Pay.	9,020
4	Mdse.	8,400	12	Acets. Pay.	2,400
5	Real Estate	5,000	13	Labor	380
6	Store Fix.	530	14	Interest	
7	Expense	250			
8	Repairs				
		23,585			23,585

When the column ledger system is used, the entries are posted into it directly from footings of the books of original entry shown on p. 17, and from the Profit and Loss entries in the Journal.

Monthly Column Ledger or Combined Journal-Ledger

	Charges	Credit Accounts														Total Charges
		1 Cash	2 Bills Rec.	3 Acets. Rec.	4 Mdse.	5 R. Est.	6 Store Fixt.	7 Exp.	8 Reprs.	9 Prop.	10 P. & L.	11 Bills Pay.	12 Acets. Pay.	13 Labor	14 Int.	
1	Cash		3000	5000	1200			10				4000			40	13,250
2	Bills Rec.			1000											15	1,015
3	Acets. Rec.				5000			50								5,050
4	Mdse.	200									1420		3000	50		4,670
5	R. Est.															
6	Store Fixt.	30														30
7	Expense	350											300	400		1,050
8	Repairs												100			100
9	Proprietor															
10	Profit & Loss							1040	100							1,140
11	Bills Pay.	4,500														4,500
12	Acets. Pay.	6,500										1500				8,000
13	Labor	300			70											370
14	Interest	30									5	20				55
	Total Credits	11,910	3000	6000	6270			1100	100		1425	5520	3400	450	55	39,230

The postings in the Column Ledger are made directly from the books of original entry in the following manner. From the Column Cash Book the total cash receipts $13,250 is entered on line 1 in the last column, Total Charges. The corresponding credits are taken from the footings of the columns on the Dr. side of the cash book and entered on line 1 under the proper headings. The total credit of cash, $11,910, is entered at the bottom of column 1, opposite total credits, and the corresponding debits to the several accounts are taken from the footings on the Cr. side of the Cash Book and entered in column 1 opposite the names of the several accounts. The entries Acets. Receivable Dr. to Mdse. $5000 and To Expense $50 are made from the footings of the Sales Book. The entries Bills Receivable Dr. To Acets. Receivable $1000 and To Interest $15, and the credits of Bills Payable, Acets. Payable Dr. $1500 and Interest Dr. $20, are taken from the Bill Book. The credits to Acets. Payable, Mdse. Dr. $3000, Expense Dr. $300, and Repairs Dr. $100, are obtained from the footings of the Purchase Book or Invoice Register. The Credits to Labor, Mdse. Dr. $50 and Expense Dr. $400, and the debit entry Labor to Mdse. $70, are taken from the payroll.

When all these entries are made the totals of the columns and of the horizontal lines are entered in lead pencil, and the sums of these totals must agree if there are no errors in addition. When the inventory of Mdse. is taken and the profit

on this account is figured, the Profit and Loss entries may be made directly in the Ledger, preferably in red ink, viz.: P. & L. Dr. To Expense $1040 and To Repairs $100, and Cr. By Mdse. $1420 and By Interest $5, and then the footings should be entered in ink and the total debits and credits balanced.

The column ledger should be a printed and ruled sheet, perforated for insertion in a loose-leaf book. An objection is sometimes made to the column ledger, that the bookkeeper is apt to make a mistake in putting a figure in the wrong column or on the wrong line, but this can happen only from gross carelessness. If the bookkeeper will fine himself $5 for the first error of this kind he will not be likely to make a second.

After balancing the column ledger the totals are transferred to the transaction columns of the Balance Sheet, as shown below, and the figures added to (or subtracted from as the case may require) those in the Balance Sheet at the beginning of the month, to obtain the figures of the balance at the end of the month.

Balance Sheet

		Bal. Jan. 1		Transactions		Bal. Feb. 1	
		Dr.	Cr.	Dr.	Cr.	Dr.	Cr.
1	Cash	1,000		13,250	11,910	2,340	
2	Bills Rec.	4,000		1,015	3,000	2,015	
3	A/c Rec.	6,000		5,050	6,000	5,050	
4	Mdse.	10,000		4,670	6,270	8,400	
5	R. Est.	5,000				5,000	
6	Store Fix.	500		30		530	
7	Expense	300		1,050	1,100	250	
8	Repairs			100	100		
9	Proprietor		10,500				10,500
10	Profit & Loss		1,000	1,140	1,425		1,285
11	Bills Pay.		8,000	4,500	5,520		9,020
12	A/c Pay.		7,000	8,000	3,400		2,400
13	Labor		300	370	450		380
14	Interest			55	55		
	Total	26,800	26,800	59,230	39,230	23,585	23,585

In using the ordinary ledger a condensed statement of the course of the business for a month can be obtained only after compiling from the books a statistical abstract. In the Column Ledger system the ledger itself is at the same time a statistical abstract, a trial balance and a balance sheet, furnishing at a glance all the information that can be obtained only with a great amount of labor from the ordinary ledger.

Notes on the Combined Journal-Ledger System

It is impossible for the Journal-Ledger to be out of balance provided the figures in the horizontal lines and in the vertical columns are correctly added. The total debits must equal the total credits, fulfilling the fundamental principle of double-entry bookkeeping.

The Journal-Ledger may, however, contain errors which must be carefully guarded against. These are:

1. Omission of items which should be entered.
2. Entering of an item in the wrong column or on the wrong line.
3. Entering an item which is an erroneous footing in the book of original entry.
4. Transposition of figures in making an entry (writing 76 for 67).

Against these may be put the list of possible errors in the Ledger and Trial Balance in the ordinary system:

1. Omission of a Journal entry.
2. Omitting to post a Journal entry.
3. Posting an entry to a wrong account.
4. Entering in the Journal and posting in the Ledger an erroneous column footing of a book of original entry.

The Ledger may be in perfect balance notwithstanding these errors, and taking a Trial Balance will not lead to their discovery. The following errors are likely to be discovered, when a hunt is made for them, after taking a Trial Balance and finding it out of balance, except in the case of two errors balancing each other:

5. Errors in adding the Dr. and Cr. columns in a Ledger account.
6. Errors in subtracting the Dr. and Cr. column footings.
7. Errors in entering the balances in the Trial Balance.
8. Transposition of figures in posting a Journal entry.
9. The Journal entry out of balance.

Excepting No. 8, these errors cannot take place in the combined Journal-Ledger system.

There are many chances of making the four above-named errors to which the Journal-Ledger is liable, and, therefore, there is a necessity for providing means for checking against them. One of the best means is described below:

The books of original entry are:

Symbol.	
C and PC	Cash Book and Petty Cash Book.
W	Salary List and Pay Roll.
B	Bill Book, for Bills or Notes Receivable and Payable.
R	Accounts Payable Book or Invoice Register.
S	Sales Book, or Sales Ticket Register, and Sales Allowance Book.
J	Day-book Journal for any entries that do not find their proper place in the other books, such as Profit and Loss entries.

Each of these books is provided with such columns as may be needed for debits and credits of Mdse., Expense, Interest and Discount, or other accounts, and it is the footings of these accounts which are entered monthly in the Journal-Ledger.

When the footings of these accounts are entered in the Journal-Ledger they are at the same time entered in Double-entry on a printed or typewritten blank as shown below:

Check on Journal-Ledger Entries

Financial Accts.						Mdse. and Expense Accts.					
Book	Account	Dr.		Cr		Account	Dr. Totals		Cr. Totals		
C PC	Cash	1311	63	690	90	Mdse. Cash	2759	67	6	55	
W	Sal. & Wages	492	00	574	00	Accts. Pay.			1301	65	
B	Notes Rec.					Accts. Rec.	2	00	3358	31	
B	Notes Pay.					Notes Rec.					
R	Accts. Pay.			2789	67	Notes Pay					
S	Accts. Rec.	3358	31	2	00		2761	67			4666 51
		5161	94	4056	57	Expense Cash	198	90	2	00	
	Add Mdse. & Exp.	3564	57	4669	94	Accts. Pay.	30	00			
						Accts. Rec.					
	Total	8,726	51	8,726	51	Sal. & W.	574	00			
							809	90			2 00
J	Profit & Loss										
	Mdse.			1,362	81	Interest. Cash			1	43	
	Expense	800	90			Accts. Pay.					
	Interest			1	43	Accts. Rec.					1 43
	Proprietor	563	34								
							3564	57			4669 94
	Total Profit and Loss	1,364	24	1,364	24						
	Total Journal-Ledger	10,090	75	10,090	75						

The totals are compared with the figures in the last line and the last column of the Journal-Ledger and checked against each other. These checked figures are then entered in the Transactions column of the Balance Sheet, and by adding the Dr. and Cr. figures to those of the balances of Jan. 1, the Balances of Jan. 31 are obtained.

These balances are further checked by comparing the Dr. balance of Cash and Notes Receivable with the cash and notes on hand; the balances of Accounts Receivable with the total of the unpaid items in the Sales Ledger or Sales Cards Unpaid; the balance of Notes Payable with the unpaid items in the Bill Book, the balance of Accounts Payable with the unpaid Invoices; the balance of Wages and Salaries with the unpaid items in the Salary List and Pay Rolls, and the balance of Property and Mdse. accounts with the inventories.

These same comparisons are necessary of course in auditing a set of books kept on the ordinary system.

CHAPTER IV

ACCOUNTS FOR RETAIL MERCHANTS. SELLING PRICES. TURNOVER

The Federal Trade Commission's System. "A System of Accounts for Retail Merchants" is the title of a 19-page pamphlet issued in July, 1916, by the Federal Trade Commission, Edward N. Hurley, Chairman. In an introductory letter Mr. Hurley says: "With the object of aiding retail merchants to improve their accounting methods we have outlined a simple system of accounts which provides for supplying the information necessary to properly direct a retail business." From the introduction the following extracts are taken:

Banks are paying more attention to the accounting methods used by the merchant to whom they extend credit. They are willing to give larger loans to the merchant who keeps his books in a way that enables him to show the bank at any time just how his business is progressing.

Another important point to which the bank gives consideration is whether the prospective borrower is making proper provision for depreciation on stock, buildings and fixtures, and his books should be so arranged as to show the amount of these provisions. No merchant can be said to be managing his business properly unless adequate provision is made for depreciation.

The aim has been to devise the least involved system which will give the information essential to successful management. The best system of accounts for any business is one which furnishes the information required with the least effort.

The system here outlined requires but four books of account: journal, general cash book, invoice book and ledger. Sales tickets and credit tickets are used for recording sales and sales returns.

When the volume of business permits, it is advisable to use three ledgers, a general ledger, a purchase ledger and a sales ledger, keeping controlling accounts of the purchase ledger and the sales ledger in the general ledger.

The pamphlet gives a list of 45 ledger accounts, of which 22 are "real" or asset and liability accounts, and 23 "nominal" or profit and loss accounts, with an explanation of their use, showing what debit and credit entries are made in each. Examples of transactions and of the method of entering them in the several books of original entry, summarizing them in the journal and posting them to the ledger accounts are unfortunately lacking, but three forms are given, a balance sheet, a profit and loss statement of one month's business, and a monthly summary of business, which are copied below.

In order to make the system more clearly understood by the student and also in order to provide a basis for some comments that it seems to require we have attempted to discover and reconstruct from the three forms the journal and ledger entries from which the forms given may have been derived.

From the explanations of the accounts and their uses the following paragraphs are taken:

Monthly Summary of Business, 1916

	Net Sales			Buying Expense		Selling Expense			Delivery Expense	
	Credit	Cash	Total	Salaries and Wages of Buying Force	Miscellaneous Buying Expense	Salaries and Wages of Sales Force	Advertising	Miscellaneous Selling Expense.	Salaries and Wages of Delivery Force	Miscellaneous Delivery Expense
Jan.	$3356.31	$1301.65	$4657.96	$25.00	$14.00	$177.33	$30.00	$3.75	$102.67	$8.08
Feb.										
Total (12 Months)										
Per cent of Net Sales										

	General Expense							Total Expense	Per cent of Net Sales
	Management and Office Salaries	Office Supplies and Expense	Insurance on Stock and Store Equipment	Taxes on Stock and Store Equipment	Losses from Bad Debts	Miscellaneous General Expense	Rent		
Jan.	$269.00	$22.03	$1.61	$2.50	$33.56	$26.79	$71.25	$787.57	16.9
Feb.									
Total									
Per cent of Net Sales									

Explanations of Some of the Accounts

4. *Reserve for Bad Debts.* Credit this account with an estimated amount based on charge sales, sufficient to provide for losses, and charge the account with the balances of personal accounts when hope of collection is abandoned.

5. *Prepaid Insurance.* Charge with all insurance paid. At the end of each month credit the account and charge No. 35 (Insurance on Stock and Store Equipment) and No. 44 (Rent Income) with their monthly proportion, the balance being an asset as "Prepaid Insurance."

6. *Accrued Interest Receivable.* Charge at the end of the period with all accrued interest (not yet paid) crediting Interest account. When the interest is received it is credited to "Accrued Interest Receivable."

9. *Reserve for Depreciation on Store and Warehouse.* Credit with the amount of depreciation, charging "Rent Income."

17. *Accrued Interest Payable.* Credit at the end of the period with interest accrued (not yet paid) on notes, etc., due others, charging Interest Account. When the interest is paid it is charged to "Accrued Interest Payable."

18. *Accrued Salaries and Wages.*—Credit this account with salaries and wages earned and unpaid at the end of each month and charge the proper expense accounts. When payment is made this account is charged.

19. *Accrued Taxes.*—Credit with the taxes due up to the end of each month, charging the proportionate amounts to the accounts to which they belong. When taxes are paid this account will be charged.

23. *Sales.* Credit with the total of the charge tickets for the month and the total cash sales from the "Cash Sales" column in the Cash Book. Charge the account, at the selling price, for all merchandise returned. The difference in this account will be the net sales, which is transferred to the credit of "Trading Account."

24. *Sales Allowances.* Charge with any allowance given a customer not contemplated when the sale was made. Allowances should not be charged to "Sales," but closed at the end of the period into "Trading Account."

25. *Merchandise Purchases.*—Charge with the face of the invoices before deducting cash discounts; also with freight, expressage and drayage. Credit with merchandise returned and with any allowances for defects in goods received. The balance of the account is transferred to the debit of "Trading Account."

BALANCE SHEET, JAN. 31, 1916

	ASSETS						
	CURRENT ASSETS						
1	Cash on hand and in bank			$1611	67		
2	Notes receivable—Trade Customers			191	84		
3	Accounts Receivable—Trade Customers	$3518	81				
4	Less Reserve for Bad Debts	33	56				
				3485	25		
	Inventory of merchandise (at cost)			2909	06		
5	Prepaid Insurance			100	14		
6	Accrued Interest Receivable				71		
	Total current assets					$8298	67
	FIXED ASSETS						
7	Store Property	4500	00				
8	Warehouse Property	1975	00				
		6475	00				
9	Less Reserve for Depreciation on Store and Warehouse	26	98				
				6448	02		
10	Store Equipment			272	71		
11	Office Equipment			74	37		
12	Delivery Equipment			396	67		
	Total fixed assets					7191	77
	Total assets					15490	44
	LIABILITIES AND CAPITAL						
	CURRENT LIABILITIES						
13	Notes Payable—Trade Creditors	1210	50				
14	Notes Payable—Banks	900	00				
15	Accounts Payable—Trade Creditors	3685	72				
16	Accounts Payable—Others	485	00				
17	Accrued Interest Payable	19	23				
18	Accrued Salaries and Wages	82	00				
19	Accrued Taxes	7	75				
	Total current liabilities			6390	20		
21	Mortgages Payable (warehouse)			1250	00		
	Total liabilities			7640	20		
22	Proprietor's Capital Account			7850	24		
	Total liabilities and capital					15490	44

PROFIT AND LOSS STATEMENT, JAN. 31, 1916

								Per Ct.	Per Ct.
23	Sales					4659	96		
24	Less Sales Allowances					2	00		
	Net Sales					4657	96		100.0
	Inventory of merchandise at beginning			3451	09				
25	Merchandise Purchases (cost delivered at store)			2759	67				
				6210	76				
	Deduct inventory of merchandise at closing	3062	17						
	Less Stock Depreciation	153	11	2909	06				
	Net cost of goods sold					3301	70		70.9
	Gross profits from trading					1356	26		29.1
	BUYING EXPENSE.								
26	Salaries and Wages of Buying Force	25	00						
27	Miscellaneous Buying Expense	14	00						
	Total buying expense			39	00			0.8	
	SELLING EXPENSE								
28	Salaries and Wages of Sales Force	177	33						
29	Advertising	30	00						
30	Miscellaneous Selling Expense	3	75						
	Total selling expense			211	08			4 5	
	DELIVERY EXPENSE								
31	Salaries and Wages of Delivery Force	102	67						
32	Miscellaneous Delivery Expense	8	08						
	Total delivery expense			110	75			2.4	
	GENERAL EXPENSE								
33	Management and Office Salaries	269	00						
34	Office Supplies and Expense	22	03						
35	Insurance on Stock and Store Equipment	1	61						
36	Taxes on Stock and Store Equipment	2	50						
37	Losses from Bad Debts	33	56						
38	Miscellaneous General Expense	26	79						
39	Rent	71	25						
	Total general expense			426	74	787	57	9.2	16 9
	Net profit from trading					568	69		12 2
	INCOME FROM OTHER SOURCES								
42	Interest	*17*	*09*						
43	Cash Discounts on Merchandise Purchases	6	55						
44	Rent income (net)	16	52						
45	Miscellaneous Outside Income	2	00			7	98		
	Total net profit					576	67		

37. *Losses from Bad Debts.** Charge this account with the amount that has been reserved for bad debts (4).

39. *Rent.* Charge with all rents paid. If the store is owned rent should be charged equivalent to the amount it could be rented for to others, crediting "Rent Income" (44). In the latter event "Rent Income" should be charged with the taxes, insurance, repairs and depreciation on the store.

40. *Trading Account.* This account shows the inventory of merchandise at opening, and it is not touched again until the books are closed. It is then charged with Merchandise Purchases (25) and Sales Allowances (24) and credited with Sales (23) and with the inventory at the close. The balance is transferred to the credit of "Profit and Loss Account." The inventory is then brought down as a new balance.

41. *Profit and Loss Account.* Charge with the balances of all the expense accounts; credit with the gross profit from trading and with the net income from other sources. The difference will be the net profit or loss, which is closed into the proprietor's account; if a partnership, to the partners' accounts according to their several interests, and, if a corporation, to the surplus account.

44. *Rent Income.* If the store is owned, the rent which has been charged to account 39 should be credited to this account and it should be charged with insurance, taxes, depreciation and repairs on store. The account is closed into "Profit and Loss."

45. *Miscellaneous Outside Income.* Credit this account with incidental receipts such as toll from telephone pay stations in the store, etc.

* This title is a misnomer since the loss has not actually been incurred. A better title would be "Insurance for Bad Debts." It represents a monthly expense charge, Reserve for Bad Debts being credited, to provide against future bad debts.

42. *Interest.* Charge this account with all interest paid and credit it with all interest received * and close into "Profit and Loss Account." (Compare Nos. 6 and 17.)

The journal and ledger entries, which have been derived from the monthly statements, are given below:

Journal

1	Cash To Sundries	1311	63		
23	To Sales			1301	65
43	To Cash Discts.			6	55
42	To Interest			1	43
45	To Misc. O. Inc.			2	00
1	Sundries To Casb			690	90
27	Misc. Buying Exp.	14	00		
30	Misc. Selling Exp.	3	75		
32	Misc. Delivery Exp.	8	08		
33	Office Supplies and Exp.	22	03		
38	Misc. Gen. Exp.	26	79		
44	Rent Income (Store Repairs)	15	01		
18	Wages and Salaries	492	00		
5	Prepaid Insurance	109	24		

The two entries above may be omitted from the Journal if a Column Cash Book is used and the footings of the columns are posted directly into the Ledger. The following entry may also be omitted and posted from the footings of the columns of the Pay Roll and salary list.

Journal—(*Continued*)

18	Sundries To Wages and Salaries			574	00
26	Salaries and Wages Buying Expense	25	00		
28	Salaries and Wages Selling Expense	177	33		
31	Salaries and Wages Delivery Expense	102	67		
33	Management and Office Salaries	269	00		
15	Sundries To Accts. Payable			2789	67
25	Merchandise Purchases	2759	67		
29	Advertising	30	00		
5	Sundries To Prepaid Insurance			9	10
44	Rent Income	7	49		
35	Insurance on Stock and Store Equipment	1	61		
19	Sundries To Accrued Taxes			7	75
44	Rent Income	5	25		
36	Taxes on Stock and Store Equipment	2	50		
44	Rent Income	26	98		
9	To Reserve for Dep'n on Store and Warehouse			26	98

* This is not clear and is not in harmony with Nos. 6 and 17. It does not seem to agree with the general principle "The account which receives is debtor to the account which gives." The fact is that "interest paid" means that cash (or other value or credit) is given on account of interest, therefore Cash is credited and Interest, which is an expense, is charged. "Interest received" means that cash is received on account of interest, therefore Cash is charged, and Interest, which in this case is revenue or income, is credited.

If we owe John Doe $1000 and settle his account by giving him a three-months' note for $1015, the entry is

John Doe $1000 To Bills Payable $1015
Interest 15

If John Doe owes us $1000 and he gives us a note for $1015 in payment the entry is

Bills Receivable, $1015 To John Doe, $1000
To Interest 15

Journal—(*Continued*)

39	Rent	71	25		
44	To Rent Income			71	25
42	Interest	19	23		
17	To Accrued Interest Payable			19	23
6	Accrued Interest Receivable	0	71		
42	To Interest			0	71
37	Losses from Bad Debts	33	56		
4	To Reserve for Losses from Bad Debts			33	56
3	Accounts Receivable	3358	31		
23	To Sales			3358	31
24	Sales Allowances	2	00		
3	To Accounts Receivable			2	00
40	Trading Account To Sundries	2761	67		
24	To Mdse. (Cost of Sales)			2759	67
25	To Sales Allowances			2	00
23	Sales	4659	96		
40	To Trading Account			4659	96
41	Profit & Loss To Sundries	804	66		
26	To Salaries and Wages, Buying			25	00
28	To Salaries and Wages, Selling			177	33
31	To Salaries and Wages, Delivery			102	67
33	To Management and Office Salaries			269	00
29	To Advertising			30	00
27	To Misc. Buying Expenses			14	00
30	To Misc. Selling Expenses			3	75
32	To Misc. Delivery Expense			8	08
34	To Office Supplies and Exp.			22	03
35	To Insurance on S. & S. Equip.			1	61
36	To Taxes on S. & S. Equip.			2	50
37	To Losses from Bad Debts			33	56
38	To Misc. Gen Expense			26	79
39	To Rent			71	25
42	To Interest			17	09
41	Sundries To Profit & Loss			1381	33
40	Trading Account	1356	26		
43	Cash Discounts	6	55		
44	Rent Income	16	52		
45	Misc. Outside Income	2	00		
41	Profit & Loss	576	67		
22	To Proprietor's Capital Account			576	67

Ledger

Cash

To Bal.	990	94	By Sunds.,	690	90
To Sundries	1311	63	By *Bal.*	*1611*	*67*
	2302	57		2302	57

2. Notes Receivable

To Bal.	191	84			

3. Accts. Receivable

To Bal.	162	50	By Sales Allowaoces	2	00
To Sales	3358	31	By *Bal.*	*3518*	*81*
	3520	81		3520	81

4. Reserve for Bad Debts

			By Losses from B. D.	33	56

Ledger—(*Continued*)

5. Prepaid Insurance

To Cash	109	24	By Sunds.	9	10
			By *Bal.*	*100*	*14*

6. Accrued Interest Rec.

To Interest	0	71			

7. Store Property

To Bal.	4500	00			

8. Warehouse Property

To Bal.	1975	00			

9. Reserve for Depreciation on Store and Warehouse

			By Rent Income	26	98

10. Store Equipment

To Bal.	272	71			

11. Office Equipment

To Bal.	74	37			

12. Delivery Equipment

To Bal.	396	67			

13. Notes Payable—Trade Creditors

			By Bal.	1210	50

14. Notes Payable—Banks

			By Bal.	900	00

15. Accts. Pay.—Trade Creditors

To *Bal.*	*3685*	*72*	By Bal.	896	05
			By Sundries	2789	67

16. Accts. Pay—Others

			By Bal.	485	00

17. Accrued Interest Payable

			By Interest	19	23

18. Salaries and Wages

To Cash	492	00	By Sundries	574	00
To *Bal.*	*82*	*00*			

19. Accrued Taxes

			By Sundries	7	75

20. Proprietor's Drawing Account (no entries)

21. Mortgage Payable, Warehouse

			By Bal.	1250	00

22. Proprietor's Capital Acct.

To *Bal.*	*7850*	*24*	By Bal.	7273	57
			P. & L.	576	67

23. Sales

To Trading a c	4659	96	By Accts. Rec.	3358	31
			By Cash	1301	65

24. Sales Allowances

To Accts. Rec.	2	00	By Trading a. c	2	00

25. Merchandise Purchases

To Accts. Pay.	2759	67	By Trading a/c	2759	67

26. Salaries and Wages, Buying

To Accrued S. & W.	25	00	By Profit & L.	25	00

27. Miscellaneous Buying Expenses

To Cash	14	00	By P. & L.	14	00

28. Salaries and Wages, Selling

To Accrued S. & W.	177	33	By P. & L.	177	33

29. Advertising

To Accts. Pay.	30	00	By P. & L.	30	00

30. Miscellaneous Selling Expenses

To Cash	3	75	By P. & L.	3	75

31. Salaries and Wages, Delivery

To Accrued S. & W.	102	67	By P. & L.	102	67

32. Miscellaneous Delivery Expense

To Cash	8	08	By P. & L.	8	08

33. Management and Office Salaries

To Accrued S. & W.	269	00	By P. & L.	269	00

34. Office Supplies and Expense

To Cash	22	03	By Profit & L.	22	03

35. Insurance on Stock and Store Equip.

To Prepaid Ins.	1	61	By Profit & L.	1	61

36. Taxes on Stock and Store Equip.

To Accrued Taxes	2	50	By Profit & L.	2	50

Ledger—(*Continued*)

37. Losses from Bad Debts

To Reserve for B. D.	33	56	By Profit & L.	33	56

38. Misc. General Expense

To Cash	26	79	By Profit & L.	26	79

39. Rent

To Rent Income	71	25	By Profit & L.	71	25

40. Trading Acct.

To Inv. (Inventory)	3451	09	By Sales	4659	96
To Mdse. Purchases	2759	67	By *Bal. (Inventory)*	*2909*	*06*
To Sales Allowances	2	00			
To Profit & L.	1356	26		7569	02
	7569	02			

41. Profit and Loss

To Sundries	804	66	By Sundries	1381	33
To Prop.	576	67			

42. Interest

To Accr. Int. Pay.	19	23	By Ac. Int. Rec.	0	71
			By Cash	1	43
			By P. & L.	17	09

43. Cash Discounts on Purchases

To Profit & L.	6	55	By Cash	6	55

44. Rent Income

To Accr. Taxes	5	25	By Rent	71	25
To Prepaid Ins.	7	49			
To Depn. S. & W.	26	98			
To Cash	15	01			
To Profit & L.	16	52			
	71	25			

45. Miscellaneous Outside Income

To Profit & L.	2	00	By Cash	2	00

From this ledger the Balance Sheet may be made as below, showing the transactions during the month as well as the balances at the end of the month. A sheet of this form with thirteen double columns would show the whole course of the business each month for six months.

BALANCE SHEET

		Trial Balance, Jan. 1				Transactions, January				Trial Balance, Jan. 31			
		Dr.		Cr.		Dr.		Cr.		Dr.		Cr.	
1	Cash	990	94			1,311	63	690	90	1,611	67		
2	Notes Rec.	191	84							191	84		
3	Accts. Rec.	162	50			3,358	31	2	00	3,518	81		
4	Res. for Bad Debts							33	56			33	56
5	Prepaid Ins.					109	24	9	10	100	14		
6	Accrued Int. Rec.					0	71			0	71		
7, 8, 10–12	Real Est. & E.	7,218	75							7,218	75		
9	Res. for Dep'n.							26	98			26	98
13	Notes Pay. Trade			1,210	50							1,210	50
14	Notes Pay. Banks			900	00							900	00
15	Accts. Pay. Trade			896	05			2,789	67			3,685	72
16	Accts. Pay. others			485	00							485	00
17	Accrued Int. Pay.							19	23			19	23
18	Accrued Sal. & Wages					492	00	574	00			82	00
19	Accrued Taxes							7	75			7	75
21	Mortgage Payable			1,250	00							1,250	00
22	Proprietor			7,273	57			576	67			7,850	24
23	Sales					4,659	96	4,659	96				
24	Sales Allowances					2	00	2	00				
25	Mdse. Purchases					2,759	67	2,759	67	2,909	06		
26–27	Buying Exp.					39	00						
28–29–30	Selling Exp.					211	08						
31–32	Delivery Exp.					110	75						
33–34	Office Exp.					291	03	787	57				
35–36	Ins. & Tax on Store Equip.					4	11						
37	Losses from Bad Debts					33	56						
38	Misc. Gen. Exp.					26	79						
39	Rent					71	25						
40	Trading Acct.	3,451	09			4,117	93	4,659	96	2,909	06		
41	Profit & Loss					1,381	33	1,381	33				
42	Interest					19	23	19	23				
43	Cash Discts.					6	55	6	55				
44	Rent Income					71	25	71	25				
45	Misc. Outside Income					2	00	2	00				
		12,015	12	12,015	12	19,079	38	19,079	38	15,550	98	15,550	98

Suggested Improvements of the Trade Commission's System

The system described by the Commission is an excellent illustration of the later elaborated methods of the old school of accountants, and it should be clearly understood by students before they proceed to modern methods in which much of the clerical labor required by the older methods is dispensed with.

The system is open to the objection that it violates the principle laid down by the Commission:

"The best system of accounts for any business is one which furnishes the information required with the least effort." Instead of its being "the least involved system which will give the information essential to successful management," it is a highly involved one, requiring much more labor to keep it than is needed with other systems.

It has 45 accounts, 14 of which, Nos. 26 to 39 inclusive, are subdivisions of expense, and are carried through all the routine of journal, double-entry ledger, balance sheet, profit and loss statement, and monthly summary. Instead of having a single Real Estate and Equipment Account, the subdivisions of it being entered once a year in certain columns of an Inventory Book, there are five separate accounts. It has two accounts for Notes Payable, one for banks the other for trade creditors. If there is any necessity for separating the two kinds of notes, they may be marked with the letters B or T in the Notes Payable Book. The same may be said of the two Accounts Payable, "trade creditors" and "others." Many of the accounts show, not actual business transactions, but fictitious or imaginary transactions, or accruing expense liabilities which there is no need of entering in the general ledger until they are paid. If there is need to have these liabilities taken into account in order to avoid inaccuracy in Profit and Loss statements, they can be entered in a memorandum "Profit and Loss Adjustment" at the bottom of each monthly balance sheet. The accounts referred to are: Reserve for Bad Debts; Losses from Bad Debts (not actual losses but merely a monthly charge to an expense account, offsetting the monthly credit to the Reserve account); Reserve for Depreciation on Store and Warehouse, the monthly credit of which is charged to another expense account; Rent and Rent Income, both of which are accounts of imaginary transactions, the buildings being owned and not rented.

Instead of using a single Merchandise account, as in older and simpler systems, it is divided into five accounts: Merchandise Purchases; Cash Discounts on Merchandise Purchases; Sales; Sales Allowances; and Trading Account. In the old systems Merchandise Account would appear as follows in the Ledger:

Mdse.

To Bal. (Invty.)	3451	09	By Cash	1301	65
To Accts. Recl. (*A*)	2	00	By Cash (*D*)	6	55
To Accts. Pay.	2759	67	By Accts. Rec.	3358	31
To Profit & Loss	1362	81	By Bal. (Invty.)	2909	06
	7575	57		7575	57
To Bal.	2909	06			

(*A*) Sales Allowances. (*D*) Cash Discounts on Purchases.

By the Commission's system the same transactions would be recorded as follows:

Merchandise Purchases

To Accts. Pay.	2759	67	By Trading Acct.	2759	67

Cash Discounts on Mdse. Purchases

To Profit and Loss	6	55	By Cash	6	55

Sales

To Trading Acct.	4659	96	By Cash	1301	65
			By Accts. Rec.	3358	31
	4659	96		4659	96

Sales Allowances

To Accts. Rec'l	2	00	By Trading Acct.	2	00

Trading Account

To Bal. (Invty.)	3451	09	By Sales	4659	96
To Mdse. Purchases	2759	67	By Bal. (Invty.)	2909	06
To Sales Allowances	2	00			
To Profit & Loss	1356	26			
	7569	02		7569	02

In these five accounts there are fifteen entries, while in the single merchandise account there are only eight. The five accounts give not a scrap more of information than the single account.

In the Profit and Loss Statement the "Net Cost of Goods Sold" is given, erroneously, as $3301.70 in the following statement:

Inventory at beginning			3451	09		
Purchase at Cost			2759	67	6210	76
Deduct Invty. at closing	3062	17				
Less Stock Depreciation	153	11			2909	06
Net Cost of Goods Sold					3301	70

The depreciation of 5 per cent, or $153.11 on the goods remaining unsold is thus made to increase the cost of the goods sold.

A more correct statement would be the following:

Inventory at beginning	3451	09		
Purchase, at Cost	2759	67	6210	76
Inventory at closing, at cost value			3062	17
Net cost of Goods Sold			3148	59

The Profit and Loss Statement would then read as below:

Sales, less Sales Allowances	4657	96
Cost of Goods Sold	3148	59
Profit on Sales	1509	37
Deduct Depreciation on goods unsold	153	11
Gross Profit on Trading	1356	26

The first improvement to be made in the Trade Commission's system is to consolidate some of the fourteen expense accounts so as to reduce their number. The "Monthly Expense Ledger," see page 31, reduces them to eight. The next is to consolidate the five property and equipment ac-

counts into one Real Estate and Equipment Account, letting the subdivisions remain in the Inventory Book. The 44 accounts of the original Balance Sheet are thus reduced to 34, as shown in the improved Balance Sheet on page 27, in which the monthly transactions are given as well as the balances at the beginning and end of the month.

A further step is to consolidate the eight expense accounts of this balance sheet into one Expense Account in the General Ledger, taking the footing of the last column of the Monthly Expense Ledger, $787.57, as the debit to Expense Account, balancing the eight credit accounts whose titles are given in the headings of the columns, the amounts being in the bottom line. By this means the number of accounts is reduced to 27.

The next stage in reducing the labor of keeping the accounts is the abandonment of the old-fashioned Journal and Ledger and the adoption of the Column Ledger, or Monthly Combined Journal-Ledger, with printed titles of the accounts, shown on page 31. For a description of this Ledger, see page 17.

One page of this Ledger is used for each month. The footings of the columns (Total Debits) and the totals of the horizontal lines (Total Credits) are transferred to the Dr. and Cr. columns of Transactions in the Balance Sheet, the titles of accounts in which are also printed. One sheet will last six months, showing a complete record of the total transactions of each account for each month if the sheet is made with thirteen double columns (Dr. and Cr.) seven of them being for balances and six for transactions.

In making entries in the monthly Expense Ledger and in Combined Journal-Ledger the figures are obtained from the footings of the columns of the books of original entry, Cash Book, Petty Cash Book, Bill Book (or Notes Receivable and Notes Payable), Invoice Register, Sales Book (or Sales Ticket Record), just as in making the entries in an ordinary journal.

In ordinary bookkeeping methods the total monthly purchases of merchandise, as shown in the Invoice Register or Accounts Payable book, would be journalized in the entry Mdse. To Accounts Payable $2759.67; $2759.67, and the entry would be posted to two accounts in the Ledger. In the Combined Journal-Ledger System the entry is made both as a journal entry and as a ledger entry at the same time by a single writing of the amount $2759.67 in the vertical column with the printed heading "Mdse.," on the horizontal line having the printed title "Accts. Payable."

Comparing the amount of labor required to enter the figures in the Expense Ledger and the Journal Ledger with the old method of writing the entries in the Journal and then posting them in the Ledger, we have the following:

Entries of figures in the Expense Ledger		18
Entries of figures in the Journal-Ledger		28
Total		46
Items written in the Journal	70	
Items Posted in the Ledger	70	
Total	140	

There are 18 journal entries comprising the 70 items, and postings are made on 29 of the ledger pages. In making a trial balance all the 45 accounts in the ledger have to be examined and their balances written down. The Journal-Ledger is self-balancing, if the columns and horizontal lines are correctly added.

In the Monthly Expense Ledger and Journal-Ledger here shown not a single transaction entered in the old-style journal has been omitted. Such entries, for example, as Salaries and Wages, Buying Expense To Accrued Salaries and Wages, $25.00, and Profit and Loss To Salaries and Wages, Buying Expense, all appear in the one entry $25.00 in the Expense Ledger, the transfer to Profit and Loss being taken care of in the credit of $787.57 to Expense in the Journal Ledger.

The Expense Ledger and the Journal Ledger may be greatly improved and reduced in bulk by removing from them the following accounts:

		Dr.		Cr.	
4	Reserve for Bad Debts			33	56
5	Prepaid Insurance	109	24	9	10
6	Accrued Interest Receivable	0	71		
9	Reserve for Depreciation of Store and Warehouse			26	98
17	Accrued Interest Payable			19	23
19	Accrued Taxes			7	75
24	Sales Allowances	2	00	2	00
37	Losses and Bad Debts	33	56	33	56
40	Trading Account	4659	96	4659	96
43	Cash Discounts on Purchases	6	55	6	55
44	Rent Income	71	25	71	25
45	Miscellaneous Outside Income	2	00	2	00
		4885	27	4871	94
	Unbalanced Accounts	100	85	87	52
	Profit & Loss Adjustment for Accts. removed from Ledger			13	33

The reasons for taking Sales, Sales Allowances, Cash Discounts on Merchandise Purchases, and Trading Account out of the Ledger and including them all in Mdse. Account have already been given, but they may be repeated here in a different form:

Transactions

(1)	Inventory at beginning	3451	09	(5)	Sell goods on Credit	3358	31
(2)	Purchase goods on account	2759	67	(6)	Make allowance on invoice	2	00
(3)	Receive Cash Discount	6	55	(7)	Inventory, final, 3062.17 less depn 153.11	2909	06
(4)	Sell goods for Cash	1301	65				

Journal Entries on the Commission's System

	Original				Transfer and Balancing		
(1)	Mdse. Inventory	3451	09				
(2)	Mdse. To Accts. Pay.	2759	67	(3)	Cash Discts. To Profit & Loss	6	55
(3)	Cash To Cash Discts.	6	55	(4) (5)	Sales To Trading Acct.	4659	96
(4)	Cash To Sales	1301	65	(6)	Trading Acct. To Sales Allow.	2	00
(5)	Accts. Rec'l. To Sales	3358	31		Trading Acct. To Mdse. ("Net Cost")	2759	67
(6)	Sales Allow. To Accts. Rec.	2	00		Trading Acct. To Profit & Loss	1356	26
(7)	Cr. by Inventory	2909	06				

In the ordinary systems the same seven original entries would be made, but "Mdse." would be used in all instead of Sales, Sales Allowances and Cash Discounts; but only one transfer double-entry would be needed, instead of five, viz., Mdse. To Profit and Loss, $1362.81; the four Trading account double entries, or eight ledger postings, being eliminated. The increased complexity due to having these extra accounts in the ledger, with no compensating advantages, is a good reason for their exclusion from the ledger.

Reserve for Bad Debts and Reserve for Depreciation on Store and Warehouse may just as well be left out of the Ledger and taken care of by a Profit and Loss adjustment statement appended to the Balance Sheet. In the Commission's system these reserve accounts are handled as follows:

4. Reserve for Bad Debts: Credit with an estimated amount, based on charge sales, sufficient to provide for losses. Charge with the balances of personal accounts when hope of collection is abandoned.

37. Losses from Bad Debts: Charge with the amount that has been reserved for Bad Debts (4).

9. Reserve for Depreciation on Store and Warehouse: Credit this account with the amount of depreciation on store and warehouse and charge the amount to Rent Income (No. 44).

The Journal entries are:

Losses from Bad Debts	To	Reserve for Losses from Bad Debts	33.56	
Profit & Loss	To	Losses from Bad Debts.		33.56
Rent Income	To	Reserve for Dep'n on S. & W.	26 98	
Rent	To	Rent Income		71.25
Profit & Loss	To	Rent		71.25

The result is to decrease the credit balance of Profit and Loss account by $33.56 plus $26.98 and put these amounts to the credit of the two Reserve Accounts. The same result can be accomplished, for all practical purposes, with less bookkeeping, by leaving these accounts out of the ledger, and making a statement concerning them in the Balance Sheet.

The pamphlet of the Commission says: "No merchant can be said to be managing his business properly unless adequate provision is made for depreciation."

Adequate provision for depreciation consists first in selling the goods at such an advance over cost and expenses that a surplus may be built up, out of which depreciation, when it takes place, may be provided for, and second, in not distributing this surplus in the form of dividends to such an extent as will deplete it below a proper reserve for depreciation. Whether or not the portion of this surplus that is kept as a reserve is credited to a reserve account in the Ledger or is kept in a surplus or Profit and Loss account is merely a matter of bookkeeping. The financial condition of the business, which a bank may consider as a basis for a loan, is precisely the same if the surplus account has a credit balance of $5000, with no reserve for depreciation, or if the credit balance is $4000 with $1000 credited to a reserve account.

There is, however, an important advantage in putting part of the surplus into a reserve account; a surplus is popularly supposed to be something that ultimately may be divided among the stockholders, while a reserve is a fund that will some day be wiped out by actual depreciation of assets. If it is kept as a reserve, stockholders will not expect it to be paid out in dividends.

Taxes and insurance appear in the following Journal entries:

Prepaid Insurance	To Cash		109	24
Insurance on Stock and Store Equipment	To Prepaid Insurance		1	61
Rent Income, Insurance	To Prepaid Insurance		7	49
			9	10
Taxes on Stock and Store Equipment	To Accrued Taxes		2	50
Rent Income	To Accrued Taxes		5	25
			7	75

If the Insurance premium $109.24 was paid in advance for a year, and $9.10 of it is charged in the expenses for January, the balance on January 31, $100.14, is an expense asset which is decreasing every day. Instead of keeping the three accounts, Prepaid Insurance, Insurance on Stock and Store Equipment, and Rent Income, open on the Ledger, the amount of $100.14 may be entered as an expense asset and the items $1.61 and 7.49 as incurred or accrued expenses in a memorandum Profit and Loss adjustment. In the same way this Adjustment may contain Accrued Taxes $7.75 as an expense liability incurred and the items $2.50 and $5.25 as incurred expenses.

Accrued Interest Payable, $19.23, and Accrued Interest Receivable, $0.71, may also be put in the Profit and Loss Adjustment, the first as a liability or credit, the second as a debit, or asset. Miscellaneous Outside Income, $2.00, received for use of the telephone in the store, may be treated as income from Expense Account, offsetting to that amount the rent of the telephone.

By removing all these accounts from the Ledger, Profit and Loss Adjustment will be as follows:

	Profit & Loss Adjustment.			
	Dr. (Liability)		Cr. (Asset)	
Insurance	9	10	109	24
Taxes	7	75		
Reserve for Bad Debts	33	56		
Reserve for Depreciation	26	98		
Accrued Int. Rec.			0	71
Accrued Int. Pay.	19	23		
	96	62	109	95
Balance, Deferred Credit to Profit and Loss	13	33		

The result of removing all these accounts from the Ledger is shown on page 32.

Here on one page is the whole record of every essential fact of the month's business that is shown in the Commission's system of 45 ledger accounts, 18 journal entries with 70 items, monthly summary, profit and loss statement, and balance sheet. The only items missing are the five separate accounts which are here condensed into one Real Estate and Equipment Account, and Trading Account. There are only 13 accounts in the combined Journal-Ledger and 10 in

the Expense Distribution, and 7 items in the Deferred Profit and Loss Charges and Credits. There are only 15 entries in the Journal-Ledger and 12 in the Expense Distribution, a total of 27, figures only, as compared with 140 items, writing and figures, in the Commission's system.

Twelve sheets with proper rulings and printed headings in this system contain the record of a whole year's business in sufficient detail for the manager's or owner's needs as far as the general course of the business is concerned. If minor details are wanted for any purpose the bookkeeper can easily supply them by reference to the books of original entry from the footings of which the Journal-Ledger entries were made.

The student is advised to make a thorough and systematic study of this chapter. He should provide himself with blank books with journal and ledger rulings, and after first journalizing and then posting the assets and liabilities, as shown in the Trial Balance of January 1, he should journalize the transactions, as in the journal entries on page 25, verifying the transfer and profit and loss entries, and post the entries into his ledger. A trial balance of the ledger should then be made, and when it is found to balance, the Monthly Summary of Business, Balance Sheet and Profit and Loss Statement, January 31, should be derived from the ledger and put into the forms given by the Trade Commission. The student should then study carefully the "suggested improvements," page 28, and repeat the work, using the combined journal-ledger system, and obtain the final results in the forms given on page 32. He will thus be enabled to satisfy himself as to the advantages of the new system.

MONTHLY EXPENSE LEDGER

Charge Accounts		Credit Accounts: 1 Cash	15 Accts. Payable	18 Wages and Salaries	5 Prepaid Insurance	19 Accrued Taxes	37 Res. for Bad Debts	9 Res. for Dep'n.	41 Profit and Loss	Total Expense Charges
26, 27	Buying Exp.	14 00		25 00						39 00
28, 29, 30	Selling Exp.	3 75	30 00	177 33						211 08
31, 32	Delivery Exp.	8 08		102 67						110 75
33, 34	Office Exp.	22 03		269 00						291 03
35, 36	Tax. and Ins. on Equip.				1 61	2 50				4 11
37	Loss from Bad Debts.						33 56			33 56
38	Misc. Gen. Exp.	26 79								26 79
44	Rent Income	15 01			7 49	5 25		26 98	16 52	71 25
	Total Credits	89 66	30 00	574 00	9 10	7 75	33 56	26 98	16 52	787 57

MONTHLY COMBINED JOURNAL-LEDGER

Credit Accts.*		Charge Accounts: Cash 1	Accts. Rec. 3	Prepd. Ins. 5	Acc. Int. Rec. 6	Sales 23	Sales Allow. 24	Mdse. 25	Salaries and Wages 26–33	Expense 27–39	Trading 40	Interest 42	Cash Dis. 43	Mis. O. Inc. 45	Profit and Loss 40	Total Credits
1	Cash			109 24					492 00	89 66						690 90
3	Accts. Rec'l.						2 00									2 00
4	Res. for B. D.									33 56						33 56
5	Prepd. Ins.									9 10						9 10
9	Depn. S. & W.									26 98						26 98
15	Accts. Pay.							2759 67		30 00						2789 67
17	Acct. Int. Pay.											19 23				19 23
19	Accr. Taxes									7 75						7 75
22	Proprietor														576 67	576 67
23	Sales	1301 65	3358 31													4659 96
24	Sales Allow.										00					2 00
25	Mdse. Purchd.										2759 67					2759 67
26–33	Salaries & W.									574 00						574 00
27–39	Expense														787 57	787 57
40	Trading Acct.					4659 96										4659 96
42	Interest	1 43			0 71										17 09	19 23
43	Cash Discts.	6 55														6 55
45	Misc. Out. Inc.	2 00														2 00
41	Profit & Loss.									16 52	1356 26		6 55	2 00		1381 33
	Total Debits.	1311 63	3358 31	109 24	0 71	4659 96	2 00	2759 67	492 00	787 57	4117 93	19 23	6 55	2 00	1381 33	19008 13

* The titles of debit accounts may be put in this column and the titles of credit accounts at the head of the columns of figures if desired.

The Condensed Accounting System

COMBINED JOURNAL-LEDGER, JANUARY, 1916

	Charge Accounts	Credit Accounts: Cash 1	Notes Rec'l. 2	Accts. Rec'l. 3	Notes Pay. 5	Accts Pay. 6	Salaries and Wages 7	Mdse. 9	Expense 10	Interest 11	Profit and Loss 12	Proprietor 13	Total Debits
1	Cash							1308 20	2 00	1 43			1311 63
2	Notes Rec'l.												
3	Accts. Rec'l.							3358 31					3385 31
5	Notes Pay.												
6	Accts. Pay.												
7	Sal. and Wages	492 00											492 00
9	Mdse.			2 00		2759 67					1362 81		4124 48
10	Expense	198 90				30 00	574 00						802 90
11	Interest										1 43		1 43
12	Profit & Loss								800 90			563 34	1364 24
13	Proprietor												
	(Other Accts.)												
	Total Credits	690 90		2 00		2789 67	574 00	4666 51	802 90	1 43	1364 24	563 34	11454 99

BALANCE SHEET

		Jan. 1 Dr.	Jan. 1 Cr.	Transactions Dr.	Transactions Cr.	Jan. 31 Dr.	Jan. 31 Cr.
1	Cash	990 94		1,311 63	690 90	1,611 67	
2	Notes Rec'l.	191 84				191 84	
3	Accts. Rec'l.	162 50		3,358 31	2 00	3,518 81	
4	Real Estate & Equip.	7,218 75				7,218 75	
5	Notes Payable		2,110 50				2,110 50
6	Accounts Payable		1,381 05		2,789 67		4,170 72
7	Salaries and Wages			492 00	574 00		82 00
8	Mortgage Payable		1,250 00				1,250 00
9	Merchandise	3,451 09		4,124 48	4,666 51	2,909 06	
10	Expense			802 90	802 90		
11	Interest			1 43	1 43		
12	Profit & Loss			1,364 24	1,364 24		
13	Proprietor		7,273 57		563 34		7,836 91
		12,015 12	12,015 12	11,454 99	11,454 99	15,450 13	15,450 13

Expense Distribution

	Cash	A/cs. Pay	Sal.& Wages	Total
Buying Exp.	14 00		25 00	39 00
Selling Exp.	3 75	30 00	177 33	211 08
Delivery Exp.	8 08		102 67	110 75
Office Exp.	22 03		269 00	291 03
Miscel. Exp.	26 79			26 79
Repairs	15 01			15 01
Insurance	109 24			109 24
Total	198 90	30 00	574 00	802 90

Deferred Profit & Loss Items

Cr. Prepaid Ins. Charged to Expense			109	24
Less Insurance Accrued (Bldgs. 7.49; Stock, 1.61)			9	10
			100	14
Accrued Int. Rec.			0	71
			100	85
Dr. Acc. Int. Pay.	19	23		
Acc. Taxes (Bldgs., 5.25; Stock, 2.50)	7	75		
Res. for Bad Debts	33	56		
Res. for Dep'n.	26	98	87	52
Bal. to Cr. of P. & L.			13	33

MERCHANTS' SELLING PRICE

A merchant in order to price his goods properly must know his overhead expenses. With a proper arrangement of his accounts the percentage of overhead may be readily obtained. Goods not priced high enough to cover this percentage are actually sold at a loss. The most convenient way of arriving at the proper percentage to add to the first cost of goods for overhead is to use the average ratio of operating expenses to net sales covering a past period. For instance, if a merchant's annual sales for the last fiscal year were $25,000 and the expense of conducting his business was $5000 his overhead was 20 per cent. By adding the desired percentage of profit on sales to this overhead percentage and deducting from 100 gives the percentage of invoice cost to selling price. The invoice cost of an article divided by this percentage gives the selling price. (Federal Trade Commission's Pamphlet, p. 6.)

The system above described for fixing selling prices is rarely, if ever, used in actual business, and in any business dealing with a large variety of goods it is practically impossible. The statement that "goods not priced high enough to cover the percentage (of overhead) are actually sold at a loss" may be far from true.

Suppose that a month's business of a certain grocery store showed the following results:

Sold	Invoice		Selling Price		Gross Profit			Turnover of Goods
	Cost per lb.	Amt.	Per lb.	Amt.	Per lb.	Amt.	%	
1000 lbs. Sugar	5¢	$50	5.5¢	$55	0.5¢	$5	10	24
200 lbs. Tea *A*	35	70	40	80	5	10	14.3	44
100 lbs. Tea *B*	40	40	50	50	10	10	25	12
50 lbs. Tea *C*	60	30	80	40	20	10	33	6
1350		190		225		35	18.4 av	
Other goods 12150		1710		2150		440	25.7	
13500 total		1900		2375		475	25	10

Overhead. Rent, taxes, insurance, interest, proprietor's services, clerk hire, cartage, stationery, postage, shortage, heating, lighting, depreciation, per month, $300 = 15.8% of Invoice Cost.

Net profit per month, $175.

According to the statement quoted above the sugar and the tea *A* "are actually sold at a loss," for the selling price is only 10 per cent and 14.3 per cent, respectively, above the first cost, while the average overhead on all the goods handled is 15.8 per cent.

The fact is that it is not correct to consider the overhead as an amount which must be uniformly distributed over all the goods sold as a percentage on their cost. The only reason why overhead is distributed on a uniform percentage of value basis is that that is an easy way to do it. The actual relation between the overhead and the cost of goods is a variable one, depending on the cost of handling, which varies with the bulk, weight, depreciation, shortage, etc., and with the turnover or rapidity with which the goods are sold. If the average amount of sugar purchased at one time is 500 lbs. and 1000 lbs. is sold per month the goods turnover is 24 times a year. If tea, C, is bought in 100-lb. lots and only 50 lbs. is sold per month its turnover is 6 times per year. The selling price of sugar has no necessary relation to the average overhead of 15.8 per cent, for the overhead properly belonging to it may be only 5 per cent. The selling price of the sugar and the cheaper tea may be fixed very low because the turnover is rapid, because the depreciation and shortage are small, and, because it is advisable to have some goods sold at a small profit in order to attract customers to the store who may be induced to buy other classes of goods on which there is a large profit.

Factory Cost and Selling Price. Many authors publish diagrams illustrating the following formulas:

1. Cost of Material + Cost of Direct Labor = Prime Cost.
2. Prime Cost + Departmental and General Expense = Factory Cost.
3. Factory Cost + Selling Expense = Total Cost to Make and Sell.
4. Total Cost to Make and Sell + Profit = Selling Price.

These formulas for finding the selling price may be useful in some few lines of manufacturing business, but, in general, only the first two lines of them are of any value. The factory cost, or what it costs to make an article, can be determined from the factory cost records provided the burden, or departmental and general factory expense, is properly distributed, and in many cases it may be predetermined, but the selling expense is generally such an uncertain quantity that both it and the profit (or loss) are not determinable until after the goods are sold and paid for. Much of the cost of selling an article this year was incurred and charged to selling expense last year, and much of this year's expenditures of the sales department will not result in sales until next year. The selling price is not always fixed by the manufacturer, it is more often fixed by competition, or by the purchaser.

Costs

Factory Costs		Selling Costs	Selling Price	Profits or Losses
Direct Material Direct Labor	Prime Cost	Proportion of Financial and Administration Costs	Gross, less Discounts and Allowances = Net Price	(See below)
Indirect Material Indirect Labor Other Factory Exp. Proportion of Financial and Administration Costs	Burden	Advertising Salesmen Branch offices Other selling expenses		

FORMULAS FOR PROFITS AND LOSSES

Net Selling Prices − (Factory Cost + Selling Cost) = Profit.

(Factory Cost + Selling Cost) − Net Selling Price = Loss.

When the selling price is not fixed by the market after the goods are made, but is a matter of contract between maker and buyer, then the formula may be

Factory Cost + Selling Cost + Profit = Selling Price.

In many factories the Prime Cost only is determined for each item of product, Direct Labor + Material, and no attempt

is made to distribute the burden over the several products. Monthly totals of labor, material, and actual burden are kept.

It is better to make no distribution than to distribute by a wrong method.

TURNOVER

The rapidity of the turnover is a very important element in conducting a retail business. It is obvious that an increase in turnover goes hand in hand with an increase in profit. A slow turnover may be due to poorly selected stock, to overstocking, or to an inefficient selling organization. No effort should be spared to increase the turnover to its maximum. To ascertain the turnover divide the cost of goods sold during the year by the cost of the average stock carried. (Federal Trade Commission's Pamphlet, p. 6.)

The turnover referred to in the above extract is only one kind of turnover, that of the goods handled. Another equally important turnover is that of capital invested. In the case of the sugar sold by the grocery store, if 1000 lbs. is sold each month and 500 lbs. is purchased every half month, the turnover is 24 if we consider that 500 lbs. is turned over 24 times a year, and this is the usual method of computing goods turnover, but according to the rule given in the pamphlet, as quoted above, we might figure that the average stock carried was half of a single purchase, or 250 lbs. (assuming that a new barrel could be obtained on the same day the old one was emptied) costing $12.50 and this divided into $600, the cost of the sugar sold during the year, gives a turnover of 48.

The turnover of capital is an entirely different matter. If a grocer could buy a barrel of sugar for $25 spot cash and sell it in two weeks for $27.50, collecting all the money before he needed to buy another barrel, his cash capital invested in sugar would be $25, and if he sold 24 barrels a year, costing $600, his turnover of capital would be the same as the goods turnover, or 24 times. But if he gave his customers three months' credit on the average he would have invested in sugar and in customers' accounts for sugar $150, making the turnover only 4 times a year, and this figure would be still further reduced by reason of the additional capital required for equipment and for expenses.

Quick Turnover. There is nothing so vitally important to the success of the business, in every direction, as the quickening of shop production and the possibility thus secured of making a quicker turnover of working capital invested.—C. U. Carpenter.

CHAPTER V

FACTORY ACCOUNTING

The first principle in modern factory accounting is that in the general books of the Company the operations of the factory shall be treated as if they were those of a separate business, belonging to outside parties. An account may be opened in the general books called Factory Plant (or Real Estate and Equipment), representing the Company's investment in the land, buildings, machinery and other permanent equipment of the factory, and another account, which may be called Factory Operation (or Manufacturing Account), is used to record the transactions between the factory and the general office. This account is charged with cash sent to the factory, with bills paid by the general office on account of the factory, and with all charges properly made against the factory for interest on the total investment in it (which includes both the cost of the plant itself and that of its operation) for insurance, taxes and depreciation, and for such portion of the salaries of general administrative officers as is rightly charged to the cost of operating the factory and not to the cost of the selling or financial departments. The monthly entries on the debit side of the Factory Operation Account will generally include the following:

GENERAL BOOKS, FACTORY OPERATION ACCOUNT

Dr. To Cash—for payroll and petty cash expenses.
To Accounts Payable—for invoices of goods purchased.
To Interest Earned, for interest on investment in factory.
To Insurance and Taxes, for $\frac{1}{12}$ of annual insurance and taxes.
To Reserve for Depreciation, for $\frac{1}{12}$ of estimated annual depreciation.
To Administration Expenses, for proportion chargeable to factory.

The account will be credited each month "By Mdse." for the value of the products shipped from the factory, and By Factory Plant for the value of any additions or "betterments" that have been made by the factory to the building or its equipment.

What is the meaning of the word "value" in this connection? The answer to this question involves all the difficulties of the theory and practice of factory accounting and cost-keeping. For any particular business the method of fixing the value to be used in crediting the factory for its shipments of goods should be determined at a conference between the management and the chief accountant. Whatever method be adopted it should be adhered to until very important reasons are found for changing it.

The "value" to be credited may be either "factory cost" or "cost of sales." Factory Costs may be either "actual" (so-called), "recorded" or "normal" costs; "Cost of Sales" may be catalogue list price less a certain percentage to cover discounts from list and estimated costs of selling, administration and estimated profit, or actual selling prices less a fixed percentage or a percentage varying with business conditions, or it may be the total of the charges against Factory Operation Account during a month (or other fiscal period) plus the decrease (or minus the increase) of the inventory during that period.

Continuous Product, Single Product. The simplest system is one that is often used in a continuous process factory, making a single product, such as pig iron, or paper of one grade, or cotton goods of one grade, in which the total expenditure of the factory in a month is divided by the number of tons or yards to obtain the inventory cost per ton or per yard for that month; then the factory is credited at the inventory cost for all the goods shipped. In this way Factory Operating account shows neither a profit nor a loss. The balance of the account represents the inventory value of the product that has not been shipped, plus the inventory value of raw material on hand and that of the "work in process" or unfinished product. The system has the merit of simplicity and of low cost for bookkeeping, but it may lead to absurd results as to unit costs when the product of any month is low, or, possibly, nothing, the factory being shut down for repairs or on account of a strike, or lack of raw material, or lack of orders.

Varied Products. In factories making a variety of product the so-called "actual cost" may be obtained by a most elaborate cost system, in which the cost of every article made includes the cost for direct material, direct labor and "burden," the burden or total indirect expenditure for a month being distributed according to some plan, such as the machine-hour rate plus a "supplementary rate," over the product of that month. This method, like the first one described, has the apparent bookkeeping merit of having the factory show neither a profit nor a loss, but it also has the demerit of giving useless and absurd cost figures when the factory is running below its normal rate.

Recorded Costs may include the actual expenditures for direct labor and material, or "prime cost," plus a burden figure which may be a fixed percentage on labor or on material or on prime costs, or an arbitrary figure per unit of product which is estimated to be sufficient to cover the average burden during the year. This is a satisfactory method from a bookkeeping standpoint, but it may lead to erroneous conclusions as to the cost of some portions of the product. By this method the books may show that the factory makes a profit or a loss according to whether the total indirect expenses for a year are less than or greater than the burden which has been charged against the cost of the several products.

Normal Cost includes the sum of direct labor and material or prime costs, and a standard burden charge on each item of product which is made by a careful estimate of the machine-hour rate which should be charged against each machine, work-bench, assembly floor, or other "productive center," such that the total of such charges to cost of product during a year of normal business shall approximate the total indirect expenses of the factory for such a normal year. In a year of brisk business the factory will show a profit equal to the excess of the sum of all the burden charges made against the cost of products over the charges against burden account or the total yearly indirect expenses. In a year of depression, when the factory is running below its normal rate, or in a year when it is badly managed so that a large part of the machinery is idle from lack of work for it, or the indirect expenses are unduly large, the factory will show a loss equal to the Unearned Burden, or the excess of expenses over the sum of the burden charges.

Different Kinds of Industries

1. Industries with continuous processes; uniform product with uniform specifications; single-purpose machines; uniform operations; simple routing. Illustrated by the manufacture of paper and pulp.

2. Industries with non-continuous processes; uniform product with varying specifications; single-purpose machines; uniform operations; simple routing. Illustrated by the manufacture of envelopes, books, and handkerchiefs.

3. Industries with non-continuous processes, varying products with varying specifications; multiple-purpose machines; varying operations; complex routing. Illustrated by machine shops.

From a lecture on "Scientific Management," by H. S. Person, Ph.D., Director Amos Tuck School of Administration and Finance, Dartmouth College, President of the Taylor Society.

Company or Private Ledger of a Manufacturing Business

Resources.	*Liabilities* (Including Capital Stock and Surplus and Reserves.)
1. Cash.	1. Capital Stock.
2. Accounts Receivable	2. Bonded Debt.
3. Bills Receivable.	3. Surplus.
4. Merchandise.	4. Reserves for Bad Debts, Depreciations, etc.
5. Office Fixtures.	5. Accounts Payable.
6. Factory Plant, including Land, Buildings, Permanent Equipment.	6. Bills Payable.
7. Factory Operating. Covers all investment in the factory except that charged to plant.	7. Accrued Taxes and Insurance.
8. Deferred charges. Includes taxes and insurance paid in advance but not yet charged to Factory or other accounts.	8. Earned Interest. Charged to Factory.
9. Outside Investments.	

Subdivision of Total Expenditure for Factory Operations

On Company's General Books

Charge Factory with all money sent to factory. Credit Cash. Charge Factory with all purchases for account of factory. Credit Accounts Payable or Cash.

Charge Factory once a month with its monthly proportion of the yearly expense for Interest, Taxes, Insurance, Depreciation. Credit Interest charged to Factory, Taxes, Insurance, Reserve for Depreciation.

Credit Factory with all goods shipped by factory or put into warehouse on Company's account.

On Factory Books

(*a*) Credit Co. with all values received from Co.

(*b*) Charge Co. with all values delivered to Co.

(*a*) Charge Stores with material received.
Labor with payroll money received and paid out on acc. of wages and salaries
Cash with other money received from Co.
Burden with the monthly charges made by Co. for interest, insurance, etc.

(*b*) Credit Finished Product, Warehouse, or Stores with goods shipped.

Inter-departmental Accounts in Factory

Charge Accounts	
Work in Process	Cr. Labor, Stores, Burden, for productive work.
Stores	Cr. Work in process, for material returned from shop.
Burden	Cr. Labor, Stores, Burden, for work done by departments not directly chargeable to Work in process.

Burden Acct. is subdivided into as many departmental divisions as may be found desirable, such as power plant, blacksmith shop, repair shop, etc.

Labor may be divided into Direct and Indirect Labor (sometimes but erroneously called Productive and Non-productive). Direct Labor is that which is expended upon the raw material converting it into finished material, and Indirect Labor is that which is employed in supervision or in keeping the factory running and is not directly chargeable to any particular part of the product.

The Factory Books. The following is a skeleton of the principal factory accounts. They may be subdivided into departments, processes, or classes of product as desired, according to the nature of the business.

Factory Accounts:

Credit Company with all disbursements made by the Company on account of factory operations.

Charge
Cash (Factory Cash)
Stores
Burden
(that part of burden that is paid for directly by the Co.'s general office, such as insurance, taxes, etc., and charges made by Co. against the factory for Interest, Reserve for Depreciation, and the proportion of business administration that is chargeable to factory operations).

Credit Cash, Stores, Labor, Burden, Work in Process.

Charge
Work in Process, for costs of unfinished products.
Warehouse, for cost of finished products.
Betterments, for cost of additions to or improvement of the factory property.

In these entries the credit to Burden is the "earned burden" or "normal burden."

Charge Company
Credit Warehouse, for goods shipped.
Betterments, for cost of betterments, when they are finished.
Work in Process, for outside work done on Company's orders.

Credit Cash, Stores, Burden, Labor, Work in Process.

Charge
Cash for any receipts of factory cash for sale of stores, or of supplies which may have been previously charged to burden, or for any cash received from workmen and credited to them or the payroll.
Stores, with factory cash purchases of material for stores, or with labor expended on materials for stores, or with materials put in stores that were previously charged to burden, or to Work in Process.
Burden, with all expenditures of factory cash for general factory expenses, with all indirect labor and indirect material. The burden of one department may be credited and the burden of another department charged when one department does work for another, or furnishes supplies that have been charged to the department burden of another department.
Labor, with payroll payments in cash or in stores charged to workmen.

OPENING A SET OF FACTORY BOOKS

The principle upon which a factory accountant opens a set of books for factory operations considered as distinct from the commercial and financial operations of a company is that the factory owes to the "owner" of the business, which, on the factory ledger, may be be called "New York Office," "Company," "A. B. Co." or "Private Ledger," all the net assets of the factory at their appraised valuation, that it credits the "Company" account with these assets, and credits it also with everything it receives from the Company, such as cash for the payroll, material and supplies, the invoices for which are certified to the Company for payment, and cash for minor current expenses, or "Petty Cash," and charges it with everything delivered to the Company or shipped to the Company's customers, the bills for which are to be paid to the Company.

For example the Company's Chief Accountant may say to the Factory Accountant, "We have had an inventory and appraisal made of everything in the factory on January 1st, the whole details of which you will find in this schedule, and have deposited in the local bank to the credit of the factory $1000 as a fund from which to pay your minor current expenses. We will send a check for the amount of the payroll every week, and we will pay all the bills which you certify to us for payment for material purchased. You will credit us with all these items and charge us monthly at the 'factory cost' with everything you send to us or to our customers. What is meant by 'factory cost' you will find in this typewritten 'Book of Instructions.'"

The Factory Accountant then opens his books with the following entries:

In the Factory Cash Book
Jan. 1, 1916

To Company	1000	00		

In the Journal
Jan. 1, 1916

Sundries To Company as per Schedule of Factory Assets, Jan. 1			200,000	00
Real Estate (Land and Buildings)	40,000	00		
Equipment (Fixtures, Furniture, Power Plant, Machine Tools, Small Tools)	80,000	00		
Material (Raw material for manufacture)	20,000	00		
Supplies (Fuel, Oil, Waste, Lumber, Paper, etc.)	5,000	00		
Mfg. a/c. (Work in progress in shops)	10,000	00		
Warehouse (Finished goods ready for Shipment)	30,000	00		
Worked Material (Partly finished products in stores)	15,000	00		

After making these entries the Management decides that the last five accounts, or the goods represented by them, should be subdivided into departments or into classes of product, so as to facilitate the determination of costs. Thus the warehoused goods might be divided into four classes, W1, W2, W3, W4, the Supplies into S1, Power-house Supplies; S2, Forge and Machine Shop Supplies; S3, Grinding- and Plating-room Supplies; S4, Shipping-room Supplies. The Accountant would then determine the most convenient way of making these subdivisions. He might properly conclude, if the business was a large and complex one, that in order to simplify the general factory books it would be better not to subdivide these accounts in the Works Journal and Works Ledger, but to keep them as controlling accounts, making the subdivisions on statistical sheets or cards or loose-leaf books. To simplify the accounts still further, and save clerical labor, he might keep no account with Worked Material, considering all partly finished goods as belonging to Mfg. Acct., and crediting that account only as the goods are delivered to the warehouse. Even Warehouse Acct. may be dispensed with, the finished products remaining in Mfg. Acct. until they are shipped, when they are charged to Company. Real Estate and Equipment may also be omitted from the Factory books and kept in the Company's General Ledger.

After the books have been opened suppose that a condensed summary of the transactions of the factory in the first month is as follows:

Material purchased, bills certified to Co. for payment	5,000
Supplies purchased, bills certified to Co. for payment	1,000
Supplies purchased, paid for out of Petty Cash	200
Labor, including salaries, paid by Co. on pay rolls	25,000
Labor, paid out of Petty Cash	200
Material delivered from Stores to Shop	10,000
Supplies used during month	1,500
Worked material, withdrawn from Stores	5,000
Worked material, delivered by Shop to Stores	6,000
Labor (inc. salaries) total credits on Pay Rolls	25,500
Current Repairs, to tools, done in shop	100
New Equipment built in shop	500
Finished Goods delivered in Warehouse, at estimated "factory cost"	35,000
Goods shipped from warehouse, at estimated factory cost	40,000

From this summary the following Journal Entries would be made.

January 31, 1916

Sundries To Company		31,000
Material	5,000	
Supplies	1,000	
Labor	25,000	
Mfg. a/c. To Sundries	42,000	
To Material		10,000
To Supplies		1,500
To Worked Material		5,000
To Labor		25,500
Sundries To Mfg. a/c.		41,600
Worked Material	6,000	
Repairs	100	
Equipment	500	
Warehouse	35,000	
Company	40,000	
To Warehouse		40,000
Sundries To Cash		400
Supplies	200	
Labor	200	

Besides the above entries the following additional charges would be made to Mfg. a/c: One-twelfth of the estimated yearly interest on investment in the factory and its contents, and yearly taxes and insurance, none of which is yet paid, $7\frac{1}{2}$ per cent on $\$200{,}000 = 15{,}000 \div 12 = \$1250$. One-twelfth of the annual estimated cost for depreciation, for obsolescence and for wear and tear and extraordinary repairs, $4800, 400

Minor repairs during the month, to close Repair a/c 100

The entry would be

Mfg. a/c. To Sundries	1750	
To Adjustment of Interest, Taxes and Insurance		1250*
To Reserve for Depreciation and Ex. Repairs		400*
To Repair a/c		100

* These two items may be credited to Company account, instead of to the two accounts named.

The Cash Book entries may be journalized at the end of the month (if they are not posted directly from the footings of the columns of a Column Cash Book) as follows:

The entries of Jan. 1 and Jan 31 (and any other entries that may have been made during the month) are posted in the Factory Ledger, as follows:

FACTORY LEDGER

Company

Jan. 31	To Warehouse	40,000	Jan. 1	By Cash	1,000
			Jan. 1	By Sundries	200,000
			Jan. 31	By Sundries	31,000

Real Estate

Jan. 1	To Company	40,000			

Equipment

Jan. 1	To Company	80,000			
Jan. 31	To Mfg. a/c.	500			

Material

Jan. 1	To Company	20,000	Jan. 31	By Mfg. a/c.	10,000
Jan. 31	To Company	5,000			

Worked Material

Jan. 1	To Company	15,000	Jan. 31	By Mfg. a/c.	5,000
Jan. 31	To Mfg. a/c.	6,000			

Supplies

Jan. 1	To Company	5,000	Jan. 31	By Mfg. a/c.	1,500
Jan. 31	To Company	1,000			
Jan. 31	To Cash	200			

Petty Cash

Jan. 1	To Company	1,000	Jan. 31	By Sundries	400

Mfg. a/c.

Jan. 1	To Company	10,000	Jan. 31	By Sundries	41,600
Jan. 31	To Sundries	42,000			
Jan. 31	To Sundries	1,750			

Labor

Jan. 31	To Company	25,000	Jan. 31	By Mfg. a/c.	25,500
Jan. 31	Petty Cash	200			

Adjustment of Int. Tax and Ins.

			Jan. 31	By Mfg. a/c.	1,250

Reserves for Depreciation and Ex. Repair

			Jan. 31	By Mfg. a/c.	400

FACTORY LEDGER (*Continued*)

Current Repairs

Jan. 31	To Mfg. a/c.	100	Jan. 31	By Mfg. a/c.	100

Warehouse

Jan 1	To Company	30,000	Jan. 31	By Company	40,000
Jan. 31	To Mfg. a/c.	35,000			

Trial Balance and Monthly Statement

A trial balance and monthly statement of the Ledger for Jan. 1 and Jan. 31 would show the following:

JAN. 1 BALANCE			JANUARY		BALANCE JAN. 31	
Dr.	Cr.		Charge	Credits	Dr.	Bal. Cr.
	201,000	Company	40,000	31,000		192,000
40,000		Real Estate			40,000	
80,000		Equipment	500		80,500	
20,000		Material	5,000	10,000	15,000	
15,000		Worked Mat.	6,000	5,000	16,000	
5,000		Supplies	1,200	1,500	4,700	
1,000		Petty Cash		400	600	
10,000		Mfg. a/c.	43,750	41,600	12,150	
		Labor	25,200	25,500		300
		Adj. of Int. etc		1,250		1,250*
		Reserves		400		400*
30,000		Warehouse	35,000	40,000	25,000	
201,000	201,000		156,650	156,650	193,950	193,950

* See footnote on page 38.

ACCOUNTING CODE FOR A MANUFACTURING BUSINESS

The principal accounts in the general books of a manufacturing concern are the following:

Assets and Expenses	Capital and Liabilities
Cash	Capital Stock
Bills Receivable	Bonded Debt
Accounts Receivable	Surplus
Factory, Real Estate and Equipment	Profit and Loss
Factory Operating (or Manufacturing Acct.)	Bills Payable
Mdse. (or Sales Acct.)	Accts. Payable
Administration and Selling Exp.	Reserve for Depreciation
Outside Investment (if any)	Other Reserves (if any)

Besides these there are other accounts which represent assets or expenses if they have debit balances, and liabilities or profits if they have credit balances, such as Taxes, Insurance, Discount and Interest. Some accountants divide Taxes and Insurance each into two subdivisions, for example, Accrued Taxes, Prepaid Taxes, but this is needless. If taxes have been prepaid, the debit balance of the account shows that fact; if there is a credit balance it represents the amount of accrued taxes, not paid, which have been charged to factory operating or some other expense account.

The transactions and the corresponding journal and cash book entries for the last month of a year or other fiscal period may be as follows:

Transactions	Journal Entries		
Stores bought for factory	Factory Operating:		
	To Accts. Payable		10,000
	To Bills Payable		10,000
Factory is charged with its monthly proportion of General Charges such as interest on factory investment, taxes, etc.	To Taxes and Insurance		300
	To Res. for Depn.		600
	To Interest Chgd. Facty		500
	To Admin. Exp.		1000
Goods were shipped from the factory and charged to Sales Acct. at factory cost	Sales To Factory Oper'tg.		40,000
Sales were made on open account and on notes rec.	Accts. Rec. 39,000 Bills Rec. 10,000	To Sales	49,000

Cash Book Entries

Cash sales were made	Cash To Sales	6,000
Cash was received in payment of notes and accts.	To Bills Rec.	12,000
	To Accts. Rec.	40,000
Cash rec. for interest	To Disct. and Int.	300
Bills and accts. pay. were paid in cash	Cr. By Accts. Pay.	22,000
	Cr. By Bills Pay.	3,000
Cash was paid for factory payroll	Cr. By Factory Oper'g	15,000
Cash was paid for administration and selling expense	Cr. By Adm. Expense	2,000
	Cr. By Sales Expense	8,000
Cash was paid for insurance, taxes, and interest	Cr. By Insurance	600
	Cr. By Taxes	400
	Cr. By Dis. and Int.	500

Transfer and Balancing Entries

After the above entries are made and posted several transfer entries are needed before making a balance sheet.

At the beginning of the month Administration and Selling Expense Accts. showed debit balances amounting to $2000, representing advances to salesmen and advance advertising. This together with $10,000 charged during the month, less a credit of $1000 which has been charged to Factory Operating is now charged to Sales Account.

The credit balance of Sales Account, $4000, is transferred to the credit of Profit and Loss.

Sales

To Profit and Loss	4000		
To Adm. Exp.	11,000		

The factory reports that the total cost of betterment work for the fiscal period is $2000 and the general bookkeeper enters it as an addition to the permanent assets.

Factory R. E. & Equip.

To Factory Operating	2000		

The factory reports the cost value of spoiled work for which no charge could be made to customers or to the cost of finished goods; also the loss of unearned burden, due to idleness.

Profit & Loss

To Factory Operating	1000		

A loss of $500 on Accounts Receivable, and the debit balance of Discount and Interest, $1200, are charged to Profit and Loss.

Profit & Loss

To Accts. Rec.	500		
To Dis & Int.	1200		

Interest charged to Factory shows a credit balance which has accumulated during the fiscal period, and is now credited to Profit and Loss as part of the profits of the business.

Interest Charged to Factory

To Profit and Loss	5500		

The factory reports that one of its heavy machines had an accident requiring costly repairs which were made in the factory, and which ought not to be charged to current repairs and thence to the cost of finished goods, but to reserves for depreciation.

Reserve for Depreciation

To Factory Operating	1000		

A re-appraisal of the factory machinery shows that it has a much higher value and longer probable life on the average than was assumed in making the appraisal five years earlier, when the estimated annual credit to Reserve for Depreciation was fixed. The management decides to let Factory Real Estate and Equipment account stand on the books at its present value but to transfer a part of the credit balance of Reserve for Depreciation to Surplus Account, making it available for dividends.

Reserve for Dep'n

To Surplus	5000		

The credit balance of Profit and loss is transferred to surplus Acct.

Profit & Loss

To Surplus	11,800		

A dividend of 8 per cent on the capital stock is declared payable Jan. 15th.

Surplus

To Dividend	8,000		

When the dividend checks are signed and mailed, a cash-book entry will close Dividend Account, Cash being credited.

The Journal-Ledger form of posting all the above entries is shown on one sheet, below, the liabilities at the beginning of the month being entered on the upper line and the assets in the left-hand column. In this sheet the balances of each account both at the beginning and end of the month are shown, as well the transactions during the month.

COMPANY'S GENERAL LEDGER

Liabilities—Credits

		Dr. Balances	Capital Stock	Bonds	Surplus	Dividend	Res. for Depn.	Interest Ch'g'd Factory	Profit & Loss	Bills Payable	Accts. Payable	Cash	Disct. & Int.	Bills Rec.	Accts. Rec.	Insur. & Taxes	Facty. R.E. & E.	Facty. Oper'g	Adm. & Selling Expense	Sales	Total Dr. (not incl. Balances)
Total Bal. 200,000			100,000	40,000	10,000		15,000	5,000	5,000	5,000	20,000										
Assets—Debits	Cash	25,000											300	12,000	40,000					6,000	58,300
	Bills Rec.	15,000																		10,000	10,000
	Accts. Rec.	45,000																		39,000	39,000
	Ins. & Taxes	2,000										1,000									1,000
	Fcty. R. E. & E.	50,000																*2,000			2,000
	Fcty. Op'g.	60,000					600	500		10,000	10,000	15,000				300			1,000		37,400
	Ad. & S. Exp.	2,000										10,000									10,000
	Dis. & Int.	1,000										500									500
	Res. for Dep.				*5,000													*1,000			6,000
	Int. chg'd Fcty.								*5,500												5,500
	P. & L.				*11,800								*1,200		*500			*1,000			14,500
	Bills Pay.											3,000									3,000
	Accts. Pay.											22,000									22,000
	Sales								*4,000									40,000	*11,000		55,000
	Surplus					*8,000															8,000
Total for Month	Cr.				16,800	8,000	600	500	9,500	10,000	10,000	51,500	1,500	12,000	40,500	300		44,000	12,000	55,000	272,200
	Dr.				8,000		6,000	5,500	14,500	3,000	22,000	58,300	500	10,000	39,000	1,000	2,000	37,400	10,000	55,000	272,200
Balances for Mo.	Cr.				8,800	8,000				7,000			1,000	2,000	1,500			6,600	2,000		36,900
	Dr.						5,400	5,000	5,000		12,000	6,800				700	2,000				36,900
New Balances	Cr.	100,000	40,000	18,800	8,000	9,600				12,000	8,000										196,400
	Dr.											31,800		13,000	43,500	2,700	52,000	53,400			196,400

* Transfer and balancing entries.

The Factory General Ledger

From the Company's General Ledger entries for the month it is seen that the debits and credits of factory operating account cover all the transactions of the company with the Factory. At the beginning of the month the account showed a debit balance of $60,000. On the Factory Ledger this will appear as a credit to Company account, and it will be balanced on this ledger by debits to Stores, Work in Process, Warehouse, and Factory Cash, and a credit to Labor account for wages due and unpaid. The credits to Company account during the month, totaling $37,400, will be debited to Company General Charges (a subdivision of Burden), $2400, representing the charges for Reserve for depreciation, $600; Interest, $500; Insurance and Taxes, $300; and Administration charges (proportion of officer's salaries and general office expense charged to the factory, $1000); also purchases of material for the factory, $20,000, charged to Stores account, and cash sent to the factory for payroll and other cash expenditures, $15,000, charged to Factory Cash.

The charges to Company account, $44,000, will be balanced by credits to Warehouse, for goods shipped, at factory cost, $40,000; to Spoiled and Defective Work, which could not be charged to the cost of finished goods in the Warehouse, say $400; to Burden account, representing unearned burden, which is a loss due to idleness or other cause, not properly chargeable to the cost of finished goods, say $600; to Betterments, $2000 for work done on additions to the factory equipment; and to Repairs and Maintenance (part of Burden) $1000 for extraordinary repairs, which will be charged on the Company's books to Reserve for Depreciation. The entries of the above-named items might appear on the Factory Journal and Cash Book as follows:

Sundries	To Company		37,400
Stores		20,000	
Cash		15,000	
Burden (Gen. charges)		2,400	
Company	To Sundries	44,000	
	To Warehouse		40,000
	To Betterments		2,000
	To Burden:		
	Spoiled work 400		
	Unearned burden 500		
	Extra repairs 1,000		2,000

Besides the above entries there might be the following representing transactions inside of the factory.

Sundries	To Labor		18,100
(Distribution of labor as per payroll and job tickets)			
Stores		300	
Work in Process (Depts. A. B. C.) *		10,000	
Auxiliary Depts. (Depts. D. E. F.)		2,000	
Betterments		600	
Burden (Supt., foreman, gen. labor)		5,000	
Warehouse		200	

* Separate accounts would usually be kept for the separate departments. The work in process might be divided into classes of product as A, steam engines; B, steam turbines, C, other products. The auxiliary departments are Power House, Tool Room, Repairs and Maintenance, Blacksmith Shop, Yard, etc.

Sundries	To Cash		14,700
Labor (Wages and Salaries paid)		14,000	
Stores, Petty cash exp.		400	
Aux. Depts., Petty cash exp.		200	
Warehouse, Petty cash exp.		100	
Sundries	To Stores		22,800
Work in Process		17,000	
Betterments		1,000	
Auxiliary Depts.		2,000	
Burden (supplies issued)		2,400	
Warehouse (supplies issued)		200	
Labor (charged to workmen)		200	
Sundries	To Work in Process		41,000
Stores (partly finished work put in stores)		5,000	
Warehouse, finished product		36,000	
Sundries	To Auxiliary Depts.		7,900
Work in Process (work done in the auxiliary departments directly chargeable to work in process)		2,000	
Warehouse (work done on finishing products in the warehouse)		900	
Burden (power plant and other general factory expense)		3,000	
Auxiliary Depts. (Subdivided in the actual accounting) work done by one department for another		2,000	

FACTORY LEDGER

		Co.	Labor	Cash	Stores	Work in process.	Betterments	Aux. Depts	Burden	Warehouse	Total Debits
Company							2,000		2,000	40,000	44,000
Labor				14,000	200						14,200
Cash		15,000									15,000
Stores		20,000	300	400		5,000			400		26,100
Work in process			10,000		17,000			2,000	8,000		37,000
Betterments			600		1,000				400		2,000
Aux. depts.			2,000	200	2,000			2,000	1,700		7,900
Burden		2,400	5,000		2,400			3,000			12,800
Warehouse			200	100	200	36,000		900	300		37,700
Total credits		37,400	18,100	14,700	22,800	41,000	2,000	7,900	12,800	40,000	196,700
Total debits		44,000	14,200	15,000	26,100	37,000	2,000	7,900	12,800	37,000	196,700
Bal. for month	Cr.		3,900			4,000				2,700	10,200
	Dr.	6,600		300	3,300						10,200
Bal. at 1st of month	Cr.	60,000	500								60,500
	Dr.			4,000	20,000	18,000				18,500	60,500
New balances	Cr.	53,400	4,400								57,800
	Dr.			4,300	23,300	14,000				16,200	57,800

Sundries	To Burden as per Burden Distribution sheet		10,800
Stores		400	
Warehouse		300	
Work in Process		8,000	
Betterment		400	
Auxiliary Departments		1,700	

Putting these entries into the Journal-ledger form they appear as shown on page 41.

A SIMPLE ACCOUNTING SYSTEM

A simple double-entry bookkeeping system for a manufacturing concern is illustrated below. The General Ledger or Private Ledger has only from twelve to fifteen accounts, but they are all that are necessary. A purchase or invoice ledger might be kept in which each creditor would have a page, and a sales ledger in which each debtor would have a page, but these are by no means required, for all the information that an invoice ledger would contain, and more, is found in the alphabetical file of the creditor's bills, and all that a sales ledger would contain is found in the alphabetical file of the carbon copies of the bills and statements rendered to the debtors. By dividing each file into two parts, Paid and Unpaid, the accountant can at any time find out by adding (preferably on an adding machine) the amounts of unpaid invoices and bills how much is owing to or by the concern on open accounts. The auxiliary Bill Book furnishes a more correct record of Bills Receivable and Bills Payable than the ledger does. A simple statistical sheet with entries made on it from the ledger at the end of each month shows the general course of the business during the year.

In this system Manufacturing Account is charged each month with all the costs of operation that appear as direct charges in the Cash Book, Petty Cash Book and Invoice Book, but it is not until the end of the year (or other fiscal period) charged with depreciation of material or equipment, or with interest on investment, or credited with the value of the manufactured products. Merchandise is credited with all sales, whether of manufactured or partly manufactured product, or of raw material that has been sold, and is not charged until the end of the year with the cost of goods sold.

The following is a statement of the summarized transactions that are journalized monthly and posted in the General Ledger.

Transactions

(*A*) Stockholders Invested $100,000 Cash.
(*B*) Paid $50,000 for Factory Property.
(*C*) Bought Material and Supplies $20,000.
(*D*) Paid for Labor, Salaries, Taxes, Insurance, and Factory Expense $25,000.
(*E*) Paid for Purchases (Cash) $10,000.
(*F*) Issued Notes for Purchases $9,000, and Interest $150.
(*G*) Paid for Advertising, Traveling, and other Selling Expenses, $5,000.
(*H*) Paid for Office Furniture $400, and Stationery, $100.
(*I*) Sold Factory Products on Acct., $18,000.
(*J*) Sold ditto for Cash, $2,000.
(*K*) Received Cash in part payment of accts., $3,000.
(*L*) Received Notes with interest ($250) added, for accts., $12,000.
(*M*) Discounted some of these notes, $10,000, bank deducting discount, $200.
(*N*) One of our banks credits us interest on deposits, $100.

Journal Entries

(Summarizing the month's entries in the books of original entry, such as Cash Book, Petty Cash, Sales Book, Invoice Book, Bills Receivable and Payable Book. The letters *A*, *B*, *C*, etc., refer to the list of Transactions.)

Cash		115,100	
(*A*)	To Capital Stock		100,000
(*J*)	To Mdse.		2,000
(*K*)	To A/cs. Rec'ble		3,000
(*M*)	To Bills Rec'ble		10,000
(*N*)	To Interest		100
Sundries			
	To Cash		90,700
(*B*)	Real Estate and Equipment	50,000	
(*D*)	Mfg. a/c.	25,000	
(*E*)	Accts. Payable	10,000	
(*G*)	Sales Expense	5,000	
(*H*)	Office Furniture	400	
(*H*)	Mfg. Acct.	100	
(*M*)	Interest	200	
(*C*)	Mfg. a/c.	20,000	
	To Accts. Pay.		20,000
(*F*)	Accts. Payable	9,000	
	Interest	150	
	To Bills Pay.		9,150
(*I*)	Accts. Rec'ble	18,000	
	To Mdse.		18,000
(*L*)	Bills Rec'ble	12,250	
	To Accts. Rec'ble		12,000
	To Interest		250

In the ordinary form of Ledger these entries would be posted as below:

Ledger

Capital Stock

		By Cash	100,000

Cash

To Sundries	115,100	By Sundries	90,700

Real Estate and Equipment

To Cash	50,000		

Office Furniture

To Cash	400		

Bills Receivable

To Sundries	12,250	By Cash	10,000

Accounts Receivable

To Mdse.	18,000	By Cash By Bills Rec.	3,000 12,000

Bills Payable

		By Sundries	9,150

Accounts Payable

To Bills Payable To Cash	9,000 10,000	By Mfg. Acct.	20,000

Ledger—(*Continued*)

Mfg. Acct.

To Cash	25,000		
To A/cs. Pay.	20,000		
To Cash	100		

Mdse.

		By Cash	2,000
		By A/cs. Rec.	18,000

Sales Expense

To Cash	5,000		

Interest

To Cash	200	By Cash	100
To Bills Pay.	150	By Bills Rec.	250
	350		350

Trial Balance

Capital Stock		100,000
Cash	24,400	
Real Estate. and Equip.	50,000	
Office Furn.	400	
Bills Rec.	2,250	
Accts. Rec.	3,000	
Bills Pay.		9,150
Accts. Pay.		1,000
Mfg. Acct.	45,100	
Mdse.		20,000
Sales Expense	5,000	
Interest		
	130,150	130,150

The system, as shown in this elementary form, is one in which the entries in the General Ledger during the year are made only of actual transactions between the concern and outside parties, the values being ascertained from bills, invoices and payrolls. It takes no account of transfers of values inside of the concern, of changes of values, or of profits or losses in the factory operations, until the end of the fiscal period.

The accounts being kept as above for twelve months a trial balance taken at the end of the period may show the following:

Trial Balance

Capital Stock		100,000
Cash	20,000	
Real Estate and Equipment	50,000	
Office Furniture	500	
Bills Receivable	5,000	
Accounts Receivable	25,000	
Bills Payable		30,000
Accounts Payable		15,000
Manufacturing Account	250,000	
Merchandise		215,000
Sales Expense	10,000	
Interest		500
	360,500	360,500

Inventory

The inventory taken at the end of the year shows.

Real Estate and Equipment		49,000	Depreciation	1000
Office Furniture		400	Depreciation	100
Mfg. Acct Matl. and Supplies	30,000			
Work in Process	20,000	50,000		
Mdse., Finished Product in Warehouse		20,000		

The depreciations $1000 and $100 may be charged either directly to Profit and Loss or indirectly to Mfg. Acct. as part of the expense of factory operations. The credit balance of interest account is due to financial rather than to factory operations and, therefore, may be credited to Profit and Loss.

The Sales Expense, $10,000, is chargeable against the gross proceeds of sales $215,000.

The following Journal entries should, therefore, be made:

Mfg. Acct. To Sundries	1,100	
To Real Estate and Equipment		1,000
To Office Furniture		100
Interest	500	
To Profit and Loss		500
Mdse.	10,000	
To Sales Expense		10,000

When these entries are posted and the inventories entered in red ink in the respective accounts Manufacturing account will appear as follows:

Dr.	Mfg. Acct.		Cr.
Bal. (Trial Bal.)	250,000	*Invty.*	*50,000*
To Sundries	1,100	*Bal.* (tr. to Mdse.)	*201,100*
	251,100		251,100
To Bal. (Invty.)	50,000		

The balance on the credit side represents the total manufacturing cost, including all the losses in the factory, of the Mdse. that was sold for $215,000 and of the $20,000 Mdse. on hand. It should, therefore, be charged to Mdse. account and the difference then appearing between two sides of the account closed into Profit and Loss by the following Journal entry:

Mdse.			23,900	
To Profit and Loss				
Sales of Mdse.		215,000		
Inventory		20,000		
		235,000		
Cr. Bal. of Mfg. Acct.	201,100			
Selling Expense	10,000	211,100		23,900

Merchandise Acct. will then be balanced as below:

Dr.	Mdse.		Cr.
To Sales Exp.	10,000	Bal. (Trial Bal.)	215,000
To Mfg. a/c.	201,100	*Invty.*	*20,000*
To Profit and Loss	23,900		
	235,000		235,000
To Balance	20,000		

A Profit and Loss Statement may now be made as below:

Total Sales		215,000	
Less Selling Expense		10,000	
			205,000
Cost of Sales			
Credit to Mfg. Acct.	201,100		
Less Invty. of Mdse. on hand	20,000		
			181,100
Profit on Sales			23,900
Profit on Interest Acct.			500
Total Profit			24,400

A Balance Sheet taken after all the closing entries are posted will show the following:

Dr.	Balance Sheet		Cr.
Cash	20,000	Capital Stock	100,000
R. Est. and Equip.	49,000	Bills Payable	30,000
Office Fur.	400	Accts. Payable	15,000
Bills Rec.	5,000	Profit and Loss	24,400
Accts. Rec.	25,000		
Mfg. Acct.	50,000		
Mdse.	20,000		
	169,400		169,400

Adjustments and Criticisms—The Auditor's Report

It thus appears from the books that the net earnings of the concern are $24,400, or 24.4 per cent of the capital stock. We will suppose that an auditor, who is well acquainted with the nature of the business and is competent to act as an appraiser as well as an auditor, is asked to report on the accounts and also to advise as to how much of the $24,400 apparent net earnings should be considered available for dividends.

He reports that the accounting system is admirable for the purposes for which it was intended, that is, keeping a record of all transactions between the Company and its debtors and creditors, and of all receipts and expenditures, and also showing in the statistical sheets the progress of the business from month to month. He says: "I have verified the cash and bills receivable on hand; I find that the balance of the Accounts Receivable correctly represents the balance due by debtors of the Company for goods sold to them, and balances of Bills Payable and Accounts Payable correctly show all the liabilities of the concern to its creditors (contingent liabilities due to endorsements of bills receivable not included); that all goods shipped to customers are accounted for by the shipping book and have been properly charged at contract prices in the Sales Book, and that the invoices for all purchases have been verified as to receipt of goods and as to correctness of prices. The books have been kept correctly, and the trial balance dated Dec. 31st, taken from the books before the profit and loss entries were made, is a true statement of the ledger balances of that date.

The closing entries, which have been made in order to determine profits and losses, depend for their validity upon certain assumptions:

1. That the depreciation in value of Real Estate and Equipment was $1000 and that of Office Furniture $100.

2. That the inventory values, Material and Supplies, $30,000; Work in Process, $20,000, and Mdse. $20,000, are correct.

3. That nothing remains of the $10,000 charged to Sales Expense which is of any appraisable value for the business of the coming year.

4. That of the total charges to Mfg. a/c $250,000, during the year, the whole amount is covered by the cost of goods sold and the cost of the material and goods inventoried, and that none of it belongs to expenses incurred partly for the past year's business and partly for business of the current and future years (such as patterns and small tools charged to expenses of manufacturing, but which have some value yet remaining).

5. That the credit of the balance of Interest, $500 to Profit and Loss is correct, which could be the case only if the book values of Bills Receivable and Bills Payable are their present values, or that the face or book values do not include interest which is not yet accrued.

6. That all the Bills Receivable and Accounts Receivable represent good accounts, collectible at their due dates.

Before I can give an opinion as to the Profit and Loss entries I must ask for an explanation of these six items."

The head bookkeeper replies to the auditor, "I can answer as to the fifth and sixth items, but as to the others I will have to refer you to the cost accountant. Referring to the sixth item there is one account receivable, amounting to $1,000, which is doubtful, as the concern is in the hands of a receiver. We may ultimately collect this account in full, but it is quite uncertain." "In that case," says the auditor, "it had better be transferred to a Suspense Account." As for the fifth item, the Interest Credit balance, the present value of the Bills Receivable is about $50 less than their face value, which includes interest not yet due. The Bills Payable were drawn at 60 days without interest, in accordance with the terms on which the materials were purchased. Of the $30,000 Bills Payable outstanding Dec. 31st, the average date of payment is about one month later. If we discounted them and paid them now we could gain $150 for interest, which we might credit to interest or to Mfg. Acct. as might seem proper.

"As the Bills Payable were issued in payment for material charged to Mfg. Acct. the entry naturally would be

Mfg. Acct. Dr. To Bills Payable, $30,000.

If we could pay the notes a month before they were due receiving a rebate of interest $150 the entries in the Cash Book would be

Cash Cr. By Bills Payable, $30,000
Cash Dr. To Interest, 150

But if we do not discount either our notes receivable or our notes payable, but let them run to maturity, what is the use of making any entries for interest not accrued, just because we wish to be exceedingly precise in our annual Profit and Loss statement? If we made such entries we would have to make counter entries later on when the interest had accrued and the notes were paid. It is better to let both Bills Receivable and Bills Payable appear on the annual statement at their face values, and if precision is desirable, to enter in a footnote the amounts of interest not accrued at the date of the statement.

As to the $500 credit balance of Interest account which we have closed into Profit and Loss, that represents the actual gain due to having interest added on notes receivable and holding these notes until near their date of maturity, when we put them in the bank for collection instead of having them discounted."

The auditor expressed himself as satisfied with this explanation, and then had an interview with the cost accountant, who showed that he had a most elaborate cost system, kept with great care, that a perpetual inventory was kept of all raw material and partly worked material in the stores, as well as of finished products in the warehouse, and that the work in process at the time of taking the inventory was all priced at its actual cost of labor and material as shown by the job tickets, plus its proper proportion of burden charge. "The inventory values," said the accountant, "are the actual cost values as they appear on the cost ledger and they are correct, as they are proved by the general ledger, the cost accounts being tied to the general accounts according to the practice of the highest authorities in accounting." On being questioned further the accountant produced a typewritten document which explained his method, as below:

CODE OF THE COST ACCOUNTANT

Company's General Ledger. All disbursements made or indebtedness incurred on account of the factory is charged in the General Ledger to only two accounts, Real Estate and Equipment, and Manufacturing Account. No credits to these accounts (except in the case of the sale of some of the real estate or machinery) are made until the end of the year. A statistical statement is made showing the total charges to Mfg. Acct. each month, and the accumulated total to the end of the year. The sources from which these charges originate are the Cash Book, which gives the amounts paid on the Pay Rolls, and Petty Cash disbursements for the factory, and the invoices for materials purchased.

All sales of goods from the factory warehouse, whether produced in the factory or purchased outside are credited to the Mdse. Acct. at the net price at which they are charged to customers in the Sales Ledger. No charges to this account (except for goods returned or for allowances) are made until the end of the year. A statistical sheet shows the monthly sales and the total sales to date.

The Factory Ledger. A double-entry factory ledger is kept, in which "Private Ledger" account is credited with all the amounts that are charged as above stated to Mfg. Acct. in the General Ledger, the following accounts being debited:

LD. Direct Labor. Labor employed directly in manufacturing, and charged on job tickets to the product made.

LX. Indirect or Expense Labor. Including salaries, and all factory labor that cannot be charged directly to specified products.

SM. Stores. Purchased material used in the manufactured product.

SS. Stores, Supplies. Fuel and other supplies purchased in quantity and issued by the stores as needed. SS. and SM. are recorded in a perpetual inventory.

SX. Expense Supplies. Minor supplies, such as small tools, charged directly to expenses of the factory departments—not inventoried.

GX. General Expense. Taxes, Insurance, Water Rent, and other expenses, details of which are entered in a General Expense book, which has columns for the different classes of expense.

BB. BM. Betterments to Buildings and Machinery. { Purchased from outside and not purduced in the factory.

ER. Repairs to Equipment.

Credits of Labor and Material Accounts—Direct Labor, LD., and Stores, SM., applied directly to the manufacture of goods, are charged on the job tickets to one of the two operating accounts, WM., worked material, which includes both work in process and work which has undergone one or more operations and is kept in store for future operations or finishing, and FP., Finished Product, which includes both the finished goods delivered to the warehouse for shipment and work which has been withdrawn from worked material stores and is undergoing the finishing processes, such as fitting, assembling, painting, packing, etc. They are also charged on job tickets to the betterment accounts, BB., buildings, and BM., machinery.

Perpetual inventories are kept of worked material in stores and of goods in warehouse.

Indirect Labor, LX., and Stores, SS. and SX., are credited, as applied or issued, on Expense books or Department Expense sheets, and charged to the following accounts:

PP. Power Plant.
EC. Office and Clerical Work.
ES. Superintendence.
ER. Repairs and Maintenance.
GX. General Expense or its subdivisions.

At the end of each month all the entries on job tickets and expense sheets are added (on adding machines) to obtain the

total hours of labor, wages earned, and value of supplies issued, and the totals of charges to the several charge accounts. A journal entry of these totals is then prepared in the following form:

JOURNAL ENTRY Date.....
Charge Accts. No.....

	Amt.	WM	FP	BB	BM	PP	EC	ES	ER	GX
Cre lit.										
LD										
LX										
SM.....										
SS.....										
SX.....										
Total.....										

When this entry is posted the labor accounts on the factory ledger will show a credit balance, since the total credits to LD. and LX. cover all the labor that has been performed during the month, as credited to the workmen on the payrolls or salary lists and as charged to the several accounts on the job tickets and expense sheets, while the debit entries are only those representing the amounts that have been paid.

Burden Account. The Total charges to PP., EC., ES., ER. and GX., represent the factory overhead or burden, but some of them are not properly chargeable to the cost of production of the current month, but should be distributed over several months. For example, if taxes and insurance, charged to GX., are paid annually, only one-twelfth should be charged to Burden each month. Also if an expensive repair job should be done in one month its cost may be distributed over several months. A journal entry is to be made each month charging Burden and crediting PP., EC., ES., ER. and GX., for so much of these accounts as pertains to the cost of that month's production, the debit balance remaining in these accounts being the amounts carried over to be credited in other months.

Distribution of Burden. The total monthly debit to Burden acct. is charged to WM., FP., BB. and BM. accounts in the following manner: Each job ticket is charged with the standard burden for the particular job, on the machine-hour rate or production-center-hourly rate basis. The sum of the charges thus made is added up and the total compared with the total debit of Burden acct. for the month, and the difference divided by the sum gives a percentage or supplementary rate which is to be added to the cost of each job.

A statistical sheet is kept showing the total cost of manufacturing operations each month, as follows:

Raw Material Purchased.
Raw Material issued by Stores.
Raw Material balance at end of month.
Labor on Worked Material.
Burden on Worked Material.
Total, Matl. Labor and Burden.
WM., L. & B. issued for Finishing.
Labor on Finishing.
Burden on Finishing.
Total cost of Finished Product.
Cost of FP. Sold.
Balance FP. in Warehouse.

The statistical sheet for the preceding year's business was then shown as given below (for convenience round numbers are used, each figure representing $1000. The accountant explained that the factory operations started with a rush in January, on material purchased the preceding month but billed in January. Some overtime was made in that month. By February the work reached a steady gait, which continued until July when there was a slight falling off for two months. On Sept. 1, a great depression of business began, which caused the shutting down of most of the factory for three months in order to reduce stocks. Dec. 1st the factory started again at nearly its normal rate.

Statistical Sheet—Manufacturing Accounts

	Matl. and Supplies Purchased	Matl. Issued, M	Mat. Bal. end of mo.	Labor on WM	Burden on WM	Total M, L, and B	WM used for FP	Bal. WM	Labor on FP	Burden on FP	Total WM, L, and B	Cost of FP Sold	Bal. FP
Jan.	20	6	14	8	7	21	18	3	5	5	28	20	8
Feb.	10	5	19	6	6	17	15	5	3	4	22	20	10
Mar.	6	4	21	6	6	16	14	7	2	3	19	18	11
April	6	4	23	6	6	16	15	8	2	2	19	17	13
May	6	4	25	6	6	16	15	9	2	2	19	17	15
June	6	4	27	6	6	16	15	10	2	2	19	17	17
July	5	4	28	5	6	15	14	11	2	2	18	17	18
Aug.	4	4	28	5	5	14	13	12	2	2	17	16	19
Tot. for 8 mo.	63	35	..	48	48	..	..	..	20	22			
Sept.	4	3	29	1	2	6	5	13	1	2	8	14	13
Oct.	1	2	28	1	2	5	3	15	1	2	6	10	9
Nov.	4	2	30	1	2	5	6	14	1	2	9	6	12
Dec.	6	6	30	5	6	17	11	20	2	3	16	8	20
Total 12 m.	78	48	30	56	60	164	144	20	25	31	200	180	20
Total 4 m.	15	13	..	8	12	..	..	..	5	9			

The Auditor's Comments

After examining the Code and the statistics the auditor said "This is all right with one exception, the addition of the supplementary burden rate to the valuation of the worked material in store and of the finished product in the warehouse. During the first eight months the direct labor cost of worked material was 48 (units of $1000 each) and of finishing 20, total, 68 units, while the burden for the same period was 48 plus 22 equals 70, the burden being practically 100 per cent of the labor cost. In the next three months the total direct labor cost was 6 and the burden 12, or 200 per cent of the direct labor cost. By charging into the inventory value of such of the goods as remain of those produced during these three months you have overvalued them and so increased the apparent profits of the year's business. Suppose that during these three months the manufacturing departments

had been entirely shut down and no goods were produced. The greater part of the burden would still be running on, costing say 8 or 10 units. You could not charge that to cost of goods if none were produced; you would have to charge it to Profit and Loss, or else let it remain in Burden Account to be charged wrongly to the cost of goods made in succeeding months. This supplementary burden, due to the partial idleness of the factory, should not be charged to the cost or inventory value of the goods produced, but to Profit and Loss. It is not a cost of production but a cost of idleness and non-production.

"It appears from the statistics," continued the auditor, "that if the product of the last four months, costing 8 plus 5 equals 13 units for direct labor, had been charged with the normal rate of burden, the burden would have been only 13 units instead of 12 plus 9 equals 21 units. There is, therefore, an overcharge of cost of $4000 for worked material and $4000 for finished product, a total of $8000. Much of this overvaluation appears in the inventory of goods on hand, a large proportion of which consists of the over-costed goods made during the three dull months. An examination of the perpetual inventory cards shows that the over-valuation in the inventory amounts to about $2000 in worked material and $2000 in finished product. The following entry should, therefore, be made:

Profit Loss To Sundries	4000	
For over-valuations in inventory		
To Mfg. a/c.		2000
To Mdse.		2000

In regard to the second query of the auditor, relating to the $1000 charged as depreciation of Real Estate and Equipment Account, and to the fourth query, relating to remaining asset values of some of the charges to Mfg. Acct. the accountant explained that the Inventory Book showed that a depreciation of 2 per cent or $500 had been assessed on Real Estate, $25,000, and 4 per cent or $1000 on Machinery, $25,000, but that $500 had been added to machinery and credited to Mfg. Acct. for betterments to machinery and equipment, in the addition to it of certain patterns and small tools, which had a present value estimated at $500. This reduced the total depreciation of Real Estate and Equipment to $1000.

The auditor agreed to this, but said that while 4 per cent was, no doubt, a sufficient allowance for the actual depreciation of the machinery below its cost value, an additional sum should be deducted as a Reserve Depreciation against obsolescence which might take place in the next ten or twenty years. He recommended that an additional 4 per cent be allowed for this. The Real Estate and Equipment account would then stand as follows:

Original Cost, Land and Buildings		25,000
Machinery		25,000
Additions to Machinery		500
		50,500
Depreciation on land and buildings, 2%	500	
Depreciation on Machinery, 4%	1000	
Reserve for obsolescence, 4%	1000	2,500
Difference		48,000

There are different ways of treating depreciation in the books, the auditor said, but he preferred to keep Real Estate and Equipment Account at its full value to the business as a "going concern," in this case at $50,500 and since the depreciation was not actual, but only theoretical, the machinery being as good as, if not better, than new, it had better be kept in a separate account, called Reserve for Depreciation, and it will appear there as a credit, offsetting the debit balance of Real Estate and Equipment, and reducing the credit of Profit and Loss account, or Surplus Account, into which the credit balance of Profit and Loss will ultimately be closed.

For the additions to machinery, estimated on the inventory at $500 present value no entry has hitherto been made, and the amount has been hidden in the general ledger in the charge to Mfg. Acct. and in the factory cost accounts in numerous charges to Repairs or General Expense which cannot be separated. Since Mfg. has been closed, except as to the inventory balance of $50,000 the only proper way to get the $500 additional value into Real Estate and Equipment Acct. is to credit it to Profit and Loss.

The following journal entries should, therefore, be made:

Real Estate and Equipment			1500	
To Profit and Loss				
Cancelling former entry of depreciation	1000			
Betterments to machinery, see inventory	500			1500
Profit and Loss			2500	
To Reserve for Depreciation:				
Est. Dep'n on Buildings 2% or	25,000	500		
Est. Dep'n on Machinery, 4% or	25,000	1000		
Est. Dep'n for Obsolescence, 4%		1000		2500

As to the third query, relating to Sales Expense, the bookkeeper showed that of the $10,000 charged to the account $3000 had been incurred for publication of a catalogue, and that $2000 of it might properly be considered as the present value of it, as a new catalogue would not be needed for several years. Also $2000 had been spent in traveling and other expenses in establishing agencies and in doing advance advertising, which expense was for the benefit of the business of future years. The auditor agreed that the entry which had charged the whole of Sales Expense to Profit and Loss should be amended by a counter entry, as below:

Sales Expense		3000	
To Profit and Loss			
for present value of expenses incurred by Sales Dept., viz.:			
Catalogue	2000		
Establishing Agencies	1000		
			3000

This would leave Sales Expense with a debit balance of $3000, representing an asset which would be gradually written off in the next two or three years.

When all these correcting entries are posted the trial balance will be changed in the following items:

	Dr.	Cr.
Real Estate and Equipment	1,500	
Profit and Loss	2,500	1,500
Profit and Loss	4,000	3,000
Reserve for Depreciation		2,500
Manufacturing Acct.		2,000
Merchandise		2,000
Sales Expense	3,000	
Suspense Acct.	1,000	
Accts. Receivable		1,000
	12,000	12,000

The balance of Profit and Loss is now reduced to $22,400 and against this is a charge of $1000 to Suspense Account which may ultimately prove to be a bad debt.

There is a contingent liability in regard to $10,000 worth of discounted notes receivable which have the company's endorsement. No account of these appears in the books, except in the form of memorandums in the Bills Receivable book, but they should be taken into consideration before declaring a dividend. The liability on them can be insured against, and a reserve of $2000 against it will probably be ample. Deducting these two amounts $1000 and $2000 from $18,400 leaves $15,400 as applicable to Dividends and Surplus.

As to the amount that should be divided among the stockholders it should always be borne in mind that a successful business is a growing business and one with increasing capital and surplus. A business that does not grow is suffering from "dry rot" and unless something happens to rejuvenate it it will ultimately fail. It is difficult to get new capital for a business that is not growing. Therefore it is most important that net earnings in normal business years should not all be divided, but that a considerable portion should be retained in order to increase the surplus and provide for future growth, and also in order to provide a fund to maintain regular dividends in times of depression.

In this case an 8 per cent dividend would appear to be about right. If checks are drawn for this dividend the following entries may be made and posted.

Profit and Loss	To Sundries	22,400	
To close P. & L. acct. for the year:			
To Dividend, 8%			8,000
To Surplus			14,400
Dividend		8,000	
To Cash			8,000

The trial balance now becomes a statement of Assets and Liabilities as below:

Assets		Liabilities	
Cash	12,000	Capital Stock	100,000
Real Est. & Equip.	50,000	Surplus	14,000
Office Furniture	400	Bills Payable	30,000
Bills Receivable	5,000	Accts. Payable	15,000
Accts. Receivable	24,000	Reserve for Dep'n.	2,500
Mfg. Acct.	48,000		
Mdse.	18,000		
Sales Expense	3,000		
Suspense	1,000		
	161,900		161,900

An Income or Profit and Loss Statement may now be prepared for the information of the stockholders as follows:

Income from Sales			215,000
Less Charges to Sales Exp.		10,000	
Deduct Catalogue and other expenses chargeable to next year's business		3,000	7,000
			208,000
Net Income from Sales			
Cost of Sales:			
Charges to Mfg. a/c.		250,000	
Add Depreciations		2,600	
		252,000	
Credits:			
Machinery betterment	500		
Inventory:			
Raw Mat'l.	30,000		
Worked Mat'l.	18,000		
Finished	18,000	66,500	196,100
Profit on Sales			21,900
Profit on Interest			500
Total Profits			22,400
Dividend 8%			8,000
Surplus			14,400

Against this Surplus there is a Suspense Acct. of $1000 for a possible bad debt, and a contingent liability on $10,000 worth of endorsed paper.

Error Due to Keeping Overhead Percentage Uniform

Some years ago, the president of a bridge company told me one day that he could not understand why his actual earnings fell so far short of his estimates. He stated that he knew the material charge was correct, that he had considerably reduced his direct labor by introducing piece work, etc., and that he was figuring his overhead at the same per cent he always had, and yet his actual earnings came over $100,000 short of his estimates. I rather surprised him by telling him that he himself had told me the cause of the difference, namely the reduction of his direct labor, and distributing his overhead at the same percentage of the reduced amount as he had used before the reduction. For instance, assuming a labor cost of $100 and overhead of $100, the overhead would of course be 100 per cent. Now if you reduce the labor cost to $80 and the overhead remains $100, and yet you only distribute 100 per cent or $80, you have $20 remaining undistributed. I told him to divide his overhead for a given time by the tonnage produced in that time which would give the unit cost of overhead per ton to be multiplied by the number of tons in the particular order under consideration. The next time I met him he told me I had solved his problem. It is an actual example showing how we may be led astray by following the same old way of doing things without giving proper consideration to the subject.—Gershom Smith, *Eng. Mag.*, June, 1909.

CHAPTER VI

COST ACCOUNTING

Factory Costs. A finished product in a factory making metal goods sometimes consists of a single piece, such as a casting, on which very little work is done, but usually it consists of many pieces, each one of which may have from one to six or more operations done on it, which are "assembled" or fastened together, first into groups of two or more pieces with their fasteners, and then the groups are assembled into the finished product, so called, which later may be plated, lacquered or otherwise "finished."

A "piece" is a single bit of metal—it may be a casting of iron or brass, or be punched or stamped from sheet metal, or cut from a rod. Anything done to it, by a machine or by hand, which causes it to progress from raw material toward finished product is called an "operation."

An "operation" is usually a work of one kind, such as drilling a hole or series of holes, or cutting a groove or two or more grooves, on one piece or on any number of pieces of the same kind and shape, and it is usually done by one man on one machine, but sometimes it is done by a man with a helper or two, on two or more machines, such as a blacksmith with a heater and a helper, heating, rough forging, die forging and trimming, the whole being classed on a single "work order" as one operation, whether it is done on one piece or on ten thousand pieces of the same kind.

Each kind, variety and size of finished product has a selling price, per single article, per dozen, hundred, gross or thousand, which may vary with market conditions.

The selling price is supposed to cover factory cost, selling expense and profit, but as the selling price may be governed by competition and as the factory cost or the selling expense, or both, may be abnormally high, relatively to the selling price, the profit may be turned into a loss.

In this treatise, only factory costs are considered, the selling expense and the selling price being matters that concern the Sales Department and the General Management.

The Factory Cost of the whole annual product covers the raw material, less the value of scrap returned from any of the operations, the Direct Labor, the Indirect Labor, including salaries, fuel and other supplies, repairs, depreciation and every other kind of expense "burden" or "overhead" that is related to the turning out of product. It does not properly include the cost of breakdowns that cause shutting down of the factory for any long period of time, nor losses of work or of profit caused by such breakdowns, nor losses due to idleness caused by fires, by business depressions, by strikes, by inefficiency of the sales department, or by a portion of the product becoming obsolete or out of fashion. These are business losses and not factory losses; and they may be covered by an insurance fund, the annual contribution to which should be considered by the Sales Department in fixing selling prices, or deducted from the surplus out of which dividends are declared.

The Factory Cost of the whole annual product, thus defined, may be obtained by the Accounting Department by the ordinary methods of bookkeeping, and when the product of the factory is a single kind of article, such as pig iron, or flour, or cloth, or automobiles of one size and style, the cost price per ton, or per barrel, or per yard, or per piece, may easily be determined month by month, but when the product is of many kinds and sizes and the operations on different parts, from raw material to finished product take place in different months the determination of the "unit cost" of each kind is a matter of great difficulty. When the number of varieties runs into thousands, and the number of operations into tens of thousands all ordinary accounting systems utterly fail even to approximate real factory costs of individual articles.

The best solution of the complex problem of obtaining unit factory costs is to divorce the Accounting Department from the Cost Department, and have the latter determine costs by an independent method.

A new definition of Factory Cost is now needed. It is not *post-mortem* cost, what the goods cost last year, but what it now costs to reproduce them or what they will probably cost during the remainder of the current year, assuming that the factory runs at a normal average rate.

What the management needs to know is the costs that can be used as a basis for fixing the minimum selling price, as a basis for inventory values from which profits and losses are computed; as a basis for comparison of costs of similar articles of different sizes or grades, or of the same article at different times; as an index of the efficiency of the factory management; and as a guide in determining whether to abandon the manufacture of some parts of the product and to push the sale of other parts.

Accounting versus Cost Keeping. Accounting has to do with payments of bills; classification of expenditures; changing records of assets and liabilities; inventories; gross and net profit; credits, finances, bank relations, notes.

The cost system takes hold where accounting leaves off. It has in common with accounting only two things—the use of the same set of figures of expenditures, and the value of the accounting as a means of proof. It deals with internal affairs only—accounting with external.

The cost system demands a somewhat different experience

and different training than does accounting. Accountants have mistaken form for substance.

No business is made a success by systems alone. Success is due to policies, energy, enthusiasm, work and sagacity.

The best way to build a cost system is from the totals down to the details, and not from the details up to the totals. Start with the totals of the three general elements, material, labor and expense, as proven with the accounting. Divide into sub-totals and then into still other subdivisions.*

It takes in a plant of any size from one to two years to build a good cost system, because so much human nature is involved.†

B. A. Franklin, *Eng. Mag.*, vol. 43, p. 705.

STARTING A COST ACCOUNTING SYSTEM

The Stores System. In organizing a complete cost system in a factory making a variety of products the first thing to be done is to establish a stores system, and to keep an accurate record of all materials and supplies purchased and of all given out to the shops. There should be a place for everything and everything in its place, whether the place be a bin, shelf or hook in the storehouse itself, or a pile in the yard, or on the floor of the factory. The storekeeper is to be held responsible for all material and for keeping record of it, until he is relieved of responsibility by turning it over to the foremen of departments either on general or standing orders, or on written orders, or requisitions, or stores issue tickets for special jobs. A continuous or perpetual inventory, or "balance of stores" record, should be kept, preferably on cards, and it is advisable to supplement these with bin cards on the bins in which the materials are kept. The minuteness of detail of these records is a question for the management to settle. Care must be taken not to let the stores system be overburdened with red tape, which costs more than it is worth. All direct material, that is raw or partly worked material that enters into the finished product, must be charged on individual stores issue tickets or job tickets, but minor supplies for the departments may be lumped together in many cases and charged monthly to department burdens.

Labor Charges. The next important thing in cost accounting is to make provision for charging all direct labor to the job on which it is employed. The best means for doing this is the job ticket.

Direct material and direct labor thus being charged to individual jobs, we obtain the prime cost, which, in many businesses, is considered sufficient for all practical requirements, but in all factories in which the burden is an important fraction of the total cost, and especially in factories having more than one department, the proper distribution of the burden is fully as important as the accurate recording of prime costs.

FACTORY ORDERS

Factory orders may be divided into several classes:

1. **Standing Orders.** These need not be in writing, but are taken for granted, such as "Keep factory clean"; "Tool room, grind all tools sent in from the shops, as directed by the foreman"; "Blacksmith shop, forge all tools as required by tool room; do all repair work required by department foremen."

A list of such orders with their appropriate symbols should be kept in the counting room and on the desks of the foremen or department clerks, so that when labor or expense tickets are made out for work done on these orders the proper charge symbol may be written on them.

2. **Office Orders,** issued either by the general office or by the factory office for certain work to be done, the details of which will be arranged by the planning department. "Example: Make 12 engines, Class E9 for stock. Deliver in warehouse within three months."

3. **Production Orders,** made by the planning department, for work to be done in the several departments. Usually these are subdivisions of the office orders. Example: Foundry, make 12 cylinders, 12 pistons, 12 flywheels, 12 bedplates, 24 bearing caps, from E9 patterns. Forge shop, make full set of forgings for 12E engines as per drawings. Main shop, do machine work on 12 engines E9, as per drawings.

4. **Job Orders,** written on job tickets, subdivisions of Production Orders, specifying work to be done by one man or by a group of men using one machine or a group of machines, or a bench or floor, on a single operation or on several operations in sequence, on one piece or on any number of pieces of the same kind. A job order is also written for the assembling of pieces into groups or into completed structures.

The job ticket when issued should contain all the information concerning the job that may be needed by the foreman of the shop, and when completed it should have such additional information as is required for the records of the Cost, Statistics and Accounting Departments.

Small Orders. A large factory may receive as many as a hundred or more such trifling orders in a day, the total costing perhaps not over $25. Under old systems of management these gave a great deal of trouble to the foremen of the several departments on account of their interfering with regular work, and to the order clerk held responsible for "chasing them through the factory" and getting them shipped within a reasonable time. No attempt was made to record their costs and there was no check upon delays and wasted motions and consequent excessive costs of production. Under modern systems of management, with a planning room to issue orders to the several departments, small orders

* This needs some explanation. If "to build a system" means to prepare a scheme for the system, we may build down from the totals to the details as stated, thus:

Total Expenditure:
Material; Labor; Expense;
Distribute to Departments or to Classes of Products;
Subdivide into Costs of Individual Products.

But in *using* a cost system we build up from details to totals, thus:

Stores issue Tickets; Time Cards; Bills for expenses.
Allocation of Expense Burden to the Machine-hour Costs.
Cost summaries of Parts or Pieces.
Cost of Groups and of Products.
Totals by Classes.
Grand Total.

† "Engineering is the science and art of overcoming the resistances of nature—including human nature."—W. K.

are executed promptly without interfering greatly with the regular work and records are made of every operation.

In order to keep the clerical work down to a minimum a system should be devised after joint study by the head of the planning room, the chief cost clerk, the chief accountant and the superintendents of the several shops, by which the progress of such work through the shops will be made automatically without any "chasing," by which the least possible number of blank forms will have to be filled and handled, and the least amount of writing and bookkeeping done consistent with obtaining a complete record of every operation and its approximate cost.

SUBDIVISIONS OF PAY ROLL

Direct Labor.—Departments A, B, C, etc.

Charged on job tickets to particular jobs on Pieces, Groups, Finished Goods, by Departments. The total direct labor on these tickets equals the total departments' direct labor pay rolls.

Indirect Labor—Departments A, B, C, etc., and Expense Departments.

TIME-KEEPING

The time may be kept on time books, time tickets (daily, weekly, or by jobs), or on the regular job tickets, which contain all the original entries both for time and for jobs.

The time may be kept by any convenient method which is most suitable for the department. Thus, in the Power Plant where a man's job is the same from month to month, the time of each fireman would be entered each day in a time book, and the cost of firing labor would be entered only once a month, as the total of all the firemen's wages for the month.

In the blacksmith shop some of the work would be direct labor, charged on job tickets to particular jobs, some work on standing orders, such as "Forge all tools as required by the Tool Room." "Repair all tools for the Power Plant." The daily time ticket may be found most suitable for this shop, with several lines on it showing by symbols the different jobs worked on in a day and the time required for each. Example:

Time Ticket, Blacksmith Shop

No. of Wkm..... Name..... Date.....

Symbol	Description of Work	Hrs.	Rate	Amt.	Symbol of Machine Used
J 1017	Job order	3½			
PPR	Repairs of tools for Power Plant	4½			
TR	Forging Tools for TR	2			
	Total	10	35	3.50	

The tickets for each day would first go to the pay-roll clerk, who would enter the time on the pay roll, then to the job clerk, who would sort the tickets by symbols, and at the end of the pay-roll period add up the hours and amounts for each symbol, take the total of the amount and compare it with the total pay roll of the shop. A Blacksmith Shop Labor Distribution Sheet is then made out which is used as needed by the Cost, Accounting and Statistics Departments.

STORES ACCOUNT

"Stores" in the factory ledger may include all raw materials that are to be used in manufacture of the product, all partly worked materials that have been returned from the shop to the stores for safe-keeping until they are needed again in the shop for further operations, all finished parts, whether purchased or made in the shop, that are to be kept until they are to be assembled into finished products, also all supplies, such as fuel, small hand tools and other things that are, when issued to the several departments, to be charged to expense accounts; or, if desired, separate accounts may be opened for each class of these items, such as raw material, partly worked material, finished parts, fuel, supplies, etc. In the latter case numerous transfer entries are needed, as will be shown below, as the materials progress from one stage of work to another.

The accounting will be simplified if all the materials for which the storekeeper is responsible are kept in one stores account in the General Factory Ledger, the subdivisions being taken care of in the continuous Inventory cards, which are properly classified. The work in progress through the shop, for which the department foremen are responsible, is kept in "Work in Process," or "Work in Shop," and the finished goods, ready for sale, under the care of the warehouseman are kept in "Finished Product" or "Warehouse" account.

Suppose a production order is issued in an engine building shop for making for stock several engines of one class and size, and job tickets are made out for all the operations required. The order is not to be rushed through the shop, and as different parts are made or partly made, they may be kept in the store until needed for further operations or for assembling. As the work progresses the job tickets are returned from the shop first to the pay-roll clerk, and then to the cost and accounting clerk, who, after figuring up the cost for labor, material and burden on each ticket, and making the proper entries on the Piece Cost, Group Cost, and Finished Product Cost cards, makes the monthly accounting entries from the statement of transactions given on the following page, which is made up from the adding machine totals of the job tickets for the month:

Petty Stores. It is well to have an inflexible rule for the storekeeper that nothing is to be given out from the stores without an order, receipt or some sort of memorandum or check representing it. To lessen the work of accounting, however, such small items as cost only a few cents each, which are chargeable not directly to product but indirectly to burden, may be lumped together and charged to general burden or to departmental burdens at the end of each month. The memorandums as they are received may be filed in a box with numerous labeled partitions or pigeonholes, classified by departments or by the kinds of material issued, and taken out and totaled at the end of the month.

Transactions	Journal Entries					
	First Method			Second Method		
Work on $500 raw material, Labor $1000, Burden $1000	Work in Process	2500		Work in Process	2500	
	To Stores		500	To Stores		500
	To Labor		1000	To Labor		1000
	To Burden		1000	To Burden		1000
Put $1200 of the product into stores, as partly worked material	Partly worked material	1200		Stores	1200	
	To Work in Process		1200	To Work in Process		1200
Work on $100 raw material, $800 work in process in the shop, $600 part worked material, $200 Labor, $200 Burden. Put all in stores, as finished parts	Fin. Parts	1900		Work in Process	1100	
	To Stores		100	To Stores		700
	To Work in Process		800	To Labor		200
	To Part W.M.		600	To Burden		200
	To Labor		200			
	To Burden		200	Stores	1900	
				To Work in Process		1900
Assembling Job, $50 R.M. from store, $200 work in Process in the shop, $400 Partly worked material from store, $1500 Finished parts. from store, $100 Labor, $100 Burden. Put all in warehouse.	Fin. Product	2350		Work in Process	2150	
	To Stores		50	To Stores		1950
	To Work in Process		200	To Labor		100
	To Partly worked matl.		400	To Burden		100
	To Fin. Parts		1500			
	To Labor		100	Fin. Product	2350	
	To Burden		100	To Work in Process		2350

Journal Ledger

First Method

Credit Accts.

Debit	Stores	Labor	Burden	Wk. in Proc.	Part Wkd. Mat'l.	Fin. Parts	Fin. Prod.	Total Dr.
Wk. in P.	500	1000	1000					2500
Pt. wkd. M.				1200				1200
Fin. parts	100	200	200	800	600			1900
Fin. prod.	50	100	100	200	400	1500		2350
Total Cr.	650	1300	1300	2200	1000	1500		7950
Dr.				2500	1200	1900	2350	7950
Dr. bal.				300	200	400	2350	3250
Cr. bal.	650	1300	1300					3250

Second Method

	Stores	Labor	Burden	Wk. in Proc.	Fin. Prod.	Total
Stores				3100		3100
Wk. in P.	3150	1300	1300			5750
Fin. Prod.				2350		2350
Totals, Cr.	3150	1300	1300	5450		11200
Dr.	3100			5750	2350	
Dr. bal.				300	2350	2650
Cr. bal.	50	1300	1300			2650

Attention is called to the extreme simplicity of the second method. Not only are all the journal entries dispensed with, but the whole of the ledger work consists in entering on a printed blank only five figures, viz.: 3100, 3150, 1300, 1300 and 2350, the totaling of the horizontal lines and the vertical columns, and the entering of the balances. The figure 3100 is the adding machine total of the entries on the job tickets of partly worked material and finished parts put in stoves; the figures 3150, 1300, 1300 are the totals of the entries on the job tickets of material of all kinds, raw, partly finished or finished, received from stores, and of labor and burden. The figure 2350 is the total of the entries on the assembly job tickets of finished goods delivered to the warehouse. The whole result of the operations is shown in the last two lines of the sheet. We have spent $1300 for labor, $1300 for burden and have reduced the store inventory $50, a total expenditure of $2650, and we have to show for it $300 increase of work in process and $2350 increase of finished goods in the warehouse.

Valuation of Stores

The best accounting uses costs as a basis. An increase in values in a thing still held is not profit. Profit cannot arise until a thing is sold.—W. M. Cole, Accounts, their Construction and Interpretations, p. 159.

A rigid adherence to this rule might lead to no end of confusion in the estimation of profits and losses in a manufacturing business in times of violent fluctuations in market prices.

Suppose a concern making electric motors in 1916 used in some of them an old stock of copper wire purchased in 1915 at 25 cents a pound and in others used wire purchased at various dates in 1916 at prices advancing from 30 to 40 cents. In taking an inventory January, 1917, shall the motors be valued at different costs depending upon the date at which the wire in them was bought, or shall they all be valued on the basis of the latest market price of wire? It is well generally "not to count chickens before they are hatched," and to err, if at all, on the safe side in fixing inventory values, but in such a case as the one above mentioned a profit does arise before a sale is made. The cost that

should be used in taking an inventory, and in fixing a base on which to figure the minimum selling price, is not the *post mortem* cost, but the present estimated cost of reproduction, based on present costs of material and labor. The advance in market values of material in stores, or of finished goods in the warehouse in 1916 should be credited to Profit and Loss, of 1916, when the inventory of January 1, 1917, is taken; otherwise when they are sold at high prices later the business of 1917 will show a greater profit than was really made in that year.

In the Profit and Loss statement of 1916 the fact should be recorded that the gross profit was not all due to manufacturing but that some of it was due to advance in values of raw material, and the fact thus recorded should be considered before declaring a dividend.

The same material may sometimes be transferred back and forth several times between the stores and the shop, so that the monthly totals of Stores Account and the Work in Process account do not show a record either of business transactions or of the amount of work done in the shop, the entries being mostly of transfers of material from one place to another. The balances of the two accounts added together show the cost values of all the material, raw or partly finished, and the balance of Finished Product (or Warehouse Account) shows the cost value of products on hand and ready for shipment. The entry Stores to Accounts Payable * is a business record of monthly purchases, the entry Finished Product to Stores and to Works in Process is a factory record of the amount of goods finished during the month, and the entry Sales Account to Finished Product is a business record of the cost value of the goods shipped.

Inventory of Warehouse and Stores

Suppose a concern makes an annual product costing $200,000, and that one-half of the total product is on hand at the end of the year, estimated to have cost $100,000.

The $200,000 cost of product is made up of material $80,000; Labor, $55,000; Burden, $65,000, and on account of the burden on all portions of the product being figured on the uniform percentage of labor basis it is estimated that one-half of the product, costing $40,000 for material and $27,500 for labor should have half of the total burden apportioned to it, making the total cost $100,000. But suppose that a more accurate method of apportioning burden should show that the $200,000 total cost should be distributed over three classes of product *A*, *B* and *C*, as follows:

	Material	Labor	Burden	Total
A	20,000	20,000	30,000	70,000
B	40,000	20,000	20,000	80,000
C	20,000	15,000	15,000	50,000
	80,000	55,000	65,000	200,000

* Or Stores to Company (or Private Ledger) if the factory books are separate from the general or financial books. In this case the entry in the general books is Factory Operating Account to Accounts Payable.

Now, when the inventory of half the product, costing $40,000 for material, is taken it may be found to consist of different proportions of *A*, *B*, and *C*, giving rise to valuations that may differ widely from $100,000, for example:

	Material	Labor	Burden	Total
½ of *A*, *B*, and *C*	40,000	27,500	32,500	100,000
All of *B*	40,000	20,000	20,000	80,000
A and *C*	40,000	35,000	45,000	120,000
A and ½ *B*	40,000	30,000	40,000	110,000
C and ½ *B*	40,000	25,000	25,000	90,000

Showing a possible difference of $20,000 above or below the $100,000 valuation based on the common method of apportioning burden, or 20 per cent of the total annual cost of production.

Inventory Valuations of Stores, of Partly Finished Work, and Products in Warehouse. The profit or loss of a business, as established by the books depends on the inventory valuations, and these will vary according to the theory upon which valuations are made, viz.:

1. At cost as shown by the books.
2. At the probable cost of reproduction.
3. At the standard cost of a normal year or average of a five-year period, called "Record Costs" or "Five-year Standard Cost."
4. At this standard cost plus or minus a percentage to cover advance or reduction in costs of labor, material or burden since the standard cost was recorded.
5. At the market or selling price less a percentage estimated to cover normal selling costs and normal profit. In a business making a great variety of products, No. 5 will rarely give valuations that do not differ widely from factory costs, for it is practically impossible to apportion even approximately the total selling expenses to the different items of product. The valuations on Nos. 1, 2, 3 and 4 bases will depend largely upon the method of distributing the factory burden. When the amount of the inventory is a large fraction of the total annual product an error in the method of distributing may lead to great errors in the inventory values, which, if they do not balance each other, may lead to dangerous conclusions in regard to profits on the business and as to the amount of dividend that may safely be declared.

On this account it is advisable that the annual inventory, on which the yearly profits available for dividends are based, should be taken at a time of the year when the value of the goods in the warehouse and of the work in process is apt to be at its minimum, and when the error in the total of the inventory valuation is, therefore, also likely to be a minimum.

Checking the Continuous Inventory

If a continuous or "perpetual" inventory is kept on cards properly filed, or in a loose-leaf Balance of Stores Book, and is checked at frequent intervals by actual counting, measuring or weighing the goods, or stores, on hand, there is no need of shutting down the factory to take the annual inventory.

Some system should be adopted to insure that each bin, or

other place for storing materials, should receive proper attention from the storekeeper's assistants, and that at least two or three times during the year its contents are inspected and compared with the balance shown on the bin card. As each bin is inspected, a memorandum, giving the symbol of the article, the quantity found in the bin, and the date, should be written and sent to the balance of stores clerk for comparison with his records.

The best time to inspect a bin, and check the bin card, is when it is empty or nearly empty. If the inspector tacks a small card, of a different color for each month of the year, on each bin, after he inspects it, he will have a continuous reminder, as often as he walks past it, of the time that has elapsed since the bin was last inspected.

COST-KEEPING BY PIECES OF PAPER

Modern bookkeeping and cost-keeping show a tendency to dispense with books, pens and ink, and laborious transcribing from one book to another and to use instead printed blanks, typewriters, adding and billing machines, and filing cases. Take the example of what is done in a shop building steam engines:

(1) The general office sends to the factory a printed blank with a typewritten order. "Build for stock twelve engines Class A, size 10×12 in., date, March 1, 1916. Deliver in warehouse on or before July 1st."

(2.) The Production Department takes from a pigeonhole or file case a mimeographed sheet headed **Schedule EA**, 10×12 in. which contains a complete list of all the parts that go into such an engine, specifying for each part its name, symbol, size, drawing and pattern number or symbol, kind of metal, which also has columns headed: Date ordered, From whom Ordered, Date to be delivered, Date received. It fills out in the proper column the number of individual pieces of each kind required for twelve engines, and sends it to the storekeeper, placing (1) in the "Unfilled orders" file.

(3) The storekeeper takes from his inventory file the sheets of **Balance of Stores** that correspond to the piece symbols marked on the schedule that may be kept in stock, and enters on them the number of pieces that are to be reserved for this particular order and marks on the schedule in the column "from whom ordered" the words "in stock" or "in stock 4, wanted 8" (or as many as may be wanted), and returns the schedule to the Production Department.

(4) The production clerk takes a lot of order blanks and writes in triplicate (using carbon paper) **orders for the materials** or finished parts (such as bolts) that are to be purchased from outside concerns, as shown by the schedule, stating the dates at which each lot of material is to be delivered to the factory, and sends these orders to the Purchasing Agent.

(5) The production clerk takes from another file blanks for **factory production orders** for each piece or lot of pieces of one kind to be made. As these pieces have been standardized as to patterns and operations the blanks may be printed or mimeographed with all details, and require to have written in ink only the date of issue, serial numbers of the office and factory orders, number of pieces to be made, and date for delivering to the storeroom or assembling floor.

(6) **Job tickets** are then made out for each operation or group of operations to be performed by one man, corresponding to each of the several production orders. These tickets may be so printed as to serve several distinct functions, viz.: (*a*) an order on the storekeeper for the material, a payroll record showing the date at which the operation was performed, the time of the man and of the machine, his wages or piece work payment, and the machine or other burden, thus making the job ticket also a cost ticket for the operation. It may have a **move coupon** attached to be given to the "move man," containing an order to move the piece or pieces to the next machine, to the storeroom, or to the assembling-room floor.

The job ticket is the most important element in the modern cost system of factories that make an "assembled" product. The job tickets may be made out, or partly made out, long in advance of the time when they are needed, and put in a file on "jobs waiting assignment" until the time arrives for them to be put on the bulletin board of "jobs in factory" and "jobs ahead."

(7) **Instruction cards** corresponding to each job are on file and they go with the job ticket to the workman or are put on a board in the workroom for his inspection.

(8) **Bills** begin to come in for the goods purchased. They take the regular course of verification and are then filed alphabetically in the file of "bills unpaid" or bills to be certified for payment.

(9) The storekeeper or receiving clerk fills out a blank for each lot of **goods received** from outside parties, has it approved, if required by the inspector of material, and sends it to the factory office where it is compared with the bill (8).

(10) The cost clerk takes the blank (9) and enters on it the unit cost of each kind of material with a proper addition for freight, express, storage, depreciation, etc., if that is the custom of the factory, and sends it to the storekeeper or balance of stores clerk who enters it in his balance of stores sheets or perpetual inventory.

(11) **Monthly statements** of the bills (8) come in at the beginning of the month; they are compared with the bills, and, if correct, are certified to the treasurer or cashier of the company. If bills are to be paid promptly, in order to obtain prompt cash discounts, a statement is made out from the bills and certified for prompt payment.

(12) After the bills are paid they are arranged alphabetically by names of dealers and in the order of dates for each dealer and filed permanently in the **Paid Bills** file.

(13) The cashier pays the bills with **voucher checks,** that is ordinary bank checks with the words "In payment of your bills of (date)" or statement of (date). Before the bills are filed, a rubber stamp legend (or a slip pasted on the bill) is filled out with the names of the account or accounts to which the bill is to be charged in the **Accounts Payable Book.**

(14) The voucher checks are all entered in the **Check Register,** which in large concerns takes the place of the right-hand side of the Cash Book.

(15) When the work of production is started in the factory

the job ticket is sent to the storekeeper as a warrant for his issuing the material that it calls for, or else a **Requisition** is made for it. This requisition to be returned to the cost clerk, or a separate bill is to be made for the material delivered with the price at which the material is to be charged to the job. The bill is to be charged on the job tickets and credited on the stores inventory.

(16) If any material that has been charged to a job is returned to the stores, such as surplus material or scrap, a **Credit Card** is sent with it for entry in the Inventory and credit on the Job tickets.

(17) Time tickets or job tickets are returned from the factory as the work progresses. They are sorted first to the names of the workmen, so that the **Pay Roll** may be made out, and then sorted by job numbers or symbols so that the cost of each job may be determined. The job totals are then added on the adding machine, together with the charges for burden, and the charges for material if they are on the job ticket. The sum of labor, burden and material on the job tickets for one week must equal the total of the jobs for the same period. The total of the burden figures is entered on the memorandum book of **Distributed Burden.**

(18) The job tickets belonging to each piece or lot of pieces of the same kind are brought together, and when the piece, or lot of pieces, is finished and ready for delivery to the storeroom or to the assembly floor a **Piece Cost Card** is made out, giving date, piece symbol, number of pieces in the lot, average cost per piece for material, labor, burden and total. This cost card is sent to the storekeeper for entry in the **Balance of Stores** or **Perpetual Inventory,** after which it is filed permanently in the Piece Cost file. The same cost card may be used at subsequent dates when other pieces of the same kind are ordered.

(19) When enough parts have been made so that " group assembling " may be begun (that is, putting together of certain parts that belong together, such as " base and cylinder group," " shaft group " or " governor group "), an **assembly job ticket** is made out, which serves as a requisition on the storekeeper for the pieces belonging to the group, and for a job and time ticket for the work of assembling. A similar assembly job ticket is made out for the assembling of the groups into complete engines and for the finishing of the engines for delivery to the warehouse. These tickets take the same course as that of the operation job tickets, described under (6), (17), and (18).

(20) **A Finished Product Cost Card** (or Engine Cost Card) is made out from the information contained in the Piece Cost Cards and in the Assembly Job Tickets, giving the cost of the engines complete. This is entered in the **Warehouse Inventory,** and the card is placed in the file of costs of Finished Product.

The Cost System is now complete except as to the method of computing and distributing burden. It includes the filling out and handling of the following cards, sheets or other pieces of paper:

1. Office Order.
2. Schedule of Parts.
3. Inventory or Balance of Stores.
4. Orders for Materials.
5. Factory Production Orders.
6. Job Tickets for Operations.
7. Instruction Cards.
8. Bills for Goods Purchased.
9. Blanks for Goods Received.
10. Monthly Statement of Bills.
11. Voucher Checks or Vouchers to be paid by the General Office.
13. Credit cards for material returned.
14. Pay Rolls.
15. Piece Cost Cards.
16. Assembly Job Tickets.
17. Engine Cost Cards.

    Besides these cards there are bound books that are connected with the system.

18. Accounts Payable Book.
19. Burden Distribution Book.
20. Petty Cash Book for minor cash receipts and payments by the factory.

The Cash Book and Check Register are not included, as they are handled by the General Office and not by the factory office.

Provided that the factory expense has been properly computed and distributed to the job tickets according to the method in use in the factory, the blanks have been properly filled out and that no arithmetical errors have been made, this system shows what was the cost of the engines and what was the cost of each piece and each operation on each piece.

These blanks, however, are not all necessary for the accounting system; many of them are required for administrative purposes, that is for getting the order systematically carried through the shop without any reference to costing or accounting.

We may have the production department entirely separate from the cost department, the former being charged with the duty of getting the engines built within the prescribed time and the latter with the duty of reporting the costs. The blanks required by the two departments then would be:

Production Department.

(1) Office Order.
(2) Schedule of Parts.
(3) Inventory.
(4) Orders for Materials.
(5) Factory-production Orders.
(6) Job Tickets for Operations.
(7) Instruction Cards.
(12) Requisitions on Storekeeper.
(16) Assembly Job Tickets.
(4a) Replacement orders for spoiled work.

Cost Accounting Department.

(3) Inventory (for prices of materials).
(8) Bills for goods Purchased.
(14) Pay Rolls.

(12) Requisitions on storekeeper.
(For prices of materials delivered by storekeeper.)
(13) Credit cards for materials returned.
(15) Piece Cost Cards.
(17) Engine Cost Cards.
(19) Burden Distribution Book.
(20) Petty Cash Book.

The Accounts Payable Book (18), Monthly Statements (10), Vouchers (11), and the Cash Book and Check Register are not included in either of these two lists, since they belong to the Financial Department.

Limitation of the Cost Accountant

With the above-mentioned seven blanks and three books properly filled out and filed the cost accountant is in position to answer any reasonable question that may be asked by the officers of the Company as to *what was the cost* of the engines, of the parts, and of the operations, and also what is the recorded cost or inventory value of raw material or of finished parts in stores. They give him all the data that are needed for this purpose. He is also in position to make such statistical sheets, reports or charts as may be required, giving monthly (or other periodical) total of expenditures for material, labor, supplies, or burden, and comparisons of present costs with past costs or with standard or predetermined costs that may have been made by the drafting or planning department. He is also able to say whether certain fluctuations in cost are due to changes in the market price of materials or to changes in wages or burden. He may also give to the financial department the figures to be entered in the monthly journal entries of the books of the general office for the purpose of "tying the cost-books to the General Ledger."

He is not able, however, to say that the costs that he reports are "true costs." They are true only to the extent that the theory and method of estimating depreciation and of distributing burden are correct and true, which they never are, they are only approximations.

The most accurate cost accounting system that deals with past events is but a historical record. It does not deal with the causes of these events, and it is not able to predict or to plan for future events. It cannot show that the unduly high cost of an engine was due to any kind of bad management in the planning room, to defective tools, to incompetent foremen or unskillful workmen. These are matters for the management to investigate after inspection of the cost accountant's and statistician's figures.

CHAPTER VII

COST-FINDING METHODS. USE OF THE JOB TICKET

Time Tickets

Time tickets may be made out on either one of the following systems:

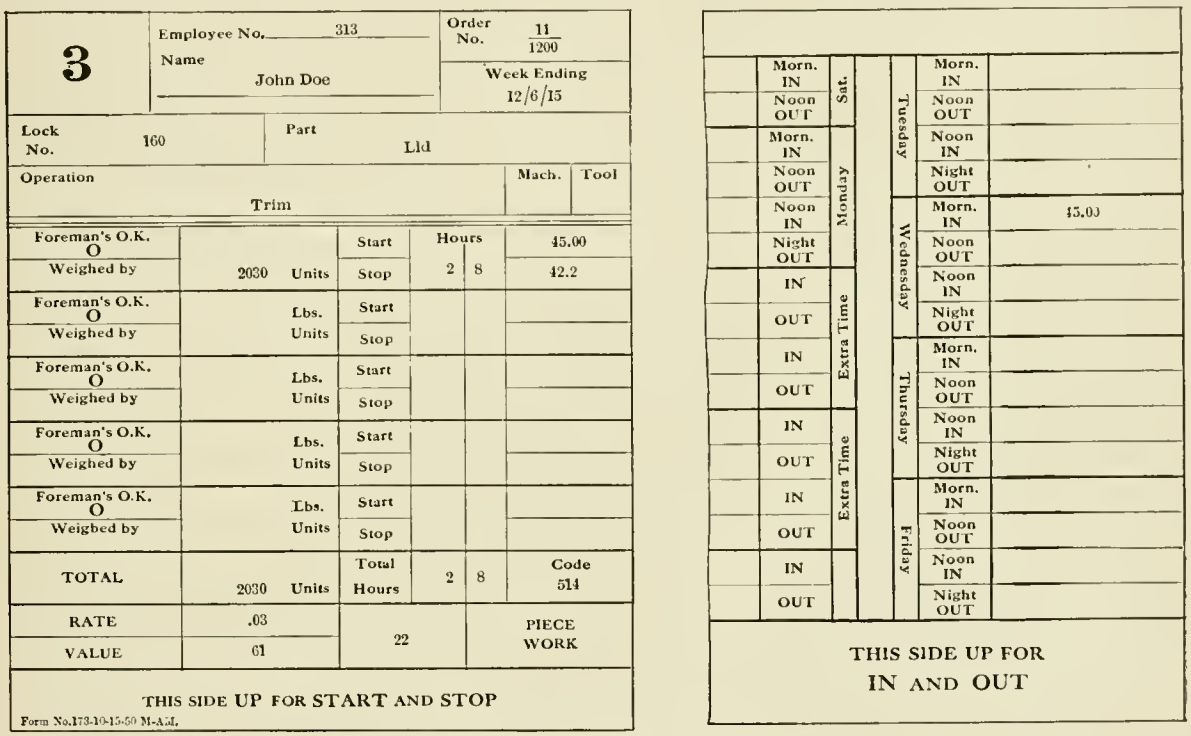
1. One ticket per man per week, showing all the jobs he works on during the week, with the time used on each job.

2. One ticket per man per day, showing all the jobs the man worked on that day.

3. One ticket per man for each job that is worked on that day.

4. One ticket for each man for each job, whether it is done in a fraction of an hour, or whether it takes a whole week. If the job runs over a week a continuation ticket is issued for each succeeding week.

Combined Time and Job Ticket. Form M1 shows the two sides of a combined time and job ticket used by the Miller



3	Employee No. 313	Order No. 11/1200
	Name John Doe	Week Ending 12/6/15

Lock No.	160	Part	Lld		
Operation	Trim			Mach.	Tool

Foreman's O.K. O	2030 Units	Start	Hours		45.00
Weighed by		Stop	2	8	42.2
Foreman's O.K. O	Lbs. Units	Start			
Weighed by		Stop			
Foreman's O.K. O	Lbs. Units	Start			
Weighed by		Stop			
Foreman's O.K. O	Lbs. Units	Start			
Weighed by		Stop			
Foreman's O.K. O	Lbs. Units	Start			
Weighed by		Stop			
TOTAL	2030 Units	Total Hours	2	8	Code 514
RATE	.03	22			PIECE WORK
VALUE	61				

THIS SIDE UP FOR START AND STOP

Form No.173-10-15-50 M-A.M.

	Morn. IN	Sat.	Tuesday	Morn. IN	
	Noon OUT			Noon OUT	
	Morn. IN	Monday		Noon IN	
	Noon OUT			Night OUT	
	Noon IN		Wednesday	Morn. IN	45.00
	Night OUT			Noon OUT	
	IN	Extra Time		Noon IN	
	OUT			Night OUT	
	IN		Thursday	Morn. IN	
	OUT			Noon OUT	
	IN	Extra Time		Noon IN	
	OUT			Night OUT	
	IN		Friday	Morn. IN	
	OUT			Noon OUT	
	IN			Noon IN	
	OUT			Night OUT	

THIS SIDE UP FOR IN AND OUT

FORM M1. COMBINED TIME AND JOB TICKET.

Lock Co. A card is used for each separate job whether it lasts a fraction of an hour or runs over several days, but if the job is not finished at the end of the week the card is returned to the cost department and a new card is issued. While the work is in progress the card is kept at the desk of the foreman of the room in which the work is done. A time clock stamps the starting and stopping time on the front or job side of the card, and the in and out times are stamped on the other side, on which the days of the week are printed. The size of the card is $5\frac{1}{2} \times 3\frac{1}{2}$ in.

The clock registers hours and tenths. It runs backwards, starting at 55 o'clock at 7 A.M. Tuesday morning (the time-keeping week begins on Tuesday) registers 50.0 at noon, and also at 1 P.M., stopping during the noon hour, and 45.0 at 6 P.M. and also on Wednesday at 7 A.M., stopping during the night. On Saturday it registers only 5 hours, from 15.0 to 10.0, and on Monday 10 hours from 10.0 to 0.0. The time clock calculates the elapsed time by subtracting the "stop" from the "start" time. As shown in Fig. 3 which is John Doe's No. 3 card for the week, the job was started at 45.0 and stopped at 42.2, the elapsed time being 2.8 hours. On the other side of the card only one figure is shown, 45.0, the man's "in" time on Wednesday morning. His next job card No. 4 shows three time figures, noon out 40.0, noon in 40.0 and night out 35.0.

The cards have large figures 1 to 10, printed on the upper left-hand corner to indicate the number of the jobs done by the man during the week, starting with No. 1 on Tuesday

morning. Some cards are provided with the place for the figure left blank, to be filled in with ink in case a man has more than ten jobs in a week.

Job cards of completed jobs are collected from the departments twice a day. They are first filed in the pay-roll section of the cabinet where they accumulate during the week. At the end of the week all job cards are collected, whether the jobs are finished or not.

A certain bonus is given if a man does 50 per cent more than the standard set for the job. Thus, a man rated at $11 per week making 50 per cent more or $16.50 per week gets 48 cents bonus, making a total of $16.98. The bonus figure is derived from a formula and curve and is taken quickly from a revolving multiplication table.

Weekly Pay Voucher. The job and time tickets of the Miller Lock Co. are summarized on a voucher sheet for each workman, which is shown in an abridged form below. The size of the sheet is 9 by 12 in., and it contains some columns in addition to those here given, such as Estimated value per 100, Standard Product, Per cent of Standard, etc.

In this factory the bonus is figured on the total weekly earnings and not on each separate job. John Doe is rated as an $11 a week man, or 20 cents per hour for 55 hours per week. On jobs 8 and 9 he was given this rate for day work,

No. 313 Name John Doe — MILLER LOCK CO., Weekly Pay Voucher

Dep't. 8 Day Work Rate 20 C'ts Per Hour — Bonus Rate 11.00 Per Week — Pay Week Ending Dec. 6, 1915

Job No.	Lock No.	Part	Operation	Quantity Units	Rate	Hours on Job	Rate per Hour	Non Prod. Day Work	Productive Day Work	Productive Piece Work	Dist. No.
1	160	Case	Rivet	9999	.10	5	.19			99	514
2	214	"	Drill	1000	.10	5	.20			1 00	"
3	160	Lid	Trim	2030	.03	2 8	.22			61	"
4	160	"	Form	9000	.02	7 2	.25			1 80	"
5	214	Case	Drill	40	.10	2	.20			04	"
6	263-9½	Cover	Countersunk	15126	.30	9 8	.30		2 94		"
7	8396	Door	Drill	28	.025	2 9	.24			70	"
8		Inspecting			.20	7 1	.20	1 42			526
9		In & Ex	Inspection		.20	5 0	.20	1 00			540
10	214	Case	Drill	1800	.10	6 3	.28			1 80	514
11	8396	Door	Drill & Ream	36	.035	3 7	.34			1 26	"
12											
13											
			Total			55 0		2 42	2 94	8 20	

Week Ending	Job No.	Shortage Reason	Am'ts	Week Ending	Job No.	Surplus Reason	Am'ts	Deductions For	Am'ts	Total Day Work		
								Restu.	50	Total Day Work	2	94
								Dues		Total Non Prod.	2	42
								Cash		Total Earned	13	56
								Mdse.		Bonus	1	28
								Scrap		Total Wages	14	84
								Surplus Paid Week Ending		Deductions		50
Date Paid Total				Date Deducted Total				Total	50	Actual Wages Rec'd	14	34

Form M2. Weekly Pay Voucher.

but on job 6 he was given a special rate of 30 cents per hour, possibly because that was the regular rate attached to that job. On the other job he received piece-work rates, as in the rate column, per piece, per hundred or per thousand according to the job. At the end of the week his total earnings are figured up $13.56, and he is given a bonus of $1.28, which is 50 per cent of the excess of his earnings above $11.00 a week.

This method is much easier for the accountant than one in which the bonus is computed on each job, and it may be satisfactory to the workman, and it may give the factory a close enough approximation to the labor cost of the several operations, but if accurate labor costs of any article or operation are desired the apportionment of the $1.28 bonus among the eleven jobs is a matter of some difficulty. The bonus $1.28 is 9.4 per cent of $13.56, the total weekly earnings; 11.5 per cent of $11.14, the total productive work; and 15.6 per cent of $8.20, the total productive piece work In figuring the labor cost, including bonus, on any job shall we add 9.4 per cent, 11.5 per cent, or 15.6 per cent to the cost, not including bonus; or, shall we consider each job by itself, and give it a bonus per hour of 50 per cent of the excess of the hourly rate earned, as in the rate column over the base rate of 20 cents per hour? Take jobs No. 2 and No. 11, for example. Was the total labor cost of No. 2 $1.00, with no bonus, or $1.094, $1.115 or $1.156? With the same percentage additions, No. 11, $1.26, not including bonus, would cost $1.378, $1.405 or $1.457, but figured with a bonus of 50 per cent of the excess of the hourly rate earned above 20 cents per hour, the hourly rate would be 41 cents, and the cost 3.7 hours × 41 = $1.517.

A bonus figured as a percentage added to the total weekly

piece-work earnings does not give a satisfactory basis either fixing piece rates or for the estimation of standard costs. Suppose that John Doe is equally skillful and equally energetic and faithful on both of the jobs No. 2 and No. 11, and that he was fairly entitled to earn $15 per week as an average. If he worked a whole week, 55 hours, on job No. 2, making 11,000 units at 10 cents per 100, he would earn 20 cents an hour, or $11.00, and would get no bonus, while, if he worked another whole week on job No. 11, making 535 units, at $.05 each, or 55 hours at 34 cents an hour, $18.70, to which would be added a bonus of one-half the excess over $11.00, or $3.85, making his earnings for that week 55 hours at 41 cents an hour $22.55, or more than double what he received for the other week.

The chief cost accountant, or cost analyzer, on glancing over this weekly pay voucher should make a memorandum for his "Tickler" "John Doe, Dec. 6, 1915, earns only 20 cents per hour drilling 214 case, and 41 cents per hour drilling and reaming S. T. P. O. door. Why?" and at a convenient time hand this memorandum and other similar ones to a cost clerk, who would first find by examining other pay vouchers or job tickets for 214 case and S. T. P. O. Door, whether the conditions noted were chronic or only accidental and unusual. If chronic, the rate fixer should be informed, and he would investigate and report whether or not the established piece rates for these two operations were the proper ones, and whether or not a time study with the aid of a stop watch should be made in order to correct them.

Workman's Yearly Record. The total hours and earnings on the Weekly Pay Voucher are entered on a Yearly

Name John Doe No. 313 | Name
D. W. Rate 20 Spec. 30 Bonus Rate 11[00] | D. W. Rate
Sex M. Age 23 Nat. A. | Sex
Total Hrs. 1914 Wages 478[50] Aver. per Hr. 25 | PREVIOUS YEAR'S RECORD Total Hrs.
Aver. per Wk. 13.75

MADE BY EATON-WATTS CO.

Date	Hours	P.W.	D.W.	Bonus	Dede.	Short	Surp.	Wages Received		Date	Hours
12/6	55	8.20	5.36	1.28	50			14.34	1		
									2		
									3		

FORM M3. WORKMAN'S YEARLY RECORD

Record Sheet, as shown in Form M3. There are two sets of headings on each sheet, and 54 ruled and numbered lines, so as to give room for a two-year record on one sheet. The sheets are bound together in a loose-leaf binder.

Most of the work in this factory is piece work, and more than 20,000 piece rates have been established. They are entered on cards which are kept in filing boxes. Burden rates are apportioned on productive wages—a standard burden. The difference between the monthly total burden on the general books and the sum of the burdens apportioned to jobs is charged or credited to Profit and Loss each month. There is no supplementary rate. Business and administration expenses are entirely separate from shop costs.

There is no inventory period—a perpetual inventory is kept. Material is charged at standard value each month, for simplicity. Apparently the material is a small part of the real cost of the product (except in the case of brass locks) and variations in market price of material make only slight variations in total cost.

When the Workman Fails to Earn His Bonus, Does the Business Gain or Lose? Suppose that under the task and bonus system of paying wages a workman is paid 40 cents per piece if he makes 10 pieces in a day, but only 30 cents per piece, the regular piece price, if he makes less than 10 pieces. If he makes 10 pieces the labor cost of a day's work is $4, if he makes 9 pieces it is only $2.70. Suppose the factory expense is $4 per man per day, and that the selling cost is the same whether 9 pieces or 10 pieces are sold in a day, and that the selling price is $1.50 per piece. We may compute the profit on the day's work of the man, as follows:

No. of Pieces	Labor Cost	Fact'y Exp.	Fact'y Cost	Selling Exp.	Total Cost	Selling Price	Profit
10	4.00	4.00	8.00	4.00	12.00	10 at 1.50 = 15.00	3.00
9	2.70	4.00	6.70	4.00	10.70	9 at 1.50 = 13.50	2.80
						Increased profit when the workman earns his bonus	0.20

But suppose the selling price is reduced to $1.30 per piece, the costs remaining as before, we now have

No. of Pieces	Total Cost	Selling Price	Profit
10	12.00	10 at 1.30 $13.00	$1.00
9	10.70	9 at 1.30 11.70	1.00

Showing equal profits whether the workman earns his bonus or not.

Suppose the price is reduced to $1.25 per piece, then

No. of Pieces	Total Cost	Selling Price	Profit
10	12.00	10 at 1.25 12.50	0.50
9	10.70	9 at 1.25 11.25	0.55
		Increased profit when the workman fails to earn his bonus	0.05

It thus appears that it is highly profitable to a concern to pay a high bonus rate when the margin of profit between the selling price and the total cost of an article is large, but that when the margin of profit is small the profits decrease when the bonus is earned.

EXAMPLES IN THE USE OF JOB TICKETS

A direct labor job ticket contains the following information: Dept. A, Week ending Jan. 8, 1917, Workman's Name and No.

Milling Connecting Rods, Piece E46.			Machine M13
Credit 50 Hrs. at 30c.	$15.00		Move to M17
Bonus 30%	4.50	19.50	Ent'd on Pay Roll W E.
Material, 1000 lbs. forgings			Ent'd on Store Inventory
E46 at 4c.		40.00	SK.
Burden 1000 lbs. at 0.2 c.	2.00		Ent'd on Cost Card CL.
50 hrs. Mach. 30c.	15.00		Pieces finished 19
Job	0.10	17 10	Pieces spoiled 1
		76 60	Ret'd to Stores —
Job finished 1/8. Approved, J. J., Foreman.			Ret'd to scrap, 50 lbs.
			Cr. for scrap 0.50

The opposite side of the card will contain the time clock record and any remarks that may be made by the foreman.

The entry made from the job ticket on the cost card will be as follows:

Cost Card — Piece E46

Date	Machine	Matl.	Labor	Burden	Total	Pcs. fin.	Spoiled	Cr. for Scrap	Cost per pc.	Remarks Standard Cost
1 8 17	M 13	40.00	19.50	17.10	76.60	19	1	0.50	4.01	3.83

Additional entries on this cost card will be made for succeeding operations on the same lot of pieces, and when they are finished, the total cost, less the credit for scrap, is added up and divided by the number of pieces made to obtain the cost per piece. This, together with the number of pieces is entered on a perpetual inventory card.

When the entries on the pay roll, inventory and cost cards have been made from all of the week's job tickets, the adding machine may be used to obtain either directly from the job tickets or from the cost cards the following totals.

Machine hours; cost of labor; cost of materials; credit for scrap or for unused material returned to stock, and burden.

The totals for four weeks give figures for the monthly bookkeeping and statistical entries. The total machine hours is entered on a card which shows the number of machine hours for different months in comparison with the estimated number of hours run in a normal month. This card, together with the monthly total material and labor costs, forms an index of the activity of the business. The monthly totals for labor, net material used, less scrap, and burden, are used for the monthly Journal entry, Work in Process Dr. to Labor, To Stores, To Burden. This entry may be subdivided and apportioned to different departments or classes of product if desired.

After all the entries from the job tickets have been made, as above described, the tickets may be assorted by machine numbers, and the number of hours that each machine was engaged during the month footed up on the adding machine. The figures thus formed may be listed and compared with the number of hours that each machine is estimated to be engaged in a month of normal business, or with the full number of working hours in a month. The result expressed as a percentage or "work-factor" may be used in estimating the "cost of idleness."

Problem in Cost Finding

Job Ticket

Dept. M. Machine Work

Job No. 101. Wk. ending Thurs. 1-20-16

Piece Symbol A, Operation Symbol *a*
Man No. 137 Name A. Smith

Mach. No. L13

Hours	Rate	Amt		
5.2	.25	1.30		
Premium	30%	.39	1.69	
Burden per hr.	20		1.04	2.73
Material				
100 lbs. Castings 3c				3.00
Total inc. Matl.				5.73
Pieces delivered 20				
Pieces finished 19				
Pieces rejected 1, scrap val.				03
Cost per piece 570 ÷ 19 = 30c,				5.70

Back of Ticket

Date
Jan.

Stop
14 Fri Start

15 Sat. Stop
Start

17 Mon. Stop 6.0
Start 3.0

18 Tu. Stop 9.2
Start 7.0

19 We. Stop
Start

20 Th. Stop
Start

Time 5.2 hours

Job Ticket

Assembling

Job No. 210
Wk. ending
Th. 1-27-16

Pcs. A, B, C
Part- Base A, B, C

Man No. 107 A. Brown

Room L Bench 10

Hrs,	Rate	Amt
4	30	1.20
Prem. 20%		.24
		1.44
Burden. 4 hrs. at 10c		.40
		1.84
Pieces cost		
A 19	5.70	
B 38	2.40	
C 57	1.80	9.90
		11 74

Groups finished 19
Av. cost 0.62

Clerical Work on Tickets

Planning Room. Make out tickets.

Pay-roll Clerk. Enter in Pay roll.

Cost Clerk. Enter all costs on *cost ticket* for Piece A.

Enter all costs on *cost ticket* for Group A, B, C.

Add up all labor charges entered on *cost tickets* for week and compare the total with pay roll total.

Add up machine hours for each machine (sorting the job tickets for this purpose) and record the totals in machine record—as a basis for computing the normal burden.

Add up burden charges entered on cost tickets for each week, and record weekly totals in Burden record.

Add up material charges on cost tickets for the week, and compare total with storekeeper's record.

Sort the job tickets by Piece symbol (or Group symbol for assembling tickets) and file them for comparison with future work on similar pieces.

What is the cost of the clerical work per 100 tickets?

How can this work be shortened to cut down its cost, and yet put on record all necessary information?

Information Written on the Job Ticket. (1) Date issued. (2) Office Order No. (3) Class Letter. (4) Piece Symbol. (5) Description of Work. (6) Room No. (7) Machine No. (8) Workman's No. (9) Workman's Name. (10) Rate, Piece or Day Work, or Bonus. (11) Man's Time. (12) Amount of Wages. (13) No. of Pieces. (14) Order on Storekeeper. (15) Material Delivered by Storekeeper. (16) Cost of Material. (17) Receipt of Finished Work by Stores or Foreman. (18) Memo. of Material or Scrap returned to Stores. (19) Burden. (20) Total Cost. (21) Cost per Piece (Material, Direct Labor, Burden, Total). (22) Order to Move Man. (23) Date of Finishing Order. (24) Bonus or Premium. (25) Man's earnings per hour.

The Storekeeper's and Burden Records may be on separate cards if desired. A list of standard burdens for pieces, groups and assembled structures may be kept and added to labor and material costs in the inventory as they may be needed, as at the end of the year, instead of entering the burden on the job tickets. The entries to be made from job tickets include:

1. Workman's Credit on Pay Roll.
2. Such Statistics as may be needed by the Cost, Statistics or Accounting Depts.

If the cards, after being entered on the Pay roll are sorted and filed by Piece Symbols they form a complete cost system for *unit costs*, without any transcribing on books or cards. To find what any Piece has cost at different periods during the year, all that is necessary is to take out of the file all the cards relating to that piece.

Total monthly costs, by classes, rooms, departments or machines may be found by sorting the cards by classes, etc., and adding up the totals on an adding machine.

If the machine-rate burden method is not used the burden figures may be left off the cards, and the burden by Classes, Rooms or Departments may be computed from the monthly totals of hours and of labor by multiplying the hours by cents per hour, or the wages by the burden percentage, determined from previous records or recent investigations.

The storekeeper's record may be omitted from the job tickets if it is not desired to keep detailed costs of material for each piece.

Office Orders

An Office Order is an order issued from the office to the shop, or to the planning room, for the execution of any kind of work, it may be for the making and shipping a single bolt, or for the making and putting into the warehouse a hundred or a thousand complete machines, each comprised of hundreds of pieces. The shop superintendent, or in modern practice the planning room, plans how the order is to be executed, and issues all the necessary shop orders for details of the work to be executed, drawings, instruction cards, and job tickets. The following is an example of an Office Order and of one of the job tickets which is part of the history of the execution and of the cost accounting related to it.

Office Order 7867. Mar. 16, 1916

Symbol	
Bf 1–6	Forge 1000 steel bolts 1×6 in. square heads.
B 1–6	Thread 500 of them, 1½ in. of standard threads.
B 1–6 sp. 12–2	Thread 100 of them, 2 in. special thread, 12 per in.
B 1–6 m	Machine finish heads of 100 of the 500.
B 1–6 ma	Machine finish all over 100 of the 500.
B 1–6 mp	Polish and nickel plate 50 of B 1–6m.

When the order is finished there should be in the Inventory,

400 bolt forgings, 1×6 in.
300 threaded bolts, standard.
100 threaded bolts, special threads.
50 threaded bolts, machined heads.
100 threaded bolts, machined all over.
50 threaded bolts, nickel-plated heads.
1000

Operation Order or Job Ticket

Date issued. Mar. 16/16. Class Letter B
Room No. Forge Machine No. BF 4 Office Order No. 7867
Clock No. 317 Name J Moran Hour or Piece Rate 0.60/100
Work. Forge 1000 1″×6″ Bolts. Piece Symbol Bf 1–6

In	Out	Hours	Total	No. of Pcs.	Totsl	Amount	
M							Storekeeper, Deliver for this order
T							1″ Round Steel
							1000 pcs. 7¾ in.
W							Del'd. Date 3/16
Th 6.7	10	3.3		160			Pcs. Wt. Price Amt.
F 0	10	10		590			1000 1725 1.4 24.15
S 0	4.2	4.2	17.5	250	1000	6.00	Storekeeper's Punch X
Wk. ending 3/18	Fin.	Rate per	Hour	per piece 60/100	Bonus	——	

Earnings per hr. 600/17.5 = 34.3¢ Matl 24.15 Burden Rate–Mach. 17.5 at 2u¢
Cost per 100 pieces $3.365 Burden 3.50
Total 33.65 Foreman's Punch O
Excess Material Returned to Store.....lb. at Scrap, lb.....at.....$.....

MOVE to Store 400 Pieces Bf 1–6 Order 7867
Room No. 16, 100
Mach. No. T2 (Rush)

Receipt by	Date	Pieces	Total
Storekeeper	3/18	250 3/20/150	400
Foreman	3/17	160 3/18/440	600

Material returned.

Punch by Storekeeper X
Foreman.

The symbols are:

B	Steel bolt, square head, standard threading.
Bf	Bolt forging.
1–6	1 in. diam. 6 in. long below head.
Sp. 12–2	Special, 12 threads per inch, 2 in length of thread.
m	Machine-finish heads.
ma	Machine finish all over.
mp	Machined and plated heads.
BF4	Bolt-forging machine, No. 4.

Definition of "Job." The work done by one man, or by one man and one or two helpers, on one kind of operation, one machine or other productive center, on one factory order, which may be for one or for any number of pieces and may take any length of time. If the time required runs beyond the end of the week a new job ticket is issued.

Other operation orders for Office Order No. 7867 will be issued according to the following list:

	Piece Symbol	No. of Pieces	Material from	Operation	Mach No.	Wages Per hr.	Burden Per hr.
1	B 1–6	500	Forge Bf 1–6	Cut threads	T 2	.20	.50
2	B 1–6 sp 12–2	100	Forge Bf 1–6	Cut threads	L 14	.30	.20
3	B 1–6m	100	Shop B 1–6	Mach. heads	M 6	.25	.30
					L 10	.25	.20
4	B 1–6ma	100	Shop B 1–6	Mach. all over	M 6	.25	.30
					L 10	.25	.20
					L 12	.25	
5	B 1–6mp	50	Shop B 1–6m	Pol. and Plate	G. B.		25
					N		2 50

Operation (1) is done on a semi-automatic threading machine with low-priced labor.

Operation (2) is done on a screw-cutting lathe by a skilled workman.

Operation (3) requires two machines, a milling machine for the sides of the heads and a lathe, L10, for the top and bottom of the heads. Separate tickets are made for the two operations if they are done by different men.

Operation (4) requires the same machines, and another lathe may be used for turning the shanks.

Operation (5) requires two machine operations, (*a*) grinding, (*b*) buffing or polishing, both before and after the plating, and the (*c*) plating operation, which includes several minor operations, such as cleaning, dipping, wiring, electroplating and drying, (*a*) and (*b*) may be done by one man whose time is recorded in the same way as in the machine shop, but the plating bath may contain portions of many different orders, and it is difficult to properly apportion the labor, material and burden cost of each. The work of the plating-room is, therefore, often lumped together as a part of general factory expense, or else the foreman of the room, after studies of costs of plating goods of different sizes and surfaces, makes up a schedule of prices to be charged for plating different classes of goods, just as if he were the owner of an independent outside shop doing work for different customers. In this case the plating cost is taken at 5 cents per bolt.

When the operation on each Job Ticket is finished and the ticket returned to the Cost Clerk, he completes all the calculations, entering the results on the ticket, and transfers the workman's credit to the Pay Roll, and the important cost figures to a Piece Cost Card as below:

Piece Costs on Order 7867. Mar. 20, 1916

	Symbol	Pieces	Hours	Rate	Amt.	Burden Rate	Amt.	Material		Total	Per 100 pcs.
Class B Bolts	Bf 1–6	1000	17.5	34.3	6 00	.20	3.50	1725×1.4¢	24.15	33 6	3 365
	B 1–6	500	1.2	20	.24	.50	.60	500×3.365	16 83	17.67	3 534
	B 1–6 sp 12–2	100	9	30	2.70	.20	1 80	100×3.37	3.37	7.87	7 87
	B 1–6m	100	4	25	1.00	.30	1.20	100×3.53	3.53	6.63	6 63
			2	25	.50	.20	.40				
	B 1–6ma	100	4	25	1.00	.30	1.20	100×3.53	3.53	11.13	11 13
			2	25	.50	.20	.40				
			10	25	2.50	.20	2.00				
	B 1–6 mp	50	2	25	.50	.25	.50	50×6.63	3 32	6.82	13.64
						5 each	2 50				
		1850	51.7		14.94		14.10		54.73	83.77	

Less 600 Bf duplicated		×3.365		20.19		
200 B		×3.534		7.07		
50 M		×6.63		3 31	30.57	30.57
850			14.10		24.16	53.20
1000	14.94					Total of order

From this sheet the following figures are entered in the Balance of Stores Book or Perpetual Inventory:

			Per 100	Amount
Mar. 20, 16	Bf 1–6	400	×$3.365	$13.46
	B 1–6	300	3.534	10 60
	B 1–6 sp 12–2	100	7.87	7 87
	B 1–6 m	50	6.63	3 32
	B 1–6 ma	100	11.13	11.13
	B 1–6 mp	50	13 64	6.82
		1000		53 20

The Inventory should already have been credited, from the first Job Ticket of this order, with the material issued, 1725 pounds at 1.4 cents, $24.15.

The method of charging the inventory only with the net product of the order, that is, 400 Bf, 300 B, etc., should be used when the several operations follow one after the other, the material upon which a second or other subsequent operation is to be performed not being sent to the stores for temporary storage, but kept in the shop. If, however, the whole of the 1000 forgings are sent to the stores, then the Inventory should be charged with them, and credited later when portions of the lot are withdrawn for later operations.

Comparison of Burden Rates. In the above table of Piece Costs the burden has been assumed to have been fixed on the standard machine-rate basis, the hourly rate for each machine having been computed from the statistics of the previous year. Omitting the plated bolts, B 1–6mp, for which the cost price is fixed in the plating room, the man-hours foot up to 49.7, the wages to $14.44 and the burden to $11.10. The average burden is 22.3 cents per man-hour, or 76.9 per cent on the wages. Applying these figures to the hours and wages for each of the several operations we obtain the following:

			Machine-hour Burden			Man-hour Burden	Burden on Wages	Excess Over Machine Burden	
	Hours	Wages	Rate	% of Wage	Amt.	Hours ×22.3	76.9% of Wages	Man-hour Burden	Per cent on Wages
Bf	17.5	6.00	.20	58	3.50	3 90	4.61	+.40	+1.11
B	1.2	.24	.50	250	.60	.27	.18	−.33	− .42
B sp.	9	2.70	.20	67	1.80	2.01	2.08	+.21	+ .28
B m	6	1.50	4 at .30 2 at .20	107	1.60	1.34	1.15	−.26	− .45
B ma	16	4.00	4 at .30 12 at .20	111	3.60	3.57	3.08	−.03	− 52
	49.7	14.44	Av	76.9	11.10	11 09	11.11		

If we assume that the machine-rate burden is correct then the uniform man-hour rate may make the burden from 40÷350, 11.4 per cent too high, to 33÷60, 55 per cent too low, and the uniform percentage on direct labor may make the burden from 111÷350, 31.7 per cent too high, to 42÷60, 70 per cent too low.

Other systems of applying burden, such as that of adding the arbitrary figure of 100 per cent to the direct-labor cost, will give still greater variations from the burden computed on the standard machine-hour rate basis, and systems in which it is attempted to distribute all the shop charges for a month over the cost of product for a month, by supplementary rates or otherwise, will often lead to absurd and useless figures of burden, such as 1000 per cent or more of direct-labor costs.

A Complete Job Ticket should give the following information:

Office Order No.
Date issued.
Date work began.
Date work ended.
Name and Clock No. of Workman.
Kind of Work.
Room or Department.
Machine.
Class of Product.
Piece Symbol.
Wage or Piece Rate.
Quantity of Material delivered for the job.
Quantity of Material and scrap returned.
No. of pieces made.
No. of pieces spoiled.
Receipt by storekeeper of the worked material or symbol showing where it has been moved to for the next operation.
Job finished or not.

When the Ticket is returned to the office the clerk enters on it:

Hours worked.
Labor cost—Hrs.×rate+bonus if any, Amount (or Pieces ×rate), Workman's earnings per hour.
Material, weight, price, amount, less value of scrap returned.
Burden, rate and amount.
Total cost for material, labor and burden.
Cost per piece (or per 100 pieces) burden and total per piece.
Standard cost.
Reason for excess above standard.

As the job tickets come into the office during the week, as the jobs are finished, and at the end of the week whether the jobs are finished or not, the costs are computed, and the tickets are put into pigeonholes corresponding to the subdivisions of the pay roll (departments or rooms) and arranged in order according to the clock numbers of the workman. The pay rolls are then made out.

The footing of each subdivision may be entered in a statistical sheet, which shows the total labor cost for the week in each department, the number of men working in it, and the total hours of labor performed during the week, the average number of hours per week per man, and the ratio of this average to the total working hours in the week.

The tickets may then be sorted in order to obtain such information as may be desired for statistical, cost, or accounting purposes.

In large factories, the information on the tickets may be punched on Hollerith cards (see page 135), and these may be sorted as to obtain easily any kind of statistics desired.

The sortings may be as follows:

By Room Numbers, to obtain total man-hours and total wages in each room (or group of rooms).

By Machine Numbers, to obtain Machine hours of each machine (or class or group of machines).

By Class letter, to obtain hours and amount for each class of product.

By Office Order Number, to obtain total cost for the week of work done on each order.

By Piece Number, to obtain total labor, material and burden and the total cost of each piece.

The tickets are finally to be filed by piece numbers and kept for five years or more for statistical purposes.

CHAPTER VIII

DISTRIBUTION OF BURDEN

The great problem in cost accounting is How shall the burden be distributed or "allocated" to the cost of the various articles produced? In the case of a factory producing only one kind of material the answer is easy: The whole cost of running the factory for a year, including material, labor and burden, divided by the number of tons or yards produced during the year, is the cost per ton or per yard, provided the factory runs the normal number of days in the year and provided that the cost of extraordinary repairs, the benefit of which extends over a number of years, is not all charged in the burden for one year but is pro-rated over the stated number of years.

When the factory is shut down for a considerable period of time, as during a strike, the loss due to the continuance of fixed charges while no product is made should not be charged as burden so as to increase the cost of the goods produced while the factory is running, but should be charged to Profit and Loss Account.

When two or more kinds or varieties of articles are produced then the difficulty of distributing the burden begins, and when the products are made in great variety the problem becomes so complex that the highest skill of the management and the accountant combined are required to effect even an approximate solution.

To obtain a clear idea of the difficulty of the problem let us consider a hypothetical case of a concern with $100,000 invested capital and total expenditures of $200,000 per year including the reserves set aside to cover depreciation. The first uncertainty the accountant meets is the amount to be allowed for depreciation. This is entirely an estimate, based upon judgment and experience, and it is included in the following table:

Yearly Expenditures

	Burden	
F 1	Interest 5% on $100,000	$ 5,000
F 2	Taxes, Insurance & Depreciation, 10%	10,000
F 3	Salaries	15,000
F 4	Indirect Labor	15,000
V 1	Interest on Borrowed Money	0
V 2	Depreciation, Maintenance	5,000
V 3	Indirect Labor	20,000
V 4	Fuel and other supplies, shrinkage, etc.	10,000
	Total Burden	80,000
	Total Direct Labor	100,000
	Total Material	20,000
	Total Factory Cost of Product	200,000

F, fixed charges, independent of value of product; V, charges which vary with the volume of product. F2 covers obsolescence of plant and equipment, and reserve for certain unusual risks such as changes in fashion of product; V2 covers depreciation due to wear and tear of machinery, and reserve for repairs and renewals.

Burden Distributed as a Percentage on Direct or Productive Labor. The total annual burden being 80 per cent of the total direct labor cost, the easiest way to apportion the burden to cost of product is to add to the cost of material and direct labor charged against every item of product, 80 per cent of the direct labor charge on that item. This may be a good enough method for the needs of some factories, in which the whole product is fairly uniform in kind and size, the machines used are nearly of the same cost, and the wage rate also approximately uniform, but when these differ to any great extent the method is highly inaccurate and may lead to absurd and dangerous conclusions in regard to the costs of some of the products.

The usual method of adding a certain percentage upon every article manufactured to cover all indirect cost is wrong in principle. The indirect cost is not the same for each class of articles.—J. L. Nicholson, Factory Organization and Costs, p. 32.

Man-hour Method of Distribution. If the $100,000 cost of direct labor in the above table represents 400,000 man-hours (say an average of 160 men working 2500 hours per year) at an average hourly wage of 25 cents, then the average burden, 80 per cent of the direct labor, is 20 cents per man-hour, which is to be added as burden to the cost for material and for direct labor of every article produced. When the wage rates and the size of machines throughout the factory are variable this method of apportioning burden is much more accurate than the percentage-on-labor method.

Example. An apprentice at $1 per day is doing rough work on a large machine. Numerous small jobs are being worked on, requiring much supervision by the foreman and much clerical work to keep track of the orders. At the same time a $4 man is doing fine work on a small tool, the job lasting all day, the amount of supervision and of clerical work being almost nothing. By the percentage on direct labor method the cost for labor and burden (80 per cent on direct labor) is

for the apprentice	$1+0.80=$1.80	
for the skilled workman	4+3.20= 7.20	$9.00

By the man-hour method, with a burden of 20 cents per man-hour and a 10-hour day, the labor+burden cost is

$$\begin{aligned} \$1+(0.20\times 10) &= \$3.00 \\ 4+(0.20\times 10) &= 6.00 \\ & \quad\quad \$9.00 \end{aligned}$$

The man-hour burden on the apprentice is 200 per cent of the direct labor cost, and that on the $4 man is only 50 per cent of the direct labor cost.

The man-hour method in this case gives a closer approximation to the true cost than the percentage-on-labor method, but it fails to take account of the fact that the apprentice's work should be charged with a higher burden than the high-priced man's, because he is using a larger and more costly tool and requires more of the foreman's time for his supervision.

A more correct distribution of the burden would be, probably, to charge 25 cents per hour burden on the apprentice's work and only 15 cents an hour on that of the $4 man. The labor and burden cost would then be

$$\begin{aligned} \$1+(0.25\times 10) &= \$3.50 \\ 4+(0.15\times 10) &= 5.50 \\ &\text{——} \quad \$9.00 \end{aligned}$$

When the man-hour method of apportioning burden is used, the charge should not be a uniform figure for all the men, but a burden table should be prepared showing a different burden rate for different classes of men, of machines, and of kinds of work.

An objection commonly made to the use of the man-hour instead of the percentage-on-direct-labor method is that it involves extra work on the part of the cost clerks. The cost of direct labor has to be figured in making out the pay roll, for which the summing up of the man-hours is unnecessary.

Variable Factors in Manufacturing that Affect the Burden Charge

Classes of product	A B C D
Size	Large Medium Small Special or mixed
Quantity in lot	(from 1 to 10,000).
Pieces in unit or item of product	(from 1 to 20).
Operations on a piece	(from 1 to 10).
Character of work	Coarse, medium, fine.
Wage system	Day work, piece work, task work and bonus
Department or Room	L M N P. (One or more machines; variable as to size, cost, frequency and cost of repairs; number of machines handled by one man; amount of supervision required.)
Work standard or non-standard	Standard (fairly large order, men and machines suitable). Non-standard (small order, rush order, machine in poor condition, underspeeded, large machine on small work, man unskilled, high-priced man on low-grade work).
Business Conditions	Normal—few Machines idle. Depressed—many Machines idle. Boom—men working overtime, rush orders interfering with regular orders, delays in receiving material.

Burden or Overhead Factory Expense.

F, Fixed Charges—Independent of Volume of Business.

1. Interest on Investment in Buildings, Equipment, and Normal Stock in Trade.
2. Taxes, Insurance, Depreciation due to Obsolescence.
3. Salaries of Officers, Superintendents and Head Foremen.
4. Indirect Labor—Engineer, Firemen, Watchmen, Head Clerks, Head Draftsman, Storekeeper.

V, Variable Charges—Dependent more or less on Volume of Business.

1. Interest on Increased Stock in Trade; on Borrowed Money.
2. Depreciation, Repairs and Maintenance, due to wear and tear.
3. Indirect Labor and tool-makers, draftsmen, clerks, cleaners, sub-foremen; all wages charged to expense accounts.
4. Supplies—Fuel, Power, Light, Oil, Small Tools, Stationery, Postage.
5. Shrinkage on Raw Material.

The cost of production of an article made in a factory at a given time is a figure that can be determined, not accurately but only approximately.

The portion of the total cost of production which is paid for the raw material, and the portion which is paid for the labor directly engaged in the production of the article (called direct labor) may be definitely known, but the portion called expense, overhead or burden (which is often more than the sum of the costs of material and of direct labor) can only be approximated.

The amount of burden charged on the books as part of the cost of an article will depend on the accounting system that is used and on the ideas of the accountant or of the management as to the method of computing the burden.

The Department Method of Distributing Burden. One of the methods of avoiding the objection to both the percentage-on-labor burden and the man-hour burden, that they take no account of the different conditions under which different men work, such as size and cost of machines, space occupied, power consumed, and cost of supervision, is to divide the factory into departments, such as foundry, smith shop, machine shop, assembly room, finishing and packing room, etc., and to compute the total annual burden of each department and distribute it to the labor cost by departments, either as a percentage on labor cost or as a charge per man-hour.

For example, we may repeat the figures of the annual burden given above (page 65) and divide them among four departments L, M, N, P, as in the following table:

Distribution by Departments

	Burden	Total	L	M	N	P
F 1	Interest	5,000	1,000	1,000	2,000	1,000
F 2	Taxes, etc.	10,000	1,000	1,000	6,000	2,000
F 3	Salaries	15,000	2,000	3,000	9,000	1,000
F 4	Indirect Labor	15,000	3,000	1,000	5,000	6,000
V 2	Maintenance	5,000	1,000	1,000	2,000	1,000
V 3	Indirect Labor	20,000	4,000	3,000	10,000	3,000
V 4	Supplies, etc.	10,000	3,000	2,000	2,000	3,000
	Burden	80,000	15,000	12,000	36,000	17,000
	Material	20,000	9,000	3,000	5,000	3,000
	Direct Labor	100,000	26,000	5,000	59,000	10,000
	Total Cost of Product	200,000	50,000	20,000	100,000	30,000
	Burden, % of Direct Labor	80	57.7	240	61.0	170
	Man-hours	400,000	104,000	20,000	236,000	40,000
	Burden, cents per man-hour	20	14.4	60	15.3	42.5

Burden Distributed by Classes of Products. Instead of dividing the factory into departments and computing the burden belonging to each, the total of the products may be divided into classes, as A, B, C, D. or say Engines, Boilers Pumps, Miscellaneous; or Heavy, Medium, Light, and Special Products. Investigations are made to find from the records of the preceding year what portion of the total burden should be apportioned to the several classes, and the percentage-on-labor or the man-hour burden rate for the current year or other period is fixed for each class accordingly. Taking the example already given and distributing the burden among four classes of products we may obtain a table like the following:

Distribution by Classes of Product

	Burden	Total	A	B	C	D
F 1	Interest	5,000	2,000	1,000	1,000	1,000
F 2	Taxes, etc.	10,000	4,000	3,000	2,000	1,000
F 3	Salaries	15,000	2,000	3,000	4,000	6,000
F 4	Indirect Labor	15,000	3,000	6,000	3,000	3,000
V 2	Maintenance	5,000	1,000	1,000	2,000	1,000
V 3	Indirect Labor	20,000	6,000	3,000	3,000	8,000
V 4	Supplies, etc.	10,000	2,000	2,000	3,000	3,000
	Total Burden	80,000	20,000	19,000	18,000	23,000
	Material	20,000	10,000	5,000	4,000	1,000
	Direct Labor	100,000	20,000	26,000	28,000	26,000
	Total Cost of Product	200,000	50,000	50,000	50,000	50,000
	Burden, % of Direct Labor	80	100	73.1	64.3	88.5
	Man-hours	400,000	80,000	104,000	112,000	104,000
	Burden, cents per man-hour	20	25.0	18.3	16.1	22.1

Comparison of Burden Costs by Different Methods. Suppose a piece or a lot of pieces of Class A is made in Departments L, N, P, with the following costs for direct labor.

Dept. L, 10 hrs. at 20c.	$2.00
N, 20 hrs. at 15c.	3.00
P, 10 hrs. at 30c.	3.00
40 man-hours	$8.00

Consider the burden to be computed in different ways: (1) 80 per cent on direct labor, $6.40; (2) 20 cents per man-hour, $8.00.

Departments	L	N	P	Total
(1) 80% on direct labor	1.60	2.40	2.40	6.40
(2) 20 cents per man-hour	2.00	4.00	2.00	8.00

(3) Different burden in the three departments.

	L	M	N
Per cent on direct labor	60	80	120
Cents per man-hour	15	20	30

On direct labor cost:		On man-hour basis	
L, 2.00×60%	1.20	10×15	1.50
N, 3.00×80	2.40	20×20	4.00
P, 3.00×120	3.60	10×30	3.00
Total	7.20		8.50

(4) Suppose there are four lots, one each in Classes A, B, C, D, with the burdens given these four classes as above.

	Avge.	A	B	C	D
Burden % of direct labor	80	100	73.1	64.3	88.5
Cost of labor $8.00, Burden	6.40	8.00	5.85	5.14	7.08
Burden, cents per man-hour	20	25	18.3	16.1	22.1
40 man-hours, Burden	8.00	10.00	7.32	6.44	8.84

By the several different ways of figuring burden it may range in this case from $5.14 to $10.00, and if the cost of material is $2.00 and labor $8.00, the apparent factory cost ranges from $15.14 to $20.00, a difference of $4.86, which is 32 per cent of the smaller figure.

The danger of estimating burden as a uniform percentage on the direct labor cost or as a uniform addition per man-hour, in a factory that makes a variety of products, is shown by these figures.

Distribution of the Machine Shop Burden—The Machine-hour Rate. In the case considered we have taken the total factory burden at $80,000. It may be subdivided among the producing departments say as below:

	Burden	Direct Labor
L Carpenter and Pattern Shop	2,600	2,400
M Blacksmith Shop	2,000	11,100
N Foundry	8,900	5,400
P Machine Shop	59,000	75,100
Q Grinding and Plating Room	7,500	6,000
	80,000	100,000

As by far the largest part of the burden is that of the machine shop it is most important that this part of the burden be apportioned to the product of the shop with as near an approximation to accuracy as possible.

By the machine-hour-rate of distributing burden each machine, work bench, or other "productive center" is assigned a certain hourly rate to be charged during a whole

year, the amount of which depends on the estimated cost of keeping it in the factory and supplying it with power, heat, light and supervision. This cost includes interest on its first cost or on its appraised value, a charge for the estimated annual repairs, probable depreciation due to wear and tear and obsolescence, and charges for space occupied, for power, for superintendence and for indirect labor, such as that of toolmakers, crane men, storekeeper, clerks, etc.

CALCULATION OF THE MACHINE SHOP BURDEN

Machines		Value	Int., Ins., Tax, Depn. etc. (*a*)		Working Hours per year	Horse-power each	H.P. Cost per year (*b*)	Sq. ft. of Space *	Cost of Space † (*c*)	Sum of (*a*) (*b*) (*c*)	Sum ÷ hours per year	Hourly Burden Rate
1 Boring Mill		$5,000	10%	=$500	1,000	10	$200	384	$192	$892	$0.89	$1.10
1 Boring Mill		2,000	12	240	2,000	5	200	180	90	530	.27	0.48
1 Planer		1,500	10	150	1,000	10	200	200	100	450	.45	.66
1 Planer		1,000	15	150	1,500	5	150	155	78	378	.25	.46
2 Planers	each	500	15	75	2,000	3	120	110	55	250	.13	.34
1 Shaper		1,000	12	120	2,000	5	200	144	72	392	.20	.41
2 Shapers	each	500	12	60	2,500	2	100	110	55	215	.09	.30
1 Miller		1,500	10	150	1,500	10	300	110	55	505	.34	.65
1 Miller		800	12	96	2,000	5	200	92	46	342	.17	.38
1 Miller		600	15	90	2,500	3	150	74	37	277	.11	.32
5 Millers	each	400	12	48	2,500	2	100	56	28	176	07	.28
1 Lathe		2,000	10	200	1,000	12	240	272	136	576	.58	.79
1 Lathe		1,500	12	180	2,000	10	400	193	96	676	.34	.55
1 Lathe		1,000	15	150	2,500	5	250	144	72	472	.19	.40
1 Lathe		800	15	120	2,500	3	150	124	62	332	.13	34
8 Lathes	each	500	15	75	2,500	2	100	96	48	223	09	.30
2 Lathes	each	200	15	30	2,000	1	40	82	41	111	.06	.27
1 Turret Lathe		2,000	10	200	2,000	5	200	112	56	456	.23	.44
1 Turret Lathe		1,000	12	120	2,500	3	150	82	41	311	.12	.33
4 Turret Lathes	each	800	12	96	2,500	2	100	68	34	230	.09	.30
1 Screw Mach.		1,500	15	225	2,000	5	200	96	48	473	.24	.45
1 Screw Mach.		1,000	15	150	2,000	2	80	82	41	271	.14	.35
1 Drill		1,200	10	120	1,500	5	150	47	24	294	.20	.41
1 Drill		800	10	80	1,500	2	60	40	20	160	.11	.32
2 Drills	each	400	12	48	2,000	1	40	26	13	101	.05	.26
5 Drills	each	100	12	12	2,500	1	50	20	10	72	.03	.24
1 Press		1,500	10	150	1,000	3	60	124	62	272	.27	.48
1 Press		1,000	10	100	1,500	2	60	92	46	206	.14	.35
5 Presses	each	500	12	60	2,000	1	40	45	22	122	.06	.27
1 Keyseater		300	10	30	100			48	24	54	.54	.75
1 Screw Press		200	10	20	100			48	24	44	.44	.65
1 Cutting-off Mach.		200	10	20	1,000	2	40	80	40	100	.10	.31
1 Centering Mach.		200	10	20	1,000	1	20	80	40	80	.08	.29
30 small Mach's Av.		100	10	10	2,500	0 5	25	40	20	55	.02	.23
30 Benches and Fittings		30	10	3	2,000			40	20	23	.01	.22
Sum for one of each kind		33,630		3898	62,700	123	4375	3696	1848	10,121		
Add for duplicates		14,970		1883	132,300	60	2785	4004	2002	6,670		
		8,600		5781	195,000	183	7160	7700	3850	16,791		

* Floor space occupied by machine, including passage ways and space for operator and for material.
† Cost of space, including rent, heat, light and cleaning, estimated at 50 cents per square foot per year.

Figuring these several charges by the year the total for each machine is divided by the number of hours which the machine may be expected to run in a normal business year, which may be judged from statistics of previous years.

A list of the machines with their several charges is made out like the one shown in the above table.

The sum of the three annual costs (*a*), (*b*), (*c*), and the corresponding hourly rate for some of the machines, may appear extravagantly high, such as the hourly rate for the large boring mill, 89 cents; the large lathe, 58 cents; the small keyseater, 54 cents; and the screw press, 44 cents; but these high figures are due to the small number of hours that the machines are supposed to be used in a year. In making estimates of costs for the purpose of bidding on contracts these high figures may, in the discretion of the management, be reduced arbitrarily, so that the actual working hours of the machines may possibly be increased and the cost of idleness thus be decreased.

After obtaining the sum of the charges (*a*), (*b*), (*c*), to be made against each machine, and the hourly rate, due to these charges, the next thing to be considered is what additional hourly charge shall be made to them in order to distribute properly the annual cost for salaries and for so much of the indirect labor as has not already been included in the costs (*b*) and (*c*) for power, heat, light, and cleaning.

Subtracting $16,791, which the table shows to be the sum of the charges against the several machines for interest, depreciation, etc., and for power furnished and space occupied, from the total machine shop burden of $59,000, we have $42,209 which remains to be distributed over the product in

some way. We may apportion it as a percentage on the direct labor, by dividing it by $75,100, the total cost of machine shop direct labor; $42,209 ÷ 75,100 = 56.3 per cent, which is to be added to the direct labor cost of every job in addition to the hourly machine charge in the table (sum of (*a*), (*b*), (*c*), charges divided by estimated hours that the machine runs in a year), but that method is the most inaccurate of all methods for a shop in which the value of the tools and the rates of wages are not fairly uniform. A much better method is to divide it by the total number of estimated man-hours, obtaining say 80 men, 2500 hours per year, $42,209 ÷ 200,000 = 21 cents per hour, which is to be added to the rate already found for each machine, giving the figures in the last column of the table as the total machine rate burden for each machine.

Production orders which benefit by certain machines should be charged a rental rate for the use of the machine, based on the length of time the machine is employed. The rate of charge for each individual machine is based on the costs of installing, maintaining and operating it. It should not be the aim purposely to allow the machine to make a so-called profit, but merely to furnish the service of the machine at actual cost, and that cost should include interest on the investment in the machine and motor (if motor-driven), rental for the space it occupies, a reserve for repairs, a reserve for depreciation and obsolescence, a charge for power and for the service of the man or men who operate it, together with a burden for crane service and diffused costs.—F. E. Webner, *Industrial Engineering*, April, 1909.

Modifications of the Machine Rate Burden. Suppose that the total residual burden after deducting the (*a*), (*b*), (*c*) charges, $42,209, is subdivided as follows:

(1) Superintendent, Asst. Supt., Purchasing Agent, Bookkeepers, Order Clerks, Stenographers, Office Supplies..	$18,000
(2) Planning Room, Time and Cost Clerks, Storekeepers, Foremen, Gang Bosses, Errand Boys.....	10,000
(3) Tool-makers, Tool-setters, Repair men, Draftsman, Transportation, Watchmen, Cleaners, Yard Men...	14,209
	$42,209

All of this sum, which amounts to 56 per cent of the direct labor or 21 cents per man-hour, has to be charged to the cost of product. It is evident that neither the percentage-on-direct-labor method, nor the man-hour method of apportionment takes account of the fact that some operations require a great deal more of the time of the overseers, clerks and other indirect labor than do other operations that require the same number of man-hours and the same expenditure for direct labor, and that the proper amount chargeable from each of the three subdivisions, (*a*), (*b*), (*c*), of the above table to different jobs is by no means proportional to the totals of each of the subdivisions.

For example, a man may be engaged a whole week on turning flywheel rims or doing other steady work on the large boring mill, requiring practically none of the time of the superintendent, foreman, storekeeper, planning room or tool-setters, and the same may be true of some of the work done on the large planer and the large milling machine, while a man may do twenty different jobs in a week on one of the small lathes or other machines, requiring a great deal of indirect labor of all kinds for his assistance. Instead of 21 cents per man-hour being the proper charge to be added to the (*a*), (*b*), (*c*), burden for each machine or bench, it may be fairer to add only 5 cents for the large boring machine and 30 cents for the small machines. One good way of adjusting the burden rates so as to obtain a reasonable approach to accuracy is to have the annual burden schedule revised by a conference of the superintendent, foremen and heads of the planning and cost departments, modifying the uniform indirect labor burden rate of 21 cents per man-hour, lowering the rates on some machines and raising it on others, in such a way as to leave the total annual amount (in this case $42,209) the same.

The Job Burden Rate. Another method which is probably even better than the one above described, is to examine the table of the subdivisions (1), (2), (3), of the total indirect burden $42,209, and the detailed table of salaries and other costs from which this total and its subdivisions are made up, and consider which of the costs should be applied to the product in proportion to the man-hours of direct labor, and which to the number of jobs done in a week or other given time. For example, it may be found that the total of subdivision (2) ($10,000), is related almost entirely to the number of jobs, a small job lasting an hour requiring as large a share of this $10,000 as a large job lasting a whole week. From statistics of preceding years it may be found how many separate job tickets may be expected to be issued in a normal business year, say in the case considered, 50,000, and this divided into what may be considered the part of the annual burden that is proportional to the number of jobs, or $10,000, gives 20 cents per job, which may be printed once for all on the blank job-cost tickets to save the trouble of writing it. When this is done the addition to the machine-hour rate is decreased accordingly from 21 cents an hour, or whatever figure may have been fixed as the proper burden for the several machines, to (42,209 − 10,000) ÷ 200,000 = 16 cents or by 10,000 ÷ 200,000 = 5 cents per man-hour.

For example, suppose that two men are each using the same kind of machine, which has a regular burden rate of 32 cents an hour, but one man works 50 hours on one job while the other works 50 hours on 20 different jobs, or $2\frac{1}{2}$ hours on each, the first man's ticket, on the regular burden rate, would read

Direct Labor	50 hrs. × 30c. =	$15.00
Burden	50 hrs. × 32c. =	16.00
		$31.00

The second would have for each job:

Direct Labor	$2\frac{1}{2} \times 30$	$0.75
Burden	$2\frac{1}{2} \times 32$	.80
		$1.55
Twenty jobs, twenty tickets,		$31.00

By the modified method, using a job charge of 20 cents per job, the first ticket would be

Direct Labor	50×30 =	$15.00
Mach. burden	50×27 =	13.50
Job burden		.20
		$28.70

The sum of the twenty tickets of the second man would be

	50×30 =	$15.00
Mach. burden	50×27 =	13.50
Twenty jobs at 20c	4.00	17.50
		$32.50

Showing a difference of $3.80, which seems only fair when we consider that the 20 jobs require a great deal more of indirect labor than the single long job.

Burden Table

CENTS PER HOUR

Hours	15	20	25	30	35	40	45	50	60	70	80	90
	Burden Charge											
1	.15	.20	.25	.30	.35	.40	.45	.50	.60	.70	.80	.90
2	.30	.40	.50	.60	.70	.80	.90	1.00	1.20	1.40	1.60	1.80
3	.45	.60	.75	.90	1.05	1.20	1.35	1.50	1.80	2.10	2.40	2.70
4	.60	.80	1.00	1.20	1.40	1.60	1.80	2.00	2.40	2.80	3.20	3.60
5	.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50	3.00	3.50	4.00	4.50
6	.90	1.20	1.50	1.80	2.10	2.40	2.70	3.00	3.60	4.20	4.80	5.40
7	1.05	1.40	1.75	2.10	2.45	2.80	3.15	3.50	4.20	4.90	5.60	6.30
8	1.20	1.60	2.00	2.40	2.80	3.20	3.60	4.00	4.80	5.60	6.40	7.20
9	1.35	1.80	2.25	2.70	3.15	3.60	4.05	4.50	5.40	6.30	7.20	8.10
10	1.50	2.00	2.50	3.00	3.50	4.00	4.50	5.00	6.00	7.00	8.00	9.00
20	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	12.00	14.00	16.00	18.00
30	4.50	6.00	7.50	9.00	10.50	12.00	13.50	15.00	18.00	21.00	24.00	27.00
40	6.00	8.00	10.00	12.00	14.00	16.00	18.00	20.00	24.00	28.00	32.00	36.00
50	7.50	10.00	12.50	15.00	17.50	20.00	22.50	25.00	30.00	35.00	40.00	45.00
60	9.00	12.00	15.00	18.00	21.00	24.00	27.00	30.00	36.00	42.00	48.00	54.00
70	10.50	14.00	17.50	21.00	24.50	28.00	31.50	35.00	42.00	49.00	56.00	63.00
80	12.00	16.00	20.00	24.00	28.00	32.00	36.00	40.00	48.00	56.00	64.00	72.00
90	13.50	18.00	22.50	27.00	31.50	36.00	40.50	45.00	54.00	63.00	72.00	81.00

For the purpose of facilitating computations of burden it is customary in some shops to express all machine-hour rates in even multiples of 5 cents; thus, a 22 cent rate would be changed to 20 cents and a 23-cent rate to 25 cents. The error in making these changes is negligible, for it is far less than probable error in the estimates for depreciation, hours run per year, horsepower, rental value of space occupied, and indirect labor, upon which the machine rate is based. A multiplication table such as is shown above may be used to facilitate computations.

Distribution of Burden in Minor Departments

Blacksmith Shop (10 men).

Equipment:	
1 Furnace	$400
1 Hammer	1000
1 Hammer	500
4 Anvils & Tools	400
Forges & Fittings	700
	3000

Direct Labor:	Each per week	
4 Blacksmiths	$24	$96
4 Helpers	15	60
1 Hammerman	36	36
1 Hammerman	30	30
10		$222

Interest, Depreciation 1b. 12%	$300
Fuel	500
Steam for Hammers	40
Iron & Miscellaneous Supplies	600
	1500
Share of Superintendent, storekeeper, clerical work, etc.	500
	$2000
Av. Time 50 wks. ×$222	$11,100
Indirect labor in the shop, none	
Expense burden for superintendence, etc.	2,000
	$13,100

The work done in the Blacksmith Shop may all be done on job tickets, either for salable goods, for expense supplies for the shop, or for repairs. There is no indirect labor charge, every man in the shop being a workman. The burden charge, $2000 per year, may be conveniently charged to the jobs at 8 cents per man-hour, 10 men, 2500 hours = 25.00 man-hours, divided into $2000 = 8 cents.

Carpenter, Pattern, and Paint Shop (5 men).

Equipment:	
1 Planer	$400
1 Jig Saw	200
1 Jig Saw	100
2 Drills	200
Sundry Tools	600
	$1500

	Per week	
1 Carpenter	$21	
1 Patternmaker	24	
3 Helpers 15 each	45	
	—	Per year
	90×50 =	$4500
Lumber & other Supplies		500
		$5000
Interest, Depreciation, etc., 15%		$225
Power, Light, Heat		100
Miscellaneous Burden		175
		$500
Direct Labor		$2400
Labor Charged to General Factory Burden		2100
Burden of the Shop		500
		$5000

Part of the work of this shop will be charged as direct labor on job tickets. On such work a burden charge of 10 cents per man-hour will amply cover the shop expenses properly chargeable to this work. The rest of the work will be done for factory betterments, general repairs, etc., on general and special orders, and will carry a burden charge sufficient to wipe out the remainder of the shop expenses at the end of the year, if it is a year of normal business.

Foundry. Making Castings for four Classes of Product A, B, C, D.

The charge for pig iron and scrap can be made by adding to the weight of the finished product the proper percentage for loss in melting. The charge for fuel can also be estimated from the weight of the finished product. The cost of direct labor is obtained from the job tickets of the molders and coremakers.

The wages of the melter and of his helper and the cost for power may be apportioned to tonnage, and charged at a certain price per ton of product to the several jobs, the price varying with the class of product.

The cost for interest, for depreciation of equipment, for sand and other supplies, for crane service, and for all other items of general expense, including foreman's wages and other indirect labor that cannot directly be allocated to the several jobs must be apportioned to them on some equitable basis.

Suppose we have a foundry making 10 tons of castings per week, divided into four classes, A, 4 tons; B, 3 tons; C, 2 tons; D, 1 ton (tons of 2000 pounds). The pay roll is $186 per week, of which $108 is direct labor of molders and coremakers, charged to jobs, and $78 is indirect (foreman, melter and laborers). A careful estimate by the foreman divides the labor among the four classes as follows:

	A	B	C	D	Total
Labor, Direct	16	38	40	14	108
Indirect	8	24	30	16	78
Labor, Total	24	62	70	30	186
Indirect % of Direct	50	63.2	75	114.3	72.2
Man-hours, Direct	60	140	140	60	400 at 0.27 = $108
Indirect cost, at 19 5¢ per hour of direct labor	11.70	27.30	27.30	11.70	400 at 19.5 = 78
At 72.2 % of direct wages	11.55	27.45	28.89	10.11	78.00
By estimate, as above	8.00	24.00	30.00	16.00	78.00

If the estimate by separate classes is correct, then the indirect labor cost figured as a uniform percentage of direct labor may be from (16.00 − 10.11) ÷ 16 = 37 per cent too low to (11.55 − 8) ÷ 8 = 44 per cent too high, and the cost figured as a uniform charge per hour of direct-labor may be from (16.00 − 11.70) ÷ 16 = 27 per cent too low to (11.70 − 8) ÷ 8 = 46 per cent too high.

If we figure the indirect labor cost on the basis of the tonnage the following figures will result.

	A	B	C	D	Total
Product per week, lbs.	8000	6000	4000	2000	20,000
Indirect labor cost	8.00	24.00	30.00	16.00	$78.00
Indirect labor, cents per lb.	0.1	0.4	0.75	0.8	0.39

The indirect labor cost of one class of castings is 8 times that of another, showing that an attempt to estimate the indirect labor cost at a uniform figure, such as ½ cent per lb., will lead to very erroneous results.

Suppose the cost of fuel, of power, and of repairs of cupola foots up to $60 per week, and the cost for interest and depreciation of plant and the cost for minor supplies together amount to $40 per week, the first may be divided in proportion to the tonnage and the second according to the direct man-hours, and we obtain the total burden as below:

	A	B	C	D	Total
Fuel, etc.	24	18	12	6	$60
Interest, etc.	6	14	14	6	40
Indirect Labor	8	24	30	16	78
Total Burden	38	56	56	28	178
Burden per man-hour	$0.633	0.40	0.40	0.467	0.445
Burden per cent of direct wages	237	147	140	200	165
Burden, cents per pound	0.475	0.933	1.40	1.40	0.89

It is advisable to divide the cost-accounting of the foundry into two parts, (1) cost per pound of melted metal in the ladles; (2) all other costs, by classes, per pound of finished product. (1) includes the raw material, fuel for the cupola, ladle and cupola repairs, power for blast and other purposes, and all labor and burden that belong to the cost of melted metal, while (2) includes fuel for the core ovens, sand and other supplies, and all labor and burden involved in turning the melted metal into finished product.

Polishing and Plating Rooms (10 men). In the grinding and polishing room as each piece is handled separately all the labor can be entered on job tickets as direct labor. In the plating room, since the goods are commonly handled in mass, pieces belonging to many different orders often being in the bath at the same time, all the labor may be considered as indirect labor, not directly chargeable to definite jobs. The plating room supplies also are used in mass, and their cost is an indirect expense, apportionable to the jobs either on the basis of an estimate by the boss plater, or as a result of an investigation of the cost of large lots of pieces of the same or similar size and shape. By such investigation a schedule may be made giving the amount that should be charged for plating per piece or per 100 pieces of different kinds of goods.

Grinding Room.

Equipment:	
Cost $2000	
Interest, Depreciation, etc., 20%	$400
Annual Cost of Wheels, Repairs and Supplies	600
Cost of Power, Heat, Light, etc.	200
	$1200
Share of factory cost for superintendence and indirect labor	300
	$1500
Direct Labor:	
6 Grinders and Polishers, 40¢ per hr., 2500 hrs.	$6000
Total Annual Cost	$7500

Plating Room.

Equipment:	
Cost $2000	
Supplies, and all expense except labor	$2500
1 Plater	900
1 Helper	600
1 Cleaner	500
Other labor	1500
Total Annual Cost	$6000

The Grinding-room Burden may be charged as 25 per cent of the direct labor cost, or at 10 cents per man-hour, in both cases making the total $1500 in a normal year.

The total cost of the plating room, $6000 per year, is all indirect, and it is to be distributed to the goods plated according to estimate or schedule of prices.

Example of Figuring Burden on Jobs or Three Machines. Suppose three machines, a large boring mill, a large planer, and a small lathe, are each operated 50 hours in a week, and that three men are available as operators, whose wages are respectively 20, 30 and 40 cents per hour. Assume that in different weeks the three men each are changed around so that each man has a week on each machine. Assume also that the work of a machine for a whole week may be on one job or on twenty different jobs, requiring twenty job tickets. Four methods of apportioning burden are considered, viz.: (1) 80 per cent on direct labor cost; (2) 24 cents per man-hour, (3) machine-hour-rate, $1.10, $0.66 and $0.23 for the three machines, respectively. (4) Machine-hour rate $1.05, 0.61 and 0.18 with a job charge of 20 cents per job. It is required to compute the burden by each system.

Wages per hour	20¢	30¢	40¢
Wages for 50 hours	$10.00	$15.00	$20.00
Burden (1) 80% on direct labor	8.00	12.00	16.00
Burden (2) 24¢ per man-hour	12.00	12.00	12.00

Burdens (1) and (2) are independent of the machine rates.
Burdens (3) and (4) are independent of the hourly rate of wages.

	Boring Mill	Planer	Lathe
Burden (3) 50 hours × rate =	$55.00	$33.00	$11.50
Burden (4) 50 hours × modified rate + 20 cent job charge:			
a. single job	52.50	30.50	9.00
b. 20 jobs	56.50	34.50	13.00

From the above figures it will be seen that, according to the method of computing burden, the product of the lathe for a given time may be charged a burden ranging from $8 to $13.00, that of the planer from $8 to $34.50, and that of the boring mill from $8 to $56.50. Of course, it is not likely that any manufacturer would charge for the rent, power, repairs and superintendence of a large boring mill or planer as low a figure as $8 or even $16 per week, but the figures show what large possibilities of error there are in adherence to old-fashioned methods of estimating burden.

Departmental and Class-of-Product Burdens. Having made a table of hourly burden rates for each machine in the shop, it is possible to avoid the vast amount of labor required, in a large shop making a great variety of small products, of entering the burden on each job ticket. The method of doing this is to divide the total product into classes, according to its kind, weight, finish or other feature by which it may most easily be distinguished, giving them symbols, as Class A, B, C, D, E, and to divide the whole factory into departments, either by rooms or by groups of rooms or parts of rooms, classifying them by the kind of work done in them, or the size or kind of tools used in them, symbolizing them as VH, H, M. L, VL, meaning very heavy, heavy, light, very light, or in any other suitable way. Taking the list of tools in the machine shop we may group them in five departments, thus:

Symbol	VH	H	M	L	VL
No. of Tools	7	11	27	44	30
Average hourly burden, (*d*) cents	55	40	25	15	12

These (*d*) rates are those corresponding to the sum of the (*a*), (*b*), (*c*), columns of the table on page 68. To them are to be added the residual burden for salaries and indirect labor that may be apportioned not to the departments or to the classes of machines, but to the classes of the product. We may then construct a department-and-class burden table, something like the following, the small letters representing figures that have to be computed or estimated.

Department	VH	H	M	L	VL
Class of Product	Hourly Burden				
A	a	b	c	d	e
B	f	g	h	i	j
C	k	l	m	n	o
D	p	q	r	s	t
E	u	v	w	x	y

In all that has preceded we have assumed that the burden, whether figured as a percentage on direct labor, as a charge per man-hour or per machine-hour or a departmental or a class burden, or a combination of them, is a "normal" or "standard" burden, that remains fixed for a year or more, independent of changes of amount of sales from month to

month or of stoppages of any part of the works due to accidents, strikes, etc. The burdens are added to the charges for material and for direct labor to obtain what may be called the "inventory cost" of the goods produced, their value in the warehouse, from which profits of the business may be computed, and which may be used as a basis of minimum selling prices.

Example. Suppose $100,000 direct labor is divided among classes and departments as follows:

Dept.....	L	M	N	P	Total
	Thousands of Dollars				
Class A	6	1	10	3	20
B	4	1	17	4	26
C	1	1	24	2	28
D	15	2	8	1	26
	26	5	59	10	100

If this labor represents 400,000 hours an average of 25c. per hour, and the burden was calculated on the old method of a uniform (say 80 per cent) percentage in direct labor cost, the burden would be, in thousands of dollars, by classes and departments.

Dept.....	L	M	N	P	Total
Class A	4.8	0.8	8.0	2.4	16
B	3.2	0.8	13.6	3.2	20.8
C	0.8	0 8	19 2	1 6	22.4
D	12.0	1 6	6.4	0.8	20.8
	20.8	4 0	47.2	8.0	80.

If the burden was calculated on the man-hour system and it was assumed that all the labor was paid a uniform rate of 25 cents an hour, the same burden for each class and department would be found, but suppose that the average wage in the several departments was different, say 20, 25, 29.5 and 20 cents, respectively, in the several departments, and the total wages divided as follows:

Dept.....	L	M	N	P	Total
Hours	130,000	20,000	200,000	50,000	400,000
Av. Wages, cents	20	25	29 5	20	25
Wages, Thous.	26	5	59	10	100

and the burden was taken at 20 cents per man-hour, the total burden for the four departments would be

	L	M	N	P	Total
In thousands of dollars	26	4	40	10	80
Instead of	20.8	4	47.2	8	80

The hours and wages in the departments and classes would be as follows (in thousands):

Class	L		M		N		P			
	Hours at .20		Hours at .25		Hours at 29.5		Hours at .20		Total Hours	
A	30	$6	4	$1	33.9	$10	15	$3	82 9	$20
B	20	4	4	1	57 63	17	20	4	101 63	26
C	5	1	4	1	81.35	24	10	2	100 35	28
D	75	15	8	2	27.12	8	5	1	115.12	26
	130	26	20	5	200.00	59	50	10	400.00	100

and the burdens, calculated respectively at 20 cents per man-hour, in thousands of dollars.

Class Dept.	L	M	N	P	Total
A	6	0.8	6.78	3	16.58
B	4	0.8	11.526	4	20.326
C	1	0.8	16.270	2	20.070
D	15	1.6	5 424	1	23.024
	26	4.0	40.000	10	80.000
Equivalent to per cent on direct labor	100	80	67.8	125	80

This method is better than the percentage of direct labor method in that it takes account of the difference in average wages in different departments, but it is still unsatisfactory in that it fails to take account of the fact that the cost of superintendence, repairs, and indirect labor generally, for each job in any department is not directly proportional to either the hours of direct labor or to the wages paid for direct labor. For example, two men may be working for the same wages on machines of the same kind and cost, but one is doing repetitive work, requiring scarcely any attention from tool-setters, foremen or indirect labor of any kind, while the other is doing a great variety of work, requiring much service from the foreman, time-setters, order and cost clerks, storekeepers, etc. It is evident that a much higher burden should be charged in the latter case than in the former. It is evident that the burden charge, whether a man-hour rate or a percentage on direct-labor cost should vary both with the department and with the class of product.

Example. Let the total direct labor in a normal year be $100,000 subdivided by departments and classes as in the preceding example, and let the total burden, as before, be $80,000. It is found by study of the statistics of the preceding years that $20,000 of this burden is what we have before called the (*a*), (*b*), (*c*) burden of machines, consisting on interest, taxes, insurance, depreciation, and maintenance, power, light, and cost of space occupied, and that $60,000 is the total cost for superintendence and other indirect labor, and for other general expenses, such as supplies.

Taking the direct labor at 400,000 man-hours per year, $20,000 is equivalent to an average (*a*), (*b*), (*c*) burden of 5 cents per man-hour, but subdividing it into departments it may be apportioned as follows:

Departments.....	L	M	N	P	Total
Direct Labor, thousand hours	130	20	200	50	400
(*a*), (*b*), (*c*) Burden	$4000	3000	10,000	3000	20,000
Cents per man hour	3	15	5	6	5

A careful estimate by the cost department to apportion the residual $60,000 to the several classes and departments gives the following approximate figures, cents per man-hour.

Departments.....	L	M	N	P
Class A	30	50	20	25
B	20	40	15	20
C	15	30	10	15
D	10	20	5	10

Adding these figures to those already found for the (*a*), (*b*), (*c*) burden and taking the subdivisions of the direct labor costs as before, we find the total burden charges as below.

Standard Burden Rates and Charges by Departments and Classes

Dept.	L			M			N			P			Total
Class	Thousand Hours	Rate	Amount	Thousand Hours	Rate	Amount	Thousand Hours	Rate	Amount	Thousand Hours	Rate	Amount	
A	30	0.33	$9,900	4	0.65	$2600	34	0.25	$8,500	15	0.31	$4,650	$25,650
B	20	.23	4,600	4	.55	2200	58	.20	11,600	20	.26	5,200	23,600
C	5	.18	900	4	.45	1800	81	.15	12,150	10	.21	2,100	16,950
D	75	.13	9,750	8	.35	2800	27	.10	2,700	5	.16	800	16.050
	130		$25,150	20		$9400	200		$34,950	50		$12,750	$82,250

The total $82,250 is sufficiently close to the $80,000 total estimated burden. Comparing the amounts of burden, in thousands of dollars, obtained by the three methods we have:

Total Burdens, Thousands of Dollars

Dept.	L			M			N			P		
Class	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
A	4.8	6	9.9	0.8	0.8	2.6	8.0	6.8	8.5	2.4	3	4.6
B	3.2	4	4.6	0.8	0.8	2.2	13.6	11.5	11.6	3.2	4	5.2
C	0.8	1	0.9	0.8	0.8	1.8	19.2	16.3	12.2	1.6	2	2.1
D	12.0	15	9.8	1.6	1.6	2.8	6.4	5.4	2.7	0.8	1	0.8
	20.8	26	25.2	4.0	4.0	9.4	47.2	40.0	35.0	8.0	10	12.7
Per cent of direct labor	80	100	97	80	80	188	80	67.8	59.3	80	100	127

Adding these burden figures to the figures for direct labor in the first table, we obtain for the total labor and burden cost by the three methods of computing burden, the following, in thousands of dollars:

Total Labor and Burden Costs

Dept.	L			M			N			P		
Class	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
A	10.8	12	15.9	1.8	1.8	3.6	18	16.8	18.5	5.4	6	7.6
B	7.2	8	8.6	1.8	1.8	3.2	30.6	28.5	28.6	7.2	8	9.2
C	1.8	2	1.9	1.8	1.8	2.8	43.2	40.3	36.8	3.6	4	4.1
D	27	30	24.8	3.6	3.6	4.8	14.4	13.4	10.7	1.8	2	1.8

(1) Percentage on direct-labor method of computing burden.

(2) Man-hour rate; uniform.

(3) Machine-hour or man-hour rate, modified by department estimates.

The modified burden rates considered in this example are standard man-hour rates to be used throughout the year in computing standard or inventory costs. They may be converted into percentage on direct-labor rates by dividing the burden figures in dollars, given in the table, by the several direct-labor charges. The following table gives the percentage-on-direct-labor rates for the several classes in comparison with the corresponding man-hour-rates.

Dept.	L		M		N		P	
Class	Man-hour rate	Per cent rate	Man-hour rate	Per cent rate	Man-hour rate	Per cent rate	Man-hour rate	Per cent rate
A	0.33	165	0.65	260	0.25	85	0.31	153
B	.23	115	.55	220	.20	68	.26	130
C	.18	90	.45	180	.15	51	.21	105
D	.13	65	.35	140	.10	34	.16	80

The man-hour rates will, in general, be much more accurate than the percentage rates unless the wage rate throughout a given department is nearly uniform. The only excuse for using the percentage rates is that they involve less clerical labor than the man-hour rates.

The above-described method of computing standard burden rates by classes and departments is, of course, not as accurate for a machine shop doing a great variety of work with different kinds of tools, as the standard machine-hour-rate, modified, as described on page 69, by consideration of the conditions under which the several machines run and also by the device of adding a job charge on each job ticket.

The question whether to use the most accurate cost system, in whole or in part, or some other system which may be less accurate but requiring less clerical work, must be determined for each business separately, with reference to the use that is to be made of the system, the degree of accuracy that the business needs, and the cost of operating the cost system itself.

The Use that is Made of the Normal Burden Figures. Recapitulating the different methods of calculating and apportioning burden, we have

(1) Percentage on Direct Labor, (*A*) uniform, (*B*) by departments, (*C*) by classes, (*D*) by departments and classes combined.

(2) Charge, cents per man-hour. (*A*) uniform, (*B*) by departments, (*C*) by classes, (*D*) by departments and classes combined.

(3) Machine-hour rate—Hourly charge for each machine, dependent on the machine and on the conditions of its operation.

(4) Machine-hour rate with job charge added.

(5) Either of the above with material burden charge added.

A short example is here given to show the application of these several methods. Three men, Smith, Brown and Jones, each working 10 hours in one day in a certain factory under the following conditions:

	Smith	Brown	Jones
Wages per hour, cents	20	30	40
Machine No.	1	2	3
No. of jobs in a day	1	1	10
Class of Product	A	B	C
Department	L	N	P

Burden Methods:

(1) *a*—100% on direct labor cost
b—L, 80; B, 100; P 120%.
c—A, 120; B, 100; C, 80.
d—AL, 90; BN, 100; CP, 90.

(2) *a*—30 cents per man-hour.
b—L, 25; N, 30; P, 35 cent.
c—A, 35; B, 30; C, 25 cents.
d—AL, 40; BN, 30; CP, 20 cents.

(3) Mach. Hr. Rate—No. 1, 40; No. 2, 30; No. 3, 20 cents.

(4) Mach. Hr. Rate—No. 1, 35; No. 2, 25; No. 3, 15 cents. Job charge added per job, 10 cents.

Burden Charges for 10 Hours

Method	Smith	Brown	Jones
(1) *a*	2.00	3.00	4.00
b	1.60	3.00	4.80
c	2.40	3.00	3.20
d	1.80	3.00	3.60
(2) *a*	3.00	3.00	3.00
b	2.50	3.00	3.50
c	3.50	3.00	2.50
d	4.00	3.00	2.00
(3)	4.00	3.00	2.00
(4)	3.60	2.60	2.50
Wages per 10 hrs.	$2.00	$3.00	$4.00

Smith's burden ranges from 80 per cent to 200 per cent of his wages, and Jones's from 50 per cent to 120 per cent according to the method of burden charge used.

It appears from the above table that the burden on Brown's 10 hours is the same no matter what burden method is used (except No. 4 in which there is a job charge), but this happens only because the rates of burden were so chosen that the average burden by either method was equal to the average wage.

Suppose that the cost of material in each case was $1.00, the total cost would range as follows:

	Smith	Brown	Jones
Labor	$2.00	$3.00	$4.00
Burden	$1.60 to 4.00	$2.60 to 3.00	$2.00 to 4.80
Material	$1.00	$1.00	$1.00
	$4.60 to 7.00	$6.60 to 7.00	$7.00 to 9.80

If the smallest burden is the most accurate in each case then if the highest burden is used the total cost in Smith's case is overestimated $2.40 or 50.2 per cent; Brown's $0.40 or 6 per cent, and in Jones's $2.80 or 40 per cent.

The burden computed by either of the four methods illustrated above may be modified by adding to it a charge for burden on material. The cost of material delivered to the tools in a shop includes not only its purchase price but also the cost for freight, drayage, handling in stores, insurance, interest on the cost while stored, crane or truck service, and for shrinkage, breakage, spoilage or other deterioration in value. These extra costs will vary with different kinds of material. They may be added as "material burden" on the job tickets, but usually it will be found better to have the storekeeper add them on his perpetual inventory cards or on his stores issue tickets when charging the shop for material delivered from the stores.

In an actual factory the question of which method of calculating and apportioning the burden should be used can be properly determined only after a careful consideration of the nature of the business and an examination of the statistics of a normal year or the average for several years, together with an estimate of the amount of clerical labor required for each method. The machine-hour method is not so formidable as it may appear, for the listing of the machines, of the space they occupy and of the charge for interest, depreciation, power, etc., need be made only once for all, with revisions once a year.

The application of the machine-hour rate to the job tickets in many lines of business need not be made on all the tickets throughout the year, if the clerical labor of doing it is considered excessive, but only on jobs of each particular kind or class once or twice a year if the conditions of such jobs are approximately uniform.

When burden is calculated as a percentage on the cost of direct labor, and the product is of a varied kind, made on different machines and involving expenses for rent, interest, depreciation, power, etc., which have no uniform relation to direct labor costs, the recorded, or bookkeeper's, costs are useless, false and misleading.

Suppose two products A and B are made in a factory each costing $500 for material, $1000 for direct labor; by the percentage or labor method of computing burden, the burden on each is $1000, but by the more accurate machine-hour rate method the burden on A is $500 and that on B $1500. Suppose the selling expense on each is $500, and that each product is sold for $3300. The accounts then show the following:

	Average or percentage Burden	Burden on Machine-hour method	
	A or B	A	B
Material	$ 500	$ 500	$ 500
Direct Labor	1000	1000	1000
Burden	1000	500	1500
Total Factory Cost	2500	2000	3000
Selling Expense	500	500	500
Min. or no profit selling price	3000	2500	3500
Sold for	3300	3300	3300
	Profit 300	Profit 800	Loss 200

If, at the taking of the inventory A has been sold, while B remains unsold, the books will show, if the burden is figured on the percentage on labor method, Profit on A $300; inventory value of B $2500; but if the burden is figured on the machine-hour rate method the profit on A will be shown to be $800 and the inventory value of B $3500, so that the percentage of labor method causes an underestimate of both the profit and the inventory value.

On the other hand, if B is sold and A remains unsold, the books show, on the percentage method, profit on B $300; inventory value of A $2500; but on the other method, loss on B $200, inventory value of A $2000. In this case the percentage of labor method causes an overestimate of both the profit and the inventory value.

If the selling prices of these products is fixed at 10 per cent in advance on the sum of the factory cost and the selling expense, the prices of both A and B, by the percentage on labor method will be $3300, but by the more correct methods the price of A will be $2750 and that of B $3800. By the percentage on labor method A will be overpriced $550 and B underpriced $550.

Keeping Labor and Material Cost only without Apportioning the Burden. In large factories making products in hundreds or thousands of varieties it is found that the cost of the vast amount of bookkeeping and clerical work involved in keeping an account of the cost, detailed, including burden of every article and every operation, is far greater than is warranted by the benefits derived from the cost-keeping system. In such cases the "factory costs" or inventory values of finished goods delivered to the warehouse are commonly determined by "estimates," made from frequent investigations during limited periods, of the material and labor costs of certain representative parts of the product, and additions for burden are made from an examination of such statistics as are available. Such estimates are apt to be grossly inaccurate, and great care must be taken not to make them too high, thus inflating inventory values, or too low, leading to the fixing of non-remunerative selling prices.

Classification of Total Expenditures by Percentages. Henry R. Towne (Trans. A. S. M. E. vol. 34, 1912), gives the following table, relating to four distinct lines of actual product, in which the several elements have been reduced to terms of the actual cost of the product when finished and sold.

		No. 1	No. 2	No. 3	No. 4
L	Productive Labor	28	17	29	19
M	Productive Material	38	33	25	27
PC	Prime Cost	66	50	54	56
ME	Manufacturing Expense	24	20	28	22
SC	Shop Cost	90	70	82	78
CE	Commercial Expenses	10	30	18	22
AC	Actual Cost	100	100	100	100

Another way of showing the relative percentages of the several elements of cost is to reduce them to percentages of the shop cost, which is taken as 100.

	No. 1	No. 2	No. 3	No. 4
L	31	24	35	24
M	42	47	30	48
PC	73	71	65	72
ME	27	29	35	28
SC	100	100	100	100
CE	11	43	22	28
AC	111	143	122	128

If there is any need of expressing the elements of cost in the form of percentages of some total, the second method seems to be the better one. The term "actual cost" is not properly descriptive; it should read "total cost to make and sell." When goods are in the warehouse, charged at factory cost, the cost of selling is an indeterminate quantity until after they are sold, and it will vary with every sale. It is doubtful if any method of expressing costs as percentages is of any practical value. The fact that the ratio of PC to ME is as 73 to 27 for one article and as 65 to 35 for another is of no particular significance. Nor is the fact that the ratio of ME to L is as 27 to 31 in one case and as 29 to 24 in another. What is needed in cost-keeping is the amounts of the several elements and the totals, not percentages.

The Ratio of "Non-Productive" to "Productive" Labor.*

With the growth of competition within the last twenty years the necessity for some knowledge of costs became evident, and the manufacturer turned to the accountant for a system of finding costs. The cost accountant promptly gave him what he called the ratio of "non-productive" to "productive" labor, which he said should be low for good management. By "non-productive" labor he meant salaries of all kinds, and all other labor that could not be charged directly to an order, including miscellaneous labor such as watchmen, sweepers, truckmen, etc. By "productive" labor was meant simply that labor which could be charged directly to an order.

While the ratio of operating expense to total income may be a fair measure of efficiency in a transportation company, the ratio of "non-productive" to "productive" labor is not only not a fair measure of the efficiency of operation in a manufacturing plant, but is often exactly the reverse.

To my mind the widespread use of this ratio as a measure of efficiency has been more effective in producing inefficiency than any other single factor, except the oft-repeated statement that you must have low wages if you would have low costs. Until these two fallacies are absolutely discredited, we cannot expect a solution of our most serious troubles.

In a factory where this ratio was used as a guide the following incident occurred: A foreman had ten men on a job, which he said could be done by eight if he could have a boy to supply them with work. He said, however, that if he made the change, the boy's wages would be called "non-productive" labor and his ratio would go up, with the result that he would be criticised, so he did not make it.

In the U. S. Navy an energetic officer studied the loading of ammunition and very much reduced the direct labor employed, but, being unable to reduce the indirect labor in the same proportion, the above ratio went up. He came in for very severe criticism, notwithstanding the fact that his total labor had been decidedly reduced.

A PROBLEM IN BURDEN CHARGING

Suppose a plant has two machines of the same kind but different sizes, No. 1 and No. 2. The total monthly burden (one-twelfth of the yearly burden) of No. 1 is $24, and of No. 2, $36, or respectively 10 and 15 cents an hour for full time, 240 hours per month. But the average or normal running time during a year is 160 hours or two-thirds time for No. 1, and 120 hours or half time for No. 2. The normal hourly burden charge credited to the two machines and charged to the cost of product is therefore $10\times240\div160=15$ cents for No. 1 and $15\times240\div120=30$ cents for No. 2. Suppose that in a normal month each machine has only one job, costing as follows, the cost including the normal burden charge and labor at 20 cents an hour.

	Labor	Burden	Total
Mach. No. 1, Job. No.1, 160 Hrs.	$32.00	$24.00	$56.00 or 20+15=35¢ per hour
Mach. No. 2, Job No. 2, 120 Hrs.	24.00	36.00	60.00 or 20+30=50¢ per hour

Job No. 1 can be done on either machine, Job No. 2 only on No. 2 machine. In a certain month Job No. 3, 80 hours, comes in, and it can be done on either machine, costing as follows, if the normal burden is charged:

	Labor	Burden	Total
Job No. 3, Mach. No. 1, 80 hrs.	$16.00	$12.00	$28.00
Job No. 3, Mach. No. 2, 80 hrs.	16.00	24.00	40.00

Making an apparent saving of $12 by doing the job on No. 1 machine. But the saving is only apparent, for the burden on No. 2 machine runs on (except the slight difference on the cost of the fuel burned in the power plant when the machine is running or idle) whether the machine runs or not.

Suppose that Job No. 1 is a regular job, taking about the same time every month, and that jobs Nos. 2 and 3 are irregular, varying from 0 to 120 hours each in different months, and in some months both No. 1 and No. 2 machines may be run part time on both of these jobs. Now the problem is what burden shall we charge to the cost of the several jobs under these different conditions as to the number of hours each machine runs in a month. In a busy month, when No. 1 machine runs full time what shall be its hourly burden, and in a dull month, when No. 2 machine runs only $\frac{1}{6}$ of full time or $\frac{1}{3}$ of its normal time what shall be the hourly burden charge for the use of that machine? If No. 2 machine is idle all the month, shall the loss due to its idleness be made up by charging an extra or "supplementary" burden on the work done on No. 1 Machine?

Those writers and accountants who hold that "the cost of manufactured products made during a certain period equals the total expenditure of the business for the same period," would answer these questions by saying that the total burden of these two machines for a month, $24 for No. 1 and $36 for No. 2 must be allotted to the cost of the product of that month. We may assume, for convenience of illustration, that the shop is "departmentalized" in the cost-accounting system, and that these two machines constitute the whole of one department. They would say that if No. 2 machine is idle, its burden $36 must be added to the $24 burden of No. 1 machine and charged against the product of that machine, making its hourly rate, if it runs 160 hours a month $60\div160=37.5$ cents instead of 15 cents. If it ran full time, 240 hours, its hourly rate would be $60\div240=25$ cents, and if it ran half time, 120 hours, the rate would be $60\div120=50$ cents.

* Extracts from a paper on "Measuring Efficiency" by H. L. Gantt. Trans. A. S. M. E., 1914.

On the other hand, if No. 2 machine ran 120 hours and its product were charged with its normal burden, 120×30 =$36.00, machine No. 1 would have no supplementary rate, if it ran its normal time of 160 hours, and its burden would be 15 cents an hour, and if it happened to run full time, 240 hours, the supplementary rate would be a negative quantity and the hourly burden charged to the cost of the work done on No. 1 machine would be only $24 ÷ 240 = 10 cents.

If, however, we follow the normal hourly burden method, the amount of burden to be charged to cost of product would be independent of the number of hours that either machine happened to run in any given month; it would be 15 cents per hour on No. 1 machine and 30 cents per hour on No. 2 machine. The burden charged to cost of product would then be as follows for the several conditions named.

	No. 1 Machine	Unearned burden, loss	Over-earned burden, gain
Half time	120 hrs. ×15¢ = $18	$6	
⅔ full, normal time	160 hrs. ×15 = 24	0	
Full time	240 hrs. ×15 = 36	0	$12
	No. 2 Machine		
½ full time	80 hrs. ×30¢ = $24	$12	
½ time, normal time	120 hrs. ×30 = 36	0	
Full time	240 hrs. ×30 = 72	0	$36

The unearned burden may be charged and the overearned burden credited to Profit and Loss each month, or they may remain in Burden account, which is charged with the total factory overhead expense each month and credited with the total earned burden which has been charged to product, the balance of the account being closed into Profit and Loss at the end of the year.

An important exception must be noted to the rule of charging to the cost of product of a machine the normal hourly burden rate of that machine. It is in the case of a machine that bears a large burden being used to do work that is ordinarily done on a machine with a smaller burden because the first or larger machine happens to be available at the time and is not needed for other work, while the second machine is crowded with work. In that case the burden charged to cost of the work done in the more costly machine should be the normal burden of the smaller machine. The fact that the smaller burden should be charged in such a case should be entered on the Job Card when it is issued from the planning room for a job to be done on a large machine that could be done on the smaller machine, so that when the card reaches the cost-keeper he will not make the error of charging the larger burden.

Another Problem. Thirty machines, symbol A, B, C, ordered in January to be delivered before April 1. A machine consists of 3 pieces A, B, C, connected by 30 bolts and nuts per machine. Only one operation is necessary on each piece. A, weighing 200 pounds, is bored and faced on a large boring mill. B, 100 pounds, is turned in a 30-inch lathe and C, 50 pounds, is turned on a 10-inch lathe. Some work is done on each of three months, the greatest amount in March, when the factory is running at less than half capacity. In January and February, the factory is running at 80 per cent of capacity. Labor costs decrease from month to month as better working tools are provided and as workmen get more skill in handling the pieces.

	Jan.			Feb.			Mar.		
	A	B	C	A	B	C	A	B	C
Castings received	5	10	0	15	10	20	10	10	10
Castings machined	5	5	0	10	15	15	15	10	15
Hours per piece	10	6	0	9	5	3	8	4	2
Wages per hour, cents	20	25	30	20	25	30	20	25	30
Av. Burden on Mach., cents.	40	25	20	40	25	20	40	25	20
Supplementary Burden—									
Church's method, cents	5	5	5	10	8	6	20	15	10
Total Burden, cents	45	30	25	50	33	26	60	40	30
Wages plus Burden, per hr. cts.	65	55	55	70	58	56	80	65	60
Wages plus Burden, per piece	$6.50	$3.30	$1.68	$6.30	$2.90	$1.68	$6.40	$2.60	$1.20
Wages & Av. Burden, per piece	6.00	3.00	1.50	5.40	2.50	1.50	4.80	2.00	1.00
Total by Church's Method	$11.48			$10.88			$10 20		
Total by Average	10.50			9 40			7.80		

The figures $1.68 and $1.50 for C in January are taken from the February record, as no C pieces were made in January.

The cost of castings, bolts, drilling bolt-holes, and assembling may be taken as the same each month, so they may be omitted from the problem.

According to the figures the cost of labor and burden per machine A, B, C, varies from $7.80 to $11.48. What cost figure should be used in inventorying these machines on April 1, and what figure should be used in making estimates on machines to be built in the future? Evidently $7.80 is the correct figure, for this is the cost of labor and burden (exclusive of drilling and assembling) at which the machines can be reproduced.

THE "SUPPLEMENTARY RATE" METHOD OF DISTRIBUTING BURDEN

Mr. A. Hamilton Church in his little book on "The Proper Distribution of Expense Burden" (*Engineering Magazine*, 1908) describes a method of distributing burden which is based on the principle that the cost of the product of a shop

in a given month must include all the shop charges of that month whether or not a large part of the machinery is idle. He describes the method as follows:

"First, we consider each machine as an independent producing centre, allocating to such centres all the expenses and charges which can, on reasonable analysis, be considered chargeable as a composite rent or machine rate method for all the factors of production therein concerned. Second, we charge to a monthly shop-charges account all charges whatever incurred in that shop, including all the items specifically represented in fractional detail by the machine rates, and also including, of course, such general items as cannot be represented in the machine rates, of which the most obvious item is the supervision of a head, or foreman.

"Then as each machine is occupied on jobs, the latter are debited with so much per hour as machine rate, and, at the end of the month the total amount so earned *is deducted from the total shop expenses*, leaving a balance which is distributed over the same jobs as a *supplementary rate*. The ratio of the supplementary rate to the amount distributed by the machine rates forms a varying barometer, whose fluctuation is an index to the current efficiency of the shop. In proportion as all machines are not kept full of work all the time, this ratio of the supplementary rate to the amount distributed by the machine rates will begin to rise. The same effect will occur if any general kind of expenditure is increased.

"There remains the question on what basis the additional distribution shall take place. It may be made into an hourly burden, or which is simpler may be reduced to a percentage of increase on the amount already distributed by the machine rate. . . . It is to be preferred that the supplementary rate should be an hourly burden rate.

"*The supplementary rate is the undistributed balance of shop charges due to idleness of productive centres.*"

Mr. Church's method was favorably received by many writers on accountancy, and was adopted by some accountants who introduced it into shops. The author believes that he was the first to publish a condemnation of it. He was then, in 1909, introducing into a machine shop a system of cost accounting based on the machine-hour rate method, the hourly burden rates for the several machines being "normal" rates which were to be kept constant for a year or more, and obtaining a copy of Mr. Church's book wrote a brief review of it for the *Iron Trade Review*, February 4, 1909, in which appears the following:

"The supplementary rate in its variations is not really an index of the current efficiency of the shop but it is an index of the condition of business generally, or of the efficiency of the selling department, which brings orders into the shop. The efficiency of the shop itself should be determined not by an accidental supplementary rate which may appear in each month but should be measured by comparing the labor cost for a particular job done on a particular machine at one period of the year with another, the machine itself being charged with the same burden throughout the year. Attempts to charge to the cost of jobs in a particular month a supplementary rate whose variations are not due to any inefficiency in the shop management but entirely to accidental fluctuations in business outside of the shop, not only introduce great confusion in bookkeeping, but may give the management erroneous ideas as to what the real shop efficiency is."

Application of the Supplementary Rate. Mr. Church gives an example of the use of his method as applied to some work done in a machine shop, which is given in condensed form below. In January the machines worked full time, consequently the supplementary rate was very low, $2\frac{1}{4}$ cents per hour; in November the shop worked barely half time and consequently the supplementary rate rose to 14 cents per hour.

Shop Charges Account

Debits	Jan.	Nov.	Credits	Jan.	Nov.
Interest on Machines	$ 53 00	$ 53 00	By machine earnings (Being total amount distributed to jobs by means of machine rates)	$576 00	$292 53
Depreciation on Machines	53 00	53 00			
Power	100 00	62 00			
Wages on Auto Machines	75 00	55 00			
Process Sundries, Oil, etc.	45 00	25 00	Undistributed balance	100 00	305 47
Floor burden, 5000 sq. ft. at 5¢	250 00	250 00			
Supervision (general)	100 00	100 00			
Total debit	$676 00	$598 00		$676 00	$598 00

Total hours, January, 4400; November, 2187

Hourly burden on the average hourly plan:

Jan. $\frac{676}{4400} = 15.4¢$, Nov. $\frac{598}{2187} = 27.3¢$ per hr.

Supplementary Rate:

Jan. $\frac{100}{4400} = 2\ 27¢$ per hr.

Nov. $\frac{305.47}{2187} = 14¢$ per hr

Cost Statement of Job

		Jan.	Nov.
10 hours Mach. No. 9 at 4¢	0.40		
6 hours Mach. No. 8 at 34¢	2.04		
12 hours Mach. No. 17 at 15¢	1.80		
3 hours Mach. No. 3 at 23¢	.69	4.93	4.93
10 hours wages at 31	3.10		
6 hours wages at 10	.60		
3 hours wages at 14	.42	4.12	4.12
Supplementary rate, 31 hrs. at 2.27¢		.70	at 14¢, 4.34
Total Works Cost		$9.75	$13.39

"The works cost of this job has gone up from $9.75 to $13.39, although precisely the same machine time and the same amount of wages was expended in the one period as in the other."

Now, what is the use of this "works cost" of $13.39? It gives no information as to what is the value at which the product should be inventoried if it remains unsold on Dec. 31. If we inventory it at $13.39 we have overvalued it at least $13.39 − $9.75 = $3.64, or 37.3 per cent, and have increased the apparent or book profits by that amount, and corre-

spondingly decreased the book-profits of the next year, when the goods are sold. It gives no information as to what the probable cost of the product will be next year, or any basis for fixing selling prices. It does nothing except to enable the bookkeeper to balance his books in such a way as to charge the goods produced each month with the whole expense of the factory, including the expense of idle time, in that month, and to cause the books to hide the fact that the factory lost money in November on account of the idle time.

If the "normal burden" method of cost-keeping had been used, assuming that the machine-hour rates, total $4.93, are those of a normal year, then the works cost of the product would have been the same in both months, and the undistributed burden would at the end of the year be charged to Profit and Loss.

Suppose a job is done on the last day of the month, which has a normal supplementary rate, and an exactly similar job is done on the first day of the next month, but on account of the slackness of business the supplementary rate in that month is extravagantly large. The cost of these two jobs will appear on the books as very different although their actual cost was the same.

It is only fair to Mr. Church to say that in his recent book, "Manufacturing Costs and Accounts" (1917), he has practically abandoned the "supplementary rate." After giving a supposititious and exaggerated case of its application he says (p. 74):

"In the case cited such apparent cost has no real value at all. It is so obviously fictitious that no one would be inclined to regard it seriously for a moment. What is the purpose in distributing the wasted expense over orders in this way. First it is a concession to those accountants who desire to get rid of all shop expense onto product as they have been accustomed; . . ."

Postscript.—However, he does not seem to have altogether abandoned the supplementary rate, for he uses it in an example five pages later, and on page 353 he says:

"If it takes $40 machine time to do a certain job to-day, when the shop is busy, it should not take any more machine time next month when the shop is slack. But if the machine should earn $80 in a month and thus be capable of doing two such jobs when the work is there for it to do, that is no reason for charging $80 as machine time in the slack season. It is much better if we express the cost of the job in the slack season in two parts thus: Machine time, $40; Supplementary rate, $40; Factory cost, $80. There are certain cases when it might be valuable to charge the cost of wasted manufacturing capacity to a special account and so, later, to Profit and Loss. By this means the true cost of doing the work would be known, the true profit on each order would also be known, and the loss due to unemployed capacity of the plant would be kept as a separate item. No clear and general rule can, therefore, be laid down as to whether the cost of wasted manufacturing capacity should be distributed over Orders by means of a supplementary rate or charged to a Waste Account and so to Profit and Loss. It does not follow in all cases that this waste is due to the conditions of trade. It is also sometimes due to poor management."

It thus appears that Mr. Church is now "on the fence" as regards the supplementary rate, as he is on the question of including interest in cost. Regarding this he says (page 394): "It is a matter of option whether it is included in costs; but if it is not, some of the advantages of advanced accounting are lost. Whether there are disadvantages that counterbalance its inclusion on this ground remains at present a matter of opinion."

A Common Fallacy of the Old School of Accountants

"There must be no evasion of the prime fact which underlies all true costing. All the expenditure of the firm; all wages of managers, foremen, draughtsmen and clerks, all materials and workmen's wages; and depreciation of plant and buildings (which, under another form, is payment for their use); in short, all the expenditure which appears on the debit side of Trading Acct. is cost of production and must, in some form or other appear in the Cost Accounts. The costings should be completed to the close of each month, as longer periods would involve much complication, and it is essential for correct results that the *establishment charges for any one month are distributed over the direct wages for that month.*"—Burton.

Suppose that a factory is building engines. The cost of an engine is the sum of the labor and material costs of each of its parts, plus the cost of assembling and finishing it and putting it on cars, plus the proportion of the establishment charges that should be charged to the cost of the engine. The building of an engine may be done in parts of three months. The drawings and patterns are finished in the first month; the castings some in the first month and some in the second, and the replacement of a defective casting in the third; the machine work in the second and third months; and the assembling, testing and shipping all in the third month. Suppose that the establishment charges (salaries of managers, foremen, clerks, draughtsmen, expenditures for light, heat and power, interest on investment, insurance, taxes, depreciation, etc.), are practically the same for each month, say $10,000 per month, but that the wages differ widely in the three months, the first month only $5000 on account of stoppages due to strikes or accidents, the second $15,000, on account of running overtime, and the third $10,000, when shop conditions are normal. According to Mr. Burton "it is essential for correct results that the establishment charges for any one month are distributed over the direct wages for that month." This was practically the universal opinion of the old school of accountants. By this method of distribution each $100 of wages charged to this engine in the first month would be saddled with $200 burden, in the second month with $66.67 and in the third month with $100. The cost of the engine arrived at in this way would be of use only to the bookkeeper—it would enable him to balance his cost accounts, but it would be of no use to the factory management or to the sales department. It could not be used properly for an inventory value nor as a basis for fixing the selling price of another engine of the same kind and size.

"**A False Theory.** There are several well-known methods of charging burden to cost, each more or less justified by the various conditions in different lines of industry. These methods have one point in common, however, in that *they contemplate charging all of the burden against the product made, regardless of whether the plant is running at full or part capacity.* The result is that during periods of forced production costs seem low, while during periods of curtailed production costs seem high, since all of the burden is distributed over a greater or lesser production.

"At the extreme periods in the cycle between business depression and prosperity this method of handling burden gives widely

fluctuating costs and causes many of the present systems of cost accounting to fail just when they are most needed.

"The Correct Theory. Contrary to the general practice stated above, the fact is that *only a part of the total burden is chargeable to the manufacturing cost of the product made during periods of curtailed production, the part chargeable being the same percentage of the total burden as the curtailed production is of the standard production.* The burden not chargeable represents the cost of unused capacity for manufacturing, and is an expense to be deducted from profits. The cost of this unused capacity for manufacturing must be disposed of in some manner.

"Consider a manufacturer who can either make his product entirely at his own plant or buy some of the parts. At a time when business is poor his cost records show that a certain parts costs 20 cents to manufacture whereas it could be purchased for 18 cents. The elements of the 20-cent cost are 4 cents for material, 8 cents for labor and 8 cents for burden. During a busy period the cost of the piece was 16 cents because the burden charge was then 4 cents instead of 8 cents.

"Now if the manufacturer had found that he could buy the parts at a saving of 2 cents each *when operating at full capacity* he might well have done so. His costs would have then shown him an opportunity to save money. But if he is guided blindly by his costs in a dull period, and purchases the parts, he simply increases his losses. He will lose the least money by continuing to make the part at an apparent loss. In doing so he disregards his costs. They have failed. Reliable costs, comparable under all conditions, are not to be secured unless the burden charged to production is only that pertaining to the equipment that is actually at work."—Clinton H. Scovell.

Mr. H. L. Gantt, in a paper on "The Relation between Production and Costs," 1915 (Trans. A. S. M. E., vol 37), uses practically the same arguments as Mr. Scovell, and reaches the same conclusions. He says:

"Most of the cost systems in use, and the theories on which they are based, have been devised by accountants for the benefit of financiers, whose aim has been to criticise the factory and to make it responsible for all the shortcomings of the business. In this they have succeeded admirably, largely because *the methods used are not so devised as to enable the superintendent to present his side of the case.* Our theory of cost keeping is that *one of its prime functions is to enable the superintendent to know whether or not he is doing the work he is responsible for as economically as possible,* which function is ignored in the majority of cost systems now in general use. Many accountants, who make an attempt to show it are so long in getting their figures in shape that they are practically worthless for the purpose intended, the possibility of using them having past.

"*The indirect expenses chargeable to the output of a factory should bear the same ratio to the indirect expense necessary to run the factory at normal capacity as the output in question bears to the normal output of the factory.*

"The view of costs so largely held, namely, that *the product of a factory, however small, must bear the total expense, however large,* is responsible for much of the confusion about costs and hence leads to unsound business policies.

"*The only expense logically chargeable to a product is that needed for its production when the factory is running at full or normal capacity.* What I propose as the real cost of an article is not what it has apparently cost in the past, but what it should cost if the proper manufacturing methods were used and the shop were run at full capacity. This might be called the *ideal cost,* and toward its attainment all efforts should be directed."

THE LAST WORD ON BURDEN—STANDARD BURDEN PER UNIT OF FINISHED PRODUCT

Under scientific management efforts are made to obtain standards for every element in manufacturing, including quantity and quality of raw material, output of machines, efficiency of labor, and time and wages for each operation. By means of time, motion and fatigue studies the methods of doing the various operations are standardized, and by the task and bonus system of wage payments the labor cost of any operation may be predetermined within a narrow range of variation. The standardization of burden is a more difficult problem, but it may be accomplished whenever the same articles of product are made continuously or frequently.

Suppose that a certain product, which is regularly made in large quantities, year after year, consists of four groups assembled together, each group having an average of five pieces, and each piece requiring on an average five operations. In this case there would be a hundred operations on each finished article (in the case of a typewriter, a cash register or a calculating machine the number of operations might run into the thousands). In the ordinary accounting system, for a hundred operations on a given lot on one office order (whether the lot be a single article, as in the case of a large engine, or ten thousand articles as in the case of small articles like clocks or valves) at least a hundred separate job tickets would have to be written—more than a hundred if some of the operations on a given lot lasted more than a week and a new job ticket was issued each week that the job lasted, perhaps a thousand if a new job ticket was issued each day. Each of these tickets would contain a great mass of detailed information (see the job tickets on pages 59 and 60). They would include the workman's name and number, his time, usually stamped by a clock, his wage or piece rate, the bonus earned and the total wages, all of which would be necessary in order to make up the pay roll, and besides this, for cost and statistical purposes, the office order number, the job number, the piece and the operation symbol, the machine number or symbol, the number of pieces operated on, and finally, if the machine-hour rate method of distributing burden is used, the burden figures corresponding to the machine hours and rate. Each one of these job tickets, under the old system, is posted, with all its variety of detail, onto piece cost cards or into a piece cost ledger, and when the pieces are assembled into groups and the groups into the finished product the assembling job tickets are further posted into cards or ledgers in order to obtain the total cost and the unit cost of the finished product.

In one factory visited by the author there were thirty loose-leaf cost ledgers, each containing probably 2000 pages, making 60,000 cost pages in all. Each one of these pages would have to be examined by a clerk at least once in order to obtain the cost figures for use in inventory valuations of finished parts in stock and of finished products in the warehouse, and a statistician might examine them in order to obtain figures for his statistical reports and comparisons of costs at one period with those at another, but except for these purposes all these books and all the costly pen-and-ink work in them are of little or no value to any one.

The machine-hour rate system of distributing burden is, undoubtedly, the best yet found for approximating the true cost of a manufactured product, and when the product consists of many pieces, each requiring numerous operations, it is necessary to obtain the burden for each operation, but

having once determined the cost of a given lot, and having standardized the cost of raw material and of labor for each piece and for the assembled product, the total burden charges obtained by adding together all the burden charges for the several operations may then be taken as the standard total burden for all similar lots, and, thereafter, there is no need of figuring the burden on each separate operation until there is a change in the method or in the speed of manufacturing, or until there is a change in the monthly charges against Burden Account, such as rent, insurance, taxes, superintendence, indirect labor, reserves for depreciation, etc.

A vast amount of clerical work may thus be saved. This plan of using a standard burden per unit of finished product may make it possible to introduce an entirely satisfactory cost system into some large factories where the old method of figuring the burden separately on each job ticket would be so costly as to make it impracticable.

When the standard task and bonus rates and the standard burden per unit of finished product have been established there is no need of writing a separate job ticket for each operation, or even for each piece or lot of similar pieces. A weekly time ticket is issued to each workman, on one side of which is stamped the clock figures for "in" and "out," morning and afternoon, and on the other side is entered the count of pieces finished each day, or each operation, together with the piece and operation symbols and the office order or lot number, which takes the place of the separate job ticket numbers in the old system.

Example. Suppose a certain product, 106X, is made of two pieces, *A* and *B*, and each piece has three machine operations. An experimental lot has been made, the best process of manufacture has been determined, time, motion and fatigue studies have been made for each operation, standard times, tasks and bonuses have been fixed, and the burden on each machine operation and on assembling, finishing, testing and packing has been calculated on the machine-hour rate basis.

A standard schedule of operations is then made out as follows:

Operation Schedule for 106X

Piece	Operation No.	Machine No.	Time for 100 pieces hours		Wage per hour, base cents	Piece rate per 100		Bonus 30 per cent		Labor cost per 100		Burden per machine hour		Burden per 100		Total labor and burden per 100	
A	1	S7	4	3	25	1	08	0	32	$1	40	0	40	0	72	3	12
	2	T6	2	7	30		81		24	1	05		30		81	1	86
	3	M10	6	0	25	1	50		45	1	95		50	4	00	4	95
B	1	P3	5	1	30	1	53		46	1	99		40	3	04	4	03
	2	D11	1	9	25		48		14		62		30		57	1	19
	3	T6	3	4	30	1	02		31	1	33		30	1	02	2	35
			23	4		6	42	1	92	8	34			9	16	17	50
Assemble		Bench	1	0	40		—		—		40		15	0	15		55
Finish		Bench	0	5	40		—		—		20		15		08		28
Test		Bench	0	2	40		—		—		08		15		03		11
Pack		Bench	1	0	40		—		—		40		15		15		55
			2	7						1	08				41	1	49
Total, 100 articles			26	1						9	42			9	57	18	99

An office, or production, order may read as below:

Order No. 1761. Jan. 2, 1917.

Make 10,000—106X, in 10 lots.

1000 per month.

The weekly time ticket of a man working on Machine T6 may show the following:

Time Ticket, Week Ending Jan. 14, 1917.

Name, J. Jones. No. 87

Jan.		In	Out	In	Out	Hours
9	M	7	12	1	5	9
10	T	7	12	1	5	9
11	W	7	12	1	5	9
12	Th.	7	12	1	5	9
13	F	7	12	1	5	9
14	S	7	12	+	−	5
						50

(Reverse side of card).

Order	Article	Piece and oper'n	Mach.	Start	Finish	Hours	Pieces	Finish or not
1761	106X–1	A2	T5	1/9 7A	1/11 4P	26	1010	F
		B3	T6	1/11 4P	1/14 12	24	700	NF

Cr. Labor 1010 at 1.05 per 100 10.60

700 at 1.33 per 100 9.31

Chg. 106X–1 19.91

When the time ticket is turned in at the end of the week the pay roll clerk credits Jones $19.91 and puts the card in a file of unfinished orders, in a folder marked 106X. When all the operations, including the packing, on the lot have been completed the cards are taken out of the folder, and the total labor costs are added on the adding machine and

entered on a Finished Product Cost Card. The total amount of the material issued for the order, taken from the Stores Issue Cards, and a credit to the job for scrap unused material or finished parts returned to stores, taken from Charge Stores, Credit Work in Process cards, are also entered on the Cost Card. The card may contain the following information:

FINISHED PRODUCT COST CARD. ARTICLE 105X. LOT ORDERED 1000

Date Finished	Order and Lot	Cost of Material		Labor Standard		Labor Actual		Burden Staudard		Finished	Spoiled	Credit Charge Store		Charge Warehouse		Cost per 100	
Jan. 28	1761–1	50	00	94	20	96	40	95	70	995	A, 15; B, 10	2	60	240	00	24	12

When this entry has been made in the cost card, an entry is made on a memorandum for Journal Entry as follows:

FACTORY COSTS. MONTH OF JANUARY, 1917

Article	CHARGE				CREDIT							
	Store		Work in Process		Store		Labor		Burden		Total	
106 X–1	2	60	240	00	50	50	96	40	95	70	242	60

And at the end of the month the several columns in this memorandum are posted and the totals entered in the Journal-Ledger. The total credits to labor should equal the total of the direct labor pay roll, and the total credits to stores should equal the total of the Stores Issue tickets for material issued for work in process.

If the lot is not completed by the end of the month and it is desired to balance the factory accounts monthly a modification of the method is made. A memorandum of the weekly charges and credits to lot 106X–1 is made as below:

Weekly Direct Labor Charges.
Order 1761—Article 106X. Lot 1.

1917	January	7	7.25
		14	24.60
		21	14.30
		28	21.40
		31	5.15
			72.70

Material issued, per stores tickets	48.50
Scrap returned, charge stores	1.80
Not finished	
Standard Labor Cost, if finished	94.20
Estimated Labor Cost to finish	21.50
Estimated burden for work done	

$$\frac{72.70}{94.20} \text{ of } 95.70 = 69.57.$$

The entry in the memorandum for Journal Entry then will be

	CHARGE				CREDIT					
	Store		Work in Process		Store		Labor		Burden	
106 X–1 (N.F.)	1	80	188	97	48	50	72	70	69	57

The next month the weekly memorandum may show:

Completion of 106X, lot 1.

Feb. 3. Labor.	23.70
Material issued	2.00
Scrap returned	0 80

and the Journal Entry Memorandum for February:

	CHARGE				CREDIT				
	Store		Work in Process		Store		Labor		Burden
106 X–1 (F)	0	30	51	03	2	00	23	70	26	13

The burden charge being the difference between the standard burden, $95.70 for 1000 articles, and the $69.57 charged in January.

This method of calculating the burden for the two months separately (in proportion to the direct labor cost in each month) is, of course, inaccurate, for the work done in the first month probably included most of the work on the large machines carrying an hourly burden rate of 40 and 50 cents while the work in the second month was largely bench work with a burden charge of only 15 cents per hour. A more accurate method of apportioning the burden for the two months would be to take from the time tickets the machine hours of the work done and from the standard schedule the machine rates, but this would involve an amount of clerical labor that would probably not be worth its cost. The error made by the shorter method of estimating the burden of the first month, whatever it may be, is corrected in the second month by charging the difference between the standard burden for the whole month and the amount already charged in the first month.

The object of cost accounting is to arrive at the factory cost of the product when it is completed and delivered to the warehouse, and not to make a monthly balancing of the accounts. An overcharge or undercharge of burden on the separate portions of a given lot finished or partly finished in two or three different months is of no serious importance when it is considered that the machine-hour rate, while the nearest approximation to an accurate burden-charging method is still but an approximation.

Moreover the "factory cost" which is most important is not always the actual expenditure incurred by the factory in making a given portion of its product, but the figure at which the product should be charged in the warehouse inven-

tory and charged to the sales department; not what the product cost to make in the past under possibly unfavorable conditions, but what it should cost at the present time or in the near future under normal conditions, in other words the probable cost of reproduction. It is the figure to be used in computing the factory profit and loss at the end of the year or other fiscal period, and the figure to be used as a basis for establishing the minimum selling price. "Warehouse value" might be a better name for it.

Interpretation of the Recorded Cost Figures. Recapitulating the figures from the above example we have the following:

	Material		Direct Labor		Burden		Spoiled	Charge Stores		Warehouse Value		Cost per 100	
Standard, 1000...	50	00	94	20	95	70	.....	.....	....	239	90	23	99
Actual, 995.....	50	50	96	40	95	70	A, 15; B, 10	2	60	240	00	24	12
Standard for 995.	49	75	93	73	95	22	.....	.....	....	238	70	23	99
Excess of actual..	0	75	2	67	0	48	.....	−2	60	1	30	0	13

It is not to be expected that the actual material and labor costs will ever be exactly equal to those of the standard schedule. Machines will break down; belts will slip; material will be harder or easier to machine; men will sometimes fail to earn their bonus, or may earn extra wages for overtime; more material will prove defective or will be spoiled in one lot than in another; the spoiling may take place in the first operation or in the last; men may sometimes be penalized for spoiling material and sometimes not, the factory in the latter case assuming the spoilage as one of the normal risks of the business. In the imaginary case above described, for the lot of 1000 articles 1010 pieces each of *A* and *B* were furnished by the stores, of these 15 of *A* and 10 of *B* were spoiled in process so that only 995 articles could be completed, 5 pieces of *B* being left over and put in stores for the next lot.

In the above case we have charged the warehouse with $240 for 995 pieces. Sticklers for absolute accuracy may find fault with these figures, one set holding that the charge is too low, for we have charged the standard burden $95.70 for 1000 articles, when 1010 pieces each of *A* and *B* were worked upon, and the direct labor cost was $2.20 more than the standard and, therefore, the burden should be greater, more machine hours than the standard having been employed on the lot; while another set would say that we have inflated the inventory by charging the standard burden for 1000 articles when only 995 were made, and, that we have also inflated it by charging to warehouse the cost of spoiled work, which should have been charged to a separate account and not to the cost of the product.

These are matters of refinement of detail which each factory should settle for itself in its "accountants' code." It may be well for the code to specify that the machine-hour burden shall include an allowance of say 2 per cent for a normal amount of spoiled or defective work and that when the actual spoilage or defective material is less than this amount no account need be taken of it in figuring costs, but that when it is in excess of this amount, as it often is in engine building, when a cylinder is spoiled in boring by a shop accident or on account of a flaw in the casting, the loss due to spoilage shall be taken account of as one of the occasional risks of the business, charged to spoiled work account, closed at the end of the fiscal period into Profit and Loss, and not be included in the inventory valuation of the product.

We must be careful not to inflate our inventory and, therefore, exaggerate our book profits, and possibly also to increase our selling prices to such an extent as to decrease our sales, and on the other hand not to underestimate our costs, which may lead to making selling prices too low, thereby lessening profits. The middle course seems to be the safest, and this may be had by specifying in the accounting code that the machine-hour rates include an allowance of 2 per cent (or other moderate figure) for spoiled work, and that the standard burden to be charged to a lot is that belonging to the number of articles ordered and expected to be made (1000 in the case described) although work is done on a few extra castings ordered with the expectation of some loss from spoilage (10 extra castings in this case) and although less than the expected number of articles (995 in this case) are actually finished. One advantage of this method is that it minimizes the clerical abor.

Advantage of the Standard Schedule. The saving of labor in accounting due to the adoption of the standard burden per unit of product has been sufficiently discussed above, but a more important advantage of the standard schedule is that it leads to obtaining prompt information in regard to the progress of work through the factory and, in regard to excessive cost of any operation. With the standard operation schedule on his desk for each kind of product that is going through the shop, the superintendent or production clerk can compare the daily count of pieces made in each operation with the standard, instantly note any serious variation from the schedule and promptly investigate the cause and apply the remedy.

Charge Unabsorbed Overhead to the Sales Department

I recently had a discussion with a public accountant in New York who claimed that overhead should only be charged to costs on the basis of normal production, and that when orders were insufficient to allow of normal production the unabsorbed expense should be charged to the Sales department, because they didn't get the orders. Some works managers and superintendents would very much appreciate such relief. For the purpose of intelligent comparison of costs some such arrangement should work satisfactorily, although probably in the steel business the excess should be charged through some special account against the income rather than to the Sales department.—Gershom Smith, *Eng. Mag.*, June, 1909.

CHAPTER IX

DEPRECIATION. INVENTORY VALUATION. APPRAISALS

Method of Treating Repairs and Depreciation in the Accounts. Suppose a shop is fitted with new machinery valued at $60,000. It is estimated that the possible depreciation due to obsolescence will require contributions to an insurance fund at the rate of 4 per cent per year, or $2400 per year, or $200 per month; that the depreciation due to wear and tear, not made up by current repairs, but deteriorating the usefulness of the machinery so that it will have to be replaced at an average time of 25 years, is also 4 per cent, or $200 per month, that minor repairs, such as renewal of bushings, replacing small gears and the like will average 2 per cent, or $100 per month. Suppose also that extraordinary repairs, due to accidents and costing from $100 to $2000 each, are apt to happen at irregular intervals, the total cost in different years ranging from $300 to $3000. It is desired to distribute and absorb these depreciations and repairs into the monthly records of costs of the several classes of product or of costs of work in the several departments. If the normal output of a certain department or of a certain class of goods is 5000 pieces per month, costing $5000, or $1 each, and in one month there is a breakdown costing $1000 increase in the repair account above the usual cost, and cutting the monthly product down to 2500 pieces, the apparent cost of these pieces, if the cost of the extraordinary repair is $1000 and it is all charged against the product of that month, may be raised to $1.50 each or upwards. It is evident that a cost so obtained is of no use to the management for any purpose. It is not a basis for the valuation of goods in the warehouse or for fixing the minimum price at which goods may be sold

Example

	1st Month	2d Month Wrong Method	2d Month Right Method
Material	$1000	$ 500	$ 500
Direct labor	2000	1000	1000
Indirect labor and all normal expenses, repairs, depreciation, etc.	2000	1500	1000
Extraordinary repairs	none	1000	
Total cost	5000	4000	2500
No. of pieces made	5000	2500	2500
Apparent Cost per piece	$1 00	$1.60	$1 00

The warehouse in the second month should be charged only $2500 or $1 each, the normal cost of the 2500 pieces made and the difference between the total and the normal cost ($4000 − $2500 = $1500) should either be charged to Profit and Loss and at the end of the year, with other profits and losses, be balanced into surplus or capital or "Company" account, or else be charged against a Reserve for Repairs account, which is accumulated for the purpose of taking care of such extraordinary repairs.

Current small repairs may be charged directly to a Repair Account which may be closed monthly into Manufacturing Acct. and distributed in the cost records of departments or classes of product. Manufacturing Acct. should also be charged monthly with one-twelfth of the average estimated yearly cost of depreciation, Reserve for Depreciation being credited, and with one-twelfth of the estimated average yearly cost for extraordinary repairs, Reserve for Ex. Repairs being credited. As actual expenditures of cash, labor or material are made for replacement of machines that have become obsolete or worn out, or for extraordinary repairs, these Reserve Accounts are charged and Cash, Labor, Material, or Mfg. Acct. credited. The balance of the Reserve accounts at the end of the year, if on the credit side, represents a fund which has accumulated and may be drawn upon for replacements and extraordinary repairs in the following years; if on the debit side, the balance represents the excess of actual expenditure for replacement and repairs above the total of the monthly credits to these accounts. This debit balance may be carried over into the next year and may gradually be wiped out by the monthly credits, or it may be transferred to Profit and Loss, as may seem best to the management.

The credit balance of the Reserve Accounts may be transferred to the credit of Equipment Acct. to reduce the inventory value of the equipment, or it may be carried forward and dealt with at some future time. Thus, if at the end of a few years after the opening of the books the Dr. balance of Equipment Acct. is $60,000 and the Cr. balance of the Reserve Accts. is $20,000, this may mean either that the equipment is worth only $40,000, having depreciated $20,000 in value, or that its present value to the Company as a "going concern" is the full $60,000, but that there is a $20,000 fund held in reserve against its possible rapid depreciation at some time in the near future. In any event the meaning of the $20,000 reserve should be clearly explained on the Ledger for the information of an auditor or examiner. If it should appear to the management that this $20,000 fund is greater than the real depreciation plus a reasonable reserve

for the future, then part of it may be credited to Profit and Loss or Surplus Account, and then to Dividend Acct., paying it back to the stockholders, but this is a matter that is for the Directors and not the Accountant to decide.

In making estimates of costs the amount to be added for depreciation of machinery, if figured as a percentage of the value of the machinery, should be based on its original value and not on a depreciated value. For example, if the machinery when new was worth $60,000 and 5 per cent per annum or $3000 is deducted from its inventory value for depreciation, this amount being charged as one of the items of cost of the annual product, the same amount should be charged to costs each year, although the inventory value may have been reduced to $40,000 or less. This annual charge does not in fact represent the actual depreciation each year; what it does represent is an annual contribution to a fund which is to be used eventually for such repairs, renewals and replacements as will bring back the value of the machinery to its original amount.

Depreciation. From notes on Business Engineering, by Alex. C. Humphreys.

Definition. Reduction in worth caused by wear and tear through use, and by obsolescence and inadequacy.

Repairs, renewals and replacements are things done to repair or compensate for the losses occasioned by depreciation.

Estimating in advance of the facts the probable and possible future depreciation to be included as one of the annual items of operating cost is a different proposition from determining the actual depreciation which is found in the appraisal of a plant in operation. The first is known as theoretical, the second as actual depreciation.

Repairs and replacements of certain minor parts of the plants are paid for out of current income and should be charged as part of the expenses of the year unless they are covered by an inclusive yearly charge to cover all repairs, renewals and replacements.

Replacements of parts greater in value may be charged as part of the expenses of the year, or their cost may be distributed over a number of years, or they may be included in an inclusive yearly charge above mentioned.

The theoretical depreciation due to obsolescence, inadequacy, or such decay as will in time necessitate renewal, is one of the cost or expense items that must be treated as an accruing liability. The first step is to estimate as closely as we can the annual loss occasioned by this depreciation. To estimate the probable life of each part of the plant it is necessary to consider the class and character of the plant, its design and construction; its capacity; the way in which it is operated; the present volume of business and prospects of the future; whether it is overworked or not; whether it is kept in good repair; and whether the cost of repairs is charged year by year against the profits.

To assume that certain kinds of apparatus and machines can each be given definite life-expectations without regard to the special conditions involved is quite indefensible. What is the life of a boiler? What is the life of an engine? Such general questions cannot be answered. No general rules can be established either for future depreciation or for making estimates of actual depreciation as an element to be considered in the appraisal of present value of plant.

Having examined each part of the plant and having developed a table of life expectations, it should be assumed for the purpose of this estimate that at the end of each life period covered by the table the parts of plant will have to be renewed. Many things may happen to change the estimate. As we should be careful to make the life estimates on the safe side we may hope for longer lives than those assumed. If as to any part we have underestimated the element of inadequacy and we find the plant wholly or in part inadequate as to capacity before the expiration of the assumed life, we, at least, have the unexpected higher rate of increase in sales to compensate for the necessity of renewing the plant in advance of our estimate. It may be in such a case that the investment of additional capital will be found to be fully warranted.

The problem of estimating accruing depreciation is a most difficult one to solve, even by the man who, by training and experience, is an expert. We should be prepared to amend our estimate from year to year as we have the opportunities to check up the correctness of the assumptions upon which we have based our estimate. All the details of depreciation estimates should be recorded fully and exactly so that as conditions change we, *or those who follow us*, may always be able to compare the results of the estimates with the facts as found. With every record, especially in accounting, the statements should be completely self-explanatory.

Depreciation and its Relations to General Expense. H. M. Norris, *Eng. Mag.* XVI (1898), p. 812. Mr. Norris sent a list of questions to several manufacturers of machine tools asking such questions as "How would you figure depreciation?" "How do you regard small loose tools, as drills, reamers, etc.?" "Into how many items do you divide General Expense, and what are they." The answers showed wide difference of opinions on all the questions; for example, one manufacturer said he carried drawings, wood and iron patterns, jigs and fixtures on his books at cost, while another charged them to expense and took no further account of them. Mr. Norris says of these things:

Drawings are not merchandise, they are merely means to an end, a necessary evil in production. Standard drawings are chargeable to capital, not as assets from which a given percentage can be written off annually, but as assets whose real value can only be approximated. Only those drawings which are in use should be valued in the assets. Patterns when seldom used have little value. Patterns should be broken up as firewood as soon as they are no longer needed. Metal patterns in regular use remain of fixed value, repairs being charged to general expenses.

Two of the replies were as follows: "We do not feel like going into all the details of our private business in the way you have suggested." "We feel that this is in a measure private information that we do not care to have disseminated generally." Mr. Norris thus comments on these replies: "A nation's progress is dependent upon the distribution of knowledge, and knowledge withheld is progress retarded. This is equally true of private enterprises, and I think it will be admitted that one of the chief essentials of progress, especially in the mechanic arts is unselfishness—a willingness to exchange ideas, a broad and liberal policy fostered by an *esprit de corps* which insures its own reward."

Four Methods of Calculating Depreciation.* If depreciation is calculated on too restricted a basis it may easily be found that money has been paid away in profits which ought to have been retained for the future. There are still divergent ideas as to the way in which it should be charged, quite apart from the percentage. The method matters little so long as enough is set aside.

There are four recognized methods of charging depreciation. 1. The reduced balance method; 2. The straight-line method; 3. The annuity method; 4. The sinking-fund method.

*Condensed from an editorial in *Engineering* (London) Jan. 19, 1917, reviewing a paper read before the Institution of Civil Engineers, by F. Gill and W. W. Cook.

Taking a hypothetical machine, costing $1000 (£100 in the original article) with a physical life of 25 years and a scrap value of $20, and an economical life of 19 years with a scrap value of $130, assume that the $1000 will provide $50 annually for the shareholders and that enough should be written off to provide $870 at the end of 19 years.

(1) Reduced balance method.

In successive years	0	1	2	3	19
The capital value becomes	1000	898.2	806.7	724.6	130
The depreciation fund becomes	0	101.8	193.3	275.4	870

The value of the machine falls very rapidly at first and very slowly toward the end, $21.90 the last year. This does not agree with the facts. A machine properly cared for suffers no damage the first three or four years.

(2) In the straight-line * method $50 is required annually for interest and $45.80 for the depreciation fund, the latter totaling $879.20 in 19 years without interest. The $45.80 is invested either in a special fund or in the business. The interest of the fund, however, goes into the general account and the dividend is swelled by this interest. In the last year the interest on the fund amounts to $41.20. If the interest be added to the depreciation fund year by year then a depreciation of $28.50 per year would be sufficient to furnish $870 in 19 years. In the case of a plant like a telephone pole (which carries its wires with uniform efficiency until it is blown down or condemned by the Inspector), it is clear that the dividends are, by the straight-line method, being reduced in the early years and augmented in the later years, while the profits are uniform. Clearly this is not good bookkeeping.

(3) The annuity method. Each year a part of the capital is repaid and a return is paid on the capital outstanding. The total charge is uniform at $78.50 for interest and depreciation and is made up of a decreasing return component and an increasing depreciation component. In 19 years the amount available for depreciation rises from $28.50 to $68.60. The capital value is written down each year by the amount of the depreciation and consequently the amount required for interest grows less and less. At the same time the interest earned by the depreciation fund is paid into the general account, so that the shareholder still gets his $50 yearly partly by earnings from the depreciated machine and partly from the fund. By this plan the plant is written down slowly at first and more quickly toward the last, which certainly corresponds with the condition of moving machinery.

(4) The sinking-fund method. The total annual charge is $78.50, made up of uniform charges each year, both for interest and depreciation The interest earned by the fund is added to it annually, while the value of the plant is not written down, but is credited with earning 5 per cent all the period. This is exactly the case of the telephone pole. The amount set aside in methods 3 and 4 is identical and the result is identical at the end of 19 years. The difference is that in one case the value of the plant is supposed to decrease annually and in the other it remains constant. The difference is one of bookkeeping mainly:

The manufacturer who adopts method (1) and accumulates money fast in the early years is in the safer position, while the one following the straight-line method (2) is not dependent on the interest of the fund to square his accounts. A big reserve fund is a most useful asset, but like many other desirable things it is difficult of attainment, especially by limited companies, whose shareholders generally think more of present dividends than of future safety.

* This refers to a downwardly inclined straight line on a plotted diagram representing the uniform annual reduction in value. In other methods the reduction of value is shown by a curve.

Depreciation of $10,000 in Twenty Years by Three Methods

Year	Straight Line Depreciation at 5%		Depreciation at 10% on Diminished Values	
	Total Depreciation	Remaining Value	Total Depreciation	Remaining Value
1	$500	$9500	$1000 00	$9000.00
2	1000	9000	1900 00	8100.00
3	1500	8500	2810.00	7290.00
4	2000	8000	3439.00	6561.00
5	2500	7500	4095.10	5904.90
6	3000	7000	4685.59	5314.41
7	3500	6500	5217.03	4782.97
8	4000	6000	5695.33	4304 67
9	4500	5500	6125.80	3874 20
10	5000	5000	6513.21	3486 79
11	5500	4500	6861.89	3138 11
12	6000	4000	7175.70	2824.30
13	6500	3500	7458.14	2541 86
14	7000	3000	7712.33	2287 67
15	7500	2500	7941.09	2058.91
16	8000	2000	8146.98	1853 02
17	8500	1500	8332.28	1667 72
18	9000	1000	8499.06	1500.94
19	9500	500	8649.15	1350 85
20	10000	0	8784 23	1215.77

Sinking Fund Method

Annual Payments of $302.43 for 20 Years. 5% Compound Interest *

End of Year	Principal	Yearly Interest	Accumulated Interest	Total of Fund	Remaining Value
1	$302.43	0	0	$302.43	$9697.57
2	604.86	15.12	15.12	619.98	9380.02
3	907.29	31.00	46.12	953.41	9046.59
4	1209.72	47.67	93.79	1403.51	8696.49
5	1512.15	65.18	158.97	1671.12	8328.88
6	1814.58	83.56	242.53	2057.11	7942.89
7	2117.01	102.85	345.38	2462.39	7537.61
8	2419.44	123.12	468.50	2887.94	7112.06
9	2721.87	144.40	612.90	3334 77	6665.23
10	3024.30	166.74	779.64	3803.94	6196.06
11	3326.73	190.20	969.84	4296.57	5803.43
12	3629.16	214.83	1184.67	4813.83	5186.17
13	3931.59	240.69	1425.36	5356.95	4643.05
14	4234.02	267.85	1693.21	5927.23	4072.77
15	4536.45	296.36	1989.57	6526.02	3473.98
16	4838.88	326.30	2315.87	7154.75	2845.25
17	5141.31	357.74	2673.61	7814.92	2185.08
18	5443.74	390.75	3064.36	8508.10	1491.90
19	5746.17	425.40	3489.76	9235.93	764.07
20	6048.60	461.80	3951.56	10000.16	0
		$3951.96			

* The formula by which the annual payment is found is $P = \frac{i}{(1+i)^n - 1}$ in which i = interest rate expressed as a decimal = .05, n = number of years, P = payment made at the end of each year. The amount of the annual payment may also be found in annuity tables. See the "Mechanical Engineer's Pocket-book," page 16.

Valuation of Machinery. "If the machines are appropriate for their purpose," says Mr. Matheson, "then their value will be arrived at by adding to their original cost the expense of installation, and deducting an amount for depreciation proportioned to their age and wear, and a further amount for any actual repairs they may require."

Mr. Matheson says:

Where the production is stimulated by a system of piece-work, the deterioration of the plant is likely to be more rapid than in a factory where the workmen are paid according to time only. In very busy times, when there is a pressing demand for the products, and profits are large, it may be expedient and remunerative to work long hours, and to force the plant and machinery to their utmost power, even at the risk of a breakdown, so as to take full advantage of the transient high prices; but in such a case a corresponding rate would have to be written off for depreciation.

Mr. Oberlin Smith, President of the Ferracute Machine Co., Bridgeton, N. J., says:*

The grand principle which lies at the root of correct valuation, and which should govern the appraiser throughout all his work, is that any article is worth, not what it *did cost, but what it would cost to replace it to-day*, providing it is so useful that it would be desirable to so replace it, were it destroyed. Thus, if a shop has a lot of machine tools which are built so near to the best modern practice that it would be desirable to duplicate them were they destroyed, they are worth exactly what said duplicates would now cost, delivered and set up in the shop, less the depreciation due to the wear and tear.

The depreciation of special tools for wear and tear need be but very little, as, if they serve their purpose at all, they must be kept in such repair as to serve it perfectly.

In practical dealings with this question, it seems to me that the best course is to give all special tools an inventory rating at their apparent value, and then to lay aside a portion of the extra profits which these tools have earned by their special usefulness, in the general reserve fund, or "Surplus," of the concern. They may thus be drawn upon, should any too sudden collapse in values take place.

In a recent paper (*Jour. A.S.M.E.*, Jan., 1917), Mr. Smith said:

Some people depreciated a set of machine tools 10 per cent each year and that soon made them worth one-half or one-quarter of their original value, when they were as good as ever. His rule had been to allow a small amount for depreciation each year and keep the tools in good order. If a tool was run down and needed repairs, or an additional part was applied to it and perhaps 50 per cent of the original value spent on it, then it was worth more at the end of the year when repaired and it was not right to keep depreciating it right along. It was worth as much as when new.

In 1916 the author saw in operation in a factory in Philadelphia a heavy punching press that had been bought from Mr. Smith's company in 1872. It had been running regularly for 44 years, always on the same kind of work, and was to all appearances as good as new. It, no doubt, had some repairs made on it from time to time, such as re-bushing or rebabbitting of its shaft bearings, and replacing some worn-out slides and gear wheels. A sinking fund reserve with an annual payment of 1 per cent of the original cost would probably have covered all of the repairs and depreciation.

The amount of interest and amortization to be charged in any well-equipped power plant is greatly a matter of financial policy and not so much a question of the actual life of the plant. In our age of technical and industrial progress, plants lose their usefulness through obsolescence rather than actual deterioration, and the management with foresight favors high amortization charges, i.e., short life, to provide a sinking fund for the replacement of obsolete with new and efficient machinery.—H. Haas, *Bull. Am. Inst. Mining Engrs.*, May, 1917, p. 867.

The Effects of Depreciation at Different Rates for Terms of Years [1]

Years	1%	2%	3%	4%	5%	6%	7%	8%	10%	12%	15%	20%
1	.990,000	.980,000	.970,000	.960,000	.950,000	.940,000	.930,000	.920,000	.900,000	.880,000	.850,000	.800,000
2	.980,100	.960,400	.940,900	.921,600	.902,500	.883,600	.864,900	.846,400	.810,000	.774,400	.722,500	640,000
3	.970,299	.941,192	.912,673	.884,736	.857,375	.830,584	.804,357	.778,688	.729,000	.681,472	.614,125	.512,000
4	.960,596	.922,368	.885,292	.849,346	.814,506	.780,749	.748,052	.716,392	656,100	.599,695	.522,006	.409,600
5	.950,990	.903,921	.858,734	.815,372	.773,781	.733,904	.695,688	.659,081	.590,490	.527,731	.443,705	.327,680
6	.941,480	.885,843	.832,972	.782,757	.735,092	.689,870	.646,990	.606,355	.531,441	.464,404	.377,149	.262,144
7	.932,065	.868,126	.807,982	.751,477	.698,337	.648,478	.601,700	.557,846	.478,297	.408,675	.320,577	209,715
8	.922,745	.850,763	.783,743	.721,389	.663,420	.609,569	.559,581	.513,218	.430,467	.359,634	.272,490	.167,772
9	.913,517	.833,748	.760,231	.692,534	.630,249	.572,995	.520,411	.472,161	.387,420	.316,478	.231,617	.134,218
10	.904,382	.817,073	.737,424	.664,832	.598,737	.538,616	.483,982	.434,388	.348,678	.278,500	.196,874	.107,374
11	.895,338	.800,732	.715,301	.638,239	.568,800	.506,299	.450,103	.399,637	.313,811	.245,080	.167,343	.085,899
12	.886,385	.784,717	.693,842	.612,709	.540,360	.475,921	.418,596	.367,666	.282,429	.215,671	.142,242	.068,720
13	.877,521	.769,023	.673,026	.588,201	.513,342	.447,366	.389,294	.338,253	.254,186	.189,790	.120,905	.054,976
14	868,746	.753,643	.652,836	.564,673	.487,675	.420,524	.362,043	.311,192	.228,768	.167,015	.102,770	.043,981
15	.860,058	.738,570	.633,250	.542,086	.463,291	.395,292	.336,700	.286,297	.205,891	.146,973	.087,354	.035,184
16	.851,458	.723,798	614,253	.520,402	.440,127	.371,575	.313,131	.263,393	.185,302	.129,336	.074,251	.028,148
17	.842,943	.709,323	.595,825	.499,586	.418,121	.349,281	.291,212	.242,322	.166,772	.113,816	.063,113	.022,518
18	.834,514	.695,136	.577,950	.479,603	.397,214	.328,324	.270,827	.222,936	.150,095	.100,158	.053,646	.018,014
19	.826,169	.681,233	.560,612	.460,419	.377,354	.308,624	.251,869	.205,101	.135,085	.088,139	.045,599	.014,412
20	.817,907	.667,609	.543,794	.442,002	.358,486	.290,107	.234,238	.188,693	.121,577	.077,562	.038,760	.011,529
21	.809,728	.654,257	.527,480	.424,322	.340,562	.272,701	.217,842	.173,597	.109,419	.068,255	.032,946	.009,223
22	.801,631	.641,171	.511,655	.407,349	.323,533	.256,338	.201,593	.159,709	.098,477	.060,064	.028,004	.007,379
23	.793,615	.628,348	.496,306	.391,055	.307,357	.240,958	.188,411	.146,933	.088,629	.052,856	.023,803	.005,903
24	.785,679	.615,781	.481,416	.375,413	.291,989	.226,501	.175,222	.135,178	.079,766	.046,513	.020,233	.004,722
25	.777,822	.603,466	.466,974	.360,396	.277,390	.212,911	.162,957	.124,364	.071,790	.040,931	.017,198	.003,778
26	.770,044	.591,396	.452,965	.345,980	.263,520	.200,136	.151,550	.114,415	.064,611	.036,019	.014,618	.003,022
27	.762,343	.579,568	.439,376	.332,141	.250,344	.188,128	.140,941	.105,261	.058,150	.031,697	.012,425	.002,418
28	.754,720	.567,977	.426,194	.318,855	.237,827	.176,840	.131,075	.096,840	.052,335	.027,893	.010,562	.001,934
29	.747,173	.556,618	.413,408	.306,101	.225,935	.166,230	.121,900	.089,093	.047,101	.024,546	.008,977	.001,547
30	.739,701	.545,485	401,006	.293,857	.214,639	.156,256	.113,367	.081,966	.042,391	.021,601	.007,631	.001,238

[1] H. M. Norris, *Engineering Magazine*, Mar., 1899.

* "Inventory Valuation of Machinery Plant." Trans. A. S. M. E., Vol. vii, p. 433.

Charge all non-perishable tools of an unusual and irregular nature to special plant at cost. Let their value remain at this figure until the saving in cost on the future probable output of said tools falls below their cost. Then depreciate dollar for dollar, in accordance with the shrinkage that occurs from time to time in the total amount of saving that will be effected during the remaining term of their usefulness.—H. M. Norris.

The Relation between Perpetual-inventory Value and Appraisal Value *

"What is your plant worth? You should know—*exactly*. You should know for insurance purposes, for financial purposes, for every purpose that has anything to do with the safe conduct of your business. You should know—*must* know—before you can calculate costs, overhead, profits; before you issue securities, make loans, place insurance. Your annual statement has a hollow foundation if its estimate of your assets as a going concern is based on the accountant's guess—a guess that has no better foundation than an estimate of costs at some past period, from which certain arbitrary percentages have been written off each year."

This statement, taken from a publication of one of the appraisal companies, can be accepted as sound without committing ourselves to the conclusion which the appraisal company is anxious to establish: that the real worth of a plant for all purposes can be established only through the work of professional appraisers.

Most plants grow from small beginnings, and during their early life expand as the needs dictate. The organization is necessarily small, because the most rigid kind of economy must be practiced, and original costs and the costs of additions are frequently so completely submerged in the total assets that no safe records of these costs can be established. The annual statements of plants so conducted have indeed a hollow foundation, for not only their assets but usually their profits are based on the accountants' guesses. Industries so managed need the assistance of a competent appraisal company to inform them of the value of their assets, as a basis for embarking on a sounder and safer system of accounting methods.

Appraisals are also valuable in establishing comparative values of plants that are about to merge, or in serving as a basis of a scheme of financing. But the claims that an appraisal is necessary for figuring overhead costs and the selling price and profit of manufactured articles, are, to say the least, sadly overdrawn.

Need for Determining a Proper Rate of Depreciation. Few owners are astute enough to foresee their needs for ten years to come, and fewer still have the means to build or expand along the lines that will give ample opportunity for future business growth. It is safer by far, therefore, to provide proper sinking funds through an ample rate of depreciation, so that when buildings that have outlived their usefulness require reconstruction, funds have been provided out of profits for rebuilding along more modern lines.

Machine tools have changed very considerably as a result of the development of the Taylor-White and other high-speed steels, and companies that followed appraisal methods of depreciation find themselves with obsolete equipment and no funds to replace it with modern equipment.

Patterns and small-tool equipment often have but temporary value and should disappear wholly from the inventory when they have served their purpose, yet these two items are fertile sources for inflation of values through appraisals.

What the management of an industry is chiefly concerned in, is to provide a fund through a proper scale of depreciation which will reimburse it for the difference between the cost price of a piece of equipment and its fair cash selling price when sold either because it is ready for the scrap heap or because some newer form or method has made a change desirable. This difference is properly a part of the cost of the product, but becomes so only by charging depreciation against the expenses of operation.

Depreciation not Properly Determined by Appraisal Companies. Has any appraisal company ever investigated the subject of depreciation from the operating standpoint and recommended a schedule of depreciation for adoption? Has any appraisal company ever advocated that depreciation be distributed as an operating expense against the product? Can any appraisal company claim with any justice that it can determine proper rates of depreciation without close contact with and full knowledge of the operating conditions and operating needs of an industry? The primary business of an appraisal company is to determine an authoritative replacement value, and its entire organization is trained for this purpose. But when the appraisers enter the field of depreciation, operating values and costs, they are doing their clients positive harm and are leading them straight to the shoals of financial disaster; for appraisals have a distinct upward tendency, and the increases in value which they show as the result of wholly extraneous conditions have the effect of lulling the manufacturer into a wrong sense of financial security.

All of those with whom I have been associated in business for the last quarter of a century have been radicals in their methods of depreciation, but with all of this strong leaning toward what might be considered an excessive write-off, we frequently find when we are ready to discard a tool or reconstruct a building, that a substantial additional amount must be charged off to profit and loss.

The great majority of industries charge off too little rather than too much, and the appraisal companies, if anything, are assisting, unconsciously, of course, in increasing this unprofitable and ofttimes disastrous habit.

I had occasion recently to go over the financial statement of a manufacturing plant which had delegated the important function of depreciation to an appraisal company. The amount charged off annually was less than one-half of the proper amount, this being due, the owner said, to the constant and considerable advance in the replacement value of the property. Here was a typical case of reducing the operating burden of a plant by crediting it with a wholly speculative and unrealizable increase in property value. In this case the appraisal company specified the amount to be depreciated each year, and was, therefore, responsible for this wholly unsound and unscientific procedure. The owner is about to build a new plant, and I take no chances in prophesying that he has some bitter disappointments awaiting him in unforseen shrinkages of assets when he abandons the old plant.

The problem of determining an adequate scale of depreciation is by no means a simple one, and it goes hand in hand with the problem of distributing depreciation against the cost of the product. It is astonishing to find how widely the practice among different manufacturers in the same line varies.

Proposed Standard Rates of Depreciation. The manufacturers of conveyors and elevators have made an effort to agree on some standardized form of accounting procedure. The preliminary meeting of the manufacturers and their accountants disclosed the fact that, out of nine manufacturers, two disregarded the question of depreciation entirely, five charged off depreciation to profit and loss, and only two charged depreciation against operating expenses, making it thereby a component part of the cost. The rates of depreciation varied widely, and the first steps taken by the conference consisted in determining a standard schedule of rates of depreciation. The rates are but compromises growing out of the judgment and experience of the individual members of the conveyor manufacturers' conference, but their correctness can later be verified by matching the perpetual inventory values which these rates will establish, against the actual experience of loss in cash value when equipment or buildings are discarded.

* Extracts from a paper by Charles Piez, Chicago, Ill., *Trans. A.S.M.E.*, 1916.

STANDARD DEPRECIATION RATES ADOPTED BY MANUFACTURERS' COST CONFERENCE, FEB. 25, 1916

	Per Cent on Cost	Per Cent on Reducing Balance
BUILDINGS AND ACCESSORIES:		
Reinforced concrete or steel and tile	2	3
Brick and steel with non-combustible roof and concrete floors	2.5	4
Brick, steel and wood	3	5
Brick and wood	3	5
Steel frame, wooden roof and corrugated-iron walls	3.5	7
Steel frame, non-combustible roof and corrugated iron walls	3	6
Concrete block, with wooden roofs and floors	3.5	8
All-wood structures, well built (20 years)	4.5	10
All-wood structures, cheap (20 years)	5	12
Sprinkler system (20 years)	4	7.5
Heating and ventilating system (20 years)	4	7.5
Water and sewer piping and sanitary fixtures (where separate)	4	7.5
Tanks and reservoirs, steel	4.5	10
Tanks and reservoirs, wood (10 years)	9	20
Steel shelving, lockers, etc.	5	12
MACHINERY AND LARGE EQUIPMENT:		
Boilers, pumps, feedwater heaters and air compressors	6	15
Power piping	6	15
Switchboards, main wiring and conduit	6	15
Engines and dynamos	5	10
Machinery, motors, machine tools, traveling cranes, etc.	4.5	10
Punch presses, bending rolls, power shears and drop hammers	4.5	10
MISCELLANEOUS REAL ESTATE IMPROVEMENTS:		
Pavements, sidewalks, fences, retaining walls, roadways, tracks, yard drainage, general conduits, tunnels, vaults, etc.	4.5	10
Cupolas, converters, melting furnaces and accessories	5	10
Annealing and heating furnaces, ovens, forges, etc.	5	10
Motor trucks	20	60
Storage battery locomotives (battery renewals to repairs)	10	30
Horses and wagons	12	35
Shafting, pulleys, hangers and belting *	50	
Machine tool accessories—Boring bars, drivers, key seating broaches, etc. (All renewals to Repairs)	50	
SMALL TOOLS:		
For machines, net additions	50	
Hand tools, net additions	50	
PUNCHES AND DIES (Standard), net additions	50	
CHILLS, IRON AND STEEL FLASKS AND ACCESSORIES, net additions	50	
FIXTURES, FURNITURE AND MISCELLANEOUS EQUIPMENT:		
1 Mechanical appliances, net additions	60	
2 Departmental wiring and electric fixtures, net additions	60	
3 Miscellaneous items (wood), net additions	70	
PATTERNS (Standard):		
Metal, net additions	75	
Wood, net additions	100	
All patterns required for a particular order or contract to be charged to the job.	5	5
DRAWINGS:		
All new standard drawings to be charged to expense.		
All drawings required for a particular order or contract to be charged to the job.		

* These and the following items are depreciated once for all at the end of the first year after their purchase by the stated percentage, and the balance is then carried on the inventory without further reduction.

In a letter to the author, explaining the high rates of depreciation for small tools, fixtures, etc. Mr. Piez writes: "Only the items that are actively used in the fabrication of standard product are inventoried in this way, all other items being charged off wholly to expense. This seems somewhat radical treatment, but, as a rule, the inventory schedules for these several classes are catch-basins for all sort of charges, which seem to swell the inventory values without adding to the real assets of the manufacturing enterprise.

With a new concern, such treatment of these items is, of course, more radical than is justified, and our own practice where entirely new departments have been built up, has been to assess these items with a depreciation charge of 15 or 20 per cent per year, until they have been marked down to the point indicated by the schedule.

In the case cited (a new shop purchasing $1000 worth of small tools at the beginning of the first year, and $100 worth in each of the ensuing three years), we should charge off 15 per cent of $1000 cost of small tools for two years, and 20 per cent for the third year, and we should write off 50 per cent of the $100.00 additional purchased each year. At the end of three years, therefore, the inventory on the original lot would be $500.00, and the inventory value of the three years' purchases of $300.00 would be $150.00, making a total inventory of $650.00 for the purchase price of $1300.00.

In the discussion of Mr. Piez's paper Mr. R. J. Hearne said:

A perpetual inventory is a time saver.

A written invoice of all goods junked is vital.

It has been found best to number each section. Symbols should be avoided. At first they seem helpful, in the end they are a nuisance.

The inventory items should all be on cards. Books are not practicable.

Appraisal of present value can only be made by a competent, honest person, who knows all the facts and is familiar with the business. Appraisals by outsiders are of little value.

Taking off a fixed percentage is unreliable. A simple test is to ask for how much cash you would be willing to part with the machine. Honestly applied this test will give an accurate value.

Mr. Piez in closing the discussion said:

An occasional check by actual count and a re-appraisal of the value of the active items on the basis provided in the schedule of depreciations is strongly advised.

In order to compare the two schedules a condensed depreciation statement for a 34-inch boring mill costing $1318 and purchased Jan. 1, 1894, developed first on a straight depreciation of 4½ per cent on the original cost and, immediately below, on a 10-per cent rate on the reducing balance, is given herewith:

INVENTORY VALUATION AT END OF YEAR

	1894	1895	1904	1909	1914	1916
At 4½%	$1258.69	1199.38	$665.69	$369.04	$73.49	$0.00
At 10%	1186.20	1067.88	413.90	284.23	144.23	116.83

By the second method the original cost is never wholly extinguished, but the amount of depreciation thus written off each year approaches more nearly the shrinkage in value that usually takes place. Under normal conditions loss in the selling value *

* Why should the selling value be considered? The equipment is not for sale as a secondhand machine; it is being used, and its value to a going concern is what it would cost to replace it if it were burned.

of any item of equipment is more rapid in the early years of its life than in the later years. Then, too, there is usually some scrap value at the end of the period.

The method employed by many manufacturers of charging depreciation to Profit and Loss is wrong, for, while this method brings the book values of assets in line with actual values it does not make depreciation a part of the cost of production. All equipment, jigs, templates or patterns especially made for a particular order should be wholly charged to that order, and the reduction in value of all other buildings and equipment, as determined by the schedule of depreciation must be considered as a legitimate expense of the business and charged against the cost of the product. The easiest way of accomplishing this is to estimate in advance the depreciation of each department of the plant for the ensuing year, and assess one-twelfth of these estimates as monthly expense charges against the departments, as factors in the departmental overheads. Depreciation charges that cannot properly be assessed against any particular department should be assessed against general expense and distributed over the product through the general expense factors.

Depreciation Appraisals for Insurance Purposes *

The method developed by the appraisal department of the Factory Mutual Fire Insurance Companies is based on the theory that if the larger factors are carefully appraised, the less important items may be estimated in groups.

The price values used for buildings and all the subdivisions of machinery are based on *replacing new at today's market* (regardless of original cost) and these price values are then depreciated as judgment dictates.

Depreciation of Buildings. A building badly out of repair naturally deserves fairly heavy depreciation. A building in good repair, but so antiquated in size and shape that it is manifestly unsuited for the uses to which it is being put, also deserves a reasonably heavy deduction. When, however, a building is of such dimensions that it perfectly answers its purpose, has remained plumb and is constantly kept in repair, actual age has little influence on judgment. It is considered that about 5 per cent of the new value is enough. In other words, buildings are not depreciated a certain per cent a year, but have a flat amount deducted on account of condition and not on account of age.

Depreciation of Machinery. Machines vary greatly both in the manner in which they wear out and in the rapidity with which they go out of date. In rare cases where a machine has been practically superseded in the market by one that will cost much less, it is better practice to use for a new value the cost of the less expensive machine rather than show an excessive depreciation. As a rule, the amount deducted applies chiefly to wear.

With machines that need repairs at all points from time to time, a day arrives after a period of years when it is better to throw them out altogether and replace with new rather than continue to repair them. Practically all textile machines come in this class, as do engines and other power plant machines, and also some machine tools, wood working and paper-working machines. To all of that nature a depreciation table is applied, allowing 2, 2½, 3, 4 or 5 per cent a year, deducted from the net and not from the gross. If a machine is entirely rebuilt, it is usually considered to be worth at that time within 5 per cent of new value and the table is applied for succeeding years. In either case, the probable average life is ascertained and the table that best fits is used, but seldom is the depreciation carried to a point beyond 50 per cent.

There are many kinds of machines where the main portion, sometimes as much as 80 per cent of the total value, remains for years with practically no wear. The small moving parts, however, wear so rapidly that they are constantly being replaced. This is true of a great variety of machine tools, metal, wood and paper-working machines. With these it is considered that the wearing parts are always in a state of 50 per cent depreciation, and the amount deducted is half of the percentage the value of the wearing parts bears to the total value of the machine. This method also applies to rolling mills, rubber mills and calendars where the frames and gearing remain intact for years and the rolls constantly wear down and are replaced.

There is another class where neither the depreciation table nor the average described above can be used. This includes most of the machinery in paper mills, bleacheries and dye works where wet processes are used. These machines wear rapidly and are frequently rebuilt. Paper machines in particular are composed of a train of parts and from time to time different sections are either rebuilt or removed entirely and replaced. The depreciation in such cases depends upon the condition at the time of the appraisal and is not influenced by the age of what remains of the original machine.

Depreciation of Shafting, etc. Shafting shows such slight wear that depreciation is seldom recognized. It is becoming the custom, however, to show either a slight deduction or else purposely record the new value at a conservative figure when, on account of poor arrangement an amount in excess of what is needed is in use.

Main belts wear slowly, while machine belts will always average 50 per cent wear, so that, as a rule, the total amount of belting is depreciated 33⅓ per cent.

Piping will last for years, except where exposed to acid fumes. Pipe covering and valves show wear, but piping as a whole is seldom depreciated more than 10 per cent.

Electric wiring wears little and is usually kept pretty well up to date on account of the rigid rules of both local authorities and the insurance companies. It, therefore, seldom deserves much depreciation.

The miscellaneous equipment classed under the head of "furniture and apparatus" is made up of objects most of which are constantly wearing out. The amount is, therefore, usually depreciated from 20 to 50 per cent.

Small tools, dies, print rolls and electrotypes wear out, but they are affected to a great extent by obsolescence. Patterns, drawings, moulds and lasts are subject to depreciation for the latter reason only. In determining the amount to be deducted from the new value of any of these the appraiser must ascertain what proportion of the equipment is indispensable or practically new.

Appraisals of Manufacturing Property *

We define the valuation of industrial property as the value at which the physical manufacturing property of a corporation is carried on its books.

Our view is that the valuation of land, buildings and equipment should be shown on the books at their original cost, less a depreciation for use or obsolescence. As a check on our valuations and on our depreciation ratios, we have appraisals made by professional appraisers at intervals of approximately ten years and compare results carefully with our valuations.

In contrast with the accounting method, which should be based on actual cost, we believe that appraisals should be made on the basis of present cost to replace, less proper allowance for age or for obsolescence, rather than on the basis of original cost, as the latter may be difficult to determine at the time of the appraisal. Great care should be exercised in comparing appraisal values made on the basis of replacement values to avoid taking advantage of an abnormal present cost, such, for instance, as would occur in the case of appraisals made at the present time, due to the very high prices of practically all materials and labor.

* Extracts from a paper by John G. Morse, Appraiser, Inspection Dept., Assoc. Factory Mutual Fire Insurance Companies, on "*Accurate Appraisals by Short Methods.*" *Trans. A.S.M.E.*, 1916.

* J. B. Milliken, Treasurer, The Yale & Towne Mfg. Co., Stamford, Conn., *Jour A.S.M.E.*, Feb., 1917.

CHAPTER X

"SYSTEMS" AND "RED TAPE." FUNDAMENTALS OF A COST SYSTEM

Use of Red Tape. Prosperity depends on "red tape"—a system of high organization which can have its root and its fruit only in strict adherence to clearly outlined divisions of responsibility and authority and in accurate recording of the minutest details.—Geo F. Stratton, *Eng. Mag.*, Vol. 34, p. 569.

Unless a controlling common sense is continually exercised, a system of red tape may be developed which will be out of all proportion to the actual requirements of the business.

System overdeveloped becomes red tape, and that perhaps is to be avoided as much as lack of system.—Humphreys on "Business Engineering."

Red Tape is simply bad system, system that has never been tackled by all the individuals of a loyal and interested organization determined to answer the following questions:

1. How can we simplify?
2. How can we eliminate?
3. How can we condense?—F. B. Gilbreth in "Practical Talks on Contracting."

Too much cost system, too many figures, defeat the real purpose of costs, clogging action.—B. A. Franklin, *Eng. Mag.*, Vol. 43, p. 709.

One of the essential elements of scientific management is study of the subject of waste, whether of capital, material or time, or even of ink and of red tape. The work of the committee on information and statistics, and especially that of the "leak hunter," will include the study of whether the excessive use of red tape hinders the progress of the work or is costly in itself, and of finding ways by which the use of red tape may be curtailed. The words "red tape" are now used to signify any systematic method of making records, issuing requisitions or orders, checking against mistakes, countersigning checks and the like. In scientific management properly applied this so-called red tape is used only so far as investigation shows it to be necessary or desirable, and automatic machinery or other means are used to make the quantity of it as little as possible.—Wm. Kent, in "Investigating an Industry."

One fact that has retarded the extension of cost accounting is the unnecessary and the expensive refinement to which it is sometimes carried. There can be no objection on principle to red tape when that tape is necessary to tie together the organization; but sometimes there may be too much of it.

It is a waste of valuable time and energy to attempt to make each detail of the estimate absolutely correct.—C. B. Thompson.

The System-mad Manager. System is the rut in which some men are proud to live.

The systematic type of manager is a decided improvement on the rule-of-thumb type.

Averages are the fallacy of the system-mad manager.—E. St. Elmo Lewis.

If there is one thing more than another that excites criticism, it is red tape that does not justify itself in practical results. It may show itself in a mass of undigested reports, troublesome to make up in the shop and impracticable to use in the office, or it may take the forms of volumes of data that no one ever looks at. Another form of red tape, not uncommon, is carrying small items of cost to such a degree that the process of determining them is more expensive than the costs themselves.—Nicholson.

Cost Systems in Government Shops. Captain Metcalfe thus describes a part of the system in use in United States Arsenals before his book* was written (1885).

Timekeeping. The timekeeper, generally the foreman, goes about the shop towards the close of the day and asks each workman how he has spent it. According to the workman's recollection he enters the time reported in a book. At the end of the month these time books go to the main office where the clerks use them in making up the pay roll, and afterward allotting the various charges among the appropriations to which they belong. But the latter part of this work is, from the nature of the case, very imperfectly performed. The entries are confusing and indefinite. So the deciphering of these entries falls, as does the statement of the work done, and the cost of the fabricated product, upon the foreman, again burdening him with work for which he is not fitted, and interfering with the free exercise of his proper functions.

Procuring and Accounting for Material. 1. Let us take the simplest case first, and suppose the material to be in store, and the foreman to know it. He makes an entry in the "Store Book"; the commanding officer signs it; the book goes to the ordnance storekeeper or one of his assistants, who sends the material and the book, when he can get it, to the foreman. The latter receipts for the material on the margin of the original entry; the material is expended on the books of the storekeeper and the transaction is at an end.

2. When there is nothing suitable in store or the foreman thinks there is not, he makes his wants known on the "Purchase Book." As this book is kept in the office, he goes there, taking a memorandum of his wants; they are thus written twice (1, 2). They are then approved by the commanding officer (3); written on an order blank (4); copied on a duplicate stub (5); signed again by the commanding officer (6); and sent to the dealer (7). The supplies come with the bill, which is copied into the inspector's book (9) and initialed by him after inspection (10). To get it out of store, the foreman, still desiring them, writes them again on the store book (11), and after being again approved by the commanding officer (12) the book goes to the storekeeper, who takes the material and the book, when he can get it, to the foreman, whose receipt (13) ends his share of the business. The initialed bill then goes to the ordnance storekeeper, who receipts for the stores on the duplicate stub (14). The assistant storekeeper also keeps a record, of a more or less perfect kind, of all receipts into (15) and issues from (16) his storehouse.

From the stubs receipted by the ordnance storekeeper and the bills received from the dealer, is made out a certificate of inspection (17) signed by the assistant inspector (18) then by the commanding officer as principal inspector (19) then the

*The Cost of Manufactures and the Administration of Workshops, Public and Private.

material is receipted for again by the ordnance storekeeper (20); then approved by the commanding officer and forwarded to the chief of ordnance for payment to be authorized (21); then returned by the chief of ordnance for payment (22); Vouchers in duplicate (23, 24) are then made out, approved by the commanding officer (25, 26) and the creditor's receipt affixed to each (27, 28) after payment. The purchase is then entered in duplicate on the monthly abstract of purchases, a cash paper (29, 30); and again in duplicate on the Quarterly Abstract of purchases, a property paper (31, 32). The Ordnance Storekeeper credits himself with the expenditure of the same items on the abstract of expenditures, also in duplicate (33, 34).

EXAMPLES ILLUSTRATING THE PRACTICAL USE OF THE SERVICE CARDS.

NOTE.—The card is here reduced to fit the page.

(7.)

SERVICE CARD, Frankford Arsenal. APR 6 1885

No.	Name.	Price per unit.
235,	Lannigan,	0,25.

Charge to—	Nature of service in detail.	No. of units. Pieces.	Time.
S-O. 107	Making 3 pair of bullet dies. (Example 3.)		2
C. T.		AMOUNT.	
O. A. 31		Doll's.	Cents.
N. 313	N. B. Make but one entry on each card.		

(8.)

SERVICE CARD, Frankford Arsenal. APR 6 1885

No.	Name.	Price per unit.
235,	Lannigan,	0,25.

Charge to—	Nature of service in detail.	No. of units. Pieces.	Time.
S-O. 107	Timing stroke of bullet machine, setting dies, gauging, etc. (Example 4.)		1
C. A.		AMOUNT.	
O. A. 31		Doll's.	Cents.
313	N. B. Make but one entry on each card.		

The Card System. Capt. Metcalfe proposes to use cards instead of books for original entries. He says:

"For every act or name to be recorded, there shall be a separate card; so that the cards being combined or classified, the acts or names they represent will be so too. For this purpose I propose the use of single cards for all initial records, and their gradual consolidation by the simplest mechanical means until they are finally transcribed into the permanent books of record.

The independence of a representative unit of record is the basis of system I propose, combined with the use of a nomenclature by which all acts and their purposes may be set forth by the actors in such form as to be intelligible to those whose proper office it is to enroll and classify them.

The following are the cards required to carry out the system:

1. The order card or ticket,
2. The service card,
3. The material card,
4. The correspondence card.

CASE II.

Drawing Material from Outside the Arsenal to be held in Charge.

MATERIAL CARD.

FRANKFORD ARSENAL, MAY 24 1883 (f.)

Receipts and issues from, 2. (f.) to 4 (f.) to to

TITLE.

Per ABSTRACT,		C. (s.c.)		
VOUCHER,		113 (s.c.)		

QUANTITY.	CLASS. C.	NAME.	CONDITION.

MATERIAL.

No. Assumed. Unit.

10 (f.) pcs.

~~brass castings from patterns furnished~~ (f. corrected by s.c.)

Actual.

40 (f.) lbs. brass cast (s.c.) (2 pieces bad, blow holes) (f.)

Price per unit. 35 (s.c.)

AMOUNT. 14 00. (s.c.)

N. B. Make but one entry on each card.

COST.

CHARGE TO				CREDIT TO			
S-O.	C.	Object.	N.	S-O.	C.	Object.	N.
214 (f.)	W. (f.)						

STOCK

PACKAGE: KIND. NO. WEIGHT, Lbs. MEASURE, Ft.

Received from, or sent to

REC'D BY	Foremen punch here.	Storekeepers punch here.	ISSUED BY	Foremen punch here.	Storekeepers punch here.

AUTHORITY, CO

{L.S.}

Samples of the service and material cards, reproduced from Capt. Metcalfe's book, reduced in size, are here shown. The actual service card is about $4\frac{1}{2} \times 5\frac{1}{2}$ inches.

The card system proposed by Capt. Metcalfe has been generally adopted in Government shops, but, as shown in some of the testimony given before Congressional Investigating Committees, much yet remains to be done in the way of cutting out unnecessary red tape. Quotations from this testimony are given on the next page.

Accounting systems in Government arsenals:

Major O. M. King, Ordnance Dept., Rock Island Arsenal, Rock Island, Ill. Testimony Jan. 12, 1913, before the Special Committee of the House of Representatives to investigate the Taylor and other systems of shop management, Vol. 2.

(Abstract), p. 1081. The engineering division makes up a list of parts necessary to finish an order. A copy of this list goes to the planning room.

The planning room determines the different operations to perform in order to complete any particular part. This is entered on a route sheet.

For each particular operation a job card is made.

A move ticket is issued, which is to follow the material from the storehouse to the different machines and to the assembling place.

When the material is moved to the first machine, the card comes back to the division, notifying it that the material is at the machine.

Then the shop card covering the operation is posted.

(Time studies and instruction cards had not then been introduced).

Gen. Crozier's testimony.

P. 1128. In ascertaining the cost of our productions, I have, of course, encountered what every manufacturer encounters, namely, the elusive nature of costs. It is very difficult to ascertain costs.

Mr. Redfield (to Mr. Pepper): I wish you would bear that phrase in mind; it would make a classic.

P. 1130. In some establishments there is a process which still exists; a timekeeper with a ruled sheet on a board would walk about the shop every day and ask each workman how much time he has spent on different jobs that he had worked on that day and put them down with more or less accuracy—often considerably less. The job card contains: No. of the work to which the expense is to be charged. Symbol of the form No. for this card. Man's name and No. Symbol for the portion of the shop in which he works. Piece symbol. Lot No. No. of the operation and enough of the description of the operation to understand it. Name of the article and a statement of what the man is to do. No. of the drawing. No. and location of the machine. All this is placed on the card when it is handed to the man. The time is stamped on the card when it is given to him, and when he returns it.

Cost Accounting in the Brooklyn Navy Yard. (Extract from the testimony of Adolph Muller, sheet-iron worker, in a hearing before a special Committee of the House of Representatives to investigate the Taylor and other systems of Scientific Management, Oct. 25, 1911, Government Printing Office, 1912, Vol. I, p. 672.)

Now, in cost accounting in repairs for ships—I am the planner over there and had occasion to make out the instruction cards to make 74 brackets for the storage of fire extinguishers. In order to get at the cost accounting on account of these brackets being made to be installed on 13 different ships, and being that there were so many operations on each bracket, it necessitated the writing of 104 instruction cards and 104 duplicates. I complained about having to write out 104 tickets for a small job that in my estimation wouldn't cost any more than $40 to do, and he instructed me to put all the job numbers on the one ticket. There wasn't room on the ticket to do it, and I suggested to attach a slip, which I did, with all the job numbers written on the slip. I distributed those slips and told the men to charge up their time pro rata, so that left the man to do more figuring according to that system than he would have had to do if he had no system at all, because prior to that the charging of the time was left to the clerk, and the clerk would divide up the time equally.

Now, the condition is this, that a man has all those job numbers, and he must divide up his time and send his card in to the accounting department in order to receive his pay, with the number and the amount of time written on it, and the result is that the men are not bookkeepers and the time isn't being sent in right and the job isn't finished yet, but the cost accounting on that job will be anything but what it should be.

A Better System. Here is the way the accounting might have been done under a better system.

The Navy Yard receives from the Bureau of Construction and Repair an order "Make 74 brackets for fire-extinguishers as per sketch herewith. Deliver them to warehouse tagged as follows, 5 for Columbia, 6 for Connecticut," etc.

The planning department has a working drawing made with complete instructions, and makes as many job tickets as there are men who are to work on the several operations. The first card contains, or has attached to it an order on the storekeeper for the raw material needed. The move man with this order gets the material and takes it to the place where the first operation is to be done, and returns the order to the planning room with the storekeeper's check on it showing that the material has been delivered, and a memorandum of the kind, quantity and price. When the workman who is to do the first operation (or series of operations), has finished his preceding job he gets the job ticket for his work on the 74 brackets, has it stamped by the time clerk and proceeds with the work. When it is finished he returns the ticket with the time stamped on it, and with the foreman's or inspector's check certifying that the work has been done properly. The job tickets for the remaining operations are given out and returned in like manner. When all the operations are finished the accounting department enters on the tickets the costs for material, labor and burden and makes a Piece Cost Card for the 74 brackets, which summarizes the information on the job tickets, credits Labor, Stores and Burden accounts with their respective portion of the costs, and charges Warehouse with the total. Thus, the cost accounting is complete up to the delivery of the brackets to the warehouse, which is credited and the different ships charged as each receives its proportion of the brackets.

The Federal Trade Commission's Cost System Fundamentals. The Federal Trade Commission, Edward N. Hurley, Chairman, has published a pamphlet of 31 pages entitled "Fundamentals of a Cost System for Manufacturers." It presents some good arguments in favor of the use of a cost system by manufacturers, and outlines in some detail the elements of such a system. In general, it shows a regular double-entry journal and ledger system, the ledger having 36 accounts. The commercial and factory accounts are all included in one ledger, and the costs determined, as far as the pamphlet goes, are the total costs for a month of "work in process" and of finished goods. The "Job Cost System" is recommended and briefly described, but no example of its use is given.

In the system described Accounts Receivable is debited with Sales, and credited with Sales Returns, Allowances, and Discounts, also with Cash for cash sales, and with Reserve for Bad Debts. Accounts payable is credited with all indebtedness incurred for material, labor and expenses of all kinds, and debited to Cash and to Discounts on Purchases as the indebtedness is settled. Work in Process is charged with Material and Labor directly expended in production, and with Overhead, which is subdivided into three departments

A, B, and C, each of which is charged on the basis of the "productive hours," 67 cents per hour for A, 52 cents for B, and 15 cents for C. The total indirect expenses, subdivided into Labor, Building Expense, Power, Insurance, Taxes, Repairs, and General Factory Expenses, together with Reserve for Depreciation are charged to these three overheads. Finished Goods is charged and Work in Process credited with the cost of goods put in warehouse, and Finished Goods is credited and Trading Account charged with the cost of goods sold. Profit and Loss is charged with Shipping, Selling Expense, General Expense, Discount on Sales and Reserve for Bad Debts, and credited with the gain on Trading Account and with Discounts on Purchases. Surplus account is credited and Profit and Loss charged with the credit balance of Profit and Loss Account.

The complete ledger entries of the 36 accounts, including 196 entries from the journal and 12 balancing entries, a total of 208, are given in six pages of the pamphlet. By transcribing the 196 entries to the form of the Combined Journal-Ledger or Column Ledger (see page 17, *ante*), and dividing the ledger into two, a Commercial Ledger and a Factory Ledger, the number of the entries is reduced to 103, viz.: 28 in the Commercial Ledger and 75 in the Factory Ledger, as shown below, on page 97. Two additional accounts are needed in making this division, Factory Account, to which all transactions between the Company's office and the factory are charged or credited in the Commercial Ledger, and Company Account, for the same transactions, in the Factory Ledger. At the bottom of the Factory Ledger there is a statement of "Details of Credits to Company Acct." containing 20 items which might have been made as entries in the Factory Ledger, increasing the number of accounts in it from 19 to 28 and the number of entries from 75 to 95, but it is more convenient to enter them in a separate statement.

In the Balance Sheet (page 96) are entered in the two middle columns the total charges and credits of the several accounts in the Commercial and Factory Ledgers. In most of the accounts the Dr. and Cr. sides balance (8 out of 15 in the Commercial Ledger and 9 out of 17 in the Factory Ledger, as shown by the check marks at the right of the figures in the columns headed Total Charges). When the account is open or unbalanced, the difference between the two sides is added to, or subtracted from as the case may require, the balance at the beginning of the month to obtain the balance at the end of the month.

On page 98 is shown a modified form of the Factory Ledger which has some advantages. The number of accounts is reduced from 19 to 10, and the number of entries from 75 to 27. Eight accounts, Building Expense, Power, Insurance, Taxes, Reserve for Depreciation, Repairs, General Factory Expense, and Shipping, are lumped together in one "control" account, General Charges, and they are taken care of in a separate ledger form, entitled Distribution of General Charges and Overheads. The last two columns are added to give the details of the entries in the Condensed Ledger: Gen. Charges to Labor, $1051.00 and to Gen. Charges, $436.66. The Details of Credits to Company Acct. at the bottom of the ledger on page 97 should also be given, to show the details of the item Gen. Charges to Company, $3079.35.

The advantages of the Column Ledger, or Combined Journal-Ledger over the old style double-entry journal and ledger have already been explained (pages 20 and 30), but for convenience they may here be restated.

Instead of a page being required for each ledger account only two pages—or sheets to be bound in a loose-leaf binder—a month are required, one for the Commercial Ledger, the other for a Factory Ledger.

Making a double entry, debiting one account and crediting another, is done by writing the amount once in the proper column and line; no other writing whatever is needed, the titles of all the accounts being printed.

The Journal is made unnecessary. Instead of making a Journal entry as follows:

	Sundries	To Power	(4)			841	00
(3)	Bldg. Exp.			84	10		
(10)	Overhead A			252	30		
(11)	Overhead B			336	40		
(12)	Overhead C			168	20		

and then posting the amounts on five pages of the ordinary double-entry ledger, a single entry is made in column 4 of the Factory Ledger, on lines 3, 10, 11, and 12, of the figures 84.10; 252.30; 336.40; 168.20. The sum of these figures 841.00 will be entered at the bottom of column 4 if there are no other credits of Power account, otherwise the total of the column will be entered when it is added up after all the entries are made.

A most important advantage, not heretofore mentioned, is that photostat copies of the journal-ledger pages and of the balance sheet may be used, instead of the usual form of reports, laboriously transcribed from the old-fashioned ledger, for the information of officers and directors.

The functions of the cost system are stated in the pamphlet as follows:

> A "Cost System" provides not only for the determination of the amount of each element (material, labor, expense), of cost properly chargeable to each job, but also provides for an improved method of bookkeeping which causes the books to reflect at all times the true financial and industrial condition of the business and renders possible the preparation of monthly statements of conditions, as well as complete monthly statements of financial and factory operations.

This long sentence charges the Cost System with far more duties than should properly be laid upon it. It charges it with certain functions which belong to bookkeeping, accounting and statistics, and to statements of industrial conditions, which are functions of other departments.

The functions of the several departments may be labeled as follows:

Bookkeeping. Recording in proper form the receipts and expenditures of the business, sales, purchases, cash, bills and accounts payable and receivable, salaries, pay roll, etc.

Accounting. Organizing the bookkeeping system and causing it to show not only the record of receipts and expenditures, but their relation to merchandise, cost of plant and of

its operation, discount and interest, depreciation, repairs and other expenses, profits and losses; financial conditions of the business.

Statistics. Historical record of accomplishment of the business. Goods made and sold, divided into classes and departments. Total and departmental manufacturing costs, buying, selling and general expenses. Comparisons by months, seasons and years, and by classes of goods dealt in.

Industrial Conditions. Reports as to labor, buildings, machinery, transportation, efficiency of manufacturing and selling departments, market conditions, etc.

Commercial Costs. Furnished by the accounting and statistical departments.

Factory Cost System. Costs (labor, material, and factory expense) of each kind of article produced, and of each job.

Monthly Balance Sheet. Jan., 1916

COMMERCIAL LEDGER

	Balance Jan. 1				Monthly				Balance Jan. 31			
	Dr.		Cr.		Charges		Credits		Dr.		Cr.	
16 Sales					13,485	60	13,485	60				
17 Sales Returns					865	20	865	20				
18 Sales Allowances					50	00	50	00				
19 Outbound Freight					120	00	120	00				
20 Trading					13,047	52	13,047	52				
22 Selling Expenses					1,120	53	1,120	53				
23 General Expenses					1,180	67	1,180	67				
24 Discount on Purchases					165	40	165	40				
25 Discount on Sales					95	00	95	00				
26 Reserve for Bad Debts			125	00	64	00	70	00			131	00
27 Profit and Loss					4,222	28	4,222	28				
28 Accounts Receivable	6,000	00			13,485	60	10,949	20	8,536	40		
29 Accounts Payable			6,250	00	15,515	90	19,499	71			10,233	81
30 Cash	17,061	00			9,875	00	15,350	50	11,585	50		
34 Capital Stock			100,000	00							100,000	00
35 Unissued Stock	15,000	00							15,000	00		
36 Surplus			5,000	00			1,518	89			6,518	89
38 Factory	73,314	00			17,765	57	9,317	77	81,761	80		
Total	111,375	00	111,375	00	91,058	27	91,058	27	116,883	70	116,883	70

FACTORY LEDGER

1 Material	3,000	00			8,084	32	6,484	32	4600	00		
2 Labor			200	00	5,692	28	6,179	07			686	79
3 Building Expenses					508	60	508	60				
4 Power					841	00	841	00				
5 Insurance					828	00	72	00	756	00		
6 Taxes					1,095	00	94	25	1,000	75		
7 Depreciation Reserve			1,240	00			328	74			1,568	74
8 Repairs					589	23	589	23				
9 General Factory Expenses					467	99	467	99				
10 Overhead, A					1,207	34	1,207	34				
11 Overhead, B					1,431	74	1,431	74				
12 Overhead, C					816	35	816	35				
13 Reserve for Overhead					273	43	273	43				
14 Work in Process	2,000	00			14,110	99	12,086	13	4,024	86		
15 Finished Goods	3,754	00			12,086 597	13 12	8,801	53	7,635	72		
21 Shipping					237	19	237	19				
31–33 Real Estate and Equipment	66,000	00							66,000	00		
37 Company			73,314	00	9,317	77	17,765	57			81,761	80
Total	74,754	00	74,754	00	58,184	48	58,184	48	84,017	33	84,017	33

Commercial Ledger. January, 1916

CREDIT ACCOUNTS

Charge Accounts	16 Sales	17 Sales Returns	18 Sales Allowances	19 Outward Freight	20 Trading	22 Selling Expense	23 General Expense	24 Dis. on Purchases	25 Dis. on Sales	26 Res. for Bad Debts	27 Profit and Loss	28 Accounts Receivable	29 Accounts Payable	30 Cash	34 Capital Stock	35 Unissued Stock	36 Surplus	38 Factory	Total Debits
16 Sales		865 20	50 00	120 00	12,450 40														13,485 60
17 Sales Returns												865 20							865 20 ✓
18 Sales Allowances												50 00							50 00 ✓
19 Outward Freight													120 00						120 00 ✓
20 Trading											4056 88							8801 53 189 11	13,047 52 ✓
22 Selling Expense													1120 53						1,120 53 ✓
23 General Expense													1090 73					89 94	1,180 47 ✓
24 Discounts on Purchases											165 40								165 60 ✓
25 Discounts on Sales												95 00							95 00 ✓
26 Reserve for Bad Debts												64 00							64 00
27 Profit and Loss						1120 53	1180 67		95 00	70 00							1518 89	237 19	4,222 28
28 Accounts Receivable	13,485 60																		13,485 60
29 Accounts Payable								165 40						15,350 50					15,515 90
30 Cash												9,875 00							9,875 00
34 Capital Stock																			
35 Unissued Stock																			
36 Surplus																			
38 Factory					597 12								17,168 45						17,765 57
Total Credits	13,485 60	865 20	50 00	120 00	13,047 52	1,120 53	1,180 67	165 40	95 00	70 00	4222 28	10,949 20	19,499 71	15,350 50			1518 89	9317 77	91,058 27

Factory Ledger. January, 1916

CREDIT ACCOUNTS

Charge Accounts	1 Material	2 Labor	3 Building Expense	4 Power	5 Insurance	6 Taxes	7 Res. for Depn.	8 Repairs	9 Gen. Facty Expense	10 Overhead A	11 Overhead B	12 Overhead C	13 Res. for Overhead	14 Work in Process	15 Finished Goods	21 Shipping	37 Company	Total Charges
1 Material																	8,084 32	8,084 32
2 Labor																	5,692 28	5,692 28
3 Building Expense		185 00		84 10	12 00	20 00	40 00	65 00									102 50	508 60 ✓
4 Power		300 00			8 00	10 00	40 00										483 00	841 00 ✓
5 Insurance																	828 00	828 00
6 Taxes																	1,095 00	1,095 00
7 Depreciation Reserve																		
8 Repairs		356 40			2 00	2 50	13 33										215 00	589 23 ✓
9 General Factory Expense		92 60	76 29														299 10	467 99 ✓
10 Overhead, A Dept.		246 50	101 72	252 30	12 00	15 00	75 00	159 00	155 90				84 32				105 60	1,207 34 ✓
11 Overhead, B Dept.		251 20	127 15	336 40	16 00	20 00	100 00	247 80	207 79								125 40	1,431 74 ✓
12 Overhead, C Dept.		185 70	101 72	168 20	7 00	8 75	43 75	115 43	104 30								81 50	816 35 ✓
13 Reserve for Overhead											119 78	153 65						273 43 ✓
14 Work in Process	6484 32	4444 67								1207 34	1311 96	662 70						14,110 99
15 Finished Goods														12,086 13			597 12	12,683 25
21 Shipping		117 00	50 86		1 00	1 25	8 33	2 00									56 75	237 19 ✓
31–33 Real Estate and Equip																		
37 Company			50 86		14 00	16 75	8 33						189 11		8801 53	237 19		9,317 77
Total Credits	6484 32	6179 07	508 60	841 00	72 00	94 25	328 74	589 23	467 99	1207 34	1431 74	816 35	273 43	12,086 13	8801 53	237 19	17,765 57	58,184 48

Details of Credits to Company Account	Matl.			Power		Building Expense			Repairs	Gen. Fcty Exp.	A	B	C	Shipping
Purchases	7800 00	Pay Roll	5692 28	Oils	45 00	Elevator Exp.	58 00	Supplies	167 00	20 00	30 00	40 00	20 00	50 00
Freight	284 32	Cost of Returns	597 12	Water	38 00	Water	16 50	Miscellaneous Expense	48 00	14 10	75 60	85 40	61 50	6 75
		Insurance	828 00	Fuel	325 00	Misc. Matl.	28 00	Factory Office Expense		265 00				
	8084 32	Taxes	1095 00	Supplies	75 00		102 50		215 00	299 10	105 60	125 40	81 50	56 75
			8212 40		483 00									

Factory Ledger—Condensed

CREDIT ACCOUNTS

Charge Accounts	1 Material	2 Labor	General Charges	10 Overheads A	11 Overheads B	12 Overheads C	13 Reserve for Overhead	14 Work in Process	15 Finished Goods	37 Company	Total Charges
1 Material										8,084 32	8,084 32
2 Labor										5,692 28	5692 28
General Charges		1,051 00	436 66							3,079 35	4,567 01
10 Overhead, Dept. A		246 50	770 92				84 32			105 60	1,207 34 ✓
11 Overhead, Dept. B		251 20	1,055 14							125 40	1,431 74 ✓
12 Overhead, Dept. C.		185 70	549 15							81 50	816 35 ✓
13 Reserve for Overhead					119 78	153 65					273 43 ✓
14 Work in Process	6,484 32	4,444 67		1,207 34	1,311 96	662 70					14,110 99
15 Finished Goods								12,086 13		597 12	12,683 25
37 Company			327 13				189 11		8,801 53		9,317 77
Total Credits	6,484 32	6,179 07	3,139 00	1,207 34	1,431 74	816 35	273 43	12,086 13	8,801 53	17,765 57	58,184 48

Distribution of General Charges and Overheads

CREDIT ACCOUNTS

Charge Accounts	3 Building Expense	4 Power	5 Insurance	6 Taxes	7 Reserve for Depn.	8 Repairs	9 General Factory Expense	21 Shipping	Total Charges	Labor Credits	General Charges
3 Building Expenses		84 10	12 00	20 00	40 00	65 00			221 10	185 00	221 10
4 Power			8 00	10 00	40 00				58 00	300 00	58 00
8 Repairs			2 00	2 50	13 33				17 83	356 40	17 83
9 General Factory Expenses	76 29								76 29	92 60	76 29
10 Overhead, A	101 72	252 30	12 00	15 00	75 00	159 00	155 90		770 92		
11 Overhead, B	127 15	336 40	16 00	20 00	100 00	247 80	207 79		1,055 14		
12 Overhead, C	101 72	168 20	7 00	8 75	43 75	115 43	104 30		549 15		
21 Shipping	50 86		1 00	1 25	8 33	2 00			63 44	117 00	63 44
37 Company	50 86		14 00	16 75	8 33			237 19	327 13		
Total Credits	508 60	841 00	72 00	94 25	328 74	589 23	467 99	237 19	3,139 00	1,051 00	436 66

BALANCE OF GENERAL CHARGES ACCOUNT

	Dr.	Cr.	Balance
Insurance	828 00	72 00	756 00 Dr.
Taxes	1,095 00	94 25	1,000 75 Dr.
Reserve for Depreciation		328 74	328 24 Cr.
Dr. Balance			1,428 01
General Charges Dr. in Ledger		4,567 01	
General Charges Cr. in Ledger		3,139 00	1,428 01

UNBALANCED ACCOUNTS, FACTORY LEDGER

Dr.		Cr.	
General Charges	1,428 01	Company	8,447 80
Material	1,600 00	Labor	486 79
Work in Process	2,024 86		
Finished Goods	3,881 72		
	8,934 59		8,934 89

CHAPTER XI

DAILY AND MONTHLY RECORDS. CHARTING OF STATISTICS. COST OF IDLENESS

DAILY RECORD OF WORK IN PROCESS. NUMEROUS OPERATIONS ON ONE PIECE.

Form NM1 shows the method used by the National Meter Co. for keeping track of the number of pieces of one kind through a sequence of several operations. The figures may require some explanation. The first figure, 33,250, is the number of pieces that had been delivered from the foundry from the beginning of the order (or it may be from the first of the year) up to Nov. 23, and 337 is the number delivered on that day. There were 54 pieces on hand at the first machine, No. 453, and the 337 added make 391; 337 pieces were drilled and passed to the second machine, No. 475, as entered in the second line under "Received," leaving a balance of 54 remaining to be drilled on the following day. The figures in the column "On Hand" show the number of pieces at the several machines at the beginning of the day, and the figures under "Balance" the number of pieces at the end of the day; which figures are entered in the "On Hand" column of the next day. Up to the end of Nov. 24, from the beginning of the order 33,937 castings had been furnished, which are all to be accounted for; 1372 had been rejected as defective, and 2550 were at the machines, making 30,015 parts that had been completed.

(Size 8×5 in.)

Stock on Hand and in Process at End of Day

Part No. B 1786 ⅝ in. Bodies Date, Nov. 23, 1915

Operation	Time on Machine	Material Furnished 33,250	Material in Process						
			On Hand	Received	Total	Finished	Defective 1362	Balance	Parts Completed 29,617
Drill C Ho	453–2	337	54	337	391	337		54	
Edge and Face	475–10	33,587	235	337	572	220		352	
Chamfer	213–4		0	220	220	155		65	
1 Rough	461–10		114	155	269	210		59	
Reface	476–10		317	210	527	216		311	
Slotting	367–1		244	216	460	60		400	
2 Rough	69–10		889	60	949	240	7	702	
Finished Cut	319–5		418	240	658	198		460	198
							1369	2403	29,815
		33,587				Nov. 24,	1915		
Drill C Ho	210–1	350	54	350	404	200		204	
Edge and Face	475–10	33,937	352	200	552	215		337	
Chamfer	213–6		65	215	280	280		0	
1 Rough	461–10		59	280	339	206		133	
Reface	476–10		311	206	517	290		227	
Slotting			400	290	690			690	
2 Rough	69–10		702		702	235	3	464	
Finished Cut	319–10		460	235	695	200		495	200
							1372	2550	30,015

Form NM1. Daily Record of Work in Process.

From these daily records of product and from the pay roll monthly summaries are made showing the direct-labor cost per piece for each operation, as shown in the Comparative Cost Record Card on the next page.

Monthly Comparative Cost Record Card

B–1786 5/8 Bodies Month Ending 4/30/15

Operation	Pieces Finished	Operator	Time	Rate	Total Cost	Cost Each
Drill Center Hole	4092	204	24½	.24½	$5.94	.001
Edge and Face	3643	16	147	.24½	36.02	.009
Chamfering	3789	149	29	.16½		
Chamfering		284	6½	.25		
Chamfering		459	27	.16½	10.79	.002
First Rough	4077	459	161½	.16½		
First Rough		149	3	.16½	27 14	.006
Refacing	4095	532	217	.23	49.91	.012
Slotting	4547	367	92½	.19	17.58	.003
Second Rough	2986	505	128	.21¾	39 15	.013
Finish Cut	2953	26	137	.25		
Finish Cut		506	10	21¾	36 43	.012
	2953		983	$222 00	$222.96	$ 058

Form NM2.

A perpetual inventory of rough and of finished parts is kept on 8×5-inch Cards.

Part No. B. 1786 Bodies Size ⅝ in.

Finished Date 1915	Rec'd	Del'd	On Hand	Rough Date 1915	Rec'd	Del'd	On Hand
11/20	Forward		6605	11/20	Forward		1913
		29	6576	11/23		337	1576
11/22	202		6778	11/24		350	1226
		52	6726				
11/24	200		7072				
		103	6969				

Form NM3

Monthly reports of each class of product are made on a form printed as follows on typewriter sheets 8½×13 inches, two forms to a sheet.

Report of ⅝ Type K. AMD Parts From 11/27 to 12/31/16

	Cylinders	Heads		Pistons	Bases		Covers
		Bottom	Top				
Symbol	B1786	S4508			B1907	3 48	B1908

Form NM4.

The side headings are "Rough Stock," On Hand, Balance Forward; "Received"; "Delivered"; "Defective Parts"; "Bal. Rough Stock on Hand"; and these headings are repeated for "Stock in Process," and "Finished Stock," and lines are also given for total stock on hand, and for total output and distribution from the beginning of the year to date for each of the parts of the machine and for the completed machine.

A weekly Labor Report is made on two typewritten sheets in the following form:

Labor Report of Pay Roll for Week Ending ——— 1916

Superintendence Traffic

Departments	Employees and Maintenance		Production	Totals
Miscellaneous:				
Shipping and Trucking	8	162.60		
Cost Dept.	6	123 37		
Meter Stock Room	2	36.45		
Engineer and Producerman	2	61.50		
Electrician and Helper	2	57.60		
Fireman	1	20.25		
Stenographer and Office Boy	2	25.05		
Watchmen (night)	2	45.75		532.57
Drafting	6	78.90		78.90
Repair—Foreman	1	26.62		
Bench and Machine Hands	18		290.32	316.94
Cap. Dept.	9		104.70	104.70
Japanning and Tinning	5		93.37	93.37
Mr. Brown—Foreman	1	43 50		
Helpers (sweepers)	2	24 75		
Bench and Machine Hands	42		754.27	822.52
(Followed by the figures for other foremen and their bench and machine hands.)				
Mr. Jones—Foreman	1	44 50	3.50	
Toolmakers, etc.	20	301.17	182.08	
Press Hands	3		55.87	587.12
Mr. Smith—Foreman	1	35.10		
Patternmakers	5	134.43		169.53
Millwrights:				
Millwrights, etc.	13	204 48	1.47	
Elevator Operators	4	39.52		245.47
Machine Dept. A. Totals				

A similar list is made out for Dept. B and for the Foundry. From the report from which the above figures were taken it appears that of the total labor cost the proportion for superintendence traffic and maintenance was 34 per cent in Dept. A, 23 per cent in Dept. B, and 7 per cent in the Foundry.

In this factory the costs of the individual articles made are reported only for material and for labor directly engaged in production. The apportionment of the costs for superintendence, traffic and maintenance, and for other items of burden or overhead, to the different products is left to the general office.

WEEKLY AND MONTHLY COST PERIODS

The fact that in our yearly calendar the lengths of the months vary is the occasion of some difficulty to cost accountants. Pay rolls are usually made for a week's time, while bills for goods purchased are either rendered monthly or else monthly statements are made out giving the totals of the bills of goods purchased during the month. Salaries are also commonly paid in monthly instalments. It is convenient for

statistical purposes to compare the cost and output figures of one month in the year with those of other months or with those of the corresponding month in the previous year, but a calendar month may contain four full-week pay-roll periods, or four weeks plus from 1 to 3 days, or three or four full weeks plus one or more days at the beginning of the month and other days at the end. If the pay-roll week ends on Saturday night the calendar month may cover parts of six pay rolls, for example, in July, 1916, which began on Saturday it would include one day, July 1, four full weeks, July 2–29, inclusive, and two days July 30 and 31.

There are several ways of minimizing the difficulty:

1. The pay roll may be made out for calendar months, and all statistics kept by these months. The total output of product (tons, yards, etc.), or the total cost of this product may be divided by the number of days in the month to obtain average daily product or the average daily cost.

2. The pay rolls may be for weeks while the statistics may be for months, the pay-roll figures for the odd days outside of the three or four full weeks being computed separately and added to the figures of the full weeks in order to obtain the monthly labor costs.

3. The pay rolls may be weekly and the expense or burden charges and the statistics for calendar months, some months including four pay rolls and some five; and, in case the year does not begin the same day that the weekly pay roll begins, the labor costs of the months of January and December would include four weekly pay rolls plus portions of the pay rolls at the beginning or end of the year or both.

4. The year, for statistical purposes may be divided into four thirteen-week periods, the first day of the first pay-roll week being the first day of January. In this way the pay-roll week would begin on a different day in different years.

5. In like manner, the year may be divided into thirteen four-week periods.

6. The pay-roll period may be a "pay-roll week" made by dividing the calendar month into four parts as nearly equal as possible. In some large works these "weeks" end on the 8th, 15th and 22d, and on the 28th to the 31st of the month, according to number of days in the month. Thus, the first period would be of eight days of which either one or two would be Sunday, the second and third periods would be each seven days, including one Sunday, and the fourth period would, in January, be of nine days with one or two Sundays, and in February of a year not a leap year, only six days, one of which might be a Sunday.

The third of the above-described methods is probably the most common. It has the disadvantage, for statistical purposes, of showing the monthly output and monthly labor cost to be sometimes for four weeks and sometimes for five, and of inaccuracy in the monthly distribution of burden, the charges to burden account being in some cases (indirect labor), for four or five weeks, and in others (salaries supplies and work by outside parties), for the calendar month, while the credits (work in process and finished product) are for four or five weeks.

The following is an example of accounting by this method:

Memoranda from which Journal-Ledger Entries are Made

Charge	Credit	Amount	
Stores	To Company	$2500	For materials purchased during the month, the bills being certified to Company for payment, as per Invoice Register.
Work in Process	To Labor	2500	Direct labor, as per job tickets and pay rolls for 4 weeks ending Jan. 28.
Work in Process	To Stores	800	Material delivered to shop, charged on job tickets or stores issue cards, for 4 weeks.
Burden	To Labor	1800	$1200 indirect labor, from pay roll for 4 weeks, $600 salaries for month.
Burden	To Stores	300	Supplies for power plant and shop, for month.
Burden	To Company	300	For repair work done on plant by plumbers, etc., as per their monthly bills certified for payment, $200.
			For charges from Company's books, monthly proportion of taxes, insurances, depreciation, water rent, etc., $100.
Finished Product			
To Work in Process		2800	For goods transferred from shop to warehouse, for month
To Labor		100	Packing and shipping, as per job tickets, for 4 weeks
To Stores		100	
To Burden		100	
Work in Process:			
To Burden		2100	For burden charged on job tickets for work done in shop, 4 weeks.
Company to Finished Product		2000	For Goods shipped, at factory cost, during month.
Labor to Company		4200	For payments on account of pay rolls

Journal-Ledger. January

Charge	Credit Accounts						
	Company	Stores	Labor	Burden	Work in Proc.	Fin. Prod.	Total Dr.
Stores	2500						2,500
Labor	4200						4,200
Burden	300	300	1800				2,400
Work in Process		800	2500	2100			5,400
Finished Product		100	100	100	2800		3,100
Company						2000	2,000
Total Cr.	7000	1200	4400	2200	2800	2000	19,600

Totals and Balances

	Dr.	Cr.	Dr.	Cr.
Stores	2,500	1,200	1300	
Labor	4,200	4,400		200
Burden	2,400	2,200	200	
Work in Process	5,400	2,800	2600	
Finished Product	3,100	2,000	1100	
Company	2,000	7,000		5000
	19,600	19,600	5200	5200

All of the accounts in the above balance sheet represent assets except the $5000 liability of the factory to the Company, the $200 liability to Labor (wages unpaid), and the $200 debit to Burden account, which represents undistributed burden. Part of this amount is due to the fact that some of the debits to this account are for the whole month while all of the credits are only for four weeks, and in other months when the credits are for five weeks the debit balance may be canceled and a credit balance take its place. If the burden had been computed for the extra days beyond the four weeks the account might have been debited, say $200 more for Labor and credited say $300 more by Work in Process, which would have reduced the debit balance to $100. At the end of the year or fiscal period it is necessary to make the entries for the days of the month that may remain beyond the end of the pay-roll week, so that Burden account may be balanced properly and the balance, debit or credit as the case may be, closed into Profit and Loss.

The sixth method, that of dividing each month into four pay-roll periods, ending on the 8th, 15th, 22d, and 28th to 31st, is probably the most satisfactory for cost accounting, as it enables all the debits and credits of Burden to be made for the full month, and avoids the trouble of making computations for the extra days beyond the weekly periods.

The Cost Period. It is advisable to have the cost period coincide with the pay roll periods as far as practicable, so that the closing days will agree. That is if the men are paid by the week the cost period may be four or five weeks. In this way calculations of wages not yet paid will be avoided and the distribution of costs simplified.—Nicholson.

MONTHLY RECORD OF PROGRESS IN A FACTORY

The monthly progress of the business is not shown by the monthly totals of the entries charging and crediting Stores or Work in Process, since many of these entries represent mere changes in location of material, but only by the credits of Labor and Burden accounts charged to Work in Process and by the record of man-hours worked per month. This is illustrated by the following table of four months' entries to the principal factory accounts.

Credit Accounts

Charge Accounts		Accounts Payable	Labor	Burden	Stores	Work in Process	Warehouse	Total Dr.
Stores	Dr. Jan.	1,000				3,000		4,000
	Feb.	5,000				1,000		6,000
	Mar.	2,000				1,000		3,000
	Apr.	2,000				4,000		6,000
Burden	Dr. Jan.	1,000	2,000		1,500			4,500
	Feb.	500	2,000		1,500			4,000
	Mar.	500	2,000		1,500			4,000
	Apr.	500	2,000		1,500			4,000
Work in Process	Dr. Jan.		3,000	3,500	5,000			11,500
	Feb.		3,500	4,000	2,000			9,500
	Mar.		4,000	4,500	4,000			12,500
	Apr.		4,000	4,500	3,000			11,500
Warehouse	Dr. Jan.					5,000		5,000
	Feb.					10,000		10,000
	Mar.					8,000		8,000
	Apr.					9,000		9,000
Sales	Dr. Jan.						4,000	4,000
	Feb.						9,000	9,000
	Mar.						10,000	10,000
	Apr.						12,000	12,000
Total Credits		12,500	22,500	16,500	20,000	41,000	35,000	147,500

The sum of Labor and Burden charged to Work in Process is for the four successive months $6500, $7500, $8500, $8500. This is a better record of the progress of the business than is given by any of the other accounts, all of which show great fluctuations on account of movements of material and changes of balances, which do not represent quantity of work done. The difference between the charges and credits of Burden account is a most important index of factory conditions, the charges showing the monthly cost of burden and the credits the amounts of normal burden charged, on the machine-hour rate basis, to the cost of product. The difference between the two represents the unearned or over-earned burden, as the case may be. The former indicates factory losses due to idle machinery; the latter factory gains on account of machinery being fairly well employed. The difference for the four months, according to the above table are as follows:

		Jan.	Feb.	Mar.	April	Total
Burden Acct.	Dr.	4500	4000	4000	4000	$16,500
	Cr.	3500	4000	4500	4500	16,500
Gain, plus, or Loss, minus		−1000	0	+ 500	+ 500	0

Here is a way of tabulating the totals of the Journal-Ledger so as to show balances, and also transactions with Company Account, Company being credited with the balance of stores of all kinds, also with payments of Labor and Accounts Payable, and charged with shipments from warehouse:

Factory Accounts

		Balance Jan. 1	Jan.	Feb.	Mar.	Apr.	Total 4 Months	Dr. Balance
Stores	Dr.	44,000	4,000	6,000	3,000	6,000	19,000	43,000
	Cr.		6,500	3,500	3,500	4,500	20,000	
Burden	Dr.		4,500	4,000	4,000	4,000	16,500	
	Cr.		3,500	4,000	4,500	4,500	16,500	
Work in Process	Dr.	35,000	11,500	9,500	12,500	11,500	45,000	39,000
	Cr.		8,000	11,000	9,000	13,000	41,000	
Warehouse	Dr.	39,000	5,000	10,000	8,000	9,000	32,000	
	Cr.		4,000	9,000	10,000	12,000	35,000	36,000
Company Cr.		118,000				Company Cr.		118,000

The " Total 4 mos." column may be omitted, and balance columns may be inserted after each month's column instead, if it is desired to show the balances of the several accounts each month.

Company Accounts

		Jan.	Feb.	Mar.	Apr.	4 mos.
Labor	Cr. Co.	5000	5,500	6,000	6,000	22,500
Accts. Pay.	Cr. Co.	2000	5,500	2,500	2,500	12,500
		7000	11,000	8,500	8,500	35,000
Sales	Co. Dr.	4000	9,000	10,000	12,000	35,000

THE CHARTING OF COSTS. THE EXCEPTION PRINCIPLE

One of the results of a good costing and accounting system is a series of statistical tables for the use of the executives. The study of these tables leads to better planning of factory policies. But tables of figures are dreary things; they are often difficult to interpret, and haste in interpreting them is apt to lead to wrong conclusions. Important statistical tables should be diagrammed on cross-section paper or "charted." The cost system, with its accompanying charts should determine and show the following. (F. B. Gilbreth, *Jour. A. S. M. E.* April, 1917.)

1. What the quantities of individual outputs should be (prophecies of outputs).
2. Prompt records of individual outputs.
3. What the costs should be (prophecies of costs).
4. Prompt records of costs.
5. Causes of fluctuations and deviations of outputs and costs from prophesied outputs and costs.

Mr. Gilbreth emphasizes the value of "the exception principle" in connection with the executives' study of charts. He says:

> No executive should make a routine motion of handling, turning over or examining charts containing data, either normal, or with considerable deviation from normal, where the causes of the deviation can be handled properly by those in lower executive positions. The exclusion of such cases can be obtained by having the executive determine zones on the charts, it being understood that as long as the points fall within the zone he is not to see the charts unless he specially requests to see them.

This is the "exception principle," that the chief executive should concern himself only with exceptional matters, that are outside of the zones of normal, everyday work.

DIAGRAM OF THE ACCOUNTING SYSTEM
Company's Books, Accounts Relating to Factory

A Permanent Investment Accounts		B Expense Accounts		C Manufacturing and Factory Operating Account		Balance
Land Buildings and Fixtures Machinery and Equipment Office Furniture and Fixtures		Taxes Paid Insurance Paid Reserve for Depreciation Administrative Expense (portion charged to Factory) Interest charged to Factory		Dr. To Cash, for Pay Roll and Petty Cash To Accounts Payable, for purchases on factory account To Expense, $\frac{1}{12}$ of B each month To Factory, gains on over-earned burden, or appreciation of assets	Cr. Factory Cost of Goods shipped from factory Factory Losses assumed by Company and not charged to cost of product, such as unearned burden, depreciation of assets	The balance of Manufacturing Account includes the current assets of the factory, viz: Stores Work in Process Finished Goods in Warehouse
Dr. For Cost or Appraised Value and Cost of Betterments	Cr. By Proceeds of Sales By depreciation. (Chg. Res. for Depn.)	Dr. For Actual Expenditure	Cr. By Factory Operating Acct. each month—$\frac{1}{12}$ of annual expense			

FACTORY BOOKS

Company Account	Stores	Labor	Burden	Work in Process	Warehouse
This account is the reverse of Account C above Cr. Company for Cash and materials received, and for Expense charged by Company	Dr. For Cost, including freight and other expense of all materials and supplies received	Dr. For payments of wages, salaries, etc.	Dr. For all indirect expenditures, cash, labor or supplies that cannot be charged directly to cost of product	Dr. For Direct Labor, and Direct Material from stores, and for burden charged to cost of work	Dr. For Factory Cost of goods made and for expenses of warehouse
Debit for goods shipped, and for other values charged to Company	Cr. For all material used by the factory and charged to Work in Process or Burden Accounts	Cr. Credits of labor on pay rolls and salary lists	Cr. By the several allocations of burden to Cost	Cr. By Factory Cost of goods put in Warehouse, and by betterment work charged to Company	Cr. By Factory Cost (including expense) of goods shipped on Company's account

Diagram of Annual Exhibit

The accompanying diagram, Fig. 2, shows a useful method of presenting the relative volume of business done in different classes of product, with the cost of material, labor, burden and selling expense, and the profit on each, both in dollars and in percentages. Horizontal distances are made proportional to the percentages of volume of business and vertical distances to percentages of factory cost; areas are proportional to the several items of expenditure and profit.

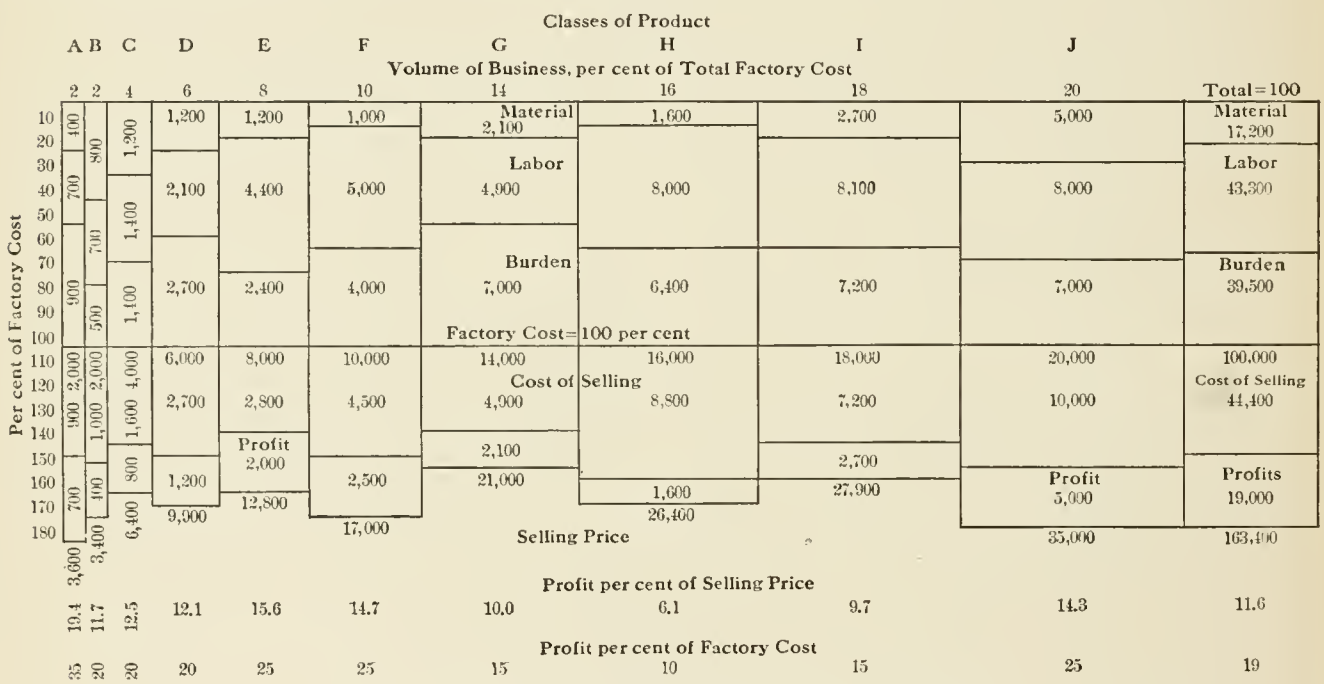


FIG. 2.—DIAGRAM OF VOLUME OF BUSINESS, COSTS AND PROFITS.

The value of such a diagram depends entirely upon the use that is made of it. The cost system is complete without it, and it is of no benefit to the management unless it is studied and acted upon. A progressive manager on receiving such a diagram from the chief accountant would probably at once notice that Class H showed a profit of only $1600 out of the total profits of $19,000, and that the profit was only 10 per cent of the factory cost and 6.1 per cent of the selling price. He would then start an investigation as to what might be done in order to insure that a better showing might be made in the following year. The investigation would include a study of the possible results of several actions that might be taken, viz.: advance of prices, lowering of costs of selling, burden, labor, material. He would then notice that Classes A, B and C showed profits respectively of only $700, $400 and $800, due not to low percentages of profits but to small volume of business, and might then take steps to increase the sales of these classes.

Cost accounts are of little value if they do not lead to action.

IDLENESS CHARTS *

There are many methods of cost accounting; but there are only two leading theories as to what cost consists of. They are:

First, that the cost of an article must include all of the expense incurred in producing it, whether such expense actually contributed to the desired end or not.

Second, that the cost of an article should include only those expenses actually needed for its production, and any other expenses incurred by the producers for any reason whatever must be charged to some other account.

The first theory would charge the expense of maintaining in idleness that portion of a plant which was not in use to the cost of the product made in that portion of the plant which was in operation; while the second theory would demand that such expense be a deduction from profits. When plants are operated at their full capacity, both theories give the same cost. When, however, they are operated at less than their full capacity, the expense of carrying the idle machinery is, under the first theory, included in the cost of the product, making the cost greater; while under the second theory, this expense of idle machinery is carried in a separate account and deducted from the profits, leaving the cost constant. *When costs are figured on the second basis, great activity immediately ensues to determine why machinery is idle, and to see what can be done to put it in operation.* It is realized at once that this machinery had better be operated, even if no profits are obtained from its operation and only the expense, or even part of the expense, of maintaining that machinery is earned.

MILL, Textile June, 1916

Symbol	Department or Mach. Class	% of Capacity used on Day Turn (10 20 30 40 50 60 70 80 90)	Total Expense of Idleness	Details of Idleness Expense Due to: Lack of Work	Lack of Help	Lack of and Poor Material	Repairs	Poor Planning	Remarks
	Spinning		18 70	18 70					
	Winding		118 74		103 74		15 00		
	Doubling		10 61	10 61					
	Twisting		17 95	17 95					
	Quilling		20 67	10 67	10 00				
	Warping		390 75			390 75			Lack of Wound Yarn
	Weaving		915 25	75 00		840 25			Lack of Warps
	Finishing		210 72			210 72			Lack of Woven Goods
	Inspecting		49 70		10 70	39 00			Lack of Woven Goods
	Shipping		216 17	66 00		150 17			Lack of Woven Goods
	Total		1969 26	198 93	124 44	1630 89	15 00		
									Approved by
									Supt.

Patent Applied For

FIG. 3.—GANTT'S IDLENESS CHART.

Fig. 2 illustrates this subject most clearly. Charts of this nature, which are being made monthly in several large plants, have already had a very educational influence on the managers of those plants. They show that idle machinery which cannot be used should be disposed of, and the money received, and the space occupied, put to some useful purpose.

If now the cause for idleness is ascertained each day we can find the expense of each cause of idleness as shown on the chart. That part which is due to lack of orders points out that our selling policy is wrong, or that the plant is larger than it should be—in other words that somebody in building the plant has overestimated the demand. It is clear, however, that no conclusion should be based on the figures for one month, but on the results for a series of months during which the problem has been carefully studied.

Expense due to lack of help means that we must investigate the labor policy.

Expense due to lack of, or poor material, is an indication of the efficiency of the purchasing policy and storekeeping system.

If in any case the expense of idleness is greater than can be attributed to all of these causes together, it must go in the last column as poor planning.†

Mr. Gantt is undoubtedly correct in favoring the second one of the two theories as to what cost consists of, but some question may be raised as to what are "the expenses actually needed for the production of the article," and, whether, under some conditions, it is not right to charge some of the cost of idle machinery to the cost of an article. It may be that the nearest approximation to true costs will be found in a compromise between the two theories. In many lines of business it is not the cost of a certain article that has to be determined or estimated, but that of hundreds or thousands of different kinds of articles, finished and unfinished, in order to obtain reasonably correct inventory valuations and profit and loss estimates. In that case it is impossible that every department and every machine can be run every day at its full capacity, or that the machine equipment can be so nicely apportioned to the orders on hand that no machines are ever idle. In the textile mill, the idleness chart of which is shown, it may be possible, if the mill is a large one and makes only one style of goods, so to balance the machinery that none of it is idle more than say 10 per cent of the time, but, if many different styles are made, the demand for which varies with the season and with the fashion, the weaving machines may be running full time and not be able to take the whole capacity of the spinning machines, some of which would, therefore, have to be idle part of the time; and it

* Extract from a paper by H. L. Gantt, on "Productive Capacity a Measure of Value of Industrial Property." *Trans. A. S. M. E.*, 1916.

† It may be due to panic or general business depression, something for which the owners of the concern are not responsible. It may also be due to permanent decrease of demand for the product caused by competition of other products, as in the cases of automobiles replacing horse-drawn vehicles, and of steam turbines replacing reciprocating engines.—W. K.

may not be possible to utilize the full capacity of the inspecting and finishing departments.

The "expense actually needed" for the production of a variety of articles may thus include, at least, part of the idle time of some machines which must be kept in the factory to meet a varying demand, but which cannot be kept continuously employed, and in such a case it is right to charge some of the cost of idleness into the "normal burden" which is distributed in the machine-hour rate to the cost of the goods. The machine-hour rate should be figured once a year, after studying the statistics of preceding years, for each machine, and it should include an allowance for the average or normal time that the machine may be expected to be idle during the coming year. If the actual idleness time in the ensuing year is greater than the amount estimated, the excess should not be apportioned to the cost of goods in any one month, or in a year, but should be charged to profit and loss, either directly or through a subordinate account, such as "Loss due to Idleness of Plant."

A modification of Mr. Gantt's idleness chart is thus suggested in order to show how much of the idleness of a machine or department is normal and necessary to the conduct of the business, and how much is abnormal or excessive. This may be made by drawing vertical lines on the chart indicating the normal percentage of full capacity which each machine or department is expected to run during a month of good business. In the chart shown, Fig. 3, doubling might have such a line at 70 per cent and twisting at 75 per cent, showing the excess idleness of doubling to be 22 per cent as compared with 52 per cent total idleness, and the excess idleness of twisting 22 per cent as compared with the 47 per cent shown on the chart.

The most important function of Mr. Gantt's idleness chart is not that it is a historical record of what happened during the past month, not a mere statement of what was the cost of idleness in that and in preceding months: it is that it is an exhibit of inefficiency which will stimulate the managers of the business to action. It leads to investigation of the causes of idleness and to the finding of methods to remedy it.

IRON WORKS STATISTICS—GRAPHICAL PRESENTATION

The accompanying table and chart, Fig. 4, taken from a paper on "A Decade of Progress in Reducing Costs," by

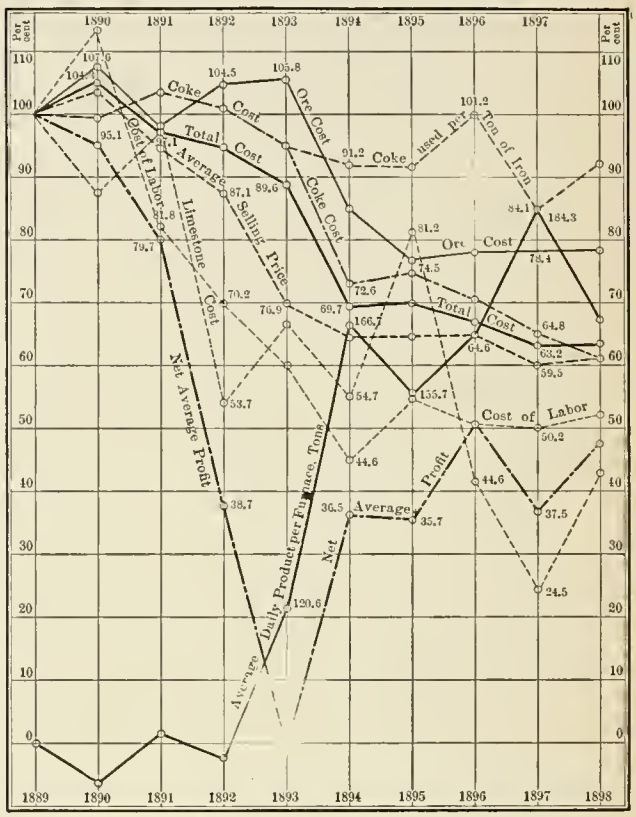


Fig. 4.—Iron Works Statistics.

Chas. Kirchhoff (*Trans. Am. Inst. Mining Engrs.*, 1899), show the relative percentages of the several items entering into the cost of a ton of pig iron, taking the costs in the year 1899, a year of high profits, at 100 per cent. The method of presentation is one that may be found useful in many industries. The chart, which is made by plotting the figures of the table, shows the fluctuations and general tendencies of costs much more clearly than do the figures themselves.

FIGURE FLUCTUATIONS IN COST OF PRODUCTION OF PIG IRON.—SOUTHERN PLANT

Comparative Statement of Pig-Iron Costs for the Year 1839 to 1898, both Inclusive, with the Figures of 1889 taken as a Unit Basis

Year	Product per Day, Tons, Per Cent	Coke Consumption per Ton Iron Per Cent	Ore Cost, Per Cent	Limestone Cost, Per Cent	Coke Cost, Per Cent	Labor Cost, Per Cent	Cost of Arbitraries, Per Cent	Cost of Sundries, Per Cent	Total Cost, Per Cent	Average Selling Prices, Per Cent	Net Average Profit Per Cent
1889	100	100	100	100	100	100	100	100	100	100	100
1890	94.1	99.4	107.6	87.6	99.4	112.8	103.3	105.8	104.3	103	95.1
1891	101	102.3	98.2	97.6	102.8	81.8	103.3	99.6	97.1	94.6	79.7
1892	98.1	100.6	104.5	53.7	100.8	70.2	106.6	112.2	95.1	87 1	38.7
1893	120.6	94.7	105.8	67.1	94.6	60.5	100	90.8	89.6	76.9	00
1894	166.7	91.2	85.4	54 7	72.6	44.6	88.3	70.1	69.7	65	36.5
1895	155.7	91.2	76.6	81.2	74.5	55.3	95.6	47.1	69.8	64 9	35.7
1896	164.4	101.2	78	41.6	70.6	50.9	127	42.1	67	64 6	50 8
1897	184.3	84.1	78.4	24.5	64.8	50.2	116 6	37.4	63.2	59 5	37.5
1898	167.7	91.2	79	40.3	64.1	51.9	113.3	33.4	63.4	61 2	47 9

Memoranda.—Arbitraries cover relining charge, general office expense, taxes and insurance. Sundries cover sand, brass and iron castings, coal to locomotive and engines and boilers and pumps, and small tools and furnace supplies.

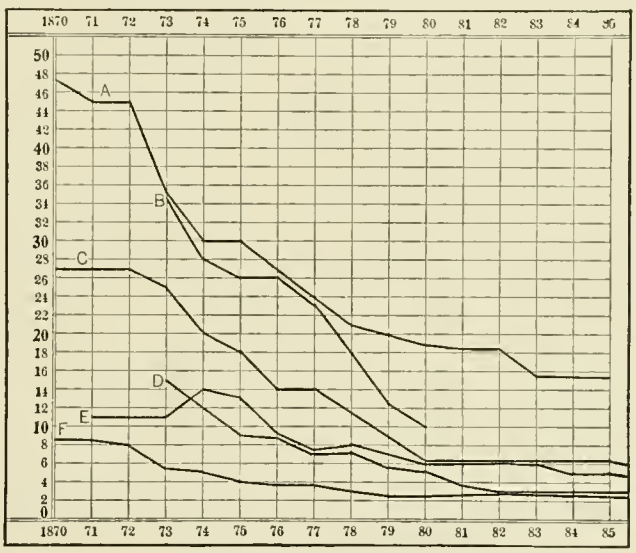


FIG. 5.—CHART OF LABOR COSTS.

Fluctuations in Labor Costs on six commodities during fifteen years under a contract and piece-work system. (Henry R. Towne, *Trans. A. S. M. E.*, 1886. From *Eng. Mag.*, April, 1916.)

CHAPTER XII

PROBLEMS AND DIFFICULTIES. STANDARD COST

ESTIMATES OF COST WHEN THE BY-PRODUCT OR SCRAP FROM ONE PRODUCT IS USED IN MAKING ANOTHER

Problem. A boiler and tank manufacturer installs a costly punching press to be used in making large disks for boiler and tank heads. The material used is steel plate, cut into squares, and the waste or scrap is 25 per cent of the original material. This waste may be sold in the market for remelting, or it may be used as the raw material for small disks or washers which are cut in a small press. At what price shall the scrap be valued in estimating the cost of the small disks, and what is the factory cost or inventory value of the small disks, and also of the large disks, (*a*) when the scrap is sold at a low price, (*b*) when the scrap is utilized in making small disks?

Cost Data, before Installing the Small Press

Operation. Cutting large steel disks.

Machine. Heavy punching press—cost, with attachments, $2000.

Material. Steel plates costing 2c. per pound delivered at the machine.

Scrap. 25 per cent of the raw material, sold at 0.8 cents per pound.

Labor. Pressman, 30 cents per hour. Helper, 25 cents per hour.

Product. 20 disks per hour. Average weight of blanks, 100 pounds.

Running Time. 600 hours per year, the market for large disks being limited.

Yearly cost for materials:		
$600 \times 20 \times 100 = 1{,}200{,}000$ lbs. @ 2¢		$24,000
Yearly cost for labor:		
$600 \times 0.30 + 600 \times 0.25$		330
Estimated burden:		
Interest, Taxes, Insurance, Depreciation, Repairs, Lubrication of machinery, $2000 @ 15%	300	
Rent of space for machinery and storage, 1000 sq. ft. @ 20¢ per year	200	
Interest on capital invested in material and product (6 turnovers a year) $4000 @ 6%	240	
Power, 0.5 H.P. @ 4¢ per H.P.-hour, 600 hrs.	12	
Superintendence, 10% of labor cost,	33	785
Total		25,115
Credit 300,000 lbs. scrap @ 0.8¢ per lb.		2,400
Cost of 900,000 lbs. of disks, average 2.524¢ per lb.		$22,715

Additional Cost after Installing the Small Press

The small press costs $500. Of the 25 pounds scrap left after making each large disk, 60 per cent, or 15 pounds is made into small disks, and 40 per cent, or 10 pounds is scrap sold at 0.8 cents per lb. The machine occupies a corner of the room in which the large machine is located, it requires no extra superintendence, and no extra investment of capital. The extra costs are:

Labor, one man 1200 hrs. per year, @ 30¢			360	00
Burden: Int. Depn. etc., on machine $500 @ 15%	75	00		
Power, 0.2 H.P. @ 4¢, 1200 hrs.	9	60	84	60
			444	60

If we charge the material at the scrap value

300,000 lbs. @ 0.8	2400			
Less 120,000 lbs. sold scrap @ 0.8	960		1440	00
Making total extra cost for making 180,000 lbs. small disks or 1.047 per lb.			1884	60

Estimated cost of small disks made from new material:

Material: 240,000 lbs. @ 2¢	4800	00		
Less scrap 25%, 60,000 @ 0.8¢	480	00	4320	00
Labor, 1200 hrs. @ 30¢			360	00
			4880	60
Burden: Int., Depn., etc., on machinery, 500 @ 15%	75	00		
Power, 0.2 H.P. @ 4¢ per H.P.-hr., (1200 hrs.)	9	60		
Superintendence (part of cost charged large disks)	18	00		
Rent, 250 sq. ft. @ 20¢ per year.	50	00		
Interest on capital, $4800 ÷ 6 = $800 @ 6%	48	00		
	200	60		
Cost of 180,000 lbs. disks @ 2.711 per lb., total			4880	60

Revised Estimate of Cost of Large Disks

Charging the small disks with part of the burden of the large disks as in the above table involves a modification of the cost estimate of the large disks as below. If we charge the small disks and credit the large disks with the scrap at a price which will make it equivalent to that of raw material, making the net cost of material for the small disks $4320 after deducting $960 for 120,000 pounds scrap sold at 0.8 cent, this charge and credit will be $4320+960=5280$, or 1.76 per pound. The revised estimate for the large disks then becomes

Material, 1,200,000 lbs. @ 2¢	240,000	
Less 300,000 lbs. scrap @ 1 76	5,280	18,720
Labor as before		330
Burden, Interest, Depreciation, etc., as before	300	
Rent, 750 sq. ft. @ 20¢	150	
Interest on capital 240—48	192	
Power	12	
Superintendence 33—18	15	669
		19,719
Total 900,000 lbs. @ 2.191¢ per lb.		

Summary

(1) Cost of 900,000 pounds large disks, material cost 2 cents per pound, and 300,000 pounds scrap sold at 0.8 per pound, total cost $22,715 = 2.524 per pound.

(2) If the scrap is credited at 1.76 cents per pound, the price charged to the small disks, and a portion of the burden is also charged to the small disks, total cost $19,719 = 2.191 cents per pound.

(3) Cost of 180,000 pounds small disks made from 240,000 pounds new material at 2 cents per pound, 60,000 pounds scrap sold at 0.8 cents; or from the 300,000 pounds scrap from the large disks, charged at 1.76 per pound, and crediting 120,000 pounds scrap sold at 0.8 cents, the small disks being charged with their share of the burden of the department, $4880.60 = 2.711 cents per pound.

(4) Cost of the small disks if made of scrap charged at 0.8 cents per pound and with only the extra burden caused by making the small disks, leaving the large disks to assume all the regular burden of the department as in (1), $1884.60 = 1.047 cents per pound.

(5) Total cost of 900,000 lbs. large disks	22,715	00	19,719	00
and 180,000 lbs. small disks	1,884	60	4,880	60
	24,599	60	24,599	60
1,080,000 lbs. average cost 2.278¢ per lb.				

Analysis of Costs	Material		Burden		Labor
Large disks	21,600 or 18,720		785 or 669		$330
Small disks	1,440 or 4,320		84 60 or 200.60		360
Total	23,040	23,040	869.60	869.60	690

Now, which of these figures is the " true " factory cost and which should be entered as the inventory value or used as a basis for quoting prices?

The net cost of material, $23,040, is based on the most favorable condition of the utilization of scrap, viz.: that all the scrap from the large disks was taken for the manufacture of the small disks and that none of it had to be sold outside on account of deficient demand for the small disks, and that no new material needed to be bought for the small disks at 2 cents per pound on account of the demand for small disks being greater. Such a balance between demand and supply of scrap of a given quality and shape is exceedingly rare, and would not be likely to repeat itself the next year. If all the disks were unsold at the time of taking the inventory for the purpose of figuring profits and losses, it would be proper to value them at the recorded cost, $24,599.60, or 2.278 per pound, although it would probably cost more to replace them when they were sold; but it would not be safe to use this figure as the basis upon which the lowest selling price for future contracts should be fixed, for that should take into consideration the fact that the recorded cost was probably abnormally low on account of the unusually favorable condition of the balance of supply and demand for scrap.

Factory costs are needed in order to get approximately correct inventory values, from which to calculate profits and losses; also in order to have a basis for minimum selling prices; the recorded costs are past history, useful to the bookkeeper, to balance his books, but the costs that are to be used as a basis for future prices should be " normal costs " or probable future costs, and these may differ considerably from the recorded costs.

The case becomes much more complicated when the product is of two or more classes, as in the case of the disks, and when, in taking the inventory there is found on hand a much larger fraction of the total annual product of one class than of another. Suppose that before taking the inventory two-thirds or 600,000 pounds of the large disks were sold at 3 cents per pound, the selling expense being 0.3 cents per pound, and one-third or 60,000 pounds of the small disks at 2.5 cents per pound with a selling expense of 0.5 cents per pound, what is the profit on each size, and what is the inventory value of the remainder?

LARGE DISKS

Sold 600,000 lbs. @ (3 − 0.3)¢	$16,200	00			$16,200	00
Cost @ 2.524¢	15,143	33	or	@ 2.191	13,146	00
Profit	1,056	67	or		3,054	00

SMALL DISKS

Sold 60,000 lbs. @ (2.5 − 0.5)¢	1,200	00			1,200	00
Cost @ 1.047¢	628	20	or	@ 2.711	1,626	87
Profit	571	80	or Loss		426	87
Sum of profits	1,628	47	or		2,626	13

Putting the transactions in ledger form we have:

Dr. LARGE DISKS Cr.

900,000 @ 2.524	22,715	00	600,000 @ 2.7		16,200	00
Profit	1,056	67	Bal. 300,000 @ 2.524		7,571	67
	23,771	67			23,771	67
or						
900,000 @ 2.191	19,719	00	600,000 @ 2.7		16,200	00
Profit	3,054	00	Bal. 300,000 @ 2.191		6,573	00
	22,773	00			22,773	00

SMALL DISKS

180,000 @ 1.047	1,884	60	60,000 @ 2		1,200	00
Profit	571	80	Bal. 120,000 @ 1.047		1,256	40
	2,456	40			2,456	40
or						
180,000 @ 2.711	4,880	60	60,000 @ 2		1,200	00
			Bal. 120,000 @ 2.711		3,253	13
			Loss		426	87
	4,880	60			4,880	60

Suppose that all the disks are sold, leaving no inventory, then, for the two assumed values of scraps, we have:

	Large Disks		Small Disks		All Disks	
	Cost	Profit	Cost	Profit	Cost	Profit
Scrap at 0.8¢ total	22,715	1585	1884.60	1715.40	24,599.60	3300.40
Per lb.	2.524¢	0.176¢	1.047¢	0.953¢	2.278	0.356¢
				Loss		
Scrap @ 1.76¢ total	19,719	4581	1880.60	1280.60	24,599.60	3300.40
Per lb.	2.181	0.519	2.711	0.711	2.278	0.356

If the scrap is charged at the market value, the apparent cost of the small disks is much too low, and the apparent profit much too great.

If the scrap is charged at a price equivalent to that of new material, the cost of small disks is too great, leading to an exaggerated inventory value and to a large apparent loss when the disks are sold. Both methods of computing costs and corresponding inventory values and profits are wrong. Some compromise value of the scrap used for the small disks must be found.

It will not be correct to lump the two sizes of disks together, using the average cost 2.278 cents per pound, thus eliminating the question of the value of the scrap, for that would make the small disks cost more than their selling price less selling expense.

It would appear to be fair to fix the price of scrap to be credited to the large disks and charged to the small disks at such a figure as would split the difference between 0.8 and 1.76 cents, making it 1.28 cents, thus allowing the large disks to gain 0.48 over the market value of the scrap and the small disks to gain an equal amount over what they would have to pay if they were made from new material at 2 cents per pound or from scrap at the equivalent value of 1.76 cents. Figuring in this way we obtain revised cost and profit estimates as follows:

Large Disks:

Material, 1,200,000 @ 2¢	24,000
Less 300,000 @ 1.28	3,840
	20,160
Labor	330
Burden	669
	21,159
Selling price, net @ 2.7	24,300
Profit, 0.349¢ per lb.	3,141

Small Disks:

Material 3000,000 @ 1.28¢	3,840
Less 120,000 @ 0.8	960
	2,880
Labor	360
Burden	200.60
180,000 @ 1.911¢	3,440.60
Selling price, net @ 2¢	3,600
Profit, 0.089¢ per lb.	159.40

Profit on investment of capital:

	Large Disks	Small Disks
Capital in machinery	2000	500
Capital in stock	4000	0
	6000	500
$3141 ÷ 6000 = 52.35%		159.40 ÷ 500 = 31.88%

This is probably a close enough approximation to true costs, considering that in actual business there would rarely, if ever, be such a balance between supply and demand for scrap that none of the large scrap would have to be sold at the market price for scrap used for remelting, or that there would be no need of purchasing new material for the small disks on account of the deficiency of scrap—also that so much of the burden charged is based not on actual expenditures but on estimates, which themselves are based on hypotheses or guesses.

Moral: There is no such thing as "true cost" when the product is varied in kind and when one product gives by-products to be utilized in another product, but the accountants and the management should make every effort to obtain as close an approximation to true costs as possible.

Elbourne (Factory Administration and Accounts) says:

"The art of costing is essentially one of close approximations rather than the collection of absolute facts. However precisely the net quantities of materials are obtained there will be a call for judgment in the prices to be charged in the costs.

"Until men become absolutely automatic machines and the administration is perfected in the last degree there can be no guarantee of the absolute accuracy of the time charged to a given job. Those systems that provide for the time lost between jobs being charged up to a special account neglect the human nature of most foremen.

"As to strict accuracy in the allocation of works expenses, this is obviously impossible, but it is in this field that so much return is yielded by a scientific investigation of the approximately true incidence of expense."

The Cost of Silver (from an article by James H. Collins in the *Saturday Evening Post*, October 14, 1916).

"Silver has been so thoroughly a by-product during the past generation that the West has almost forgotten how to figure costs upon it.

"Some estimates of cost can be made from the reports of representative mining companies. The mountain at Bingham, Utah, worked by steam shovels, last year yielded 150,000,000 pounds of copper, 370,000 ounces of silver and 35,000 ounces of gold. The cost of operating was $12,000,000 and the metals sold for $27,000,000. This gave an all-round cost of less than 50 per cent; and as the silver sold for 50 cents an ounce its cost might be set at about 23 cents. The Bunker Hill and Sullivan mine, in Idaho, yielded 75,000,000 pounds of lead and 1,300,000 ounces of silver. Operating costs were about $3,000,000 and the metals sold for about $4,000,000. With silver at 50 cents an ounce the cost was 37 cents."

When silver is produced as a by-product of gold and copper or of lead, it is absurd to say that its cost is 23 cents or 37 cents per ounce, or any other figure. A farmer might figure the cost of raising sheep, but he could not figure separately the cost per pound of producing wool, hides and mutton.

HOW TO REDUCE COSTS. STANDARD COST

The cost accountant may consider that his work is finished up to any given date when he is able to show figures for the cost of each article in the warehouse, the cost of assembling it from the finished parts, the cost of each part, and the cost of each operation on each part, but when all of these figures are available the work of the cost analyzer (or of the Factory Cost Committee) has only just begun. His problem is to answer the questions. Why did this operation cost so much? What are the elements into which this operation may be divided? What is a reasonable standard time for each element? What must we do to bring down our actual operating times to or near the standard time?

Assuming that the operation in question is one done on a machine tool, in order to reach minimum costs the following requirements must be met *before the machinery operation is started.* (C. U. Carpenter on "Profit-making Management.")

1. There must be ample stock delivered to the workman before he stops work upon his preceding job.
2. The stock must be so placed as to be most easily reached or handled by the workman. This presupposes a *standard place* for the stock.
3. The clamping devices must be simple, effective and *standard*, and must be supplied to the workman before he is ready to start.
4. The tools must be *standard* in every respect, ground to proper shapes and supplied to the workman before he is ready to start.
5. The jigs, fixtures, punches, dies, gages, etc., must be so designed as to be handled easily, quickly and accurately, and must be at the workman's side before he is ready to begin work upon his new job. These tools and gages must be inspected for accuracy regularly so that the foreman and workmen may have full confidence in them.
6. All stock coming into a department *must be inspected* before it is placed upon the department platform.

To the above-named requirements several more may be added, which relate to the machine itself, such as: The machine must be of the kind and size best suited for the work; it must be rigidly supported, in good repair; properly belted and geared; lubricated with the right kind of oil; its working table at the proper height and its operating levers, handles or wheels so arranged as to involve the least possible fatigue to the workman; it should be in a sanitary location and well lighted.

When all of these requirements are fulfilled, and not before, time studies should be made, by means of a stop watch or other timing device, such as Gilbreth's chronocyclegraph, of the following: 1, The time required to handle the part or parts; 2, The time required to "set up" the job; 3, The time required for the machinery operation; 4, The time required to remove the work.

The next consideration in the matter of reduction of costs, and obtaining standard costs, is the selection of the kind of man best suited for the work. It is evident that if the work is of a simple and repetitive character, such that an ordinarily intelligent and willing day-laborer can do it easily after a few weeks' practice under instruction, it is not good economy to have it done by an all-round expert machinist, a 4-dollar-a-day man. A $2 man, encouraged by a bonus which will enable him to earn $3 a day without undue fatigue, when he becomes skillful, will do more work than the $4 man, whose rightful place is in the tool room or in charge of a machine operating on a variety of work requiring a wide range of knowledge and experience.

Standard conditions, standard times and standard task and bonus rates having been thus determined by the cost analyzer or the cost committee for different operations, the figures are handed to the cost accountant, who now has a new and most important job, the preparation of Standard Prime Cost cards for different operations, and the charting of costs of operations on all the machines of the shop, so that a basis may be had for the **Predetermination of costs** of future work.

When job tickets and instruction cards are given out for new work, the standard times may be entered on them, and if in actual operation the standard times are not reached the foreman may be called on for an explanation and the proper remedy applied.

Some of the things to be considered when costs appear to be too high are listed below:

Idle time.
Load factor of machines.
Revision of burden charges.
Can total burden be reduced?
Is it properly apportioned to departments and machines?
Cost of the cost accounting system.
Re-design of patterns.
Change in system of manufacture.
Change in material.

Standard Costs. Manufacturing plant has the capacity for a certain production, and incurs burden charges in maintaining that capacity. These charges must be distributed over the *standard* production. This means the determination of *standard* costs for burden, as well as for labor and material, and enables a *standard* of cost to be established for all products. If the cost accounting is to be of maximum value, much emphasis must be laid on the importance of knowing more than present cost alone. Costs should be established which represent *standards* by which to gain a true conception of the value of results.—Clinton H. Scovell.

Universal Cost Formula (Harrington Emerson).

Material cost + Man cost + Machine cost = Value

Q, T, and t, are the Quantity Factors
P, W, and R are the Quality Factors
$QP + TW + tR$ = Value.

Cost Formula separating Burden from Direct Costs:

(1) $QP + TW + tR + P + M + S + R$ = Cost

QP = Value of Direct Material,
TW = Value of Direct Labor,
tR = Cost of Machne Hour,
P = Cost of Power,
M = Cost of Maintenance,
S = Cost of Supervision,
R = Cost of Rent,

(2) $Q(P+Bp)+T(W+Bw)+t(R+Br)=\text{Cost}.$

Q = Quantity of Direct Material.
P = Price per unit of material.
Bp = Burden on Price.
T = Quantity of Direct man-hours.
W = Hourly Wage.
Bw = Burden on Hourly Wage.
t = Quantity of direct machine-hours.
R = Rate per machine-hours.
Br = Burden on rate.

Causes of High Cost of Work in Government Arsenals (Extract from a statement by Col. C. B. Wheeler, Ordnance Dept., U. S. A., in the hearing before the House of Representatives Committee to investigate scientific management, Vol. 1, p. 110).

After considerable thought on the subject I am led to believe that the present unsatisfactory condition as to relative cost of manufacture to which attention has been invited, results from a series of conditions most, if not all, of which are correctable by proper management and which, of course, can be materially assisted by hearty cooperation.

The following appear to be the principal causes which increase cost of production, or have a tendency to, and to which especial attention must be constantly given to insure results tending toward economy, viz.:

1. Frequent changes in management.
2. Absence of system and shop management.
3. The number of working days each year allowed for holidays and vacations, amounting each year at Watertown Arsenal to an expenditure of approximately $30,000.
4. Lack of a proper stock of supplies.
5. The conduct of all work on the day's pay system.
6. The restrictions imposed by laws and regulations especially as to the procurement of material.
7. Lack of coordination of the work being carried on in the different shops.
8. Multitudinous duties of foremen.
9. Lack of sufficient tools of proper power.
10. Loss of time in looking for proper and necessary tools and fixtures.
11. Loss of time due to employees waiting at grinders and at the tool room.
12. Loss of time due to breakages or repairs of machines and belts.
13. Loss of time waiting for the next job.
14. Losses due to lack of proper instructions or to spoiled work.
15. Lack of a proper tool-room equipment.
16. Lack of proper transportation facilities in the shops, such as cranes, hoists, and runways.
17. Wastage and lack of economy in the operation of the power plant.
18. Lack of proper attention to costs of detailed operations.
19. Endeavor to make parts with poor facilities and at great expense which can be procured very much cheaper.
20. Delays in getting material when needed, causing changes in plans.
21. Additional cost of transportation service between shops under a system that permits a helper for each teamster.
22. The large amount of metal that is frequently left on castings and which has to be removed.
23. The commencement of work before a sufficient supply of material is on hand to finish the job.
24. Failure to take full advantage of the machines or tools provided; and, finally, a lack of information as to the best practice.

Perhaps the most important of all these items is lack of system and shop management, since once established many of the other items would naturally be drawn into line for elimination. A system that would most economically produce the results desired is under consideration and already some progress has been made toward its adoption. It is expected when in running order to relieve the management, including the foremen, from numerous exhausting details, the time consumed on account of them being more profitably employed in other directions.

Concerning methods of distributing expense burden, Col. Wheeler said (page 791):

Prior to 1906 shop expenses were unknown to the Ordnance Department, and all labor, no matter how promiscuous or difficult of apportionment, was charged directly to order. This involved an immense amount of unprofitable clerical labor. The department was, however, so wedded to this old system of charging everything directly to orders, and was otherwise so conservative, that for a long period after Congress authorized the taking of a valuable share of productive labor costs to pay shop expenses, there was a feeling that the efficiency of an establishment was measured by the smallness of the shop expense percentage, and great stress was laid upon the ratio of the nonproductive to the productive labor at the various arsenals. This standard for the measurement of efficiency is entirely wrong. The only proper way of considering this matter is to determine whether or not the non-producer is profitable—that is to say, fully occupied in keeping the skilled producer at the kind of work for which he was employed and for which he is best fitted. A comparison of shop-expense percentages is generally misleading and can not measure efficiency of production.

The method now in force is one which causes orders passing through the manufacturing departments to contribute more equitably their proper share to the shop expense fund by apportioning the shop expenses to them in accordance with the man-hour or machine-hour costs involved in their execution. The result of such apportionment is that the larger pieces requiring the larger and more expensive machines contribute more per hour to the shop expense fund than do the smaller pieces requiring smaller machines or perhaps only bench work. Any system of shop expense recruitment based upon a percentage of direct labor charges means that smaller work carries the larger.

REDUCING THE COST OF THE COST SYSTEM

The chief objection to all elaborate cost-finding systems is that they cost too much; that their operation involves the employment of a small army of clerks, and that the information obtained is not worth what it costs. A good cost system is a necessary element in scientific management, the aim of which is the elimination of useless work and of waste motions, and the consequent reduction of costs. The principles of scientific management should be applied to cost systems themselves as well as to manufacturing operations.

In order to illustrate what may be done in the direction of reducing the cost of a cost system we may take an imaginary case of the costing of an order for 10,000 locks in a large hardware factory in which all the paraphernalia of a cost system based on the normal machine-hour rate have been installed. Every machine, work-bench or other center of production has its hourly burden rate fixed, all work is done and all stores are issued on written orders. Job tickets are used for each operation on each piece that enters into the finished product, and from the data obtained from these tickets is found the cost of each product delivered into the warehouse.

The raw materials, which are in the store ready for the manufacturing operations, consist of iron and brass castings,

steel drop forgings, sheet, band, wire, rivets and screws. The clerical work done in connection with the progress of the order through the shop involves the following:

Permanent blue print or carbon: 1 stores issue for all the material; 1 schedule of parts; 1 route sheet; 1 set of instruction cards.

Production order, reading as follows:

Production Order No. 1117. Date 2/20/17.
Make 10,000 locks, style X—45.

The part and routing schedules show that there are 10 parts to each lock (not counting duplicates of any part) and that there are on an average five operations on each part, besides the operations of inspection of parts, assembling, testing, japanning, final inspection and packing.

The work is done by ten different men, using ten machines or work benches.

The time of each man averages forty days of nine hours each, making a total of 3600 man-hours.

All the work is on piece work or task and bonus, and the average earnings are thirty cents per hour.

The total direct labor cost is	$1080 or	10.8 cents per lock.
The total material cost is	500 or	5.0 cents per lock.
The total burden cost is	920 or	9.2 cents per lock.
	2500	25.0 cents

In order to obtain the labor and burden costs we start with the time-keeping. Here we meet the first application of scientific management to the cost system, the finding out, by careful investigation and accurate recording, which is the best and at the same time the cheapest way of keeping time. There are many different ways, starting with the old-fashioned foreman's or time-keeper's time book. Those in common use may be compared as below:

TIME-KEEPING SYSTEMS

Daily Time Tickets	Weekly Time Tickets	Job Tickets
10 men, 40 days, 400 tickets. (1) As there are 60 jobs on each lock there may be two or three jobs entered on some of the daily tickets. (2) Or else a separate ticket may be issued when a man works on more than one job in a day, making say 800 tickets.	The 40 days may include 6 whole weeks and parts of two others, making 8 weeks. (3) 10 men, 80 tickets, each ticket having a record on it of the different jobs done by a man in each day. (4) or a new ticket may be issued when a man changes his job during the week. This may double the number of tickets, making 160 tickets.	As there are 60 operations on each lock one ticket may be used for each, on which an entry is made of the man's No., Name, Machine No., Production No., Job No., Part and operation symbol, Hours, Pieces made, Piece Rate, Bonus and Burden. All of these data are transcribed from the time tickets. (5) 60 tickets, 160 or 800 entries, according to whether daily or weekly time tickets are used. (6) Combined Time and Job tickets. No. 4 tickets may have entered on them all the data of the jobs, thus saving the transcribing of 160 tickets.

The combined time and job ticket No. 6 has the following information:

Production Order, 1,117
Job No., 19,172
Week ending 3/10/17
Workman's No. 126
Workman's name, J. Jones
Machine No. L 13
Piece symbol, AEF
Operation symbol, Dg
Hours, 54
Pieces made, 1520

Piece rate, 0.9	13 68
Bonus, 30%	4 10
Wages	17 78
Burden, 54 hr. ×30	16 20
Labor and Burden cost	33.98

Material (on store card)
Defective pieces, 12

The back of this card has the "in" and "out" times stamped on it by the clock, from which the hours for the week are figured. The burden rate is taken from a table of the normal rates of the several machines. The card may also have a memorandum of the number of spoiled or defective pieces, stating whether they were due to flaws in the material or to bad workmanship.

The cards are sorted by workmen's numbers and posted on the pay roll. They are then sorted by machine numbers, and the total hours for each machine for the week entered on the machine-hour record sheet. They are finally sorted by piece symbols, and the figures are entered on the piece cost cards. They are then filed in envelopes or folders bearing the piece symbols for future reference.

The Piece Cost Cards may contain the following information:

Piece Symbol AEF
Prod. order 1,117,
No. of pieces Finished
Material lbs. @
Total direct labor Total cost
Total burden Cost per 100 pcs.

Job No.	Operation	Pieces	Labor	Burden	Total
19171	Fg.	2000	4.00	3.00	7.00
2	dg.	1520	17.78	16.20	33.98
3	mg.	1400	9.30	10.00	19.30
1	fg.	2200	4.40	3.30	7.70
2	dg.	And so on	until all the	operations	on AEF for
3	mg.	10,000 lo	cks are finis	hed:	

Labor and Burden on 42 pcs. spoiled
Cr. for value of scrap

The totals on the Piece Cost Cards are transferred to a Finished Product Cost Summary.

Finished product X—45
Prod. order 1117 Finished 4/21/17
No. made 10,000 Cost each $0.25

Piece	Material	Labor	Burden	Total	Cost per 100
AEF					
G					
H (etc.)					
Inspection					
Assembling					
Japanning					
Testing					
Packing					
Total	500	1080	920	2500	$25.00

The final result, $25 per 100, is entered on the Stores Inventory Card for X–45 and is used as a basis for the annual inventory value, for fixing selling prices, and for various statistical purposes.

Let us suppose that the cost system above described has been installed by a " systematizer," and is in operation in one department only of the hardware factory, the lock department, and that the first production order has been completed under it, the daily time ticket, No. 2, having been used. The manager investigates the results, and he is satisfied that the reported cost, 25 cents per lock, is as near to the true cost as can be ascertained by any system. It is accurate as far as the cost of material and direct labor is concerned, but the burden is based on two assumptions which may be far from accurate; one is the estimated life of the machinery, from which the charge for depreciation reserve is based, and the other is the estimated number of hours that the machines will run during a normal year, from which the normal hourly burden of the several machines is calculated. The calculated total burden in the cost of the 10,000 locks, $920, may be as much as 25 per cent, or $230, too high or too low, and the true cost of the locks instead of being 25 cents may be anywhere between 22.7 cents and 27.3 cents, a difference of 9 per cent in either direction. In fixing the minimum wholesale selling price the manager will add the 9 per cent to the recorded factory cost, in order to be on the safe side, besides making a liberal estimate for selling and administrative costs.

He now begins to figure the cost of the cost system. For a production order involving the work of ten men for forty days, it has involved the writing of 800 time tickets, 60 job tickets with 800 entries on them transcribed from the time tickets, 10 piece cards with about 20 entries on each, and one cost summary card, with about 10 entries. If the whole factory has 1000 men, working 300 days in the year, on light hardware involving a multiplicity of operations and the same clerical work in proportion, the 861 cards will be multiplied by 7500, making nearly six and a half millions of cards per year and about as many transcriptions from one card to another.

No time study or motion study of clerical work has been made and the cost of cost-keeping has not been segregated from the cost of making up the pay roll, doing the ordinary bookkeeping, and making statistical records, but the manager makes a rough guess that there will be 6,000,000 cards handled in a year, that one minute's time on the average will be spent on each, making 100,000 hours of clerical labor, at 20 cents per hour = $20,000 cost of the cost system per year.

The manager, while startled at the figure, has more important matters in hand than studying the merits of cost systems, so he turns the job over to a scientific management expert, for study and report on the questions whether this cost system is suitable for the requirements of the business, and whether or not its cost can be reduced.

The expert is not a cost accountant, which is probably to his advantage, for he has nothing to unlearn.

He starts his investigation by getting acquainted with all the facts that are available in connection with the cost system as applied to these 10,000 locks. He finds the time tickets, pay rolls, job tickets, stores, issue cards, piece cost cards, and cost summary, all leading up to the final conclusion, that the cost of these locks, packed and delivered to the warehouse is 25 cents each. He finds the theory or theories on which the cost system is based, viz., that the cost of a lock is the sum total of the cost of every machine or manual operation on every piece, and the cost of every piece of raw material that enters into the lock, and that each piece and each operation or job is saddled with what is supposed to be its proper share of the " burden " or general expenses of running the factory, including administration and supervision, planning, clerical work, power, heat, light, lubrication, internal transportation, services of watchmen and cleaners, storekeepers, messengers, stationery, and other supplies for the factory or office, besides a charge for depreciation due to wear and tear, obsolescence and inadequacy and a charge for interest on the investment in the factory and its operations. He examines the theory and method of allotment of the burden, and finds that the old-fashioned and grossly inaccurate methods " percentage on direct labor " and " man-hour," have been rejected and the more modern and more accurate normal machine-hour rate method adopted. The method of fixing the rates for the several machines and production centers is investigated and approved.

The first criticism he makes is that the estimated normal number of hours of operation of the various machines in a year is only a guess, and that there are no available statistics by which the estimate might be checked. This defect, however, will be corrected in time. The probable error of the estimate is not serious and is on the right side, that is it tends to make the recorded cost greater than the true or approximately true cost.

The next minor criticism is that the whole burden is distributed on the machine-hour rates, whereas a more strictly accurate accounting would distribute on this basis only that portion of the burden that had a relation to the machine hours, distributing the rest of it partly on material and partly as a job charge for clerical and supervisory service, independent of the time the job lasted. This refinement, however, in a general hardware manufacturing business, where nearly all the work is done in large lots and each job usually lasts several days or weeks, is probably not necessary. The material burden may be included in the prices charged by the stores to the factory, and this avoids the trouble of entering it on the job ticket.

So far as the theory and accuracy of the cost system is concerned with the exception of the two minor objections stated above, the expert finds no fault with it, but in regard to the mechanism for carrying out the system he finds it unnecessarily complex and troublesome. The first important objection is that the use of the daily time ticket No. 2 and the transcribing of the figures on it to 60 job tickets involves a needless waste of labor. He recommends for it the substitution of the combined job and weekly time ticket No. 6.

Continuing the investigation he has all the records tran-

scribed onto 160 job tickets in order that they may be analyzed and conclusions drawn from them. He subdivides the production order for 10,000 locks into ten orders for 1000 each, and makes a tabulation of the material, labor and burden cost of each of the ten lots. Since each lock requires exactly the same amount of material, the cost of material for each of the ten lots is the same, and since the work is done and paid for on the task and bonus system, after numerous time studies have been made to determine the proper task and the men have become so skilled that they always earn their bonus, the daily variation in the men's wages is slight, while there is almost no variation in the total labor cost from week to week or from one lot of 1000 to another. The machine hours also are practically uniform with each lot, and, therefore, the burden charge has the same uniformity. If the total burden charge for the 10,000 locks is $920, and the burden computed for each lot of 1000 locks ranges only from $90 to $94, what is the use, he says, of computing the individual burdens on each one of the 60 operations? If we obtain the labor and burden costs of each operation on the first 1000 locks on the combined job and weekly time-card system, what is the use of continuing this elaborate and costly system for the other 9000, provided no change in the machine methods or labor conditions have taken place?

It is desirable to know, for statistical purposes, and to study the comparative results at different times and with different machine methods, the cost of each piece and of each operation on each piece of lock X–45, but this can be determined with all the needed accuracy just as well on 1000 locks as on 10,000.

The expert then recommends the following modifications of the cost system. Have the Production Order read as follows:

Production Order No. 1117 Date 2/20/17
Make 10,000 locks, style $X-45$

Obtain detailed costs, including burden, of each operation on the first 1000 or 1500 locks by the combined job and weekly time-card system (No. 6). For the remainder use weekly time tickets only (No. 3), without job tickets, obtaining labor cost only, to be charged to the production order No. 1117. The weekly time tickets will have the following information:

Production Order 1,117, (continuation)
week eoding 3/17/17
Workman's No. 156
Workman's name J. Jones
Machine No. 13
Hours 54
Pieces made 1500
Piece rate cents .09 13.50
Bonus 30% 4.05
Wages 17.55
Defective pieces
Symbol AEF – Dg

If the man works on more than one machine or on more than one operation during the week the entries on the card may appear thus:

Machine No.	B	L 13	L 13	Total
Symbol	AEF, Fg.	AEF, Dg.	AEH, Dg.	
Hours	24	20	10	54
Pieces	1200	560	300	
Piece rate		0.9	0.8	
Hourly rate, cents	30			
Wages	$7.20	$5.04	$2.40	
Bonus		1.51	.72	
	$7.20	$6 55	$3.12	$16 87

Piece Cost Cards and Cost Summary Cards will be made up from the job tickets of the first lot only, and from these the burden per 100 or per 1000 locks will be calculated, and this burden will be considered the standard burden charge on these locks as long as the piece rates of the various operations remain unchanged and the weekly earnings of the men when working full time remain fairly constant. The final cost of the 10,000 locks, at which they are to be charged to the warehouse, is then made up as follows:

	Per 100 Locks.
Material:	
As per stores issue cards	$5.00
Labor:	
Total of all the time tickets (by adding machine)	10.80
Burden:	
10,000 locks (Standard burden 9.20 per 100)	9.20
	25 00

The machine numbers and machine hours are entered on the weekly time tickets so that they may be entered in the machine time record, which is kept for the purpose of computing the loss due to idle time of machinery, and the number of hours the machines will probably run in a normal year, which is used in establishing the normal machine-hour rate.

The next time a production order for the same style of locks is run through the factory it will not be necessary to make job tickets for a portion of the order unless there has been a change in the manufacturing method, in the piece rates or in the speed of the machines. The weekly time ticket gives all the information required for pay roll, statistical and accounting purposes, and the burden is added only when the order is finished, at the standard rate determined when the previous order was going through the factory. By these modifications of the cost system the cost of operating it will be greatly lessened.

PROBLEM. THE FACTORY COST OF STEAM ENGINES AND OF STEAM TURBINES

Suppose that a factory is equipped for the manufacture of Corliss engines, with a total investment amounting to $200,000, subdivided as follows:

Machinery and other equipment, including power plant	$100,000
Land, $10,000; Building, $20,000; all other assets less liabilities, $70,000	100,000
	$200,000

Case A. Suppose that in a fairly good year the total product of the factory was sold for $200,000, made up of factory cost, $170,000; selling expense, $10,000; profit, $20,000, and that the factory cost was shown by the books to consist of the following items:

Interest on investment at 5%	$10,000	
Taxes and Insurance, 2½% on 120,000	3,000	
Depreciation of Building 5%	1,000	
Reserve for Depreciation of Equipment, 6%	6,000	
		$20,000
Power Plant Expense:		
Labor	2,000	
Fuel and Supplies	2,000	
Current Repairs	1,000	
		5,000
Machinery, current repairs	3,000	
Tool room expenses	4,000	
Drawings and Patterns	3,000	
		10,000
Superintendence	5,000	
Planning Room	5,000	
Office Expense	5,000	15,000
Other Indirect Labor		15,000
Miscellaneous Supplies		5,000
Total Indirect Expense		70,000
Direct Labor		70,000
Direct Material		30,000
Total Factory Cost		$170,000

Suppose that in this year the factory machinery is on the average 30 per cent idle, on account of the impossibility of an engine works having the production of the several machines so perfectly balanced that every machine will be employed continuously the whole time.

Case B. Suppose that in another year of exceptionally brisk business it is possible to reduce the idle machine time to such an amount that the factory handles 20 per cent more material, and uses 20 per cent more direct labor, without any increase of the indirect expense. The factory cost then will be

Indirect Expense	$70,000
Direct Labor	84,000
Direct Material	36,000
	$190,000

and the total sales will also be increased 20 per cent, or to $240,000 without any increase of the selling expense, the profit and loss account showing:

Gross Sales	$240,000
Selling Expense	10,000
	$230,000
Factory Cost	190,000
Profit	$40,000

Case C. Suppose that a few years later the advent of the steam turbine has reduced the demand for Corliss engines to such an extent that it is no longer possible to sell the larger sizes of them in competition with larger factories which are able to build them cheaper, and, in consequence, the larger planing and boring machines remain idle a whole year; the smaller sized engines for which there is still some demand continuing to be built, but in smaller numbers, so that the total direct labor is cut down to $35,000, and the direct material to $15,000, and the sales to $100,000, while the indirect expenses, which have been pared down as much as possible, appear as follows:

Interest, Taxes and Depreciation as before	$20,000
Power Plant Expense	4,000
Machinery, current repairs	2,000
Tool Room Expenses	2,000
Drawings and Patterns	1,000
Superintendence, Planning Room, Office Expenses	12,000
Other Indirect Labor	10,000
Miscellaneous Supplies	3,000
Total Indirect Expense	$54,000
Adding direct labor, $35,000, and direct material, $15,000	50,000
Total Factory Cost	$104,000
Selling Expense	10,000
	$114,000
Selling Price	100,000
Loss	$14,000

Summary

	Case A	Case B	Case C
Material	$30,000	$36,000	$15,000
Direct Labor	70,000	84,000	35,000
Indirect Expense	70,000	70,000	54,000
Factory Cost	$170,000	$190,000	$104,000
Selling Expense	10,000	10,000	10,000
Profit	20,000	40,000	Loss 14,000
Factory Cost	$200,000	$240,000	$100,000
Per cent of Selling Price	85	79 2	104

Indirect Expenses expressed in percentages

	Case A	Case B	Case C
Of Material	233.3	194 4	360 0
Of Labor	100.0	83.3	154 3
Of Material and Labor	70 0	58 3	108 0

Several problems arise in connection with the figures of cost shown by the book entries of these three cases A, B, C.

1. Can the recorded factory costs be used as a basis for fixing selling prices? *Answer:* No, the selling prices are fixed by market conditions and not by the apparent factory costs.

2. Can these costs be used to determine the inventory value of the engines remaining unsold at the end of either of the three years? *Answer:* They can in Case A, for in that year factory conditions were normal, and the book cost of the engines is probably as near an approximation to their value as merchandise in the warehouse, ready for sale, as can be obtained by any fair method of appraisal, but in case B the engines are worth more than their apparent cost, and they should be valued on the basis of the factory conditions of Case A, that is on the basis of normal cost. In case C the engines are worth less than their apparent book cost, because that is higher than the selling price, even if the cost

of selling them was reduced to nothing. The engines remaining unsold are worth no more than they would be if they had been made under the conditions of Case A.

3. What should be the recorded costs of the engines in cases B and C to be used in charging them to the selling department at factory cost, or in valuing them for the inventory? *Answer:* Assuming that the direct labor and material cost the same per engine in all three cases, then the engines should be charged or valued at the sum of the direct labor and material plus the normal burden or indirect expense per engines found in Case A. This would make the total cost to be charged against the engines as follows for the three years:

	Case A	Case B	Case C
Material	$30,000	$36,000	$15,000
Labor	70,000	84,000	35,000
Burden, 100%	70,000	84,000	35,000
Factory Cost	170,000	204,000	85,000
Selling Expense	10,000	10,000	10,000
Total Cost	180,000	214,000	95,000
Selling Price	200,000	240,000	100,000
Profit	20,000	26,000	5,000

4. How do you explain the profit of $26,000 instead of $40,000 in Case B and the profit of $5000 instead of a loss of $14,000, as shown in the former estimate? *Answer:* The profits of $26,000 and $5000 are merchandise profits of the selling department, which in Case B bought the engines from the factory for $204,000, spent $10,000 in selling expenses, sold them for $240,000 and made $26,000 profit; and in Case C, bought for $85,000, selling expense, $10,000, sold for $100,000, making $5000 profit. The difference between $26,000 and $40,000 is gain in the factory due to running overtime or with a larger labor force, caused either by greater activity of the selling force, the increased reputation of the engines, or general improvement in the demand for engines. This difference of $14,000 may appear in the factory books as a credit balance of Burden account, as overearned burden, and in the general books as a credit to Profit and Loss Account. The factory books would show the following:

Dr.	Burden		Cr.
To various expense accts.	$70,000	By charges to Engine Costs	$84,000
To company, to transfer balance, overearned burden	14,000		

The company's general books would show:

Dr.	Profit and Loss		Cr.
		By factory, overearned burden	$14,000
		Sales, profits on sales	26,000

Dr.	Factory		Cr.
To Profit and Loss, transfer overearned burden to Company	14,000		

In Case C, the difference between $5000 profit and $14,000 loss, or $19,000, is the loss due to idleness of men and machines in the factory caused by the decreased demand for steam engines, consequent upon the increased use of steam turbines. It would appear in the factory books as below:

Dr.	Burden		Cr
To various expense accts.	$54,000	By charges to Engine costs	$35,000
		By Company, to transfer balance, unearned burden	19,000

and in the Company books:

Dr.	Profit and Loss		Cr.
To Factory, loss due to unearned burden	19,000	By Sales a/c, profit on sales	5,000

Dr.	Factory		Cr.
		By Profit and Loss, unearned burden	19,000

5. Do the figures for overearned or unearned burden constitute an index of the efficiency of the factory or of its management? *Answer:* Not at all. The efficiency is practically the same in each case as far as the figures show, since the direct labor and material costs bear the same proportion to the selling price of the engines in all three cases.

6. What do figures of overearned or unearned burden indicate? *Answer:* They may, and generally do, indicate less or greater idleness of the machinery due to business conditions or to greater or less activity of the sales department, or to underestimates or overestimates of what is the normal burden of the several machines. Only a detailed investigation of all the facts can determine which.

7. It appears that the Company's total profits on manufacture and sales of engines were $40,000 in Case B, and the loss $14,000 in Case C, whether they are figured by the first method or by the second, in which the $40,000 in Case B is made up of $26,000+$14,000, and the $14,000 in Case C is made up of $19,000−$5000. What then is the use of complicating the bookkeeping by dividing the profits or losses into two parts and of computing overearned or unearned burden? *Answer:* The advantage is in giving the owners a greater amount of desirable information as to whether the profits and losses are due to the factory, to the selling department, or to general business conditions, and as to the cost of idleness in the factory. The subdivision is of especial advantage in giving more accurate inventory values of the product remaining unsold at the end of the year and of the work in process, on which inventories the profit and loss estimates depend.

8. Is the $14,000 loss in Case C the actual loss in the engine business during the year. *Answer:* By no means; this apparent loss, as shown by the books, includes as one of the elements a charge for reserve for depreciation of 6 per cent on $100,000=$6000, but as some of the heavier and more

costly machinery has been thrown entirely out of service, probably permanently, by the cessation of demand for large engines, these machines, costing, say, $20,000, have suddenly depreciated perhaps $10,000 more than the amount that has accrued to their credit in the reserve account. There has also been a large depreciation in the value of the drawings, patterns, jigs and special tools used in manufacture of the large engines, their value now being practically nothing. The total loss, therefore, instead of being $14,000 is more likely to be double that figure.

Continuing the record of these supposition cases, we may next suppose that at the end of the year of Case C the accountant presents to the directors of the company the tabulated statement above given showing a loss of $14,000 on the year's business, and also statements of the assets and liabilities of the concern at the beginning and end of the year, which may be condensed as follows:

STATEMENT JAN. 1

Net Resources

Real Estate and Equipment	$130,000	
Less Depreciation Reserve	30,000	
		100,000
Other assets less liabilities		80,000
		$180,000

Capital Stock and Surplus

Capital stock	$150,000
Surplus	30,000
	$180,000

STATEMENT DEC. 31

Net Resources

Real Estate and Equipment	$130,000	
Less depreciation reserve	37,000	
		93,000
Other assets, less liabilities		73,000
		166,000

Capital Stock and Surplus

Capital Stock	$150,000
Surplus	16,000
	$166,000

The president says: Notwithstanding the loss of $14,000 and the consequent reduction of our surplus from $30,000 to $16,000, as shown in the books, our financial position is good. We have no notes payable outstanding, $10,000 cash in the bank, and $10,000 invested in bonds that are good collateral to borrow on. The question is shall we declare our usual 6 per cent dividend, which will take $9000 and reduce the surplus on the books to $7000?

The general manager replies: " The books do not tell the whole story. The accountant has charged only $7000 to depreciation reserve during the year, taking no account of the fact that $20,000 worth of our best machinery is now permanently idle, and ought to be sold at a quarter of its cost, in order to save insurance and taxes, and to make room for other machinery, if we can find some other product to make. Unless our sales department can get more business for the factory we had better be preparing for going into liquidation, rather than be declaring a dividend."

The accountant was requested to answer the general manager, and he said: " The books never do tell the whole story. It is impossible that they can. They record the facts of actual transactions, such as the receipts and payments of cash, and the purchase and sale of goods; they record our guesses as to depreciation and depreciation reserve; but they do not record other things, such as appreciation of real estate and changes in market value of materials in store. Our apparent surplus of $16,000 is based on the theory that the net value of real estate and equipment is $93,000, its actual depreciation below its original cost being the $37,000 accumulation in the reserve for depreciation account. This reserve account is based on a pure hypothesis, that 6 per cent per annum on original cost will cover the average depreciation on all the machinery, during the whole of its life, including the depreciation due to obsolescence and inadequacy. It probably was fixed at this figure without any thought that the whole business of manufacturing engines was apt to become obsolescent, and that the heavier machines which might reasonably have been expected to have a life of 30 or 40 years would become out of date in less than 10 years. Whether or not the $37,000 in the reserve account covers the total depreciation at the present time cannot be told by any system of accounting. The only way to determine it is to have an appraisal made, and even an appraisal at the present time will only be an approximation to the true value of the heavy machines. They are an expense and not an asset if they are kept standing idle; they are worth their secondhand or scrap value if they are going to be sold, and they may be worth all that they cost if they are going to be used in making other products. There is no use in changing their value on the books until we know what is going to be done with them."

The president then said: " The accountant is right. The apparent surplus of $16,000 is only a book figure. It will be reduced to nothing at the end of next year if we sell the large idle machines at their present market value and continue the engine business at its present rate of sales $100,000 a year; it will be turned into a deficit of perhaps $40,000 or $50,000 if we liquidate the concern, either selling the business as a whole or selling the assets in parcels; it may be doubled if we continue in business, making other things which will keep our machinery running. The immediate question before us is that of declaring a dividend. The surplus, whatever it may be, has been accumulated by keeping the dividends low, returning to the stockholders only a portion of the net earnings in order not to have to stop dividends during a year or two of poor business. It would disappoint and embarrass the widows and orphans among our stockholders if we suspended dividends. If we decide to liquidate we may as well

pay the $9000 dividend now. We have the cash to pay it with, and it will only be an installment of the larger dividend that will be paid when the concern is wound up.

" I have had an appraisal made, and find the depreciation reserve on the books is $20,000 larger than the actual depreciation of our assets, basing the appraisal on the present value of the plant to a going concern, its cost of reproduction less a reasonable reduction for wear and tear; but it is $30,000 less than the probable depreciation if we intend to retire from business and sell the assets for what they will bring.

" I now have a proposition to make for continuing the business and enlarging it. The A. B. Steam Turbine Co. has been building turbines for three years, and after overcoming many difficulties has now established an excellent reputation for its machines, but it has used up all its available cash and credit resources and is deeply in debt. I have made an arrangement with the company and its creditors, subject to your approval, to take over all its business. It will transfer to us its drawings, patterns, machinery, including some costly special machinery, and its stock of materials, supplies and finished parts, for $50,000 payable in stock of our company at par, and will give to us an exclusive license under its patents, for an annual license or royalty fee of $10,000 payable cash in advance each year, with the provision that when our sales of turbines amount to over $200,000 a year, there shall be an additional payment of 5 per cent on the excess. We can also secure the services of the chief engineer and the chief salesman of the company at reasonable salaries. I have had reports on the turbine and on the machinery by two turbine experts, and they assure me that the proposition is a bargain. I propose that we have a committee of three, two of our directors and our factory superintendent, to examine into the matter and report at a special meeting to be called by them next week.

" I may say further that if we go into this business it will be advisable to manufacture turbines in advance of orders, so that we may have a few of each size, either completed, or nearly completed, on hand for prompt delivery. We should also carry quite a large stock of castings and other material and should invest some money in advertising and in salesmen's expenses. This will call for an additional issue of stock and I am ready to subscribe for $20,000 of it, payable in installments as it may be needed."

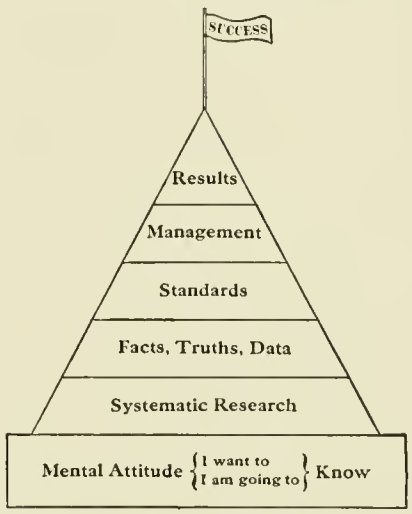
The dividend was declared, the committee appointed and the next week the proposition was accepted and the new business was taken over. The accountant was instructed to make a new statement of assets and liabilities and to bring in a scheme for a system of accounting which would show separately the factory costs of engines and turbines of the several sizes.

SCIENTIFIC MANAGEMENT

That form of management that conducts a business or affairs by standards obtained through systematic research, experiment or reasoning.—Geo. D. Babcock, 1915.

The laws of management worked out by Taylor and his disciples are as fundamental as those of falling bodies. No manager or management can avoid making use of them in some form or other if they are honestly out for the combination " high wages and low labor costs."—H. F. L. Orcutt, *Engineering* (London) Sept. 7, 1917.

Costing and Scientific Management. Scientific management is a system based on the conception that the whole routine of the works, down to the last detail of every operation, is organized by the management, so that confusion, over-lapping, delay and waste (both human and material) are avoided, and the course of the work is planned to run as smoothly, rapidly and efficiently as possible. This system applies not only to works management, but also to costing and all the other accessories. There is yet little recognition in this country [Great Britain] of the necessity that costing should be undertaken by those who have a real knowledge of the work in question. Generally there is more improvement possible in the arranging for costing than in any other department of works. Costing can and should be the greatest asset to the management; it should be the pulse of the whole organization, instead of being merely an approximately accurate record of performance in the past—sometimes in the distant past.—From a paper on " The Question of Scientific Management," by James Richardson, *Engineering*, Dec. 21, 1917.



The Pyramid of Scientific Management

Scientific management is really intensive thinking. It means that every problem shall be solved intellectually and not by means of trial and error . . . . . and we may add to this that a large percentage of mankind not only hates such a practice, but is quite incapable of carrying it on.—From an editorial in the same issue of *Engineering*.

CHAPTER XIII

USES OF COSTS. VARIOUS OPINIONS ABOUT COSTS

CONCLUSIONS TO BE DRAWN FROM COST STATISTICS

When the directors of a company have a sheet of cost statistics of the business laid before them what chief facts should be studied and what conclusions may be drawn?

The cost statistics should show the factory costs of labor, material and burden for each of the several classes of product; they should also show the quantity of product of each class.

The general books, or the books of the sales department should show the amount of sales, the cost of selling and the profits realized on each class of product. The factory costs, quantity of product, selling cost and profit (or loss) on each class of product should all be considered together, and the relation of profits to costs and to quantity should be studied.

The principal object of the study is to determine what course of action will lead to the greatest profits in the future, both the immediate future and the distant future.

The objects of a business are: 1, to make profits that may be used to pay dividends; 2, to organize and operate the business so that it may have a long life, even when subject to strong competition. The condition of long life is growth. When growth ceases and stagnation ensues decay comes sooner or later.

Cost Keeping should be not merely the keeping of records of what goods *have cost*, but also of what they should cost under standard conditions, from which may be predicted the probable costs in future.

When actual costs are notably higher than standard costs the reason why they are higher should be promptly ascertained and recorded.

Uses of a Cost System. 1. To find the factory cost of articles delivered to the warehouse.

(*a*) As a basis for fixing the price at which they shall be charged to the sales department.

(*b*) As a basis for fixing their inventory value.

2. To find the cost of the several elements that enter into the total cost (viz., material, labor and burden) of a finished article, of each part, and of each operation on each part.

3. To furnish comparative records of costs of articles made at different times, or by different methods of manufacture, or under different conditions.

4. To discover which part of the products of a concern are unprofitable; in order to form a judgment as whether to push the manufacture of an article or to abandon it.

5. *To inform competing manufacturers what our costs are*, in order to induce them to keep a cost system and thereby to discover that they are selling goods below cost.

It is no satisfaction to a producer to know that the ignorance of his competitor will destroy that competitor, if another equally ignorant and dangerous follow him. The only hope lies in a complete education of all who enter a given competitive field, else that field is hazardous.—J. Newton Gunn, in "Business Engineering," by Alex. C. Humphreys, page 479.

The competitor most to be feared, while he lasts, is one who does not know his costs, nor understand how to obtain them.—Henry R. Towne.

Many concerns charge a certain percentage for overhead irrespective of what the expense really amounts to, and when they take an annual inventory, are surprised to find that their corrected earnings are very much less than they estimated. This ignorance or carelessness in the matter of the correct overhead is, I think, responsible for a great deal of ruinous competition, and although in many cases the low bidders fail after doing business for a longer or shorter period according to their resources, there always seem to be some new ones coming along so as to prevent the manufacturers whose costs contain *all the cost* getting the proportion of business to which they are entitled.—Gershom Smith, *Engineering Magazine*, June, 1909.

Uses of Cost. An accurate and reliable knowledge of costs is indispensable to success in closely competitive manufacturing and merchandising business.—S. S. Wheeler, *Trans. Efficiency Society*, Vol. 1 (1912), p. 175.

The function of the cost department is to gather information from which the management can outline its policies.—Clinton H. Scovell.

The main value of the knowledge of unit costs is not to fix the selling price, but to lead to methods of cost reduction and control.—B. A. Franklin, *Eng. Mag.*, Vol. 43, p. 121.

A cost system should primarily be so devised as to give the manufacturer an accurate knowledge of his *most costly and expensive operations*, so that he may know unerringly these "high spots" and attack them vigorously. The cost system should provide a club with which to beat down costs.—C. U. Carpenter.

Indirect costs may amount in some instances to as much as two or three hundred per cent of direct costs. Failure to take them into consideration may lead speedily into bankruptcy. —C. B. Thompson.

What do I want to know? How can the facts best be obtained, summarized and averaged so as to get the most out of them with the least trouble and expense?—J. L. Nicholson.

Among the uses of costs are:

1. The financial or accounting use, as showing how money was expended.

2. Comparison with estimated results, as in Mr. Emerson's method, the discrepancy between estimated and actual results being regarded as preventable waste.

3. The technical use, showing the cost of every process on every part, enabling a close check to be made on efficiency of production.

4. Use as a basis for fixing premium or bonus rates.

5. The commercial use, as a basis of fixing remunerative prices, and for selecting that class of product that can be most profitably manufactured.—A. Hamilton Church, *Eng. Mag.*, Vol. 38, p. 185.

It is the business of costs to represent facts and nothing but facts.

The object of cost accounts is to register and record every stage and step of production as they actually happened—it should be nothing else.—*Ibid.*, page 184.

A cost system that represented facts and nothing but facts would be of little use except to the bookkeeper. It might enable him to balance his books and to show that all the money expended was accounted for in the records. It might show what were the costs for labor and material on each item of product, but it could not correctly assign a burden charge to each item, for such a charge is based upon something more than bare facts, it depends on a theory of the method of distribution of burden, and on the application of that theory to estimates, which are only approximations, and often very rough approximations, to facts.

The true cost is not what an article is produced for in good times, in bad times, or the first time, but what it can be produced for in the ordinary average routine of shop practice.—B. A. Franklin, *Eng. Mag.*, Vol. 42, p. 921.

The cost of a thing is what has to be paid to get it.* The "factory cost" of a manufactured article is what it costs the owner of the factory to get the article into the factory warehouse under normal shop conditions. It does not include the cost of storing and insuring it after it is in the warehouse, nor the cost of advertising and selling it. The latter are commercial costs, and in the accounting system they should be kept entirely separate from the factory cost.

The cost of idleness of machinery caused by lack of orders, failure to get raw material, strikes, or other abnormal cause should not be charged as part of factory cost; it should be charged to Unearned Burden, or to Profit and Loss.

The general advantages of any cost system are:

1. To reduce costs.
2. To increase production.
3. To introduce machines to do work hitherto done by hand.
4. To equalize the output in each department.
5. To serve as a guide in selling.
6. To serve as a guide in pricing.
7. To serve as a basis for judging the product, efficiency and diligence of the workmen.
8. To place the employer in a position to get a safe basis, independent of the judgment of the foremen of the different departments, on which to reward the efficient and to develop the promising but inefficient.
9. To act as a moral stimulus to every workman and to insure fair distribution of reward to all.

A cost system will not tell you what your costs should be. It will simply tell you what your costs are.

Costs by themselves mean nothing. We must have standards of comparison by which to test their value.—"Efficient Cost Keeping," E. St. Elmo Lewis, 3d edition, 1914, published by the Burroughs Adding Machine Co., Detroit, Mich.

Objects of Cost Keeping. 1. Determination of the price at which the product can be offered in the market.

2. Lessening production costs—To attain this the most minute attainable subdivision of cost is demanded.

Production expenses cannot be reduced in gross, but must be attacked in small parts.

The experienced cost-keeper may divide the expense account into a hundred or more subordinate accounts, while the inexperienced one may keep it in a single account or at most divide it into a very few heads. Henry Roland, *Eng. Mag.*, Vol. 16, p. 47.

A knowledge of the total cost of a machine is of use only in fixing the selling price or in taking an inventory. It is of no practical value in reducing costs. The information is too general.

It is impossible to reduce the cost of a machine to its minimum figure without first obtaining an accurate knowledge of the time consumed in the manufacture of each piece. The workman must be offered some incentive. The piece-work, premium and different systems * are conducive to this end, but should be used after and not before the acquisition of reliable time records. It is necessary to know the cost of every operation on each piece. We must adopt some form of job ticket.—H. M. Norris, *Eng. Mag.*, Vol. 16, p. 385.

The cost of any equipment made by the plant itself must include its share of burden.

Installation charges are one part of the cost of a machine.

Special tools for a particular order should be charged against that order.

The cost of experimental work should be made a deferred charge which will not be absorbed until the result of the experimental work are in actual operation.

Machines and appliances perfected through experiments should be considered as assets, their theoretical value being the sum of all the elements of cost that have been incurred in their behalf during the cost of the experiments.

Over, short and damage account. Wastes, shrinkage, defective work are charged to this account, and it is credited with value received for any disposition of the items charged. The balance becomes part of the indirect expense.—J. L. Nicholson, "Cost Accounting Theory and Practice."

Controlling Cost Records. Accounts may be kept in the general ledger, which should control the various items of production costs. For example, accounts should be kept with material, labor, indirect expense, work in process, and part-finished stock, entries being made to these accounts in the same manner as if they were kept in the factory ledger.—Nicholson.

Keeping the various items of factory costs in the general ledger involves much unnecessary bookkeeping. These items should be kept in the factory ledger, and the general ledger need have only one account for factory operations, charging it with all cash sent to the factory and with invoices certified by the factory for payment by the general office, and crediting it, at factory cost value, for goods shipped from the factory.

What is "Control" and a "Controlling Account"? These words are used by many authorities on accounting in a sense that is different from their ordinary meaning. To control means to compel, to manage, to restrict. In the accountant's sense it means to summarize or to lump together, for example, when many expense accounts are kept in the cost records their totals are brought together and entered in a single Factory Expense Account in the factory or general

* One of the difficulties the student meets is the number of different meanings and applications of the word "cost." It is both a noun and a verb, and as a verb it seems to have a different significance when used in the past, present and future tenses. The bookkeeper uses it in the past tense. "What did it cost to get this article into the warehouse?" He needs this figure in order to balance his books and account for the expenditure. The factory manager wants to know "what is this thing costing now; how can we reduce costs?" The owner of the factory, "What will this thing cost next year?" so that he can fix next year's prices.

* For information on wage systems see F. W. Taylor's "Shop Management," F. B. Gilbreth's "Primer of Scientific Management," and "Motion Study." Gantt's "Work, Wages and Profits," and Knoeppel's "Maximum Production."

ledger, and this is called a control or controlling account. It does not control anything, it only shows the totals of several minor accounts of a class.

It is proper to expect from a cost system:

1. Final costs; that is the cost of completed units of the product at the door of the factory.

2. Partial costs; the cost of component parts, or costs at certain stages of their production.

3. Comparative costs between one period and another—like articles under different conditions.

4. Costs of operations—direct-labor cost, so that it shall be possible to change from day to piece work.

5. Indirect costs by classes and groups—a basis for the distribution of indirect expense. Crude systems with careful handling produce better results than elaborate systems poorly run.

The best plan for factory organization and costs can be evolved only after many months and, perhaps, years of painstaking development and modifications.

Cost finding is not merely the work of an accountant, it is the work of an engineer, supplemented by the best accounting knowledge that he can command.

Costs have no value except in comparison, that action may be directed by experience.

The end of cost keeping is cost reduction. The cost records must be *made use* of, or they are of no value.—J. N. Gunn, *Eng. Mag.*, Vol. 20, 705.

Cost Securing—gathering details by means of shop order, requisition, time cards, etc.

Cost Compiling—entering the data on proper forms.

Cost Comparison—placing the latest information beside other information.

Cost Analysis—thought and deduction applied to the cost comparisons.—C. E. Knoeppel, *Eng. Mag.*, Vol. 33, p. 172.

Theories of Costs. Many of the questions about cost and value would become simpler if we would give up the idea that there is any abstract "cost" or "value," and instead should work on the basis that the business of the accountant and engineer is to provide data which will enable the executive to take action.

There is no such thing as an abstract "cost," or if there is it is of no use to any one. Sometimes we want to know whether we have made or lost money during a given period. In other cases we want to know how much our expenses will be increased if we put some by-product on the market. In that case we want to know only the real extra cost of the by-product. In still other cases a factory owner may want to know whether he had better shut down his factory for a period, or run it until the market for the product improves. To answer this question he needs an entirely different set of figures than when he is deciding whether or not to build a new factory.

Practically every theory of cost or theory of valuation helps to answer some particular question, and we shall continue to have new cost theories and new value theories so long as new questions are coming up to be answered.—R. S. Hale, *Jour. A. S. M. E.*, Feb., 1917.

It is a fundamental mistake not to check the burden charged to cost through the machine rates with the actual burden during corresponding periods. Unless this is done, machine rates, developed in an effort to secure accurate costs, may be so inaccurate as to lose much of their potential value. It is equally a mistake to omit the necessary check on any other kind of burden methods. If the percentage-on-labor or the man-hour methods are used, control should be established to make an accurate comparison between the amount of burden applied and charged to cost and the amount of expense burden actually incurred.—Clinton H. Scovell.

Many cost systems which have fairly good records of material and labor fail entirely in their purpose because they deal so inadequately with the subject of burden. Important elements of indirect costs are thrown together in a "general expense" account, concealing the leaks and wastes that reduce efficiency and curtail profits. Scientific management is never complete unless there is developed at the same time an accounting practice which shall adequately reflect for the management the *net* results of all industrial endeavor.—Clinton H. Scovell.

Interpret the Figures into Actions. The day of guesses is past. Knowledge of costs of each article produced or handled, of expenses by departments, of the performances of each salesman, of the work turned out by each workman and machine, of the stocks on hand, of the gross profits and the net profits month by month, are necessary to success. The man *who can interpret these figures into actions* that produce profits is the successful manager. But, first of all, he must have the figures.—Charles R. Stevenson, General Manager of the National Veneer Products Company Factory, Sept. 15, 1916.

Functions of the Cost Accountant. In the past the principal function of a cost system, besides indicating a limiting selling price, has been to enable those in financial control to criticize those operating the factory. These criticisms are usually from one to three months late, and are so general in their character as to afford, as a rule, no guide whatever by which the superintendent can be governed. Such a system is too often most highly prized for its worst defect, namely, that it enables those in financial authority to criticize without taking any responsibility whatever for showing how to do better.

Before we can expect to get any great benefits from the newer managerial idea, we must readjust our ideas of the functions of the cost accountant, *who must become the servant of the operating executive as well as of the financial executive.*

As long as the cost accountant is simply a critic, he may be called "non-productive," but when he furnishes the superintendent with prompt information which enables him to reduce costs he becomes "productive." Promptly detailed information of what is being done each day, furnished in such manner as to be readily compared with what has been done, and what can be done, is the best method of measuring efficiency.—H. L. Gantt, *Trans. A. S. M. E.*, 1914.

The end and aim of cost accounting should be to know not how much a certain order cost for its constituent productive elements, but why it cost what it did, and under what conditions the cost might be reduced.—F. E. Webner, *Eng. Mag.*, Vol. 35, p. 591.

The Chief Cost Accountant. A proper head to the department of cost keeping must be as much an engineer as an accountant, and capable not merely of compiling figures, but of using the information when the facts are compiled; for the end of cost keeping is cost reduction. This man must be so efficient that he may be depended upon by the highest official of the company and he will naturally be high in the counsels of the latter. . . . A man who fills such a position will have no sinecure.—James Newton Gunn, *Eng. Mag.*, Jan., 1901.

The Manager of the Future. Before the cost accountant can become efficient the management must become efficient, because if the management is not efficient the cost work will not be organized and functionalized so that it can reflect truly, adequately and completely the real value of the business performance.

The efficient manager knows a cost system to be a means to an end, and not an end in itself.

The systematic manager occupies his time in writing history; the efficient manager is writing scientific prophecies. He is scientifically determining what is going to happen the day after to-morrow. He is systematic, too, but his system is projected into the future.

The manager of the future will be more of an accountant, more of an engineer, no matter how much of a financier or salesman he may be.—E. St. Elmo Lewis.

Devising a Cost System. If the work is to be undertaken by the regular office force the system must be one that they can handle.

The cost accounting must work along the line of least resistance and begin with as simple a system as possible. This is the reason for introducing at first an estimating system, which will soon show where more complete methods should be applied.

There are conditions that remain constant from year to year, and when a cost system has obtained the results by detailed methods for one or two years that part of the system may be dropped and the results considered as a constant quantity. There is little merit in verifying established data, especially if the verification is involved or expensive and can be accomplished approximately by other means.

Whatever kind of system is devised every precaution should be taken to avoid making it top-heavy.—Nicholson.

If the original data of time and material are kept and filed by cost symbol or number, then in some lines of business the compiling, comparison and analysis need be done for one-tenth or one-hundredth of all the data, selecting the pieces whose cost is desired to be known; thus greatly decreasing the cost and the complexity of the cost system. For example, if it were attempted in a hardware factory employing 1000 men or more, and making 10,000 different styles and sizes of product, nine-tenths of which are made on piece work, by the same processes and machines year after year, to have a cost system in which all the original data were transcribed to piece cost, group cost and finished product cost cards, each with labor, material and burden cost tabulated, and in which a monthly summation of all these cards was made for the purpose of making journal entries for the general books, thus tying the cost system to the bookkeeping, the cost of the cost system would be so great as to endanger the profits of the concern.

It is not imperative to record the cost of each individual machine if it is an exact duplicate of others whose cost is known. It is sufficient that the cost of individual parts or operations be recorded so as to note any variation of cost due to changes in the cost or in the efficiency of labor or material. —John Sturgess, *Eng. Mag.*, Vol. 36, p. 940.

When a new construction is in progress or important alterations are being made in an existing machine, the manager requires the most minute subdivisions of costs, so that he may know in what sections of work or in which departments he must seek to economize. But at other times when the works are producing machines of standard patterns only or executing reproductions of previous orders, such subdivisions are not so necessary. It is then usually sufficient to ascertain the total on each machine or structure so as to insure that it does not exceed a normal amount. —F. G. Burton, "Engineers' and Shipbuilders' Accounts."

In the securing of costs in a specific case it is necessary to regard:

a. The character of the enterprise.

b. The value of the information when secured.

c. What use should be made of the facts.

d. The provision in the organization of having the facts used as intended.

e. Whether or not those for whom the facts are intended are competent to use them.

f. Whether through proper inspection there is assurance that the facts have been used.

g. In what degree of refinement should the costs be presented. —J. Newton Gunn, in Humphrey's "Business Engineering," p. 500.

Unintelligence was and is still exhibited:

By the lack of appreciation of the vital necessity of having any facts used in the operating department capable of proof in the final accounts of the corporation or firm.—*Ibid.*, p. 499.

If by the words "final accounts" is meant the general books of the concern, this is an entirely unnecessary "tying of the costs to the general books." The sentence should end with the words "capable of proof." If the "operating department" makes a boiler, for example, all the facts concerning its cost may be proved by the job tickets and stores issue cards, not by the "final accounts."

Many people believe that costs may be usefully manipulated and twisted and arranged so that they cease to represent what actually happened but what in the opinion of the manipulator ought to have happened. A simple illustration of this is the argument, not infrequently met with, that where machine rates are in use a job done on a large, heavy planer that could have been done on a lighter machine should not be "penalized" by bearing the burden incident on a large machine. It would be just as proper to insist that where premium work is in use a piece of work should always be costed at its lowest rate of production.—A. Hamilton Church, *Eng. Mag.*, Vol. 38, p. 21.

The "argument" that the job should not be "penalized" by the burden of the large machine is a perfectly sound one if the costs are to be used as a basis of inventory values or of selling prices. If a job for a light planer comes into a shop and all the light planers are busy while a heavy planer is idle, "eating its head off" with unearned burden, it is advisable to do the job on the heavy planer, but to charge only the burden of a light planer which would ordinarily be used for the job. Why should a job be "penalized" just because the light planers all happened to be busy when it came into the shop?

The following is an example of incorrect reasoning which sometimes follows a strict adherence to the machine-hour system of distributing burden: An owner of a machine shop who had a tabulated hourly burden charge for each machine, varying with the size of the machine, the cost of running it and the number of hours that the machine was expected to run in a year, noticed that a small piece was being turned in a very large lathe. He told the foreman that he should not use the lathe for that piece because the burden charge on it was too heavy, and it would make the piece cost too much. The foreman replied that all the other lathes were busy and that there was no heavy work on hand for the large tool, and he thought he would make the big lathe "do something for its keep." The foreman was right, and, moreover, the burden that should be assessed against that piece in making up its cost, if the cost was to be used as a basis for estimating on future orders for similar pieces, is not the machine-hour rate of the big lathe, but only that of a small one, on which the work would ordinarily be done.

Systems of factory accounting must show not only the cost of the product but also indicate the working conditions and efficiency of all departments. The manager must have some means by which he can check large unnecessary expenditures or heavy losses. He should be able to detect increases in cost above normal or any unnecessary investments in stock for manufacture.—C. U. Carpenter, *Eng. Mag.*, XXIV, 39.

To make savings of money, service and time, the cooperative [accounting] adviser to an executive must be able: (*a*) To

distinguish clearly between records which are vital to the future policies of a business and those which are merely historical.

The past in industry as a determinant for policies is of value only as it is vitally concerned with the future.

b. To omit many [accounting] refinements that cost much money and lead to a "false and delusive accuracy"; to avoid so far as possible doing work that "costs more than it is worth."—Dr. Hollis Godfrey, in a paper on "Application of Engineering Methods to the Problems of the Executive, Director, or Trustee." In the original the word "engineering" is used where "accounting" appears in the quotation.

"Tying in" the Cost Records to the General Accounts. When the cost records are "tied in" with the general accounting, the management has complete control not only over the operating expenses of the factory, but over the inventories of raw material, work in process, and finished product.

Cost calculations are sometimes made entirely detached from the general bookkeeping, but it is very rarely that such records have anything like their full value, and their use is always attended by the very considerable risk that they cannot be proved by the showing on the financial books at the end of the year or other closing period.—Clinton H. Scovell.

The original entries of factory costs of salable products or of betterments are made on job tickets and stores issue tickets. Those of auxiliary department costs are made on the pay rolls of the several departments for labor and on stores issue tickets or store books for indirect material. The burden charges to cost of salable products or betterments are made on job tickets, on stores issue tickets (for material burden) on piece cost cards, or on cost summaries, according to the system of burden distribution that has been adopted.

The costs are "tied to the general books" through the journal entries on the factory books: Sundries to Labor, Sundries to Cash, Sundries to Stores, Sundries to Burden, the Sundries being Work in Process, Stores, Betterments, Burden. The cost accounts are balanced or "proved" by the total credits to labor equalling the total of the pay rolls, by the total credits to Stores equalling the total of the stores issue tickets, but this is by no means a "proof" of the accuracy of the costs. Their accuracy depends entirely upon the accuracy of the original entries on the job tickets and stores issue tickets, and upon the correctness of the method or theory as well as the clerical accuracy of the distribution of burden. Any error in these will be carried forward into the general books, where it will remain undiscovered. The costs may be tied to the books but cannot be proved by them.

"Complete control over the operating expenses of the factory" cannot be obtained by any system of accounting. That is a function of the management which is independent of the accounting system.

With the cost books once established the best modern method is to incorporate their record in total in the general financial books. **The cost books must be interlocked** with the financial books.

The cost books contain the data showing the analysis of the elements of cost, all of which should be controlled by the financial books so as to permit of a verification of the mathematical accuracy of the transactions on the cost records.—Nicholson.

It is desirable that cost accounts should be based on an elastic system, and that while they are built up on the same foundation and, in general, must agree with the financial books of the concern, **they should not be interlocked** with them.—F. G. Burton, "Engineers' and Shipbuilders' Accounts"—The Accountant's Library, Vol. XIV.

WAGE SYSTEMS

The Bonus Plan. Explained in detail by Mr. Gantt in his valuable paper read before the A. S. M. E. in December, 1901. Distinctly a system of task work combined with the use of instruction cards for the workmen and a bonus for accomplishing the task within the time set for it.

This bonus system of pay has always appealed to me as the most easily understood, the easiest to introduce with little opposition, and the most effective of all systems yet produced. It is adaptable in some forms to almost any other system of pay that may be already in existence in the shop. It is the easiest to introduce in case the men are working upon the day-work basis. Nor is it difficult to persuade the workmen to abandon piece work for it in case the reward is made sufficient. I have been introducing it into works under my control with marked success. – C. U. Carpenter.

A Benefactor to the Race. Every cheapening of production brings a more than proportionate increase of consumption. There is no greater benefactor to the whole race, from a material point of view, than the man who, by diligence or inventiveness, makes one hour of labor suffice for the work which formerly took two. His blessing is like in kind and great in proportion to his who makes two blades of grass grow where one grew before.—Editorial in *Eng. Mag.*, June, 1900.

The man who causes one man to cut the grass that two or three men cut before is a public benefactor.—W. Kent, 1914.

The Cincinnati Milling Machine Co., in a pamphlet describing its factory, explains its wage system as follows:

Wages are paid weekly. (*a*) An hourly rate is established for each employee, according to his skill and experience.

(*b*) Additional Compensation. We aim to provide detailed instruction sheets for all operations, which will show in detail the method of handling the job to best advantage and with the least labor. On this sheet is also shown the normal or standard time for the performance of the operation. If this work is done in this time, the workman is paid a bonus, which approximates a one-third increase in wages. If the work is done in less time than the standard time shown on the instruction sheet, the employee receives the bonus as above and a premium in addition to the bonus. If it takes an employee longer than the standard time to do the work, he has an opportunity to earn a premium for all the time that he saves inside of standard time plus 40 per cent. This premium time is also clearly stated on the instruction sheet. The above standard time is in all cases reasonably and fairly set, and the average man has no difficulty in earning the bonus. The time is set with great care and when it is once set, it is never changed until the job itself is changed or some change is made in the method of performing the operation, or different tools or jigs are employed.

The Flow of Values. The two diagrams, Fig. 6, page 125, show a method of illustrating the "flow of values." The same final results are accomplished by each. The total expenditures for labor, material and burden are all accounted for, as shown in the block marked "Results." The difference between the two diagrams is that in the first the total of labor, material and burden flows in three large streams into Work in Process, while in the second it flows through a great number of small streams, through departments, classes, and operations, which later are concentrated into a few large streams that lead to the total result. We may put flow meters on all these small streams, and their total may equal the total

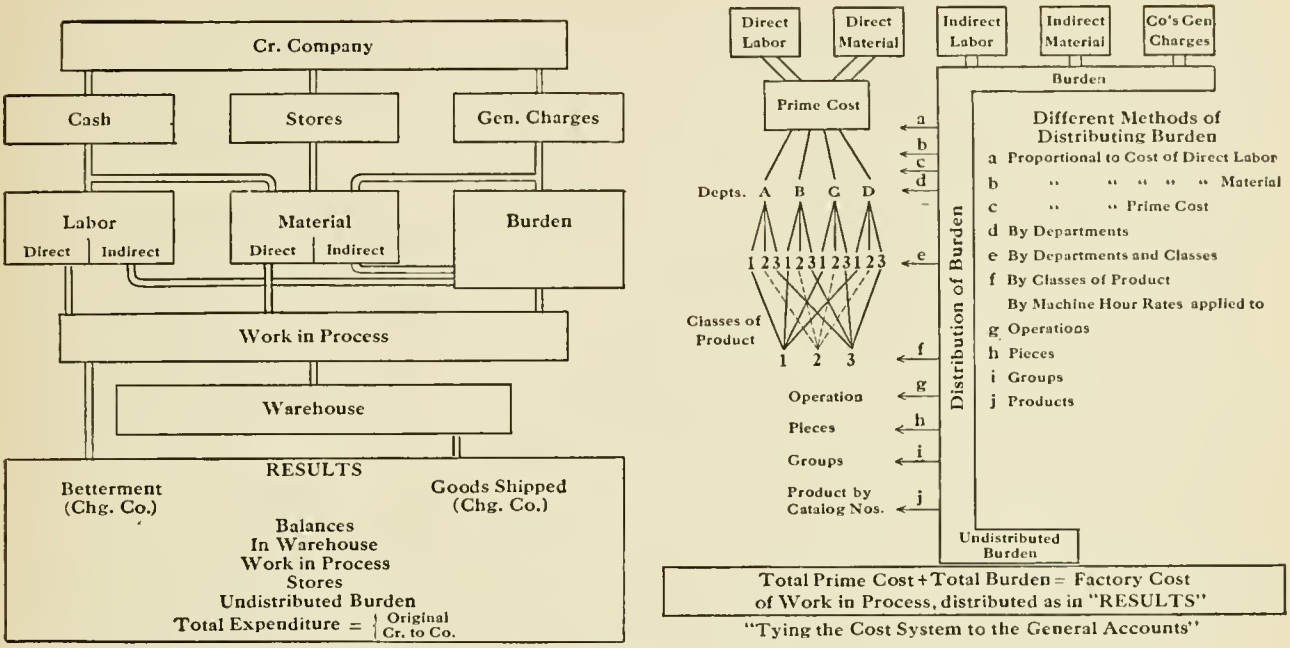


FIG. 6.—DIAGRAMS ILLUSTRATING THE FLOW OF VALUES.

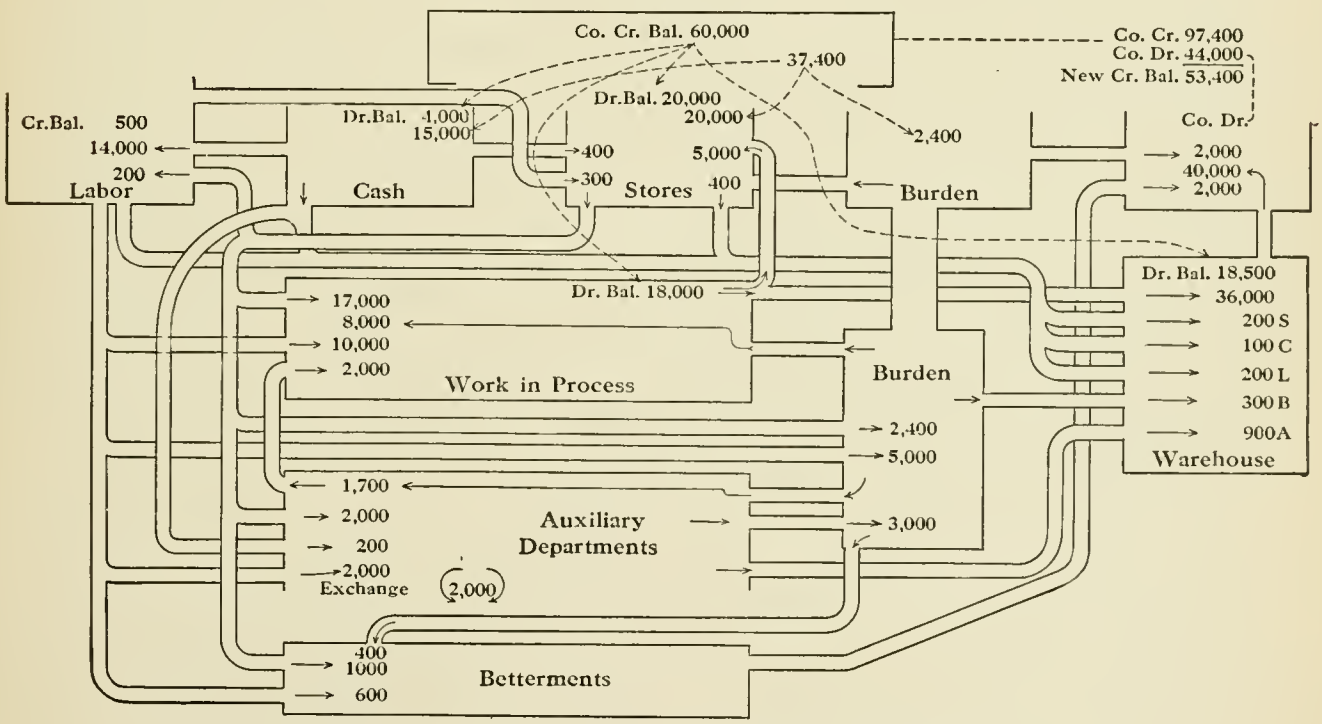


FIG. 7.—THE FLOW OF VALUES. FACTORY LEDGER. (See page 41.)

of the meters on the pipes leading from Labor, Material and Burden, which agrees with the meter measuring the Results. Thus, we have " tied the cost system to the general accounts," and we have " checked the burden charged through the machine rates with the actual burden during corresponding periods." It is a great satisfaction to the bookkeeper to have done this. It proves that his books are in balance, that he is a good arithmetician, that every expenditure has been entered and charged to some account, but it does not prove the accuracy of the cost accounts. Material and labor may have been charged to one article that belonged to another. The burden may have been distributed according to a wrong system and one product greatly overcharged and another as greatly undercharged. The idea that the cost accounts are " proved " to be correct by tying them to the general accounts is a delusion.

Diagrams of " flow of values " have sometimes been made with figures of the values inserted. They may be of some use in explaining to students the theory of accounts, but they are of no practical use to accountants. Fig. 7 shows such a diagram made from the figures given in the Factory Ledger on page 41, and Fig. 8 one made from the General Ledger, page 40. On comparing the diagrams with the column ledgers it will be seen that the ledgers give all the information that the diagrams do, and more, and they also give it in a more simple and easily understood form.

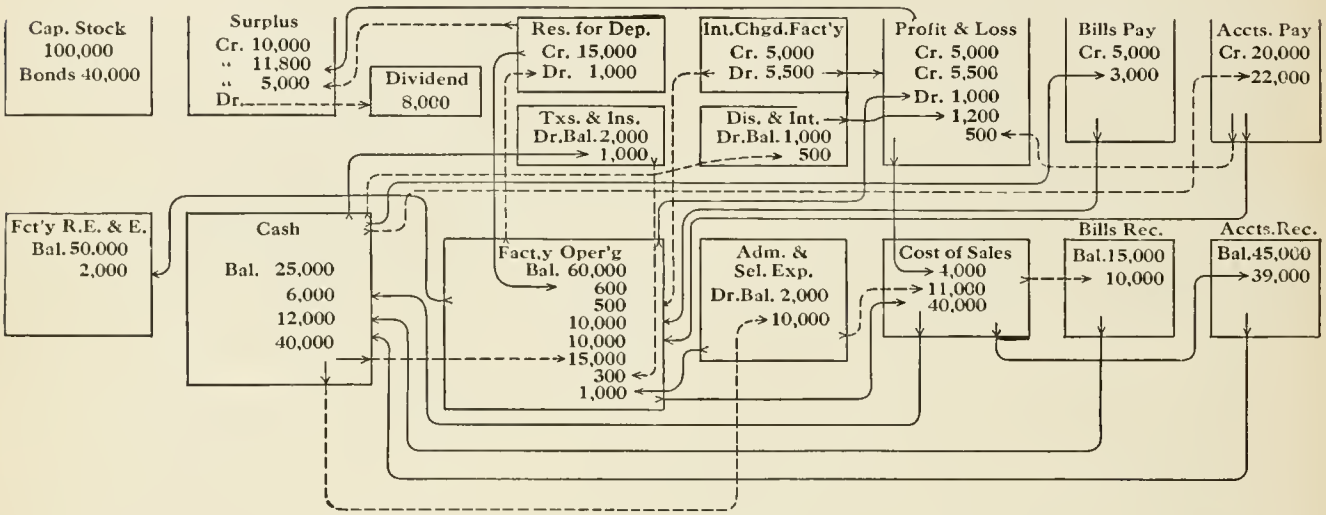


Fig. 8.—The Flow of Values. General Ledger. (See page 40.)

Predetermined Costs—Standard Costs. There are two methods of ascertaining cost. 1. Ascertain them after the work is completed. 2. Ascertain them before the work is undertaken. The first is absolutely incorrect, mixing up with costs incidents that have no connection with them. Real costs are divided into (1) standard costs, (2) *avoidable* loss.

There was a railroad shop in which charges were distributed with such painful care that the shop sweepers subdivided their time to the various locomotives around which they loitered. But locomotives, as well as men, can loiter, and one of them stood in this shop three months, waiting for a steel deck plate. Being familiar with its number the workers charged all the time they could not account for to this locomotive, so that at the end of three months the total amounted to more than $500. In principle there is no difference between charging an hour of wholly wasted time to a locomotive and charging it with two hours of time when one hour should have accomplished the work. The moment specific wastes of any kind are charged to a definite order instead of being charged to some inefficiency account real costs are vitiated.

Because costs are not standardized the variations due to inefficiency are in the records either increased or lessened by the much larger variations due to change of conditions. A job done one month under 100 per cent conditions but with 60 per cent labor efficiency may equal in (recorded) cost the same job done in another month under 60 per cent conditions but 100 per cent labor efficiency.

In one month surfacing a slide valve cost $37.00 and in another month $3.65. The object of cost accounting is to record accurately present (not past) facts, and to facilitate future improvements.

"A day's work," "a pound of material," "the performance of a machine," should be predetermined in all cases. The difference between standard costs and actual costs is the loss due to inefficiency.

Allotted costs = standard cost + current wastes. Current wastes are predetermined by assuming that they will be relatively of the same percentage as for an immediately preceding period.—Harrington Emerson, *Eng. Mag.*, Vol. 36, p. 336.

Defects and Troubles of Bad Cost Systems. The cost keeping is usually under the jurisdiction of the bookkeeping department who are apt to make too much of a bookkeeping proposition of it.

A manufacturing concern installed two different systems within two years, and at enormous expense, and for a long time they had costs coming on through three different systems, and it was more than three years before they got anything satisfactory, and then the costs were not as satisfactory for commercial purposes as the ones they obtained by their original system.

A system should be adapted to the particular needs of the business.—W. M. S. Miller, *Eng. Mag.*, Vol. 36, p. 832.

The systems which failed were: Group Cost, Operation Cost, Piece Cost. They involved an immense number of cards and

entries and a delay of from a few days to several weeks before any tangible total could be arrived at, and that was not trustworthy.—John Sturgess, *Eng. Mog.*, Vol. 36, p. 940.

Axioms Concerning Manufacturing Costs. By Henry R. Towne, *Trans. Am. Soc. Mech. Engrs.*, 1912.

Axiom 1. Every cost (of a manufactured article) includes three fundamental factors, labor, material, expenses.

Axiom 2. The expense factor should be split into two parts; manufacturing, commercial.

Axiom 3. A manufacturing cost has three phases: prime cost, shop cost, actual cost.

Axiom 4. Accurate cost information is vital to good management.

Axiom 5. Accurate costs imply the correct classification of every expenditure.

Axiom 6. Every production expenditure should be charged directly to its proper account.

Axiom 7. All non-productive expenditures should be properly grouped for final distribution.

Axiom 8. The normal basis for distributing manufacturing expense is productive labor.

Axiom 9. The normal basis for distributing commercial expense is shop cost.

Axiom 10. An accounting system should show results both by departments and by totals.

Axiom 11. A contract product may require a more complex accounting system than a stock product for the accurate determination of costs.

Axiom 12. An accounting system should be embodied in a code of instructions for the guidance of those responsible for its operation.

Axiom 13. Symbols are better than titles for recording charges in an extensive accounting system.

Axiom 14. Extraordinary gains or losses, in order not to distort the statistical value of the annual profit and loss record, should be covered into the surplus account between the closing of the books for the old year and the opening of the books for the new year.

Axiom 15. Interest on borrowed capital should not be treated as an operating expense, but should be charged direct to the profit and loss account of the year.

Axiom 16. Final profits properly signify the amount earned on the capital invested. If interest on capital is deducted this fact should be stated, and interest should be computed on the total capital employed.

Axiom 17. Terms used to designate profits should indicate clearly the stage of profits to which they refer, and should be mutually understood.

Axiom 18. Speculative profits and losses should be segregated from those due to the normal operations of a business.

Axiom 19. A reduction in cost implies a corresponding reduction in inventory.

Axiom 20. Expenditures in one year which cover the requirements of several years should be distributed over the years to which they fairly apply.

Axiom 31. An annual inventory of all property is indispensable to accurate knowledge and to good management.

Axiom 22. Valuation of fixed property should be subject to annual review and to fair depreciation.

Axiom 23. An accounting system should present facts, without bias in any direction.

Axioms are statements of what are supposed to be self-evident facts. Some of Mr. Towne's so-called axioms are by no means self-evident, and some of them are open to serious objection, as below:

No. 2. Each department has its own expense factor, and that of the manufacturing department has nothing to do with that of the commercial department.

No. 3. A manufacturing cost has three elements, direct material, direct labor, and expense. The sum of the first two is often called "prime cost," and the sum of the three is shop cost, which is the same as manufacturing cost or factory cost. The term actual cost has no well-defined significance.

No. 7. The modern term for "non-productive" is "indirect."

No. 8. In the best systems of cost-accounting the basis for distributing manufacturing expenses is the normal machine-hour rate. The cost-of-productive-labor basis is the most faulty.

No. 9. Commercial expenses have no relation whatever to shop costs. A shop may make two classes of products, the shop cost of each in one month being $1000. It may cost for selling expenses $100 for the first lot and $1000 for the second.

No. 15. Interest on borrowed capital is a financial expense which has nothing to do with cost accounting, but interest on the whole investment of the factory, whether cash obtained by the sale of stock or borrowed money, is a manufacturing cost. It should be charged against the factory and credited to Interest Earned, or some such account, in the Company's general or private ledger.

No. 16. Final profits include Interest Earned, Profit of the Selling Department, and any other profits, less all the losses. They are all finally closed into Profit and Loss, the balance of which, for the year, shows the final profits, or losses as the case may be.

No. 21. An annual inventory is not at all necessary if a continuous inventory is properly kept, the cards being frequently checked as the quantities or amounts of the several items inventoried are at their lowest stages.

The above axioms together with these comments were submitted to a professional accountant for his opinion on them, and he replied as follows:

"I would avoid axioms as a plague. The thing for the cost accountant is to use his own common sense at all times, and STUDY HIS OWN PROBLEMS rather than those of others. For a clear outline of the whole field let him go to some one book such as the present, for general principles only."

Subdivisions of Costs. F. A. Parkhurst in his book on "The Predetermination of True Costs" subdivides costs as below:

- True Costs
  - Direct Costs
    - Direct Labor
    - Direct Material
  - Indirect Costs
    - Administration
    - Financial
    - Sales
    - Operating

A better schedule of division is as follows:

- Factory Cost
  - Direct Labor
  - Direct Material
  - Factory Expense
- Total Expenditure
  - Factory Cost
  - Commercial Expense

Mr. Parkhurst says that he "considers the word cost to include all items both direct and indirect, including the minimum profit factor." This is an unusual definition of cost. The cost of a thing to us is what we have to pay to get it. It does not include either our selling expense nor any part of our profit that may be made when we sell it.

Costs of Organizations; of Patents and Patent Litigation; of Experiments. There are often some costs incurred in connection with a business that are neither factory operating costs nor commercial or selling costs, such, for example, as the legal and other expenses of organizing a corporation, expenses connected with the ownership of patents, and the cost of experiments which may or may not prove successful. Accounts for these expenses should be opened in the general books, and whether or not any part of them should be charged to factory costs of production is a matter for the management to determine as is also the question whether they should be entirely written off at the end of the year, by charging them to Profit and Loss, or carried in the books as assets, a portion of them being written off each year.

The Westinghouse Electric and Manufacturing Co. in 1917 reported as part of its assets Patents, Charters and Franchises, $4,285,206.51, while the General Electric Co. carries on its books Patents, Franchises, and Good Will at a total valuation of $1.00, writing off each year the total expenditure upon them.

Interest on Factory Investment Should be Charged to Cost

Inflated Inventories.* The most serious objection to reckoning interest into costs, in the opinion of some accountants, is that to do so "inflates" the value of an inventory. The debate arises over the word *inflate*, for there can be no doubt that, so far as a calculation of interest on investment increases cost, it logically raises the price at which manufactured goods are carried in an inventory. To the present writer this seems no objection at all. Seasoned lumber is worth more than green lumber. Paper, wines and leaf tobacco are more valuable when properly "aged." The cost of this aging process is almost exclusively a capital cost. The cost of carrying is an entirely appropriate part of manufacturing costs and should be recognized in pricing the inventory of finished goods.

The capital cost of converting rags into paper is just as inevitably an addition to its cost, and just as fair an addition to its inventory price as the cost of seasoning or loft-drying the paper. The capital cost of converting seasoned lumber into furniture is just as fair an addition to its inventory price as the cost of seasoning it beforehand. Frequently a liberal use of capital diminishes other costs, and the too meager use of capital increases other costs. Interest on investment is the conventional and logical way of expressing capital cost. Why isn't one kind of cost as good an addition to value as another? There is, therefore, no reason why an inventory should not be carried *at all its cost*, including so much thereof as may be due to interest on the investment employed.

The more carefully one considers the varied uses of accurate costs the more certainly does he arrive at the conclusion that interest on investment should be reckoned as a factor.

The Rate of Interest. The rate of interest which should be charged to cost depends upon the income which the capital might be expected to earn if invested in high-grade securities where no manufacturing or trading risks are taken. . . . The Harvard Bureau of Business Research recommends the use of the ordinary interest rate on reasonably secured long-time investment in the locality in which the business is situated.

Interest on investment in a plant is very rarely included in the cost of manufacture, but should be in all cases.—J. L. Nicholson, "Factory Organization and Costs," p. 33.

Two factories, A and B, are making machine screws. A has a small capital, uses low-priced screw-cutting lathes, purchases raw material in small lots as needed, carrying only a small stock. A's yearly interest on the capital invested is only $1000. B has ample capital, uses modern turret lathes and a few automatic screw machines, purchases material in large lots and carries large stocks in order to buy at the lowest prices. The annual product of B is the same as that of A, but it is made at a much lower labor cost, and at a somewhat lower cost for material. The interest on the capital invested, however, is $4000 per year, and this must be charged as part of the burden cost of the screws made, in order to arrive at their warehouse, or inventory, value.

Mr. Nicholson, in *Journal of Accountancy*, Vol. 15, p. 330, says: "The writer firmly believes in the theory that interest on capital invested shall be charged to the proper expense accounts before ascertaining the actual profit from manufacturing or trading." He quotes Wm. Morse Cole as follows: "Since one of the purposes of accounting is to show whether the return is adequate, the interest would seem necessarily to be involved somewhere in the accounting."

F. E. Webner, in his "Factory Costs," says: "The interest on an investment in plant and equipment, or rent paid for the use of a factory, would seem to be almost as direct an incident of cost as labor, material, power or incoming freight."

Problems on the Charging of Interest. A blast furnace in Northern Ohio at the close of the navigation season on the lakes has a million dollars invested in a pile of ore sufficient to run the furnace during the next five months. It has half a million dollars invested in a storage plant and in the hoisting and conveying machinery required to transfer the ore from the piles to the bins at the furnace. The transportation company that brings the ore from Lake Superior has its vessels lying idle while the lakes are frozen. A furnace in Alabama has its ore delivered directly from cars to the ore bins, and never has more than two weeks' supply of ore on hand. The northern furnace is handicapped, as compared with the southern furnace, by having to charge against the cost of its ore the interest on the capital invested in the storage piles and in the handling machinery; and the transportation company has to charge in its cost of freighting interest on the cost of its vessels during the whole year although they are idle for five months. In this case the cost of idleness is a legitimate charge against the cost of production.

A southern warehouseman at the beginning of the cotton picking season has a million dollars invested in mortgage bonds which pay 6 per cent interest; he also owns an empty warehouse and an idle baling plant, costing $200,000 but at present earning nothing. He sells his bonds at par and buys a million dollars' worth of cotton which he bales and stores. Each month that he holds the cotton, it is costing

* From Clinton H. Scovell's "Cost Accounting and Burden Application."

him $5000, the interest on his bond investment, which he charges to the cost of cotton. He also charges to it the interest on his investment in the warehouse and baling plant, $1000 per month, or $12,000 per year. If he sells the cotton in portions of one-tenth of the whole quantity per month for ten months, each portion must bear as part of its cost one-tenth of the whole interest charge for one year on the plant, or $1200, plus $500 per month for the number of months it has been held, as its share of the interest on the purchase price, whether it is shipped the first month or the tenth. If it is shipped the first month the space it occupied in the warehouse remains idle until the next crop is stored, and in this case the cost of unavoidable idleness, a necessary part of the cost of doing a cotton warehouse business, must be charged to the cost of the cotton handled.

Example. If the warehouse is filled October 1st and the shipments of each month are billed to the sales department at the end of the month at warehouse cost = purchase cost +interest+all other expenses, such as taxes, insurance, inspection, baling and handling, depreciation of plant, superintendence, etc., and that out of the receipts from sales (supposed to be for spot cash) an amount equal to the sum of the purchase and interest costs is reinvested in 6 per cent bonds, a statement of the cost of cotton at the end of each month for purchase and interest only, omitting the expense costs, might be made as below:

End of Month.	Lot No.	Purchase Cost.	Interest on Purchase Cost.	Interest on Plant Cost.	Rebate of Interest.	Purchase +Interest.	Total Invested in Bonds.	Interest on Each Lot of Bonds.		Interest on Interest Re-invested.
								Mos.		
October	1	$100,000	$500	$1,200	$66	$101,700	$101,700	11	$5,500	+$93.50
November	2	100,000	1,000	1,200	60	102,200	203,900	10	5,000	110
December	3	100,000	1,500	1,200	54	102,700	306,600	9	4,500	121.50
January	4	100,000	2,000	1,200	48	103,200	409,800	8	4,000	128
February	5	100,000	2,500	1,200	42	103,700	513,500	7	3,500	129.50
March	6	100,000	3,000	1,200	36	104,200	617,700	6	3,000	126
April	7	100,000	3,500	1,200	30	104,700	722,400	5	2,500	117.50
May	8	100,000	4,000	1,200	24	105,200	827,600	4	2,000	104
June	9	100,000	4,500	1,200	18	105,700	933,300	3	1,500	85.50
July	10	100,000	5,000	1,200	12	106,200	1,039,500	2	1,000	62
August										
September										
		$1,000,000	$27,500	$12,000	$390	$1,039,500	$1,039,500		$32,500	$1077.50

The sum of the interest on purchase cost of the several lots, $27,500, and the interest on the several bond investments, $32,500, is $60,000, the same as would have been received from the original investment of $1,000,000 in 6 per cent bonds. If greater accuracy is desired, the charges against each lot for interest on plant cost may be reduced by the figures in the column headed Rebate of Interest, representing the money that might be earned by the investment of $1200 for periods ranging from eleven months to two months. This modification would diminish slightly the figures in the succeeding columns. Account may also be taken of the fact that each lot of bonds purchased earns interest (and the interest may be compounded quarterly) as indicated by the figures in the last column.

Interest and Cost. "*The Journal of Accountancy* has consistently maintained that except for the purposes of comparison the inclusion of interest as an element of cost was technically unsound and furthermore was unwise from a public point of view." (Editorial in *J. of A.*, Vol. 22, 1916, p. 206.)

The Bureau of Business Research of the graduate School of Business Administration, of Harvard University, maintains that interest is an element of cost. It says (*J. of A.*, Vol. 22, p. 209):

The bureau has come to the conclusion that every business, whether or not incorporated, should have a specific charge for interest on the cost of investment—the amount the capital could earn if invested elsewhere. No business is truly profitable unless it yields the proprietor not only a salary for his time and rent for his store, but also interest on his investment. The bureau has decided, furthermore, that it is more practicable from an accounting standpoint to consider this interest charge a part of expense rather than a distribution of profit.

The Federal Trade Commission's pamphlet on "The Fundamentals of a Cost System for Manufacturers" says (*J. of A.*, Vol. 22, p. 213):

As seasoned material has a higher value . . . the interest on the capital locked up during the seasoning forms in a sense a direct part of the cost of the material . . . it is impossible to get true relative costs unless consideration is given to interest on the capital employed.

Cost accountants and industrial engineers, for comparative and statistical purposes, almost unanimously advocate including interest in cost, and so far as interest is included in cost for comparative or statistical purposes it serves a useful purpose.

Auditors, on the other hand, . . . take the ground that interest is not an element of cost, and that to include it in cost results is an inflation of inventory values and an anticipation of profits.

It is recommended that where interest on the investment is treated as an item of cost that the interest charged to the goods be eliminated from inventory values, and that in preparing profit and loss statements the amount of the interest charged to costs during the period be returned to income under the specific caption "interest on investment."

Suppose a furniture factory buys on the first day of the year a lot of green lumber for $10,000 and seasons it for a year before using it. At the end of the year it has cost

in addition $400 for storage, insurance and taxes. The accountant also adds to the cost $500 for interest, crediting Interest on Investment, and it is now inventoried at $10,900. The Profit and Loss statement will show no profit on lumber but a profit of $500 on interest on investment. If the lumber had not been bought, but instead the money had been invested in 5 per cent bonds, the profit due to interest earned would have been $500.

Suppose instead of buying the green lumber on the first of the year, it had bought it on the last day of the year after it had seasoned in a lumber yard. If the price of green lumber had not advanced, the seller would charge not less than $10,900 in order to cover his expenses, including interest on his investment. It is evident that the true inventory value of the lumber at the end of the year is $10,900 whether it was purchased by the factory on the first or on the last day of the year.

But the Trade Commission recommends that where interest on investment is treated as an item of cost "the interest be eliminated from the inventory values" and "returned to income under the specific caption 'interest on investment.'"

It is not clear what the expression "returned to income" means. It is probably a technical term used by some accountants, having a different meaning than the same words when used in ordinary language. There is no "income" in the case, but only "outgo." If the interest is eliminated from the inventory, Lumber account would appear as follows:

LUMBER

To Cash (purchase price) $10,000.	By Int. on Invest., $500.
To Expense (storage, etc.), $400.	Bal. (Inventory) $10,400.
To Interest on Investment, $500.	

The recommendation of the Commission is certainly wrong. The inventory value is $10,900 instead of $10,400, for it cannot be purchased in its seasoned state for less. The $500 interest is part of the cost at the end of the year whether it was purchased green at the beginning of the year and stored in the factory sheds, or whether it was purchased at the end of the year after it had been stored in the lumber yard of the seller. In the first case the purchaser earns $500 interest by investing $10,000 in lumber, and in the second hand case he may earn the same interest by investing the money in bonds.

CHAPTER XIV

CLASSIFICATION. SYMBOLS. BOOKKEEPING BY MACHINERY

Classification.* A classification should provide for an orderly and logical grouping of subjects which will bring together, more or less automatically, in their proper relationship the various divisions and subdivisions, and enable the location of any desired subdivision quickly and without the need of cross-indexing. It must also be flexible enough to permit wide expansion.

The method of numbering consecutively in one series is the extreme opposite of logical classification.

In working up the classification appended hereto, the writer has followed the method developed by Frederick W. Taylor, based on the plan made familiar by Melvil Dewey, which is extensively used in cataloguing books in libraries. The basis of the Dewey classification is the designation by a numeral of each of the main or generic groups into which the matter classified is divided.

Mr. Taylor attempted, in endeavoring to classify the expenses, activities and products of a manufacturing plant, to use the Dewey scheme, but found that it was awkward to be limited to ten classes or ten subdivisions, and that there were frequently numerical values to be embodied in a symbol, these numerals being in danger of being confused with those used to designate classes or subclasses. Hence he settled upon the use of letters for the classification proper, which has the advantage of permitting a symbol to be to a great extent mnemonic. While Taylor undoubtedly developed to its fullest usefulness the mnemonic system of classification, he always referred to Oberlin Smith as the originator.

In using this system we ascertain, by reference to the first sheet, showing the main classes, the letter designating that in which the subject with which we are concerned would naturally fall. Next, we refer to the sheet giving the subdivisions of that class, and so on until we get to the elementary subdivision.

The final test of any classification is use, so the one herewith submitted for Machine Shop Practice must not be regarded as either complete or final, but only as a starting point from which to work.

PROPOSED TENTATIVE CLASSIFICATION OF MACHINE SHOP PRACTICE

Main Classes

A Administration, Management and Maintenance of Plant and Machinery
B Building and Yards
C
D
E Employees
F
G General—Covering a wide range of subjects treated in an interrelated manner
H
J
K
L
M Machinery (other than transportation)
N
P Power Transmission
R
S Materials—Their purchase, storage and handling, and machinery for hoisting and transportation, of them
T Tools and Appliances—Their construction, use and maintenance
U
V Various Features of Machine Shop Practice not otherwise classified
W
X
Y
Z

* H. K. Hathaway, *Trans. A. S. M. E.*, 1916.

A Administration, Management and Maintenance of Plant and Machinery

AA Accounting—Costkeeping
AB Building Maintenance — Caring and Cleaning
AC*
AD Drawings for Machine Shop Use
AG General—Relating to Management and Organization treated as a whole
AM Maintenance of Machinery
AP Planning of Work
AS Supervision
AT Timekeeping
AW Wage Systems

B Buildings and Yards

BC Construction—Types
BF Fire Protection
BH Heating
BL Lightning
BS Sanitation
BV Ventilation
BY Yards

E Employees

EB Beneficial Associations and Other Shop Organizations
ED Discipline
EE Employment—Selection of employees with respect to fitness for work
EH Health Maintenance
ER Record of Employees
ET Training of Workers — Apprenticeship, Shop Schools, etc.

M Machinery (Other than Transportation)

MP Punching, Stamping and Bending
MT Machine Tools
MV Various Machinery not otherwise classified
MW Welding

MT Machine Tools

MTA Abrasive (Grinding) Machinery
MTB Boring Mills
MTC Cutting-off Machines
MTD Drill Presses
MTG General — Relating to more than one kind of machine
MTK Keyseaters
MTL Lathes
MTM Milling Machines and Rotary Planers
MTP Planers, Shapers, and Slotters
MTV Various Machine Tools not otherwise classified

MTA Abrasive (Grinding) Machinery

MTAD Drill Grinders
MTAP Polishing Machines
MTAT Tool Grinders
MTAU Universal Grinders
MTAV Various Grinding Machines not otherwise classified
MTAW Emery Wheels — Their Construction Materials, and Uses

* Left blank. In Mr. Hathaway's paper there are numerous blank spaces in each subdivision, as in his list of main classes, all the letters of the alphabet being used except I, O and Q. The blanks are omitted here in order to save space. It is well not to use Z, as when written it is apt to be mistaken for the figure 2.

P Power Transmission

PB Belting
PE Electrical
PL Lubrication
PR Rope Drives
PS Shafting — other than Countershafts (which are included with machines)

S Materials, their Purchase, Storage, and Handling, and Machinery for their Hoisting and Transportation

SA Store-room Arrangement and Store System
SH Handling — Transportation while in process of manufacture and the implements and machinery used for transportation
SM Characteristics of Various Materials
SP Purchasing
SS Shipping

T Tools and Appliances, their Construction, Use and Maintenance

TA Tool-room Arrangement and Administration
TC Cutting Tools
TG Grinding, Lapping and Polishing
TH Holding Devices
TJ Jigs, Fixtures, and All Special Tools for Duplicate Work
TM Measuring Tools
TP Punching, Bending and Stamping
TV Vise and Floor Work. (Including Erection and Assembling and the Tools and Appliances used in connection therewith)

TC Cutting Tools

TCB Broaching Tools
TCC Cold Saws
TCD Drilling and Boring Tools
TCM Milling Cutters
TCP Paring Tools
TCS Slotter Tools. (Other than Paring)
TCT Thread-cutting Tools

Letter Symbols Versus Numbers. Letters for symbols have some advantages over numbers. In the first place they may be made mnemonic, aiding one to remember the thing signified by them. Secondly, fewer characters are needed, since numbers are made of only ten digits, 0 to 9 inclusive, while 22 different letters (of one style) may be used, omitting O, I and Z because they are apt to be mistaken for 0, 1, and 2, and Q because it is difficult to make; if two styles are used, capitals and lower case, there are 44 available characters. The number of different things that may be represented by combinations of two, three, and four characters is as follows:

	One	Two	Three	Four
No. of digits	10	99	999	9,999
No. of letters:				
One style	22	484	10,648	234,256
Two styles	44	1,936	85,184	3,748,096

The following is a mnemonic listing of operations in a machine shop, the final letter, lower case g, representing "ing" or operation and the capital initial letter the first letter of the name of the particular tool or operation.

Ag Assembling
Bg Boring
Bw Bench Work
Cg Centering
Cpg Chipping
Cog Cutting off
Dg Drilling
Eg Erecting
Fg Filing
Fng Finishing
Gg Grinding
Hg Helping
Lg Laying out
Lng Lining
Mg Milling
Pg Planing
Phg Polishing
Rg Reaming
Sg Shaping
Slg Slotting
Tg Turning
Tgr Rough Turning
Tgf Finish Turning
Thg Threading
Tpg Tapping
Vw Vise Work

Nomenclature of Machine Details. (Abstract of a paper by Oberlin Smith, *Trans. A. S. M. E.*, 1881.)

The requisites for a good system of names and symbols are: 1st, isolation of each from all others that did, do, or may exist in the same establishment. 2d, suggestiveness of what machine, what part of it, and, if possible, the use of said part—conforming, of course, to established conventional names as far as practicable. 3d, brevity combined with simplicity. Of the importance of isolation to prevent mistakes and confusion; of suggestiveness to aid the memory; of brevity to save time and trouble, it is hardly necessary to speak.

To define Terms: "Machine name" and "Machine symbol" refer respectively to the name and symbol of the whole machine or other article of manufacture; for it will be noticed that the system is applicable to almost any products, except those of a textile or chemical nature. "Piece name" and "Piece symbol," in like manner, refer to the separate pieces of which the whole is composed.

Our system, as finally decided upon, is as follows: Machine names and piece names are determined by the designer in general according with the principles already pointed out, being, of course, made as brief and suggestive as possible, with no two machine names alike, and no two piece names alike in the same machine. In this nomenclature no positive laws can be followed but those of common sense and good English. A machine symbol consists of a group of three arbitrary capital letters. A piece symbol consists of an arbitrary number and follows the machine symbol, connected by a hyphen; thus, FPA–2 might symbolize the force-pump handle, smallest size. The machine symbol may be used alone when required, as FPA.

As thus described, these symbols fully possess the qualities of isolation and brevity. To make them also suggestive, some attention must be paid to what letters to use. In practice, we aim to make the first two letters the initials of the general name of the machine, and the last letter one of an alphabetical series which will represent the size of the machine. An example of this is shown in the symbol for the smallest-sized force pump FPA. If there is any chance of a future smaller or intermediate size, gaps should be left in the alphabetical order. This "initial" method cannot always be strictly followed, because of such duplicates as FPA for force pump and foot press. The remedy would be to change one initial for one beginning some synonymous adjective, that is, foot presses might be symbolized TPA, assuming that it stands for treadle press. Usually the least important machine should be thus changed. From this it will be seen that, in defining the theory of this scheme, the words "arbitrary letters" were purposely used. The idea is to make the system thoroughly comprehensive. There might be such a number of machines having identical initials that the letters would be almost arbitrary. In practice, the designer can usually succeed in making the symbols sufficiently suggestive.

In considering how many letters to use in a symbol, consideration of brevity advised two, suggestiveness three or four. Two letters did not allow of enough permutations nor indicate well enough the kind and size of machine. Three seemed amply sufficient in the first respect, as it provided over 17,000 symbols. If, for any reason, in the future four letters should seem desirable, the addition of another would not materially change the system. If three letters hyphened to a number of one, two or three digits

should seem bulky, remember that this symbol can stand by itself anywhere and express positively the identity of the piece. Its comparative brevity is shown by comparing the second and third columns of the following table (A). In the different lines an idea is given of the application of the system to a variety of products not usually made in any one shop.

TABLE A

1st Full Name of Machine and Piece	2nd Our Symbol for it	3rd Symbolic Name as often used	4th Characters in Col. 2	5th Characters in Col. 3	6th Excess of Col. 5 over 4
6″×4″ Engine Lathe, spindle head	ELA–4	Engine Lathe A–4	4	13	9
No. 4 Power Press frame	PPD–1	Power Press D–1	4	12	8
7″×14″ Steam Engine, crank shaft	SEG–51	Steam Engine G–51	5	14	9
Buckeye Mowing Machine, left axle nut	MMD-81	Mowing Machine D–81	5	16	11
No. 3 Glass Clock, main spring	GCC–105	Glass Mantel Clock, C–105	6	20	14
One-Hole Mouse-trap, choker wire	MTA–3	Wooden Mouse-trap, A–3	4	17	13

TABLE B

FPL No. 3 Foot Press

Piece No.	Same as	Piece Name	Material	Quantity	Weight: Rough Weight	Weight: Finished Weight	Weight: Aggregate Finished Weight
1		Frame	Cast Iron	1	220	200	200
2		Gib	Cast Iron	1	10	9	9
3		Side Bar	Cast Iron	1	45	40	40
4		Front Leg	Cast Iron	2	30	30	60
5		Back Leg	Cast Iron	1	40	40	40
6		Treadle	Cast Iron	1	17	15	15
7		Lever	Cast Iron	1	85	80	80
8	FPH–8	Lever Weight	Cast Iron	4	5	5	20
9		Pitman	Cast Iron	1	12	10	10
10	FPH–10	Clamp Sleeve	Cast Iron	2	3	2¼	4½
21		Lever Pin	Steel	1	2½	2	2
26	FPJ–26	Treadle and Pitman Bolt	Iron	3	¾	½	1½

Table B is a specimen of part of a page of our "Symbol Book," in which are recorded any machines which have arrived at such a state of perfection and salability as to be marked "Standard" on our drawings.

This table almost explains itself. The piece numbers in the first column do not have the letters prefixed, because the latter stand at the top of the column. "Same as" means that the piece is identical with a piece belonging to some other machine, and can be manufactured with it. If it is common to several machines in a set, the smallest of the set in which it occurs is given. The "quantity" column tells the number of pieces of a kind required. The last "weight" column, added upward, shows the total weight of the machine. The piece numbers are "gapped" after each kind of material, and also at the ends of "groups," as described further on. This is to allow for future changes and additional pieces; also that other nearly similar machines having more pieces may, in general, have the same piece numbers.

The order in which the pieces are numerically arranged cannot follow positive rules in all cases. In our list of instructions (too long to be here quoted) we direct a classification by materials. In each class we group pieces of the same general character, in regard to the prevailing work to be done upon them, and in natural "machine shop" orders; i.e., first planing, then drilling or boring, then turning. We also aim to place the heaviest and most important pieces first. Between each group we "gap" the numbers.

Regarding position in naming pieces, we assume a front to the machine (where the operator is most likely to be placed), and define direction tersely as "forward," "back," "right," "left," "down," "up." The adjectives of position prefixed to piece names are, of course, derived from these words, as "upper," "lower," etc. A perpendicular row of similar pieces, say 5, would be rated upper, second, third, fourth and lower. A number of different-sized pieces of similar name may, in like manner, be prefixed smallest, second, third, etc.

Before closing, a brief reference to certain (two) supplementary symbols may not be out of place. One is a small letter after a piece symbol (as FPL–21–a), signifying that the piece is obsolete, the standard FPL–21 having been altered. After a second alteration, the last obsolete piece would be suffixed "b," and so on. Thus, duplicate pieces of old-style machines can be identified and supplied to customers. The other symbol referred to is to indicate the number of the operation in the construction of a piece, and is written thus: FPL–21–1st, FPL–21–2d, etc. Its use is of great value on detail drawings, time cards and cost records.

A good system of symbols must have four qualities:

1. Simplicity combined with efficiency.
2. Definiteness — just one symbol to one thing, and one thing to one symbol.
3. Mnemonic quality; that is it should be capable of being easily remembered.
4. It must be brief.

Here is a choice specimen from a catalog: "Lower left-hand-cutting-blade-set-screw-lock-nut"—a full-blooded linguistic dachshund.—C. B. Thompson.

Record of Equipment. A method of keeping track of every piece of equipment in a power plant is shown by W. Sailes, in *Power*, March 21, 1916. It may be used as a model for the record of all the machinery in a factory, giving the original cost, present valuation, condition, performance, and cost of upkeep of each particular machine. The record is kept on cards, like WS1, classified in groups and filed in one or more cabinet drawers, as shown in Fig. 9.

Class..... No..... Location.....
Service..... Method of Operation....
Special Data:
Maker..... Purchased through.....
Date of Purchase..... Date Installed.....
Price Delivered..... Cost Installed.....
Blue Print No..... Mfrs. Serial No.....
List of Repair Parts.....
Nearest House carrying Repair Parts.....
Performance Guarantees.....
Accessories:

Kind	Purchased from	Date	Price	Cost Installed

FORM WS1.—RECORD OF INDIVIDUAL EQUIPMENT.

Record of Repairs, Inspections, etc. Class and No.....

Date	Report of Details	New Parts or Material Used	Total Cost

Inventory Value	Initial Cost	1915	1916	1917	1918	1919	1920	1921	1922	1923
	Main Unit ($)									
	Accessories ($)									
	Total Valuation									

Notes:

(Reverse of Card.)

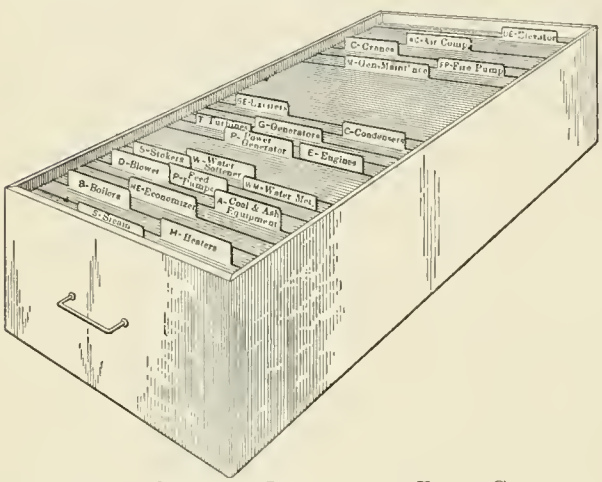


Fig. 9.—Method of Indexing and Filing Cards.

Mr. Sailes says: "The first step in a complete power-plant record should be the identification of every piece of equipment in the plant, and the establishing of a record of its cost, upkeep, performance, etc., thereby simplifying the matter of keeping a schedule of the present valuation, condition, capacity and cost of upkeep of each particular machine. This system of identification also prevents confusion when giving instructions concerning any particular piece of equipment.

"One of the best methods is to classify all power-plant apparatus into, say, three main groups: (1) Steam Generating; (2) Power Generating; (3) General Maintenance."

Plant Inventory. Mr. H. M. Norris designed the two forms shown below for keeping a continuous record of the machine tools in a shop, with their original cost, cost of installation and of repairs, depreciation, and appraised value in different years. The forms are 4×6 in., and have a margin for filing in a loose-leaf book.

Mr. Norris says: "The book accomplishes nine distinct objects. It shows: (1) just what tools have been made for each machine; (2) the date when each was made; (3) what each cost; (4) the total valuation of the tools added each year; (5) the amounts by which each has been depreciated; (6) the year in which said depreciation was made; (7) the amount by which the full set has been depreciated; (8) the total valuation of all tools at the beginning of any year; (9) the total valuation of all tools at the close of any year.

STANDARD PLANT LEDGER

Machine No. 3 Plain Miller

Maker Cin. Milling Machine Co. Cost $ 650.

Location: Floor 2 Row 2 No. 8

Purchased 1-6-90 Estimated Life 15 Yrs.

New or S.H. New Prob. Selling Value: $ 185.

Weight 3400 Pounds Req'd Rate of Dep'n 8 %

91	598	96	395
92	550	97	413
93	506	98	420
94	446	99	386
95	429		

Losses, Repairs or Additions Tending to Neutralize or Augment Depreciation

Description	Order	Date	Credit	Debit
General Overhauling	8624	12 15 96	50 00	
Rack Attachment	Sold	3 6 97		40 00
	2742	8 14 "	80 00	
(14 additional lines)				

For Cost of Installation and List of Attachments See Reverse Side

Form N1. Inventory of Tools.

SPECIAL PLANT LEDGER

Tools for No. 1 Radial Drill Symbol 64

Mark	Made	Cost	Total	1890	1891	1892	1893
6 A 1		25					
" 2		15		5			
" 3		30	70				
" 4	2 4 90	48 50					
" 5	4 6 "	6 75					
" 6	7 15 "	10 25	65 50		10 25		
" 7	1 3 91	8					
" 8	3 7 "	5 50			1 50		
" 9	5 9 "	10 25	23 75				
Valuation in January				70 00	130 50	142 50	
Shrinkage During Year				5 00	11 75		
Valuation in December				65 00	118 75		

Several additional columns

Form N2. Reverse of N1.

"Instead of having to go over, and revalue, from one to two thousand special tools every year, it is necessary only to note what tools have been rendered obsolete since the last inventory, the entries being made by the chief draftsman at the time of making the alterations in the corresponding drawings and patterns which destroyed their usefulness."

Each individual machine in a group should carry its own particular designating letter and number. For instance the subdivision might be made as follows:

STEAM-GENERATING EQUIPMENT, " S "

Boilers	B	Economizer	HE
Stokers	S	Water Meter	WM
Blower Equipment	D	Boiler-Feed Pumps	FP
Coal and Ash Equipment	A	Water Softener	W
Coal Weigher	CW	Steam Meter	SM
Ash Weigher	AW	Gas-Analysis Outfit	GM
Feed-Water Heater	H		

POWER-GENERATING EQUIPMENT, " P "

Turbines	T	Condensers	C
Engines	E	Condenser Air Pumps	CPA
Generators	G	Condenser Water Pumps	CPW
Exciters	GE	Condenser Circ. Pumps	CPC

GENERAL MAINTENANCE, " M "

Cranes	CH	Air Compressors	AC
Fire Pumps	FP	Elevator Pumps	PE

In a plant having eight boilers, the designation would be Sb–1 to Sb–8. If there were three turbines the designation would be Pt–1 to Pt–3. Cranes would be designated as Mch–1, etc.

Wherever possible a standard form of lettering, as well as color, should be used.

BOOKKEEPING BY MACHINERY

Bookkeeping Machines. Are you still paying large salaries for dips into inkwells, "flourishes," blottings and ink-spots—for illegibility, mistakes and erasures—for *brain* additions and subtractions, late statements and trial balances freighted with *trials?*

Why?—when a bookkeeping machine will substitute neat readable type-printed entries, machine-accurate figuring—will save hours of time daily, keep each account in daily balance, prove postings daily, get statements out on the first, and reduce trial balances to a mere formality?—(From an advertisement in *System*).

The great advance in bookkeeping methods made in the last thirty years consists chiefly in getting rid of the labor of making pen-and-ink entries in large books, and of transcribing from one book to another, and of "brain additions and subtractions." The means by which these advances have been made are: cards; loose-leaf books; carbon paper; typewriting machines; mimeograph and other duplicating machines; cash registers; filing cases and cabinets, with their folders, flags and indexes; index racks; adding machines; calculating machines; tabulating machines; photostats; addressing machines. Descriptions of these numerous devices are unnecessary here, as most of them are well advertised, and those interested may obtain, by writing to their manufacturers, illustrated circulars describing them. Following is a list of several leading manufacturers, taken from the advertising pages of *System.*

Baker-Vawter Co., Benton Harbor, Mich. and Holyoke, Mass. Filing systems, steel ledger and statement tray.

Burroughs Adding Machine Co., 217 Broadway, New York. Figuring and bookkeeping machines; ledger-posting machines; 98 machine models.

National Cash Register Co., Dayton, Ohio. Cash registers; credit files, "cuts out all bookkeeping of customers' accounts."

Dalton Adding Machine Co., Norwood-Cincinnati, Ohio. Adding and calculating machine.

Stickney and Montague, 54 Franklin St., New York. "Direx-All" addressing and listing machines.

Wilson-Jones Loose Leaf Co., 3021 Carroll Ave., Chicago. Loose-leaf systems and binders.

Cincinnati Time Recorder Co., Cincinnati, Ohio. Clock records and time keepers. 60 models.

Graphic Duplicator Co., 228 West Broadway, New York. Duplicating machines.

Elliott-Fisher Co., Harrisburg, Pa. Bookkeeping machines.

International Time Recorder Co., Endicott, N. Y. Time recorders, 250 styles.

The Rand Co., North Tonawanda, N. Y. Visible index, 10 styles.

John C. Moore Corporation, Rochester, N. Y. Loose-leaf forms and binders.

Stromberg Electric Co., Harvester Bldg., Chicago, Ill. Time recorder for cost keeping. It records on the job ticket the starting and stopping times in hours and decimal fractions, automatically deducting the dinner and other non-working periods. Electrically operated recorders controlled by a master clock.

The C. J. Root Co., Bristol, Conn. Automatic counters.

Kalamazoo Loose Leaf Binder Co., Kalamazoo, Mich. Loose-leaf devices and accounting systems.

The A. W. Shaw Co., Chicago, Ill. Correspondence course in retail merchandising and stores records.

Addressograph, 910 W. Van Buren St., Chicago. Addressing and listing machines.

Duplicator Manufacturing Co., Chicago, Ill. Duplicating machines.

Marchant Calculating Machine Co., Oakland, Cal. 208 Broadway, New York.

The Automatic Time Stamp Co., 158 Congress St., Boston, Mass. Time stamps.

The Elliott Addressing Machine Co., Cambridge, Mass. Hand, foot and electric addressing machines.

Mailometer Company, Detroit, Mich. Machine for sealing, stamping and counting envelopes 250 per minute.

Alvah Bushnell Co., 925 Filbert St., Philadelphia, Pa. Vertical file pockets.

Art Metal Construction Co., Jamestown, N. Y. Steel filing cabinets.

Chas C. Smith, Exeter, Neb. Index tags and signals.

W. A. Morschhauser, 1 Madison Ave., New York. Calculating machine.

Felt & Tarrant Mfg. Co., 1733 N. Paulina St., Chicago, Ill. "Comptometer" adding and calculating machine.

A. B. Dick Co., Chicago and New York. Edison-Dick mimeograph.

The J. C. Hall Co., Providence, R. I. Voucher check system.

Commercial Camera Co., Rochester, N. Y. The "Photostat," for copying cost sheets, vouchers, statements and accountings. Copies direct on paper in a few minutes. Write for the Photostat book.

The Zenith Systems Corporation, Tonawanda, N. Y. Card filing system, visible index.

The Hollerith Tabulating System, which was first used in compiling the records of the U. S. Census of 1890, is now extensively used by large manufacturing concerns for lessening the labor of accounting and cost finding. The following description is taken from circulars of The Tabulating Machine Co., New York City.

The essence of the Hollerith System is the preparation of a slip, or card, to represent each transaction (or essential part of a transaction) in such a form that these slips can afterwards be sorted out upon any desired basis of classification, and that each group—having been so sorted—may be added,

so as to show the total effect of this group of transactions under any desired number of headings.

The "System" consists of three machines: The Puncher (Fig. 10), the Sorter (Fig. 11), and the Tabulator (Fig. 12).

The Puncher is operated somewhat like an ordinary typewriter, but, being simpler, can be worked more rapidly. Its purpose is to cut perforations in cards (Fig. 13), so as to enable the other two machines to "take hold of" them. All cards for use in the standard machines are uniform in size ($7\frac{3}{8}\times3\frac{1}{4}$ in.); but the headings given to the various columns may be varied to suit particular requirements. The top right-hand corner of the card is cut off, to ensure that all cards are placed in the machines the right way up.

The card has 45 vertical rows of figures (letters are sometimes used in some of the columns).

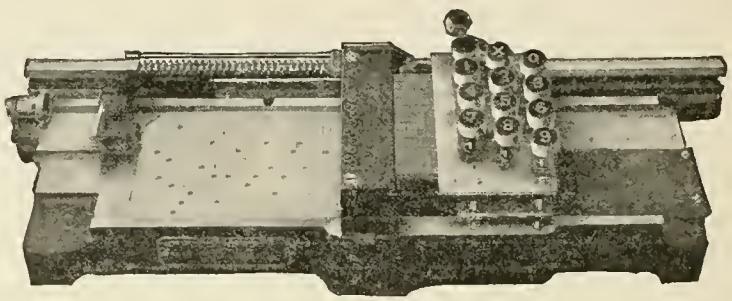


Fig. 10.—The Puncher.

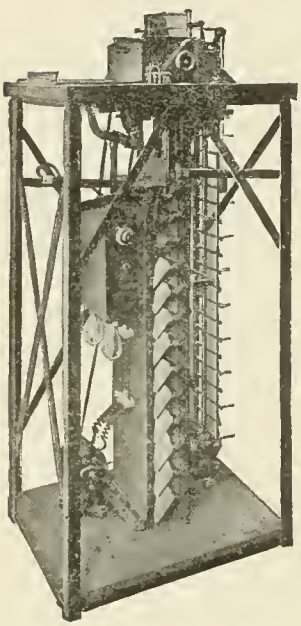


Fig. 11.—The Sorter.

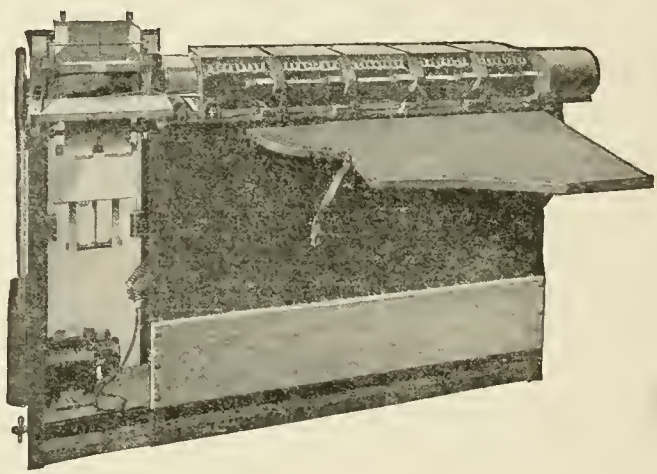


Fig. 12.—The Tabulating Machine.

When cards are being punched in series many consecutive cards may require to be punched identically in (say) the first nine or ten columns. To save time, a "Gang Punch" is often employed for this purpose, which can be rapidly "set" by the operator to any desired combination, and will punch cards a dozen or so at a time. Punching is not highly skilled work: boys or girls soon learn to punch cards *accurately* at the rate of 250 per hour. Each card represents a "transaction."

The Sorting Machine (Fig. 11) is worked by electricity from an ordinary lighting socket. By its aid anyone can sort cards at the rate of about 15,000 per hour. The operator sets the pointer of the machine against the column representing the basis upon which the sorting is to proceed, and the machine does the rest. The cards are placed vertically in position on the table of the machine in batches, and in due course find their way into one or another of the receptacles shown one above the other in the lower part of the machine. Cards not perforated at all, which may have been included by mistake, are also sorted out automatically. If the sorting basis consists of more than one column of figures the cards are first sorted for the hundreds column, then each hundred group must be sorted according to the tens column, and subsequently according to the units column. Operating at a speed of 15,000 per hour, it is not a lengthy process.

The Tabulating Machine (Fig. 12) is also worked by electricity. It takes the cards sorted out into groups by the preceding process, a group at a time, and shows—in as many columns as may be required—the total of any desired columns thereof in tabulated form. Fig. 12 model shows five tabulated divisions. The machine will classify about 9000 cards per hour.

The sectional totals must, of course, be taken off the Tabulating Machine by hand, and built up into daily totals. An effective check is secured by agreeing the "daily" totals arrived at upon one basis of sorting with the "daily" totals

arrived at by another basis of sorting; but *there is no limit to the number of different ways in which the same series of cards may be built up into daily totals—each*, of course, *showing a different basis* of classification. For illustration, the daily total of "Sales" may (if desired) be built in many different ways—all, perhaps, equally useful, although not all equally usual—.e.g, Customers, Departments, Code Numbers of Goods sold, Salesmen's Numbers, Districts (Customers' addresses), Customers' occupations, etc.

Form 1936 Revised J.T.450
Depmt.
THE PENNSYLVANIA STEEL CO.
Man's No. 10
Date Dec. 22 1908
Time Started A.M. 7 P.M. 6
Name John Doe

Time Finished	No. Pos.	Order No.	Sub. No.	Charge	Mach. No. or Employment	Do not write here: Time	Rate	Cost		
10	9	684120	01	84G	121-1	3	27½	82½	4	5
11	9	684320	04	91G	122-1	1		27½	1	5
12	9	682140	09	81G	134-3	1		27½	3	0
1.50	9	684120	03	50G	108-1	1		27½	1	5
2.50	9	684124	02	72G	143-1	1		27½	1	5
3.50	8	684220	07	90B	802-1	1		27½	1	5
6	6	685120	01	90F	801-1	2	1/6	59½	3	3
								2	1.68	
								2.79		

No Time allowed unless Reported on this Card Daily

	P.M. In	P.M. Out	A.M. In	A.M. Out	Total		A.M. In	A.M. Out	P.M. In	P.M. Out	Total
Night or Over Time	127	128	128	129		Day Time					

Form PS1. A Specimen Time Card of the Machine Shop.

Form PS2 shows a requisition on the storekeeper, and Fig. 13 the corresponding card by which all the data concerning the stores issue are tabulated.

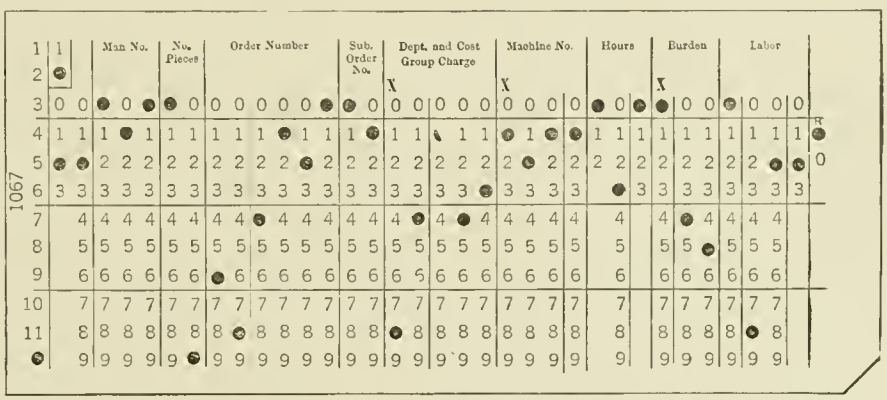


Fig. 13.—Tabulating Machine Card Corresponding with Item 1 of Form PS1.

REQUISITION ON STOREKEEPER
Storekeeper 12-18-08 Section Date
Please deliver to Department 98 784.05
Order No.

Weight or Quantity	Description	For Office Use Only: Unit	Price	Value	
	Emery Wheel				
	784.05 — 10			4	33

Signed
The Pennsylvania Steel Co.

Frog & Switch Department-Storehouse Shipping Tag
Deliver to Bed No.
WANTED
P.M.
A.M.
Date
Filled by
Order No.

Form PS2.—Requisition On for Storekeeper.

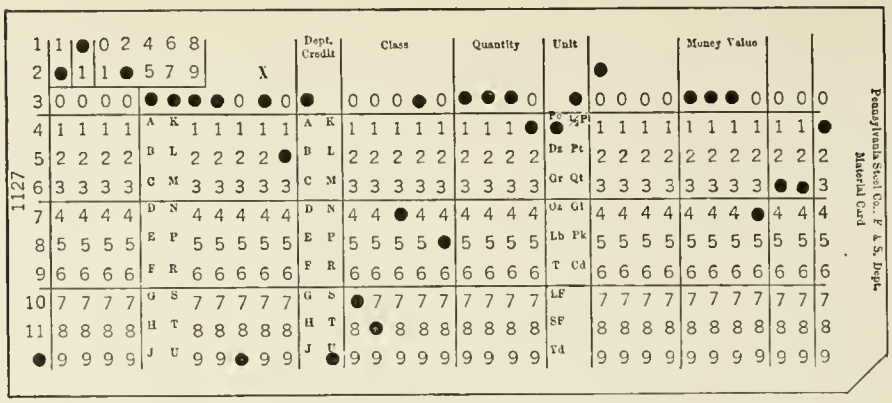


FIG. 14.—MACHINE CARD PUNCHED TO CORRESPOND TO FORM PS2.

An Elapsed-time Recording Machine is made by the Bishop Calculating Recorder Co., Woolworth Building, New York. On starting a job a card is inserted in the machine, which cuts a notch in the edge of the card. When the job is finished another notch is cut, and the time-controlled mechanism is so arranged that the second notch always shows a direct reading of the elapsed hours. The noon hour and non-working periods are automatically subtracted. By placing the notched card on a "wageometer," a form of wage table made by the company, a direct reading of the amount due the workman is at once shown. A tabulating machine may be used in combination with the recorder, to sort the cards automatically by man, job or operation number and to compile the amounts.

The Periodograph, made by Gisholt Machine Co., Madison, Wis., consists of a master clock and a panel board kept in one of the offices of the factory and a number of time-stamping registers which are placed in convenient locations throughout the shops. A unit of time, usually a tenth of an hour, is called a period, and the periods are counted consecutively through the working hours of the day, week or month that the shop runs, non-working hours being automatically omitted. A job card is issued for each job and the card is stamped with the periods at which the job is started and finished. The difference is the number of periods the man worked on the job. The printing on the cards varies with the kind of work done and with the system of shop accounting in use. Form PR is a sample of a card used in a machine shop. It shows that man No. 187 started on order 1271X July 6, period 412, but was stopped at period 443. He started again at period 475 on the same day and worked continuously to period 857 July 10, when the job was completed.

Another form of card contains spaces for the following information: Name and number of workman; piece name and number; operation name and number; machine number; shop order number; number of pieces; number spoiled; number defective; setting up time allowed; time per piece allowed; time each; stopped; completed; total time, hours; labor cost; premium; total labor cost; Inspector's OK and date; also six spaces similar to those in Form PR for the clock stampings and the entry of the period differences.

D.C. No. 187 Name J. Doe Ord.

Our Ord. No. 1274X B/P 3004

Bore & Face

1	Bench Work			
2	Blacksmith			
3	Bolt Cutting			
4	Boring Mill			
5	Cutting Off			
6	Drill Press			
7	Erecting			
8	Gear-Cutting			
9	Grinding			
10	Helping			
11	Hydraulic Press			
12	Keyseating			
13	Lathe Work			
14	◯ Milling	10	Jul	857
15	◯ Planing	6	Jul	475
16	◯ Repairing			382
17	◯ Sawing	6	Jul	443
18	◯ Slotting			
19	◯ Shaping	6	Jul	412
20	◯ Tapping			31
21	◯ Testing			
22	Turret Lathe			

Change Card When You Change Jobs

KEEP CARD CLEAN
PUT IN RACK AT
NOON AND NIGHT

Periodograph System Patented Gisholt Machine Co. Madison, Wis., U.S.A.

Total Periods 413
Cost Labor 12.39
Shop Ex. 14.45
Stopped ✓ Completed X

Adamson Machine Co. Form P83

This End Up
This Side Front
When Stamping

FORM PR. PERIODOGRAPH CARD.

The Monroe Calculating Machine is an adding and calculating machine the three principal parts of which are a standard flexible adding machine keyboard for setting up the numbers to be added, subtracted, multiplied or divided, a crank at the right of the keyboard for performing the operations, and a carriage at the top of the machine holding the dials which show the results and the proofs of the operations as they are performed.

The main crank operates in either direction, forward or clockwise for addition and multiplication, backward or counter-clockwise for subtraction and division. There are two stopping places, after a forward turn stop at the upper position, after a backward turn stop at the lower position. Automatic locks

provide against operating errors which might result if the turn is not ended at the proper position.

The machine is made by Monroe Calculating Machine Co., Woolworth Building, New York. The following examples of its operation are taken from the "Instruction Book."

Addition. 325+456+222=1003.

Set the automatic release key with the arrow pointing to the right. See that the dials are clear. Set 325 on the keyboard at the right and turn the crank forward a full turn to the upper position registering 325 in the lower dial. Set 456 on the keyboard and turn the crank forward again; this adds 456 to 325. Set 222 on the keyboard, turn the crank forward once more, registering the result 1003 in the lower dial.

Subtraction. 1003−445=558.

At the end of the preceding example 1003 appears in the lower dial; to subtract 445 from it set 445 on the keyboard, turn the crank backward a turn and a half to the lower position and the answer, 558, appears in the lower dial.

Multiplication. 4346×122=530,212.

Turn the crank forward two turns, stopping at the upper position. With the carriage shifting lever shift the carriage one position to the right and make two more turns. Shift carriage again and make one turn.

The three successive steps register in the result dials as follows:

1st Step	2d Step	3d Step	
00000002	00000022	00000122	Upper Dial
00000008692	000095612	00000530212	Lower Dial

Division. 477591÷224=2132; remainder 23.

Set the dividend 477591 in the keyboard and by one turn of the crank forward register it in the lower dial. Clear the upper dial and the keyboard, set the divisor, 224, in the keyboard and shift the carriage 3 spaces to the right so as to bring the divisor 224 directly under the 477 of the dividend, the first position for dividing.

Turn the crank backward, subtracting 224 from the first three figures of dividend (477) as many times as it can be subtracted, that is twice. The red 2 in the upper dial indicates the first figure of the result, as shown under 1st step below,

Shift the carriage one space to the left, again subtract the 224 as many times as possible from the three figures of the dividend that appear immediately above it, that is, once. See 2d step. Continue this shifting and subtracting until no further subtraction can be made.

The figures as they show up on the machine at the end of each step are as follows:

1st Step	2d Step	3d Step	Last Step	
00002000	00002100	00002130	00002132	Upper Dial
0000029591	000007191	000000471	000000023	Lower Dial

The instruction book shows numerous examples of the solution of special problems and of the use of various "short cuts," such as multiplication and division of decimals, shortening multiplications, taking off discounts and chain discounts, accumulative multiplication, use of reciprocals, prorating, figuring interest, etc.

The Marchant Calculator, made by Marchant Calculating Machine Co., Oakland, Cal., is shown in Fig. 15. Instead of the usual adding-machine keyboard it has a series of movable disks with the figures 1 to 9 on their rims. The operations are thus described in the instruction book.

Addition. 245+3275+84=3604.

Space carriage to unit column. Place 245 on machine and turn handle forward one stroke; clear levers, set up 3275 and repeat operation until all the numbers have been added into machine when total amount will be accumulated in the right hand dials.

Subtraction. 24567−13245=11322.

Space carriage to units column, set 24567 on levers and turn handle forward one stroke as in addition; clear levers and set up

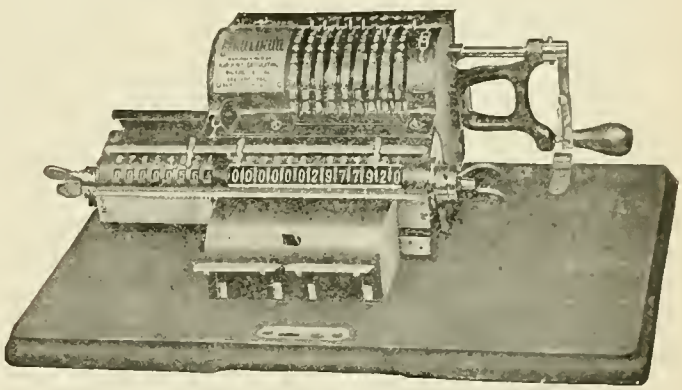


Fig. 15.—The Marchant Calculating Machine.

13245, the number to be subtracted, and give a backward or reverse turn to the handle, answer appearing in right hand dials.

Multiplication. 245×5281=1293845.

Place 5281 on setting up levers—shift carriage to third column (because the multiplier has three figures), and turn handle forward two times—shift carriage to second column and turn handle forward four times—shift to first column and turn handle five times, completing the operation. In order to check the operation see that you have the proper figures set on the levers and the proper numbers appearing in the proof dials.

Division. There are two systems of division used on the *Marchant.* Division by Addition, and Division by Subtraction.

Division by Addition is the fastest method known, and although more difficult to learn, is preferable to the Subtraction method.

To illustrate the two methods in as simple a manner as possible we will divide 25 into 100.

Addition Method. Set the divisor 25 on levers, space carriage to units column, and turn handle of machine forward as in addition, watching the Product dials for 100, the dividend, to appear. In four forward turns you have 100 and the quotient 4 is shown in the left-hand dials.

Subtraction Method. Set the Dividend 100 on levers and add it into machine by one forward turn of handle, clear the left-hand dial of the Fig. 1 Clear the levers and set up Divisor 25, then *reverse* the handle action. In four backward turns the Dividend 100 has been taken from the lower dials and the quotient 4 appears in left-hand dials.

CHAPTER XV

OLD-SCHOOL COST ACCOUNTING. IRONWORKS BOOKKEEPING

BOOK-KEEPING AT AN IRON BLAST FURNACE IN PENNSYLVANIA

In the year 1872 the author was engaged as bookkeeper at a blast furnace in Northern New Jersey. He was first sent to two furnaces at a works near Easton, Pa., for three weeks to study the system of bookkeeping then in general use in the principal furnaces of the Lehigh Valley, so that he could open and keep a set of books on the same system at the New Jersey furnace. The system used at the Pennsylvania works was old-fashioned double entry with Cash Book, Journal and Ledger, and such auxiliary books as are needed at a blast furnace, such as Furnace Book, in which were entered daily the weights of the coal, ore and limestone used by the furnace and the product of pig iron with its several grades, Coal and Ore Book, Shipping Book, Labor Book, etc. There were also Time Books for each department, such as Furnace, Foundry, Mine, Farm, Blacksmith Shop, Wheelwright Shop, and Outside Labor. In the latter book the kind of work that each man was engaged upon was marked by a symbol so that at the end of the month the total outside labor could be distributed to the several accounts to which it should be charged. There was a Company Store in which the men traded, and it kept a Store Ledger with an account for each man. At the end of each month the store sent to the office of the furnace the charges against each man, which were entered on the Labor Book together with charges for Rent, Doctor, Cash Advanced, etc., and the balances due the men were paid a few days after the end of the month. In the Labor Book the men's names were grouped by departments, and it was ruled with columns for credits for Labor, charges for Store, Rent, Doctor, etc., and Balance.

Journa entries were made from the Labor Book, charging Furnace, Foundry, Mine, etc., and crediting Labor, and charging Labor and crediting Store, Rent, Doctor, etc.

Invoices for goods purchased were marked with the accounts to which they should be charged, such as Store, Furnace, Mine, etc., and Journal entries were made from them, Store Dr. to Sundries, General Supplies Dr. to Sundries, etc., the Sundries being the names of the creditors from whom the goods were purchased. A Ledger account was kept with each creditor in the old-fashioned way, which involved a great deal of labor for the bookkeeper and often caused considerable delay in getting a monthly trial balance. When the monthly statements from creditors came in they were checked against the ledger entries, and the original bills and statements were then sent to the New York office to be paid, and a long journal entry was made, Sundries (names of creditors) Dr. to Company, which when posted balanced the creditors' accounts.

Each department, Furnace, Mine, etc., was charged directly, as above stated, with the labor and with the goods purchased belonging to it, as far as possible, and also with such supplies, General Charges (outside labor) or service of teams, and with goods delivered to it from the Store, Farm, Blacksmith Shop or other department, as it might have received during the month. The original entries for these transfer accounts were either Day Book entries or invoices or memorandums from the several departments.

Each department also was credited with the products it had shipped or delivered to other departments, at cost price as nearly as it could be estimated, thus Ore was charged and the several mine accounts credited with all the iron ore produced by the mines, the price per ton being the total charges against the mines during the month divided by the number of tons produced. The several departments, Blacksmith Shop, Wheelwright Shop, Furnace, Limestone Quarry, and Saddler Shop, not only had operating accounts with these names, but also separate Supply Accounts and Tools and Fixtures Accounts.

After all of the various debits and credits to all these accounts had been entered in the journal and posted in the ledger, an entry was made Pig Iron Dr. to Sundries, crediting Coal, Ore and Limestone Accounts for the materials used, and the several operating accounts above named with the labor and supplies furnished by the departments, charging or crediting Pig Iron also with any balance representing profits or losses in these accounts. Thus, the total cost of pig iron in any month was the sum total of all the charges that had been made to Pig Iron account for the month less any credits that had been made for slight profits in the operating accounts. At the end of the year, when a general inventory was taken, apparent profits and losses in operating accounts were credited or charged to Pig Iron account for December. At the end of 1872, at this Pennsylvania furnace Farm account was credited and Lime account charged with a profit of $791.84 of Lime account, and Pig Iron then charged and Farm account credited with $1127.27 loss on Farm, and Pig Iron charged and Store credited with $4163.93 loss on Store, which indicated that in that year, at least, the workmen had not been overcharged with the store goods and farm products they had purchased.

When pig iron was shipped on orders from the company it was charged on the furnace books at a round figure slightly in excess of the average cost per ton of the pig iron remaining on hand as it appeared on the books, thus, in June, 1872, the cost of pig iron on the books was $21.40 per ton and the iron shipped during that month was charged to the company at $22.00. In July, 1873, the apparent cost was $34.39 per ton, and the shipments were charged at $35.00.

It will be noted that this method of obtaining the cost of

pig iron, while quite satisfactory from a bookkeeper's standpoint, since it enables the books to be balanced each month, and makes the total cost of pig iron in any month the total cost of running the establishment in that month, is far from giving the true cost, for it takes no account of interest on the investment, depreciation from wear and tear or from obsolescence of the plant, nor of the cost of relining the furnace, which had to be done about every two years. In fact, the two furnaces at this plant were already obsolete and had to be torn down and replaced by a large furnace in a few years. In 1872 the average price of No. 1 Foundry pig iron, at Philadelphia, was $48 per ton, having risen from $33 in two years. In 1873 the average price had dropped to $43, and it continued dropping until 1878, when the average price was only $17.50. In these five years three-quarters of all the furnaces in the United States became obsolete and had to be rebuilt or abandoned.

Following is a list of the ledger accounts kept at the iron works in Pennsylvania, together with brief samples from some of the other books, from notes which the author has kept since his two visits to the works in 1872 and 1873:

Ledger Accounts at a Pennsylvania Blast Furnace

Blacksmith Shop Tools and Fixtures.
Blacksmith Shop Supply.
Blacksmith Shop.
Back-vein Ore (and ten other Ore Accts.)
Company (New York Office).
Cash.
Coal.
Coal Wharf.
Engine Room Tools and Fixtures.
Engine-room Supply.
Engine Room.
Furnace Tools and Fixtures.
Furnace Supply.
Furnaces.
Farm (includes Horses and Teams).
General Repairs.
General Charges Tools and Fixtures.
General Charges.
Labor.
Limestone Quarry Supply.
Limestone Quarry.
Limestone.
Moulding Shop.
Office.
Ore.
Pig Iron.
Rent.
Saddler Shop Tools and Fixtures.
Saddler Shop Supply.
Saddler Shop.
Savings Fund.
Store.
Wheelwright Shop Tools and Fixtures.
Wheelwright Shop Supply.
Wheelwright Shop.
Wood.

Total representative accts.	46
Personal accts.	51
Total	97

Sample of Cash Book

1872		Cash Dr.		Credits Ledger		Credits Labor Book	
June 1	On hand, balance from last mo.	757	15				
3	H Frankenfeld, for hay			57	00		
	Blacksmith Shop, work done		50				
4	Lime Acct. Lime sold in May	191	54				
	Gen. Ch. T. & Fix. Horse of R. F. Stover			150	00		
	Joe Lewengood. Acct. Labor					1	00
	Office Acct. Washing Towels				50		
	Savings Fund. Wm. Martin deposited	100	00				

FURNACE BOOK

Seventy-fourth Weekly Report for Furnace No. 1, Blast No. 11. Week Ending Aug. 30, 1872

Date August	Charges each Day	Coal per Charge	Ore per Charge	Limestone per Charge	Total Coal	Total Ore	Total Limestone	Proportions of Ores Used I	S	J	B	O	R	Remarks
S 24	29	24	21	10½	696	609	304[2]	⅛	⅛	⅛	⅛	⅛	⅜	
M 25	27	24	21	10½	648	567	283[2]	⅛	⅛	⅛	⅛	⅛	⅜	
T 26	27	24	21	10½	648	567	283[2]	⅛	⅛	⅛	⅛	⅛	⅜	
W 27	28	24	21	10½	672	588	294	⅛	⅛	⅛	⅛	⅛	⅜	Stopped 2 hrs. fixing pump.
T 28	26	24	21	10½	624	546	273	⅛	⅛	⅛	⅛	⅛	⅜	
F 29	22	24	21	10½	528 / 221	462	231	⅛	⅛	⅛	⅛	⅛	⅜	Stopped 4 hrs. repairing arch.
S 30	25	24	21	10½	600	525	262[2]	⅛	⅛	⅛	⅛	⅛	⅜	
Average Coal 2-10-3-23					4637	3864	1932	Average Ore 2-2-1-21						

	Quantity of Iron Made 1	2A	2B	3	4
S 24				6	
M 25				6½	
T 26					6½[m]
W 27				5½	
T 28				6½	
F 29				4	
S 30					7[m]
				28½	13½

	1	2A	2B	3	4
S 24				7	
M 25					8[m]
T 26				7	
W 27				7½	
T 28				6	
F 29					7[m]
S 30				4	2½
				31½	17½

Average Limestone, 1—1-0-26. Total Iron, 60 No. 3, 31 Mott = 91 tons.

	Tons	Cwts.	Qrs.	Lbs.
Ore on hand	10,053	16	3	0
received	904	7	1	0
used	193	4	0	0
balance	10,765	0	0	0
Coal on hand	5,049	11	0	0
received	1,022	14	0	0
used	231	17	0	0
balance	6,640	8	0	0
Limestone used	96	12	0	0

The weights of coal, ore and limestone charged into the furnace were given in hundredweights (112 pounds) and the averages per gross ton of iron made were recorded in the old style in tons, cwts., quarters and pounds. It is interesting ing to note that the total product for the week was only 91 tons. No. 2 furnace, working on better ores, made in the same week 108 tons, with a coal consumption of 1–18–0–4; ore, 1–15–0–14; and limestone, 0–16–3–16. These were about the average figures for a small blast furnace using anthracite coal at that time. Ten years later the small furnaces were replaced by a large one, coke was used instead of anthracite for fuel, fire-brick ovens were substituted for cast-iron hot-blast stoves, the production mounted to over 100 tons per day, and the fuel consumption was reduced to less than a ton of coke per ton of iron made. Comparing the figures in the above table with the following report of the same furnace in 1857 it appears that no improvement in practice had been made in the 17 years prior to 1873.

Note from an old Report Book of the same Furnace:

Furnace No. 1, Blast No. 5, 84 weeks ended April 4, 1857.

	Tons	Cwts.	Qrs.	Lbs.
Average Coal per ton of Iron	1	18	0	23
Average Ore per ton of Iron	2	2	3	26
Average Limestone per ton of Iron	0	16	1	0
Average Iron made per week	96	3	1	10

Furnace No. 2, Blast No. 4, Blowed out Feb. 27, 1856 Blowed in Aug. 4, 1856:

Ran 83 weeks, blast ended Mar. 12, 1858.

Iron made first six weeks, 93, 84, 124, 109, 111, 116 tons.

	Tons	Cwts.	Qrs.	Lbs.
Average Iron per week for 83 weeks	112	9	1	16
Average Coal per ton of iron	1	16	0	12
Average Ore per ton of iron	2	1	1	24
Average Limestone per ton of iron	0	15	0	9

Report of a Larger Pennsylvania Furnace

Week ending Nov. 24, 1871

Material Consumed						Product of Furnace					
Coal	Ore			Limestone		No. 1x	No. 2x	No. 2	No. 3	White	Aggregate
289	426 ¾			289			11½	167½	7	14½	200½ ton
Stock on Hand at Last Report						30	51½	25	½	5½	112½
Iron Shipped	1x	2x	2	3	w						
Glen I Wks.			50								
W. F. & M. Co.			70								
Barber & Co.		10									
Total Shipped							10	120			130
Stock on Hand						30	53	72½	7½	20	183

Heading of a Monthly Pay List at a Charcoal Furnace in New Jersey in 1871

We, the subscribers, do hereby acknowledge to have received the sums prefixed to our names respectively, in full payment of the amount due us for work done between the dates specified, and we, the subscribers, as witnesses, do hereby certify that we have witnessed said payments where the receivers could not sign their own names.

Heading of Columns: Name. Employment. Commencement and Expiration of time of Service. Time Employed. Work Done. Rate. Total Amount Paid. Paid in Goods. Debit Balances. Credit Balances. Paid in Cash. Signatures of Payees. Witnesses. Remarks.

LABOR BOOK
Summary of Pay Roll, June, 1872

	Debits								
	Bal. from Last Month	Store	Rent	Coal	Wood	Farm	Doctor	General Charges	Total
Furnace: (33 names here)									
Total	20.94	375.91	68.00	3.00	10.14	12.15	21.00	1.50	512.64
General Charges: (33 names)									
Total		240.93	44.50	2.77	6.89	3.00	13.00	57.93	369.02

Credits					Balances		Cash	Balance to Next Month	
Time	Rate	Amount	Bal. last Mo.	Total	Debit	Credit	On Pay Day	Debit	Credit
(33 items)									
Total		2015.98	10.31	2026 29	1.38	1515.03			

BOOKKEEPING AT A NEW JERSEY BLAST FURNACE

When the author opened the books at the New Jersey furnace he followed the general system that he had found in Pennsylvania, but made several changes in order to decrease the number of accounts kept in the Ledger. For example, instead of having separate accounts for Blacksmith Shop Supply, Blacksmith Shop Tools and Fixtures, and Blacksmith Shop (operating account), there was only one Blacksmith Shop account, the Dr. Balance of which at the beginning of the year represented the inventory of its equipment, and a General Supply account, which included the supplies (other than furnace raw material) for the furnace and for all the auxiliary departments. Later all the personal accounts of parties from whom goods were purchased and whose bills were credited to New York office for payment, were taken out of the ledger and one general account, Accounts Payable, substituted for them, the bills being listed in an Invoice Register, which was provided with columns headed with the names of the accounts to which the goods purchased were to be charged. There were several ore mines owned by the Company about four miles from the furnace, and a mines store, in which all local accounts relating to the miners were kept, but the furnace books were a sort of clearing house between the mines and the New York office. All the bills for goods purchased, certified by the mines manager, were sent to the furnace for record, and in the furnace books were charged to Mines account and credited to Company, while Company was charged with the ore shipped to outside parties at the arbitrary price of $5.00 per ton. The mines had been run, more or less profitably, for over a hundred years, and no cost accounts had ever been kept at them. The system of charging New York office with the pig iron shipped at the book cost for the month in which it was made, thus showing neither profit nor loss on the furnace books, was not adopted for the ore shipped, as the books kept at the mines store gave no means of estimating the cost at the several mines, but at the arbitrary price of $5.00 per ton (which at that date was below the market price for good grades of New Jersey ores). The mines account showed a profit of over $50,000 in the year 1873, thus overbalancing all the losses at the furnace, including the cost of new construction, as will be shown below.

The method of bookkeeping used at the furnace is shown by the following journal entries and the notes explaining them.*

The "Summaries for Posting" at the top of the second column on the next page were not used in the actual bookkeeping, but they are given here in order to diminish the number of entries in the columns Personal Accounts and Horses and Teams in the Ledger on page 147. By means of these summaries sixteen ledger postings have been reduced to four. They have not been used in the Column Ledger on page 148.

* The furnace has been abandoned for many years, but the mines and stores are still operating. In 1916 the author found at the furnace store the old books that he kept 43 years before, and copied from the Journal the entries here given.

Journal Entries

March 31, 1873

No.					
1	P. R. G. (Manager)	3000	00		
	To Company, for Cash brought from New York			3000	00
2	Cash To Sundries	1496	69		
	To Store			60	00
	To Coal			18	69
	To Wood			14	00
	To P.R.G. (Manager) Cash for Pay Roll			1400	00
	To Horses and Teams (for use of team)			4	00
3	Sundries To Cash			1496	10
	Labor	838	67		
	Other accounts, mostly personal	657	43		
4	Sundries To Labor			2381	68
	Blacksmith Shop	99	63		
	Wheelwright Shop	44	50		
	Horses and Teams	283	70		
	Office	233	34		
	General Charges*	337	00		
	General Repairs	16	50		
	New Construction	138	63		
	Furnace	1228	38		
5	Sundries To General Charges			333	80
	Wood (cutting wood)	75	20		
	Horses and Teams	8	60		
	Furnace	23	20		
	General Supplies (getting timber for W.W. Shop)	47	80		
	Coal (unloading)	44	80		
	Ore (unloading)	3	20		
	Limestone (unloading)	6	40		
	New Construction	84	40		
	Mines (hauling coal)	40	20		
6	Labor To Sundries	1441	95		
	(Charges against workmen on pay roll)				
	To Store			1322	55
	To Coal			9	56
	To Wood			64	50
	To Horses and Teams			42	14
	To General Charges			3	20
7	Sundries To Horses and Teams			326	00
	(Charges for hauling done)				
	General Supplies (timber for W.W. Shop)	51	50		
	Furnace (timber for repairing houses)	135	75		
	New Construction	12	75		
	Mines	59	50		
	Wood	66	50		
8	Sundries To Store			111	30
	(For supplies furnished)				
	Furnace	16	60		
	Horses and Teams	16	41		
	Personal accounts (transferred from store to office)	78	29		
9	Coal To Sundries	493	51		
	To Horses and Teams (hauling)			219	67
	To Mines (hauling by mine teams)			98	09
	To Personal accounts (outside teamsters)			175	75
10	Limestone To Sundries	55	60		
	To Horses and Teams (hauling)			31	41
	To Mines			22	22
	To Personal accounts			1	97

* General Charges covers outside labor, not charged directly to the other accounts on the pay roll, but distributed to them in the next entry according to notes made in the time book of the outside labor loss.

Journal Entries—Continued

No.						
11	Pig Iron	To Sundries	99	00		
	Hauling 132 tons to R.R.					
	To Horses and Teams				80	44
	To Mines				5	25
	To Personal accounts				13	31
12	Horses and Teams		0	88		
	To Personal Accts. (G. White, ½ day)				0	88
13	Personal Accounts		14	82		
	To Horses and Teams				14	82
14	Sundries	To Blacksmith Shop			2	75
	Mines		1	50		
	Personal Accounts		1	25		
15	Personal Accounts		1	50		
	To Wheelwright Shop				1	50
16	Store	To Sundries	4	90		
	To Wood				1	50
	To Horses and Teams				3	40
17	Mines		253	00		
	To Coal (furnace coal sent to mines)				253	00
18	Sundries	To General Supplies			292	55
	Furnace		285	05		
	Blacksmith Shop		5	00		
	New Construction		2	50		
19	Sundries	To Personal Accounts			13,475	97
	As per Invoice Register					
	Mines		6,827	07		
	Store		311	10		
	General Supplies		806	84		
	Coal		4,501	10		
	Limestone		124	00		
	General Repairs		877	28		
	New Coustruction		28	58		
20	Ore. Spanish ore bought for furnace mixture		1,061	95		
	To Company				1,061	95
21	Sundries	To Mines			9,187	28
	Company (for ore shipped on Company's account)		8,050	00		
	Ore (hauled to furnace)		156	50		
	Store (goods shipped to Furnace Store by Mines Store, Cr. Mines account)		936	44		
	Coal (unloading by men on Mines Payroll)		29	16		
	General Supplies (received from mines)		15	18		
22	Mines		1,703	58		
	To P. R. G. (Manager) Cash for Mines Pay Roll				1,703	58
23	Company		1,401	70		
	To Pig Iron Shipped in March:					
	10 Tons at 139.42 (Feb. Cost) 1394.20					
	Hauling to Station 7.50				1,401	70
24	Personal Accounts		14,092	72		
	To Company (Invoices certified to Company for payment)				14,092	72
25	Pig Iron	To Sundries	10,799	23		
	316 tons made in March Av. Cost $34.18					
	To Coal				3,605	11
	To Ore				3,787	84
	To Limestone				479	04
	To Wood				24	00
	To Office (includes Supt's salary)				236	34
	To Blacksmith Shop				76	88
	To Wheelwright Shop				14	00
	To General Repairs				908	16
	To Furnace (Labor 251.58, Sunds. 416.28)				1,667	86

Summaries for Posting

Entries 8 to 15

Horses and Teams

Nos.	Dr.		Cr.	
8, 6	16	41	42	14
12, 7	0	88	326	00
9	17	29	219	67
10			31	41
11			80	44
13			14	82
			714	48

Personal Accounts

Nos.	Dr.		Cr.	
8, 9	78	29	175	75
13, 10	14	82	1	97
14, 11	1	25	13	31
15, 12	1	50		88
	95	86	191	91

The posting of the above 25 journal entries required entries on only 21 pages of the ledger containing representative (asset or operating) accounts, as compared with 46 pages containing such accounts in the books at the Pennsylvania works. In both places the personal accounts might have been contained in two pages, Accounts Receivable and Accounts Payable, if desired.

All of the posting might have been done on a single page of a Works Ledger, such as is shown on page 147. The page is a large sheet containing a column for each account. It is strictly double entry, the debit items being entered in black ink and the credit items in red. The balances shown are those of the single month posted, and do not include balances brought forward. These might be entered below the monthly balances in the following manner:

	Company		P.R.G.		Cash		Store		Office	
Debits	9,451	70	3000	00	1496	69	1251	44	233	34
Credits	*18,152*	*67*	*3103*	*58*	*1496*	*10*	*1403*	*85*	*236*	*34*
Balance, Month	*8,700*	*97*	*103*	*58*		59	*241*	*41*	*3*	*00*
Balance from last Mo.	*24,316*	*10*	260	72	24	60	1760	50	*3*	*00*
Balance Forward	*33,017*	*07*	157	14	25	19	1519	09	0	00

A still better plan is the use of the Combined Journal-Ledger, which dispenses with both the journal and the old-style ledger. All the journal entries have been posted into the single form shown on page 148. It will be noticed that it contains fewer figures than the form on page 147, it avoids the red-ink entries, and there is less trouble in making the additions. All the entries can be made in it directly from the footings of the auxiliary books of original entry, except a few that may require explanations, and they can be taken

from a Blotter or Day Book, kept in journal form, for the record of those special transactions that are not included in the regular monthly or routine entries in the other books.

Four additional lines should be added to this Journal-Ledger, giving the Dr. and Cr. Balances brought forward from the preceding month and the new balances carried forward to the next month.

A carbon, or a photostat, copy of this Journal-Ledger may be used for a monthly statement to be sent to the Company's office. It forms both a trial balance and a record of the business for the month.

The use of the condensed form of monthly ledger shown on page 148 would make unnecessary many of the longer journal entries. For example, No. 4, "Sundries to Labor" consists of the footings of the columns of the Labor Book, and these could be posted directly into the ledger without going into the Journal. Entry No. 5 comes from a summary of small entries in a Day Book called General Charges, and as this summary is entered in this book in permanent form at the end of the month, it might be posted directly into the ledger. Entry No. 19 is but a transcription of the footings of the columns of the Invoice Register, and there is no need of putting it in the journal.

The entry "Pig Iron to Sundries" for the preceding month is something of a curiosity. Here it is except as to the details of the charges for different kinds of ore which ranged from $3.40 to $9.63 per ton.

Feb. 28, 1873.

Pig Iron To Sundries				
For Cost of making Pig Iron in February including filling of furnace and all expenses since Jan. 27, 58¾ tons at $139.42	8190	·63		
To Coal			3886	97
Ore			2638	37
Limestone			322	07
Furnace			1557	14
Office			242	49
Wood			90	00
General Repairs			53	59

The corresponding entry for March was for 316 tons at 34.18	$10,799.23
The corresponding entry for April was for 241½ tons at 36.87	8,902.86
Total for 3 months 616¼ tons at $45.26	$27,892.72

The average price of No. 1 Foundry Pig Iron, at Philadelphia, that year was about $43. The Furnace went out of blast at the end of April and it made no more iron for nine years, or until the "boom" year 1882.

In Journal entry No. 23 there is a charge to the Company for 10 tons of iron shipped at $139.42 per ton, plus a charge of $7.50 for hauling the iron to the railroad and loading it on a car. In April, 30 tons more was shipped and charged at the same price per ton. In May the charge was as follows:

18¾ tons (Feb.) at $139.42	$2613	83		
91½ tons (Mar.) at 34.18	3127	47		
Hauling	86	69	5827	99

This is a very satisfactory system of bookkeeping for the furnace, for no matter how high the cost of making pig iron it all gets charged to the Company when the iron is shipped, so that the books are balanced without the trouble of computing and entering profits or losses.

On the Company's books at the New York office, however, there would be a different story. Pig Iron account would be charged and the New Jersey furnace would be credited with each shipment of iron at the apparent cost of the iron on the furnace books in the month in which it was made, plus the cost of hauling to the railroad and loading on cars. Pig Iron would be credited with the amount received from the sale of each lot shipped.

Assuming that all the iron made at the New Jersey furnace had been shipped before June 30, and that a single entry was made for it at that date before closing the books, and that at the same time an entry was made charging all the iron made at the two furnaces in Pennsylvania during the six months, whether it was shipped or ordered stored for Company's account, at the book cost at these furnaces, the Dr. side of Pig Iron account would appear as follows (omitting the charges for hauling):

Pig Iron

To Penna. Furnaces								
1873	Jan.	745½ tons at	30	06	22,529	97		
	Feb.	705	27	77	19,577	85		
	Mar.	841½	27	97	23,536	75		
	Apr.	861	28	20	24,280	20		
	May	903½	35	31	31,902	58		
	June	822	37	28	30,662	80	152,490	15
		4879 av.	·0	18				
To N. J. Furnace								
	Feb.	58¾ tons at	139	42	8,190	63		
	Mar.	316	34	18	10,799	23		
	Apr.	241½	36	87	8,902	86	27,892	72
		616¼	45	26			180,382	87

(The figures for tons and cost per ton were taken from the furnace books.)

What would appear on the credit side of the account would depend upon the dates at which the iron was sold. If the whole 5495¼ tons had been sold at the average price of No. 1 Foundry at Philadelphia, in 1873, $43, it would have brought $236,295.75, an apparent profit of $55,912.88, less the cost of selling, bad debts, etc. (there were many bankruptcies in 1873). But if it had been stored for a year or more (as was done by many furnaces in the Lehigh Valley in 1873–4), and sold at the average price of 1874, $30, it would have brought only $164,857.50, showing a loss of $15,525.37, besides cost of storage and loss of interest.

The apparent cost of 616¼ tons of pig iron at the New Jersey furnace, $45.26 per ton, was far below the actual cost (on the basis of charging all the expenses of the plant to pig iron), for the following items appear on the books charged respectively to New Construction No. 1 Furnace and Repairs of No. 1 Furnace, that were later charged to Company.

Expenditure on No. 1 Furnace from Sept 1/72 to Jan. 27 73 (Converting a charcoal furnace into an anthracite furnace)	18,137	26
Cost of repairing No. 1 Furnace, including all expenses at Furnace from Apr. 27, 1873, to Dec. 31, 1874	7,436	51
There were also entries for the cost of building No. 2 Furnace and its appurtenances Mar. 31, 1873, to Nov. 30, 1874, totaling	32,618	82
Total	58,192	69

All of which was a dead loss. The work of building No. 2 furnace was abandoned when the furnace was half finished in 1874, and No. 1 furnace after being repaired was not put in blast until 1882, when, after another disastrous campaign, it was finally abandoned.

The system of bookkeeping used at the Pennsylvania furnace was a fine example of double-entry carried to an extreme. Everything was journalized and posted and balanced monthly, and monthly costs of operation were obtained for the two furnaces (taken together, no attempt being made to get separate costs) for the blacksmith shop, wheelwright shop, moulding shop, and for each separate mine, but the costs obtained were merely accountants' costs; they gave no information to the management as to the causes of variations in costs nor anything as to how the costs of any item might be reduced. The "costs were tied to the general books" to the limit; "the costs were proved by the books," but they were of no practical value.

The chief thing lacking in the system is a statistical statement of comparative monthly costs, which might be made on a single sheet lasting a year. The following is such a statement for the three months' campaign of the New Jersey furnace:

Cost of Pig Iron 1873

	Feb.*	Mar.	Apr.
Pig Iron Made—tons	58¾	316	24½
Coal per ton of iron, tons	9.22	2.02	1.97
Ore per ton of iron, tons	7.19	2.27	2.33
Limestone per ton of iron, tons	1.82	0.50	0.65
Book Cost per ton of iron:			
Coal	55.94	11.41	12.16
Ore	44.97	11.99	13.93
Limestone	5.50	1.52	1.94
Labor, including Office	20.22	4.71	6.20
Supplies and Sundries	4.13	0.68	0.66
Repairs	8.72	3.87	1.98
Total	139.42	34.18	36.87
Cost of Raw Material, per ton:			
Coal	6.07	5.65	5.33
Ore	6.24	5.28	5.97
Limestone	3.01	3.01	2.66
Total Book Cost per month	8190.63	10,799.23	8902.86
Normal Cost †	1938.75	10,428.00	7769.50
Furnace Operating Loss	6251.88	371.23	1133.36
Furnace Operating Loss, per ton	106.42	1.18	3.87

* Remarks. The February costs included filling the furnace and all costs of the plant from Jan. 27. Furnace lighted 10 A.M. Jan. 30; Blast put on 4.30 P.M. First cinder Jan. 31, 6 P.M. The furnace worked very badly from the beginning. Stopped filling April 27, 2 P.M. Stopped blast 1 P.M., 28th. Length of blast 13 weeks.

Weekly product: 23, 16¼, 1, 21¾, 56¼, 72½, 86, 77¾, 54¼, 58½, 77¾, 64¾, 6½. Total 614½ tons. Grades 463½ No. 3, 83¾ mottled, 19¼ white, 49¾ silver gray.

† Normal or Inventory cost, based on average costs (at that date) of material and average good practice.

2 tons Coal	at $5.75	$11.50
2.2 tons Ore	at 5.50	12.10
0.8 tons Limestone	at 3.00	2.40
Labor		4.50
Supplies, Repairs, etc.		2.50
		$33.00

The above statement illustrates the fallacy of "charging to the product all the factory costs of the month," which is advocated by many accountants, and letting the cost remain on the books as an inventory value, crediting this value to Pig Iron account and billing the iron to the Company at the same value when it is shipped. As was shown above the shipments in April were billed part at $139.42, the February book cost, and partly at $34.18, the March cost. If any of the April iron had been shipped in April it would have been billed at $36.87.

A far better method of treating the pig iron account is after charging it as above with all the operating costs for the month, to credit it and charge Profit and Loss with the difference between the operating cost and the "normal cost," which is the estimated cost with the prevailing prices of materials and fairly good furnace practice for a furnace of that size. The iron will be inventoried at this normal cost until it is shipped, and when it is shipped will be billed to the Company at the same cost.

Another bookkeeping device for figuring costs at a blast furnace is to charge furnace operating account with the monthly cost for materials, labor, supplies and regular repairs, together with a fixed sum, say 50 cents per ton of iron made, which is credited to Reserve for Extraordinary Repairs, which is allowed to accumulate until the furnace is blown out, when it is drawn upon to pay for the cost of relining and other repairs. At the end of the month Pig Iron is charged and Furnace Operating credited with the pig iron made at the estimated normal or inventory price. The balance of the operating account will represent a profit or loss which can either be transferred to Company at the end of the month or carried to Profit and Loss account on the furnace books until the end of the fiscal period, when the latter account is closed into the Company account.

An itemized statistical statement, like the one shown above, is one of the most important parts of blast-furnace cost accounting, for it gives the information that the owners or directors most need. The items under Book Cost should include the total expenditure in dollars as well as the cost per ton, and they should include also Reserve for Extraordinary Repairs and Depreciation, Administration Expenses (relating to the furnace and not to the selling department) and Interest on Investment. The statistics also should be charted, as shown on page 106, entries being made monthly.

IRON WORKS LEDGER, March, 1873

Journal Entry No.	Company	P.R.G.	Cash	Store	Labor	Personal Accounts	General Charges	General Repairs	Office	Horses and Teams	Blacksmith Shop
1	*3000 00*	3000 00									
2		*1400 00*	1496 69	*60 00*						*4 00*	
3			*1496 10*		838 67	657 43					
4					*2381 68*		337 00	16 50	233 34	283 70	99 63
5				*1322 55*			*333 80*			8 60	
6					1441 95		*3 20*				
8				*111 30*		95 86				*714 48*	
14, 15						*191 91*				17 29	
16				4 90						*3* 40	*2 75*
18											5 00
19				311 10		*13,475 97*		877 28			
20	*1,061 95*										
21	8,050 00			936 44							
22		*1703 58*									
23	1,401 70										
24	*14,090 72*					14,090 72					
25								*908 16*	*236 34*		*76 88*
											63
Total Debits	9,451 70	3000 00	1496 69	1252 44	2280 62	14,844 01	337 00	893 78	233 34	309 59	104 63
Total Credits	18,152 67	3103 58	1496 10	1493 85	2381 68	13,667 88	337 00	908 16	236 34	721 88	79 —

Journal Entry No.	Wheelwright Shop	General Supplies	Wood	Coal	Ore	Limestone	Furnace	Mines	Pig Iron	New Construction	
2			*14 00*	*18 69*							
4	44 50						1228 38			138 63	
5		47 80	75 20	44 80	3 20	6 40	23 20	40 20		84 40	
6			*64 50*	*9 56*							
7		51 50	66 50				135 75	59 50		12 75	
8, 9				493 51			16 60	*98 09*			
10						55 60		*22 22*			
11								*5 25*	99 00		
14, 15, 16	*1 50*		*1 50*					1 50			
17				*253 00*				253 00			
18		*292 55*					285 05			2 50	
19		806 84		4501 10		124 00		6827 07		28 58	
20					1061 95						
21		15 18		29 16	156 50			*9187 28*			
22								1703 58			
23									*1,401 70*		
25	*14 00*		*24 00*	*3605 11*	*3787 84*	*479 04*	*1667 86*		10,799 23		
Total Debits	24 50	921 32	141 70	5068 57	1221 65	186 00	1688 98	8884 85	10,898 23	266 86	
Total Credits	15 50	292 55	104 00	3886 36	3787 84	479 04	1667 86	9312 84	1,401 70		

JOURNAL-LEDGER, March, 1873

Credit Accounts

Dr.	Co	P.R.G.	Cash	Store	Labor	Personal Accounts	General Charges	General Repairs	Office	Horses and Teams	B.S.Shop	W.W. Shop	General Supplies	Wood	Coal	Ore	Limestone	Furnace	Mines	Pig Iron	New Construction	Total Dr.
Co																			8050 00	1,401 70		9,451 70
P.R.G	3,000 00									4 00				14 00	18 69							3,000 00
Cash		1400 00		60 00										1 50					936 44			1,496 69
Store						311 10				3 40												1,252 44
Labor			838 67	1322 55			3 20			42 14				64 50	9 50							2,280 62
Personal Accounts	14,090 72		657 43	78 29						14 82	1 25	1 50										14,844 01
General Charges					337 00																	337 00
General Repairs					16 50	877 28																893 78
Office					233 34																	233 34
Horses and Teams				16 41	283 70	0 88	8 60															309 59
B.S. Shop					99 63								5 00									104 63
W.W. Shop					44 50																	44 50
General Supplies						806 84	47 80			51 50									15 18			921 32
Wood							75 20			66 50												141 70
Coal						4,501 10													29 16			
						175 75	44 80			219 67									98 09			5,068 57
Ore	1,061 95						3 20												156 50			1,221 65
Limestone						124 00																
						1 97	6 40			31 41									22 22			186 00
Furnace				16 60	1228 38		23 20			135 75			285 05									1,688 98
Mines		1703 58				6,827 07	40 20			59 50	1 50				253 00							8,884 85
Pig Iron						13 31		908 16	236 34	80 44	76 88	14 00		24 00	3605 11	3787 84	479 04	1667 86	5 25			10,898 23
New Construction					138 63	28 58	84 40			12 75			2 50									266 86
Total Cr	18,152 67	3103 58	1496 10	1493 85	2381 68	13,667 88	337 00	908 16	236 34	721 88	79 63	15 50	292 55	104 00	3886 36	3787 84	479 04	1667 86	9312 84	1,401 70	0	63,526 46
Total Dr	9,451 70	3000 00	1496 69	1252 44	2280 62	14,844 01	337 00	893 78	233 34	309 59	104 63	44 50	921 32	141 70	5068 57	1221 65	186 00	1688 98	8884 85	10,898 23	266 86	63,526 46
Balance Cr	8,700 97	103 58		241 41	101 06			14 38	3 00	412 29						2566 19	293 04		4217 99			12,863 91
Balance Dr			0 59			1,176 13					25 00	29 00	628 77	37 70	1182 21			21 12		9,496 53	266 86	12,863 91

COST OF IRON WHEN BY-PRODUCTS ARE MADE

Iron works accounts tend to become complicated when valuable by-products are made in addition to the principal product. For example, a blast furnace makes slag, some of which may be sold as a raw material for making cement. It also makes a vast quantity of gas, part of which is used for furnishing and heating the blast for the furnace itself, but another part may be sold to an Electric Co. to be used in gas engines to make electric current. There may be coke ovens run in connection with the furnace, making more coke than the furnace can use, and the surplus is sold at the market price. The Electric Co. may also purchase some of the gas from the coke ovens, and the tar and gas washings may be sold to a Chemical Co., at a price to be agreed upon, for the manufacture of by-product chemicals. The Iron Co. itself may carry on a cement works, a by-product plant, and an electric plant, as branches of its business. Under these circumstances it becomes a problem how to find the cost of pig iron and of the other products.

Example. A modern blast furnace with coke ovens adjoining makes 10,000 tons of pig iron in a month. The coke ovens make 20,000 tons of coke in the same month, of which half is used by the blast furnace and half is sold. The following are the statistics of cost, the coke being charged to the furnace at the market price, $3 per ton:

BLAST FURNACE:	
20,000 tons Ore @ $5	$100,000
10,000 tons Coke @ $3	30,000
5,000 tons Limestone @ $1	5,000
Labor, $1 per ton of Iron	10,000
Supplies, 50¢ per ton of Iron	5,000
Current repairs, 30¢ per ton of Iron	3,000
Reserve for Ex. repairs	5,000
Interest on Investment	4,000
	$162,000
Average Cost $16.20 per ton.	
CREDITS:	
Furnace Gas sold	$10,000
Slag sold	1,000
	11,000
Dr. Balance	151,000
Inventory: 10,000 tons Pig Iron	162,000
Apparent profit on Furnace	11,000
COKE OVENS:	
30,000 tons Coal @ $1.40	$42,000
Labor, 20¢ per ton Coal	6,000
Supplies, Repairs, Interest, etc.	6,000
	$54,000
20,000 tons Coke make average cost per ton $2.70	
CREDITS:	
10,000 tons Coke to Furnace @ $3	$30,000
Gas sold	3,000
Tar and Washings sold	3,000
	$36,000
Dr. Balance	$18,000
Inventory: 10,000 tons Coke @ $2.70	$27,000
Apparent Profit on Coke Ovens	$9,000

Several questions arise in connection with this statement.

1. Should not the credits of $6000 for by-products of the coke ovens be deducted from the gross cost of coke, $54,000, making the cost of coke per ton $2.40 instead of $2.70, and the inventory of coke on hand made $24,000 instead of $27,000?

2. Should not the blast furnace be charged with coke at the net cost price $2.40 per ton, instead of $3, the market price, making the cost of pig iron $15.60 per ton instead of $16.20?

3. Should not the pig iron cost be further reduced by crediting the furnace with $11,000 for by-products, making the net cost of pig iron and the inventory value per ton $14.50?

In the simplest form of accounting no attempt would be made to separate the blast furnace from the coke ovens in the general ledger and to determine unit costs of product from the ledger, but all charges and credits would be made to a single Manufacturing or Operating Account as below:

Dr.	OPERATING ACCOUNT		Cr.
Ore, 20,000 tons @ $5	$100,000	Furnace Gas	$10,000
Coal, 30,000 tons @ $1.40	42,000	Furnace Slag	1,000
Limestone, 5,000 tons @ $1	5,000	Oven Gas	3,000
Labor	16,000	Oven Tar, etc.	3,000
Supplies, Repairs and Reserves	19,000		
Interest	4,000		17,000
		Balance	169,000
	$186,000		
			$186,000

Inventory 10,000 tons Coke @$ 2.40	$24,000	
10,000 tons Iron @ $14.50	145,000	169,000

Thus showing no profit, all the credits for by-products going to reduce the cost and the inventory value of the coke and the iron. Or, if the inventory were made at the gross costs given in the first table it would appear as follows:

10,000 tons Coke @$2.70	$27,000
10,000 tons Iron @ 16.20	162,000
Inventory	189,000
Less Balance of Account	169,000
Profit, $11,000 on Furnace, $9,000 on Ovens	$20,000

If the above simple method of keeping the accounts were adopted the costs would be kept in a separate book, and in this book the cost-accountant might figure costs and inventory values by two or three different methods, or on two or three different assumptions as to the method of treating the by-products of the accounts, for the information of the management. The directors could then choose which of the methods would be the best for obtaining unit costs to be used as a basis for inventories, for fixing minimum selling prices or for determining profits available for declaring dividends.

There are several advantages in this method of separating the cost system from the accounting system. By having a single operating account all the actual expenditures and actual receipts may be posted to it from the Invoice Book, Sales Book, Pay Roll Book, etc., immediately after the end of the month and a balance sheet taken which shows the general course of the business. The balancing of the general books does not have to be postponed until estimates of costs are made, and no question arises as to whether the furnace shall

be charged with the coke at the market price, $3, or at $2.70, or at $2.40, or whether the furnace should be credited with the receipts from the sale of by-products, so that the book cost of pig iron may thereby be lowered. All these troublesome questions may be avoided by the general bookkeeper and turned over to the cost accountant and to the management.

When the market value of a by-product is a considerable fraction of the value of the whole product it becomes impossible to determine what is the real cost of either the principal product or the by-product, and the only way to fix the inventory value of either product is to take the market price less the estimated cost of selling, including the cost of storage, transportation and interest charges. Thus, if a certain mine produced an ore containing, at market values, $20 worth of gold, $10 worth of silver and $15 worth of copper per ton of ore, and the total cost for mining, concentration, smelting, refining, transportation, management and selling was $35 per ton, the profit would be $10 per ton of ore, but the cost per ounce of gold or silver, or per pound of copper, could not be stated.

Cost Keeping in a Rolling Mill

Puddle Mill No. 1, Etna Iron Works.

Pay Roll for Week ending Saturday 191

Furnace No.	Name	Muck Bar Made Pounds								
		M	T	W	T	F	S	Total	Rate	Wages
1	J. Welsh T. Jones									
2	R. Morgan W. Reese									
20	Furnaces Total									

	Total tons	Labor per ton $
Material, tons pig iron	@$	
Material, tons scrap	@	
Material, tons pig scrap	@	
Material, tons pig ore	@	
Material, tons pig cinder	@	
Fuel	@	
Repairs * Material (Items)		
Repairs Labor (Items)		
Charge to this week's product for repairs		
Foreman's Wages		
Other labor		
Other charges, burden (details) per ton		
Total		
Less value of cinder made		
Total cost of muck bar		
Total cost per gross ton		

The cost of refined bar is figured in the same way. The raw material is muck bar, charged at the puddle-mill recorded cost, and scrap, either purchased, drawn from other mills, or sheared crop ends from the bars made. All this scrap is usually charged at the market selling price in carload lots.

* This charge may be an estimate based upon previous statistics. A memorandum account of repair is kept for the actual cost of repairs each week, which will be totaled as a charge to Repairs and the account will be credited each week with the weekly charge to Muck Bar.

The skilled labor is commonly paid by the ton, and common labor by the day. Repairs and other burden are treated as in the puddle mill and a weekly statement is made showing the totals of raw material, labor and burden, bars and scrap produced, and cost per ton of refined bar made.

MACHINE-HOUR RATES IN A STEEL WORKS

Mr. Gershom Smith in an article in *Engineering Magazine*, June, 1909, thus described the method of establishing the machine-hour rates which he used in the works of the Pennsylvania Steel Co., Steelton, Pa., about seven years earlier:

"The first step was to ascertain the floor space of the shop under consideration, and to divide this space into the sum of the upkeep of land, depreciation of the building, the power plant and power-transmission machinery, also general machinery for common use throughout the shop, such as overhead cranes, etc., also expense of a general nature, such as heat, light, superintendence, non-producing labor (that is, laborers), current minor repairs, etc., the quotient being the yearly value of floor space per square foot.

The next step was to ascertain the square feet of floor space occupied by each machine, and to apportion to this machine its pro rata share of the aforementioned items, on the basis of its square feet of floor space.

In the case of a building of several floors, the floor space on each would have to be considered, and it is probable that the engineers would decide that certain floors being more valuable in the matter of location than others should stand a greater share of the depreciation of the building.

Some machines require more clear space around them than others for the handling of work. Any floor space not occupied by machines or in operating them should be charged pro rata to all machines. In one shop the total square feet represented was 4278, the machines actually occupied 833½ sq.ft., and the working space allowed was 833½ sq.ft. additional, leaving 2611 sq.ft. for aisles, storage, etc. This 2611 sq.ft. was pro rated to the 1667 sq.ft. apportioned to the machines so that each square foot apportioned was charged with the expense of a little over 2½ actual square feet of floor space.

Next, the depreciation on the cost of the machine itself is ascertained, including installation and necessary equipment such as counter-shaft, belting, motors, tools, and machine fixtures. To this must be added the proportion of cost of power, this figure being furnished by the mechanical superintendent and based on horse power, also supplies, and all expense directly applicable to the machine.

Having taken all such expense into consideration, based on the totals of one year, the next step is to ascertain by careful enquiry (to be verified and if necessary corrected later from actual data), the number of hours per month or per annum which each machine will run under normal conditions. Having ascertained the number of hours per annum, we use this as a divisor, and the total yearly cost of the machine (ascertained as described), as the dividend, the resulting quotient giving the machine's hourly rate. As it would be impractical to operate this plan with a different rate for every machine in the shop, the machines have been divided into ten groups, with a different rate for each group and the machine is assigned to the group nearest to its ascertained rate. The desire is to provide a slight leeway per hour on each machine to cover unforeseen expenses, and also to provide a reserve in normal times which can be drawn on in subnormal times, and thus to keep the expense rate fairly even.

Where owing to trade conditions the machines do not operate sufficient time to absorb the total expense, if there is no reserve to draw on, I prefer to show the deficit as a charge against the department income or profit and loss account, thus keeping the costs on a normal basis."

CHAPTER XVI

MODERN ACCOUNTING SYSTEMS FOR STEEL WORKS

A STEEL WORKS ACCOUNTS

The following outline of accounts for a Steel Manufacturing Company including crucible and open-hearth, steel making, rolling, cold rolling, etc., has been furnished to the author by Mr. Albert Walton of Philadelphia, manufacturing accountant and industrial engineer. The general outline as far as the main accounts are concerned is analagous to the arrangement that would be satisfactory for a machine shop and foundry, or for a large corporation with varying manufacturing activities. Forms used by Mr. Walton will be found on pages 164 to 169.

Some extracts from Mr. Walton's letters are given below.

"One factor that has often been overlooked by both manufacturers and accountants is that of having the cost system an actual part of the accounting system. Many concerns are content to have a memorandum cost system, built in part on estimates made by superintendents and foremen, but I have never found such a system that would stand investigation or analysis.

"A properly arranged accounting system is one that requires the data from which the entries into the General Ledgers are made up, to be established from the various shop and other reports, made up daily and carrying accumulative totals and balances, so that, if necessary, it would not be required to wait until the end of the month to obtain a balance sheet, the record being in such shape that a prompt and accurate statement could be made at any time. The cost of arranging such a system is not any more expensive than many methods that do not even give monthly results and frequently only enable a Profit and Loss statement to be made once a year.

"In one actual case the remodeling of the cost system resulted in a reduction of 16 clerks in the accounting and cost department. Prior to the rearrangement the books were closed only at the end of the fiscal year, and it was necessary to close down the factory employing 800 men for about ten days to take the inventory. With a considerably reduced office force, they now have a monthly balance sheet and income statement, and the cost of taking inventory on Dec. 31st, 1914, was reduced $2400.00, this being the first yearly closing after making the accounting and works system change, and at the end of this present year, 1915, there will be a further reduction. This shows what can be done by the elimination of needless detail and by concentrating the work of the office and shop clerks in directions that result in the accumulation of only those data that are absolutely necessary for the cost accounts, the general books and the statistical reports.

"A certain company of international reputation found that their estimated profits on a line of heavy machinery, the sales of which run over $1,000,000, per year had not materialized. They were doing business with absolutely no attempt to arrange their estimate in detail that could be satisfactorily compared with the cost of manufacture of the machines. They had not kept costs of manufacture in detail by kind of machines built, and of course had paid no attention to the costs of parts of individual machines, so that whether certain machines were made profitable and others at a loss was unknown.

"Their real mistake was in accepting large orders, based upon the guesses of their engineers as to what the work could be gotten out for—and accepting their estimates with too much assurance that the figures were correct. Their engineers are good designers but very poor estimators. In this case there was a loss that ran into over $100,000 that could have been prevented had attention been paid to detail costs and the proper detailing of estimates.

"A simple but very satisfactory method of routing work is in effect at one plant, all output being scheduled practically three months in advance, and weekly sub-schedules issued for the shop to work to; planning boards are not used, but a special form of job ticket follows the work through the shops, being carried in a special holder (see Fig. 16, page 167) on the truck. There are 200 standard size trucks used for handling work, and there has been worked out a system, whereby a truck load of parts constitutes an order, and this truck starts from the foundry or stock room, and after passing through all necessary shop departments winds up either at the erecting department or at the finished part store room.

"The tickets are made out in advance in the Production Department from the Production Schedule book, in which is predetermined the quantity of parts to be brought through each week of the year. This card is sealed in a holder with celluloid front that is attached to the truck; the only column open for use of the workman is the one headed "operatives," thus preventing the changing of any figures by the operator, the inspector only having access to the card record and he being furnished with pliers and lead rivets for opening and resealing the holders. The use of this holder did away with a great many abuses that had existed prior to properly safeguarding the cards."

Ledger Accounts.—Analysis of Entries Thereto and Account Symbols for a Company Operating Steel Furnaces, Rolling Mills, etc. By Albert Walton.

CHART OF LEDGER ACCOUNTS AND SYMBOLS

	Assets			Liabilities			Loss and Gain			Profit and Loss.
	A Current.	*B* Inventory.	*C* Fixed.	*D* Current.	*E* Reserve.	*F* Capital.	*G* Revenue.	*H* Cost.	*J* Expense.	
1	Cash	Melting Stock	Real Estate	Accounts Payable	Depreciation	Capital stock	From Outside Securities	Cost Adjustment	Discount on Sales	K.I.
2	Petty Cash No. 1	Crucible Ingots and Billets	Buildings	Notes Pay-Payable	Relining Furnaces	Bonds	Discount on Purchases	.....	Executive Expense	
3		O. H. Ingots and Billets (Made)	Machinery and Equip-	Accrued Int. on Bonds	Rolls	Surplus	Interest Received	.....	Sales Expense	
4	Treasurer's Fund	O. H. Ingots and Billets (Purchased)	Branch Property	Accrued Taxes	Contingencies	.....	.....	.....	Claims and Allowances	
5	Accounts Receivable	Billet Cost Adjustment	.....	Accrued Pay Roll	.....	.....	Sales *A*	Cost of Sales *A*	Freight Allowed	
6	Bills Receivable	Work in Process	.....	Dividend	.....	.....	Sales *B*	Sales *B*	Interest Paid	
7	Unexpired Insurance	Finished Stock	.....	Income Tax Deducted	.....	.....	Sales *C*	Sales *C*		
8	Outside Securities	Finished Stock on Order	.....	Deferred Charges	.....	.....	Sales *D*	Sales *D*		
9	Cash Advanced to Branches	Wire Dept. Stock	.....	Private Accounts	.....	.....	Sales *E*	Sales *E*	*X* and *P* Expense Ledger	
10	Unexpired Taxes	Wire Dept Process Stock	.....	.....	.....	.....	Sales *F*	Sales *F*	Accounts, *X* 20 to 614 *P* 60 to 4024	
11	.....	Wire Dept. Finished Stock	.....	.....	.....	.....	Sales *G*	Sales *G*	(see list in following pages)	
12	.....	Fuel	.....	.....	.....	.....	Sales *H*	Sales *H*		
13	.....	Melters Supplies								
14	.....	General Stores								
15	.....	Stock Adjustment								
16	.....	Scrap								
17	.....	.....	.....	.....	.....	.....	.....	.....	.....	
20–22	.....	Warehouses								

EXPLANATION OF ACCOUNTS

Acct. Symbol — Account

A1 CASH

(Financial Ledger)

Sub-accounts, A1A, A1B, etc., for various Branches.

Analysis of Entries

Debit at end of month with:

Cash received and deposited in banks during the month. See Cash Received Book for details.

Credit with:

The amount of checks issued during the month (entries made at end of month). See Check Register for details.

Balance: The available cash in Banks at end of month.

A2 PETTY CASH No. 1

(Financial Ledger)

Debit with:

Amount placed in fund to meet currency requirements.

Credit with:

Disbursements from the fund, as per Petty Cash Book.

Balance:

Funds on hand to meet petty cash disbursements, and pay roll advance payments.

Acct. Symbol — Account

A4 TREASURER'S FUND

(Financial Ledger)

Debit with:

Moneys issued to meet Treasurer's special disbursements.

Credit with:

Disbursements made. Details in Treasurer's private Journal.

A5 ACCOUNTS RECEIVABLE

(Financial Ledger)

Debit with: The total Charge Sales at the end of each month.

Credit with:

a. Footings of "Accounts Receivable" column of Cash Received Book, at end of each month. Includes all payments received from customers plus the discount allowed.

b. Allowance to customers for goods returned. Claims allowed, etc. charged to Mdse. or to Profit and Loss.

e. Accounts that are uncollectible, charged to Reserve for Bad Debts or to Profit and Loss.

Balance: The amount due and collectible from customers. Should agree with the result of a trial balance of customers' ledger cards.

Acct. Symbol — Account

A6 BILLS RECEIVABLE

(Financial Ledger)

Analysis of Entries

Debit with:
The face value of notes received from others.

Credit with:
The face value of notes received from others that have been paid, discounted, or otherwise disposed of.

Balance:
Represents the face value of notes on hand.

A7 UNEXPIRED INSURANCE

(Operating Ledger)

Debit with:
Cost of Insurance (from Accts. Payable Book).

Credit with:
The monthly proportion of insurance premiums that have been charged to this account, the proper Operating Expense Accounts being charged.

Balance:
Represents the Cost of Unexpired Insurance.

A8 OUTSIDE SECURITIES

(Financial Ledger)

Debit with:
Cost of Stocks and Bonds of other companies purchased or acquired.
If deemed advisable to depreciate at any later period the value of such stocks when first acquired, charge Profit and Loss with the difference between actual cost and the Company's valuation.

Credit with:
Cost (or valuation) of Stocks and Bonds of other companies sold. The difference between the Cost (or valuation) and Selling price should be charged or credited to Profit and Loss Account.

Balance:
Represents the Company's valuation of Stocks and Bonds of other Companies on hand.

A9 CASH ADVANCED TO BRANCHES

(Financial Ledger)

Sub Accts.	
A9A	Branch
A9B	
A9C	

Debit with:
All items of Cash Advanced to Branches.

Credit with:
Disbursements made by Branches from this fund, debiting the various accounts chargeable therewith, as per the distribution furnished by Branches.

Balance:
Unexpended cash in hands of Branches at the time their report of disbursements was made.

Note:
Branches should make report of their disbursements as of the last day of each month and mail it to the main office not later than the first business day of the succeeding month.

Acct. Symbol — Account

A10 UNEXPIRED TAXES

(Operating Ledger)

Debit with:
Amount of taxes paid.

Credit with:
The monthly proportion of taxes charged to operating expense accounts.

Balance:
Amount of taxes paid but not yet charged to operating accounts.

B FACTORY OPERATING ACCOUNTS

B1 Melting Stock
B2 Crucible Ingots and Billets
B3 O-H Ingots and Billets, Own Make
B4 O-H Ingots and Billets, Purchased
B5 Cost Adjustment
B6 Mill, in Process
B6a Mill Cost Adjustment
B7 Finished Rolled Product, Warehouse A
B8 Finished Rolled Product, Warehouse B
B9 Wire Dept. Stock
B10 Wire Dept. Process Stock
B11 Wire Dept. Finished Stock
B12 Fuel
B13 Melters' Supplies
B14 General Stores
B15 Stock Adjustment
B16 Scrap

Debit with:
a. Cost of Material purchased.
b. Cost of Inbound Freight on Materials.
c. Pay Roll and other expense in connection with fabricating material in process.

Credit with:
a. Cost of Materials transferred to other accounts while in process of fabrication and when finished.
b. Cost of Materials sold, at which time the proper Cost of Sales account will be charged.

Balance:
Represents the Cost of Materials on hand.

Note:
The debits and credits to the various accounts for materials transferred to other accounts during process or when finished and delivered to finished stock B7, B8, B11, will be compiled from the current records and reports furnished by each department, and from the distribution of pay roll and other expenses. Journal entries will be made at the end of each month covering these various transfers. B5, Cost Adjustment, will be used as a balancing account to take up the differences between actual prices paid for or actual costs of rolled billets and the estimated values that may at times have to be used when the billets are worked up prior to the receipt of outside invoices or of the approval of them in case of a price dispute, and when the cost of billets of our own makes are not obtainable until after the end of a current month. In these cases the entries will be as follows:

Example:

Dr.	Billet Account		Cr.
Stock	50,000	(1)	1000
		(3)	146

Dr.	Billet Cost Adjustment		Cr.
(1)	1000	(2)	1146
(3)	146		

Dr.	Mill in Process		Cr.
(2)	1146		

In entry No. 1, it is assumed that certain billets of a value estimated at $1000 are used from stock for a specific rolling order. At the end of the month the true cost is found to be $1146, this amount is credited to Billet Cost Adjustment and debited to Mill in Process Account as per entry No. 2. The credit balance of $146 will be closed into Billet Account as shown in entries No. 3. A clear record of the transactions is thus made. This refinement in accounting applies principally to mills rolling short orders for special specification steel where it is necessary to estimate the cost prior to the end of a month.

Example:

Dr.	B 20 Warehouse (New York)		Cr.		
To B 7	100 tons Billets @ 26	2600	By Cost of Sales, Class A, 50 tons @ 27 (1)		1350
To B 11	100 tons Wire @ 30	3000	By Cost of Sales, Class B, 50 tons @ 31.50 (1)		1575
To J 3	Sales Warehouse Exp.	250			

This entry is typical of the method of charging stocks received from the Home Warehouse to Inventory Accounts at the transferred Cost Value, to which is added the monthly charges covering the cost of the selling expense of the Branch Warehouse. This addition to cover Branch expenses, freights, etc., calls for the establishment of a higher cost of sales, and this has been assumed in the above entry to be covered by $1 per ton on billets and $1.50 per ton on wire.

Subsequent entries will then be as follows:

Dr. (H 5 and H 6, Cost)	Sales (G 5 and G 6, Revenue)	Cr.
To B 20 (1) H 5: Cost Billet Sales 1350	(2) G 5. Sales Billets	1500
To B 20 (1) H 6: Cost Wire Sales 1575	(2) G 6. Sales Wire	1800

Dr.	A 5. Accounts Receivable		Cr.
Sales, G 5 and 6	3300		

These entries explain the method of crediting Warehouse, B20, and debiting the proper Cost of Sales accounts H5 and H6, also the crediting of the proper Sales Revenue accounts G5 and G6, and debiting Accounts Receivable, A5.

The subsequent entries to cover the adjustment of claims and allowances to customers will be found under Claims and Allowances, J4.

Accounts H5, H6, Cost of Sales, and G5, G6, Sales (Revenue) will be closed at the end of a fiscal year. At the end of each calendar year the debit balance in H5–6 and the credit balance in G5–6 will, when compared with each other, set up the Gross Profit on Sales, and in making up a Monthly Income Statement would show as follows:

	For Month	% of Cost	For Year to Date	% of Cost
Gross Sales	$135,000		642,715	
Less Cost of Sales	114,000		503,400	
	21,000	18.4	139,315	27.6

B6-a, Mill Stock Adjustment, represents a balancing account to prevent undesirable fluctuations in Mill Stock Accounts, due to Mill Report errors. It is an account similar to Billet Cost Adjustment and it is used in the same manner where it is necessary to estimate the cost of rolling prior to the actual monthly cost being established. Outside purchases, however, do not enter into consideration. The accounting for a specific case would be as follows:

Dr.	B 6. Mill in Process		Cr.	
		(1)	$1000	00
		(3)	50	00

Dr.	B 6a. Mill Cost Adjustment			Cr.	
(1)	$1000	00	(2)	$1050	00
(3)	50	00			

Dr.	B 7. Warehouse (Finished rolled steel)		Cr.
(2)	$1050	00	

Entries No. 1 and 2 are made during a month; after the cost is established early in the following month, the correcting entry No. 3 is made.

Accounting entries covering the rolling of ingots into billets and of billets into finished Rolled Product:

Dr.	B 6. Mill in Process		Cr.	
(1) Billets	1380	(2) Finished product	1600	
(1) Ingots	1000	(6) Scrap	30	
(4) Pay roll	200	(3) Billets (rolled)	1150	
(5) Expense (overhead)	200			

Dr.	B 3a Ingots		Cr.
		(1)	1000

Dr.	B 3b Billets		Cr.
(3)	1150	(1)	1350

Dr.	B 7 Finished Product (Warehouse A)		Cr.
(2)	1600		

Dr.	D 5 Pay roll		Cr.
		(4)	200

Dr.	X—Expense		Cr.
		(5)	200

Dr.	B 1c Melting Stock (Scrap, Sub-account)		Cr.
(6)	30		

This entry shows the source of the various entries establishing the debits and credits of B6, Mill in Process, and it is assumed that all the expense debited thereto has been absorbed by the product and scrap made. In actual practice there will be a balance of work in process to carry forward into the succeeding month's account.

Stock Adjustment

This account will be debited or credited with the amount of any important errors, discovered during a year to have been made in the physical inventory taken at the end of the previous fiscal year, which it would not be correct or advisable to debit or credit to specific current inventory accounts. At the end of the current year the balance in Stock Adjustment Account should be debited or credited to Surplus Account, thus withdrawing the correction from the current year's statements as to operating results, that should not be affected by errors applying to the preceding year.

Acct. Symbol	Account
B20	New York Warehouse
B21	Chicago Warehouse (Consigned Stock)
B22	San Francisco Warehouse (Branch Acct.)

Analysis of Entries

Debit with:

Cost of Materials transferred from Stock Accounts B7 and B11.

Credit with:

Cost of Materials sold, at which time the proper Cost of Sales account will be charged.

Balance:

Represents the cost of materials on hand.

Note:

Materials carried at outside Warehouses are billed to them at cost. When sales are made from these stocks in addition to crediting the specific Warehouse Stock, the Cost of Sales Account (proper subdivision) should be charged with the cost of the specific sale—and General Sales (proper subdivision) should be credited with the billing value. This will then bring all sales into General Sales Account, and set up the Gross Profit on the Company's business. If it is desired to maintain a separate identity for each Outside Warehouse and credit the sales made from each to its own account it can be accomplished by carrying subsidiary Sales Accounts for each outside Warehouse, treating them as follows:

Entries Covering Transactions at Branch Warehouses

Branch Warehouse Account

Debit with:

a. Cost of materials transferred to Branch.

b. Warehouse expense, salaries, commissions, insurance, freight, etc. (This may be on a percentage basis to maintain a fair distribution of expense.)

Credit with:

Cost of sales made, as established at Branch, so as to ensure a fair cost of sales f.o.b. Branch.

Balance:

Represents the cost value of stock on hand.

Note.

The sales for the month will be credited at billing value and charged at the transfer value plus the proper proportion of Warehouse Expense. The difference between this revised Cost and the billing value will give the Gross Profit on such sales.

INVENTORY SUB-ACCOUNTS

The Inventory Accounts B1 to B24 represent the principal or controlling inventory accounts and each is subject to further subdivision as deemed necesesary:

For example: B1, Melting stock may be subdivided as follows:

B1*a*. Melting Bar.

b. Shovel scrap, punchings, etc., purchased.

c. Own make scrap.

d. Ferro-manganese.

e. Ferro-silicon.

f. Tungsten.

g. Vanadium, etc.

Similarly other divisions would be established on form necessary to cover the different kinds of finished Rolled steel, Fuel, General Stores, etc. The Inventory Account B3 and B4 may be divided into:

B3A, O-H Ingots—Own make.
B3B, O-H Billets—Own make.
B4A, O-H Ingots—Purchased.
B4B, O-H Billets—Purchased.

In the detail accounting this would be done—even though for balance-sheet purposes they were combined together.

Acct. Symbol	Account
C1	REAL ESTATE (Operating Ledger)

Debit with:

a. Cost of land purchased.

b. Cost of surveying, title insurance, recording fees, etc.

c. Cost of important improvements, i.e., grading, constructing roads, etc.

Credit with:

Cost of land sold, Profit or Loss on sales of real estate entered in this account, but if land is sold Profit and Loss Account would be credited with profit or charged with loss, resulting from the sale. Example: If land cost $10,000 and sold for $15,000 cash, the Journal Entry would be Cash $15,000, To Real Estate $10,000, To Profit and Loss $5000.

Balance:

Represents cost of land owned.

Acct. Symbol	Account
C2	BUILDINGS (Operating Ledger)

Debit with:

a. Actual Cost of buildings purchased or constructed.

b. Cost of replacing buildings, or important parts thereof, destroyed by fire, flood, etc., or on account of ordinary wear and tear.

Credit with:

Cost of buildings replaced (if any) at which time Reserve for Depreciation (Buildings) should be charged.

Balance:

Represents cost (or appraised value) of Buildings owned.

Example of Account C–2. Original cost of building, $20,000. Depreciation Reserve, Cr. balance, $4000. Present net value, estimated, $16,000. Damage by fire, estimated, $8000. Received cash from Insurance Co., $6000. Repaired damage at cost of $10,000. Appraised value of building now $18,000. Required the entries to be made:

C2. Buildings

Jan. 1	Balance, Cost	$20,000	Mar. 20	By Cash from Ins. Co.	$6,000
June 5	To Cash (repairs)	10,000	June 5	By Depn. Reserve	4,000
			June 30	By Profit and Loss	2,000
			June 30	By *Balance*	*18,000*
		$30,000			$30,000
July 1	To Balance (present value)	$18,000			

E 1. Depreciation Reserve

June 5	To Buildings	$4,000	Jan. 1	Cr. Balance	$4,000

Acct. Symbol — Account

C3 MACHINERY AND EQUIPMENT
(Operating Ledger)

Debit with:
a. Cost of all machinery and equipment purchased or built.
b. Cost of first installation, but not subsequent installations due to changes which do not add to asset value, which should be charged to Operating Expense.
c. Cost of additions and alterations, only however when such changes increase the original efficiency of machine or equipment.
d. Cost of new Machinery or of replacing machinery or equipment scrapped or sold on account of wear or obsolesence.

Credit with:
a. Cost of any machinery or equipment sold the difference between the cost and the amount it sold for being charged against Reserve for Depreciation Account (Machinery and Equipment).
b. Cost of any Machinery and Equipment replaced or scrapped, Reserve for Depreciation Account (Machinery and Equipment) being charged.

Balance:
Represents the cost of Machinery and Equipment on hand.

C4 BRANCH PROPERTY
(Operating Ledger)

Debit with:
Actual cost of property owned.

Credit with:
Cost of any property sold, the difference between the cost and the amount it sold for being charged against Reserve for Depreciation account. If the Reserve is insufficient charge the deficit to Profit and Loss.

Balance:
Represents cost of branch property owned.

D1 ACCOUNTS PAYABLE
(Financial Ledger)

Debit with:
a. Footings of "Accounts Payable" column per Check Register (Entry to be made at end of month).
b. Amounts allowed by creditors for materials returned, damaged, etc.

Credit with:
Footings of " Accounts Payable " column per Voucher Record (Entry to be made at the end of month).

Balance:
Represents the amount owing to creditors for Materials, etc., purchased, and should agree with the aggregate amount of unpaid Vouchers.

D2 NOTES PAYABLE
(Financial Ledger)

Debit with:
The face value of all notes redeemed.

Credit with:
The face value of all notes issued.

Balance:
Represents the aggregate face value of notes payable outstanding.

Acct. Symbol — Account

D3 ACCRUED INTEREST ON BONDS PAYABLE
(Financial Ledger)

Debit with:
Payments of interest on outstanding Bonds.

Credit with:
Interest accrued for the month on outstanding Bonds (entry made at end of month), charging Profit and Loss.

Balance:
Represents the amount of interest accrued but not due.

D4 ACCRUED TAXES
(Financial Ledger)

Debit with:
Amount of Tax Bills when they are paid.

Credit with:
Estimated monthly proportion of taxes, at which time debit the various Operating Expense Accounts to which taxes are charged, with the proportion proper to each.

Balance:
Represents Estimated Taxes accrued but not due.

D5 ACCRUED PAYROLL
(Operating Ledger)

Debit with:
All payments for labor.

Credit with:
a. Labor charged to Productive Accounts.
b. Labor charged to Non-Productive Accounts.
c. Salaries not paid from Treasurer's fund.

Balance:
Represents pay roll accrued but not due for payment.

D6 DIVIDENDS
(Financial Ledger)

Debit with:
Dividends paid.

Credit with:
Dividends declared.

Balance:
Represents dividends due but not paid.

D7 INCOME TAX (Deductions)*
(Financial Ledger)

Debit with:
Items of Income Tax deducted from Salaries and paid to the Government, Cash being credited.

Credit with:
a. Any adjustments that may be necessary.
b. Amount of Income Tax return made to the Government.

Balance:
Will represent the amount of Income Tax Collected but not remitted.

*Example of Entries to D7, Income Tax:

Mfg. a/c	To Salaries	500	
G.M's Sal. for March			500
Salaries	To Income Tax	60	
1% Deducted from G.M's Sal. for year			60
Salaries	To Cash	440	
Bal. pd. G.M.			440
Income Tax	To Cash	60	
Paid to Govt.			60

Acct. Symbol	Account

D8 DEFERRED CHARGES

(Financial Ledger)

Debit with:

Amount of bonus set aside as due specific employees, Accrued Pay roll being credited.

Credit with:

Amounts of bonus paid to specific employees, Operating Expense being charged.

Balance:

Will represent Bonus set aside but not yet paid to employees.

D9 PRIVATE ACCOUNTS

(Financial Ledger)

Debit with:

Amounts paid to employees chargeable to their private account, crediting Cash.

Credit with:

Amounts as established by properly approved traveling and other expense vouchers, and with cash returned, expense accounts or Cash being charged.

Balance:

If a debit will represent the total amount of Company's fund in hand of employees, as traveling and special expenses, that have not been accounted for to date, and will be transferred to the Asset side of a balance sheet. If a credit will represent a liability.

E1 RESERVE FOR DEPRECIATION

Sub Accts.
E1A Reserve for Building.
E1B Reserve for Machinery and Equipment.

(Operating Ledger)

Debit with:

a. Cost of replacing building, machinery and equipment, or important parts thereof, at which time credit Building or Machinery and Equipment Account.

b. Difference between cost and selling price of Buildings, Machinery or Equipment sold, the proper asset account, C2 or C3 being credited.

c. Cost of Buildings, Machinery or Equipment discarded or scrapped, the proper asset account, C2 or C3, being credited.

Credit with:

At the end of each month one-twelfth of the total estimated depreciation for the year, at which time debit the various Operating Expense Accounts to which Depreciation is chargeable with the proportion proper to each.

Balance:

Represents the available Reserve for Depreciation. When compiling a Balance Sheet the balance of this account should be deducted from the Asset Accounts C2 and C3, in order to show their estimated present value.

Note:

At the end of fiscal year any difference between the estimated depreciation charged off monthly and the actual depreciation as established at close of year will be adjusted through Profit and Loss Account.

E2 RESERVE FOR RELINING FURNACES

Sub Accts.
E2A Relining O-H Furnace.
E2B Relining Crucible Furnace.

(Operating Ledger)

Debit with:

Cost of relining Furnaces (except for unimportant and minor repairs which will be absorbed in Operating Expense) crediting Pay Roll and Material accounts with their respective portions of relining expense.

Credit with:

The estimated monthly charges to Operating Expense Accounts to which rebuilding furnace expense is chargeable.

Balance:

Represents the available reserve for rebuilding Furnaces.

Note:

At the end of the fiscal year any debit or excessive credit balance in Reserve for Rebuilding Furnace Account should be closed out as follows:

a. If a debit balance by charges to Operating Expense Accounts sufficient to close out the debit balance and leave a reasonable credit balance to carry over into the succeeding year.

b. If an excessive credit balance by credits to Operating Expense Accounts and debits to Reserve for Rebuilding Furnaces of an amount sufficient to close out the excess portion of the credit balance.

c. The division of such adjustment between Open-Hearth and Crucible Operating Expense Accounts will be based upon the experience gained during the year and the amount of rebuilding that has been necessary.

d. It will be proper to carry forward at the end of each year a reasonable credit balance in Reserve for Rebuilding Furnace Account, the amount depending upon the physical condition of the furnaces at that time and representing the approximate cost of restoring them to first class condition.

Acct. Symbol	Account

E3 RESERVE FOR ROLLS

(Operating Ledger)

Debit with:

The Cost of making new and changing and repairing old rolls, Pay Roll and Material accounts being credited with their respective portion of this expense.

Credit with:

The estimated monthly charge to Mill Accounts to which Roll expense is chargeable.

Balance:

Represents the available reserve for providing new and repairing old rolls.

Note:

At the end of a fiscal year any debit or excessive credit balance in this account will be adjusted in a manner similar to that arranged for the account Reserve for Rebuilding Furnaces E2.

E4 RESERVE FOR CONTINGENCIES

Sub Accts.
E4A Special and General Expenses.
E4B Strike Expenses.
E4C Special Experiments and Investigations.
E4D Patent Litigation and Expenses.
E4E Bad Accounts.
E4F Bonus to Employees.
E4G Extraordinary Repairs and Renewals.

(Financial Ledger)

Debit with:

All expenses of such kinds as it has been determined to provide for through this reserve.

Credit with:

An Estimated monthly charge to Operating Expense Accounts of Manufacturing departments. On special occasions when it is anticipated that extraordinary charges may be pending against this account it will be proper to raise sufficient credit in the account to meet them by direct charges to Profit and Loss.

Balance:

Represents the available reserve for Contingencies.

Note:

The purpose of the Reserve for Contingencies is to provide for certain expenditures that will have to be met at specified times and for others that may be unforeseen. The principal expenditures that will be paid from this reserve are as follows:

E4A. *Special and General Expenses.*

Will include payments made to special agents for services and expenses while engaged on special work not connected with current operations and construction, also payments to employees and others in consideration of extra services in directions that are beneficial to the Company's interests.

E4B. *Strike Expenses.*

E4C. *Special Experiments and Investigations.*

Will include special experiments and investigations that may affect Operating and Sale Departments, but which will not be charged thereto unless the experiment or investigation accrues ultimately to the credit of such Departments, when it will be proper to credit this Account E4C, and charge the department benefited thereby with all or a portion of the expense as may be deemed advisable.

E4D. *Patent Litigation and Expenses.*

Will include all expenses connected with protecting or securing patents and patent rights. Amounts paid for patents purchased may be charged to this account.

E4E. *Bad Accounts.*

Will include all uncollectible accounts receivable charged off.

E4F. *Bonus to Employees.*

Will include bonus amounts paid to employees who participate in the division of bonus based upon the net profits on a year's operations.

E4G. *Extraordinary Repairs and Renewals.*

Will include the cost of such repairs and renewals that are extraordinary in character and which, if charged into the current cost of operations would unduly increase it. This account will not include the rebuilding of Open-Hearth and Crucible Furnaces, and the replacing of broken Rolls, which are taken care of through special reserve accounts.

Acct. Symbol	Account

F1 — CAPITAL STOCK

(Financial Ledger)

Analysis of Entries

Debit with:

Par value of shares retired.

Credit with:

Par value of shares issued.

Balance:

Represents par value of stock outstanding.

F2 — BONDS

(Financial Ledger)

Debit with:

Amount of Bonds retired.

Credit with:

Amount of Bonds issued.

Balance:

Represents amount of bonds outstanding.

Acct. Symbol	Account

F3 — SURPLUS

(Financial Ledger)

Debit with:

Dividends declared, at which time credit Dividend account.

Credit with:

Net Profit as shown by Profit and Loss Account after the closing entries have been made, at which time Profit and Loss account should be charged, thus causing the latter account to balance.

Balance:

Represents the accumulated net profits to and including the last closing period, less any dividends paid.

G1 — INCOME FROM OUTSIDE SECURITIES

(Financial Ledger)

Debit with:

Losses sustained on Stocks sold.

Credit with:

a. Income (dividends) received from Stocks owned.

b. Profits realized from Stock sold.

Balance:

Represents net income from Stocks of other Companies.

G2 — DISCOUNT ON PURCHASES

(Financial Ledger)

Debit with:

Discounts taken but not allowed by creditors.

Credit with:

Footings of "Discount" column in Check Register book (entries made at end of month). This footing represents cash discounts allowed by creditors.

Balance:

Represents Net Discounts on Purchases.

G3 — INTEREST RECEIVED

(Financial Ledger)

Debit with:

Any adjusting entries.

Credit with:

All interest received on past due accounts.

Balance:

Will be transferred to Profit and Loss accounts at closing period.

G5 to G12 — GENERAL SALES

(Representing Division of Sales by classes of goods. A to H inclusive.)

(Fiuancial Ledger)

Debit with:

The debit side of this account will be kept in the Operating Ledger and will be known as Cost of Sales Accounts H5 to H12 inclusive.

Credit with:

The billing value of Sales made during month (both cash and charge sales).

Balance:

When the Cost of Sales Account (kept in Operating Ledger) is deducted from the credit postings in general Sales Accounts the balance will represent Gross Manufacturing Profit on Sales.

Acct. Symbol | Account

H1 — **COST ADJUSTMENT**

(Operating Ledger)

Analysis of Entries

Debit or Credit with:

a. Such adjustments as are necessary on account of using arbitrary prices in establishing cost values.

b. Gains of losses on Sales which at the time of Sale were credited to cost at an arbitrary price.

Balance:

Will be closed out to Profit and Loss at closing periods.

Note:

Cost adjustment entries will be adjusted from time to time, the basis for adjustment being value instead of tonnage as the former more nearly represents the most equitable basis. The postings to this account will come from all Producing Depts. and the detail of the account should be kept on supporting sheets in such manner as to show each department's cost adjustments separately.

H5 to H12 — **COST OF SALES**

(Representing Classes of Goods, A to H inclusive).

(Operating Ledger)

Debit with:

a. Cost of Sales of Product shipped each month.

b. Gross profits taken on Product sold and afterwards returned by customer.

Credit with:

The credit side of this account will be kept in the Financial Ledger and will be known as General Sales Account G5 to G12 inclusive.

Balance:

The debit postings in these accounts will offset the credit postings in General Sales Accounts, the credit balance remaining in the latter accounts representing Gross Manufacturing Profits on Sales.

J1 — **DISCOUNT ON SALES**

(Financial Ledger)

Debit with:

The footing of "Discount" column in Cash Received Book (entry made at end of month). This footing represents cash discounts allowed to customers.

Credit with:

There will be no credits to this account excepting possibly readjustments for corrections of discounts revised.

Balance:

Represents Net Cash Discounts allowed to customers.

J2 — **EXECUTIVE EXPENSE**

(Financial Ledger)

Debit with:

a. All expenses chargeable to Executive Dept.

b. All expenses that are general to the Company's business as a whole and not directly chargeable to other accounts.

Credit with:

Any items that should result in diminishing the charges to this account. Charge Factory Operating Account B with the proportion of J2 that belongs to the factory.

Balance:

Represents Net Executive Expense.

J3 — **SALES EXPENSE**

(Financial Ledger)

Debit with:

All expenses connected with maintaining the Selling Department.

Credit with:

Any items that should result in diminishing the charges to this account.

Balance:

Represents Net Sales Expense.

J4 — **CLAIMS AND ALLOWANCES**

(Financial Ledger)

Debit with:

Allowances to customers for product returned, claims allowed, etc., at the same time credit Accounts Receivable.

Credit with:

All adjusting entries which will represent debits to stock and scrap accounts for salvage value of material returned; debiting General Plant Expense for manufacturing loss sustained, and debiting the proper sale accounts for loss of profits thereby.

Balance:

Will represent the volume of claims and allowances not disposed of.

J5 — **FREIGHT PREPAID AND ALLOWED**

(Financial Ledger)

Debit with:

Freight prepaid and allowed on shipments.

Credit with:

Correctiug entries if any affecting previous debits.

Balance:

Represents Net amount of Freight prepaid and allowed on shipments.

J6 — **INTEREST PAID**

(Financial Ledger)

Debit with:

All interest items on Notes Payable.

Credit with:

Any adjusting entries.

Balance:

Will represent the amount of interest paid.

K1 — **PROFIT AND LOSS**

(Financial Ledger)

Debit with:

a. Such items of expense as cannot be properly chargeable to any other account.

b. With closing entries at closing periods.

Credit with:

a. Such items of expense as cannot be properly credited to any other account.

b. With closing entries at closing periods.

Balance:

After all closing entries have been made the balance in this account will represent the Net Profit for the period and should be transferred by Journal Entry to Surplus Account.

Acct. Symbol — Account

SUB ACCOUNTS OF LEDGER ACCOUNTS

To be kept in Subsidiary Ledgers and closed into the Controlling Accounts in Operating and Financial Ledgers at end of each month.

B14–1 PAINTS
B14–2 REFRACTORIES
B14–3 ELECTRICAL MACHINERY AND SUPPLIES
B14–4 PIPE FITTINGS
B14–5 MISCELLANEOUS STORES
B14–6 OILS AND GREASES
B14–7 LUMBER
B14–8 STATIONERY
B14–9 MISCELLANEOUS CASTINGS
B14–10 ROLLS
B14–11 PATTERNS
B14–12 MACHINERY AND EQUIPMENT
B14–13 NEW CONSTRUCTION
B12–1 ANTHRACITE COAL
B12–2 BITUMINOUS COAL
B12–3 GAS COAL
B12–4 COKE
B12–5 COKE DUST
B12–6 WOOD
B12–7 FUEL OIL
B12–8 CITY GAS

(Inventory Ledger)

Analysis of Entries

Debit with:
a. Cost of materials purchased.
b. Cost of Inbound Freight on materials purchased.

Credit with:
Disbursements made during month, established from Stock Keepers' requisitions and special reports of materials used, to be priced and extended by General Storekeepers' office and forwarded to Cost Dept. in shape for distributing to cost accounts.

Balance:
Represents the cost of materials on hand in each sub account.

Note:
There will be no balance left in the four accounts B14–10, B14–11, B14–12, B14–13, as all items charged thereto will be immediately credited out to the final account to which they are chargeable, being first charged to a Store or Inventory Account as a convenience in accounting for all receipts through Stores Account, B14.

B15A STOCK ADJUSTMENT

(Inventory Ledger)

Debit or Credit with:
Such adjustments as are caused by overruns and shortages of raw materials, process and finished products.

Balance:
Will be closed out to Profit and Loss at closing periods.

B15B BILLET PRICE ADJUSTMENT

(Inventory Ledger)

Debit with:
Stock Preparing Expense and credit as outlined under heading "Stock Preparing Expense" Account, P70 to P710.

Acct. Symbol — Account

X20 to X216 LABORATORY EXPENSE

(Expense Ledger)

Debit with:
All charges for Pay Roll and other Expense.

Credit with:
Proper proportion of Laboratory Expense chargeable to various other Expense Accounts.

Balance:
This account will close out at end of each month.

Note:
The distribution of this expense will be based upon the service rendered the various Operating Depts. and other accounts, and the detail distribution sheets should show separately the charges for Chemical, Metallurgical, Physical Testing and Open-Hearth Chemical Laboratories.

X30 to X320 PAY, COST AND ACCOUNTING EXPENSE

(Expense Ledger)

Debit with:
All charges for clerical and other Office Expenses in connection with the Pay Roll and Cost Keeping.

Credit with:
Proper proportion of charges to various other Expense Accounts.

Balance:
This account will close out at end of each month.

Note:
The distribution of this expense will be based upon the service rendered the various Operating Depts. and other accounts as near as it can be established, and may be covered by percentage rates varied as occasion may require.

X40 to X434 GENERAL PLANT EXPENSE

(Expense Ledger)

Debit with:
All charges for Salaries, Pay Roll and other Expenses that are not charged to Departments.

Credit with:
Proper proportion of charges to various other Expense Accounts.

Balance:
This account will close out at end of each month.

Note:
The distribution of this expense to other Expense Accounts, will be in proportion to the service rendered, as near as it can be determined; certain items at times can be charged directly to specific Operating Expense Accounts, the balance may be distributed by percentage ratios varied as occasion may require.

X50 to X514 GENERAL STORE HOUSE EXPENSE

(Expense Ledger)

Debit with:
All charges for Salaries, Pay Roll and other Expenses.

Credit with:
Proper proportion of charges to various other Expense Accounts.

Balance:
This account will close out at the end of each month.

Note:
The distribution of this expense will be prorated to the other expense accounts in proportion to the value of materials, etc., issued to each during the month.

Acct. Symbol — Account

P60 to P68 WAREHOUSE EXPENSE

(Expense Ledger)

Analysis of Entries

Debit with:
All charges for Pay Roll and other Expenses.

Credit with:
Proper proportions of charges to various Cost of Sales Accounts.

Balance:
This account will close out each month.

Note:
The basis for distribution of this expense will be in proportion to service rendered for storing and shipping steel, the general items being prorated in proportion to the direct distribution and charged to the proper cost of sales accounts H5 to H12.

P70 to P710 STOCK PREPARING EXPENSE

(Expense Ledger)

Debit with:
All charges for Pay Roll and other Expenses.

Credit with:
Charges to Billet Price Adjustment Account.

Balance:
This account will close out each month.

Note:
As this expense is practically an addition to the cost price of billets, it will be covered by adding arbitrary amounts per ton to all billet prices, establishing different arbitrary prices for various kinds of billets as past experience indicates to be proper. A sub account Billet Price Adjustment will be kept in the Inventory Ledger and this account will be charged with Stock Preparing Expense and will be credited with the amounts established through the use of the arbitrary prices per ton that have been added to the cost of billets handled by this department during the month. The arbitrary prices used will be adjusted from time to time as the balance in Billet Price Adjustment Accounts shows need thereof.

P80 to P812 INDUSTRIAL RAILWAY EXPENSE

(Expense Ledger)

Debit with:
All charges for Pay Roll, Fuel and other Expenses.

Credit with:
Proper proportion of charges to various other Expense Accounts.

Balance:
This account will close out each month.

Note:
The distribution of this expense will be based upon service chargeable to various other expense accounts.

P90 to P910 ELECTRIC LIGHT AND POWER EXPENSE

(Expense Ledger)

Debit with:
All charges for Pay Roll and other Expenses.

Credit with:
Proper proportion of charges to various other Expense Accounts.

Balance:
This account will close out each month.

Note:
The distribution of this expense to other Expense Accounts will be based upon meter readings for power furnished, and service given that cannot be metered will be prorated to expense accounts chargeable therewith on a basis furnished by Chief Electrician at the end of each month.

Acct. Symbol — Account

P110 to P1112 STEAM EXPENSE

(Expense Ledger)

Debit with:
All charges for Pay Roll, Fuel and other Expenses.

Credit with:
Proper proportion of charges to various other Expense Accounts.

Balance:
This account will close out each month.

Note:
The distribution of Steam expense will be in proportion to steam furnished to various departments, and the basis for distribution will be furnished by the Master Mechanic at the end of each month.

P120 to P1226 CRUCIBLE DEPT.

(Expense Ledger)

Debit with:
All charges for Pay Roll, Productive materials, Fuel and other Expenses.

Credit with:
Ingots and scrap produced.

Balance:
At the end of each month the total cost of Crucible Dept. will be charged against the Product turned out during the month. As ingots will be credited to Crucible Dept. during each month at certain fixed prices determined in advance, there will be a debit or credit to Cost Adjustment Account covering the difference between this fixed price and the actual cost as established at the end of the month. If the debit or credit balance becomes abnormal a revision in the fixed price will be in order.

Note:
A monthly cost and expense exhibit will be made out covering the month's operation of Crucible Dept.

P140 to P 1420 HAMMERS Nos. 1–2
P150 to P1512 HAMMERS Nos. 3–4
P160 to P1620 HAMMERS Nos. 5–6
P170 to P1710 16 IN. ROLL TRAIN
P180 to P1812 10 IN. ROLL TRAIN
P1820 to P1830 12 IN. ROLL TRAIN
P190 to P1910 8 IN. ROLL TRAIN
P200 to P2010 ROLL TRAIN No. 2 MILL

(Expense Ledger)

Debit each account with:
All charges for Pay Roll, Productive materials, Fuel and other expenses.

Credit each account with:
Productive stock and scrap produced.

Balance:
At the end of each month the total cost of each Hammer or Mill Dept. will be charged against the product turned out by each during the month. As the product from the departments will be credited during a month at certain fixed prices determined in advance, there will be a debit or credit to Cost Adjustment Account covering the difference between this fixed price and the actual cost as set up at end of month. If the balance becomes abnormal a revision in the fixed prices used will be in order.

Note:
A monthly cost and expense exhibit will be made out covering the operations of each Hammer and Mill Dept.

ACCT. SYMBOL — ACCOUNT

P210 to P2112 ANNEALING AND TREATING EXPENSE

(Expense Ledger)

ANALYSIS OF ENTRIES

Debit with:
All charges for Pay Roll, Fuel and other expense.

Credit with:
Such portions of this expense as is established by using the arbitrary rates per ton adopted to cover them and charge to Cost of Sales Account H5 to H12.

Balance:
After charging out to Cost of Sales the amount based upon tonnage of shipments, the balance will be debited or credited to Cost Adjustment Account.

Note:
Some annealing expense will be chargeable to Wire Dept. and the balance to Cost of Sales H5. The remainder of the expense will be distributed to such division of Cost of Sales Account as work was performed for.

P220 to P226 ROLL TURNING EXPENSE

(Expense Ledger)

Debit with:
All charges for Pay Roll and other expense.

Credit with:
Proper proportion of Roll Expense chargeable to various sizes of Rolls handled, this amount to be charged to the Reserve for Rolls Account.

Balance:
This account will close out at the end of each month.

Note:
The detail of Cost on New Rolls and Repairing and Changing Old Rolls will be entered on a card record for each roll.

P230 to P239 ENGINE ROOM EXPENSE

(Machine Shop)

(Expense Ledger)

Debit with:
All charges for Pay Roll and other expense.

Credit with:
Proper proportion of charges to other expense accounts to which power is furnished.

Balance:
This account will close out at end of each month.

Note:
The distribution of this expense will be based upon data as to power consumed, furnished by Master Mechanic.

ACCT. SYMBOL — ACCOUNT

P240 to P2424 MAINTENANCE EXPENSE

(Expense Ledger)

Debit with:
All charges for Pay Roll and other Expense.

Credit with:
Proper proportion of Maintenance Expense chargeable to other expense accounts.

Balance:
This account will close out at end of each month.

Note:
The detail distribution of Pay Roll, General Stores, etc., chargeable to this account will be kept in separate detail for Machine Shop, Pattern Shop, Blacksmith Shop, Bricklayers and Pipe Fitters, so that proper distribution can be made of this expense to the other expense accounts chargeable therewith.

P290 to P2918 INSPECTING EXPENSE

(Expense Ledger)

Debit with:
All charges for Pay Roll and other expense.

Credit with:
Proper proportion of charges to the various classes of material on which inspection was performed.

Balance:
This account will close out at end of each month.

Note:
The distribution of this expense will be based upon Pay Roll reports of time spent by inspectors on the various classes of material inspected.

P300 to P3054 WIRE DEPT. EXPENSE

(Expense Ledger)

Debit with:
All charges for Pay Roll, Productive materials, and other expenses.

Credit with:
Productive stock and scrap produced.

Balance:
At the end of each month this expense will be closed out to Process Stock B10 and Finished Stock B11 in accordance with the Dept. Inventory and shipment reports.

Note:
A monthly cost and expense exhibit will be made out covering the month's operations.

P400 to P4024 OPEN HEARTH DEPT. EXPENSE

(Expense Ledger)

Debit with:
All charges for Pay Roll, Productive materials, Fuel and other expenses.

Credit with:
Ingots produced.

Balance:
At the end of each month the total cost of Open Hearth Dept. will be charged against the cost of producing ingots B3. As ingots from the Open Hearth Dept. will be credited thereto during a month at certain fixed prices determined in advance there will be a debit or credit to Cost Adjustment Account covering the difference between this fixed price and the actual cost set up at end of month. If the balance becomes abnormal a revision in the fixed prices will be in order.

Note:
A monthly cost and expense exhibit will be made out covering the month's operations.

TRIAL BALANCE—BALANCE SHEET—INCOME STATEMENT

The following are typical forms of trial balance, balanee sheet and ineome statement for a steel works. The titles of the accounts, and the symbols are different from those used in the foregoing list of accounts.

Trial Balance as of

		Debits		Credits	
A1	Real Estate	2,000	00		
A2	Buildings	8,000	00		
A3	Machinery	20,000	00		
A4	Furniture and Fixtures	2,000	00		
A5	Miscellaneous Tools	3,000	00		
B1	Cash	1,250	00		
B2	Petty Cash	250	00		
B3	Accounts Receivable	35,000	00		
B4	Bills Receivable	6,500	00		
B5	Prepaid Insurance	260			
B6	Prepaid Taxes				
B7	Outside Securities				
B8	Cash Advances	1,500	00		
B9					
B10	Branch Accounts Receivable	2,450	00		
C1	Merchandise	12,000	00		
C2	Raw Materials	20,000	00		
C3	Work in Process	25,000	00		
C4	Finished Product	16,000	00		
C5	Supplies	2,000	00		
D1	Capital Stock			100,000	00
D2	Surplus			15,000	00
E1	Accounts Payable			25,500	00
E2	Accrued Taxes			450	00
E3	Accrued Pay Roll			1,500	00
E4	Income Tax Deductions				
E5					
F1	Reserve for Depreciation			5,000	00
F2	Reserve for Bad and Doubtful Accounts			1,500	00
G1	Sales of Factory Product			135,000	00
G2	Sales of Purchased Goods			75,000	00
G3					
G6	Discount on Purchases			47	00
G7	Interest Received			35	00
G8	Sales to Branches (Coosigned Goods)			7,500	00
H1	Cost of Sales, Factory Product	122,000	00		
H2	Cost of Sales, Purchased Goods	71,000	00		
H6	Claim Adjustment	900	00		
H8	Cost of Sales, by Branches (Consigned Goods)	7,250	00		
J1	Discount on Sales				
J2	Sales Dept. Expense	3,410	00		
J3	Claims and Allowances	3,701	00		
J4	Freight, Prepaid and Allowed	500	00		
K1	Profit and Loss	561	00		
	Total	366,532	00	366,532	00

Balance Sheet as of

Assets:				
Fixed Assets:				
Real Estate and Buildings	10,000	00		
Machinery, Tools, etc.	25,000	00		
Total	35,000	00		
Less: Reserve for Depreciation	5,000	00		
Total Fixed Assets:			30,000	00

Balance Sheet as of—Continued

Brought Forward					30,000	00
Current Assets:						
Cash			1,500	00		
Accounts Receivable	35,000	00				
Bills Receivable	6,500	00				
Total Receivables	41,500	00				
Less: Reserve for Bad Accounts	1,500	00	40,000	00		
Prepaid Insurance			260	00		
Cash Advances			1,500	00		
Total Current Assets:					43,260	00
Inventory Assets					75,000	00
Miscellaneous Assets					2,450	00
Total Assets					150,710	00
Liabilities:						
Capital Stock					100,000	00
Surplus					15,000	00
Current Liabilities:						
Accounts Payable			27,000	00		
Accrued Taxes			450	00		
Total Current Liabilities					27,450	00
Profit and Loss					8,260	00
Total Liabilities					150,710	00

Income Statement for Ending

Gross Sales to Outsiders:						
Mill Product	135,000	00				
Purchased Goods	75,000	00				
Total Gross Sales to Outsiders			210,000	00		
Gross Sales to Branches:						
Mill Product	5,000	00				
Purchased Goods	2,500	00	7,500	00		
Total Gross Sales					217 500	00
Less: Allowances:						
Returned Goods	1,500	00				
Price Adjustment	1,000	00				
Def. Matl. and Work	500	00				
Business Policy	500	00				
Poor Service	201	00			3,701	00
Total Net Sales					213,799	00
Cost of Sales:						
Factory Product	122,000	00				
Purchased Goods	71,000	00				
Sales to Branches	7.250	00				
Claim Ajustments	900	00			201,150	00
Gross Profit on Sales %					12,649	00
Deduct: Selling Expenses					3,910	00
Net Operating Profit %					8,739	00
Deduct: Discount on Sales Charges to Profit and Loss	561	00			561	00
Total less Deductions					8,178	00
Add: Discounts on Purchases	47	00				
Interest Received	35	00				
Credits to Profit and Loss*					82	00
Net Profit for Period					8,260	00

* These items are debits and credits to Profit and Loss that have not been charged or credited to manufacturing accounts. They usually represent adjustments affecting matters not directly connected with operations.

FORMS USED BY MR. WALTON IN STEEL WORKS AND OTHER ESTABLISHMENTS

Form W1.—Schedule of Parts and Operations

This sheet is used in developing a routing and scheduling system in a heavy hardware and tool factory where the first requisite is to obtain a systematic record of what is manufactured, arranged in Bill of Material form and containing necessary data as to operations in each department and their usual sequence.

From No. 630-1000-11-20-15
(*Loose Leaf Binder Sheet Size 14 x 11 in.*)

SCHEDULE OF PARTS AND OPERATIONS

SIZES MADE ARTICLE

UNIT OF QUANTITY SHEET OF

	Number of Pieces	NAME OF PART	MATERIAL USED		Bought Outside and Price	LIST OF OPERATIONS			Economical Quantity to Order	REMARKS AND FINISHED WEIGHT
			Kind	Size and Quantity		OPERATION	Piecework or Daywork	Dept. Where Done		
(*50 lines, 6 per inch*)										

Form W2.—Requisition Card (5×3 in.)

Pa. Order No.	This is Req. No.	Subject
Received	Origin	Issued to Dept. 13
Date	DEPT. 12	
Supplier	Needed	Ordered in above
Name	Date	Date

Wanted (*2 lines, 5 per inch*)

See Specifications

Remarks *3 lines*

Forwarded

Date Requisition to Purchasing Dept.

The other side of this card has columns and ruling (5 per inch) and headings as below:

Date Hurried	Date Promised	Date Hurried	Date Promised

Form W3.—Requisition for Supplies (5×3 in.)

Form 66, 2M. 11 AP 00 Contract No.	Structure No.	Pc. No.
No. Pcs.	Origin	For details see
Kind	DEPT. 12	B/M
Measure Each	Dept. Forward to Dept.	
Rate	On Date	
Money Value each		

Remarks

Forwarded Material O.K. and Req. Forwarded to Origin

Date Date

From 12 To 73

Date

Material Requisition--Supplies

Form W4.—General Store Room Card

For rough and unfinished parts carried in store rooms.

RECORD OF UNFINISHED STORES

Name Sec. No.

Mat'l Bin No.

Symbol Assembly Weight Each

Used on Carry For { Repairs ____ Pcs. / Production ____ Pcs. } When stock is Down to ____ Pcs. Order ____ Pcs.

No. per Unit

ORDERS						RECEIPTS AND DELIVERIES					
Date	P. O. No.	S. O. No.	Amount Ordered	When Req'd	Bal. Due on Order	Date	P. O. No.	S. O. No.	Amt. Rec'd	Amt. Del.	Balance on Hand
	(*22 lines, 4 per inch*)				(*Size 5 x 8 in.*)						

(*Reverse of Card*)

ORDERS						RECEIPTS AND DELIVERIES					
Date	P. O. No.	S. O. No.	Amount Ordered	When Req'd	Bal. Due on Order	Date	P. O. No.	S. O. No.	Amt. Rec'd	Amt. Del.	Balance on Hand
	(*27 lines, 4 per inch*)										

Form W5.—In and Out Stock Card

Designed to hang in front of bin.

(*Size 4½ x 8 in.*) ◯ (*Brass eyelet*)

Part No.

Name

Location	Bldg.	Floor	Row	Shelf	Bin

Condition

Unit of Measure Minimum

Date	Received	Date	Issued	Balance
	(*33 lines, 6 per inch. Column headings and rulings continued on reverse side*)			

FORM W6.—TIME STUDY BLANK FOR GENERAL MACHINE-SHOP USE

(Size 6 x 9 in.) TIME STUDY

Name of Part
Symbol Group Mat'l
Operation
(6 lines, 6 per inch)
Type of Machine No. Pcs. Machined
Machine No. Gang No. Dept.
Belt Motor Kind of Steel Tools

No.	Operations	Speed	Feed	Cut	Men	Minutes Actual	Minutes Allowed
	(23 lines, 6 per inch)						

Total Time in Minutes
Total Gang Hours ____ Men
Remarks (10 lines)

Name of Operator or Leader Rate Effy
Time Study No. Made by Date
Approved by Schedule No. Date

FORM W7.—COMBINATION CLOCK AND TIME CARD

Individual job tickets are preferable to these one-day time cards, but for some classes of work this card is well arranged.

THIS SIDE OUT

(Size 5¾ x 3¾ in.) DAILY TIME CARD Date

No. Name
Dept. Time From To
Week Ending Rate

Order No.	Name	Pattern No.	Operation	Hours	Pieces	Amount
	(5 lines 4 per inch)					
	Total					

The reverse of the card with columns for the clock-stamp record is as below.

Time	Hours	Rate	Amount	
Regular				
Overtime				

(3 lines)

	Morning		Afternoon		Overtime		
	In	Out	In	Out	In	Out	
	(7 lines 4 per inch)						
	O. K.						

FORM W8.—JOB TIME TICKET (Size 5×3 in.)

Tickets of the same size and style, printed on different-colored paper, are used for different departments. The printing varies with the kind of work done.

CONTRACT NO.	STRUCTURE NO.		PC. NO.
MONEY VALUE	DEPT. 8	MACHINE NO.	OPERATION
HOURS / QUARTERS	DATE		MAN NO.
REMARKS (6 lines, 5 per inch)			

Samples of the printing on some other cards are shown below. These are **group cards**, used when more than one man works on a single job.

CHARGE NO.			DATE
OPERATION	DEPT. 27	MACHINE NO.	MONEY VALUE
No. of Pieces in Lot / No. Pcs. Finished this day / Weight of Pcs. Finished			HOURS / QUARTERS
REMARKS (5 lines)			

TIME O.K.	TOTAL TIME FOR DAY	HOURS	QUARTERS
GROUP CARD (See other side)		D-S-G--FORGE SHOP	

The reverse of this card is headed as below:

Man No.	Name	Time for This Card Hrs.	Time for This Card Qrs.	Total Time for Day Hrs.	Total Time for Day Qrs.	Rate	Money Value	
Smith								
Helpers								

Department No. 29 has the same card except that the word "Leaders" is printed instead of "Smith." Dept. No. 47, Sheet Iron Dept., is similar except that the third line is as follows:

HOLES IN EACH PIECE	TOTAL HOLES PUNCHED	SHAPE	HOURS	QUARTERS

and on the reverse side "Punchers" is used instead of "Leaders." An individual time and job card for the same department has printing as follows:

FORM W9.—JOB TIME TICKET

Charge No. 25.1			Date 1-12-01
Man No. 2016	Name J. Davis		Money Value
Operation Drilling	Dept. 47	Machine No. B26	Hours 7 / Quarters 1
No. Pcs. Finished This Day 4 / Total No. of Holes 451	Size of Holes 1"	Thickness of Work ⅞"	Rate
Remarks (3 lines)			

Time O.K.	Total Time for Day	Hours 10	Quarters 0
		D-S-A--Sheet Iron Dept.	

Particular attention is called to the value of the information that is obtained from Form W9 with a minimum of clerical work. It not only credits the workman with $7\frac{1}{4}$ hours time and charges order No. 25.1 with the same amount of time, but it shows that in that time on machine *B*26 451 holes 1 inch diameter were drilled in metal $\frac{7}{8}$ inch thick. If this latter statement is posted on a card headed Drilling 1-inch Holes it forms a basis for estimating the cost of future work in which the drilling of holes is an important element. A drawer containing cards for each kind of operation that can be done on each class of tool is a most valuable aid to the estimator in making predeterminations of costs of any machine or operation.

FORM W10.—PAY-OFF SLIP

(Size 6 x 4 in.)

PAY OFF SLIP

PRESENT THIS SLIP AT PAY OFFICE

CASHIER please pay ..... 191....

Man No..... Name.....

Worked in Dept.....

Wages due on last pay period ending.....

Wages due this pay period ending.....

Total earnings.....

Less deductions.....

Net amount due

Received payment for all wages due to date

Head Timekeeper

Witness

NOT NEGOTIABLE

FORM W11.—TYPICAL PREMIUM TICKET

(Size 4 x 6 in.)

PREMIUM WORK

Operation	Premium	Order No.
Name of Part	Limit	Symbol

Number Pieces Finished						Def. Pcs.	SUMMARY
Date	Pcs.	Hours	Date	Pcs.	Hours		
(12 lines 4 per inch)							Premium Time
							Actual Time
							Time Saved
							Bonus Time
							Rate
							Bonus Amt.
							Figured
							Checked
Totals							Credited

Key Number | Name

O. K. for Pieces Finished

Inspector

NOTE:- All Records on these tickets to be made by the Timekeeper, and left at machine where work is being done until it is finished.

Timekeeper

The reverse side of the card has the following:

PREMIUM SYSTEM REGULATIONS

1. Each employee shall be guaranteed his regular day's wages for all time at work.

2. A limit once set and worked upon shall not be reduced except through the introduction of new methods in process of manufacture.

3. No limit shall be placed upon the amount of premium an employee may earn and receive; large premium earnings on the prescribed limits shall be desired.

4. All premiums earned shall be paid on regular pay days of the Company.

5. This card is for use of the men during the progress of a job, and shall be left at the Operator's Machine. Time should be checked daily by workman, and errors rectified with the Timekeeper and Foreman before cards are forwarded to the Office. No claim for errors in time can be allowed after card is sent in for payment.

6. All defective parts must be reported to Foreman immediately on discovery. Day rate only will be paid on such parts.

FORM W12.—PRODUCTION CARD (see holder, on next page)

Card No. 9673 Date June 1, 1915

Part No. 1384 Chopper # 10 Body "A"

Find in 45 Pieces in Track

Store in

Store and report 500

Issued by

Job No.	Dept. No.	NATURE OF JOB Pcs. on Gate-2	Operative's No.	Price per 100 cts.	Pay for
10340	4	Moulding			
1041	11	Grinding	672	10.	500
1042	11	Belting	896	9.	498
2479	7	Boring	754	17.	496
2480	7	Turning Out Side	692	6.5	496
92	7	Drill for Cl. Screw	688	8.5	496
		Size of Card 4¼ x 6 in.			
		21 lines, 6 per inch			

Card returned Good pieces

Condition

Transferred from Card No. Inspector

Job No. Last Operation	Job No. Where Defective	Scrap	Missed Oper.	Extra Work	Dept. No.	REMARKS and Foreman's Signature	Loss Quantity	Loss Price per Piece	Loss Total
1042	1042	✓				Belted Out	2		
2479	2479		✓			Missed Boring	2		
Back of Card 3 x 4¼ in.						19 lines, 5 per inch			

FORM W13.—SHOP ORDER CARD. Suitable for machine shops.

(Size 5¾ x 7 in.)

Order No.

Date Issued Date Wanted

Make Pieces. For Dept.

Symbol

Operation	No. Pieces Finished	No. Pieces Defective	Inspected by	Key No.
Plane	13 Additional lines, 4 per inch, with printed side heads, Bore, Turn, Face, Mill, Screw Mach., Drill Spindle,			
Shape	Polish, Erect or Fit, and four blank spaces.			

THIS TICKET MUST BE CAREFULLY PRESERVED AND SENT TO COST DEPT. WHEN WORK IS FINISHED.

(Reverse Side)

Pieces Delivered

To Store Room			To Erecting Floor		
Date	No. Pcs.		Date	No. Pcs.	

9 lines 4 per inch, 2½ in blank space at bottom

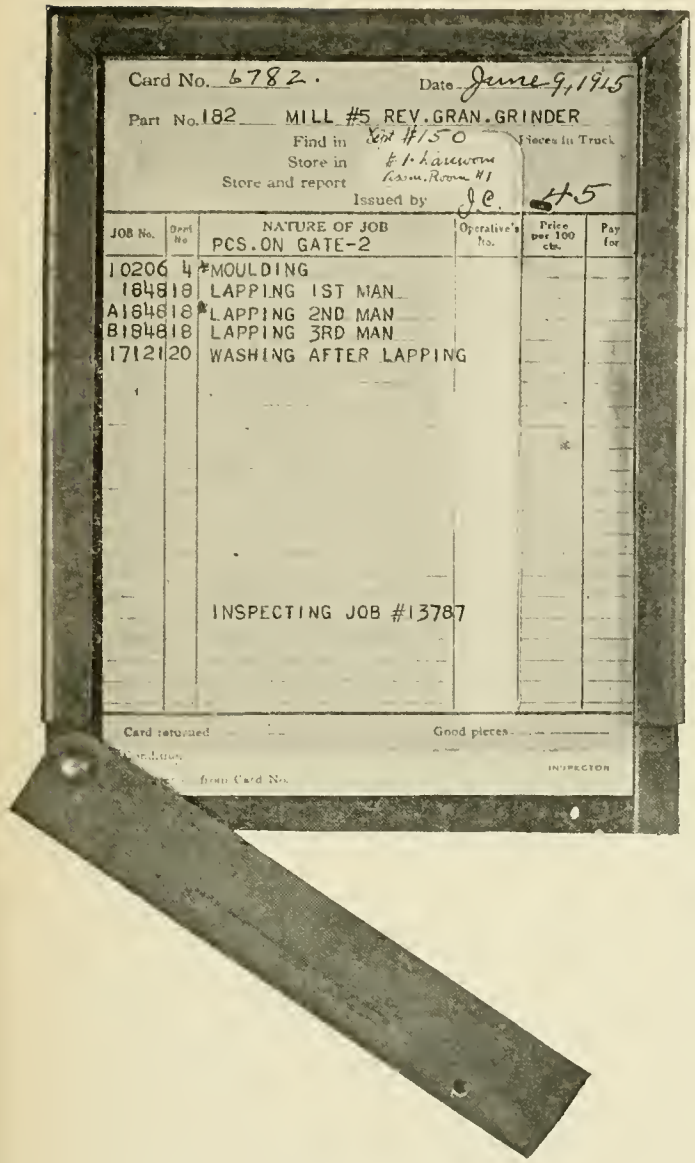


FIG. 16.—WALTON'S CARD HOLDER.

(See description on page 151.)

FORM W14.—PATTERN COST CARD

(Issued by Supt. of Pattern Shop.)

(*Size 6¼ x 4¼ in.*)

Symbol

Date Issued

Key No.

Name

Note:-Send this stub to Cost Department when issued.

PATTERN COST CARD

Symbol

For Dept.

Workman Date 191

Key No. New Changed

Date	Hours Worked	Date	Hours Worked	Material Used

Finished / Partly Finished

Total Hours Cost of Material, $

Rate Cost of Labor, $

Expense, $

Send this to Cost Dept. the day pattern is finished. Total Cost, $

FORM W15.—OPERATION AND PART COST CARD

Enabling any combination of costs to be obtained by gathering together the required cards covering a particular assembly, a complete engine or machine, etc.

Where interchangeable parts are used on different sizes of engines or machines it saves duplication of cost cards. An entire cost system has been introduced successfully on this card basis in plants making hundreds of different types and sizes of engines, pumps, etc. (D, day work; P, piece work.)

(*Size 6½ x 7 in. Printed on both sides*)

Part Symbol

Used on Wt. Each Mat'l

Operation		No. Made	Cost Each	No. Made	Cost Each	No. Made	Cost Each	No. Made	Cost Each
	D								
	P								
	D	(*Repeat for 6 times, two lines for totals, then repeat 6*							
	P	*more times and two lines for totals*)							

(*Five more double columns*)

FORM W16.—COMPARATIVE RECORD OF COSTS OF OPERATIONS AND PARTS AT DIFFERENT DATES

Symbol B426 Part A Wt. 4.5 lbs. Mt'l Cast Iron

Date	Piece	1/5/15		4/11/15															
Order No.	Work	1426		2891															
	Rate	No. Made	Cost Each	No. Made	Cost Each	No. Made	Cost Each	No. Made	Cost Each	No. Made	Cost Each	No. Made	Cost Each	No. Made	Cost Each	No. Made	Cost Each	No. Made	Cost Each
Turn D.W.																			
Turn P.W.		100	.02	100	.02														
Drill D.W.																			
Drill P.W.		100	.003	100	.003														
Mill D.W.		98	.041																
Mill P.W.				100	.035														
Bore D.W.																			
Bore P.W.		97	.03	98	.025														
Key Seat D.W.																			
Key Seat P.W.		97	.035	98	.0325														
Total Cost		97	.1261	98	.1143														

(*Size 6¼ x 4½ in. Printed on both sides*)
(*8 lines for 4 other operations. D.W., Day Work. P.W., Piece Work.*)

FORM W17.—REQUEST SENT TO FOREMAN

To explain why costs of operations have increased.

(*Size 7 x 6½ in.*) **COMPARATIVE LABOR REPORT** No.

Date 19 Symbol

Part

Operation

Mr. Head of Dept.

Please note Labor as given below.

Date	Order No.	Key No.	Name of Workman	Time Allowed	Time Taken	Rate	Cost Each	Results

(*3 lines, ⅜ in. spacing*)

Remarks

Previous Records show

(*3 lines*)

(*1 in. space*)

Cost Dept.

Form W18.—Material Used from Stock

Record of structural shapes, bars, etc., in plants where a well-arranged stock yard system is in effect.

(*Size 8¼ x 7 in.*)

MATERIAL USED FROM STOCK

Req. No. _____
Drawing No. _____
Shop Bill Page _____
Sketch No. _____ Date _____ 19 ___ Order No. _____

MATERIAL WANTED					Cut From			Ret'd to Stock			Weight of Material Used	Price	Amount	Item No.
No. Pieces	Shape	Section	Length Ft.	Length In.	No. Pieces	Length Ft.	Length In.	No. Pieces	Length Ft.	Length In.				
		(*12 lines, ⅜ in. spacing*)												

Form W19.—Inventory Ticket

This ticket reduced the work of taking and recording an inventory. The tickets are numbered consecutively on a numbering machine, so that every ticket issued may be accounted for. The details will of courses vary a the class of material varies.

(*Size 7½" x 6¾ in.*)

No. 17 **INVENTORY TICKET** Symbol _____

No. Pieces _____

Bin No. _____ Room No. _____ Dept. _____ Drawing No. _____

Rough
Finished
Part Finished (Give operations below)

KIND OF MATERIAL

Steel		Castings	
Mach.		Iron	
O.H. or Mild		Steel	
Cold Rolled		Malleable Iron	
Boiler Plate		Yellow Brass	
Tire Plate		Red Brass	
Fire Box		Bronze	
Struc. Shapes		Misc. Mat'ls Iron Pipe	
Galvanized Sheet		Brass Tube	
Black Sheet		Drop Forge	
Blue Anne. Sheet		Rolled Brass	
Wrought Iron			

Special Materials (Give kind)
Lumber (Give grade and kind)
(*4 lines*)

Full Desc. of Part
(*4 lines, ¼ in. space*)

PART OF MACHINES

Steam Engine		Hull'r	Alf
Separator		Feed.	Clov.
Ruth Feeder		Water Wagon	
Hand Feeder		Oil Wagon	
Huller			B
Grain Grader		Gil	C
Wind	Sep.	Eng.	E
Stack.	Hull.		F
Special (Give name)			

Weight Each
Total Weight
Quantity
Size
Counted by
Count Checked by

Use Separate Sheets for Finished, Partly Finished, and Rough Parts

Form W20.—Requisition for Small Tools

(*Size 8½ x 6½ in.*)

REQUISITION ON SMALL TOOL DEPT. FOR TOOLS OR EXCHANGE

Note: Foreman must sign requisition and see that proper description is given of tools required.

Sec.	Dept. No.	Time Ch'k	Name	Page No. Tool Book	(Are Tool Checks Required Yes or No)

Files					Drills				Taps				Dies					Miscellaneous	Bin No.
Quan.	Length	Style	Cut	Bin	Quan.	Size	Shank	Bin	Quan.	Size	Pitch	Bin	Quan.	Size	Pitch	Style	Bin		
	(*8 lines, 4 per inch*)																		

	Brush	Lock	Oil Can	File Handles			Hack Saws			Raw Hide Mallets					Chisels					
				Large	Medium	Small	8"	10"	12"	No. 1	No. 2	No. 3	No. 4	No. 5	Flat Amt.	Flat Size	Cape Amt.	Cape Size	Gouge Amt.	Gouge Size	Diamond Amt.	Diamond Size
Quan.																					
Bin No.																					

Date _____ _____ Foreman

FOREMAN'S COPY. To be returned by Small Tool Dept.

Form W21.—Tool and Pattern Requisition

This blank has been introduced in many shops when it was necessary to use some judgment in authorizing repairs and making new equipment, which if left to the foremen and superintendents often caused needless expenditure.

Factory _____ (*Size 8¼ x 7 in.*)

TOOL AND PATTERN REQUISITION

To _____ Dept. Date _____ 191____

From _____ Dept. Account to be charged _____ Order No. _____

Repair _____ (*5 lines, ¼ in space*)

Est. Cost _____

Labor _____

Mat'l _____

Total _____

Make (*4 lines*)

Required for use on _____

Present Cost of Work on one piece _____ Expected saving by use of new _____ per piece _____

Aprox. pieces made per month _____ Aprox. monthly saving if new _____ is made _____

Estimated Cost of Tool - Labor _____ Mat'l _____ Total _____

Remarks _____ (*4 lines*)

_____ } Factory Manager — Approval required if labor estimated is over $10.00

_____ } Shop Supt. — Approval required if labor estimated is over $2.00 and up to $10.00

_____ Foreman or other person originating this requisition

NOTE:-After proper approval of this requisition it must be sent to Factory Accountant for entry and assignment of Order No.
No work must be done on this requisition until receipt by Shop of order authorizing it from Accounting Department.

(*The reverse side of this blank is as below.*)

COST OF THIS JOB

Pay Period and Item	Labor	Material	Total	Summary
	(*20 lines, 3½ per inch*)			

Form W22.—Suggestion Card

This form was successfully used in many shops in systematically caring for suggested modifications in design when development work was under way.

(The other side of this sheet is blue cross-section or "quadrille" ruling, 4 lines to the inch.)

(*Size 8¼ x 7 in., ruled lines ¼ in. space*)

SUGGESTED MODIFICATION IN DESIGN

To Engineering Dept., From Dept., Date 191

We would suggest the following changes in the Design / Material / Req'd Finish } for Symbol _____

Names of Part _____

Used on _____

The changes proposed are as follows: (*8 lines, 4 per inch*)

The advantages to be gained by the change are

(*8 lines, 4 per inch*)

We have on hand at this date _____ pieces of this part

The value of these parts on hand is _____

Scrap value will be _____

Loss if present stock becomes obsolete _____

Date _____ 191 } Change approved by Engineering Department

Supt. of Dept.

NOTE:-Make sketches on other side. No changes to be adopted until first accepted and approved by the Chief Engineer.

SCHEDULE OF ACCOUNTS OF ANOTHER STEEL WORKS

The author is indebted to Mr. Gershom Smith for a copy of the schedule of accounts (shown on page 170) which he designed for the Pennsylvania Steel Works in 1905. The original schedule, of which this is a revision, was designed by him in 1902.

Form No. 1255, Revised, 11-8-05.

THE PENNSYLVANIA STEEL COMPANY

	Assets			Liabilities			Loss and Gain			
	A Fixed	B Cash Quick and Receivables	C Inventory	D Direct	E Reserve	F Indirect	H Costs	G Revenue	I Expense	
1	Plant	Cashier, Steelton	Stores—Supply Dept.	First Mtg. Bonds	For Plant Depreciation	Dividends		Income from Securities	Administrative	1
2	Other Real Estate	Treasurer	Stores—Fuel	Consolidated Joint Mortgage Bonds	For Other Real Estate Depreciation	Profit and Loss	Rentals	Rentals	Selling	2
3		Accounts Receivable Customers	Stores—Ore	Coke Oven Bonds	For Accounts Receivable	Income		Other Income	Extraordinary	3
4	Fuel Cars	Accounts Receivable Freight Overcharges	Stores—Pig Iron	Car Trust Bonds	For Depreciation on Cars	Capital Stock Preferred	Car Service	Car Service	Fixed Charges	4
5	Cornwall Ore Bank Holdings	Accounts Receivable Income from Sec.	Stores—Recarburizers	Cornwall Bonds	For Depreciation in C.O. Bank Holdings	Capital Stock Common	Discount on Sales	Discount on Purchases	Discount on Coke Oven Bonds	5
6		Accts. Recl., Steelton, Adv. Expenses	Stores—Scrap		For Inventory Fluctuation		Miscellaneous	Miscellaneous	Taxes	6
7		Accounts Receivable Contr. Deposits	Mer. Mill General Stock		For Bombaugh Farm					7
8	In Escro Girard Tr. Co.		Mill Expense							8
9	Cornwall Bonds in Treasury	Accounts Receivable P.S. Co. N.J.	Elec. Power Plant				Electric Power Plant	Electric Power Plant		9
10		Accounts Receivable Suspense	Pattern Shop		For Relining Blast Furnaces					10
11		Accounts Receivable Md. Steel Co.	Iron Foundry	Accounts Payable M. S. Co.	For P.S. Co. Iron		Iron Foundry	Iron Foundry		11
12	Bonds—Miscellaneous	Notes Receivable	Roll House	Accounts Payable Purchases						12
13	Stock—Miscellaneous	Car Service	Tin Shop	Accts. Payable Freight						13
14	Stock C. & L. R. R.		Smith Shop	Steelton P. R. Contingent Account			Smith Shop	Smith Shop		14
15	Stock Leb. Co L. H. & F. Co.	Accrued Interest Penn. Mary C. Co.	Machine Shop	Accrued Interest and Taxes	For 1903 Plant Depreciation		Machine Shop	Machine Shop		15
16	Stock Leb. Water Co.		Boiler Shop	Pay Rolls Unpaid	General Erec. Co.		Boiler Shop	Boiler Shop		16
17	Prospective Purchases		Blast Furnaces	Notes Payable	For Prospective Purchases					17
18	Patrick Co. Notes		Open Hearth		For Patrick Co. Notes					18
19			Bessemer		Differences					19
20	Plant Additions	Special Deposit Girard Trust Co.	Blooming Mill No. 1	Girard Trust Co. Loan	For Plant Additions					20
21	Other R. E. Additions	Plant Expend. Clearing Account	Blooming Mill No. 2				Blooming Mill No. 2	Blooming Mill No. 2		21
22			Slabbing Mill				Slabbing Mill	Slabbing Mill		22
23		Rolls charged to Customers	Rail Mill				Rail Mill	Rail Mill		23
24			Billet Mill				Billet Mill	Billet Mill		24
25		P. S. Co. Indemnity Fund	20 In. Train		For P. S. Co. Indemnity Fund		Merchant Mill 20 In.	Merchant Mill 20 In.		25
26			13 In. Train				Merchant Mill 13 In.	Merchant Mill 13 In.		26
27										27
28	Girard Trust Co., Trustee Cornwall Bonds									28
29	Girard Tr. Co. Trustee Car Tr. Bonds	Works Accountant		Comptroller						29
30	Girard Tr. Co. Trustee Coke Oven Bonds	Advance Expense Account		P. S. Co. N. J. Loan						30
31		P. S. Co. N. J. Loan								31
32		Accounts Receivable Adv. Exp. Acct. Phila	Hammers				Hammers	Hammers		32
33			Steel Foundry				Steel Foundry	Steel Foundry		33
34			F. & S. Dept.				Frog and S. Dept.	Frog and S. Dept.		34
35			B. & C. Dept.				B. and C. Dept.	B. and C. Dept.		35
36			Material for Resale				Material for Resale	Material for Resale		36
37			Transportation					Transportation		37
38			Outgoing Freight in Suspense				Interest on Floating Debt	Miscellaneous Interest		38
39			Freight on Ore in Suspense				Extraordinary Repairs			39
40			Material in Suspense	Accounts Payable Material Unbilled						40
41			Car Service and Demurrage in Suspense		Burden					41
42										42
43										43
44										44
45	Lebanon Furnaces	Lebanon Cashier	Lebanon Furnaces	Lebanon Pay Roll Unpaid	For Lebanon Inventory Fluctuation		Lebanon Furnaces	Lebanon Furnaces	Lebanon Expenses (Phila.)	45
46	Lebanon Plant Additions				For Lebanon Plant Depreciation					46
47					For Lebanon Relining					47
48					Lebanon Coke Oven Reserve					48
49					Lebanon Concentr. Reserve		Penn. M. Coal Co.			49
50					B. and C. Differential		Acid Exp. Depts. not operating			50

CHAPTER XVII

FOUNDRY COSTS—COST OF COAL

COST FINDING IN AN IRON FOUNDRY

A brief statement of some of the difficulties met with in obtaining foundry costs will be found on page 71.

The results of one month's operation of a certain foundry are given in the tables below. (See page 173.)

The system shown in Mr. Walton's tables may be quite satisfactory for some foundries, where the castings are made not for sale as castings, but to supply the machine departments of a large factory, where the sizes are generally small and the output fairly uniform from month to month, where the daily wages do not greatly vary, and where no crane service, heavy molding machines, or pit molding are needed. The final figure, $46.58 per ton, is a sufficiently close approximation to "factory cost," at which the castings are to be charged to the manufacturing departments in which they are used, or valued in the inventory. Monthly statistical sheets, showing the monthly variation in the several expense items, furnish a check on undue advances in these items and indicate where economies may possibly be effected.

For a jobbing foundry, however, making both large and small castings, using high-priced skilled labor on some products and low-priced labor on others, where some castings require crane service, pit molding, power for chipping and cleaning, and others do not, and both large and small castings are sold at a small margin of profit, under intense competition, the average cost, $46.58, is an unsafe figure to rely on in fixing selling prices or in making inventory valuations.

In such a foundry the first thing to be done in obtaining costs is to make a strict separation between the cost of melted metal in the ladle and the cost of making this metal into castings ready for delivery. The latter cost is to be subdivided into direct labor and indirect, or burden, costs, and each of these is to be classified according to the different kinds and sizes of castings and the conditions under which they are made.

The variable conditions are:

Heavy, light and medium castings.

Plain and cored castings; dry sand and green sand.

Bench, floor, pit, and machine molding.

Cleaning by hand or by machine.

Flasks, wood or metal, snap flasks. Depreciation of flasks.

Crane, buggy or hand transport.

Labor, highly skilled or ordinary; day work or piece work.

Number of flasks put up by a man per day; or tons made per man per day.

Risk of spoiled or rejected castings.

Supervision and inspection on different kinds of castings.

The direct-labor cost of any casting or group of castings may be determined in the usual way by time and job tickets for each production order, but the proper allocation of the total monthly or yearly burden to the several classes of castings will require careful consideration of all the above variable conditions together with time studies of certain representative castings or groups of castings.

Making some assumptions as to the cost of melting we may make a restatement of Mr. Walton's figures in such a form as to show separately the melting cost, and the cost for direct labor, indirect labor and other expenses outside of the melting department, as follows:

	Monthly Cost.			Cost per Ton of Castings		
	Melting	Other than Melting	Total	Melting	Other than Melting	Total
General factory expense	498.81	1723.84	2222.65	1.36	4.70	6.06
Repairs, maintenance and supplies	391.13	394.79	785.92	1.07	1.08	2.15
Cupola labor	291.83	.....	291.83	.80	.....	.80
Direct labor, molding	.....	4591.20	5990.23	.....	12.52	16.33
core-making	.....	1399.03		.....	3.81	
Productive labor charged to burden	395 63	1875.63	2271.26	1.08	5.12	6.20
Total of the above items	1577.40	9984.49	11,561.89	4.31	27.23	31.54
Metal, fuel and flux	5512.15	.....	5,512.15	15.04	.....	15.04
Net cost 366.6 tons good castings	7089 55	9984.49	17,074.04	19 35	27.23	46.58

The total burden outside of the melting department is $3994.26. Dividing by the direct labor, $5990, gives 66.7 per cent as the average percentage of burden to direct labor.

Assuming 25 days per month, 10 hours per day, or 250 hours per month, and dividing this into $5990 gives $23.96, say $24 per hour, or the wages of 80 men at an average of 30 cents per hour.

$80 \times 250 = 20{,}000$ man-hours per month. Dividing this into the burden $3994, say $4000, gives an average burden rate of 20 cents per man-hour.

The product was 366.6 net tons, or 733,200 pounds. Dividing this into $3994 gives 0.545 cents per pound, or $10.90 per ton.

The average total cost per ton may thus be stated as follows:

Metal, fuel and flux	$15.04	
Burden, melting department	4.31	$19.35
Direct labor, molding, casting, etc.	16.33	
Burden, other than melting	10.90	27.23
		$46.58

If the castings were divided into classes according to the conditions under which they were made, we might find that both the direct labor and the burden might differ in some cases as much as from 50 per cent below to 100 per cent above the average, so that a revised statement of costs might read as follows:

Cost of Different Classes of Castings, Per Ton

	Minimum	Maximum	Average
Melting Cost	$19.35	$19.35	$19.35
Direct Labor	8.17	32.66	16.33
Burden	5.45	21.80	10.90
Total	$32.97	$73.81	$46.58
Cost per Pound, Cents	1.69	3.69	2.33
Burden per Pound, Cents	0.27	1.09	0.545
Burden per man-hour, Cents	10	10	20
Burden Per Cent of Direct Labor	33.3%	133%	66.7%

An ideal cost system for a foundry is one in which the costs are predetermined as far as possible, by having standard piece work, or task and bonus, rates for all direct labor, and a standard schedule of burdens for all the different classes of castings. Burden account should be charged with all the monthly expenses, including reserve for depreciation, interest on investment, taxes, insurance, repairs, supervision and other indirect labor, etc., and credited with the sum of all the standard burdens which have been charged to the cost of finished product. The balance of burden account is unearned or over-earned burden, which at the end of the year is to be charged or credited, as the case may be, to Profit and Loss.

COST-FINDING IN BRASS, BRONZE, AND ALUMINUM FOUNDRIES *

Method of Departmental Divisions

The natural division into which the Manufacturing Expense of the jobbing brass foundry falls are: Melting, molding, coremaking, cleaning, inspection, shipping, pattern making, machining, general. They are subsidiary departments of the foundry. The inspection and shipping costs may be combined in summarizing the departmental costs, for easy comparison from month to month. This plan of collecting the cost data makes possible the detection of variations in the costs of each department.

The following items make up the costs of casting:

Metals (A)

Department or Class No.

A1. Purchased metals: such as copper, tin, lead, zinc, phosphor, purchased scrap.

A2. Foundry scrap, resulting from heads, gates, pickings, and defective castings.

Manufacturing Expense (B)

B1. Melting: labor (B10), supplies (B11), overhead (B12).

B2. Molding: labor (B20), supplies (B21), overhead (B22).

B3. Coremaking: labor (B30), supplies (B31), overhead (B32).

B4. Cleaning: labor (B40), supplies (B41), overhead (B42).

B5. Inspection: labor (B50), supplies (B51), overhead (B52).

B6. Shipping: labor (B60), supplies (B61), overhead (B62).

B7. Pattern Making: labor (B70), supplies (B71), overhead (B72).

B8. Machining: labor (B80), supplies (B81), overhead (B82).

B9. General: labor (B90), supplies (B91), overhead (B92).

Buildings and Equipment (C)

C1. Buildings: labor (C10), supplies (C11), overhead (C12).

C2. Equipment: labor (C20), supplies (C21), overhead (C22).

Selling Expense (D)

Selling expense may cover salesmen's salaries, advertising, traveling, interest, discounts, outbound freights, etc., as the management may decide. Overhead is not charged to Selling Expense.

Metals. A1 metals carry their original purchase prices until each lot is exhausted; or, until, at the close of any inventory period it is found advisable to write the prices down. A2 metals are readjusted to the prevailing market value of metals at each inventory period, monthly or quarterly.

The most important feature in handling non-ferrous metals is the recognition of the loss which occurs in melting. The following example illustrates the actual condition:

	Lbs.	Lbs.
Metal charged	20,000	
Good castings made		10,000
Gates, risers, scrap, etc.		8,000
Dross, pickings, etc.		1,000
Loss by difference		1,000
Total	20,000	20,000
Loss, % of metal charged		5%
Loss, % of good castings		10%

The metal lost in melting must be carried by the pound of good castings produced when making prices. In the case of manganese bronze, the yield of good castings is often as low as 25 per cent of the charged weight, because of the heavy shrinkage and the need of long runners. The furnace loss may run 7½ per cent, which brings the melting loss on a 25 per cent yield to 30 per cent.

Manufacturing Expense. The labor is distributed from the time cards returned by each department, as shown on the pay roll. Overhead is carried to each department in proportion to its dollars of labor.* The foremen are charged up to their respective departments, such as melting, molding, coremaking, etc. Foundry clerks in charge of time cards, order cards and foundry records are charged to molding. The superintendent's time may be divided over melting, molding,

*Condensed from *Service Bureau Bulletin No.* 4, 1917, issued by the Committee on Foundry Methods of the National Founders' Association.

*This indicates a survival of ancient and inaccurate methods. If wages in one department should be raised the proportion of overhead to cost of direct labor in that department should be decreased. Labor on machine molding should be charged with a heavier burden than labor on bench molding.

FOUNDRY COSTS

IRON CASTING COST SHEET (Monthly Exhibit Sheet—Albert Walton)

Account Item	Net Tons	Price per Ton	Amount	Per Ton Good Casting Material		
				Pounds	Per Cent	Cost
Pig Iron Charged:						
D	143.430	13.62	1953.52			
C	4.200	13.62	57.20			
A	136.050	13.62	1853.00			
L	1.325	16.02	21.23			
Total	285.005	13.63	3884.95	1554	77.7	10.59
Scrap, etc., Charged:						
Shop Scrap	53.840	12.00	646.08			
Foundry Scrap	222.205	12.00	2666.46			
Chills	.630	12.00	7.56			
Bought Scrap	.500	12.00	6.00			
Total	277.175	12.00	3326.10	1512	75.6	9.07
Gross Metal Charged	562.180	12.82	7211.05	3066	153.3	19.66
Less Scrap Produced:						
Defective Castings	28.372	12.00	340.46		7.7	
Foundry Scrap	144.720	12.00	1735.64		39.5	
Total	173.092	12.00	2077.10	944	47.2	5.13
Net Metal Charged	389.088	13.79	5133.95	2122	106.1	14.00
Fuel:						
For Melting, Coal	.750	2.95	2.21			
For Melting, Coke	68.395	4.80	328.65	376	18.8	
For Core Ovens, Coke	9.680	3.70	35.82	52	2.6	
Total Fuel	78.825		366.68	428	21.4	1.00
Fluxes:						
Limestone	11.515	1.00	11.52	62	3.1	03

General Foundry Expense	Amount		Cost per ton, Good Castings	
General Factory Expense, Dept. No. 1	775	25	2	11
Machine Shop, Dept. No. 2	21	73		06
Pattern Shop, Dept. 10	193	27		53
Forging Shop, Dept. 15	16	33		04
Tool Room Dept. 16	4	14		01
Carpenter Shop Dept. 19	16	03		04
Stable and Hauling Dept. 32	61	15		17
Power Dept. 25	431	69	1	18
Depreciation	352	70		96
Taxes and Insurance	47	52		13
45. Loss on Defective Castings	302	84		83
Total General Foundry Expense	2222	65	6	06
42. Repairs, Maintenance and Supplies:				
Labor in Repairs and Maintenance	165	54	0	45
Material in Repairs and Maintenance	69	25		19
43. Tools and Miscellaneous Supplies	551	13	1	51
Total R. M. & S.	785	92	2	15
41. Producing Labor:				
A Foreman and Assistants	357	05	0	97
B Clerks and Weighers	234	26		67
C Hauling Metal	5	10		01
D Molding and Casting	4591	20	12	52
F Cleaning and Shipping	421	53	1	15
G Sand Blast Labor	38	96		11
H Pickling Labor	97	99		26
K Cupola Labor	291	83		80
L Inspection	419	40	1	14
M Shaking Out Labor	301	50		82
N Core Making	1399	03	3	81
P General, not included above	395	47	1	07
Total Producing Labor	8553	32	23	33
Total Metal, Fuel and Flux	5,512	15	15	04
Total Labor and Expenses	11,561	89	31	54
Net Cost 366.6 Tons Good Castings	17,074	04	46	58

Total Number of Heats	25
Coke used in Cupola per Heat	2.7 Tons
Good Castings per Heat	14.663
Iron Melted per lb. Coke	5.7 Pounds

Metal Practice	Tons	Per Cent
Good Castings	366.584	65.21
Defective Castings	28.372	5.05
Scrap	144.74	25.74
Loss	22.489	4.00
Gross Metal Charged	562.185	100

Monthly Foundry Reports

The metal reports of a large concern in New England have the following items.*

IRON FOUNDRY	Jan.	BRASS FOUNDRY	Jan.	PRESS SHOP METAL	Jan.
Pig, lb.		Copper Melted		Metal from Rack	
Scrap, lb.		Other New Metal		Product	
Back Stock,† lb.		Scrap Turnings and Skimmings		Resulting Scrap	
Gross Melt, lb.		Back Stock		% Scrap	
Less Back Stock					
		Gross Melt			
Net Melt		Less Back Stock			
Product					
		Net Melt			
Loss in Melting		Product			
% of Gross Melt					
		Loss in Melting			
		% of Gross Melt			

* Columns for 12 months and yearly total

† The " back stock " consists of gates, sprues, etc.

coremaking, and cleaning, when inspection, pattern making, machining, shipping and general are handled directly by a works manager. Arbitrary divisions of some items of the pay roll will be necessary, as they will vary with the size of the foundry and its general organization plan.

Assuming an arbitrary set of figures for illustration, the following summary may be made. The figures are cents per pound:

Department	Labor	Supplies	Overhead	Total
Melting	0.53	0 10	0.47	1 10
Molding	1.03	0 12	0.94	2.09
Coremaking	0.29	0.12	0.27	0 68
Cleaning	0.35	0.10	0.32	0.77
Inspection	0.08	0 00	0.07	0 15
Shipping	0.06	0.04	0.06	0 16
Machining	0.02	0 00	0.01	0 03
Pattern Making	0.03	0.02	0.02	0 07
General	0.30	0 10	0.39	0.79
Total	2.69	0.60	2.55	5.84

From such a summary ratios, or percentages of total expenses to molding labor, are obtained. For example, we have the ratio of total Manufacturing Expense to Molding Labor, 5.84 to 1.03, or 5.67. A foundry having such a ratio could use 6 for this item in making up an estimate on castings which may be considered suitable to its plant and equipment and its class of labor and general organization. This ratio, however, assumes that all pieces are cored. Estimates on plain work under this plan would drop the item of coremaking from the summary giving a new ratio, and a lower estimated cost. Estimates on difficult cored work might double the coremaking item, but would retain the standard ratio of Manufacturing Expense to Molding Labor. From such a table several valuable ratios may be obtained.

The supplies for the melting, molding, coremaking and cleaning departments are further subdivided from month to month, the costs being carried on the page with the summary.

Buildings and Equipment. Any labor which the foundry applies to the upkeep of its buildings and equipment is charged to these accounts. Such labor carries with it certain materials (referred to as supplies above), as shown by requisitions. This labor should carry also its share of the Overhead, proportional to the dollars of labor applied. In turn the depreciation applied to Buildings and Equipment is carried into Overhead each month, to be charged to the various items of Manufacturing Expense, as shown in the summary. Expenditures for buildings erected by contract, or for equipment by purchase, are charged to these accounts in the same way, and charged out regularly to Overhead.

Estimating. The factors that enter into any estimate are shown in the following example:

Metals	30 00¢ per lb.	
Melting Loss	2.40	32.40
Molding Labor	1.10	
Manufacturing Ratio	6	
Manufacturing Expense	6.60	6.60
Selling Expense	1.20	1.20
Sale Cost		40.20
Sale Price (basis 10% profit)		44.00

The metals are figured on the basis of market quotations at the time. The melting loss assumes a 4 per cent loss in the furnace, with a 50 per cent yield of good castings. The molding labor has been estimated from a yield of 500 pounds for $5.50, direct molding cost. The ratio of 6 has been found to be correct for the foundry in question, within reasonable limits.*

The Selling Expense is the average selling expense, per pound, for the past six months. It includes salaries of salesmen, traveling expenses, advertising, outbound freight, cartage, entertaining, bad debt reserve, commission reserve, discounts, etc.

Illustration of a Cost Statement

This account is the total of all the different alloys made. It might cover the following items:

For the month of.....

Alloy No.	Amount Charged	Good Castings	Bad Castings	Gates and Risers	Melting Loss
1	33,900	19,000	2000	12,000	900
2	49,400	30,000	3000	15,000	1400
3	13,400	8,200	800	4,000	400
4	15,500	9,000	1000	5,000	500
5	6,000	3,800	400	1,600	200
Total	118,200	70,000	7200	37,600	3400

From this we have, averaging all metals:

118,200 lbs. metal charged	@	28.0¢	$33,096.00
Credit 7,200 lbs. bad castings	@	28.0¢	2,016.00
Credit 37,600 lbs. Gates and Risers	@	28.0¢	10,528.00
73,400 lbs. metal consumed	@	28.0¢	20,552 00
70,000 lbs. good castings	@	29.36¢ per pound	
Productive Labor item 2			$ 700 00
Productive Labor item 3			200.00
70,000 Good Castings, made @ 1.28¢			$ 900 00
Tonnage Group, items 4 to 6			$ 300 00
Tonnage Group, items 7 to 10			200 00
General Expense Group, items 11 to 15			300.00
General Expense Group, items 16 to 20			200 00
General Expense Group, items 21 to 23			150 00
70,000 lbs. Good Castings, made @ 1.64¢			$1,150.00
Total 70,000 lbs. Good Castings, @ 2.93¢			2,050 00

The *average* manufacturing cost of 70,000 pounds of castings is then

Metals	$20,552.00
Manufacturing Expense	2,050.00
Total (average per lb., 32.29¢)	$22,602.00

*This method of applying the overhead, averaging it over the whole product and using a uniform ratio for all departments will give erroneous and misleading figures of the cost of castings if they vary in kind and size. The overhead on melting should cover cost of fuel, repairs of furnaces, breakage of crucibles, etc., and will usually be a high percentage of the direct labor cost of melting, while the burden on bench molding is a low percentage.

Averages and percentages based on averages should always be looked on with suspicion by cost accountants.

Summary. In summarizing it is assumed that depreciation has been charged to Expense, and that the Selling Expense for the month amounts to $1,000.00.

Castings on hand at first of month 5,000 lbs.	$ 1,500 00
Good castings made during the month 70,000 lbs.	22,602.00
Total @ 32.00¢ per pound 75,000 lbs.	$24,102 00
Good castings not shipped at end of month 10,000 lbs.	3,200.00
Castings shipped 65,000 lbs.	$20,902.00

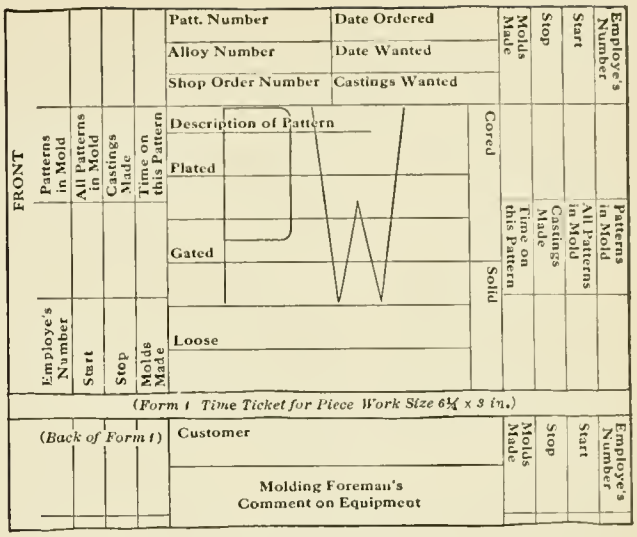
To show the profit we have:

Castings invoiced 65,000 lbs.	$23,990.00
Manufacturing cost of castings 65,000 lbs.	20,902.00
Gross Profit	$ 3,088.00
Selling expense	1,000.00
Net profit for the period	$ 2,088.00

Forms and Routine of the Direct and Indirect Items Plan.

The Time Card of the usual time-clock type shows the hours worked, and the department or cost item (as molding) to which the wages are chargeable. The Time Clerk checks the employees' time during each day to prevent errors. All the wages on the Time Card are distributed and checked on the Labor Distribution Sheet.

The Day Work Card is sent with the pattern to the molder. The Pattern Clerk enters the pattern, alloy and shop order numbers, date ordered, date wanted and castings wanted, and checks the cored or solid items. The Foundry Clerk enters the other items as the molder starts and stops, or completes the order. In noting the kind of patterns, full data should be entered, as for a plated pattern: " 10 on iron plate for 12 in.×18 in. Berkshire; 2 cores." This card is used for all patterns not working on a piece price basis.



FORM BF1 PIECE WORK CARD

The Piece Work Card is used for piece work, it being advisable to use a different color from that of Day Work Card.

CUSTOMER	Pattern Number		
Address			
Kind of Pattern and reason for changing	Date	O.K.	Rate
(Size 5 x 3 in., ruled lines)			

Form No.

FORM BF2 PIECE RATE CARD FOR PATTERN CHANGES

The Piece Rate Card is the office record of the piece rate set by the Superintendent for any particular pattern.

DAILY MOLDING REPORT — Date

Customer	Pattern Number	Shop Order Number	Molder's Number	Number Castings Made			Cored or Solid	Piece Work	Time	Alloy	Foreman's Comment
				Plated	Gated	Loose					
	(Size 8½ x 10 in., 24 ruled lines)										

FORM BF3

When an employee is transferred from one department to another, as from Melting (4) to General Labor (5), during the day, notice of the transfer is sent to the Pay Roll Clerk by the employee's foreman.

DAILY CASTING REPORT — Date

Customer	Pattern Number	Shop Order Number	Molder's Number	Total Castings		Good Castings		Bad Castings		Cored or Solid	Piece Work	Time	Alloy
				Pieces	Pounds	Pieces	Pounds	Pieces	Pounds				
	(Size 8½ x 10 in., 24 ruled lines)												

FORM BF4

The Daily Molding Report is made out each day by the Foundry Clerk, one copy going to the Superintendent, one to the Inspector, and one to the Cost Clerk. Time is entered in hours and tenths of an hour as 1.5. Piece-work must be indicated by a check (√), so that the Inspection Department may go over the piece-work castings first in order that the pay roll record may not be delayed.

The Daily Casting Report is made out each day by the

CORE CARD	
Customer	
Pattern Number	Date Ordered
Alloy Number	Date Wanted
Shop Order Number (Size 5 x 3 in.)	Number of Cores Wanted

Form No.

FORM BF5

CORE ROOM
Piece Work Report
Date

Customer	Pattern Number	Employe's Number	Pieces Made	Piece Rate	Amount	Hours P.W.	Hours D.W.	
(Size 6⅛ x 5¼ in.; 17 lines)								

FORM BF6

Inspector. One copy goes to the Foundry Clerk, who from it makes out a Work Card (Day or Piece), for the required shortages; one goes to the Cost Clerk; and one to the Pay Roll Clerk, who checks the piece-work time against the Time Cards and Day Work Cards, to find the wages due each molder.

MANUFACTURING EXPENSE CARD

Customer				Alloy Number		Plated Gated Loose		Changes in Pattern				Pattern Number	
Date Ruo	Shop Order Number	Good Pieces Made	Weight Good Pieces	Average Weight	Molders Time	Molders Rate	Amount	Molding Cost Per Pound	Core Makers Time	Core Makers Rate	Amount	Total Amount	Productive Labor Cost Per Pound
	(Size 8½ x 5 in., 14 ruled lines)												

FORM BF7

SUMMARIES

Date	From To	Good Pieces Made	Weight Good Pieces	Amount Molding Time	Molding Cost Per Pound	Amount Core Making Time	Core Making Cost Per Pound	Metal Per Pound	Overhead by Tonnage	Overhead by Molding	Overhead by Core Making	Mfg. Cost Per Pound	Manager's Comment
	(Size 8½ x 2½ in., 5 ruled lines)												

FORM BF8

The Core Card is made out by the Pattern Clerk, and goes with the core box to the Core Room Foreman. The Piece-rate Card is used to register the piece rates on cores, being rubber stamped Cores Only. The number of good cores made is reported to the Pay Roll Clerk by the Core Room Foreman, on the card Core Room: Piece-work Report.

Manufacturing Expense Card. It is considered best to collect the costs by customer, since his business must be treated as a whole, regardless of the fact that some particular pattern may run at a loss. To do this, the details are collected by pattern number. The Manufacturing Expense Card is summarized from time to time, to note the effect of tonnage, and particularly to note the effect of a revision in pattern as indicated by a comment in the space Change in Pattern. When a change is made, a new card should be started. In order that this card may check with the books the actual cost of metals consumed for this alloy for the month must be used. This is true also of the overhead ratios or per cents. The sum of all the costs shown on these cards, for any month must check, within close limits, to the books. The metal loss will be the average metal loss for the alloy in question.

The Requisition Slip is used by the foremen, for supplies, as sand, coke, shovels and tools. A summary of the Requisition Slips shows the supplies used for any period.

REQUISITION FOR SUPPLIES

To Stores Clerk _____ Date _____

Kindly Supply the following: Department _____

	(Size 6 x 3 in.; 6 lines)

FORM BF9

PLANT SUB-ORDER

Date _____ Dept. _____ No. _____

Description of work to be done, in detail

(Size 6½ x 4¾ in.)

Copies to						
Authorized by			Signed by			

FORM BF10

The Plant Sub-Order shows the labor expended on Buildings and Equipment, covering reconstruction and changes, as well as repairs and renewals.

Month of Pounds Good Castings	DISTRIBUTION OF ITEMS OF EXPENSE										
Day	Molding Labor Acct. 2	Core M'k'g Labor Acct. 3	Total of Accts. 2 & 3	Melting Acct. 4	General Labor Acct. 5	Repair Labor Acct. 6	Crucibles Acct. 7	Fuel Acct. 8	Charcoal Acct. 9	Refraction Acct. 10	Total of Accts. 4 to 10
	(Size of form 19 x 8½ in.)									Columns for other accounts viz: 11. Foremen 12. Clerks 13. Cleaning 14. Inspection 15. Repairmen 16. " 17. Molding Sand 18. Other Supplies 19. " "	

(Headings Continued)							% Acct. No. 2 % Acct. No. 3	
Molding's Share of General Exp. Acct. 20	Total Acct. 11 to 20	Core Room Foremen Acct. 21	Core Room Supplies Acct. 22	Core Making Share General Expense 23	Total of Accts. 21 to 23	Overhead Acct. 24	Buildings and Equipment 25	Total
	(21 ruled lines)							

Totals											
Accts. 24											
Per Lb.											
Ratio of Accts. 11 to 20 to Acct. No. 2											
Ratio of Accts. 21 to 23 to Acct. No. 3											

FORM BF11

Distribution of Items of Expense. On this sheet the daily or weekly expenses are summarized to complete any selected period, as one month. Accounts 2 and 3 are productive labor accounts. Accounts 4 to 10 are known as the Tonnage Group. Accounts 11 to 20 take the proportion of account 24 and the depreciation of account 25 that account 2 shows of the total of accounts 2 and 3. Accounts 21 to 23, in the same manner take account 3's proportion of productive labor. Accounts 24 and 25 do not form part of the total cost except as distributed in this way. The proportion of accounts 2 and 3 is first determined. Account 24 is then distributed to its proper places. Depreciation of account 25 is distributed in the same way. This distribution would then summarize as follows:

Good Castings made	100,000 lbs.
Molding Labor Account, No. 2	$1,500.00
Coremaking Labor Account, No. 3	500.00
Accounts 4 to 10	1,000 00
Accounts 11 to 20	1,200 00
Accounts 21 to 23	500.00
Account 24	600.00
Account 25, 400.00 @ 10%	40 00
Total Account 24 and 25	640.00
% Molding Labor 75.0	
% Coremaking Labor 25.0	
Share of Accounts 24 and 25	
To Accounts 11 to 20	480.00
Share of Accounts 24 and 25 to Accounts 21 to 23	160.00

Revising this we have:

Molding Labor	$1,500.00	1.50¢ per lb.
Coremaking Labor	500 00	0.50¢ per lb.
Tonnage Group (4 to 10)	1,000 00	1.00¢ per lb.
General Expense: Molding (11–20)	1,680 00	1.68¢ per lb.
General Expense: Coremaking (21–23)	660.00	0.66¢ per lb.
Total	$5,340.00	5.34¢ per lb.

Ratio General Expense:	
Molding, to Molding Labor	1.12
Coremaking, to Coremaking Labor	1.32

WORKS MANAGER'S DAILY REPORT — Date											
Alloy	Gross Product	Weight of Good Castings	Weight of Bad Castiogs	Total No. of Pieces Made	No. of Good Pieces	No. of Bad Pieces	% Loss by Weight	% Loss by Pieces	Average No. of Men Per Day	Average Wt. Per Man Per Day	Average Wt. Per Casting
	(Size 8½ x 5½ in., 19 ruled lines)										
Total											

FORM BF12

The Works Manager's Daily Report is made out daily, by the Cost Clerk, from the Daily Casting Report.

The Metal Requisition is sent to the Store Room Clerk by the Metal Room Clerk. Through these requisitions the Store Room Clerk makes the necessary deductions on his stock cards, which gives him a perpetual inventory on each class or group of metals. This Metal Requisition is also used by the Cleaning Room Foreman who delivers scrap back to

METAL REQUISITION — Date	
Pounds	Description
(Size 6 x 2¾ in., 15 ruled lines)	

	Received by	Checked by

FORM BF13

the metal room, and gets a receipt for the amount. This enables the Metal Room Clerk to carry an inventory of each alloy, on the metal room stock card.

Time

HEAT TICKET

Furnace No. _____ Heat No. _____

Alloy No. _____

Pounds Wanted _____

Remarks _____

(Size 5½ x 3 in.; 4 ruled lines)

Time

FORM BF14

The Heat Ticket is issued by the Melting Foreman on the Metal Room Clerk, for each heat wanted. Each heat ticket is passed through a time clock conveniently located, as the heat is sent to the melting department.

METAL REPORT

Heat Number	Furnace Number	Alloy Number	Total Charge	Class A 1 Metals	% Class A 1 Metals	Class A 2 Metals	COPPER	
							Lot No.	Pounds
(Size of Form 24 x 8 in.; 24 ruled lines)							(Ten additional double-columns, for Tin, Lead, Zinc, Phos Copper, Phos. Tin A1 and A2 Meta. Lbs.)	

FORM BF15

The Metal Report is made out each day, by heats, and is summarized for the week or month. It shows every pound of material that goes into the furnace. The net metal consumed during the period is arrived at as illustrated in the following example:

In Metal Room December 1st	40,000 lbs.
From Store Room	15,000 lbs.
From Cleaning Room	10,000 lbs.
Total	65,000 lbs.
Issued on Heat Tickets	40,000 lbs.
In Metal Room December 31st	23,000 lbs.
Lost in Melting	2,000 lbs.
Total	65,000 lbs.

Each alloy must be handled in this way.

General. To make a success of any Cost System the mechanical details of handling and recording operations must be closely followed. Stock cards must be carefully kept; bins must be provided in the store room and metal room. Defective castings and gates and risers and other scrap must be returned to the metal room, and the proper records kept of the return. Cleanliness and orderliness must be maintained. Records must not be allowed to fall behind.

The accompanying cost forms (here reduced in size to save space) may be obtained, with prices, from the Service Bureau, National Founders' Association, 29 South La Salle St., Chicago.

Caution in Regard to the Use of Forms. The Cost of Goods does not Include the Cost of Selling them. (Extracts from "Efficient Cost Keeping," by E. St. Elmo Lewis.)

Great care should be taken in the introduction of a cost system in a factory. A firm manufacturing a specialty and employing about 1200 men in the factory, introduced a system that ultimately required nearly 250 printed forms. When these forms were rearranged and a proper system was installed, all but 23 of them were discarded. The saving, of course, was tremendous.

Before installing a cost system, it is important to decide what you want it to tell you. Analyze your conditions closely, then see that the cost system fits these conditions.

Over-systematizing generally comes as a result of "letting the system work out itself," instead of having some specialist come in and work out a complete plan of cost keeping, coherent, logical, thorough, with definite objects in view.

Mere forms do not make a system; nor does an adding machine, a typewriter, or a few clerks make a system. They are simply the physical expression of a system.

No form should be put in operation until it has been carefully considered, both in its relation to the specific thing that the form is to record, and in its relation to every other form in the system.

Put on the form just as many data as you consider necessary. Don't use any one form for entirely different classes of data.

The cost of goods when placed in the shipping room does not include the expense necessary to market the product.

Selling expense varies even more than manufacturing cost. Selling expense is often several times the complete manufacturing cost.

Manufacturing costs and selling costs are two separate and distinct propositions and must not be confused with one another.

The cost system should fit the business. A system well adapted to meet the needs of a machine-tool concern would not fit a dairy and vice versa.

"*Improving the system of management means the elimination of elements of chance or accident, and the accomplishment of all the ends desired in accordance with knowledge derived from a scientific investigation of everything down to the smallest detail of labor, for all misdirected effort is simply loss, and must be borne either by the employer or employee.*"*—*H. L. Gantt.*

COST AND PRICE OF COAL †

Four general items of cost normally control the price of coal to the Consumer: 1. Resource cost (the amount charged as the value of the coal in the ground); 2. Mining cost; 3. Transportation cost; 4. Marketing costs. Under usual conditions each of these items includes a margin of profit.

The cost of mining is divided between labor, 70 to 75 per cent; material 16 to 20 per cent; taxes, less than 1 per cent to 3 per cent for bituminous coal, and 3 to 7 per cent for anthracite; selling expenses, nothing to 5 per cent; workmen's compensation for injuries may reach 5 per cent for bituminous coal. The census of 1909 indicated an average mining cost of $1 a ton for bituminous coal and $1.86 for anthracite.

The taxes in West Virginia last year (1915) levied on coal lands and coal mine improvements were equivalent to nearly 3 cents per net ton of coal produced.

The average selling cost for bituminous coal is probably 5 to 10 cents per ton, and for anthracite coal the usual charge of sales agencies is 10 cents a ton for steam sizes and 15 cents for the prepared sizes.

In interstate traffic, both rail and water, bituminous coal probably pays an average freight of $2 per ton; the average for anthracite is higher.

The cost of handling the coal, exclusive of freight, from the time it leaves the producer until it is in the consumer's bin, may be termed the marketing cost. Coal that gets a long way from the mine may pass through many hands before it reaches the consumer, and it not only pays commission all along the line, but is subject to shrinkage and deterioration. The margin in the retail business between cost on cars and price delivered is from $1.25 to $2 per ton, and is not more than nnough to give on the average a fair profit.

*Or passed along, by means of increased selling prices, to the final consumer.—W. K.

†The reference to the authority for these statements has been mislaid.

The resource cost, what the operator has to pay for the coal in the ground, is expressed as a royalty or depletion charge. One of the latest leases by a large coal land owner (the Girard Trust of Philadelphia), provides for the payment of 27 per cent of the selling price of the coal at the breaker. This is equivalent to $1 a ton tribute paid to private ownership. The present average rate of royalty on anthracite is probably between 32 and 35 cents a ton on all sizes, which is from 12 to 14 per cent of the selling value at the mine. The tendency is still upward. At the beginnign of the last century the great bulk of the anthracite lands were patented by the State of Pennsylvania for $2 to $4 an acre; in the middle of the century the price of the best land rose to $50 and in 1875 to $500. Now, $3000 an acre has been paid for virgin coal land, and little is on the market. The present average resource cost of bituminous coal is not much over 5 cents a ton or about 4 per cent of the average selling value at the mine. In the Pocahontas and Pittsburg districts the royalties are much higher.

The prospects of relief from high prices of coal are not promising. The prices of labor and material for mining tend to advance. The mining methods are far less wasteful than formerly, the average recovery in anthracite mining being 65 per cent as against 40 per cent only 20 years ago. Not much further improvement can be made in this direction. The increased safety of mines and the workmen's compensation laws add something to the cost of coal. Reduction in the cost of marketing is possible; it is stated that the delivery of coal is costing the retail dealers 50 cents a ton more than is necessary.

Exact mining costs cannot be determined until the operators have accomplished their reform of standardized accounting. Too often the operator includes in his account only the two largest items, labor and material. When the market for bituminous coal is dull, the company whose land costs little or nothing is able to set a lower limit of price than the company whose coal must stand a charge of 5 or 10 cents or more, be that charge called royalty, depletion or amortization. The analysis of the cost elements that enter into the price of coal, emphasizes our lack of specific facts which can be supplied in the future only through the "installation of uniform cost-keeping methods and uniform and improved accounting systems," to quote from the declaration of purposes of the Pittsburg Coal producers. With the results of such bookkeeping in hand, more definite reply can be made to the public's appeal for relief from high prices.

Cost of a Ton of Anthracite Coal from Mine to Cellar *

A ton of anthracite of stove coal (2240 pounds) delivered in the coal bin in New York District at $7.25 averages at the mine $3.55 and yields a return on the investment of 20 cents.

* From an advertisement signed by the leading anthracite coal operators. Philadelphia *Press*, Feb. 14, 1916.

Retailing Cost (Average) per ton:	
Rent of office and yard; lighterage, handling at yard, breakage, cartage, administration expenses, and retailer's profit per ton	$2.15
Transportation (Average) per ton:	
Freight from Lehigh and Schuylkill regions to New York harbor	1.55
Production cost (Average) per ton:	
Colliery cost, per ton, labor (approximately $1.80), materials of all kinds, royalty, taxes, depreciation of coal lands and equipment, administration expenses, and accident indemnities per ton	2.40
Loss on small sizes of coal sold at less than cost of production	.95
Operator's earnings, available for return on investment (Latest report of U. S. Census shows less)	.20
	$7.25

Anthracite coal as it comes from the mine is a mixture of all sizes, from lump to dust, and contains a certain amount of rock, slate and bone.

The report of the U. S. Geological Survey for 1914 gives the amount and percentage of each size produced in that year in the entire field. By using these percentages and by assigning to each size of coal the average receipts at the mine realized by some of the larger companies it is determined that each 100 tons of coal dumped into the breaker would produce the following average results:

		Tons	Average Price Realized	Total Value
Domestic sizes sold above the cost of production in 1914	Lump and broken	5.30	$2.95	$15.63
	Egg	12.40	3.45	42.78
	Stove	20.60	3.55	73.13
	Chestnut	23.00	3.75	86.25
Sizes sold below cost of production in 1914.	Pea	11.80	1.30	50.31
	Buckwheat	13.40		
	Rice	6.80		
	Barley	6.70		
		100.00		268.10

Average value per ton, $2.68.

Losses from shrinkage, storage and rehandling bring the price down to about $2.60 per ton at the mine, to which adding loss in small sizes sold below cost of production (95 cents) makes a total of 3.55 per ton. The anthracite operator gets from 55 cents to $3.75 per ton for his coal, selling 40 per cent of his output below the cost of production.

CHAPTER XVIII

HARDWARE FACTORY AND MACHINE-SHOP ACCOUNTS

ACCOUNTING SYSTEM IN A LARGE HARDWARE FACTORY

A large factory employing over 4000 men makes a great variety of hardware and other metal products. Its catalogues list over 40,000 varieties of product and the machining and other manufacturing operations required are stated to be over a million in a year. What follows is largely taken from the "accounting code" of this factory and from explanations kindly furnished to the author by the management. By request the name of the factory is omitted.

The accounting and other clerical work having relation to records of production and of costs is divided into three divisions: Accounts, Statistics and Costs. The accounting system records the results of the business by classes of product and as a whole, the statistical system furnishes additional information required by the management, and the cost system is designed to furnish approximate costs per unit of each kind and size of finished product.

Productive Classes and Departments. The whole product of the factory is divided into "Productive Classes," represented by the letters A, B, C, etc., and the different manufacturing departments in which the work is done are represented by other letters or by numbers of rooms, these letters, both of product and departments, and room numbers being used as accounting symbols. The principal departments are Forge, Iron Foundry, Brass Foundry, Press Shop, Rod Shop, Machine Shop, Plating Department, Power Plant; and minor departments are assembling and inspecting rooms for different products, stock rooms, japan shop, pattern shop, tool shop, and drawing, packing, shipping and other rooms.

All work done in, and all material used in, any department is charged directly as far as possible to the Class Accounts, A, B, C, etc., and all expenditures that cannot be so charged are either charged to the department or to one of several factory or other expense accounts or to a betterment or a special account. Charges to department or to expense accounts are summarized monthly and apportioned to the several class accounts according to definite rules established by the Accounting Bureau.

Accounting Symbols. The terms used in the accounting system are defined as below, and each is given a letter symbol.

Direct Labor: All labor spent directly on salable products.

Material. All material that becomes part of the salable products.

Indirect Labor: All labor that cannot be charged directly to one or more classes of product.

Supplies: Articles other than "Material" used in the plant.

Shop expenses: Indirect labor, supplies, salaries and other items charged to expense accounts.

Stores: Stocks of materials and supplies (not finished products).

Betterments: Additions to and betterments of property. Divided into three groups (1) Real Estate and Buildings, (2) Power Plant, Equipment and Fixtures, (3) Machinery, Tools, Patterns and Flasks.

The Expense accounts are subdivided into fifteen groups, each with a symbol number, viz.:

1. Indirect Wages, including foremen, machine setters, time-keepers, time-study men, route-board men, order clerks, stock handlers, watchmen, inspectors, yard laborers, cleaners, sweepers, janitors, errand boys and other miscellaneous labor.
2. Bonus payments for overtime.
3. Welfare work.
4. Freight and express.
5. Slippage, difference between estimated and actual labor costs.
6. Shop stationery.
7. Maintenance of existing equipment and fixtures.
8. Maintenance of machines, tools, patterns and flasks.
9. Maintenance of real estate and buildings.
10. Water.
11. Gas and electricity.
12. Works salaries, general.
13. Wages paid to injured employees, and pensions.
14. Spoiled work. Lost labor and material on work scrapped.
15. Miscellaneous supplies and charges not otherwise provided for.

Stores accounts are subdivided into several sub-accounts, each with its appropriate symbol, such as SC, Central Scrap Store; SE, Plant Supply Store; SP, Press-shop Metal; SS, General Supply Store; SU, Power-house Fuel; SV, Other Stores.

Stores Records. Stores records are kept in the Stock and Order Department on Perpetual Inventory or Balance of Stores Cards, size $7\frac{1}{4}\times4\frac{1}{2}$ in. The headings on the end of each card are printed as below:

WHERE STORED LIST No.		ACCOUNT PART No.		HF1
Sect.	Shelf Drawer	Max. Min.	Econ. Quan.	
				Date

FORM HFI. BALANCE OF STORES CARD.

And the heads of columns are printed on a long side, as follows:

ORDERED		RECEIVED		ON HAND	DELIVERED		ALLOTMENT RECORD ALLOTED			SHIPPED		
Date	Quantity	Date	Quantity	Quantity	Date	Quantity	Date	Number	Quantity	Date	Quantity	Balance
(21 lines 5½ per inch)												

Entries are made on these cards from purchase invoices or other records as goods are received, and from Stores Tickets, signed only by authorized persons, when goods are delivered.

In the stores connected with the iron and brass foundries and with the fuel supply (other than steam fuel) charge books are kept. At the end of each month the Accounting Bureau summarizes the entries in these books and makes proper credits and debits, and extends and summarizes the Stores Tickets, crediting and debiting the proper accounts.

On all stores tickets are entered the symbol of the room in which the materials or supplies delivered from the stores are to be used, also the charge account symbol, which is the class symbol, A, B, C, etc., if the materials are to be used directly in one class of product, or a department symbol, M, N, P, etc., if they are to be used in a department on more than one class, or the symbol X to show that they are to be used for general purposes and cannot be charged either to a Class or to a Department, or a Betterment Account symbol XA, XC, etc., if they are to be used for betterments.

Every expense charge is indicated by a numerical symbol (1 to 15) followed by the symbol of a Class, or of a Department, or by X.

Example. Miscellaneous supplies (15) for the Press Shop (P) would be charged to 15P if they were to be used on work of various classes. A repair part (8) for a press used in Class A goods exclusively would be charged to 8A, but, if for a press used for more than one class of work, to 8P.

Expense Charges. Indirect (or so-called "Non-productive") labor is charged on labor or job tickets in the same way that material is charged on store tickets. For example a charge for the wages of a bus-foreman who spends all his time on Class A work is 1A; if he spends half his time on Class A and half on Class C, the charge is ½ 1A, ½ 1C. If his time cannot be charged directly to a class or to a department then the charge is 1X.

In this particular factory, accounts are kept for selling and administrative expenses and with branch offices and stores. Each is subdivided, with numerical symbols representing salaries, traveling expenses, rent, stationery and supplies, telegrams, postage, etc., to which any expenditure on behalf of these accounts is charged. Thus, if Chicago office (53) sends a telegram (117) about Class A goods the charge is 53A, 117.

Time-keeping. Credit to Workman on Pay Roll. Verification of Pay Roll.

The time of each employee is registered by a Day Clock Recorder, which is placed in each room or group of rooms occupied by from 100 to 250 employees. The clock record is made on a long paper strip, giving the Clock No. of the workman, and the In and Out time, A.M. and P.M.

Each morning the clock records of the day before are transcribed to Time Summary Tickets, one for each man, on which his total hours for a week are added up.

HF 2 2-16 60 M

TIME SUMMARY TICKET Room No._____

Name

Date	A.M.	P.M.	Total Hrs.	Irregularity
(9 lines 4½ per inch)				

Checked_____ Approved_____

FORM HF2. TIME SUMMARY TICKET (5×3-in.).

The work done by each man during a week is reported to the Pay Roll Room by jobs, as each job is finished, on Day Work Credit and Piece-work Credit Tickets. If a man's job is not finished at the end of the week a new job ticket is issued to him or to his foreman for the next week.*

HF 3 1-16 200-00

DAY WORK CREDIT TICKET

Fin.	Total Hours	Amount
Start	Room	Dept.

Clock No. Name

Chg. Acct. Mach. No. O.H.S.

Part No. Order No. Day Rate

List No. and Description of Work	Hours	Pieces	Value
			Rate
			Value

FORM HF3. DAY WORK CREDIT TICKET (5¼×3½ in.).

A similar ticket of a different color is used for piece work.

HF 4 11-15 500-00

PIECE WORK CREDIT SLIP

Room No._____ Charge Acct._____

Dept._____ Cut No._____ Order No._____

Clock No._____ Name_____

Work_____ Rate_____

Date	Mach. No.	Started	Finished	Time in Hours	Pcs. Finished	Amount
(8 lines 6 per inch)						

Approved_____

Duplicate printed in red ink below the crease line, on the reverse side.

FORM HF4. PIECE-WORK CREDIT SLIP (5¼×3 in.).

* In this factory a "week" is a pay-roll period, the month being divided into four periods ending respectively on the 8th, 15th, 22d, and the last day of the month.

These tickets are made in duplicate, by carbon paper, and one copy is kept in the office for record and the other goes to the workman, who hands it back when the job is complete.

As the tickets are returned to the Pay Roll room, the time clerks place them in the order of the Clock Nos., by departments, and file them along with the Time Summary Slips until the end of the week. They are then tabulated on a Burroughs adding machine for Clock Nos., Hours and Wages for each job, and Total Hours and Total Amount for the week, for each man. The total hours thus found are checked against the total hours on the man's Time Summary Ticket. If any discrepancy is found it is investigated and the error corrected.

The Pay Roll Sheets for each room are then made out. Stencils with the names of the men and their clock numbers, in the order of the numbers, are put in an Addressograph machine, and thus printed on the sheet, and the hours and amount are entered on it by a recording and adding machine.

On pay day each man's money is put in a pay envelope on which his name and number are printed, the envelopes are arranged in the order of the numbers and put in cases for each room and sent to the rooms. The men form in line in the order of their numbers and as they march past the pay window, and are identified by their foreman who stands by, each receives his envelope from a clerk.

The Hollerith Tabulating Machine Record. When the Day Work and Piece-work Credit Tickets have been checked against the Time Summary Tickets the records on them are punched on Hollerith Tabulating Cards for use in the Hollerith sorting and tabulating machines. (For description of these machines see page 135.) The information given on the punched cards consists of the following items: Year, Month, Week, Room, Clock No., Productive Piece Work, Expense Piece Work, Special Shop Orders; Expense or Operation No., Class Letter (kind of product), Order No., Betterment or Repairs, Hours, Pieces, Amount.

HF5

1 Mo / 2	1 Wk / 2	13 15 17 YEAR / 14 16 18 ROOM	Special	Clock	Special	Kind of Work	Operation	Charge Acct.	Order Number	Repeat	Betterment or Repairs	Overhead Symbol		Pieces	Amount
3	3	0 0 0	0 0	0 0 0 0	0 0	0	0 0 0 0	0 0	0 0 0 0 0	0	0 0 0 0	0	0 0	0 0 0 0 0	0 0 . 0 0
4	4	1 1 1	1 1	1 1 1 1	1 1	1	1 1 1 1	1 1	1 1 1 1 1	1	1 1 1 1	1	1 1	1 1 1 1 1	1 1 . 1 1
5		2 2 2	2 2	2 2 2 2	2 2	2	2 2 2 2	2 2	2 2 2 2 2	2	2 2 2 2	2	2 2	2 2 2 2 2	2 2 . 2 2
6		3 3 3	3 3	3 3 3 3	3 3	3	3 3 3 3	3 3	3 3 3 3 3	3	3 3 3 3	3	3 3	3 3 3 3 3	3 3 . 3 3
7		4 4 4	4 4	4 4 4 4	4 4	4	4 4 4 4	4 4	4 4 4 4 4	4	4 4 4 4	4	4 4	4 4 4 4 4	4 4 . 4 4
8		5 5 5	5 5	5 5 5 5	5 5	5	5 5 5 5	5 5	5 5 5 5 5	5	5 5 5 5	5	5 5	5 5 5 5 5	5 5 . 5 5
9		6 6 6	6 6	6 6 6 6	6 6	6	6 6 6 6	6 6	6 6 6 6 6	6	6 6 6 6	6	6 6	6 6 6 6 6	6 6 . 6 6
10		7 7 7	7 7	7 7 7 7	7 7	7	7 7 7 7	7 7	7 7 7 7 7	7	7 7 7 7	7	7 7	7 7 7 7 7	7 7 . 7 7
11		8 8 8	8 8	8 8 8 8	8 8	8	8 8 8 8	8 8	8 8 8 8 8	8	8 8 8 8	8	8 8	8 8 8 8 8	8 8 . 8 8
12		9 9 9	9 9	9 9 9 9	9 9	9	9 9 9 9	9 9	9 9 9 9 9	9	9 9 9 9	9	9 9	9 9 9 9 9	9 9 . 9 9

Form HF5. Card for Tabulating Machine. (Full size.)

All the cards are kept in piles by rooms or departments until the end of the month. There may be as many as 100,000 of them. The sorting machine is then used to sort them in any way that may be desired for statistical or accounting purposes, such as by departments, classes of product, order numbers, etc., and after subdivision by this machine the tabulating machine is used to add up the totals of hours, pieces and wage amounts of any subdivision, for example, the monthly total of hours, pieces and productive day work on Class A in Room No. 104. The total figures thus obtained are written down in the columns of statistical sheets for the use of the statistical, cost and accounting departments.

Monthly Statistical Sheets Derived from the Hollerith Cards, Pay Roll Distribution

The Hollerith cards, punched according to the records on the Day Work or Piece-work Credit Slips, are arranged in piles representing producing rooms or groups of rooms, or departments, about 40 piles in all. Each pile is then run through the sorting machine and divided and tabulated so as to give the total hours and amounts, which are entered in writing as the machine shows the total figures, on a long statistical sheet which has hours and amount columns for each of the following headings:

HF6

STATISTICAL DISTRIBUTION OF PAYROLL FOR MONTH OF 1916

Room or Dept.	PRODUCTIVE PIECE WORK				TOTAL PIECE WORK		PROD. DAY WORK		BETTERMENTS		SPECIAL		TOTAL PROD.	
	Regular Operations		Special Operations											
	Hours	Amount	Hours	Amount	Hours	Amount	Hours	Amount	Hours	Amount	Hours	Amount	Hours	Amount
21-41														
B. Group														
C. "														
Power														
Transportation														
Messengers														
Sweepers														
Yard														
General														
(About 50 lines in all)														

(Headings continued)

TOTAL EXPENSE WORK		REGULAR EXPENSE NOS.				(Seven other number colums)	TOTAL PAYROLL		
		1		2					
Hours	Amount	Hours	Amount	Hours	Amount		Hours	Amount	

Form HF6. Statistical Distribution of Pay Roll.

This sheet distributes the total pay roll, giving both hours and amount of wages, whether day work or piece work, by rooms or departments, whose symbols are given in the column at the left, and by the different kinds of work named in the headings of the hours and amount columns.

A second sorting and tabulation of the cards is made for the Accounting Department, giving amounts only and not hours of labor, dividing the labor into Direct and Indirect, and subdividing each into classes of Product, as A, B, C, for so much of the labor as can be directly charged to such products; into labor for making different kinds of supplies, SE, SF, etc., for betterments XA, YC, etc., and for special orders not otherwise classified. One large sheet is made for Direct (or so-called " Productive ") Labor, and another for Indirect or " Non-productive."

Of the latter, as much as is possible is entered in the " Class " columns A, B, C, etc., on the basis of special studies made by the management of the Accounting Department (for example, part of the time of a foreman in the Press Shop might be charged to one or more of the classes, and part to the Press-shop symbol, P), and the remainder, called the " Residuum," is charged to the various supply, betterment, department, or room expense symbols. When the " Residuum " columns are added up their totals have to be apportioned in some way to the several classes of products, A, B, C, or to supply or betterment accounts, or to special orders which do not come under these headings. The principle upon which this apportionment is made is to charge the " Residuum " of any department to the different classes in proportion to the direct labor done in that department for these classes. For example, if 30 per cent of all the direct labor of department M is done for Class A, and the total " residuum " of department M for a given month is $1000, then $300 of that amount would be charged to Class A.

Accounting Distribution of Pay Roll

This distribution shows charges against Classes or Departments. It distributes from rooms into classes. The figures are amounts only, not hours, taken from the second running of the cards through the tabulating machine.

Productive

Rooms or Dept.		Class Total	SE	SF	SS	ST	Special Orders	Better-ments	N. Y. Office	Total Prod.
Mfg. Rooms	(Twelve columns)		(Four columns for different kinds stores or supplies)							
Rooms 64-66	A, B, etc., to L)									
Dept. C										
Dept. D										
Dept. L										
etc.										
Other Rooms										
		(Headings continued on Second Page)								

Non-Prooductive

Rooms or Dept.			Residuum		Total Non-Productive
	(Twelve columns A to L)	Mfg. Rooms	L, M, N, 354, P, R, T, U, V, SF, etc. (15 columns)	Others	

Form HF7. Accounting Distribution of Pay Roll for Month.

The Non-Productive (or indirect) Labor is charged directly as far as possible to the Classes of Product, A, B, C, etc., on the basis of special studies by the manager of the Accounting Bureau: thus the time of the foreman of the Press Shop would be charged as far as possible to Classes A, B, C, etc., and the amount not so charged is called Residuum, charged to Press Shop or to any other department to which the foreman rendered service. This Residuum is charged at the end of each month, by journal entry, to the Classes in proportion to the productive labor done in that department for these classes.

J. E. No. 201
Feb. 1916
Posted to
Works Ledger

JOURNAL ENTRY

Subject

Distribution of Pay Roll as shown in sheets "Accounting Pay Roll Distribution."

Description	Controlling Account	Class or Dept.	Detail
Dr. Work in Progress, Labor	100,000		15,000
			30,000
			etc.
Dr. Work in Progress, Expense	100,000		20,000
			40,000
			etc.
Dr. Residuum Expense	20,000	L	4,000
		M	6,000
		N	2,000
		etc.	
Dr. Power Plant	2,000		
Dr. Betterments	1,000	YR	200
Dr. Special Shop Orders	3,000	YT	800
Dr. Stores	2,000	SE	500
		SS	600
		etc.	
Dr. Melted Metal	10,000	MC Iron	6,000
		MT Brass	4,000
Dr. Private Ledger (Charge for some work not pertaining to Factory Product.)	100		
Cr. Private Ledger (for sum of Dr. entries	238,100		

J. E. No. 202
Feb. 1916
Posted to
Works Ledger

JOURNAL ENTRY

Subject

Materials purchased, as shown in Invoice Record Sheets

Description	Controlling Account	Class or Dept.	Detail
Dr. Stores	50,000	SA	20,000
		SB	20,000
		etc.	
Dr. Expense Supplies	10,000	SC	5,000
		etc.	2,000
Dr. Power Plants	10,000	F	9,500
		U	500
Dr. Betterments	5,000	Y R	3,000
		Y T	2,000
Cr. Private Ledger	75,000		

By the above entries Private Ledger Acct. (which is the same as "Company" or "New York Office") is credited with everything that the Company does for the factory in the way of sending checks to meet its pay rolls and paying its bills for purchasing of all kinds, and the debit entries divide the total sums thus credited among the several principal controlling accounts and subordinate accounts kept in the Factory Ledger.

Numerous other journal entries are made each month from other statistical sheets, distributing the "residuum" expenses of departments M, N, P, etc., the several subordinate store accounts, melted metal, expense supplies, power plant, repairs, crediting these accounts and charging maintenance and other expense accounts, the several productive classes, betterment accounts and special accounts, such as Experiments, and Adjustment Accounts, which are used to spread over a year or longer certain charges such as Insurance, Taxes, Extraordinary Repairs, which should not be charged against the product of the particular month in which they are incurred or are paid for.

The object of all these entries and counter entries is finally to distribute and post in the Factory Ledger all the monthly cost of running the factory (which in the first two entries has been credited to Private Ledger Account) to the cost of producing the several classes of goods, and to betterment and other accounts which represent assets.

The journal entries are not made in a book, but on loose sheets. They may originate from the statistical clerks who make the sheets for distribution of labor, stores, and expense accounts, or from an officer of the company who has authority to determine, for example, whether a certain expenditure shall be charged as a betterment or as a repair, or what adjustments shall be made for changes in value of material, but all journal entries before being posted are verified and passed upon by an auditor or other authorized person.

Works Ledger

The Works Ledger, into which the Journal Entries are posted, is of an unusual form, designed especially to minimize clerical labor, and to get a great amount of information recorded in a small space where it may easily be found by officers who may have occasion to use it.

Each account, whether controlling or subordinate, is given a single page, which lasts usually a whole year, except Residuum Account, which has a page for each month, as there are many cross-entries and adjustment entries to be made in this account. The ruling of the ordinary accounts is as follows:

WORKS LEDGER

1916	Labor	Expense	Material	Other Accounts	Total
Jan.					
Feb. etc. to Dec.					
Total					

A page of Residuum Expense Account, which contains the remainder of the expenses and supplies that have not already been distributed to the Classes of Products appears as follows (the actual page, of course, has many more entries, and the amounts are not round figures, as here shown).

Works Ledger

January, 1916 — Residuum Expense

Total	Jour. Entry No.	Mfg. Acct.	Rooms 7–16	Rooms 22–31	Dept. L	Dept. (Several Cols.)	All Other Rooms
18,700	01	1400			4000	8000	5300
2,900	*05*	*100*	*200*		*1000*	*800*	*800*
20	36			20			
500	55		500				
16,320		*1300*	*300*	*20*	*3000*	*7200*	*4500*

The figures italicized above are written in red ink. Black figures are debits and red figures credits to Residuum, except the red ink figures at the bottom, which are the net credits (difference between black and red figures) of the accounts named at the head of the columns. The red ink total, $16,320, is the debit balance of Residuum which remains to be distributed by a journal entry to Manufacturing Acct. (a control account) and to its Class subdivisions, A to L, which entry will close Residuum Account for the month, leaving no balance.

The distribution is made on the following principle, the Residuum of Mfg. Acct. ($1300) is apportioned to the Classes in proportion to the ratio which the productive labor charged to these classes bears to the total productive labor, and the residuum of the rooms and departments is apportioned to the classes in the ratio which the productive labor charged to the several classes from the rooms and departments bears to the total productive in these rooms and departments, with the exception of the balance of the last column, "All Other Rooms," including Power Plant and other rooms in which little of no productive labor is done, which is treated in the same way as Mfg. Acct.

For example, if the total productive labor charged from the several departments and rooms to the classes is $100,000 for the month a statement is made showing its subdivisions as below, using round figures in thousands of dollars for convenience.

Productive Labor		A	B	C	D	E	F	G	H
		Thousands of Dollars							
Total	100	10	15	20	10	5	20	10	10
Mfg. Accounts.	10	1		3			4		2
Rooms 7–16	20	4		7			1	5	3
Rooms 22–31	20		10		6		4		
Dept. L	15	2	4			2	3	4	
Other Depts.	20	2	1	6	3	2	4	1	1
Other Rooms	15	1		4	1	1	4		4

The residuums are now to be divided in the proportions of the figures up the several columns A to L to the figures in the total columns, as in the statement below.

	Total	Distribution of Residuum							
		A	B	C	D	E	F	G	H etc.
Mfg. accounts	1,300	130		390			520		260
Rooms 7–16	300	50		190			50	50	50
Rooms 22–31	20		10		6		4		
Dept. L	3,000	400	800			400	600	800	
Other Depts.	7,200	720	360	2160	1080	720	1440	360	360
Other Rooms	4,500	300		1200	300	300	1200		1200
	16,320	1600	1170	3850	1386	1420	3814	1210	1870

A journal entry is now made and posted crediting Residuum $16,320 and charging the several classes the figures at the foot of the respective columns.

After all the posting for the first month of the year is done a trial balance taken from the Works Ledger would show a credit balance of Private Ledger account which would be the sum of the inventory of raw material and supplies Jan. 1, of the invoices of material received during the month, which have been certified to the Company for payment, and of the sums received from the Company for the pay rolls. All the other accounts would have debit balances, representing the charges made to the several productive class accounts, to betterments, special orders and adjustments. The debit balances of the class accounts represent all the charges made against these accounts during the month for material, supplies, labor and expense, whether the work done exists at the end of the month in the shape of work in process, finished goods in the warehouse, or goods shipped. In the succeeding months the debit balances of these accounts and the credit balance of Private Ledger increase, no counter entries for goods shipped being made, and at the end of the year the balances are a summation of all the work done during the year. The Works Ledger has nothing to do with commercial accounts, but is concerned only with total monthly cost of production by classes.

The three departments of Accounting, Statistics and Costs are in this factory kept separate. The Accounting department furnishes, as above stated, the total costs by classes. The Statistics department furnishes records of men, hours, materials, etc. The Cost department furnishes unit costs of product, piece rates, etc.

Determination of Costs. In the factory referred to costs are determined by a special investigation of each piece and of each operation. The raw material for a piece or a given number of pieces of the same kind is weighed and it is priced (for "Recorded Cost") at the average price of a five-year period. The product of the weight and price per pound less the value, at a standard price, of the scrap returned from the operations is recorded as the Cost of Material. On small work it is commonly figured per 100 pieces. The direct labor cost is determined by a time study of each operation, which is made for the purpose of fixing piece rates.

The sum of the costs of material and of direct labor so found is called the Prime Cost. The overhead expense added is a percentage on direct labor which has been determined for

the department or rooms in which the operation is done, or for the Class of Product.

A " Part Cost " card is made for each part or piece.

The material is entered in the first line below the headings and the several operations in their regular sequence below. If the department or room overhead is used it is figured separately for each operation, but if Class overhead is used all the direct labor cost of the several operations is added together and the percentage applied to the sum.

It is recognized that this method of figuring overhead is not as accurate as the machine-rate method, but, as the articles made are generally of light weight, and the machines used in a given department or room, or for a given class, do not vary greatly in first cost or in cost of upkeep, it is considered that the error of the method is not great enough to warrant the use of a more accurate method which would cost more for clerical work.

The amount of the standard percentages to be added for overhead in the several classes or departments is determined by the Accounting Department from the statistics of one or more previous years.

The sum of the standard costs of material, labor and overhead is what is known as the " Recorded Cost," (Shop Cost) which is entered on the " Part Cost " card for permanent use. When a " Present Cost " of any article or part is needed for any purpose, the Part Cost card is taken from the file and its record is copied on a Present Cost Estimate, on which there is added to or subtracted from the recorded or standard figures any " Adjustments " or changes that have taken place in prices of material or labor or in overhead ratio, the amounts of such changes being determined by the Accounting Department and furnished by it to the Cost Department monthly.

When the annual inventory is taken the values are figured on the " Recorded Cost " basis, and are then adjusted to correspond with the present costs.

The standard overhead percentage, or ratio, added to the direct labor cost is based on statistics of indirect labor and other actual expenses, not including depreciation, but in figuring present costs adjustments are made for depreciation and for " slippage," which latter term in defined as follows: Slippage is the difference between estimated labor costs as shown on the unit cost cards and actual labor costs. Example: A unit cost card shows an operation covered by a piece rate based on manufacturing in large quantities. The operation is performed on a small quantity at day work rates, which results in a labor cost in excess of that shown on the unit-cost card. The difference in cost is termed slippage and is included in shop overhead expenses.

An allowance for spoiled work, determined for each class or department from statistics of previous years, is also made in figuring the overhead cost.

Because of the clerical labor involved in rewriting all the cost cards at one time, changes in actual cost of labor, due to a general increase of wages are not made on the Recorded Cost cards except by stamping on them with a rubber stamp. (For example, Dir. Labor Inc. 5 per cent, Jan. 1, 1915.)

Group Cost Cards.—Group costs are made by adding the separate totals of the Part Cost cards to the labor and overhead cost of assembling the group.

Cost of Finished Product Cards are made up from the Part and Group cards and from the labor and overhead cost of assembling and finishing the cost of the completed article. A total is made showing the cost in a " no finish " condition, and the cost of finishing is then added.

HFS

Comp'd by_____ Date_____ **COST OF FINISHED PRODUCT** Design_____

Check'd by_____ Date_____ List No._____

Revis'd by_____ Date_____ Dept. _____ Metal_____

Article _____ Based on Quantities of _____ Cat. No._____ Page_____

Changes_____ Cost per_____ Auth'n No. _____

SUMMARY	Original	Revised	Revised	FINISHES					
Labor				Total No Fin.		Total No Fin.		Total No Fin.	
Overhead				Finish		Finish		Finish	
Material				Total		Total		Total	
Total No Finish				Total No Fin.		Total No Fin.		Total No Fin.	
Add Finish				Finish		Finish		Fiolsh	
Total Cost				Total		Total		Total	

Part or Group Nos.	Description	Weights, Prices and Op'n Nos.	Dept.	Hours	Overhead Sym.	Overhead Rate	Labor	Overhead	Material	Labor	Overhead	Material
	(32 ruled lines, 4 per inch) 45 on other side of card.)											

Form HFS. Cost of Finished Product.

The unit costs of products that are regularly made and for which piece rates have already been established are found by examination of job and material tickets for operations, parts, groups, and assembled product, and adding the department or class overhead computed by the accounting department. For new products time studies are made and the first orders are watched in their progress through the shop to obtain actual labor and material costs. For estimates on a product not yet made, the product is analyzed into its component parts for weights of raw material and of finished piece, and the labor of making and assembling together with the overhead, are estimated on the basis of recorded costs of similar products, and a figure is added for a factor of safety.

A sample of an estimate of cost is given below.

Records of actual cost are kept on cards which are filed

HF 9

ESTIMATE OF COST

Name _____ Estimate No. _____

Article: Escutcheon Plate — Sheet Brass

Request from _____ Order No. _____ Class A

Quantity Basis _____ Compiled by _____ Date 4/25/16

Patterns, Tools & Drawings

	PRESENT	RECORDED
Cost per 100		
Finish	A 2 1 0	A 2 1 0
Labor	4.493	4.000
Overhead 100%	4.493	3.600
Material	17.310	7.000
SHOP COST Total	26.296	14.60
Commercial Expense 10% (on recorded shop cost)	2.920	2.14
Actual Cost	29.22	16.79

Description (PER 100)	Wgts., Prices and Cut Nos.	Hours	Dept.	Overhead Sym.	Overhead Rate	5 yr. avg. material	Overhead	Current Material	Total
PLATE	Gross net 33 lbs @.40 — scrap 1 lb @.18								
Sheet Brass						4600		13020	
RE-INFORCING COLLAR	Gross								
Sheet Steel	36 lbs @.05					150		180	
THIMBLE	Gross 11# @.40 — scrap 3# @.18								
Sheet Brass						2000		3860	
						6750		17060	
Deduct 5 yr. avg. material								6750	
Increase in cost of material								10310	
Labor and material as recorded cost						4000		7000	
8% to cover increase in wages						320			
						4320			
4% to cover bonus (general)						173			
Total — Labor and material						4493		17310	
(The figures used are fictitious)									
On steel and cast iron gross weight of metal is used, no allowance being made for scrap, for the reason that the scrap value is so small.									

FORM HF9. ESTIMATE OF COST.

for convenient reference. Small cards giving total cost of an article at different dates and with different finishes are also kept.

The system described appears to be fairly satisfactory for a large factory that makes a great variety of goods. To carry it on with any degree of accuracy requires the division of the product into classes, that each class receives its proper apportionment of burden, and that careful records and statistics are kept of base or normal costs as established in a year of normal business or deduced from average results of a number of years, and of the variations in wages, in cost of material and supplies, and in selling prices or discounts.

Original and Revised Costs

A revision of the Cost of Finished Product is required when new schedules of raw material prices and overhead expenses are issued from the Treasurer's office (usually at yearly intervals, but monthly when market prices are rapidly fluctuating), and also when changes of method of manufacture are reported by the planning room. Orders for

changes of method are referred to the Cost Bureau if the changes affect the cost of product.

Estimates on Special Work; Cancellation and Changes of Orders; Spoiled Work; Defective Returned Goods

In making estimates for special work outside of the regular line of products special charges are made for each setting up of machines, to cover office work on each order. The Cost Bureau estimates the office time required to make cancellations and changes of orders, and makes a fixed charge per hour for clerical work. When any work is spoiled tickets are made out by the foreman, and the Receiving Room makes out tickets for all defective work returned. These tickets are sent to the Cost Bureau and to the Accounting Bureau for record, and are used to furnish data for modifications of estimated costs of finished articles and for proper charges to the several classes of product.

Annual Inventory

Inventory cards are issued to the foreman the day before beginning to take the inventory. The cards are serially numbered, and verified when returned to see that none are missing. They are priced by the Cost Bureau on the "recorded cost" basis, for material and labor, and the totals are then modified by the latest changes in "revised costs." Expense ratios for different classes of product are furnished by the Accounting Bureau to the Cost Bureau. The expense ratio is applied on the productive-labor cost.

Method of Charging Supplies Issued by Stores

A fine example of the use of modern labor-saving methods in the accounting methods of this factory is shown in the use of a tabulating machine card which serves the combined purpose of a requisition on Stores for material, a bill from the stores for the material delivered and a tabulating card which when passed through the tabulating machine with other cards will give the monthly total of the kind of material as to quantity and price, the total charge for supplies to the charge account and its subdivisions and the total credit to the Stores. The punched figures on one such card and their meaning are as follows: 0016, branch of the power department; 53, the numerical symbol for U, meaning Power Plant; 0131, the kind of material; 70, room No.; 0010, 10 lbs.; Lb., 0020, 20 cents; 65, symbol for SE, a credit supply account.

By different settings of the tabulating machine any combination of groups of two or more items may be sorted and their monthly totals obtained, for example the total amount of supplies delivered by store room SE to the Power Plant, or the total weight and price of asbestos cement delivered by the storeroom.

Statistical Reports

The department of Statistics prepares from the large statistical sheets of distribution of labor, material and expense, and from the Works Ledger such monthly and annual statistics as are desired by the officers and directors of the Company for their information. They are usually tabulated on 6×9 in. cards, ruled with columns for months. One of these cards gives the statistics of a single class of product or a single account of any kind, by months, for several years. A line at the bottom of the card gives the monthly average for each year.

A monthly wage report is made on a card ruled with columns for months and side heads as below:

HF14
MONTHLY WAGES REPORT
19 No.

OPERATING HRS.	Jan.	Feb.
Total No. of Op. Hrs.		
Total Wages per O.H.		
Piece Work "		
Day Work "		
Indirect Wages "		
MEN. HOURS		
Total No. of Men Hrs.		
Average No. of Men		
Total Wages per M.H.		
Piece Workers per M.H.		
Day Workers " "		
Indirect Wages " "		
Ratio Indirect Wages to Total Wages		
Ratio Piece to Direct		
Total Wages $		

(Other columns, March to December, and Total Column.)

Form HF14. Monthly Wages Report (9×6 in.).

Statistics of wages and salaries are also kept by weeks and by rooms, and the men-hours are analyzed by rooms, productive and non-productive work. Purchases and inventories of raw material and of supplies are reported on monthly by classes or kinds, and betterments are classified and tabulated. Reports are made of the expenditures for fuel, labor, supplies and repairs of the power plant, of the daily and monthly consumption of metal and fuel in the foundries and their product in castings and scrap, also of the weight of sheet metal used and of product made in the press shop.

Labor Turnover

One interesting bit of statistics is furnished by the Employment Bureau. It is called the Labor Turnover, that is the number of new men employed each month to take the place of those who have left or been discharged, and the percentage this turnover bears to the total laboring force. Records are kept for each department or group of rooms. Although it does not appear in the accounts this labor turnover has an important influence on costs of manufacture, for every time a new man is hired it costs something to "break him in," and until his output is equal to that of the man who left, the machinery is not being operated with its usual efficiency.

Monthly Estimate of Increase or Decrease of Inventory, and Profits or Loss

A monthly estimate is made by classes of products on the assumption that the ratio (found from the statistics of a preceding year) between the manufacturing cost (material, labor and factory expense) of the goods sold of a given class and the sales of that class remains practically constant for each month of the current year. Thus, if the sales of a certain class of goods amounted in 1915 to $1,000,000 and the factory cost of these goods was $700,000 then the ratio is 0.70. If the sales of this class in a certain month in 1916 amount to $100,000 then it is assumed that the goods sold cost 0.70 of $100,000 or $70,000.

If during the same month the total charges for manufacturing this class of goods is $90,000, the estimated *increase of inventory* is found by subtracting $70,000 from $90,000, giving $20,000. If the charges are only $60,000 the *decrease* of inventory is $70,000–$60,000 = $10,000.

If the sales of Class A in March, 1916 amount to	100,000
and the estimated cost at 70 per cent of sales is	70,000
The difference is called " gross profit "	30,000
If the selling and administrative expense, and the extraordinary expenses of every nature, chargeable to the class sales total of $100,000 amount to	20,000
The estimated net profit for the month is	10,000

Adjustments in these figures are necessary if there have been changes in prices of materials and in ratios of shop expenses to direct labor. The amount of these adjustments will be found from the Material Adjustment Account in the Works Ledger and from a memorandum Expense Adjustment Account kept outside of the Ledger.

The adjustment accounts represent the difference between the actual expenditures in the current year for material and shop expense over the established prices of materials and expense ratios on which shop costs (unit cost cards) are based and the inventory is computed.

An actual inventory is taken at the end of each year, the prices being taken from "unit cost cards." The prices of material on these cards are average prices for a five-year period.

The labor cost on these cards is taken from lists of established piece rates.

The shop expense ratios on these cards (ratios to direct labor) are based on the actual operations of a certain year.

Having taken the inventory and priced it on the unit cost card basis its value and the cost of sales for the year are to be adjusted in order to get values to be entered in the private ledger.

Method of Making a Monthly Estimate of Increase of Inventory and of Profit and Loss without a Monthly Inventory.

When a factory makes hundreds or thousands of different articles the cost of clerical work for making and tabulating an inventory oftener than once a year, even when a perpetual card inventory is kept in the stores and the warehouse, becomes prohibitory. The method described below of making a monthly estimate of increase (or decrease) of inventory and a monthly profit and loss estimate, or a modification of it, is in use in some large factories.

The total product of the factory is divided into a limited number of classes, say six to twelve, and the monthly totals of charges to Manufacturing Account, including Material, Direct Labor and Burden, are apportioned to the same classes. The monthly total of sales is likewise divided, as are also the selling and administrative expense connected with the sales department, together with a margin allowed for minimum profit, the sum of these three being designated by the abbreviation S A P below. The sales of any given class minus S A P is called the "Cost of Sales" of that class.

From the statistics of each month an estimate is made for each class, charging it with the total expenditure for manufacturing and crediting it with the cost of sales. If the former is greater, the excess is taken as the increase of inventory, provided there has been no change in selling price or in the cost of material labor and burden.

Suppose the total charges against Mfg. Acct. for a given class in a certain month is $1000, that the sales of that class amount to $1200 with S A P = $300, leaving the cost of sales $900; then the increase of inventory is $1000 − $900 = $100.

To illustrate this method we will take an example, using small figures for convenience. Assume that the statistics of production and sale for a certain class in a normal year show an average production and sale of 1000 articles per month, a cost for labor $250; for expense, $350; for material $100, total factory cost $700. Sales $1000, leaving for expenses and normal profit, S A P, $300. We will for the present assume that for the first three months of the following year complete statistics of the number of articles made and sold each month are available and that an inventory is taken at the end of each month, the figures being as follows:

Inventory Jan. 1. 2000 pieces at 0.70 = $1400

	Jan.	Feb.	Mar.	Total
Production, pieces	1200	600	1200	3000
Cost of Production:				
Direct Labor	$330	$180	$360	$870
Expense	360	300	360	1020
Material	144	72	144	360
Total	834	552	864	2250
Cost per piece	$0 695	0.92	0.72	
Advance in wage rates per cent	10	20	20 above normal	
Advance in price of material, per cent	20	20	20 above normal	
Relative cost for expense, per piece	$\frac{6}{7}$	$\frac{10}{7}$	$\frac{6}{7}$	

(As compared with normal expense cost of 35 cents per piece. The expense per piece in February is high on account of the small product.)

	Jan.	Feb.	Mar.	Total
Sales, pieces	1500	1000	1000	3500
Advance in selling price, per cent	10	15	20	
Sales price	$1650	$1150	$1200	$4000
S A P	400	300	320	1020
Apparent Net Cost of Sales	1250	850	880	2980

The S A P includes the actual costs of selling and administration plus the normal minimum profit from the previous year's statistics; with these data it is now required to find the increase or decrease of inventory (pieces and value) at the end of each month, and the profit (or loss) as compared with the normal profit.

The result may be tabulated as follows:

	Jan.	Feb.	Mar.
Pieces made	1200	600	1200
Pieces sold	1500	1000	1000
Inventory	Dec. 300	Dec. 400	Inc. 200
Inventory at end of month	1700	1300	1500

SALES ACCOUNT

	Charges			Credits		S A P	Net Cost
	Pieces			Pieces			
Inventory	2000 @ 0.70	$1400					
Jan.	1200 @ 0.695	834	Jan.	1500 @ 1.10	$1650	$400	$1250
Feb.	600 @ 0.92	552	Feb.	1000 @ 1.15	1150	300	850
Mar.	1200 @ 0.72	864	Mar.	1000 @ 1.20	1200	320	880
	5000	3650		3500	4000	1020	2980
			Balance	1500	Bal. of	Acct.	670
				5000			3650

Product			Cost of Sales		Net Cost	Profit
	Pieces		Pieces			
Inventory	2000	Jan.	1500 @ 0.70	$1050	$1050	$1250	$200
		Feb.	500 @ 0.70	350			
			500 @ 0.695	347.50	697.50	850	152.50
Jan.	1200		500 @ 0.695	347.50			
		Mar.	200 @ 0.695	139	762.50	880	117.50
			300 @ 0.92	276			
Feb.	600		3500				
				2510	2510	2980	470
Mar.	1200		Inventory:				
			300 @ 0.92				
			1200 @ 0.72	276			
				864	1140		
	5000			3650	3650		

The balance of Sales Account being $670, and the inventory $1140, the difference, $470, is the profit, as in the last column of the table.

The profits are over and above the normal or minimum estimated profit P of the S A P as above defined.

It should be observed that the apparent value of the inventory and of the profit are both enhanced on account of including in the inventory value 300 pieces at $0.92 made in February when the manufacturing expense was excessive on account of the decrease in factory production which might have been caused by an accident or by a strike. If these 300 pieces were valued at $0.72, the cost in March, then the inventory value would be 1500 pieces at $0.72=$1080, or $60 less than the recorded value, and this $60 would be subtracted from the $470 profit, making it $410.

Now suppose that we have no records of the number of pieces made and sold, nor of the inventory each month, and it is desired to obtain an estimate of the increase or decrease of the inventory and a profit and loss estimate at the end of each month. The data of production costs are as follows:

	Jan.	Feb.	Mar.
Direct Labor	$330	$180	$360
Expense	360	300	360
Material	144	72	144
	834	552	864
Advance in wages, per cent	10	20	20
Advance in material, per cent	20	20	20
Expense, relative to normal product	$\frac{8}{7}$	$\frac{10}{7}$	$\frac{8}{7}$

We first reduce the actual costs to their equivalent normal costs by dividing them by percentage adjustment factors, as below.

Jan.		Feb.		Mar.	
$330 \div 1.10 = 300$		$180 \div 1.20 = 150$		$360 \div 1.20 = 300$	
$360 \div \frac{8}{7} = 420$		$300 \div \frac{10}{7} = 210$		$360 \div \frac{8}{7} = 420$	
$144 \div 1.20 = 120$		$72 \div 1.20 = 60$		$144 \div 1.20 = 120$	
	840		420		840
Actual cost as above	834		552		864
Decrease	6	Increase	132	Increase	24

We then in like manner reduce the receipts from sales to their equivalent base prices, by dividing them by factors for advance in selling prices.

	Jan.	Feb.	Mar.	Total
Receipts from sales	$1650	$1150	$1200	$4000
Divide by	1.10	1.15	1.20	
Equivalent normal sales	$1500	$1000	$1000	$3500
Less normal S A P, 30%	450	300	300	1050
Normal Sales Cost	1050	700	700	2450
Normal Mfg. Cost	840	420	840	2100
Inc. Dec. of Inventory:	Dec. 210	Dec. 280	Inc. 140	Dec. 350
Add original Inventory, $1400	1190	910	1050	
Net receipts from sales	1250	850	880	2980
Less normal Sales Cost	1050	700	700	2450
Apparent profit on sales	200	150	180	530
Apparent loss on Mfg. Costs	−6	132	24	150
Apparent net profit	206	18	156	380

This apparent profit is based on the inventory being taken at the normal value, $1050 at the end of March, making no allowance for increased costs of production. A statement may be made, however, which will show the inventory values and the calculated profits based on advanced inventory values as follows:

		Normal		Actual	Profit	Loss
Inventory	$1400	Sold	$1050 for	$1250	$200	
		Made	840 for	834	6	
Balance	350	Sold 350 }	700 for	850	150	
	840	Sold 350 }				
		Made	420 for	552		132
Balance	490	Sold 490 }	700 for	880	180	
	420	Sold 210 }				
		Made	840	864		24
	Normal	Cost			536	156
Inventory	210	276		Less	156	
	840	864				
					380	
	1050	1140	Increase of value		90	
			Profit, as before		470	

Which profit may be reduced, by a revaluation of the inventory on the basis of the March manufacturing costs, increasing the normal value, $1050, in the ratio $\frac{864}{840}$ making it $1080, or $60 less than the recorded value, and reducing the profit by the same amount, making it $410.

In this manner we reach the same result that was reached on the assumption that a perpetual inventory was kept. In the example it was assumed at the beginning that the inventory was of 2000 pieces each at 70 cents, totalling $1400, and that the total production was all of the same kind of pieces, but the revised example, in which the number of pieces is left out of the calculation, would have been just the same if the pieces were of a thousand or more different kinds or sizes, but of one general class, such as light hardware.

Some of the other forms used in this factory are shown below.

HF 10 9-15-10 M

REQUISITION FOR PARTS ACCT.

Date	Operation No.	Part No.
Room No.	Finish	Order No.
Metal	Quantity Ordered	List No.

Article

Description (5 lines)

Ec. Quan. in Lot — Move to — Promise

Lot No.	Date Wanted	Lot No.	Date Wanted	Lot No.	Date Wanted	Lot No.	Date Wanted
	(3 lines)						

Date	Quan. Ship'd	Date	Quan. Ship'd	Date	Quan. Ship'd	Date	Quan. Ship'd
	(4 lines)						

Date Rec'd

From _____ Acct. _____

MOVE TO _____ Part No. _____

List No. and Article

Order No. _____

Quantity

_____ Trays

_____ Boxes

Location of work in Cage	
Section	Bins

Parts have this day been received

In Cage No. Date Part No.

Article Order No.

From List No.

Signed Cage Attendant Quantity

Route Clerk Check	Stock Record Clerk Check	Completes Lot No.	Indicate by an X	
			Rough Material	Worked Material

FORM HF10. REQUISITION FOR PARTS ($4\frac{1}{2}\times7\frac{3}{4}$ in.).

HF 11 (Size 5 x 3 in.)

FOR BRONZE CASTINGS

Charge Acct. _____

Order _____ No. _____

List No. _____ Pat. No. _____

Part _____

Due Date _____

Quantity _____

FORM HF11. REQUISITION FOR BRONZE CASTINGS (5×3 in.).

(Size 3 x 5 in.)

Clock No. _____ Rate _____

Name

Date	No. in Flasks	No. of Flasks	Hours
10 lines, 3 per inch			

BACK OF FORM HF11.

HF 12 (Size 8½ x 11 in.)

RETURNED GOODS REPORT

Class _____ Date _____ 191

Quantity	List No.	DESCRIPTION	Finish	Disposition
(26 lines 3 per inch)				

FORM HF12. RETURNED GOODS REPORT ($8\frac{1}{2}\times11$ in.).

HF 13 OPERATION AND ROUTE RECORD. Class _____

Article Part No.

Metal for 1000 Pieces Economic Quantity

Operation No.	Number of Patterns	Operations	Dep't or Room	Number of Oper'ns	Daily Output	List of Articles used for
(11 lines 4 per inch)						

FORM HF13. OPERATION AND ROUTE RECORD (6×4 in.).

HF 15 (Size 4½ x 4 in.)

TICKLER

Room No.	Operation No.	Order No.
Metal	Finish	Due Date
List No.	Quantity Ordered	Promise

Description

Room	Due Date	Room	Due Date	Room	Due Date
(5 lines 4½ per inch)					

FORM HF15. TICKLER ($4\frac{1}{2}\times4$ in.).

HF 16 (Size 6 x 4 in.)

TICKLER CARD

Return to _____ Issued _____

Date _____ (4 lines 3 per inch)

Subject _____ (4 lines)

FORM HF16. TICKLER (6×4 in.).

A MACHINE-SHOP'S COST SYSTEM

A certain machine-shop in Philadelphia, employing something less than 200 men, and manufacturing a few specialties of its own, has a most elaborate cost system, the results of which are carried into the general books every month. It furnishes to its bookkeepers a set of typewritten instruction books. From these instruction books the following notes have been taken, some of them in greatly abridged form.

INCENTIVE

The incentive for having a cost department is to establish a legal base for the selling price of an article and to determine the amount and source of profit for the different products.

HF17 **DETAILS OF RETURNED GOODS TICKET** Ticket No. Page No. Date

Name _____

Quantity	List No.	Article	Finish	Price	Extension	Total
Size of ticket 2¼ x 6 in.						
16 ruled lines						
Punched for loose leaf book						

FORM HF17. DETAILS OF RETURNED GOODS TICKET.

FUNDAMENTAL PRINCIPLES

a. Make the cost of manufactured products made for sale during a certain period equal total expenditure of the business for the same period.*

b. Connect the costs with the general bookkeeping.

c. The books must keep perpetual inventories accounts of raw material on hand—totals only.

Expense { 1. Direct Expense; 2. Construction; 3. Indirect or Overhead } may be incurred by { *a.* Labor charges; *b.* Material; *c.* Miscell. charges (not *a* or *b*). }

d. Two classes of overhead expense:

1. *Shop Expense.* That which attaches itself to the running of the machinery.
2. *General or Business Expense.* That which is incurred by the Business or Administration and which has no connection with Manufacturing.

e. Two compartments for filing cost data:

1. For current period, not yet entered on the Cost Records.
2. Finished data, entered on the Cost Records.

WAGES RECORDS—TIME CARDS

Time Cards (three kinds):

The first card is issued when a job is given out. It contains blanks for a complete record of the job except as to the material used in it, which is entered in a "Stores Issue" card (Form P4). If the job is not finished in one day, a Continuation card is issued on each succeeding day. It does not contain as much information as the first card. The record on the successive continuation cards is transferred to the first card when the job is finished. (Forms P1, P2, P3.)

* This "principle" is fundamentally a wrong one. See a criticism of it on page 200.

9M-9 In Out **FIRST TIME CARD AND BONUS RECORD** C

Total Wages $ | Operation Symbol

Mach. Time	Time Allowed	Bonus Time	Bonus Wages	No. Pcs.	
			$	Dr. No.	

If Job Is Not Finished Scratch Out This F | If Job Is Finished Scratch Out This NF | Mach. No.

										Total
Day										
Pieces Finished										
Time Units										

Workman's Name _____ Man's No. DM _____

I Have Checked These Entries and Believe Them To Be Correct.

Hrs. X Cost No. _____ Signed by Foreman _____

Route Sheets	Pay Sheet	Cost Sheet	Bonus Earned / Bonus Not Earned	
			The Above Work Has Been Inspected And Found O.K. / Defective	

FORM P1. FIRST TIME AND BONUS CARD

Daily Entries on Pay Roll. The pay roll clerk sorts all cards according to the men's numbers.

Duplicate Earnings Record. Make out each man's earnings record, filling in the man's name, number and date, and the amount of time on day's work and on bonus work. The slip is laid aside to be completed later by listing the bonus jobs that are completed. The original goes to the man; the duplicate is kept for the shop record. (Form P5.)

Sort time cards and bonus and inspection records according to the Charge Symbol "C."

Enter time on the respective bonus records; check finished work with Inspection Card and Order, Bonus earned and not earned.

Day-work time cards are set aside until it is time to enter the value of labor and the Relative Cost Factor (explained later).

In / Out — Charge Symbol: C

Department DM
Day Rate

If Job Is Not Finished Scratch Out This — F
If Job Is Finished Scratch Out This — NF

Operation	No. of Pieces Finished	Man's Time	Machine Time	Machine No.

Workman's Name — Man's No. DM

I Have Checked These Entries and Believe Them To Be Correct.
Signed by Foreman or his Representative

Route Sheets	Bonus Record	Pay Sheet	Cost Sheet Man's	Cost Sheet Machine

BONUS WORK Time Note

D.M. 5

FORM P2. CONTINUATION BONUS TIME CARD

DM 12
In 51.0
Out 5-27-15 52.1

Order Number DML

Department M
Day Rate 3.00
Man's Time 1.9 hrs.

Length of Belt 19′10″
Belt Symbol D5-CO

Maximum Tension 54 Minimum Tension 31
Cleaned and Greased Grease used
Dressed while in use New Dressing used
Amount taken out Length put in
Length of Splice Cement used
Tension in lbs. indicated by each spring balance: Before Tightening 0; After 54
Workman's Name Welsh Man's No. 128

Entered In		
Pay Sheet	Cost Sheet	Belt Record
C.L.	J.M.	R.S.P.

BELT MAN'S RECORD (Size 4¼ x 4¼ in.)

DAY WORK Time Note

FORM P3a. BELT MAN'S RECORD

IN / OUT — C

DEPARTMENT D M
DAY RATE

If Job is not finished Scratch out this — F
If Job is finished Scratch out this — N F

Operation	No. of Pieces Finished	Man's Time	Machine Time	Machine No.
(5 lines, 4 per in.)				

Workman's Name Man's No. D M

I have checked these entries and believe them to be correct:
Signed by Foreman or his Representative

Route Sheets	Pay Sheet	Cost Sheet Man's	Cost Sheet Machine

DAY WORK Time Note

DM 1

FORM P3. DAY-WORK TIME CARD. (4¼×4¼ in.)

Stores Symbol: S
Charge to Order No.
Location

Quantity	Unit	Total Weight Lbs.	Unit Value	Total Value

Description

Month	Day	Year
		191

Storekeeper
Please issue above to
At M. On 191
Signed by Man to Whom Stores are Issued

Entered in Balance	D.V.	Cost	

Stores described above have been issued
Signed by Gen. Storekeeper or his Representative

AS 9 STORES ISSUE 20 M 12-16 Form M33

FORM P4. STORES ISSUE CARD

All time cards, except continuation cards which have been transferred to the first card or bonus record, must be given a labor value = man's hourly rate × No. of hours he has worked on the job. The value of the bonus card = cost of labor for the time worked + the amount allowed for bonus.

The charge symbol is a mnemonic symbol, made up of a combination of letters of the alphabet and numbers, which include the symbols of the class of work done (i. e., D, shop expense; X, part construction; Y, construction; P, M, G, T, R, L, etc., different classes of "worked materials" that are part of the finished products), together with the symbol of the piece or group of pieces upon which the work is done or the symbol of the particular kind of expense work.

Relative Cost Factor or "Cost Number." This is a number entered on a list once a year for each machine, work-bench of assembling floor, obtained by computing the annual cost

Name No. Date

YOUR TIME AND EARNINGS WERE AS FOLLOWS ON

BONUS JOBS FINISHED					Bonus Made
Symbol	Allowed	Taken	Saved	Lost	
(Nine ruled lines)					

Actual Time Worked		TOTAL EARNINGS	TOTAL	
On Day Work	On Bonus Work			
			Signed	

FORM P5. WORKMAN'S TIME AND EARNINGS

(indirect expense, not including wages of the operator) of maintaining the machine in operation, viz.: the sum of the rental value of the space occupied and its proportional cost for power, light, heat, insurance, taxes, interest, repairs, depreciation, superintendence, cleaning, watchman, small tools, stores, clerical expense connected with the shop, etc., and dividing this annual cost by 3000 hours if the machine runs days only or by 6000 hours if it runs day and night. This "Cost Number" is not the actual cost per hour during the time the machine actually runs, but a relative figure which is to be multiplied by an expense rate ("DM" rate, explained below) to obtain the hourly machine cost.

In listing the relative cost numbers for the several machines select the nearest even figures, neglecting decimals. From 10 to 50 cents the cost numbers should increase by 2 cent jumps, and from 50 cents upward by 4-cent jumps.

It is not necessary to have a Relative Cost Factor on any job which does not have to bear shop expense. On all jobs charged to indirect expense or overhead charges the R.C.F. is not worked out. To make use of this factor in such cases would be charging expense to expense, which is a point in cost-keeping that should be guarded against.*

Jobs charged to Construction should have a R.C.F. Jobs charged to Part Construction, or work that adds partly to the permanent value of the plant and partly to shop expense (by reason of quick depreciation) do not have a R.C.F. because the amount of depreciation is charged to shop expense.†

Shop Expense Rate ("DM rate"). The total monthly shop expense is distributed over the total productive work (worked materials and construction of machinery for the shop) in the following manner: The number of hours each machine runs during the month is multiplied by its relative cost number, and the sum of these products is divided into the total shop expense for the month. The quotient is the DM rate for the month. This is multiplied by the "Hours ×Cost Nos." obtained from the time cards for each job, the product being the amount of shop expense apportioned to the job. The sum of all these products should balance the total shop expense for the month.

Example:

$$\frac{\text{Shop expense for month}}{\text{Hours} \times \text{cost numbers}} = \frac{6249.75}{2273.84} = 2.7246, \text{ DM rate for month}$$

COST-COLLECTING CARDS

A cost card is made out for each job order or charge symbol that is in operation, giving each factor of the cost, viz.: wages, stores, and indirect or overhead expense, the latter including both shop expense and business expense. At the end of the month the cards are collected and the entries totaled. The totals are entered on a Detailed Cost Sheet of Worked Materials opposite the respective charge symbols and on an Expense Analysis Sheet. (Forms P6 and P12.)

EXPENSE DISTRIBUTION SHEET

The cost-keeper sends to the bookkeeper a Distribution of Wages, Stores and Worked Material so that he may make the proper entries on the books. Total wages distributed = total monthly pay roll. He gets from the bookkeeper the record of all expenses not entered on the shop records. An Expense Distribution sheet is made out to show how the shop and general or business expenses are apportioned to the construction and the worked materials accounts. Form P15 is a sample of this sheet (abridged by omitting the columns for the several classes of worked materials). The figures given are random figures, in even dollars, and have no relation to the actual figures of any month.

GENERAL BUSINESS EXPENSE

Indirect expenses must, if we are to apportion them correctly to the product manufactured, be split up into General Business Expense and Shop Expense. All expenses whether direct or indirect must ultimately be charged against the product.

General Business Expense consists of such charges as would be necessary whether the concern made or bought the goods, such as advertising, salaries of officers, salesmen's salaries, traveling expenses, interest, legal expense, shipping, etc.

These expenses are each month charged on to the productive work done during the month in proportion to the direct or productive wages charged to the productive jobs in progress during the month as shown by the cost sheets. The total amount of general business expense is divided by the total direct wages charged against the productive jobs. This gives a proportional number or rate ("B" rate). Multiplying the amount of wages on each job by this rate gives the amount of business expense to be charged against the job.*

STORES

No material is issued without a written order (See Form P4, Stores Issue Card). The value of the material issued is entered on this order. The stores are classified as far as possible on the Balance of Stores sheets, or inventory cards, according to the purpose for which they are to be used, such as B, business expense; DM, shop expense; Y, construction of machines; P, L, G, etc., varies classes of products; SS, stores for sale. The stores issue cards are totaled for each class and a stores distribution sheet is sent to the bookkeeper at the end of the month.

Orders are also written for Worked Material to be issued from Stores (Form P7), and credit tickets are made for unused or worked material returned to stores. (Forms P8, P9).

* It is not evident that charging expense to expense should be guarded against. Suppose a new crank-shaft is wanted for repairs of a machine tool. Its cost should include its proper share of the burden of the blacksmith shop, where it is forged, and of the machine shop, where it is finished.

† This also seems to be wrong. If the carpenter shop makes a pattern to be used in the foundry, where it depreciates rapidly, the cost of the pattern should include its proper share of the burden of the carpenter shop.

* For a criticism of this method see page 200.

Size 18 × 14 in.
Containing six forms like this, the side heads, except the first three lines being duplicated in in lower half of the sheet.

DETAIL COST SHEET OF WORKED MATERIALS

Description _____ Symbol of Cost Class _____

For Month of				
Shop Expense Rate				
B Expense Rate				
Date Order is	STARTED _____		FINISHED _____	
ORDER NUMBER				
Check line when order is finished				
Quantity called for on Order				
Kind of work to be done				
Month in which work is done				TOTALS
Mach. hours x cost numbers				
WAGES				
B EXPENSE				
SHOP EXPENSE				
STORES				
Worked Material from Stores				
Miscellaneous				
TOTAL COST				
Total Quantity produced				
Rate of cost per unit				
POSTED BY				
Check line when order is posted				

FORM P6. DETAIL COST SHEET OF WORKED MATERIALS

WORK OF THE BOOKKEEPER

The bookkeeper receives the Stores Distribution sheet above mentioned and also, from the cost-keeper a similar sheet showing the Distribution of Labor. From these he makes journal and ledger entries crediting Stores and Accounts Payable (Pay Roll) and charging the several accounts, A, B, D, Y, P, M, G, etc., for the stores issued or work done. Advertising, Freight, Legal Expense, Traveling Expense, Loss on Goods Shipped, No Charge, and Expense for Outside Work charged against salable products, constitute miscellaneous charges. As these accounts are controlled by the Business Department, the bookkeeper knows the proper distribution and can make the debit and credit entries without help from the Cost Department. However, the cost-keeper has the detail cost of all products, and this detail must balance with the totals kept in the books. The bookkeeper sends to the cost-keeper a detail distribution of Miscellaneous Expense.

AS 13

Worked Materials Tag No. C

Charge to Order No.

Issued for

Quantity Issued	Unit		Number Pieces	
Total Weight	Total Value		Drawing No.	
			Machine No.	

	Month	Day	Year
Issue Written			19
Delivered			19

WORKED MATERIALS ISSUED

Storekeeper

Mr. _____ (Do not fill out Name for Orders on Storekeepers)

Please Issue above { To / To Bearer

Signed by Man for Whom W. M. are Issued _____

Apportioned	Balance Sheet	Tag	Cost Acc't	Worked Materials described above have been Issued
				Signed by Storekeeper or his Representative _____

FORM P7. WORKED MATERIALS ISSUED

AS 16

Stores Tag No. | Credit Order No.

Quantity	Unit	Total Weight Lbs.	Total Value

STORES CREDIT

Month	Day	Year
		19

Please Credit Work Materials Order No. _____

with _____ (3 lines)

and charge to _____

Remarks _____ (4 lines)

The Storekeeper will enter Value of Stores on this Card

Tag	Balance Sheet	Cost Sheet		Card O.K. Shop Office	Sig. of Inspector who delivers Goods to Stores	Signature of Storekeeper or his Representative

FORM P8. STORES CREDIT

AS 17 Worked Materials Tag No. | Credit Order No.

Quantity	Unit	Total Weight Lbs.	Total Value

WORKED MATERIAL CREDIT — Month | Day | Year: 19

Please Credit Work Materials Order No. _____ with _____

and Charge to _____

Remarks _____

(5 lines, 5 per inch)

The Balance of Stores Clerk will enter Value of Worked Materials on this Card

Stores Sheet	Balance Sheet	Cost Sheet		Card O.K. Shop Office	Sig. of Inspector who delivers goods to Stores	Signature of Storekeeper or his Representative

FORM P9. WORKED MATERIAL CREDIT

The Journal entries each month include the following:
Stores to Accts. Payable, for materials purchased.

Work in Shop (or Worked Material in Process)..... { To Stores, for purchased materials issued. To worked materials in Store for stored material on which work has been done.

Mdse. Sales to Stores, for stores sold.

Worked Material in Process to Accts. Payable, for Pay Roll.

Miscellaneous Expense to Accts. Payable, for expenses other than those charged to stores or to work in shop.

Worked Material in Process to Miscellaneous Expense. Stores to worked material in Process, for materials on which work has been done, whether finished or not, returned to the stores for safe-keeping.

Worked Material in Stores to Worked Material in Process, for finished or partly finished product. (The finished product, ready for shipment, might be charged to Warehouse or to Finished Product).

Entries made once a month from a list of values of each product finished, made out by the cost-keeper.

As part of the product is turned into the store room as Partly Finished or Stock Parts, it is necessary to transfer a certain amount of Worked Material back to the shop, therefore a distribution of total materials transferred to and form the stores has to be made each month. Both debits and credits of worked materials must be taken from the shop records. In recording credits the cost-keeper must note from which worked materials in Stores Account the goods were issued, and the total amount credited to Worked Material in Stores must equal the total debit to Worked Material in Process Account. Worked material issued and charged to one of the indirect expense accounts B or DM is credited to one of the subdivisions of the worked material in stores accounts, depending on the kind of material issued.

We may draw from Worked Material in Stores a product belonging to one class which is necessary to complete a product of another class. Thus if a bolt classified under is M needed for G the entry would be Worked Material in Process, G, to Worked Material in Stores, M.

Entry for worked materials drawn from stores:

Dr. Worked Materials in Process		Cr. Worked Materials in Store	
B	20	G	1,100
DM	190	L	550
G	1,010	M	12,070
L	500	P	1,200
M	13,000	R	400
P	200	T	2,000
R	400		
T	2,000		
	17,320		17,320

Worked material drawn from stores for the purpose of returning it to the shop does not constitute an expense for the current month if it is chargeable to a direct product. In case worked material is drawn from stores and charged to an indirect or overhead expense account, then it must be charged in with the other classes of indirect expense when this expense is distributed to the direct product.

The indirect expense accounts B and DM are charged to the several classes of direct product, Worked Material in Process, and to Construction, by means of the Expense Distribution sheet heretofore described, Form P15. If the distribution is correct the B and DM accounts will balance.

A list of Worked Materials Finished during the month is made out, giving the cost of each lot and the unit cost (taken from detail cost sheets) and sent to the Balance of Worked Materials clerk. The total of each class of product is sent to the bookkeeper who debits Worked Material in Stores and credits Worked Materials in Process. (Form P10.)

Products shipped to customers are charged to Accounts Receivable for each class of product sold, and the total of this account is credited to Mdse. Sales. For debits to this account and corresponding credits to Worked Material in Stores the bookkeeper gets from the cost-keeper the cost value of the products shipped, and the account is balanced into Profit and Loss. The Balance of Worked Materials in Stores (Form P11) shows the cost value of worked materials on hand.

When the general ledger is posted and proved by a trial balance, Monthly Statements are made out, including the following:

Expense Analysis Sheet, a detailed analysis of each class of expense for the current month and for the preceding month. This analysis enables the administration to observe the class of expenditure which needs attention. (Form P12.)

Finished Materials, showing the cost of each lot, unit cost, and best previous cost of each article finished during the month. Each class of product is kept separate and the total cost of each class given.

Income Account, a sheet showing the amount and source

(*Sheet 18 x 14 in. Ruled 44 lines, in blocks of 3*) **EXHIBIT A.** _____ Sheets, Sheet No. _____ From Classes _____

WORKED MATERIALS Finished during the month ending _____ Day of _____ 191 To Classes _____

Description or Name of Article or Cost Sales	Symbol	Quantity	Total Cost of Worked Materials Finished during the Month	COST PER UNIT								Remarks
				This Month	Last Month	Average this Year to Date	Average last Year to Date	Best Previous Cost				
								Amount	Month	Year		

FORM P10. WORKED MATERIALS FINISHED

(*Size 12 x 17 in. including 3 in. margin for binding*)

BALANCE OF WORKED MATERIALS

DESCRIPTION _____

NOTE:- When the Material is in Process of Manufacture in the Shop, the Quantity must be added to Columns 1 and 4. After it has been delivered to the Stores, add the Quantity to Column 2 and subtract from Column 1. When it is apportioned, add Quantity to Column 3 and Subtract from Column 4. In all cases bring down Balance on Hand, in each Column affected.

1.- Shop. Worked Materials. I.E. Worked Materials in Process of Manufacture in the Shop				2.- Stores. Worked Materials. I.E. Worked Materials Temporarily in Stores awaiting further use					
Date Started in Shop	Lot No.	No. of Pieces or Quantity	Cost	Date Received from Shop W.M.	Lot No.	No. of Pieces or Quantity	Cost	Rate of Cost per Piece	Issued for Order No.
(*48 lines, 5 per inch*)									

(*Headings Continued*) When quantity available falls to _____ Issue Manufacturing Order for _____ AS 11

3.- Apportioned Worked Materials. I.E. Worked Materials Apportioned for Orders, but not yet Issued				4.- Available Worked Materials. I.E. Worked Materials in Stores and Shops not Apportioned		
Date Apportioned to an Order	Lot No.	No. of Pieces or Quantity	Order No. for which Apportioned	Date	No. of Pieces or Quantity	Remarks

FORM P11. BALANCE OF WORKED MATERIALS IN STORES

AP 45 (*Sheet 18 x 14 in. Ruled 48 lines in blocks of 3*)

DETAIL ANALYSIS OF EXPENSES _____ Sheets. Sheet No. _____ For Month of _____ 191

Name or Symbol of Account	THIS MONTH							TOTAL AMOUNTS				REMARKS
	Wages	Salaries	Total	Stores	Misc.	Worked Materials	This Month	Last Month	Average This Month to Date	Same Month Last Year	Average Last Year	

FORM P12. EXPENSE ANALYSIS SHEET

(*Sheet 18 x 14 in. 44 ruled lines*) **EXHIBIT B** _____ Sheets, Sheet No. 2

Sub-Divisions of INCOME ACCOUNT for Worked Materials and for Stores Sold Month of _____ 191

Description	Symbol	Average Cost per Unit	Average Selling Price per Unit	Quantity Sold During the Month	Total Cost of Merchandise Sold During the Month	Total Selling Price of Merchandise Sold During the Month	Profit	Loss
Total Sales of (*Class of Product*								
(*7 Classes here listed with*								
from 3 to 9 lines allowed								
for each.)								

FORM P13. INCOME ACCOUNT FOR WORKED MATERIALS AND FOR STORES SOLD

(Sheet 18 × 14 in.)

EXHIBIT B

_____ Sheets. Sheet No. 1

Month of _____ 191_____

INCOME ACCOUNT	(I. E. Profit and loss account) for month, giving summary of sales for the month and actual cost and selling price.
TOTAL SALES	(I.E. Shipments) of merchandise delivered during the month, and delivery and erection work billed during the month.
TOTAL COST	Of merchandise shipped during the month.
TOTAL PROFIT	On merchandise sold, and from delivery and erection
TOTAL PROFIT	From other sources
TOTAL LOSS	On merchandise sold, and from delivery and erection
TOTAL LOSS	From other sources
NET PROFIT	
NET LOSS	
TOTAL COST	Of merchandise finished during the month
TOTAL ORDERS	For merchandise on our books at end of month

Seven columns headed this month, last month, corresponding month last year, average per month this year to date, average per month for corresponding period last year, Total for this year to date, Total for last year.

Classes of Merchandise sold and profit derived from same	THIS MONTH Cost	Selling Price	Profit	LAST Cost
1st worked materials	*Twelve columns, in four groups, this month, last month, total for this year to date, total for last year, each with three columns: Cost, Selling Price, Profit.*			
2nd stores sold				
Worked materials are subdivided as follows				
26 lines follow for G, L, M, P, R and T. classes and their subdivisions				
MH Hinge machines				
MJ Jarring machines				

FORM P14. INCOME OR PROFIT AND LOSS ACCOUNT

of Profit and Loss with comparisons and averages for previous and corresponding periods. (Forms P13 and P14.)

The selling price for each class of product sold is entered in the Register of Accounts Receivable, which is divided into columns for each class. At the end of the month this register is totaled and the total of each class is transferred to the Income sheet. The cost of each article shipped is entered on the Stores Issue orders, which are checked with the Register of Accounts Receivable to see that each article is billed to the customer. The totals of each class are transferred to the Income sheet and the Profit or Loss figured.

GENERAL LEDGER BALANCE SHEET

Form P16 shows a balance sheet which is the conclusion of the bookkeeper's work for the month. The first five lines under the headings Total Assets and Total Liabilities give the general condition of the business at the end of the month, with comparisons with the preceding month and with January 1 and July 1. The remainder of the sheet subdivides the figures of each of these five lines into details.

PROOF OF THE COST SYSTEM

The Instruction Book, from which the matter on the preceding pages has been abstracted, contains the following:

The bookkeeping system offers the only means of proof of the cost system. The general ledger balance sheet offers the only representation of the condition of the business. For proof of this note the second division on the Dr. side of the balance sheet; there you will find the important part of Industrial Accounting. These accounts give the actual cost of all material bought from outside and of all manufactured product.

The bookkeeping system is no proof of the cost system. It is merely a method of condensing and recording in double-entry form the original data which are found in the wages cards, stores-issue cards, salary lists and bills for miscellaneous expenses grouped in the cost-collecting cards, transferred to the expense analysis sheet, entered in the journal, and finally posted in the ledger. If the original cost data contain errors, if errors are made anywhere in the cost-collecting cards, or if the theory upon which the expense distribution to cost of product is an erroneous one, all these errors are carried forward into the ledger where they are effectually concealed in Section 2 of the debit side of the balance sheet, in the "actual costs" of Stores, Worked Materials in Stores and Materials in Shop, and in the erroneous figures of Profit and Loss, on the credit side.

"The general ledger balance sheet offers the only representation of the condition of the business." But in a time of business depression it may not show that the "actual cost" of Stores was the cost at which they were contracted for six months before and that the market price of them now is 25 per cent lower, that the "Materials in Shop," "Cost to Date" were also purchased when prices were high, and that the "Worked Material in Stores" was made when the shop was running on half time and when the shop expense, DM, was double, and the business expense, B, was three times the normal rate. The Profit and Loss account is made up by inventorying all the materials at their inflated "actual costs," not deducting anything for shrinkage in the market value of the raw material or for loss due to idleness in the factory during the months of depression. Such is the

(*Blue-print sheet 29 x 42½ in. including 2½ in. margin at left for binding*)

EXPENSE DISTRIBUTION

JOHN DOE MANUFACTURING COMPANY

For the month of _____ 19____

			Ra	B	Shop Expense A	Shop Expense D	Construction X	Construction Y	Worked Materials P.M.G.T.R.L.	Stores Sold S		Z	
			Rates	General Expense	Auxiliary	Direct	Part Coostruction	Construction	(*One column for each class*)	Stores Issued for Sale		Totals of Entries in Horizontal Lines	
				B	A	DM	X	Y	(*Totals*)	SS			
Stores used during the month	The distribution of all stores used is obtained from the cost sheets in the planning department	1		$100	50	200	40	160	300	410	1	1260	Total cost of stores used
Miscellaneous expenses	Taken from the miscellaneous columns in the register of accounts payable Enter any misc'l charges for worked mat'l X, or Y, on detail cost sheets	2		400	130	230	40	250	600		2	1650	Total of miscl. expenses
Taxes, Insurance, Depreciation, fnterest	and any other accounts that are pro-rated Those expenses are taken from entries in the general journal	3		—	10	70	20	40	200		3	340	Total pro-rated expenses
Wages	Taken from the cost sheets and chocked with poy rolls for the month	4		200	110	200	100	250	500		4	1360	Total Wages
Totals of all columns	I.e. Total direct expenses charged to the departments, construction, part constr., worked material & stores sold	5		700	300	700	200	700	1600	410	5	4610	
Selling expenses for stores sold	Deduct 10% of cost of stores sold, 5S, from total general expense, 8B, and add same to cost of stores sold, enter at 6B and 6S.	6	10%	41						41	6	Total of all expenses for the month	
Balance of general expense	To be apportioned to construction, part construction and worked materials	7		659							7	Total of entries in this column = total of line #5	5Z = 17Y + 18Z
Apportion general expense	Multiply wages for constr., part constr., & worked materials by gen. expense rate (B rate) and enter results on this line in respective columns	9		Balance of general expense apportion and enter at 9X, 9Y, 9M, 9P, 9G, 9T, 9R, & 9L			78	193	388		9		
Total part construction		10					278				10		
Apportion part construction	One half to auxiliary expense coter at 11 A. One half to construction enter at 11 Y.	11			139		Total part construction transfer ½ to 11A. ½ to 11Y.	139			11		
Total auxiliary expense	Transfer to direct shop expense. Enter at 12 D.	12			439	439					12		
Total shop expense	To be apportioned to construction and worked materials	13			Total auxiliary expense transfer to 12D	1139					13		
Apportion shop expense	To constr. and worked mat'ls. by multiplying the "hours X cost numbers" for each account, as given on line 14, by the shop expense rate (DM rate-15 R.)	16				Total shop expense apportion to 16P, 16M, 16G, 16,T, 16R, & 16L.		342	797		16		
Total construction		17						1374			17		
								Total coostruction					
Total cost of worked materials and stores sold		18							2785 Total Cost	451 Total Cost	18	3236 Total cost of Wkd. Mat & S S.	
General expense rate	Divide balance of general expense to be apportioned (7B) by sum of wages for constr., part constr., & worked mat'l. (8X = 4X + 4Y + 4P + 4M + 4G + 4T + 4R + 4L)	8	B Rate = $\frac{7B}{8X} = \frac{659}{180+250+500} = 0.0775$				850				8		
Hours X cost numbers	For construction and worked materials. Total at 14Z.	14					Sum of wages for constr., part constr. and wk. mat. 8X = 4X + 4Y + 4P + 4M + 4G + 4T + 4R + 4L	300 Hours X cost numbers for construction	700 Hours X cost numbers for each class P.M.G T.R L.		14	1000	
Shop expense rate	Divide total shop expense (13D) by total hours X cost numbers (14Z).	15	D.M. Rate = $\frac{13D}{14Z} = \frac{1139}{1000} = 1.139$								15	Total hours X cost numbers for constr. & worked materials	

FORM P15. EXPENSE DISTRIBUTION SHEET

THE JOHN DOE MANUFACTURING COMPANY

General Ledger Balance Sheet for Month of 191 Compared with Preceding Month, Etc.

DEBIT			CREDIT	
TOTAL ASSETS The Total Assets are Divided on the next five lines below into:-			TOTAL LIABILITIES The Total Liabilities are divided on the next five lines below into:-	
1. PLANT AND OTHER FIXED ASSETS		(*Four columns*	1. LIABILITIES TO STOCKHOLDERS	(*Four columns*
2. MATERIAL IN STORES AND IN SHOP		*headings: This*	2. MISCELLANEOUS	
3. CASH AND OTHER QUICK ASSETS		*Month, Last*	3. EXTERNAL LIABILITIES	
4. UNAPPORTIONED EXPENSES		*Month, Jan. 1, 1916,*	4. EXPENSES APPORTIONED IN ADVANCE	
5. MISCELLANEOUS		*July 1, 1916*)	5. INCOME, OR PROFIT AND LOSS ACCOUNT	
These groups are again subdivided as follows:-			These groups are again subdivided as follows:-	
1. PLANT AND OTHER FIXED ASSETS			1. LIABILITIES TO STOCKHOLDERS	
Coostruction(Depreciatioo Deducted)			Capital Stock	
Patents			Surplus Fund	
Real Estate			Dividends Uopaid	
Buildings				
2. MATERIAL IN STORES AND IN SHOP			2. MISCELLANEOUS	
Stores	Actual Cost			
Worked Material Stores	Actual Cost			
Materials io Shop	Cost to Date			
3. CASH AND OTHER QUICK ASSETS			3. EXTERNAL LIABILITIES	
Casb in Haods of Cashier				
Cash in Baok				
			Notes Payable	
Accounts Receivable			Accounts Payable	
Individuals aod Co's. Miscellaneous			Iodividuals and Co's. Miscellaneous	
Stock of other Co's.			Mortgage	
Notes Receivable				
4. UNAPPORTIONED EXPENSES			4. EXPENSES APPORTIONED IN ADVANCE	
			Insuraoce	
			Interest	
Adjustment Account			Adjustment Account	
Depreciatioo				
Royalties				
Accounts in Suspeose				
5. MISCELLANEOUS			5. INCOME OR PROFIT AND LOSS ACCOUNT	
Consignmeot			Profit for Current Month	
			Previous Balance	

FORM P16. GENERAL LEDGER BALANCE SHEET

result of following the "fundamental principles": "The cost of manufactured products made for sale during a certain period equals the total expenditure of the business for the same period," and "Connect the costs with the general bookkeeping." "There you will find the important part of Industrial Accounting!"

DISTRIBUTION OF GENERAL BUSINESS AND SHOP EXPENSE

The instruction book used in the accounting room of the Philadelphia concern, after showing how the total business expense of a month is distributed over the cost of the product in proportion to the wages or direct labor cost on each productive job, continues as follows:

While this method of distributing General Expense is as proper for that class of indirect expense as any that can be devised it would not be proper for Shop Expense.

Two lathes, one 100 in.×50 ft., on large forgings, 25 cents an hour wages, the other 16 in.×4 ft., on fine work, 50 cents an hour, high skill needed. Now, on the basis of wages the work in the small lathe would have twice the amount of shop expense that would be charged to the 100-in. lathe. The work done on the larger machine should have charged against it 20 times as much for these items as is charged against the work done on the smaller machine.

	Large Lathe			Small Lathe		
Wages	10 hrs. @ 0.25	$2	50	10 hrs. @ 50¢	$5	00
Machine Burden	10 hrs. @ 1.00	10	00	10 hrs. @ 5¢		50
		$12	50		$5	50
Business Expense	10 hrs. @ .25	2	50	10 hrs. @ 50¢	5	00
		$15	00		$10	50

Why should a day's work on large forgings be charged with business expense only $2.50, and a day's work on small pieces $5.00? The large forgings may be sold in small lots to a hundred customers, and may require expensive advertising and traveling, much clerical work and great effort of the sales manager, while the fine work may all be contracted for to a customer across the street, involving a minimum of business expense. Perhaps a better division of the $7.50 business expense among these two jobs would be: heavy forgings, $7.00; fine work, 50 cents. There appears to be less reason for apportioning business expense as a percentage or direct wages than there is for apportioning shop expense on that basis.

The instruction book then proceeds to say:

The Shop Expense Rate is a figure by which the product of the machine hours on any producing job and relative cost numbers must be multiplied in order to find the amount of shop expense chargeable to that job. The total amounts thus charged to the various producing jobs must equal the total shop expense for the month.

The machine time is multiplied by its hourly rate and the amount entered on the cost sheet. At the end of the month these amounts are added up and the actual shop expense is divided by the total of the machine hours × the respective machine rates. This gives our Shop Expense Rate for the month, by which we must multiply the machine hour times their rates charged against each productive job, and enter the amounts of shop expense chargeable to the various jobs on their respective cost sheets.

EXAMPLE

	Large Lathe			Small Lathe		
Wages	10 hrs. @ 25¢	$2	50	10 hrs. @ 50¢	$5	00
Av. cost of burden based on 2500 hrs. per year	10 @ $1.00	10	00	Based on 3000 hrs. per year: 10 @ 5¢		50
		$12	50		$5	50
Burden this month	Hrs. × cost No. 100 × 1.00	$100	00	250 hrs. × 0 5	$12	50

Total hours × cost Nos., both lathes $112.50

Actual shop expense $225.00 DM rate 225 ÷ 112.50 = 2

Wages	100 hrs. × 0 25	$25	00	250 hrs. @ 50	$125	00
Shop Burden	100 × 1.00 × 2	200	00	250 × .05 × 2	25	00
		$225	00		$150	00

If 10 pieces or units are made, Average cost, large lathe, $22.50. Average cost of 10 units in small lathe, $15.00. Let us consider this example under two widely different conditions, say those of July and August, 1914. In July the shop ran full time and the shop expense was normal; DM rate = 1. In August it ran only half time, and there were extraordinary expenses for repairs, making the DM rate 2.5.

	Large Lathe				Small Lathe			
		July		Aug.		July		Aug.
Wages	100 hrs. @ 25¢	$25	00		250 hrs. @ 50¢	$125	00	
Wages	50 hrs. @ 25¢			12 50	125 hrs. @ 50¢			$62 50
Burden	100 @ $1.00 × 1	100	00		250 hrs. @ .05 × 1	12	50	
	50 @ 1.00 × 2.5			125 00	125 hrs. @ .05 × 2.5			15 62
		$125	00	$137 50		$137	50	$78 12
10 units made, average cost		12	50		10 units average	13	75	
5 units made, average cost				27 50	5 units average			15 62

These figures if carried into the inventory lead to over-valuation, and they hide the fact that the factory lost money in August on account of idleness.

The wages + burden cost per unit of forgings made in the large lathe advanced from $12.50 to $27.50, while that of the fine work made in the small lathe advanced only from $13.75 to $15.62.

Suppose we abandon the "DM rate" and figure this example on the basis of the average or normal yearly burden, $1.00 per hour for the large lathe and 5 cents per hour for the small one.

	Large Lathe				Small Lathe			
		July		Aug.		July		Aug.
Wages	100 hrs. @ 25¢	$25	00		250 hrs. @ 50¢	$125	00	
Wages	50 hrs. @ 25¢			$12 50	125 hrs. @ 50¢			$62 50
Burden	100 hrs. @ 1.00	100	00		250 hrs. @ 5¢	12	50	
Burden	50 hrs. @ 1.00			50 00	125 hrs. @ 5¢			6 25
		$125	00	$62 50		$137	50	$68 75
10 units, average cost		12	50		10 units, average	13	75	
5 units, average cost				12 50	5 units, average			13 75
Normal burden on this lathe	1 mo. @ $2500 per yr.	208	33	208 33	Normal burden	12	50	12 50
Burden earned		100	00	50 00	Burden earned	12	50	6 25
Unearned burden		108	33	158 33		0	00	6 25

The balance of unearned burden at the end of the year is to be charged to Profit and Loss.

The costs for labor and burden at which the products may be entered in the inventory according to these several ways of figuring, although the cost of material and the rate of wages are unchanged, are as below:

	Large Lathe		Small Lathe	
D M rate = 2	22	50	15	00
D M rate = 1	12	50	13	75
D M rate = 2 5	27	50	15	62

The figures $22.50 or $27.50 may be "true costs" for the purpose of the bookkeeping system, which is to make the books balance at the end of each month, "tying the costs to the general books," but they are utterly useless for any other purpose. They cannot be used either as inventory values, as a basis of profit and loss estimates, or as a basis for fixing future prices, nor are they of any use as statistics which may indicate to the management any way of reducing costs.

The charging of business expense to cost of product by the "B-rate" method, dividing the total business expense of the month among the whole product in proportion to the direct labor cost of each job makes the cost-keeping system still more inaccurate. Take the labor and burden costs of the large forgings per unit in July and August, as given above, by the DM rate method, $12.50 and $27.50, add to them the cost of material $10.00, and apportion to them the business expense on the basis of the labor cost $2.50 multiplied by the B rate, 2 for July and 4 for August, and we have:

	July		Aug	
Material	10	00	10	00
Labor	2	50	2	50
Shop Burden	10	00	25	00
Business Burden	5	00	10	00
Total Recorded Cost	27	50	47	50
Selling Price	32	50	32	50
	Profit 5	00	Loss 15	00

By this method, if the goods made in August, 1914, are not sold until January, 1915, the loss of $15.00 which should have been charged to Profit and Loss in 1914 as part of the loss due to idleness of the factory is wrongly carried over as an asset until 1915, and the loss of $15.00 will then wrongly appear as a loss on the business of the year 1915.

Another source of error in the use of this method is the charging to the cost of the work done in August, whether the work is finished or not, the business expense of the same month, when a large part of the business expense related to this work, such as advertising, traveling, salesmen's salaries, etc., may not be incurred for several months later. The salesmen's expense in August may be partly for working off an accumulated stock made in preceding months, and partly for getting orders to be executed several months later, with possibly none of it for selling the goods worked on in August.

A large part of the total business expense may be incurred in selling a minor portion of the product or in introducing a new product, while the greater part of the product is sold with a relatively small business expense. It is not good accounting to charge to the cost of production of one article any part of the business expense of selling another article.

A considerable portion of the business expense of a concern consists of the salaries of the president and general manager. In a properly organized business scarcely any of their time is spent in connection with the work of the current month in the factory; but nearly all of it on work to be done in the future. If the factory is running on half time during the current month the whole of their salaries should not be charged to the cost of product of that month, thereby increasing the inventory value of that product.

The only right way to treat business expense of the selling department is to divorce it entirely from factory costs, and to treat it as an expense of a mercantile business which is separate from the factory.

CHAPTER XIX

COSTS IN A WOODWORKING SHOP; A BAKERY; A TEXTILE MILL; A POWER PLANT

COST ACCOUNTING FOR A WOODWORKING SHOP

The Time-Study Method

Suppose a shop is making doors and sash of standard sizes for regular stock, also doors and sash of irregular sizes for special orders, and is cutting, planing, grooving, gluing and finishing a multitude of shapes and sizes, some on large and some on small orders; what sort of cost system can be devised for it which will at the same time be reasonably accurate and not too expensive? It is manifestly impracticable to use the complete job ticket system that is applicable to a machine shop or factory working on metal products, for the reason that for many of the small orders the cost of the clerical work of the job ticket, cost summary and distribution of burden would be more than the value of the product. The apportionment of the labor cost also is a matter of great difficulty, for on some orders the pieces would pass in sequence from one machine to another, some machines being operated by one man, some by two, and some by three, including the man engaged in passing the lumber from the car or pile to one of the men at the machine, and in the case of a very small order the actual labor cost of the work done by one man might be only a fraction of a cent.

For example, in making one sash, for a single plate of glass, to specified dimensions, from $1\frac{1}{4}$ inch stock, the operations would be:

1. Getting a board from a pile or car of kiln lumber.
2. Planing it on both sides.
3. Sawing it to the length of the longest dimension of the sash.
4. Returning to a pile the piece not used.
5. Sawing four strips, the top and bottom strip of different widths, the two side strips of one width.
6. Flat-edging one side of the top and bottom strips.
7. Edging and grooving one side of each of the side strips.
8. Molding the inner edge of all four strips.
9. Cutting four mortises and four tenons.
10. Drilling holes for corner pins.
11. Gluing and assembling.

The recording of the cost of lumber for each separate order or job also involves more clerical work than it is worth. The waste of lumber in cutting boards into the different widths and lengths of pieces required for the several orders differs with the sizes of the boards and of the pieces, and also with the quality of the lumber as regards its freedom from knots and cracks.

The Accounting System of a woodworking establishment may be made comparatively simple. In the General Ledger Factory Plant is charged with the appraised value of the real estate and equipment. Factory Operating account is charged with the appraised or inventory value of the material and supplies on hand at the beginning of the year ,including work in process and finished work ready for shipment, also with monthly disbursements of cash for pay roll and other expenses, with accounts payable certified by the factory for payment, and a monthly charge of one-twelfth of the annual cost for interest on the total investment in the factory, insurance, taxes, and reserve for depreciation. The account is credited, and Sales Department charged, with the invoices rendered by the factory for goods shipped, at "factory cost" or the prices agreed upon between the factory and the sales department as to what shall be considered factory cost.

On the Factory Ledger, Company account is credited with the charges made in the General Ledger against Factory Operating account, Cash, Lumber, Supplies and Burden being charged. Cash is credited with cash payments for Labor, Supplies and other expenses. Lumber is charged, and Labor and Burden credited for expenditures connected with the handling, storage and drying of lumber. Work in Process is charged with the cost of manufacturing operations, Lumber, Labor, Supplies and Burden being credited. A Power account may be kept, charging it with labor in the power plant, with fuel and other supplies, and with burden, for its proportion of interest, taxes, insurance, etc., crediting it by Lumber, for the value of the steam used for drying and by Work in Process for the remainder of the monthly expenditure for the power plant.

Company account is charged and Work in Process credited with shipments of finished product.

At the end of the year, when an inventory of Lumber, Supplies and Work in Process has been taken these accounts may show either gains or losses. The apparent gains in Work in Process may be done to the charges to Company for the products shipped being higher than their real cost, and the gains in Burden to the sum of the monthly credits to Burden and corresponding charges to Lumber and to Work in Process being higher than the charges against Burden during the year. The apparent losses may be due to idleness or inefficiency, to excessive wastes of lumber, or to errors in the costing of finished product that lead to undercharges to Company for the goods shipped. All of these gains or losses are to be closed into Company account at the end of the year.

Statistical records and charts should be made, with monthly entries, showing the principal facts of the progress of the business. They may contain the following items:

Lumber received—Feet B.M. Cost.

Lumber delivered to factory—Feet B.M. Cost.

No. of men employed—Man-hours. Payroll.

Credits to Company—Cash, Accts. Payable, General Charges.

Coal used in Power Plant. Total Cost for Power.

Cost of Drying per 1000 feet B.M.

Machine Record—Hours each machine ran per month.

Total Charges to Work in Process.

Total Credits to Work in Process (shipments).

Increase or decrease of Inventory (estimated).

Apparent gain or loss in Work in Process account.

Charges and Credits of Burden account.

Apparent loss and gain in Burden account.

The recorded gains and losses should be scrutinized monthly to learn whether they are due to bookkeeping or costing errors, to undercharging or overcharging of burden or other costs, to bad planning of work or other inefficient management, to idleness of machinery, to unusual waste of lumber or other cause. Gains may be made, when the factory is crowded with orders, by planning the work so as to bunch orders and minimize the time required for setting tools, blades and gages and for starting and speeding up the machines, and so as to lessen the waste of lumber, also by running machinery overtime, so as to decrease the proportion of burden to direct labor cost.

A study of the losses may show that the chief loss is caused by idle machinery and that this is due to inefficiency of the sales department. Steps may then be taken to remedy this condition.

Cast Finding by the Time-Study Method. It being impracticable to use the job ticket system, obtaining the material, labor and burden cost of every operation on every part or piece of the product, the best method of determining the costs at which the several sizes and styles of product are to be billed to the sales department or entered in the inventory is to obtain by systematic measurement, time study and analysis the standard labor, material and burden costs of selected representative articles, and from them to compile price schedules and charts from which the standard factory cost of any size of any given style may be quickly ascertained.

The cost of material for sash, for example, may be obtained by measuring the number of feet, board measure, of lumber required to fill orders for several different sizes of one style of sash. When the figures are plotted on a curve showing the relation of amount of lumber to size of the sash, the cost of material for any intermediate size may be readily determined.

For the labor costs, studies must be made of the time required for each operation on several different styles and sizes of sash. For this purpose time-study cards should be prepared, as below, and a stop-watch with a long hand indicating hundredths of a minute should be used to obtain the elemental times of each operation.

TIME STUDY MACHINE NO. DATE

Operation *Rip Sawing.* For *Sash.* Size *36 × 30 inches*
Driving Shaft Revs. per min, *420.*
No. of Blades or Tools in Use *4.*
Feed { Hand / Automatic } *16* ft. in *0.80* min. Ft. per min. *20.*
Size of Plank, *16* ft. × *12* in. × *1¼* in. Makes material for *5* sash.
Waste *30* per cent.

Test No.	1		2	3	4	5	Aver.
Operations	Start and Fin. Hr. Min.	Time Min.					Time Min.
Oiling machine	7.01	10					
	02.00	0.90					
Setting tools & gages.	04.15	2.15					
Starting & speeding	04.25	0.10					
	04 50	0 25					
Total preparing		3.40					3.20
Placing material	04.50						
Feeding material	04.70	0.20					
	05.90	1.20					
Removing material	06.20	.30					
Total operating time		1 70					1 65

The result of the above time study shows that the actual operating time on a single plank is 1.65 minutes, on the average, including the time for placing and removing the material, but that it takes 3.20 minutes for getting the machine ready for doing the work. This preparing time would be the same for a hundred planks, if they were all cut to the same sizes, as for one, and it is part of the burden which must in some way be distributed over the product.

Burden Distribution The first step in planning the method of distributing the burden is to make a schedule of the annual burden pertaining to the use of the machines, and to deduce therefrom an hourly burden charge, or machine-hour burden, in the manner customary in metal-working shops. The burden not pertaining to machine hours, but rather to the material handled, must be estimated separately. These estimates may result in statements like the following:

Estimated Annual Machine Burden

Machine	A	B	C	D	E	F	G	H_1	H_2	H_3	Total
Int., Ins., Tax Dep'n, Rep's.	$300	$280	$240	$180	$160	$120	$ 80	$ 60	$40	$20	$1480
Rent of Space	120	90	90	60	45	45	45	45	30	30	600
Cost of Power	300	240	180	150	120	60	30	30	30	30	1170
Indirect Labor	220	220	170	170	120	70	50	50	50	50	1170
Total	$940	$830	$680	$560	$445	$295	$205	$185	$150	$130	$4420
Est. Hours per Year	2400	2400	2200	2000	2000	2200	1800	1500	1500	1300	
Burden Charge, Cents per hr.	40	35	32	28	22	14	12	12	10	10	

Burden on Material, not chargeable to machine hours.

Storage, space 2000 sq.ft. at $2. Int., Ins., Tax, Dep'n, 15 per cent.	$600
Handling, Piling, etc., 2 men at $900	1800
Supervision, Clerical Work, Watchman, Insurance on Material, Interest on Investment in Material, etc	3600
	$6000

This $6000 is to be apportioned in some way to the cost of the finished product, but it is directly proportional neither to the quantity of material used in an article, to the direct labor cost, to the man-hours or to the machine-hours. The best way of distributing it is probably a combination of material burden and job burden. An order for a single sash involves as much clerical work as an order for a hundred sash of the same size, as much time for setting gages and tools in the machines, nearly as much supervision, and a far greater amount of storage space relatively to the quantity of material.

Suppose the amount of material handled is two kiln-car loads, of 8000 feet B.M. each, per day, or a total of 4800 thousand feet B.M. per year, and that the number of job tickets or orders is 30 per day on the average (one ticket for one article or any number of articles of one kind and size), or say 9000 job tickets per year, a charge of $1 per 1000 feet B.M. would make $4800 per year, and a charge of 20 cents for each job ticket would make $1800 per year for job burden; the total, $6600, is 10 per cent more than the estimated burden on material, and these charges may therefore be considered fair and safe. In a large factory a greater refinement in the distribution of the burden not chargeable to machine hours may be desirable, but it should not be undertaken until after an analysis of a year's statistics of burden costs and charges has been made.

When the method of making burden charges has been decided upon and enough time studies have been made to obtain fair average operating times, Cost Estimate Cards may be made out as follows:

Cost Estimate. 36×30-inch sash. Style A. Plank, 16 feet × 12 × 1¼ inch = 20 feet B.M. makes 5 sash, average 4 feet B.M. each. 1000 feet B.M. makes 250.

		Per Sash
Cost for Material at $30 per M. 30 ÷ 250		12 00 cents
Material Burden. $1 per M.		0.40
Labor Operation No. 1.	Standard Operating Time per Plank... 1.65 min.	
	Add 20% for rest periods and delays.. .35	
	2.00 min.	
	Time per sash 0.4 min. at 40 cents per hour	0 27
	Machine Burden, 30 cents per hour × 0.4 ÷ 60	0.20
Operation No.	(Add Labor and Machine Burden for each of the other operations)	
	Total	

Add Job Burden = 20 cents divided by the number of sash of one size on one shop order.

(Example: If an order was for one sash the addition would be 20 cents, but if it was for 40 sash of one size the addition would be 20 ÷ 40 = 0.5 cent.

When cards like the above have been made for several size of one style of sash a large Price Schedule Card (from which charges from the factory to the sales department are made) may be prepared as below:

FACTORY COST OF ..... Width, In.					..... SASH, STYLE A			
		20	22	24	44	46	48	
Height, In.	20	*16*						
	22			*18*				
	24		*18*		*27*			
	41							
	46							
	48						*36*	

Form WW. Schedule of Factory Cost of Sash

The blank spaces on the card are filled in from time to time as results of time studies on the work going through the shop accumulate. Charts of curves may be made from such figures as are available, and they may be used for estimates of costs of intermediate sizes, time studies of which have not been made.

The same time studies may be used in the preparation of cards showing the cost of machine operations independent of the size of the sash, such as cost of sawing strips, of planing and grooving, of cross-sawing, of assembling, gluing, etc. These will be useful in making estimates on new orders for unusual sizes, and for giving data to the management which may lead to reduction of cost of some of the operations.

All of the cards should be filed in such a manner that they may be readily accessible. A good way of filing the large factory cost schedule, for example, is to put it under a heavy glass plate covering the billing-clerk's desk.

Planning and Scheduling Work for the Shop. This is usually done by a planning or production clerk, and is not the work of a cost accountant, but as in a small shop one man may perform the functions of bookkeeper, cost clerk, production clerk and correspondent, it may not be out of place here to suggest to him how he may shorten his own work and at the same time save some of the labor of the shop foreman and some of the time required for adjusting the gages and cutting tools of the machines when changing from one dimension of product to another. By doing this he is qualifying himself to be some day the manager of a large shop.

A schedule of dimensions for sawing strips, and for planing and grooving them, for the several standard sizes of sash, may be made as below, and copies of it tacked to posts near the rip saw and the strip planer.

Widths of Strips for Standard Sash

Sash Widths.		20 to 28			30 to 36			38 to 44			46 to		
Heights		B	T	2S	B	T	2S	B	T	2S	B	T	2S
	Saw	2¾	1¾	2¼	3	2	2¼	3¼	2¼	2½	3½	2½	2¾
20 to 28	Pl.	2½	1½	2	2¾	1¾	2	3	2	2¼	3¼	2¼	2½
30 to 36		same			same								
38 to 44													
46 to													

B, bottom strip; T, top; 2S, two sides. Pl., plane and groove. "Same" means the same dimensions as above.

A card for the length of strips should be prepared for the cross-saw as follows:

Lengths of Strips for Standard Sash

Sash Widths.	20		22		24	26
Heights	BT	2S	BT	2S		
20	24	24	26	24		
22	24	26	26	26		
24	24	28	26	28		
26						

Shop Order Cards may be sent into the shop, reading about as below:

Office Order No. 724. Customer.
Date.....
Job Orders.
4317..... 1 sash 20×20 standard
4318..... 4 sash 30×30 standard
4319..... 4 sash 36×30 standard
4320..... 2 sash 46×36 special, see sketch

These cards should be made in triplicate, on different colors of paper, say manila for the strip sawing, white for the planing and grooving, and yellow for cross-sawing and subsequent operations. The yellow card follows the work through the shop to the shipping room where it meets the shipping order, or to the finished product storing room where the sash is stored. In either case it is returned to the office, where the invoice may be made from it, after the "factory costs" of the several sizes, taken from the standard cost schedules, are written upon it, or it may be filed in the inventory of stored goods. The total of the values entered on all these cards during the month is the figure for the monthly credit to Work in Process account.

The Timekeeping System used with this method of costing may be the simplest possible. It may be an ordinary time book, with the number of hours each man works in each day being entered upon it, or a clock system with "in" and "out" cards or other kinds of record. In either case a symbol should be used to show whether the man is working on production, in which case his time is charged to Work in Process, or whether his work is "indirect labor," in which case it is charged to Burden.

Use of the Cost System in other Businesses. The time-study method of costing above described is applicable to many other kinds of factories than woodworking, and it may be used in certain departments of large factories in which other systems, such as the job ticket and machine-hour system, are used. Each department of a factory should have the cost system that is best adapted to the needs of that department.

COST ACCOUNTS FOR A BAKERY

A bakery may make loaves of bread of different sizes and qualities, rolls, pies, cakes, etc. A job ticket should be made daily for each style, quality and size, giving the number required of each. The following form may be used:

Date.....

MAKE 300 LOAVES XXX BREAD

Material	Amount	Cost
Flour	1 bbl.	5.50
Yeast	1½ lb.	.30
Lard	3 lb.	.36
Sugar	2 lb.	.10
Salt	3 lb.	.03
Incidental		.40
Total Material		6.69
Labor, total per day	6.30	
Proportion for this order one-third		2.10
Oven and Fuel:		
Total this day	2.40	
Proportion one-third		.80
General Expense for day	5.40	
Proportion one-third		1.80
		11.39
Number loaves made	290	
Cost each		.03

The proportion of the total daily labor, oven and expense cost which is to be apportioned to the several job tickets is to be estimated on any basis that may seem most equitable such as on the number of pieces, weight of product, or selling value.

A daily cost card may be made, summarizing all the job tickets of the day in the following form:

Date.....

Kind	Bread XXX	Bread X	Cake A	Cake B	Total
Material	6.69				
Labor	2.10				
Oven	.80				
General Expense	1.80				
Total	11 39				
No. of pieces	300				
Cost each	.03				

The cards for a month may be added together and entered on a monthly cost card, on which the total material may be compared with the bills for material purchased, the total labor with the pay roll, and the total for oven and general expense taken together with the actual payments on expense accounts. On this card also may be entered the cost of selling and delivering, the charges and receipts from sales and the monthly profits.

TEXTILE COST ACCOUNTING *

Cost Estimates and Cost Records. Consider that an order for a fabric has been received, conditioned on a certain price. The records show that this fabric was previously made at a certain cost. It obviously would not do to accept this order without taking into consideration all changes in conditions that have taken place since the former production. Wages may have increased, automatic looms may have replaced plain looms, the price of raw material may have advanced, and a number of the elements of cost may have changed, which would alter the previous cost. Consequently an estimate is made, based on the known facts taking these changes into consideration as accurately as possible. The order is accepted because the estimate indicates that, provided the conditions considered therein hold true, a profit should result from the sale. During the actual manufacture of the order, however, alterations of conditions occur which were not anticipated. The production decreased, the percentage of second quality goods increased; perhaps a number of such cost factors varied. In consequence the anticipated profit becomes doubtful, and it is evident that the estimate cannot be used as a guarantee of profit. After the fabric is completed, the cost is carefully compiled and the true cost, regardless of the existing conditions, determined. This affords a proof of the accuracy or inaccuracy of the preliminary estimate, determines whether or not the order has been profitable and becomes a basis for estimating more accurately on future orders.

* Condensed from a paper by C. B. Annett and C. F. Cunningham. *Trans. A. S. M. E.*, vol. 35 (1913), p. 555.

The general storekeeper should have charge of and be responsible for all raw materials, semi-finished and finished stock wherever located. This does not necessarily imply that all stores should be centralized in one place, but it does imply that one person should be held responsible for its proper care and for correct reporting of the receipts and disbursements of all materials.

Lot Costs. There are two general methods of collecting cost data: (*a*) By definite lots or orders; and (*b*) by operations. The first method provides for the determination of the cost of definite quantities of product and is applicable only to cases where the material can be processed in definite lots and kept intact through the several operations. These requirements render this method impracticable in such textile mills as largely manufacture what are known as staple products. The production in such cases is so continuous that it cannot be readily segregated into lots or batches.

Production orders should be issued as the authority for processing all materials entering directly into the product. They should be numbered serially and all expenditures of labor and material on account of them should be charged to these numbers. It is not essential that an order should cover the complete process from raw material to finished product, but it is necessary that it should cover a complete stage of production.

All disbursements of materials from stores should be priced at cost and charged to the proper order number.

For collecting labor cost data, timekeepers should be supplemented, so far as possible, with mechanical recorders which can neither err nor misrepresent.

Distribution of expenses may be divided into two parts: First, the distribution of the general expense of the mill, together with power, heat and light to the producing departments; and second, the apportionment of the total departmental expense thus obtained over the product passing through the departments.

Power should be distributed on the basis of power consumed, depreciation on the basis of the value of the plant and equipment used by the department. In a similar manner each item of general expense should be taken up, and the most equitable method of distribution determined.

The total departmental indirect cost thus obtained may be apportioned over the product by any one of several methods. It is generally desirable in textile mills, however, to use the machine hour basis or its equivalent, as the machine is largely the unit of production.

The cost of direct material and direct labor can be determined as soon as the order is completed, but the exact amount to be added for indirect expense cannot be ascertained until after the close of the period. It is, therefore, common practice in figuring current costs to use the rates based on the results of previous periods. While this is the only practicable method to pursue when immediate cost figures are required, it nevertheless is liable to error and should only be used when it is not practicable to wait until the close of the period.

Operation Costs. The second method, that of operation costs, as the name implies, provides for the determination of the cost of individual operations. Given the total cost of each operation and the loss by shrinkage of material from operation to operation, the total cost of any product, or the cost at any desired stage of completion may be found by combining these costs. They must, however, be combined only with a full knowledge of the shrinkage and the exact order in which the several operations were performed. This method is applicable to mills in which the production is continuous, and, therefore, is adapted to a large class of textile mills, especially those manufacturing staple cotton goods.

The foundation of operation costs rests upon an accurate knowledge of the shrinkage from operation to operation. There are in use several methods of measuring production, but none of them are entirely satisfactory.

Because of the fact that the majority of the fibres used in the manufacture of textiles are subject to a considerable variation in weight, due to the rapidity with which they absorb and discharge moisture, if weight is used as the unit of measure it is subject to a corresponding variation. The most practicable unit of measure for yarn, both finished and semi-finished, seems to be the pound. Cloth may be measured either by the pound or the yard, whichever is the more convenient.

The collection of the cost data under this plan differs from that used in the first plan, in that there is no special production order number against which the various expenditures of labor and material can be charged and it is, therefore, necessary to use the operation as the unit of cost. It is essential to this scheme that the various operations be definitely determined and designated by a number. The several different kinds of product should also be numbered.

All disbursements of direct material from stores should be priced at cost and charged in the mill ledger to the first operation through which the material passes, classified to kind of raw material. Provision should be made for accounting for the value of the waste made in each operation. The direct material accounts should be subdivided as to kind of raw material, rather than kind of product, as it is usually impracticable to obtain a report of waste classified as to kind of product. Each operation and each kind of material should be credited with the proper amount for waste. Shrinkages are constant only in so far as the cause is either natural or due to mechanical appliances, and shrinkages due to "human elements" are subject to wide variation. Considering that the waste in woolen mills is over 50 per cent of the raw material and in cotton mills over 15 per cent, it seems well worth while to give this problem serious consideration.

All direct labor should be analyzed as to operation and kind of product and charged in the mill ledger to the proper account. The total indirect cost for each operation should be determined in much the same manner as explained under lot costs. It should then be apportioned to the several kinds of product and charged to the proper accounts in the mill ledger. At the close of any period, the unit cost of any operation may be determined by dividing the total expenditure on the operation for the period by the total amount of product which has passed through the operation during the same period.

The total cost of any given product cannot be determined simply by adding together the several operation costs, considering the shrinkage from operation to operation. To obtain the cost of any operation in the completed product, it is necessary to increase the operation cost, in reciprocal proportion to the shrinkage from the end of that operation to the finished product. For example, if the cost of an operation is $0.015 and the shrinkage of product is 25 per cent, the operation cost in completed product would be $\frac{\$0.015}{100\% - 25\%} = \$0.02$. It would be possible to determine the total cost of product by this method, except for the fact that the exact sequence of operations is not readily ascertainable, making it impossible to determine accurately the amount of shrinkage, especially in a mill making a variety of products.

A more satisfactory method is to build up the total cost, operation by operation, beginning with the first operation and charging forward to each succeeding operation the cumulative cost of all preceding operations.

In many cases, the product of one operation is made into a number of different kinds of product in a succeeding operation. For example, one size of roving may be spun into several sizes of yarn and it is necessary in such cases to apportion the amount charged forward from the previous operation to the succeeding operation, based on the total production of each kind of product in the succeeding operation. By this method of cost finding, the inventory of product in process is automatically priced and, further, it is possible to determine the cost of the product shipped during the period. The operation cost method not only provides for obtaining the detail costs by operations, but also the total cost of all kinds of product.

A mill or inventory ledger should be opened, designed to collect and control the various facts regarding the manufacturing costs and inventory records. This should be done regardless of whether costs are determined by means of the definite lot or operation plan. The mill ledger at the close of each period should be in balance with the controlling account in the private ledger.

The various items of expense not distributed or applying to product in process, should be so segregated that they can be easily checked against uncompleted costs and the uncompleted costs in turn checked against the product in process account. By this means at the close of each period, be it one or four weeks, or one or several months, the accuracy of the costs compiled during the period is demonstrated.

STANDARDIZATION OF POWER PLANT OPERATING COSTS *

The cost of manufacture of power or any other commodity is the chief criterion upon which the market price, range of use, legislation, future developments, social welfare, etc., are depending. Few if any of these questions can be intelligently answered from the knowledge of actual costs, owing to the effect of an unknown factor—degree of perfection of the actual performance. A cost report should tell:

a What the power costs.
b What it should cost.
c Where the loss has occurred.
d Why the loss has occurred.

These questions answered, elimination of waste is a comparatively simple engineering problem.

Estimates of probable future expenses are usually based either on past performances modified by expectations, or on data obtained from actual performance of another plant considered as similar. The accuracy of such estimates depends at least on the following conditions:

a How reliable were the cost records used.
b How near the possibilities were realized.
c How close is the similarity of the equipment of plants under consideration.
d What effect the location has.
e What effect the nature of load has.
f What effect the labor market produces.
g How completely the future factors were foreseen.

Since there is, however, no assurance that in the *sample plant* the operating methods are perfect, neither is it reasonable to expect that another plant is in every respect identical to the *sample plant.*

Table 1 presents examples of a typical effort to make use of cost data comparing monthly cost reports of seven central stations. Their equipments are widely different; no two of them use the same grade of coal; the arrangement of machinery requires in some cases double the number of attendants. There are differences in characteristic of current, distribution of load and peaks during the day, etc. Under such circumstances we cannot say from these data that one is operating more efficiently than another.

Even if all factors are fully accounted for, the fact that two plants are equally economical does not tell how far each of them is from the possible degree of perfection.

Proper tabulation and distribution of costs is of less importance than a satisfactory method of analyzing the data collected.

CLASSIFICATION OF EXPENSES

All expenses incurred in the course of power production fall under analysis into two main groups:

a Constant (within a certain range) for any output.
b Variable in some direct proportion with the output.

Expenses that are independent of volume of output are at the same time independent of each other and do not characterize the efficiency of processes performed in the power plant. Their effect on unit cost is represented by a parabolic curve decreasing with the increase of output. They are exemplified by interest on investment, depreciation, sinking fund, insurances, management, pay roll (in some cases), taxes, etc.

Expenses that vary with the output of the plant characterize, other conditions being constant, the efficiency of operation, and their elements stand together in dependent

* Abstract of a paper by Walter N. Polakov, presented at the Meeting of the New York local section of The American Society of Mechanical Engineers, January 11, 1916.

Comparative Cost of Operation and Maintenance of Power Plants—June, 1915

			A		B		C		D		E		F		G	
			Dollars, Total	Cents per kw-hr.	Dollars, Total	Cents per kw-hr.	Dollars, Total	Cents per kw-hr.	Dollars, Total	Cents per kw-hr.	Dollars, Total	Cents per kw-hr.	Dollars, Total	Cents per kw-hr.	Dollars, Total	Cents per kw-hr.
Operation	Labor	Boiler Room	2,233	.036	1,639	.056	2,686	.025	4,967	0195	3,076	.0318	3,283	.0855	1,133	.052
		Turbine Room	1,116	.018	679	.024	1,682	.016	3,156	0124	1,471	.0153	1,472	.0383	756	.035
		Electrical	1,080	.018	522	.018	536	.005	982	.0039	1,105	.0114	264	.0120	144	.007
		Superv.—Janitors and Watchmen	563	.009	531	.018	601	.006	1,230	.0049	460	.0048	1,061	.0276	149	.007
		Total Operating Labor	4,993	.081	3,374	.116	5,506	.052	10,336	.0407	6,113	.0633	6,281	.1634	2,184	.101
	Material	Coal	20,535	.335	7,338	.252	29,945	.285	73,803	.2908	35,260	.3648	11,820	.3075	8,587	.395
		Water	675	.011	59	.002	16,18	.015	475	.0019	1,353	.0141	789	.0205	30	.002
		Lubricants	84	.002	61	.002	44	.001	226	.0009	270	.0028	135	.0035	68	.003
		Miscellaneous Material	194	.003	157	.005	27	.000	2,043	.0080	35	.0004	555	.0145	149	.007
		Miscellaneous Charges	20	.000	Cr. 1	.000	757	.007							129	.006
		Total Operating Material	21,510	.351	7,614	.261	32,394	.308	76,549	.3016	36,920	.3821	13,300	.3460	8,966	.413
		Total Operation	26,503	.432	10,989	.377	37,901	.360	86,886	.3423	43,034	.4454	19,582	.5094	11,150	.514
Maintenance	Labor	Building	40	.001	129	.004	190	.002	1,312	.0052	140	.0015	77	.0020	2	.000
		Boilers	291	.005	319	.011	703	.007	641	.0025	751	.0078	279	.0073	139	.006
		Boiler Room Auxiliary Apparatus	173	.003	268	.009	594	.005	520	.0020	280	.0029	66	.0017	31	.002
		Turbines	1,055	.017	27	.001	328	.003	55	.0002	361	.0037	286	.0075	1	.000
		Auxiliary Apparatus	142	.002	21	.001	561	.005	322	.0013	176	.0018	334	.0087	6	.000
		Electrical Apparatus	9	.000	1	.000	399	.004	119	.0005	353	.0037	85	.0022	1	.000
		Piping	85	.001	54	.002	389	.004	433	.0017	119	.0012	131	.0034	136	.006
		Miscellaneous	49	.001	55	.002	132	.001	55	.0002	396	.0041	1	.0001	23	.002
		Total Maintenance Labor	1,847	.030	876	.030	3,299	.031	3,460	.0136	2,580	.0267	1,263	.0329	343	.016
	Material	Building	212	.004	99	.004	799	.008	3,490	.0137	2	.0000	29	.0008	15	.001
		Boilers	295	.005	66	.003	895	.008	1,389	.0055	702	.0072	169	.0044	457	.021
		Boiler Room Auxiliary Apparatus	50	.001	40	.001	836	.008	529	.0021	88	.0009	73	.0019	36	.002
		Turbines	78	.001		.000	739	.007	27	.0001	18	.0002	78	.0020	5	.000
		Auxiliary Apparatus	41	.001	8	.000	1,344	.013	68	.0002	143	.0015	1,300	.0338	28	.001
		Electrical Apparatus	14	.000		.000	138	.001	766	.0031	137	.0014	162	.0042		
		Piping	20	.000	7	.000	220	.002	574	.0023	81	.0008	200	.0052	149	.007
		Miscellaneous	8	.000	2	.000	127	.001	82	.0003	209	.0022			60	.003
		Total Maintenance Material	720	.012	226	.008	5,100	.048	6,927	.0273	1,383	.0143	2,013	.0523	752	.035
		Total Maintenance	2,568	.042	1,102	.038	8,399	.079	10,387	.0409	3,963	.0410	3,276	.0852	1,095	.051
Summary		Total Labor	6,841	.111	4,250	.146	8,805	.084	13,797	.0543	6,693	.0900	7,545	.1963	2,527	.117
		Total Material	22,230	.363	7,841	.269	37,495	.356	83,476	.3289	38,303	.3964	15,314	.3983	9,718	.445
		Total Labor and Material Power Station Proper	29,072	.474	12,091	.415	46,300	.440	97,273	.3832	46,997	.4864	22,859	.5946	12,246	.562
		Other Items Charged to Power Station Accounts	676	.011	676	.023	294	.003	2,024	.0080			966	.0252	255	.013
		Total	29,748	.485	12,768	.438	46,595	.443	99,298	.3912	46,997	.4864	23,826	.6198	12,502	.575
		Net Output in kw-hrs. (thousands)	6,133		2,915		10,509		25,286		9,664		3,844		2,171	
		Total Power Generated (thous.)	6,211		2,941		10,625		25,385		9,781		4,043		2,171	
		Lb. Coal per kw-hr.	2.68		2.72		2.18		2.062		2.682		3.78		3.40	
		Cost of Coal per 2000 lb., Dollars	2.50		1.85		2.613		2.803		2.72		1.61		2.33	
		Load Factor—Machine, Per Cent	59.6		74.5		64.56		73.17		86.6		49.0		64.0	
		Load Factor—15 Min. Max., Per Cent	45.3		23.8		36.37		90.44		58.1		35.0		112.0	
		B.t.u. per net kw-hr. Output	38,289		33,513		30,716		29,561		38,046		43,627		49,300	

FORM POL. 1. COST OF OPERATION AND MAINTENANCE OF POWER PLANTS

sequence. If represented graphically, they show very irregular shaped curves peculiar to each set of equipment. Unit cost has a tendency to drop with increased output, as the efficiency of boilers, turbines, etc., tends to improve with increased load; yet as with higher degrees of overload the efficiency decreases, the unit cost rises. With further increase of load when an additional unit is started, the efficiency again begins to improve until their cumulative efficient capacity is exceeded, when the unit cost commences to increase again. Such waves are sometimes very pronounced and generally, throughout the range of the plant's capacity, the number of waves on the unit cost curve is equal to the number of generating units installed.

The criterion of economy is formulated by the interplay of three factors, *time*, *product* and *cost*. When only one factor varies, its effect on economy can easily be foreseen. Thus greater product, without change of time required or cost, increases the economy. Increase of either time of production or cost of production reduces the economy.

To determine the *economic limit* reached by continuous increase or decrease of influential elements is by no means an easy problem, but unless it is solved we are in the dark not only as to *what economy can be obtained*, but also *what changes in conditions and methods are essential.*

STANDARD COSTS

It is relatively unimportant whether the maximum limit of economy is determined empirically by rigorous observations, tests and analyses of all influential elements, or calculated from the principal data already available. *It is imperative that such study be made and the economy limit established, as this is the only criterion for judging the actual performance. Unless standard costs are established there is no measure of existing losses or exact knowledge how to eliminate them.*

In the determination of standard operating cost, such factors as inherent efficiency of equipment, its efficiency under different loads, prices of fuel and supplies, necessary and sufficient number of attendants and their compensation, etc., are taken into consideration for a given plant. Any deviation observed between the actual operating cost and this standard cost indicates that some of the necessary conditions were not lived up to and, if standardization has been carried out in sufficient detail, it leads directly to the allocation of the loss to operating methods. On the other hand, any change in the basic data used in determination of the standard cost being known, adjustment of the standard cost can easily be made before the blame is put at the door of the operators. The efficiency of the thermo dynamic process should be made a subject of a thorough investigation to ascertain first the maximum efficiency limit of each partial process, and then the result of their interplay. When this is accomplished, the entire process will be restudied for the purpose of standardizing methods and adjusting for such a balance of efficiencies of partial processes as will secure the maximum profit or economy from the expenditure of time, energy and money involved. It is sometimes found that the most economical thermal efficiency is somewhat below the maximum obtainable, as the slight additional gain in efficiency necessary to reach the maximum is not warranted by the expenditure required for its attainment. When these limiting conditions are studied and determined, a method can then be defined for each member of the working force, prescribing his duties and the conditions he must maintain to secure the *most profitable* degree of efficiency.

Upon the conclusion of these studies, the best efficiency of each unit and their combination being known for any load, the standard cost for any output in a given time unit can be conveniently represented in graphical form.

The principles of determining the standard cost of maintenance and upkeep of the plant and equipment are substantially the same; the method of study, however, is somewhat different. It involves a study of design and construction of all elements of equipment; minute records of their service and cost of maintenance may lead to a modification of design, use of cheaper renewable parts, etc. Next, the standardization of supplies, beginning in the laboratory and followed by actual service tests, helps to determine not alone the purchase price, but the lowest service cost. Finally, time studies embracing schedules for inspection, routes for maintenance men, standardization of tools, motions, methods, etc., conclude the investigation. The criterion is, of course, not the wages of the employee, but freedom from accidents, breakdowns and the lowest attainable cost of upkeep per unit of the plant's output.

CURVES OF STANDARD COSTS

Upon conclusion of this double analysis of the maximum economy obtainable, the graphs of standard cost of power production may be drawn. Curves may be conveniently arranged in the coordinates of cost and product per unit of time.

Figs. 1 and 2 represent curves of standard operating costs. It is evident that any number of curves may be plotted following the above method, each curve representing an itemized standard cost according to the adopted classification. Fig. 1 is thus prepared for a medium size public utility central station.

Fig. 2 illustrates a few characteristic curves of standard cost per kilowatt-hour for various rates of output of a large central station feeding the lines of an electrified trunk railroad.

USE OF STANDARD COST CURVES

The entire cost record visualized by graphical representations of the items of account is found very convenient. An example of such a graph is seen in Fig. 3, wherein the actual unit cost and the standard unit cost are plotted to the same scale, the deviation of one from the other suggesting at a glance the degree of perfection of the performance. The total expense curve and the cumulative expense curve may be shown on the same graph to a suitable scale; the latter curve is found serviceable for comparing these items

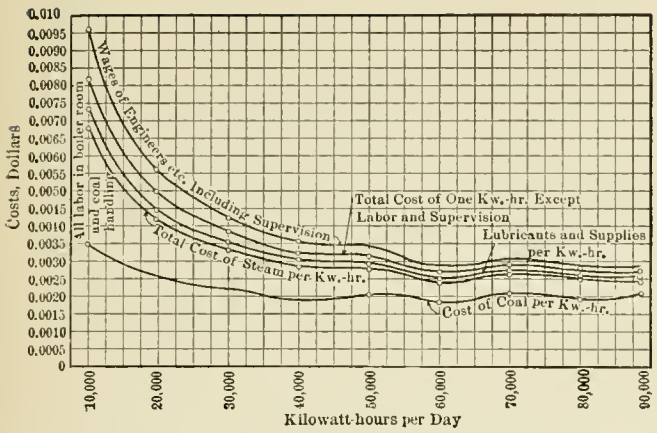


FIG. 1.—CURVES SHOWING VARIATION IN STANDARD COSTS OF OPERATION IN A PUBLIC UTILITY CENTRAL STATION.

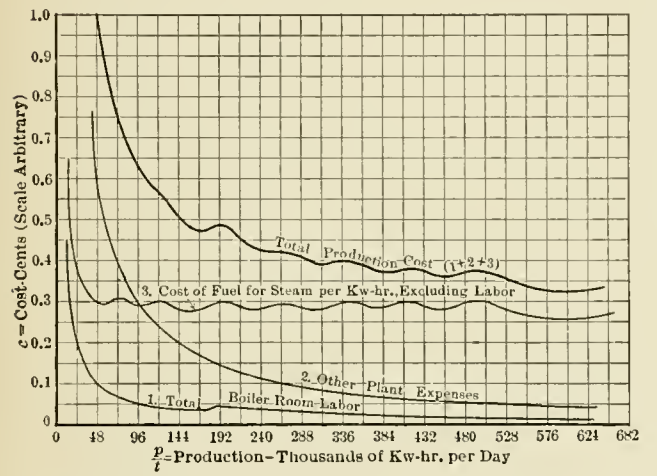


FIG. 2.—CURVES SHOWING VARIATION OF STANDARD COSTS OF POWER PRODUCTION AT AN ELECTRIFIED RAILWAY CENTRAL PLANT.

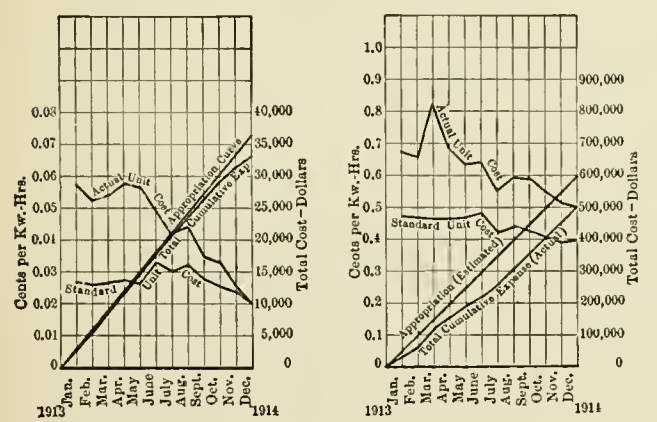


FIG. 3.—VISUALIZED RECORDS OF THE ENTIRE COST OF POWER PLANT OPERATION, IN WHICH THE ACTUAL UNIT COST AND THE STANDARD UNIT COST ARE PLOTTED TO THE SAME SCALE.

with the appropriation made. A cost system kept on a card file in this manner will represent clearly in any desired detail for any length of time and at any period:

a How much was spent.
b How much each unit of output cost.
c How much it should have cost.
d What the fluctuations of expenses and unit cost are.
e What the fluctuations of efficiency are.
f How close the actual amount spent in any time is to the appropriation.

If the exact total of expenditure is wanted it can be had at any time from the book records, whereas the use of books and figures exclusively lacks the comprehensiveness and visual instructive value of graphs.

By comparing standard costs of one plant with those of another, one gains the knowledge of how much cheaper the power can be produced in one plant than in another, due to its various physical advantages. Again, by comparing how near the actual cost of one plant is to its standard cost with the difference between actual and standard cost of another plant, one has at once a measure of quality of methods and management. Without such accurately predetermined standard costs that are individual for each plant and condition of load, no correct comparison is possible, and conclusions from a mere study of accountants' figures are apt to be grossly in error.

STANDARDIZATION OF PROTECTIVE CHARGES

In the above discussion of standard cost we left out of consideration a very important feature—namely, fixed charges borne by the plant. It is a common policy to install in power plants considerable spare equipment, partly as a protection against possible breakdown and partly to take care of high peak loads. In both cases, it would not be logical to adulterate production costs by the addition of all overhead charges incident to this idle equipment.

Inasmuch as the spare equipment has a function identical to a stand-by plant at some distant point of transmission line or a breakdown emergency connection with a power company nearby, it seems entirely proper to segregate this portion of charges and treat them in the same manner as the bills of an emergency contract, *i.e.*, to carry the cost on a separate business account.

If, in the case of a plant built and equipped to produce twice the output it normally carries, fixed charges are dumped together with operation costs, it reflects unfairly on the ability of the superintendent and his operating force; whereas if they were properly charged to a separate account, the excessive charge against the stand-by equipment, both for fixed charges and running expense, would produce a stimulus for the business departments to secure additional load.

COMPARISON OF COSTS AND EFFICIENCIES

The essentials of knowledge gained through a comparison of actual cost in conjunction with the standard are:

a Relative supremacy of plants proper.
b Relative advantages of managerial methods.
c Relative extent of preventable losses.
d Relative advantages of prices of materials, etc.

These cannot be found unless there is a comparable basis or scale for comparison, which is offered by standard costs determined for each plant individually, as at least ten main variables must be accounted for, as follows:

a Nature of load.
b Character of service.
c Conditions imposed by location.
d Inherent efficiency of equipment.
e Arrangement of equipment, floor plan, etc.
f Cost-efficiency of fuel and supplies.
g Legal requirements.
h Methods of operation.
i Labor conditions.
j Methods of compensation for service.

Each of these variables being in its turn a product of a plurality of factors, it is manifestly impossible to state, without the aid of carefully worked out standard costs, that the economy of one plant or another is satisfactory, or where and how it can be bettered.

Inasmuch as standard cost cannot be determined without first finding out how the maximum economy can be secured, the process of standardization of costs is also a process of devising the best way for operation and management. Once both methods and results are positively established, costs are but the form of expression of the final result. It is true that the standard cost is influenced by the price of commodities used in the course of generation of power, as well as by some conditions beyond the control of the management and operating engineers, but the adjustment of the standard costs to every change of these factors can be made as simple as the use of a slide rule. Furthermore, a separate account should be kept for such charges as are the part of business policy, so that a division of responsibility between those managing the production and those directing the business can be drawn.

CHAPTER XX

COSTS IN A PRINTING SHOP

The manager of a printing shop must know what prices to charge for its product; first, the prices must not be so high as to drive away customers; second, they must not be too low, or there will be no profit made. In a proper system of cost-keeping the cost of the product delivered into the shipping room must be kept entirely distinct from the cost of securing orders, the cost of advertising, the losses from bad debts and other expenses or losses of the commercial department.

Selling Price = Factory Cost + Selling Cost + Profit.

Factory Cost = Cost of Direct Material + Cost of Direct Labor + Burden.

We shall consider here only the factory costs.

The cost of material is the purchase cost of paper, ink, binder's materials and other supplies, plus such addition as should be made for freight, storage, insurance, interest on investment in materials, store-keeper's services, and any other expense relating directly to material charged by the storeroom to the shop on job tickets or stores issue tickets. Some of these additions might be considered as general factory burden, but it seems better to treat them as burden on material.

The labor cost of the several jobs should be entered on job tickets if they are short jobs, or on cost books (entries made weekly) if they are long jobs. For convenience weekly job tickets may be made for these jobs, and these tickets may be filed according to job numbers, instead of being entered in a book, together with the stores issue tickets for the same job numbers.

The labor in a printing establishment may be subdivided into several classes, such as Hand Composition, Machine Composition, Cylinder Press, Job Press, Proofreading, Binding (which itself may be subdivided into different operations) Packing and Shipping, and Indirect Labor of various kinds. The labor done on any job may also be divided into chargeable hours (sometimes called "sold hours") and non-chargeable hours, the former being the time actually employed in typesetting, proofreading, correcting and press-work, which may be charged to the customer, if the charge to him is made on the basis of the time spent on the job, and the latter the time spent on repetition of the work that has been imperfectly done, the time waiting between orders, or time spent on work which cannot be charged to the customer, such as that taken in distribution of type, cleaning of presses, etc. This non-chargeable time is treated as part of the department or shop burden.

The total shop burden may be figured weekly or monthly, as most convenient. It includes unproductive shop labor, spoiled work, and the weekly or monthly proportion of rent, heat, light, power, insurance, taxes, repairs, depreciation, salaries and supplies not charged directly to jobs, which belong to the shop and not to the office or selling department. This burden may be subdivided among the several departments of the shop, such as Hand Composition, Machine Composition, Cylinder Press Work, Job Press Work, Bindery Work, General Shop Expense, the latter being apportioned to the several departments as far as practicable.

A method of apportioning the general expense to the departments is described as follows by one writer:

> Under direct printery expense we may charge those elements that can neither be charged directly to particular jobs nor pro-rated by departments. These elements represent the general operating and maintenance expenses that are incurred for the benefit of the entire plant as a plant. They must be pro-rated over all the jobs passing through the plant. Such items as the salary of the shop superintendent may be advantageously pro-rated according to the following rule. Pro-rate the salary to the different departments in the proportion that the expenses of each department bear to the total direct printery expense. This rule is based on the assumption that the relative amounts of expense charged to the different departments are indicative of the cost importance of that department in proportion to the cost of the whole shop. For example, suppose that the salary of the superintendent is $200 per month, the total expense charged to departments during the month is $1840, and the expense charged to the machine composition department during the month is $184. Then $20 may be charged to the machine composition department as its fair share of the salary of the general superintendent. It should be observed that this rule like many other working cost rules, is based on assumption rather than fact. To illustrate: The foreman of the bindery may be efficient and the foreman of the machine composition department may be inefficient so that the superintendent spends a greater relative share of his time with the machine composition department than with the bindery. It is but fair to say that such examples are exceptions and that while they should be safeguarded against, it is impracticable to devise any system of pro-rating that is so comprehensive as not to work unfairly under exceptional cases.

It is probable that instead of the "exceptions proving the rule," this rule is one of those that are "more honored in the breach than in the observance." There seems to be no logical relation between the subdivision of the superintendent's time, mental energy, and initiative among the several departments and the relative expenses of these departments. For example, the hand composition room may have very little expense charged against it, the maintenance charges being small, but the superintendent gives

most of his time and thought to it, on account of the multiplicity and variety of orders passing through it, while the linotype and monotype machine room has heavy charges for repairs, interest on investment, depreciation, fuel, oil and power, but the superintendent has little to do with this room because the work done in it is of a uniform character and the jobs are few in number and long in time. The only fair rule is for the superintendent to make an analysis of his own activities and charge the several departments with such fractions of his salary as he thinks proper, consulting the owner or general manager as to the fairness of the apportionment. It may be found that a large part of his salary should be charged to the several departments in proportion to the number of orders passing through them, and that the remainder had better be apportioned on the basis of man-hours or machine hours.

The distribution of the total monthly burden, departmental and general, among the several jobs, may be done on any one of the bases that are in common use, viz., as a percentage on direct labor, as a percentage on direct labor and material, on the man-hour rate, on the machine-hour, or work-place, rate, or on the last named combined with a fixed charge per job to cover that portion of the burden which has no relation to the cost of a machine hour, such as superintendence and clerical work.

In determining the burden to be charged to any job the management should endeavor to reach the *most just* figure, based upon normal business conditions, the figure that should be used in establishing minimum prices for future orders or inventory values of finished goods in the warehouse. In case of depressed conditions, such as idleness due to strikes or other causes, the whole of the monthly burden should not be charged to the jobs, but some of it should be charged to unearned burden or cost of idleness, and finally to Profit and Loss. If the percentage-on-labor method of distributing burden is used, on account of its being the easiest method for the bookkeeper, it should be recognized as being liable to great inaccuracy and likely to lead to wrong conclusions.

The amount of hourly burden that should be charged on the job tickets to the several jobs, on the machine-hour basis, should be the normal hourly burden of an average month, for the particular machine, work-place or production-center, and not the burden that would be found by a "supplementary rate" method, absorbing the whole burden of a particular month in the cost of the work produced in that month. The viciousness of this method has already been discussed on pages 79 to 81. The difference between the sum of the burdens charged to all the jobs in a month, which is found by adding on an adding machine all the burdens on all the job tickets, and the total actual burden for the month, or the debits to burden account on the shop ledger, is unearned burden, if the debits to the account exceed the credits, or overearned burden if the credits are in excess. At the end of the year the excess of the account on one side or the other is closed into Profit and Loss.

Plimpton Press, Norwood, Mass. The principal business of this concern is the manufacture of books for different publishers. Statistical records of the work done on each order from each publisher are kept on cards 8×5 in. for each of the three departments, Composition, Press Room and Binding. The headings of these cards are shown below:

Composition

PUBLISHER — ORDER NO.
TITLE — STARTED — CHARGED

	PERIOD ENDING					AUTHOR'S HOURS				DIRECT CHARGES TO PRODUCT				
					Total					Date	Charged by	Eng.-Elec.	Designing	Sundries

Under the headings there are ten ruled lines with side-heads at the left as follows: Wages 1st week, 2nd week, 3d week, 4th week, Total, Burden, Eng.-Elec., Designing, Sundries, Mfg. Cost.

The reverse of this card is the same as the front.

Press Room

PUBLISHER — BOOK SYMBOL
DESCRIPTION — STARTED — ORDER NO. — COMPLETED

	PERIOD ENDING					PERIOD ENDING					Totals
Text	1st Week	2nd Week	3rd Week	4th Week	Total	1st Week	2nd Week	3rd Week	4th Week	Total	

Twenty-four lines (6 per inch) are ruled below the heading. The side heads, printed in the first column under the word text, are as below:

M. R. 1st Form	Illustrations	Miscellaneous	Time chargeable to Publisher	Operating Expense
M. R. Add Forms	M. R. 1st Form	M. R. 1st Form	Total Press Hours	Shop Expense
Run	M. R. Add Forms	M. R. Add Forms	Wages	Total Manufacturing Cost
Total	Run	Run	Paper	Adm. and Selling Expense
	Total	Total	Sundries	Total Cost

The column rulings are single, for hours, for the first sixteen lines, and double, for dollars and cents, for the last eight lines.

The reverse of this card has a printed heading as follows:

DIRECT CHARGES TO PRODUCT — EXPENSE DATA

Date	Description	Paper	Sundries	Period Ending		

Bindery

PUBLISHER — SYMBOL — ORDER NO.

TITLE — QUANTITY

Started		Quantity	Price	Sale	Mfg. Cost	REMARKS
Completed						

	PERIOD ENDING			Total	DIRECT CHARGES TO PRODUCT					
					Date	Description	Stores	Worked	Direct	Sundries
Wages 1st Week										
Wages 2nd Week										

Under the heading are 26 ruled lines, and in the column under "Period Ending" are nine side-headings for the two money columns, viz.: Hours×cost No., 1st week, 2nd week, 3rd week, 4th week, Total Shop Exp. Rate, Operating Exp. Rate, Adm. and Selling Exp. Rate,* Remarks, and in the same column on the last three lines are printed Disposition, Selling Price, Presswork, Paper.

The other side-heads are: 3rd week, 4th week, Total Wages, Burden, Stores, Worked Mat'l, Direct Mat'l., Sundries Mfg. Cost.

Workman's Job and Day Tickets

When a job is given out a "First-Time Card and Bonus Record" ($4\frac{1}{4}\times4\frac{1}{4}$ in.), Form P1, page 192, goes with it, a duplicate (carbon copy) being kept in the planning room. The card is returned when the job is finished during the day when it is given out and a card for another job is issued, but if it is not finished the card is returned at the end of the day and a different card, Form P2, page 193, is issued for the next day, and so on for each succeeding day until the job is finished. These supplementary cards are filed with the first card as they are returned and the time recorded on them with the number of pieces finished each day are transferred to the "First-Time Card," on which the bonus time and wages and the total wages are computed for insertion in the pay roll and in the cost records.

For day work the supplementary card is printed in red ink and the words "Day Work" are used at the bottom instead of Bonus Work. Bonus Record also is omitted.

A "Time and Earnings" card ($4\frac{1}{4}\times4\frac{1}{4}$ in.), (see Form P5, page 193) is given to each workman for each day's work.

Stores Issue and Stores Credit Cards. A Stores Issue Card ($4\frac{1}{4}\times4\frac{1}{4}$ in.), Form PP3 is filled out for every lot of stores requisitioned for use in the shop. From this card entries are made on the tag attached to the bin in which the particular stores are taken, on the balance of stores or perpetual inventory book, in the monthly record of stores issued in the cost record of the particular order. When stores are re-

*The use of the terms "Hours×Cost No." "Shop Expense Rate," etc., indicate that the cost system used here is the same as that of the Philadelphia machine shop, which is described and criticised in a preceding chapter. In fact, many professional accountants have studied and adopted the erroneous methods of this system and have introduced them in numerous establishments.

SFSC

Quantity Issued	Balance shown on Stores Tag	Written by	Issued Month	Day	Year 19

STORES ISSUE

Description

Appor-tioned	Entered Tag	Stores Account	Balance Account	Cost Acct.	Unit Value	Total Value

Stores Symbol	Quantity Required	Unit

Move from (Location) To

Issue Signed by Material Issued by

Title Symbol

Charge to

FORM PP3. STORES ISSUE

SFSC

Quantity Received	Balance shown on Stores Tag	Written by	Received Month	Day	Year 19

STORES CREDIT

Remarks

	Entered Tag	Stores Account	Balance Account	Cost Acct.	Unit Value	Total Value

Stores Symbol	Quantity Returned	Unit

Move from (Location) To Placed in Loc.

Credit Signed by Material Received by

Title Symbol

Credit

FORM PP4. STORES CREDIT

SFSW

Quantity Issued	Balance shown on Stores Tag	Written by	Issued Month	Day	Year 19

WORKED MATERIAL ISSUE

Description

Appor-tioned	Entered Tag	W.M. Account	Balance Account	Cost Acct.	Unit Value	Total Value

Worked Material Symbol	Quantity Required	Unit

Move from (Location) To

Issue Signed by Material Issued by

Title Symbol

Charge to

FORM PP5. WORKED MATERIAL ISSUE

SFSD

Quantity Received	Balance shown on Stores Tag	Written by	Received Month	Day	Year 19

WORKED MATERIAL CREDIT

Remarks

	Entered Tag	W.M. Account	Balance Account	Cost Acct.	Unit Value	Total Value

Worked Material Symbol	Quantity Returned	Unit

Move from (Location) To Placed in Loc.

Credit Signed by Material Received by

Title Symbol

Credit

FORM PP6. WORKED MATERIAL CREDIT

turned from the shop a Stores Credit Card, Form PP4 is filled out, and the proper entries made from it.

Worked Material Issued and Worked Material Credit cards, similar to the stores cards are used for all worked materials that are stored for future use. (Forms PP5 and 6.)

A STANDARD COST SYSTEM FOR PRINTERS

The United Typothetæ and Franklin Clubs of America, 608 South Dearborn St., Chicago, published (1916) a pamphlet (24 pages, 9×12 in., price 25 cents) containing the Standard Cost Finding System devised by the American Printers' Cost Commission. The system has been in use since 1910, and has met general acceptance in the printer's trade. What follows is condensed from the descriptive portion of the pamphlet.

The Standard Cost-finding System is the result of cooperative effort on the part of the printers in the United States and Canada, and is a concrete example of what can be accomplished through organization.

It is a method of cost-finding made standard by adoption at the five International Cost Congresses held in the various cities of this country, of a set of fundamental principles upon which the system is based. The System is primarily for the use of printers, and through its installation and operation they are enabled not only to ascertain the exact cost of an hour's work in their various departments, but also the exact cost of any piece of work produced.

The System was endorsed by the United Typothetæ of America in 1910, and the Federal Trade Commission, through its Board of expert cost accountants, approved it in 1916 as "comprehensive in its scope, in accord with the best methods, and well designed along sound, simple and practical lines for the determination of the cost of printing."

Some of the recommendations of the American Printers' Cost Commission:

1. The standard unit of production in the several departments shall be the PRODUCTIVE HOUR.

2. The standard hour cost shall be the GROSS COST; namely, labor, plus all items of expense—direct departmental and general overhead.

3. When selling expense, stock handling, storage, receiving and shipping are kept as separate departments, these items are

not included in the general overhead, in arriving at the productive hour cost of the various departments.

The standard method of caring for the overhead expense shall be to charge direct to each department all necessary items and to distribute office or general overhead expense on the basis of total department costs, including pay roll.

5. For the purpose of closer study of costs, as many departments as practicable should be formed.

6. Selling expense should, where possible, be kept as a separate account and be absorbed by cost of completed work upon a percentage basis.

7. Stock handling, storage, receiving and shipping should, where possible, be kept as a separate department or departments, the expense to be applied upon a percentage basis against the cost of paper stock.

To cover cost of handling stock (when stock handling is not made a separate department) we suggest a minimum of 10 per cent be added to the delivered price at the plant, profit to be added to this amount.

8. When segregation of selling expense, stock handling, storage, receiving and shipping is found to be impracticable, these items shall be included in the general overhead and distributed over the departments upon the basis of total department costs.

16. That in the operation of a printing plant to its average capacity, a minimum profit should be 25 per cent added to cost of production.

19. That where type and material are kept standing for the convenience of the customer, a proper charge should be made.

20. That in presswork ink should be charged as a special item, and not included in the cost per hour of presswork.

21. As a requisite for determining costs, we endorse and deem necessary the use of an efficient loose-leaf inventory.

22. Experience has demonstrated that inventories for insurance adjustments by appraisal companies have proven most satisfactory.

Synopsis of Forms

The Job Ticket. For purely physical reasons the use of an envelope form of Job Ticket is advocated. By the use of an envelope, the loss or misplacement of copy is minimized; into the envelope is put all copy, proof sheets and any written instructions concerning the job, also a copy of the complete job, insuring a complete history of the job, valuable for future reference and free from those ravages of time and dust to which records otherwise handled are usually subjected.

On the face of the envelope is space for instructions to each department of the plant.

It is recommended that the salesman or party receiving the order from the customer shall fill out the Job Ticket.

The Job Ticket accompanies the job through the various processes, and after the job is completed it becomes a part of the archives of the business for possible future reference.

Individual Job Record. This form is kept in a loose-leaf binder, the successive leaves being consecutively numbered.

The binder containing the sheets of this form will be the most referred to of any of the system. This form contains the gist of that which the cost system aids to disclose, to wit: Cost on individual jobs. This form will show the time taken on each operation of the job, together with its labor cost, as well as the material used both by quantity and money value, also the summing up of the costs of labor and material to show the cost of the job and the selling price thereof.

If the system is properly kept and all charges properly made, then the sum of all the profits shown by these sheets should be the net profit for the period in which it is taken.

When the job is completed, the cost computed and the job charged to the customer, then the sheet should be taken out of the binder and filed into a transfer, or enclosed in the Job Ticket Envelope. There are then left only the live or uncharged jobs which are still in process, making practically a going inventory of material and work in process.

Daily Time Tickets. Each employee is required to render a daily statement of the disposition of the total hours employed. It is in effect the itemized bill of the employee for his day's work. From this record is made up his pay roll record.

The operations listed on the back of the Time Tickets are divided, showing which are chargeable and which are non-chargeable, making it easy to divide the time on the ticket under the proper heading and, in turn, to carry it to the pay roll blank, divided under the headings, "Chargeable" and "Non-chargeable."[1] The chargeable time is also entered against the job, under the proper department heading on the Individual Job Record.

Bindery. The operations listed on the back of the time ticket cover all work that can be done in that department, and therefore it will not be necessary to resort to improvised terms to designate the work done. The "kind of work" done is entered by number. The ticket is so arranged as to be suitable for either time work or piece work.

In the Bindery there are four classes of chargeable work, A, B, C, and D.

Class A covers the machine hours of the more expensive machinery, operated by higher priced employees. Class B covers the time of higher priced employees doing work which does not require the use of machines. Class C covers the machine hours of the machines of small value, perforators, etc., operated by lower-priced employees. Class D covers the time of bindery girls which does not require the use of machinery.

In Classes A and C the machine hour is the chargeable unit, and wages of the operators are carried to the Department Pay Roll Summary, as in the pressroom.

It is advisable, as far as possible, to ascertain the cost of each individual machine or group of machines.

In Classes B and D the individual hour is treated in the same manner as the individual hour in the composing room, the worker's hour unit being the chargeable unit.

Machine Composition Department. *Monotype.* The Keyboard and Caster should be treated as two separate machines and the unit of time is the machine hour, the wages being carried to the department pay roll.

Linotype. In linotype work the machine hour is the unit and the operator's and machinist's wages are charged to the linotype department pay roll.

When machines are used for casting borders, quads, leads, slugs, and the like, the time devoted to such work is to be charged to the department using such material as a direct department expense, or an equipment expense if it becomes part of the general equipment of the hand composing room.

Metal. The metal used for ordinary machine composition returns to the machine composition department for remelting, therefore it will not be necessary to make a metal charge between different departments.

Metal used for casting material or equipment for the hand composition department should be charged to that department and credited when returned.

Press Department. The press being the factor in time and record keeping, a ticket should be turned in for each press instead of each employee. When desired, a pay roll slip can, in addition, be turned in by the employee. The time is entered against the job the same as from the other tickets, but, in addition, the delays and idle time are reported, which are charged against the individual press. This opportunity to disclose the aggregate of lost hours in the pressroom and to know just what caused the loss, is an extremely valuable feature about a cost system. It enables the management to eliminate otherwise unseen "leaks."

Department Pay Roll. The pay roll has, perhaps, more to do with the accuracy of the entire Cost-finding System than any other blank or form. The pay roll of each department should be kept separately, and these departments should compare with the department headings on the Recapitulation Sheet of Department Labor Cost.

An employee working in several departments on and off,

N.B.-When you can fill out this sheet properly you will know the cost of production in your plant.

Standard Uniform Cost Finding System. Form 9H-Medium Size.
United Typothetae and Franklin Clubs of America.
※ Items in General Expense Column

STATEMENT OF COST OF PRODUCTION FOR MONTH OF July 1916

		Selling Expense	Stock Handling, Storage, Receiving and Shipping	General Expense	Hand Comp.	Linotype	Job Press		Total Expenditures
	(Amounts to be changed according to Inventory)	$ 450.00	$ 650.00	$ 1725.00	$ 9358.00 / 1800.00	$ 4575.00	$ 2650.00		40.630.00
	Sq.Ft. Floor Space	625	1315	625	2347	293	900		13368
	Candle Power and Horse Power	21 C.P. H.P.	9 C.P. H.P.	21 C.P. H.P.	70 C.P. H.P.	10 C.P. ⅞ H.P.	15 C.P. 15 H.P.		
ITEM NO.									
1	Pay Roll	472.99	300.16	1001.87	1107.85	201.86	402.63		5293.64
2	Rent and Heat	8.45	38.92	18.45	69.50	8.40	26.83		385.25
3	Light	1.15	1.41	3.15	10.56	1.48	2.31		42.72
4	Power		1.65			4.93	8.83		89.46
5	Insurance and Taxes	.76	11.30	2.93	9.15	7.78	4.50		79.27
6	Interest on Department Investment	2.25	33.25	8.63	26.90	22.87	13.25		233.15
7	Depreciation	3.75	5.42	14.37	89.58	38.13	22.09		383.33
※ 8	Bad Debts			90.22					90.22
9	Spoiled Work		1.13	13.91	13.81		2.17		73.17
10	Department Direct Expense	48.06	24.02	16.53	38.11	6.85	58.05		444.29
※ 11	Office Stationary and Postage			76.68				(Six additional columns)	76.68
※ 12	Advertising	8.42							80.42
※ 13	Cartage and Car Fare		26.20						26.20
※ 14	Other Miscellaneous Expense			14.50					14.50
15									
16									
17									7438.30
18	Total General Expense			1387.24					
※ 19	Total Selling Expense.	617.83		617.18					
※ 20	Total Stock Handling and Shipping		443.46	443.46					
21	Total General Expense			2448.53					
22	Total Department Cost without General Expense				1365.46	292.30	540.66		4989.77
23	Distribution of General Expense (Pro-rated on basis of Department COST) .4907+%				670.03	143.43	265.31		2448.53
24	Total Cost of Departments				2035.49	435.73	805.97		7438.30
25	Chargeable Hours of Each Department				1331	223	916		
26	NET COST PER CHARGEABLE HOUR				1.53	1.96	.88		
27	Average Net Cost per Hour for _____ Months								
28	PERCENTAGE OF PRODUCTIVE TIME				59%	74%	56%		
29	Pay Roll Cost per Chargeable Hour				.83	.90	.44		
30	Department Cost per Chargeable Hour				1.02	1.31	.59		
31	General Expense Cost per Chargeable Hour				.51	.65	.29		

FORM 9H. MONTHLY STATEMENT OF COST OF PRODUCTION

should be instructed to turn in a time ticket in each department in which he has worked, or a combination ticket having a column for each department in which he may work.

In the pay roll the record is kept, showing how much time is chargeable and how much is non-chargeable. This record will show what percentage of the entire pay roll is non-chargeable, a barometer by which the efficiency of the department management is gauged.

Chargeable and Non-chargeable Hours. This record should be kept that comparisons can be made from month to month and from year to year. Headings should be made for as many departments as it is desired to preserve a record of.

The figures will be for a period of one month, and will show the chargeable and non-chargeable time by departments. This information will show, among other things, whether the percentage of non-chargeable time is within reason. Taking the total pay roll of a department and dividing the amount by the total chargeable hours, gives the *pay roll cost* of the chargeable hour.

Press Department Record. This form shows the chargeable and non-chargeable hours, and the number of impressions each day from each press; also, how much time was expended on the make-ready and how long each day the press was idle. The entries on this form are made from the pressroom Daily Time Record.

These records indicate the pulse beat of the plant and constantly tend toward increased production at a comparatively decreased cost.

Statement of Cost—No. 9H. This form is the keystone of the System; it reflects the essence of what has gone before it.

A monthly statement is strongly recommended. It is a foregone conclusion that the results from the statements will vary

from month to month, yet that variation should be known as well as the reason therefor.

This method is advocated from the fact that the practice of finding an average of averages is generally conceded to be inaccurate and is wholly incorrect.

It is advisable to have headings on this blank for every department for which cost of production is to be found.

Division of Expense. Manufacturing expense is distributed to the various departments as follows:

Pay Roll. Divided as per Time Reports in the various Departments; Superintendent's salary distributed over departments he supervises.

Rent and Heat. Divided according to the floor space occupied by each department.

Light. Divided according to the number of gas burners or candle-power lamps used in each department.

Power. Divided according to the horse-power hours and is found by multiplying the horse-power of motor on a machine or group of machines, by the actual running hours and dividing the hours into the power charge.

Insurance and Taxes. The total for the year is determined on actual inventory value. Each month one-twelfth is distributed over departments according to the inventory value of equipment in the department.

Interest on Investment. The standard rate of 6 per cent per annum, hence .005 per month, will be charged to each department upon the value of the equipment in such department. Interest on the investment in the building, together with maintenance costs thereof, will be spread over the various departments in lieu of rent.

Depreciation. The standard rates of annual depreciation and obsolescence on different properties as fixed by the International Cost Congress will be applied monthly on the purchase price of the equipment in each department, on the following basis:

Type	25 per cent
Standard Machines	10 per cent
Type Stands, Chases, Stones, etc.	10 per cent
Buildings owned and occupied by plant	5 per cent

Bad Debts. The total sales for the year are determined by past experience, and from that amount 1 per cent is found and divided by twelve to arrive at the amount per month. Distributed over departments through General Expense.

Spoiled Work. Absorbed through General Expense, or charged direct to department at fault.

Department Direct Expense. Expense incurred for any particular department should be charged direct to that department.

Office Stationery and Postage. Absorbed through General Expense.

Cartage, Carfare, and Miscellaneous Expense. Absorbed through General Expense.

Advertising. Absorbed through General Expense or Selling Expense.

Selling Expense. Absorbed through General Expense or treated as separate department.

Stock Handling and Shipping. Absorbed through General Expense or treated as separate department.

Total General Expense. Distributed over departments on basis of total department cost.

Résumé. Each workman turns in a Daily Time Report showing what jobs he has worked on and what work has been performed. The Foreman each evening checks them against inaccuracies and then passes them to the Cost Clerk. From these Time Tickets the Pay Roll is made up or checked. The total time, chargeable and non-chargeable, shown on the pay roll of each department is entered in the monthly record of the department, chargeable and non-chargeable hours under the proper department head; the total of each pressroom Daily Time Ticket is carried to the monthly Record of Chargeable and Non-chargeable hours and Press Impressions, which, when entered daily, gives a record for the month. The monthly total of the pay roll of each department is then carried to the Statement of Cost. Thereafter through the process outlined, is learned the amount of money expended in each department, and, dividing the total (as shown on line No. 24) by the number of chargeable hours, the cost of each productive hour is ascertained.

The Cost Clerk posts or charges to each Individual Job Record the time taken on each operation, as shown by the employee's Daily Time Ticket. When the job is completed, the number of hours expended in each department are totaled and the extension is made at the average price per hour as determined by the Statement of Cost. This will give the total cost including all overhead, department and general. To such figures should be added the proper proportion of profit which should not be less than 25 per cent added to cost of production.

The first essential feature is that all material and supplies shall be strictly accounted for. One person should have control over all issues from stockroom. No material should be issued except on a regular requisition. The Stock Clerk, after filling the order passes the requisition to the Cost Clerk to be charged against the job on the individual Job Record. The Stock Clerk can enter the requisition on his record, making deduction for the amount given out, and show the balance remaining on hand.

The following list of operations in the printing and allied trades is arranged for the convenience of those using Cost Systems so that they can all use the same number for the same operation and so that the number will at once identify the department in which the operation is performed.

This is arranged for by having the first figure of each number indicate the department except in the hand composing room, which is indicated by two figures instead of three figures, thus:

1 to 99—Hand Composition.
101 to 199—Machine Composition, viz.: 101 to 149 lino., 150 to 199 mono.
201 to 299—Presswork.
301 to 399—Bindery work.
401 to 499—Litho Dept.
501 to 599—Photo-Engraving.
601 to 699—Electrotyping.
701 to 799—Steel Plate and Die Work.

In the lists of work items, those marked with a * indicate that the time is chargeable; those with a † that it is non-chargeable. Items marked with both * and † may be either chargeable or non-chargeable, according to circumstances. Thus, changes or corrections made on the press which are clearly due to errors made by the office would be non-chargeable, while if they are made by order of the customer they would be chargeable.

The pamphlet from which the above extracts are taken contains a complete set of forms, ten in number, all of them $8\frac{1}{2}\times11$ in. in size, so that they may be put in a 9×12 in. envelope. The forms are the following:

Form 1. Job ticket. Envelope 9×12 in. Has ruled spaces for complete instructions regarding the job, Date, Salesman, Job No., Date Wanted, Customer's Name and Address, Quantity and Description of work, Stock, Ruling, Composition, Plates, Press, Bindery, Office Delivery.

Form 2. Individual Job Record. Ruled so as to contain summaries of the time tickets for Hand and Machine composition, Cylinder and Job Presswork, Bindery, Deliveries, and the complete costs for Stocks, Composing, Presswork, Bindery, and Miscellaneous, to the total of which costs the profit 25 per cent is added to make the selling price.

Form 3C. Compositor's Daily Time Ticket. Contains the employee's name and clock number, date and columns for Job No., Customer's Name, Kind of Work (by symbol

EFFICIENCY RECORD AND COST ACCOUNT FOR ALL KEYBOARDS: MONTH OF 191

Summary of Wages / Keyboard Operators						
Wages of Keyboard Operators on Composition						
Wages of Keyboard Operators on Changes						
Wages of Keyboard Operators on Miscellaneous						
Total Wages of Keyboard Operators exclusive of Time Outside of Keyboard Dept.						
Total Ems Set						
Wage Cost Per 1000 Ems						
Ems Per Hour on Composition						
Minutes for Correction Per 1000 Ems						
Total Correction Cost Per 1000 Ems						

MACHINE ACCOUNT

Net Value Keyboard Plant as shown in Last Month's Report

Monotype Invoice No.	Additions

Deduct Discarded Material at Depreciated Value

Net Value

Amount to be Charged for Depreciation this Month

Net Value to be Carried to Next Month's Report

MAINTENANCE

Monotype Invoice No.	Keyboard Paper Lbs.	Keyboard Paper Cost	Repair Parts	Misc.
Totals				

Total of above Expenses

Date	Misc. Expenses

Total Maintenance

COST SUMMARY

Wages of Keyboard Operators on Composition	
Wages of Keyboard Operators on Changes	
Wages of Keyboard Operators on Miscellaneous	
Total Wages of Keyboard Operators exclusive of Time Outside of Keyboard Dept.	
Machine Depreciation	
Maintenance	
Power	
Light and Heat	
Rent (Floor Space)	
Interest	
Insurance	
Taxes	
Proof Reading Ems at Cts. Per 1000	
Proportion of Composing Room Expense	
Proportion of General Expense	
A Total Keyboard Expense Without Corrections	
B Total Hours on Composition	
Cost per Productive Hour Without Corrections A÷B	
A Total Keyboard Expense Without Corrections	
Total Correcting Cost	
C Total Keyboard Expense Including Corrections	
B Total Hours on Composition	
Cost per Productive Hour Including Corrections C÷B	
D Total Ems Composed	
Cost per 1000 Ems Uncorrected A÷D	
Cost per 1000 Ems Corrected C÷D	

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KEYBOARD SUMMARY: MACHINE NOS. MONTH OF 191

OPERATOR	KEYBOARD NO.							Day of Month	OPERATOR	KEYBOARD NO.						
Time Summary for Each Day					Total Gross Ems	Total Operator's Wages	Correction Time in Minutes	Total Correction Cost		Time Summary for Each Day					Total Gross Ems	Total Operator's Wages	Correction Time in Minutes	Total Correction Cost
Total	Composition	Changes	Misc.	Time Off Keyboard						Total	Composition	Changes	Misc.	Time Off Keyboard				
	(31 lines, one for each day)								1									
									Totals									
Per Cent of Total Hours					Gross Ems Per Hour on Composition		Minutes for Corrections Per 1000 Ems			Per Cent of Total Hours					Gross Ems Per Hour on Composition		Minutes for Corrections Per 1000 Ems	
Total Non-Productive Hours = Changes + Misc.		Percentage Non-Productive Hours to Total Time of Keyboard		Wages Per 1000 Ems	Correction Cost Per 1000 Ems					Total Non-Productive Hours = Changes + Misc.		Percentage Non-Productive Hours to Total Time of Keyboard		Wages Per 1000 Ems	Correction Cost Per 1000 Ems			

(Size of blank 11 x 8½ in. including margin for loose leaf binder)

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FORM LM1. EFFICIENCY RECORDS FOR KEYBOARDS

number), Time Commenced, Time Left off, Hours chargeable and non-chargeable.

Form 3MC. Machine Compositor's Daily Time Ticket.

Form 3P. Pressroom Daily Time Ticket, with names of pressman and feeder and number of impressions.

Form 3B. Bindery Time Ticket.

Form 4. Department Pay Roll. Contains names of workmen, columns for hours chargeable and non-chargeable for six working days, total hours (C. and N. C.) rate, amount, and cost of non-chargeable hours. At the bottom there are figures of total department pay roll, total chargeable hours, average pay roll, cost per chargeable hour, and ratio of non-chargeable to total pay roll.

Form 5. Monthly Record of Department Chargeable and Non-chargeable hours, with lines for each day in the month, and columns and figures for hours (C. and N. C.) for Hand and Machine Composition, Cutter, Folder and Bindery C, Bindery D.

Form 9H. Statement of cost of production for month. This form is here reproduced (with columns for Small Cylinder, Cylinder Press, Cutting, Machine Folding, Bindery C and Bindery D omitted).

There are two criticisms that may be made of this statement of cost of production. The first is that Selling Expense is added into General Expense and distributed or pro-rated on the basis of department cost. There is no necessary re-

lation between the costs of the work done in two departments, say hand composition and linotype, and the cost of selling the product of these departments. If each department produced $1000 worth of work in a month the cost of selling the work of one might be $20 and that of the other $200. The second is that it takes no account of the loss due to idleness of a department through failure to get orders for it. Suppose that there was no work and no pay roll for the linotype, its departmental expense ($292.30−$201.86 = $90.44) and its share of the general expense ($143.43) would have to be distributed to the productive hours of the other departments, unduly increasing the apparent cost of the productive hour or net cost per chargeable hour in each of the departments. If a linotype failed to get any work in a given month there is no reason why the loss incurred thereby should go to increase either the cost or the selling price of hand composition or press work or binding. The loss should appear in the accounts as "unearned burden," and if that account had a debit balance at the end of the year it should be charged to Profit and Loss.

The errors in cost estimates due to these two departures from the principles of the best accounting systems are, however, probably not serious in any well-managed printing establishment, and it may not be worth while to keep an unearned burden account in order to avoid them.

Monotype Cost Records. The Lanston Monotype Machine Co., Philadelphia, issues a pamphlet entitled "Monotype Cost and Efficiency Records" with sample blank forms.

Profit and Loss Statement for Month of 191

Ratio of Total Expense	Classified Items See reverse side for explanations	Totals	Labor Departments						Office and Shipping Dept.	Paper Stock	Mdse. not chargeable to labor and otherwise unprovided for
			Hand Composition and Monotypes	Linotypes	Cylinders and....% Stockroom	Job Department		Bindery			
						Composition	Platens and....% Stockroom				

The classified items printed in the column with this heading are as follows:

Advertising
Allowance
Bond Interest
Cartage (Includes Motor Truck)
Commissions
Depreciation
Discounts on Sales
Expense
Ink
Insurance { Fire / Liability }
Interest and Note Discounts
Legal Expenses
Light
Maintenance—Electrical Work
Oil
Pay Roll Total—$
Labor Departments
Maintenance
Office
Salesmen (if on salary basis)
Shipping Department
Stock Handling
Power { Electric / Gas }
Rent
Repairs
Rollers
Salary—Officers
Spoiled Work
Stationery
Taxes
Telephone
Type Washes
Uncollectible Accounts
Water Supply
Wire and Bindery Supplies
Wrapping Paper and Twine
Office Column Total
Same Pro-rated (Per Total Expense)
Totals, Including Overhead

Merchandise Purchases
Electros and Engravings
Metal
Outside Labor
Paper Stock
Publication Bulk Postage, etc.
Totals

Grand Total Cost of Departments
Inventory First of Month
Inventory Last of Month
Total Decrease (Add to Costs)
Total Increase (Subtract from Costs)
Net Increase—Decrease

Total Net Costs (Everything to this point includes all expenditures)

Income
Metal
Publication Postage, etc.
Sales (other than classified above)
Total Sales
Discounts on Purchases
Depreciation Reserve Interest
Total Income

Gross Profit / Gross Loss { (Deduct Total Net Costs from Total Income) }
Net Profit
Equivalent to { % of Net Sales / % on Net Costs }
Departmental Ratio to Net Costs

Comparative Statement Addendum

Month of		Net Sales	Total Income	Total Expense	Net Profit	Profit Percentage of Net Sales	Profit Percentage on Net Costs
	191						
	191						
	Increase						
	Decrease						
Summary							
From	191						
To	191						
From	191						
To	191						
	Increase						
	Decrease						

Form LM3. Profit and Loss Statement

The object of this system is to furnish the necessary blanks (5) to enable the Monotype user, *First*, to determine the Productive Hour Cost of both keyboarding and casting in accordance with any of the standard cost system methods; *Second*, to increase production by furnishing data as to the efficiency of both the keyboarding and the casting departments; that is, (*a*) the efficiency of individual operators (their output per hour and its cost, including cost of corrections) and (*b*) the cause of non-productive time (lack of work or delays in operating). The system is a compilation of the best features of a number of systems in actual use.

A statement is made of seven principles upon which the system is based. The first two are of especial interest to cost accountants.

First. The object of a cost system is to show the manager what work costs in his shop under any given conditions. A cost system that gives only total costs, without any explanation of excessive costs, serves much the same purpose as the lock on the front door; it keeps work out of the office.

Second. While the first object of a cost system is to furnish information as to prices to charge for work, it is almost as important that it point the way to increasing efficiency and reducing production costs so that work may be sold at greater profit.

Forms LM1, LM2 show the printing on the blanks used for efficiency records of keyboards and casting machines (reduced in size).

Profit and Loss Statement

All expenses that can be positively identified with a department should be charged to that department and all others charged to Office, to be finally pro-rated over each department. For instance: Compositors' tickets printed for the Composing Room should be charged as "stationery" expense against that department, but order tickets, although used by all the departments, should be charged to Office.

The most equitable pro-rata distribution to the other departments of the Office and Shipping Department expense is on the ratio that each individual department (pay roll included) bears to the total expense.

EFFICIENCY RECORD AND COST ACCOUNT FOR ALL CASTING MACHINES: MONTH OF 191

Day of Month	Time Summary for Each Day: Total	Comp.	Changes	Delays	Waiting	Type Making	Total Ems	Total Lbs. Type	Wages: Operator	Runners
1		(*31 lines, 4 per inch*)								
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23										
24										
25										
26										
27										
28										
29										
30										
31										
Percentage of Total Hours							Net Ems per Hour on Composition	Lbs. Type per Hour	Total Wages	
Total Non-Productive Hours Changes + Delays + Waiting			Percentage Non-Prod. Hours to Total Hours				Wages on Composition per 1000 Ems		Wages per Lb. Sorts	

COST SUMMARY	
Wages Composition	
Changes	
Delays	
Waiting	
Type Making	
Total Wages	
Machine Depreciation (See Over)	
Metal " (" ")	
Maintenance	
Power	
Gas	
Water	
Light and Heat	
Rent (Floor Space)	
Interest	
Insurance	
Taxes	
Proportion Comp. Room Expense	
" General "	
Total Casting Room Expense	
Credit by lbs. of type made in hours at cents per hour	
Net Casting Room Expense	
Total Productive Hours	
Cost per Productive Hour	
Total Ems Composed	
Cost per 1000 Ems	

Size 11 x 8½ including margin

Form LM2. Efficiency Record of Casting Machines

CASTING MACHINES NOS. MONTH OF 191

MACHINE ACCOUNT		METAL ACCOUNT				MAINTENANCE				
Net Value Casting Machine Plant as Shown in Last Month's Report.		Net Value Metal on Hand as Shown in Last Month's Report.				Monotype Invoice No.	Caster Parts	Mold Repairs	Matrix Replacements	Misc.
Monotype Invoice No.	Additions Items	Date	Pounds	Purchased From	Cost	(*13 lines*)				
	(*17 lines*)									
Deduct Discarded Material at Depreciated Value	(*5 lines*)	Deduct Amount Received for Metal and Dross Sold				Totals				
						Total of Above Expenses				
						Date	Misc. Expenses			
Net Value		Net Value				(*10 lines*)				
Amount to be Charged for Depreciation This Month		Amount to be Charged for Depreciation This Month								
Net Value to be Carried to Next Month's Report		Net Value to be Carried to Next Month's Report				Total Maintenance				

Reverse of Form LM2

In this statement, labor is divided into six classifications, viz.: Hand Composition (including all processes done by "hand"), Linotype Composition, Cylinder Presswork, Job Composition (department for "job" work as distinguished from publications, etc.), Platen Presswork, and Binding. In our plant, the Monotype machines are used so extensively for making type for hand use, that while separate records are kept, the cost is included in Hand Composition. See Form LM3, page 221.

Titles and Definitions of Accounts

Advertising. All items of publicity promoting expense that can be so classified, viz.; Advertising in trade journals, newspapers, etc.

Allowances such as shortage or overcharge are charged to the department at fault, otherwise to Office.

Bond Interest. Interest on bonded indebtedness, pro-rated to departments according to value of departmental investment.

Cartage and Express. Charged to departments incurring it, otherwise to Office and Shipping.

Commissions. Money expended for obtaining business. Pro-rated to the departments on the basis of the departmental proportion of the salesmen's monthly total sales.

Depreciation. Fixed percentage or proportion is included in the costs of every department each month, and deducted from the value of the Machinery and Fixtures account.

Discount on Sales. Pro-rated to departments on basis of their proportion of the total sales on which discounts were granted.

Expense. Charged as much as possible direct to departments. Items which cannot be included under Repairs or other classifications.

Ink. Total amount purchased for each department, adding to, or deducting therefrom, the difference between the value of the ink inventory at the beginning and at the close of the month.

Insurance—Fire. One-twelfth the year's expense and pro-rated as per investment.

Insurance—Liability. Includes Workmen's Compensation and Public Liability.—Pro-rated on basis of monthly pay roll at the premium rate.

Interest and Note Discounts. Interest or discount on notes given or discount on notes received. Not for interest on investment, *which is purposely not included.*

Legal Expense. Charges for collecting accounts and other legal services.

Light. Charged to departments according to use, on the basis of meter readings.

Maintenance—Electrical Work. New work that makes a real and tangible asset is considered a Machinery and Fixtures account item. Most electrical work is not an asset and, therefore, considered an expense to be charged to the department incurring it.

Oil. Charged to departments according to use.

Pay Roll. The pay roll sheets are arranged so that each department shows not only its productive labor, but such non-productive labor as foreman, distribution, boys employed in the department, even floor sweeps or porters for that department. The gross amount of pay roll is classified and labor not wholly chargeable to one department, such as proofreading, is divided and charged to departments in proportion to service rendered. Office and Shipping, although individually itemized, are finally pro-rated to the other departments.

Power. Charged to departments according to use on the basis of meter readings. Gas used for Linotypes and Monotypes is charged to them as power expense and not as light.

Rent. Charged to departments on the proportion of space occupied by them.

Repairs. Charged to departments incurring them. When actual costs for a month are unusually low, a reserve is established for future additional cost.

Rollers. Charged to departments according to use. When actual costs for a month are unusually low, a reserve is established for future additional cost.

Salary—Officers. For officers of the company; not included, in the Office Force pay roll.

Spoiled Work.—Billed at cost and charged to the department incurring it, or to the Office, if the Office is at fault. Includes also those allowances which have to be made because of spoiled or inferior work.

Stationery. Distributed to the departments incurring the expense.

Taxes—City Personal. The estimated total for the year pro-rated monthly and apportioned as per investment. Federal Income Tax pro-rated to the departments on the basis of their monthly earnings.

Telephone.—Charged to Office.

Type Washes. Charged to departments using them. Percentages of use are established and the cost divided accordingly.

Uncollectible Accounts. Reserve for bad debts established and charged to Office.

Water Supply. Monthly proportion of yearly cost pro-rated to departments on the basis of number of faucets in each department.

Wire and Bindery Supplies. Includes also such purchases as silk, cloth, paste, glue, etc., adding to, or deducting therefrom, the difference between the inventory value of these items at the beginning and at the close of the month.

Wrapping Paper and Twine. This is part of the Shipping expense, adding to, or deducting from the total purchases for the month, the difference between the inventory value of these items at the beginning and at the close of the month.

In cases where wrapping paper and twine is billed to a particular department, the cost thereof is charged to that department.

The blank lines following may be used for other accounts desired.

Office and Shipping Department Total. Pro-rated to the other departments as per ratio of total expense, including pay roll.

Totals Including Overhead. By using the chargeable hours in any department as the enumerator, these totals will give cost per hour (*exclusive of interest on investment, which is purposely not included*). To obtain the true costs per hour, it is absolutely necessary to keep accurate records of the chargeable hours in each department for the month.

All the accounts classified above are such as are incurred directly in connection with manufacturing, in distinction from such as electros and engravings, and paper stock, which are not labor items, and labor purchased outside, which cannot properly be interjected in hour costs.

Merchandise Purchases

Electros and Engravings. Total cost of all electrotyping, engravings, original designs, etc. Included in the Composing Room costs because that department is credited with the value of the sales thereof.

Metal. Total amount billed each month and credited to the Metal account through Sales Book. Separate and distinct from metal purchased for increasing the supply.

Outside Labor. Total cost of manufacturing done outside, because of lack of special facilities required, or necessitated by overtaxing capacity. Charged to departments that otherwise could have done the work, as these departments receive due credit through the Sales Book.

Paper Stock. Total purchases for "print" paper, excluding wrapping, tympan, slip-sheets, make-ready, proof paper, etc., which items are charged to the departments using them.

Publication Bulk Postage. Value of Bulk Postage, prepaid stamps, expressage and freight that is chargeable to customers. Must not be confused with Cartage.

Inventory. At the end of each month, an inventory of work in process is taken from the Office record tickets and figured at

actual average costs. To their respective departments is added the inventory value of electros and engravings, paper stock, supplies, etc., on hand, and the difference between the total inventory at the end of the month and that at the beginning of the month in each department, added to or subtracted from the Grand Total Cost of Departments, produces the Net Costs.

Income means sales and any other money or accounts received not properly included therein. The term "Sales" covers almost everything sold, even waste paper and paper stock cases, which are billed to the purchasers. Does not include proceeds of old or discarded machinery sold.

Discount on Purchases. Received for cash payments and pro-rated to departments on basis of their total purchases. Does not include so-called "trade discounts."

Depreciation Reserve Interest. Interest accrued monthly on Depreciation Reserve on deposit in bank and pro-rated to departments on same basis as the charge for Depreciation.

The blank lines which follow may be used for

Bank Balance Interest. Received quarterly or semi-annually from Bank for interest on daily balances. Pro-rated in proportion to individual departmental profits for those particular periods.

Bills Receivable Interest. Received on promissory notes and pro-rated to departments on the basis of their proportion of the total sales for which the notes were received.

The **Net Costs** deducted from the Total Income will produce the

Net Profit or Loss, both in gross, and detailed by departments.

Federal Printing Co. (with which is consolidated the Greenwich Printing Co.), New York. This is a large establishment making a specialty of printing, binding, and mailing weekly and monthly technical and trade journals. It has a recording cost system similar to that of the United Typothetæ. The blank forms for reporting the time spent by the workmen on the several jobs have been designed with great care so as to furnish the desired information with a minimum of clerical labor. Reproductions of the principal forms (greatly reduced in size), together with some notes concerning some of them, are given in the following pages.

Made by _____ (*Size of Sheet 8½ x 11 in.*) FEDERAL PRINTING COMPANY Order No. _____
Checked by _____ Previous Yes _____ No
Salesman _____

ESTIMATE

Date _____ 191_ Date Billed _____ L P $ _____

For _____
Address _____
Description _____

SPECIFICATIONS—Give Details
Quantity _____
Consisting of _____ Pages and _____ No Cover / Cover—Flush—Ext.
Trimmed Size Inside _____ X _____ Oblong / Upright
" " Cover _____ X _____ Exten. / Flush
Inside Printed in _____
1st & 4th Cover Printed in _____
2d & 3d " " " _____
Bound _____
Delivery to be made _____

	ITEMS
COMPOSITION Inside—Type Page _____ X _____ Picas / Inches	(*Three more columns for totals etc.*)
_____ Pp. _____ Pt. _____ Ems to Page Mono. Lino. @ _____ Per Page _____	
_____ Hours Time Work @ _____	
Imposition _____	
Lock-up _____ @ _____	
" Foundry _____ @ _____	
EXTRAS _____	
Cover _____ Pages _____ @ _____	
Lock-up _____ Page Forms _____ Hours @ _____	
EXTRAS	
From ELECTROS _____ Sets Unblocked / Blocked	
_____ Pages Size _____ X _____ = _____ In. @ _____ = _____ Per Pp.	
_____ % Mis.	
ENGRAVINGS _____ HALF-TONE _____ LINE _____ DRAWINGS	
Quantity _____ Size _____ X _____ = _____ In. @ _____	
_____ % Mis.	
STOCK - INSIDE _____ Basis _____ Ours / Supplied	
Reams | Sheets | Size—Weight | Description | Total lb. | Price per lb.	
_____ Cutting _____ % Mis.	
STOCK - COVER _____ Basis _____ X _____ = _____ Ours / Supplied	
_____ Cutting _____ % Mis.	
INSIDE—PRESSWORK _____ CYLINDERS _____ PLATENS _____ AUTO	
No. Forms | No. Pp. in Forms | Paper Size of Form | M Imp. Each | Make-ready | Running | Total Hr. per Form | Grand Total | Per Hr.	
Slipsheeting—Bronzing—Extras _____	
Extra, for Color, Fine Black and Heavy Forms INK _____	
COVER—PRESSWORK _____ CYLINDERS _____ PLATENS _____ AUTO	
Extra for Color, Fine Black and Heavy Forms INK _____	
Slipsheeting—Bronzing—Extras _____	
BINDING—Ours—Outside (See over for details) _____	
RULING, CUTTING AND MISC. ITEMS _____	
PACKING—CASING—CASES—CARTAGE _____	
Order placed with _____ Totals	
Reason: _____ Quote	

☞ Stop—look—think—and ask yourself. Have I provided for and included everything?
All estimates must be carefully checked for errors of omission or calculation. Never "take a chance."

FORM F1. ESTIMATE

When this estimate has been made and checked a proposition is made to the prospective customer on a standard size letter sheet ($8\frac{1}{2} \times 11$ in.) ruled and printed as in Form F2.

We herewith submit our proposition for furnishing you the following:

Description or Name	
Quantity No. Pages Trimmed Size	
Composition	
Original Designs Engravings Electrotypes	
Paper Stock	Where paper has to be specially made, it is understood that the conditions of the paper trade, which we are compelled to accept, shall govern, and that over-runs or under-runs will be accepted and charged for or deducted
Presswork	
Bioding	
Price Terms: *Strictly Net*	Quoted subject to immediate acceptance, owing to possible fluctuations in cost of material and labor
Delivery F.O.B. New York City	Subject to strikes, accidents and other causes beyond our control It is understood that five per cent over stipulated quantity will be accepted and paid for
When referring to this bid, kindly mention number	Any and all changes from original copy or any variation of original specifications necessitating additional work or expense will be charged for extra All plates and paper held in stock at owner's risk and subject to a storage charge for all time in excess of one year, unless governed by a special agreement

Form F2. Proposition

BINDING DETAILS			
FOLDING – Hand	@		
" "	@		
" Machine	@		
" "	@		
GATHERING – Hand Machine	@		
INSERTING	@		
STITCHING – Hand Machine – Saddle-side	@		
SILK – Floss – Cord	@		
COLLATING – Tipping – Pasting	@		
TRIMMING	@		
PADDING	@		
PUNCHING – Perforating	@		
STAMPING – Numbering	@		
STRINGING	@		

Form F1*a*. Binding Details. (On back of Form F1.)

The Order Ticket, Form F3, page 226, is a large envelope of heavy paper, printed on the front in red ink. The back of the envelope has blanks printed in large type for the time record of different stages of the job in the composing room, press rooms and bindery. The one for the composing room is here given. The blanks for pressroom-cylinder and pressroom-platen contain date and time columns for On Press and Final Delivery to Bindery and Shipping Department; and the blank for the Bindery has columns for Final Sheets Received and Final Delivery to Shipping Department and Mail. The Remarks column in each of these blanks is 5 in. wide, and each heading after the word Remarks contains the following instruction: Give any pertinent information concerning the order which may be of use in billing, etc., noting particularly delays or customer's variations from original specifications necessitating extra work.

(9¾ x 11¾ in.)(less margin)

Salesman

No. ORDER TICKET Former No.

Entered 191

For Customer's Order No.

Address

Quantity Description

COMPOSITION: Type page, size picas wide by picas deep. Type style text

Type style, cover

Proof to Promised for Sent out Returned Imposition

Overlays Yes No Keep standing Yes No Our imprint Yes No

ELECTROTYPING from sets { blocked / unblocked } electrotypes halftones { incorporated in plate / electrotyped }

ENGRAVINGS from DRAWINGS from

PAPER STOCK: ☞ Do not deliver more than specified quantity

	Rms.	Shts.	Size	Weight	Description	Ordered from	By	Req.No.	Date	Cutting Instructions: No.Pcs.	Size	Out of	Slip Issued
Inside			X	—			Us / Cust				X	Shts.	
			X	—			Us / Cust				X	Shts.	
Cover			X	—			Us / Cust				X	Shts.	
			X	—			Us / Cust				X	Shts.	

PRESSWORK: ☞ Be sure the paper stock is in before going to press, and do not, under any circumstances, run more than specified quantity.

OVERLAYS Yes No SAVE Yes No

	No. Forms	No. PP.	Paper allow. each Form: Rms.	Shts.	Size	Produce Net No. Imps. each Form	Imposition—Kind of Form, etc.	Slip Sheeting	Color Ink	To print on
Inside					X					Cyl.—Plat.—Auto
					X					Cyl.—Plat.—Auto
Cover					X					Cyl.—Plat.—Auto
										Bronzing Yes No

BINDING: Outside by

Ours Quantity Trimmed Size x inches, consisting of pages { and / without } cover { lap / flush }

Ruling by Numbering by in ink, from to PADS OF each. Perforate Yes No

SHIPPING: ☞ Two samples of complete order must be enclosed in this ticket

Complete order to be delivered not later than 191

To Express / Freight / Wagon { Prepaid / Collect }

Address

Special Instructions:

Marked for

Date of final Delivery 191

Estimate: No. — Yes Billed Under Date Board No.

FORM F3. ORDER TICKET (ENVELOPE)

ORDER RECORD

COMPOSING ROOM Job / Pub.

		DATE	TIME	REMARKS:
1st Proof	Out		A.M. P.M.	
	In		A.M. P.M.	
2nd Proof	Out		A.M. P.M.	
	In		A.M. P.M.	
3rd Proof	Out		A.M. P.M.	
	In		A.M. P.M.	
4th Proof	Out		A.M. P.M.	
	In		A.M. P.M.	
5th Proof	Out		A.M. P.M.	
	In		A.M. P.M.	
Final O.K.	In		A.M. P.M.	
Foundry	Out		A.M. P.M.	
	In		A.M. P.M.	
To Press	Platen / Cylinder	Signed	A.M. P.M.	Foreman

FORM F3*a*. ORDER RECORD, COMPOSING ROOM. BACK OF ENVELOPE F3

(Size 3⅝ x 5½ in.)

No.________________ Name ________________________

Week Ending ____

DAY FORCE

Day	In Morning	Out Lunch	In Lunch	* Out Final or Supper	In Supper	Out Final	Office Use
Fri.							
Sat.							
Sun.							
Mon.							
Tues.							
Wed.							
Thu.							

* If you are not working overtime stamp your Final Out in this column

No credit will be given on Pay Roll unless your time is properly stamped

(See Over)

Form F4. Weekly Time Ticket for Clock Record. Day Force

(Another blank is used for the night force.)

The reverse side of this card contains rules and instructions, some of which are the following:

Cards must be stamped at *actual time you are ready for work* and *not on arrival.* At quitting time the cards must be stamped when you *stop* work and *not when you are ready to leave the building.*

Cards must be left in the racks at all times.

Should your card be lost, report immediately to foreman.

PROOF ROOM Ticket

Reading			Revising				Working Time		Copy-Holding			Miscellaneous For Work Unclassified	For Office Use	
Text	Adv.	Job Dept.	Text	Adv.	Job Dept.	O.K.'ing for Press			Text	Adv.	Job Dept.		Ch'ge-able	Non-Ch'ge-able
						Columns for Order No. and Customer or Publication precede these columns, and they are followed by spaces for time clock stamps.								

Form F5. Proof Room Ticket

Form P5 and P7 are the same size as Form P6. Under Working Time the hour and minute figures are printed, from 8 A.M. to 5.30 P.M. on the Day Ticket, and from 5.30 P.M. to 2 A.M. on the Day Overtime Ticket.

(Size of Ticket 10¼ x 9½ in.)

COMPOSITION TICKET

Name ____________________ Hours ____________

Use an X in the column that shows the kind of work done and draw a line through time across the page

Size of Adv.	Proportion Set	COMP	Corrections Hand	Corrections Lino.	Corrections Mono.	Alterations Hand	Alterations Lino.	Alterations Mono.	Working Time		Make-up	Lock-up	Lock Fdy.	Dist.	Miscellaneous For Register or Corrections on Press, Smash, Handling Cuts, Etc.	For Office Use Ch'ge-able	For Office Use Non-Ch'ge-able
(Four columns precede this. Order No., Customer or Publication, Name of Advertiser, Size of Adv.)			Changes made by and chargeable to us	Changes made by and chargeable to us	Changes made by and chargeable to us	Changes made by and chargeable to customer	Changes made by and chargeable to customer	Changes made by and chargeable to customer	8.00 8.06 8.12 8.18 8.24 8.30 8.36 8.42 8.48 8.54 9.00 9.06 9.12 9.18 9.24 9.30 9.36 9.42 9.48 9.54 10.00 10.06 10.12 10.18 10.24 10.30 10.36 10.42 10.48 10.54 11.00 11.06 11.12 11.18 11.24 11.30 11.36 11.42 11.48 11.54 12.00	 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2.0 2.1 2.2 2.3 2.4 2.5 2.6 2.7 2.8 2.9 3.0 3.1 3.2 3.3 3.4 3.5 3.6 3.7 3.8 3.9 4.0	*(and so on, until 5.30 or 9.5 hrs.)*						*(Space beyond this for time clock stamps)*

If you have taken up a partly set adv. or have one unfinished at close of day, or have someone helping you, state the fraction you set, which with the other fraction makes the whole adv. Thus, "Size of adv. ½ page" "Propoportion you set, ⅛ page" This leaves the remaining ⅜ to be reported elsewhere.

Totals	
Gross	

Working Hours { 8.00 A.M. 12.15 P.M. / 1.00 P.M. 5.30 P.M. } DAY Use Overtime Ticket for all Overtime

Please read and observe instructions on reverse side

(A similar ticket, but printed in red, is used for overtime, the times running from 5.30 P.M. to 2 A.M. or 8.5 hrs.)

Form F6. Composition Ticket

LINOTYPE No.____ Daily Record. Name ____________ Hours ________

Use an X in the column that shows the kind of work done and draw a line through time across the page

Comp.	Cor.	If correcting someone else's original composition, indicate whose	Alt.	Working Time		Size of Face	Picas Wide	Total Ems	For Office Use Ch'ge-able	For Office Use Non-Ch'ge-able
(Preceding Columns for Order No. and Customer or Publication)	Changes made by and chargeable to us		Changes made by and chargeable to customer	8.00 8.06 8.12 8.18 8.24 8.30 8.36 8.42 8.48 8.54 9.00 9.06 9.12 9.18 9.24 9.30 9.36 9.42 9.48 9.54 10.00 10.06 10.12 10.18	 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2.0 2.1 2.2 2.3					

For Office Use	Totals	Text		Totals	
		Border		Gross	

Form F7. Linotype Daily Record

(Size 8½ x 9½ in.)

CYLINDER PRESS TICKET

Clock No. _____ Pressman _____ Hours _____
Press No. _____ Clock No. _____ Feeder _____ Hours _____
Date _____ 191_____
Use X for Automatic and for Make-Ready and Running: Draw a line through the

Order No.	AUTO	Customer or Publication	Folios of Form and No. pp.	Color Ink and Quantity	MRY	RUN	Miscellaneous Smash, Comp. on Form, etc.

(Headings Continued)

time across the page (up to "For Office Use" column) in taking up each new order.

Working Time		Counter at Start	Counter at Finish	Net Run	For Office Use		
					Ch'geable	Non-Ch'geable	Laid Off
5.30							
5.36	0.1						
5.42	0.2						
5.48	0.3						
5.54	0.4						
6.00	0.5						
6.06	0.6						

FORM F8. CYLINDER PRESS TICKET

This ticket is for day overtime, first shift, 9.5 hours from 5.30 P.M. to 3 A.M. The reverse side of the ticket contains Instructions to Foreman and Pressmen, as follows (somewhat abridged):

Machines must be started at the ring of the starting gong, and shall not stop until the gong rings for stopping.

Each press has its own ticket each working day, whether running or not. For overtime or night work, only the presses that run use tickets.

A pressman running two machines repeats his name and time on each ticket, and each ticket shows only the actual time of the feeder. If more than one feeder is employed, give names of each and their time.

In starting work draw a line through the commencing time straight across the ticket up to, but not through the column "For Office Use." In changing from "make ready" to "running," put an X in the column to indicate the operation and draw a line from and through the column straight across and up to column "For Office Use." In changing to a new order, draw a line clear across the ticket and up to column "For Office Use."

If no help is employed on a machine write "Laid Off" in Miscellaneous column and indicate the length of time.

Waiting for form is not to be charged to an order unless the foreman so instructs.

When a form is lifted, say so and give the reason, and when reinstated start the counter where you left off and indicate that it is a "lifted form."

Delays or interferences that seem to the foreman to be on account of customer are to be referred each day to the office, and if chargeable, the word "charge" is to be recorded, and such words used in its description as would be clear to the customer if so billed. If there is a smash, or cut pulls off, mark page number and always pin a proof of the page to the ticket.

Where extra help is required, such as slip-sheeters, state how many were employed and their time.

Make out your ticket as completely and as concisely as you know how and upon completion of each individual operation. Be very careful that every entry be absolutely correct, and be as neat as you can. *Do not wait until the end of the day and have to trust to your memory.* If you are in doubt as to the method of filling in this ticket, ask your foreman.

A similar ticket, 8½×13 in. in a different color, is used for day overtime.

The back of Form F9 contains instructions, some of which are given below, also a "Kind of Work" Index and a wage-calculating table which are here given in full. (See page 234.)

This ticket is for payroll purposes, so that it is absolutely necessary that you fill in the headings carefully, giving date, your name and clock number.

Do no work without getting an order number to charge to.

Be careful, particularly if you are a pieceworker, to get the exact quantity you have produced, and be sure you have the right order number and name, the number that properly indicates the kind of work you have done, the correct rate per hundred, and the correct total charge.

All your time tickets must be deposited at quitting time in the basket provided for that purpose. Should your ticket be lost, report immediately to forewoman, *otherwise you can not receive credit on the payroll for the work you have done.*

SCALE OF WAGES

FROM 1 TO 8 HOURS—BASIS 8 HOUR DAY

Rate per Week	Hours								Fractions		
	1	2	3	4	5	6	7	8	¼	½	¾
4.00	.08	.16	.25	.33	.41	.50	.58	.66	.02	.04	.06
4.50	.09	.18	.28	.37	.46	.56	.65	.75	.02	.04	.07
5.00	.10	.20	.31	.41	.52	.62	.72	.83	.02	.05	.07
5.50	.11	.22	.34	.45	.57	.68	.80	.91	.02	.05	.08
6.00	.12	.25	.37	.50	.62	.75	.87	1.00	.03	.06	.09
6.50	.13	.27	.40	.54	.67	.81	.94	1.08	.03	.06	.10
7.00	.14	.29	.43	.58	.72	.87	1.02	1.16	.03	.07	.10
7.50	.15	.31	.46	.62	.78	.93	1.09	1.25	.03	.07	.11
8.00	.16	.33	.50	.66	.83	1.00	1.16	1.33	.04	.08	.12
8.50	.17	.35	.53	.70	.88	1.06	1.23	1.41	.04	.08	.13
9.00	.18	.37	.56	.75	.93	1.12	1.31	1.50	.04	.09	.14
9.50	.19	.39	.59	.79	.98	1.18	1.38	1.58	.04	.09	.14
10.00	.20	.41	.62	.83	1.04	1.25	1.45	1.66	.05	.10	.15
10.50	.21	.43	.65	.87	1.09	1.31	1.53	1.75	.05	.10	.16
11.00	.22	.45	.68	.91	1.14	1.37	1.60	1.83	.05	.11	.17
11.50	.23	.47	.71	.95	1.19	1.43	1.67	1.91	.05	.11	.17
12.00	.25	.50	.75	1.00	1.25	1.50	1.75	2.00	.06	.12	.18
12.50	.26	.52	.78	1.04	1.30	1.56	1.82	2.08	.06	.13	.19
13.00	.27	.54	.81	1.08	1.35	1.62	1.89	2.16	.06	.13	.20
13.50	.28	.56	.84	1.12	1.40	1.68	1.96	2.25	.07	.14	.21
14.00	.29	.58	.87	1.16	1.45	1.75	2.04	2.33	.07	.14	.21
14.50	.30	.60	.90	1.20	1.51	1.81	2.11	2.41	.07	.15	.22
15.00	.31	.62	.93	1.25	1.56	1.87	2.18	2.50	.07	.15	.23
15.50	.32	.64	.96	1.29	1.61	1.93	2.26	2.58	.08	.16	.24
16.00	.33	.66	1.00	1.33	1.66	2.00	2.33	2.66	.08	.16	.25
16.50	.34	.68	1.03	1.37	1.71	2.06	2.40	2.75	.08	.17	.25
17.00	.35	.70	1.06	1.41	1.77	2.12	2.47	2.83	.08	.17	.26
17.50	.36	.72	1.09	1.45	1.82	2.18	2.55	2.91	.09	.18	.27
18.00	.37	.75	1.12	1.50	1.87	2.25	2.62	3.00	.09	.18	.28
18.50	.38	.77	1.15	1.54	1.92	2.31	2.69	3.08	.09	.19	.28
19.00	.39	.79	1.18	1.58	1.97	2.37	2.77	3.16	.09	.19	.29
19.50	.40	.81	1.21	1.62	2.03	2.43	2.84	3.25	.10	.20	.30
20.00	.41	.83	1.25	1.66	2.08	2.50	2.91	3.33	.10	.20	.31
20.50	.42	.85	1.28	1.70	2.13	2.56	2.98	3.41	.10	.21	.32
21.00	.43	.87	1.31	1.75	2.18	2.62	3.06	3.50	.10	.21	.32
21.50	.44	.89	1.34	1.79	2.23	2.68	3.13	3.58	.11	.22	.33
22.00	.45	.91	1.37	1.83	2.29	2.75	3.20	3.66	.11	.22	.34
22.50	.46	.93	1.40	1.87	2.34	2.81	3.28	3.75	.11	.23	.35
23.00	.47	.95	1.43	1.91	2.39	2.87	3.35	3.83	.11	.23	.35
23.50	.48	.97	1.46	1.95	2.44	2.93	3.42	3.91	.12	.24	.36
24.00	.50	1.00	1.50	2.00	2.50	3.00	3.50	4.00	.12	.25	.37
24.50	.51	1.02	1.53	2.04	2.55	3.06	3.57	4.08	.12	.25	.38
25.00	.52	1.04	1.56	2.08	2.60	3.12	3.64	4.16	.13	.26	.39

(*Note on Form F9. Bindery Daily Time Ticket.*)

(Size 8½ x 11 in.)

Bindery Daily Time Ticket _____ 191 _____

Employee _____ Clock No. _____

"Kind of Work" Column must be filled in, using numbers

Every time you change jobs or kind of work draw a line through the time across the page. Only piece workers

Order No.	Customer or Publication	No. Folds or Sections	Kind of Work (See Over)	Working Time	

(Headings Continued)

Wages {Per Week $_____ Hours _____
{Per Hour $_____ (Time Work Only)

listed on back of sheet. Take separate ticket for overtime

need figure out their time, or wages, in column headed "Time Work." Time workers need not do this.

Quantity	Piece Work		Time Work			
					Chargeable	Non-Chargeable
	Rate per 100	Cost	Hours	Rate per Hour	When you use an Order No.	When there is no Order No.
		$ c			$ c	$ c

FORM F9. BINDERY DAILY TIME TICKET

ORDER NO.		BILL ISSUED _____
COMPOSITION:		
____ems 6 pt.	@	
____ems 8 pt.	@	
____ems 10 pt.	@	
____Full-page advs.	@	
____Half-page advs.	@	
____Quarter-page advs.	@	
____Small advs.	@	
____hrs. Hand Alterations	@	
____hrs. Machine Alterations	@	
ELECTROS:		
____Full-page advs.	@	
____Half-page advs.	@	
____Quarter-page advs.	@	
____Small advs.	@	
PRESSWORK:		
____32-page form	@	
____16-page form	@	
____8-page form	@	
____4-page form	@	
____8-page cover	@	
BINDING:		
BULK POSTAGE (See over for items)		

FORM F23. RECORD FOR ITEMIZED BILL

(The Details are on the Cost Ticket, Form 22, page 236)

RECAPITULATION OF
LIGHT AND POWER
DISTRIBUTION TO DEPARTMENTS

Departments	Location	LIGHT		POWER	
		K.W.	Value	K.W.	Value
Cylinder Press	Basement				
	Elevator				
	2d Floor				
	3d Floor				
	4th Floor				
	Total				

The other departments in this distribution record are Comp. Room, Linotypes, Job Comp. Platens, Bindery, Office, Shipping, Stock, Baling Machine, Maintenance

FORM F18*a*. RECAPITULATION OF LIGHT AND POWER DISTRIBUTION. (See F18, page 234)

MAINTENANCE Ticket *(Size 8¼ x 9¾ in.)*

Carpenter—Electrician—Machinist Dated _____ 191 Name _____ Clock No. _____ Hrs. _____

Describe in the proper column the kind of work done and draw a line through time across the page.
Give details as to the department for which the work was done and material used.

MAINTENANCE - REPAIRS, ETC.	Working Time		NEW WORK - ORIGINAL CONSTRUCTION
	8.00		
	8.06	0.1	
	8.12	0.2	
	8.18	0.3	
	8.24	0.4	
	8.30	0.5	

(Working hours 8 A.M. to 12.15 P.M. and 1 P.M. to 5.30 P.M. Another blank is used for overtime)

FORM F10. MAINTENANCE TICKET

DAILY COMPOSING ROOM RETURNS—CHARGEABLE

HAND COMPOSTION

ORDER NUMBER	NAME IF A PUBLICATION GIVE TITLE	COMPOSITION		OFFICE CORRECTIONS						AUTHOR'S ALTERATION					
				First		Stone		Press		First		Stone		Press	
		Reg.	Over	Reg.	Over	Reg.	Over	Reg.	Over	Reg.	Over	Reg.	Over	Reg.	Over
(Large sheet 28 × 20 ins. with two sets of headings, one on each half of the sheet, 130 ruled lines below the headings, in blocks of 5 followed by ruling for total.)															

(Headings Continued)

Date day 191

HANDLING		MAKE-UP		LOCK-UP		L.U. FDY.		REGISTER		ENGR.				BANK	
Reg.	Over	Reg.	Over	Reg.	Over	Reg.	Over	Reg.	Over	Reg.	Over	Reg.	Over	Reg.	Over

Form F11. Daily Composing Room Returns

COMPOSITION RETURNS

Name_____ *(Size 12 × 12½ in. including margin for binding)* Order No._____

Description Date Entered_____ 191

Indicate Second Shift in Red Ink — BOOK ROOM — Cross out whichever heading does not apply — JOB ROOM

Date 191	Name of Compositor	Totals of Reports		Composition		Corrections						Alterations						Handling		Make-Up		Lock-Up		Lock-Up Foundry		Register		Engraver		Misc.			
						First		Stone		Press		First		Stone		Press																	
		No.	Hours	Reg.	Over	Reg.	Over	Reg.	Over	Reg.	Over	Reg.	Over	Reg.	Over	Reg.	Over	Reg.	Over	Reg.	Over	Reg.	Over	Reg.	Over	Reg.	Over	Reg.	Over	Reg.	Over	Reg.	Over
	Brt. Fwd.																																
				(55 ruled lines, in blocks of five)																													
	* Totals																																

* See over for Recapitulation of Totals

Linotype and Monotype Returns on Reverse Side Sheet No._____

MACHINE WORK ONLY. NO HAND WORK.

Order No._____

LINOTYPE											MONOTYPE										Totals of Reports
											KEYBOARD							CASTER			
Date 191	Operator	Totals of Rep's		Composition		Corrections		Alterations		Body	Ems Exclude Alt.	Date 191	Operator	Composition		Alterations		Body	Ems Exclude Alt.	Operator		
		No.	Hours	Reg.	Over	Reg.	Over	Reg.	Over					Reg.	Over	Reg.	Over					
	Brt. Fwd.												Brt. Fwd.							*Columns same as under Keyboard*		
	Totals												Totals							Totals		

Indicate all Special Time in Red Ink

RECAPITULATION OF TOTALS

	BOOK-JOB Cross out whichever heading does not apply		LINOTYPE			MONOTYPE					
						KEYBOARDS			CASTERS		
	Hours Regular	Hours Overtime	Hours Regular	Hours Overtime	Total Ems	Hours Regular	Hours Overtime	Total Ems	Hours Regular	Hours Overtime	Total Ems
Composition											
Alterations											

Form F12. Composition Returns, and Recapitulation

(*Sheet 14 x 15 in for Loose-leaf binder, ruled on both sides, 35 lines to a page.*)

COMPOSING ROOM PAYROLL FOR WEEK

	Employee	Friday		Saturday		Monday		Tuesday	
		Charge	Non Charge	Charge	Non Charge	Charge	Non Charge	Charge	Non Charge
	Amounts brought forward								

(*Headings Continued*) Sheet No._____

ENDING 191

Wednesday		Thursday		Total Time	Rate Per Week	Total Amount	Paid on Account	Amount Due	Remarks	Overtime
Charge	Non Charge	Charge	Non Charge							

FORM F13. COMPOSING ROOM PAYROLL

PRESS RETURNS

Name

Description

DATE	Press No.		AUTO	Folios of Form and No. pp.	INK If Black leave vacant QUANTITY	COUNTER AT START	COUNTER AT FINISH	NET RUN	MISCELLANEOUS Smash, Comp. on Form, etc.
	Plat.	Cyl.							
Size of Sheet	12¾ x 12 in.,			*45 ruled lines beneath the headings, followed by*					

RECAPITULATION Totals

	IMPRESSIONS	MAKE-READY			RUNNING			SPECIAL
		Regular	Over	Double	Regular	Over	Double	
Cylinders								
Platens								

Enter time for Two-color Cylinders and Autopress in red ink.

Sheet No.

(*Headings continued*)

REPORTS

Date	Cylinders	Two-Color	Platens

Order No._____

TIME

CYLINDERS									PLATENS			
Make-Ready				Running					Make-Ready		Running	
Regular	R Over	Night	N Over	Regular	R Over	Night	N Over		Regular	Over	Regular	Over

FORM F14. PRESS RETURNS

Sheet 15¾ x 15 in. for loose leaf binder Printed and ruled on one side only

RECAPITULATION CYLINDER AND PLATEN PRESS RECORDS —— Month of _____ 19____

	Press No.	FIRST SHIFT								
		TOTAL IMPRESSIONS	CHARGEABLE HOURS				NON-CHARGEABLE		Laid Off	No. of Forms
			Make-Ready		Running					
			Reg.	Over	Reg.	Over	Reg.	Over		
Under "Press No." are printed the figures: 1 to 45 for cylinder presses, with a ruled line for each.										
The same headings are used for Second Shift and for Platens. The "Press" column under Platens contains 25 letters A to Z with a ruled line for each.										
On the same sheet, below the totals of the columns there are printed the following instructions and additional forms.										

INSTRUCTIONS

Overtime to be entered at actual time. The total hours recorded for the month should be equal to the regular working hours of the first shift, multiplied by the total number of presses, plus the overtime hours of the first shift, plus the hours represented by the presses running on the second shift. The presses NOT RUNNING on the second shift on which no labor is employed are not considered in this record. Observe carefully the distinction between "NON CHARGEABLE" and "LAID OFF" time. Include under the classification "NON-CHARGEABLE" the time of those presses that are standing temporarily for any reason that is NOT CHARGEABLE TO CUSTOMER. Include under the "LAID OFF" classification the time of those presses on the FIRST SHIFT ONLY that are standing being either out of commission on account of repairs, or because of no work, THERE BEING NO LABOR EMPLOYED ON THEM. Indicate in the column provided for that purpose the number of COMPLETED forms produced.

TO ASCERTAIN

ITEMIZED TOTAL COST Obtain figures from PROFIT & LOSS STATEMENT

ITEMIZED COST PER CHARGEABLE HOUR—Use TOTAL CHARGEABLE HOURS as a divisor, dividing total cost of each item.

ITEMIZED COST PER THOUSAND IMPRESSIONS—Use TOTAL IMPRESSIONS as a divisor, dividing total cost of each item.

	Itemized Total Cost		Itemized Cost per Chargeable Hour		Itemized Cost per 1000 Impressions	
	Cylinders	Platens	Cylinders	Platens	Cylinders	Platens
Depreciation						
Ink						
Light						
Payroll						
Power						
Repairs						
Rollers						
Balance Overhead						
TOTALS						

INKS

	BLACK			COLORED		
	Pounds	Total Cost	Average Cost per lb.	Pounds	Total Cost	Average Cost per lb.
Cylinders						
Platens						
Totals						

SUMMARY

CYLINDERS				PLATENS	
Total Hours	Per cent of Total			Total Hours	Per cent of Total
			Chargeable		
			Non-Chargeable		
			Laid Off		
	100.0		Grand Totals		100.0

Total Impressions _____

Average Impressions per Running Hour _____

Average Impressions per Hour including Make-ready _____

Average Impressions per Running Hour on Automatics _____

FORM F15. RECAPITULATION CYLINDER AND PLATEN PRESS RECORDS

PAY VOUCHER

Fill in this voucher carefully and accurately as it is used as your statement of wages due. No wages can be paid without it.

Name _____ Clock No. _____

Department _____ Night / Day

For week ending _____ 191____

	HOURS WORKED (Indicated in hours and tenths)		
	Regular	Overtime	Special
Friday			
Saturday			
Monday			
Tuesday			
Wednesday			
Thursday			
Total Hours			

Checked by _____ Total Amount Due $_____

TEAR OFF AND RETAIN THIS PAY RECEIPT

PAY RECEIPT

Fill in this receipt carefully and accurately giving totals of time and wages as shown on your pay voucher.

TEAR OFF AND RETAIN THIS PAY RECEIPT AND PRESENT TO PAYMASTER WHEN YOU RECEIVE YOUR ENVELOPE, AS IT IS ACCEPTED AS YOUR RECEIPT (SUBJECT TO CORRECTION IN THE EVENT OF ERROR) FOR WAGES RECEIVED. NO WAGES CAN BE PAID WITHOUT IT.

SUMMARY OF TIME AND WAGES

For week ending _____ 191____

TOTAL HOURS

Regular Time	=	$
Overtime	=	
Special Time	=	
Totals	=	$

Received the amount stated above, subject to correction in the event of error.

Name _____ Clock No. _____

Department _____ Night / Day

FORM F16. PAY VOUCHER AND PAY RECEIPT

Order No. (Sheet, 23 x 12½ inches) Date Entered 191

Customer

Description

BINDERY

PIECE WORK

	Stitching		Folding			Gathering		Inserting			Mailing	Covering	Tip Strip	Silk Sewing	
	14		28			29		33			58	36	40-41	42	
Total Cost	@	@	@	@	@	@	@	@	@	@	@	@	@	@	@
(Three columns precede this: Date, Employee & Oper. No.)															

(Size of Sheet, 23 x 12½ inches 50 ruled lines, every fifth line heavy ruling)

(Headings Continued)

Sheet No. Order No.

RETURNS Binding Make-up: Hand Machine

TIME WORK

	Stitching		Folding		Gathering		Inserting		Covering		Mailing		Stamp	Tip Strip	Silk Sew	Carry	Pad	64-65	
	14	15-16	28	68	29	30-31-32	33	34-35	36	37-38-39	58	59-63	43-44	40-41	42	55	67	66	
Quantity	Cost	Cost	Cost	Cost	Cost	Cost	Cost	Cost	Cost	Cost	Cost	Cost	Cost	Cost	Cost	Cost	Cost	Cost	Cost
(Five columns precede this: Date, Employee, Oper. No. Time & Total Cost)																			

MACHINE WORK

	Cut-trim		Folding		Cleveland Jobber		Covering		Chain Stitching			Gathering Stitching		Gathering Stitching-Covering		Smash	23		
	1-2-3	4-5-6		7-13		69-71		17-18		72-74			19-21			22	27		
Total Cost	Cost	Cost	Quant.	Cost	Quant.	Cost	Quant.	Cost	Quant.	Cost	Total Cost	Quant.	Cost	Quant.	75-77	Cost	Cost	Cost	Cost
(Four columns precede this: Date, Employee Oper. No. & Time)											(Four columns precede this: Date, Employee Oper. No. & Time)								

FORM F17. BINDERY RETURNS

Form FI7 contains also an index of the "Kind of Work" and a "Recapitulation" with columns for quantities and costs. The items of the recapitulation are as below:

RECAPITULATION

CUTTING

1 Cutting flat stock.
2 Trimming pamphlets, etc.
3 Seybold trimmer.
4 Seybold trimmer helper.
5 Jogging.
6 Carrying.

MACHINE FOLDING

7 Operator.
8 Helper.
9 Box tending.
10 Hand feeding.
11 Refolding.
12 Bundling machine.
13 Carrying from folders.

CLEVELAND JOBBER

69 Operator.
70 Feeder.
71 Box tending and carrying.

WIRE STITCHING

14 Operator—Piece.
14 Operator—Time.
15 Taking off.
16 Carrying or jogging.

MACHINE COVERING

17 Operator.
18 Helper.

CHAIN STITCHING

72 Operator.
73 Taking off.
74 Carrying or Jogging.

MACHINE GATHERING—STITCHING

19 Operator.
20 Helper.
21 Carrying.

MACHINE

MACHINE GATHERING—STITCH—COVER

75 Operator.
76 Helper.
77 Carrying.

OTHER MACHINE WORK

22 Smashing.
23 Perforating.
24 Punching.
25 Round cornering.
26 Numbering.
27 Eyeletting.

HAND WORK

28 Folding—Piece.
28 Folding—Time.
68 Refolding.

GATHERING

29 Gathering—Piece.
29 Gathering—Time.
30 Laying up.
31 Jogging.
32 Carrying.

INSERTING

33 Inserting—Piece.
33 Inserting—Time.
34 Jogging.
35 Carrying.

COVERING

36 Covering—Piece.
36 Covering—Time.
37 Carrying.
38 Re-covering.
39 Taking off covers.

MISCELLANEOUS HAND WORK

40 Tipping.
41 Stripping.
42 Silk sewing.
43 Stamping.
44 Postage stamping.
45 Tabbing.
46 Taking apart.
47 Gumming.
48 Counting.
49 Interleaving.
50 Stringing.
51 Reinforcing.
52 Tissuing.
53 Metal clips.
54 Paper seals.
55 Carrying.
56 Errands.
57 Wrapping and tying. (not mailing).
67 Padding.
78 Cancelling.

MAILING

58 Wrapping.
59 Inclosing—turn in flap.
60 Inclosing—sealing flap.
61 Tying.
62 Counting.
63 Helping.

PRESS ROOM CHARGES

64 Smut sheeting.
65 Bronzing.
66 Jogging flat sheets.

Total Wages.

FORM FI7*a*. REVERSE OF FI7. MACHINE WORK IN BINDERY

(Size 15¼ × 11 in.)

ELECTRIC LIGHT AND POWER METER READINGS

From_____ 191____ To_____ 191____

Taken by_____

LIGHT				POWER	
Meters and Location	Department	Readings	Department Charged to, with Per cent. to each	Department Charged to, with Per cent. to each	Readings
Center West Wall 3d Floor	Comp. Room Cylinder P. R. Platens Bindery Office Maintenance	Present Reading_____ Previous Reading_____ Consumed_____	Comp. Room 30%_____ Press Room 10%_____ Platens 15%_____ Bindery 40%_____ Office 3%_____ Maintenance 2%_____	Comp. Room 10%_____ Press Room 30%_____ Platens 10%_____ Bindery 40%_____ Maintenance 10%_____	Present Reading_____ Previous Reading_____ Consumed_____
(Similar records for meters in eleven other locations)					

FORM FI8. ELECTRIC LIGHT AND POWER METER READINGS

(*Sheet 14 x 15 in ruled on both sides for Loose-leaf book, 35 lines to a page.*)

PRESS ROOM PAYROLL

	No.	Employee	Fri.	Sat.	Mon.	Tues.	Wed.	Thur.
		Amounts brought forward						

(*Headings Continued*)

WEEK ENDING _____ 191____

	Total Time	Rate Per Week	Total Amount	Paid on Account	Amount Due	Remarks	Overtime

FORM F19. PRESS ROOM PAYROLL

(*Page 22 x 19 in. 36 ruled lines*)

SALES FOR THE MONTH OF 191

Order No.	NAME	DESCRIPTION	Key	Total Charge	Composing Room and Monotypes
		Amounts brought forward			

Headings Continued

Linotypes	Cylinders	Two Color Cylinders	Job Department			Bindery	Paper Stock	Publication Postage, etc.	Metal	True Cost
			Comp. Room	Platens	Autopress					

FORM F20. SALES FOR THE MONTH

SALES LEDGER

Rating $\frac{D}{B}$ _____ Name _____

Credit Limit _____ Address _____

	Date 191	Order No.	Quantity	DESCRIPTION
(*Loose leaf Ledger Sheet 14 x 13¾ in. Ruled 46 lines to the page*)				

Headings Continued Sheet No. _____

	Folio	Key	Debits	Credits	Key	Folio	DESCRIPTION	Date 191

FORM F21. SALES LEDGER

(Size 9½ x 11½ in.)

COST TICKET

Order Entered _____ Billed _____ Salesman _____ S.B. Page _____ Order No. _____

For _____ Billed _____

Address _____

Description _____

The reverse of this Cost Ticket contains a Billing Description with 42 ruled lines and a blank for Paper Stock and other items. The headings are as below.

Former Nos. _____

Estimate: No - Yes _____

Customer's Order No. _____

No. Pages _____ { and / without } Cover ____

Trimmed Size ____ x ____

Total Ems Set / Caster Record if Mono. { Linotype _____ / Monotype _____

ELECTROS - ENGRAVINGS - DRAWINGS

Date	From	Description	Price

PAPER STOCK - { Ours / Customer's }

	Date	From	Rms.	Shts.	Size	Wt.	Description	Price
Cover Inside								

INK

MISCELLANEOUS ITEMS

POSTAGE, CHARGEABLE EXPRESS OR FREIGHT, CARTAGE, ETC.

DELIVERIES - (ENTER RECEIPTS EACH DAY)

Date	Quantity	Date	Quantity	Date	Quantity

SPECIAL NOTE:

	Hours	10ths	@	COST	BILLED	M	L
COMPOSING ROOM: Composition							
Overtime							
Alterations							
Overtime							
Monotype-Key							
Overtime							
Casters							
Overtime							
Alterations { Key / Cast }							
Overtime							
LINOTYPES: Electros							
Engravings							
Llootype							
Overtime							
Alterations							
Overtime							
CYLINDERS: Metal { Mono. / Lino. } lbs.							
Forms							
Cover							
Gross Impressions							
Hours, Regular							
Overtime							
Slipsheeting or Bronzing							
Ink { Black / Colored }							
JOB DEPARTMENT (Enter 2 only Items in red): Composition							
Overtime							
Alterations							
Overtime							
Platens-Forms							
Description							
Gross Impressions							
Hours, Regular							
Overtime							
Slipsheeting or Bronzing							
Ink { Black / Colored }							
BINDERY: Description { Outside / Ours }							
Wages, $ ____ + ____ %							
Cutting							
Perf.-Num.-Rul							
STOCK: Inside							
Cover							
Puck-Ship-Cartage, etc.							
Totals							
Net P-L							
Stamps, Bulk Postage or Chargeable Express or Freight							
Total							

Order No. _____

FORM F22. COST TICKET AND BILLING RECORD

_____ Order No. Bill Issued _____

BILLING DESCRIPTION	ITEMS	TOTALS

PAPER STOCK

Date	From	Rms.	Shts.	Size	Wt.	Description	Price	Cost

Date	From	Description	Cost

FORM F22*a*. BILLING DESCRIPTION (Reverse of F22).

CHAPTER XXI

REPORTS TO STOCKHOLDERS; EDUCATION OF ACCOUNTANTS; COST OF IDLENESS; MISCELLANEOUS FORMS; BIBLIOGRAPHY

REPORTS TO STOCKHOLDERS OF LARGE CORPORATIONS

The forms in which printed annual reports of large corporations are made by the president or the directors to the stockholders are illustrated below. Particular attention is called to the statements concerning maintenance, depreciation and reconstruction in the report of the American Telegraph and Telephone Company.

The report of the General Electric Company is notable as an extreme example of "writing off" expenses of all kinds and charging them to "cost of sales." The company ha regularly paid 8 per cent dividends for several years, in both good and bad times. If it had paid 10 per cent some of the stockholders might have been gratified, but the result would have been a much poorer annual report for the year 1916. The "sound and conservative" policy of "writing off" has been fully justified by the splendid condition of its finances to-day. "The company has no note payable."

It is Surplus rather than Capital Stock that earns Dividends. The reason usually given for the accumulation of a large surplus instead of paying large dividends to stockholders is that it is a necessary and proper provision against the vicissitudes of business, fluctuation in demand, depression in trade, obsolescence both of plant and of product, and for the need of new capital to ensure the steady growth of the business which is needed to supply increasing demand. Another good reason is that it provides a fund which may be used to purchase the latest improvements in labor-saving machinery, the use of which will earn large profits. A concern with a million dollars capital, all invested in plant, stock in trade, bills and accounts receivable, with no surplus, may have all it can do to earn the bare interest on its investment, but if it had a quarter of a million surplus it might invest that in improved machines which would earn 20 per cent per annum on their cost. A statement of earnings might then show:

Old Plant	$1,000,000 @ 6%	$60,000
New Machinery	250,000 @ 20%	50,000
Total		$110,000

which is 11 per cent on the capital stock, or 8.8 per cent on the sum of capital and surplus.

"It is the straphangers that pay the dividends," the president of a street railway corporation is reported to have said.

Extract from the Report of the Directors of American Telephone and Telegraph Company

New York, March 12, 1917

BELL TELEPHONE SYSTEM IN UNITED STATES

COMPARISON OF REVENUE AND EXPENSES, 1915 AND 1916

(All Duplications including Interest, Dividends and other Payments to American Telephone and Telegraph Company by Associated Companies are Excluded.)

	1915	1916	Increase
Exchange Revenues	$169,155,944	$188,888,149	$19,732,205
Toll Revenues	62,929,980	72,971,668	10,041,688
Miscellaneous Revenues	2,338,431	2,715,463	377,032
Total Operating Revenues	$234,424,355	$264,575,280	$30,150,925
Depreciation	$ 44,586,841	$ 49,631,966	$ 5,045,125
Current Maintenance	31,171,272	34,923,549	3,752,277
Traffic Expenses	45,785,432	53,748,707	7,963,275
Commercial Expenses	23,583,274	25,698,913	2,115,639
General and Miscellaneous Expenses	11,049,191	11,902,470	853,279
Total Operating Expenses	$156,176,010	$175,905,605	$19,729,595
Net-operating Revenues	$ 78,248,345	$ 88,669,675	$10,421,330
Uncollectible Revenues	$ 1,703,210	$ 1,480,502	$ 222,708*
Taxes	13,001,903	14,916,448	1,914,545
Operating Income	$ 63,543,232	$ 72,272,725	8,729,493
Net Non-operating Revenues	6,022,932	7,080,384	1,057,452
Total Gross Income	$ 69,566,164	$ 79,353,109	$ 9,786,945
Rent and Miscellaneous Deductions	$ 3,384,407	$ 3,735,470	$ 351,063
Interest Deductions	18,095,643	18,378,931	283,288
Total Deductions	$ 21,480,050	$ 22,114,401	$ 634,351
Balance Net Income	$ 48,086,114	$ 57,238,708	$ 9,152,594
Deduct Dividends	32,897,065	35,160,119	2,263,054
Surplus Earnings	$ 15,189,049	$ 22,078,589	$ 6,889,540

* Decrease.

COMBINED BALANCE SHEETS, 1915 AND 1916

(Duplications Excluded)

	Dec. 31, 1915	Dec. 31, 1916	Increase
ASSETS:			
Telephone Plant	$ 880,068,520	$ 946,293,248	$ 66,224,728
Supplies, Tools, etc.	15,951,582	24,032,099	8,080,517
Receivables	43,518,625	66,029,580	22,510,955
Cash	45,716,330	80,692,829	34,976,499
Stocks and Bonds	72,652,646	81,815,476	9,162,830
Total	$1,057,907,703	$1,198,863,232	$140,955,529
LIABILITIES:			
Capital Stock	$ 440,711,200	$ 463,101,569	$ 22,390,369
Funded Debts	353,236,464	422,586,617	69,350,153
Bills Payable	2,404,920	3,738,451	1,333,531
Accounts Payable	29,039,127	38,280,436	9,241,309
Total Outstanding Obligations	$ 825,391,711	$ 927,707,073	$102,315,362
Employees' Benefit Fund	9,114,329	9,151,000	36,671
Surplus and Reserves	223,401,663	262,005,159	38,603,496
Total	$1,057,907,703	$1,198,863,232	$140,955,529

MAINTENANCE, DEPRECIATION AND RECONSTRUCTION

During the year $84,906,000 was applied out of revenue to current maintenance and depreciation, an increase of $8,846,000 as compared with 1915. Current maintenance increased $3,752,000, averaging 3.9 per cent on the average plant in service, which compares with 3.7 per cent in 1915.

The provision for depreciation of plant during the year was $49,983,000, an average of 5.6 per cent of the cost of plant and an increase over 1915 of $5,094,300.

Plant which originally cost about $44,000,000, but which had reached its limit of serviceable life, was removed and replaced by new and improved construction, or sold, as compared with $42,000,000 in 1915. After deducting this amount less salvage from the provision for depreciation, the balance, about $25,000,000, increases the reserves for such depreciation and obsolescence, which must be provided for out of current expenses, but cannot be currently determined or expended. As stated in last year's report, it is the continuing policy of the Bell System to provide out of earnings each year amounts as represent the estimated wear and tear, obsolescence and inadequacy of plant accruing that year, so that when any plant comes to be retired sufficient reserve has been gradually acquired to meet the loss of capital due to such retirement. This is the sound and conservative policy for the protection and guaranty of the future of the plant, and it is the only way by which telephone users pay for the wear of the plant incident to or concurrent with their use, instead of passing this cost on to the future users. Lack of recognition of this principle has caused many failures in all industries, and particularly in the telephone business. This principle is now generally accepted and the practice is firmly established by the accounting rules of the Interstate Commerce Commission and the various state commissions.

Extracts from the Report of the General Electric Co. April 16, 1917

Value of Orders received for electrical machinery and supplies in 1916		$167,169,058	00
(50% greater than for the largest previous year, 1913)			
Amount of sales billed		134,242,289	69
Less cost of goods sold, including all operating, maintenance and depreciation charges		118,948,198	58
Net Profit on Sales		15,294,091	41
Income from other sources		3,866,881	95
Total net income		19,160,973	36
Less Interest on debenture bonds	571,444 96		
Dividends on Stock	8,121,646 00	8,693,090	96
Carried to Surplus		10,467,882	40
Surplus at January 1, 1916		23,692,871	03
Surplus at December 31, 1916		$34,160,753	43
Capital Stock issued		101,512,500	00
Number of employees in the factories and offices of the Company and subsidiary companies, about 79,000			

The Company has followed its customary practice in writing off against income its total expenditures during 1916 for patents, applications for and licenses under patents and other outlays relating thereto, amounting to $891,880.30. The patent account is carried at $1.00 as in previous years.

The Company has no note payable, nor is there any paper outstanding bearing its indorsement.

On January 31, 1893, the book value of your manufacturing plants was	$ 3,958,528	21
During the 24 fiscal years to December 31, 1916, additional expenditures have been made aggregating	88,634,909	55
Total	92,593,437	76
Written off during the twenty-four years	62,688,673	44
Book value of all plants at December 31, 1916	$29,904,764	32

	Net Book Value Jan. 1, 1916		Additions During Year		Written Off		Net Book Value Dec. 31, 1916	
Real Estate and Buildings	$20,038,337	31	$1,860,729	25	$2,452,875	44	$19,446,191	12
Machinery	9,524,992	21	5,732,187	13	4,798,608	14	10,458,571	20
Patterns	1	00	113,888	06	113,888	06	1	00
Furniture and Fixtures	1	00	1,121,450	36	1,121,450	36	1	00
Total	$29,563,331	52	$8,828,254	80	$8,486,822	00	$29,904,764	32

ASSETS

Patents, Franchises and Good Will					$ 1	00
Cash:					12,167,706	92
Stocks, Bonds and Other Securities	$33,773,678	08				
Notes and Accounts Receivable	26,816,297	28				
Advances to Subsidiary Companies	4,739,818	68				
Installation Work in Progress	4,196,020	35	69,525,814	39		
Merchandise at Factories	43,963,220	49				
At district offices, on consignment, in transit, etc.	7,197,418	98	51,160,639	17	120,686,453	56
Manufacturing Plants			29,904,764	32		
Real Estate, other than Manufacturing Plants			863,187	70		
Furniture and Appliances (other than in factories)			1	00	30,767,953	02
					$163,622,114	50
LIABILITIES						
Debenture Bonds					$12,047,500	00
Accounts Payable			$7,874,872	89		
Accrued Taxes			1,149,256	36		
Accrued Interest on Debentures			196,518	68		
Dividend payable January 15, 1917			2,030,154	00	11,250,801	93
Advance Payments on Contracts					4,650,559	14
Capital Stock Issued					101,512,500	00
Surplus					34,160,753	43
					$163,622,114	50

Extract from the Report of the Westinghouse Electric and Manufacturing Co.

REPORT OF THE AUDITORS

New York, May 8, 1917.

TO THE BOARD OF DIRECTORS,
WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY,
NEW YORK.

We have made an audit, for the year ended March 31, 1917, of the books and accounts of the Westinghouse Electric & Manufacturing Company, and the following proprietary companies, viz.: Westinghouse Lamp Company, Westinghouse Lamp Corporation, H. W. McCandless & Company, The Bryant Electric Company, The Perkins Electric Switch Manufacturing Company, R. D. Nuttall Company, Westinghouse Electric Export Company and Westinghouse Electric & Manufacturing Company of Texas.

We have verified the Stocks and Bonds owned, the Cash and the Notes Receivable, by count or by proper certificates from the depositaries.

The investments in Stocks and Bonds of other Companies are conservatively valued on appraisals made by us from market quotations and financial reports and other available data as to operating results.

We have examined the Accounts Receivable and in our opinion the reserves created therefor are sufficient to cover probable losses.

The inventories of Raw Materials and Supplies, Finished Parts, Completed Apparatus, and Work in Progress of the subsidiary companies were taken under our general supervision and valued at cost or less. No inventories were taken at the Works of the Westinghouse Electric & Manufacturing Company because the demands upon the Company for production were so great that it was not considered desirable to close the works for this purpose. We have, however, carefully reviewed the book accounts and, based on such examination and past experience (the book records under the comprehensive system of accounting followed having been found by such experience to be reliable) together with the reserves created to provide for possible shortages, we believe that the inventory values are conservatively stated, and

WE HEREBY CERTIFY that, in our opinion, the accompanying Consolidated General Balance Sheet of March 31, 1917, and Consolidated Statement of Income and Profit & Loss for the year so ended are correct; and we further certify that the books of the Companies are in harmony therewith.

(Signed) HASKINS & SELLS,
Certified Public Accountants.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY AND ITS PROPRIETARY COMPANIES IN THE UNITED STATES

(Except New England Westinghouse Company)

Consolidated General Balance Sheet

ASSETS

	March 31, 1917
Property and Plant:	
Factory Plants—Real Estate, Buildings, Equipment, etc.	$22,701,110.02
Investments:	
Stocks, Bonds, Debentures, etc., of other Companies	$18,156,577.43
Current Assets:	
Cash	$12,625,574.67
Notes Receivable	4,935,511.06
Accounts Receivable	32,757,631.71
Total Current Assets	50,318,717.44
Working and Trading Assets:	
Raw Materials and Supplies, Finished Parts and Machines, Work in Progress, Goods on Consignment and Apparatus with Customers, Inventoried at Cost or less	$31,934,594.79
Other Assets:	
Patents, Charters and Franchises	$4,286,206.51
Insurance, Taxes etc., paid in advance	145,604.80
Total Other Assets	$4,431,811.31
Total	$127,542,810.99

Liabilities	March 31, 1917
Capital Stock:	
Preferred	$ 3,998,700.00
Common	70,813,950.00
Total Capital Stock	$ 74,812,650.00
Collateral and Long Term Notes	$ 2,803,750.00
Real Estate Purchase Money Mortgage	$180,000.00
Current Liabilities:	
Notes Payable—Bank Loans	$15,100,000.00
Accounts Payable	5,988,180.82
Interest, Taxes, Royalties etc., Accrued, not due	2,470,164.29
Dividend on Preferred Stock, payable in April	69,977.25
Dividend on Common Stock, payable in April	1,239,244.13
Unpaid Debenture Certificates, Bonds, Notes and Interest and Dividends	149,254.32
Total Current Liabilities	$25,016,820.81
Reserve:	
Against Inventories, Notes and Accounts Receivable, etc.	$ 6,624,291.52
Profit and Loss—Surplus	$18,105,298.66
Total	$127,542,810.99

Consolidated Statement of Income and Profit and Loss for the Year Ended March 31, 1917

Gross Earnings:		
Sales Billed		$89,539,442.09
Cost of Sales:		
Factory Cost, including all Expenditures for Patterns, Dies New Small Tools and Other Betterments and Extensions; also depreciations of Property and Plant, Inventory Adjustments and all Selling, Administration, General and Development Expenses and all Taxes		72,077,751.53
Net Manufacturing Profit		$17,461,690.56
Other Income:		
Interest and Discount, Dividends, Royalties, etc.		1,386,546.57
Gross Income from all Sources		$18,848,237.13
Deductions from Income:		
Interest on Bonds and Debentures, Notes, etc.		768,348.30
Net Income Available for Dividends and Other Purposes		$18,079,888.83
Profit and Loss Credits:		
Profit and Loss—Surplus, March 31, 1916		9,246,707.03
Gross Surplus		$27,326,595.86
Profit and Loss Charges:		
Dividends on Preferred Capital Stock	$ 279,909.00	
Dividends on Common Capital Stock	3,750,000.02	
Appropriations to Reserve Account	5,000,000.00	
Miscellaneous (Net)	191,388.18	9,221,297.20
Surplus, per Balance Sheet		$18,105,298.66

COLLEGE EDUCATION IN ACCOUNTING *

1. *What kind of accounting is meant.* The accounting here treated is the work of the expert accountant, who aids materially in the management of business by furnishing financial statements and data, after the work of the entry clerk is complete.

2. *The education of a person desiring to become an accountant.* The accountant should receive just as ample an education as the manager. This is to enable him to execute his duties with the greatest sureness and effectiveness. His education must be accomplished in a much shorter time and through different routes from that of experience.

3. *The necessity for such an education.* The public and high schools furnish no education of help to the accountant, as the commercial courses in these schools only give instruction in typewriting and bookkeeping, in which he is not interested. Little knowledge is obtained in the lower schools that is of real value to the student, and it is the author's opinion that the curricula of American schools should be greatly changed, so as to really furnish a practical instruction.

4. *It should be a college education.* As the accountant must be able to cope with the mature mind of the management of the firm, it is necessary for him to have a mature education, and this can only be received in a college.†

5. *The methods of teaching the subject.* The greatest difficulty is to make the courses as practical as they will be found in actual business. The author suggests a method similar to the clinic service of the doctor. He suggests letting the student work under guidance on the books of charitable institutions and small business concerns. The progress would be much greater and the knowledge obtained more profound.

6. *The qualifications of the student.* Before beginning the study of accounting, the student should possess a thorough general education which will enable him to understand the use of technical terms and fully grasp the instruction offered him. Accounting can not be fruitfully taught before the third year of a collegiate education.

7. *The postgraduate course seems better.* The postgraduate course seems more adequate to prepare a man for this work as only a graduate possesses that knowledge of the world so lacking in the college man.

The subdivisions of the courses in accounting in general may be enumerated as follows: Philosophy of accounts; practical accounting; accounting procedure; accounting systems; simple accounting problems; advanced accounting problems; auditing; advanced auditing; private auditing; accountants' reports; corporation finance; accountancy of investments; and cost accounting.

* Extracts from a paper by John G. Geijsbeek, presented at the Second Pan-American Scientific Congress, December, 1915. *Bureau of Education Bulletin*, 1916, No. 25, "Commercial Education," p. 58. See also the Proceedings of the Congress, Section IV, Part 1, page 532.

† This is too broad a statement. The education obtained in American colleges is often anything but "mature," and the "mature mind of the management" commonly comes from an education in the "college of hard knocks."

TECHNICAL EXPERIENCE NECESSARY TO THE ACCOUNTANT

Even in those engineering concerns which have installed much up-to-date machinery and which are well on the road in improved methods of production there does not seem to be sufficient recognition of the fact that the status of practically all the so-called commercial staff must be regulated by the shop organization. Systems, routine and nomenclature are now originated in the shop instead of in the office. This surrender of control on the part of officials like the accountant is not an easy task. It will not be consummated until our so-called bookkeepers in engineering offices are made to qualify for this task by having served a practical course in the productive departments. This work should consist partly of manual work and partly in the "works" accounting and costing departments. This technical experience is absolutely necessary to the commercial accountant to make him realize that his work must harmonize with the details of the productive departments. This harmonious working is a necessity to make clear statements and returns which interlock with "factory" returns. Confusion and discrepancies are sure to be the rule if this is not accomplished, and patched-up incongruous statements of accounts and results will be continually presented to those who need exact statistics for their guidance and information.—From an article on "The Training of our Industrial Forces," by H. F. L. Orcutt, in *Engineering* (London), Sept. 7, 1917.

AN ENGLISH VIEW OF COST ACCOUNTING

The following extracts are taken from an editorial in *Engineering* (London) Oct. 12, 1917. From these it appears that British manufacturers are still in the dark ages of cost accounting, but they are beginning to see light.

If any firm, through ignorance of the principles which should govern the ascertainment of true costs, underestimates the cost of competitive work, and secures an order through incorrect calculations, not only that firm, but also its competitors, must suffer.

While trading and cost accounts should be made interdependent there should also be a clear distinction between them. . . . The trading accounts indicate what has happened and refer to the past, whereas cost accounts are for the purpose of future estimate, improvement and effort.

The interdependence of the trading and cost accounts may be sufficiently effected by opening records in the trading accounts to represent different productions, for instance—separate accounts for each process, class of manufactures or contracts, or in the case of similar productions—if convenient—accounts for grouping a number of processes, manufactures, etc. Arranging the trading accounts in this manner provides a check assuring the accuracy of the cost accounts, and shows the correct value of "work in progress" (stock).*

Apportionment of "Establishment Expenses" (On cost).†—This item presents the greatest difficulty in arriving at "production costs." Various plans have been tried, each no doubt justified by certain considerations and open to equally sound objections. The "machine rate" occasionally employed in connection with engineering work is a case in point. If a machine can be used regularly doing work of constant value, a machine rate for distributing on-cost may be satisfactory, but there are few producing concerns that could maintain this condition. Irregular and variable employment is more general, and in these circumstances any attempt to apportion the total establishment expenses on this basis must take into account many elements of uncertainty, and therefore introduce complications too cumbersome for practical purposes.

"Permanent Charges."—Ground, buildings, plant and machinery, administration and permanent staff, advertising and traveling. Each of these expense items, though more or less a standing charge, differs in each department, in relation to output, according to the conditions of production. It is therefore more convenient to slump [lump?] the lot and decide a fixed rate of distribution based on normal output, at which the rate allocation should be made in proportion to production units for any period.

Fluctuating Charges.—Building repairs, plant repairs, loose tools upkeep, indirect labor, stores consumed in the course of manufacture, and material scrapped, should increase or decrease in the same ratio as the production units, but as these charges are frequently subject to irregular variations, they should be entirely allocated as they occur (say monthly) so that they can be scanned and accounted for immediately any change takes place. It does not follow that the distinction between permanent charges and fluctuating charges makes it necessary to use two rates in apportioning on-cost. One rate, made up of a fixed figure (permanent charge) plus a changing figure (fluctuating charge) is sufficient.

It is unfortunate that those engaged in engineering business have not arrived at something approaching general agreement on the subject of estimating and costing. To a large extent this has been due to conservatism originating with the management and transmitted to officials. Practically all initiative has been suppressed, consequently little progress has been made in the direction of adopting new ideas. The manner of preparing cost records has, to a large extent, become obsolete, and continues to vary considerably in many concerns. The financial accountant in his view of costing becomes too academic, and the technical man is handicapped by inexperience. Sir Robert Hatfield, in the discussion on Professor Ripper's paper read before the Royal Society of Arts, remarked: "As to costing it was necessary to specialize upon this as it was upon engineering problems. Many firms had little idea what their products were actually costing."

Too frequently there is a tendency to follow "the law of average"—a polite way of describing "rule-of-thumb"—in costing. . . . The misunderstanding that often exists respecting the purpose of cost accounting leads to further reliance on the "law of average" . . . whether averaging is adopted or whether records made under varying conditions are used to estimate the cost of repeat jobs, the results must involve considerable speculation, and in any case procedure of this kind is tantamount to working backwards. Normal cost records are surely a more definite basis, for upon these the effect of any change of circumstances can be estimated more accurately.

TO WHAT ACCOUNT SHALL THE EXPENSE OF IDLENESS BE CHARGED?*

In determining the cost of a manufactured article, should we include all the expense incurred while that article is being manufactured, or should we include only those expenses which contribute to its production?

There is a great variety of opinion as to what the "burden" charge on any particular work should be. This overhead or "burden" may be divided into two parts:

a. That which is incurred through simple ownership or rental of the plant and keeping it ready for operation.

*The error of this statement is shown on page 124.—W. K.

†"Establishment charges" and "on cost" are terms used by English writers to mean the same thing that is called "overhead" or "burden" in the United States.

*Extracts from a paper on "Expenses and Costs," by H. L. Gantt. Journal of the Amer. Society of Mechanical Engineers, Dec., 1917. (See also Idleness Charts, page 105.)

b. That which is incurred by operating the plant, exclusive of direct labor and material.

The first part is made up of ownership or rental of a number of machines or work benches, properly housed. The second part consists of such items as power, oil, waste, repairs, etc. We are able to determine for each machine in the factory both an idle- and an operating-expense rate.

Any article manufactured on a machine should undoubtedly bear the operating-expense rate for the time during which the machine was operated on it.

The expense of maintaining the machine in idleness during the time it was not operated cannot legitimately be charged to the work done while it was operated, and should be put into another account.

In every plant there are to be considered two kinds of burden:

a. That which produces goods and which can legitimately be charged to the cost of those goods, and

b. That which produces nothing, and must be put into some other account.

A careful consideration of the expense incurred while the plant is idle leads to very fruitful results: first, an attempt to find out why the plant is idle, and then an attempt to eliminate the causes of idleness, which are lack of work, lack of help, lack of material, repairs, etc.

The accountant has looked upon costs as a bookkeeping proposition, whereas, in truth, costs are much more closely connected with engineering and production than with the subjects of bookkeeping and accounting.

Money spent without any corresponding production must be kept separate from that which was productive, either directly or indirectly.

The following question is put to us by the accountant and financier, "What are we going to do with this expense of idleness?" they having never before realized that it cost something to be idle.

My frank answer to that is that I do not know. Moreover, I don't care, provided they do not charge it to me in the products which I buy from them. My recommendation, however,would be that they see how they can eliminate such expense by proper managerial methods.

Mr. Gantt is on the right track when he says frankly "I do not know." Confession of ignorance is often the beginning of wisdom. In scientific management it is the substratum below the foundation (see the "pyramid," page 119), whose bottom courses are "I want to know" and "I am going to know." But when he says "I don't care" he takes the position of the selfish consumer, who thinks he should not pay any portion of the cost of the business risks which the enterprising manufacturer assumes when he provides facilities for meeting the fluctuating and intermittent demands of his customers.

One of the risks is that of idleness of some part of the machinery for some part of the time, even when business conditions are normal. This risk the ultimate consumer pays for, just as he pays for insurance against fire and other accidents in the factory and for all the usual losses that are due to lack of "proper managerial methods."

Mr. Gantt seems to assume that the engineer, the financier and the accountant are three different persons, with different and possibly antagonistic opinions. In fact the manufacturer is often financier, engineer and accountant combined, and he regards the question of cost as equally one of bookkeeping, of production and of finance.

Let us apply Mr. Gantt's question "What are we going to do with this expense of idleness?" to a concrete hypothetical case, and endeavor to find an answer.

A certain factory puts in an expensive machine, or group of machines, to make a product for which there is a limited and fluctuating demand. The extent of the demand will depend to a large extent upon the price which the consumer is asked to pay for the product, and upon the activity and the expenditure of the selling department. If the factory charges the article to the sales department at too high a "factory cost" there may not be enough margin between this price and the price asked of the consumer to warrant any great expenditure by the sales department in an attempt to increase the demand, and consequently the factory will be insufficiently supplied with orders. If, on the other hand, the factory does not charge enough to cover the cost of material, labor and burden, the factory will be run at a loss.

The thing to be done is to make a careful estimate of the probable burden under different assumed conditions of demand, and try to fix a standard burden per unit of product or per machine hour, to be used in establishing the "factory cost," which is defined as the "warehouse value" or the price at which the article is to be billed to the sales department. It is, as nearly as can be ascertained, the cost of reproducing the article at the present prices of material and labor, with a normal burden charge, that is the estimated burden per machine hour or per unit of product when the machinery is run at the expected normal number of hours per year.

Example. Let the cost of the machine, or group of machines, be $10,000 and let the yearly burden estimate be as follows:

Fixed Charges					
Interest on investment, at 5%	$500				
Reserve for depreciation due to obsolescence of machine or product					
Sinking fund, 20 years, 5%	302				
Taxes	100				
Insurance	50				
Rent of space occupied	200				
	1152				
Variable Charges					
Number of hours the machine runs per year		0	1000	2000	3000
Supervision, indirect labor, small tools		$500	$600	$700	$800
Power		100	150	200	250
Light		40	60	80	100
Repairs, oil, waste, etc.		0	100	200	300
Depreciation due to wear and tear		0	100	200	300
		640	1010	1380	1750
Total burden, fixed and variable		1792	2162	2532	2902
Burden per machine hour		$——	$2.16	$1.27	$0.97

When the machine is idle for the whole year the burden charge against it is $1792. It receives no care from the superintendent, and uses no power and no light, but charges have to be made against it for these items because it has been provided with facilities for their use. The $1792 is the factory loss due to idleness. The loss of the business may be far greater, for the sales department may have incurred

expenses without making sales, and there are no profits, which might have been made if the space in the factory had been occupied by other machinery making products for which there was an active demand.

The management, with this estimate before it has now to consider what is the probable number of hours per year that the machine will run under normal conditions of business, and normal activity of the sales department, and what is the corresponding normal burden that must be added to the cost of material and of labor to obtain the factory cost, at which the product is to be billed to the sales department or valued in the inventory.

Suppose 2000 hours is selected as the most probable time, and $1.27 as the most probable normal burden charge. The factory may run 3000 hours, but this machine is idle one-third of the time. The cost of the 1000 hours of idleness is included in the $1.27 per hour, and thus it gets charged, through the sales department, to the consumer. But suppose that through inactivity of the sales department the machine is called on to run only 1000 hours per year. The total burden according to the table is $2162, but burden account is credited and factory product is charged only 1000 hours at $1.27, or $1270, leaving an extra cost of idleness of $892 which remains as a debit balance of Burden account, to be charged later to Profit and Loss or "some other account."

If, however, a great demand for the article should spring up, causing the machine to run 3000 hours per year then Burden account would show the following:

Dr.	Total burden, as per table	$2902
Cr.	Burden charged to cost, 3000 hours at $1.27	$3810
	Overearned burden due to extra activity (which is to be credited to Profit and Loss)	$908

The question "what are we going to do with this expense of idleness?" is thus easily answered if we adopt the principle of the normal machine-hour burden or the normal burden per unit of product. Burden account is charged with the sum of the fixed and variable burden expenditures, and credited (cost of product being charged) with the normal burden—so many machine hours at so much per hour, or so many units of product at so much per unit. The cost of product thus includes a charge for a normal amount of idle time of the machines. If the idle time exceeds the normal amount the cost of the excess of idleness will appear as a debit balance of Burden account. If it is less than the normal amount then there will be a credit balance of Burden account, which will finally be transferred to the credit of Profit and Loss.

There is nothing new in this method of treating the expense of idleness. It was described by Gershom Smith in his article in *Engineering Magazine* of June, 1909, quoted on page 150. He says:

> Where owing to trade conditions the machines do not operate sufficient time to absorb the total expense, if there is no reserve to draw upon I prefer to show the deficit as a charge against the department income or profit and loss account, thus keeping the costs on a normal basis.

Mr. Smith seems to have used the method in connection with machine-hour burden rates as early as 1902. The present author used it in the same way in 1909, as mentioned in his article in the *Iron Trade Review*, Feb. 4, 1909, quoted on page 79, but he had used it in connection with the old-fashioned method of charging burden as a fixed percentage on direct labor, as early as 1887. Manufacturing account, in the factory ledger, was charged, and Factory Expense credited, with a percentage on direct labor, and in the cost ledger the same percentage on direct labor was charged to the cost of individual articles. Factory Expense was charged with all the factory burden, and if at the end of the year it showed a debit balance, this represented the unearned burden, including the cost of idleness in excess of the normal amount, and it was closed into Profit and Loss.

BLANK FORMS USED IN COST ACCOUNTING

In the preceding chapters numerous blank forms used in the production, accounting and statistical departments of various industries have been given. On pages 164 to 169 will be found reproductions of several forms contributed by Mr. Albert Walton, which have been found useful in metal-working establishments. An index to all the forms in this book will be found on page 259. Several cards used in different factories are shown below, viz.:

In an automobile factory, six forms:

Form A-1256

WORKMAN'S ABSENCE REPORT

NAME ____ CLOCK NO. ____

LEFT WORK	Mo.	Day	Hour A.M. P.M.	WILL RETURN	Mo.	Day	Hour A.M. P.M.	DID RETURN	Mo.	Day	Hour A.M. P.M.

EXPLANATION:- Absences or Lates are allowed:- Check

When causing No Overtime Work.

When No Lot Urgent Tags ahead of Man.

When Workman arranges with Foreman for Workman's job to go on without delaying Production.

REMARKS:- Specify condition of work ahead of Man:-

SIGNED:- DEPT. FOREMAN

NOTED				(NOT) ALLOWED				CHECKED WITH WORKMAN'S RECORD			
Mo.	Day	Yr.	Hour A.M. P.M.	Mo.	Day	Yr.	Hour A.M. P.M.	Mo.	Day	Yr.	Hour A.M. P.M.
Signed				Signed				Signed			
D M Clerk				Employ. Sup'v'r.				Emp. Dept. Clerk			

FORM AU1. WORKMAN'S ABSENCE REPORT

(Size $4\frac{3}{8}$ in. sq.)

Form A-1257-Mfg.

WORKMAN'S RATING REPORT

NAME				CLOCK NO.			OLD RATE	NEW RATE

NEW RATE BEGINS	Mo.	Day	Yr.	CONTINUES UNTIL	Mo.	Day	Yr.	REPORT ISSUED	Mo.	Day	Yr.
PERIOD BEGINS				PERIOD ENDS				PERIOD LENGTH	Hrs.		

FACTOR	EXPLANATION	RECORD	STANDARD
e	Per cent of task time earned		
P_a	" " " absence per hour worked		
P_d	" " " time spent on day work		
P_t	" " " time suspended		
S	Average cost of spoiled work per hour		
N	No. of major processes can do		
y	Years of continuous service		
C	Conduct and co-operation		

REMARKS:

(This card is made in triplicate, white, pink, and yellow, one for the workman, one for the paymaster, and one to the tickler)

Your record through the current period will increase or decrease your rate for the coming period.

AUTHORIZED	APPROVED	APPROVED
Production Manager	Superintendent	Dept. Foreman

FORM AU2. WORKMAN'S RATING REPORT

Returned
Form A-1277 Mfg.
Issued

MAN'S NO. D M

NAME

IDLE TIME Hrs. | 10s

CHG. TO F-No.

DRAW. NO. | LOT NO. | OPER. NO.

MATERIALS		INSTRUCTIONS	
	Not on Floor.		Lacking, or Missing.
	Lot Incomplete.		Defective, or Incomplete.
	Tags Missing.		No Blue Print.
	Not up to Machine.		Delayed for Inspection.
			Waiting at Cage.

MACHINE		TOOLS	
	Break-Down.		Lacking, or Missing.
	Repairmen Working on.		Defective, or Faulty.
	Belt Trouble.		Delayed for Grinding
	Power Shut-Offs.		Delayed for Supplies

INSTRUCTIONS:- Carefully check item causing delay. Idle time will not be allowed if report is incomplete.

FOREMAN

CLERK

FORM AU4. IDLE TIME RECORD

Form A-1272-Mfg.

Returned
Issued

MACHINE SYMBOL

LOCATED IN DEPT.

IDLE MACHINE RECORD

ELAPSED TIME Hrs. | 10s

MACHINE		TOOLS	
	Break-Dowo.		Fixture Lacking.
	Under Repair.		Fixture Defective.
	Power Shut-Offs.		Supplies Lacking.
	Belt Breakage.		Supplies Defective.

MAN		MATERIALS	
	Absent.		Not up to Machine.
	No. Regular Operator.		Urgent on Preceding Machine.
			Ahead of Schedule.
			Up but No Orders.
			Up but No Inst. Card.

INSTRUCTIONS—Check opposite cause; forward to planoing department for record.

SIGNED DEPT. CLERK

NOTED PLAN DEPT.

FORM AU3. IDLE MACHINE RECORD

F 25 AP

Department D M

Charge Premium Only to

Workman's Name | Workman's No. D M

Record of Time Worked, Good Pieces Claimed, and Day Wages advanced on

PREMIUM JOB

Operation No.—Piece Symbol—Lot No.

Month	Day	Number of Good Pieces Finished each Day	Time Worked Hrs.	Time Worked Min.		Hrs.	Min.
					B Premium Date Time allowed		
					Prem. Limit C=AB Time		
					Time Taken D		
					Time Saved E=C−D		
					Premium F=½E Time		
					Man's Rate	Prem. Earnings	
Totals		Workman's Claim A		D	F×	=	

Passed Inspector A

Post Premium Only

Payroll | Cost

Form A-1083

PREMIUM CARRY OVER CARD

FORM AU6. PREMIUM CARRY OVER CARD

Returned Form A-1077-B Issued	5:00 P.M. 11/28 7:00 A.M. 11/28	Drawing No. 21547	Lot No. 32

Man's Name	Jones	Man's No.	D 6 M 23

Piece Symb. I	Oper. No. 2	Operation Name Drill & Tap

						Hours
Original Pieces Issued	100					
Machine for this Operation	14 D P D 6 M	No. of Good Pcs. A claimed Finished on this Job	30	B Prem. Base Time Allowed	Per Piece 0	.5
Machine Work'd on this Opr'n		MACHINE		Prem. Limit C=AB Time	15	0
		Time	Cost No. / Rel. No.	Time Taken D	9	0
Machine for next Operation	20 D P D 2 M			Time Saved E=C−D	6	0
If Job is not finished Scratch out this ☞		K	Inspected	Prem. F=½ E Time	3	0
If Job is finished Scratch out this ☞		NF	D.M.H.	Earning Time G=D+F	12	0

Route Sheet	Pay Roll	Man's Cost	Mach. Cost	Man's Job Card	Man's Rate	Earnings
				~~DAY WORK D~~ or PREMIUM G	× .40 =	4 80

(Coupons for Inspector and Move Man)

I have inspected the first pieces on this job and found them O.K. Form A-1077 Signed by	Drawing No.	Lot No.

Man's Name	Man's No. D M

Piece Symbol	Oper. No.	Operation Name

Original Pieces Issued						
Machine for this Operation						
Machine Work'd on this Opr'n		Material	Data	Means	Started	Finished
Machine for next Operation						

Returned Form A-1077-A Issued		Drawing No.	Lot No.

Man's Name	Man's No. D M

Piece Symbol	Oper. No.	Operation Name

Original Pieces Issued		Reasons					
Machine for this Operation		Pieces Spoiled		Wt. Material			
Machine Work'd on this Opr'n		Pieces Defective					
Machine for next Operation		Pieces for Repair					
Mark off Machines Not worked on		Good Forw'rd'd		Moved to	Mo.	Day	Hour	Rec'd by
Route Sheet	Moved by 1st							
	Inspected by							
	Moved by 2nd							

FORM AU5. MAN'S JOB CARD

In a factory making a variety of small articles, seven forms:

NO. OF PIECES	DATE	ORDER NO.
NAME		
MATERIAL		

	OPERATION	Dept.	MACH.	First Lot	BEGIN Second Lot	Third Lot	Fourth Lot
1	*(3 lines, 4 per inch)*						
6	Sandpaper	K3					
7	Polish	"					
8	Stamp	"					
9	Drill	K4					
10	Fill	"					
11	Brush	"					
12	Trim	"					
13	Repolish	K3					
14	Clean	K7					
15	Pack	"					
16	*(10 lines, down to line 25)*	"					

5m 6-16 Form B 119 SHOP ORDER

Reverse

DEPT. P P

OPERATION	RECEIVED				
Date	Daily	Total	Daily	Total	Daily
			(Five additional double columns)		

FORM CE1. SHOP ORDER.

Name	Pieces for Machine A B	Part No.
Material		

Operation	Dept	Machine No.	Class	No.	Tool Location	Pieces per Hour	Remarks
(15 lines, 4 per inch)							

MASTER ROUTE CARD Date

(The reverse side has the same printing, omitting the top heading)

FORM CE2. MASTER ROUTE CARD

RET'D ISS'D		Part and Order No.
Man's Name		Man's No.
Time Allowed	Time Taken	Finished
		Not Finished
Bonus	Hourly Rate	Transferred
		Breakdowo
Pay for	Wages	Caught Up
Machine No.	Machine Expense	Man Expense

Name of Part or Job

Operation Name	Oper. No.	Amount Finished	Rate	Wages
(3 lines)				

Entered in					O.K. for Quality	O.K. for Quantity
Dept. Clerk	Schedule	Man Record	Pay Roll	Cost Record		

B 140 PRODUCTION CARD

FORM CE3. PRODUCTION CARD.

Order No.	Article	Oper. No.	Time Taken	Amount Finished	Piece Rate	Wages	
	(Headings on the reverse side of Card CE3.)						
	(15 lines, 4 per in.)						

FORM CE3. PRODUCTION CARD, REVERSE)

RET'D ISS'D		Dept.
Man's Name		Man's No.
		Hourly Rate
Machine No.	Machine Expense	Man Expense
Name of Part or Job		

Order No.	Operation Name	Oper. No.	Time Taken	Amount Finished	Piece Rate	Wages	
	(7 lines, 4 per in.)						

Entered in					O.K. for Quality	O.K. for Quantity
Dept. Clerk	Schedule	Man Record	Pay Roll	Cost Record		

B 104 PRODUCTION CARD (Overtime)

FORM CE5. PRODUCTION CARD, OVERTIME

(Size 17 x 11 in.) Date Ordered 4/19 1917 Article 167 Y. RECORD OF PROGRESS
No. of Pieces 600 Order No. 250

	Operation Name		Mark			Bandsaw			Cut Flat Edge			Round Edges			Turn Pocket			
	Date	Material	Product	Wages		Product	Wages		Product	Wages		Product	Wages		Product	Wages		
	16																	
	17																	
	18																	
	Apr. 19		600		55	450	2	00										(Numerous columns for other operations)
	20					150		75	450	2	80							
	21								150	1	00							
	23											600	3	00	50	1	50	
	24														100	3	00	

FORM CE4. RECORD OF PROGRESS OF AN ORDER

Rec'd Finish'd		Machine Symbol	Charge Symbol
Operator		Repair Order No.	
		Partly - Totally Disabled	
		Month / Day / Year	___ A.M. ___ P.M.
Parts Broken or Worn			
Cause of Break			
Work in Machine at Time			
Please make above repairs by		Mo. / Day / Year / A.M. / P.M.	
Machine available for repairs on			
This order must be sent to Repair Office			
1M Sets-9-16-B136	REPAIR ORDER		Foreman

(The reverse side of this Card is printed as below)

Oper. No.	Operation	Class of Work	Workman	Rate
1	*(10 lines, 4 per inch)*			
2				

Wages		Expense		Material		Expense		Total Charges	

To be Kept by Repair Office

FORM CE6. REPAIR ORDER

Iss'd Rec'd		From Dept.
		To Dept.
Order No.		Pieces or Quantity
Name of Part		
1¼ in. space		

O.K. for Quantity Issued	O.K. for Quantity Received
Checker	Checker

TO BE SENT TO MFG. OFFICE
FORWARDING TICKET

ORDER NO.

Pieces or Quantity

This coupon must remain with material for identification

B120 Identification Coupon

FORM CE7. FORWARDING TICKET AND IDENTIFICATION COUPON

Form LS is a Job and Time Ticket used by Lodge & Shipley Co., Cincinnati, Ohio.

(Size of Card 6 x 4 in.)
Operation: Shop No.
Name of Piece: Sym. & Pc. No. Start
Quan.
Prem. allow. Per Pc | Tracers Check | Premium Paid | Detach | To Come
Defective | Spoiled
Man No. Workman: Stop
Stop
Start
Previous Time on this Job
Man No. | Time | Man No. | Time
Total Allow | O.T. | Rate | Earnings
Actual Time
Prem.
Notes:
Finished or not Finished
657

Reverse Side
Man No. _____
THIS SIDE OUT
Put Card In Receiver To These Marks

Day	Present	Absent	Late	Overtime	Notes
Thur.	(7 lines, Thurs. to Wed.)				

Form LS. Job and Time Ticket. (Lodge & Shipley Co.)

Form PR is a common form of Pay Roll.

Forms NE 1 and 2 are two cards used for general machine work by Nash Engineering Co., South Norwalk, Conn.

(Size 3¼ x 8¼ in.)
Name _____
Date _____ No. _____

Extra Time			Regular Time			
		SATURDAY	A.M.	IN		
			NOON	OUT		
				IN		
(Spaces for 7 days)			P.M.	OUT		
(Total at bottom)			A.M.			

Form NE1. Clock Time Card

This time card is Form L38, furnished by Simplex Time Recording Co., Gardner, Mass.

(Size 3½ x 8¾ in.)
No. 6A Form L 61-E
JOB CARD
Job No. List No. Dwg. No.

Operation	Rec'd	Fin.	Def.		Elapsed Time	
(13 lines)				IN		
				OUT		

Form NE2. Job Card. (Size $3\frac{1}{2} \times 8\frac{3}{4}$ in.)

(Size 11½ x 16¾ in.)
Examined and Registered _____
Correct _____
Approved for Payment _____
PAY ROLL
Week Ending
Mo. | Day | Year
Pay Sheet _____ Dept. _____
Total This Sheet _____
Number of Sheets _____
Total This Dept. _____

	Name	No.	Rate	Total Time	Pay	Deduct	Net Pay	17 columns for deductions and remarks
	45 lines 3 per inch							

Form PR. Common Form of Pay Roll

COST RECORD
Name _____

Date Issued	Order No.	Pieces Ordered	Pieces Received	Material Total	Material Per	Labor Total	Labor Per	Expense Total	Expense Per	Total Cost	Total Cost Per _____	Rate of Expense
	(16 lines)											

Form CR. Cost Record. (Size $6\frac{3}{4} \times 3$ in.)

Forms CR, PW are a Cost Record and a Plant Work Job Card which are found useful in many shops.

PLANT WORK JOB CARD Workman No._____

(Size 6 x 3¾ in.) Week Ending_____

Mon.	Tues.	Wed.	Thur.	Fri.	Sat.	Sun.

New Work Order No. (4 lines space)	Hours	Ck.	Rate	Amount	Ck.

Repair Order No. (45 spaces)

1	2	3	4	5	6	7	8	9							

FORM PW. PLANT WORK JOB CARD

(Size of Card 3¾ x 6 in.) Workmen Nos.

Week Ending_____

	Size	Description
A		
B		
C		

Lot No.	Special Order No.	Figure No.	Symbol

Operation No.	Grinding	Polishing	Buffing	Color Buff	Worked with Nos.

Quantity	Quantity	Time	Rate	Wages	Incomplete-Continued
Good A	Def	Reg ___	P.W.		
Good B	Def	Over ___	P.W.		Entered
Good C	Def	___	P.W.		
		Total ___	D.W.	Total	
		CK	CK	CK	

FORM LC1

(Reverse Side)

BUFFING AND POLISHING JOB TICKET

When work is on more than one Lot Number, record quantities on each Lot Number in Separate Columns

Lot No.	Lot No.	Lot No.	Lot No.	Lot No.
(6 lines)				

	1		2		3	
	On	Off	On	Off	On	Off
M.	(7 lines, Mon. to Sun.)					

Overtime_____ Hrs. Reg. Time_____ Hrs.

FORM LC1. BUFFING AND POLISHING JOB TICKET (The Lunkenheimer Co.)

Form LC1 is a job ticket used in one department of the Lunkenheimer Co., Cincinnati, O., manufacturers of valves and other articles of iron or brass.

Other weekly time and job tickets of the same size and general character but with different printing and different colors are used for other departments, such as Screw Machine, Assembling, Finishing and Testing; also a Time Card for miscellaneous indirect labor.

Form LC2 shows the printing on the Analysis of Pay Roll, and Form LC3 that on the Pay Roll Distribution Voucher of the Lunkenheimer Co.

PAY ROLL DISTRIBUTION VOUCHER

The Lunkenheimer Co. Cincinnati, Ohio. Week Ending.....

Brass Foundry	2	Direct Labor.
	3	Indirect Labor.
	7	Repairs, Patterns.
	8	" Machines, Tools and Equipment.
	9	Errors and Experimental.
	10	General Expenses.
Iron Foundry	22a	Direct Labor, Molding.
	22b	" " Coremaking.
	23a	Indirect Labor, Cupola.
	23b	" " Anneal Furnace.
	23z	" " Sundry.
	27	Repairs, Patterns.
	28	" Machines, Tools and Equipment.
	29	Errors and Experimental.
	30	General Expense.
Brass Factory	42a	Direct Labor, Lathe.
	42b	" " Screw Machine.
	43c	" " Punch.
	42d	" " Bench and Test.
	42e	" " Buffing and Polishing.
	42f	" " Plating.
	43a	Indirect Labor, Lathe.
	43b	" " Screw Machine.
	43c	" " Punch.
	43d	" " Bench and Test.
	43e	" " Buffing and Polishing.
	43f	" " Plating.
	43g	" " Lathe and Bench Dist.
	43z	" " Other Distributive.
	47a	Repairs, M. T. and E.—Lathe.
	47b	" " " Screw Machine.
Brass Factory	47c	Repairs, M. T. and E.—Punch.
	47d	" " " Bench and Test
	47e	" " " Buff. and Pol.
	47f	" " " Plating.
	50	Errors and Experimental.
	51	General Expense.
Iron Factory	62a	Direct Labor, Lathe.
	62b	" " Bench and Test.
	63a	Indirect Labor, Lathe.
	63b	" " Bench and Test.
	63z	" " Distributive.
	67a	Repairs, M. T. and E.—Lathe.
	67b	" " " Bench and Test.
	67z	" " " Distributive.
	70	Errors and Experimental.
	71	General Expense.
Power	81	Labor.
	83	Repairs.
	84	General Expense.
Distributive	91	Packing and Shipping Expense.
	92	Stable Expense.
	93	Drafting Expense.
	94	Laboratory Expense.
	97	Accounting Costs, Timek'g and Orders.
	100	Repairs, Machines, Tools and Equip.
	101	R. R. Maintenance and Repair.
	103	Repairs, Real Estate and Buildings.
	104a	Sundry Expense, Rec'g. St'ge, Transp'n.
	104c	" " Pattern Shop.
	104d	" " Tool Room.
	104e	" " Tool Storage.
Distributive	104f	Sundry Expense, Cleaning and Sweeping.
	104g	" " Japanning.
	104h	" " Emp. Club Room.
	104j	" " Inspection.
	104l	" " Police and Fire Pro.
	104m	" " 25% Bonus, Pr. Lab.
	104n	" " 50% Bonus, Pr. Lab.
	104z	" " Miscellaneous.
Adjmts.	112	Pattern Making.
	113	New Tools in Process.
	114	Stock Tools in Process.
Sh. Dept.	133	Sherardizing Labor.
	134	" Expense.
	136	" Equipment Repair.
Selling	154	Advertising.
	155	Salesmen's Salaries.
	158	City Sales Department.
	160	Exhibit Expense.
	161	Miscellaneous.
Adm. and General	162	Salaries of Officers and Clerks.
	163	Stationery Department.
	165	Office.
	169	Restaurant.
	170	Automobile.
	171	Donations.
	172	Miscellaneous.
	111	Labor—Credit

TOTAL

Correct.....

Approved.....

FORM LC3. PAY ROLL DISTRIBUTION VOUCHER

ANALYSIS OF PAY ROLL

The Lunkenheimer Co., Cincinnati, Ohio. Period.....

(Column Headings)

Descriptive	Hours	Wages	No. of Men	Av. Rate per Hour	Compared with: No. of Men Inc.	No. of Men Dec.	Rate Inc.	Rate Dec.

Under Descriptive are the following:

Brass Foundry

1 Floor and Bench Molders.
2 Machine Molders.
3 Core-Makers, Day-work.
4 Core-Makers, Piece-work.
5 Molders' Helpers.
6 Sundry Core-room Laborers.
7 Refining Laborers.
8 Furnace Tenders.
9 Sand Shovelers.
10 Grinders.
11 Cleaners, Filers and Sprue Cutters.
12 Sand Blast Operators.
13 Testers—Rough Castings.
14 Foremen.
15 Miscellaneous.
151 Briquetting.

Total—Brass Foundry

Iron Foundry

16 Floor and Bench Molders, Day.
17 " " " Piece.
18 Machine Molders, Day-work.
19 " " Piece-work.
20 Core-makers, Day-work.
21 " " Piece-work.
22 Cupola Tenders.
23 Cleaners, Chippers and Filers.
24
25 Foremen.
26 Miscellaneous.

Total—Iron Foundry

Factory—Non-Productive Departments

27 Foremen, Factory Productive Departments.
28 Tool Room.
29 Pattern Shop.
30 Power Plant.
31 Millwrights.
32 Blacksmiths.
33 Janitors.
34 Truckmen and Elevator Operators.
35 Receiving and General Stores.
36 Brass Casting Stores.
37 Iron Casting Stores.
38 Finished Stores.

Factory—Non-productive Depts.

39 Tool Storage.
40
41 Painting.
42 Japanning.
43 Inspection.
44 Wrapping.
45 Shipping.
46 Stable.
47 Watchmen.
48
49
50 Miscellaneous.

Total—Factory N. P. Depts.

(Size of sheet, 16¾ × 11, divided in two parts No. 56.)

Factory—Productive Departments

Iron.
51 Machine Hands, Day-work.
52 " " Piece-work.
53 Bench Hands, Day-work.
54 " " Piece-work.

Total—Iron

Punch
55 Machine Hands, Day-work.
56 " " Piece-work.

Total—Punch

Brass Lathe and Bench
57 Machine Hands, Day, Brass Valve Dept.
58 " " " Lubricator Dept.
59 " " " Cock-P. V. Dept.
60 " " " Injector Dept.

Total

61 Machine Hands, Piece, Brass Valve Dept.
62 " " " Lubricator Dept.
63 " " " Cock-P. V. Dept.
64 " " " Injector Dept.

Total

65 Bench Hands, Day, Brass Valve Dept.
66 " " " Lubricator Dept.
67 " " " Cock-P. V. Dept.
68 " " " Injector Dept.

Factory Productive Departments

Brass Lathe and Bench

Total

69 Bench Hands, Piece, Brass Valve Dept.
70 " " " Lubricator Dept.
71 " " " Cock-P. V. Dept.
72 " " " Injector Dept.

Total

Summary—Brass Valve Dept.
" Lubricator Dept.
" Cock and Pop Valve Dept.
" Injector Dept.

Total—Brass, Lathe and Bench

Screw Machine
73 Machine Hands, Day-work.
74 " " Piece-work.
75 Automatic Machines.

Total Screw Machine

Milling Machine
76 Machine Hands, Day-work.
77 " " Piece-work.

Total—Milling Machine

Buffing and Polishing
78 Polishing, Day-work.
79 " Piece-work.
80 Buffing, Day-work.
81 " Piece-work.
82

Total—Buffing and Polishing

Other Depts.
83 Testers—Finished work.
84 Plating.
85
86
87
88

Total—Other Departments

Total—Factory Prod. Depts

Total—Manufacturing Depts.

Misc.
89 Sherardizing Dept.
90 Administrative and Selling Depts.

Total—Miscellaneous

Grand Total of Pay Roll

Form LC2. Analysis of Pay Roll

After the job cards of the several departments have been sorted by workmen's numbers and the time and wages entered on the pay rolls they are sorted by piece and operation symbols and entered in cost ledgers. These are large loose-leaf books, and there is a large number of them, each containing about 2000 pages. They are indexed by departments and by piece symbols, and from them can be obtained all the detailed information of the labor cost of each operation on any lot of pieces that has been worked on.

The Joseph & Feiss Co. Clothcraft Shops. Form JF is a multiplication table (here reduced in size, only the corner portions being shown) devised by the Joseph & Feiss Co., of Cleveland, Ohio, to save the labor of calculation of wages due on piece work. A separate blank is printed for each piece-work rate used in the shop. The labor of making a garment is subdivided to the utmost. A sewing machine operator may be given a pile of from 100 to 500 sleeves to have one or two seams run on them, with one of these job tickets. When the job is finished the inspector marks on the ticket the number of pieces done, and the wage figure is seen immediately. The operator's name and address are printed on the ticket by means of an addressograph. If a man does more than one job in a day separate tickets are issued each day. The route clerk so plans the work as to keep the number of tickets or slips as few as possible. At the end of the day the slips are handed in and they are posted to the pay roll. Each operator has a ruled book in which he records his earnings each day. The pay-roll clerk keeps a yearly pay-roll record giving each man's daily earnings.

No. _____ Dept. _____ Name _____
In _____ Out _____ Hours _____ Day _____
Price .0065 Operation _____

1	2	3	4	5	6	7	8	9	10	11
0065	013	0195	026	0325	039	0455	052	0585	065	0715
31	32	33	34	35	36	37	38	39	40	41
2015	208	2145	221	2275	234	2405	247	2535	26	2665
61	62	63	64	65	66	67	68	69	70	71
3965	403	4095	416	4225	429	4355	442	4485	455	4615
91	92	93	94	95	96	97	98	99	100	101
5915	598	6045	611	6175	624	6305	637	6435	65	6565
121	122	123	124	125	126	127	128	129	130	131
7865	793	7995	806	8125	819	8255	832	8385	845	8515

451	452	453	454	455	456	457	458	459	460	461
2.9315	2.938	2.9445	2.951	2.9575	2.964	2.9705	2.977	2.9835	2.99	2.9965
481	482	483	484	485	486	487	488	489	490	491
3.1265	3.133	3.1395	3.146	3.1525	3.159	3.1655	3.172	3.1785	3.185	3.1915

Slips _____
Date _____

20	21	22	23	24	25	26	27	28	29	30
13	1365	143	1495	156	1625	169	1755	182	1885	195
50	51	52	53	54	55	56	57	58	59	60
325	3315	338	3445	351	3575	364	3705	377	3835	39
80	81	82	83	84	85	86	87	88	89	90
52	5265	533	5395	546	5525	559	5655	572	5785	585
110	111	112	113	114	115	116	117	118	119	120
716	7215	728	7345	741	7475	754	7605	767	7735	78
140	141	142	143	144	145	146	147	148	149	150
91	9165	923	9295	936	9425	949	9555	962	0685	975

470	471	472	473	474	475	476	477	478	479	480
3.055	3.0615	3.068	3.0745	3.081	3.0875	3.094	3.1005	3.107	3.1135	3.12
500										
3.25										

FORM JF. PIECE WORK JOB TICKET. THE JOSEPH & FEISS CO. (Size 8×5 in.)

The author wishes here to express his thanks to Messrs. Joseph & Feiss for the courtesies extended in his visit to their shop and his gratification in seeing the evidences of their success in handling the labor problem in such a way as not only to increase wages and at the same time to decrease production costs, but also to greatly reduce the "labor turnover," that is, the percentage of the total working force replaced during the year.

(Size 8 x 5¼ in.)

REPORT OF DELAYS

_____ Shop. Date _____ 191___
To _____ Turn.

Number of Machine	Electrical		Mechanical		Hydraulic				Nature of Delay
	Hrs.	Min.	Hrs.	Mio.	Hrs.	Min.	Hrs.	Min.	
	(11 ruled lines)								

Note:-Report fully and accurately.

Foreman

FORM W23.—REPORT OF DELAYS.—(Albert Walton)

Mr. Walton says of this form: Of value especially in a shop operating high-priced machine tools, but like all such reports it is useless unless followed up; in other words, when there has been a delay that was avoidable something should happen, otherwise it is of no use to report it.

In cases where the work is upon special contracts and the work not standard, consideration must be given to the time within which each department must do its share of the work, calculating from the given delivery date. This time should be entered upon the Special Stock Tracing and Cost Sheet. The cost entries are made from the workmen's time tickets. The headings of the column of the sheet are as follows:

Operation.	Quantity.	Depart-ment.	Date Delivered.	Should be Finished by	Date Returned.	Time Consumed.	Bonus Time.	Actual Labor Cost.	Work-man.	Machine No.	No. of Pieces Lost.	Why.
						Hrs. Min.	Hrs. Min.					

.FORM CC—SPECIAL STOCK TRACING AND COST SHEET.—(C. U. Carpenter)

Other items on the sheet are: Total, Order No., Material, Weight, Cost, Name of Stock, Total Cost, Box No., Date, Should be finished by.

Other Forms. Elbourne, Factory Administration and Accounts, gives 145 "Routine Forms to assist the reader in settling routines to suit his own particular forms, and possibly to guide him in designing his own forms." Each form is accompanied by an explanation of its use.

Nicholson, Factory Organization and Costs, gives 73, which are classified as below with the number of different styles in each class:

Purchase Requisitions	3
Purchase Orders	3
Report of Material received	3
Stock Record—Raw Material	3
Production Order	5
Material Requisition	3
Bill of Material	1
Report of Material delivered	2
Time Tickets	5
Payroll and Labor Distribution Sheet	7
Production Reports	2

Stock Records—Finished Product	3
Cost Records	6
Defective Work Reports	1
Statement of Factory Expenditures	2
Operating Ledger	1
Billing Systems	2
Register of Sales and Costs	6
Accounts Payable Voucher	1
Register of Accounts Payable	3
Check Voucher	2
Cash Systems	2
Drawings, Pattern and Equipment Records	4
Monthly Financial Reports	3

BIBLIOGRAPHY

Books on Cost Accounting.—The first important book published in the United States describing the modern system of cost accounting was that of Captain Henry Metcalfe, U. S. A., the first edition of which appeared in 1885. It is still a standard work and is now in its third edition.* It contains reprints of Mr. Oberlin Smith's paper on "Nomenclature of Machine Details," read before the American Society of Mechanical Engineers in 1881, and of Captain Metcalfe's paper on "The Shop Order System of Accounts," read before the same society in 1886. The book describes at length the organization of the United States Arsenals and their old and unsatisfactory methods of bookkeeping. The author proposes a new system, based on cards instead of books, which is the foundation of the best systems that are now in common use. It includes order, labor, material (or service), requisition and correspondence cards, abbreviations and symbols, signatures by punching, stamps, racks, pigeon-holes, trays, methods of sorting cards, and of making journal and ledger entries. Forms HM1 and 2, page 93, are reproductions (greatly reduced in size) of two of Captain Metcalfe's cards.

Between the years 1900 and 1917 Engineering Magazine made a specialty of publishing articles on cost accounting and scientific management, many of which were afterwards published in book form. From 1908 to the present time many other books on these subjects, and on accounting in general, have appeared. The following list contains most of them:

The Complete Cost Keeper. H. L. Arnold. Some original systems of shop cost accounting. Advantages of account keeping by means of cards instead of books. 3d edition. Eng. Mag. Press, 1903. Describes systems used by Strieby & Foote, Hyatt Roller Bearing Co., De Laval Separator Works, Struthers, Wells & Co., National Switch & Signal Co.

Practical Cost Accounting for Accountant Students. Clinton E. Woods. 2 vols., 6×8¾ in., 119 and 258 pp. Universal Business Institute, New York, 1908.

The Proper Distribution of Expense Burden. A. Hamilton Church. 5¼×7¾ in., pp. 116. Engineering Magazine Co., New York, 1908.

*The Cost of Manufactures and the Administration of Workshops, Public and Private. By Captain Henry Metcalfe, Ordnance Department, U. S. A. (Retired). Third Edition, 1907. 6×9¼ in. pp. 366. New York, John Wiley & Sons.

Accounts, Their Construction and Interpretations. W. M. Cole. Houghton, Mifflin & Co., Boston, 1908, pp. 345.

Factory Organization and Costs. J. Lee Nicholson. Half leather, 8½×11½ in., pp. 410. Kohl Technical Publishing Co., New York, 1909.

The Cost of Mining. James Ralph Finlay. McGraw-Hill Book Co., New York.

Cost Keeping and Management Engineering. A treatise for engineers, contractors and superintendents engaged in the management of engineering construction. H. P. Gillette and R. T. Dana. M. C. Clark Publishing Co., Chicago, 1909.

Production Factors in Cost Accounting. A. Hamilton Church. Eng. Mag. Co., 1910, pp. 187.

Cost Keeping for Manufacturing Plants. S. H. Bunnell. D. Appleton & Co., New York, 1911. Good description of machine-hour rule.

Factory Costs. By F. E. Webner. Cost Accounting Specialist. New York, 1911. Ronald Press Co., pp. 611.

Cost-keeping and Scientific Management. Holden A. Evans. McGraw-Hill Book Co., New York, 1911, pp. 260.

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The Science of Accounts. A presentation of the underlying principles of modern accounting. H. C. Bentley. Ronald Press Co., New York, 6¼×9¼ in., pp. 393.

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A Method of Determining Costs in a Cotton Mill. H. W. Nichols. E. Anthony & Sons, New Bedford, Mass., 1915, 6×9 in., pp. 115.

General Factory Accounting. F. H. Timken, Efficiency Engr. Trade Periodical Co., Chicago, 1914, pp. 171.

Efficient Cost Keeping. E. St. Elmo Lewis. Burroughs Adding Machine Co. 3d edition, Detroit, 1914, 5¼×7½ in. pp. 256.

Auditing and Cost Finding. Seymour Walton and Dexter S. Kimball. 5¾×9 in., pp. 480. Alexander Hamilton Institute, New York.

Problems in the Principles of Accounting. W. M. Cole. Harvard University Press, Cambridge, Mass., 1915, 6×9 in., pp. 102.

Predetermination of True Costs. Frederic A. Parkhurst. 6×9¼ in., pp. 96. John Wiley & Sons, New York, 1916.

Cost Accounting and Burden Application. By Clinton H. Scovell. 5½×8 in., pp. 328. D. Appleton & Co., New York, 1916.

How to Find Factory Costs. C. Bertrand Thompson. 6½×9¾ in., pp. 191. A. W. Shaw Co., Chicago, 1916.

Shop Expense Analysis and Control. Nicholas Thiel Ficker. Eng. Mag. Co., 1917, 6×9 in., pp. 236.

Cost Accounting for Oil Producers. Clarence G. Smith. Bulletin 158 of the U. S. Bureau of Mines, 1917. Pamphlet, 6×9 in., pp. 123.

The following works deal entirely with English practice which, in many respects, differs widely from the American:

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Advanced Accounting. L. R. Dicksee. Gee & Co., London.

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Motion Study. A method for increasing the efficieney of the workman. Frank B. Gilbreth. D. Van Nostrand Co., New York, 1911, pp. 116.

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The Psychology of Management. The Function of the Mind in Determining, Teaching and Installing Methods of Least Waste. Lillian M. Gilbreth. Sturgis & Walton Co., New York. 8vo, 2d edition, 1917. $2.50.

Fatigue Study: A First Step in Motion Study. Frank B. Gilbreth and L. M. Gilbreth. Sturgis & Walton Co., 1917. 12mo. $1.60.

Applied Motion Study. Frank B. Gilbreth and L. M. Gilbreth. Sturgis & Walton Co., 1917. 12mo, pp. 220. $1.60.

Red Tape of the Interstate Commerce Commission. The price of a round-trip ticket between Los Angeles and Pasadena is 25 cents. If the return coupon is not used within ten days after the printed date of the outbound ticket the conductor will refuse to receive it and tells the passenger that he can get a refund of 10 cents for it on presentation at the ticket office in Los Angeles. When it is presented the refund clerk carefully fills out a blank form with a description of the ticket which the passenger signs with his name and address, and then gets the 10 cents. In case the conductor has inadvertently punched the ticket before handing it back to the passenger the clerk refuses to receive it, but states that it may possibly be redeemed in the Traffic Manager's office up-stairs. In that office the clerk fills out a claim blank, which the passenger signs; then he fills out a check-book stub and a regular bank check, printed on safety paper, which the passenger may deposit in his own bank or collect it from the refund agent as he may prefer. The bank check is reproduced below. The agent explained that the Railway Co. was not to blame for this red tape, as it was enforced on the Company by the Interstate Commerce Commission.

Several better ways of transacting this business may be suggested. The tickets might be marked "good until used," or "not good after 30 or 60 days," and in that case the conductor might be authorized to receive the ticket as good for 10 cents in part payment of a single fare, 15 cents, or of a round-trip ticket, 25 cents.

Form 5451

PACIFIC ELECTRIC RAILWAY COMPANY

Traffic Department

No. 39592

Claim No.....

Los Angeles, Cal., January 30th 1918

ASSISTANT TREASURER, PACIFIC ELECTRIC RAILWAY COMPANY,
Los Angeles, Cal.

10 Cents

PAY TO THE ORDER OF Ten Cents DOLLARS

In settlement of Claim for Refund of Fare Filed with this Company January 30th, 1918
If Presented for Payment within Ninety (90) Days from Date Hereon.

THIS DRAFT NOT VALID IF DRAWN FOR MORE THAN FIFTY DOLLARS

Collect through Farmers & Merchants National Bank, Los Angeles, Cal.

Payable only when Countersigned by D. W. PONTIUS, or J. E. Glancy
O. A. SMITH, or H. D. PRIEST.

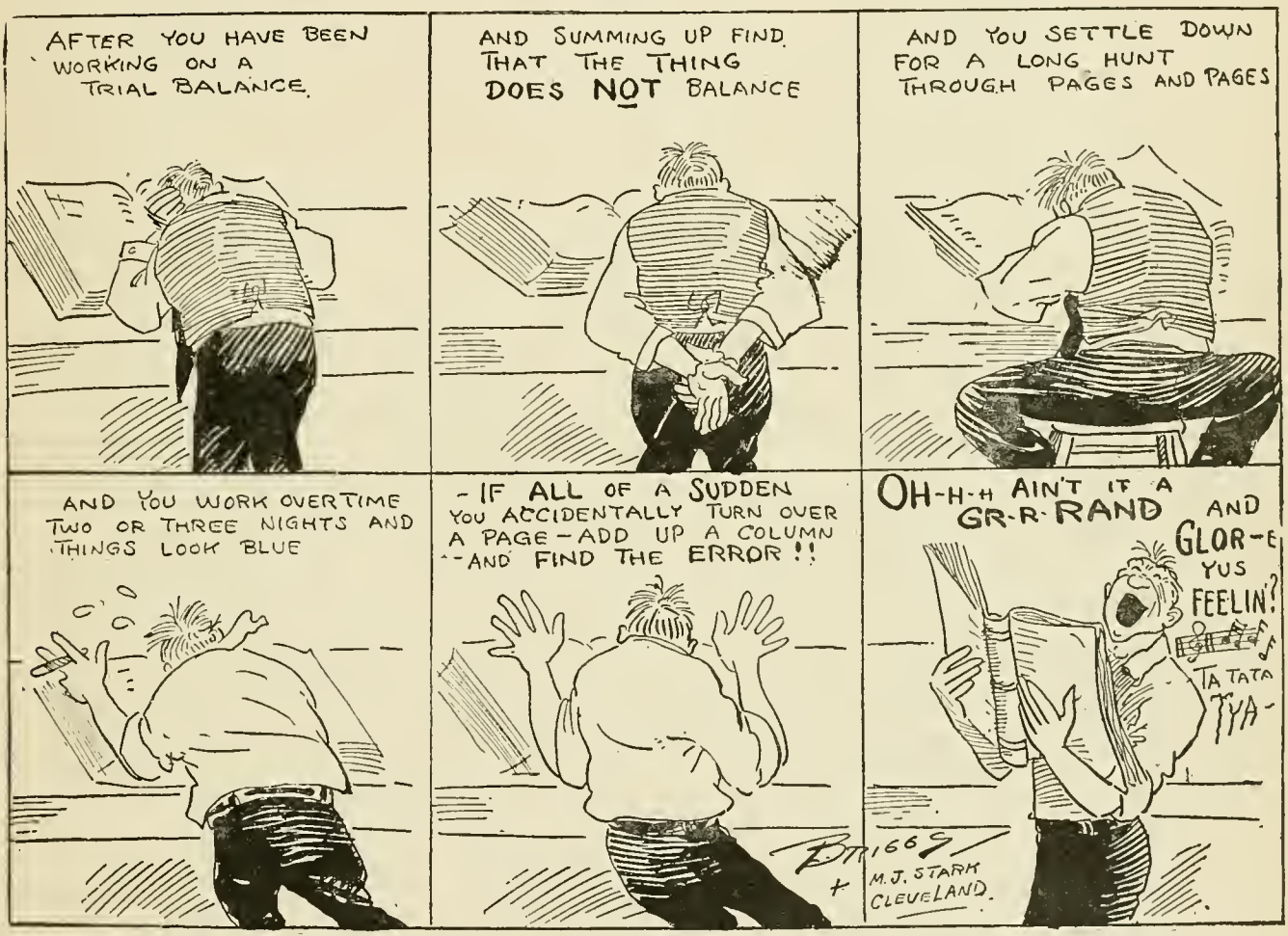
Countersigned by: J. E. Glancy

D. W. Pontius

Traffic Manager.

New York Tribune APRIL 20, 1917 (By permission)

Ain't It a Grand and Glorious Feelin'? - By BRIGGS



Rather undignified for a serious book, but "a little nonsense now and then is relished by the wisest men." This man did not use the self-balancing Column Ledger.

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