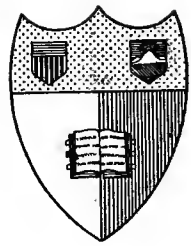
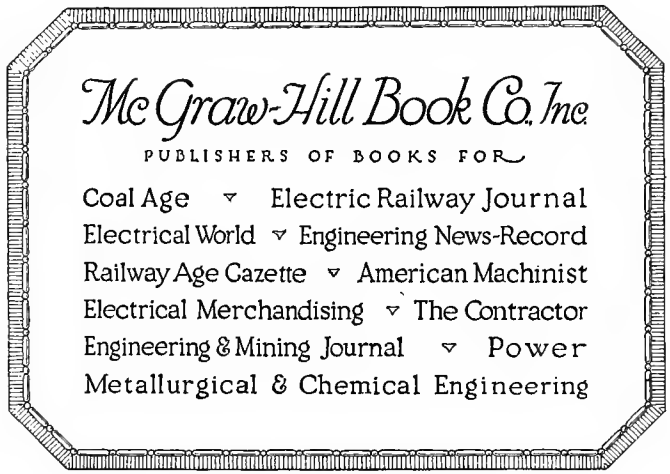


DATE DUE

DEC 1 [illegible] 30			

MANUFACTURING COSTS AND ACCOUNTS


McGraw-Hill Book Co. Inc.
PUBLISHERS OF BOOKS FOR
Coal Age ▿ Electric Railway Journal
Electrical World ▿ Engineering News-Record
Railway Age Gazette ▿ American Machinist
Electrical Merchandising ▿ The Contractor
Engineering & Mining Journal ▿ Power
Metallurgical & Chemical Engineering

MANUFACTURING COSTS AND ACCOUNTS

BY

A. HAMILTON CHURCH

AUTHOR OF "THE PROPER DISTRIBUTION OF THE EXPENSE BURDEN," "PRODUCTION FACTORS," "THE SCIENCE AND PRACTICE OF MANAGEMENT," ETC.

FIRST EDITION

SECOND IMPRESSION

McGRAW-HILL BOOK COMPANY, INC.

239 WEST 39TH STREET. NEW YORK

LONDON: HILL PUBLISHING CO., LTD.

6 & 8 BOUVERIE ST., E. C.

1917

THE MAPLE PRESS YORK PA

PREFACE

While many excellent treatises exist on Cost Accounting, there is none, as far as I know, that can be placed in the hands of a student for the purpose of gradually introducing him to the underlying principles on which manufacturing accounting of all kinds must rest.

The subject is so vast, and the side issues so numerous that to compile a treatise that shall not be, on the one hand, quite unwieldly, or on the other, quite inadequate, is a very difficult task. The temptation to elaborate minor points is constantly present, and in doing so the main thread of the subject is apt to be interrupted. It has seemed more important to present a comparatively simple view of the general structure of cost accounts than to attempt the detailed description of specific systems, on which in fact many adequate volumes are already in existence.

At the same time, the peculiar position of the cost accountant had to be kept in mind. The cost man is rarely an accountant in the full sense of that word. He lives in a world of detail, and is apt to undervalue the broader groupings that alone interest, as a rule, the general accountant. It has been attempted in the present work to show the cost accountant the relation of his work to the general accounts. Further, the peculiar value of detail to the technical arm has been emphasized with a view to exhibit to the general accountant a viewpoint that he sometimes misses.

The aim of this book is, therefore, somewhat different from that of existing works. The why and wherefore of cost accounting is its peculiar field, and it is hoped that armed with this fundamental information the student will have no difficulty in applying his reading to the particular problems he may meet.

THE AUTHOR.

CONTENTS

MANUFACTURING COSTS AND ACCOUNTS

PART I

GENERAL OUTLINE OF MANUFACTURING ACCOUNTS

CHAPTER I

PURCHASING—PRODUCTION—MARKETING

Manufacturing is the art of making changes in the condition of material by the application of labor and machinery. These changes may affect either the form, the substance or composition, or the dimension of the material operated on, or all these together. To begin with we must always have material in some shape or other. Often we require more than one kind of material. Alteration in the status or condition of material is the essential fact in manufacturing, and cost accounting has for its aim the ascertaining of the cost of these alterations. All expenditure within the factory that does not contribute in some way to the alteration of the status or condition of material is wasted expenditure. The more advanced methods of accounting are able to distinguish between expenditure that is wasted in this way, and expenditure that has actually and usefully contributed to productive processes.

The different kinds of changes in material usually met with are the following:

1. The material remains unchanged in substance, nothing being added to or taken away from it, except possibly waste particles. The original material is only changed in form or dimension.

2. It may be split up as it proceeds, and various byproducts taken from it.

3. It may be added to as it proceeds, and combined with new material or other forms of the same material.

In tracing the cost of changes in material, the accounting will obviously be complex or simple, according to the amount of detail that we wish to record. If, for example, we only wish to ascertain the cost of the whole series of changes, disregarding the cost of each intermediate stage, it will be fairly simple. But in proportion as we begin to look for the cost of the intermediate changes, it will become complex. The final stage of complexity is reached when we require to find the cost of *every* change, however slight, in the status of *every* piece of material that goes into the product. This ultimate development is represented in many varieties of engineering cost accounts.

It was pointed out above that these changes in the status of material were wrought by the application of labor and of machinery. Included in the term "labor" is every kind of human activity, both mental and manual. Skill and experience are, of course, as much part of the cause of the changes in material as the actual physical labor of operating machines or handling product.

Before we commence a manufacturing business we have nothing but cash, or a bank balance which is the equivalent of cash. Our first act in setting up an industry is, therefore, **purchase,** and by purchase we acquire:

1. Buildings, machinery and equipment.
2. The services of officials, managers, operatives and laborers.
3. Outside coöperation, such as insurance, rent of land or premises, taxes, professional service, etc.
4. Material.

Having acquired these things and services, we proceed to organize them in such a way that material is continually changing its status or condition—continually progressing from the raw stage to the finished stage. Having arrived at the finished stage, we have, instead of the original raw material, something quite dissimilar in either form, substance or dimension. This new thing is our salable product. Commonly also, we have certain wastes, such as spoiled or discarded material which may or may not have a market value, and we may also have expended money on services that were not used. The latter have no value at all.

From an accounting viewpoint, therefore, manufacturing consists of three prime divisions, viz.:

Expenditure on purchases—equipment, labor, material, service.
Transformation of material into salable product.
Marketing salable product.

These prime divisions must be preserved in all manufacturing accounting schemes. In practical language they are briefly classified as:

PURCHASING—PRODUCTION—SALES

I. PURCHASING

In considering purchases and their relation to costs, we come at once to a division of great practical importance. Purchases may be divided into three main classes:

1. Those of which the value depends on their being used at once, and become a dead loss if not so used.
2. Those which can be stored for a reasonable time without deterioration, and can be taken out of stores and used at any moment they are wanted.
3. Those of which the value slowly diminishes, more quickly if they are used, less quickly if they are not used.

In the first class all labor must be included. Unless there is employment for a man, any wages he is paid are a dead loss. Labor cannot be stored in the slightest degree. Rent and taxes are in the same class. Rent of an office that is not being used is obviously an irrecoverable loss. Every kind of purchase of which the value is measured by time, must necessarily be put to use before the time paid for has elapsed, or the payment has no economic value at all.

In the second class belong all ordinary raw materials. Most material is capable of reasonable storage. If it deteriorates it then becomes waste, in proportion to the amount of deterioration. It does not pass to any other class.

The third class is a most important one, embracing as it does, nearly all capital investment—buildings, machinery, equipment, tools. The value of any of these does not depend on immediate use, as does that of labor. The value of a building, or a lathe or a crane does not vanish within a week or a month if unused. But on the other hand, from the moment of erection in the shop, a lathe or crane begins to lose value, even though it is not being called on to do work.

This classification is a rough one, though useful to remember.

The division between 2 and 3 is somewhat arbitrary when the smaller articles are in question, and is based on practical considerations chiefly. Theoretically many kinds of material would deteriorate if stored for a number of years, but practically this never happens in a well-managed plant. If material is subject to deterioration then, of course, it would not usually be purchased save in such quantities as were wanted for immediate use. For all practical purposes, therefore, we may say that material likely to be found in the stores of a well-managed plant is not subject to deterioration.

Small tools, such as files, occupy the border line between Classes 2 and 3. As long as they are in the stores, properly packed and cared for, they cannot be regarded as subject to deterioration. As soon, however, as they are issued to the shops they pass to the third class, and become subject to a quickly diminishing value.

This brings us face to face with an important feature of the third class of purchase. *All such items do not diminish in value at the same rate.* As soon as a file is put into use, it diminishes in value in a visible and obvious way. But a solid stone or steel and concrete building has a much more extended career of usefulness. A file may last a few days in regular use; a good building may still be serviceable in 50 or even 100 years under favorable circumstances.

Between these extreme limits practical experience has discovered a whole range of differences in the useful life of equipment. This slowly diminishing value of capital investment in industrial buildings, equipment and tools is called "depreciation," and is an important element in cost as will be seen later (see Chap. III). Briefly, however, we may say that each class of purchase in Class 3 has its own rate of diminishing value, or depreciation, *and this is the basis on which the original purchase price is charged to cost.*

From the foregoing it will be seen that purchase is an initial transaction, wholly separate from costing. To keep an account of purchases, however accurately, throws no light on cost. This is because all purchases do not pass at once into manufacturing operations, but are, as it were, held up for longer or shorter periods, before they are made use of. Referring again to the three classes of purchases mentioned above, we find that:

Purchases in Class 1 must be immediately transferred to cost

(which, by the way, may be either manufacturing or selling cost) because they can under no circumstances be stored.

Purchases in Class 2 are not necessarily, nor usually, transferred to cost at once. They consist of materials which may be purchased today for use a week or a month hence, or longer. Their purchase price must be charged to cost only when they are actually used, and not before.

Purchases in Class 3, consisting of buildings, equipment, machinery and tools, are of such a nature that they are slowly used up only in the processes of manufacture. But as they *are* used up in the end (and also tend to get out of date, and become of diminished value on that account) it is evident that their purchase price must be charged to cost on some reasonable basis which takes into account this peculiarity of slow consumption. This is usually effected by a depreciation charge based on their expected life. Thus if a machine is expected to last 20 years or say 1,000 weeks, then $\frac{1}{1000}$ of its purchase price may be charged to cost every week.

Another plan is to connect the life of the item with the quantity of product it is expected to handle before it is worn out. Thus, if a melting furnace costs $1,200 and experience has shown that it will melt 600 tons of metal before it is worn out, then $\frac{1}{600}$ of the purchase price is added to the cost of every ton melted. The choice of one of these methods will depend on circumstances that cannot be discussed here. The main point to observe now is that the purchase price of items in Class 3 is transferred to cost *little by little*, the rate of transfer depending on the class of item, and the experience of practical men as to its probable life.

II. PRODUCTION

In every working period, say for convenience, a month, there will be (if the foregoing classification is observed) a transfer of purchases to production and selling made up of the following principal items:

1. Wages and salaries paid during the month.
2. Rents, taxes, insurance and other "outside" items.
3. Materials actually used during month.
4. Reasonable charges for building, equipment, etc. Depreciation.

When these items are added together they represent the total

cost of production and selling for the month. If now the product is of such a character that the same amount of work in process (*i.e.*, work begun but not finished) is in the shop at all times, or if it is of such a nature that each month's work can be cleared up, leaving nothing in an incomplete condition and if each month's output is sold during the month, then we have here all that the commercial accountant requires to know about cost. For he will be able to put these elements of cost on one side, and selling price on the other, the difference between being profit for the month. Thus:

Wages and salaries, rents, taxes, etc. Materials used. Depreciation. **Balance: Profit.**	Sale price of product.

FIG. 1.—Statement of cost, sale price and profit.

NOTE.—*The items on the left of the statement will include expenditure on production and also on selling.*

But an account of this kind, even though it accurately records the facts about what is a very simple transaction, is not yet a cost account in the proper sense. The cost accountant is concerned not with the profits of the business, but with the result of expenditure on production. The above statement does not distinguish between cost of making and cost of selling. If there is more than one kind of product it throws no light on which is the most profitable to manufacture or the easiest to sell. It is merely a commercial result, true as far as it goes, but not going very far.

At the very least the cost accountant will desire to distinguish between the cost of making and the cost of selling. He will want to know the cost of making product *A* separately from the cost of making product *B*. He may desire to know much more than this. He may wish to ascertain just in what way the money has been expended in the making of the product, how much on this process and how much on that. He may desire to ascertain the value of and the reasons for waste. All these things are problems of cost accounting, and their use is found not in ascertaining broad commercial results, but in throwing light on manufacturing details, and providing the technical men with

data by which they can study how to reduce cost and increase output.

The first step toward cost accounting is to separate the expenditure on production from that on selling.

Having isolated cost of production, the next step is to look about for some means of connecting the transferred purchase figures thus isolated with the quantity of salable product produced in the month. This may be quite easy or altogether impossible to arrive at by any arithmetical process. It will be quite easy, if, for example, some uniform product such as one width, grade and substance of paper has been the only thing produced in the period. All that is necessary in that case is to ascertain the number of yards (or, if preferred, pounds) of such product that has been made, and to divide the total yards or pounds into the total expenditure on production. The quotient will be the cost per single pound or yard.

If, however, the product is not of a uniform character—if, for example, it happens to have been 1,000 kettles, 10 tons of flat-irons, 5,000 lb. of brass hooks, and 3,000 military shovels—then it is impossible to obtain any arithmetical relation between the total of cost of production, and the output of product.

It is true that if all product were to be weighed, and by this means an output of say 40 tons of product were established, it would be arithmetically possible to divide the total cost by 40 and so ascertain a cost per pound of product as before. But such a figure would be meaningless. It would depend on the accidental proportion of each article on the occasion in question. Exactly the same articles, making the same total weight, but mixed in different proportions of each, would, on the next occasion of costing, give rise to a wholly different cost figure per pound. An attempt to ascertain cost in this way would, therefore, be worse than useless, it would be misleading.

The cost accountant who had only data as to total expenditure on production before him would be utterly baffled to find the cost of his various products unless he went into greater detail. If he were asked to state the cost of a kettle, or of a pound of brass hooks, he could give no reply. Similarly in the case of the paper output just referred to, although he could state the cost per pound of the finished product, if he were asked how much of the cost represented power, how much operative labor, and how much supervision, he could not reply. If it were discovered that

another mill were producing more cheaply, and even if the details of its cost were known, he could throw no light on the question "Why are our costs higher than those of the other mill?" He could not tell whether they were higher all round, or whether some special efficiency in some one direction was responsible for the lower cost of the other mill.

Faced with this problem, it is easily realized that merely to ascertain the ingoings and outgoings of a factory or of a shop is not cost accounting. It is only commercial accounting, useful for general bookkeeping, but useless for any technical purpose.

Another kind of difficulty might also present itself. If the nature of the business were such that the "work in process" (*i.e.*, work begun but not finished, and, therefore, lying in the shop in a half-finished condition) fluctuated considerably, so that it might be higher at the end of one month than at the end of another, then even the broad result, shown in Fig. 1, would fail in accuracy. For if all that went in did not come out, or if in a subsequent month, more came out than went in, and both of these cases would occur in such a business, then it is clear that the relation between cost and selling price is no longer a simple and direct one, but that profit will be affected by the degree to which unfinished work remains in the shop each month. Further, it would be impossible to arrive at a satisfactory unit cost (per pound or yard) of product, since we can no longer divide the cost of what went in by amount actually produced, because the latter is in all stages of completion, and an indeterminate quantity of it was also partly produced by expenditure in a previous month.

In practice, this difficulty is overcome, where there are no proper cost accounts, by what is called stock-taking. The advantage of a monthly balance sheet must, of course, be foregone, for stock-taking is too costly and disturbing an operation to be carried out frequently. Every 6 or 12 months a list or "inventory" is taken of all work in process, and a value assigned to the items on a more or less correct basis. The accountant is then able to introduce the value so ascertained on the right side of the statement, Fig. 1, so that he has on one side the cost of operating the business, and on the other the results, namely, sales at sale price, and some unfinished work at supposed cost price. The balance, profit, is taken out as before. This old-fashioned method of bookkeeping—it cannot be called accounting—is still in use. It is, of course, utterly out-of-date.

Cost accounting has taken its rise from the necessity that exists in modern business to know more than broad commercial results. The difference between cost systems is not so much due to the difference between industries, as in the very varying degree in which technical detail is valuable in different industries. In some industries, the product is of so simple and uniform a character, and the operations so unvaried, that elaborate analysis of cost would have but small technical value. In other cases, the reverse of these conditions obtains. In some industries selling prices could not be safely fixed without the close observation of cost as regards the smallest detail of production. In others analysis of cost is necessary to keep production up to the high-water mark of efficiency. But in all these instances, cost keeping can begin only when the prime divisions of purchase, production and selling or marketing have already been made. Cost accounting depends for its success on the analysis and isolation of dissimilar items, and determination of their exact relation to the changes wrought in material.

III. MARKETING THE PRODUCT

The cost of a product should be its cost at the factory gate. As soon as an article is finished, and turned over to the warehouse to be stored there against future sale, or to be shipped at once to a customer, the factory has no part or lot in its future. Production cost should, therefore, be separated rigorously from the cost of marketing the product.

The efficiency of manufacturing and the efficiency of selling have no relation to one another. Efficiency may be high in one and low in the other. Extremely efficient manufacturing may be discounted by extravagant or inefficient methods of marketing. On the other hand, skilful marketing may offset an unduly high cost or poor grade of production.

The word "marketing" has been used here in place of the more usual word selling, because in truth marketing is a more comprehensive term. In foreign trade, especially, the selling of product —making a sale—is by no means the end of the story. Marketing includes (besides the act of selling, and the publicity, traveling and other expenditure leading up to the sale) the important questions of suitable and careful packing, shipping, shepherding the consignment among the pitfals of foreign custom regulations,

and arranging for payment on terms and through channels which in some cases may be quite roundabout. Marketing does not end until the money has been received and the customer known to be satisfied. It thus includes what is known as the credit department of businesses.

None of these expenditures can properly be charged against production. It makes no difference to the factory whether a bale of goods, or a consignment of product of any kind, is consumed in the home city, or in Maine or Texas or Oregon—or whether it finds its way ultimately to the interior of China or Brazil. But to the marketing department it makes a great deal of difference, particularly in the amount of trouble and outlay involved in completing the transaction *after* the sale is made. This department should, therefore, bear the burden of its own transactions.

The subject of the cost of marketing has received but little attention, yet it is a very important one. Where a plant makes several different products, where it sells in different markets, where it has a variety of means on which it relies to effect sales, where some of its transactions involve constant watchfulness to prevent loss from bad debts, and other transactions are free from this drawback—in all such cases the importance of good marketing accounts becomes pronounced. Just as there are many factors which it is necessary to analyze and take into account if we would obtain an intelligent idea as to the way our money is being spent on production, so in the cases just enumerated there are several factors that affect our cost of marketing unequally as regards portions of our total sales. And just as some shop expense is found, on analysis, to be incurred by one class of product or one order in greater degree than another, so if proper marketing accounts are kept, it will be found that certain expenses bear more heavily on one product or one customer's order than on another product or order. Knowledge of these facts must obviously affect our selling, and in fact our whole business policy.

If we consider the marketing or, as it is commonly though perhaps unfortunately called, the selling department, as an independent corporation (as is sometimes actually the case) and if we regard it as buying finished goods from the factory at factory cost, and that all its operations thereafter are just those of a wholesale merchant, we shall have adopted the proper view of the true relations between the selling department and the

factory, and the consequent sharp division to be drawn between them in setting up a system of accounts.

IV. DIVISIBLE EXPENSES

There are certain expenditures that will occur to everyone as having no natural classification either as factory or selling expense. Examples of such items are the president's salary, the upkeep and salary list and expenses of the main office, etc. There are usually a number of such items.

The existence of these items does not affect the principle of division already laid down. They arise from the fact that the work of such officials is sometimes devoted to matters relating to purchasing, sometimes to production, and sometimes to selling and marketing. Analysis will frequently show, with comparative ease and accuracy, what proportion of the item is chargeable to one or other of the divisions. In other cases, as, for example, that of the president and the higher executive officials, a somewhat arbitrary determination has to be made, but if this is done with care after discussion of all the circumstances, a division can be made that does substantial justice, and allots to each department a fair share of the expense in proportion to benefits received by each.

CHAPTER II

THE MECHANISM OF ACCOUNTING

All business transactions are in essence the transformation of cash into something else and its return to the condition of cash again. In simple buying and selling we begin by having a stock of cash; we exchange this cash for goods of some kind; and then we sell the goods for cash again. If our business is successful our sale will return the original amount paid for the goods plus an increase of the total sum involved which will be our profit. We have here two transformations, first of cash into goods, then of goods into cash.

No business is really as simple as this. It costs money to do business. In other words all businesses have expenses—rent, postage, stationery, car-fares—at the very least. But this means that the transformations of cash will be correspondingly complex. We begin with a stock of cash, as before. But only part of it is transformed into goods for sale. Other portions are transformed into rent, into letter-paper, bill-heads, business cards and envelopes, into postage stamps, and into car-fares. When our goods are sold we have to get a price large enough to replace the original goods, to pay for the rent, stationery, stamps and fares, and still leave a surplus or profit.

The object of accounting is to enable us, either at wide intervals, or frequently, to find out what is the present condition of our original stock of cash, which in business language is termed our capital. Bookkeeping is the mechanism by which we are placed in a position to observe how we stand. Accounting is the interpretation of the results presented by bookkeeping.

The mechanism by which the results of any business whether large or small are brought to a focus is a very simple one. Perhaps from this very simplicity it is not grasped by everyone as it should be. The elements of bookkeeping, of which we are now going to speak, should, therefore, be mastered by everyone who aspires to understand manufacturing accounts.

This mechanism, or we might almost say, these tools of the accountant are four:

1. *Books of original entry,* in which transactions are recorded. These transactions are always of the nature of transformations, such as cash into goods or services; goods and services into work in process; work in process into finished and salable goods; salable goods into sales on credit; sales on credit into cash received; and so on.

2. *Journals.*—These are frequently combined with books of original entry, and serve to indicate the destination of the transactions summarized in them; such as cash received by check, which is credited to the persons paying it, and charged against Bank, and so forth.

3. *Ledger Accounts.*—The nature of a ledger account should be thoroughly studied because it has a somewhat abstract significance in many cases. Some ledger accounts are simple enough, such as, for example, the cash account. We may view it as two columns of figures. That on the left sums up all the cash we have paid into the till. That on the right sums up all that we have taken out of the till. If at any time we add up both columns, the "balance," or difference between them, will represent obviously the amount of cash left in the till. Such an account is a REAL account. It represents actual, tangible property. Any balance that remains in it must necessarily always be on one side, because it is impossible that more cash can be paid out than has come in.

All ledger accounts, however, are not of this simple and obvious character. They do not always represent tangible assets or property. This arises from the nature of double-entry bookkeeping which demands that every transaction be entered twice, *corresponding to both sides* of the transformation involved. Every transformation involves considering "what it was," and also "what it has become." And both these facts must be represented in ledger accounts.

Thus, to take the simplest case above, we begin with a balance of cash in one ledger account, and this is balanced by a corresponding item of capital in another ledger account. Whatever transformations we effect in the form of cash, the value of these must always balance with the entry of capital, until we have either made a profit (which is an addition to capital) or a loss (which means that our capital has diminished).

When we buy goods, the transformation must be recorded in both its aspects: (1) Cash must be credited; (2) Goods must be

charged. If we have spent all our cash in buying goods, the "balance" in the ledger account for Cash will be wiped out by the credit. And the ledger account for Goods will contain an equal value, which will balance the entry in Capital account as before.

These transactions are not easy to follow in words unless one is familiar with the subject. And when more detailed and intricate matters have to be traced, great familiarity will not always prevent errors. It is, therefore, highly desirable to use symbols in tracing accounting schemes, and the system to be followed in this work will now be explained, and the above simple cases worked out on it.

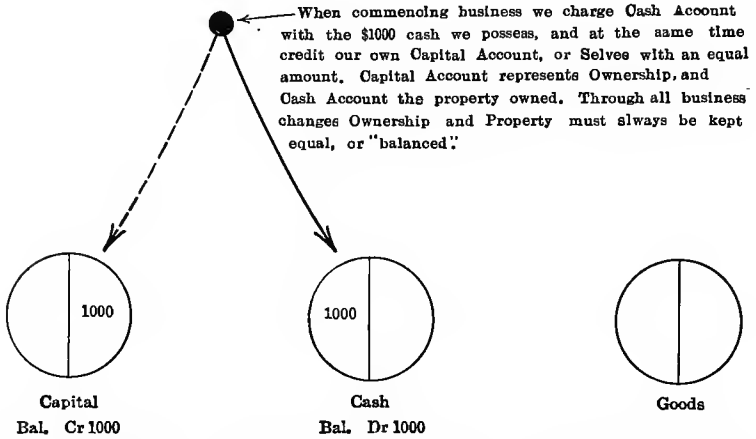


FIG. 2.—Diagram representing ledger accounts before starting business.

A ledger account is conveniently symbolized by means of a circle divided vertically so as to represent the debit and credit sides. A circle is selected to distinguish ledger accounts readily from all other books and blanks, which must necessarily be drawn as rectangles owing to their variety of size, shape and lettering. Fig. 2, therefore, symbolizes the state of affairs in the simplest case spoken of above, wherein we commence with $1,000 cash. In opening the books, our proprietorship in the cash is represented by an entry of $1,000 to the credit of selves, or in other words to the credit of Capital account.

This is because the underlying principle of double-entry bookkeeping is a balance between proprietorship on the one hand and goods or property on the other. As we shall see in the simple

cases to be discussed, this balance is always maintained, however various the changes or transformations that take place in our property. If we abstract the balances in the above accounts they form a Balance Sheet thus:

Assets	Capital and liability
Cash in hand, $1,000.	Capital, $1,000.

We will now suppose that we part with some of our cash and receive goods in exchange. We have now to introduce into our diagram a new feature, namely, a book in which transactions are recorded. In modern practice such books of original entry are

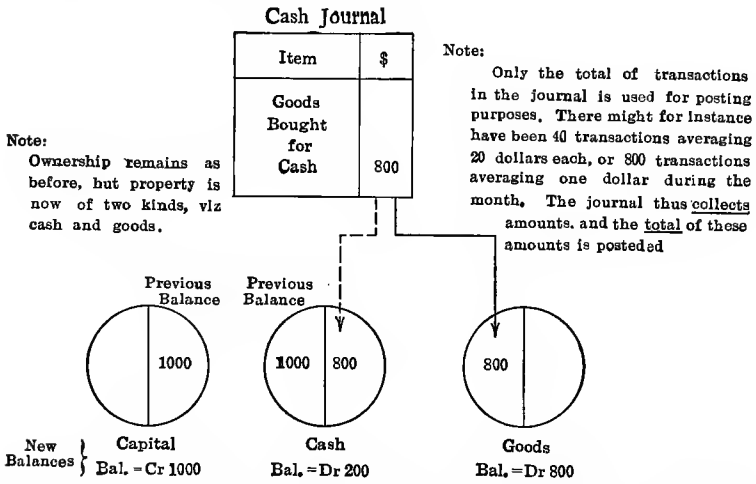


FIG. 3.—Diagram showing simple case of goods purchased for cash. The balances below the ledger accounts are those remaining after the entries have been made.

NOTE: Plain lines = debits or charges. Dotted lines = credits.

when possible made into "journals" or posting mediums also, so that certain frequent classes of transactions can be totalled separately and posted in a lump sum to the ledger accounts affected. The alternative to this is, of course, separate posting of each item. Arranging original books of entry as journals is, therefore, a labor-saving device of an important character.

Figure 3 represents a very elementary form of this kind. As only one transformation is concerned, namely, Cash into Goods, only one *column* is required to record the amounts. When we have purchased $800 worth of goods for $800 cash, and have recorded the transactions, the results will be as shown in

FIG. 4.—Transactions involving expenditure of cash for expenses as well as for goods.

Fig. 3. The book of original entry shows the total of the transactions ($800) and from the column recording this two lines start, one dotted, which represents a credit, and one plain, which represents a charge or debit. Cash account is thereby shown to be credited with $800 and Goods account is shown to be debited with $800. Starting at the posting medium or journal, and following the lines we can see just what accounts are reached and affected by the transactions recorded in the journal. In this case the whole matter is very simple but in the course of this book we shall find the use of this kind of *symbolizing* very useful to explain complicated transactions. *Its principle, should, therefore be thoroughly mastered by the reader at this stage.*

The transactions shown in Fig. 3 can now be subjected to the test of a Balance Sheet, thus:

Assets	Capital and liabilities
Cash in hand, $200	
Goods in hand, $800	Capital, $1,000
$1,000	$1,000

From this we see that our transformation of cash into goods has not affected the balance between capital or proprietorship and assets or property. The only difference is that our capital is now represented by two kinds of property instead of one, but the totals of Property accounts equal Capital account just the same. We must now extend the system to the representation of the second simple case mentioned above, in which cash is paid out not only for goods, but also for certain business expenses. Fig. 4 shows the extension of the symbolization to cover this case.

In this figure the journal is shown at an advanced stage of development. On the left side the items are recorded and their amounts. On the right side a series of columns is provided, each of which is devoted to collecting the amounts relating to one class of transaction. In entering up a transaction the amount is first entered on the left-hand column, and then "allocated" to one or other of the columns on the right. Allocation means determining to what account the item is properly chargeable. In practice, of course, the headings of the columns would be selected to represent the more frequent classes of transactions, and each such column would have many entries in it. Infrequent allocations are placed in a spare column at the right hand, and are separately posted to the ledger accounts affected.

The journal records a total payment of $910 cash, which is accordingly credited to Cash account. Now as the total allocations must always equal the left-hand column, we shall expect to find various accounts charged with items equal in total to $910. Following the plain lines we find that this is actually so. $800 has been charged to Goods and smaller amounts to Rent, Stationery, Postage and Traveling, making $910 in all.

All these transformations of cash having been recorded and completed, the next question is whether our assets are still equal to our capital. Before answering this question, certain peculiarities of the new ledger accounts—Rent, Stationery, Postage and Traveling—must be considered.

We have seen that Cash and Goods are both "real" accounts, that is, they represent actual tangible property. But none of these new accounts represent anything in our possession. We have paid the rent to the landlord, have used up the stationery, have put the postage stamps on our letters, and the traveling money has been dropped into the boxes of the street cars. Obviously, therefore, the balances in these accounts do not represent property. In other words they do not represent anything real. For this reason such accounts are usually called NOMINAL accounts. But if they do not represent anything real, how can we set them against capital to preserve our Balance Sheet as before?

As a purely bookkeeping proposition we cannot do so. If we list the assets and capital as before, the result would be as follows:

Assets		Capital and liabilities	
Cash in hand,	$90		
Goods in hand,	$800	Capital,	$1,000
	$890		$1,000

Obviously this will not do. The Balance Sheet no longer balances, and the reason is that on the face of the transactions we have lost money. We have incurred expenses for doing business, but as yet our business has only consisted in buying goods. We have sold nothing. Therefore, to restore equality in our Balance Sheet we should have to put a new line on the left-hand side of the sheet, thus:

Loss, $110.

With this item included, the sheet would balance as before.

The practical effect of the item would be to wipe out $110 of our capital and reduce it to $890, the amount now represented by property.

This is the bookkeeping viewpoint. The accounting viewpoint might be quite different, and this illustrates the difference between bookkeeping and accounting. The accountant would consider all the circumstances of the case. The figures might for instance represent the first month's transactions of a new firm, and in such a case it would not be practically true that capital had been lost. The balances in the nominal accounts might be looked at in the light of expenditure that would speedily bring results, and, therefore, need to be held up or "suspended" for a time. Cases like this frequently occur, as for instance when a large sum has been paid out for "goodwill" which is held up and only liquidated by degrees. Another example may be found in heavy expenditure on an advertizing campaign, part of which is suspended and spread over future months. Naturally, decisions as to what may be legitimately held up in this way require mature experience, for otherwise great danger is involved.

Supposing, however, that it is decided to "suspend" the expenditure represented by the balances in the nominal accounts for the present, then the form of the Balance Sheet would be as under:

Assets		Capital and liabilities	
Cash in hand,	$90		
Goods in hand,	$800	Capital,	$1,000
Suspended expense,	$110		
	$1,000		$1,000

This restores the equation in the Balance Sheet, but at the price of introducing fictitious assets into it, which is only justifiable if the benefit of the expenditure represented by such entry is legitimately chargeable to future transactions.

This simple case may be expanded one degree further. We will assume that in the month following some goods were sold for cash at a profit. This involves an entirely new element in our transactions. Hitherto all transformations have been *equal*. So much cash was transformed into an equal value of goods, or of stationery or postage stamps. Now, however, we sell $200 worth of goods, and in return receive, not $200 cash,

but $400 cash. In other words we have made a gross profit (that is a profit from which the expenses of doing business are not yet deducted) of $200. It is desirable, therefore, to arrange our ledger accounts so that this item of gross profit is isolated, and can be seen separately.

Figure 5 shows the mechanism necessary. The ledger accounts are the same as in the last example (Fig. 4) and the transactions are assumed to be those of the period immediately following the Balance Sheet which was prepared showing "suspended" expenses amounting to $110. The book of original entry is termed the Sales Journal. Its peculiarity is that each item is entered from two aspects, that is, in two values. First, it is entered from the viewpoint of its cost at which it stands in the Goods account. Secondly, it is entered from the viewpoint of the price it has fetched, or its sale price. Briefly, this may be summed up as an entry of "What we gave for it," and another entry of "What we got for it." Each of these entries must be charged and credited to ledger accounts. Having made the entries and totalled all of them for the period, we proceed to post the totals to ledger accounts, just as we did in the case of the Cash Journal.

Taking the total of cost of goods first, as we have taken these items out of our stock of goods, we credit Goods account with their value. As we have parted with them to a purchaser, we charge Sales account with the same value.

Taking the total of sales at sale price next, as we have received cash to the full value, namely $400, and have put it in the till, we charge Cash with that amount. As this money has come from the purchaser we credit Sales account with the same value. These credits and charges can be very clearly followed on the diagram—dotted lines being credits and plain lines charges or debits.

When all these entries to ledger accounts are made and the accounts themselves balanced off, we should be in a position to prepare another Balance Sheet. As, however, we have now a complete cycle of transactions to consider, some of them being gross profit and some being expenses brought forward from the previous period, it will be preferable to consolidate the accounts, or rather their balances, so as to deduct the expenses from the gross profits, and so ascertain net profit, thus making the statement in the Balance Sheet much clearer.

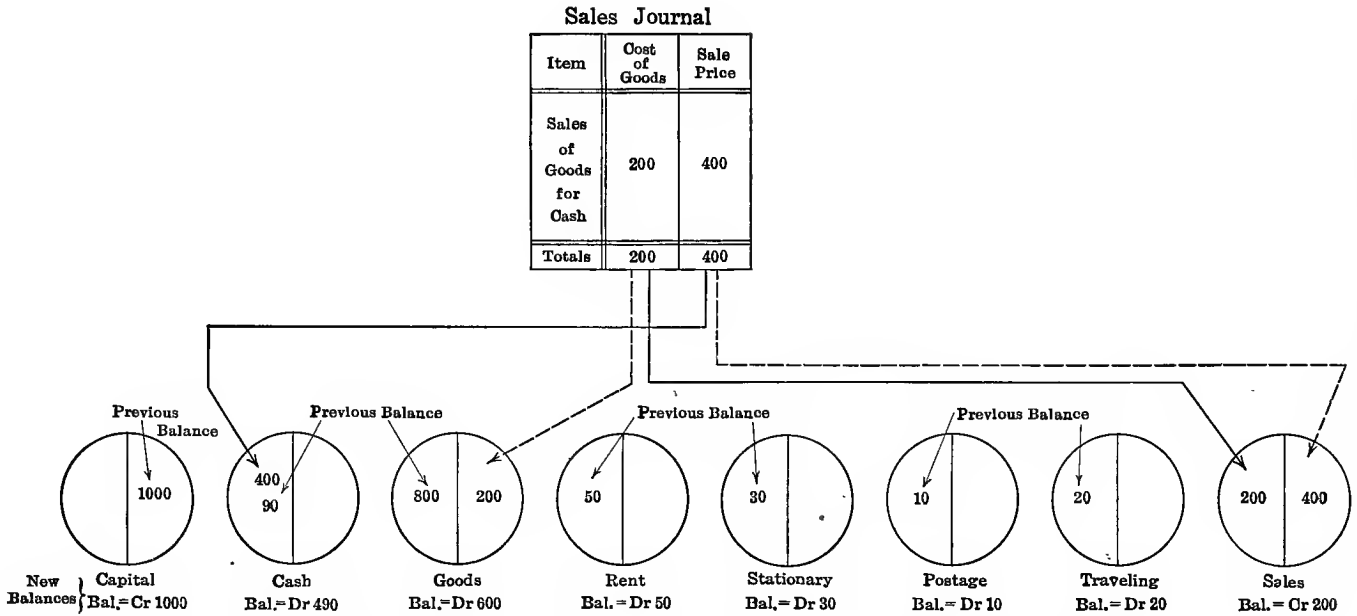


FIG. 5.—Transactions subsequent to those shown in Fig. 4, and involving sales of goods for cash.

The Trading account is prepared as under:

TRADING ACCOUNT FOR MONTH OF_____

Dr.		Cr.	
To Expense accounts, viz.:		By Sales account:	
Rent	$50	Gross profit	$200
Stationery	$30		
Postage	$10		
Traveling	$20		
Net profit	$90		
	$200		$200

It may assist the student to show the process of crediting and charging involved in preparing such a Trading account. Fig. 6 shows a Closing Journal which is the source of the transactions. First, the group of Expense accounts are individually credited with the amount standing against each, and then the total for the whole group is charged to Trading account. Similarly, the balance in Sales account ($200, see Fig. 5) is charged to that account and credited to Trading. This, of course, has the effect of simple transfer of all the items dealt with, from one account to another. All the debit balances in the Expense accounts shown in Fig. 5 are now transferred to the debit side of Trading account. In the same way, the credit balance of $200 which stood in Sales account is now transferred to the credit side of Trading account. The balances in the expense accounts and in Sales accounts are, therefore, wiped out completely.

The transactions of the Closing Journal are not transformations of real things into a new form. They merely serve to rearrange certain of the nominal accounts and consolidate them. All the property of the firm is still represented by the real accounts, viz., Cash and Goods. The nominal accounts simply serve to explain why those quantities of real property exist as they are. In the last Balance Sheet, Cash and Goods were less than might be expected, and the nominal accounts for expense, being admitted to the Balance Sheet, explained the shortage. Similarly, in the balance now to be prepared, based on Fig. 6, though all the Expense accounts have disappeared, we have a nominal account, namely Trading, which will explain why we have more capital now than we had at the last Balance Sheet.

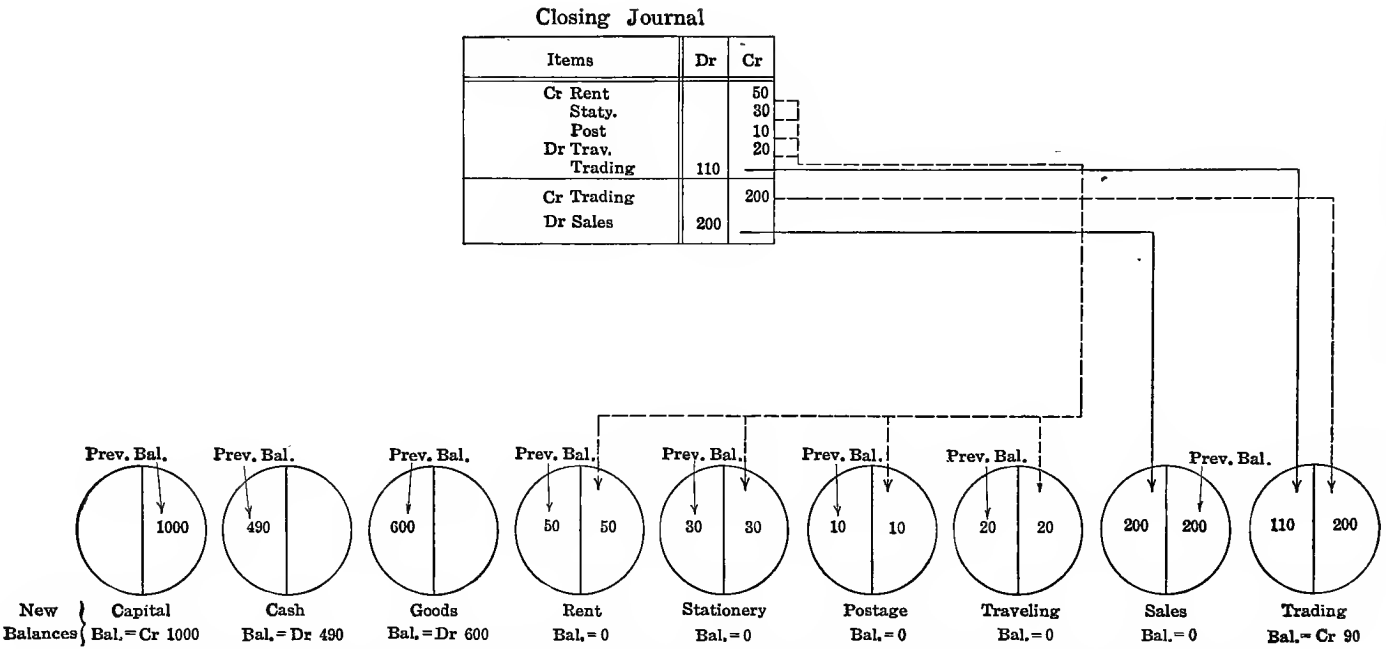


FIG. 6.—Transactions shown in Figs. 4 and 5 brought to the point of closing Expense and Sales accounts into Trading account.

BALANCE SHEET

Assets		Capital and liabilities	
Cash in hand,	$490	Capital,	$1,000
Goods in hand,	$600	Surplus,	$90 (from Tdg. A/c)
	$1,090		$1,090

This "surplus" is, of course, our net profit. In this simple case it may be mentally checked by remembering that our gross profit was $200, and our expenses (brought forward from the last Balance Sheet as "suspended") were $110. Deducting $110 from $200 we have $90, the amount of the net profit on the whole period.

These elementary exhibits have been introduced for the purpose of familiarizing the reader with the outlines of the mechanism or bookkeeping. Books of original entry arranged as journals or posting mediums, ledger accounts, and the Balance Sheet comprise the whole art and mystery. If it be remembered that every transaction, without exception, has two aspects, namely its original condition and its new condition (as, for example, when cash is transformed into goods) and, therefore, that every transaction must go through three bookkeeping stages:

1. It must be recorded as a transaction.
2. It must be debited or charged to some account.
3. It must be credited to some other account.

—if these very simple facts are kept in mind, then considerable progress will have been made toward mastery of the principles on which all accounting rests.

CHAPTER III

THE MECHANISM OF COST ACCOUNTING

The simple arrangements for keeping track of the results of buying and selling described in the last chapter would require supplementing in any business of importance by mechanism to keep track of credit transactions. Instead of sales resulting in an immediate return of cash, they merely result in indebtedness on the part of individual customers. At a later stage, this indebtedness is transformed into actual cash, namely, when the customer pays his account. Clearly, therefore, we should have to provide an intermediate account, or rather set of accounts (one for each customer) in between Sales and Cash. This is usually done by providing a Sold Ledger containing customers' accounts, to which are charged sales at sale price, or *indebtedness*. When the customer pays, his ledger account is credited, and Cash charged with the amount of the payment.

This device of an account placed in an intermediate position to other accounts, so as to take care of peculiar circumstances in certain transactions is an important one. All business transaction, as we have seen, form a regular series:

Cash—purchases—sales—cash.

When we intercalate a sold ledger into this series it becomes:

Cash—purchases—sales—indebtedness—cash.

Now when we come to consider manufacturing businesses it will be evident, from what was said in Chap. I, that a new term must be placed midway in this series, after purchases and before sales, to represent the changes in the condition of materials that are brought about by manufacturing operations. The series would then become:

Cash—purchases—factory operations—sales—indebtedness—cash.

It is this new intermediate term that we have to discuss in this chapter.

Manufacturing accounts are far more complex than those of a simple merchant business. Not only is there, as a rule, a considerably greater variety of purchases, but in many industries to follow the history of the combination of these purchases into

product, taxes the art of the bookkeeper, and the science of the accountant to the full. This is because manufacturing consists not only in the direct application of labor to material—though this is the obvious and popular conception of manufacturing—but also in the setting up of a whole series of special organizations, of which the services, though applied to produce changes in material, have rarely any real quantitative relation to the goods produced by their aid.

As a simple illustration we may take the power house, which has to be established, maintained and operated in most plants of importance. Now the cost of producing power does not vary directly as the quantity of power consumed. A considerable reduction in the demand may not lead to any noticeable reduction in the expense of producing and delivering power to the shops. The same remark applies to other services set up by the manufacturer for the purpose of ministering to actual production—they have no direct ratio to production—their expense does not fall as production falls, nor does it rise as production rises, at any rate not in proportion to production itself.

Of course, much the same might be said of certain of the expenses of a merchant business. Rent of premises, for example, remains the same when the merchant is full of business, as when he is waiting for orders that do not come. This is true. But in most manufacturing businesses the expenses of this class are not only very numerous and very varied, but they form *a large proportion* of the total activity of the plant. It is this fact that gives complexity not only to the bookkeeping mechanism of manufacturing accounts, but also makes their accounting interpretation difficult.

In the first chapter we saw that purchases, in regard to a manufacturing business, are not all chargeable at once to manufacturing operations. Those of which the value is measured by time, such as wages and salaries, are, of course, so charged, period by period. Material and supplies on the other hand are only charged as they are used or consumed. And the important class of purchases represented by equipment and buildings, machinery, etc., are charged to Manufacturing in a special and peculiar way, namely, by what is termed depreciation, which is really an arbitrary determination expressing the rate at which the equipment is supposed to be used up in carrying out manufacturing operations.

In setting up manufacturing accounts our first care will be, therefore, to provide mechanism so that each of these kinds of charges for things purchased shall reach manufacturing account at the proper time. In other words, before we consider manufacturing operations themselves we must take measures to assemble the elements of cost in all their various forms, making sure that the right amount of each belonging to a given period is charged, so that each financial period bears its own share of the expenditure incurred.

It is most desirable, at this stage, that the reader shall get rid of any preconceptions he may have as to what is termed "capital investment" in buildings, machinery, equipment, etc. Many persons look on this as something apart from the ordinary nature of things purchased. The long life of a building or a heavy machine and the mystery that sometimes surrounds the question of what is termed depreciation, seem to lift these items into a class by themselves. Though this is true to a certain extent it is important to remember that when we buy a building or a machine it is only a purchase of something that is used up in the process of manufacture just like a gallon of oil or a ton of coal is used up. The only difference is that the consumption is an invisible one, since it is so slow that our daily contact with these articles does not enable us to perceive any reduction in their value.

But if a visitor to a plant just erected were to go away, and be absent for 10 or 15 years, he would on returning to it (if he had a good memory of what he observed at first) quite readily see that deterioration had taken place. And if instead of 15 he stayed away 30 or 40 years, he would find on his return that the hand of time had lain heavily on this apparently imperishable capital investment. He would not only observe deterioration, but almost certainly considerable changes in the equipment—newer types of machines would have been substituted for some of those he knew. The buildings would almost certainly strike him as old-fashioned and not up to modern standards, and he would observe probably that some of them had been altered and patched. In short, observation of so-called capital investment items at considerable intervals of time would disclose that, just like any other purchased article, they were being used up in the course of manufacturing operations.

It follows from this that depreciation is not a fancy or arti-

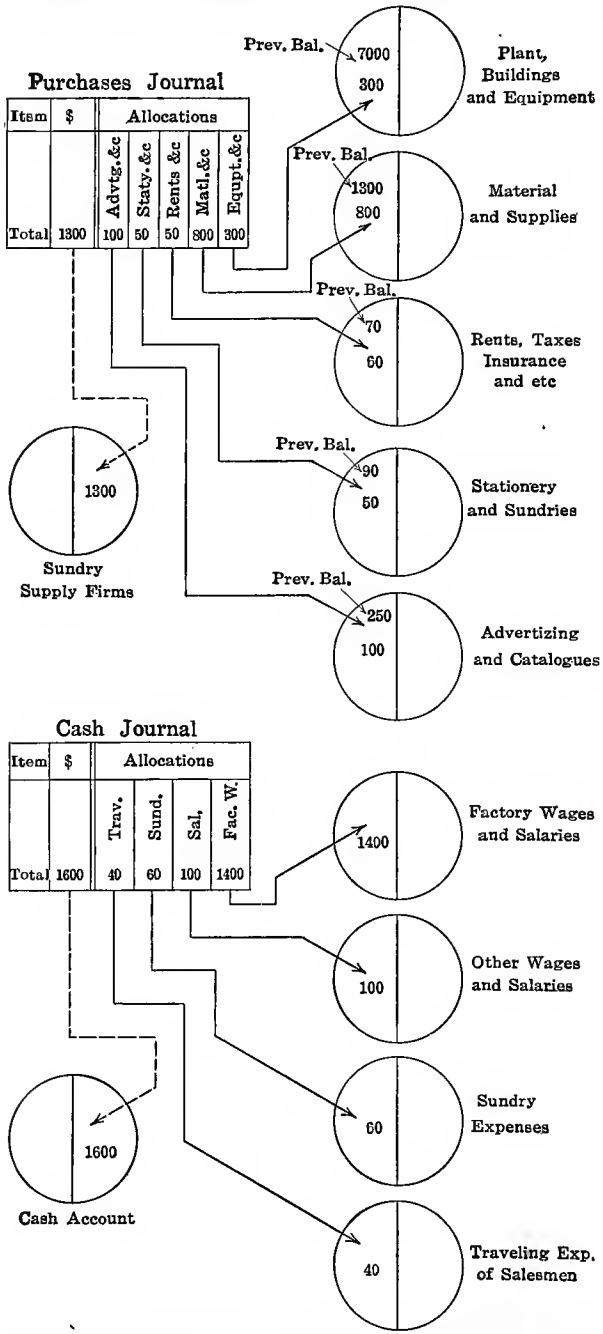


FIG. 7.—Principal classes of purchases in a manufacturing business. NOTE: Charges may be made to any ledger account from either journal if necessary.

ficial idea, but that it is the nearest approximation we can make to a very ordinary fact—the fact of consumption of an article by using it. And, therefore, if we are to obtain the true cost of manufacture of our product, the value of our equipment that we use up daily, monthly and yearly must be included in that cost, just as the cost of using up a file or a pound of grease must find its place in cost, and for exactly the same reason. In assembling our components of cost, a charge for the slowly dissipating purchase price of buildings and equipment must be carefully determined and regularly made. The amount of such charge and the basis on which it is calculated need not be discussed until later. We must assume here that such a charge can be calculated, and provide the mechanism for assembling it along with the other components of cost.

Figure 7 shows the first stage in assembling the components of cost. This diagram is not, of course, exhaustive. It shows only some of the more important and interesting classes of purhcase, and these are, for convenience, grouped more closely than they would be in practice. A single ledger account, for instance, is given for Plant, Buildings and Equipment. In practice, several separate ledger accounts would be used for such items, and the same remark applies to some of the others. The principle involved can, however, be better examined by taking a few important groups.

This principle is a simple one. Two books of original entry are shown. One of these, the Purchase Journal, represents purchases on credit; the other, the Cash Journal, represents purchases for cash. In the first case the total for the month, $1,300 is credited to sundry supply firms, and represents *our* indebtedness to *them*, to be discharged by payment of cash at some convenient future date. The allocations of this sum are summarized in the various allocation columns and charged to the respective ledger accounts as shown.

The same procedure is followed in the case of the Cash Journal, with the exception that credit is made to Cash account—as the money has been paid out directly, such purchases not having been made on credit.

The result of these transactions is that we now have a series of accounts that show the present form of the purchases we have made during the month. Some of these accounts will be

observed to have balances in them, which have been brought down from previous months. It is very important to understand why some have balances and some not. The accounts that contain balances are those representing forms of purchase

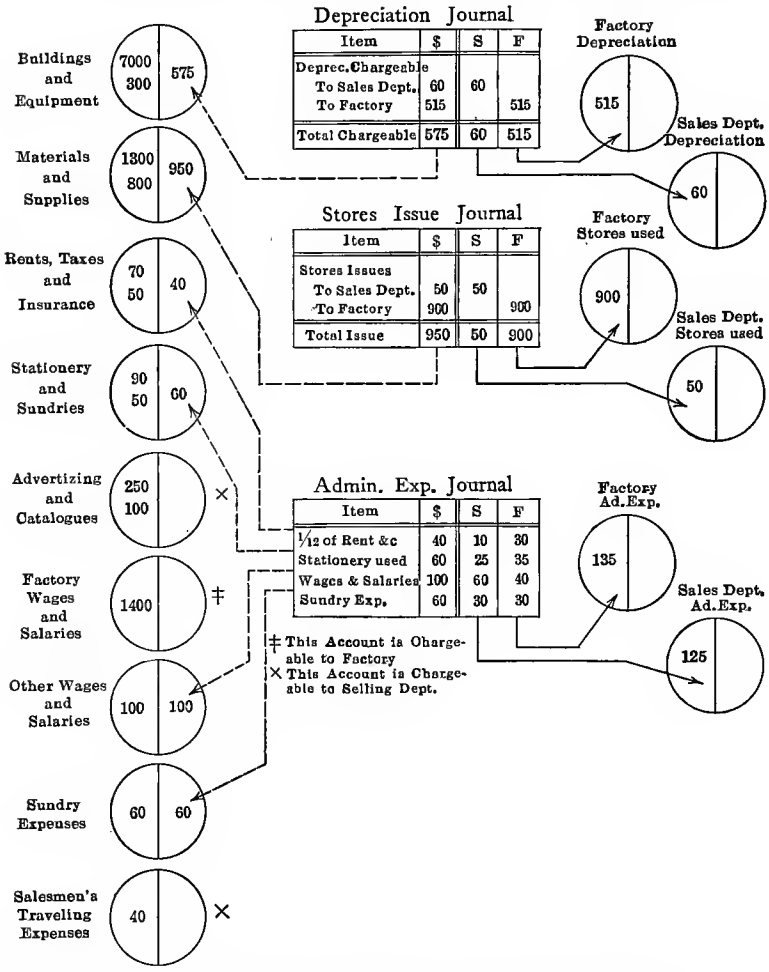


FIG. 8.—Credits to accounts shown in Fig. 7. Purchase transferred, *as consumed*, to Factory and to Selling Dept. respectively.

which do not go immediately and directly to costs (or to sales expense) but are held up in an intermediate state while only the proper amount chargeable to one month's business is taken out of the total each month.

The first of such accounts is Plant, Buildings and Equipment. The balance brought forward represents the value of these items at the end of the previous month, *after* that month's depreciation had been deducted and charged to manufacturing. The new total \$7,000 + \$300 = \$7,300 will presently, as we shall see, be subject to a credit for the current month's depreciation, and a new balance will be carried forward.

The second such account is Materials and Supplies. A balance of \$1,300 is brought forward, and this represents what was left in stores *after* the previous month's actual consumption had been deducted and charged to manufacturing. To this we have added \$800 making a new total of \$2,100, and this will presently be subject to a credit for materials consumed in the current month, leaving a new balance to go forward.

The third such account is Rent, Taxes, Insurance and similar items. Though this is not, like the foregoing, a property account, but an expense account, still it is a kind of purchase that needs measuring out, month by month in definite amounts, quite irrespective of the actual amounts that may have been invoiced in any period. Thus it may be customary to have bills rendered for such times every 6 months, or even annually, but we must not, therefore, charge Production with the whole sum so invoiced at once. The total yearly expenditure on such items must be determined, and Production charged with one-twelfth of the total amount. The balance of \$70 in this account represents items billed to us, but not yet charged to production. After adding the new amount \$50 we have a total of \$120, from which presently we shall deduct the proper monthly charge and carry the balance forward.[1]

The Stationery and Supplies, and Advertising and Catalogues are obviously of the same character as Materials and Supplies already mentioned. The balances in these accounts represent property in hand, and not yet issued for consumption.

On the other hand, Wages and Salaries, being payable for the current month's work, are chargeable at once, without any portion being held back or suspended. Sundry Expenses, and Traveling

[1] Sometimes the regulation of items like rent, etc., is effected by passing "proforma" invoices through the Purchase Journal for the actual month's proportion. Credit is made to the personal account of the landlord, etc. The practice is not a good one.

Expenses of Salesmen are similarly chargeable against current month's work.

The principal items of purchase are now assembled in ledger accounts, ready for allocation to the places they belong. To do this a new set of journals comes into play, serving to analyze and guide the analyzed amounts to their proper destination. The mechanism for this step is shown by Fig. 8.

It will have been noted, however, that the arrangements just described are merely an extension of the simple purchase mechanism described in the last chapter. All that we have done so far is to sort out our purchases into certain broad groupings, corresponding to peculiarities that it is important to keep in mind. We have collected items that we are going to charge at once to Production, such as Factory Wages, in one account, items that we are going to charge at once to Selling Expense, such as Traveling Expenses, in another account, and we have also provided separate accounts for such items as are only passed to Production as consumed, such as Materials, Equipment, Rents, etc., or only passed to Selling Expenses as consumed, such as Advertising and Catalogues.

So far we have merely made a preliminary classification of purchases, we have not yet intercalated into the series any new variety of mechanism, or in other words we have not yet attained the position of being able to do any costing. We are still at the stage:

Cash—Purchases—

only we have introduced into the system a greater variety of purchases and have correspondingly developed our system of ledger accounts to record them.

Before leaving the question of purchases, attention may be called to the fact that in some businesses, notably machine shops and engineering works, a not inconsiderable portion of both equipment and materials is made in the factory itself. New machines, tools, parts made in quantities for future use, patterns, molds, jigs and foundry flasks, are commonly made in such plants, and from a bookkeeping point of view may be regarded as purchases from selves, instead of from an outside supplier. In fact, invoices might be passed through the Purchases Journal, charging the Equipment or other account concerned and crediting production, instead of crediting an outside supply house. It is,

however, better practice to employ a special journal for this purpose, so that this class of transaction can be viewed separately. For our present purpose, however, we need not consider purchases from selves, since in many plants no such transaction occurs, and where it does, the procedure is exactly similar to that adopted for transactions with outside firms, except that Production is credited instead of a supplying firm.

Having assembled purchases in a series of accounts, the next stage is to consider each of these separately, and ask whether we have all the data necessary for charging each item up to its next destination, and crediting the ledger account accordingly. On examining the accounts we see that only in the case of three accounts: namely, Factory Wages and Salaries; Advertising and Catalogues; and Salesman's Traveling Expense, are we sure of the destination of the purchase in question. Both the latter are obviously matters of marketing the product and have nothing to do with manufacture. We need not concern ourselves further with the amounts in these two accounts, but will leave them as they are until we take up the question of Sales Expense.

The remaining accounts tell us nothing. We do not know how much of each is to be charged to Production and how much if any is to be charged to Selling Expense. This can be determined only by obtaining further data.

Such data are forthcoming by means of a new set of journals, which carry the analysis or classification of purchases to the point that what is chargeable to Production is, once for all, separated from what is chargeable to Selling Expense. And when this stage is completed all the expenditure on Production will be segregated, as well as all the expenditure on Selling. In particular the nature of the manufacturing cost problem will then begin to shape itself before us.[1]

Figure 8 shows the further steps necessary to transfer the items of purchase assembled in Fig. 7 to ledger accounts representing respectively Sales Expense and Factory Cost. The ledger accounts shown on the left are the same as those shown on the right

[1] In practice a somewhat shorter path is followed than that indicated here, in the case of some of the items. But the detailed method here described is selected because it demonstrates very clearly the nature of the operations that are necessary to collect and analyze purchases into the two groups of Production and Selling Expense. The shorter methods followed in practice are the same in principle, but more difficult for the beginner to follow. They are described in Part II.

of Fig. 7. The first account containing the charges for purchase of buildings and equipment is dealt with by means of a Depreciation Journal. The entries in this journal are based on a grouping of Buildings and Equipment according to their uses, so that all the items used for the purpose of manufacture are in one group and all those used for the purposes of storing finished goods and selling are in another. The depreciation rates for each group are thus ascertained separately, and one-twelfth of the annual total charged through this journal to Sales Department and Factory respectively.

The whole question of calculating depreciation charges and grouping the items must be left till a later chapter. All that need be considered now is that it is feasible to so separate and charge the depreciation rates. The result of the operation is that we now have two accounts (on the right hand of diagram) containing charges for Factory Depreciation and Sales Department Depreciation respectively, while a credit for the total of these two amounts is made to the Buildings and Equipment account.

The next account to be dealt with is that for Materials and Supplies. As these are kept in stores, the journal which records their issue to the factory or to the sales department, is called the Stores Issues Journal. Each item is entered and priced out as issued, and allocated to one or other of the columns shown. When the whole month's transactions are complete, the totals are added, and the grand total of issues credited to Materials and Supplies account. The individual totals of issues to factory and sales department respectively are charged to the two accounts shown on the right hand. By this operation we have credited Materials for everything that has been taken out of stores and have charged either Factory or Sales Department with the proportion used by each. In practice the issues to sales department are comparatively trifling.

Other accounts: viz., Rents, etc.; Stationery, etc.; Wages and Salaries not belonging to Factory; Sundry Expenses, have now to be considered. These are called Administrative Expense, because some part of each belongs to a class of expenditure that is of a generally administrative nature, such as the upkeep of the general office, salaries of the higher officials, etc. The division of these items between the two active departments, namely Sales and Factory, is a matter of careful determination and adjustment, the basis of which must be left to a later chapter. It

is sufficient to note here that such a division can be made, so that all expenses of this class can be allocated either to Sales or Factory. As in the case of Depreciation, one-twelfth of the annual amount of items like rent, insurance, etc., is entered on

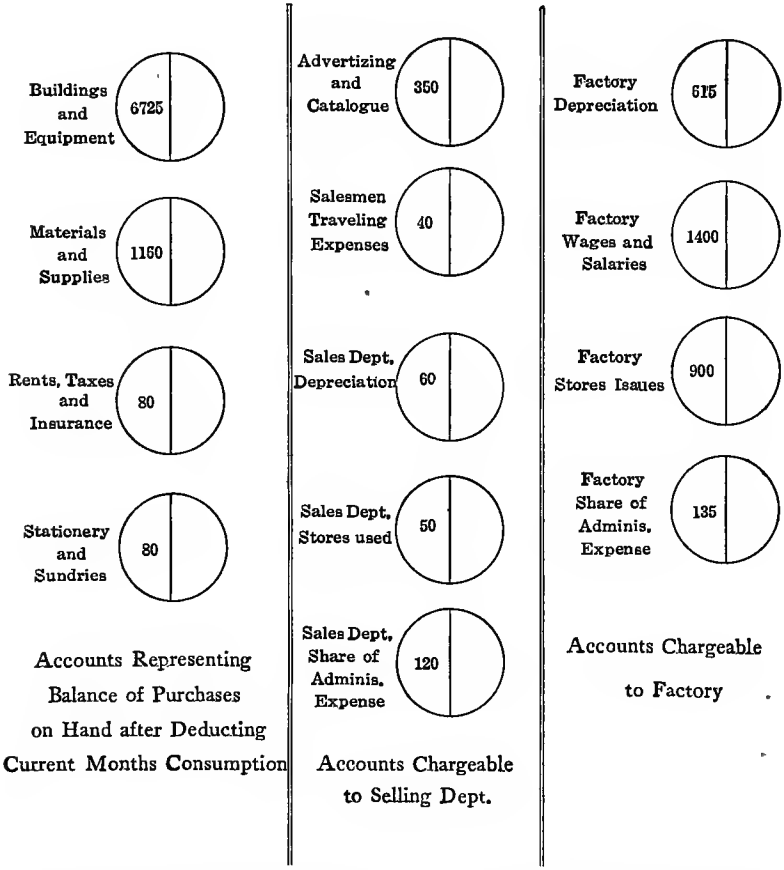


FIG. 9.—Accounts shown in Fig. 8 after all journal entries have been completed. There are three groups, viz.: Balances left in Purchases accounts as shown in Figs. 7 and 8, and Balances in the new accounts pertaining to Selling Dept. and Factory respectively.

the journal, and credited to the different accounts concerned, and the totals charged to Factory Administrative Expense, and Sales Administrative Expense respectively, as shown by the diagram. Stationery is charged according to consumption and the other items according to actual amounts expended.

The only accounts not dealt with on the right hand of the diagram are Advertising, etc.; Factory Wages, etc.; and Salesmen's Expenses. No journalizing is necessary for these at this stage, since their destination is sufficiently indicated. Advertising and Catalogues obviously belongs to Sales Department; Factory Wages to Factory; and Salesmen's Expenses to Sales Department.

Figure 9 shows the stage at which we have now arrived, after all the charges and credits have been made and the accounts balanced off. It will be seen that there are now three groups of accounts. The first group contains:

Balance of buildings and equipment on hand at month end.

Balance of materials and supplies on hand at month end.

Balance representing amount of payments for rent, insurance, etc., not yet due to be charged to Factory or Sales.

Balance representing stationery on hand unused, at month end.

Three of these accounts represent property on hand, and the other represents "held up" expense as already explained.

The next group of accounts comprises those which are chargeable to Sales Department. These will be considered later.

The third group of accounts comprises those chargeable to Factory, namely:

Factory depreciation.

Factory wages and salaries (brought from left hand of Fig. 8 without journalizing).

Factory stores issues.

Factory share of administrative expenses.

These last four accounts are the components of factory cost. They represent what has gone into the factory. Our next task will be to see how the product which results can be connected with these components of cost so that we can price out each delivery of product and so be able to credit Production with the factory cost of all the articles produced.

CHAPTER IV

MECHANISM FOR CONNECTING COST WITH PRODUCT

The essential feature of cost accounting is the connection of the expenditure incurred in manufacturing, with individual quantities or items of product. As we have seen in the last chapter, the first step in manufacturing accounts is to assemble all components of cost chargeable in one month, and to charge them to certain ledger accounts. The next step is to clear these particular accounts and charge them to Manufacturing account. This provides us with definite information as to what has gone into the factory, and it will be obvious that the final step is to provide data that will enable us to say what has come out of the factory.

As the factory exists for making product, and as product comes out of the factory, the data we require must be based on the quantity of product delivered out of the factory. We must, therefore, establish a connection between dollars of *cost* and weight, length, number or individual pieces of *product.*

When we have done this, and not before, can we make the necessary credit to Manufacturing account for the work accomplished by the factory in the month.

We are now approaching the most interesting and at the same time the most difficult problems with which we have to deal. Hitherto what we have done is, in principle, common to all kinds of manufacturing business. It has consisted in isolating from other items just those charges which have been incurred for the sake of production. This must always be done, whatever the kind of business with which we are dealing. But from now onward the mechanism we set up will depend entirely on the nature of the business and the degree to which detail is desirable.

As there are hundreds of types of manufacturing business it is obviously impossible to attempt to provide specific description of the mechanism suitable for each. Fortunately, however, the elements or components of cost are comparatively few, and they

can be combined with product only in a limited number of ways. Consequently instead of having to consider innumerable kinds of business, we can confine our attention to a few types of cost methods. These few methods cover the principles on which all cost accounts in any kind of business must necessarily be based.

There are, to begin with, two broad types of cost methods—non-departmental and departmental. Only very simple kinds of business can be handled on the non-departmental plan. The large majority of plants contain such diversified kinds of operations that correct costing is possible only by isolating each main class of operation, calling it a department and costing it by itself. But, for example, a firm confining itself to machine-printing for the trade by the aid of a set of machines all about the same size and capacity, or a dyeworks handling one class of goods, or a jobbing foundry doing only hand-molding—all these are examples of simple businesses which contain only one department, and therefore belong to the non-departmental type.

But if the machine-printing firm set up a composing room, or a linotype shop; or if the foundry added a machine shop to its business, then departmentalization would become necessary. Generally speaking, most firms carry on several different types of production simultaneously, even though the same product is carried through all of them, and wherever this condition exists departmentalization is necessary. It is also desirable when, as for example in engineering works, certain machines are grouped together for a special purpose, even though other departments may contain exactly similar machines.

Though non-departmental accounts present the simplest case, they need hardly be treated as a separate description of cost accounts, because after all, the non-departmental type is really a case of a business with one department. There is no difference in the methods applied *within* the shops between a business having but one department and a single department of a more complex business. With the proviso that it is kept in mind that some types of business have only one department, we may proceed to consider the remaining features of cost accounting.

Just as we allocated current purchases between the factory and the sales department, so to begin with we make an allocation of factory cost elements to various departments, if there is more than one. All the factory cost elements are thus allocated. The

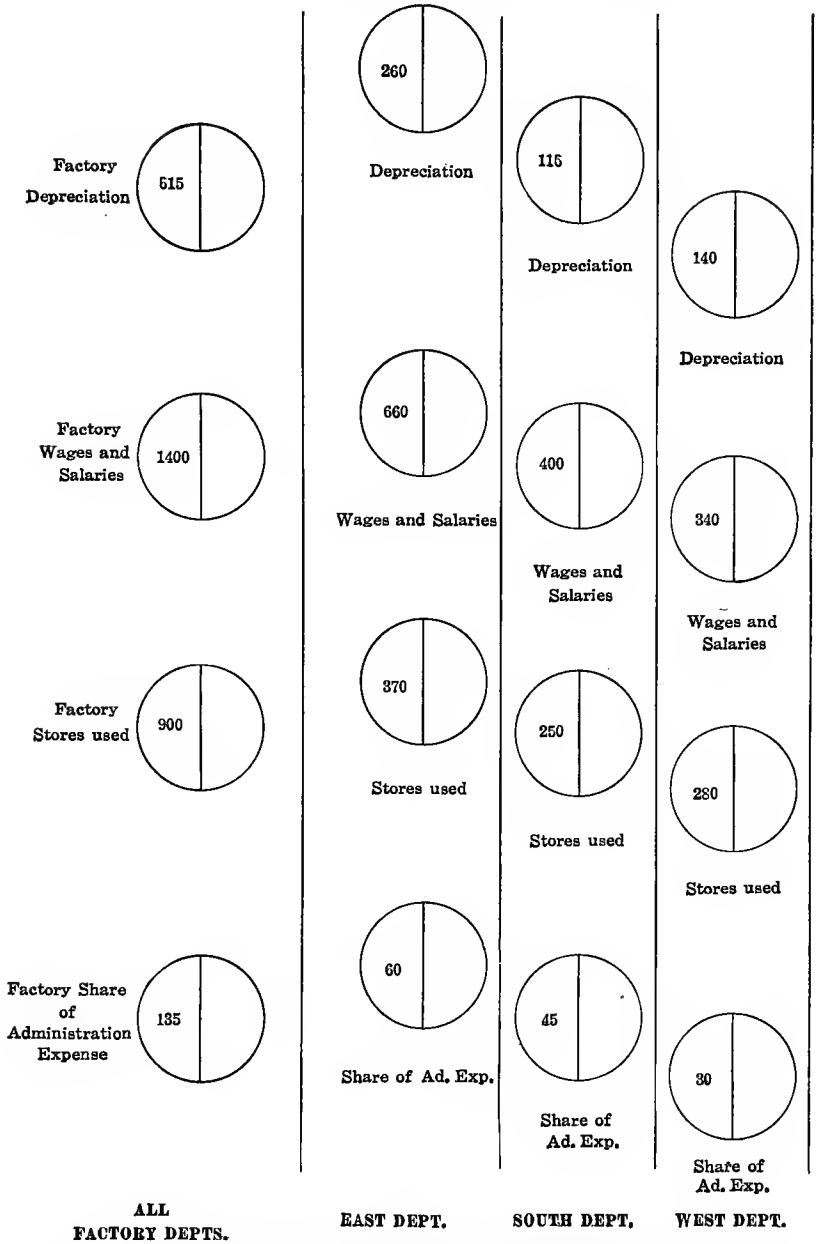


FIG. 10.—Departmentalization of cost elements.

NOTE: Journalising would be effected by subdivided columns in journals shown in Fig. 8.

result is that instead of one general factory cost elements group of accounts as shown in Fig. 9, we have now a set of separate departmental cost element accounts as shown by Fig. 10.

Figure 9 represents in fact the cost element as arranged for a single or non-departmental business. If the business were organized in departments, then the journalizing made in Fig. 8 would be extended to allocate the elements at once into departmental groups instead of into a single factory group. For this reason Fig. 10 shows no journals. The three departmental groups of accounts may be considered as derived directly from Fig. 8, by means of additional columns in the journals there shown.

We have now arranged our cost elements in three groups corresponding to as many departments engaged in turning out product. For all practical purposes each department is a separate factory, and we can arrange our cost mechanism to suit the particular type of work done in it, quite irrespective of the cost mechanisms which may be suitable for the other departments. To begin with, therefore, it will be desirable to know what different kinds of cost mechanisms are available, and in what the difference between them consists.

Material entering into product presents no special difficulty. It is charged *direct* to the unit quantity of product selected for costing, whatever that may be. Material entering into product is frequently called direct material.

The remaining components of cost are depreciation; the department's share of administrative expense; stores and supplies not entering into product, but used up on maintenance or repair; and wages and salaries.[1] The latter item, as will be seen presently, frequently requires further analysis. It is made up of two different classes of item—wages and salaries of persons not process workers and wages of operatives who are engaged on process work on product. The latter operatives are spoken of as direct labor, and their wages are called direct wages, meaning that they are, in many cases, chargeable *direct* to unit quantity of product, same as material.

If we analyze Wages and Salaries account in this way we divide it into two portions, viz.:

1. Direct labor (or direct wages).
2. Expense labor (or expense wages), sometimes called in-

[1] This assemblage of cost components is not exhaustive, but may be regarded as a typical example.

direct labor or indirect wages. This latter class is simply what is left after deducting direct labor. By whatever term it is called it really means "not-direct" labor.

We shall see immediately that this distinction is of great importance, since the main varieties of cost system hinge on the manner in which direct labor and direct material on the one hand, and all the remaining elements of cost, on the other, are applied to product.

The components of cost will now stand as follows:

1. Material entering to product (direct material).
2. Direct labor.
3. Administrative expense.
4. Stores and supplies (indirect material).
5. Expense wages and salaries (indirect wages, etc.).
6. Depreciation.

These last four items form a group by themselves, and this group bears various names, such as overhead, expense, burden, etc. We shall generally refer to it as expense.

The elements of cost are now consolidated into three groups, namely:

1. Direct material.
2. Direct labor.
3. Expense (made up of items 3, 4, 5 and 6, above).

The art of costing consists in connecting these items with unit quantity of product. Direct material being always charged straight to unit quantity we are left face to face with:

1. Direct labor.
2. Expense.

and our problem is how to apply these to product, so that on taking up a piece of the latter we can say what it has cost.

There are three main conditions governing the selection of an appropriate cost system, viz.:

The method in which direct labor and expense are applied to the product.

The unit quantity of product selected for costing.

The degree of detail required in the costing of this unit quantity.

Each of these main conditions is itself subject to variation, thus:

METHODS OF CHARGING DIRECT LABOR AND EXPENSE

(*A*) Direct labor and expense are merged and averaged, and charged to unit quantity of product on a time basis.

(*B*) Direct labor is charged to unit quantity on a time basis. Expense is averaged and charged as a percentage on direct wages, or on the time taken by direct labor (hourly burden or percentage method).

(*C*) Direct labor is charged to unit quantity, and expense is similarly charged by means of a machine rate, both on a time basis (scientific machine rent method).

SELECTION OF UNIT QUANTITY OF PRODUCT

(*d*) Unit is the whole output of one class of product.

(*e*) Unit is less than the whole output, but a definite quantity, such as 500 lb. or yards, or a lot of 100 articles. But the unit is still for a complete article, without distinction as to cost of separate parts, if any.

(*f*) Unit is the individual piece or part, or a lot of say 100 similar pieces or parts. (Engineering cost type. No subdivision of unit quantity possible beyond this.)

AMOUNT OF DETAIL IN COST OF UNIT QUANTITY

(*g*) No detail. All processes within the department lumped together in a single total.

(*h*) Each process costed separately. (An unbroken series of processes may be grouped and considered as one process.)

It will be seen from the foregoing that there are no less than eight conditions governing the selection of a costing method. In order to make their relative bearing clearer they may be stated as follows:

There are three methods of charging labor and expense to product.

There are three degrees of subdivision of the unit quantities to which cost is to be applied.

There are two degrees of detail in regard to the departmental cost of whatever unit quantity is selected.

The great complexity of cost accounting is due to necessity of selecting the most correct method of charging labor and expense and the most appropriate degree of subdivision of unit quantity, and of detail, in any given set of circumstances.

Expense Arising Within the Department.—In practice, indirect material and indirect labor take their rise partly within the department itself. The wages of laborers and cleaners, and

the cost of supplies, such as oil and waste, are familiar examples. In the discussion of methods of costing now about to be entered on, it will be assumed that such items have already been separated from the cost of direct production, and assembled separately.

By making this assumption the necessity of describing the mechanism for making this separation is avoided at this stage, and as it has no significance whatever as regards the ultimate destination of the indirect material and the indirect labor, there is no disadvantage in omitting it.

In machine shops and engineering works, where the operative labor is of such a character that it may be used for making repairs, the days work of any operative may include *both* direct production and indirect labor. These must be sorted apart in every case, before anything else is done, but after such sorting is accomplished we have precisely the condition of affairs here assumed, namely, that all direct labor is in one account and all indirect labor in another. The mechanism for doing this does not affect the main argument, and acquaintance with it may well be postponed until a general acquaintance with the broad outline of cost accounting has been made. It is fully dealt with in the second portion of this work.

CHAPTER V

COSTING ON METHOD A

The most convenient way to attack the subject of cost mechanisms will be by taking each of the three Methods A, B, and C by which labor and expense are connected with output and discussing it separately. We therefore begin with:

Method A: Labor and Expense Merged and Averaged.—The merging of direct labor with expense is only possible under certain conditions. If in a department we have several machines a, a, a, a (Fig. 11), each of which can be used indifferently for making the product, and if the wages of the operators of these machines are identical, or so very similar that the difference may be ignored, then it is obvious that any one hour of operative labor

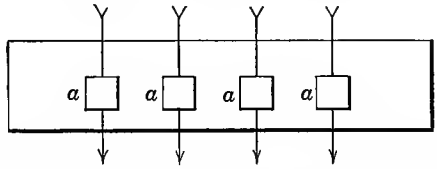


FIG. 11.—A department having four archives, each identical. Such a department is said to have four "simple" streams of product.

is worth exactly the same as any other hour, and no object is gained by charging it as a separate item to Product. In a soap-boiling room, for example, the operators may be at work now on one kettle and now on another, and as long as they are paid day wages, it is obvious that it is a matter of indifference which kettle they are working on. Similarly in an envelope-folding department, if we have ten machines and say eight operatives, each operative being assignable to any machine, and each being paid the same wages, then an hour's work at any machine will be the same as an hour's work at any other machine.

If the work is performed by gangs or groups of men, then there may be different rates of wages *within* the group (*e.g.*, a foreman), but as long as the total wages of the group are always the same, they may be shifted about from one machine a to another

machine a just as though they were one man, without disturbing the principle that one hour's labor is as good as another hour's labor.

The principle may be extended to cover cases where there is a slight difference of wages among operators, as for instance where length of service is rewarded by increased wages, provided that there is no permanent connection between certain kinds of work and certain duties. Where labor is fluid, and the work as it comes along is assignable to any operative, then the conditions for merging labor and expense exist.

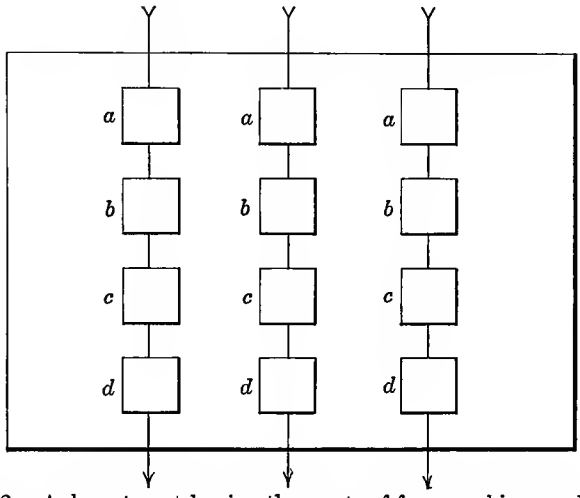


FIG. 12.—A department having three sets of four machines each. Each series, a, b, c, d is a continuous process, and identical with the other two. Such a department is said to have three compound streams of product.

When operatives are paid by piecework Method A is inapplicable.

It may happen that product goes through a *series* of processes in the department, and that each stage has a different rate of wages. Fig. 12 illustrates a shop in which product passes through three stages a, b, c and d. Now the operative at a may be paid one rate, at b, another rate, and similarly for c and d. Provided that the total wages $a + b + c + d$ in each series are the same, then merging is proper. Or to put it another way, if all a operatives are paid at one rate, all b operatives at another, and similarly for c and d operatives, and particularly if all a operatives are interchangeable, and also all b, c and d

operatives are also interchangeable each in his own class, the same conditions exist. Of course, it is assumed that all product follows the entire series of processes *a*, *b*, *c* and *d*, in every case.

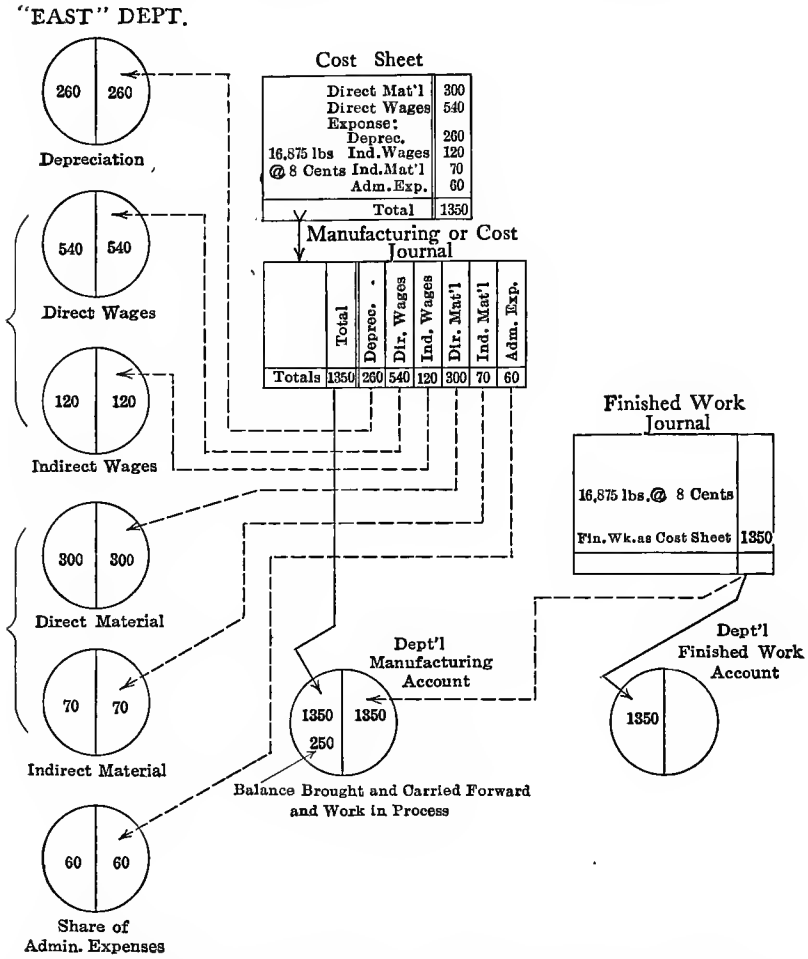


FIG. 13.—Costing on Method A (single product). The ledger accounts on the left are those of the "East" Department in Fig. 10, but Wages and Material accounts have been further journalized into "Direct" and "Indirect."

A department arranged like Fig. 11 is termed a shop having four simple streams of product, and one like Fig. 12 is termed a shop having three compound streams of product. In the former

case each *machine a* is a producing unit. In the latter case each *series* of machines *a, b, c* and *d*, forms a producing unit.

Simple and compound groups of machines cannot coexist in the same department, nor can the compound groups differ among themselves; otherwise incorrect costs will result.

Figure 13 represents the ledger accounts belonging to the "East" Department (see Fig. 10) with the exception that the accounts for Materials and for Wages and Salaries have been subdivided into Direct and Indirect in each case, for the reasons just given. This subdivision, by the way, would be made through the original journal entries in Fig. 8, all the necessary splitting up into departments and special accounts for each department being really done at one operation. It has been thought better, however, to gradually develop the matter stage by stage instead of presenting the reader with a complex journalization at the beginning.

The departmental accounts shown in Fig. 13 may be grouped as follows:

Direct Material. Chargeable direct to unit quantity of product, as mentioned above.

Direct Labor.

Expense accounts, viz.:

Depreciation.
Indirect Wages.
Indirect Material.
Administration Expense.

We have now to find some way of charging Direct Labor and Expense to Product.

Single Product Costs on Whole Output.—In this case the unit quantity of product is the *whole* of the output. Of course, it will at once suggest itself that no costing of the whole output can be made unless the output is homogeneous. If it were made up of brass kettles and fire-irons, for instance, to cost the output either by weight, or by number of articles, would be meaningless.

To cost an output as a whole, it must be homogeneous.

Such a product would be yarn in a spinning room, or envelopes of one size and make passing through an envelope-folding department by the million, or soap in a soap-boiling room, or any product which is either continuous and possesses no parts, or of which each piece is like every other piece.

If we have such a product, we must still have some unit by

which to cost it. It must be measureable, weighable or countable. Then we can express the whole product of the department for one month as so many thousand gallons, yards, pounds or thousands, and then if we divide the total departmental cost by this figure, and add Direct Material, we arrive at the departmental cost per gallon, yard, pound or per thousand. It will be noticed also, that though not specifically mentioned, *a time basis is implied.* In this case the time basis is one month, which is the same period of time as covered by our journalizing. For this reason the time question does not obtrude itself, but it is there just the same, as we shall see immediately that we come to consider the case when two or more products have to be costed on the basis of the whole output of each.

To ascertain the cost of a single homogeneous product for one month a Cost Sheet is made out as follows:

Cost of direct material.....	$300	22 per cent.
Cost of manufacture, viz.:		
Direct wages.....	540	40 per cent.
Expense, viz.:		
Depreciation.....	260	19¼ per cent.
Indirect wages.....	120	9 per cent.
Indirect material.....	70	5¼ per cent.
Administration expenses.....	60	4½ per cent.
Total cost of product.....	$1,350	100 per cent.

Divide by quantity made, viz., 16,875 lb.; Cost per pound, 8 cts.

NOTE.—Frequently each of the components of cost is expressed as a per cent. of total cost per pound as well as in money. This is for convenience in comparing monthly figures.

In many cases, of course, there would be no direct material to be considered in the work of a department. In the case of an envelope-folding department, for example, the department would receive the blanks already cut to shape and gummed, and the cost of its operations would merely be a process cost. But this process cost would, just the same, be expressed as cost of folding envelopes per 1,000. Whether or not direct material enters into the work of the department makes no difference whatever in the method of costing. The form of the above Cost account, for instance, would be just the same, omitting the first line. The cost would be expressed per pound of the quantity *handled.*

This Cost account is now made the source for crediting the departmental cost element accounts, and charging the departmental Manufacturing account. A Cost or Manufacturing Journal is made use of, as shown in Fig. 13. It will be noticed that there is already a balance standing to the debit of Manufacturing account. This represents work in process carried forward monthly, and it is assumed that this balance remains constant from month to month. In some cases no balance remains, a machine printing shop, for example, or other shops doing process work only, no direct material being charged to Cost.

Only one more step is necessary and that is the crediting of Manufacturing account and the charging of Finished Work account with the value of product delivered to the next department or to warehouse. The Finished Work Journal takes care of this. The total in it is necessarily, in this case, the same as that in the Manufacturing Journal, because the month's product is dealt with as a whole. Fig. 13 shows the course of the entries. The costing operations are now complete for the month.

This is the simplest kind of cost keeping possible. It is limited in application to the conditions mentioned, namely a homogeneous product, passing regularly through exactly the same operations every time.

Two or More Products Costed on the Whole Output of Each.—If there are *two* or *more* kinds of product, each going through exactly the same steps of manufacture, the total cost of each will be proportionate to the output of each, **provided** that the rate of production of each kind is strictly the same. If one kind takes longer than another to pass through the series of operations in the shop then the cost of each kind will not be proportionate to output.

This is so important a point that it must be thoroughly understood. All costing is based on a measurement of time. In the simplest case above mentioned, when we assemble the elements of cost (excluding material entering into product), what we have really assembled is the cost of manufacturing capacity for a certain period of time, actually a month. Another way of expressing the same fact is by saying that it is the cost of manufacturing capacity for 200 hr. (if we assume that there are 200 hr. in the working month) multiplied by the number of streams

of product going through the shop.[1] From this it follows that every hour of this manufacturing capacity has its price. If we are dealing with a single uniform product, we may safely assume that one hour's production is like another hour's production, or at any rate if it is not it should be. We could, therefore, have expressed our cost in the example just given in this form:

Total cost of department, $1,050	
Hours in month, 200 × 10 streams of product, 2,000 hr.	
Cost per process-hour, 52½ cts.	
Total process-hours on product, 2,000	
Cost of product, 2,000 × 52½ cts.	$1,050
Add direct material	300
	$1,350
Cost per pound (16,875 lb.)	8 cts.

This, of course, would be a roundabout way of arriving at the cost compared with the other method, yet it has a practical value for estimating purposes. If we know the cost of the hour's work of a machine or series of machines (stream of product) and can estimate how many hours' work are involved in a job on which we are bidding, we obtain a close figure. A modification of such a method is widely used in the printing trade.

Now if we have, not one uniform product, but two or more similar but not identical products, we cannot say that 1,000 lb. of *A* and 500 lbs. of *B* have cost $100 and $50 respectively out of a total cost of $150, for 1,500 hr. work, unless we are *sure* that *A* actually took 1,000 hr. and *B* 500 hr. For if we were to find afterwards that *A* took 1,200 hr. and *B* 300 hr., then the actual cost of *A* would have been $120 and of *B* $30. Yet this method of basing cost on proportional output is not uncommon, although it is utterly erroneous save in the exceptional case that the time occupied is in exact proportion to the output of each.

When there are two or more products, therefore, passing the same shop, the question of **time recording** comes into play save in the few instances where we are sure that each product has the same rate of production as any other. A concrete case would be the envelope-folding department of a stationery

[1] By "streams of product" is meant the series of processes followed by the product. Two or more such streams may be proceeding simultaneously, see Fig. 12.

works. Here we have a number of machines of about the same character, operated by girls of about the same skill and wage, and although any machine could not be used for any job, the rate of production and the operating cost of all machines including operator is much the same. If now we have, during a month, 20 different kinds of envelopes to fold, in lots varying from 1,000 to 50,000 substantially exact costing will be found by ascertaining the cost of a process-hour, and recording the total number of hours worked on *each kind* of envelope by all the machines.

The process-hour in this case is the individual machine-hour, since each machine completes the whole process (compare Fig. 11). The total number of hours worked by all machines is, therefore, divided into the total cost of running the department, including direct labor, and the resulting figure is obviously the cost of one hour's work of one machine.

If, on the other hand, the process work done on the envelopes were accomplished by sets (of say three machines) then we should treat three machines as one producing unit (compare Fig. 12). Thus if the department contained 30 machines, each of which accomplished the whole process, then the monthly cost of running the department would be divided by 30. But if the 30 machines were arranged in 10 groups of three machines, and each envelope had to pass through a set of three machines before it was finished, then the cost of running the department would be divided by 10. Using the phrase adopted above, we might say that in the former case there were 30 simple streams of product passing through the shop, and in the latter case 10 compound streams. It is the number of distinct groups of processes, of streams of product, not the actual number of machines, that is the divisor.

In costing several products on Method A, the necessity for recording what proportion of the total working time of the department has been taken up by each product, and the corresponding necessity for calculating, first the cost of the process-hour, and then the cost of the output of each product separately, makes the use of additional mechanism necessary. Fig. 14 shows this mechanism developed from Fig. 13, but carried in this instance to the point of making separate charges to Finished Work for three separate products, called *X*, *Y*, and *Z*.

The Time Record summarizes the work of the various machines,

and groups the process-hours worked on *X*, *Y*, and *Z*, showing totals of 1,000, 400 and 600 hr. respectively, out of a departmental total of 2,000 process-hours. Each of these totals for *X*, *Y*, and *Z* is entered on the Cost Sheets, of which there is one

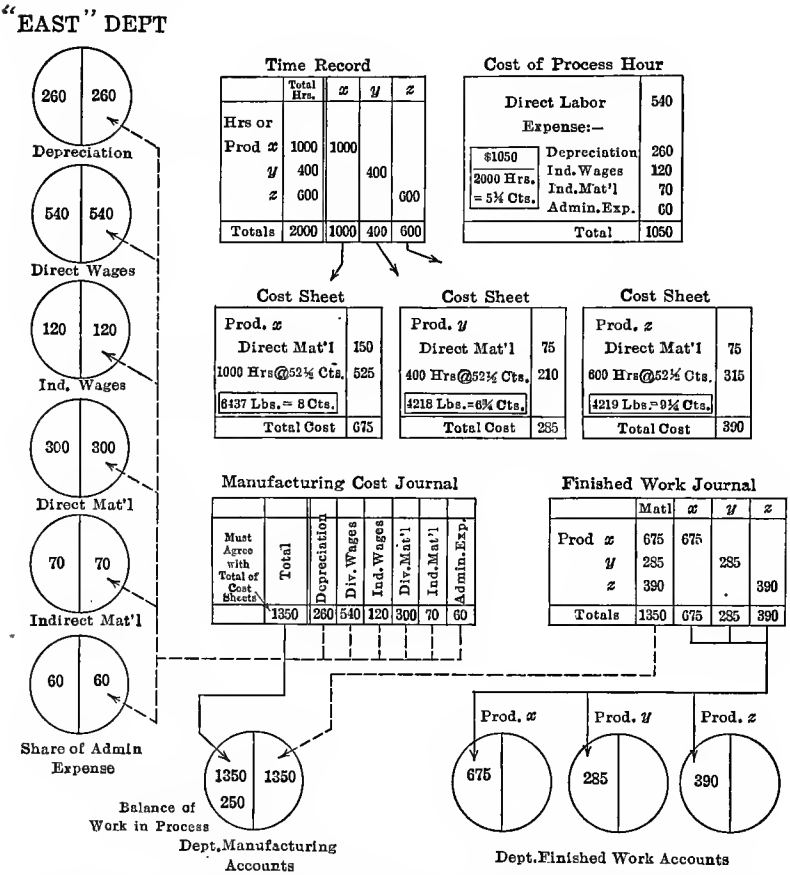


FIG. 14.—Costing on Method A (two or more products). Total departmental cost divided between products in ratio of *Time* occupied by each. This gives three different rates per lb. Simple division of total costs by respective weights of products would give false costs in this case.

for each product. The departmental total of 2,000 hr. is entered on the Cost of "Process-hour" Sheet.

On this latter sheet are then entered all the components of cost which are chargeable to the department except direct material. (Direct material is often entered direct on separate Cost

Sheets.) The total of departmental cost thus found, $1,050, is then divided by the total process-hours, as shown by Time Record, and the result is the cost of a process-hour, viz., 5¼ cts. This figure is then entered on the cost sheets, so that the value of time on each product can be extended.

One Cost Sheet is used for each separate product. On it are entered, first the cost of direct material; secondly, the process-hours on the product, from Time Record, and the cost of process-hour, from the other sheet. The extension is then made, showing $525 for product *X*; $210 for *Y*; and $315 for *Z*. Each sheet is then totalled, so as to show total cost of the whole amount of product. This total cost is then divided by the weight in pounds of the output (or yards, gallons, thousands, etc.) giving the cost per pound.

The total of all the cost sheets together must agree with the Cost Journal total, from which debits and credits are made exactly as in Fig. 13.

In order to clear Manufacturing account, and to charge the Finished Work accounts for products *X*, *Y*, and *Z*, respectively, the total cost of each is entered in the Finished Work Journal and allocated to the proper column. Manufacturing account is then credited and Product *X* account charged with its total, and the same with the other product accounts.

Study of Fig. 14 will enable all these changes to be understood without effort. In this diagram, however, a slightly different method of showing the credits and charges made from the journals is employed. Instead of a line being drawn from each column of the journal to the corresponding ledger account, all credits are consolidated in one dotted line, and charges in one solid line for each journal. These branch off afterward to the respective ledger accounts. This method is used to avoid the multiplicity of lines otherwise necessary, and will readily be understood by the reader who has followed the detailed method used in previous diagrams.

Attention may be drawn to the fact that in the example given, an attempt to find the separate cost of each of three products by simply dividing departmental cost among them in proportion to output of each would give rise to false figures. The main product *X* will be seen to have the same cost per pound as the whole product in Fig. 13. But the products *X* and *Z* are respectively higher and lower than the average price of 8 cts.,

which would be forthcoming if cost were taken out on the proportionate basis. This is because the rate of production of *Y* and *Z*, instead of being the same as that of *X*, was in fact respectively slower and faster. This has resulted in a difference of cost per pound as between the three products amounting to a considerable divergence from average cost. While *X* is 8 cts., *Y* falls to 6¾ cts. and *Z* rises to 9¼ cts.

Costing by Lots on Method A.—This is really an inversion of the last method. Instead of taking a whole month's product and then ascertaining the weight or quantity of it, we specify the weight or quantity, and ascertain how long it has taken to make it. The first step is to ascertain the cost of the process-hour, as in the example, Fig. 14. But the time record, instead of taking note simply of *differences in product*, must concern itself with *differences in lots*. This implies that the lots must be identified in some way and this requirement brings us to a new and very important part of the mechanism of costing, namely, orders.

Orders are the mechanism by which cost is grouped with particular items or lots of product. In the two cases just described orders are unnecessary, but they might be used, and in fact the scope of orders may be best understood if we begin with simple cases like these.

Where we have only one product, which we cost every month, we might charge the monthly total to an order number. If, for example, each month's production received a separate order number, and the Cost Sheet on Fig. 13 were to be headed with such a number, then on filing such cost sheets numerically, any month's production could be referred to by the order number. Instead of asking for costs for June, 1915, we might ask for the cost of Order No. 84.

Where two or more products are in question, each product might have its own series of orders, such as *X*84, *Y*84, *Z*84, etc. In such a case each of the cost sheets shown on Fig. 14 would be headed by its appropriate order number. The Time Record, instead of recording time by the name of the product, would then record it by the order number representing each product for the current month.

These possible instances are given to show that order numbers can be made to represent either the whole output for a period, or the whole of several different outputs. We have now to consider the case of *less* than a whole output, *i.e.*, instead of having

only one order per month, we may have several, each representing definite quantities of the total product.

The introduction of orders also produces a fresh complication in that, instead of each month's output being costed without remainder, it will generally happen that some orders will be unfinished at the month end.

To begin with, the case of a department manufacturing a single kind of product may be considered. Orders may be issued for lots of product, based either on weights, quantities, numbers, etc. In shoe factories lots of two, three or four dozen pairs are not uncommon. But orders may vary from single articles to any number in a lot.

The mechanism is exactly the same as that shown in Fig. 14, except that all charging is now to order numbers. If the different products *X*, *Y*, and *Z*, in Fig. 14 are considered as different quantities of the same product, the cost sheets will show the cost of each lot. There will be, of course, *just as many cost sheets as there are order numbers*, and the totals on them must agree with the total in the Cost Journals by means of which the credits to the cost components accounts and the charge to Manufacturing account are made.

Only *completed* orders are entered on the Finished Work Journal. The total in this journal is then credited to Manufacturing account and charged to Finished Work account. Since only completed orders are thus entered, it is obvious that the credit to Manufacturing account will not agree with the charge to that account. This implies that a balance will always stand in that account, *and this balance will vary from month to month.* Such balance represents, of course, the work done on orders which have not yet been completed and entered to Finished Goods Journal.

Costing by Individual Parts on Method A.—Practically, this case never occurs. Method A is usually applied to homogeneous products, which can be divided by quantity or number so as to allow of orders for specific lots, but such a product rarely has component parts capable of individual costing. Nevertheless, if required, an order could be issued for a single part, if such existed, and the separate cost of such a part thus obtained.

CHAPTER VI

COSTING ON METHOD B

Whenever degrees of skill exist as between individual operatives, recognized by differences in wages, or where piecework or bonus methods of renumeration are in vogue, then Method A cannot be applied, since it is based on the idea that any operative is interchangeable with any other operative, of the same duty, for all accounting purposes. When, therefore, we have different rates of wages for doing the same class of work, or what is the same thing, unequal earnings in the same time owing to the introduction of piecework or bonus, then it becomes necessary to make a new treatment of the components of cost, as follows:

Direct material. Charged direct to order number.

Direct labor. Charged direct to order number.

Expense. Charged to order number either by:

1. Averaging it and charging to Orders in proportion to direct labor or labor hours, or by:

2. Connecting it with the use of machines and charging to Orders by an hourly rate.

It is the first of these methods of dealing with expense that is the peculiar feature of Method B, which we shall now discuss.

Method B: Direct Labor Charged to Order, Expense Averaged and Charged in Proportion to Direct Labor.—This method, which is the most widespread of all methods of costing, has the disadvantage of being exceedingly incorrect save in particular circumstances. The only case in which the averaging of expense by means of percentages is correct is when all the machines are of the same cost, occupy the same space, take about the same power, entail about the same supervision, make about the same call on the shop transport service (cranes, handling, etc.). These conditions do exist in the case of departments such as those described under Method A, where any machine or group of machines can be used indifferently for product, but as soon as machines begin to differ among themselves, the method

now to be described is only approximate. It correctly records direct material and direct labor against each order, but it only correctly records expense against each order when machines are all about the same size, cost and character. If expense is very small compared with labor and material then no great harm is done, but unfortunately, this method, on account of its "simplicity" is commonly applied in shops where expense may be anywhere from 90 to 150 per cent. of direct wages, to the great detriment of true results.

It has two varieties: one in which expense is charged to Orders in proportion to the amount of direct *wages* on each; the other, supposed to be more accurate, but really not much more so save under special conditions, charges expense to Orders on the basis of the number of direct labor *hours* on each.

The form in which results are obtained, *i.e.*, whether by the whole output of each of several products, or by lots of individual articles, depends upon the manner in which orders are made out. Two or more separate kinds of product can be costed as a whole, by issuing one order for each class of product. Thus if we are making brass kettles and candlesticks, an order would be issued for the monthly output of kettles and one for the monthly output of candlesticks. But where Method B is in use, it is more usual to issue orders for definite lots, say for lots of 100 kettles and 200 candlesticks. It is also possible to treat one or more products as a whole, and other products by lots. Thus in addition to having orders running for 100 kettles and 200 candlesticks we might have another order running for the whole month's output of fire-irons. In the latter case, of course, the number of articles actually produced in the month would have to be ascertained and used as the basis for ascertaining their cost per hundred or per pound, whichever way we desired to express the cost.

By the plan of charging costs to order numbers, we may in fact, obtain costs of any quantity of any product, such quantity varying from the whole month's output of one product, down to lots of any quantity, even a single article. But it should be remembered that if an order is made out to cost the whole output of a product, or for very large lots which may require the whole month or even more than a month to complete, no light is shown on any intermediate *variations* in the cost of production, nor, in practice, can such information be subse-

quently obtained. By making out orders for small lots, the cost of one such lot can be compared with the cost of a similar lot made at another time, and thus a close control over the efficiency of production maintained.

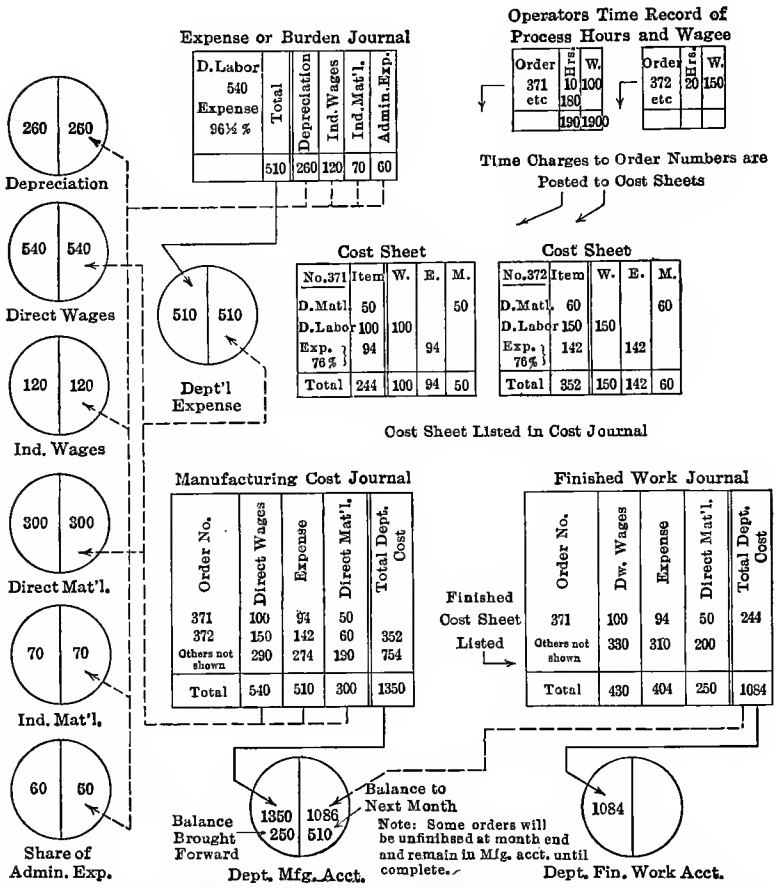


FIG. 15.—Costing on Method B. Direct labor charged to order numbers. Expense averaged and pro-rated over Direct labor.

NOTE: An order number may represent the whole output of one product, or definite lots or quantities of product.

For the purposes of the accountant, the larger the quantities of product dealt with in one order the simpler and easier is his work. But the manufacturer uses costs for other purposes than accounting, and control of efficiency is one of them. The

selection of the unit quantity, and therefore the form of order, is not a matter which rests wholly with the accountant. On the other hand, the device of issuing lot orders is indicated whenever the lots vary slightly among themselves, as for example in lots of shoes or of switch parts, each lot representing a special pattern slightly differing from the previous one, or from the standard pattern made in bulk on a whole product order.

However the orders are subdivided into lots the important point to observe is that the whole field of production in any department is occupied by work on orders of one kind or other. This being the case, it follows that under Method B, where operative labor is charged direct to order numbers, each operative will have to charge *all* of his time to one or more orders. In Fig. 15, therefore, which exhibits the method of costing on Method B, the first stage is that of the operatives' Time Sheets, on which the whole of his working time is allocated to one or other of the various orders running in the department. This time, when extended into money value, is posted to the corresponding Cost Sheets, each of which represents a single order number.

Direct material used on an order is also posted to the corresponding Cost Sheet. We have then all the components of the cost of each order, except expense.

Expense, it will be remembered, is aggregated and charged to order numbers either as a percentage on direct labor or as an hourly charge for each process-hour. Before this can be done, the whole amount of expense must be ascertained, and its ratio to the whole amount of operatives' wages (*i.e.* direct labor) worked out. Or if the hourly plan is to be followed, the total number of process-hours worked must be found, and divided into the expense total in order to ascertain the hourly "burden."

The Expense or Burden Journal serves to collect expense into one total and also to credit Depreciation, Indirect Wages, Indirect Material, and other departmental expense ledger accounts. The total is charged to a new account, viz., Departmental Expense or Burden. It is the total now standing to the debit of this latter account that has to be prorated over direct labor or charged to costs on the basis of an hourly burden rate.

To ascertain the amount of direct labor or of process-hours in the Cost Sheets, they are listed in series. This is conveniently done in the Manufacturing Cost Journal, since we shall then be

able to use the totals for charging and crediting ledger accounts as well as prorating expense. The particulars entered are as follows:

Order No. Direct Wages. Expense. Direct Matl. Total. The column headed expense is left blank at first entry, since we have as yet nothing to put in it. When all the Cost Sheets have been entered and the wages column totaled and agreed with the balance in the Direct Wages ledger account, and when the same has been done for direct material, we are then ready to fill out the blank expense column by calculating what portion of expense is chargeable against each order number.

As the total of expense in $510 and the total of direct wages is $540, this can be expressed by saying that expense is 94½ per cent. of direct wages. Consequently, if we take the first entry shown, namely Order No. 371 with a direct wages charge of $100, then we may enter the blank expense column with 94½ per cent. of this, or say $94, as the amount of expense properly chargeable against Order 371. The next entry is Order 372, with a direct labor charge of $150. 94½ per cent. of this is $142, which we accordinglyenter as the expense charge against Order 371. And so with the remaining orders.

When all the order numbers have been thus treated, the total of the expense column will be $510, or in other words, all the expense will have been successfully prorated over direct wages on orders.

The Cost Journal being now totaled up, postings to ledger accounts may be made. Credits are: Direct Wages $540, Departmental Expense $510, Direct Material $300; while on the other hand, a charge is made to Departmental Manufacturing account of $1,350, which represents the total departmental cost of all the orders for the month, including direct wages, direct material, and each order's percentage of the expense.

It will be noticed that the effect of all these operations, namely a charge to Manufacturing account of $1,350 is precisely the same as was obtained in Fig. 14. Commencing with the same cost elements we have arrived at the same results. This is, of course, inevitable, since $1,350 represents the total work of the department in producing goods. But, on the other hand, the manner in which this total is divided among the cost accounts is wholly different. In the former case material was charged direct, and

all wages and other expenses merged in one total and charged out to Orders on a basis of the cost of a process-hour. In the latter case material is also charged direct, but so are direct wages, and the remaining expense is charged in proportion to wages.

Costs of a particular order under these two methods (A and B) will be the same only if the amount of wages earned by the operative in 1 hr. are equal, as well as the number of hours. The average value of an hour was shown to be about 5¼ cts. on Method A, and this remains the same on Method B, though now split up into two parts, viz.: the hour of direct wages, and the hour of expense; but these two together necessarily make up the total hour at 5¼ cts. as before. But we must now suppose that a certain order was worked on piecework. In this case the hour of direct wages would no longer be worth only 2.7 cts., but perhaps 3 or 3½ cts., and as expense is prorated in proportion to direct wages, then the rate of expense per hour would, for that order, rise also. The same would happen if instead of all operatives doing the same class of work being paid alike, there existed different degrees of skill among them, which differences of skill were recognized by differences in wage rates. An hour's work of the higher-paid operative would cost more than 2.7 cts., and on the other hand some of the operatives would probably be below the former average and their hour's work would cost less than 2.7 cts.

All this can be summed up by saying that though in the instances exhibited, the total output of the shop has cost the same, yet as regards individual orders some are above and some below the cost found by Method A, simply because that was an average cost. Method A would be correct, and Method B would give no different results in costing orders provided that the condition postulated for the application of Method A were present. But if they were not present, and if different wage rates were paid in the shop, or different rates of earnings were possible owing to some piecework or bonus arrangement, then Method A would not give correct results, but Method B would give much nearer results. That is, Method B would be correct as to direct labor and direct material, but would still probably not be exact as to expense.

Little need be said as to the variation of Method B already mentioned, wherein the expense is prorated to Orders not on the

basis of direct wages, but on the bases of process-hours. The only additional mechanism necessary to apply this variation would be the provision of columns alongside the direct wages columns, both in the Cost Sheets and the Cost Journal, in which columns would be entered the number of hours worked by the operative of each order. The total expense for the department would then be divided by the total process-hours as shown by totaling the new column in the Cost Journal, and the value of a process-hour in terms of expense thus found. In the case exhibit it would be \$510, 2,000 hr., 2½ cts. per hour. Then each entry in the Cost Journal would be extended at this rate, and the expense entered in the proper column as before. Under some conditions this method would bring slightly more correct results than the other, particularly where the system of piecework was in use. But it does not remove any of the objections to the use of Method B mentioned at the beginning of this chapter.

So far we have considered only the costing of orders. That is to say that the arrangements hitherto described provide the cost of an order as a whole, without considering whether it is made up of a single part or several parts. We can, however, on Method B in either of its variations, do more than this. Suppose that an order is for sets of fire-irons, each set consisting of poker, tongs and fire-shovel. Then if we issue an order for 5,000 sets, we shall get the cost in a lump sum without detail. But by the additional device of component numbers or part numbers, we can get the record in as great detail as we desire.

If the order number for the 5,000 sets is No. 378, then we may call 378/1 pokers, 378/2 tongs and 378/3 fire-shovels. If now, the operatives charge their time accordingly, we shall be able at some convenient time to collect all the items charged to 378/1 and so ascertain separately the cost of 5,000 pokers. The process is, of course, repeated with regard to /2 and /3.

Further, suppose that in making pokers in the department under discussion, they went through three separate processes, it will not be difficult to analyze the time record so as to disclose how much of the cost was due to say, filing, grinding and polishing respectively. The actual mechanism for doing this need not be described now, but it will easily be seen that if we know what work each individual man is doing, all the data for such an analysis are present. The cost of Order No. 378 could, therefore, now be presented in the following shape:

COST OF ORDER NO. 378 FOR 5,000 SETS FIRE-IRONS

	Dir. labor	Expense	Dir. mat'l	Total	
378/1 for 5,000 pokers:					
Filing	120	96	....	216	
Grinding	130	104	....	234	
Polishing	200	160	....	360	
Total for 378/1	450	360	....	810	Each 16¼ cts.
378/2 for 5,000 pairs tongs:					
Filing	140	112	....	252	
Grinding	150	120	....	270	
Polishing	300	240	....	540	
Total for 378/2	590	472	....	1,062	Each 21¼ cts.
378/3 for 5,000 shovels:					
Grinding	90	72	....	162	
Polishing	500	400	....	900	
Total for 378/3	590	472	....	1,062	Each 21¼ cts.
Grand total for 378	1,630	1,304	....	2,934	58¾ cts. per set

Expense rate = 80 per cent. of direct wages. No material charged.

In this example it is assumed that no material is chargeable by this department, but that process work, namely, filing, grinding and polishing is done by it on blanks received from another department. The total cost of the order is $2,934, equal to 58¾ cts. per set of articles. By the analysis shown, however, we see that the pokers cost 16¼ cts. each, the tongs 21¼ cts. each and the shovels also 21¼ cts. each. On examining the detail of the last figures we observe that though the total process-cost of each is the same, it is very differently made up. Tongs have three processes and shovels only two, and we see that the polishing process in the case of shovels forms a very important item of cost.

This table is already a very detailed statement of the cost of Order 378, but we can extract yet further information from the figures:

Process-cost of pokers:

Filing	4.32 cts. each
Grinding	4.68 cts. each
Polishing	7.20 cts. each

Process-cost of tongs:

Filing	5.04 cts. each
Grinding	5.40 cts. each
Polishing	10.80 cts. each

Process-cost of shovels:

Grinding	3.24 cts. each
Polishing	21.24 cts. each

Further than this it is not possible to go under ordinary circumstances. Yet it is obvious that other information might be desired. For example, a poker has three portions, the knob, the stem and the iron or prod. We might find it advantageous to know what it cost us for process work on each of these portions separately. This could be done without much difficulty if the operative were instructed to note the part he was working on, so that he would record his time as on "Order 378/1, Polishing, Knob," and so forth.

It will be readily understood that all this detail has very little necessity for commercial accounting purposes. If the fire-irons are always sold in unbroken sets of poker, tongs and fire-shovel, then the accountant would have no interest in knowing any detail at all. The figure of $2,934 for 5,000 sets would alone interest him, since from this he obtains the cost per set, and so is able to credit Manufacturing account with finished work. Later on he will also require the same cost per set for sales purposes, but at no point will he be interested in the cost of pokers, tongs and shovels separately, still less in the process costs of grinding, filing, etc.

The value of such detail is, however, very great to those who are responsible for manufacturing operations, and a frequent source of the friction that arises over cost systems is the inability of the acountant to perceive the importance of such detail to others, and particularly of the importance of providing it *with exceeding promptness.* Technical detail of this kind is next to valueless if not available for discussion while the circumstances are fresh in everyone's mind.

We have now to consider the crediting of Manufacturing

account with the value at cost of finished work. The Cost Sheets now provide the data by which the cost of any finished order is ascertained. As each order is finished it is entered in the Finished Work Journal (see Fig. 15) and the total of all finished orders for the month credited to Manufacturing account and charged to Finished Work account. It is sometimes thought well to rule the ledger accounts for manufacturing and finished work with columns for direct labor, direct material and expense. In this case postings from both the Cost Journal and the Finished Goods Journal are made in the same form.

Only one Finished Work account is shown in Fig. 15, though more than one can be used if it is desired to keep two or more lines of product distinct. Generally, where several lines of product are running at one time, an account for each separate line of product is desirable.

When orders are introduced for definite quantities it will almost inevitably happen that some of them will be unfinished at the month end, and will consequently not be transferred to Finished Work account. This implies that there will be a balance in Manufacturing account of a varying amount at each month end. This balance will be represented by Cost Sheets still in hand in the department and the balance should be checked with the total of Cost Sheets remaining on hand.

When one of the orders represented by such Cost Sheets is completed, it will of course be charged to Finished Work, credited to Manufacturing account, and withdrawn from the current file of orders in hand, just in the same way as if it had been finished during the month in which it had first been put in hand.

CHAPTER VII

COSTING ON METHOD C

The two methods of costing hitherto discussed are both dependent on averaging at some point. In Method A all elements of departmental cost (excluding direct material) are thrown into one sum, and then spread over product on the basis of an average cost—either an average *monthly* cost or an average *hourly* cost as the case may be. In Method B while direct material and direct labor are both charged to the actual items of product to which they naturally belong, expense on the other hand is thrown into one lump sum and averaged over all product on one of two bases. Sometimes this basis is a simple percentage distribution of expense in proportion to the amount of direct labor already charged to the product, and sometimes the average cost of an expense-hour is calculated, and expense is charged to Product according to the number of process-hours involved in its production.

We may sum up these two methods by saying that in the first, *both labor and expense are averaged* over product on a time basis, and that in the second, *expense is averaged* over product on a time basis. It becomes evident that a third method is desirable, namely one in which *no averaging at all* is made use of, but both labor and expense should be charged to Production exactly as and when incurred by each order or process. Such a method was worked out by the author in 1901, and is known as the "Scientific Machine Rate" method. It will now be discussed as:

Method C: Material, Labor and Expense all Charged Direct to Product, As and When Incurred.—The mechanism for charging direct material and direct labor to Orders is the same in this method as in Method B. The special feature of Method C is in its treatment of the various items of expense, and the way in which charges for expense elements are made to Orders, on the one hand, and to an undistributed expense account on the other. For a valuable feature of the production factor and machine rate method is the power it furnishes of distinguishing between

expense actually and usefully applied to production, and expense that is wasted and contributes nothing to production, owing to part of the departmental equipment being idle.

The principle on which Method C is founded is a simple one. Expense is incurred for the purpose of running the machines or other production centers of the department, because manufacturing consists of two main actions: first, the application of operative (direct) labor to product; and secondly, the application of equipment, supervision, etc., by aid of which such direct labor is applied to product. No labor works on product with its hands alone, always tools, and in modern manufacturing machines are generally employed. In some cases, even, and these are increasing in number every day, the rôle of labor is subsidiary to the rôle of the machine—that is to say that labor does not contribute any special skill or experience, but acts rather as an accessory to the machine, as in the instance of automatic machines of various classes.

But *if expense is incurred for the purpose of running machines, there ought to be some connection between its amount and the duty of any given machine.* A simple illustration is that of power. The whole charge to the department for power is obviously connected intimately with the power-using capacity of the individual machines. Now if all the machines consume the same amount of power, then it is obvious that a uniform or. average hourly rate for power might be made to all product, on whatever machine it happened to be processed. But if, on the other hand, it should happen that all machines do not consume the same amount of power, but that some consume say 12 hp. per hour, and others only ½ hp., then an average charge for power becomes misleading. Here then is an example where the averaging of an expense detail leads to very incorrect results, while at the same time the way to rectify this incorrectness is pointed out. Instead of making an average charge for power, it would be desirable to ascertain what is the hourly consumption of each machine and then charge Orders with the power actually used in working on them.

Thus, if one order is processed at a machine taking 12 hp. per hour, at a cost of say 2 cts. per horsepower, then if the work has taken 3 hr. we have a legitimate charge against that order of $12 \times 2 \times 3 = 72$ cts. And if another order has been processed on a machine taking only ½ hp. per hour, and the work has

taken 3 hr. also, then we have $0.5 \times 2 \times 3 = 3$ cts.—no inconsiderable difference in the cost of the work for power alone.

Under the percentage method (B) both these orders would have been charged alike with an average cost for power (included and disguised in the expense total) which might have been at the rate of 5 cts. an hour for any machine. This would give for the first order $5 \times 3 = 15$ cts. cost for power, etc., and for the second order $5 \times 3 = 15$ cts. for power also. In the first case the charge would be 57 cts. too little, and in the second case 12 cts. too much.

Of course, on Method B no separate charge is made for power, which is merged in the conglomeration of items that go to make up expense, but if an analysis were made of such expense we should find it made up of a number of items, including power, which were distributed and averaged over product on just such an unsatisfactory plan as that here exhibited. The peculiarity of Method C is that it discards the usual classification of the cost components into direct material, direct labor and expense or burden, and in place of expense it substitutes production factors (of which power is one) and ascertains with considerable exactness the connection of each of these factors with the cost of running individual machines. The demonstration just made of the erroneous results arising from the averaging method as applied to power could be, if space permitted, extended to show that other factors were subject to the same errors when included in a lump sum of expense and averaged.

In the three methods of costing (A, B and C) there are three stages of inquiry and answer as to the direct charges made to Product. In the first method (A) we ask:

What is this direct material used for? and the answer is given that more of it is used for one kind of product or one order and less for another kind of product or another order.

In the second method (B) we extend the range of our inquiries, and ask two questions:

What is this direct material used for?

What is this direct labor used for?

the answer to both queries being the same, namely, that more of each item is used for this order and less for that, or more for this product and less for that.

In the third method (C) we extend the range of our inquiries

still further, and this time take in the whole of the components of departmental cost. We ask three questions:

What is this direct material used for?

What is this direct labor used for?

What is this expense incurred for?

and the answer to all three queries is the same, namely, that all three of the items have individual relations to each order. Further we are enabled to state that, under given conditions, certain portions of the expense have relation to no order at all, or in other words have not entered into production, but have been wasted.

It will be readily understood that Method C, involving as it does a careful tracing of the incidence of every different class of expense, is by no means so "simple" to set up as the other two methods. The simplicity of all three methods is, in fact, in inverse proportion to their accuracy when we apply them to complex conditions. There are cases in which both A and B give accurate results, but when machinery of varying capacity comes into use in an industry, and orders may be worked on now by large, expensive and high-power machines and again by small, cheap and low-power machines, then the conditions themselves are complex. Complex conditions necessarily involve complex solutions if we are really to get accurate results, and not merely inaccurate averages. In point of working, when once the system is set up, there is not much difference between B and C, especially where the hourly-burden variety of B is used for comparison.

Figure 16 exhibits the mechanism necessary *to establish* Method C. Fig. 17 shows the *routine working* of this method in costing orders. It will be noticed that while Fig. 16 is entirely different to anything yet considered, Fig. 17 on the other hand differs but little from previous figures illustrating the working of methods A and B. It will, of course, be understood that in this chapter no attempt is made to detail the methods by which the analysis of the various factors is carried out in practice, but only to show the general outline of the principles involved. The practical application of the method will be dealt with in the second portion of this work.

To begin with we have, as before, certain accounts which contain the whole of the cost components chargeable against the department. We exclude consideration of direct material and direct labor, since these are charged to individual orders, and confine ourselves to understanding how expense is so handled

that it finds itself finally charged to individual orders in the amount which each order *has logically and actually incurred.*

The principle of **standardization** comes into play at this point. Our charges to Product are made through hourly machine rates, but these rates are standard rates, which represent the cost of running the machine for 1 hr. under standard and favorable conditions. This is a matter that does not arise from any particular month's accounts, but is determined on a basis of estimate as to how the normal expenditure of the shop, (when the shop is running full time) divided into factors, contributes to the running of each machine.

In Fig. 16 a very general idea is given of the method by which machine rates are determined. First, all the normal expense of the department is tabulated, and analyzed into production factors. Then a list of machines is made, and each production factor is allocated between the different machines on appropriate bases. The total found allocated against each machine when all the production factors have been dealt with, is the individual cost of running machines. This amount, divided by the number of working hours in the period for which the calculation has been made (usually machine rates are based on one year's expense) gives an hourly machine rate, which is the amount that is chargeable to Orders for the use of the machine (Fig. 16*A*).

The machine rates are so adjusted that when all the machines are working "full" time, then all the expense chargeable against the department is distributed over the orders that have been worked on. But it will readily occur to everyone that in the course of a month, it may not have been possible to keep all the machines full of work. In some cases this is inevitable, as for example, such machines as are subsidiary to others, and have an output greater than any possible use for it. In such cases "full" time is considered to be the normal time of use of such machines. For example, if we have a subsidiary machine, such as an envelope gummer, serving six folding machines, and of such a capacity that to keep all the folding machines full of work, it need only be run 75 per cent. of the working time of the department, then the "full" time of such a machine is fixed at 75 per cent. of the "full" time of the folding machines that it serves. Of course, should at any time, more folding machines be installed, the "full" time of the gumming machine would be increased proportionally.

In other cases, this principle of curtailing the "full" time of a machine does not apply. If we have 30 milling machines, and during a slack period six of them are idle, that is a totally different matter. The whole 30 could be used if we had work for them. It might even happen that there was really enough work in the shop, but that owing to bad planning one-fifth of the "full" time of the 30 machines was left unused. Both these latter cases are similar in effect. *They imply wasted opportunities.* But neglect or inability to employ opportunity to the full should not be visited on the work actually performed. In other words, *the cost of idle machines should be separated from the process-cost of work.*

This is a most important matter from the viewpoint of estimating. Suppose we have a job that takes the "full" time of three of our milling machines for a month, and let us assume that the hourly machine rate of each of these particular milling machines is 25 cts. an hour, and further that the working hours are 200 a month. Then the actual process-cost[1] of doing the work is:

$$3 \times 0.25 \times 200 = \$150.$$

Now supposing that by some unfortunate circumstance we could provide no other work at all in the shop, and that all other machines were closed down. Let us suppose that the 27 milling machines not occupied on the above order, absorbed at various hourly machine rates when working "full" time, $1,080. What was the cost of doing the work on the three machines that were busy?

Is it $150 or is it $150 + $1,080 = $1,230?

On the percentage method (B) the latter is the answer that would be given. On that method, all the expense is discharged on to the jobs that have been actually worked. If only three machines had been at work, then the orders worked on at those three machines would have to bear the burden of the *whole* expense of the shop. From the merely accounting viewpoint that is a sufficiently good answer, since the $1,080 has to be taken out of Manufacturing account somehow, and the easiest way to get it out is to let it cling to the skirts of whatever work has been executed in the shop. In one sense it does represent

[1] Direct material and labor are excluded from this discussion in order to bring out the facts as to expense into clear relief.

the cost of manufacture of the department output. The money $1,230 has been *spent*, and only three machines' output has *resulted*. This output has, therefore, "cost" $1,230.

The practical fallacy underlying this method is exhibited by the question, "By whom should this cost be borne?"

Obviously it is not the customer who has lost the money which has been wasted through the fact that we have not enough work to fill the shops. He will not expect to pay more because we have been commercially unlucky or inefficient. If more work of the same class is offered to us while our shops are still in the same condition, would it be wise to quote $1,230 for the work? The answer is obvious. If we did so, we should lose the order.

On Method B, there is no way out of this dilemma, because it is not possible by that method to arrange any accurate division between expense legitimately incurred on a particular job and that portion of the percentage which is due to idle machines. It has been suggested that a "normal" or "minimum" percentage might be set up and used for estimating purposes, but this is only possible when conditions obtain under which Method B is in itself a correct costing method. To apply the principle of a "normal" percentage rate to all work indiscriminately would be fallacious, unless all machines were of the same size, value and power consumption.

It is evident that the correct answer to the question is that the increased "cost" must be borne by the firm itself. It must be deducted in the end, and by some convenient mechanism, from the firm's own profit. This is, of course, what happens if we leave it in cost, and that is why accountants look with so much favor on the plan. By putting into cost of an order the wasted expense that has been incurred in a shop, Profit is automatically reduced without any further attention from the accountant. Unfortunately, however, it is the *wrong* profit that is thus reduced, and orders that are in reality very profitable may be made to show a narrow margin of profit or even a loss.

When several machines in a shop stand idle, it is *not the profit of any particular order* that should be reduced, but the general profit of the whole business, or at utmost the profit of the department in which the loss was incurred, if the business is organized on a basis of profit-making departments.

Method C enables this to be effected. The cost of doing the job above mentioned will always be $150, whether the shop

is busy or slack. Consequently we always know what to bid on similar work. The question then arises, What becomes of the $1,080 which has been wasted through the unfortunate fact that we have had insufficient work to fill the shop?

There are two ways of disposing of it. Either way deducts it from profit in the end. It may be charged at once to Profit and Loss account and thus deducted directly from profit, or we may do something which brings up the individual cost to a figure similar in form to that which would be reached on Method B, viz., by striking a ratio between the actual expense cost of jobs and the total of wasted expense, thus:

Legitimate expense on work	$180
Wasted expense	1,080
Total	$1,230

Wasted expense = 600 per cent. on cost of work.

Having ascertained what percentage to add to the legitimate cost of the work in order to absorb the whole of the department expense, we may proceed to prorate over actual jobs so as to show cost in two divisions, namely:

Cost of job	$180
600 per cent. on cost of job	1,080
Total cost of job	$1,230

In order to give a clearer idea of this method in its full bearing on the cost of orders we will assume that the $180 work is really made up of three distinct orders, costing respectively, for machine rates, $60, $90 and $30. It will be assumed that this is merely a machining job for a customer and, therefore, that there is no charge to be made for direct material. Direct labor is day work, and is respectively $50, $75 and $25 for each job. The total expense for the shop is as before $1,230.

Costs may then be stated as follows:

	Order 678	Order 679	Order 680	Total
Direct labor	$50	$75	$25	$150
Machine rates	60	90	30	180
True cost of work	$110	$165	$55	$330

Undistributed expense $1,080 = 600 per cent. on expense distributed to jobs through machine rates. This is called "Supplementary Rate."

Supplementary rate on above jobs	$300	$540	$180	$1,080
Apparent shop cost.....	$470	$705	$235	$1,410

Now it will be clear that (neglecting selling expense) a fair profit on the orders would be made by charging:

Sale price.....	$147	$220	$73	
Real profit.....25 per cent.	25 per cent.	25 per cent.	on sale price	
Apparent loss.....	$323	$485	$162	

This is, of course, an exaggerated case, but for that very reason shows the importance of keeping undistributed or wasted expense clear from the cost of orders.

It will be seen that by this method we have two costs for each order, namely:

True shop cost of doing the work.

Apparent shop cost of the order.

The latter cost is true cost *plus a percentage to represent a proportionate share of the wasted manufacturing capacity* that has been incurred in the shop owing to the fact that there was not enough work to keep all the machines employed.

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. But if instead of three machines being at work and 27 idle, 27 machines were at work and only three idle, the difference between true and apparent cost would not be so striking, and there would in fact be nothing on the face of the figures to show their falsity. Yet they would still be false and misleading, if we took apparent cost as a basis for bidding on work.

It may be asked 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; secondly, there is a certain amount of danger of establishing a precedent to the effect that departmental expense can be written off to Profit and Loss; thirdly, there is a distinct advantage in having the whole story told in respect to each order, viz., its true shop cost and the in-

crease on this which is due to failure to keep machines supplied with work. Because it must not be forgotten that this supplementary rate is due to idle machines *whatever the cause.* In most cases the cause will be want of work, but it might quite easily be want of management, and inefficiency in distributing what work was actually in the shop. For this latter reason alone it is undesirable to make a practice of writing off undistributed expense to Profit and Loss. Such a condition should be called to attention all along the line, not hidden away. By making a supplementary distribution to Orders, the fact of wasted expense is kept prominently before everyone. At the

ITEM	TOTAL	BLDG'S	POWER	STORES TRANS.	SUP.	ORG'N	MACH.
Depreciation							
Repairs							
Cleaning							
Storekeeping							
Cranemen &c							
Supervision							
Clerks							
Stationery							
Messengers							
Light & Heat							
Power etc							
TOTALS							

FIG. 16.—Analysis of expense into production factors.

same the true cost of the work is also shown, and it is clearly seen whether the individual order was profitable or not, even though the slackness of business should have overwhelmed that profit by a general loss due to expense that has been wasted. This question is further discussed in Chap. XIX (Part II).

Figure 16 shows an outline of the mechanism by which machine rates are settled. To begin with, all the expense legitimately chargeable to the department for a certain period, usually one year, is listed in considerable detail Then item by item, the question is asked, "For what is this expense incurred?" Thus, for example, when the item of depreciation is under discussion it will be found that part of it is due to the capital invested in

buildings, part to that invested in power transmission gear, motors, etc., in the shop, part to investment in cranes, stores fittings, scales, etc., and the remainder, probably, all to the productive machinery itself. The amounts chargeable against these several divisions or "production factors" having been calculated, the columns are entered up accordingly.

Other items of expense are dealt with in a similar way. In practice it will be found that every legitimate item of departmental expense will be chargeable in an exact amount to one or other of the production factors, after a little investigation. When all the items of expense have been thus allocated, the columns are totaled, and the yearly charge for each production factor is then known.

The next step is to ascertain what amount of each factor

FACTOR	BASIS OF DISTRIBUTION	TOTAL	MACHINES								
Buildings	Space										
Power	H.P.used										
Stores Tpt.	by use										
Supervision	as incurred										
Organization	Equal										
Machines	Individual										
	TOTAL										
	HOURLY RATE										

FIG. 16A.—Analysis of production factors into individual machine rates.

is chargeable to individual machines. To begin with certain data with regard to each machine are accumulated, viz.:

The working space it occupies.

The horsepower it consumes.

What cranes or other transport appliances serve it.

How is it grouped as regards supervision.

Its capital or investment value (purchase and installation price).

On these data as bases the distribution of the amounts collected under each production factor can then proceed.

1. The buildings factor, including all expense for the upkeep and maintenance of the building, and its lighting, heating, cleaning and repair, is reduced to a square foot basis. Thus, if the buildings factor is $4,000 and there are 2,000 sq. ft. in use by machines in the department, then the space charge

is $2 per square foot. As the number of square feet working space occupied by each machine is known, the charge against individual machines for buildings factor is easily calculated.

2. The power factor is similarly allocated on the basis of the horsepower consumed by each machine.

3. The stores-transport factor is allocated by finding out which machines call on which cranes or other transport appliances, and adjusting their charges accordingly. A charge for storekeeping and yard service to each machine according to the character of the work it handles can also be made.

4. The supervision factor is allocated to machines on a per capita basis, unless certain machines have sub-foremen over them, in which case such machines are, of course, charged with the cost of such supervision, as well as bearing their share of the general supervision.

5. The organization factor, including cost of clerical work, stationery, messengers and so forth, is allocated to machines on a per capita basis, unless there is special reason to load it on certain machines more than on others owing to the character of the work they perform, such as special lines of product requiring greater fuss and attention on the part of the organization staff.

6. The machinery factor is allocated on the capital investment value of each machine. It includes depreciation, repairs and cost of oiling and keeping machines in working order. The depreciation charge is based, of course, on the proper depreciation rate for that particular kind of machine, the repair charge on experience or judgment as to probable repairs on the average, and the maintenance charge on a set allowance for waste, oil, etc.

When all the production factors have been allocated among machines in this way, the total charge against each is divided by the working hours for the year, with the result that an hourly machine rate appears, which is the price to be charged against all orders for the use of the machine.

The foregoing is, necessarily a very brief sketch of the mechanism that is necessary to determine machine rates on Method C. More definite particulars will be given in Chaps. XIX and XX in the second part of this book. Sufficient, however, has been said to show the broad principle on which the method is based. It is that every item of expense, save and except

direct labor and direct material, can be logically connected with the working hours of productive machines. On a former page it was suggested that "if expense is incurred for the purpose of running machines, there ought to be some connection between its amount and the duty of any machine." From what has just been described, it will have been seen that in actual fact there is such a connection and that by carefully considering the aim and end of each class of expense it is possible to find its money value. It will also be understood that when all the machines are working full time, then all the expense will be absorbed by Orders through the device of charging machine rates for the use of the machines themselves.

Such charges are in effect rents. In some industries, as for example, the shoe manufacturing trade, productive machines are actually rented by manufacturers instead of being purchased by them. When the rent paid for such machines includes the cost of repair and maintenance by the renters, then *the rent so paid is almost identical with the productive machinery factor* above, save, of course, that it will include an item representing profit to the owner. If now, in such an industry, the manufacturer buys his power from corporation mains, then the charge made to him *closely represents the power factor* described above. If now he were to rent premises for his work, and such rents were to include free lighting and heating, then the rent so paid *would closely agree with the building factor* above described. The factors remaining are, of course, necessarily part of the local expenses of the business and could not very well be represented by a rent paid to an outsider.

It will be seen, therefore, that this is no fanciful analysis of expense, but that it is merely the reduction of all expense to natural groupings, which are practically rents paid by the shop for certain definite kinds of SERVICES rendered. Once these factors are perceived and their money value ascertained, their further application to individual machines requires no labored argument to show its practical value.

The costing of product on Method C (Fig. 17) is on very similar lines to the percentage method shown in Fig. 15. The only differences are these:

The time on each order is taken as before, but not only direct wages but also machine charges are figured on the Time Sheet. Cost Sheets are charged accordingly. When the Cost Sheets

are listed in the Cost Journal, the total of the machine rates is ascertained and credited to the Departmental Expense account. Unless all the machines have been working full time, this credit

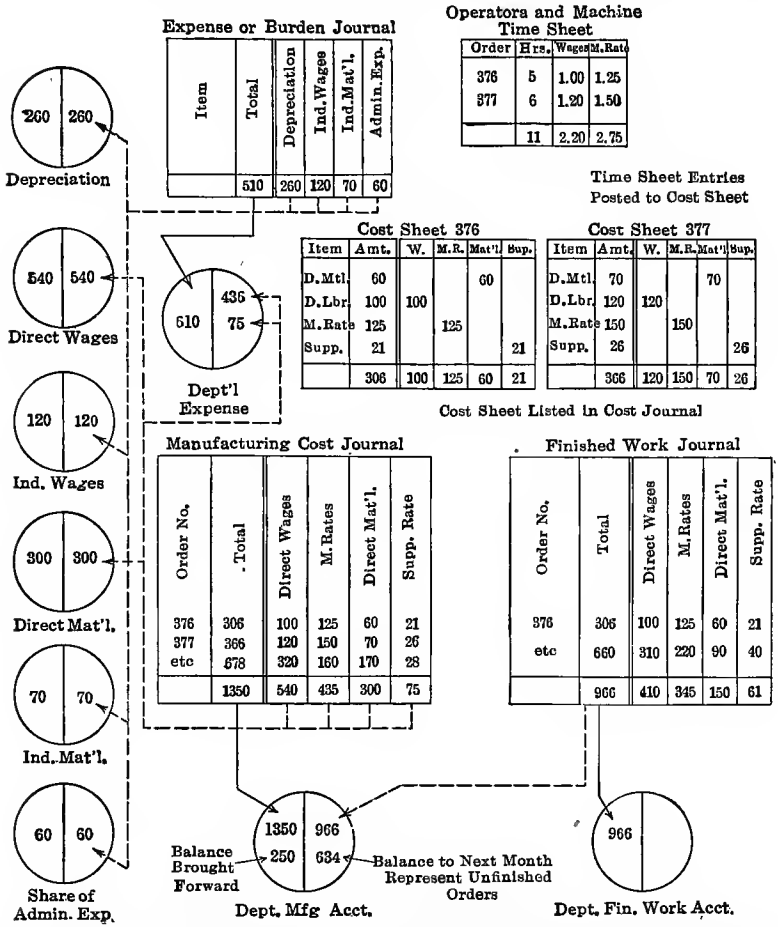


FIG. 17.—Costing on Method C. Direct labor charged to order numbers. Expense charged to order numbers through machine rates. Undistributed expense (due to idle machines or wasted manufacturing capacity) prorated over orders as supplementary rate.

will not suffice to wipe out all the amount standing against that account, but a balance will be left, representing undistributed expense (*i.e.* expense that has not been distributed to Orders by means of machine rates). The ratio between this

undistributed balance and the total of machine rates is then ascertained, and prorated over all orders in the Cost Journal in the column headed "Supplementary Rate." This prorating is, of course, also transferred to the Cost Sheets when made. In all other respects the two methods are identical in their manner of working, as will be seen by comparing the diagram Fig. 17 with that of the percentage method, Fig. 15.

CHAPTER VIII

THE FINAL STAGE OF COSTS

In the preceding chapters we have discussed the three principal methods of taking out departmental costs. In most cases, however, businesses consist of more than one department, and consequently there must be provided some mechanism for unifying or combining the various departmental costs so that the complete cost of a product or of an order can be ascertained.

There are two ways of effecting this, and the selection depends on the nature of the work. The first method is indicated where the work done by departments forms a regular series, so that, commencing with the direct material, each department performs some operation on it and forwards it to the next department. In such a case the finished cost of one department may be considered as the direct material cost of the next department.[1] When the work has passed through the whole series of departments, the final cost will obviously be the complete cost of the original raw material, plus all the work done on it by the successive departmental operations.

If there is no such regular sequence of work as this, then another method of unifying or combining departmental costs must be adopted. When, for example, sundry departments turn out portions of work which are then forwarded to a central point to be assembled or put together (machine building affords a good example) or when work passes successively, but not with unfailing uniformity, through several departments, then it becomes necessary to provide a mechanism for collecting the various departmental costs belonging to a given order, so that the complete cost of the order may be known.

If we regard the matter from the viewpoint of orders, we see that *until* the whole order is finally completed and passed into

[1] As for example, the product of a foundry, *i.e.*, castings, becomes the raw material of the machine shop. The method should only be adopted in a case similar to this, viz., where the product as made is both directly purchaseable and directly salable at that stage.

warehouse, the cost of the order at any month end may be scattered through several departments, and may represent portions of the order in various stages of completion. As long, however, as each department is charging its work to the same order number, it is evident that the whole cost of the order will at some time or other be capable of unification or collection into one total.

This, on the other hand, is hardly sufficient. We must provide methods of ascertaining, at any given moment, what is the condition of the order, and how much money has already been expended on it. Further, when the last operation has been performed on it, we should be able to cost the whole order promptly, without the necessity for consulting departmental accounts for that purpose.

In the previous chapters, the cost of production in each department was charged to a departmental Manufacturing account, and the amounts in this account were represented by Cost Sheets, in themselves representing orders. If there was at any moment $5,000 in Manufacturing account, then also there would be $5,000 on the Cost Sheets. Then as the work of the department on any order was completed the Cost Sheet was withdrawn, and entered on a Finished Work Journal, and by this means credited to Manufacturing account and charged to a departmental Finished Work account. When this is done, the department has no farther interest in that order.

While it was desirable to exhibit the clearance of orders out of departments in that way, for purposes of illustration, departmental Finished Work accounts, would be, in practice, of very little service. The balance in the departmental *Manufacturing* account is, of course, of great significance, since it shows what amount of money is locked up in the shape of work in process. But the balance in a *departmental* Finished Work account tells us nothing of significance. When an order is entered there it is already beyond the range of the department. Instead, therefore, of setting up as many Finished Work accounts as there are departments, it will be both simpler and more significant to charge all finished work from the departmental Finished Work Journal to a general Finished Work account embracing all departments. This is obviously simpler, and it is more significant because we have now one total for all work that has passed through departments. The balance in such an account will be represented by all the finished Cost Sheets from all departments.

Any given order that is in course of manufacture, therefore, is represented by Cost Sheets in two places:

1. In the departments, the corresponding cost being contained in the Manufacturing accounts of the different departments concerned.

2. In the cost office, the corresponding cost being contained in the general Finished Work account.

Now as soon as the final department has done its work on the order, and has passed the last Cost Sheet through its Finished Work Journal, then all the Cost Sheets will be in the cost office, and all the corresponding cost will be contained in the Finished Work account. By collecting Cost Sheets, we ascertain the entire cost of the order from first to last.

It may be asked why it is necessary to take the cost of an uncompleted order out of the departmental Manufacturing accounts until such time as the order is finished in all departments. The reason is that where we set up Manufacturing accounts for each department, the balance in such accounts should show with precision what is the value at cost of the unfinished work in the department itself. It is then responsible for its own shortcomings. But if the cost of work really finished were to be left in the departmental account until other departments had done their share of work on the order, then the balances in the Manufacturing accounts would cease to have any real significance. In such a case they might as well be consolidated into one account, which would be a general Manufacturing account for all departments together.

By the plan advocated we divide work in process into two groups: (1) Work that has been completed by a department; (2) work that is still passing through the shops, and as the latter items are kept departmentally, we are able to ascertain through which shops. In many instances the knowledge of how much work was in process in this department as compared with that department would be valuable, though from the commercial accounting viewpoint it is not of great importance.

Figure 18 shows the general idea of the mechanism just described. On the left we have four departmental Manufacturing accounts. In department *A*, the work is still in process and the Cost Sheet is, therefore, still in the department and has not yet been entered on the Finished Work Journal. In departments *B*, *C* and *D* all work on that order has been completed.

The cost, as per Cost Sheets, has, therefore, been entered on the respective Finished Work Journals, has been credited to the respective Manufacturing accounts, and charged to the general Finished Work account. The amounts thus transferred are represented by Cost Sheets withdrawn from the departments.

The final stage of costs is the assembly or collection of all the Cost Sheets belonging to a single order. In very many

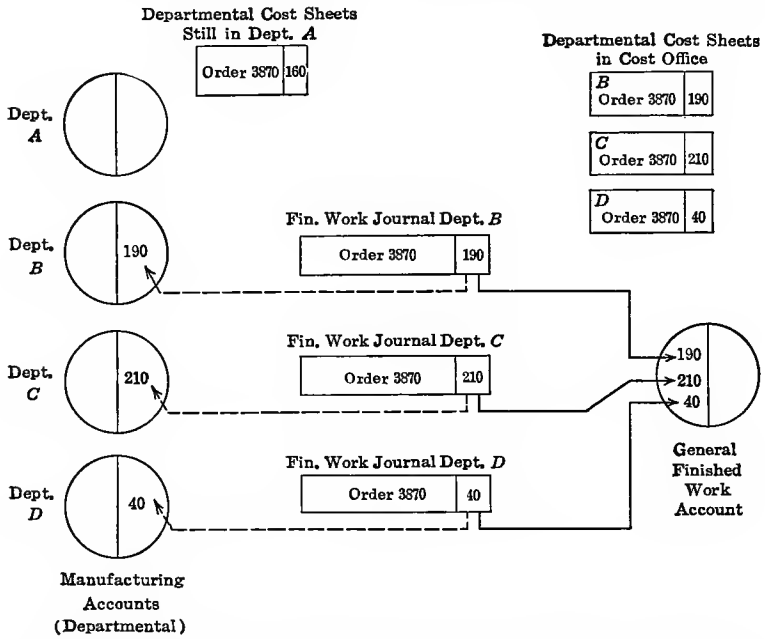


FIG. 18.—Showing four departments working on the same order. In department *A* work is still in progress. In *B*, *C*, and *D* it is completed, and its cost in these departments has been credited through the Finished Work Journal to the Department Manufacturing account. It has also been charged to the General Finished Work account. When department *A's* cost is similarly transferred, the cost of the order as a whole will be complete, and will all be represented in the General Finished Work account.

cases there is no material added in any department beyond the first department that starts the product. It is, therefore, frequently possible to eliminate all reference to direct material from the departmental accounts, leaving these to deal only with direct labor and with expense, distributed by one of the three methods described in previous chapters. In such case direct material, instead of being charged to departments, and

thence into costs will be charged direct from the Stores Issues Journal (Fig. 8) to a Material Cost Sheet kept in the cost office, and at the same time to Finished Work account. The latter will then contain: (1) All labor and expense on work completed by departments; (2) all direct material. It will readily be understood that this latter method is a "short cut," as it eliminates the passage of direct material through the intermediate stage of departmental accounts, but brings it to the same place in the end.

The final cost of an order will be:

1. Direct material.
2. Departmental direct labor.
3. Departmental expense.

When all these have been collected, and no more work remains to be done, then the factory has no further interest in the order, and our next step must be to provide mechanism to take the cost of such finished orders out of the factory system of accounts, and charge it to the selling system of accounts.

CHAPTER IX

WASTE AND SPOILAGE. SCRAP. BYPRODUCTS

Nearly all manufacturing operations are accompanied by waste and spoilage. The cause may be either inevitable or accidental, but whatever the cause, these items present some of the most annoying and complex problems with which the cost accountant has to deal.

Waste is not quite the same thing as spoilage, though the line is hard to define. Spoilage is always accidental, though a certain percentage of spoilage may be inseparable from certain kinds of work, *e.g.*, castings. Waste on the other hand arises out of the operations of manufacture itself, and though it can be foreseen, its amount is generally a variable quantity.

A good example of waste is afforded by the process of cutting shapes or blanks from sheets such as leather hides, cloth bales, metal strips or sheets, rubber, celluloid sheets, etc. In such cases there are produced out of a given sheet so many good and usable blanks and so much waste, but just how much of each depends on certain conditions. The skill of the operator, and the condition of the hide or sheet will vary to a certain degree, sufficiently so to make the output of blanks from a given number of hides or sheets a varying quantity.

In other industries, waste occurs by reason of shrinkage of material, by evaporation of moisture, by ejection of sediments, scums, and so forth, at various stages of the work.

Spoilage means imperfect work. In this case there is nearly always a loss of labor and expense as well as of material. In a lot of 50 pieces it may happen that only 45 will ultimately pass the inspector, the remainder having fallen by the way for one reason or another. Breakage, imperfect work, use of unsuitable material, faults and flaws in material are some of the usual reasons. But if this spoilage occurs midway in the process of producing the 50 pieces, then it is obvious that the time spent on the production of the spoiled ones is rendered valueless.

There are two main ways of meeting this condition. Either the whole cost of producing the lot is charged against the 45

good pieces, with a credit for the scrap value of the material thrown out; or, the missing parts may be "replaced" and the cost of replacing them charged to a Spoiled Work account.

This brings us to another problem of the cost accountant, namely, scrap. Scrap is in the nature of a byproduct of low grade. The special feature of scrap is that it is produced in the course of manufacture. The most familiar example of scrap is that produced by metal cutting tools (turnings, chips, filings). In the case of the blanks cut out of sheets, hides, etc. referred to above, scrap is also produced, but this scrap is not the waste there referred to. Such a process involves both scrap and waste—scrap in all cases, waste when the material fails to yield as many blanks as it would under favorable conditions. The scrap is what is left after all the blanks have been cut out of the sheet.

Waste has no market value. It represents either a failure to produce standard efficiency, or a shrinkage in value. Scrap, on the other hand, has generally a market value though this may be small compared with the original cost of the material. In some cases, of course, where the material itself is costly, scrap is carefully collected. Brass and copper turnings, and to a still greater extent, filings of precious metals such as silver and gold, have a value unaffected by the form in which the scrap exists.

Spoilage has value only in as far as the spoilt material can be classed as scrap. All the rest is loss. Very great values may be wiped out as spoilage by an unlucky accident. In an ordnance factory a large gun approaching completion was relegated to the scrap heap, through the workman in a moment of abstraction picking up a wrong pair of calipers, and making a cut accordingly. The gun lies on the scrap heap, carrying with it many thousands of dollars expended on it in the long series of processes—melting, casting ingots, forging, tempering, turning and boring that all but brought it safely to the final stage. The scrap value of a huge forging of this class is diminished by reason of the costly nature of the work of cutting it up into manageable proportions.

It will be seen that waste, spoilage and scrap are three separate things:

Waste is a *loss of quantity* of product, due to failure to extract the most out of material, or to inevitable conditions of manufacture.

Spoilage is the *destruction* of material already in process, and carries with it not only the value of the material spoiled, but also all the labor and expense that has been expended on it up to the time it was condemned.

Scrap is material of no use for the purpose that the original material was used for. It may arise from spoilage, as in the case cited above, but more usually it is a kind of byproduct such as cotton-waste in cotton-spinning, sprues and gates in castings, turnings and filings in metal working, the remnants of sheets from which all the possible blanks have been cut or stamped, and so forth. It should be noted that scrap from one industry is frequently the raw material of another industry. When this happens, higher prices can be obtained for such scrap than would be possible otherwise.

The distinction between waste, spoilage and scrap is important because their treatment from an accounting point of view is by no means identical.

Waste usually implies that having paid so much for a given length, weight or quantity of raw material, some of this disappears in course of manufacture, either by inferior skill, or by inevitable changes of condition, so that at the end of the series of processes we have less material than we started with. Scrap may or may not result from this loss. Once we admit that waste is inevitable, or highly probable, then it follows that the chief preoccupation of the accountant will be to observe whether it is, in any given instance, greater or less than may be reasonably expected.

This in turn opens the way to two distinct views as to regarding an increased waste. If we have carefully worked out standards of normal waste, then the excess on any particular occasion *can be ascribed to preventable causes.* In that case we may take the increased portion of cost out of the Cost Sheet (and, therefore, out of Manufacturing account) and charge it to a special Wastes account, leaving the actual cost of production of the order equivalent to, or rather identical with standard cost.

The object of doing this is twofold. First, the amount of loss due to preventable causes is ascertained separately and forms a valuable guide to the technical efficiency of the shop; secondly, standard cost is substituted for varying cost in as far as variation in the amount of waste affects it. This is of value for commercial reasons.

If there is scrap produced that has a market value, and if more of it is produced when waste is high than when it is normal, then, theoretically, the excess of scrap should be credited to the Wastes account. Unless, however, the scrap is really valuable as in the case of brass, copper, or precious metal, this is not worth doing. Scrap should, of course, be credited in all cases to Manufacture, but this is a question of *excess* scrap corresponding to *excess* waste.

Spoilage is a much more complex affair to deal with than simple waste, since it involves generally four elements: loss of material; loss of labor and of expense on work done on the material; deduction of residual or scrap value of the spoiled material; replacement of the spoiled part, and proper disposal of the cost of such replacement.

In foundry work there is a regular percentage of spoiled work, which is usually fairly constant for one class or type of casting in the same shop. As between different shops the widest variation exists as to what is regarded as a normal expectation of spoiled or "bad" castings. The simplest way of dealing with this particular case is to ignore the bad castings. That is to say that if we pour 10 tons of metal from the cupola, and get 9 tons of "good" and 1 ton of "bad" castings, then the cost of the cupola charge and of the molding labor and expense is considered to rest on the 9 tons of "good" castings.

This plan is simple, but cannot be applied in every case of spoilage. In the case of a uniform product like iron castings which are costed by the pound, it is possible to take the cost of production on the one side and over against it place whatever quantity of product good luck has actually produced. But in other cases, as, for example, in machine shops, and all industries where the product is discrete and not uniformly reducible to a cost per pound, yard, etc., wholly different methods must be employed. In such cases when a piece has been spoiled it has to be replaced, and the farther it has progressed from its starting point, the more loss there is incurred when it is spoiled.

If we have a lot of 50 pieces of brass, to be turned, bored, milled and drilled, and if five fall out at the turning stage, four while being bored, one while being milled, and two on final inspection after the drilling has been done, then it will be obvious that a complex condition exists. If we ignored the pieces that dropped out, and simply considered the 39 that survived as the product

of the whole series of processes, the cost would have but little significance, because it obviously depends on the particular number of pieces dropping out at those particular stages. If we had a second lot of 50 pieces, and six fell out while milling, and five while drilling, there would be again 39 left, but an entirely different cost would result because each piece that fell out carried an average larger amount of labor and expense with it than on the first occasion. It is evident, therefore, that the elimination plan will not work satisfactorily in such cases.

It is unfortunately the truth that to devise a really exact plan is very difficult. In the case of large lots, say 1,000 and upward, it is fairly easy, but in the case of lots in small quantities the processes on which last a long time, say several hours, it will be evident that a good deal depends on the question *at what part of the process did the spoilage occur?* Was it only just begun? Or was it nearly or quite complete? Or how far midway between these extremes? In heavy engineering work this becomes a question of some importance.

In practice the question is answered as near as possible. When a piece is condemned, a "replacement" order is issued to make a new piece *up to the point at which the spoiled piece had reached.* This is roughly indicated, thus:

"Replace cutter-bar. Turn, bore, *and mill 2 hr.*" When the operator has gone thus far on the replacement order, he turns it in, and resumes work on the original order number. By this means the cost of replacing the spoiled part is ascertained with fair accuracy. The cost of the replacement work is not charged to the original order, but is charged to a special Spoiled Work account. By this means the direct material for the replaced part, the direct labor of turning, boring and 2 hr. of milling it, with the expense or machine rates corresponding, are separated from the original order. It only remains to deduct the scrap value of the material of the spoiled part, and this is deducted from the replacement order.

A complete dovetailing is thus effected. The replacement-order cost is considered as representing the part that was originally spoiled, and the original cost of that part remains in the main order. It is true that we have taken away the spoiled part from the main order, but on the other hand *we have given back a good part at exactly the same stage of manufacture.* The cost of the misfortune is, therefore, all in the replacement order and that in

consequence is entitled to be relieved by the value of the scrap part. It is exactly the same as if the work on the replacement order had resulted in turning, and boring the part, milling it 2 hr. and then spoiling it.

Scrap is an easier matter to deal with. There are only two questions to be considered: (1) What is its value? and (2) What shall be credited with this value? The cause of the scrap must, of course, be considered. Whenever possible, credit should be to the order making the scrap. But this is rarely possible, save in the case where we are costing by whole products. A scrap coming from one kind of product should obviously not be credited to any other nor to a mixed account. Failing credit to the order we may endeavor to credit it to the material involved. Foundry sprues and gates are an example of this procedure; they are credited to the cupola "pour," and thus help to reduce the cost of "good" castings.

In many cases, neither of these methods can be used, since the scrap is no longer identifiable with any particular class of material or with any particular order. The mixed turnings in a machine shop are an example of scrap of a very general nature. In such a case, credit for scrap may be made to Profit and Loss account. It has frequently nothing to do with the particular shop in which it happens to be made. It arises from material and, therefore, becomes a byproduct giving rise to a very small but *general* revenue.

The operations of a foundry exhibit all three classes—waste, spoilage and scrap—in a very clear manner. To begin with a certain weight of materials is put into the cupola, and part of this never reappears. A shrinkage takes place that is wholly lost. The remaining weight does reappear in the form of liquid metal. In pouring the liquid metal into molds, three forms are produced: "good" castings, which are product; "bad" castings which are really spoilage; and "sprues and gates" which are necessarily produced, but are of no use. These are to be regarded as a scrap byproduct.

The way in which waste due to shrinkage is handled for accounting purposes in this case is to ignore it. But all the same its amount is noted, and reduced to a percentage which is regarded as unsatisfactory if it exceeds a certain figure. By ignoring this waste, we have:

10,480 lb. Cost of pig, fuel, etc.	10,000 lb. of liquid iron.
Cost of labor.	Waste (4.9 per cent.)
Expense.	

thus ascertaining the cost of liquid iron actually forthcoming, and ignoring that which has shrunk in process of melting.

This output of liquid iron is then charged to what results from the pouring thus:

Cost of 10,000 lb. of liquid iron.	8,000 lb. "good" castings.
	1,000 lb. "bad" castings.
	1,000 lb. sprues and gates.

The "bad" castings and the sprues and gates are credited at their scrap value, leaving the "good" castings to bear the remaining cost of the liquid iron.

In this case the spoilage is of such a nature that it has very close relation to the product that was actually extracted from the pouring. It is indistinguishable from it, since if "good" is more, "bad" is less, and *vice versa*. It is just simply a pound of iron in one form and not in another. It can be taken at once out of the total, less any residual value it may have. Sprues and gates, on the other hand, are scrap pure and simple, very similar to machine turnings. They are not interchangeable in any way with "good" castings. There might be none at all, without increasing the "good" castings by a single pound. As a by-product the only thing we have to consider with regard to them is their scrap value, and to what they should be credited—obviously to the liquid iron from which they came. When this is done, cost of production is clear of them.

To sum up the problems afforded by waste, spoilage and scrap, we may say that:

Waste is something that disappears, or else fails to appear. In the former case, what remains is usually considered as product, and its weight or amount is taken as the basis of cost. In the latter case (instanced by cutting blanks out of sheets) the possible minimum may be taken as standard, and any increased unit cost beyond this considered as preventable waste, and so charged. Or the amount actually realized may be made the basis of cost.

Spoilage is something that is destroyed after having been worked on. It usually implies loss of labor and expense as well as of material. The methods of handling it are various, but the

general principle to be observed is, if replaceable, that the cost of replacing up to the stage at which the original spoilage occurred shall be charged to a Spoiled Work account. If not replaceable, then usually the loss must fall upon the actual quantity of product that remains, less any scrap value that the spoiled material may have. This procedure, of course, increases the cost of the product that survives, and is only justifiable if it is of a very uniform character as in the case of castings cited above.

Scrap is a byproduct arising from process work, or is the result of spoilage. In either case, a value must be put on it, and this value must be credited to the source from which the scrap actually and not apparently, flows, if this source is discoverable. Otherwise it must be treated as a credit to Profit and Loss.

Byproducts.—In some cases, notably in those industries that depend on chemical changes in their material, part of the material is rejected from the main process at certain stages. If such "reject" has no commercial value, it is simply waste. As already explained, it disappears, and is of no further importance from the cost viewpoint. On the other hand, it may have a considerable commercial value. In soap-making, for example, during the process of mixing and boiling the ingredients, sundry rejections take place, some of these being run to the sewer as of no commercial value, but others are collected for the purpose of recovering one of the byproducts arising from the chemical changes that have taken place, namely glycerine.

Glycerine is not directly given off in a pure state from the soap-kettles. What is drawn off is a sweet and salty water that becomes the raw material of a fresh set of processes, ending in the recovery of so much salt, and so much pure glycerine.

In cases of this kind it will be evident that a credit must be made to Manufacturing account, for the value of the byproduct recovered, less, of course, the cost of recovery. In some cases it is possible to determine in advance the quantity of byproduct that exists in the raw material. The amount of glycerine in tallow, for example, can be thus determined. This gives the option of two methods of procedure. We may either charge the whole cost of the tallow to Soap-manufacturing account and subsequently credit the latter with the value of glycerine recovered, or we can charge the glycerine content at once to Byproduct account, and the remainder to Soap-manufacturing. In the latter

case, of course, no further credit to Manufacturing account is necessary as far as the glycerine byproduct is concerned.

Mention has been made of a salty constituent of the liquid material drawn off from the kettles. This may be used to illustrate another feature of chemical manufacture, rarely met with in other industries. The salt is actually recovered by the same series of processes that recover the glycerine. But it is not a byproduct because it does not arise from the original raw materials used for manufacture. It is added during the boiling processes, but is not intended to remain in the product. It merely serves to promote chemical changes, itself being practically unaltered. When it is recovered, therefore, it is used over again.

If the quantities used and those recovered are constant, it is clear that cost is not affected. The salt is merely carried round and round, dissolved at this stage and reappearing as a solid at a later stage. But if, as is usually the case, there is a leakage, and all the salt does not reappear, part of it escaping recovery, then Manufacturing account must be charged with new salt introduced.

It will be seen that the treatment of byproducts is practically the same as that of scrap. The main difference lies in the fact that most byproducts are subject to further processes and treatment before they assume commercial form. Two considerations have, therefore, to be kept in view: (1) crediting the Manufacturing account with the value of the reject; (2) keeping costs of the further processes necessary to put the byproduct in commercial form. Byproduct recovery is, of course, handled as a separate department, for which the raw material is the liquid or solid reject thrown out of the main process.

The question of what price to put on the reject is a very delicate one. This is the value at which credit is made to Manufacturing account, and charged to Byproduct account. It is evident that three bases of charge exist in some cases, two always. These are: (1) Manufacturing account can be credited with the sale price of the byproduct, less cost of recovery. In this case no profit can be shown by the byproduct department. (2) No price, or a merely nominal price can be placed on the reject, which is equivalent to making a present of its raw material to the byproduct department, and enabling it to show a profit. Of course, in this case the cost of the main product is increased proportionately. This method is clearly impracticable in most instances since it would make the main product unsalably high.

(3) When the amount of the byproduct content in the original raw material can be calculated (as in the case of glycerine in tallow just mentioned) then a fair price can be put on the reject, based on the relative weight of the materials as divided between main and byproduct.

Thus if we buy a ton of something, at a cost of $50, and by analysis or other means we are able to say that ultimately 44 per cent. will find its way into main product and 56 per cent. into byproduct, then it is obvious that $22 and $28 are the respective sums to be charged to main and byproduct Manufacturing accounts, for each ton of raw material purchased. Both main and byproducts are then on their own merits, and each will be able to show its own profits, unaffected by the others transactions. Of course, in such cases, careful record must be kept to ensure that the raw material does actually divide up in the proportion forecasted by the analysis.

CHAPTER X

AUXILIARY EQUIPMENT—DESIGNS, PATTERNS, MOLDS, JIGS, ETC.

In considering the manufacturing process in its general aspect, we have hitherto considered what might be called straight-line manufacturing, in which the turning out of salable product (including byproduct) is the only preoccupation of the manufacturer. The larger bulk of industry is of this character. But on the other hand, some of the most important industries, including the great engineering group in most of its branches, have to face a problem of a wholly different character to any yet discussed. Before they can proceed with the straight-line manufacture of their product, they have to provide intermediate appliances, sometimes of a very costly character, which may be considered as auxiliary equipment specialized to the point of only furnishing facilities for making one article, or perhaps usable for only one order.

From what has been already said, in previous chapters, with regard to the manner in which the cost of *anything* can be obtained (provided that a special order has been issued to which all direct material, direct labor, and expense are chargeable) it will readily be understood that the difficult nature of this problem of auxiliary equipment does not lie in the ascertainment of the cost of such equipment. The making of a drawing in the drafting department, of a pattern in the pattern shop, or of a mold or jig in the machine shop is neither more nor less difficult than the costing of a salable article. In fact any one of such articles might be made in the shops for sale to a customer without in any way changing the method of costing applicable to the case.

Moreover, to show that it is not the cost of such articles that provides the difficulty of the problem, we may take the case of a business (and such actually exist) where such articles are not produced inside the plant at all, but are purchased from the outside. The problem is not in the least simplified by this procedure.

The difficulty arises in the fact that such auxiliary equipment has, for the most part, *an indeterminate life.* That is to say, when we either make or purchase a pattern, mold, or jig, it is in very many cases an almost impossible task to determine how often it will be used, how many articles in which it will ultimately be auxiliary in production, or in extreme cases, whether after the initial use for a specific job, it will ever be used again.

If we had an order for 100 articles, and to produce such articles it were necessary to make or purchase a pattern, a mold, and two or three jigs, and if we were sure that we should never get a similar order, then the problem would be simple. We should simply charge all this auxiliary equipment up to the order itself, since all these things would need to be paid for out of the profit realized on the order. Their subsequent relegation to scrap would only interest us, in as far as there was any residual value in the materials. This value, when ascertained, we should, of course, credit to the order.

But if we obtain such an order, or still more if we are bidding on such an order, and are not at all certain whether it may not be followed by duplicate orders at a later date if we are successful in getting the first one, then ample room for indecision exists. If we charge to the estimated cost all the auxiliary appliances necessary, it may be that we shall not get the order at all. This will certainly follow if someone who already holds the trade is bidding against us, because *he* will certainly not be adding the cost of all the auxiliary appliances to every 100 articles he delivers. On the other hand, if we go on the theory that our auxiliary appliances, when made, will serve for the reproduction of 5,000 articles before they are worn out, and if, for that reason, we only add one-fiftieth of their cost to our bid, we shall make a fair price, and may succeed in getting the business. But in that case, if we do *not* subsequently receive orders, from time to time, that will ultimately amount to 5,000 articles, we shall be losing money equal in amount to the unexpended value in the appliances left on our hands.

This is the difficulty which presents itself in most cases of auxiliary equipment. The more specialized it is, the more doubtful is the solution. In some cases, where the appliance is used for the production of a kind of product that is in itself the raw material of a subsequent process, the difficulty is very

considerably diminished, since in this case, it is generally possible to make a more or less accurate forecast, barring accidents and unforeseen contingencies, of the probable life of the auxiliary item. In making steel ingots, for example, the molds used are often very large and costly, but the life of an ingot mold, that is the number of tons that it will produce before being relegated to scrap is fairly well ascertainable. Consequently, we are enabled to make a tonnage charge for the use of such auxiliary appliances as ingot molds that thus becomes part of the cost of the steel itself.

In cases of this kind, the calculation of a basis of charge for the use of the mold is not a matter for the accountant. It is a purely technical matter, depending on a knowledge of the facts. But if such knowledge is non-existent, then it may fall to the accountant to institute such records as will later furnish a basis of fact for a decision. Such a record is not, however, part of the accounting system proper.

We need not pursue the subject into greater detail. The general bearing of the problem is all that it is necessary to observe. This may be summed up as follows:

In certain industries auxiliary equipment (the things that help to make other things) is necessary. Its peculiar feature is that it is not general in application like machines, for these are used on one order after another indifferently, but auxiliary equipment is special. This specialization varies in degree down to cases in which the auxiliary appliance can be used for one specific article alone, and this may mean for one order or its subsequent duplicates, if any. As there is in many cases no positive information on the life of the appliance—that is, the number of times it will be used—the utmost caution must be taken in dealing with such auxiliary appliances. The safe plan is to charge them up to orders as soon as possible, provided that the order will bear the strain.

In all industries where orders are turned out by the use of auxiliary appliances specially made for them, the final cost of the order as disclosed by the Cost Sheet should show what has been expended for new auxiliary appliances in connection with it, even though only a portion of this expense (or none of it) has been charged up to the order.

Wherever auxiliary appliances such as patterns, molds and jigs accumulate, frequent scrutiny of their book value should

be made, so that no undue inflation of assets arises from the presence of items that have as a matter of fact no certain future use.

From the accounting viewpoint, the cost of all such auxiliary appliances, whether purchased or made in the plant itself, should be charged to special accounts as soon as they are completed. Thus we may have an account for patterns, one for molds, one for jigs, etc. Then, whatever portion of the expenditure on such items can be charged to specific orders should be so charged, and credited to the account. The remainder should be written down periodically on some basis to be settled after due consideration of all the facts. Where there are several lines of product which are being costed separately, then the auxiliary appliances should be classified in ledger accounts in the same way, thus patterns for product *A*, jigs for product *C*, etc. Loss on auxiliary appliances, through non-use, can by this means be confined to the line of product that has incurred it.

CHAPTER XI

SALES AND SELLING EXPENSE

It cannot be too strongly emphasized that the cost of manufacturing a product and the cost of selling it, are wholly distinct, and have no relation to one another whatever.

In many industries this is fairly obvious. In a large concern the factory may be in one place and the selling department in another, so that there is a physical separation of the two classes of effort. But in other industries, part of the factory organization is at times mixed up in selling operations, as in the case of a drafting room that prepares sketches or designs for submission by the selling department to a probable customer. Or men may be detached from the shops for demonstrating purposes, or to remedy defects that have developed when the goods were already in possession of the customer. In such cases there is an apparent connection between the works and the selling organization, and their relative spheres are not so clearly defined.

Further, there is always a class of expense which appears to be common both to the factory and the sales department. The salaries of the president, directors, and perhaps of a general manager, the clerks, stationery, lighting and heating of the general offices, the expenditure of postage, and petty expenses—all these seem of a very general nature, and not pertaining decidedly either to factory or selling necessities. Even when a city office attends to the selling, and is thus physically separated from the factory, these apparently common expenses may exist, and in addition, the purchasing agent, who obviously exists for the sake of the factory, may form part of the city office organization.

A little consideration will serve to show, however, that the cases are exceedingly rare when anyone of these officials is engaged at the same moment on business pertaining to the factory and to the selling department. In fact it is practically impossible that this should be so, for the two classes of transaction cannot meet. It would seem, therefore, that the apparently common nature of the expense is accidental, and arises from the fact that managers

and clerks divide their attention between factory and selling matters, in much the same way as men in the shops divide their attention between orders. And the solution of the difficulty is to provide some mechanism whereby the time devoted to factory business is separated from that devoted to selling business.

In the case of the president and the administrative officers there is indeed more room for indecision than in the case of routine workers. Correspondents, clerks and bookkeepers do definite work, which is capable of close classification, but the higher officials have large matters to deal with embracing the welfare of the business as a whole. In their case, therefore, a somewhat arbitrary classification of their activity will have to be made.

In the cases cited in the second paragraph above, where departments of the factory extend assistance to the selling arm, the charging of such activity to that arm is a simple matter of bookkeeping, provided the exact significance of each class of transaction is determined.

The first step, therefore, in organizing the mechanism of sales and selling expense is to provide a series of accounts to which all such expense can be charged. In addition to these there will be accounts containing what might be called the raw material of sales, namely, the accounts which contain the quantity and cost of the various descriptions of product as turned over by the factory for sale.

In Fig. 8 (Chap. III), typical selling expense accounts were enumerated as under:

Advertizing and Catalogues.
Salesman's Traveling Expense.
Depreciation.
Stores Used.
Selling Department Share of administrative expense:
  Rent, insurance, etc.
  Stationery.
  Salaries.
  Sundry Expense.

These accounts are not exhaustive, and in practice might be subdivided to a greater extent than shown, but unless a rigid analysis of expense items is to be undertaken for the purpose of determining how each such item was concerned in the selling of individual lines of product, as will be discussed later, there is no absolute necessity for having finely subdivided accounts. If

all selling expense is to be merged in one total and spread evenly over sales of all classes, then a few general accounts will serve the purpose.

Having thus collected all the items of selling expense and of cost of salable goods, the next step is to consider the work of the selling department with a view to determine whether all the different kinds of product are sold with the same selling effort, that is, at the same selling cost, or whether certain kinds of product really take more effort to sell, that is, cost more to sell than others.

If we find that it is the fact that some products do take more effort to sell than other kinds, then the next step is to analyze our sales expense in such a way as to determine, if possible, how much more one product costs to sell than another. In other words, we seek to express the ascertained fact that products differ in their call on the selling expense, in dollars and cents.

When the incidence of selling expense on the various products has been ascertained, we are then in a position to charge each product only with that portion of the selling expense that it may reasonably have been judged to have incurred. In the case of each product we shall then have the following data:

1. Factory cost of product.
2. Add cost of selling this product, giving **total cost of the product, sold.**
3. Deduct from selling price of product, giving **profit on this class of product.**

Ascertaining Gross Profit on Separate Classes of Product.—If our investigations go to show that no class of product absorbs more selling energy or expense than any other, then the problem is simplified. We need not go to the trouble of analyzing our selling expense to determine which items have been incurred in the effort to sell this product and which to sell that. All that we need to do is to total all the selling expense and distribute it to the different product *in proportion to the sales made of each class.* In other words, we shall charge our selling expense as so much per cent. on the dollar of sales, irrespective of whether the goods sold were kettles, tongs or fire-irons. In a large number of industries this simple method of charging selling expense will provide substantially satisfactory results. In other cases it would seriously mislead, and give rise to wholly erroneous impressions as to the real profitableness of the different lines of product.

Figure 19 illustrates this simple method of dealing with selling expense. Three different products *A*, *B* and *C* are shown but as each of them is treated alike, operations on *B* and *C* are omitted from the diagram.

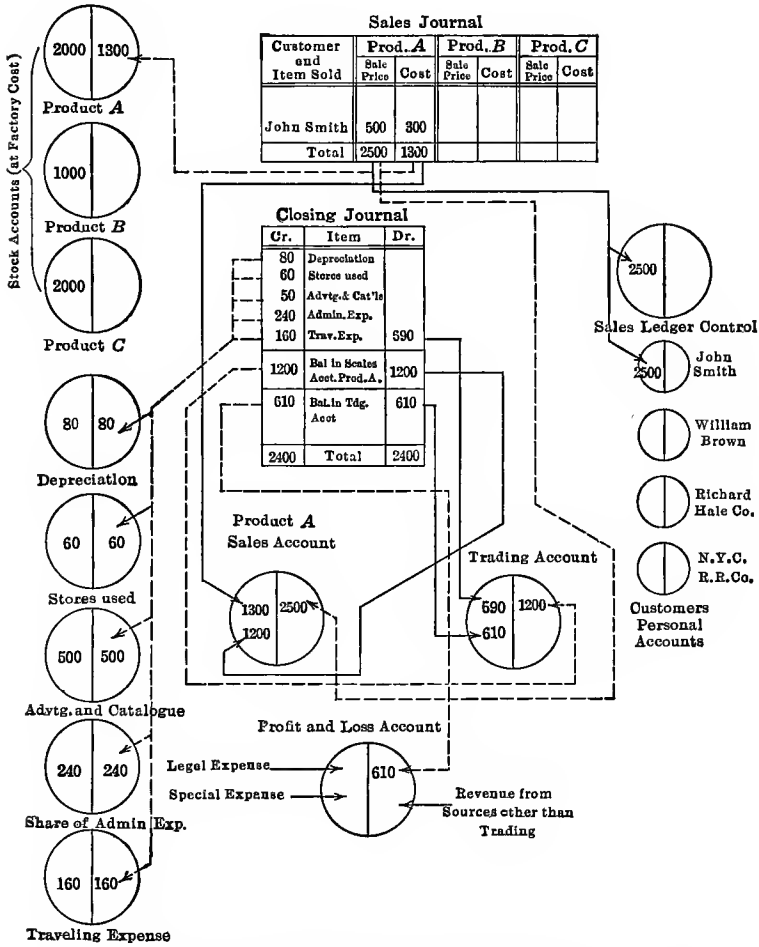


FIG. 19.—Selling expense distribution.
NOTE: Selling expense assumed to bear uniformly on all products.

The Sales Journal is ruled with double columns, providing for separate entry of transactions relating to the three products. Each sale is entered in the usual way, in the order of completion. Both the cost price at which the article stands in the

Stock account, and the sale price payable by the customer are entered against each sale. At the month end, the columns are totalled, and charged and credited as follows:

The total of the sale price column is charged to the Control account in the Sales Ledger. (The amounts of each sale are also, of course, individually posted to the customers individual accounts in the same ledger.) It is also credited to Product *A* Sales account. Then the total of the cost price column is credited to Product *A* Stock account, and charged to Product *A* Sales account. These transactions can easily be followed on the diagram.

By these postings we have taken out the "goods sold" from the Stock account (at cost price) and have charged them to the customer at sale price. The difference between cost and sale price, which represents gross profit on this class of product sold during the month, is found to be indicated in the Sales account, because we charged that with cost and credited it with sale price, consequently the balance must show the difference or gross profit.

We have next to deduct the expense of selling from this gross profit. The selling expense components having been already collected in the Selling Expense accounts (at the left of diagram), we list these in a Closing Journal. We also enter in the same journal an item representing the balance, or gross profit, in each of the product Sales accounts (only one shown, viz., product *A*). The various Expense accounts are then credited and their grand total of expense charged to Trading account. The second item on the journal, charges Sales accounts with the balances standing in them (gross profits) and credits Trading account with similar amounts, *i.e.*, it *transfers* the balances in Sales accounts to Trading account.

By doing this we have assembled all the gross profits made on products *A*, *B* and *C* in the Trading account, and against these profits have placed the total of selling expense incurred in the period. As a result the balance in Trading account will now show the net profit on trading.

A third entry in the Closing Journal now transfers this trading profit to Profit and Loss account, where it may be supplemented by other items of revenue, such as rents from workman's cottages, income from investments, etc., and over against this inclusive revenue may be set special expenses, such as the writing down of goodwill, legal expenses, or any other items that cannot be regarded as the outcome either of manufacturing or selling.

It will be observed that though the gross profit on each product was ascertained separately, when it comes to ascertaining net profit, the three products were consolidated, and selling expense set against the total. Of course, it would be possible to have three separate Trading accounts, and divide up the expense between each in proportion to the amount of sales in each account. But in this case, as each class of product is assumed to take the same amount of selling effort, the *rate* of profit on each product will necessarily be the same, and nothing would be served by keeping separate Trading accounts for each product. Every $100 worth of profit, whether made on *A*, *B* or *C*, will be diminished by the same percentage of expense. In other words, the difference of profitableness between the three profits lies in the gross profit made on each, and the expense of selling bears equally on each class alike.

This is by no means always actually the case. In many industries the expense of selling bears much more heavily on one class of product than on another. Under such circumstances the above mechanism is inadequate. Separate Trading accounts must not only be kept for each product, but the selling expense itself must be subjected to close analysis to determine a basis on which to divide it up between the different Trading accounts. This type of business must now be considered.

Ascertaining Trading Profit Separately for Different Classes of Product.—The first step must necessarily be the determination of the difference between one product and another in regard to the selling expense incurred by each. If, for example, we are making a product like tool-steel, of a class that is used exclusively by machine shops, and are also making another class of steel used only by edge-tool makers, and if we are selling both these products direct to consumers (*i.e.*, not to merchants who purchase both kinds from us), then it is not difficult to see that if we advertize in trade papers that appeal only to machine shops, and if we rely on circularizing to get our business from the edge-tool makers, then we have here two classes of selling expense, one of which is wholly confined to the first product, and the other to the second product. If again, we have one traveling man who devotes his whole time to calling on machine shops and another who calls on edge-tool plants only, then we have a fresh class of expense divisible between the two products so that each gets what it rightfully incurs. And if it should happen that

one of these products was sold among a class of small users of no great financial stability, so that a higher percentage of bad debts was incurred in the sales of this product than of the other, then again it would be manifestly unjust to allow the latter product to bear any of the loss due to the peculiar circumstances attending our transactions in the other.

These examples could be multiplied, but sufficient have been given to show the principle involved. Every item of selling expense must be scrutinized with a view to asking, "Is this expense incurred for the sale of any particular class of product?" If it is, then it must be included in the total chargeable against transactions in that product. When all the various items have been analyzed in this way there will always be a residuum that cannot be so analyzed, such, for example, as the salary of the sales manager. Such items must be allocated by judgment. It will not always do to distribute them in proportion to sales of the different products, since it might very well happen, for example, that a high-priced manager might be engaged to give most of his time to develop business in one special product, which it was considered desirable to push. If this were the case, then that special product must be loaded with more than its proportionate share of the manager's salary.

As Selling accounts are not within the scope of this work, and can only be briefly considered, we need only take note here that the apportionment of selling expense unequally between products can be done by suitable methods of analysis, and confine our attention at this point to the way in which it affects the accounting mechanism.

The arrangements shown in Fig. 19 will not be affected up to and including the transactions in the Product Sales accounts, one of which is provided for each separate class of product. Beyond this point new arrangements are necessary.

As many separate Trading accounts will be required as there are separate Product Sales accounts. The balances in the latter instead of being transferred to a common Trading account as shown in Fig. 19 are each transferred to an individual Trading account (*A*, *B*, or *C*). This procedure assembles the gross profits on each line of product in a separate ledger account in order that the *individual* amount of selling expense pertaining to *A*, that pertaining to *B* and that pertaining to *C* may be placed over against the individual gross profits of *A*, *B* and *C*.

We thus obtain the individual net profits on *A*, *B* and *C*. These individual net profits are then transferred to a common Profit and Loss account, just as shown in Fig. 19.

All that remains to be explained is how the individual items of selling expense pertaining to *A*, *B* and *C* are charged to these individual Trading accounts. This is done by means of a special journal which takes the place of the transactions shown in the first five lines of the Closing Journal in Fig. 19, assisted by a greater subdivision of Selling Expense accounts than there shown.

The theoretical form of this Expense Journal would be something like Fig. 20. Each item of selling expense represented by a separate ledger account would be analyzed here, being credited in one sum to the Expense account, and allocated on whatever basis had been fixed for that item between *A*, *B* and *C*. When all the items had been dealt with in this way the total of column *A*

SALES EXPENSE JOURNAL

CR.	EXPENSE ITEM	*A*	*B*	*C*
	TOTALS			

FIG. 20.—Journal for distributing Sales Expense between three classes of product.

would be charged to the new individual Trading account *A*, and so with the other columns (to *B* and *C*, respectively).

A very close idea of the real profits obtained on each line of product, both gross and net, would result if the analysis of expense were carried out with reasonable attention and skill.

Basing Selling Expense on the Production Hour.—In some businesses, notably the printing trade, where goods are not made for stock, but for immediate delivery to the customer, it is not unusual to reduce selling expense to one sum and then divide this sum by the number of hours worked by the plant, so as to obtain what is termed a "selling-hour" or "sold-hour." It is usually worked in connection with costing Method A.

If we have a shop turning out a simple product or process, such as printing impressions on paper, then, under the conditions suitable for Method A, we can express the cost of process work in that shop by saying that it cost so much (say $1) per hour. If a certain order has taken 3 hr., then its shop or departmental cost

is $3. The advocates of the sold-hour method then proceed to argue that if during a certain period, say a month, the cost of selling has been say $100 and the department has worked 200 hr., then the cost of selling the product of the shop is 50 cts. per hour. Adding this to the departmental production cost we have $1.00 + $0.50 = $1.50, which is the cost of the product *sold.*

Such a method of procedure is extremely fallacious except under conditions when Method A is a correct method of costing, and in addition where selling transactions were very uniform in character. As will readily be seen it is an averaging method, all expenses both within and without the shops being reduced to an average cost per hour. It is therefore subject to the objections to all averaging methods, namely, that they are incorrect just in proportion as actual conditions are not uniform. For a small jobbing business where orders are sought day by day by one or more town travelers, and do not greatly differ in amount, such a system gives sufficiently close results. But for plants of considerable size, with a varied description of equipment and of output it cannot be recommended.

Grouping of Sales Otherwise than by Products.—Though the analysis of sales belongs rather to commercial than to manufacturing accounting, it may be well to point out that if the cost and sale price of each individual transaction be known, it is possible to group these transactions in any grouping we please. The most called for will undoubtedly be territorial grouping. Each of the Sales accounts may, for example, be subdivided into City and Country, into Domestic and Foreign (if an oversea business is transacted), into Eastern, Southern and Western Territory, into individual State groups, and so forth. In a large business this is highly desirable, as it facilitates the division of posting between several bookkeepers. To do this, separate Sales Journals are kept corresponding to groups of divisions, or alternatively, instead of allocating sales to different product columns, they may be allocated to different territorial columns.

By an intelligent grouping of data, the most valuable information on the course of business is obtained as a byproduct of the actual accounting. Decrease or increase in the volume of sales in the aggregate can be rapidly traced down to the sources, so that answers to the questions, "In what line of product" and "In what localities" is the increase or decrease taking place? are forthcoming without research.

CHAPTER XII

SUMMARIZING THE RESULTS OF A BUSINESS PERIOD

In the previous chapter the accounting mechanism was carried to the point of ascertaining the net trading profit on the business as a whole, or alternatively, the separate trading profits on two or more individual lines of product. We have now to consider the final mechanism by which the condition of the whole business is exhibited at the end of a period, and contrasted with the performances of past periods, and also sometimes with previous expectations as to what would happen in the period itself.

In reviewing the changes that have taken place in a given period, say a month, we may regard the matter from two points of view: First, the fact that the Trading account or accounts exhibit a balance on the credit side, which is profit; secondly, the nature of the transformations that have taken place in the various forms of our property—cash having progressed through the stage of purchases, materials, manufacturing operations, product, sales, and so back to cash again.

This cycle of changes, however, is never complete as a whole. We begin the first period of our business with cash only, it is true, but at no subsequent period do we ever find ourselves in possession of cash alone, unless indeed the business is sold. Always at the end of a period, our property which once was cash, is present in a variety of forms: buildings, machinery, store of materials, work in process, stock of finished goods, debts owing to us, and some cash. This being the case it is also obviously true that at the beginning of any period after the initial period, our property is similarly represented by value in a variety of forms.

In order to fully understand the situation, therefore, it is necessary for us to consider the forms of our property at the beginning of a period and contrast them with the forms it has assumed at the close of the period, in order that the story told by the Trading account may not only be seen in all its bearings, *but also proved to be true.*

For in order that a certain sum, say $4,000, which is declared by the Trading account to represent profit for the period, shall

be accepted as being really profit, we have first to make sure that our property during the period has, in actual fact, been increased by $4,000. This increase will hardly ever be found in cash alone. It will generally be found in an increased value of other things as well, such as debts owing to us, stock of finished goods, stock of raw materials, or other kinds of property. The increases *in all these forms of property taken together*, must equal the $4,000 declared by the Trading account to be profit.

But our scrutiny of the forms in which our property exists at the end of the period must be directed to something beyond simple verification of the *amount* of increase. We must pay some attention to the nature of the increase, or in other words to the *kind* of property that has increased in value, because as a practical matter of business it is necessary to prevent our property passing, to too great a degree, into "fixed" forms, which will not be realizable in cash at the proper season.

For example, on comparing our property today with its status at the beginning of the period, we might find that much of the increase was in raw materials, or in equipment, or that an ominously large portion of it was in debts owing to us which showed no signs of moving toward payment, in other words in doubtful or bad debts. This state of affairs would discount our satisfaction at the fact that the Trading account showed a profit of $4,000, because the possibility of getting that profit in the form of cash (which is the ultimate aim of any business whatever) was more remote than might appear at first sight.

In order, therefore, that the manufacturer shall have a firm grasp of what has happened in his business during the period, he should be presented with the following data, as promptly as possible after the close of each month:

Abstract of the Purchase Ledger transactions.
Abstract of the Sold Ledger transactions.
Abstract of the Storekeeping transactions.
Abstract of the Equipment transactions.
Abstract of the Work in Process transactions.
Abstract of the Finished Stock transactions.

All these accounts represent movements of certain kinds of property, and their balances at the end of the period represent the present value of each kind.[1] In addition to these property accounts, he should have:

[1] Purchase ledger balances are, of course, liability, *i.e.*, negative property.

Sales accounts.
Trading accounts.
Profit and Loss accounts.

Then, with the exception of cash, the balance of which is generally known from day to day, he will have all the principal items before him that need watching and comparing. The balances of these and some minor ones will also be listed so that all the property is placed on one side and all the liabilities on the other. This arrangement is called a Balance Sheet, and its essential feature is that when all liabilities and all assets have been listed, the two sides will exactly balance when the amount of profit shown in Profit and Loss account is placed in its proper position on the sheet. This balancing vouches for the correctness of the figures claimed to be profit.

Mechanism should be provided for the comparison, period by period, of each of these items with those of past periods. Graphic representation of the rise and fall of balances is also very desirable.

In regard to each of the sets of transactions mentioned above, the data supplied will embrace the following points:

1. What was the amount at the beginning of the period?
2. What has been added during the period?
3. What has been taken out during the period?
4. What is the amount at the end of the period?

By arranging this information (which is, of course, merely the recapitulation of the charges, credits and balances of ledger entries) in vertical columns, we are enabled to place each period's data side by side so that changes can be readily followed and their amounts compared.

Figure 21 shows the form in which information as to the various property accounts may be presented. In each case the status of the account at the beginning of the month, the total of charges that have been made to it, the total of credits it has received, and its consequent new status at the end of the month are stated. When such a form is filled out to the extent of several columns (months) a considerable amount of comparative information is disclosed by running the finger along the horizontal items.

In Fig. 22 is shown a form which performs the same office for the Sales and Trading accounts. In this case a merged Trading account is shown. If, however, the net trading profit on two or more separate lines of profit were required, separate Trading accounts would be provided as explained on a previous page.

Purchase Ledger (Accounts Payable)

	Jan.	Feb.	Mar.	Apr.	May	June
Accounts Paid						
Discounts taken						
BALANCE FORWARD						
Total						
Bal. from Last Month						
Purchases this Month						
Total						

Sold Ledger (Accounts Receivable)

	Jan.	Feb.	Mar.	Apr.	May	June
Bal. from Last Month						
Sales this Month						
Total						
Accounts Received						
Discounts Allowed						
BALANCE FORWARD						
Total						

Storekeeping

	Jan.	Feb.	Mar.	Apr.	May	June
Bal. from Last Month						
Stores & Mtl's Purchased						
Total						
Stores & Mtl's Issued						
BALANCE FORWARD						
Total						

Buildings, Equipment &c

	Jan.	Feb.	Mar.	Apr.	May	June
Bal. from Last Month						
Added this Month						
Total						
Depreciation this Month						
BALANCE FORWARD						
Total						

Work in Process

	Jan.	Feb.	Mar.	Apr.	May	June
Bal. from Last Month						
Direct Material						
Direct Labor						
Expense Burden						
Total						
Delivered to Warehouse						
BALANCE FORWARD						
Total						

Finished, Stock Acct. (One for each Line of Product)

	Jan.	Feb.	Mar.	Apr.	May	June
Bal. from Last Month						
Delivered from Factory						
Total						
Sales at Cost						
BALANCE FORWARD						
Total						

FIG. 21.—Form showing movements of assets and liabilities, month by month.

Beneath each of these forms a series of statistical data could be recorded if required. Thus the Sales accounts could be reduced to:

Gross profit per ton, bale, or pound sold.

Average size of order.

Average gross profit per order.

Sales Account, Product *A*

	Jan.	Feb.	Mar.	Apr.	May	June
Amt. of Sales at Cost Bal.=GROSS PROFIT						
Total						
Sales at Sale Price						
Total						

Sales Account, Product *B*

	Jan.	Feb.	Mar.	Apr.	May	June
Amt of Sales at Cost Bal.=GROSS PROFIT						
Total						
Sales at Sale Price						
Total						

Sales Account, Product *C*

	Jan.	Feb.	Mar.	Apr.	May	June
Amt of Sales at Cost Bal.=GROSS PROFIT						
Total						
Sales at Sale Price						
Total						

Trading Account (All Products)

	Jan.	Feb.	Mar.	Apr.	May	June
Sales Expense, Viz:- Salaries and Wages, Office Expenses Traveling Exp. Etc. Etc. Bal.=NET PROFIT						
Total						
Gross Profit on *A* " " " *B* " " " *C*						
Total						

FIG. 22.—Comparative monthly statement of gross profits in three lines of product, and total net profit.

If separate Trading accounts for each line of product were provided for the reasons already discussed, similar information could be worked out for net profits, thus:

Net profit per ton, bale, or pound sold.

Average net profit per order.

Such figures would have very little purpose if gotten out for a

single month only, but if worked out over a series of months, and arranged in columnar form, so that variations from month to month were easily comparable, information would be furnished as to the trend of trade, and whether it was maintaining or changing its character, that would be very useful.

These forms complete the strictly manufacturing and trading transactions of the business, but we have yet to collect other items of revenue not proceeding from trading, and against them we have

Profit & Loss Account

	Jan.	Feb.	Mar.	Apr.	May	June
Legal Expenses Goodwill Written Off Fire Loss Written Off Bal. = SURPLUS						
Total						
Net Profit for Tdg.Acct. Revenue from Invest'ts Other Revenue						
Total						

Balance Sheet

	Jan.	Feb.	Mar.	Apr.	May	June
Cash in Hand and Bank Accounts Receivable Stores & Materials Work in Process Unsold Fin. Stock Buildings, Plant &c Investments						
Total						
Accounts Payable Capital Account SURPLUS						
Total						

FIG. 23.—Comparative monthly profit and loss account and balance sheet.

to set such special expenses as must be met from the profits of the business, and are not fairly chargeable either to manufacturing or selling expense. Examples of these are the cost of litigation, the reduction of goodwill or patent-rights, the writing down of fire losses not covered by insurance and so forth.

Figure 23 gives the form for assembling these items month by month, for comparative purposes. The revenue from trading and the amounts written off from one month to another are clearly visible. So also is the net result of all, namely, the

surplus. This is the amount by which, after every possible deduction has been made, our total possessions have been increased. Whether or not we elect to regard it as **divisible profit** depends upon circumstances, and particularly upon the status of the different varieties of our property. As a final means of determining our policy towards surplus, we list all our assets and liabilities in two divisions. To the liability side we add our Capital account, which represents the liability of the business to its owners, as explained in Chap. II. Having thus listed all our Property accounts on one side, and our Liability accounts including Capital account on the other, we add them up, and on extracting the difference between them, it should exactly equal (if our books have been correctly kept) the **surplus** shown in the Profit and Loss account. By placing this item at the foot on the liability side, an exact balance is obtained, and the Balance Sheet **balances,** thus proving the correctness of our results.

The reason why surplus is placed on the liability side of the Balance Sheet merits some attention. It is placed there, of course, because it is only there that it will assist a balance, but this reason, though a good one, does not explain *why* surplus is a liability.

The answer will be found in the principle that all accounting is based on the difference between ownership and property. It is true that we know it to be profit since that fact is proved by its origin, which we have traced from gross profit on sales, through net profit on trading to surplus on profit and loss. But we should still be obliged to do the same thing even though we had no accounts at all to help us discover the origin of the surplus.

Consider what the Balance Sheet is. It is not a record of what has happened in between dates. It is a record of quantities and values of property *at* a certain date. Now in listing our property and setting against it all our liabilities, which latter are divided into liabilities to outside parties (accounts payable) and liability to the owners of the business (Capital account), we find that we have more property than we have liabilities. We do not need the books to tell us this, since we can arrive at the value of our property by count and valuation, in other words, by a stock-taking. It is more convenient and infinitely more speedy to take it from the books, but if necessity

arises it can be obtained otherwise. Whichever way it is obtained we should still find that there was a difference between assets and liabilities, and that, as a matter of fact, there was a **surplus** of assets over the liabilities set down.

In other words our property has increased since we last observed it.

But from the principles laid down, property must always be represented by ownership. Therefore, as we know that no one outside the business has any claims on it (all such claims having been already listed as accounts payable) it follows that it must be owned inside the business, and as Capital account represents inside ownership, therefore, *it is an item of exactly the same class* as Capital account. Instead, however, of placing it at once with capital, we keep it as a separate item, and express its true status by placing it alongside capital. It thus represents a surplus of property in existence but not represented elswhere as capital.

Surplus is the ownership of surplus property. It is not property in itself, since that is all listed on the assets side of the Balance Sheet. It can, therefore, only represent ownership in that portion of the property not already earmarked as owned, by appearing in the Capital account.

Many persons are quite confused over such matters as the nature of surplus, and the meaning of capital. That is because capital as the symbol of ownership is commonly mixed up with its appropriation to individuals through shares, stocks and bonds. The latter are, however, merely devices for settling the *distribution* of ownership among individuals. The confusion is made denser by the existence of financial expedients like bonds, which appear to create various kinds of capital. From one standpoint they do, since the owner of a bond does not stand in the same light as regards ownership of the property of the business as does a stockholder. But actually there is only ownership on the one side and property on the other, though for convenience this ownership is split up, and given to individuals in unequal degree and in unequal amount. Still, when all the different kinds of capital are added up, they form simply a general total of ownership which is, or should be, represented by an equivalent in property.

With these financial details we have nothing to do save as in the present instance where they may be invoked to throw

light on an obscure point. Strictly speaking Manufacturing accounts should end at the factory gate. The disposal of product is not peculiarly a manufacturing activity. Of course, product must be sold, but there is no peculiarity about the sale of product by the manufacturer. That portion of his business is exactly the same as the business of any merchant who purchases goods at wholesale and sells them again. Therefore, in the foregoing resumé of manufacturing accounts a good deal has been ignored—as, for instance, bill transactions—that may loom large in the selling department of a manufacturing business. Such matters are purely commercial, and for information respecting them some authority on commercial accounting should be consulted.

CHAPTER XIII

RECAPITULATION

The entire cycle of manufacturing accounting has now been traced. Beginning with the simplest transactions and their record in ledger accounts, an outline has been given of all the more prominent operations of purchase, manufacture and sale, as these are reflected by accounting methods. The object has been to introduce the reader gradually to the numerous subdivisions and classifications necessary, and to show how these are eventually consolidated again into a few heads and the accuracy of results vouched for by the Balance Sheet.

The beginning of the cycle has been shown to be purchase. Purchased items, including wages, salaries, materials, and so forth, are first subject to an analysis which divides them into two classes—manufacturing and selling. An intermediate class, such as certain salaries and office expenses, have to be divided between manufacturing and selling on an arbitrary basis, after careful examination of the situation.

Some of the items purchased go at once into manufacturing; others are held up in storage until actually wanted for manufacturing purposes; others again are chargeable to manufacturing by very small but continuous increments (depreciation).

That portion of the purchased items that is charged to manufacturing, has in its turn, to undergo separation into classes. First we have direct material, *i.e.*, material which actually goes into and becomes part of salable product; next we have direct labor, *i. e.*, labor which is directly applied to causing changes in product itself, mostly by the aid of machines and tools; lastly we have what is termed expense, or indirect expense, or burden, which is in fact nothing but a remainder—what is left after deducting direct material and direct labor from the total of all items chargeable to Production.

These three elements of cost, direct material, direct labor, and expense have to be connected with definite quantities or with individual items of product, and this is the actual sphere of cost

accounting. The principal differences between cost systems lie in the methods adopted to connect these elements with product.

Direct material is always charged to Product, either to the whole quantity of product turned out in a shop during a month, or to some lesser unit quantity or lot.

Direct labor and expense, on the other hand, are applied to product in three main ways, which have been arbitrarily called, in the foregoing chapters, Method A, Method B and Method C. In each of these varieties, costing is applied either to whole output of one product, or of several products, or to lesser units designated by order numbers. In some instances costing is carried as far as the individual part, and to each process on such part.

On Method A direct labor and expense are thrown together and charged to Product on some time basis, which may be the whole month, or alternatively, may be an hour. The latter plan furnishes an average hourly cost, for any work done in the shop, and can, therefore, be applied to any quantity of product large or small. Where less than the whole of a product is costed, the lots are designated by order numbers, and charges are made to these order numbers based on the time they have been worked on. Method A though correct enough in those cases to which can be applied has a very narrow range of application.

Method B differs from Method A in its handling of direct labor. On this method, direct labor is charged direct to Product, either the whole product for the month, or any less quantity, designated by order numbers. Each order is charged with the actual wages of the operative, according to the time he has spent on such order. The expense, on the other hand, is reduced to an hourly average rate, as in Method A and charged to Orders on the basis of the time that each order has been worked on by direct labor, or alternatively, the total of expense is set against the total of direct wages, and their percentage ascertained. Then every item of direct labor on an order is increased by the amount of this percentage. This is termed "prorating" expense over direct wages. On this method every order will have, as its cost: (1) Direct material; (2) direct labor; (3) expense based either on an hourly rate, or on a percentage of direct labor.

Method C. The three methods of costing are, in fact, three degrees of definiteness in the charging of direct labor and expense to Product. In Method A *both* are averaged and reduced to a single charge per period, which may be a whole month, but is more

commonly an hour. In Method B we eliminate the averaging as regards direct labor, but retain it as regards expense. In Method C the averaging method disappears altogether, and each order is charged with an exact quantity of expense which analysis shows is its rightful share. On Method C expense is subject to a thorough analysis, instead of being thrown together into one sum. Each item is scrutinized from the viewpoint of "What has it been expended for?" and in practice it is found that all items can be grouped in a few groups representing certain indirect services to production. This being ascertained, the next step is to ascertain how much each order is benefited by these indirect services, and the answer is found by considering that each service is really a service rendered to a machine. By calculating the total of all services chargeable to a particular machine, we are enabled to make an hourly charge for the use of the machine, just as we make an hourly charge to Product for the use of a man.

This at once brings up a totally new problem. If expense is thus charged to Orders on a basis of machine rates, it follows that if a machine is idle part of the time, the case is exactly equivalent to paying a man wages and allowing him to stand about idle. In other words, waste or loss is incurred. Method C enables this loss due to idleness of machines to be calculated in a money equivalent. As each machine has its hourly rate, all machine time that has been consumed in working on orders can be totalled. When this total is deducted from the total charge for expense to the shop, the difference represents wasted expense. It represents the cost of *manufacturing capacity that has not been used.*

In some cases this amount can be charged off to Profit and Loss. In most cases, however, it is better to prorate it over the actual machine charges to each order, as a "supplementary rate." Whichever plan is adopted, its significance remains the same. It is not cost of *production*, but cost of unused capacity to produce.

The true manufacturing cost of an order is ascertained by Method C under all conditions of slackness or pressure in the shop. Neither of the other methods can do this. As each of them is dependent at some point on averaging, their manufacturing cost necessarily goes up as work falls off. On Method C the actual cost of manufacturing remains the same at all times, accompanied by a supplementary amount that rises or falls according as all the manufacturing capacity of the shop is being wasted or utilized.

When the cost of work on an order in one or more departments has been found by one of the foregoing three methods, then, in most cases, there remains the task of collecting all the departmental costs and identifying them with a particular manufacturing or customer's order. As each department finishes its share of the work, it is credited with the cost value of what it has done, and a Finished Work account is charged. When all the departments have completed their share of work on an order, the cost of the latter is credited to Finished Work account and is charged to a Warehouse, or Finished Goods account. This completes the cycle of purely manufacturing accounting. What remains has to do with the marketing and selling of the finished product.

The subject of wastes, spoilages, scrap and byproducts, and also that of auxiliary equipment such as patterns, molds, etc., were briefly discussed. These are complications that may arise under any method of costing, but their presence or absence has no bearing on the principles hitherto discussed. They are simply details, troublesome to handle in practice, because of the necessity of tracking down all their ramifications, which often are very complex.

In regard to the accounting necessary to ascertain the profits on the marketing of product, methods of analyzing selling expense, and of that portion of the administration expense that is chargeable to the selling department, were described. Where possible, selling expense should be analyzed in all cases where different lines of product are handled, particularly if different methods of marketing them are in vogue. The method of ascertaining gross profit on each separate line of product was shown, and the further developments necessary if, by analysis of selling expense, the net profit on each separate line was also to be ascertained.

When this has been accomplished, the cycle purchase—manufacture—sale has been completed. It only remains to consider the arrangements necessary to draw together the results of a month's operations, so as to show the present status of each kind of property we possess, and thus verify the trading profits as disclosed by the accounts of the selling department.

A series of reports were suggested, designed to provide the management with a complete summary of the principal transactions that had taken place during the month, issuing in a com-

plete Balance Sheet, showing the amounts sunk in the various assets, the liabilities, the capital and the surplus. This last amount represents the degree to which net assets have been increased by the manufacturing and selling operations of the period, added to any other items of revenue that may have accrued from non-trading sources.

In Part II of this work the actual operations will be considered in greater detail, and specimen blanks and rulings given. In Part III the subject of factory reports and returns, and the circumstances under which they are required, and by whom, will be discussed.

PART II
COST ACCOUNTING

CHAPTER I

THE GENERAL DIAGRAM

The object of this book is to provide the reader with an insight into the principles underlying manufacturing accounting. To do this effectively it has been necessary to confine the treatment strictly to the subject of accounting, which is a wholly distinct matter from administration though it touches it at various points. What is called the "system" in an industrial plant is commonly made up of several different series of organizations, amongst which that of accounting is only one.

Accounting has primarily to do with the recording and comparison of money values. It analyzes the different classes of expenditure, records and observes their combinations during the process of manufacture, ascertains the cost of grouped auxiliary activities such as, for example, the power plant, determines the relations of these auxiliary activities to the main activity of producing goods, and finally sums up the result of the whole process in the form of costs—each item of finished goods being connected as closely as possible with the actual cost which has been incurred in making it.

In the first part of this book a general idea has been given of the division of manufacturing accounting into three sections, namely, buying, manufacturing or production, and selling. Now both buying and selling exist in all commercial transactions, and are not therefore specially to be identified with manufacturing activities. Our attention must therefore be directed chiefly to the middle one of these three divisions, namely, production. The accounting of this division is usually referred to as manufacturing costs, or more briefly, cost accounting. The chief differences between the various methods of cost accounting which we shall describe, resides in the amount of subdivision or detail

required in the result and also in the way in which indirect expense, or as it is commonly called, burden, is applied to the various orders or jobs.

When we consider the very large variety of industries that exist, it will be evident that it is impossible to discuss them all, since to do so would mean not one, but many volumes. On the other hand, as we are dealing with the subject of manufacturing accounts in general, and endeavoring to throw light upon the principles upon which they are arranged, it will be equally evident that the selection of any particular industry as an example would give a very inadequate treatment of the subject. It happens, however, that though there is great variety in detail, the object sought, and the general methods of treatment, are much the same in all industries. For instance, though in a locomotive shop and a knitting mill the wording and design of the various blanks will obviously be entirely different, still there is a great similarity in the accounting aim which each of these industries is seeking, namely, the detail cost of certain processes and operations. Though the processes or operations may be of quite a different nature and be known by entirely different names, still the general result aimed at is much the same. The accountant, therefore, does not require an initial knowledge of the innumerable details of a great variety of industries, provided he has a good grasp on the methods by which values are analyzed and combined, and the result of operations tabulated, so as to be able to apply these methods to any industry with which he is called on to deal.

In the present work, therefore, we shall discuss the general framework of ledger accounts which is common to nearly all kinds of manufacturing business, and shall present blanks and forms which are typical rather than specific; and we shall endeavor to explain what is the general object of the blank or account, and its relation to the general system of manufacturing accounts, in such a way that the possibility of adaptations to suit particular circumstances, will not present insuperable difficulty.

In the general diagram (see folding page at end of book) a general view of the more essential features of a system of cost accounts is shown. It should be explained that this particular diagram is based on what is known as the percentage method of applying burden (Method B). This has been selected, not because it is considered that this system is the best, but because of all systems of dealing with expense burden, it is the most usually

employed, and will be most familiar to the generality of readers. Further, as it is a very simple method of handling burden, it is for that reason very suitable to be considered in a preliminary survey of the field of cost accounting.

In its most abstract form, cost accounting may be considered as the record of the process of ebb and flow of quantities and values from the first stage of purchase to the last stage of finished goods. Near the left-hand side of the general diagram will be observed two columns of symbols representing ledger accounts. Into these accounts there is perpetually flowing a series of quantities and values, emanating from the Purchases and Cash Journals These quantities and values may be regarded as a flowing tide running into the reservoirs represented by the ledger accounts. On the right-hand side of these accounts the field of production is situated. Here we have two principal journals, namely, the Burden Journal and the Manufacturing Journal, which serve to discharge the reservoirs represented by the two columns of ledger accounts and to transfer the quantities and values contained therein to new reservoirs, namely, Burden account and Manufacturing account respectively. The amount accumulated in the Burden account is itself later transferred to Manufacturing account by medium of a special column in the Manufacturing Journal. This journal, therefore, serves two purposes: first, to transfer several items from the main ledger accounts to Manufacturing accounts; and, secondly, to transfer burden from the Burden account to Manufacturing account.

So far we have a flood tide flowing from the Purchases Journal and the Cash Journal and piling itself up in reservoirs of the left-hand ledger accounts (which will usually be called in this book the "main" accounts), then we have an ebb tide flowing away from these ledger accounts by the channel of the two journals just mentioned, and piling itself up in the Burden account and the Manufacturing account respectively. A further transaction is the ebbing of the tide from the Burden account and its piling up in the Manufacturing account, which now, therefore, accumulates *all* of the amounts that have flowed away from the main ledger accounts.

Simply to observe the amount of this ebb and flow is in general not sufficient for the purposes of the accountant. A peculiarity of cost accounting is that it requires to connect the amounts piling up in Manufacturing account *with particular lots of goods.* The

mechanism for effecting this connection is found—first, in the series of production orders[1] and component orders by which we identify or label specific items of work and their subdivisions; and secondly, in the mechanism for charging definite items of workmen's time, and definite values of stores and materials issued to particular order numbers or job numbers. When the transactions of a period, such as a month, are completed, the whole of the expenditure in the shops, both on burden and on direct manufacturing, should be represented by a number of items entered on Cost Sheets, *each of which Cost Sheets represents a particular production order or component number.* The difference between various systems of manufacturing accounts lies, almost wholly, in the way in which particular lots of goods—represented or identified by production orders and components—are connected with burden on the one hand and direct manufacturing cost on the other.

As each Cost Sheet represents the time, material and burden which has been incurred in manufacturing the article represented by that component order number, *and as every dollar in the Manufacturing account must be represented on one or other of these sheets,* it will be evident that upon the completion of a component, we may withdraw one of these sheets, and find upon it the entire cost of that component to date. It then becomes a simple matter to enter the value thus arrived at on a new journal, which is the medium for withdrawing the amount from the Manufacturing account and placing it in a Finished Components account. We have thus again an ebbing away from the Manufacturing account and a piling up in a Finished Components account, representing a fresh stage of our transaction.

If a production order consists of 20 components, each component order representing a process, or a number of processes, on a particular part or component, then on the completion of all the component orders contained in the production order, we may collect all the Cost Sheets, and having aggregated them, the total cost of the production order itself is made known. This cost will be associated with a definite quantity of goods, which may be

[1] In this work a production order is considered to be the order issued for the manufacture of a definite quantity of product. Component orders are subdivisions of production orders. In some industries no subdivision is required. Component orders are then unnecessary. Component orders are sometimes called Part orders or Job orders.

either a single built-up article such as a machine, or it may be a million pieces of one kind. Having collected all the components on a production order, we are ready to transfer them from the Finished Components account to a Finished Goods account. This is done by means of another journal called the Finished Goods Journal. The total cost of a production order (*i.e.*, the total cost of all its constituent parts) is entered on this journal which serves as a medium to withdraw values from the Finished Jobs account and transfer them to the Finished Goods account. This represents the final stage in manufacturing cost proper. All that is left is the question of sale of the goods so produced and the selling expense thereby incurred.

If there are several lines of product, that is, several different classes of goods being manufactured at one time, it is convenient to have several Finished Goods accounts, each one corresponding with a particular class of product. This being so, and it being remembered a Cost Sheet, or Sheets, exists for every dollar recorded in these accounts, it will be understood that when a sale is effected, the cost price of that sale can be very readily ascertained. This, of course, means that the gross profit on such a sale is easily ascertained. To ascertain the gross profit for a period, say a month, we may make use of a Sales Journal which has two columns, in one of which the cost price, and in the other of which the sale price, is affixed to each transaction. Totalling these columns will show at once the gross profit that had been made in any given period. Frequently, however, this simple method is not considered desirable, inasmuch as it gives too much publicity to facts which would thus be too widely known. To avoid this publicity two journals are made use of, one containing the cost price and the other containing the sale price, the record of transactions being duplicated in each. This, however, is a matter of detail.

If there were no expenditure entailed in making sales, this disclosure of gross profit would, of course, give all the information necessary, but as a matter of fact, selling is usually a very costly operation. It involves not only a great amount, but a great variety of expenditure. Where there are several classes of product it can be easily understood that some of this expenditure will be incurred more for the sake of one product than for the sake of another. In other words, the incidence of expenditure on products will not be equal. It is, therefore,

necessary to set up a mechanism which will enable us to ascertain as nearly as possible what expenditure belongs to what product.

Though this cannot be done with precise accuracy in many cases, still it can often be effected in a way that is worth while, and as a result we are able to charge the different classes of product with the respective shares of expenditure which it is judged may have properly incurred. The alternative to this is to prorate selling expense evenly over sales without reference to the classes of product dealt with. The object of doing this is, of course, to enable us to ascertain net profits with regards to each different class of product we are selling. When cost of manufacture and cost of selling have been deducted from sale price, then there is nothing left but profit, provided our allocations have been correctly made.

The whole course of the ebb and flow of manufacturing activity is now visible. There was a constant flood tide toward the purchase reservoirs. From these reservoirs there is a constant ebb toward the shops, with the result that values are constantly being piled up in a new reservoir of parts in process of manufacture. A third stage is where there is an ebb from the reservoir of parts in the process of manufacture and a flowing tide toward the reservoir of parts completed. Then again there is a transfer from this reservoir of parts completed to a reservoir of orders completed, and finally a constant emptying of the reservoir of orders completed and a piling up in the accounts of sales of goods. This ends the chain of productive activities, but, of course, there remains the question of the amounts received by reason of the sale of the goods, and then division into classes of goods, in each of which gross and net profit must be ascertained.

Hitherto we have spoken of a simple, direct industry. In many cases, however, the process of manufacture is neither simple nor direct. Before we can manufacture goods, it is very frequently necessary to make extensive preparations and to construct a variety of auxiliary appliances, such as patterns, molds, jigs, fixtures, templets, etc., the cost of which must be kept quite distinct from that of the goods themselves. As has been shown in Part I, this necessitates finding and disposing of the cost of such auxiliary appliances, which often presents perplexing problems for the accountant. If, when we accept

an order for goods, we know that the same goods will never be required again then it is obvious that the cost of all the auxiliary apparatus and appliances must be recovered in the sale price of the goods. In such cases, although the cost of such auxiliary appliances should be ascertained separately, it must be considered as part of the cost of production and should be charged later against the sale price. But this is rarely the case. It more frequently happens that when we put in hand a pattern or jig, it is with the expectation of a future use for it, quite apart from the immediate order in hand. Whole classes of such appliances, moreover, are entirely secondary in their nature and do not go directly into the cost of product, or of any particular order at all. Such, for example, are the molds used in casting steel ingots. The ingot is only an intermediate product. It is not salable, or at any rate it is not commonly sold, but when made, an ingot may be charged ultimately to any one of several different classes of goods or orders. So that when we cast the ingot, we are not prepared to say what its ultimate destination will be. Much less then are we able to say when we put in hand the manufacture of a mold, what will be the ultimate destination of the ingots that may be cast in it. In such cases the Cost Sheet of the ingot must bear part of the cost of making the mold; and just how much the amount of this charge should be is sometimes a difficult question to determine. It depends, obviously, on the use which will be made of the mold, that is, of its useful life and this cannot always be predicted.

A less formidable problem is afforded by the question of special forms of wage remuneration, such as piecework, premium or bonus. Though piecework may be regarded as in the nature of a contract with the man at a certain price for so many articles, it may also be regarded as a case in which we pay the man his ordinary wages while he is doing the work and then on the completion of it we pay a bonus or difference between his day work earnings and the total amount of his contract. Where burden is based upon time, it is necessary to ascertain the number of hours taken by the man on the work, whether it is daywork or piecework. In such cases, therefore, the piecework balance must be regarded as an additional payment paid to the man over and above his ordinary day's wages, and some mechanism has to be set up to bring this balance into the Cost Sheet.

While the prime function of cost accounting is to find cost, it

has also a secondary aspect which is of great importance. The administrative success of manufacturing depends largely on prompt information as to what is going on from hour to hour, or at any rate, from day to day in the shops. Though the ultimate object of cost accounting is to ascertain the cost of finished goods and to record this cost in Cost Sheets, it is almost equally important, from an administrative point of view, to keep in close touch with the various processes of ebb and flow, already mentioned, and to observe closely the condition of the various reservoirs, or ledger accounts, at frequent intervals. Moreover, as the nature of the information required by the administration is frequently rather different to that required by the accountant, greater subdivision of information is required than that afforded by the ledger accounts themselves. This demand is met by what are termed "reports," which are prepared from day to day, or in some cases, weekly or monthly, and may be regarded in many cases as a kind of cross-classification of the information which otherwise would have to be extracted from the ledger accounts themselves. Generally speaking, the nearer the user of the reports is to the prime transactions, namely, the expenditure of wages and the issue of material (that is to say, the nearer he is to the shops) the more important is it that information of this kind should be furnished promptly and at frequent intervals. The shop foreman is surrounded by a multitude of details and if anything has to be brought to his notice so that he may make use of it intelligently, it must be red hot. On the other hand, the superintendent and the higher officials are needing, not so much the small details as general tendencies and broad results. Information for their use, therefore, requires to be gathered and presented at longer intervals, so that a better perspective of the whole course of operation is afforded.

In addition, therefore, to the general scheme of accounting shown in the general diagram, a secondary scheme of reports has also to be set up. This secondary scheme is generally of a much more individual character than the general scheme of accounting, that is to say that in the nature of the reports which are afforded to the executives, one business differs from another much more than in the case of the general accounting scheme. The system of reports, in other words, is more or less peculiar to the business and depends, in fact, considerably on

the point of view of the executives and the way in which they are accustomed to look at the facts of production.

Though strictly speaking, manufacturing accounts should begin with the receipt of the invoice, or other document representing the purchase of goods or services, a preliminary chapter on ordering and purchasing has been given, because of the importance of recognizing purchase, in every case, the origination of the manufacturing process. Purchase, however, is a study in itself, and several excellent works have been written dealing with this branch of activity. It has only been introduced here to give an idea of its relation to the general subject of costs.

CHAPTER II

PURCHASE ORDERS

The routine of purchasing extends from the first discovery of the want of the goods or articles to their receipt, storage, payment and entry in ledger accounts. As was explained in the first portion of this work, manufacturing consists of a cycle of operations which may be briefly summarized as:

PURCHASE—MANUFACTURE—SALES

Purchase is, therefore, the gate by which everything enters the business, whether materials, equipment or labor; or services of various kinds, such as advertizing, insurance, etc., rendered either to the manufacturing or the selling division of the undertaking. We must not, therefore, fall into the error of regarding purchasing as having to do *only* with the ordering of stores and materials for current use, though in fact such transactions form usually the largest part of purchasing activities.

The principal elements of a purchase are the following:

1. Specification of what is wanted.
2. Requisition for a specific quantity.
3. Official sanction for the purchase.
4. Obtaining bids, with or without samples or guarantees.
5. Accepting bid, and ordering.
6. Receipt of purchase, with or without examination or test.
7. Checking, passing, and paying invoice.
8. Entry of purchase invoice in appropriate journal.

In addition to these main stages, some of which may be omitted in certain classes of purchase, though always implied, various mechanisms must be set up for facilitating the checking, tracing and control of transactions so that they may be conducted with the minimum of labor and confusion.

Specification.—The modern tendency to replace rule of thumb in management by foresight and exact measurement has developed the use of specification. Generally speaking this may be

defined as a clear idea, reduced to writing, of what it is we wish to purchase. In some cases this has always been customary. If we are about to write insurance, for example, a detailed statement of the nature and value of what we propose to insure is absolutely necessary. A lease, or a deed transferring ownership of land are also examples of very definite specifications. In contracting for the erection of a building, specifications have always held a prominent and necessary place. In purchasing machinery, the specification may be simply the catalogue description of the machine furnished by the maker, or may be extended to comprise definite guarantees as to performance, power-consumption, etc.

Most of these cases are concerned with the expenditure of considerable amounts at infrequent intervals, but after all the success or failure of a business is much more likely to depend on successful purchase applied to the two great main streams—labor and material—which flow continuously through the plant, because inefficiency here is recurrent and cumulative. In modern plants, therefore, specification is applied as far as possible to everything that is purchased, and not merely to large and infrequent items.

In *American Machinist* for Feb. 29, 1912, is a very suggestive paper contributed by Mr. Henry Williams, Naval Constructor, U. S. N., describing some remarkable results obtained by the adoption of specifications for purchases, based on previous study of the purpose for which the supplies were required. Tool steel, which is purchased in 50-ton lots, was reduced 15 cts. per pound, "with the net result that a little better quality is secured now, at a very considerable saving." Applied to varnish, a more suitable quality was obtained at a reduction in price in many cases approaching one-half that formerly paid. Many thousand dollars were saved annually by careful specifications of shellac. One and a quarter cents a pound on 800,000 lb. were saved on the purchase of "white zinc."

In private businesses the figures might be less imposing but equally significant. Specification is especially desirable in regard to staple material, such as pig iron in the case of a foundry, where the efficiency of manufacture may be seriously affected by unknown variations in the quality. Coal, again, is an article of very variable composition, and modern firms find it advisable to make their contracts on a basis of "calorific values," that is, on the actual

amount of heat units as ascertained by analysis, instead of trusting to trial and error to point the way to a satisfactory fuel.

One of the results that are reached by a careful review of the whole field of buying and its reduction as far as possible to a series of specifications is that of standardization. The fewer the varieties of materials that it is necessary to purchase, the larger, as a rule, will be the quantities that can be contracted for at one time and the lower the bids securable. By standardizing material and by arranging that designers shall give first preference to the use of standard varieties and sizes of material, a long chain of economies is set up. Fewer transactions in requisitioning, bidding, ordering, checking and bookkeeping are involved, less complex arrangements for storekeeping, and greater simplicity all round are the consequences of a judicious standardization of material, instead of leaving the designer to introduce new sizes and varieties capriciously without a thought whether they are really essential to the work in hand.

In some kind of businesses, of course, these remarks do not apply. The choice of material is strictly conditioned by the nature of the product. Whatever new varieties of material are introduced are called for by the customer. Again in other businesses the perpetual search after novelty makes new varieties of material welcome rather than the reverse. But in most engineering types of business, where product is made up of a large number of parts with screws, nuts, bolts, handwheels, levers and such like common accessories, standardization may play a very important part in the economy of production. Also the use of materials which are already commercially standardized, instead of slight variations from them, which variations have little or no technical efficiency, is an equally important matter.

The wording of specifications is a matter calling for great care and precision. In many cases a knowledge of trade customs in regard to the item specified is necessary, it being a not uncommon practice for goods to be sold as dozens, gallons, tons and so forth when really the quantities are somewhat higher or lower than appears on the face. Wherever possible, the principle of limits or margins as to composition or dimension, between which variation is permissible should be adopted. If samples or test pieces are required, the conditions under which these are to be drawn from the bulk should be specified. Wher-

ever any definite public standard exists, such, for example, as the standard engineering specifications, these should be adopted rather than any small variation from them, because what is in general demand can usually be procured at a cheaper rate than any individual requirement.

It must be kept in mind that the object of a specification is not to obtain the highest grade product, at the lowest possible price; but to obtain exactly that grade of product that can be

GENERAL MANUFACTURING CO.
WORKVILLE N.Y.
SPECIFICATION
No _____ Date _____
For _____

This Specification Consists of ___ Sheets

Body of Specification Written here

The material must pass the following tests which will be applied by us on the delivery of each consignment.

FIG. 24.—Standard specification blank.

most economically used, at the lowest price. This frequently necessitates experiment to discover what is the lowest-grade product that can be profitably used. In Mr. Williams' article, above referred to, he mentions several cases in which experiment showed that the superior brands of certain articles previously used were in fact wasted, inasmuch as their high qualities were not being called on in the uses to which they were being put. By substituting a lower grade, and rigidly specifying the requirements, it was found possible to save considerable sums without the slightest sacrifice of efficiency.

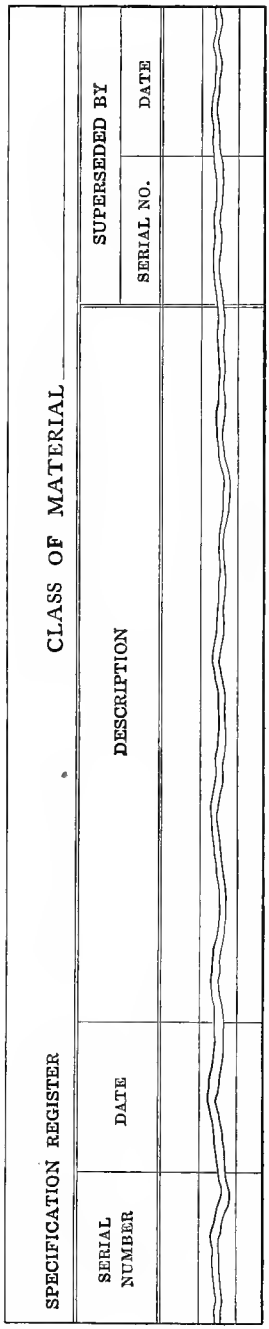


FIG. 25.—Specification Register.

When the acceptance of material is dependent on its passing specific chemical or mechanical tests on delivery, this fact should be clearly brought out, and the tests detailed without ambiguity so that no dispute may arise in case of rejection.

Standard specifications should be made on uniformly sized sheets (Fig. 24) each specification being given a reference number and date, thus:

"*Specification No.* 5,467, *dated Aug.* 7, 1915, *for Lacker*,"

and may be manifolded, or printed, and kept in vertical files, so that copies may be forthcoming without delay when bids are desired. Where a specification covers two or more sheets, they should be bound by a strong eyelet in the top left-hand corner, and the number of sheets contained in the specification stated on the first sheet under the title. Each specification should, of course, bear the printed title and address of the firm. Where a number of specifications are in use, a Specification Register (Fig. 25) should be set up. This may be in loose-leaf form, each page being devoted to one variety of specification. Thus, if several specifications for different kinds of lacker are extant, one page will be headed "Lackers" followed by the serial number and dates of all such specifications, with such additional descriptions as may be desirable for identification. Superseded specifications would be ruled off in the register in red ink,

and all the outstanding copies removed from the files. A Serial Register is also desirable and can be made by binding all specifications as they are issued in numerical order, thus forming an official record of the whole series. A superseded specification would not, of course, be withdrawn from this register, but merely marked "Superseded" and reference given to the new serial number by which it is superseded.

The accountant has usually very little to do with specification, it being obviously a purely technical matter outside his experience. But where it is adopted, it falls to him to see that due arrangements are made for the verification of deliveries as being in accord with specification before payment is made for the goods.

Purchase Requisitions.—While specifications are concerned with quality of articles purchased, purchase requisitions have to do chiefly with quantity. The one indicates what kind of an article is required and the other how much of it. If, therefore, a standard specification already exists, it is only necessary to refer to it by number and date on the requisition, and add the quantity considered to be required, and then the purchasing agent has all the data necessary for him to proceed.

Modern practice is reducing the purchase requisition to more of a routine affair than formerly. At one time the quantity of supplies carried was a matter of accident, and the quantity requisitioned on any occasion was a matter of haphazard judgment. Therefore, it is generally recommended in old textbooks that every requisition be passed on by the manager. Nowadays the quantity of each kind of stores that is to be kept in hand is usually worked out in advance, and consequently the amount to be ordered on each occasion of replenishment is worked out also. This reduces the requisition in most cases to a mere notification to the purchasing agent that certain items of stores have fallen below the minimum limit.

Purchase requisitions may be for materials that are produced in the plant as well as for articles purchased outside. In this case, the quantity to be ordered from the shops is also in most cases a matter of previously settled routine.

In some cases purchase requisitions will not be for standard materials, but for some special article required for a particular customer's order, or for a repair or other special work being carried out on the equipment itself. In this case the purchasing

agent must satisfy himself that no more has been asked for than is really required for the purposes of the order or repair.

In a well-planned system the minimum quantities of each article carried in stock will have been fixed with due regard to the normal time required to obtain delivery of a further supply. Where the article is a stock one, and can be obtained from several sources, a very small minimum can be fixed without risk. But where time of delivery is doubtful, a larger margin should be allowed. In both these cases the purchasing agent will proceed in a routine manner. But in the case of special material being required for a customer's order, or any other purpose that is not immediately pressing and urgent, the requisition should state the date at which it will be wanted. Without this information the order might be placed with a firm which, though otherwise preferable, was really unsuitable by reason of a reputation for not keeping to promises of delivery.

Purchase requisitions may in some cases be very urgent, as, for examples, in breakdowns, or where by failure of the system some important matter has been overlooked at the last moment. In such cases routine must be sacrificed, and everything done to get the goods into the plant with the least possible delay—all routine observances being completed after the delivery.

The sources from which purchase requisitions may arise are many. As regards ordinary standard stores and materials they will originate in the stores department. In the case of special material required for a customer's order they should be originated by the first person who is in a position to discover the want. In some businesses this will be on the receipt and "dissection" of a customer's order. In other cases, as in an engineering plant, the making up of a "bill of material" will be the point at which the fact of special material being required will first disclose itself. In the case of urgent repair work, they may originate from the foreman in charge of the job. They may also come from the selling department, calling for printed matter, special advertizing, and so forth. In large businesses there may be a separate official for the keeping of stationery, and office supplies, who requisitions for his own wants. This last case may be regarded, however, as a storekeeping transaction. Requisitions may also be for new equipment and may be originated by the manager or works engineer. In this case it may happen that the agent is directed to obtain some specific patented article, or to confine his inquiries

to certain specified firms. This is equivalent to making a special *specification* to cover the particular case.

In a very large plant the principal difficulty arising from purchase requisitions is that of overlapping, or duplicate requisition. One department may apply for material which exists already in plentiful supply in another portion of the same plant. With a proper system of storekeeping this danger is eliminated, but in the absence of such a system it is a failure of very common

PURCHASE REQUISITION

Date _____ From _____

Quantity _____

Article _____

Date Required _____

Advise Mr _____ on delivery

Required for _____

_____ Bids Invited * Date _____

Purchase Order No. _____ issued to _____

Date _____

Originated by	Approved by

* Spaces provided on back for names of firms from whom bids have been Invited

FIG. 26.—Purchase Requisition.

occurrence. The proper place to eliminate this defect is in the storekeeping department, that is to say by centralized control of all stores.

Purchase.—Requisition blanks (Fig. 26) are very simple, being mainly memoranda stating the kind and number of the article required. But as there is a difference in their treatment, as indicated above, it will be well to have them of three colors: (1) for ordinary requisitions based on minimum balance of stores

being reached; (2) for materials of a special nature that must be delivered by a definite, but future date; and (3) rush requisitions, in which the material is wanted immediately, and all routine must be put on one side to obtain its instant delivery.

Purchase requisitions should be made in triplicate, one copy being retained by the originator, and two being forwarded to the agent. When the agent issues a purchase order, the date, number and firm are endorsed on the requisition, and one copy stamped and returned to the originator, to signify to him that the goods are on order, and to enable him to make inquiry if they do not come in to time. This copy should be filed by the originator in a tickler, according to date of delivery. The copy retained by the purchase agent is used first to keep a memorandum of firms invited to bid, and when a bid has been accepted, to record the purchase order number, date and name of firm. It is then filed under the name of the originator.

Obtaining Bids and Issuing Orders.—In many, perhaps most cases, it will not be necessary for the purchase agent to invite bids. He will already have at hand all the data necessary for decision as to whom the order is to be given. Though this is not a matter of accounting, it may be desirable to indicate the nature of the mechanism that should be set up for this purpose. Purchasing depends for its success primarily on knowledge of the market, using that term in its broadest sense. It also depends on an intimate knowledge of the storekeeping organization of the plant, and a comprehensive grasp of the whole purchasing situation, particularly as to the way in which orders may be given out so as to obtain the maximum benefit from the volume of business done. For, though there is no sentiment in business, yet a firm that is continually changing its sources of supply, loses the advantages which accrue when a supplier regards an account as steady and regular and worth an effort to keep. In purchasing, it is not always a matter of price, within reasonable limits, that should determine the destination of an order. Firms that have a reputation for keeping promises of delivery, who exercise care in packing, who give prompt satisfaction to complaints, and in some cases, who are indulgent as to credit, may be more satisfactory to deal with in the long run, than one that quotes cut prices accompanied by an indifferent service in other respects. To secure the full advantage of trade it must to some extent be regular, and this consideration will influence the degree to

which the practice of seeking bids on every possible occasion is exercised.

In some businesses, particularly those of an engineering character, the variety of purchases is very great. It is, therefore, necessary for the purchase agent to classify and index all available information, and to keep good records of bids received, so that there may be no loss of time in searching for prices and descriptions when an order is to be given out. The information to be indexed thus divides itself into two main classes: (1) trade literature; (2) bids and correspondence with supplying firms.

The indexing and classification of trade literature is complicated by the manner in which a large portion of it is issued. Notwithstanding all the agitation that has taken place at different times to standardize the sizes of catalogues and booklets very little uniformity has as yet been reached in this respect. The idea that a trade catalogue must possess strong individuality shows great persistence, and it is not at all certain that it is not to some extent justified. But from the viewpoint of the indexer it is an unqualified nuisance, especially when a number of different lines of manufacture are included in one more or less portly and handsomely bound volume.

Where the space can be provided, it is probable that no better arrangement can be found than open bookshelves, for the carrying of trade catalogues. Volumes will stand upright, and pamphlets and booklets can be either placed on filing boxes (transfer or magazine cases) or they can be roughly sorted into sizes and made into a volume by clips. The grouping of catalogues must depend on the number carried, and also on the variety of subjects covered. In a large collection covering a wide range of subjects, shelves may be apportioned to subjects; thus one shelf may be devoted to "machine tools" or "paints, varnishes and stains." Catalogues of a general nature may either be cut up and rebound in sections, if they are of sufficient importance, or shelves may be set apart for "general" catalogues, and at each individual shelf a reference card may be placed referring the inquirer to the "general" shelf, and indicating page and name of catalogue in which, for example, some information or "machine tools" or "paints, varnishes and stains" may be found. Of course the reference would be specific, thus:

Gear-cutting Machines. See General Catalogues, Smith and Granger, page 34.

Where this plan can be adopted it is to be preferred to more elaborate arrangements. The only catalogues that require to be indexed are the "general" ones. Of course such a division would not be of much use to a stranger, but to anyone regularly working with the catalogues, and who makes a business of carefully looking through every new one that is added to the library, it would prove serviceable.

In some cases a catalogue devoted almost entirely to one class of article will contain a few pages given up to others in a wholly different class. In this case, the catalogue should be placed in the group to which the main contents refer, and the other pages taken out and placed in the magazine case of the shelves to which *they* refer. Or, if it is desired not to mutilate the catalogue, then a plain leaf bearing a reference as above mentioned may be placed in the magazine cases, or the reference card at the shelf may be endorsed to show the locality of the main catalogue, thus:

Aluminum Paint. See Metals and Alloys Catalogues, Wilson, page 23.

A little care and ingenuity will make this method of handling trade catalogues quite satisfactory. The main precaution to be taken is the indexing of articles which are *not* of the same kind as the group under which the catalogue is kept. As each catalogue is received, a label bearing the date, and stating the group under which it is to be kept, should be placed at the top right-hand corner. This helps to ensure that it will be replaced on the right shelf when it is returned after use. When a new catalogue is received any previous catalogue that is superseded by it should be withdrawn from the shelves.

Where a more elaborate method is desired, card-indexing may be resorted to. Cards will be kept for each firm, giving location of each catalogue (which may be arranged either according to alphabetical order of firm name, or numerically) and also for specific articles. On the article card, the name of each firm making or supplying that article with reference to the page and catalogue is entered. Each card thus forms a list of all the firms to whom inquiries or invitations to bid may be addressed when the article is being purchased.

The second division of information required by the purchasing agent is that which has been obtained through correspondence with the firms themselves. This, being perfectly definite, is

easily indexed. A card will be kept for each article, and the name of the successful firm and their price will be entered whenever a bid is accepted. A corresponding card for each firm invited to bid is also desirable, and a useful feature will be the entry of each bid received from the firm, with their price and also the successful price. By this means the general position of a firm on competing bids is registered, and firms that are habitually out of the running may be, in time, eliminated from the list.

Purchasing agents who have to buy staple commodities subject to variation of the market, as for instance, cotton, or pig iron, must of course possess much higher qualifications than those who merely purchase ordinary supplies. A thorough knowledge of the sources of production, and of the influences tending to alter market price, must be combined with an intimate knowledge of the resources of the plant, its prospects of future business, the general state of credit and other important questions, so that long-term contracts can be entered into with safety and profit.

The use of a special blank for inviting bids saves unnecessary typewriting of phrases which are common to all bids. The information given on this blank should disclose to the bidder all the data by which it is expected he will be bound in the event of his bid being accepted. The principal items are: place of delivery; date goods are required, or alternatively, date at which bidder promises delivery; stipulations as to payment of freight; terms of account, *e.g.*, 30 days net.; as to charge for packing cases and containers; latest date at which bid can be considered. Figure 27 provides a suggestion for an Inquiry Blank of this kind. The paper used should be sufficiently thin to allow of several copies being manifolded at one time.

In some cases, bids will be invited on the basis of samples, either inclosed with the inquiry, or open to the inspection of bidders at some stated place. In the latter case the place, and the hours at which the samples may be inspected should be mentioned in making the inquiry. Sometimes the bid will be invited on the basis of a guarantee of some kind, and the terms of this should be very fully disclosed. When bids are invited on specification, the inquiry should state the number or quantity of the articles, and the conditions of delivery, etc., and a copy of the specification attached to the inquiry.

When all bids are in, and one of them has been decided on as

acceptable, it will promote good feeling if the courtesy of an advice of rejection is extended to the unsuccessful bidders. This may take the form of a printed postcard, bearing the words, "We desire to thank you for your bid on ————, and to inform you that the order has now been placed." A notification of this kind clears up uncertainty, prevents unnecessary follow-up efforts, and saves the time both of the firms bidding and also of the purchasing agent making the inquiry.

Having accepted a bid, the next step is to issue a purchase

GENERAL MANUFACTURING CO.

WORKVILLE, N.Y.

19

INQUIRY

To

Please Quote your Price on the following

General Mfg. Co.

Conditions

Delivery Fob

Terms 30 Days Net

Cases or Containers to be Credited on Return

Delivery Required by

This Inquiry will be Closed on

FIG. 27.—Blank for inviting bids.

order for the goods to be delivered. The purchase order should repeat the conditions as to delivery, terms, etc., stated on the inquiry, and in addition specify the distinguishing marks or stencils to appear on packages. The purchase order, therefore, will be a blank very similar to Fig. 28. The portion below the signature does not appear on the copy sent to the supply firm.

As it is desirable that the receiving department shall be advised of approaching deliveries, and also be able to identify them when they come in, it is advisable to manifold the purchase order (omitting any price figures that may appear on it) and for-

ward the copy to the receiving clerk. He will file it in a tickler a day or so ahead of expected delivery, and will thus be in a position to identify the consignment on arrival.

There are, of course, other classes of purchases than those of goods. Services of all kinds payable in salaries and wages, and such items as insurance, rent, taxes and so forth, are just as much purchases as are pig iron, machinery, or oil and waste. But it would be unnecessary to discuss the routine pertaining to such transactions, except indeed as to the conditions under which

GENERAL MANUFACTURING CO
WORKVILLE, N.Y.

PURCHASE ORDER NO.

To _____

Deliver the goods mentioned below not later than _____ F.O.B. _____

Mark Packages _____

Price _____ Terms _____

The above Order No. to Appear on Your Invoice

_____ Signature _____

Order Acknowleged _____	Account Chargeble
Promised for _____	
Delivery Urged _____	
Goods Delivered _____	
Invoice Passed _____	

FIG. 28.—Purchase Order.

labor is employed, which will be dealt with in a later chapter. The outline of purchasing routine just given belongs rather to the subject of organization than that of accounting proper, for as will be noticed, no question of accounts has yet arisen. The routine of purchasing is, in fact, much the same for a manufacturing business as for any other, and has only been enlarged on here since it sets in motion all subsequent activities, and is therefore an appropriate introduction to the subject of manufacturing accounts.

CHAPTER III

RECORDING PURCHASE EXPENDITURES

Having briefly discussed in the previous chapter the principal precautions to be taken in making purchases, we now enter on the subject matter of manufacturing accounts, inasmuch as for everything purchased, that is, for every expenditure, there must be documentary evidence of some kind, and this forms the starting point of a series of entries to be made in the accounts of the business.

Everything purchased has to be paid for eventually, but not necessarily at the moment of purchase. That is to say, purchases may be of two kinds, as regards terms of payment: (1) the purchase may be for cash; (2) the purchase may be on credit. There is also a third class of transaction, when purchases are paid for at once, not in cash, but by a credit instrument, called a note or bill. This is, in fact, a deferred cash payment, but as the handling of bills or notes is a part of general accounting, and is a subject by itself it will not be discussed here.

Each of these two classes of transactions is recorded in different journals. Cash purchases are recorded in the Cash Journal, purchases on credit in the Purchases Journal. A variant of the latter, widely used in the United States, is known as the Voucher Record, which is intended to avoid the necessity of further posting of the transactions to a purchases ledger. This will be dealt with later.

The object of each of these two journals, in fact of all journals, is very similar. They serve to make a list of the transactions in sufficient detail for their subsequent identification, with the money value of each transaction appended, so that at the end of a financial period, say a month, we have a complete list of a particular class of transactions. This information having been accumulated in as much detail as is necessary for the given purpose, we are enabled to charge each of the transactions to one set of accounts and credit it to another set of accounts, or in the simplest case, we may merely make a total of the entire set of

Missing Page

transactions and charge this total to one account and credit it to another. In general, however, several accounts are involved, and in order to handle these transactions conveniently, it is usual to make a number of separate columns in the journal, each column representing some account in regard to which the transactions are expected to be fairly numerous. By writing the amounts in the proper columns, we are enabled at the end of the period to add up these columns, find the totals, and charge or credit these totals to the accounts effected, thus avoiding the trouble of posting every separate transaction, item by item. In the Cash and the Purchases Journals, now in question, we have excellent illustrations of this mechanism of journalizing. In the case of the Purchase Journal every item has to be credited to the personal account of a creditor, and the total of these transactions at the end of the period is also posted to the credit of a Creditor's Control account. With regard to the charges to be made from this journal, these fall under a number of heads and though the heads themselves may vary in different businesses and require more subdivision in some than in others, some such division as shown in Fig. 29 will in general be necessary.

The first three columns of the Purchase Journal, as shown in Fig. 29, are devoted to the written description of the item, that is to say, to the date of the transaction, the firm from whom the goods or services were purchased, a brief description of the items, sufficient for identification, and the price paid or invoice

Date	Firm	Item	Invoice		Selling Exp.	Works Exp.	Department Expense			Stores	Rent	Plant	Sundry Account	
			Fol.	Amt.			1	2	3				Accts.	Amt.

FIG. 29.—Purchase Journal.

value of the transaction. The remaining columns serve for the allocation of charges. In the particular ruling shown, we have in the first column, an opportunity to segregate all those charges which pertain to the selling department. In the second column are sundry items chargeable to the factory but not assignable to a particular department at the moment. In the next three columns, we have accommodation for expense charges against departments 1, 2, and 3, respectively. The stores allocation column is a very important one. In this column are charged all stores and materials purchased whatever their subsequent destination may be. In the next column items like rent, taxes and insurance are charged, then a column is devoted to purchases of plant, new equipment, and such like additions to value. Finally we have a sundry accounts column, space being provided for the name of the account to be charged and for the amount. This column is used for charges to accounts which do not occur frequently. In fact, the whole idea of providing columns is to take up transactions which do occur frequently. They are simply for the purpose of saving time in posting. There is no advantage in a large number of columns, but a positive disadvantage on account of the unwieldy size of the book, and such columns should be therefore confined to classes of transactions which do occur with reasonable frequency. As these will vary in business to business it is obviously impossible to give more than a general idea of the classifications usually to be met with in manufacturing. Thus, for example, in some businesses it might be necessary or desirable to split up the stores column into several columns. It might be thought advisable to have separate columns for fuel, for pig iron, for brass or for any other special product which was purchased frequently and required to be recorded separately from the general total of stores and material purchased. In the same way the selling expense column might be subdivided into traveling expenses, advertizing, etc., according to the necessities of the business. Under the head of general expense we might have subdivisions such, for example, as a special column for postages and telegrams, but all these matters do not involve any principle, but are rather dictated by convenience. It is not necessary for us, therefore, to do more than generally note their possibilities.

At the end of the financial period, say monthly, all these columns are totalled. The total of the first or invoice column is carried

to the credit of a Creditor's Ledger (Accounts Payable) Control account. It will also be understood that each item is posted separately to the credit of the personal account of a creditor, and the total of such individual credits will, of course, equal the total of the column which has been carried to the Control account. With regard to the allocation columns, all of these except the last one on the right-hand side will be totalled and these totals carried to the debit of the various accounts affected. In the case of the column on the right-hand side headed "Sundry Accounts," a *recapitulation* must be made of the different items, that is to say, all those chargeable to one account must be collected together and the total charged to the account in question, then the same process is followed with the other items. In other words the total at the foot of the sundries column has to be split up into several subtotals each of which is charged to its proper account.

At the end of the month when all entries in the book are completed, and all columns have been totalled, a check on the accuracy of the work is obtained by observing that the totals of all the allocation columns, including that of the right-hand column for sundry accounts, is equal to the total in the invoice column. This shows that all our charges are equal to all our credits and the book is, therefore, self-balancing in this respect.

A variant of the Purchases Journal is frequently made use of. This is

Voucher No.	Invoice: Dated	Invoice: Paid	Firm	Item	Amt.	Selling Exp.	Works Exp.	Department Expense: 1	Department Expense: 2	Department Expense: 3	Stores	Rent	Plant	Sundry Account: Accts.	Sundry Account: Amt.

FIG. 30.—Voucher Register.

called the Voucher Register and is shown in Fig. 30. Its ruling is practically identical with that of the Purchases Journal, with the exception that no provision is made for posting individual items to creditors' accounts. The theory of this book is that all transactions are settled in cash closely following on the purchase. A serial number is given to the vouchers or invoices received and columns are provided, not only for the date of invoice, but also for the date of payment by the firm. Inspection of the register thus discloses at any time the invoices remaining unpaid. In order to obtain a check on this amount it is advisable to set up an account corresponding to the Creditor's Control account and which may be termed Accounts Payable. This should be credited with the total of all invoices in the sixth column headed, "Amount," and as invoices are paid through the Cash Journal, this account should be charged with the amount of the payment. The balance in the account at the end of the month should correspond to the total of all the unpaid items in the Voucher Register. Though the Voucher Register is an excellent labor-saving device, where accounts are paid promptly, it is a source of much confusion if credit is taken on a considerable scale. Unless, therefore, accounts can be settled promptly on receipt, it will save much confusion to employ a regular Purchases Journal with individual accounts for each creditor. Unquestionably in any large business the financial arrangements should be such that accounts are settled promptly. One of the claims made for the Voucher Register is that it forces the necessity of such prompt payment and thereby secures discounts on purchases which would otherwise be lost.

We have now to consider transactions in which cash is paid immediately and we have also to consider receipts of cash. Both these transactions are dealt with in what is called a Cash Journal. The left-hand side of such a journal, shown in Fig. 31, deals with receipts, and the right-hand side with payments. As the principal source of receipts is from sales, the allocation columns by which credits are given to the persons from whom cash is received, are divided into two sets, one dealing with sold ledger accounts and the other dealing with sundry accounts. The date, the source, and the item, with the amount, are first entered and then the amount is also set out in one of these two allocation columns. If it is a check received from a customer it is entered in the sold ledger accounts column which is threefold: First, we have a

RECEIPTS		Amt. Rec'd.	Sold Ledger Accts.			Sundry Receipts			PAYMENTS		
Date	Item		Fol.	Amt.	Disct. Allowed	Acct.	Fol.	Amt.	Date	Check No.	Item

FIG. 31.—Cash Journal (left-hand).

Amt. Paid	Bought Ledger			Selling Exp.		Works Exp.	Salaries	Wages	Rents &c		Stores	Sundries		
	Fol.	Amt.	Disct. Taken	Fol.	Amt.				Fol.	Amt.		Acct	Fol.	Amt.

FIG. 31A.—Cash Journal (right-hand).

column for the folio number of the individual customer; secondly, we have a column for the amount of the check; thirdly, we have a column for the discount taken by the customer—the total of these last two columns being, of course, equal to the amount of his indebtedness to us. All other receipts are entered in the sundry receipts column, which contains space for entering the name of the account, the folio, and the amount. At the end of the month all these columns are totalled. The total of the column headed, "Amount Received," is charged to Cash account. The totals in the two columns under the head of sold ledger accounts are charged to a Sold Ledger Control account. The individual items in the sundries column are collected together in the same way as described for the sundries column in the Purchases Journal and posted to the credit of the accounts concerned. In addition to this, each separate item appearing under the head of sold ledger accounts is credited to the individual account of the customer, these individual credits being, of course, equal in amount to the total credited to the Control account. The totals of the two allocation columns (omitting discounts) should, of course, balance the total in amount received column, thus establishing a proof of the correctness of the transactions. The total in the discount column is credited to a Discounts Allowed account.

The right-hand side of the Cash Journal deals with cash payments. Spaces are provided for the date, check number, the person to whom paid, nature of the item, and the amount. The rest of the page is devoted to the allocations. The first principal group of payments will undoubtedly be those for goods purchased. We have, therefore, a triple column headed "Bought Ledger," giving a space for the folio, the amount, and discount taken. Next we have a column headed "Selling Expense," followed by one for "Works Expense." Separate columns are also provided for salaries and wages, one for rents, insurance and taxes. In some cases it is advisable to have a column for stores, wherein small cash purchases may be directly charged to Store account. Finally, as usual, we have a sundries column. These may be regarded as usual allocations in a manufacturing business, but, of course, will be varied according to individual necessities.

We may now take a general view of what is intended to be effected by the Purchases Journal and the Cash Journal. The latter is, of course, really two journals, one dealing with cash

receipts, and one with cash payments. It is only for convenience that they are combined in one book and it will be obvious that the two classes of transactions have very little to do with one another. Generally, however, provision is made for ascertaining the cash balance at the foot of each page, so that it may be made known in a moment without delay, but for all other purposes the two halves of this journal may be considered as separate books. We need only, at the present moment, to consider that side of the Cash Journal which relates to payments. The general purpose, then, of the Purchases Journal and the Cash Payments Journal is, in the first place, to acknowledge the source of the purchase and to credit either cash or some individual supplier, and on the other hand to charge the items thus acquired to one of several different accounts corresponding to the natural divisions of the business. At the beginning of the month we shall have had a supply of cash in hand, and at the end of the month part of this cash will have been transmuted into other things represented by the allocations in the Cash Payments Journal, and we shall also have received credit from various supplying firms, and the credit so received will have been transmuted into other things as shown by the allocations in the Purchases Journal. It will appear then that our cash has decreased, and our credit, that is to say our liability, increased. We may regard this matter as virtually a decrease in cash, because later on it will have to be met by a payment of cash. For theoretical purposes, therefore, we may say that cash has been transmuted into a number of other things, services and goods, and we will now proceed to trace these various allocations into their ledger accounts. On reference to the general diagram, a double column of ledger accounts will be seen near the left-hand side. For the most part these represent the different expenditures which have been made at the expense of cash. Thus, we have to begin with, "Stores Account," which as we have seen, may receive a charge, either from Cash Journal or Purchases Journal. Next, we have "Plant Account" which may receive an occasional charge through Purchases Journal. The third account is headed "Patterns, Jigs, Etc." This is rarely charged from outside sources, except in the rare case of a pattern or jig having been purchased from outside. The next two accounts, "Depreciation," and "Interest," are nominal accounts and do not represent anything in the nature of pur-

chase; we may, therefore, leave their consideration to a later period. "Rents Account" may also be charged either from Cash Journal or Purchases Journal. This account is merely typical of a number of separate accounts which would in the ordinary course be set up for such items as rent, different kinds of insurance, taxes, etc. In order to avoid unnecessary complications, one account has been made as representative of the entire class.

Now all these ledger accounts have in the diagram been placed in one group by themselves because there is a certain peculiarity about them. *The charges made to them month by month, are not necessarily, or even usually, expended on manufacture during that same month.* This means that each of these accounts will have a balance in it at the end of the month, representing the difference between *what has been put in* through Cash and Purchases Journals, and *what has been taken out* for purposes of manufacturing.

All ledger accounts in the right-hand group, on the other hand (except Interest), deal with items of such a nature that *they are passed at once* into manufacturing month by month, and, therefore, do not have any balance remaining in them. The Works Wages account, and the Works Salaries account are charged from the Cash Journal. The Works Expense account may be charged from either of the journals. Spoilage account, on the other hand, is not chargeable, usually, from either of these journals, but from another source about which we shall speak later. In addition to the ledger accounts shown in this double column, there are also other accounts which are charged to Selling Expense. The total effect of these transactions is that we have diminished our Cash account, *or have incurred liability which will ultimately lead to the diminishing of that account,* and we have piled up values received in one or other of a number of accounts which are named according to the class of purchase we have made. So far we have not dealt with any manufacturing operations and have merely paved the way by preliminary classifications of purchases in ledger accounts which classifications represent the subsequent uses of the articles purchased. A fresh set of transactions which will lead to the withdrawal of values from all these accounts and their combination in new form, either in the interests of selling or of manufacturing, has now to be considered.

Reference has been mentioned more than once to the fact that the accounts shown here are merely intended to be typical. They will in most cases require amplification and more particularly will require subdivision, as for example, in the case of Rents account, already just mentioned. Plant account also is normally subdivided into a number of different plant and equipment accounts. For example, buildings, machinery, tools, power plant, transportation appliances, office equipment, etc., will all have separate ledger accounts. But this is merely a matter of convenience, and not a difference in principle. Our purpose will be served if we consider the Plant account as typical of a class of accounts. It may be subdivided to any extent that is found necessary for any particular business. On the other hand, there is no manufacturing business in which the Plant account will be wholly absent and the same remark applies to all the other accounts presented here. When the Cash and Purchases Journals have been balanced up and all the postings made, the first stage in manufacturing accounting has been completed. This is by far the simplest stage, and except in as far as the title of the accounts themselves are peculiar to manufacturing, there is nothing special about this part of the accounting scheme that is not common to all businesses which begin by purchasing. Special peculiarities of manufacturing accounting will be found, on the other hand, to commence with the employment of the values which have been heaped up in the ledger accounts just discussed.

In the ensuing chapters the groups of ledger accounts concerned with manufacturing operations will be considered. Those which are concerned with selling expense are outside the scope of cost accounting and have been briefly dealt with in Part I in such a way as to show their relation to the general scheme of accounts.

CHAPTER IV

PURCHASES NOT IMMEDIATELY CHARGEABLE—STORES

It has been pointed out that while some purchases are chargeable immediately to production, as for example, the purchase of labor in all its forms, others on the contrary are not so chargeable. This may arise either from the transaction being a purchase in bulk, for storage, of articles that will gradually be used and charged only at the time of using, or it may arise from the nature of the thing purchased, as for example, a new building, or a large and powerful machine. It will be quite evident that a purchase of 10 tons of copper, when the average monthly consumption is only 1 ton, cannot be properly charged against the current month's production when it happens to be received, and still less can the purchase of a machine which will probably last for 15 or 20 years, be charged either against the current month or even the current year in which the purchase happens to be made.

In all cases where purchases are not immediately chargeable to production, it is necessary to set up mechanism for charging out a proper amount in each current period, and also for ascertaining the *balance* left on hand at the end of each such period. This balance is, of course, an asset, and the amount of it must appear in the Balance Sheet if correct accounting is to be realized.

I. STORES

The first group of purchases which we shall consider under this head of "purchases not immediately chargeable" is that commonly called "stores." This is a somewhat indefinite term, being sometimes confined to mere supplies such as oil or waste, and sometimes extended to all consumable articles which, at some time or other will be charged to the shops, either for direct manufacture or for service purposes. It is used in this work in the latter sense. The dividing line between stores and certain classes of tools and equipment is rather fine. A file is usually

considered as stores, and so are the blades of a hack saw. But the hack saw itself, even though its total cost may be far below the value of some single transactions in stores, is considered as equipment. The division is, however, quite clear in practice. Stores are charged when used. They are not subject to depreciation, and are not charged out by means of a depreciation rate. Items of equipment are never charged out as a whole, but always by means of a depreciation rate. The significance of this distinction will be understood later, when the meaning of depreciation has been explained.

Storekeeping is a complex process, since it involves not only a very large number of transactions, but each of these transactions is in itself manifold, and though not all of them become the subject of accounting, most of them must collectively or individually be reflected in the accounts. For the most part stores are purchased in bulk, and their receipt must be accompanied with a scrutiny to determine whether the delivery is strictly in conformity with the terms of the order, and in some cases with specification. The price has to be verified, the quantity vouched for, the cost of freight ascertained and combined with the price for accounting purposes, and then the stores themselves have to be allotted a definite space, a definite reference number or symbol, and a stores item ledger card appropriated to that particular class of goods. All these transactions have reference only to the receipt of stores. Their distribution to the shops and the question of balances on hand form entirely new series of transactions.

In order to issue stores to the shops, the storekeeper requires written authority, which not only is his voucher for parting with the goods, but furnishes the necessary data for the proper charging of the item to the purpose (represented by an "order") for which it has been consumed. The quantity involved is, of course, also recorded, and then the item has to be priced out so that the proper amount may be credited to Stores account and charged to the right division of production. It will be obvious that in the majority of cases stores issue transactions will be much more numerous, though for smaller amounts, than stores receipts.

Each different kind of stores, and in a large plant these will sometimes run into many thousands, usually requires a separate accounting both as to receipt and issue. A ledger card is therefore appropriated to each such kind or article, and the first entry

on it, as mentioned above, is that recording the receipt in bulk, and in some cases the cost of freight is also included. Later entries will record the different quantities issued to the shops, and also the order numbers to which they have been issued. At the close of each day, or week, or month, as may be desired, a balance may be struck on each of these ledger cards, and the balance shown, as regards quantity, should correspond with the actual quantity of that item actually and physically in the storehouse. In modern plants, a number of such comparisons between the quantity as shown by the ledger card and the quantity as ascertained by count or weighing are carried out every day. This is termed a "perpetual inventory." The term is not a good one. "Continuous inventory" would more nearly describe both the purpose and method of the work.

The principal ledger account concerned with stores is that shown on the general diagram as "Stores account." This, however, is merely intended as representative of a group of accounts, which though all Stores accounts, are for convenience allotted to particular classes of stores in some cases. Thus, for example, we may have several special accounts for brass, copper, pig iron, sulphuric acid, dyes, cotton, or whatever goods are bought with sufficient frequency or in sufficient quantity to make it worth while to provide a special ledger account for them and one general Stores account for all other kinds of stores. On the other hand, there is no absolute necessity for such subdivision of the Stores account. It is simply a matter of convenience, and where such subdivisions are not in use then a general account to be entitled Stores account or more properly Stores Control account will serve every purpose of the most rigid accounting.

When a Stores Control account is used, then it generally becomes desirable to have a number of strictly *subsidiary* accounts in which detail can be grouped as and when required, and this subdivision can be carried to any desired extent, until we have, as in some engineering businesses, thousands of such subsidiary Stores accounts. In the present work such accounts will be termed Stores Item accounts to indicate that they are subsidiary in character and merely represent the itemized detail of the transactions reflected in the Stores Control account.

If we have 100 transactions, say, for example, purchases of 100 different kinds of stores, and if we list these in a Purchase Journal,

then, as shown in the previous chapter, it is a simple matter to add all these amounts together, and charge them in one sum to a Stores account. Similarly if we have a list of another 100 transactions representing issues of stores to the shops, and list these in a suitable journal, then it is an equally simple matter to add all the amounts together and credit them in one sum to Stores account. Now when this has been done, if we take out the balance in Stores account, it obviously should agree with the actual balance of stores physically remaining in the storehouse. For many accounting purposes this is all that is necessary, provided that a "stock-taking" or inventory is made at regular periods to ensure that agreement between what should be in stores as shown by the account, and what actually is there as ascertained by count or weighing really does exist.

But under such an arrangement, if we find at the end of a period that our stores balance is $50,000, that does not tell us what quantity and value of the *different kinds* of stores we carry still remain in the storehouse. It gives no itemized detail. To obviate this inconvenience, the division of Stores account into several accounts is frequently desirable, as mentioned above, but this subdivision cannot be carried very far in the general ledger without becoming unwieldy. It will serve if we have say half a dozen important lines of stores, and 50 or 100 kinds that do not amount to very much. We can then provide separate stores accounts for the former, and one general account for the latter. But where our stores transactions are both numerous and range over a large number of different kinds of material, then it becomes advisable to employ the device of a General Stores control account, to which everything is charged and credited in lump sums, and a card ledger of Item accounts, to which the individual transactions are charged and credited.

The distinction between a Stores account, or several Stores accounts in the General Ledger, and one Stores Control account in the General Ledger controlling a number of Stores Item accounts in a card ledger, should be thoroughly grasped. In the former case each of the accounts ranks the same, and transactions must be subdivided before posting to the General Ledger at all. But when this posting is done, it is final. No further detail is available anywhere. Where a Control account is employed, all transactions can be listed and posted in one (monthly) total to the debit of the account, and similarly to its

credit. But in this latter case the individual transactions must themselves be posted, item by item, to the Item Ledger Cards, so that we have not merely the balance of stores in hand as shown by the Control account, but also we have the balance of each individual kind of goods on hand as shown by the Item Cards.

These Item Cards represent the different kinds of stores we carry. It must not be supposed, however, that, where Item Cards are in use, it is necessary to have a card for every single variety of stores. A card for miscellaneous or general stores can be set up, and everything charged and credited to this that is not represented by a special card. Thus if we have 1000 kinds of stores, we may have say 200 specially allotted cards for the 200 most important classes of goods, and lump all the rest together as miscellaneous. This is a matter for judgment in the individual case, but generally speaking it is far better to have a separate card for each variety of stores, as this minimizes the chance of error, and, when the ledger is once opened, does not increase the work as much as might be thought at first sight.

At any given moment the balances of all the Item Ledger Cards should equal the balance in the Stores Control account. No charge or credit must be made to the Control account that is not made also to one or other of the Item Card accounts. The Stores Control account lies in the main stream of the accounting system, while the Item accounts are merely explanatory of the lump sum entries in the Control account. It will be inferred, therefore, that from a purely accounting point of view they are not essential, and in fact their value is almost entirely an administrative one. They provide a control over stores, permitting frequent verification of balances in hand, signalling the consumption of stores below a given minimum, and permitting in some cases a considerable amount of planning in advance of the purchase requirements, so that the demands of the shops take nobody by surprise.

In a fully developed stores system, a Stores Item Ledger Card will be assigned to each different kind of goods used by the plant. These may run into the thousands, and it will therefore be evident that the physical arrangement of the cards and the physical arrangement of the storehouse must be brought into line. The grouping of the cards must be similar to the grouping of the goods as stored. And as it is more convenient and much quicker to pick out cards by numbers than by names, a carefully worked

out system of symbolizing and numbering stores is essential to the smooth working of the plan.

The creation of a symbol system is not the business of the accountant, inasmuch as symbols are a kind of shorthand that depends for its usefulness on purely technical considerations. Their possibilities will vary with each kind of manufacture, and they are found in practice in all stages of simplicity or complexity. In setting up a Card Item Ledger, however, the guiding factor will be accessibility, particularly to those items that are handled most frequently. While in a general way the arrangement of the cards must follow the symbol numbering system in use, the cards most in demand can be separately and conveniently placed, or alternatively can be distinguished by tabs or other signs so as to be readily identified.

If we assume the case of a new plant, the working of the Stores Item Ledger can be readily understood. As each consignment of goods is received with the corresponding invoice, it has a definite bin, rack, or other receptacle assigned to it, and at the same time a distinguishing symbol number. A card is then headed with the description of the goods and with this same symbol. The weight or quantity of the consignment and the purchase price are then entered on the card, and a price per unit quantity figured. At the end of a week, if no stores have yet been issued, the total found by adding all the card entries on an adding machine will necessarily equal the total of all invoices received for stores as disclosed by the amount charged against the Stores Control account. In other words, these Item Cards are the subdivision or explanation of the Control account total.

In the second week we will suppose that purchases have ceased and that issues have begun. Every issue will require pricing out at the current issue price found on the Item Card, and all transactions being listed, and their total amount credited to the Stores Control account, and further each transaction being individually credited on the proper Item Card, it follows that if we add all the credits on the Item Cards on an adding machine they must equal the total amount credited to the Stores Control account. It follows, from this and the foregoing paragraph, that as the charges on the cards are equal to the charges in the Control account and the credits on the cards are also equal to the credit in the Control account, then the balances of all the cards, if added on an adding machine must equal the balance in the

Item _____ Ref No. _____

Minimum Stock _____ Quantity to Order _____

Receipts (Add to Balance)		Transactions		Issues (Deduct from Bal.)		Balance		Current Price for Issues
Qt'y	Amount	Date	Order No.	Qt'y.	Amount	Qt'y.	Amount	

FIG. 32.—Stores Item Ledger Card.

Stores Control account. That is to say, if the balance in question is $50,000, the cards will explain how this balance is made up—so much in brass castings for valves, so much in lubricating oil, so much in 1-in. hexagon nuts, and so forth.

Figure 32 represents a typical Stores Item Ledger Card. In posting to this card, the date and order number are entered in the column headed "Transactions," the quantity and amount of the transaction, if a receipt of material, being entered in the left-hand column, and if an issue, in the right-hand column. To begin with, the original or initial receipt of the item is entered under "Receipts," and its quantity and amount also entered in the column headed "Balance." Then, as each issue is entered under "Issues," its quantity and amount is also *deducted* from the figures in the balance column and the new balance substituted. Similarly any fresh receipt of material is entered under receipts and its quantity and amount *added* to the figures in the balance column. By this means a running or continuous balance is kept, the object of which is to ensure that the stock of that particular item of stores shall not fall below a certain minimum level which has been determined in advance. At the top of each card will be entered both the minimum stock that should be always in hand, and also the proper quantity to be requisitioned when the minimum is approached. By this means unexpected shortages are obviated, and on the other hand, excessive stocks are also obviated, since both the minimum and the quantity to be requisitioned for replenishment are both specified.

At the right hand of the card a column headed "Current Price for Issues" will be observed. To begin with, this will be calculated on the purchase price of the goods, plus freight charges where these are important enough to be posted to the account. No further entry will be necessary in this column until a fresh receipt of goods has been entered, and only then if this fresh consignment *bears a different price from the earlier one.* When this happens, the entry is carried out as usual and the balance entered in the balance column. A new price is then calculated by dividing the total quantity in hand into the total amount or value in hand. The resulting figure is then set in the price column, and all future issues made at that price.

Figure 33 represents a more advanced form of Stores Item Ledger Card, in which provision is made, not only for keeping account of actual receipts and issues as they occur, but also for

Item _____ Ref. No. _____

Minimum Stock _____ Qty. to Order _____

Orders			Receipts (Add to Balance)		Transactions		Issues (Deduct from Bal.)		Balance		Current Price	Appropriations		
Date	O.No.	On Order	Qt'y	Amount	Date	O.No.	Qt'y	Amount	Qt'y	Amount		Date	O.No.	Unissued

FIG. 33.—Stores Item Ledger Card arranged for controlling future supply and consumption.

registering quantities on order from supply firms, and quantities appropriated to production orders already received, but for which the goods have not yet been drawn out of stores. It will be seen, of course, that these additional facilities are not matters of accounting, but are purely of administrative interest. Nevertheless, as the practice of looking ahead in this way is making rapid strides, it is as well that this additional function of the Item Ledger Card should be discussed.

The middle portion of the card is exactly similar to that just described and is used in precisely the same way. It takes care of actual movements of stores inward and outward. The division on the left hand headed "Orders" is intended to keep tab on orders sent to supply firms for the item, and on deliveries made on account of such orders. When a purchase order is sent out, the date and order number are entered in the columns provided, and the quantity is also entered in the left-hand column of those headed "On Order." When a delivery is made the quantity is crossed off. If on the other hand, only a partial delivery is made, then the original quantity is crossed off, but the balance yet undelivered is placed in the next column to the right. Thus if 100 articles are ordered, and only 75 delivered, the 100 is crossed off, and 25 put in the next column. A glance at this division of the card, therefore, shows exactly what quantities are still to come in, and also the date and number of the order.

This information is chiefly useful when read in connection with the division on the right of the card, headed "Appropriations." The object of this is to record future demands due to production orders on the item, so that when the balance actually on hand is considered, and the balance of undelivered goods on purchase orders also taken into account, the storekeeper can see whether it is necessary to requisition for further supplies of the item, without waiting for the minimum to be actually realized. Thus, if there is a balance of 40 articles on hand, and production orders are received and entered in the appropriations columns calling for 70 articles in the near future, it will be obvious that immediate steps should be taken to increase the stock. But on the other hand, if the orders column shows that a purchase order for 100 articles has been recently given out and that 75 articles have yet to be delivered on that order, then it is obvious that the situation is pretty safe. It is, of course, understood that as an issue is made on any of the production orders entered in the appropriation

columns, the original quantity is struck out and the new figure representing unissued balance substituted, just as in the case of orders, above described. By this means the appropriation columns show the balance of quantities appropriated to production orders but not yet issued, just as the order columns showed the balance of quantities on purchase order, but not yet delivered.

This advanced variety of Stores Item Ledger Card cannot be employed unless the administrative system of the plant is highly developed. It implies some kind of planning department in which each production order is dissected and a "bill of material" made out before actual manufacturing operations are commenced. Unless a mechanism of this kind exists the simpler form of ledger card should be employed.

Having now shown how each different kind of stores is, or can be, represented by an individual Stores Item Ledger Card, which will disclose at any time the exact amount of such item that should be on hand, we may now proceed to discuss the regular routine of storekeeping, commencing with the receipt of goods.

CHAPTER V

STORES (*Continued*)

The operations of storekeeping begin, naturally, with the receipt of goods. The position of the storekeeper is somewhat similar to that of a banker. He is responsible for what he receives and this responsibility continues until he has issued it against a proper authority or voucher. It is obvious, therefore, that his duties will commence with a careful record of what he receives, and he must also ensure that what he actually receives coincides with what he is supposed to receive, *i.e.*, deliveries must be in strict conformity with orders and specifications.

The mechanism by which such conformity is insured will vary in different plants and industries. The checking of weights and quantities, the inspection of quality, the verifying of conformity to specification (which may in some cases involve chemical or mechanical tests) are not matters of accounting. We must assume, therefore, that each consignment is subjected to all necessary scrutiny in these respects, and that on being found acceptable, it is a proper subject for entry in the accounting system.

The principal operations involved in recording a receipt of stores are these:

Recording the quantity and description.

Checking with the order.

Checking with the invoice.

Checking the invoice.

Entering invoice in Purchase or Voucher Journal.

Entering description and price in Stores Received Book.

Posting each item to Stores Item Ledger Cards.

Posting total of stores purchases for month to Stores Control account.

The diagram Fig. 34 shows the principal blanks and books used in connection with stores accounting. The Stores Control account and its subsidiary Stores Item Ledger Cards are placed in the center of the diagram. The forms on the left have to do

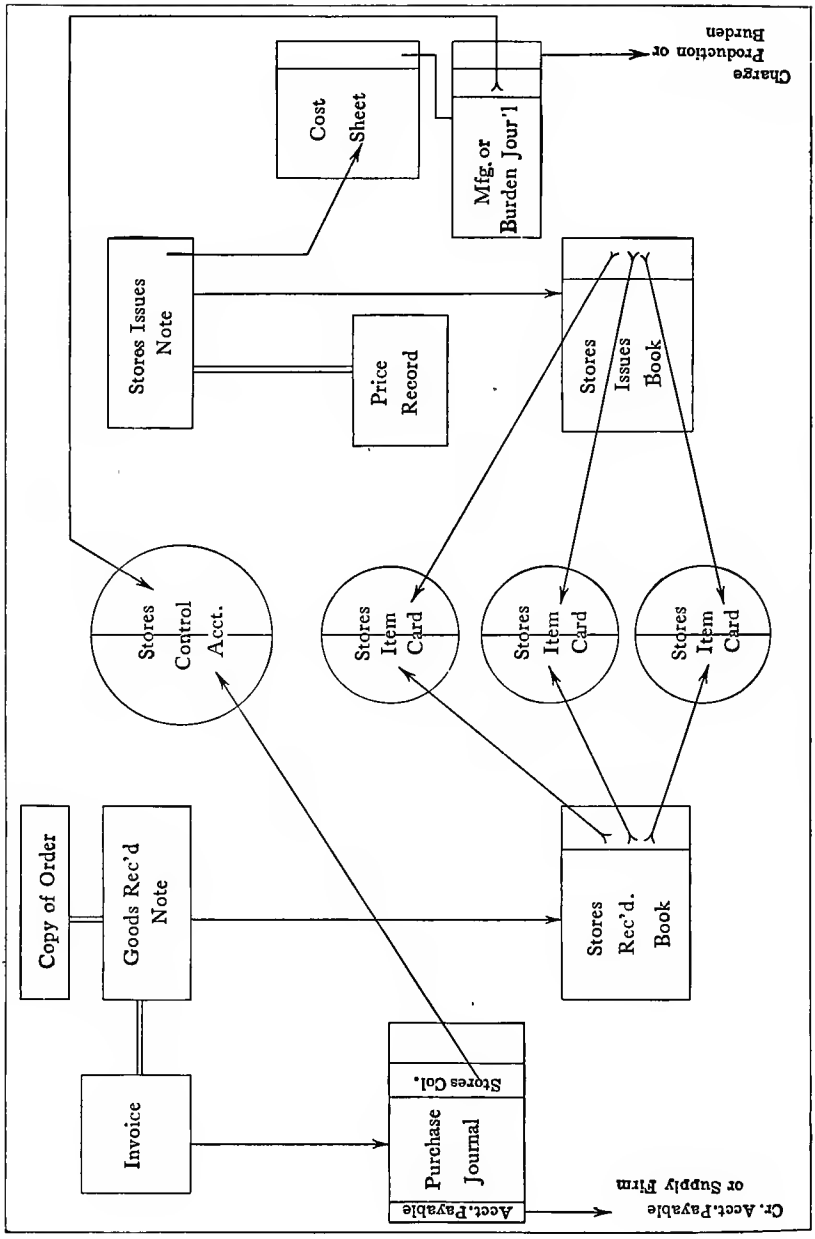


FIG. 34.—Diagram of stores accounting.

with charges to Stores accounts and those on the right to crediting the same accounts.

On receipt of a consignment, the first accounting step is to compare the quantity and description with the copy of purchase order which will be on file. If this is correct, a "Goods Received Note" (Fig. 35) is made out in duplicate. One copy is forwarded to the general office, and one remains on file. The copy sent to the office awaits the arrival of the priced invoice and is attached thereto if in order. The invoice is then checked up with the purchase order, as to quantity, description and price, extensions are checked, and the invoice certified as correct. The first step in actual accounting is then made by entering the invoice on the Purchases or Voucher Journal, and allocating the amount to the stores column. At the month end the total in this column is carried to the debit of the Stores Control account as shown in the diagram.

The individual items of stores received have now to be charged to the individual Stores Item Ledger Cards. We have already the quantity and description of each item on the Goods Received Notes duplicate retained by the receiving clerk. But so far the storekeeper, or the bookkeeper in charge of the Stores Item Ledger, has no knowledge of the price to be entered against each consignment. To convey this information to him various methods may be adopted. One way is to require invoices in duplicate from the supplying firm. One copy of these, after certification, is passed to the Item Ledger keeper for his use.

A less elaborate method is to pass the invoices themselves to the Item Ledger keeper, after they have been entered on the Purchases Journal. They are returned to the office after the necessary entries have been made from them. A somewhat better plan is to make use of the copy of the Goods Received Note that was attached to the invoice. After the latter has been certified, the price is marked on the note in the space provided, and the note itself detached and sent to the Item Ledger keeper who then has before him all the necessary data for his entries. And he can sort these notes into any order that will facilitate his work.

Whichever of these methods is employed, the entries should first be made in a Goods Received Book (Fig. 36). This provides columns for date, goods received note number, supply firm name, purchase order number, description of item, stores

GOODS RECEIVED NOTE MAIN STORES DATE _____ NO. _____

Received from _____

Per _____ Car No. _____ Package No. _____

Purchase Order No. _____ Inspected by _____

The above Consignment has been Received in Good Condition

Packages $\frac{\text{have been}}{\text{will not be}}$ Returned _____ Storekeeper

Checked with Purchase Order _____ Checked with Invoice _____

FIG. 35.—Goods Received Note.

reference number, quantity, price, two columns for price register and ledger card respectively, and amount. This book is the official record of goods received. It is the official source for charges to the Item Ledgers, and regulates the work of the stores bookkeeping in other ways.

Assuming that the certified and priced Goods Received Note method is that employed, the ledger keeper begins by sorting his notes into groups according to the classes of goods. He then turns to the index of Stores Reference Numbers, which is a classified list of all the different stores carried, with their reference symbols attached (described under Issue Price Register, below). These symbols he marks on the notes. He is then ready to begin making his entries. All the entries indicated by the above columns in the Stores Received Book will be easily understood, with the exception of the column headed "Price Register." This is only used if the new consignment alters, in any case, the issue price of the item, as will be explained later.

Having entered all his notes and endorsed them as entered by means of a rubber stamp or otherwise, these notes should then be sorted back in numerical order, so as to ensure that no notes have been missed in the course of their various handlings. Missing numbers should be traced and every consignment of goods thus accounted for in the Stores Received Book.

The next step is to post, item by item, all the entries in the Stores

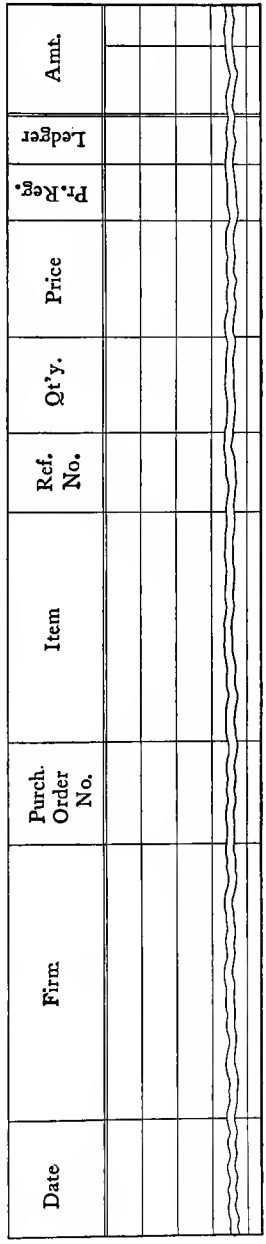


FIG. 36.—Goods Received Book.

Received Book to the proper ledger card, as indicated by the symbol number. As it is easy to make errors in such numbers, the precaution should be taken of verification by observing the name of the item on the card at the time of making the charge. As each item is posted, the new balance is taken out as described above, and if the new purchase price is different from the former issue price, a new issue price must be calculated and entered in the column provided. This new issue price must also be entered in the price register column in the Goods Received Book, so that the price may be recorded on the Issue Price Register as will be described presently. As the posting of each item is completed a check mark is placed in the column head "Ledger Card" to indicate that it has been dealt with.

When all these operations are completed, the ledger cards will be up to date as far as receipts are concerned. Nothing further can be done until the month end, when the following agreement must be made:

The total of the stores column in the Purchase or Voucher Journal must be agreed with the total of the amount column in the Stores Received Book. If any discrepancy exists it signifies that the Stores Control account and the Stores Item Ledger accounts will not agree if tested, and such discrepancy must, of course, be hunted down and rectified.

We have now to consider the other side of the diagram (Fig. 34). This has to do with the issues of stores, and the mechanism whereby Stores Control account on the one hand is credited with the total issues of stores for the month, and the Item Ledger Cards, on the other hand, credited with the individual issues of stores items as they occur. It has already been stated that before parting with any item of stores, the storekeeper requires some authority or voucher, just as a banker requires a written order or check. In practice, however, such authority varies in character, and does not always take the shape of a specific written order for each issue.

The difference between system and "red tape" lies in the more perfect adaptation to circumstance of the former. Red tape is in fact due to a kind of mental inertia that refuses to recognize differences where they exist, and attempts to apply general solutions to problems that are really different. A carefully designed system on the contrary is based on a full appreciation of consequences. It gives due weight to the relative importance

of things. If, therefore, it is to be recognized as a general principle that the storekeeper shall have authority for each disbursement of stores, that does not necessarily imply that a separate written order shall be forthcoming for the issue of a pencil, for replenishment of an oil-can, or for a pad of scratch-paper.

Authority to the storekeeper to disburse goods will generally take two forms. First, authority in the form of standing orders, which permit regular supplies of oil, waste, files, stationery and other current supplies, to be issued without the formality of written vouchers, control being based upon observation of the amount of such issues at regular periods. Secondly, authority in the form of written requisitions or vouchers, which specify the articles required, and the order number to which they are to be charged.

These latter requisitions, again, may take various forms. In some businesses by far the larger part of the stores that will be required on a given production order can be determined in advance with close precision. In such cases, the authority to the storekeeper takes the form of a specification or "bill of material" enumerating all the items that are required for each order. It is from such bills of material that the appropriation columns in the Stores Item Ledger described in the last chapter, are filled out. When this method is in use, all that is necessary to complete the system as far as the storekeeper is concerned, is some mechanism by which the signature of the person who actually draws out each item from stores can be recorded against each such item.

In other cases, either because the administrative system of the plant is not sufficiently advanced, or on account of the nature of the business, requisitions are made on the storekeeper only as and when the necessity for the item is discovered. Such requisitions must come from someone having recognized authority to make them, just as a banker will only honor checks on a corporation's account from officers who have received formal authority to sign them. Here again there is frequently an opportunity for red tape, namely, by so arranging that the person signing shall have only a perfunctory interest in the matter, as where a busy foreman has to countersign an order for a few bolts. It is far better to issue the bolts to the man using them, on his own application, leaving it to the foreman to hold the man responsible for any misuse of the privilege, which an exact system of stores

accounting could not fail to bring to light sooner or later. On the other hand, if the foreman has few enough men under him, so that he is in close touch with the detail of every man's work, then the requisitioning of stores may be confined to him.

The details of such arrangements will vary with each plant considered. Generally speaking, however, articles of the nature of regular supplies that do not enter directly into production orders will be handled most satisfactorily by standing orders for regular quantities, while all material entering into production directly must be authorized by either bills of material or individual requisitions or vouchers. In all cases the following elements will be necessary to a proper stores issue transaction:

Authority.
Kind of stores.
Quantity or weight.
Order number to which chargeable.
Signature of person taking away.

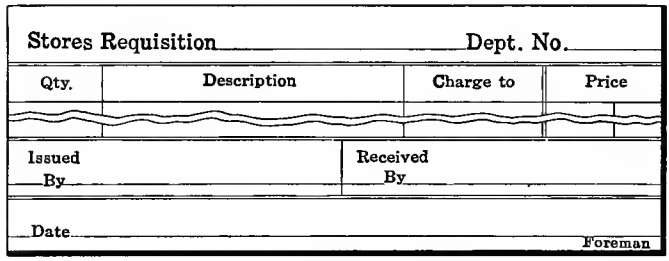


FIG. 37.—Stores Issues Note.

Figure 37 represents a Stores Requisition embodying these elements. Such blanks will be useful for all the ordinary transactions of issue. For stores issued on standing orders, a rough issues book can be kept in which columns are assigned for each of the above elements, omitting the first. As regards issues made on bills of material the procedure will vary according to the way in which the issues are made. When it is the practice to assemble all the items on a bill of material, and issue them in one lot at one time, the transaction is completed by signature of the bill by the person taking away the goods. Where, on the other hand, the issues are made at different times, it is perhaps simpler in the end to fill out a requisition for each issue, which can be signed by the drawer—a note of the requisition number being

made on the bill of material, thus avoiding the possibility of duplicate withdrawal.

The essential features of an issue transaction, from the storekeeper's viewpoint, are the obtaining of a record which shall clear his responsibility, and at the same time form the basis of pricing, so that the necessary accounting entries of the transaction may be effected. After issue of the goods he will be in possession of rough memoranda, either in a Standing Order Issue Book, or in the shape of signed bills of material and requisitions, indicating quantities and descriptions of stores issued, and the next step is to ascertain the money value of these transactions, or in other words, to price them out.

The pricing out of stores is always a troublesome matter on account of the great variety of kinds and sizes usually involved. Every article, though differing only minutely from another, as for example a series of nuts and bolts or wood-screws, has an individual price, and to make matters worse such prices in many cases are not stationary, but will vary with each new consignment of goods received. It is probable that greater inexactness creeps in at the pricing stage than at all other stages of storekeeping. Arrangements for identifying items, and ascteraining their correct issue price, demand therefore somewhat careful consideration.

In the previous chapter the manner in which the receipt of a consignment of goods at a new purchase price is entered on the Stores Item Ledger Card, and a new issue price calculated, was described. When transactions are few, this record will suffice, as the ledger card may be turned up, the current issue price ascertained, and the necessary entries made all at one time. Generally speaking, however, this simple procedure is impracticable. The ledger keeper will be too busy to attend to both pricing and posting and a separate pricing mechanism must be set up.

Figure 38 represents a convenient form of Issue Price Register. This is in the form of a "Rand" index, which consists of slips of paper enclosed in flat transparent celluloid tubes, each such slip and tube being independent of the others, and the slips, or any of them, can be pushed up and down in the frame as required. It follows that a new slip can be inserted at any point between any two existing slips, so that, if the slips are arranged in alphabetical order or by sizes, any new item can be inserted in its proper place. Just as a card index is in essence a book with

removable leaves (and the loose-leaf derivative of the card index is actually a book with removable leaves) so the "Rand" index is a leaf with removable lines. Its advantage over a card index is that each leaf can be run down with the eye, exactly as a dictionary or a directory, saving a great deal of time in turning over cards to find the required item. If, for example, we have one leaf devoted to "wood-screws," then all the range of sizes (up to about 80) are displayed before the eye, and the required size and its price can be picked out more quickly than by any other method of indexing. Also, should a new size of screw make its appearance in stores, a new slip bearing its data can be placed in exactly the correct sequence, according to the manner in which the reference has been arranged.

It will be easy to understand that a number of "Rand" index leaves, with their line slips, can be arranged so that any item of

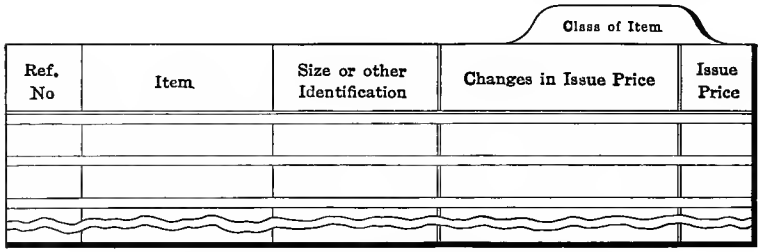


FIG. 38.—Issue Price Register (Rand index type).

stores can be found in short order. The leaves being classified by kinds of goods, form not only a pricing index but also a location index to the contents of the stores, if the stores reference numbers are a guide to the location, as they should be.

The column ruling of the slips will usually provide the following data:

Name of item.

Size, or other identification.

Stores reference number.

Current price.

In addition to the ruling on each slip, each leaf will have a tab at the top or side, specifying the class of stores dealt with on such leaf. Examples of such tab headings are: "Wood-screws," "Forgings," "Brass castings," "Dyes," "Oils," "Files," etc.

Supposing such an index to be compiled at the first starting of a

plant, it will be evident that arrangements must be made, first, for the regular and systematic addition of new varieties of stores, and secondly, for the regular alteration of issue prices, whenever, by the reduced or increased price of new consignments, the former issue prices are no longer correct. Such an arrangement was provided by means of a special column in the Goods Received Book (see above) headed "Price Register." The use of this column will now be explained.

When, in posting from the Goods Received Book to the Stores Item Cards, it is found that a new issue price is involved, this is worked out and entered in the price column on the card, as described above, *and also entered in the "Price Register" column in the Goods Received Book.* The same procedure is followed if the item is a new kind of stores requiring a new Stores Item Card to be made out for it. Only in the latter case, an indication, such as the letter "N" is placed alongside the price, to show that a new price slip must be made out for the item. A glance down this column in the Goods Received Book will show the pricing clerk exactly what price slips have to be altered, and what new ones are necessary. The data can be kept up to date in this way with a minimum of trouble.

The first step in accounting for stores issues is, then, the pricing out of the items issued and the affixing of the symbol number, if this is not already done. The next step is to compile an official Stores Issues Book, which bears the same relation to the credit side of the Stores Item Ledger Cards as the Stores Received Book does to their debit side. The information to be provided for in this book will naturally be the same as that on the Stores Requisition Notes.

As the number of transactions of stores issues is commonly much greater than that of goods received, it is desirable to economize work as much as possible. To this end it is advisable to post to the Item Ledger Cards from the original documents, and make summaries in the Stores Issues Book only by groups of items or by departments as may be found convenient. But as it is most important that the total in the Stores Issue Book should coincide with the actual credits to the card ledger, special precautions must be taken.

As soon as all the stores requisitions have been priced out, they should be added on an adding machine to ascertain the total amount involved. They should also be consecutively numbered

by a numbering stamp. The amount and the first and last numbers having been temporarily entered in the Stores Issues Book, the notes may be handed to the card ledger keeper for posting to his cards. As he does this he should stamp each Note to that effect. Whatever documents are handed to him should be treated in the same way, *i.e.*, some of the documents may be Stores Requisition Notes, others Bills of Materials, and others again the pages of the rough book kept for recording issues against Standing Orders. They should all be consecutively numbered and all included in the total. When he has entered all on his ledger cards, they are returned to the clerk in charge of the Stores Issues Book, and his first step is to see that all the numbers are

Stores Issued		Date_____ Sheet No_____	Total for Sheet $	
Order No.	Dept.	Description	Number	$
Job No.			Weight	
Order No.	Dept.	Description	Number	$
Job No.			Weight	
Order No.	Dept.	Description	Number	$
Job No.			Weight	

FIG. 39.—Stores Issue Record (sectional type).

returned, and that the total amount is accounted for. He then can proceed with entering up the Stores Issues Book.

The grouping of the items of stores issues in this book will depend upon the arrangement of the plant in the first place, and secondly, on the nature of the monthly returns that are expected by the administration. Stores issued on standing orders will form one group, those of production orders another group. Both these classes may be subdivided in various ways. Then in some plants a distinction will be made between departments, all the items issued to one department being entered separately from those in other departments. These distinctions will be discussed at a later stage, it being sufficient to note now that the whole of the stores issues must be entered in either one or several totals in the Stores Issues Book.

Figure 39 represents a simple form of Stores Issues record, suitable for a small plant or a repair shop. As each issue of stores is made, whether on standing or production orders, the quantity, description, order number, department, etc., are entered on one of the "sections" between the heavy black lines. Only one item is entered on one section. As each sheet is filled out, it is turned over to the pricing clerk to be priced, and the symbol number added, and at the end of the day or other convenient period, each sheet is added and the total amount entered on the stub at the top. All the stubs being aggregated, a temporary total is entered on the Stores Issues Book and the sheets are then passed under a knife (a cutting machine such as is used for photographic prints answers very well) and cut across at the heavy black lines. Each item is thus set free so that it can be sorted into any grouping desired.

The sections are first sorted in this way into groups representing standing orders and production orders respectively, and then any further subdivision by departments or series of order numbers is made by further sorting, and the final groups of sections are then aggregated on an adding machine and their amounts entered on the Stores Issued Book (Fig. 39*A*). The total of such groups must of course agree with the total of the stubs temporarily entered as above described.

The sections are then ready for the use of the Item Ledger clerk, who, in his turn, sorts them into whatever grouping is most convenient for him, and proceeds to post them to credit of his ledger cards.

Where many transactions have to be posted daily to a Card Item Ledger, and balances taken out, the work will be facilitated by using a keyboard arithmometer calculating machine of the "positive" type, such as the Monroe. The old balance is struck on the keyboard and transferred by a turn of the handle to the arithmometer dials, the quantity and amount of the issue or receipt is then struck on the keyboard, and a right- or left-hand turn of the handle either adds or deducts the figures, leaving the new balance visible in the dials. The importance of correct calculation of balances makes the use of a machine advisable where such balances are being taken out hour after hour.

The result of the transactions as to stores issues above described may now be seen as a whole. First, we shall have a complete itemized record of each issue in the form of notes,

DATE OF ISSUE	DAILY TOTAL VALUE ISSUED		SELLING DEPT.	STANDING ORDERS DEPARTMENT						PRODUCTION ORDERS DEPARTMENT						PLANT ADD'N ORDERS DEPARTMENT					
				1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
Thursday	$		$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$
Friday																					
Saturday																					
Sunday																					
Monday																					
Tuesday																					
Wednesday																					
TOTAL W.E.																					
Thursday																					
etc																					
TOTAL W.E.																					
TOTAL ISSUES FOR MONTH																					

FIG. 39A. Stores Issues Summary Book.

bills of material, rough issue book, or perhaps of the "sections" just described. The actual form is of very little consequence provided it fulfils the conditions laid down as essential. This record is then priced out and the proper stores reference symbol number affixed, if this has not already been done, and the whole of the items are then summarized in one or more groups and entered in a Stores Issues Book. Each item is also credited individually to the Item Ledger Card as indicated by the symbol number. We have therefore a number of individual credits on the cards and a total of these credits in the column of the Stores Issues Book. The next step is to verify this amount in some way, and to observe how it agrees with a credit made from another source to the Stores Control account. Before this can be understood some little explanation is necessary.

The object of recording each issue of stores in detail is not only for storekeeping purposes. It is also necessary for ascertaining manufacturing cost. The standing orders above referred to, for example, represent various classes of expense such as repairs, cleaning and maintaining machinery, running the power plant, etc., that do not go directly into any production order. It is necessary to ascertain the value and nature of stores issued against each of these kinds of expense. The standing orders are arranged so that such expense can be grouped intelligibly.

Similarly with regard to production orders. These are issued for the purpose of keeping the expenditure on each such order distinct from that on the others. Therefore even though no Stores Item Ledger were kept, it is still necessary to record and price out every item issued from stores so that its value may be entered on Cost Sheets. Every order, whether standing or production, has its own individual Cost Sheet.

Further than to note their existence and their purpose we have nothing to do with Cost Sheets at the present moment. It is necessary, however, to state that all the documents used by the card ledger clerk for entering up his credits (*i.e.*, Notes, bills of material, sections, etc.) are also used subsequently by the cost clerk for the purpose of making charges to his Cost Sheets. The items have been taken *out* of stores, and they have been put *into* manufacturing. So far the blanks and books described have had to do only with the former set of transactions. The way in which Cost Sheets are arranged and charged will be discussed later.

It is sufficient to say here that they are so charged and that

every item of stores issued is represented by an entry on one or another of the Cost Sheets. Consequently if we make a list of the stores values charged to Cost Sheets during any period, that list can be, and is, used as the official source of crediting Stores Control account and charging manufacturing accounts of various kinds with the value of stores consumed. It is this total that must be checked with the total in the Stores Issue Book, to ensure that all the credits to Item Cards when aggregated equal the credit made from manufacturing to Stores Control account.

The diagram of stores receipts and issues, Fig. 34, shows the relation of the different books and blanks involved. The Stores Issues Note (or its equivalent in other form) is connected by a double line with the price record, and by single lines with the Stores Issues Book on the one hand, and with the Cost Sheets on the other. From the Stores Issues Book lines are drawn to the credit side of the Item Cards, because theoretically such credits are made from the Stores Issues Book, though to economize work they are usually made direct from the original document and only a summary entered in the Stores Issues Book. It will be seen therefore that the story of the stores issues as told by the Item Ledger Cards will be the same as that told by the Cost Sheets, only the transactions will be classified in an entirely different way, namely, according to *kinds* of stores in the one case, and according to order numbers (that is to say according to the *uses* made of the stores) in the other.

It will also be understood that if we list the entries on the Cost Sheets which have reference to stores issues during say a month, the amount ought to agree with the summaries in the Stores Issues Book for the same period. This listing is effected in a journal, or rather in two journals, one relating to standing orders (or burden) and the other relating to production orders. And from these journals, only one of which is shown in the diagram, a credit is made to Stores Control account, which credit must be agreed with the total of stores issued as shown by the Stores Issue Book.

CHAPTER VI

STORES (*Continued*)—CONTINUOUS INVENTORY

The whole cycle of stores transactions has now been described. As regards the main stream of accounting it is very simple, as will be seen from an inspection of the diagram, Fig. 34. The invoice, representing a purchase of stores, is entered on the Purchases or Voucher Journal, and this ultimately credited to the supply firm (or to Accounts Payable) and charged to Stores Control account. The Stores Issue Note representing an issue of stores is entered on a Cost Sheet, and the current charges to this Cost Sheet being entered in a Manufacturing Journal at the end of the month, the value of the issue is ultimately credited to Stores Control account and charged to one of the manufacturing accounts. At any given moment there will be a balance in Stores Control account representing the value of stores on hand and not yet issued.

In some businesses this is all that is done to control storekeeping. In other businesses more than this is felt to be necessary, and in that case a set of subsidiary Stores Item accounts are set up and charged and credited in the manner described above. The balances in these Item Ledger Cards if added together will equal the amount of the balance in Stores Control account at any moment.

It has also been explained that one object of keeping Item Cards is to enable watch to be kept on the replenishment of stores, and in some cases, the planning of supply some distance ahead is also effected by using space on each card for a record of purchase orders given out, and appropriations to production orders.

Lastly, the employment of Item Cards enables the troublesome and costly process of periodical "stock-taking" to be eliminated. In place of the general upset involved in stock-taking, a regular routine is set up called a "perpetual" or "continuous" inventory which may now be briefly described.

As the balance of each item of stores that is supposed to be

on hand is known from day to day—a fresh balance being made after every new receipt or issue—it will be obvious that it is a simple matter to verify the accuracy of such balance by simply counting or weighing the articles in question. If then matters are so arranged that the items most frequently used, and those of which the unit value is high (such as brass or copper) are verified at frequent intervals, and the less important materials less frequently several valuable results are attained. In the first place, the physical verification is more likely to be correctly made than when done under the pressure and scramble of a general stock-taking. Secondly, the fact that frequent comparison of actual stocks with their book amounts is made has a satisfactory influence on the men who are responsible for issues, and makes them more careful to see that proper record is made of every transaction, and that nothing is given out without a record. Thirdly, expensive mechanical appliances for weighing and counting, that greatly reduce the amount of the work and increase its accuracy, can be employed, since a large number of such operations are not being carried on simul-

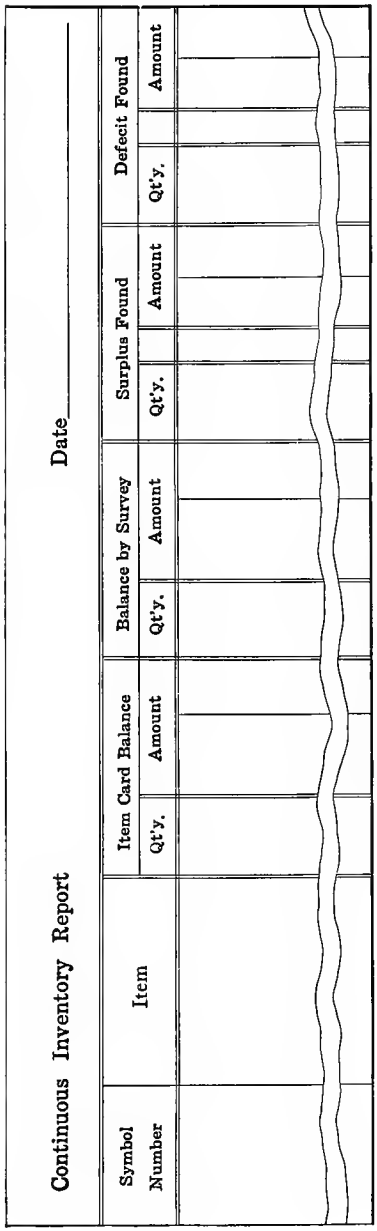


FIG. 40.—Continuous Inventory Report.

taneously. Finally, stronger confidence is felt in the accounting when it is known to be supported by a continuous verification of this kind.

The system of continuous inventory should be carefully planned in advance. The whole of the stores should be reviewed and scheduled so that the stocktakers give the right amount and frequency of attention to the important items. And systematic record of discrepancies must be made, not only because they must be adjusted in the books, but also to ascertain where and why errors occur with greatest frequency.

Figure 40 shows a suitable form of Continuous Inventory Report. The principal provisions are: symbol number; description of item, size, etc.; quantity and amount of balance on hand as shown by the Item Ledger Card; quantity and amount of articles actually on hand as found by survey; and two further columns to take care of the difference between ledger and survey values, one being for all cases in which a surplus is found, that is to say, where *more* articles exist in the storehouse than are indicated by the Item Card, and the other for all cases where a deficit is found, that is, where fewer articles are found by the survey than indicated by the Item Card.

The question of the disposal of discrepancies is a matter of some difficulty, since it is not obvious at this stage how they have originated. Of course if a discrepancy is serious in amount, whether of the nature of a surplus or a deficiency, every effort must be made to trace it, and discover how the error has been brought about. But minor errors will certainly be found and though each of these may be inconsiderable, and moreover some being deficits and some surpluses, will tend to cancel out, still it is obvious that they must be dealt with somehow in the accounts in a systematic way.

If, on taking an inventory of a particular item, it is found that there is a deficiency, say only 50 articles worth $10 where the Item Ledger Card shows an expected balance of 80 articles this discrepancy may have arisen from one of several causes. First, it may have been due to a failure to post a credit from the Stores Issues Note to the Item Ledger Card. Or it may have been due to the articles having been taken out of stores without any record being made of their issue. Or such a record may have been made, but lost. This loss may have taken place (in the absence of proper precautions as described above) after

entry was made on the Stores Issues Book, and before entry on the ledger card.

Now some of these errors are confined to the Stores Item Ledger and some have a wider effect. A mere failure to post an entry would be rectified by making a belated entry after survey had shown the discrepancy to exist. But if an issue has been made without any record, then Stores Control account, Cost Sheets, and Stores Issue Book will all be wrong, as well as the Stores Item Ledger itself. If a record was lost between the Stores Issues Book and the ledger clerk, this would have the effect of a failure to post, and could be rectified in the same way, but if the documents are used by the cost clerk after the ledger clerk, then Cost Sheets would be in error also.

If it is possible to add the balances on all the cards on an adding machine at the end of each month, and check the total so obtained with the total in Stores Control account, and this can readily be done if the number of cards is not too great, then we divide errors at once into two classes—errors of posting and failures to record issues. Discrepancy between the total in the Control account and the aggregate total of all the cards is obviously a bookkeeping error, but if these agree, and discrepancies are found between the item card balance and actual survey, these latter will be due to either failure to record issues or to incorrect record of issues.

With knowledge of the correctness of the card totals, rectification of discrepancies can be made on a surer basis. If during a month a net shortage of stores amounting to $50 is discovered by survey, this amount is really chargeable to Manufacturing, since it represents items that should have been charged out but have not. As it will probably be impossible to ascertain to what order number it ought to have been charged (unless any individual item is considerable) all we can do with it is to charge it to Works Expense, by which means it will ultimately be distributed over Production in the shape of burden. This can be done by a journal entry each month.

On the other hand, if a comparison of the totals of all the cards with the balance in Stores Control account reveals a larger balance in the item cards than in the Control account, this discrepancy is not chargeable against anything, because the Control account balance is the true accounting balance, and the Item Cards are mere memoranda which have failed to tally

with the official account. In general such a discrepancy will mean failure to post one or more stores issue items, though, of course, it may also imply a simple clerical error either in entry or calculation of balances. If such errors persist, the remedy is more careful posting and in particular, verification after each set of postings of the amounts so posted, and the resulting balances. This is troublesome and takes time, but on the other hand incorrect records are worse than useless.

The simplest way of verifying postings of stores issues is to enter them in batches of say 50 at a time. First the total charges on the 50 notes are added on a machine. Then the postings are made, the former balances being noted on a long slip of paper. The new balances are made, entered on the card, and also on the slip of paper alongside the previous balance. When all the 50 entries have been completed, the old balances on the slip are added up, and the original total of charges added to this amount. The two together will equal the total of the new balances. If a discrepancy appears, the list is cut in half, and the additions made on each half. This will confine the error to one of 25 entries, which can then be compared until the faulty one is discovered. Generally speaking the idea is to confine possible error to small groups of entries and clear up the verification of each group before proceeding.

This question of errors in Stores Item Ledgers and discrepancies with surveys has been discussed at some length because not infrequently a system of the kind is installed and subsequently abandoned as unworkable owing to the discouraging amount of errors and discrepancies constantly coming to light. And of as has been pointed out, such errors may mean several things, may come from various sources, and demand different methods of rectification. But the discouragement experienced from the high percentage of discrepancies would be largely obviated if it was felt that the balances on the Item Cards were at least to be depended on from the bookkeeping viewpoint. This can come about only by monthly comparison of the total balances in the Item Cards with the balance in the Stores Control account, and in general a perfect agreement between these can only be secured by a system of verifying postings as they are made, as just described.

But if we are sure of the correctness of our cards, and that they really represent all the *recorded* transactions, then the field is

narrowed down considerably if surveys disclose considerable discrepancies. For as pointed out above, such discrepancies can only arise from carelessness in making issue records, either in the way of issuing stores without any record at all, or from incorrect records as to kinds and amounts. This being the case, the proper remedy is obvious and is not difficult to apply.

There is, however, another possible error in Stores records of an even more subtle character, easy to make and very difficult to detect. This is an error in pricing. If, in pricing out a Stores Issue Note, for, say 15 articles, the unit price is read as 18 cts. instead of 23 cts., or if a wrong extension is made, the error is fundamental, and goes through the whole stream of accounting with very little chance of detection, unless Stores Items Cards are in use, and not very readily even then.

The only way in which such an error could be discovered, unless by accident, would be at the moment of entering a new consignment of stores received, and the averaging out of a new issue price. It would only then be discovered if the new price looked suspicious to the ledger clerk. It is therefore desirable to have all issue pricing checked carefully before proceeding to make use of the figures, as in no other way can errors be detected with certainty, and even if detected at a later stage it would involve too much trouble to set them right unless the individual amounts were considerable. Moreover, such attempts at rectification after the event are apt to lead to immense confusion, as unless altered at every stage of their career (as for instance on the Stores Issue Note, in the summary total in the Stores Issue Book, on the Item Cards, and on the Cost Sheets) it would simply mean that balances are upset, with probably a long search before the cause was found.

In all the foregoing discussion of the routine of recording receipts and issues of stores, it has been taken for granted that goods are invariably coming in, and stores invariably going out. As a matter of practice this is not always so. Goods are sometimes returned to the suppliers, and stores issued are sometimes returned from the shops. As regards the former class of transaction, this will not, in most cases, affect the accounting, since such rejections are commonly made before the invoice has been accepted, or any record made of the receipt. But as regards issues, this is not so. Returns of surplus material into stores, which has been taken out but not all used for a given piece of work,

are of not infrequent occurrence in some cases. Such transactions can, if not too many, be dealt with in the ordinary journals and Received and Issue Books, by making the entries in red ink, thereby signifying that the usual charges and credits are reversed. Postings can then be made accordingly. But in large plants it is sometimes desirable to keep separate journals and receipt and issue books for such purposes.

Such books would be: Purchases Returned Journal; Goods Returned Book on the purchases side; and Stores Returned Book on the issues side. Goods Returned Notes and Stores Returned Notes would also be provided. The relations of these various books and documents will be obvious without further description, especially on studying the diagram, Fig. 34, as they simply reverse the operations which have been fully described above. It will, of course, be understood that no entries will be made in these books except to reverse charges or credits *that have already been made.* Thus if a consignment of goods has been received, but not accepted in any way, or any entry made regarding it, it is obvious that it does not require taking out of the records by a reverse operation. But where such books are provided it is usual to enter all transactions as they occur, so that, for example, an invoice would be passed through, and record of its rejection made in the Purchase Returned Journal. Whether or not this elaboration is necessary or desirable depends upon local circumstances.

In the absence of a proper mechanism for recording return of surplus stores, however, the bad practice frequently obtains of issuing certain kinds of stores on memorandum, such for example as a piece of bar steel, from which a piece has to be cut. Then when the steel is returned, the net weight used is made the basis of a stores issue note, and passed forward in the usual way. This may not be for some time afterward, and the transaction may be forgotten or the memorandum mislaid. It is, therefore, better to have a proper mechanism for returns into stores, each transaction being thus recorded at the time it happens, with a probable minimizing of errors. As stores returns are much more frequent as a general rule than returns of goods purchased, the method of red ink credits can very well be used for the latter, even when the former is provided for by special Stores Return Notes and corresponding Stores Returned Book.

Stores chargeable to Selling Expense. In most cases there will be a small proportion of items issued by stores each month to the

selling department. A special column is provided in the Stores Issues Book for the record of such items. The total of this column forms the authority for an entry in the Selling Expense Journal, and does not affect the factory accounts at all.

CHAPTER VII

PURCHASES NOT IMMEDIATELY CHARGEABLE—BUILDINGS AND PLANT

While stores may be defined as the materials *with* or *on* which we carry out the operations of manufacture, plant may be defined as the devices *by* which such operations are effected. Though buildings are of sufficient importance to be classified by themselves, they are really a variety of plant, and in some instances, as in the case of ovens, furnaces, hearths, etc., it is difficult to draw a hard and fast line between them. In the general diagram, therefore, the general term "plant" is used as representative of a class of purchases, wholly different from stores in the main, since they are not immediately consumed or used up, or changed in the course of their employment, and hence cannot be charged to any particular order or use.

In practice, plant is usually subdivided into buildings, machinery, power plant, electric equipment, cranes and transporting appliances, transmission gear, permanent and perishable tools, factory fixtures, office appliances, and so forth. Most of these items enter the accounting system by means of purchase, though this is by no means always the case. Factory fixtures and tools are quite as often made by the firm itself as they are purchased.

There is also, in many industries, another variety of plant, usually made or constructed by the firm itself, though sometimes purchased from outside. This may be described as auxiliary equipment, such as patterns, molds, dies, jigs, machine fixtures, shoe lasts, printing rolls, and in general all such articles as are of the nature of special equipment of which the use is confined to the production of one kind of article, and is of no use for other kinds.

From an accounting viewpoint the peculiar and distinguishing feature of plant is that it is chargeable against Production by what is termed depreciation, that is by a regular amount proportionate to the expected useful life of the plant item. Though this amount is usually calculated on a time basis, as for instance

in the case of a building costing $20,000, and expected to last 40 years, the annual charge against Production will be $500; yet such charges are sometimes calculated on other bases. A furnace for example may cost $4,000, and have an expected output, before it has to be rebuilt, of 8,000 tons, in which case a charge against Production can be based on the anticipated tonnage, instead of the expected years or months of life. The cost of the furnace would thus be charged to Production at the rate of 50 cts. per ton.

From these instances it will be seen that a depreciation charge is not a definite or hard and fast thing like the purchase price of a pound of brass rod. Though the original cost of the item of plant is always known with as much precision as the cost of the rod, when it comes to charging Production, or in other words making an issue price, there is a great difference between stores and plant. The brass rod is weighed, issued, and used up there and then, and the issue price of a pound is prorated from its cost price per ton. But when we buy a machine for $500, we do not cut bits off it and issue them against specific jobs. We cannot say that this or that job has used up $5 worth of the original value of the machine. We are really obliged to make a guess at the amount by which the value of the machine has been diminished or used up on account of its use on a particular job. And though this guess may be refined, and based on experience, it is nevertheless true that all depreciation rates are very approximate in their nature, and liable to be affected by causes quite unforeseen at the time the rate was first estimated and fixed.

For example, the useful life of a machine depends to a great extent on the manner in which it is used, and on the practice of the shop with regard to cleaning, caring for and maintaining its machines. It also depends on the degree of intensity to which it is worked, whether for 8, 16 or 24 hr. per day. If habitually overstrained its life is shortened, to say nothing of possible accidents which may permanently enfeeble its constitution.

Nor is this all. Even though a machine is used fairly and uniformly as contemplated when the rate of depreciation was fixed there is another influence that may shorten its period of usefulness in an unexpected way. The progress of the technical art in which it is employed may develop more efficient machines for doing the same work, so that it becomes advisable to scrap it long before it is worn out. The machine becomes obsolete, and loss of value from this cause is called "obsolescence."

Again, unless the machine is of a very generalized type, such as an engineer's lathe, another type of misfortune may overtake it. If it is a machine that can be used only for certain definite kinds of work or some special article, as for example many of the machines used in automobile and bicycle manufacture, it may happen that changes in demand, or in style, make the manufacture of that special article no longer profitable. In this case, unless the machine can be transformed for another use, it is a dead loss.

All these remarks apply to plant and equipment in general, but they apply with much greater force to what has been termed auxiliary equipment, patterns, jigs, molds, and all that class of articles which are used to make other things with, and can only as a rule be used for making one specific thing. This class of equipment provides some of the most troublesome problems that the manufacturing accountant has to deal with, because the element of uncertainty becomes greater in proportion to the degree of specialization of the equipment.

In those industries that are dependent on the changes of fashion, as for example in the manufacture of shoes, wherein the cost of lasts will sometimes bear an appreciable relation to the cost of manufacture, and in the engineering industries where complex patterns and jigs are necessary, necessitating high-priced workmanship and some of the most accurate work that is known to industry, the difference between profit and loss may reside in a correct solution of the charging of auxiliary equipment to production on a proper basis. But the selection of a just basis for charges is a very difficult matter, as not infrequently the future demand for the product for which the auxiliary equipment is made cannot be foreseen with any approach to accuracy. And the dilemma is this; if we assume too small a future demand and throw all the cost of the auxiliary equipment on this, the increase of cost thus brought about may handicap the selling possibilities; or, on the other hand, if we overestimate the demand, and make a lower charge to production accordingly, it may happen that when demand has ceased, the auxiliary equipment is not all paid for by being charged out into cost, and a loss is thereby incurred that is not recoverable in any way, and may in fact wipe out a large fraction of the profits supposed to have been made by the manufacture of the product.

From the foregoing it will be understood that depreciation

rates on buildings, plant and equipment vary among themselves. A building which lasts 50 or 70 years and a pattern expected to be used for a dozen articles only, will obviously be charged to Production at very different percentages of their original cost. And between these limits practical experience has worked out a range of customary depreciation rates for most of the items of plant and equipment used in modern industries, and though it cannot be said that different authorities exhibit any too close an agreement on these rates, still there is a considerable amount of experience available in fixing them. Moreover, the problem is simplified from the accountant's standpoint by the fact that such rates are usually applied uniformly to whole classes of equipment, on the principle of average. In general the accountant will not fix these rates, since the problems involved are of a technical nature, and his interest in them is confined to arranging the mechanism of charging them to Production. Nevertheless, when it comes to the apportionment of charges for auxiliary equipment, a watchful attitude on his part as regards the effect of whatever rates have been fixed in wiping out the original cost of such equipment with sufficient rapidity may be very valuable indeed.

Once the question of depreciation rates has been settled, and the rates have been fixed, the accounting of buildings, plant and equipment can be considered a simple problem. It is usual to provide ledger accounts for these items, and a separate account for the monthly amounts charged for depreciation, the latter being journalized half yearly or yearly, and so transferred to credit of the various plant accounts.

The diagram, Fig. 41, shows the general relation of Plant accounts to Purchasing on the one side and to Manufacturing on the other. In the center of the diagram a Plant account is shown, which as in the similar diagram for Stores, may be taken as representative of a Control account. The small circles below represent the Plant Ledger Item Cards, which correspond in function to the Stores Item Ledger Cards previously described. That is to say that they are the subdivisions of the balance at any time existing in the Control account. The journal on the left side is the medium for charging Plant accounts, and on the right the method of crediting depreciation to the Plant accounts is also shown.

Items purchased are charged to Plant accounts through the

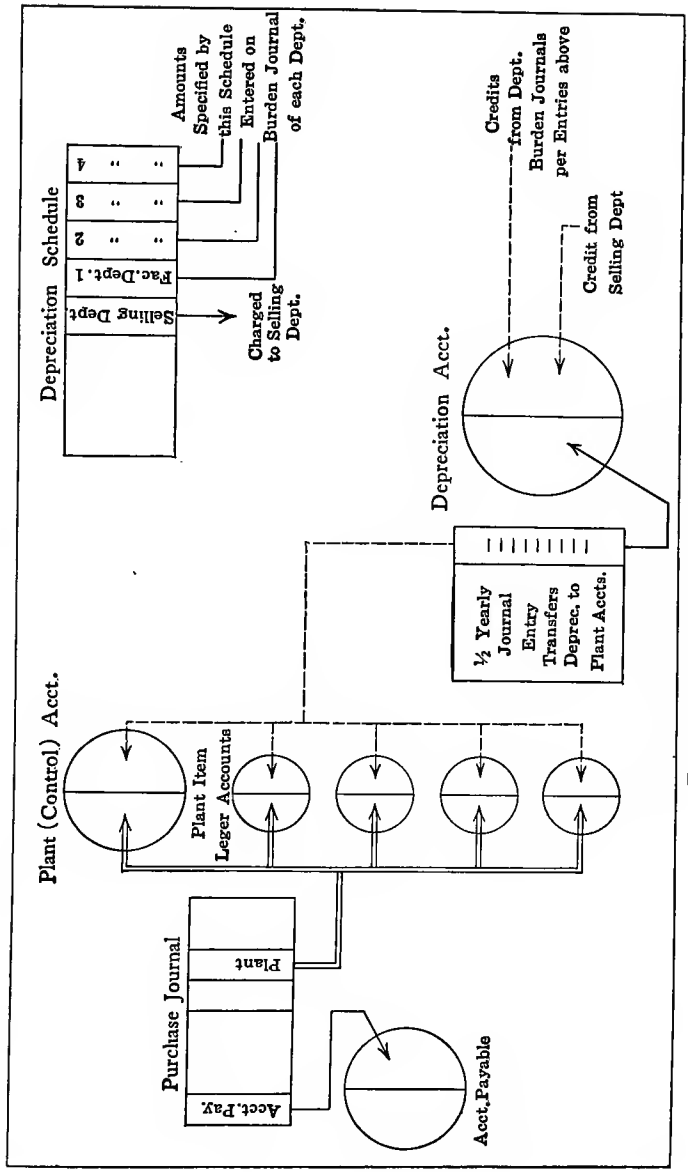


FIG. 41.—Diagram of Plant accounts.

special column in the Purchases Journal (or Voucher Record Journal) and are credited to the supply firm or to Accounts Payable, as explained in the chapter on Purchases. Another journal (not shown) is a special one, and takes the place of the Purchase Journal in those cases in which items of plant or equipment have been made in the shops instead of being purchased from outside. Each such item is entered and the total for the month credited to Manufacturing account instead of to a supply firm. The charges to Plant accounts are made in exactly the same way as those from the Purchase Journal. It may be regarded as a journal dealing with "purchases from selves." The items could in fact, in a small plant, be passed through the regular Purchase Journal if a special column were provided on the credit side so that credits to Manufacturing account were thus separated from those arising from actual purchase.

The other side of the diagram requires more explanation. It has already been explained that the cost of plant is not charged directly to Manufacturing, but through the medium of what is called a depreciation rate. As each class of plant requires a different rate, it is necessary to set up some mechanism whereby the total depreciation for each such class for a year can be calculated and can be allocated in the proper amount to the various departments of the factory. The Depreciation Schedule (see below for a detailed description) is arranged to perform this function, and by its means entries are made in the Burden Journal of the proper amount due to each department. At a later stage than that with which we are now dealing, these depreciation figures are charged to Production on some selected basis, and credited to Depreciation account.

The credit balance in this latter account is, of course, a set-off against the cost of plant as it stands in the Plant ledgers. If the value of plant as shown by the Control account is $50,000, and the amount of depreciation credited the first month is $500, then it is obvious that our plant is only worth $49,500. But it is not necessary to perform the clerical work of crediting each individual Plant Item Card each month with the amount of depreciation thus charged to Manufacturing. The Depreciation account is, therefore, intercalated in between Burden Journal and Plant account. It serves to receive and store up credits on account of depreciation until such time as it is convenient to transfer the items to the credit of Plant. This may be done yearly

or half yearly according to the financial period of the firm's accounts. When it is done, Depreciation account is, of course, clear, and the various Plant Item accounts, as well as the Control account, have diminished balances by just the amount so transferred.

The cycle of operations regarding plant will now be quite clear. First, we have a ledger account or accounts which are Control accounts for the principal divisions of our plant. These, for example, may be titled, Buildings, Machinery, Power Plant, and so forth, and each of them will have a particular section of the Plant Item Ledger Cards devoted to that class of equipment. The balances on all the cards in any one section will agree at all times with the balance in the Control account pertaining to it. No charge or credit must be made to any Item Card without the corresponding Control account being also charged or credited at the same time. But while the Item Cards are charged with individual transactions the Control accounts are charged only with monthly totals of such transactions.

The mechanism of charging the Plant accounts is simple. Charges have two sources, one arising from purchases from outside firms, the other arising from transfers from the shops (purchases from selves).

Credits to plant accounts, except in the exceptional case of plant being sold, in which case a special entry would be made in the General Journal to cover the transaction, are made by means of depreciation rates. These rates are calculated by means of a Depreciation Schedule, and entered on a Burden Journal, of which the use will be described later. This journal credits Depreciation account each month. At some convenient season, usually the end of the firm's financial period, these credits are transferred to the various Plant accounts. This completes the cycle.

We have now to consider in more detail some of the blanks and books by which these transactions are carried out. The central feature of the system is necessarily the Plant Item Card Ledger (Figs. 42 and 42A). As in the case of the Stores Item Card, this is usually so arranged as to afford facilities for information not pertaining strictly to the main line of accounting, but of great value from the administrative point of view. The form suggested in this figure provides for the following data:

1. Ledger account, with columns for charges, credits and

Class of Equipment	1	2	3	4	5	6	7	8	9	10	11	12	No.

Description

Maker_____ Date Bought_____ Est Life_____ Years. Dep. Rate_____%

Record of Repairs Estimated Actual Repairs $_____ Yearly

Date	Nature of Repairs	Cost	Date	Nature of Repairs	Cost
	Forward			Forward to New Card	

FIG. 42.—Plant Item Ledger Card (face).

Idle Time Record																								

LEDGER ACCOUNT

Date	Item	Debits	Credits	Balance

FIG. 42A.—Plant Item Ledger Card (reverse).

balance. The cost of the original purchase, with any added items for freight, installation, etc., is posted from Purchase Journal to the column headed "Debits." The annual credit for depreciation transferred from Depreciation account is posted from the General Journal to the column headed "Credits." The balance column shows the present value of the machine. Should the machine be sold the amount will be journalized in the general journal, and posted to the credits column, thus eliminating all balance. In most cases this will entail a loss, since it is hardly to be expected that the price obtained will be equal to the existing book value of the item. The difference will be taken care of in the journal entry, being carried to Profit and Loss. Thus if the book value of the item is $509 and it is sold for $200, the journal entries will be as follows:

Cr. Machinery account (and item card).....	$500
Dr. John Jones (purchaser).....	200
Dr. Profit and Loss (loss on sale).....	300

Until the machine is sold, however, its present value (at the end of each financial period, after all depreciations have been credited) will appear on the card, and the total of all such balances in any given section of the Item Ledger will agree with the balance in the corresponding Control account.

2. Idle Time Record. This will be found immediately above the ledger account. It consists of spaces in which the number of hours in which the machine has been standing idle and unused during a month is entered.

3. The face of the card is headed with a series of numbers, each of which represents a different class of equipment and each of which should be represented in a separate Control account. Thus, section 1 may mean buildings; section 2, power plant, etc. Tabs or signals are affixed to the top of the card, making a cross-index by classes of equipment.

4. The next space on the card is for the purpose of registering data about the machine: condensed description of it, name of maker, date bought, and, for purposes of depreciation, the estimated years of useful life, and the depreciation rate which it has been decided to apply to it.

5. The remainder of the card is given up to a record of the repairs and their cost, which may be necessary during the life of the machine. This record, though in terms of cost, is

only a memorandum and is in no sense a part of the accounting scheme. It merely serves to record the frequency and cost of repairs, so that a general idea of the behavior of the machine may be gathered by the technical men concerned. It is not at all necessary that this information should be collected on the same card as the real accounting items. In fact, for reasons of accessibility in large plants it may often be better to make it into a separate record. The principle is not thereby affected.

The serial number of the item should appear at the top right-hand corner of the face of the card. These serial numbers are allotted to each machine as installed, and are usually painted in a conspicuous place on the machine itself. A system of numbering items of equipment is of the greatest possible service in many directions if properly carried out, but unless so carried out may become a positive nuisance and source of confusion. There are several ways in which the series of numbers can be arranged. The choice of a system will depend on what we wish to do, or in other words, in what way we wish to make use of the numbers.

Their prime use is to identify the machine with its record on the Card Item Ledger, wherein the original cost, makers, name and so forth can be traced—information of the utmost importance to have at hand in case of destruction of a shop by fire. Where technical data are posted to the ledger card as suggested above, quick reference to the right card is also necessary. But as machines and equipment generally are grouped according to the necessities of the shops, and cards are grouped according to the necessities of the accountant, it is not always easy to devise a system of numbering and arrangement of cards that will meet all demands on it without too much cross-reference and clerical work in keeping up indexes.

Generally speaking it is desirable to have a division by classes of Plant (corresponding to the Control accounts) and also by location of machines. It is frequently desired also to make the symbol number indicate what kind of machine, such as lathe, planer, etc., is in question. The value of incorporating this latter information in the symbol number is doubtful, and even when provided has but limited use. The main use of symbol numbers is this: "Given the number of a machine, where is the card referring to it?" A simple consecutive numbering of each item as installed would meet this case were it not for the necessity for grouping the cards for accounting purposes in

particular ways. For example, it is necessary to be able to identify at sight all the cards belonging to particular classes of equipment and therefore to particular Control accounts. Next, we require to have a division of the cards by departments, or in other words, by location of the item, and this latter arrangement must be sufficiently flexible to allow of frequent transfers of items from one department to another when machinery, motors, etc., are moved about the plant, as usually happens.

Perhaps the simplest way of meeting the problem is by allotting a letter to each *class* of equipment, and serially numbering each new item of that class as it is installed. We shall thus have as many series of numbers running as there are classes of equipment. A serial register will be kept for each of these series, and a number, once allotted to an item, say a motor or a lathe, *will always be identified with that item as long as it remains in the plant.* Then, to identify the item with a department, it will be well to assign numbers to departments, and add the departmental number to the above symbol. Thus if electric equipment is class E, and a new motor is installed and the next vacant number on the register is 345, that motor will henceforth be known as E345. If now it is located in department 7, the symbol will read E345/7. If later it is transferred to department 8, it will read E345/8. On the motor itself only the symbol E345 will be painted, since it will be obvious to anyone repairing it, for example, that it is in department 7 or 8 as the case may be. Further should it be retired from active service temporarily and placed in stores, the symbol will read E345/Stores which will at once signal that it is temporarily out of use.

The arrangement of the Item Ledger Cards will be as follows: Each card will be tabbed with its class letter, say E, as described above. All the cards for one department will be grouped together in serial order irrespective of their class letter. Then if it is desired to find E345/7, we shall turn to group 7 in the card ledger, turn up serial number 345, and if there are more than one of this number, reference to the tabs will serve to separate the one desired with a minimum of trouble.

By this means we can at any time ascertain the total value of plant of any class in any department, or of any class by itself, or of any department by itself as desired, and we can also promptly identify any item by its reference number. Further

if the departmental number is omitted from the symbol by mischance, it is not a difficult matter to look for E345 in one group after another, say three, four, or even ten groups, till it is found. This is a much easier matter than to identify a machine of which the number has been changed without record of the change being made, as is not infrequently the case where a system of numbering is adopted requiring fresh numbering at each transfer from one department to another. By this plan, also, separate indexes for the purpose of cross-classification are not necessary, although, if desired, lists of equipment by sub-classes can be compiled. Thus machinery can be subdivided into lathes, planers, shapers, etc. As the symbol number of an item is never changed, this entry has to be made only once, namely, when the item is installed.

The Card Item Ledger having been set up, and all the different items of plant and equipment posted from the journals, it will be evident that if all the balances on the cards belonging to class E are aggregated on an adding machine, they should agree with the total balance in Control account for electric equipment. In some cases, it may be considered advisable to subdivide the control account departmentally, so that the total of class E for each department is shown separately. This is easily done by providing a ledger page with several columns, each such column representing a department. If this arrangement is adopted, then the balance in each such subdivision should agree with the class E cards by their departmental classifications. The arrangement is obviously convenient for many purposes, in localizing errors, for example, but it has the disadvantage that every transfer of an item of equipment from one department to another will require adjustment in the control account, by transfer of the value of the item from one column to another, with a consequent rectification of balances.

The principal object for which classifications of plant and equipment are required from the accounting viewpoint is for the correct allocation of depreciation to departments. To do this effectually something more than a ledger account is required, and for this reason it is well to keep the latter as simple as possible without departmental columns. The mechanism by which the plant is plotted out so as to exhibit its relation to departments on the one hand and to depreciation rates on the other is termed a Depreciation Schedule, Fig. 43 (see also diagram, Fig. 41).

One sheet of such a schedule is devoted to one class of equipment, say electric equipment. The various items of equipment are listed in serial order on the sheet, together with their book value, which is entered in the column headed "Total" under the subheading "Cost." Against each item is placed its depreciation rate, and the yearly amount of the depreciation calculated and entered in the next column. The remaining columns, headed "Department 1," etc., are for the purpose of distributing the depreciation to the departments in which the items are located. If, for example, a certain item is valued at $500 with a depreciation rate of 2½ per cent. this will mean a yearly charge to manufacturing of $12.50, which is entered accordingly in the third column under "Total." Now if this item is located in department 2, the following entries are made in the department 2 columns: First, the book value is entered; next, the yearly depreciation charge; and then, one-twelfth of this amount (or one-thirteenth where the plan of 4-week months is in use). When all the items have been thus distributed to departments the following agreements are made: (1) The totals of all departmental columns headed "Cost" should equal the total of "Cost" in the total column. By this means we obtain a summary of the cost of equipment for each department. (2) The totals of all departmental columns headed "Yearly Depreciation" should equal the same item in total column. This shows the annual charge for de-

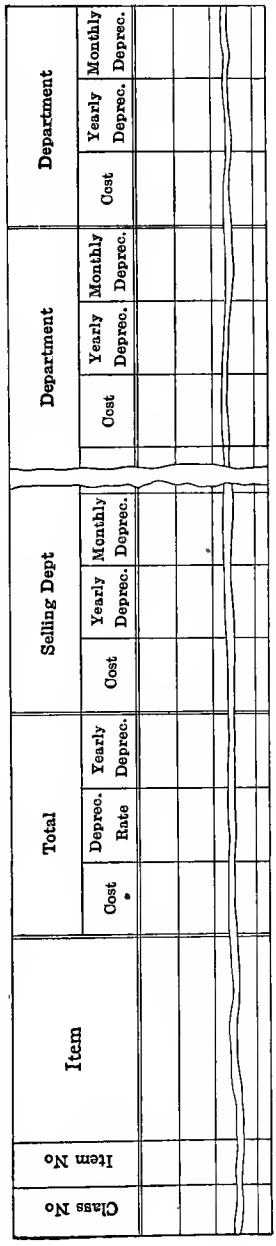


FIG. 43.—Depreciation Schedule.

preciation to be borne by each department. (3) The totals of all department columns headed "Monthly Depreciation" should equal, when multiplied by 12 or 13 as the case may be, the total of yearly depreciation in the total columns.

In practice, a shorter method than the above may be employed, if no considerable movements of equipment between departments is likely to take place during the financial year. The ledger cards having been departmentalized as explained above, each class of equipment may be taken separately (picked out by the tabs), divided into as many groups as there are different rates of depreciation concerned, and each set of cards bearing the same depreciation rate aggregated and entered as one item on the Depreciation Schedule. Thus, if class E, totalling $50,000 is really made up of $20,000 rated at 3 per cent., $15,000 rated at 4 per cent. and $15,000 rated at 5 per cent., we may enter these items in three lines on the schedule thus:

	Cost	Rate	Yrly. Dep.
Sundry items.....	$20,000	3 per cent.	$600
Ditto.....	15,000	4 per cent.	600
Ditto.....	15,000	5 per cent.	750
Total for class E....	$50,000		$1,950

Next, by sorting our cards into sub-groups according to departmental location, we can ascertain how much of the equipment belonging to the 3 per cent. group is located in department 1, how much in department 2 and so forth. These amounts, and their yearly depreciation are then entered in the departmental columns as before.

The short method has exactly the same result as the longer one, and the sheets are balanced in the same way, but, of course, the advantage of having a tabular statement or inventory of the plant and equipment of each class is sacrificed. Which method should be selected will depend on circumstances. In some methods of costing (see Method C in Chap. XX) a somewhat detailed analysis of equipment is necessary, and in that case it can be made on the Depreciation Schedule quite conveniently. In other methods as long as a correct summary by departments is made that is all that is necessary for accounting purposes.

When all the schedules have been made out and a recapitulation taken, it is evident that we shall be in possession of the yearly and also the monthly amounts which are to be charged against manufacturing in each department. With the way in

which these figures are used we have nothing to do at present, except to note that each month certain Burden Journals will be the sources whence a credit for the amounts *indicated by the schedule* will be made to Plant and Equipment. This credit is not, however, in practice made monthly to the Plant accounts. To do so would involve too much labor. On reference to the diagram (Fig. 41) it will be seen that the credit received from the manufacturing department is made to a Depreciation account, month by month, and *this credit must be agreed with the amount as indicated by the Depreciation Schedule.* At the end of the financial period, whether yearly or half yearly, the amount standing to the credit of Depreciation account is transferred to the credit of sundry Plant Control accounts and to the individual Item Cards.

The way in which this operation is effected is by a virtual reversal of the process of compiling the Depreciation Schedule. As each monthly credit from manufacturing was agreed with the monthly total of the schedule, it follows that the yearly total of credits in Depreciation account will agree with the total of the schedule. If, then, the schedule has been made up on the itemized plan, each card can be individually credited by its aid. If on the group total plan, then the Item Cards must be sorted by classes and departments and depreciation rates, and individual credits made on each by aid of a calculating machine, the total of each sub-group being agreed with the group total on the schedule before proceeding to the next group. This process, though intricate to describe, is really very simple and rapid if properly carried out. When it is done, and the corresponding credits made to the Control accounts, the new balances on the cards will equal the old balances less the amount transferred from Depreciation account—in other words, the cards and Control accounts will now show the new and depreciated value of the plant after the year's operations have been completed. This new value will be the basis of preparation of a Depreciation Schedule for the following year.

The whole of the principal operations by which plant items are recorded, and by which they are credited with depreciation having now been exhibited, it only remains to consider how far unexpected happenings may affect the charging of depreciation. Rearrangements of machinery do not, of course, affect the departmental allocation of depreciation unless plant items are trans-

ferred from one department to another. The three occasions on which the depreciation schedule is subject to serious disturbance are: (1) Transfers from one department to another; (2) new items purchased or made by selves; (3) items condemned and withdrawn from active service. Theoretically any one of these changes should be at once taken into account, but in practice such a continual upset of the schedule is not necessary. Small changes need not be taken into consideration until the end of the financial period, unless they happen to embrace items of equipment of which the depreciation rate is very high, say, 7½ or 10 per cent. Of course, if rearrangements have been made on a considerable scale, or new plant has been introduced so as to modify manufacturing processes, then immediate notice should be taken of it. In such cases the best procedure is to close out the account of the departments affected by transferring the depreciation already accrued, and making a fresh schedule in which the new arrangements are reflected. But the mere purchase of one or two new machines of an ordinary kind, or the simple exchange of machines between departments may be ignored until the end of the period, or at any rate until some future time when it becomes convenient to transfer accrued depreciation to the item and control accounts concerned.

Depreciation chargeable to the administrative and selling departments. A certain proportion of the total depreciation will naturally be chargeable to the selling department on account of office buildings, equipment, warehouses, tools, etc. used by that department. A special column is, therefore, provided in the Depreciation Schedule to take care of such amounts, and the total of this column is made the authority for an entry in the Selling Expense Journal, whereby Selling Expense is charged and Depreciation account credited, just as Factory Burden is charged and Depreciation credited as shown above. This charge to Selling Expense need not detain us further. It does not come into the factory accounts proper, but is handled as described in Ch. XI, Part I.

Depreciation on buildings and equipment (office furniture and machinery, etc.) used by the higher officials, and the general office—usually falling under the heading of administrative expense—will be prorated on the schedule between selling and factory department on some approved basis contingent on the particular circumstances.

CHAPTER VIII

RENTS, TAXES, INSURANCE, ETC.

So far we have been considering the purchase and disposal of actual tangible articles, stores, buildings, machinery and equipment which can be seen and handled, weighed and counted, or otherwise identified at any moment. We have now to consider a new class of purchase, namely, purchase of service.

Service may be purchased in various forms. Thus the salary of the president is a payment for service, so is the wage of a laborer. A lawyer's bill is also a claim for payment for service, an auditor's fee is a charge for service, even though in these two last cases the payments are made to persons not enrolled on the books of the organization. Generally speaking any payment that is made for something that cannot be touched or handled is for the most part a payment for service of some kind. The particular kinds of service to be considered in this chapter are rents, taxes and insurance.

While most kinds of services are not paid for until rendered, it is not infrequently the case that some or all of the services just mentioned are paid for in advance. In other cases, as for example, employers' liability, the main part of the service may be paid for in advance, subject to an adjustment at the end of the period covered, which adjustment may either be of the nature of an increase in the charge or a reduction. It will be seen, therefore, that this class of purchases presents somewhat different problems from those previously discussed, and requires somewhat different arrangements to control it.

On the general diagram only one typical account is shown as representative of the whole class. But in practice, rent, taxes, water rate, and the different classes of insurance may have separate ledger accounts. This is merely a matter of convenience and involves no principle.

Two principal considerations exist in relation to this class of purchases. First some mechanism must be set up to "hold up" or more properly speaking hold "in suspense" such payments as have been made, but for which the service has not yet been

rendered, and secondly for charging to Manufacturing month by month, the proper amounts, allocated by departments, that may be considered as having accrued within the month. This means that while a regular monthly amount is to be charged to manufacturing departments, the actual payment, or accepted liability, may be entered in the ledger at any time during the year. Thus we may pay rent every 3 months in advance, or insurance once a year in advance, or we may receive a bill for rent and enter it in Purchase Journal without paying it, but whatever procedure these transactions follow, the regular monthly charge for the services covered by them must be made to Manufacturing and allocated to departments quite irrespective of either billing or payment.

The allocation of such charges to departments necessarily implies a basis for calculating such charge. Hitherto in the purchases we have considered, the physical existence of the item was a sufficient guide to its relation to the accounts. But we are now dealing with intangible values, and it is, therefore, necessary to set up some arbitrary basis on which they may be distributed. No single basis will commonly suffice for all this class of charges. But, on the other hand, the selection of a suitable basis and the calculations involved are of a simple character so that substantial accuracy in their allocation to departments can be attained without too much labor.

In the case of rent much will depend on what is actually paid for under this head. If, for example, we are leasing a piece of land, then the area occupied by the various departments will be a convenient basis. On the other hand, if we are leasing a complete factory, buildings and all, then consideration will have to be given not only to the area of land occupied, but also to the nature of the buildings used by each department. We shall have in this latter case to calculate true rent, compounded of a charge for both land and buildings, just as if, being owners, we wished to rent out each of the buildings to separate tenants.

There is also the further complication, common in many countries, in which a lease has been *purchased.* That is to say, a large sum has been paid down for possession of the premises or the land, subject to a further annual payment of rent until the end of the term for which the lease has been granted. In this case provision must be made for amortization of the lease, that is to say the sum so paid down must be treated on the lines

of depreciation of a machine, and so much charged off each year so that when the lease expires its entire cost has been reduced to nothing. The real meaning of a transaction like this is that instead of paying a high rent each year for say 50 years, a considerable sum is paid over on taking possession, and then a small rent paid every year instead of a high rent.

The precise way in which the basis will be arranged will depend, therefore, on the nature of the payment. In any case, the aim will be to so allocate the total rent charge among departments that each bears a fair proportion of the total. Taxes will be allocated in the same way.

Fire insurance is sometimes distributable on more than one basis. There may be a separate rate of insurance for buildings and for equipment and stock. In this case, building insurance will be prorated on a basis of building value in each department, while the other variety will be distributed on a basis of values contained in the buildings.

Employers' liability insurance will generally be allocated to departments on a basis of the number of employees or on the average pay-roll. In a few cases, a department may bear a higher rate, owing to specially hazardous employment. In this case, of course, the premiums paid will be segregated and applied to that department alone, such department being omitted from the general prorating of the remainder of the insurance charge.

The diagram, Fig. 44, shows the general scheme of treatment of this class of purchase. The ledger accounts in the center of the diagram are merely representative of the class. There may be several such accounts dealing with separate but similar items of expense. In each case the account is *charged* from Purchase or Voucher Journal (or in cases where cash is paid in advance, from Cash Journal) the landlord's or the insurance company's account (or cash) being credited. The *crediting* of the ledger accounts is effected in a very similar manner to the crediting of Plant Ledger accounts, namely, by the aid of a Distribution Schedule which is used to assemble the items and indicate their distribution to departments on a yearly basis. Then one-twelfth or one-thirteenth of the amount chargeable to each department is entered on the Manufacturing Burden Journal and thereby charged to production and credited to the Rents, etc., Ledger accounts concerned.

As the credits to the ledger accounts are made each month on the principle of dividing the annual charge into monthly amounts, and as, on the other hand. the charges to these accounts may be

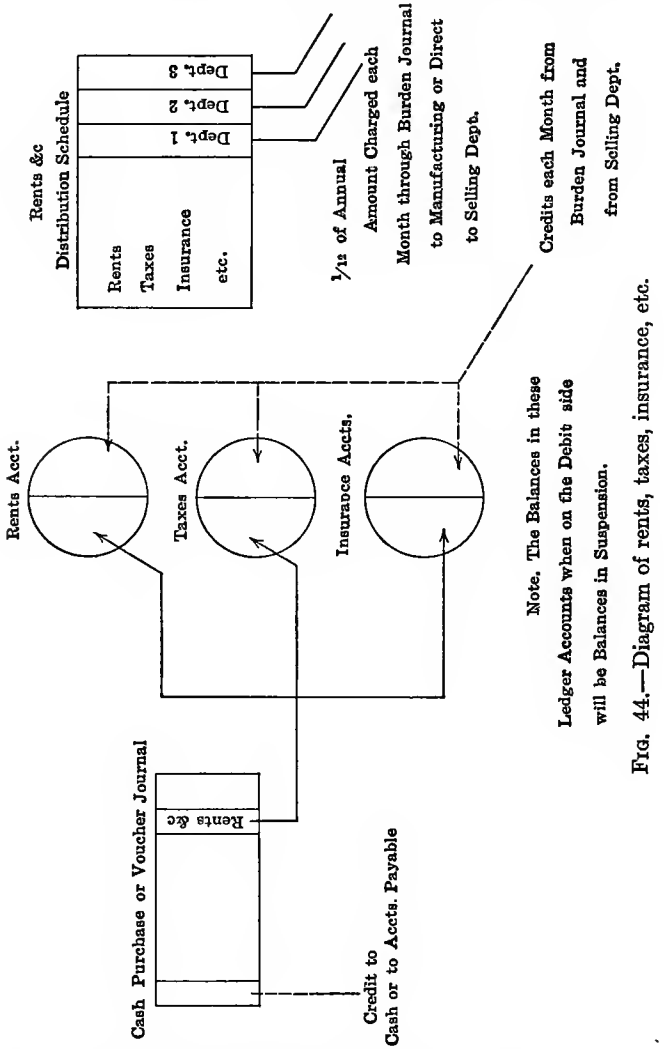


FIG. 44.—Diagram of rents, taxes, insurance, etc.

made in one or more sums at any period of the year, and may be in the nature either of ordinary purchases, or of payments in advance, it will be evident that the balances in these accounts

are of a wholly different significance to those already considered in the case of stores or plant. The latter balances are always in the nature of values of tangible property remaining on hand. They are always on the debit side, since it is impossible to credit an account of this kind with more than it contains. We either have stores or we do not have them. In the former case the ledger will have a balance to its debit, in the latter case it will have no balance at all.

In the class of accounts we are now considering balances may occur on either side of a ledger account at various times, and it is advisable to fully understand the significance of this phenomenon. If, for example, we take the case of rent payable every 3 months, but not in advance. Then at the end of the first month, the Rents account will receive a credit from Manufacturing for the monthly amount calculated on the Rents Schedule and charged through Burden Journal as explained above. There will be no corresponding debit from any source, so that Rents account will contain a credit balance. The same thing will happen the next month, only the balance will, of course, now be larger. The third month, however, while a new credit is received from Manufacturing, a debit is also received through Cash or Purchases Journal representing the bill for the whole quarter's rent. This will equal the three credits received from Manufacturing, so that at the end of this third month, there will be no balance at all in the Rents Ledger account.

Now if the rent was payable in advance, exactly the reverse behavior of balances would be observable. The first month there would be a large balance on the debit side, the second month this would be smaller, and at the end of the third month there would be no balance at all. How then are we to regard these balances in either case?

Technically speaking, the first case is an example of a Reserve account and the second of a Suspense account. The first balance is a reserve against a future known liability, and the second is an amount already paid out and considered to be held in suspense against a future known call on the service it represents. This explanation, however, may not be very clear to the student not familiar with accounting terminology, and it may be desirable, therefore, to examine the matter more closely.

To take the second case first—our proceedings are very

similar to those described in relation to the charging out of stores. To begin with there is a debit balance in the ledger account, representing rent paid, just as there might be a balance in a particular stores account representing brass purchased. And in both cases we credit the account with the amount consumed month by month. In the case of the brass by actual weight and handling. In the case of the rent by calculation of what 1 month's rent will amount to. In either case what is left in the account will be a debit balance representing the amount unconsumed. In either case what is left in the account will be an asset. There will be actual property in brass, and actual property in a right to enjoy service. In the one case we have unexpended material, in the other unexpended service. There is no difference in point of value between the two classes of asset, except that one is salable supposing the plant to go out of business and the other is not. As long as the plant is a going concern, both are equally valuable.

Nevertheless, there is an obvious risk involved in paying for services not yet rendered, and, therefore, such payments though necessarily considered as assets, are viewed by the accountant in a special way. The balances are considered as being as it were, asleep, and not available except at a future date. Such accounts, therefore, as contain balances of this kind, are termed "Suspense" accounts.

We may now consider the first of the two cases. Here we have no balance in the account to begin with. On the other hand, we begin to make credits to it, without having anything to draw on. It is evident that some kind of fictitious transaction is implied here. It is totally unlike anything we have met hitherto. In the case of stores such a transaction would be meaningless. We could not credit a brass account for brass that had no existence. Similarly we could not credit depreciation to a plant account that was a blank sheet of paper. What is it then that we do when we credit a blank ledger page with a monthly amount representing rent?

What we are doing is to provide against the future. We cannot use brass without having brass, we cannot depreciate a machine without having a machine, but we can enjoy service without paying for it. If we know the value of the service we are enjoying and can put a price on it, then although it has not been paid for actually, we can enter this amount month by month, on

a blank ledger page, so that when the time comes to pay for the period that has expired, the amount involved will have already been charged out against Manufacturing, just as though payment had been made month by month. Technically this is called setting up a "reserve" against a future known liability.

Such a balance is not, of course, an asset. It does not represent anything of the nature of property. In the other class of balance discussed above, what was represented was an actual purchase—a purchase in advance of immediate needs, but still an acquisition. In the present case the figures entered on the credit side of the ledger page are merely intelligent anticipations of a purchase that will presently be made, the purchase in question being of such a nature that it can be enjoyed before any charge for it appears in the accounts.

It is quite true that from one aspect, the purchase of service is already completed when a contract for it is made. But while this is true from an administrative viewpoint, from an accounting viewpoint everything begins with the receipt, acceptance and entry of the invoice or bill on the journal. No charge to any account can be made until this stage is reached. Consequently we have to regard the transaction now under discussion as one in which the enjoyment of service takes place in advance of payment or accepted liability for it. This being the case, our present transaction signifies that we have charged to Manufacturing on the one hand, and credited to future liability on the other a calculated amount, which amount will presently be set against an actual payment on the liability in such a way that no balance will be left. To set up a credit balance in this way is called making a "reserve," and as it is obvious that in essence it represents a payment that will ultimately have to be made out of cash, it is not an asset, but a liability. When by payment of the accrued amount the balance is wiped out, cash is correspondingly depleted.

Services then, which are paid for in advance, and charged out to Manufacturing by monthly installments, give rise to ledger balances which are in the nature of assets, and are termed suspense balances. Services paid for at intervals after they have been enjoyed and credited at monthly intervals by Manufacturing give rise to ledger balances which are in the nature of liabilities and are termed reserve balances.

The Distribution Schedule (Fig. 45) by which rents, taxes, water rents, insurance and so forth are charged to manufacturing

Rents, Taxes Insurance, Compensation etc.	All Departments			Selling Dept.			Dept. 3		
	Amt.	Basis of Distrib.	Yearly Und. Value	Dept. Basis	Yearly Amt.	Monthly Amt.	Dept. Basis	Yearly Amt.	Monthly Amt.
Rent		sq.ft.							
Taxes		sq.ft.							
Fire Insurance		$							
Employees Liability		$							
Water									
etc									
etc									
Total Distributable									

FIG. 45.—Rents, etc. Distribution Schedule.

departments provides columns for the total amount to be distributed annually, and also columns for each department. In each case the basis of distribution is entered, and the amount prorated over the departments according to the share of the basic figures shown against each. Thus if rent is payable on land area, the total basis may be 100,000 sq. yd., of which department 1 will occupy 30,000; department 2, 7,000; department 3, 16,000 and so on. The annual charge against each department is then entered in the columns provided, and one-twelfth or one-thirteenth of this amount placed in the "monthly amount" columns. Vertical addition of these latter columns shows the amount chargeable against each department each month. The Distribution Schedule is not a journal, but merely serves to tabulate and calculate the monthly charges which are then entered on the Manufacturing Burden Journal of which we shall speak later. From this journal credits are made to the Rents, etc., Ledger accounts and charges to Production account.

Rents, taxes, etc., chargeable to selling department. As in the case of depreciation, a certain proportion of rents, etc. is chargeable to the selling department. The amount so chargeable is entered on the special column provided in the Rents Schedule, and forms the authority for a journal entry crediting the various Rents, etc. accounts and charging Selling Expense. Such items are thus separated from the factory accounts proper, and are handled as indicated in Chap. XI, Part. I.

CHAPTER IX

TIME AND PAY

In the last chapter we considered the accounting of purchased services rendered by firms or persons outside the plant. We have now to consider services rendered by employees of the plant, including both salaried officers and wage-earners. The subject of time and pay, as in the case of all other purchases, falls into two divisions, corresponding to the debit and credit side of the ledger accounts, viz., Wages account and Salaries account. First we have to consider the source and mechanism of entries to the debit of the account, and then the way in which credits are made, and what corresponding charges to other accounts are necessary. In other words we have to ascertain the amount payable to each individual, and also the nature of the service he has rendered for the payment, and to what account such service is chargeable.

The subject of time and pay is complicated by the number of different bases on which earnings are computed. First, we have simple time, as in the case of salaried men, or day wage-earners. Secondly, we have simple piecework, in which so much is paid for each piece completed, quite independently of the time taken. Thirdly, we have the various bonus and premium systems, based for the most part on day wages, but with additional payments proportionate to the saving of time from a standard allowance. Fourthly, any or all of these systems may be used, and in addition extra bonuses or rewards may be earned for departmental efficiency; and finally, extra payments may be made on some profit-sharing basis, dependent on the result of the business during a financial period.

The mechanism for the computation of the amount payable to each employee, also, is sometimes clear and distinct from the mechanism for computing the allocation or charging of earnings to various cost accounts, but on the other hand the two mechanisms are frequently combined. And the method of charging earnings to costs is intimately connected with the problem of

orders, and these again depend on the type of cost system that is in use.

In this chapter we shall confine our attention as far as possible to operations connected with the debit side of the Wages and Salaries account, leaving till later the operations concerned with crediting such account and the corresponding charging to Manufacturing. This is in conformity with the manner in which other classes of purchase have been treated in previous chapters.

The principal document in which particulars of the amounts to be paid out are entered is termed the pay-roll. This bears the same relation to purchases of service as the bill or invoice does to purchases of stores, plant or exterior service. It is the prime authority for payment, and its correct compilation is, therefore, a matter of great importance. The pay-roll is commonly divided into two separate books, one dealing with the wage-earners and minor officials, the other dealing with the higher officials. This latter is usually called the Salaries Book. The distinction is only a matter of convenience. From the accounting viewpoint the two books are on exactly the same footing, and in small plants the pay-roll itself sometimes contains both sets of payments.

The pay-roll is not a book of original record in many cases, though in small plants it sometimes is. The original record is the "Gate" record, namely, the document on which is recorded the times at which the employees enter and leave the plant. In other cases the pay-roll is made up from the shop or departmental records, usually cards or slips that are filled out to show how the time has been used on or distributed to orders.

To describe all the various devices that are in use and the different methods that are employed in securing gate time and time on orders would require many chapters. Such a discussion would also be unprofitable, inasmuch as, in the author's opinion there is very little to choose between the various methods—accuracy depending much more on the way in which they are carried out than on the employment of any specific combination of cards forms, clocks, etc. In this chapter, therefore, attention will be given rather to the essential ends to be reached than to particular ways of reaching them. But as some mechanism must be introduced for the sake of illustration, the very simplest and most elementary will be selected for that purpose, as the underlying principles will be more clearly demonstrated in that way. And to

begin with it will be assumed that payment on a simple time basis, that is daywork, is alone employed in the plant.

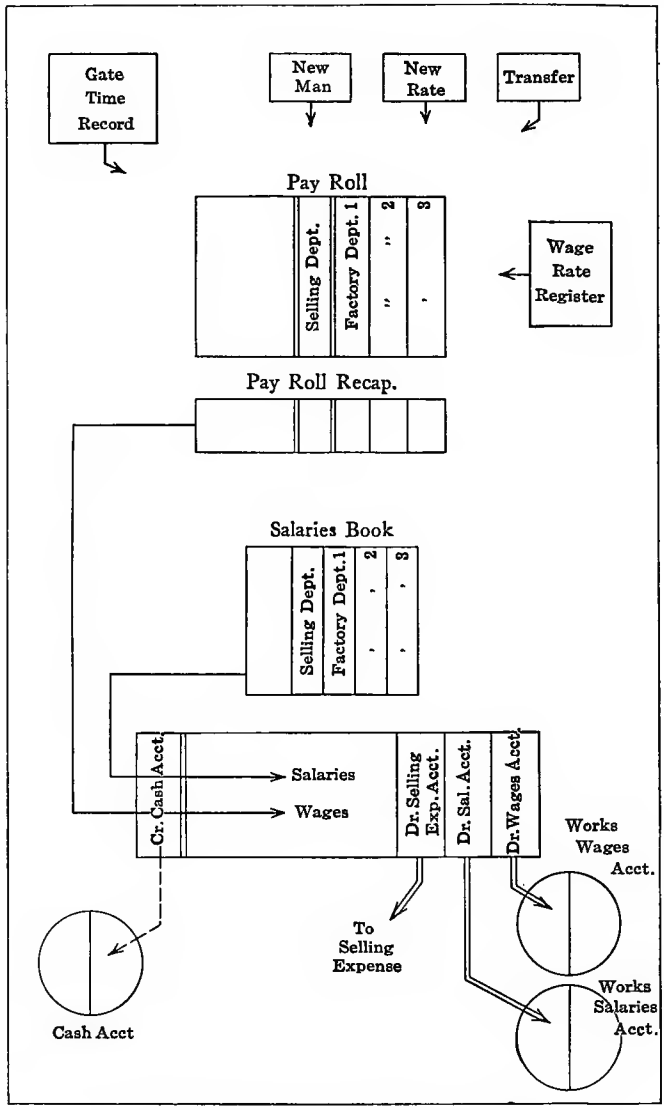


FIG. 46.—Diagram of time and pay (daywork).

The diagram Fig. 46 shows the principal books and blanks concerned with the record and accounting of time and pay on

the daywork plan. The first and most important consideration is to obtain a trustworthy record of the time actually worked by each employee. While, as stated above, it is possible to obtain this information from the shop records where great care is taken in the recording of the latter, it is the author's opinion that, owing to the peculiar nature of the transactions involved, and the many temptations to fraud constantly present, it is in all cases desirable to provide a wholly independent gate time mechanism for the computation of earnings. Then where careful shop records are also available, the agreement of the two records will form the best safeguard against both accidental and intentional errors.

The cycle begins with the identification of the man. On engagement each employee will be assigned a check number or clock number, which serves to designate as a rule his department or type of labor as the case may be.

Pay Roll Gate	New Employe	Wage Register
Name		
Dept.	Check No.	
Trade	Rate	
Began Day		
Work Hour		Foreman

FIG. 47.—Advice of engagement.

On the engagement of a new employee the first step is to fill out the blank, Fig. 47, in which the name, the department, the check number, the trade and the rate of the new employee are entered. This is signed by the foreman or other person entrusted with the engagement of new employees. The day and hour at which he began work is also entered. This advice note is then forwarded to the gate office where a record is made of the new number. The note is then forwarded to the pay-roll office for entry on the pay-roll.

There are various methods of registering the in and out time of employees as they pass the gate. The method now most usually adopted is that of the clock system. Each employee is allotted a card, which cards are kept in racks, so numbered that the employee can immediately pick out his card in passing the rack, without any delay. To record his time the man takes out his card and inserts it in a slot in the clock frame, pulls a lever,

and thereby obtains a stamped entry of the actual time at which he passes the clock. He then places the card in a similar rack on the other side of the clock, as indicated by the numbers arranged on the rack. This procedure is gone through each time he enters or leaves the plant. The principal objects aimed at in instituting a system of gate time keeping are these: First, to ascertain the hour and minute at which each employee enters and leaves the premises. Secondly, to distinguish those who are late from those who have arrived punctually. Thirdly, to record absentees. In different plants the method of handling late attendance varies. In some cases as soon as the whistle blows, further access to the clocks is shut off and the men are required to wait for a given time, say ¼ or ½ hr., before they are allowed to record their time and pass the clock. In other cases the men are allowed to pass the clock at all times, but are not credited for their attendance until the ¼ or ½ hr. has elapsed. These measures are obviously adopted for the sake of discipline and from the accounting point of view the main thing to be observed is, that whatever mechanism is set up shall clearly distinguish between late arrivals and punctual arrivals. One way of doing this is by the use of a clock which prints late arrivals in a different colored ink. This saves the time of the gatekeeper in going over the cards, inasmuch as where entries appear in black ink, he knows that the full time has been made, without the necessity of referring to individual entries. On the other hand, where colored figures appear, they call attention to the necessity for scrutinizing them and ascertaining whether the man is to be penalized or not, or to what extent he is to be penalized.

The method of making a gate time record will vary in different cases. Where a daily system of time and cost keeping is in use a simple list of the absentees and late arrivals will be sufficient. A printed form can be used, listing all the numbers current in the various departments, and against these numbers a check mark may be placed if the man has made full time for the day, and where he has failed to do this, the actual number of hours he has made should be substituted for the check mark. In the case of absence, the word "absent" will be written against his check number. Where, on the other hand, pay-rolls and costs are made up only weekly then it is usual to make use of a book in which a column is provided for each day of the week and the various entries just mentioned are made day by day opposite the

man's check number. Then at the end of the week the total time that he has made is aggregated and placed in a total column.

The use of mechanical appliances for recording gate time in place of the old-fashioned check system, must not give rise to a false security. No clock system is positively proof against fraud. It is essential to have a timekeeper whose integrity may be relied on and whose duty it is to watch the men as they make their entries at the clock. Otherwise, several kinds of fraud may be perpetrated. For example: One man may take down and stamp two or three cards, or in the case of those clocks which record late arrivals in colored ink, the private use of colored carbon paper by the men has been known to transform late arrivals into punctual arrivals, as far as the color went. If the records are to be accurate the making of them must be supervised regularly, and if this is done the temptation to beat the clock will not so readily arise because a safe opportunity will be lacking.

From an administrative point of view it is desirable that the timekeeper should prepare lists of late arrivals and absentees, for the use of the management. In this way the men who are habitually late can be picked out and admonished. It is also desirable to furnish the foreman with the names and numbers of absentees as soon as the usual period of grace, say ½ or ¼ hr., has elapsed, in order that he may make provision to carry out the work of the absentees. From the accounting viewpoint, however, the principal thing which is sought to be affected by the institution of gate time is the ascertainment of the amount due to each man, day by day. Fig. 48 shows a blank suitable for recording gate time where information is only required to be summarized weekly. It contains columns for the department, check number, and name of man and also columns for each day of the week, subdivided into ordinary and overtime. In these columns the number of hours worked are entered. Next come summary columns for aggregating the ordinary time, and extending it into wages, and also for aggregating overtime, and extending it into wages. The final column shows the amount payable to the man.

The gate time entries thus recorded must now be entered on a pay-roll. Fig. 49 represents a pay-roll suitable for weekly entries. This is, in effect, a copy of the gate timekeeper's record, with the exception that the daily entries of time are omitted, only the total of hours and ordinary wages and the total of hours

Gate Time						W.E.						
Dept.	Check No.	Name	Friday					Ordinary		Overtime		Total
			Ordy.	O.T.	Ordy.		O.T.	Hr.	Wages	Hr.	Wages	

FIG. 48.—Record of gate time and wages.

No.	Mans Name	Rate	Hrs.	Ordy Wages	Overtime			Bonus Earned	Total Earnings	Deductions				Total Payable
					Rate	Hrs.	Amt.			1	2	3	Total	

FIG. 49.—Weekly pay-roll.

and overtime are entered opposite each man's name. Additional columns are also provided for the addition of bonus earned, which is, of course, a matter entirely independent of time and, therefore, it does not enter into the gatekeeper's record. Further, columns are provided for deductions, which may be for various purposes which need not now be further discussed. The total earnings, less the total deductions, form the total payable, a column for which is provided on the extreme right hand of the sheet.

We have now to consider a more advanced form of time and cost keeping in which records are made each day of the man's gate time, this being agreed, *day by day*, with the account of his work in the shops as shown by a Time Sheet or set of Time Cards. In such a system the gate time is used mainly as a check upon the accuracy of the Time Card. These latter form the official source of all entries. While these cards and method of their compilation will be dealt with later, it will be necessary to state at this point that a record is made up in the shops showing what each man has done during the day, that is to say the orders on which he has worked, and the time he has devoted to each order. As regards any particular man there may be only one card, supposing that he has been working only on one job all day, or there may be half a dozen cards representing the allocation of his time to half a dozen different jobs. Each morning the previous day's cards are received by the pay clerk, and put through a series of operations, including *verification* of the actual hours worked, its *extension* into money against each order worked upon, the *totaling* of the amount of money earned, and the *recording* of the latter in a daily pay-roll. The object of this procedure is to obtain an exact agreement between the pay-roll totals and the different allocations to orders. It also enables the exact cost, day by day, of each order to be ascertained, and various cost classifications set up, such as the division of time into productive and non-productive, the total amount allocated to repairs, the expenditure on indirect labor, and various similar items, which information, if promptly ascertained each day, is of great importance to the management officials.

The first duty of the pay clerk upon receiving the men's cards will be to aggregate the hours worked on an adding machine, and compare the total so accounted for, with the gate time as shown by the timekeeper's returns. Any discrepancy must be immediately inquired into. For the most part such discrepancies will

arise on the matter of late attendance, odd quarters and half hours being frequently credited to the man where the gate time disallows them. On first introducing such a system, errors of this kind will be found frequently, but with steady persistence in running down each such error, day by day, as it is found, and interviewing the persons concerned in a tactful manner, a very few weeks will suffice to produce a high degree of agreement between gate time and shop time as shown by the cards.

Having made this agreement, and having found that each man's time, as shown by his cards, actually agrees with the time as shown by the timekeeper's record, the pay-roll clerk then proceeds to extend this time into money. To do this he must have, of course, an up-to-date and convenient form of record of the

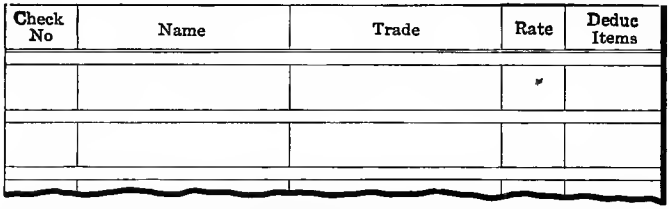


FIG. 50.—Wage Rate Register (Rand index). The slips can be withdrawn or inserted at any place.

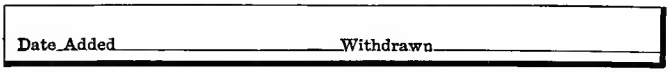


FIG. 50A.—Back of one of above slips showing date record. Withdrawn slips are filed alphabetically in reserve file.

men's rates. Such a record is shown in Fig. 50. The record is made in a Rand index, which is a frame holding slips of cardboard (or paper in celluloid tubes) which can be inserted in any order and withdrawn for alteration or substitution at any moment without disarranging the rest of the record. The face of the slips will contain spaces for check number, name of man, trade, rate, and a further column for noting that his total pay is subject to deduction of some kind or other, such as, for instance, where the employer collects club money, etc. The various leaves of the index can be so arranged that one or more leaves is devoted to each department. In each leaf the numbers will run, of course, serially, so that when the pay clerk receives a pile of cards, from any particular department and has sorted these into men's

numbers, and has checked each man's time with the clock, he can then turn without loss of time to the wage rate register and ascertain the man's rate. Each Shop Card or Time Card is then extended at this rate, and the cards are then ready to enter on the pay-roll.

The operation of reckoning wages is a simple one if proper arrangements are provided. There are many schemes for calculating wage rates but most of them are somewhat complex. The simplest method is to have a "ready reckoner" Fig. 51 and as printed reckoners are not easily to be found it may be advisable for the firm to construct its own. The ready reckoner blank, Fig. 51, is printed as shown in the illustration and the various money amounts are intended to be entered by hand. One such sheet is allotted to a particular rate and this rate may be so much per week, or month, or so much per hour, as desired. It will be seen that the sheet provides spaces for the money amount, or money value of ¼ hr., and so by quarters of an hour up to 12 hr. Two columns are provided, one for ordinary day time and the other for overtime. This enables overtime calculations to be made by simple reference to the sheet. In dealing with each man's cards, therefore, the corresponding sheet to his rate is turned up. The amounts chargeable to each order are rapidly entered on the cards by reference to the ready reckoner and then, as a check on the accuracy of the extension, the total amount of time represented by all the cards, is also extended into money and checked with the total of the various allocations as shown on the cards themselves. Thus, if there are five cards and the man has worked in all 8 hr., at 20 cts. an hour, making the total payable of $1.60, then all the cards must aggregate exactly $1.60. This is by no means a matter of course, inasmuch as the work on one or more orders or jobs may have involved reckoning ¼ hr., in which case there may be a discrepancy between the aggregate of all the cards and the total per ready reckoner of 1 or more cents. It is most important that this discrepancy should be eliminated at this stage. The total due to the man should be reckoned upon the full amount of time, that is to say the 8 hr. that he has worked, and, if any discrepancy exists it should be eliminated by altering the amount on one of the cards to the extent of a cent or so in order to bring the total of the cards to agreement with the total per reckoner. The necessity for this must be understood. After the entry on the

RATE_____

HRS.	ORD'Y.		OVERTIME		HRS.	ORD'Y.		OVERTIME	
¼					6¼				
½					6½				
¾					6¾				
1					7				
1¼					7¼				
1½					7½				
1¾					7¾				
2					8				
2¼					8¼				
2½					8½				
2¾					8¾				
3					9				
3¼					9¼				
3½					9½				
3¾					9¾				
4					10				
4¼					10¼				
4½					10½				
4¾					10¾				
5					11				
5¼					11¼				
5½					11½				
5¾					11¾				
6					12				

FIG. 51.—Blank for "Ready Reckoner."

pay-roll of the total amount payable to the men, the cards themselves will be passed on to the cost department, and at a subsequent stage an agreement between the pay-roll for any period and the costs for any period will have to be made. Now, if discrepancies between the total time per pay-roll and the allocated time per cards are left, these will mount up in a short while to quite a considerable sum, and render it impossible to get any satisfactory agreement between cost and pay-roll.

The total amount of each man's earnings for the day having been found and agreed with the small pile of cards which represents his day's work, the aforesaid earnings must now be entered upon a pay-roll. The blank, Fig. 52, represents a form of pay-roll suitable for use in this way. Each vertical column represents the record of one man for one week. Some of the horizontal columns represent the days of the week, as will be seen by reference to the figure and each of these horizontal columns is divided into two portions by a thin line. The vertical columns are also divided into two portions. This means that four little squares are provided against each day of the week and for each man. The upper pair of each set of squares is intended for the record of the ordinary hours and the ordinary wages. The lower set of squares is intended for the record of overtime hours and overtime wages. It is recommended that these latter figures be inserted in colored ink. At the foot of the columns spaces are provided for totaling, first, the ordinary time, secondly, the overtime, also for any bonus to be paid, leading to a grand total of earnings for the week. Then comes a space for deductions, and a further space for the total net amount payable to each man. Cross-totaling of each horizontal column gives the total payable for the day, and as one or more sheets of such a pay-roll are identified with particular departments, it is a very easy matter to obtain the total payable in each department each day. This is necessary for agreement with cost figures later on.

It will be seen by the foregoing that we have ascertained the *money* value of each man's *time* for each day; that we have agreed this *money* value with the *money* value charged against each of the *orders* on which he has worked as shown by the shop cards; and, that we have entered this daily amount to his credit in a pay-roll, distinguishing between overtime and ordinary time. The cross-totaling of this pay-roll gives us the

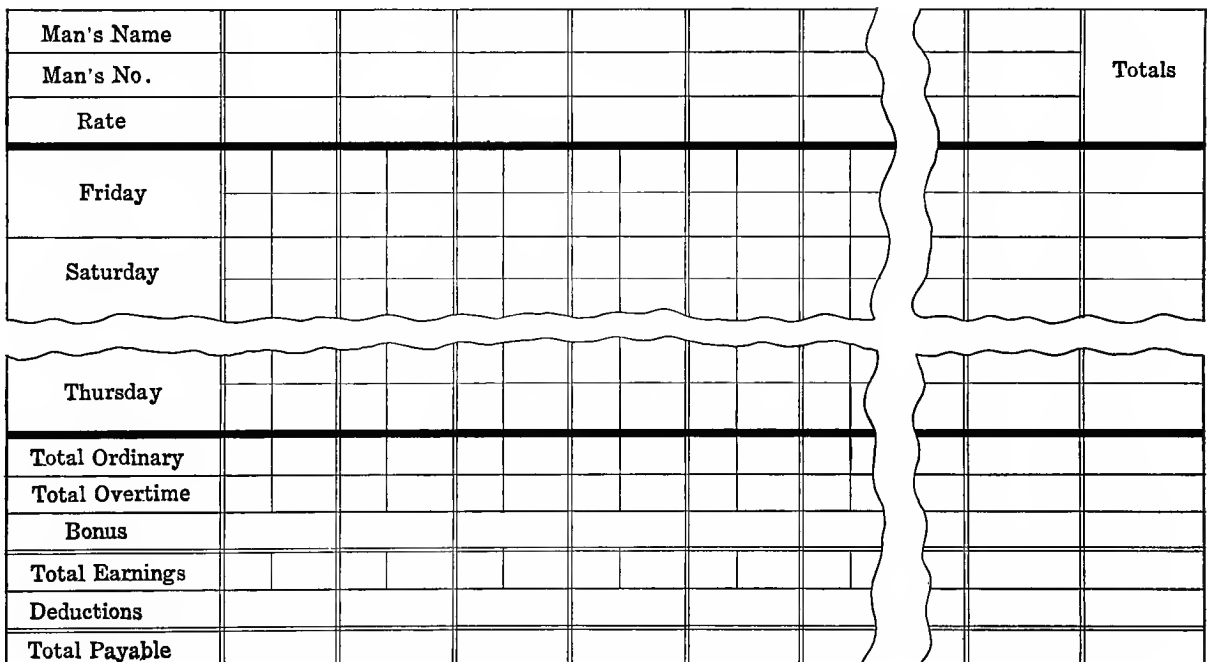


FIG. 52.—Pay-roll for daily cost and pay method.

total amount chargeable to each department each day, and if necessary this may be subdivided into overtime and ordinary time. The vertical totalling of the pay-roll gives us the total earnings of the man for the week. *All these totals are in agreement.* We have, therefore, laid a secure foundation for our costing operations at a later date. By handling the time daily we are enabled to track down any errors immediately they occur, and while they are fresh in every one's mind. As the Shop Cards have been extended into money it will be seen later that prompt information of various kinds can be afforded to the management.

In other words we have cleared up each day's work as we go along, and it follows from this that the operations of making out the pay-roll at the end of the pay period are confined to simple addition of the amounts already entered. Each day's time having been checked with the gate, no further check is necessary. Moreover, as the time credited to each man is shown on the pay-roll, if any dispute arises the matter can be traced to the particular day on which the discrepancy occurs, with great ease. It is, of course, understood that in all cases of dispute between the workman and the firm the clock time is to be taken as authoritative.

So far we have only considered the question of day wages. In a large number of plants, however, some system of payment by results will be found in use. The system adopted may be that of straight piecework, in which a given price is paid for an article or so many articles as completed by the man, or it may be some of the more complicated systems of premium or bonus are employed. From the point of view of the pay-roll, however, we have only two things to consider. First, the *authority* for entering an amount on the pay-roll to the particular man, and secondly, how far *verification* can be applied to the item. It is evident that our system of checking by means of gate time will not apply here. The man's earnings are obviously quite independent of the time that he may spend on the work Nevertheless it is an excellent plan to have all men, whether day workers or piece workers, registered at the gate in the same manner. In some cases the calculation of burden is dependent upon the number of hours the men work. In all cases it is most advantageous for the management to know the relation between the time actually spent on the job, and the hours worked by the man. But from a purely accounting point of

view there is no relation between gate time and bonus or piecework earnings. We shall, therefore, have to depend on some other source for the verification of amounts alleged to be due to particular men.

This is sometimes a matter of difficulty. The calculations of piecework earnings is a somewhat technical matter. In other cases, where list prices are in use and the kind of work does not vary greatly, it is not a difficult matter to provide the pay-roll clerk with a set of the piecework prices and thus enable him to check up the extensions, and not only the extensions but the correctness of the price placed against each item. Two factors are obviously involved: First, the number of pieces or quantity of work done; and secondly, the price to be paid for each piece or set of pieces. The first of these items is more difficult of verification than the second in some plants. Where articles are made and turned into stores the storekeeper's record of the quantity received, and for which he is responsible, may be taken as a means of checking the statement of the piece record. But in many shops the work passes from one man to another. Prices are subject to deductions for imperfect and spoiled work. Lots which start out complete in number become diminished in the course of their passage through the shop, so that the piece workers towards the end of the passage are working on a less number than those at the beginning. It is obvious that no simple mechanism can be described for taking care of conditions like these.

It is, therefore, sufficient to point out here that whatever records are presented to the pay clerk as his authority for entering an amount to the credit of a man on the pay-roll should be subject to some system of verification by him or for him. With this proviso duly applied there is nothing special about the treatment of piecework in a pay-roll such as that just described. The amount earned by the man each day on finished contracts is entered precisely the same as if it were daywork, except that, of course, no hours appear against each entry. It is advisable that piecework, also, be entered in a specially colored ink and its amount brought out in departmental totals separately from that of day time and overtime. The word "piecework" as used here includes all kinds of payments by results except departmental bonuses or group bonuses, which are extra earnings made to men for some special efficiency which has been brought about by their united effort. Such bonuses are usually calculated at intervals

of a month. They should then be entered on the line devoted to "Bonus" is the pay-roll. All other bonuses such as those arising out of premium systems or bonus systems, will be treated as ordinary piecework and entered as just described.

In many cases indeed, especially where jobs last a considerable time, it is not an unusual practice to credit men with their day wages in the ordinary way, and then, upon the completion of the job, reckon up the difference between the day wages so received, and the piece or contract price of the work, and credit them with the difference. This is called a piecework balance, or premium balance. It is entered in exactly the same way as if it were a straight price for the work done. From many points of view this method of settling piecework earnings is preferable to the more common practice of ignoring the daywork earnings and

Pay Roll Gate	Transfer	Wage Register
Name		
Old Dept.		New Dept.
Check No.		Check No.
Rate		Rate
Trade		Trade
Transferred Date		Foreman
at Hour		Foreman

FIG. 53.—Advice of transfer to another department.

making entries only on the completion of the piecework. Whether or not it can be adopted depends very largely, however, on the kind of work being done at the plant.

Minor arrangements to facilitate the work of the pay clerk include notification when a man is transferred from one department to another, and also when a man has had his rate changed or advanced. Fig. 53 represents an advice of transfer giving all data necessary to enable alterations to be made on the pay-roll and in the wage register. Fig. 54 shows a blank also suitable for changing rate. Such changes of rate should only be made at the end of pay periods. The practice of changing the rate suddenly in the middle of the week is a very confusing one and there is no real necessity for it.

It is the usual practice to keep a record of each workman's changes of rate and other data concerning his employment.

These are sometimes very elaborate, but a convenient and sufficiently comprehensive record for most purposes will be found in Fig. 55. The lower part of the card is, of course, not filled out unless the workman leaves or is discharged. When this happens,

Change of Rate

Name_____ Check No._____

Department_____

Rate of above has been changed to _____

to take effect in next Pay Period

Entered on Reg._____ Foreman_____

FIG. 54.—Advice of change of wage rate.

the card is taken out of the current file and placed in a "Former Employees" file in alphabetical order. The use of the card will be easily understood from examination of the wording.

The diagram, Fig. 46, may now be referred to, in order that the whole cycle of operations with regard to time and pay may be

Name				Check No.		Trade	
Address							
Date Started				Date Left			
Rate	Date	Rate	Date	Rate	Date	Rate	Date

Record

Work _____ Time-Keeping _____

Honesty _____ Sobriety _____

Industry _____ Intelligence _____

Cause of Leaving _____

Signed _____

FIG. 55.—Workman's record card.

viewed as a whole. Though nothing has been said about the Salaries Book, it will, be readily understood that this is nothing but a subdivision of the pay-roll made for convenience. In some cases the entries in the Salaries Book are controlled by clock, in the same way as those in the pay-roll. But as changes

in the salaried staff are infrequent, no elaborate mechanism is necessary to keep the entries in this book up-to-date, as regards transfers, changes of rate, etc.

In regard to the earnings of shop employees we have seen that entries arise from gate time, *or* from shop records (Time Sheets or Time Cards) *agreed* with gate time, or from shop records of piecework or premium earnings. The entries in the pay-roll may be made weekly, or daily. In the latter case, daily agreements are made with the shop records before entry, so as to ensure that the basis of pay and of cost is the same. The amounts due to each man are cross-totalled so that the amount paid in each department is also ascertained daily.

When the pay-roll is completed, it forms the official authority for the payment of the money. It thus corresponds to the bill or invoice in the other forms of purchase transactions previously considered (purchase of stores, of plant, etc.). The Salaries Book is correspondingly the official authority for the payment of salaries. Consequently the totals as shown by these two books are entered on the Cash Journal, and credited to Cash on the one hand and respectively to Wages account and to Salaries account on the other. All the mechanism above described is set up to bring about this result correctly.

At the end of the month we shall have sundry weekly debits in these two accounts, just as we had sundry debits in Stores and Plant accounts. These are charges to Manufacturing in essence, and as all charges to Manufacturing are credited through the cost system, or more specifically through either Manufacturing or Burden Journals, the manner in which these credits are made may be conveniently postponed for the present.

In the case of salaries there will be, and in the case of weekly wages there may be a certain number of employees whose time, in whole or in part, is chargeable to Selling Department. Such amounts are indicated on the Salaries Book and pay-roll and are charged in the Cash Journal to the selling expense column. They are thus diverted at the beginning from salaries and wages pertaining to manufacturing operations, and we need not consider them further.

CHAPTER X

WORKS EXPENSE, AND ADMINISTRATIVE EXPENSE

Purchased items chargeable against works expense are usually neither many nor important. Most of the expenditure coming under this classification arises within the shops from the use of material and the application of labor, and is, therefore, charged through costs and not through the purchasing mechanism.

Inasmuch as all tangible purchases are chargeable in the first place to Stores account, and all labor and service within the plant is chargeable either to Wages or Salaries account, it will be evident that any purchases classified as works expense must be in the nature of services rendered by outsiders. Unless such items as power from electric mains, or gas from a gas undertaking are purchased from outside, purchases on works expense will be confined to sundries such as postage stamps, telephone charges, telegrams, and such freight and carriage charges as are not absorbable by stores. Repairs carried out by outside firms would also be included under works expense, even though such repairs included the supply of new parts. If, however, such new parts were billed separately, care would have to be taken that they were not included in or confused with stores. In the majority of cases, bills for repair work would include the supply of parts for repair in a general total even though they were separately itemized. Such general total would be a works expense.

Invoices or bills for an item of works expense are entered in the Cash Journal, or Purchases Journal as the case may be, Cash or Accounts Payable being credited, and Works Expense account being charged. The columns headed department expense in Purchases Journal are not used unless we have several Works Expense accounts, one for each department.

The credit to Works Expense account comes from the Manufacturing Burden Journal, and the way in which items of works expense are analyzed and charged to various departments will be dealt with under that head.

Normally there will be no balance remaining in the Works

Expense account at the month end. But it may happen occasionally that where a large sum has been expended in a given month, or what amounts to the same thing, a large bill has been received or paid in a given month, for contract work in repairing buildings, part of the amount may be held up for distribution in later months. Thus if a bill for $1,000 has been received, it may be considered desirable to charge this amount to Manufacturing Burden in say 10 monthly installments of $100 each. In this case the credit received each month from Burden Journal will be only for $100, leaving at the end of the first month a balance of $900, at the end of the second month $800 and so forth. The presence of this balance converts the Works Expense account into a suspense account representing a payment made of which the benefit has not yet accrued. It will thus appear as an asset on the Monthly Balance Sheet, though, of course, it is so only in a qualified sense. Usually, however, such an item would be journalized to a special suspense account temporarily opened for the purpose.

Administrative Expense.—In all plants there will be a certain class of expense that is mixed in character, and not obviously divisible between selling expense and factory expense. The salaries of the president, vice-presidents and higher officers of the corporation, partners' salaries in a private firm, salaries of correspondence clerks and bookkeepers, depreciation of office buildings, equipment, furniture and fixtures, stationery, phone charges, etc. It is frequently the practice to assemble such items in an Administrative Expenses account, as was indicated in Chap. III (Part I) and then to prorate this, by means of a journal entry, between factory and selling expense. Provided that, when doing so, the bearing of each item on the division is considered, this is a good way of meeting the difficulty. But as the division has to be made at some time or other, and as it is important that no general percentage be applied to the diverse items making up the total, it is perhaps just as well to make the division at the time the first entries are made regarding the respective items in the books of account. Thus when entering salaries in the *Cash Journal*, it is a simple matter to fix a percentage on which such salaries should be charged to Selling Expense and Factory Expense respectively. When considering depreciation in the *Depreciation Schedule*, it is not difficult to arrange that depreciation on items mentioned above is prorated between Selling

Expense and Factory Office Expense to begin with. Rents, taxes and insurance are dealt with in the *Rents, etc. Schedule.* And so on. If each separate class of mixed expense is dealt with in this way, and is divided on its own individual percentage, fixed after consideration of the relative bearing of selling and factory use of the item in question, closer accuracy is likely to result than if all such charges are massed in one total, and this total roughly divided between selling and factory on an arbitrary basis.

The familiar heading "administrative expense" will not, therefore, appear in the accounts now to be discussed. It is assumed that mixed items are separated into factory and selling expense at the **first time of their entry in the books,** and consequently do not require a massing or distributing in any formal or special account or journal.

CHAPTER XI

GENERAL VIEW OF THE FOREGOING OPERATIONS

All the operations described hitherto are antecedent to actual manufacture. Beginning with receipt of a bill or invoice or, with a payment of cash, and ignoring for the present all such transactions as are incurred on behalf of the selling department of the business, we have seen how each class of purchase, by means of appropriate columns in the Cash and Purchases Journals, is steered, so to speak, into its own particular ledger account. Thus we have on the debit side of these accounts, a continual piling up of amounts representing purchases of stores, plant and equipment, auxiliary equipment, labor (in the form of wages and salaries), service (in the form of rents, insurance, taxes, etc.), and of minor services assembled under the head of works expense.

On reference to the general diagram, the typical accounts representing these classes of transactions will be seen in two columns, the journals on the left hand providing the mechanism for charging the ledger accounts, and the blanks immediately on the right providing the mechanism for measuring out the amounts chargeable to Production in each financial period, say monthly.

Thus we have the Stores Issue Book, which contains the summary of the transactions relating to the issue of stores and materials; the Pay-roll Allocation Summary which summarizes the amounts earned by and payable to each worker (a Salaries Book being a usual subdivision of the pay-roll, but not an essential one); the Depreciation Schedule which is a medium for calculating how much of the original value of the buildings, plant, tools and other equipment has been used up by reason of manufacturing activity during the period; and other schedules for calculating the incidence of regularly recurring purchased services, such as insurance, rents, taxes, etc. These mechanisms are not journals. They merely serve to collect, or in some cases to calculate, the data for journalizing.

We have now to consider how the amounts piled up in the abovemention ledger accounts are credited with the amounts charge-

able to Production in the given period, and we shall find that a prime distinction is made between two classes of such expenditure, something like one-half of it being considered as burden, and the remainder as the direct expense of production. All the former class is dealt with through the Burden Journal, which credits the foregoing ledger accounts on the one hand, and charges various manufacturing departments (in departmental Burden accounts) with their due share of burden. All the latter class is dealt with by means of a Manufacturing Journal, or rather by a series of Manufacturing Journals, one for each productive department, which credit Stores, Wages and Works Expense accounts with the amounts directly chargeable against Production, and charges Departmental Manufacturing account. The latter journal *also serves as the medium by which burden is distributed over production orders*, so that in addition to the above-mentioned credits, the departmental Burden accounts are also credited, and Departmental Manufacturing account charged. These operations can be readily followed on the general diagram, even without the detailed explanation which will be given in the following chapters.

As we are now about to enter upon the transactions of manufacturing proper, and as the form of these transactions, that is to say, the allocations and subdivisions of expenditure, is dependent upon the way in which **orders** are issued, the nature and purpose of orders will be considered first. It is a cardinal rule of manufacturing accounting that no expenditure shall take place save in virtue of an order, which is equivalent to saying that every item of expenditure in the plant, whether in the shape of stores, labor, or service of any kind, must be **charged** to an **order number.** Then, as every order number is represented by a Cost Sheet (or set of Cost Sheets) it will follow that the whole of the expenditure in a given period, say a month, will be represented somewhere or other by entries on Cost Sheets. Now all the Cost Sheets pertaining to direct production are assembled and listed in the Manufacturing Journal, and those pertaining to overhead expense or burden are assembled and listed in the Burden Journal, consequently when a ledger account, such as Stores, has been credited from Burden Journal and also from Manufacturing Journal, the amount so credited will agree with the total stores issues for the month. Agreements of this kind, as will be seen later, provide a guarantee of the correctness of the very numerous transactions which are recorded on the Cost Sheets.

In connection with the chapters that follow the student should keep in mind (1) that no expenditure can be credited to the ledger accounts unless it appears somewhere on a Cost Sheet; (2) that every Cost Sheet represents an order number; (3) that labor is employed and stores are issued only in virtue of an existing order. It will be seen, therefore, that the order sets everything in motion within the plant. To its corresponding Cost Sheet the expenditure on the order is charged. And at the end of the month these Cost Sheets are listed and summarized, and grouped in various ways, but primarily into the two great divisions of burden and production. Finally burden is distributed or prorated over the Cost Sheets representing production orders, so that Manufacturing account finally is charged with an amount equal to all the credits that have been made to the ten ledger accounts shown on the left hand of the general diagram. This account, therefore, shows the cost of manufacture for the month, if we neglect the balance from the previous month, and if no credits have yet been made for finished work withdrawn from the shops.

The total of all the production Cost Sheets at any month end must agree with the balance in Manufacturing account, *inasmuch as they form the detail of that balance,* much in the same way as the Stores Item Ledger Cards were regarded as the detail of the Stores Control account. Manufacturing account may be regarded as a Control account of work in process, and the various Production Order Cost Sheets may be regarded as subsidiary Item Ledger Cards.

One further explanation may be given at this stage with regard to burden. One of the objects of Burden Journal is to allocate burden to departments, but these are not necessarily all productive departments. If, for example, in the example shown in the general diagram, we consider that department 1 is the power plant, then it will be understood why that department is shown as "prorated" over the remaining departments 2 and 3. The fact is that though it is important to ascertain the whole cost of running that department separately, it is in itself an expense, or in other words it is not a productive department. Its whole cost must, therefore, be absorbed by the actual productive departments on some basis—which basis in the case of the power plant would be the amount of power considered to be taken by each of the productive departments. Two-thirds might, for example, be taken by department 2 and one-third by department 3. The

whole cost of department 1 would, therefore, be prorated between 2 and 3 in that proportion. Thus the amount standing in the column devoted to department 1 is extinguished. Of course, a similar result would be attained by charging a ledger account with the cost of department 1 and then crediting it with the two-thirds absorbed by department 2 and the one-third absorbed by department 3. But such a ledger account is not really necessary, since it would never under any circumstances contain a balance.

Further, it may occur to the reader that some work might be going on in the plant, which though of the nature of an expense, it was not convenient to charge out to any particular department in the month in which it occurred. Thus, for example, a very extensive repair of a building by the firm's own men might be proceeding. How would such expenditure be held up, and distributed over future months by installments? Although incurred for the benefit of department 3, it would not be chargeable all at once to that department. It would be held up by the simple means of charging it to a "Suspense" account, instead of to the Department 3 Burden account. Alongside Department 3 Burden account, we should have a second account labelled Department 3 Burden Suspense account. The amount in this account could be charged in any way desired to the Burden account, month by month, by an entry through the General Journal.

Items Chargeable to Selling Expense.—It should be understood that almost any kind of purchase whether of material or service may require dividing between the factory and the selling department. Thus certain pay-roll items, and certain stores issue items may be chargeable to Selling Department, and a certain proportion of depreciation (on buildings and equipment used by the selling department), and of rents, insurance, etc., will require allocating each month to the same department. Further sundry items like stationery, office salaries, postages, telephone rents, telegrams, etc., will also be divisible between factory and selling.

In the first part of this book, (see Chap. III, Part I) special journals were shown for the allocation of this class of item, but in practice these are usually unnecessary. The division between selling and factory has to be made somewhere, it is true, but the formality of a special journal or journals is superseded by the addition of columns to the Pay-roll Summary, the Stores Issues Book, the Depreciation and Rents Schedules, etc., so that the

amounts chargeable against Selling are separated from those chargeable to Factory at the very commencement. Then we have left items like salaries, and office expenses which are mixed in character, that is to say that certain expenses such as salaries of the higher officials, can be divided between Selling and Factory only on some arbitrary basis. This basis must be carefully thought out and fixed by authority, and the division can then be made month by month in the proportion authorized, at the first time of entry. Thus, salaries will be allocated between selling and factory in the Cash Journal; telephone rents, postages and minor expenses will be as far as possible tabulated, and the relative use of them by selling and factory recorded, but there will be in most cases, a residuum which can be allocated only on an arbitrary basis. This will be done in the Cash Journal, or in the Purchases Journal as the case may be, at the time of first record of the transactions.

The alternative to this procedure is to charge all such mixed items to a General Expense account, and then allocate the various items between factory and selling by means of a special journal, as shown in Fig. 8 (Part I). Though perhaps the most logical and systematic way to handle the problem of mixed expense, the assistance it affords is more apparent than real, as long as care is taken to see that the various items of this character have actually been split up in the various books of first entry as described above.

It is, of course, important to insure that all items reaching the Works Expense account, are *really* works expense, and do not contain any proportion of what should be selling expense. By throwing all doubtful items into a General Expense account and thus splitting this up, a certain amount of increase in safety is attained, but except in special cases should not be necessary.

CHAPTER XII

ORDERS—SERVICE OR STANDING ORDERS

The object of setting up a manufacturing plant is to make goods or otherwise turn out salable product. But very little acquaintance with factory work demonstrates that a considerable amount of activity is constantly going on that has no *direct* relation to the making of anything salable. We may observe, for example, men cleaning windows, sweeping floors, arranging stores on shelves, shovelling coal, stoking furnaces, repairing machines, buildings, and tools, running errands, and a hundred other varieties of occupation for which obviously no customer is going to pay directly.

But at the same time it is well to keep in mind that all these occupations have to be paid for by the customers of the firm *indirectly*, since the only revenue of a manufacturing plant (in its manufacturing capacity) is the various sums which are paid to it by customers in return for product purchased by them.

On the other hand, when we see a man working at a machine on material that we recognize as part of salable product, when we see him turning a bolt that we know is part of the steel traps that we sell, or when we observe him working a loom on which is being woven some of the cloth which we sell, then there is no difficulty in understanding that part of the price received from the customer will go *directly* to pay the wages of men so occupied.

It appears then that the revenue of our plant as received from the customers in return for product furnished to them must be applied first, in paying for the raw material of which our product consists, and also for the wages of men who have directly worked up this raw material, and secondly, part of this revenue must be applied to paying for coal consumed in our power plant, for oil and waste consumed in our shops, for lumber consumed in making patterns, for brass and steel consumed in making templets and jigs, for the wear and tear (depreciation) on our buildings, plant and equipment, and also for the wages of our power-plant staff, of our pattern makers and tool makers, cleaners, laborers, foremen, superintendents, clerks, and so forth.

The first class of expenditure is called direct or productive expense, the second class is called indirect, unproductive expense, or shortly—burden. The distinction between the two classes of expenditure is perhaps unduly accented by the use of these terms, which imply that one kind of expense is in some way more useful or legitimate than the other. In a well-managed plant on the contrary there is no difference between the value of the direct expenditure and that of the indirect expenditure. The only difference is that the former can be measured directly and simply in relation to the quantity of work carried out in a given time, and the latter requires more complex methods of measurement and connection with quantity of product.

Every man and every dollar of expenditure ranked as pertaining to indirect expense or burden is really performing **service.** And in a well-managed plant every item of such service will be indispensable service, and, therefore, as necessary to the productive process as is the work of the men at the looms or vats or machine tools, who are working directly on salable product. As a matter of fact all the miscellaneous activities usually found throughout a plant can be reduced to a few well-marked groups of service, so that the apparently heterogeneous character of indirect expense is not so marked as it often appears.

Now, it will be evident that in a plant of any size some mechanism must be set up to indicate to the men what work is required and what portion of it has been assigned to them, and further some additional mechanism must be established so that the time they spend on the work, the material they use on it, and the cost both of labor and material, may be recorded against each job or lot of work done. And further still, to this record of labor and material must be added certain other expenses, such as depreciation, rent, insurance; a share of the cost of supervision; a share of the cost of the organization of timekeepers, clerks, stenographers, correspondents and so forth. These necessities imply first an **order** system and secondly a **cost** system. The two are so closely connected that it is difficult to consider one without at the same time considering the other.

The prime rule in regard to orders is that no work may be undertaken, and no expenditure within the shops incurred, save by virtue of a numbered order.

The second rule in regard to orders is that no wages can be paid and no stores issued save as against a record of the

order numbers to which work and such material is properly chargeable.

The third rule in regard to orders is that every expenditure for the purpose of carrying out an order must be recorded on a Cost Sheet, such Cost Sheet being individual to that order and containing nothing but expenditure upon that order.

Now, as has already been pointed out, orders fall into two principal classes. One class is that of Production Orders, and the second that of Service Orders. The former deal with those processes performed on the material which, later, is to be sold as product, and the latter deal with all other expenditures. Even this classification is subject to exceptions. There are some operations so little identifiable with particular lots of work, that though performed on material that is strictly salable material, yet the operations are more of the nature of service than of direct production. Such, for example, will be the operations of annealing, varnishing in vats, tempering, and generally any operation in which a number of separate lots of goods belonging to separate orders are worked on at the same time and in a uniform way. Generally speaking, however, Production Orders are those issued for performing work directly on salable material, and Service Orders comprise all other work.

In large plants, and in most machine shops, the term salable material needs to be used with qualification. Such shops make things for their own use, usually tools, jigs, patterns, etc.; but sometimes actual machines. A firm will also sometimes undertake building operations on its own behalf. Therefore, a Production Order may embrace work done on material salable either to an outside customer *or to the firm itself*. In this case the firm is its own customer, but that does not affect the distinction already drawn. It only extends its scope a little. Usually, however, orders of this class are not referred to as Production Orders, but as Plant Orders, or by some similar term to indicate that they are for the firm's own benefit. In the present work they will usually be termed Plant Addition Orders.

In considering orders it will be convenient to begin with Service Orders, leaving Production Orders to follow later. One reason for this method of attacking the subject is that ultimately all the expenditure on Service Orders has to be apportioned in some way or other to the Production Orders. There are several ways of doing this, and these are known as the various methods of

burden distribution. We need not note more than their existence at this stage. From what has been said already it will be readily understood that the reason for distributing all the cost of Service Orders over the various Production Orders is that *only the latter fetch money.* They alone represent salable product, and, therefore, in order that service may be paid for, it must at some time or other be transferred to and included in the cost of salable product, so that the price asked for the latter is sufficient to cover not only the direct cost of the product but also its share of service.

One of the great sources of business failure is neglect of cost of service. Where no proper accounting system is in operation to ensure that cost of salable goods does actually include cost of service in addition to direct cost of production, the cost of service is frequently guessed at, and not infrequently underestimated, with a resulting loss on sale.

Service Orders are of two kinds: Standing Orders and Special Service Orders.

Standing Orders cover all the usual routine service operations. Special Service Orders are issued where some unusual operation must be undertaken, such as the general repair of a machine or overhaul of a building. The distinction between the two classes of Service Order is usually one of magnitude. The limit varies in different plants, but is usually based on an understanding that any repair or other service work likely to amount to more than a certain sum, say $20, must be authorized by a Special Service Order, which must be issued or signed by some authorized person. In all other respects the two classes of Service Order are identical.

Standing Orders are so named because they are permanent. That is to say that they represent a classification of the usual kinds of service, and to each item of this classification a permanent order number is affixed, so that, for example, if the letter Q is assigned as a prefix distinguishing Standing Orders, Q35, may represent building repairs, Q36, machine repairs and so forth. These numbers do not change. Each has a Cost Sheet appropriated to it, and the costs thus ascertained are charged into Burden account at the end of each month, leaving the sheet blank to receive the detail of the next month's expenditure. In this way though the numbers never change, yet virtually each month's expense is isolated without difficulty. On the other hand, the system of Standing Orders ensures that expenditure on service *is recorded in the same way* month after month, so that accurate

comparisons can be made as to the expenditure, in very considerable detail, and with a minimum of trouble.

The object of setting up Standing Orders is to record expenditure on service *so that the record is significant.* It is of no use to record figures unless they mean something. Now, when we have a great variety of expenditure, as in the case of a manufacturing plant, we must be able to distinguish between the various uses of the service performed, or the figures will have little significance. If, for example, we know that in a given month $5,600 has been spent on repairs, this tells us something, but if we think the figure too high we have no means of finding out the location of the excess. If, however, our Standing Orders, instead of merely providing one item for repairs, had provided separate items for building repair, machine repair, repairs to fixtures, tool repairs, and so forth, we should be able to lay our finger on the division in which the increase had occurred. And if a further subdivision had been provided, so that each department had a set of Standing Orders for its own expense, we should be able to trace the increased expenditure on, say, machine repair, to the particular department in which it had been incurred. And this localization of the increase would be made with practically no more work than would be involved in providing the bare information that repairs as a whole had cost $5,600.

The setting up of a system of Standing Orders is, therefore, a matter of considerable importance, and the degree of control to be attained over expenditure on service will depend largely on the wise laying out of the Standing Order system.

Though in particular industries there may exist special kinds of service expense, yet these will not commonly be important. The functions underlying manufacturing activity are closely similar in all industries, and some such scheme as will now be described will apply to almost all plants.

It will have been understood from the foregoing chapters that burden is made up of three elements: first, material consumed, such as oil, waste, fuel, etc.—any material, in fact, that does not form part of the salable product; secondly, internal service, represented by wages and salaries; thirdly, outside service represented by charges for rent, insurance, taxes, etc. And it will be remembered that wear and tear on plant, buildings, machinery and other equipment (which is really a slow consumption of material) is, in practice, charged against manufacturing opera-

tions by means of a depreciation rate. In considering these elements of expenditure for the purpose of arranging a set of Standing Orders, it is obvious that one or more main classifications may be made, according as we look at the facts from one or another viewpoint.

In laying out a Standing Order system so as to collect expense in intelligible forms, the first and most obvious necessity is to separate the expense pertaining to one department from that pertaining to another. In other words we must "departmentalize" expense. We must ascertain, as shown above, what amount has been spent, say, on repairs, in each department. But it is also desirable to be able to view expense from another angle, and collect like classes of expense into similar groups in each department. By aggregating these departmental groups, we can then observe the total expenditure on any class for the whole plant. Thus, to take a simple example, we may isolate the cost of cleaning windows in each department by assigning a Standing Order number to that particular form of activity. This enables us to compare the cost of such work in department 1 with the same work in other departments. It also enables us, by aggregating the cost in all departments, to view the cost of window cleaning as a whole. Then should we receive a bid from a window-cleaning company to do the work for the whole plant at a fixed rate of remuneration we are enabled to see at once whether such offer is advantageous or not.

Standing Orders, therefore, are provided in each department to take care of all the different kinds of service activity found in each such department. This may be done with any desired degree of detail. But if each department is dealt with singly, it might happen that comparison between one department and another would be difficult. Therefore, it is usual to lay out a scheme of numbers so that each hundred, for instance, represents a department. Thus, numbers 100 to 199 may represent the power plant, 200 to 299 the first operating department, say the machine shop, 300 to 399 the second operating department, say the foundry, and so forth.

Within each department, similar items are numbered similarly, thus sweeping and cleaning may be 108 in the power plant, 208 in the machine shop, 308 in the foundry, and so on. It is evident that a cross-totaling of the 08 items will give us a total of cost of sweeping and cleaning throughout the entire plant.

While this method gives useful information, it is desirable that the detail items themselves shall be grouped in such a way that the cost of certain large groups of service shall be known, both within each department and in the aggregate. Thus, for example, the group of expense connected with buildings, their repair and maintenance, lighting and heating, is obviously a clear-cut field of activity that should be separated from all others. In the same way, the cost of keeping, storing, conveying and handling material throughout the plant forms another field of activity of a separate nature. The cost of supervision is another such group. The cost of factory organization, that is, of offices, clerks, office appliances, stationery, blanks and books is another. And finally, we have the cost of auxiliary service departments such as the power plant, compressed-air or hydraulic plants, etc., which must be first ascertained separately and then prorated on some adequate basis, to the productive departments making use of the power.

It is, therefore, not sufficient to simply list all the service activities, and give them similar numbers in the various departments (varying only as to the hundred figure). The items themselves should be arranged in a certain order, so that, for instance, all the items relating to buildings are together, all those relating to stores and transport of materials are also together and so on. It may happen in some cases that certain departments have one or more items peculiar to themselves. A foundry, for example, will have certain activities such as "chipping" or "fettling" requiring separate listing. A power plant will have others, as, for example, "ash removal." And it may further happen that some departments may lack activities generally found in others, as, for example, a department having no windows could not have an item relating either to the repair or the cleaning of windows, but in general this will not affect the scheme. Where activities are absent, the corresponding number is simply omitted. On the other hand, where extra activities are in question, care must be taken not to omit them in laying out the scheme, as otherwise no vacant space may exist in the series of numbers at the proper place, and we may have to resort to the inconvenience of using numbers like 106a, etc. which would easily lead to confusion and error.

The groups into which items are collected are known as "production factors." They are at least six in number, as follows:

Buildings (or space) factor.
Stores-transport factor.
Supervison factor.
Organization factor.
Power factor.
Productive machinery factor.

In some cases, as indicated above, there may be more factors than these. There may be, for example, more than one kind of power factor, and in the case of machine shops there may be a separate tool room factor, the cost of which must be prorated to certain of the productive departments just as the power factors have ultimately to be prorated.

As we have nothing to do at this stage with the way in which these items are charged to Production, but are only concerned here with their collection in convenient form, it will be sufficient to exhibit a skeleton scheme of Standing Orders, arranged in the above-mentioned manner. Fig. 56 shows such a scheme, which, of course, is intended to be merely suggestive. It will require modification and addition according to the nature of the business, and the particular local circumstances of the plant. In general, however, it will be pretty widely applicable.

It should also be noted that an extension of the Standing Order scheme may readily be made to indicate *specific* items of equipment worked on in the way of repairing. Thus 560 represents the repair of productive machinery in department 5. Now, as each machine or piece of equipment should be numbered, as explained in a former chapter, it is an easy matter, if machine number 203 has been repaired, to write the Standing Order number thus; 560/203. This not only identifies the class of work that has been performed, namely, repairs to machinery, and the department in which it has been done, namely, department 5, but also specifically identifies the machine so repaired, namely, No. 203. It should be mentioned here that the use of a decimal point instead of a stroke, thus 560.203 is frequently recommended in connection with schemes of this kind. There is no advantage whatever in such a practice, and it tends to surround with an appearance of mystery what is really very simple. To talk about decimal points confuses many persons, whereas almost anyone can grasp the idea that the Standing Order number must be followed by the machine number, separated by a stroke.

Group or Factor	Key Number	Item of Expense	Dept.1 Supt. & Prod'n	Dept.2 Factory Offices	Dept.3 Stores	Dept.4 Power Plant	Dept.5 Productive	Dept.6 Productive	Dept.7 Productive	Dept.8 Productive
Building or Space Expense Items	00	Depreciation of Buildings etc *	100	200	300	400	500	600	700	800
	01	Rents, Taxes, Insurance on Bldgs &c *	101	201	301	401	501	601	701	801
	02	Repairs to Building Structure	102	202	302	402	502	602	702	802
	03	Repairs to Building Equipment *	103	203	303	403	503	603	703	803
	04	Current for Lighting	104	204	304	404	504	604	704	804
	05	Steam for Heating	105	205	305	405	505	605	705	805
	06	Painting & Kalsomining	106	206	306	406	506	606	706	806
	07	Cleaning Windows	107	207	307	407	507	607	707	807
	08	Other Sweeping & Cleaning	108	208	308	408	508	608	708	808
	09	Sundry Supplies	109	209	309	409	509	609	709	809
Stores Transport Expense Items	20	Depreciation on Cranes, Trucks, Fixtures &c			320		520	620	720	820
	21	Insurance on Ditto			321		521	621	721	821
	22	Repairs to Ditto			322		522	622	722	822
	27	Wages of Cranemen & Handlers			327		527	627	727	827
	28	Salaries Storekeepers & Storeclerks			328					
	29	Sundry Supplies			329		529	629	729	829
Supv'n Item	30	Wages of Foreman				430	530	630	730	830
	37	Share of Adminis. Salaries	137							
	38	Salaries of Supt. & Production Staff	138							
Factory Organization Expense Items	40	Depreciation on Office Equipment	140	240	340	440				
	41	Insurance " " "	141	241	341	441				
	42	Repairs to " "	142	242	342	442				
	44	Stationery, Books & Blanks	144	244	344	444				
	45	Telephone, Telegrams & Postages	145	245	345	445				
	47	Wages of Messengers, Watchmen &c	147	247	347					
	48	Salaries of Clerks	148	248	348					
	49	Sundry Supplies	149	249	349	449				
Power Plant Expense Items	50	Depreciation on Power Equipment				450	550	650	750	850
	51	Insurance " " "				451	551	651	751	851
	52	Repairs to Power Equipment in Power Plant				452				
	53	" " " " elsewhere					553	653	753	853
	54	Fuel				454				
	55	Feed Water				455				
	57	Wages in Power Plant, Boilers				457				
	58	" " " " Engines &c				458				
	59	Sundry Supplies, & etc				459	559	659	759	859
Productive Machinery Items	60	Depreciation on Machines & Benches					560	660	760	860
	61	Insurance " " "					561	661	761	861
	62	Repairs to " " "					562	662	762	862
	63	Cleaning & Oiling Machines					563	663	763	863

* Including Lighting, Heating, Ventilating & Fire Equipment

Note- Where no Standing Order Numbers are given the Item of Expense does not usually arise

FIG. 56.—Principal items of Factory Expense tabulated as "Standing Orders".

Moreover, strokes are much less likely to become blurred or erased than dots.

In engineering works the drafting room, and the tool room will in general require separate extensions for their special activities, both these departments, like the power department, being of the nature of expense, and having ultimately to be prorated over productive departments in order to extinguish their cost. All departments that make nothing for sale, but are simply auxiliary aids to productive work, will be dealt with along similar lines.

The Standing Order scheme has for its main object to collect and classify all activity, and consequently all expenditure within the factory that is not directly connected with actual work on product. It is, therefore, often called indirect expense. In many industries, this indirect expense, as collected through Standing Orders, when added to certain other items such as depreciation, rents, insurance, etc., forms more than half the total shop cost of production. It forms, therefore, a very important element in the successful running of a shop, and as will be seen later, an imperative necessity exists for ascertaining the amount chargeable against each Standing Order number, each day, and for promptly bringing it to the attention of the foreman and others concerned in the arrangement of work. For this reason whatever detailed subdivisions are made, should be made in consultation with the technical force, so that the daily information to be extracted from costs will be of real service to the shop officials, enabling them to exercise effective control over expense.

In some cases as has already been pointed out, the Standing Orders are limited in scope. This chiefly applies in the case of repairs. Many establishments make it a rule to require a signed special order before repair work of more than $20 in value is put in hand. In such cases a special series of orders is sometimes made use of, which may be simple numbered blanks, on which is written particulars of the work to be done. One copy is kept by the official authorizing the work, one sent to the cost department, and one to the foreman supervising the job. When the job is finished the cost department is advised, and the cost of the work is then transferred to the proper Standing Order number. In some cases it will suffice to issue the signed order, but to charge the work to the usual Standing Order number. The only object of a separate order is to ascertain the cost of the special job,

apart from the normal expense going against the order. In engineering works, a separate order number series will in general be advisable. In other kinds of plant, identification of the time and material on a special job will usually be possible without recourse to this device.

In laying out a scheme of Standing Orders, then, the first requisite is to assign a series of hundreds or it may be thousands among the different departments, so that say the 500 series represents the "polishing" shop, or the "kettle" room, or the "wood heel" department or the "foundry" as the case may be, and then to ascertain what activities are common to all departments. In

Group	Item of Expense	Dept. 9	Dept. 10
Drafting Room Expense	Depreciation on Equipment	980	
	Insurance " "	981	
	Repairs to "	982	
	Salaries of Engineers & Draftsmen	984	
	Wages of Tracers, Printers &c	985	
	Blue Print & Photo Supplies	986	
	Drafting Material & Supplies	987	
Tool Room Expense	Depreciation on Equipment		1090
	Insurance on Equipment		1091
	Repairs to Equipment		1092
	Wages of Toolkeepers		1093
	Wages of Toolboys & Messengers		1094
	Tool Breakages		1095

FIG. 57.—Extension of Standing Order Chart to include special expenses of drafting and tool rooms.

general these activities should be grouped by production factors, such as the buildings (or space) factor, the stores-transport factor, the power factor and so forth. Then having arranged these in series with suitably subdivided details, the numbers from 1 to 69 are assigned to them, so that when prefixed by the hundred figure indicating the department, the particular activity, say building repair to floor, will be known as applying to that department. Further, those departments which are auxiliary to the productive departments, such as a tool room and whose activity is, therefore, itself of the nature of expense, must have their special activities tabulated, and the numbers from 70 to 99 assigned to them.

By this means, if we see, for example, Standing Order No. 452, we shall know at a glance that it refers to some special activity in department 4, and as we know that department 4 is the power house, we shall quickly be able to ascertain that, in fact, it means labor employed on repairs to machinery in the power house. In the same way we might have 1,093 representing some kind of work in department 10, and if 10 were a tool room, further reference would disclose that 1,093 was labor of tool attendants, who issue and receive tools from the tool stores.

If great subdivision were desired, more than 100 numbers would be required for each shop. In such cases, rather than use the numbers 100 to 299 for department 1, it is very much better to allot each department a complete 1,000 numbers. Department 1 would then take the numbers 1,000 to 1,999, department 2, those from 2,000 to 2,999 and so forth. Numbers cost nothing, while the gain from having easily recognizable groups identified with each shop is very great.

It must be understood that the Standing Orders applying to *productive* departments collect only such items as are *directly* chargeable to such departments. Thus, for example, there will be in each productive department, Standing Orders representing wages (see 523, 623, etc. in above table) chargeable against stores-transport factor. These will represent the local cost of handling stores and finished parts. In light industries these will be chiefly wages of truckers, laborers and so forth. In heavy industries they will represent the wages of cranemen. Additional numbers serve to record the cost of repairing cranes, oil and supplies for same. Also it may happen that subsidiary stores for half-finished parts may be set up for the service of a particular department. Such expense will be part of the Stores-transport Standing Orders of that department.

But this will still leave a considerable amount of expense chargeable against the main stores department itself. This expense will include the cost of upkeep of the building, wages and salaries, stationery, repairs to fixtures, etc. These expenses will be collected under a department classification, say, department 3 in the table above. Similarly, the local expense of the power plant will be collected under, say, department 1 in the table. When all the expense of running such departments (which are *non-productive* departments) must be prorated over the actual productive departments.

In the case of power plant department this will be effected on the basis of the amount of power judged (or measured) as being used by each productive department. In the case of other non-productive departments, the prorating is made on some arbitrary percentage, which is fixed by the management after due consideration of all the circumstances of the case. In some plants, the expense of running the stores department is not prorated to productive departments but is added as a percentage to the cost price of stores issued during the month. This is a practice that is allowable in some cases, but needs to be adopted with caution, especially where costly material is handled alongside cheap material. The cost of handling the one is probably in most cases no greater than that of handling the other, but this method naturally tends to penalize the more expensive material and lets the cheaper kind off too lightly. A case may be mentioned where a heavy steel casting that had never been in the stores at all, but had passed from the delivery team direct to the machine, had picked up a heavy stores charge, out of all proportion to its merits, simply because it happened to have been made of an expensive alloy for a special purpose.

The object of Standing Orders, therefore, is to collect items of expense chargeable against all departments of the factory, whether such departments are productive or non-productive and then when all are collected, *the amounts standing against the non-productive departments are prorated on some approved basis over the productive departments.* This applies whatever the classification adopted for the Standing Orders. It is not, of course, essential to group the items by production factors as shown in the table. But as, in general, the items must be collected in some way or other, it is best to so arrange them that they are grouped so that the cost of different kinds of service is isolated. That is to say, that the cost of maintaining and running buildings is a natural group that should be kept separate, and so with the other production factors.

CHAPTER XIII

ORDERS—PRODUCTION ORDERS

Production Orders cover all activities performed on salable material. Expense on Production Orders, whether of material or labor is usually termed direct expense to distinguish it from expenditure on Standing Orders, as explained in the previous chapter.

Production Orders vary very much in character, according to the type of industry. In some industries, the Production Order system is elementary, perhaps two or three being issued in a month. In other industries, notably all kinds of engineering industries, the order system is elaborate and complex. It will be well to consider the reason of these differences at the outset.

If our industry is a "continuous" one, such as paper-making or soap-making, and if we have one chain of machines or departments, each performing some specific work on a perfectly uniform product, then it is obvious that there is very little scope for an order system. As Production Orders are a device for identifying specific items of product, and as in this case one part of our product is absolutely identical with every other part, there is no need for any order system, unless, indeed, our statement of monthly production were for convenience considered as an order, each month's product being charged to a separate serial order number.

But if not one, but two, products were in question, say, for example, two varieties of soap, and if our machines were now occupied on one kind and now on another, then the desirability of instituting an order system would make itself felt. To obtain correct costs, it would be advisable to record the time occupied by each batch of soap as it passed through the machines, so that, the cost of operating could be divided between the two products in proportion to the time occupied by each. And this cost divided by the respective weights of soap produced on each order would be the cost of the soap per pound.

The next case we may consider is one where the product is uniform as regards substance, but individual as regards weight.

Such a case is observable in a foundry. The same mixture of metal may be running all the time, but quite a number of different articles may be cast from it. In such a case each individual batch would be distinguished by a separate order number, and if the product on each order number were weighed, we should find the cost of the order by simple division into the total cost of output of the foundry for the day.

But it might also happen in the case of the foundry that more than a difference of weight was involved as between one order and another. It might happen that one kind of work required longer to mold, perhaps also more skilled molding than another. Here is an additional reason for identifying each separate kind of work by an order number. The molders, instead of having their wages thrown into a common fund of foundry cost, would charge their time **directly** to order numbers, so that the individual differences in cost of molding would be charged against each separate order.

Finally, we may consider the case of an engineering shop. Here we may receive an order from a customer for a complete machine. This machine may contain hundreds of separate parts. These parts may originate in different ways. Some may be cast, others forged from bar or bloom, some may be cut off from solid rod, some may be made from sheet metal, while others again may be formed of wire. And on each of these original pieces, all sorts of operations may be performed. The casting or forging may be drilled, milled, planed, slotted, turned, filed; the piece from the rod may be worked up in an automatic machine, the sheet may be spun or pressed into shape or punched and bent, the wire may be coiled or straightened and so forth.

An endless variety of shapes and sizes of many kinds of materials will be the results of the shop activities, and all these pieces have then to be fitted together with great accuracy and the resulting machine tried and tested out before the customer's order can be considered as complete.

Now, it would be quite possible to perform all this activity to a single order number, without any subdivision. By that means we should know the cost of the machine, and as we know what we sold it for, we should also know whether or not we had made a profit. But supposing that after all, it was found that we had not made a profit, but a loss instead. What should be done to discover the reason for the loss?

Very little could be done. The cost would be an inextricable

jumble of material of all kinds, and of operative labor of all kinds, to say nothing of burden,[1] and no amount of study of it would tell us anything definite or satisfactory. The need for a comprehensive and detailed system of Production Orders, enabling us to ascertain the cost of each part or component of the machine, would be forced on us. And probably we should not be satisfied even with this. We should also require to know the separate cost of each process or operation on each dissimilar piece. Thus, if the baseplate were in question, we should want to know the cost of the metal contained in it, the cost of molding, the total foundry cost; the cost of planing, drilling the holes, slotting and scraping the slides, and whatever other operations were performed on the baseplate, *each separately.* Only by doing so, and by being in a position to contrast such detail costs with the cost of similar pieces done on a previous occasion could we conduct our business intelligently and safely.

But in the case of such a machine, we should still want some simple and effective method of viewing the cost of the detailed processes and of the material used as a single group. In other words though we want great detail, we also want the detail of this order kept entirely separate from the detail of other orders. Some method must, therefore, be devised of identifying the order as a whole and also of identifying the details as well.

This is effected by issuing a Production Order for the whole machine, and Job, Piece, or Component Orders for the individual parts and processes. This nomenclature is by no means universally adopted. Sometimes the Production Order is called a Work or Works Order. Component Orders are often called Part Orders. But by whatever names they may be known, the relation of the subsidiary order to the main order is always the same. The Production Order covers all the work of whatever kind, but no specific work; the Component Order is the specific instruction to someone to do specified kinds of work on a specified piece of material.

It will be seen, therefore, that Production Orders are of two kinds, those dealing with total lots, batches or outputs, known as Production Orders, and those dealing with subdivisions of such lots, batches or outputs, known as Component Orders, or Part Orders. It also will be evident that not all industries

[1] This is not an imaginary case. The writer has met engineering cost records kept in exactly that way.

require their Production Orders subdivided into Component Orders, since detail such as is set up by Component Orders is not always required.

There is also an intermediate class of Production Orders known as Departmental Orders, which stand midway between Production Orders and Component Orders. In many plants it is considered necessary to manifold the whole or part of the Production Order and to send the complete or partial instructions to all the separate departments concerned in the production of that order. By partial instructions is meant that only such details as interest particular departments are sent to those departments. The complete Production Order is in fact *dissected,* and the information conveyed on it is distributed among the various departments concerned. The difference between a Departmental Order and a Component Order is that the latter is commonly confined to the work on one kind of component, while a Departmental Order may be concerned with many such components, but only with those actually worked on within the department. It will be understood, therefore, that Departmental Orders, in many cases, require further splitting up into Component Orders so that production may be set in motion.

From the accounting viewpoint the main thing to be observed is that the system of issuing numbered Production, Department and Component Orders *controls the form in which the cost data will ultimately be obtained.* With the form of orders as controlling the efficiency of production we have nothing to do here. The degree in which subdivision of labor is necessary is, of course, a purely technical matter, but wherever labor is subdivided the accountant should be ready and able to produce figures showing the detail cost of the subdivisions.

Fortunately, a very detailed order system does not imply a correspondingly complex accounting. In cost work a great amount of identification of individual work with particular jobs and orders, is obtained as a byproduct as it were. Thus, for example, if we have five departments, and each Production Order is split up into five Departmental Orders, it does not follow that we require five separate series of numbers for such orders. On the contrary, if the number of the original Production Order is, say J8,765, then this same number will appear on each Departmental Order, and time will be charged to it in each department, without any confusion arising, because the records of time will

be made in such a way (as, for example, by each department having a different colored Cost Sheet) that it will be evident at a glance which department is concerned. Similarly, if we have a Component or Part Order calling for several operations on the part, it is not necessary to have a separate number for each operation, as the nature of the time record will disclose what kind of work is being done, so that it is easy to separate and classify each operation, and obtain the cost of it, even though several different operations have been charged to the same Component Order number.

Production Order No._____

For_____

Date_____ Wanted by_____

Shipping_____

Customer_____

Address_____

Their Order No._____ Date_____

Bill of Material_____

Job Schedule_____

Tool Schedule_____

Pattern Schedule_____

Special Instructions

FIG. 58.—Production Order (manifolded).

In general, therefore, we shall have two series of numbers to take care of—one series pertaining to Production Orders and Departmental Orders, and the other pertaining to Component or Part Orders. Any desired amount of detail in cost can be obtained from these two series.

Production Orders are frequently of two kinds, those arising from orders received from customers, and those giving instructions for the manufacture of articles for stock. From the accounting viewpoint no difference in procedure is involved as between these two classes of orders.

The form of Production Orders necessarily varies in different industries. In some a few lines of information convey all there is to be said about any order. In others a considerable amount of written information has to be inserted. Fig. 58 shows one form of Production Order, which can be used either for customer's orders or for stock orders. In many plants all information about the destination of the order is in fact suppressed on the copies that go to the manufacturing departments, so that the shops are in ignorance whether they are working on customer's or stock orders.

The essential elements of a Production Order are (1) information as to the goods to be made. This information may be simple reference to some standard goods made by the firm, or it may be a lengthy description and require supplementing by elaborate specifications, blue prints and so forth. (2) The date at which the goods are to leave the factory. (3) Spaces for entry of check marks signifying that the necessary Bill of Material (where such is in use) the necessary Part Orders, and the necessary Tool Schedule (where special tools have to be made for the work) and Pattern Schedule have been put in hand. (4) Particulars as to the customer, his order number, shipping instructions, etc., where the order is not for stock. (5) Space for special notes and instructions, as, for example, where special attention has to be paid to some point where satisfaction has failed to be given on a previous occasion, or where some extra finish or other unusual condition may be emphasized.

The manifolding of Production Orders is a matter depending on the internal organization of the plant, and its extent. One copy is retained by the order clerk, one should be sent to the cost accountant, one to the shipping clerk or the warehouse clerk, and other copies to the various departments concerned in making the goods. Whether or not these latter are modified for each department, so that each foreman receives information only about that portion of the order that concerns him (thus making them into Departmental Orders) is a matter also depending on the way in which the plant is organized. The chief thing to observe from the accounting viewpoint is that each Production Order shall be numbered consecutively, and that if split up departmentally, that each Departmental Order shall bear the same number as the original order.

This is secured by means of a Production Order Register (Fig.

59) in which a series of numbers are printed or stamped, and each new order receives an assignment of the next vacant number. Brief particulars of the order sufficient for identification are then entered against the number, and columns are frequently provided for date promised and date delivered, and sale price. Where date columns are used, an additional column as shown may be usefully provided, in which is entered the difference between the promised date and the date of actual delivery, this being the delay which has taken place.

Where production consists of standard processes, as in most manufacturing industries not of an engineering character, it is a common practice to have Production Orders prepared in the form of printed slips (Fig. 60). From an accounting viewpoint these present no special features, being merely labor-saving devices rendered possible by the fact that all such work goes through regular and invariable stages. The printed slip

Progressive No.	Date	Customer	For	Date Promised	Date Delivered	Delay	Price	

FIG. 59.—Progressive Number Register of Production Orders.

is frequently in coupon form, much like a long-distance railroad ticket, so that as the order progresses through the various departments, one coupon after another is detached and sent into the office having control of the course of production. In this way the regular progress of the order is signalled, and any order that is lagging behind can be looked up and urged forward. The figure explains itself, save that the small squares contain the dates at which the work should leave each department. Provision is also made for noting the falling out of the original number of parts by spoilage, in order that provision may be made for supplementary parts to be put in hand. But in many trades, where special lots are put in hand for customers, it is understood that whatever number comes through in the batch, having survived all the accidents of production, shall be accepted by the customer as fulfilling his order. He does not, of course, pay for the spoiled parts, but is invoiced on the basis of the number actually shipped.

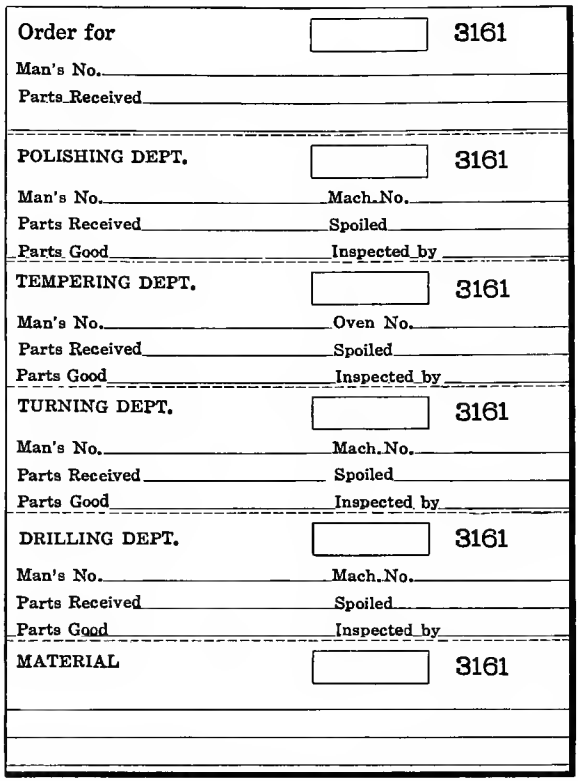


FIG. 60.—Combined Production and Department Order for standardized process work.

Component
Schedule
Production Order No.

Customer
Their Order
Date
For

Name of Component	Process	Component Order No.

FIG. 61.—Component Schedule for parts and processes.

The foregoing (Fig. 60) is, of course, a Departmental Order, or rather, set of Departmental Orders. But there is nothing to prevent additional coupons being inserted, so that two or more coupons apply to a single department. Thus, for example, there might happen to be two distinct drilling processes, each having its separate coupon. This would be equivalent to the issue of Component Orders for these separate processes, but in standardized work of this kind it is not usual to recognize any smaller subdivision than the department, even though the material may pass through several machines in any one department. In the example given all time and material would be charged against order 3,161, in whatever department the work was done.

We have now to consider those cases in which considerable detail is required in the costing of a Production Order, involving the ascertainment of cost of perhaps scores or hundreds of parts, each or many of these parts being subjected to more than one process or operation.

In such cases, the best procedure is to list all the separate parts on a Component Schedule (Fig. 61). Against each component, its name and the different processes or operations to be performed on it are entered. When the list is complete, numbers are assigned to each component from a Component Order Assignment Register (Fig. 62) which is a plain columnar book, one column containing progressive numbers from 1 to 9,999, and the other column being left blank for insertion of Production Order numbers. An entire block of numbers is assigned to a particular Production Order, corresponding to the number of components it com-

Component Numbers	Assigned to Prod. Order
K 1760	3290
K 1761	"
K 1762	"
K 1763	"
K 1764	3291
K 1765	"
K 1766	"
K 1767	"
K 1768	"
K 1769	"
K 1770	"
K 1771	"
K 1772	3292
K 1773	"
K 1774	"
K 1775	"
K 1776	"
K 1777	"
K 1778	"
K 1779	3293
K 1780	"

FIG. 62.—Component Order Number Assignment Register.

prises. Thus, in the example shown, Production Order 3,291 has a block of component numbers assigned to it, beginning with 1,764 and ending with 1,771. It is sometimes the practice to run a letter of the alphabet before each component number, such letter changing with each hundred numbers. Thus numbers 1 to 99 would be prefixed by A, numbers 100 to 199 by B and so forth. The object of this is to enable errors in numbers to be discovered before accounting entries have been made. Thus if an error in the component number K1,768 were made, so that it read K1,968, the cost clerk would know at once that no such combination existed, and that something was wrong. The same would be true if K2,768 were written. There is no great importance in the idea, but it certainly assists in discovering and localizing errors in numbers before mischief is done. This, however, is a matter that does not concern us at the present stage.

Component Order No. _____ Production Order No. _____

Part _____ Qty _____

Operation _____

Man's Name _____ No. _____

Machine No. _____ Date Due _____

No. Good _____ No. Bad _____ Inspected _____

FIG. 63.—Simple form of daywork Component Order.

The Component Schedule having been completed, it is a frequent practice to make out a complete set of Component Orders in advance. One of these will be made for each operation on each component, so that in some instances there will be two or more such Component Orders bearing the same component number. A suggested form for such an order is shown in Fig. 63. The principal items to be filled out are Production Order number, component number, name of part, quantity required, nature of the operation to be performed, and the date at which the component should have been completed as far as the operation in question is concerned. When the whole series of Component Orders are completed, they are sorted out in departmental groups, and forwarded either to a production department charged with controlling the course of production, or to the various foremen of departments.

In the case of Component Orders, work on which is to be done

on some piecework, premium or bonus plan, the form Fig. 64 may be used. This is similar to Fig. 63, except that additional space is provided, for particulars of the time allowance, or piecework price, the earnings of premium or bonus, and for a detachable stub, on which the extra earnings of the man may be entered, certified, and checked. This stub goes to the pay-roll office and to the cost clerk as will be described in the chapters on Costing.

In practice there are a number of different blanks and methods of transmitting orders to the departments and the men, besides the general types shown here. In non-assembling industries, that is industries which do not make one part of the order in one place and another portion in another with the necessity for subsequent assembly and fitting of the separate parts together to form the completed article, it is not uncommon to find what might be termed a "waybill" or "follower" system in use. The Waybill or "Follower" is a Production Order, in which the different steps of manufacture are enumerated, and perhaps the use of certain subsidiary materials indicated, and the document accompanies the

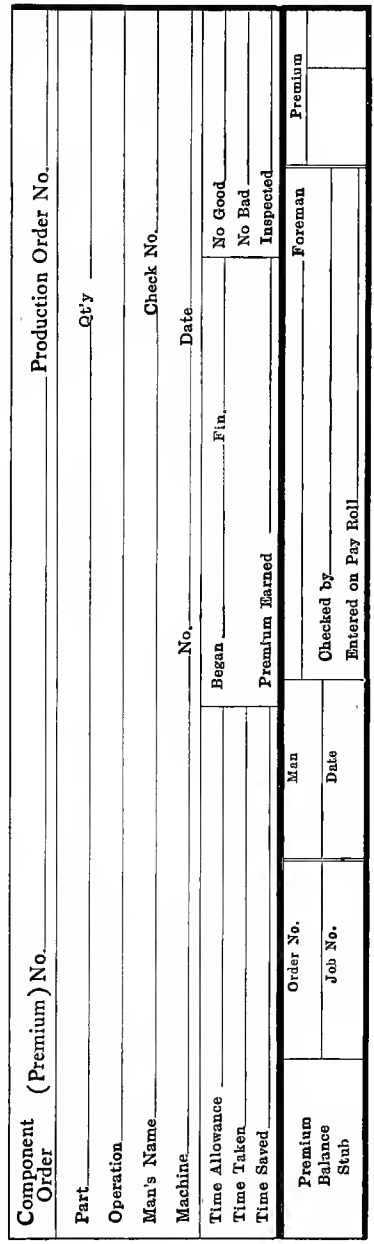


FIG. 64.—Component Order (premium or piecework) with detachable stub.

goods from point to point through the shops, until completed. Time is, of course, charged to the order number borne by the Waybill itself. A good example of such a system of orders is to be found in printing plants, wherein the Production Order blank is printed on the outside of an envelope, the envelope itself being occupied by the draft or "copy" belonging to the customer. Space is provided on the Production Order blank for particulars as to material (paper stock) to be used, for instructions as to type and style of composition, for data as to the kind and color of ink to be used, and other departmental information, including shipping instructions.

Such a Follower is, in fact, a combined Production and Departmental Order similar in intent to that shown in Fig. 60. It has exactly the same accounting validity. Indeed from the accounting viewpoint very little importance attaches to the physical shape, or ruling of the order blanks, but much to the relation between the components or processes, and the number and quantity of goods to be made. For as was said above, the order number series control the amount and nature of the detail that can be provided by the cost accountant.

This is so important a matter that it will be well to discuss it at some length. Production Orders represent definite quantities of work. In cases where all work goes through *unvarying* stages, it is evident that if we establish connection between any of these stages and a Production Order number, ultimate detail is attained without the necessity for any further complexity. Thus, for example, if only one polishing process takes place on each order, then a daily record of all orders on which polishing has been done exhausts all the information to be obtained about polishing. A polishing charge against Production Order 5,674 can only mean one thing. Similarly with all the other processes in a fixed or standardized series.

But, on the other hand, if Production Order 5,674 contains several parts or components, some or all of which are likely to be subject to the polishing process, then it will obviously not exhaust the questions that may be asked if we only record so many hours and dollars against polishing on Order 5,674. For it might be asked, "how much was expended on polishing this component and how much on that?" To answer such an inquiry we should have to set up a mechanism for identifying individual kinds of components, or, in other words, in addition to a Produc-

tion Order series of numbers we must have a Component Order series of numbers.

On the other hand, supposing the work of the polishing department consisted of polishing handwheels and levers, no other components ever reaching the department, then it is obvious that unless we establish a firm connection between all the components of a Production Order and the Production Order number itself, we should be unable to say which handwheel and which lever belonged to any particular machine. We would get to know the cost of polishing each and every one of such articles that passed through the polishing shop, but we should not be able to identify any of them with the finished and assembled machine they were ultimately built into. This is equivalent to saying that in all cases Component Orders are subdivisions of Production Orders. Production Orders can exist without Component Orders, but we cannot have the latter save as subdivisions of the former.

Whether it is necessary to go the length of setting up a Component Order mechanism will depend first on the nature of the work. It does not follow that we must have Component Orders because components exist in our product. It may easily happen, as in shoemaking, that though there are several components, the processes performed on each component are separate and distinct. The processes on one component are never applied to another component. Thus no ambiguity arises. All work on a lot is charged to a simple Production Order, but if required, the cost of each process on each component can readily be sorted out and ascertained separately. Component Orders are, therefore, necessary only when a number of components go through like processes. The classic example of this condition of affairs is the engineering industry. Machine-shop manufacture includes comparatively few different kinds of processes, but often innumerable different components. The former may reach a score, the latter may reach thousands.

Consequently, to say that Production Order 5,674 was chargeable with 100 hr. and $25 cost for milling, would be indefinite indeed. For it might happen that 20 separate parts or components of Order 5,674 had passed through a milling operation. Hence, we supplement the order series which gives us 5,674, with another order series that gives us *separate numbers for each of the* 20 *components* comprised in 5,674. Then the milling

machine operator will charge his time to Production Order 5,674, Component Order 2,359, and so forth. By this means the ambiguity disappears. We know precisely what Production Order and what component of that Production Order is in question, and this information exhausts the subject. If the milling operator's time sheet lists all the Production Orders, and all the Component Orders he has worked on during the day, the whole field of costing is covered as far as he is concerned.

Production Orders, then, control the cost of lots, and of all processes on lots. (A lot may, of course, be simply one article, or it may be a million articles.) If the article to be made consists of separate parts or components, the Production Order will still control the costs satisfactorily *unless any one process is performed on more than one kind of component.* Then in order to be able to ascertain process cost on individual kinds of components, each of the latter must be distinguished by a number, that is, Component Orders must be instituted.

Even this is not a hard and fast rule. It often happens that some one process is of very general application, as for example, tempering or annealing, dipping in varnish vats, and in some instances, an operation like drilling. In such cases it is not an infrequent practice to substitute a fixed charge based on quantity or weight or number of articles handled, for a regular costing operation. Each Production Order thus receives a debit for the services of the operation as a whole, components being ignored. This, however, is a detail that need not divert our attention. It is introduced only to show that sometimes the occurrence of a process common to many components does not necessarily give rise to a necessity for Component Orders.

It must not be forgotten, however, that orders control the issue of material as well as the charging of time. In standardized work, as in machine building, it is customary to originate instructions as to the issue of material by means of a Bill of Material, Fig. 65. One such bill is issued in connection with each Production Order, and as will be seen by the ruling, provision is made for entering the Component Order number against each item specified. This latter provision is, however, not necessary unless Component Orders are necessitated as described above. For, as will be seen from inspection of the bill, each component is issued and priced separately, and as long as its name is fixed and not subject to any ambiguity of description, its cost can be readily

identified after the issue details have been filled out by the storekeeper.

In Fig. 60 it will also be noticed that the bottom coupon (the first to be detached) is devoted to material. The order is first sent to the storekeeper, who either issues the material there and then, or orders it if not on hand, and when he issues it to the foreman of the drilling department, detaches the coupon and sends it in to the production control clerk. At the same time he charges up the material to the order number shown on the coupons. The rest of the order accompanies the material into the shop.

The part played by the Production Order in regard to material is, therefore, a simple one. Material is usually controlled by the

Bill of Material ——— Production Order No. ———

Customer ———

Their Order ——— Dated ———

For ———

Q'ty.	Component Order No.	Material Required	Ref.No.	Issued	Price	

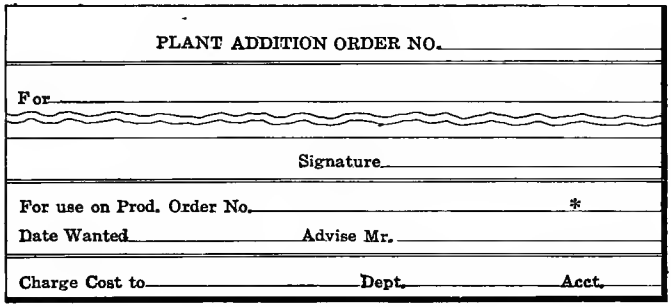
FIG. 65.—Bill of Material and Stores Issues Record.

Production Order itself, or by a Bill of Material in conjunction with it. In some cases, however, material is drawn out of stores and charged to Component Orders, but this practice is on the decline, being superseded by the far better method of listing in advance all the material likely to be required on a given Production Order, and getting this to the storekeeper at the earliest possible moment, instead of waiting until presentation of a Component Order, when it is often discovered that no material of the kind is available.

In engineering work particularly, the making out of a Production Order may involve the preparation and issue of certain auxiliary orders at the same time. The Bill of Material has already been mentioned. Of similar nature are the Tool Sched-

ule and Pattern Schedules (see Fig. 58). These specify what special tools, jigs, dies, and fixtures are to be used in connection with the order, and what patterns are to be sent to the foundry in connection with the casting of components. These operations have no accounting significance, unless, as will often happen, *new* tools, patterns, dies, etc., are necessary, or patterns have to be *altered* in some way to suit the specification of certain components.

In such cases (new tools and patterns) Plant Addition Orders are necessary. In the case of altering patterns, the expense is sometimes taken care of by a Standing Expense Order chargeable against foundry operations generally, but sometimes separate record is made of such expense, and it is charged against the Production Order for which it has been incurred.


PLANT ADDITION ORDER NO.

For

Signature

For use on Prod. Order No. *

Date Wanted Advise Mr.

Charge Cost to Dept. Acct.

FIG. 66.—Plant Addition Order.

Figure 66 shows the essential features of a Plant Addition Order, which is used for all addition to capital values, as well as for the making of new tools and patterns. Thus, new fixtures, erections of all kinds, new machines, additions to existing buildings, new wiring and piping and in general any new work for the firm itself will be authorized by a Plant Additions Order. The essential features of such an order are, a serial number which will be obtained from a Plant Additions Orders Register very similar to Fig. 59, space for particulars of the order, date wanted, person to be advised when completed, department and account chargeable, and, in the case of new patterns, tools, etc., space for indicating what Production Order has given rise to the necessity for the new work. The order will be signed, stamped or initialled by the party authorizing the work.

The activities set up by these Plant Addition Orders are treated in exactly the same way, from the accounting viewpoint as work on Production Orders. They are in fact Production Orders, only the product is not sold, but charged up to the firm's own Capital account. They represent work which it is more convenient for the plant to undertake on its own premises and with its own men, than to purchase from outside firms. Therefore, until the costs of such an order are completed, and it is ready for crediting to Manufacturing account, it is treated exactly as if it were a Production Order of the ordinary kind. What happens to it on completion will appear in a later chapter.

CHAPTER XIV

COST SHEETS AND BURDEN

The subject of Cost Sheets is so intimately connected with that of orders, that we must refer to it in a preliminary way at this point, although, in fact, the sources of the entries to be made on these Cost Sheets, namely, the charges for material, time, premium balances, depreciation, etc., have not yet been considered. These will be dealt with in succeeding chapters.

Just as orders cover the whole field of factory activity, inasmuch as nothing can be done in the factory save by authority of an existing order, whether a Standing Order, a Production Order, or a Plant Addition Order; so Cost Sheets cover the whole field of the *record* of such activity. Every act undertaken to carry out an order, whether in the way of consuming material or of using up time, must be reflected in a Cost Sheet.

Every order number has a corresponding Cost Sheet.

This applies not only to Production Orders, Plant Addition Orders and Component Orders, but also to Service Orders. Every expenditure of wages, salaries and material in the shops must find its way to a Cost Sheet.

Reference to the general diagram will show that Cost Sheets have different destinations according to their class. Cost Sheets of Service Orders find their way, through Burden Journal into Departmental Burden accounts, while Cost Sheets of Production Orders (or of Component Orders collected under their Production Order grouping) find their way to Manufacturing accounts through Manufacturing Journal, and Plant Addition Order Cost Sheets find their way to Plant Additions account through the same journal.

Further it will be observed that production makes a credit to Departmental Burden account, which credit really represents an absorption of burden by individual Production Order Cost Sheets on one or other of the methods of allocating burden that will be described later. At this stage it is only necessary to note that the total accumulated in Burden account each month is

distributed by fixed rules over all the Cost Sheets that represent Production and Plant Addition Orders.

We have thus two great groups of Cost Sheets—those which collect particulars of service or burden expenditure, and those which collect particulars of cost of production and new plant. These two classes of Cost Sheets are totally different in character and aim. Service Cost Sheets represent Standing Orders, and are consequently cleared or charged off at the end of each month, though the Standing Order numbers remain alive and unaltered. Production and Plant Cost Sheets on the other hand, remain open and uncredited until completion of the work for which they have been issued. Then they are withdrawn and the numbers are not reissued. Thus they may last for two, three or any number of months, and in each month will be charged with the wages and material expended on them, and *also with a proportionate amount of burden.*

It will be recognized, therefore, that Service Cost Sheets are very simple affairs. They have but to provide for the collection, daily or weekly, of certain items of wages and material, and at the end of the month, the total of these items is charged off through Burden Journal, leaving a clean slate for the next month's items.

But on the other hand Production Orders (whether for salable goods or for plant additions) require Cost Sheets that will take care of wages and material expended on the order, and also take care of the allocation of burden. Now as burden may be allocated to Production on three wholly different methods, it follows that there will be three distinct types of Production Cost Sheet corresponding.

Moreover, there is the difference between Production Orders and Component Orders to be taken care of. While the form of their Cost Sheets is exactly the same, as might be expected, since the latter represent small portions or subdivisions of the former, still some mechanism has to be set up whereby all the Component Orders pertaining to any one Production Order may be summarized and presented in some convenient or logical grouping, so that the entire cost of the Production Order is shown. In other words, having found the cost of separate components by means of Component Orders and Component Cost Sheets, we must combine this information, so as to show the cost of the whole.

From what has already been said about Production Orders, it will be readily understood that any plant that has a simple Production Order system, necessarily has a simple Cost Sheet system. In a continuous industry, where the product is uniform in character from month to month, and each Production Order issued covers the whole manufacturing activity for a whole month, then a single Cost Sheet to which are charged all the direct wages and direct material for the month, is all that is necessary. But even in this case, subdivision of service costs into their several classes, as explained in a former chapter, is desirable in order that comparison of one month with another along the observable lines of expense may be made. The total of service items is then chargeable to the single Production Order without any particular method of allocation.

But when we have more than one Production Cost Sheet, then the total of service items *must be divided between the Production Cost Sheets* on some predetermined plan. If we have say, six Production Orders running, then burden must be prorated over all the six. This may be done in different ways, and it is the existence of this necessity of distributing burden over Production Cost Sheets on some definite principle that makes all the complication of cost keeping. As will be seen in later chapters, there are three well-defined ways of doing this, depending upon the nature of the business to some extent, and the degree of refinement and accuracy that is sought for.

So far we have spoken of burden as if it were wholly derived from the expenditure of wages, salaries and material, which are charged out to Cost Sheets representing Standing Orders. But there are other items of importance that form part of burden. Reference to the general diagram will show that credits are made from the Burden Journal to Depreciation, Rents, Taxes and Insurance, Works Expense, Spoilage and Interest accounts. (Interest, however, is an optional item, and the circumstances under which it is chargeable will be considered in a separate chapter. It may be ignored at the present stage of our discussion.)

All these credits are made because equivalent charges have been made to Standing Orders, by means of the schedules shown in the diagram, or by special entries in the case of works expense and spoilage. Thus there will be Standing Orders for depreciation on buildings, and one such order number will be allotted

to each department. Similarly each department will have a set of Standing Order numbers that will take care of monthly charges for rent, taxes, insurance of one kind or another, special items of works expense, the cost of spoiled work, etc. Thus alongside the Standing Orders to which salaries, wages and material are chargeable there will be other Standing Orders to which such items as depreciation, etc. are chargeable. These tabulated, calculated or scheduled charges will be made once a month, and consequently a single entry on the corresponding Cost Sheet will suffice for the whole month's accounting for that item. And as such charges are immediately passed on to the Departmental Burden accounts by means of Burden Journal, it is evident that the provision of a Cost Sheet for such items is a merely formal matter, and in fact is frequently dispensed with, as will be shown later. Nevertheless, theoretically all such items are chargeable to a Standing Order Cost Sheet, and this Cost Sheet is entered on Burden Journal precisely as the other kind of Standing Orders which collect items of salary, wages and material are entered. There is no difference between them in principle.

Standing Order Cost Sheets, then, are the medium of collection of items of wages, salaries, material, and such items as depreciation, etc. that have been found chargeable against particular departments for particular services during the month. When all such items are entered, they are totalled, and the total charged out in Burden Journal against the department responsible. Credits are also made through the Burden Journal for the corresponding amount of wages, salary, material, depreciation, etc., as shown by the general diagram. By this procedure the Standing Order Cost Sheets are discharged of all contents, and as far as that month's work is concerned are cancelled.

Production and Plant Addition Cost Sheets are the medium by which items of wages and material directly identifiable with work on such orders are collected. When all the items for the month are so collected, and each sheet is totalled, some method is found of prorating all the burden, which has been extracted from the Standing Order Cost Sheets, over them. This share of burden is then charged to each Cost Sheet.

The Cost Sheets are then entered in Manufacturing Journal, and the current month's wages, material, and burden totals being entered in the proper columns (see general diagram) credits are made to Stores, Wages, Burden (and in some cases to

Work Expense account), and debits to Manufacturing account for the total of Production Order costs, and to Plant Additions account for the total of Plant Addition costs.

If we consider a plant at the end of its first month of operation, when nothing has yet been completed or taken out of the shops, then it will be obvious that all the expenditure chargeable to the factory has now arrived in the Manufacturing account and the Plant Additions account. Or, if there were no plant additions in hand, as would probably be the case in a large variety of industries, all such expenditure would now be represented in Manufacturing account. For example, all expenditure on wages and salaries, having been divided to begin with between Standing Orders and Production Orders, *and all Standing Order cost having been transferred to Burden account, and then allocated over Production Order Cost Sheets*, it follows that the latter now contain *all* the expenditure on salaries and wages. Part of this will be direct, and will be shown on the Production Order Cost Sheets as direct wages, the remainder will be disguised as burden, of which a share has been allotted to each order. But between direct wages and burden, the whole of the charge against Factory for wages and salaries will be found on the Production Order Cost Sheets.

Similarly, the transfer of all the other items of expenditure could be traced, and the same would be found to be true. The complete collection of Production Order Cost Sheets, therefore, at the end of the month, contains the complete cost of production for that month. And as this total is charged to Manufacturing account by means of the entries on Manufacturing Journal, it follows that Manufacturing account *contains the whole cost of uncompleted orders now in the plant.* And the various Production Order Cost Sheets *are the detail of that total.*

In other words, the balance in Manufacturing account at any month end is an amount of which the detail items are to be found on the Production Order Cost Sheets. In a sense, Manufacturing account is like a Control account, of which the Cost Sheets are the Item accounts, similar to Stores Control account and Stores Item Cards, or Plant Control account and Plant Item Cards.

The function of Cost Sheets may now be summed up in a few words. Standing Order Sheets collect items of service expense, including depreciation, etc., and by grouping these sheets in departmental groups and entering them on a Burden Journal, we

are enabled to credit Wages, Stores, Depreciation, etc., accounts, and debit Department Burden accounts. When this is done, the Standing Order Cost Sheets are like a cleaned slate, and the same order numbers are ready for the next month's items.

Production Order Cost Sheets collect items of direct labor and direct material. They also collect a share of burden which is allotted to them on some definite basis which will be considered later. Being entered on Manufacturing Journal, the totals of direct wages are credited to Wages account, the totals of direct material to Stores account, and the totals of burden to Burden account. Manufacturing account is then charged with the aggregate, namely, direct wages, plus direct material, plus burden.

Plant Addition Cost Sheets are dealt with in the same way as Production Sheets, but are charged to a Plant Additions account instead of a Manufacturing account.

The use of Standing Order Cost Sheets does not end with the grouping of service cost into Departmental Burden accounts. They are also tabulated for comparative purposes as will be seen later. In fact the principal object of the subdivision of service costs into so many items is for the purpose of tabulation and comparison. This will be considered in a later chapter.

Production Order Cost Sheets go on accumulating direct wages, direct material and burden each month, until the work they represent has been completed and has passed out of the shop. When this happens a credit to Manufacturing account equal to the entire face value of the Cost Sheet takes place. Hence the balance in Manufacturing account is at all times represented by the pile of live Cost Sheets. Similarly the value of the work in process in any department is equal to the balance in that department's Manufacturing account. And the value of any particular item of such work is shown by the corresponding Production Order Cost Sheet. Thus we have three things that are identified:

Actual work in process in shop.

Live Cost Sheets.

Balance in Manufacturing account.

The term Production Order Cost Sheets has been used largely in this chapter to the exclusion of Component Order Cost Sheetss But what is true of one is true of the other. Component Order. being only subdivisions or fractions of a Production Order, their treatment is exactly similar. From the point of view of work

passing through the shops, that is, of work in process, there is no difference between one kind of order and the other. Both have to be charged with direct wages, and direct material, both have to participate in the distribution of burden, both have to be charged to Manufacturing account. If it takes several Component Orders to make up one Production Order, that is a matter that has significance at a later stage, but does not affect the present argument. Therefore, wherever Production Order has been mentioned in this chapter, Component Order may be substituted for it without altering the complexion of the statements made.

CHAPTER XV

COSTING

In the foregoing chapters of Part II the various books, forms and ledger accounts have been described that prepare the way for costing operations. It has also been shown that all costing operations are applied to orders, and that the mechanisms by which costs are identified with particular orders are known as Cost Sheets.

We have now to consider the forms, books and ledger accounts concerned in the process of costing. And though three distinct methods of costing are to be described, implying considerable variation in the actual rulings of forms and blanks, still there will be in general a very similar routine to be gone through, because the *elements* of cost are the same in all three methods of applying cost to orders. These elements all arise in the same way, and are indeed identical in all cases. They are the amounts that have been heaped up in the ten ledger accounts on the left-hand side of the general diagram.

In all varieties of costing the following mechanisms must be set up:

1. Departmental Burden accounts, of which the subdivisions are Standing Order Cost Sheets. This implies a method of charging indirect material and indirect wages and items such as depreciation, etc., expended on Standing Orders, first, and as regards the totals, to Burden account; and secondly, as regards the individual transactions, to Standing Order Cost Sheets. These two sets of charges must, of course, agree, the latter being only the subdivided detail of the former.

2. A method or plan by which departmental burden, so collected in Burden account, can be distributed over and charged to individual Production Order Cost Sheets on some approved basis. The total so distributed must also be charged to Manufacturing account. This total and the aggregate of individual charges to Production Order Cost Sheets must, of course, agree, inasmuch as the latter are merely the subdivision of the former.

3. Departmental Manufacturing accounts, of which the subdivisions are Production Order Cost Sheets. This implies a method of charging direct material, and direct wages first, and as regards the totals, to Manufacturing account, and secondly as regards the individual transactions, to Production Order Cost Sheets.

4. In some cases, a separate class of Production Order called Plant Addition Orders will be in use, but will be treated exactly like Production Orders, except that the account to which they are charged, and of which their Cost Sheets are a subdivision, is termed Plant Additions Manufacturing account, or simply, Plant Additions account.

When these mechanisms have been set up and operated, Production Order Cost Sheets will contain the following:

Direct Wages expended on the order.

Direct material used on the order.

A share of the monthly expenditure on burden.

Manufacturing account will have been charged with:

Total of wages expended during the month on production.

Total of material expended during month on production.

Total of all other wages, material and expenses, such as depreciation, etc., collected first in a Burden account and then distributed over Production Order Cost Sheets.

In carrying out these operations, two journals are used, one in which Standing Orders are listed, and the other in which Production Orders (and Plant Addition Orders where in use) are listed. These journals are the mediums by which the ten ledger accounts shown at the left-hand side of the general diagram are credited. At this point various agreements are secured which prove the accuracy of the work up to the point of entry on Cost Sheets.

The more important of these agreements are the following:

AGREEMENTS SECURED BY BURDEN JOURNAL

1. Total of stores issued to Standing Orders is agreed with aggregate of individual charges of stores to Standing Order Cost Sheets.

2. Total of wages and salaries chargeable on pay-roll to Standing Orders is agreed with aggregate of wages and salaries charged to individual Standing Order Cost Sheets.

3. Total of amount shown by Depreciation Schedule as chargeable against the department is agreed with aggregate of actual amounts charged to Standing Order Cost Sheets.

4. Totals of amounts chargeable by other schedules is agreed in the same way.

5. Any items chargeable in the nature of works expense to the department are agreed in the same way.

6. Spoilage chargeable against the department and charged to Standing Orders is agreed in the same way.

The Burden Journal is usually arranged so that a column is provided for each department (see general diagram) but in some cases a separate Burden Journal for each department may be used, the columnar arrangement being merely for convenience.

7. Both sides of the journal must, of course, balance. All the credits to the ten ledger accounts must balance all the charges made to the Departmental Burden accounts.

These operations verify the correctness of the postings to the Standing Order Cost Sheets, as far as total values are concerned (they do not, of course, verify the posting being made to the correct *individual* Cost Sheet, but only that a posting of the proper amount has been made to *some* Cost Sheet) and they ensure that burden as charged in the Departmental Burden accounts is equal in total to these postings on the one hand and to the total of expenditure on the other.

AGREEMENTS SECURED BY MANUFACTURING JOURNAL

1. Total of stores issued as charged on Stores Issued Book is agreed with aggregate of material posted to individual Production Order Cost Sheets.

2. Total of direct wages as charged on pay-roll to Production Orders is agreed with aggregate of wages posted to individual Production Order Cost Sheets.

3. Total of departmental burden as indicated by Burden account balance is agreed with aggregate of burden charged to individual Production Order Cost Sheets.

4. In a few cases items of works expense, such as traveling expense incurred for some productive purpose, may be chargeable to a Production Order Cost Sheet. Such charges are totalled and verified here.

5. Both sides of the journal must, of course, balance. Credits

to Stores account, Wages account, Works Expense account, and Burden account must equal all the charges to Manufacturing account and Plant Additions Manufacturing account. Sometimes a special column is provided for charging spoilage (see general diagram).

These operations ensure that all direct wages and direct material have been charged to a Production Order Cost Sheet (but they do not ensure that the correct individual sheet has been posted) and they ensure that the total of charges to Production Order Cost Sheets on account of burden equals the amount properly chargeable as shown by the Burden account. Similarly for works expense items when they exist.

The work in the shops represented by Production Order Cost Sheets has now been *costed.* Each piece of work having been put in hand by virtue of a Production Order number, and all direct material and direct wages having been charged to that number, and again, each such number having its own individual Cost Sheet to which these material and wage transactions have been posted, it follows that the material and labor cost of each piece of work has been recorded. And the extent of detail, that is the size of the individual item of work so costed, will depend, as was shown in the chapter on "Orders," on the way in which the orders have been made out in the first case. In some cases these orders will represent large and in other cases small lots. Again, some Production Orders are subdivided into very small lots, each such lot being authorized by a Component Order, which then takes the place in all costing operations, of the original Production Order from which it is derived. The Production Order then serves only as a device for collecting the cost of the different components together at a later stage.

But in addition to direct wages and direct material, a distribution of burden has taken place over the various Production Order Cost Sheets (though nothing has yet been said of the basis on which such distribution is undertaken), so that as a matter of fact, our individual Production Order Cost Sheets now show the total factory cost of production. That is, the product they represent has been *costed.*

In the ensuing chapter three ways of applying burden will be described. Though two of them will differ outwardly in a considerable degree from the process described in this chapter, still in the main the principle will be the same, namely, that burden is

first ascertained, amassed or collected; secondly, it is distributed in some way or other over Production Orders so that it ceases to exist as a separate entity, or in other words, no balance is left in Burden account. In the first variety of burden distribution we shall consider direct wages are not charged to orders. All wages are treated as burden, but direct material remains as a direct charge to Production Orders. In the second variety, the process described in this chapter will be followed very closely. In the third variety, the measurement of burden applicable to any particular Production Order is effected automatically by means of a device known as a machine rate, but in all three of them the student will do well to keep in mind the fundamental process of costing as described here.

CHAPTER XVI

DEPARTMENTS

Before passing to consider specific methods of costing it may be as well to define somewhat more formally, than has been done hitherto, what is meant by a department. As usually employed the term has a somewhat loose significance. It may mean a building, and the different buildings or even floors of a plant may be referred to as its departments. It may also mean a kind or division of activity, as when, for example, we speak of the power department, or, in non-engineering industries, the repair department, the latter being commonly a machine shop forming the headquarters of the repair staff. There is also a stores department in most plants, and this may or may not be identified with a single building. Then, again, different productive shops are called departments, and it sometimes happens that more than one such productive department is covered by the same roof.

It is necessary, therefore, to define the sense in which the term is used in this work. Such terms as cash department, purchasing department, pay department have no other signification than to indicate clerical work connected with cash, purchase and pay respectively. Stores department where used means the whole system of handling, pricing, receiving and issuing stores, and the keeping of the records pertaining to them. It means in fact all that class of activity that is supervised by a storekeeper.

The cost department similarly means all that activity presided over by a cost accountant.

The power department includes all activity relating to the generation and transmission of power, and commonly also of heating and lighting the premises.

All these are expense or service departments, and the cost of conducting them finds its way to Standing Orders as explained in Chap. XII (Part II) and sooner or later becomes part of burden, to be distributed over Production Orders.

But as will be seen as soon as we discuss the question of the methods of distributing burden, the latter must first be depart-

mentalized, that is distributed to productive departments, before it is distributed to the various Production Order Cost Sheets representing work within those departments. It is, therefore, necessary to define what a productive department really signifies.

A productive department may be defined as any homogeneous group of productive activity. The division may be based on the type of processes carried on in the plant, as, for example, the cupolas of a foundry, the folding room of an envelope factory, the kettle floor of a soap works, the tempering house of an armor plant, the cutting room of a shoe factory, or the milling machine department of an engineering shop. These are examples of simple departments based on processes. But in other cases the division into departments may be based on the nature of the product rather than on the nature of the process. Thus we may have an aeroplane department and a high-speed engine department. But, in general, departments organized on the nature of the product are in effect separate factories, and might themselves be divided up into process departments.

The more homogeneous the activity in a department, that is to say the less variety in the kind of processes it employs, the more perfect from a cost-keeping viewpoint is its departmentalization, and the simpler are the methods necessary to cost its product. The more various sizes of machine, men at different rates of wages, and different varieties of product are included in one department the more complex and difficult will costing become.

The aim, therefore, should be to split up productive activity into as many departments as are naturally indicated by the nature of the processes and product. And for this purpose it may often be necessary to consider one building as containing several departments. This procedure, it is true, introduces troubles of its own, as, for example, the cost of maintaining and repairing the building, and depreciation on it, has to be divided between the departments. But this can be done on a percentage basis fixed once for all, while on the other hand the gain in clearness of perception as to the cost of processes may be worth many times the trouble involved.

Productive departments may be defined, therefore, as the natural process divisions of the business. In many businesses departments and buildings or departments and floors will be coincident, but it will often happen otherwise. The departments will then

have the appearance of being somewhat arbitrary and artificial, but if the division is skilfully carried out, this will be the reverse of the truth. Departments and the physical arrangement of them in buildings should coincide, but for practical reasons it cannot always be done. That should not prevent its being done in the accounting.

CHAPTER XVII

COSTING ON METHOD A (DEPARTMENT HOUR-COST METHOD)

The general principles of costing by Method A have been discussed in Part I, Chap. V. In the present chapter the actual blanks and accounts necessary to practise the method will be described.

There are two variants of this method, one in which the division of cost between products, if there is more than one, is on the basis of the relative output of each product; and the other in which the division of cost is based on the time occupied by each product in passing through the different stages of manufacture. In the latter case Production Orders are usually issued covering definite lots or batches of product.

As explained in the chapter above referred to, this method of costing depends for its validity on there being no substantial difference in wage rates between operatives engaged in any one department. This being assumed, then it is obvious that no advantage is gained by recording direct wages against each Production Order, since each item would be alike, or in simple proportion to time occupied on the job. And as burden is also considered, on this method, to be distributable on a time basis, it follows that direct wages and burden may be combined and charged to orders on a time basis as a single item. The only thing left to be identified with individual orders is direct material.

This means that if we have a manufacturing plant containing, say five departments, then, material being charged to the order directly, each of the five departments' work will be reduced to single charges per hour, and the departmental cost of any job is known when we know how many hours it has taken to perform the work on it in each department.

The simplest case is where only one product is being turned out, perfectly uniform in character. In this case our time unit may be a month, and the departmental cost for the month

divided by the tonnage or other measure of product will give us the departmental cost per ton or other unit.

The next simplest case is where two or more products are being turned out, each of which is known to be produced at the same rate of production, in which case division of total cost between the different products will obviously be in proportion to the total output of each.

The third case is where two or more products are being turned out, each of which has its own rate of production. This is a more complex matter than the foregoing, since a record has to be made of the time occupied by each product. The departmental cost has then to be reduced to an hourly rate, and the time taken *by each product* multiplied by this hourly rate in order to find the value of the total time consumed each month on each product. Then each product's total cost must be divided by its tonnage, etc., so that a cost per pound, etc. may be found.

A fourth case is where either one or several varieties of product are put through in limited lots. In all the former cases we have assumed a uniformity in each product so that any fraction of it was indistinguishable from any other fraction, several varieties of soap, for example. Now, however, we have to deal with a case in which differences may exist between batches of product, as for example, lots of articles differing slightly from one another in their demands on the operative work of the department. Production Orders are then issued for each such batch or lot, and the time of operation is also recorded. This time multiplied by the cost of the departmental hour gives the departmental cost of the batch.

The simplicity of this method of costing is really not so great as it appears. The cost of product, it is true, is very simple, being confined to a record (1) of the direct material used on each Production Order, and (2) a record of the time taken by each order in each department. One of the great advantages of the method is that if we can forecast the time which should be taken to do any variety of departmental work, multiplying this time by the cost of the departmental hour gives us a close idea of the cost of the operation. For estimating purposes this is sometimes very useful.

On the other hand, the necessity of recording cost of *service* still remains, and as service is made up of many small items it

is still necessary to set up a cost mechanism to take care of it. In small plants, it is true that even this is hardly necessary, since only a few men will be engaged on service work, and no elaborate record need be made for the purpose of controlling their work. But if the plant is of any considerable size, the adoption of a simple system of costing Production Orders does not in the least obviate the necessity for closely watching expenditure on service. Accuracy and facility of control must not be sacrificed to simplicity, and apparent economy in the making of cost records may be in reality highly wasteful, if it enables small inefficiencies to slip by day after day, and month after month.

It will be assumed, therefore, that the plant is not so small that it can afford to neglect the control of service or burden expenditure, and this implies that a cost system must be sufficiently developed to record material and time on Standing Orders in some detail, though as the industries to which this method can be successfully applied are not in general so highly organized as those of the engineering type, a somewhat simpler and more elementary Standing Order system can usually be adopted with safety.

In any cost method certain stages have to be gone through, and these may be summarized as follows:

1. Distribution of material cost to Standing and Production Orders.
2. Distribution of wages to Standing and Production Orders.
3. Collection of Standing Order costs and their distribution to Departmental Burden.
4. Listing of Production Order costs, and distribution of Departmental Burden over them.
5. Charging of Production Order costs plus burden to Departmental Manufacturing account, and crediting of the elements of such cost to the ten ledger accounts on left-hand side of general diagram.

Figure 67 (p. 310) is a general diagram for Method A. It replaces the central part of the large folding general diagram, which is arranged for Method B. In Fig. 67, the ten ledger accounts are shown at the left-hand side as before, except that the account for patterns has been omitted. The depreciation and other schedules are also shown as before. The remainder of the diagram is special to Method A and shows the whole course of

operations, from the crediting of the purchased items on the left to the charging of Departmental Manufacturing accounts on the right.

The *crediting* of Departmental Manufacturing accounts with the values of *finished* product being the same whatever method of costing is employed, will form the subject of a separate chapter, after the three methods, A, B, and C have been described.

The Order System.—As all costing operations depend on the way in which the order system has been laid out, it will be well to begin by discussing Standing Orders and Production Orders. Fig. 68 shows a suggested scheme of Standing Orders suitable for plants using Method A. The grouping by production factors mentioned in Chap. XII (Part II) has not been followed, though this, of course, is optional. In a large plant it might be advisable to use it, but Method A is not often applied to large plants. Three service departments are indicated, namely, one grouping the office force, costs, pay, etc., the superintendent's staff, and all production men, tracers, etc.; the second takes care of all storekeeping officials, truckers and handlers, and so forth; the third represents the power-plant men. These three departments are obviously expense departments, and have to be prorated some time or other over the productive departments in proportion to the assumed call of the latter on their services. Three productive departments, 4, 5, and 6, are also shown, with Standing Order numbers arranged to collect the usual items of expense in each such department. This scheme will, naturally, need modifying in some particulars in many cases.

As regards Production Orders, it is assumed that there is more than one product passing through departments during the costing period. Consequently, a series of Production Orders is required. These usually may very well be of the waybill or strip-ticket type (Fig. 60) described in Chap. XIII (Part II). They will be issued and registered as described in that chapter. Such Production Orders may represent either the month's production of different kinds of product, or they may represent individual lots of one or several kinds of product. If only one kind of product of a homogeneous character was being made, then only one such Production Order would be required each month, to assemble the cost of the whole month's product. In that case, of course, no actual order would be necessary, but a number representing it might be used for office purposes.

EXPENSE ITEM	Office & Suptce	Stores	Power	Prod. 4	Prod. 5	Prod. 6
Depreciation	100	200	300	400	500	600
Insurance	101	201	301	401	501	601
Rents & Taxes	102	202	302	402	502	602
Buildings Repairs Labor	110	210	310	410	510	610
" " Material	112	212	312	412	512	612
Machinery Repairs Labor			313	413	513	613
" " Material			314	414	514	614
Other Repairs, Labor	115	215	315	415	515	615
" " Material	116	216	316	416	516	616
Labor, Trucking & Handling		220		420	520	620
" Cleaning & Laboring	121	221	321	421	521	621
" Watchman etc	122					
Sundry Supplies	123	223	328	423	523	623
Labor Power Staff			330			
Fuel & Feed Water			331			
Sundry Power Supplies			332			
Salaries, Supt. & Prod. Staff	140					
" Foremen				441	541	641
" Storekeeping			342			
" All Office Men	143					
Office Expense	144					
Sundry Office Supplies	146					
Sundry Works Expense	146	246	346	446	546	646
Spoilage & Wastes				450	550	550

FIG. 68.—Standing Orders.

Distribution of Material.—Material will be issued and charged against Standing Orders and Production Orders as described in Chap. IV (Part II). When required for Standing Orders it will be issued against a Stores Requisition (Fig. 37) and when for a Production Order it will be usually issued against a Bill of Material, which is a list of stores required on any Production Order. When the issues thus made are priced out they are entered on a Stores Issues Book (Fig. 69) either in detail or summary. Bills of Material will be, in general entered as one item, while requisitions against Standing Orders will be entered singly. The sectional form of Stores Issue Sheet (Fig. 39) will not usually be necessary in costing on Method A as stores transactions are few. Ordinary posting will serve all purposes.

When the Stores Issue Book is entered up, as regards the item, quantity, price and value of the issue, an **allocation** is made to

Date	Item	Ref. No.	Qty.	Price	Value	Charge to Order No.	Fuel & Feed Water S.O.331	Sundry Power Supplies S.O.332	Office Supplies & Stationery S.O.145	Other Standing Orders	Direct Mat'l. to Prod. Order

FIG. 69.—Stores Issues Book (Method A).

(The totals of columns SO. 331, 332 and 145 are charged direct on Burden Journal without an intermediate cost sheet.)

one of several columns so as to indicate the destination of the item. Fig. 69 shows a convenient form of Stores Issues Book. Columns are provided for issues against Production Orders, also against Standing Orders, but three special columns are also provided to take care of the allocations to Standing Orders 145, 331 and 332, representing power department and office department respectively. The reason of this will be given later.

The documents from which Stores Issues Book has been written up are then available for posting to Cost Sheets. Every item in the Production Order column must be posted to its proper Material Sheet (Fig. 70). Every item in the column headed "Other Standing Orders" must be posted to the proper Standing Order Cost Sheet (Fig. 73), while the items in the three remaining columns are dealt with later, as no Cost Sheets need be made out for them. This, however, is merely a "short cut," and if desired Cost Sheets can be made out for Standing Orders 145, 331

and 332, in which case these columns would be omitted from the book, and all Standing Order material posted to Cost Sheets in the same manner.

When this operation has been carried out, the cost of all material issued will have been posted to some Cost Sheet or other, (except that chargeable against the three numbers just mentioned) and consequently if we were to list all our postings to Cost Sheets, the total would equal the total of the issues of stores for the period. In other words, we have now obtained a separate account of stores issued against each Standing and Production Order on which we are working at this time. Methods of verifying that this is so, and for crediting Stores account with the values thus withdrawn from stores, will be described presently.

PRODUCTION ORDER COST SHEET

For._____ Qty._____ No._____

MATERIAL

Date	Item	Ref. No.	Qty. or Wt.	Price	Value
				Total	

FIG. 70.—Production Order Cost Sheet for material.

Distribution of Wages.—In Method A no complications with piecework will occur, as the method is not correct if piecework is employed. The principle of the method rests on uniformity of wage rates within departments on equivalent processes, as already explained, consequently no method of payment which would make earnings unequal can be employed. Gate time, as explained in Chap. IX (Part II) is, therefore, the foundation of the pay-roll, and as under this method all operatives' time (men engaged on process work) is charged to Burden account, and *not* to Production Orders, we do not require any additional mechanism for distributing wages to Orders save in the case of certain men, mostly of the repair staff whose work may be directed now to the benefit of one department and now of another. Such men,

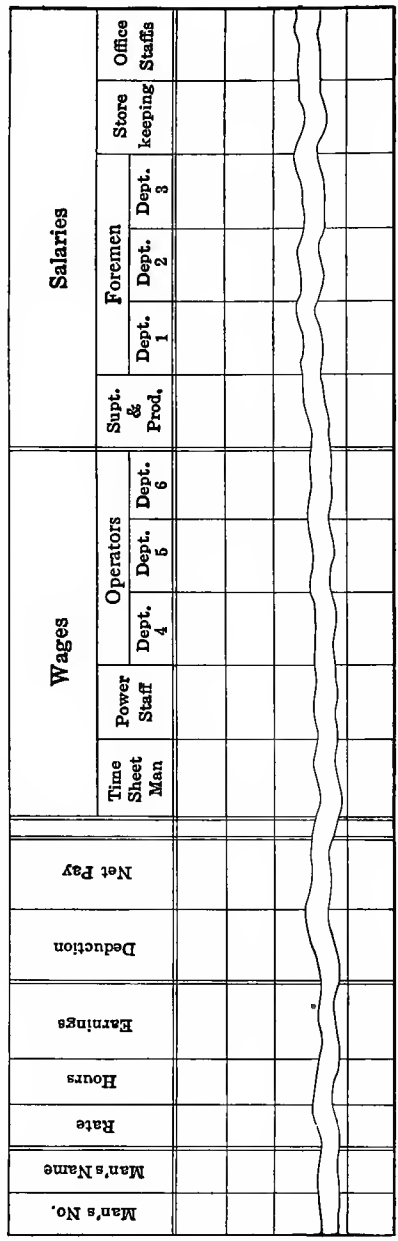


FIG. 71.—Weekly Pay-roll (Method A).

therefore, require time sheets; all the others are simply entered on the pay-roll under the routine given in Chap. IX, and entries in Burden Journal are made direct from the data given there. Fig. 71 shows a suitable pay-roll for Method A. This is arranged on the weekly plan, since the nature of the work for which this method can alone be used is usually that of steady progress of large or even continuous lots, so that the necessity for quick and prompt control of costs is rarely present. Of course, if desired, a daily pay-roll like Fig. 52 can be employed, but in that case a summary must be made somewhat in the form of Fig. 71 each week.

With one exception, all wages are chargeable to Burden account without further subdivision or classification. This exception is the case of the repair men, laborers, etc., who may divide their time between departments. Such men's wages are, therefore, all allocated to the column headed "Time Sheet Men." Next comes a column for power staff wages, then three columns to take care of operatives' wages, each productive department being listed separately. A salaries division is also shown, though this, of course, can be arranged in a separate book if desired. Columns are provided for superintendent and production staff, for the foremen of the three productive departments, for storekeeping staff, and for office staff. The remarks made as to Stores Issues Book apply here also. Instead of having separate columns as shown, each man's time could be posted to its proper Standing Order number on a Cost Sheet, and in this case there would only be four columns, namely, three for operative department wages, and one for Time Sheet men, and each man would have to use a Time Sheet, and these Time Sheets would be posted to the Standing Orders. The method shown is a short cut justifiable in view of what might be termed the comparatively sluggish circulation of work in a plant likely to be organized on Method A. Very detailed accounts are out of place in such a condition.

Repair men and laborers who divide their time between departments will have Time Sheets like Fig. 72. These are arranged for weekly return. In general this will be found sufficient. The division of time between departments will be only approximately correct, but this will depend a good deal on the supervision exercised. A daily return of time distribution, to be used in connection with a daily pay-roll, as will be described in connection with Method B, can be used if desired, but

will not in general be worth the expense incurred where Method A is in use. The Time Sheet when made up and checked against gate time, is extended into money, which must agree exactly with the amount entered on pay-roll. Each line of the Time Sheet will represent a charge to be made against a Standing Order, and consequently must be separately posted to Standing Order Cost Sheets. When all postings have been made, the result would be, if we listed all such postings, that all the wages appearing under the column headed "Time Sheet Men" would be charged up on one or other of the Standing Order Cost Sheets. These postings, added to the amounts shown in the other allocation columns of the pay-roll would then equal in amount the

Man's Name_____ W.E._____

Man's No._____

Standing Order Number	Work	Thu.	Fri.	Sat.	Sun.	Mon.	Tue.	Wed.	Hrs.	Wages.	

FIG. 72.—Time Sheet for men working on repairs and other standing orders (Method A).

wages and salaries paid for the period. Methods of verifying this and securing the proper credits to wages and salaries accounts will be described presently.

Collecting Standing Order Costs and Charging Them to Departmental Burden.—While Standing Order Cost Sheets could be issued to cover all the Standing Order numbers shown in Fig. 68, in practice this will not be necessary. Cost Sheets will only be issued for such Standing Orders as are worked on by Time Sheet men, that is to say, by men such as repair men and laborers, who divide their time between departments and different kinds of work. All other Standing Orders are provided for, either by the classifications in the Depreciation, etc., Schedules or by special columns in the Stores Issues and Wages Books.

Fig. 73 shows a Standing Order Cost Sheet, providing columns for material (as allocated to the column, "Other Standing Orders" in Stores Issues Book); for wages (as allocated to the column "Time Sheet Men" in pay-roll); and for works expense, namely, sundry items which have been charged to Works Expense account, and which are chargeable against building repair or some such item. As such items will be very few no special mechanism is necessary to list them. They will be picked out of the ledger account, and posted to Cost Sheets, until all the items in the account are exhausted, except as provided below. At the end of each month, the Cost Sheet will be totalled up, and a fresh sheet bearing the same number opened to take care of the next month's charges.

STANDING ORDER COST SHEET

For_____ Dept._____ No._____

Date	Item	Mat'l.	Wages	Works Exp.	Total

FIG. 73.—Cost Sheet for standing orders (Method A).

The Burden Journal, Fig. 74, is the medium by which credits are made to the main ledger accounts on the left of the diagram, and charges are made to the Productive Departments Burden accounts. In this journal on Method A all the elements of manufacturing cost are collected with the exception of direct material, as it will be remembered that, on this method, operatives wages are considered part of departmental burden. The journal also provides a mechanism for prorating the cost of the non-productive departments over the productive departments on approved bases of allocation.

The sources of the various entries to be made on this journal will be understood from an inspection of Fig. 74, in which they are enumerated. Depreciation, rents, insurance, etc., will be taken from the schedules, already divided into separate

Stores	Deprec.	Rents, Ins'ce &c	Wages	Salaries	W'ks. Exp.	Spoilage	Expense Item
	✓						Depreciation
		✓					Insurance
		✓					Rents & Taxes
			✓				Building Repairs Labor
							" " Material
✓			✓				Machinery Repairs Labor
✓							" " Material
			✓				Other Repairs Labor
✓							" " Material
							Labor, Trucking & Handling
			✓				" Cleaning & Laboring
			✓				" Watchmen etc.
✓			✓				Sundry Supplies
			✓				Labor Power Staff
✓							Fuel & Feed Water
✓							Sundry Power Supplies
				✓			Salaries Supt. & Prod. Staff
				✓			" Foremen
				✓			" Storekeeping
				✓			" All Office Men
					✓		Office Expense
✓							Sundry Office Supplies
					✓		Sundry Works Expense
						✓	Spoilages & Waste
			✓				Operatives Wages
✓	✓	✓	✓	✓	✓	✓	Totals to be Credited

(Left)

FIG. 74.—Burden

NOTE.—The check marks (✓) indicate

Per	Expense Depts			Productive Depts		
	1 Office & Supt	2 Stores	3 Power	4	5	6
Schedule for Month						
Schedule for Month						
Schedule for Month						
Service Cost Sheets						
,, ,, ,,						
,, ,, ,,						
,, ,, ,,						
,, ,, ,,						
,, ,, ,,						
,, ,, ,,						
,, ,, ,,						
,, ,, ,,						
,, ,, ,,						
As Pay Roll Allocation						
As Stores Issues Book						
,, ,, ,, ,,						
As Pay Roll Allocation						
,, ,, ,, ,,						
,, ,, ,, ,,						
,, ,, ,, ,,						
As Charged in Wks. Exp. Acct.						
As Stores Issues Book						
As Charged in Acct.						
As Charged in Acct.						
,, ,, ,, ,,						
As Pay Roll Allocation	×	×	×			
Prorating of Office &c						
Prorating of Stores Dept.						
Prorating of Power Dept.						
Charge to Productive Depts.						

(Right)

Journal (Method A).

the usual allocations in credit columns.

charges against each of the six departments. Repairing and laboring items will be taken from the Standing Order Cost Sheets. Power staff labor will be taken from the proper column in the pay-roll. Fuel, feed water and power supplies will be found in the columns in Stores Issues Book appropriated to those items. Various items of salaries will also be taken from the respective columns in the pay-roll. Sundry office expense will be taken from the entries in the Works Expense account, as will also any special items chargeable against departments and not covered either by Standing Order Cost Sheets or by the above office expense time. Finally, spoilages and wastes will be charged to the various departments that are chargeable with them. The distribution of the total in Spoilages account will be, in general, authorized by a memorandum from the superintendent, classifying such charges and allotting the departmental responsibility. The total covered by this memorandum will, of course, agree with the balance in Spoilage account at the month end.

On the left side of the Burden Journal, columns are provided for collecting the credits to be made to the main ledger accounts. On the right-hand side a column is provided for each of the departments, and at the bottom of the three service or non-productive department columns, a prorating arrangement will be observed, by which each department's total can be distributed over the productive departments.

It must, of course, be understood that separate ledger accounts could be set up for collecting the departmental cost of non-productive departments, and then the balances in these accounts could be made the subject of journal entries so that each balance was prorated over the three productive departments. In most cases there is no advantage in this course, which entails extra work without any corresponding advantage. Generally speaking, there is but little advantage in setting up a ledger account unless it is expected to carry a balance at some time or other, or unless, as in the case of Works Wages account, Salaries account, and some others, it represents some definite stage in the gradual process of transforming cash and credit into finished goods. Accounts are set up for departmental burden in productive departments because such burden is not always distributed in full, or may even be over-distributed as we shall see presently. The matter is, however, one of option and many accountants

prefer to multiply ledger accounts rather than to shorten the process of charges and credits by short-circuiting accounts that have no balances in them. This is often due to a desire to preserve a record of certain classes of transaction, as for example, the totals of the expenditure in the three non-productive departments shown in Fig. 74. But such records exist on the face of the journal as indicated, and no additional security or worth is attained by putting such items in and out of ledger accounts each month. If unexpected varieties of charge are feared, not foreseeable by the designer of such a journal, they can be provided against by leaving a few blank lines, and a blank column on the left-hand side of the journal, so that credits may be made from it to *any* account, and any kind of item entered on it and charged to any department.

The basis on which the non-productive department totals are prorated over the productive departments will vary. The power department total will be prorated on the estimated or metered amount of power taken by each department. The other two non-productive departments will usually be prorated on a basis of proportionate division, if, as is usual in Method A, each department is a necessary and invariable link in the chain of production. Such proportionate division will be either on the basis of the number of operators in each department, or the number of unit processes. In any case the division is quite arbitrary, but must be in proportion to the total amount of work done by each department on the product as a whole. Perhaps division on the basis of men employed in each productive department is as fair as any. In plants organized for costing on Method A such expenses should bear a small proportion to the rest of the productive department costs.

The last entry on the journal is that of operative wages in the productive departments. This item is taken from the pay-roll, and is added in to the productive department burden, as shown. Consequently when the proratings have been made, and the productive department columns have been added up, the cost of **manufacturing capacity** in each department for one month has been obtained. (It will be remembered that the direct material on which this manufacturing capacity is exerted is charged to the Production Orders.)

Before showing how cost of manufacturing capacity is identified with particular Production Orders, the course of debits and credits

set up through the Burden Journal must be traced. The general diagram for Method A (Fig. 67) exhibits the relation of the journal to the main ledger accounts on the one hand, and to Departmental Burden accounts on the other. The sources of information giving rise to entries on Burden Journal are seen to be, first the schedules, secondly the Standing Order Cost Sheets. Theoretically all the data in pay-roll and Stores Issues Book should be entered on Standing Order Cost Sheets and not give rise to journal entries directly. But as explained above, special columns in these two books collect certain groups of data that are identified with particular Standing Order numbers, and we are thus able to short-circuit the intermediate step of the Cost Sheet except in the case of men who do varied kinds of work during the pay period, that is work on more than one Standing Order.

When the data provided by schedules, Cost Sheets and special allocations in pay-roll and Stores Issue Book have been entered on the journal, and small items like works expense and spoilages all accounted for in one way or other, and the non-productive department totals have been prorated over productive departments, we are then ready to make credits and charges. The course of these will be shown by the dotted lines, which represent credits, and the double lines which represent charges. Single lines represent data carried from one document to another, not yet in ledger accounts.

The following agreements must exist at this stage, after postings and pro-ratings have been made:

The aggregate of totals of the three *productive* departments on the right hand of journal must agree with the aggregate of totals of all the credit columns on the left-hand side.

The total of stores column must agree with the aggregate of all columns in Stores Issues Book except direct material.

The total of depreciation column must agree with the total chargeable for the month against factory as shown by the Depreciation Schedule.

The total of rents, insurance, etc., must agree with the total chargeable for the month against factory as shown by the Rents, etc. Schedule.

The total of wages column must agree with the aggregate of all columns in the pay-roll (grand total of the works pay-roll).

The total of the salaries column must agree with the grand total

of the works salaries pay-roll. The two books are shown as one in the example given.

The total in works expense column must agree with the total of all items in the balance of Works Expense account, less such as are chargeable to Production Orders. This latter class of item will rarely, and in many plants, never occur.

The total spoilages column must agree with the amount standing as a balance in Spoilages account.

Distributing Departmental Burden Over Production Order Cost Sheets.—Having now obtained a total in Departmental Burden accounts representing the cost of manufacturing capacity of each department for the month, we have now to set up mechanism for obtaining departmental costs of specific Production Orders.

If there is only one product going through, then the departmental burden will be the departmental cost of whatever quantity of product has been made during the month. We have, therefore, only to find out what quantity or weight was produced and divide this into the cost to ascertain the cost per pound or yard, as the case may be, in each department. The total cost of manufacture will accordingly be as follows:

Cost of direct material.....	3 cts. per pound.
Cost of department 4.....	12 cts. per pound.
Cost of department 5.....	14 cts. per pound.
Cost of department 6.....	8 cts. per pound.
Factory cost of product.....	37 cts. per pound.

If two or more products are going through, which do not differ in their rate of production, that is to say one product does not require more time to pass through any process than any other product, then departmental costs will be attained by dividing them up between the different products in proportion to the quantity or weight of the latter.

But if this condition does not exist, and if the various products passing through do not take exactly the same time to pass through each process, or if some processes are omitted in regard to certain products, then it is clear that division of departmental cost between products cannot be made on a basis of relative weight or quantity. The element of time taken must be introduced. The same thing must happen if, instead of costing product by the

whole production of each kind for a month, we desire to know the cost of individual lots. The **time taken** by each such lot must obviously be ascertained, unless such lots are absolutely homogeneous and can be costed by weight, which will rarely be the case.

Production Orders will be issued for each item *of which we require to know the separate cost.* Thus we may have one product going through which is quite homogeneous, and can be costed by weight, once we know what the whole month's production of that particular product has cost. Then we may have another kind, not so homogeneous, say a mixture which is varied according to individual customer's requirements, thus necessitating individual costing of direct material, and which requires a little more grinding, sifting, precipitating, etc. than the standard kind just mentioned. One single Production Order can be issued for the whole month's production of the first product, and individual Production Orders will be issued for the separate lots of the second product.

Correspondingly, one Cost Sheet will record all the month's costs on the first product and as many Cost Sheets will be required for costing the second product as there are separate lots going through.

The way in which direct material is charged to Production Order Material Sheets (Fig. 70) has been described. All the material used during the month on the first product will be charged to one sheet. Material used on the second product will be charged to the individual Production Order Material Sheets as and when issued.

It now remains to ascertain the **time taken** by all work on the first product, and also the time taken on individual lots of the second product. Consequently a mechanism for ascertaining **time taken** by each Production Order at each stage of process work will be necessary. Fig. 75 shows a Time Record of Process Work, in which space is provided for recording the Production Order number and time of commencement and completion, and total hours worked against each order and each day. Such a record may require considerable supervision to secure correctness, being in fact subject to as many errors as workmen's time records, which will be dealt with in a later chapter.

The total hours worked should agree with the actual working hours of the department, and in the absence of any better check

should be vouched for by the foreman. Where single operators are engaged on process work, the addition of the operative's name and clock number will enable the Time Record to be checked up with the Gate Time Record, but as frequently in work of this kind men work in groups, and late arrival of one or more in the group does not necessarily stop the process, the matter of checking the record must be left to the decision of those applying the method in any particular case. It will suffice here to point out the necessity for careful supervision, both as to hours assigned to any order, and also to the correctness of the order numbers themselves. Because the element of wage cost is absent in this

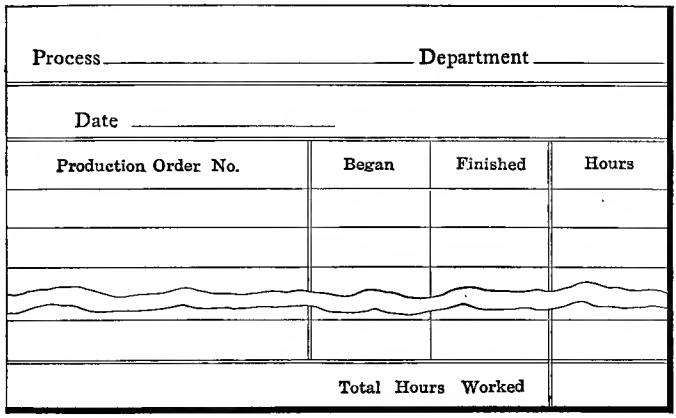


FIG. 75.—Departmental Process Time Record.

kind of record does not in the least reduce its importance, since cost will ultimately be based on the figures appearing on it.

It must not be overlooked that in arranging the points at which Time Records are set up, care must be taken that each process has an equal labor value, *i.e.*, employs the same number of men. If a department contains three series of processes, each series consisting of five machines and requiring a group of six men to operate the five machines, then each of the three series will require a separate Time Record. But should it happen that certain product does not pass through the whole series of five machines, then it will no longer be possible to adopt the group method of arrangement, and each machine must have a separate Time Record. The unit processes selected must comply with two conditions: (1) they must be continuous, so that product

of any kind passing through one machine in a series passes through all; alternatively to this, they must be separate machines (2), an equal number of operators must be represented in each of the unit groups. It follows from this that single machines and series cannot be included in the same department, nor can series be of unequal size. The principle of the method depends on the averaging of factory expense and of operative wages, consequently *the unit selected for Time Record must contain equal expenditure of wages*, which would not be the case if, in the same department, processes requiring a series of three operators were mingled with processes requiring single operators.

Dept Cost as Burden Acct.	$
Productive Hours	$
Cost of Departmental Hour	$

FIG. 76.—Determination of value of department hour.

There is also to be considered the case of a department, such as a floor of mixing vats, where a gang of operators attend on say a dozen vats, only some of which will, in general, be in operation at any one time. Such a department can obviously only be costed as one unit, and the cost of manufacturing capacity will be the departmental burden as collected in Burden Journal. But on what basis can this be distributed on products? If all varieties of product take the same time in being mixed and manipulated, then the volume or weight of each product will be the basis of distribution. But if some kinds of product take more time than others, and require more attention, mere volume or weight would not be a true basis of distribution. The time that each product took in passing through the department would have to be recorded, and all these times added together being divided into the total departmental cost would give the hourly cost to be applied to individual orders. But even this would be incorrect if, for example, mixtures remained in the vats for mere convenience of storage. It is obvious that such storage time has nothing to do with use of manufacturing capacity and must be eliminated. The true basis will, therefore, be the time actually consumed in process work. As soon as any mixture is matured so that it is ready for removal to the next department, the process on that lot must be considered terminated. In this way the work of the gang, though perhaps never at one time all working

together on one vat, is averaged and diffused over all the vats in work in strict proportion to the time they are under observation and occupying the floor.

Figure 76 shows a blank useful for determining the value of the department hour. The first line is filled out with department cost as indicated by the balance in Burden account (as posted from the departmental column in Burden Journal); the second line is filled out with the total of department hours worked. This figure is the aggregate of all the totals of Time Records during the month. It represents the process-hours worked on unit processes whether these are single machines or groups of machines, or single operators and groups of operators. The third line in the blank is for the figure obtained by dividing the productive hours into the departmental cost, thus finding the cost of one departmental hours work.

PRODUCTION ORDER COST SHEET

For_____ Qty._____ No._____

DEPARTMENT

Date or Period	Process	Cost		Monthly Total	
		Hrs.	Value	Hrs.	Value
Departmental Total Cost					

FIG. 77.—Departmental Production Order Cost Sheet.

Having thus provided for a record of process-hours, the aggregate of which forms the total of productive hours of the department, and having divided this total into the departmental burden for the month, and so obtained the average cost of one process-hour, and having, moreover, made a record of the process-hours against each Production Order worked on, the next step is to post this latter record to the individual Production Order Costs Sheets, and extend the money value of the hours so posted. Fig. 77 shows a Departmental Production Order Cost Sheet. Space is provided for date, name of process, and hours worked as indicated by the Time Records. A column is also provided for the money

value of these process-hours. As a Production Order may be in work over the end of a month, columns are provide for the totaling of each month's figures separately.

When all the Time Records have been posted to Production Order Cost Sheets and extended at the departmental hourly rate, then the aggregate of such extensions for the current month on all the Production Order Cost Sheets should equal the total standing in the Departmental Burden account. To secure this agreement and to provide a mechanism for crediting the Departmental Burden account and charging the Departmental Manufacturing account, a Departmental Manufacturing Journal, (Fig. 78) is made use of.

MANUFACTURING JOURNAL ——— DEP'T ———

Order No.	Hrs.	Dept. Cost @ —Per Hour		Spoiled Work	
Totals					

FIG. 78.—Department Manufacturing Journal (Method A).

Each current Production Order is listed herein, the total process-hours standing against it, and the total cost of production corresponding are then placed opposite the order number, and the whole being totalled up, we arrive at the total process-hours for the month, and also the total production cost for the month in that department. The total of hours should agree with the similar total in Fig. 76 in all cases.

The total department cost as listed in the journal is now credited to Department Burden account and charged to Department Manufacturing account (see general diagram for Method A, Fig. 67). If all these operations have been carried out at the same time, namely at the end of the month, the Burden account will be exactly credited, so that no balance is left in it. But as will often happen it is desired to withdraw particular Production

Order Cost Sheets (because the orders are completed) during the month, then the extension of time will necessarily be made at the previous month's rate, and this may prove to be either higher or lower than the actual rate for the month when ascertained. In such cases the amounts listed in the journal, when totalled, may prove to aggregate more or less than the total in Burden account, thus leaving either a credit or debit balance in the latter to go forward to the next month. In general this will not signify, but if conditions are known to be changing, such as a general falling off of orders, then it will be desirable to advance the last month's rate to a higher figure if it is desired to make use of it for costing and closing out particular Production Orders before the close of the month.

Crediting Direct Material to Stores Account and Charging to Manufacturing Account.—The departmental cost of production has now been disposed of, as far as the present stage of the accounting process is concerned. All the main ledger accounts have received their proper credits, and the whole of the values represented by such credits have found their way on to Production Order Cost Sheets, and these having been listed in Manufacturing Journal, have in turn found their way to Departmental Manufacturing account. Of course, the main ledger accounts will not be completely credited until this procedure has been completed for all the productive departments, and for direct material, which virtually ranks as a department in this method.

MATERIAL JOURNAL

Production Order No.	Cost of M't'l.
Total Material	

FIG. 79.—Production Order Material Journal.

The way in which direct material is charged to special Material Cost Sheets, Fig. 70, one such sheet for each Production Order, has been described above. To transfer it to the debit of Manufacturing account a Material Journal is employed, Fig. 79. This is simply a list of the current Production Order Cost Sheets against each of which the value of material issued during the current month is entered. The total of all entries is obviously the value of material drawn from stores on the one hand, and chargeable to production on

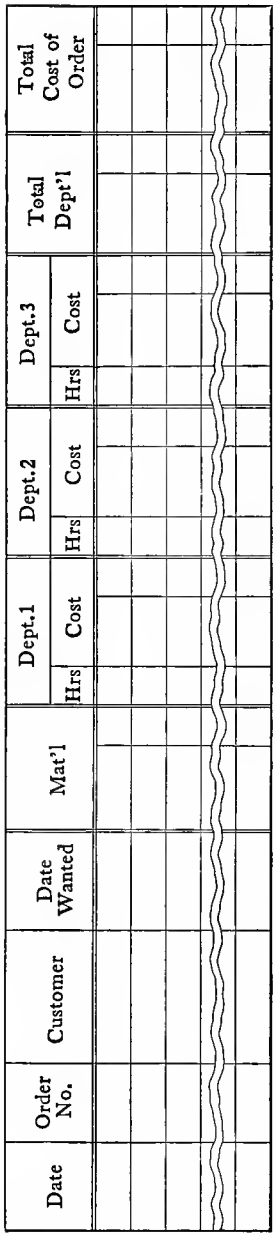


FIG. 80.—Order Register, Cost Record and Tracer for Method A.

the other. This total is, therefore, agreed with the column in Stores Issues Book, Fig. 69, which carries the allocation of stores issues to direct material, and is then credited to Stores account and charged to Material in Process account.

The whole cycle of costing operations on Method A has now been described, and the different steps can be followed out by the reader on the general diagram of Method A, Fig. 67. All the credits made to the main accounts on the left are now represented by amounts standing to the debit of Departmental Manufacturing accounts and to Material in Process account. The detail of these debits is contained in various Production Order Cost Sheets and Production Order Material Sheets. It follows that when an order has passed through all departments and has been completed, the finished factory cost of such an order is readily found by collecting together the Departmental and the Material Cost Sheets pertaining to it. The process of crediting Manufacturing accounts and Material in Process accounts will, however, be left to a later chapter, as it is independent of the method of costing and is the same for all methods whether A, B, or C.

Order Register.—A variety of Order Register specially suitable for Method A is shown in Fig. 80. If Time Records are posted daily to Cost Sheets, and extended at

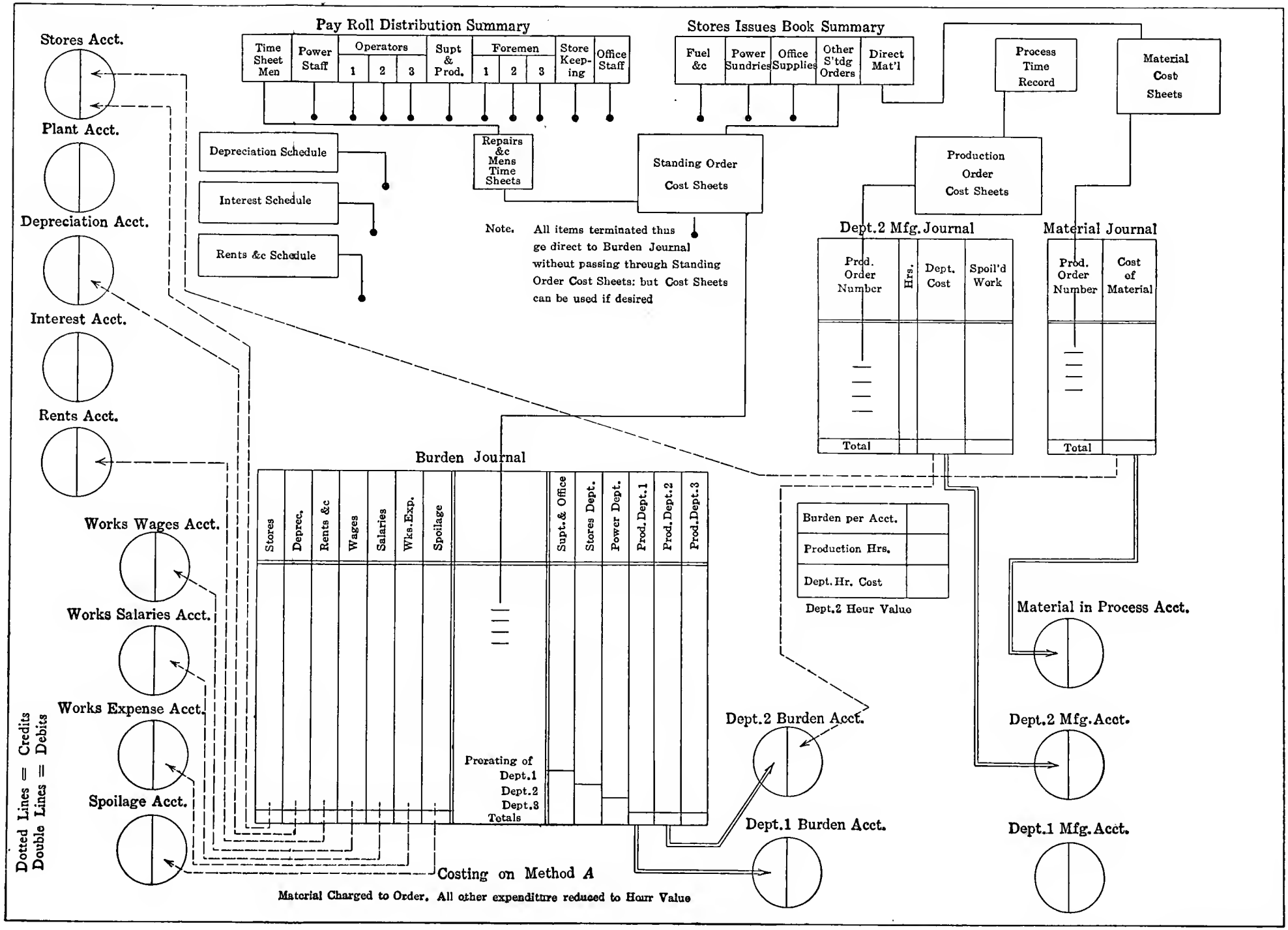


FIG. 67.—General diagram (Method A).

(*Facing Page* 310.)

the previous month's rate, then, if the strip-ticket system of Production Orders, Fig. 60, is employed, departmental cost may be figured and entered as fast as the strips are returned from the various departments. In this way the Order Register becomes a tracer, and the stage which any order has reached may be seen by inspection of the register. If desired, the actual costing operation may be deferred till the month end, when the true current departmental hour cost is known. In that case a simple check mark may be placed in the hours column of each department as each strip ticket is returned, thus preserving the tracer feature of the blank, and postponing its cost record function till the end of the month.

Spoiled Work.—It will have been noticed that the Departmental Manufacturing Journal, Fig. 78, contains a column headed "Spoiled Work." This is to contain the cost of supplementary orders issued to replace spoiled parts (see Chap. IX, Part I). Such orders are called Replacement Orders, and work on them is chargeable, not to Departmental Manufacturing account, but to Spoilage account, as is indicated on the general diagram.

CHAPTER XVIII

COSTING ON METHOD B (HOURLY BURDEN OR PERCENTAGE PLAN)

In costing on Method A described in the last chapter, it is assumed that the rate of wages is uniform for all processes throughout the departments, and that overhead expense or burden bears uniformly on all such process units. This being the case, wages and burden are thrown into one sum, and expressed as process-cost per hour in one figure.

In costing on Method B, now to be described, it is assumed that unequal amounts of wages will be paid for 1 hr. work on different processes, and this may arise from the wage rates being in themselves different, or from some system of paying by results, such as piecework, premium, or bonus being in vogue, so that unequal sums are received by employees for 1 hr. work in the department.

But this assumption does not extend to overhead expense or burden. It is still assumed, as regards burden, that it bears *equally* on all processes throughout the department, or on all men in proportion to their wages. Consequently burden is distributed over production on one of two bases—either it is reduced to what is known as an hourly burden, that is a charge for burden for each hour worked in the department on productive work, or it is reduced to a ratio or percentage of productive wages. That is to say that if the burden for a given department is $400 and 4,000 hr. have been worked on productive work, the hourly burden is reckoned at 10 cts. an hour, or alternatively, if the productive wages in the department were $800, then the burden percentage is said to be 50 per cent.

This method of costing is very widely used at the present time. In many cases it is quite correct, in some cases approximately correct, in others wholly incorrect.

It is correct in as far as the assumption made as to the uniform bearing of overhead expense on all processes is true. In proportion as the assumption tends to be divorced from the facts of pro-

duction it becomes incorrect. It is necessary, therefore, to consider what this assumption implies.[1]

In a former chapter it was shown that burden is first of all departmentalized before it is applied to costs. It was shown that considerable pains are necessary before the amount of burden applicable to each department is determined. We do not ascertain the total of burden and then distribute it *equally* between departments. On the contrary, attention is paid to the amount of equipment each department contains, and the cost of the building it occupies, and on these values such charges as depreciation, rents, insurance, taxes, etc. (also interest where this is included in cost) are apportioned. Similarly we collect the internal expense of each department, such as its own repairing, cleaning and laboring costs, separately. And in prorating expense departments over productive departments some basis is taken that implies measuring the cost of service as each department has received it. Thus the power-plant cost is distributed over productive departments in proportion to the power, light and heat they have used.

Now departmentalizing is merely localizing expense to certain groups of production centers. Departments are usually planned so that they represent some distinct division of the productive scheme which is so different from other divisions that it merits being costed separately. Thus if we are making soap, the kettle-floor costs are separated from the packing, mixing, boxing and other departments. In engineering plants the foundry, the machine shop, the grinding shop and the fitting floor will be made into separate departments. All these departments, when mapped out, will be charged with overhead expense service in proportion as they have made use of it.

This is equivalent to saying that one group of production centers (a production center being any place by and at which work is done, such as a machine, a vat, a bench, etc.) does not absorb the same amount of the different kinds of service which we collect through Standing Orders as other groups. Each such group, called a department, absorbs its own proper share.

Now this principle can be carried a step further. If in a given

[1] Readers desiring to follow up the question of burden distribution in greater detail than is possible in a general work are referred to the author's special studies: "The Proper Distribution of the Expense Burden" (2nd edition, 1913) and "Production Factors" (1910).

department, we have 20 production centers, we may very well ask whether the burden assessed against the department is, as a matter of fact, properly distributable equally between them. Should each one of them bear one-twentieth of the total? And when we remember that burden is really made up of a number of wholly different kinds of charges, it may seem likely that some of our production centers may enjoy certain kinds of service, say for example, the power service, to a greater extent than other centers. If, in short, some of them are large and costly machines, using considerable power, covering considerable floor space, using the services of expensive cranes, and so forth, while others are small, cheap, light machines, then it will be obvious that the distribution of burden *within* the department should be based on some principle that will allocate it to the production centers in proportion to the use each makes of the different kinds of service.

If, therefore, there is a considerable difference between machines, in cost, size, power consumption, use of transport machinery and service, then the hourly burden or percentage plan (Method B) is not correct. To employ it under these circumstances is pretty nearly as bad as it would be to divide the total of all burden between departments in proportion to their number and not in proportion to their use of the various services of which burden represents the aggregate cost.

This rule, however, must be applied with caution. If a department consists of a series of machines through which all product necessarily passes, then if some of the machines in the chain are larger, etc., than the others, it will not prevent the use of Methods A or B, because the whole chain of machines is considered as one machine. And if there were three or four such chains of machines in a department, they would be virtually similar production centers. But, on the other hand, the moment the machines or set of machines used in one process in a department call for service in different proportion to other machines or sets of machines, then neither Method A nor Method B can be considered as satisfactory methods of costing.

On the other hand, if a department contains, say, 50 milling machines of practically the same size and make, then if all the work is daywork and all operators are paid at the same rate, Method A can be satisfactorily applied. If the same machines are manned by operators working on a piecework or premium

system, then Method B will be satisfactory. But if a number of machines of different sizes and kinds are in use, then Method C is the only accurate method of costing.

Method B is also satisfactory for all hand industries or departments in which hand industries are carried on. By hand industries is meant those in which the machinery and equipment employed by the workers is negligible. Cutting rooms, sheet-metal shops, and the molding floors of most foundries may be cited as examples. Other cases may be mentioned in which, though machinery is employed, it is very incidental to the hand skill, even though in some cases costly and consuming service. Thus in a blacksmith shop, drop stamps and steam hammers, hack saws, forges, etc., may be in use, but only intermittently. They are rather aids or auxiliaries than actual production centers. But, on the other hand, if such a shop were organized for continuous manufacture of some kind, so that certain machines were kept steadily at work on production, that would alter the case. Another case where Method B is sufficiently accurate is the repair shop of a mill or other plant of a non-engineering character. The machinery in such a shop is usually of a miscellaneous character, and whether one machine or other is used on a particular job depends on convenience. It is true that even in this case a repair job requiring the services of a large planer should be visited more heavily with burden than one requiring only benchwork or the services of a light drill, but as repair machinery is rarely kept in constant use, that is to say a considerable percentage of machines is often idle, the ultimate result under either Method (B or C) would be much the same, and therefore B, being the simpler, would have the preference.

To sum up the foregoing arguments—Method B is indicated where the assumptions on which it is based are true, namely when the distribution of expense *within* departments is obviously equal as between one production center and another. If, on the other hand, a department contains a variety of machinery, some taking more service in the way of power, space, transport facilities, supervision, etc., than others, then Method C should be used.

In some cases a department that calls for Method C on account of variety of machines, can be resolved into two or more departments, each sufficiently uniform in their equipment to justify the employment of Method B. *Departmentalization is the key to accuracy in costing*, and the peculiar merit of Method C is that

it carries the principle of departmentalization as far as the production centers themselves, that is to say, to the ultimate limit possible. It is this that makes it the most accurate of all systems. But as said above in other words, this ultimate simplicity is already reached for practical purposes when a department contains only machines of practically the same cost, size, and call on service. When that is the case, further departmentalization is unnecessary—Method A will give accurate results if wages are uniform throughout the shop, and Method B will take its place if wages or earnings per hour are not uniform.

Having now explained the circumstances under which Method B is applicable, the practical working of the method can be described.

The General Diagram.—The large folding diagram at the end of this book represents a general scheme of cost accounts on Method B. The left-hand portion of the diagram deals with the distribution of purchases to the main ledger accounts (indicated by circles) and has been fully covered in previous chapters. The symbols above the large square represent the order system, while those on the extreme right of the diagram deal with the clearing of departmental accounts and the ultimate charging to Finished Production Orders account.

The portion of the diagram within the large square represents the cost system proper. The various sources of information as to the elements of cost are: the schedules for depreciation, rents, insurance, taxes, etc.; interest (which, however, being optional in all costing methods will be dealt with separately in a later chapter); and the summaries of pay-roll, Salaries Book, and Stores Issues Book.

The method by which allocation of wages to Orders is effected (namely, by Time Sheets and piecework earnings notes) and of stores issues to Orders (by means of Stores Issue Sheets) is displayed; and the Order Cost Sheets to which the items from the foregoing are posted are shown immediately underneath. Below these documents are shown the Burden Journal on the left hand, and the Manufacturing Journal on the right hand. The Burden Journal receives the data collected by the Standing Order Cost Sheets, and some from the Depreciation, etc., Schedules, and when all entries have been completed, becomes the source from which are made, first, credits to the main ledger accounts; secondly, distribution of the service cost of non-

productive departments to productive departments; and thirdly, charges of the total of burden thus ascertained against productive departments to a Departmental Burden account, one for each department.

The Manufacturing Journal, one of which is used for each productive department, lists the various Production Orders (and in some plants Plant Addition Orders, which are merely a special kind of Production Order), and then becomes the medium, first, for distributing burden over Production Orders, either on the hourly burden or the percentage method; secondly, for crediting the Department Burden account with the total so distributed; thirdly, for charging Departmental Manufacturing account with the total of direct wages, direct material and burden as listed in the journal.

The Order System.—While the Standing Order scheme indicated for Method A can be applied in Method B the larger scale of operations of plants suitable for organizing on Method B makes it desirable that a more elaborate Standing Order system, based on separating the costs of service into several principal groups, called production factors, should be employed. Moreover, should it be desired at any time to put the costing of any department on Method C this arrangement of Standing Orders, besides giving greater precision in the control of overhead expense, will render the introduction of Method C much easier. Fig. 56 in Chap. XII (Part II) shows a Standing Order table, grouped by production factors, and arranged for four non-productive and four productive departments.

It will be noticed that the main difference between this table and that suggested for Method A lies in the greater subdivision of items, and their assembly or grouping in divisions corresponding to definite classes of expenditure. Thus the whole field is divided up into: (1) expenses connected with buildings and premises; (2) those connected with storage of material and its handling and transporting from place to place, both between departments and between machines or production centers; (3) those connected with superintendence, including the share of administrative salaries to be borne by the factory; (4) those connected with the factory organization, including share of the general office expense (depreciation, insurance, stationery, books, phones and postages borne by the factory); (5) those connected with the generation of power and its trans-

mission to machines; (6) those connected with the productive machinery itself, chiefly depreciation, insurance, and repair and maintenance. All factory expense can be legitimately placed in one or other of these groups, and each such group represents a particular kind of service rendered to production and called upon to a different degree by each department.

In Method B no special use is made of this grouping except in the way of reports and returns in which the different factors are given separate existence. This will, however, not be considered until the chapter on "Reports and Returns." But as the data must be arranged in some form, and it makes no particular difference to this method, in what form they are arranged so long as the allocation to departments is sufficiently detailed and clear, it is just as well to adopt the production factor classification. Once arranged it implies no more work to collect the data than if they were grouped in any other order. The table given in Fig. 56 is, of course, only a suggestion. In many plants modifications would be required, and in some it would require amplifying, as for instance in an engineering works, where tool rooms, compressed-air systems and other non-productive departments exist. This was dealt with in Chap. XII (Part II).

In a large number of the plants employing Method B both Production Orders and Component Orders will be necessary. As explained in Chap. XIII (Part II) Component Orders are subdivisions of Production Orders. When they are in use, the Production Order number becomes merely a device for collecting all the component costs belonging to a particular Production Order; but it does not follow that such subdivision is necessary in the case of every order. A given Production Order, for example, might have only one Component Order to which all work on the Production Order was charged. From this elementary stage, to a series of Component Orders giving the very greatest amount of detail, is obviously a matter of arrangement of the Component Orders at the commencement. In this way, some costs may be obtained in great detail, while others are obtained in less detail. When Component Orders are in use at all it is best to give all work a Component Order, even though only one such order is required on a given Production Order. The way in which Production Orders and Component Orders are registered and issued was discussed in Chap. XIII (Part II).

Cost Sheets.—Figure 81 shows a Standing Order Cost Sheet arranged for collecting items of wages, material and sundries chargeable against Standing Order numbers. Fig. 82 represents a Cost Sheet which may be used for collecting items that do not arise within the factory, but are obtained from the Schedules of

STANDING ORDER COST SHEET

For_____ Dept._____ No._____

Date	Item	Hrs.	Wages	Mat'l.	Wks. Exp.	Total

FIG. 81.—Standing Order Cost Sheet.

Depreciation, etc. The use of these latter sheets is optional. Entries from the schedules may be made direct to the Burden Journal if preferred, but in case it is required to obtain a record on Cost Sheets uniform with the other Standing Order costs, this

STANDING ORDER COST SHEET

For_____ Dept._____ No._____

Month	Deprec.	Ins'ce	Rents	Taxes		Total

FIG. 82.—Standing Order Cost Sheet for items taken from Schedules.

intermediate stage of Cost Sheets for such items may be used. Each of these Cost Sheets lasts one month. As soon as the last item for the current month has been entered on a sheet, a new sheet for that Standing Order is made out to take care of the new month's items.

Figure 83 shows a Cost Sheet for Component Orders. As will be seen, it is arranged for recording both labor and material. In most plants using this method, it is customary, on account of the number of parts in the product, to make the record of material alongside that of labor, but of course there is no absolute necessity for this. Separate Material Cost Sheets could be issued as in the case of Method A. In this case the Component Order would be the same as that shown, except that the columns relating to material would be absent. When such separate Material Cost Sheets are used the procedure with regard to them is the same as already outlined for Method A. A separate Material Journal is used—material in this case being regarded as a department.

Whether this plan can be adopted, and it possesses advantages in the direction of simplicity when it can, will depend on the nature of the work. In highly standardized work, such as repetition machine building, where the exact quantity and nature of material can be foreseen and tabulated, separate Material Cost Sheets in connection with a "master schedule" of Production Orders, as will be described in the chapter on clearing Manufacturing account, afford close control of material. But in non-repetition work, it is safer to use the plan of charging all material to the Component Order on which it is first issued.

Referring to Fig. 83, it will be noticed that the hours, labor, and material sections are provided with columns headed "Monthly Total." These are for the purpose of bringing out the total of individual months separately, in case the Component Order is being worked on, or remains in the department, over the end of a month. The total of the first month's transactions are brought out in the "monthly" column for entry on the journal. Next month, only the items charged in that month will be so brought out. The addition of the various monthly totals will of course represent the cost of the item to date. The column headed "burden," on the other hand, has no separate column for a monthly total, since it is in itself a monthly figure, calculated either on the monthly total of hours or of wages. It, therefore, appears only once in any month. Works expense is also posted in one sum monthly (if any such item happens to occur, as when a man has been sent outside the plant for some purpose connected with the order) so that no separate column is required for ascertaining its total in any month.

Works expense, however, might be incurred, as in the case just

PRODUCTION ORDER NO._____ COMPONENT ORDER NO._____

Date Issued_____ Date Completed_____ Department_____

For

LABOR							BURDEN	MATERIAL					Sundry Works Expense	Grand Total
Date	Man	Mach	Hrs	M'th Tot.	Wages	Monthly Total		Date	Description	Wt.	Cost	Monthly Total		
	Totals													

FIG. 83.—Cost Sheet for Production Orders.

mentioned, in a way that prevented its association with any particular *component.* In this case a special Component Order should be issued, headed "Outside Expense" or similar title, and all such expense charged to it, so that it will eventually come through as part of the cost of the Production Order, though not chargeable against any actual physical component.

In a plant where Component Orders were not necessary either because detail cost was not desired, or because the work contains no parts or subdivisions to which Component Orders could be applied, the same blank would be applicable, except that, of course, the words "Component Order Number" would be omitted.

The calculation of the burden amount is made after the departmental accounts are closed for the month. But it may often happen that it is required to close out the cost of an order immediately it is completed. In this case, the burden figure used in the previous month will be used as a basis of calculation, whether on hours or wages, and the resulting calculation will be entered in the monthly burden column. At the month end, this figure will be entered in the Burden Journal along with the other charges to the order, and must be considered as already distributed when the burden distribution is undertaken. If the percentage or hourly burden proves to be higher or lower than that used, the matter cannot be remedied if the costs of the order have already been dealt with and made use of at further stages of the accounting. In general, this will not matter as the difference between one month's burden percentage and another will not be great. But if the cost was only wanted provisionally, that is for estimating or other purpose of an informal character, then the calculation may be made in pencil on the Cost Sheet, and ignored when burden distribution is being made at end of the month.

The cost of a Production Order will be the sum total of the separate costs of its components. But as departments are concerned only with components, the collection of Component Order costs and their transfer to a Production Order Cost Sheet, or Master Cost Schedule, is not made until after the last departmental job has been completed. In machine works this will be the assembling or "fitting" departments operation. The complete machine being assembled on a "Fitting Order" which ranks precisely as a Component Order, notwithstanding that the work represented on it is not identified with any single component, when the cost of this final work is completed, the whole set of

Component Orders relating to the Production Order are tabulated, and the aggregate cost of all of them is, of course, also the cost of the Production Order.

Distribution of Material.—The original documents representing material drawn out of stores will be Stores Requisition Notes or Bills of Material as described in Chap. V. (Part II). Where Bills of Material are in use it will be preferable as a rule to treat material as a department, that is to make out a Material Cost Sheet for each Production Order, instead of charging to individual Component Orders. This method was described in connection with Method A. In all other cases, and in any case as regards Standing Orders, separate entries will be made on a Stores Issues Book similar to Fig. 39. Daily allocations to the different classes of orders and to departments will be also made in a summary book similar to Fig. 39*a*. By this procedure, separate totals are obtained for the three classes of orders in each department. The items may then be entered on the different Cost Sheets which will be arranged in groups corresponding to the above-mentioned allocations. When any given group has been entered up, the entries just made should be aggregated on an adding machine and agreed with the total for that class of orders and department as shown by the Stores Issues Summary. By this means correct posting, as regards the amounts at any rate, is assured as we go on. It is much better to spend a little time at this stage to ensure correctness than to have errors to trace at a later stage.

At the month end, the Stores Issues Summary Book will be totaled up, and the amount chargeable against each department for material issued to each class of order will be found. This figure must agree with the totals of Cost Sheets as they are listed in the Burden and Manufacturing Journals, as will be shown presently. It need hardly be pointed out that when the entering up of Stores Issues on Cost Sheets is completed, the Cost Sheets will now contain, in one place or another, items aggregating in value to the whole of the Stores Issues for the month. In other words, all material taken out of stores has now been charged to some or other Cost Sheet, and therefore to some or other order, whether Standing, Production or Plant Addition.

Distribution of Wages.—In general, the daily system of recording time and wages described in Chap. IX (Part II) will be used

in connection with Method B. The daily pay-roll, Fig. 52, will be used in connection with some Time Sheet mechanism for ascertaining how each man has divided his time between various orders.

Not all men, however, will require Time Sheets. Only those men who work on different orders, sometimes on one and sometimes on another, will require them. Many men will be engaged on permanent jobs which are chargeable against a single Standing Order during the whole month. Such men's wages can be charged not oftener than once a week to Cost Sheets, if a special place on the pay-roll is devoted to them.

In all other cases Time Sheets *or some equivalent mechanism* must be employed, in order to ascertain how the total earnings of the man, as indicated by gate time, has been expended on orders. It is not intended here to describe the innumerable devices that have been designed for this purpose. Though excellent for the purpose, and frequently great labor savers in the computation of "elapsed time," that is, the time that has elapsed between the hour of starting the job and that of finishing it, they introduce no new principle in accounting, although in some cases they provide a higher degree of precision and accuracy than is commonly found without their use. But as the principles involved can be more clearly shown by considering the use of an ordinary Time Sheet, that form of record will be selected for description. It may be added in regard to any other method, that it should provide the same information and yield precisely the same results as that now to be described. The method may be different and even superior, more practically accurate or easier, but the aim is the same. Moreover, a Time Sheet method can be made absolutely accurate by a little care, while on the other hand, the more automatic methods, if negligently applied, may easily give inaccurate results. It may be admitted, however, that the use of clock methods and time stamps, particularly where these automatically calculate "elapsed time," are a considerable help if proper arrangements are made in joining them up to the system.

Figure 84 represents a type of Time Sheet that will illustrate the requirements of any method adopted to secure a record of the distribution of men's time to orders. The following information is provided for:

At the top a stub summarizes the days time and wages.

Dept No. 5	Man's Name		Clock No.	Mach No.	Total For ☞ Date)		Hrs.	Wages
Began	Order No.	Work		Man's No.	PW	Good	Hrs.	Wages
Finished	Component No.			Mach No.		Bad		
Began	Prod. Order	Work		Man's No.	PW	Good	Hrs.	Wages
Finished	Component No.			Mach No.		Bad		
Began	Prod. Order	Work		Man's No.	PW	Good	Hrs.	Wages
Finished	Component No.			Mach No.		Bad		

FIG. 84.—Time Sheet—cut up at thick lines after extension and verification.

The sections below are separated from the stub and from each other by very thick lines, so that at the proper moment they may be cut up by a cutting machine in the same way as described for the Stores Issue Sheets, Fig. 39, in Chap. V (Part II).

Each of these sections records the time spent on one job, which may be work on a Standing Order or otherwise. Spaces are provided to record:

* Order number.
* Component number.
* Man's number.
* Machine number.
* Nature of work.
* Time job commenced.
* Time job finished.
  Hours taken.
  Wages earned.
* Number of pieces good.
* Number of pieces bad.

If instead of being on daywork the man is employed on piecework, a space is provided for the piecework price.

At the end of the day the Time Sheet, filled out as to all the items marked (*) above, is taken from the man, and next morning is put in hand for extension, verification and completion. The routine of these operations has been fully described in Chap. IX (Part II). It should, however, be explained that the sections above shown (Fig. 85) which are afterward cut up for sorting into order numbers, are equivalent to separate Time Cards as used in most mechanical systems of time-cost keeping. Such cards necessarily contain the same amount of information as the sections, but as a rule, nothing equivalent to the stub for totaling the day's earnings is used.

When all these operations have been performed, the sections are cut up and sorted to their order numbers, Standing Order or Production Order as the case may be. The latter are then sorted into their Component Orders, corresponding to individual Component Cost Sheets. Hours and wages, together with other data as called for by the rulings, are then entered on the Cost Sheets, until every section has been disposed of.

The sectional Time Sheet described is suitable for those workers who keep their own Time Sheets. Repair men and others whose movements are not very closely supervised may

use such sheets satisfactorily, and the record will be probably as accurate in this form as in any other. But as regards productive workmen, it is generally recognized that Time Sheets or Cards should be kept **for** them and not **by** them. In some plants this is effected by providing each sub-foreman or "gang boss" with a telephonic communication to a cost clerk who keeps all the Time Sheets or cards and makes the entries on them according to the data telephoned to him. Where such a system is in use, the section Time Sheets have advantages over separate cards in that each man's record is consecutive and can be picked out without hesitation. The day's items, also, are together until verification, extension and entry on pay-roll is completed.

PIECEWORK STATEMENT

Man_____ Dept._____ W.E._____

Clock No._____

Prod. Order No	Comp. Order No	No. of Piece	Price Each	Total Piece Earning	Day Time		Balance Due
					Hrs.	Wages	
	Totals						

FIG. 85.—Weekly statement of pieceworker's earnings.

Where any of the various systems for paying men by results, that is by piecework, premium or bonus, are in use, some additional mechanism must be provided for getting the balances due to the men over and above their ordinary day wages into the pay-roll on the one hand and into the Cost Sheets on the other. The general precautions to be observed in dealing with premium, etc., balances were discussed in Chap. IX (Part II). The first necessity in any such system, as far as the accounting is concerned, is the provision of an *authority* for the payment of the extra earnings. Fig. 64 gives a suggestion for a form of Premium Order useful in connection with the sectional Time Sheets above described, inasmuch as the stub at the foot of the order can be

detached, after entry on a weekly statement of earnings individual to the man in question, and then included with the day's Time Sheets for entry on the pay-roll, and later passed to the cost clerk for charging to Cost Sheets.

Figure 85 gives a specimen ruling for an individual earnings record as applied to ordinary piecework, and Fig. 86 a similar record arranged for Premium or bonus earnings. These blanks are practically the only special arrangements necessary to bring piecework or premium systems into the scheme of the general accounting, but the remarks in Chap. IX (Part II) as to verification of the authority and the amount of earnings should be kept in mind.

After the pay-roll has been entered up from the Time Sheets

PREMIUM EARNINGS STATEMENT

Man_____ Dept._____ W.E._____

Clock No._____

Prod. Order No	Comp Order No	Time All'ce	Time Taken	Time Saved	Prem. per Hour Saved	Balance Due
Totals						

FIG. 86.—Weekly statement of premium worker's earnings.

and piecework, bonus or premium notes, the individual cards (or the cut up sections if the section Time Sheet is used) must be sorted into three groups, namely, Standing Orders, Production Orders and Plant Addition Orders, the amounts chargeable against each department being kept separate. The respective totals are then entered on a blank, Fig. 87, which thus shows the distribution of wages to the three classes of orders in each department separately. The total for the day as entered on this blank will, of course, be agreed exactly with the total for the day as entered in the pay-roll. By this procedure the fact that every cent shown on the pay-roll is represented on the Time Cards or Sections, thus proving this step of the accounting. Further agreement will be made later to prove that all these items have,

Wages & Salaries	Total Earnings	Selling Dept.	Standing Orders — Departments						Production — Departments						Plant Additions — Departments					
			1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
Thursday																				
Friday																				
Saturday																				
Sunday																				
Monday																				
Tuesday																				
Wednesday																				
Total W.E.																				
Thursday																				
Friday																				
Total W.E.																				
Total for Month																				

FIG. 87.—Distribution summary of Pay-roll and Salaries Book showing totals chargeable to the three classes of order in each department—daily, weekly, and monthly.

as a matter of fact, reached and been accurately recorded on individual Cost Sheets.

COLLECTING STANDING ORDER COSTS AND CHARGING TO BURDEN

When all the wages, material and sundry works expense items for the month have been posted to the different classes of Cost Sheets, the preparation of Burden Journal may commence. Fig. 88 shows such a journal arranged in conformity with the scheme of Standing Orders as given in Fig. 56. The use of the journal will be understood from inspection of the rulings. Columns are provided for each of the non-productive and productive departments, and alongside each column the Standing Order numbers affecting each department are given. To ascertain the total burden chargeable against each department, the total of each Cost Sheet is entered opposite its Standing Order number. When all the Standing Order number spaces are so filled out the statement of burden will be complete. In many cases, however, the items relating to depreciation, rents, insurance, etc. which come from the schedules will be entered direct on the Burden Journal, without passing through Cost Sheets. This is simply a matter of convenience—a short cut—as obviously there being only one entry each month for each of these items it is hardly worth while to go through the formality of entering them on Costs Sheets, to be immediately closed and transferred to the journal. Theoretically, however, they should be posted to Cost Sheets, in accordance with the principle that each Standing Order number is represented by its individual Cost Sheet.

When entering any group of Cost Sheets in the journal, as for instance the 02 group, "Repairs to Building Structure," opportunity is taken to aggregate all wages, all material, and all works expense on the sheets and place it on the corresponding line on the left hand of the journal, under the corresponding columns. In this way each line of the journal provides charges to departments on the right-hand side and credits to the main ledger accounts on the other (compare general diagram). The same procedure is gone through with regard to all other entries, so that when all the Standing Order Cost Sheets (and all the entries from schedules) have been completed, and all columns totalled, we have a complete story of credits to the main ledger

accounts on the left side and a complete story of charges to departments on the other. The credits are then made in due course, and thus finally disposed of.

The right-hand side of the journal requires, however, a further operation. The totals appearing against the non-productive departments require to be prorated over the productive departments on the basis of the call on the service made by each productive department. When this is done, then all the amounts represented by credits will be balanced exactly by charges to the productive departments.

This is exactly the same procedure as described in connection with Method A. And with the exception that in Method A operative wages are included in burden, the ground covered by the two journals is the same, only the journal suggested for Method B is more highly developed, and goes into greater detail with regard to the items of expense.

The following agreements will have to be made at this stage:

The total of Stores account credit column must agree with the aggregate of all columns in the Stores Issues Summary (Fig. 39*a*) relating to issues against Standing Orders.

The total of depreciation credit column must agree with the total for the month shown as chargeable against the factory in the Depreciation Schedule. The rents, etc. column must similarly agree with the totals shown as chargeable in the Rents, Insurance, etc. Schedule.

The total in the wages credit column must agree with all columns in the Pay-roll Distribution Summary, Fig. 87, relating to Standing Orders. The total in the salaries credit column must agree with the amount chargeable for the month against factory, unless salaries are included in Pay-roll Summary, in which case this column will not be required.

The total in the works expense account credit column will be agreed with such items in the Works Expense account as are chargeable against Standing Orders.

The total in the Spoilage account credit column must agree with balance in Spoilage account, the assessment of which against productive departments will have been made by virtue of a memorandum authorized by the superintendent.

All these agreements having been made, the correctness of the data may be assumed. Finally, the cross-total of all credit columns must be agreed with the cross-total of all *productive*

Cr Stores Acct.	Cr. Depreo. Acct.	Cr. Rents&c Acct.	Cr. Wks. Wages Acct.	Cr. Salaries Acct.	Cr. Wks. Exp. Acct.	Cr. Spoilage Acct.	Cr.	Item of Expense
								Depreciation of Buildings &c
								Rents Insurance &c "
								Repairs B'ldg Structure
								" B'ldg Equipment
								Current for Lighting
								Steam for Heating
								Painting & Kalsomining
								Cleaning Windows
								Other Sweeping & Cleaning
								Sundry Supplies
								Deprec. Cranes, Trucks, Fixtures
								Insurance Ditto
								Repairs Ditto
								Wages, Cranemen, Handlers
								Salaries, Storekeeper, Clerks
								Sundry Supplies
								Wages of Foremen
								Share of Administrative Sal.
								Sal. Supt. & Prod Staff
								Deprec'n Office Equipment
								Insurance Ditto
								Repairs Ditto
								Stationery, Books, Blanks
								Phones, Telegrams, Postages
								Wages, Watchmen, Messengers
								Salaries of Clerks
								Sundry Supplies
								Deprec'n Power Equipment
								Insurance Ditto
								Repairs, Ditto, in Power Plant
								" " " elsewhere
								Fuel
								Feed Water
								Wages in Power Plant, Boiler
								" " " " Engines &c
								Sundry Supplies, Oil etc
								Deprec'n Machines & Benches
								Insurance " " "
								Repairs " " "
								Cleaning & Oiling " "

Fig 88 Burden Journal

Collects all Factory Expense per Standing Orders and Schedules and Distributes Non-Productive Department Expense over Productive Depts.

Credits Ledger Accts. with all Expenditure on Manufacturing except Direct Material and Direct Wages

Note Items Marked (*) in Total Column may be entered direct from Schedules or Thro. Cost Sheets

FIG. 88.—Burden Journal

Total All Depts	Dept.1 Supt.& Prod.	Dept.2 Fact. Offices	Dept.3 Stores	Dept.4 Power Plant	Dept.5 Productive	Dept.6 Productive	Dept.7 Productive	Dept.8 Productive
*	100	200	300	400	600	800	700	800
*	101	201	301	401	501	601	701	801
	102	202	302	402	502	602	702	802
	103	203	303	403	503	803	703	803
	104	204	304	404	604	604	704	804
	105	205	306	405	606	805	705	805
	100	206	306	406	506	806	700	806
	107	207	307	407	607	607	707	807
	108	208	308	408	608	608	708	608
	109	209	309	409	509	600	709	809
*			320		520	820	720	820
*			321		521	621	721	821
			322		622	822	722	822
			327		527	827	727	827
			328					
			329		629	629	729	829
	137			437	537	837	737	837
	138							
*	140	240	340	440	540	640	740	640
*	141	241	341	441	541	641	741	841
	142	242	342	442	542	642	742	642
	144	244	344	444	544	644	744	844
	145	245	345	445	545	645	745	845
	147	247	347	447	647	847	747	847
	148	248	348	448	548	648	748	848
	149	249	349	449	549	649	749	849
*				450	550	650	750	650
*				451	651	651	751	851
				452				
					653	653	753	853
				454				
				455				
				457				
				458				
				459	550	859	759	859
*					560	660	760	860
*					661	861	761	861
					562	662	762	862
					563	863	783	863
Prorating of Dept.2								
Prorating of Dept.3								
Prorating of Dept.4 as per Details below:								
Prorating of Power								
Note. These items(**)to be omitted here if included above ** .. .. Lighting								
** .. .. Heating								

(Method B).

departments columns, when the operations on this journal are completed. The main ledger accounts will be credited with their respective credits, and the Departmental Burden accounts will be charged with the amounts shown in the respective productive department columns (see general diagram). All the expenditure of the factory on service has now been allocated to productive departments, and the elements of this service, namely, wages, materials, depreciation, etc., have been duly credited to the main ledger accounts.

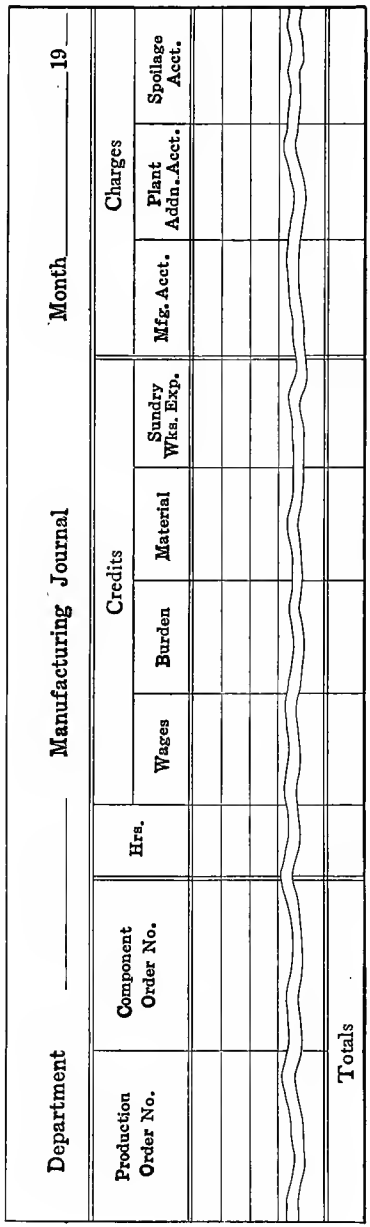


FIG. 89.—Departmental Manufacturing Journal (Method B).

Distributing Departmental Burden over Production Order Cost Sheets.—Having now ascertained the amount of burden chargeable against each productive department, the next step is to list all the Production Order Cost Sheets (including Plant Addition Cost Sheets) so that we may distribute the proper share of burden to each, in proportion either to the productive or direct wages expended on each, or (if that plan is preferred) in proportion to the productive hours worked on each. The first step is to provide a medium for the listing. Such a medium is the Departmental Manufacturing Journal (Fig. 89), which

provides spaces for entering the individual Component Order Cost Sheets, stating their respective Production Order and Component Order numbers, the total hours worked in the month on each one, the amount of wages charged against each one, the value of the material charged against each one (if the material is not dealt with separately by means of Material Cost Sheets as outlined above), and any items of works expense that may be chargeable. Three total columns are also provided, and the total of the costs after burden is added will be placed in one of these three according to whether the order is for Production, Plant Addition or is a Replacement (Spoilage) Order (see Chap. IX, Part I).

When all the orders have been listed and totalled in columns, certain agreements are necessary:

The total of wages column in the journal must agree with the total of productive wages and plant addition wages as shown for that department on the Pay-roll Distribution Summary (Fig. 87).

The total of material column in the journal must agree with the totals of stores issued to Production Orders and Plant Addition Orders in the Stores Issues Summary to that department (see Fig. 39*a*).

The total of works expense column in the journal must agree with the total of works expense items in the Works Expense account chargeable against Production Orders (this will be a very unusual occurrence).

When these agreements are effected, Wages account, Stores account and Works Expense account will be credited with the totals of the respective columns, so that all charges against direct production will now have been credited to the main ledger accounts, in the same way as the charges for indirect expense or service were credited through the Burden Journal. All the charges against factory will now, in fact, have been so credited.

The next step is to provide for the distribution of departmental burden which has been collected in the Departmental Burden account over Production Order and Plant Addition Order Cost Sheets. This distribution may be effected on one of two plans, either on the total productive hours as indicated by totalling the "Hours" column of the journal, or on the total productive wages as indicated by the total of the wages column. Fig. 90 is a convenient blank for use with the first-mentioned

plan. The first line of the blank is filled out with an amount equal to the balance in the Departmental Burden account, the second line is filled out with the total productive hours worked in the department as just found by adding the "Hours" column, and then by dividing the burden amount by the total hours we find the burden cost of 1 hr., or, as it is usually expressed, the "departmental hourly burden."

Having found this multiplier, the next step is to multiply the hours set down against each individual order by it. The resulting figure will be the departmental burden chargeable against that order, and it is entered in the column headed "Burden." When all orders have been thus treated, the column headed "Burden" is totalled, and should obviously equal exactly the amount standing as a balance in Departmental

Departmental Burden	$
Total Hours Worked	
Dept'l Hourly Burden	$

FIG. 90.—Determining ratio of burden on hourly-burden plan.

Departmental Burden	$
Total Productive Wages	$
Dept'l Burden %	%

FIG. 91.—Determining ratio of burden on percentage plan.

Burden account, and this agreement having been made, Burden acount is credited with the amount.

Each line of the journal is then cross-totalled, so that the amounts for:

Wages
Burden
Material
Works expense

standing against each order number are aggregated. The total of these is then placed either in Manufacturing account column, if the order is a Production Order; or in Plant Additions account column, if the order is a Plant Additions Order; or in Spoilage account column, if the order is a Replacement Order. Each of these columns is then totalled.

A final agreement must then be made. The aggregate of the four credit columns headed wages, burden, material, sundry works expense, must agree with the aggregate of the three

debit columns, Manufacturing account, Plant Additions account and Spoilage account. This being effected, these three ledger accounts are charged with the totals of the respective columns, and the round of operations on Manufacturing Journal is then complete.

All the charges against factory of whatever kind, will now have found their place in one of these three accounts, and the detail of such amounts will be represented by the individual Cost Sheets. It should be explained, however, that the items calculated as burden against each individual order, are posted to the corresponding Cost Sheets (Fig. 83) as soon as the total has been agreed with the balance in Burden account. Every item of expenditure made by the factory, including such charges as depreciation, etc., are now represented, in one form or other, on the Production (and Plant Addition Cost Sheets) that is to say, either as direct wages, direct material, direct works expense (negligible in importance) or as burden. Certain of these Production Order Cost Sheets will, however, represent work that has become valueless for some reason or other, and thus is chargeable against Spoilage account. The others remain as good assets, and form the detail as just mentioned of the Manufacturing account and (if there is one) of the Plant Additions account.

If the percentage method of distributing burden is employed instead of the hourly burden plan, all the foregoing is unchanged, except that a blank like Fig. 91 is used for determining the basis of distribution. The total of departmental burden is, as before, placed in the upper space on the blank, but immediately below, instead of the total productive hours, the total productive wages is inserted. The ratio between such wages total and the burden total is then found and expressed as a percentage. Thus if wages are $400 and burden is $300 we say that burden is 75 per cent. of wages. If wages are the same but burden is $600, burden is called 150 per cent. of wages. This percentage figure is applied as a multiplier to each individual order just as the hourly value was applied, and the resulting figure is set down in the burden column and posted to the Cost Sheet in precisely the same way

Some authorities consider the hourly burden plan a great improvement over the percentage plan, but as usually employed the present writer does not consider there is any great difference

in accuracy between them. In the circumstances under which alone Method B is accurate, discussed above, the hourly plan is somewhat more accurate than the percentage plan, but as B is applied to all sorts of circumstances, it is hard to say whether, as a general principle, the hourly plan always maintains its superiority. It will depend very much on the individual case.

Normal Burden.—The term "normal" burden is sometimes applied to the hourly burden or percentage figure obtained in a department when all the resources of the department are fully employed and production is consequently at a maximum. Omitting the considerations of overtime (which might be considered in this connection as a kind of "forced-draft" working) it will be obvious that under such circumstances the ratio between the cost of service (burden) and productive activity is at a minimum. This normal burden figure represents the figure that should be used in estimating, because it represents full employment of the **manufacturing capacity** of the plant, and any higher figure than this represents the influence of unfavorable circumstances and a consequent **waste** of manufacturing capacity due to part of the plant being idle. This function of normal burden has recently been announced in certain quarters as a remarkable and new discovery, but it has always been known to cost specialists and applied daily for many years. But it must be remembered that the application of normal burden to any individual job is strictly dependent for its accuracy on the suitability of Method B for the industry in question. If Method B is in use under circumstances in which it does not give correct cost, then reliance on normal burden in estimating might easily lead to grave error and loss.

Normal burden is also dependent on the possibility of keeping the plant full of work at all times. That is to say that it will not apply to any industry in which there are seasonal variations. To apply it to such conditions would lead to serious consequences, inasmuch as the busy seasons have to pay for the slack seasons. Normal cost in such a case would have to be an *averaged* cost. The whole course or cycle of seasonal costs would have to be reviewed, and a normal burden fixed on that would cover the cost of enforced idleness in slack seasons. Otherwise, if prices were based on the minimum cost observed in busy seasons, it would be too low. Not sufficient profit would be made in the busy season to pay for the heavy charges of the slack season.

Prorating Burden on Quantity or Weight.—In certain industries where the product is a simple one, through individual lots may require more or more skilled labor than other lots, or are paid for on a piecework or premium basis, and must, therefore, have direct labor charged to them, the department burden may nevertheless bear a closer ratio to weight or quantity produced than to either time taken on the job or to wages paid on it. In such cases the total weight or quantity of the output must be ascertained and burden divided by it. The result will be a burden charge per hundred, or per pound. Then, when entering orders on Manufacturing Journal, the quantity or weight produced on each order is given (instead of hours worked) and this multiplied by the above burden charge will give the burden chargeable to the order.

Molding-floor costs in foundries are frequently arranged on this plan—tonnage burden being substituted for hourly burden or percentage on wages burden.

CHAPTER XIX

COSTING ON METHOD C (SCIENTIFIC MACHINE RATE PLAN)

It has been pointed out in former chapters that the line of approach to accuracy in cost keeping is adequate departmentalization. In proportion as we isolate unlike processes and machines and skills, the clearer the connection between cost and individual items of product will be perceived. As has already been pointed out the three methods A, B and C are three degrees of approach to the elimination of averaging. In A all expenses and all productive wages were considered to average over all jobs in proportion to time taken. In B expense only was considered to average in this way, and direct wages were charged against individual orders. In Method C, now to be described, mechanism is introduced to identify all expense with the cost of working *individual machines*, or "production centers," so that each machine becomes as it were a separate department, with an accurately determined departmental cost. We have then only to determine how long each order has remained in the department (or in other words how long it has been operated on at the machine) to find its due and proper charge for machine service. And as direct wages are on this method, as in Method B, charged against each Production Order, it is evident that we have here the closest degree of accuracy that is possible in any system of costing.

But as explained in previous chapters, this method is necessary only when a department contains equipment varying to a considerable degree amongst itself. Where a department contains 20 machines or production centers of any kind, all practically alike, then Method C affords no advantage over B when B is applied on the hourly burden plan.

The organization of costing on Method C naturally falls into two main divisions, one connected with the finding of the burden charge against each department, and the other connected with the determination of the amount chargeable, of this total, against each production center.

The method of collecting the various items of service expense, and distributing it to departments as burden is precisely the same as that described for Method B. This is obviously so, because, as already explained Method C deals exclusively with the distribution of such burden expense **within** the department. The form of the Standing Orders, the pay-roll, the stores issues system, and the Depreciation Schedules will, therefore, not require special description, inasmuch as they are the same as just described in the last chapter.

New matter in connection with Method C will deal: (1) with the form of Time Sheets, Standing Order and Production Order Cost Sheets, Plant Addition Cost Sheets, and Manufacturing Journal, all of which require additional columns to record the machine time and machine earnings (which are machine time multiplied by a machine rate, just as a man's earnings are his time multiplied by his wage rate); and (2) the various blanks required for subdivision of the normal departmental burden into production center burden. This last mechanism is equivalent to a sub-departmentalization of the department into its ultimate production centers, or nearly so. This latter determination is carried out only at long intervals, or when some rearrangement within the department has disturbed the original computation of machine rates.

The current working of Method C will be seen to be no more difficult or laborious than that of Method B once the machine rates have been determined in a satisfactory manner.

As the working of Method B will be fresh in the memory of the reader we shall first proceed to describe the actual working of the method, leaving till later the method of fixing the machine rates. For the present it must be assumed that each machine is provided with a machine rate, *which rate is made up of elements representing the individual call of that machine on the various serivces, as mapped out by the Standing Order system.* Thus a given machine rate may be made up of a large charge for space, a small charge for power, a high charge for supervision, a low depreciation rate and so forth, the aggregate of these separate charges being combined so as to form *a single hourly rate* chargeable against production for the use of that machine. Other machines will have these various elements of service combined in a different proportion, so that each machine will have its individual machine rate, much as every man has his individual wage rate.

The Order System.—This will be similar to that described for Method B. Standing Orders are arranged so that, as regards each department, the groups of expense relating to buildings, power, etc., are segregated, and their total ascertained separately. This information is made use of in fixing machine rates and also in applying verification from time to time as to the accuracy of the rates.

Production and Component Orders will be also similar in all respects to those described for Method B.

Cost Sheets.—In costing on Method C additional columns must be provided on the Cost Sheets in which the amounts charged through machine rates to each order can be recorded. An additional column is also necessary in the case of Production

STANDING ORDER COST SHEET

For_____ Dept._____ No._____

Date	Item	Hrs.	Wages	Mach. Earn.	Mat'l	Works Exp.	Total

FIG. 92.—Standing Order Cost Sheet (Method C) for engineering shops.

Order or Component Cost Sheets only, to take care of what is known as supplementary rate, to be discussed presently. Standing Orders and Plant Addition Orders do not take supplementary rate, which is in fact a mere ratio between unused manufacturing capacity of the department and that used productively.

Figure 92 shows a Standing Order Cost Sheet. This differs from that shown for Method B (Fig. 81) in having a column headed "Machine Earnings." This column will be used only in engineering plants, where it may happen that repair, etc. work is done by one department for another to a Standing Order number. It might also be used in a repair shop of a non-engineering factory or mill, where it was desired to make use of machine rates in connection with the repair shop machines. As

Production Order No. _____ Component No. _____

Date Issued _____ Date Completed _____ Department _____

For

Date	Man	Mach	Hours	Wages		Mach. Earnings		Supp Rate	Material					Sundry Works Expense	Total
				Amt.	Monthly Total	Item	Monthly Total		Date	Item	Wt.	Amt.	Monthly Total		
Totals															

FIG. 93.—Production Order Cost Sheet (Method C).

already stated, however, this is usually not advisable. Consequently the provision of such a column will be unnecessary in the case of Standing Order Cost Sheets, save in machine shops that may undertake occasional or regular repairs for other departments. The use of such a column does in fact bring annoying complications into play. Additional columns have to be provided in Burden Journal, so that the amounts collected on Standing Order Cost Sheets in this way can be credited to the Burden account of the department doing the work. In the discussion of Method C that follows, it will be assumed that such columns are **not** in use. It is necessary, however, to call attention to the fact that under certain circumstances they are required or at any rate are advisable.

Standing Order Cost Sheets similar to Fig. 82, for collection of depreciation, etc., items from schedules can also be used in the same way and under the same circumstances as described in connection with Method B.

The Production Order Cost Sheet (Fig. 93) used in Method C is similar to that described in the last chapter, except that no "Burden" column appears. Its place is taken by a column headed "Machine Earnings," which is double, like that devoted to wages—the left-hand division takes care of the daily entries, while the right-hand division is used for bringing out totals at the month end, in the way already described for wages. It will readily be understood that these columns receive the entries of machine rate extensions, that is, hours worked on the job multiplied by the machine rate per hour that has been allotted to each machine in the department. Another column is provided for "supplementary rate" an item which is distributed over Production Orders after Burden Journal is made up for the month, much in the same way as burden was shown to be distributed in the last chapter. The meaning of supplementary rate will be explained later.

General Diagram for Method C.—Figure 94 (p. 352) shows a general diagram for Method C which may be compared with the large folding general diagram for Method B. This diagram may be referred to in reading the ensuing detailed description of the working of the method.

Distribution of Material.—There is no difference between Methods B and C in regard to the manner in which material is handled in any of the records.

Machine Shop No.1	Man's Name		Check No.	Mach. No.	Total for Day ☞		Hrs.	Wages	M.Earn.
Began	Order No.	Job		Man's No.	PW	Good	Hrs.	Wages	M.Earn.
Fin.	Piece No.			Mach. No.		Bad			
Began	Order No.	Job		Man's No.	PW	Good	Hrs.	Wages	M.Earn.
Fin.	Piece No.			Mach. No.		Bad			
Began	Order No.	Job		Man's No.	PW	Good	Hrs.	Wages	M.Earn.
Fin.	Piece No.			Mach No.		Bad			

FIG. 95.—Time Sheet (Method C).

Distribution of Wages.—While no difference between Methods B and C exists as regards the handling of wages items, the Time Sheets or Time Cards used for recording men's time are provided with an **additional** column (see Fig. 95 where a sectional Time Sheet otherwise similar to Fig. 84 is shown). On the extreme right will be seen a column headed "Machine Earnings." This is filled out by the cost clerk before the sheets are dissected, by multiplying the "hours" entry by the machine rate. This should be done after the sheet has been checked with gate time and fully completed as regards wages. In addition to being a wages distribution record, the sheet thus becomes a machine earnings distribution record.

Collecting Standing Order Costs and Charging to Departmental Burden Accounts.—The procedure is exactly the same as that described for Method B except in the special case that Standing Order Cost Sheets are provided with a column for machine earnings, and this exception has already been referred to above.

Distributing Departmental Burden over Production Order Cost Sheets.—At this point Methods B and C part company. Hitherto the differences between the two systems have been confined to extra columns in certain blanks on which information could be recorded as to the machine hours taken on different jobs, and the extension of these hours, by multiplying by a machine rate, into money value. But the effect of this procedure, if the machine rates have been accurately fixed, is that Production Order Cost Sheets have *already* been charged with burden, inasmuch as the machine rates represent very carefully worked out individual charges for the various services as absorbed by the different machines or production centers. When, therefore, we list all Production Orders and Plant Addition Orders in a Departmental Manufacturing Journal (Fig. 96) at the month end, we shall obtain a total of burden so distributed, and it will be a matter of interest to observe whether the amount so distributed is actually the same as the amount standing to the debit of Departmental Manufacturing account.

If the shop *is working full time*, and there has been no lack of orders, then the amount distributed by machine rates to Orders should be exactly or very nearly the same as the amount to debit of Departmental account. If this is not the case, *under the circumstances mentioned*, then some error has occurred in

fixing machine rates, OR some inefficiency in the shop exists. It is, of course, important at the outset to be able to determine which of these two causes has been concerned in the result.

The use of Manufacturing Journal will be easily understood from inspection of Fig. 96. It is the same as that shown for Method B with the exception that instead of a column headed "Burden" we have a column headed "Machine Earnings" which, as explained above, takes its place; and another column headed "Supplementary Rate" the use of which will now be explained.

Supplementary Rate.—If, when all the Production and Plant Addition Orders for the month have been listed and totalled in Manufacturing Journal, we find that the amount in "Machine Earnings" column is equal to the balance against the department in the Burden account, then it is evident that when the posting has been effected there will be no balance left in Burden account. This is equivalent to saying that all the burden has already been distributed to Orders by means of machine rates. In that case there is obviously no further distribution possible, and no "supplementary rate" will be required.

Department _____ Manufacturing Journal Month _____ 19__

Production Order Number	Component Order Number	CREDITS						CHARGES		
		Wages	Mach Earn.	Supp. Rate	Mat'l	Wks. Exp.	Mfg. Acct.	Pl. Ad. Acct	Spoil. Acct.
Totals									

FIG. 96.—Departmental Manufacturing Journal (Method C).

But this exact distribution is contingent (assuming for the moment that all machine rates are correctly fixed) on every machine having worked full time. If it should happen that a number of machines have worked less than full time, then it becomes obvious that the machine earnings which they would have discharged on to Orders if they had been working on orders *has not been distributed at all.* When this happens, it is also obvious that the credit from machine earnings column in Manufacturing Journal will not wipe out the balance standing against the department in Burden account, but that a balance of greater or less amount will still remain against the department.

Now, if we also reckon up the value of the machine-hours on the various machines that have *not* been charged to Orders, that is, which for some reason or other have stood idle, then this amount must either be equal to or more than the balance in Burden account. If the balance in Burden account is greater than the amount of machine earnings thus listed as idle, then it is evident that machine rates are at fault, since if, instead of their being idle, all machines had been engaged on orders and had so charged their earning to Orders in the machine earnings column of the Manufacturing Journal, *they would still have failed to wipe out* the balance in Burden account.

But if the amount in Burden account remaining after machine earnings have been credited, is equal to the value of the idle machine earnings, then obviously everything is correct, since if they had been distributed over Orders, they would have become machine earnings and so have wiped out the balance in Burden account.

On the other hand, it may be found that the machine earnings listed as due to idle time would amount to *more* than the balance against the department in Burden account. This is likely to be the case if the rate of production has fallen off, and orders are scarce, since in that case a little of the service charges against the department will have been reduced below normal—the charge for power, for example, though not falling off in proportion as production falls off, yet is reduced to some extent if a large percentage of idle machines obtains. So that in general we shall be content with the result if the balance not wiped out by machine earnings is a smaller amount than the value of machine earnings calculated as lost due to idle time.

This balance has to be removed from Burden account. The

question is, first, "what does it represent?" and secondly, "how shall we dispose of it?" These are very important questions.

The answer to the first is that it represents **waste.** And the particular variety of waste it represents is **wasted manufacturing capacity.** The price of this wasted capacity is the balance remaining in Burden account after the machine earnings charged to Orders have been credited. It is now easy to see why this balance must never be more than the undistributed machine earnings would amount to. It is because the price of the wasted capacity is the amount of those earnings **less** any economies that have been effected in view of the slack condition of work. If no such economies have been effected, then the balance will be **equal** to the total of undistributed machine earnings. In no case can the balance ever be legitimately more than the value of the undistributed machine earnings, as that would show that some items had escaped being represented in machine rates.

Total Dep't'l Burden		
Total Machine Earnings		
Balance——% **= Supplementary Rate**		

FIG. 97.—Determining supplementary rate.

These assertions must be taken as being approximate. Very small variations may occur, without upsetting the general principle involved. It will hardly ever happen that no balance is left in Burden account after machine earnings charged to Orders have been credited, even if the shop is working full time. If some overtime is worked occasionally during the month a slight amount of overdistribution may even occur, but in general this should be a trifling percentage of the amounts handled. A certain elasticity in matters of this kind must necessarily be allowed.

As a matter of general practice, therefore, any balance remaining in Burden account after machine earnings have been credited through Manufacturing Journal must be distributed as a supplementary rate over Production Orders **only.** Such distribution must not be made to Plant Addition Orders, as that would be to

include an item of waste as part of the cost of plant, thus making an illegitimate profit on such orders.

Figure 97 shows the blank used in calculating the percentage on machine earnings, which must be added to the latter in order to exactly absorb the balance against the department in Burden account. The total amount of the balance before crediting is entered in the upper space; the total of machine earnings per Manufacturing Journal is entered in the second space, and subtracted; the result is placed in the lower space, and will represent the balance yet to be distributed. This is expressed as a percentage of the machine earnings.

Thus, with total burden charge against the department $3,000, machine earnings charged to Orders $2,400, the following entries would be made:

Balance in Burden accounts	$3,000
Deduct machine earnings	2,400
Balance undistributed (waste)	$ 600

600 being 25 per cent. of $2,400, supplementary rate is 25 per cent. accordingly. This amount has, therefore, to be charged to all Production Orders as listed in Manufacturing Journal. To do this 25 per cent. is calculated on the amount of machine earnings standing against each order number, and the resulting figure is placed in the column headed supplementary rate. When this operation is carried out, supplementary rate column is totalled, and the total credited to Burden account, thus extinguishing all balance in that account.

If Plant Addition Orders are included in the Manufacturing Journal, as they probably would be in most engineering shops, then a slightly different procedure must be followed. After the amount ($600) has been found as above, the percentage must be reckoned not upon the $2,400 but on such less amount as represents machine earnings on Productive Orders only. Thus, if $600 of the $2,400 were on Plant Addition Orders, and $1,800 of it on Production Orders, then the percentage to be found would be that of 600 to 1,800, namely 33.33 per cent., and this percentage when applied to the Production Order machine earnings only, would, of course, yield a total of $600 in the supplementary rate column, as before.

When all these operations are carried out, then the new amounts due to calculated supplementary rate are posted to the

respective Cost Sheets in the same way as burden is posted to the Cost Sheets in Method B. Costing operations are then complete, each Production Order having received its due share of every kind of factory expenditure, and none of the latter being unaccounted for. The total now in Manufacturing account will, as before, equal the aggregate of all the credits made to the main ledger accounts on the left side of the general diagram. The way in which Manufacturing account is credited when work is finished and removed from the department will form the subject of a separate chapter. It is, of course, the same for all three methods of costing.

OTHER DISPOSITIONS OF WASTED MANUFACTURING CAPACITY

In the majority of cases the procedure described is the only safe one. There will often be a small supplementary rate even when the shop is full of work, because it is practically impossible to maintain all machines, in many kinds of industries, at full work during a whole month. In other industries, however, of a non-engineering character, full operation is common, and in such the absorbtion of burden by machine earnings should be very close indeed.

It has been stated (and will be readily understood if we realize that this method practically makes each individual machine into a separate department for costing purposes) that all amounts not passed to Orders through machine earnings are waste. If a department should have only one large machine, and it is used only half its time in a particular month, through slackness of trade, it is perfectly obvious that half the expenses of the department have been wasted. Half will have been charged to Orders and half will remain uncharged. This uncharged portion will not be as great as it would be if the machine were working, inasmuch as power at least will be cut off, and probably other expenses will be curtailed also. Therefore, something of the loss which would otherwise occur will have been saved. Still there will be a considerable loss, not 50 per cent. of the normal charges for the month, but say 80 per cent. of this figure (*i.e.*, 80 per cent. of 50 per cent.).

This amount is that which is distributed over the production for the month by means of a supplementary rate. But it is obvious that this is only another, and roundabout, means of

ultimately charging it to Profit and Loss account. By charging it to Production Orders we increase the cost of the latter, and consequently when we come to set this cost against selling price so as to ascertain gross profit, such profit is diminished to an extent equal to the amount of supplementary rate included in the cost.

It may be asked, therefore, why the balance in Burden account should not be charged at once against Profit and Loss instead of being distributed over Production Orders and so made into a part of cost.

Some writers advocate this. It is, of course, a simplification of the method, inasmuch as the distribution of the amount by means of a percentage to each Production Order and the posting of the amount to each Cost Sheet is saved. And in certain cases the method may be adopted, particularly where departments contain few machines of large size, performing more or less regular and simple processes. But there are often reasons why this is undesirable. In an armor-making plant, for example, the wasted manufacturing capacity due to no work may be very high. Yet it is very desirable to express this loss as a percentage of actual cost, and in fact make it part of such cost, *because it has to be recovered in the selling price* of the armor.

This feature of the matter is obviously very important. The actual time cost of the product is not its true cost unless the market is of such a nature that *we may hope to fully employ our plant at all normal states of trade.* Not all industries are in this position. Plants making some special product of which the demand is very intermittent must provide manufacturing capacity capable of taking care of such demand at the maximum period. Perhaps 3 months in the year the plant may be very busy and at other times slack. In such cases the wasted manufacturing capacity in the slack months has to be paid for by the profits made throughout the year, and it would be a dangerous policy to charge wasted capacity in any month to Profit and Loss. It would tend to cover up important facts, and give a misleading view of the whole situation. On the other hand, it is very valuable to know what proportion of factory cost represents actual production and what proportion represents mere idle equipment. If for no other purpose, this is valuable from the point of view of manufacturing efficiency. The machine rate method has this virtue, that it represents the true

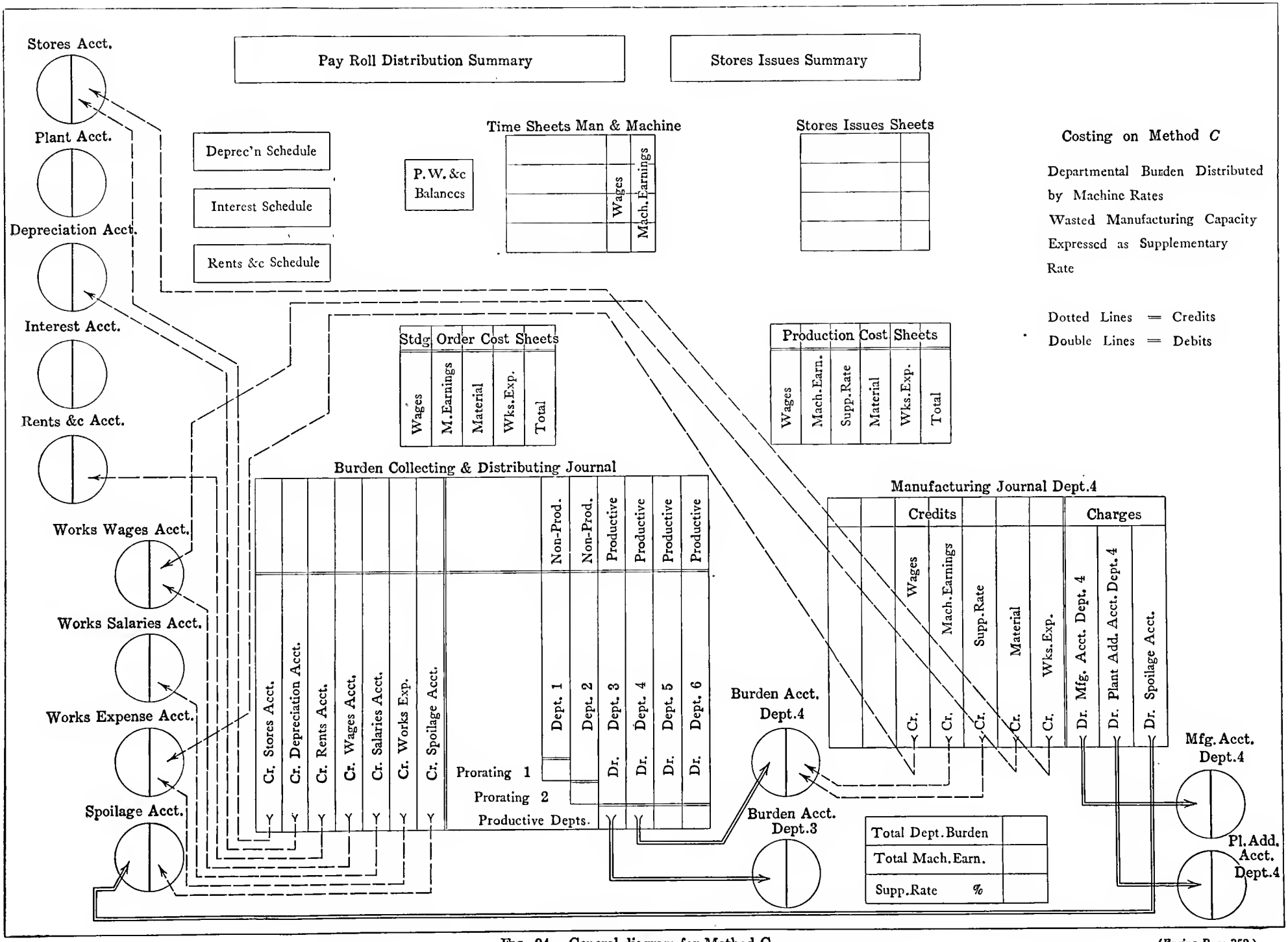


FIG. 94.—General diagram for Method C.

(*Facing Page* 352.)

shop or department cost of the product *at all periods* irrespective of the slackness or otherwise of the shops. If it takes \$40 machine time to do a certain job today 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* to the job in the slack season. It is much better, and will make the situation much clearer to everybody if we express the cost of the job in the slack season in two parts thus:

Machine time	\$40
Supp. rate	40
Factory cost	\$80

There are certain cases when wasted manufacturing capacity might be required as a separate item. Thus, if we have to maintain a repair department in connection with our product in a certain locality, the prices which we get for our work being regulated by competition, or at any rate by other considerations than actual cost, then 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. If there is any doubt about the matter in a specific case, then preference should be given to the distribution method. There are certain dangers in writing off wasted capacity. The department is apt to take the view that their responsibility is relieved thereby. Now 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. Even though the machine time of jobs is not increased, there may be quite remediable slackness in keeping machines at work. One of the advantages of Method C is in fact that it focusses attention on something that is too frequently neglected, namely, the keeping of machines at work.

In many plants where no accurate and systematic watch has been kept on this matter, it is surprising what the application of a record to machine performance will reveal. Now supplementary rate, or rather its percentage, is to some extent a barometer of idle machines. If it is rising, it signifies that machines are more idle, and whether this is justifiable or not is soon seen from a reference to the Order Register.

Summary of Method C.—Method C has now been described as to its working features, though the manner in which machine rates are fixed and verified has yet to be discussed. It is essentially a method of measurement of burden charges in proportion to service absorbed by individual machines. This being the case, and such charges being reduced to a cost per hour for each machine, a division into hours that have been employed usefully to make product, and hours that have been wasted, is an obvious one. And if it were not the case that idle machines mean usually reduced service in some respect or other, it is evident that we could say, simply, that the cost of the *wasted* time was so many hours multiplied by the machine rate; just as we do say that cost of *utilized* time, as applied to Orders, is so many hours multiplied by the machine rate. Actually, however, it will be something less than this, since, to say nothing of other services, an idle machine is not consuming power.

Therefore, the cost of wasted capacity is *not* the wasted hours multiplied by the machine rate of each idle machine, but simply the difference between machine time charged to Orders and the total burden allocated to the department during the month.

Having ascertained the cost of wasted capacity in this way, we must get it out of Burden account. One way, and the usual way, of doing this is to prorate it over Production Orders as a percentage of waste. Another way, to be used only under special circumstances, is to charge it to a Waste account, and so later to Profit and Loss.

In either case the true cost of doing the work, when direct labor and direct material are added in, is shown separately on the Cost Sheet, and this true cost will be the same at all times, whether the shop is busy or slack, if the job has been done with the same technical efficiency in both cases. If it has not, then that fact is visible on the face of the Cost Sheet, wholly divorced from any complications due to the amount of work in the shops on either occasion.

CHAPTER XX

COSTING ON METHOD C (DETERMINING THE MACHINE RATE)

It will, of course, be understood at the outset, from what has been said in previous chapters, that before considering the distribution of burden *within* any department, a thorough and rigorous departmentalization of all factory expense, and its entire separation from selling expense, and certain other expenses such as legal expenses, that come out of profit and cannot be charged to customers by way of cost, must be made.

In the present chapter it will be assumed, therefore, that such departmentalization has been carried out, and that the various items of expense chargeable against the factory are collected by means of a Standing Order scheme on the lines suggested by Fig. 56. This being the case, two kinds of expense have to be considered, namely, that chargeable against the department itself, such as the depreciation, repairs, etc. of its own building; the salaries of the employees of all kinds within the department, the depreciation, repairs, etc. of its own productive machines or production centers, and in general all those expenses which are listed under productive department columns in Fig. 56. In addition to these interior expenses, we have also to consider the prorating of the various non-productive departments over our productive department, and the way in which such prorated expense must be charged against the production factors of the department.

Figure 98 (p. 366) shows, in the upper portion, the main elements which are collected into departmental production factors. These are only suggestions, inasmuch as each plant will have individual items of expense, either additional to or replacing those shown. Individual plants will also have, in some cases, to provide for additional production factors, as, for example, when certain machines in the department are driven by hydraulic power or compressed-air power, or when a tool-room service is maintained for the use of the department. In

the latter case not merely the cost of the service itself, such as space charge for the room occupied, wages of attendants and messengers, etc., but also depreciation and other charges for the *use of the tools* will have to be allotted to the machines making use of each class of tool. Thus, for example, if we have among our machines some large boring lathes, the depreciation, maintenance, etc. of the boring bars used by them will have to be made part of a special tool factor, and a charge included in the machine rate of each of the boring machines to take care of such items of expense.

Referring to Fig. 98, it will be seen that the first step is to assemble in great detail every item of expense chargeable against each of the factors. This expense must be that incurred, as shown by the past records of the firm, *when the department is working full time.* Of course, a number of the items are annual, and quite irrespective of the number of hours the department is working. Depreciation, rent, taxes, insurance, interest (if charged), salaried men, and so forth, are not affected by working hours within limits, but others, such as the charge for power made to the department, and some floating labor, will be higher when the shop is full of work than when it is not.

Further, these expenses must be *annual* figures. They must represent the whole of the charges for one year, since items like heating and lighting at any rate will vary in amount between one part of the year and another. A selected month will, therefore, not meet the case.

When all the expense items have been collected in groups, corresponding to production factors, then the distribution of each factor to individual machines or production centers may be considered. Each individual machine, as shown in Fig. 98, will also have certain individual items of its own to be taken into account. Depreciation, interest (if charged) and insurance on the capital value of the machine, the annual cost of its repair and maintenance, the annual cost of cleaning it, and of oil, waste and similar supplies must be carefully worked out. These items form the individual factor of the production center, and, therefore, are part of the machine rate. The way in which the production center's share of the service represented by each of the other factors, when worked out, is entered against the machine as part of the machine rate, will be understood from the figure. Each factor is worked out to a figure representing *its own share* of the hourly machine rate, and this is done with considerable accuracy.

That is to say that if the space factor for a given machine is found to be $63 per annum, and the working hours are 2,500 per annum, then the exact factor hour rate is $0.0252. This figure will be recorded against the machine, for a control purpose that will be hereafter described. Otherwise, the addition of all the annual factors, divided by the working hours per year give the hourly rate for that machine.

We may now consider, briefly, the collection of data for each separate factor, and the basis on which, in each case, a distribution between machines is effected.

Space Factor.—Figure 99 represents a schedule used for preparation of the space factor distribution. In this, as in all

Description of Prod. Center	Prod. Ctr No.	Working Area Sq. Ft.	Lighting Call	Annual Space Charge	Annual Lighting Charge	Annual Rate	Hourly Rate
	201		1				
	202		1				
	203		1				
	204		1				
	205		2				
	206		1				
	207		1				
	208		2				
	222		2				
	223		1				
	224		3				
	225		1				
Total Charge Against Dept.			50				

FIG. 99.—Schedule for distributing building or space cost to production centers.

subsequent factor schedules, columns are provided for a list of machines, giving brief description and number of each. The basis on which space cost is distributed to machines is that of the working area occupied by each. Consequently the working

areas, that is the space occupied by the machine itself, plus sufficient free space around it to permit handling of work, will be measured up, and entered opposite each machine. In some cases space may be occupied in a shop by enclosures belonging to other factors, as, for example, a sub-stores or a time office. In such cases the item in question must be listed, with the area it occupies, and when the value of the space has been determined, it must be charged up to the factor concerned. Thus in Fig. 98 charges for space factor are suggested against each of the other factors. But unless the services represented by such factors occupy space in the department, being considered such as office room or store room, this item will not materialize.

The item of lighting may in some cases require a separate treatment. Where overhead lighting is in use, then obviously each machine benefits in proportion to the area it occupies, but in shops where the exigencies of production demand separate lighting then the share taken by each machine must, so to speak, be weighted, so that some machines get more lighting charge than others. This may be done by considering the share of each machine in the general lighting as 1, and then adding "votes" to such machines as take individual lighting, in proportion to the number and size of the lights used by them. Then when all the "votes" are totalled (as in column "Lighting call" Fig. 99) the total lighting charge is divided by this figure, and the value of 1 vote found. This value is, of course, multiplied by the number of votes allotted to each machine, and forms the lighting charge for that machine. This device will rarely be necessary. Modern systems of lighting diffuse illumination over floor area in such a way that individual machine lights are unnecessary in most cases.

If no separate calculation for lighting is made, then the two columns headed "Lighting call" and "Annual lighting charge" will be omitted from the schedule. The annual expenditure on the class of expense represented by the space factor is simply totalled, and this total divided by the total working area of all machines, to find the space charge per square foot, per year.

Multiplying this unit charge by the working area of each machine gives the annual charge for space for each machine. This figure is entered in column headed "Annual Space Charge" if lighting is reckoned separately, or in the column headed "Annual Rate" if not. Division of this figure by the working

hours per year gives the hourly charge against each machine for the space factor.

When interest is included in cost, and the land on which the factory is built is the property of the firm, then a Land Schedule must be prepared, tabulating the interest charge per square foot, and allotting the proper amount to each department: this amount will then be included in the depreciation item of the space charge.[1]

Power Factor.—Figure 100 shows the schedule for distributing power factor to individual machines or production centers. The power factor has commonly two divisions, charges incident on the presence within the shop of shafting, pulleys, belts, motors, switchboards, etc., and the charge for power supplied by the power department, whether mechanically or electrically transmitted.

Expenditure on the former division is collected by means of the Standing Orders of the 50, 51, 53, 59 groups (see Fig. 56) for each department separately. Expenditure on the power plant itself is collected by means of the Standing Orders as listed under department 4, power department, (Fig. 59). When all the expenses of generating power have been collected, it is prorated over the departments taking power, on a horsepower basis.

Referring to Fig. 100, the way in which each of the two divisions of power factor is assessed against machines will be readily understood. Against each machine or production center the average horsepower taken by the machine is set down. In the next column the average cost of the horsepower-hour, as indicated by the prorating above, is multiplied by the horsepower taken, and entered against each machine. This horsepower cost figure will be that obtaining under the most favorable conditions of production, when all the departments are running full time. In the next column the interior expense of the department on its transmission equipment is assessed against each machine. Finally, each line is cross-totalled, thus giving the total annual power factor charge against each machine. Dividing this by the normal hours in the working year gives the hourly charge for the power factor. This is expressed to four places of cents.

In some cases, however, a somewhat different procedure

[1] See the author's "Production Factors" for a full discussion of the various conditions under which land factor is chargeable.

is preferred. The sphere of the power department is considered to include delivery of the power to the machine itself. In that case whatever devices are used within the shop, such as main shafts, belts, motors, switchboards, etc. are considered to be the property of the power department, and consequently the costs of the Standing Orders of the 50, 51, 53, 59 groups are

Description of Prod. Ctr.	Prod. Ctr. No.	H.P. Taken per Hour	Annual Power Charge	Charge for Power Eq'pt. in Shop	Annual Rate	Hourly Rate
	201	1				
	202	½				
	203	¾				
	204	1				
	205	7				
	206	1				
	207	1				
	208	3				
	221	1				
	222	2				
	223	1				
	224	¾				
	225	1				
Total Charge against Dept.						

FIG. 100.—Schedule for distributing power cost to production centers.

charged not against the shop but against the power department, and merged in the general total of power costs. By this means there is only one element in the department power factor, namely the cost of the horsepower-hour, all power costs of whatever kind being included in this. Space does not permit of discussing the circumstances under which such a disposition of the power service charges is justified, but under certain circumstances the arrangement is preferable. The arrangement is,

of course, equivalent to taking current from the mains, the supply company furnishing the motors and other shop equipment necessary, without charge to the consumer.

Stores-transport Factor.—The items composing this factor will vary greatly in different plants. In some it will be a very important factor, in others it will be of very small dimensions. It includes, as in the case of the power factor, one division arising out of expenses within the department, and also a division representing the prorated share of the general stores department, and it may be also, outside crane and yard service in large plants.

The former division of expense will consist of the expenditure on transporting and moving material, including work in process, in and about the department. It may thus include charges for crane equipment, conveyors, etc., wages of crane men and movemen, depreciation on and cost of repairs to the equipment, etc. These items are collected within each department by the Standing Orders of the 20 to 29 groups (see Fig. 59).

The other division of the stores-transport factor, namely the cost of the stores department, and other agencies outside the department, will be collected by the Standing Orders listed under the column devoted to department 3. The items here will require expanding in many cases, as for instance to include yard service. When collected, such items are prorated to the various departments on a basis presently to be discussed.

Within the department, if the industry is one using heavy cranes or travelers, it is necessary to map out the floor area of the shop into "crane areas." This is effected by filling out a blank like Fig. 101, in which the annual expenses for each crane area or "bay" as assessed separately, in order that they may be divided among the machines served by the crane. Fig. 102 shows how this is done. Columns are provided for each crane area or bay, and a mark is placed in the column opposite the machines that are situated in that bay. Then the total cost of the crane service in the bay is prorated over the marked machines on a basis of the service judged rendered to each, having regard to the kind of work done at each machine. It does not follow, of course, that each machine receives an equal charge. It might happen that some machines in a bay made no use whatever of the crane facilities. Charges will be adjusted accordingly.

In the next column of the distribution schedule, Fig. 102,

STORES TRANSPORT FACTOR Building No._____ Dept._____				
ITEM	Total	Bay No.1	Bay No.2	Bay No.3
Crane No.				
Span				
Capacity				
Cost				
Area				
STATEMENT OF ANNUAL EXPENSE				
Depreciation				
Insurance				
Interest				
Repairs				
Current				
Cranemen				
Other Labor				
Supplies				
Total				

FIG. 101.—Analysis of crane costs per bay.

Description of Prod. Center	Prod. Ctr. No.	Crane Bay No. 1	Crane Bay No. 2	Crane Bay No. 3	Truckers & Handlers	Dept. Share of Stores Dept. &c	Annual Rate	Hourly Rate
	201		*					
	202			*				
	203			*				
	204		*					
	205	*						
	206			*				
	207		*	*				
	208							
	209			*				
	210			*				
	211	*						
	212	*						
	213			*				
	214			*				
	215		*					
	216			*				
	217			*				
	218			*				
	219			*				
	220							
	221			*				
	222		*					
Total Charge against Dept.								

FIG. 102.—Schedule for distributing stores-transport cost to production centers.

space is provided for assessing the charge to each machine for the corps of movemen and handlers employed in the shop when it is working full time. This will be assessed in the same way as crane service, namely, after consideration of the kind of work done by each machine and its call on the service of the movemen.

A column is also provided for distributing the total of the prorated charge for stores department, to the machines. In the first place, this prorating will have been made on the basis of the kind of work done in each department, and its relation to the outside service. It will be proportional to the size of the department, of course, and also to the nature of the work carried on in it, and the call of this latter on the services of the stores department. No general rule can be laid down, as decision depends on a close and careful review of the circumstances in each case.

Naturally, the considerations that have been taken into account in prorating a certain sum against any department will follow the amount into the shop and be used in arranging the distribution of the amount to each individual production center. A very close and satisfactory distribution can be attained with a little analysis and judgment. Either the distribution will be a uniform one or it will not. In the latter case, there will be reasons why it should not, and the giving of relative weight to each of these reasons is a matter of detail offering no insuperable difficulty.

When all these columns (Fig. 102) have thus been filled out, cross-totals are made as in the former schedules, giving annual and hourly charge for the stores-transport factor against each machine or production center.

Supervision Factor.—Figure 103 shows the schedule for distributing the cost of supervision to production centers. Again, there will be certain items arising within the department, and some outside. The former are represented by Standing Orders of the 36 group (see Fig. 56); the latter by the prorating of the total cost of the department of superintendence and production over the various productive departments. In this latter department the factory share of the salaries of the higher officials is also included.

Within the department it may happen that particular groups of machines are under the care of sub-foremen or "gang bosses." Columns are, therefore, provided in the supervision schedule for each such official, and the machines under his care are marked

Description of Prod. Center	Prod. Ctr. No.	Sub Foreman No.1	Sub Foreman No.2	Gen'l Foreman & Assistant	Share of Gen'l Sup'vn	Annual Rate	Hourly Rate
	201						
	202						
	203		*				
	204						
	205		*				
	206	*					
	207						
	208						
	209		*				
	210						
	211	*					
	212						
	213		*				
	214	*					
	215						
	216	*					
	217						
	218	*					
	219		*				
	220						
	221						
	222						
Total Charge against Dept.							

FIG. 103.—Schedule for distributing supervision to production centers.

as in the case of crane bays (see Fig. 103). The salaries of the sub-foremen are then divided among the machines under his special care. The next column collects the salaries of the general department foreman and his assistants, and this total is distributed over machines either equally or, if circumstances warrant it, on a basis of "weighting" some machines more than others.

Finally, a column is provided to collect the department's share of the prorated expense of department 1 (see Fig. 56). This department assembles the cost of superintendent's office, and of the production staff, tracers, etc., and also the factory share of the higher officials' salaries. When all the cost of department 1 has been assembled, it is prorated over productive departments in general proportion to their productive pay-roll, though in this case also "weighting" is permissible, if it is judged that certain departments take more than the average share of supervision and attention from the superintendent's and production staffs.

Distribution within the department is usually on a basis of equality as between machines, but the same considerations as to weighting will apply in this case also whenever there is justification for it.

When all these items have been assessed against machines cross-totalling gives, as before, the annual and hourly charge against each production center for the supervision factor.

Organization Factor.—Figure 104 shows the schedule for distributing organization factor expense to production centers. Usually there will not be any interior organization expense, within a department, since any cost or time clerks stationed there may be considered as part of department 2, and any clerks as part of the supervision charge (when they are merely clerical help for the foreman). In some plants, however, the 40 to 49 series may require applying to one or more departments, but this will in general only apply to very large plants.

Except in the case just mentioned, all organization expense comes from outside, and is represented by the prorating of department 2 (see Fig. 56). This prorating is made on a basis of the relative productive pay-roll of the department, and within the department may be made on an equal basis as between machines, unless there is reason to the contrary, when the share of certain machines may be weighted. The guiding principle will be the

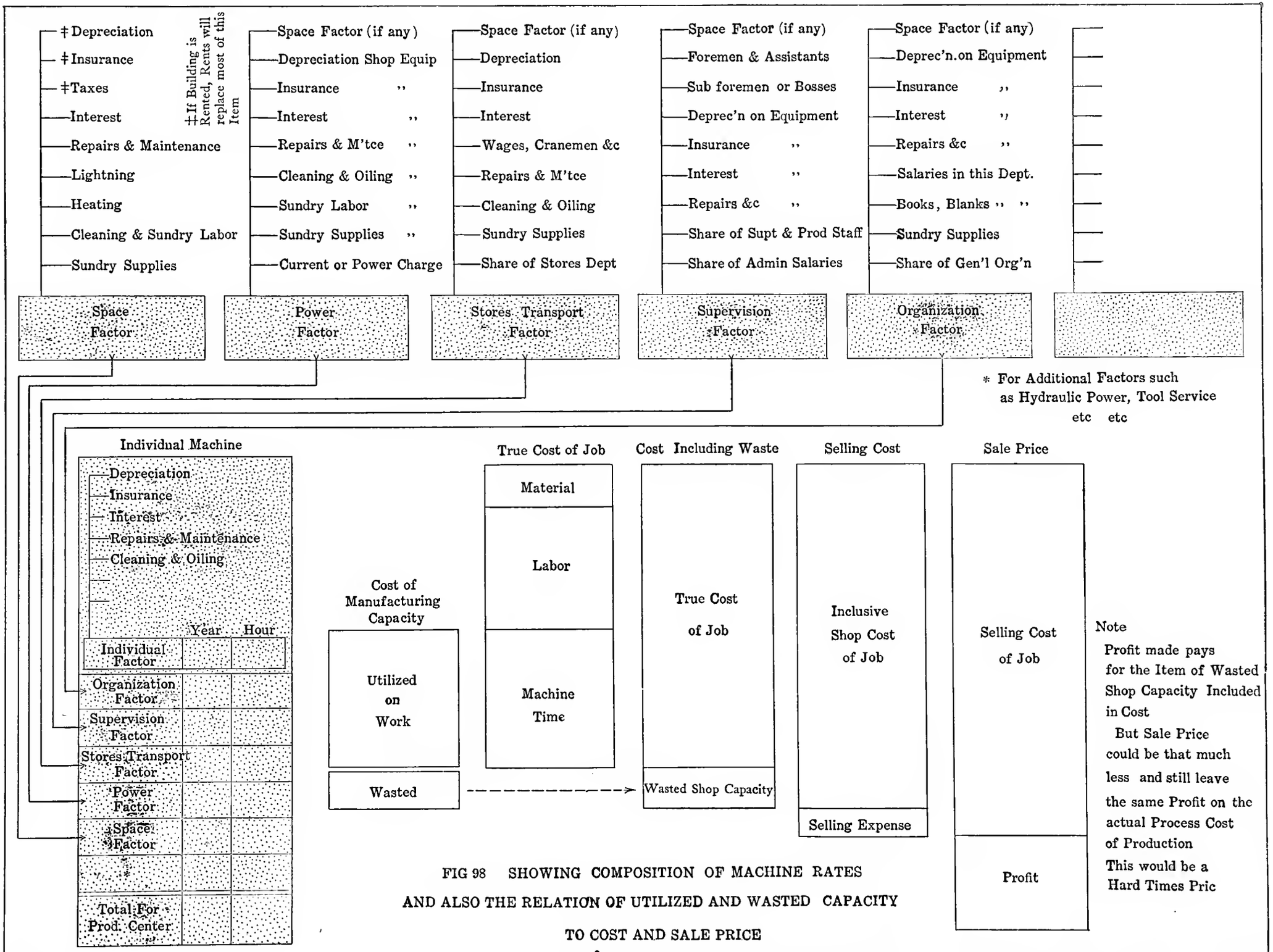


FIG 98 SHOWING COMPOSITION OF MACHINE RATES AND ALSO THE RELATION OF UTILIZED AND WASTED CAPACITY TO COST AND SALE PRICE

(*Facing Page* 366.)

degree to which the nature of the work gives rise to detailed recording, etc., so that more expense of the kind arises from the work of one machine or production center than of another.

The usual cross-totallings, and reduction to hourly value are made as in the case of other schedules.

Description of Prod. Ctr	Prod. Ctr. No	Organization Expense in this Dept	Share of General Factory Organization	Annual Rate	Hourly Rate
	201				
	202				
	203				
	204				
	205				
	219				
	220				
	221				
	222				
	223				
Total Charge against Dept.					

FIG. 104.—Schedule for distributing organization expense to production centers.

Individual Machine Factor.—Each machine or production center has an individual factor, representing the charges and expenses arising out of its depreciation, repair, etc. Fig. 105 shows the schedule for determining these individual factors. The expenses to be distributed are those collected by the 60 to 63 group of Standing Orders (see Fig. 56). They are wholly individual, not merely to the department, but to each production center.

The first item is that of depreciation. Columns are provided for the cost of the machine, the depreciation rate pertaining to

it, and for the resulting annual sum chargeable for depreciation. These particulars will be in agreement with the Depreciation Schedule (Chap. VII, Part II). A similar column is provided for insurance, and for interest when this is charged into Cost (see Chap. XXIV, Part II). The next two columns are used for placing against each production center an estimate of the average amount of repairs, and of supplies such as oil, waste, etc. likely

Description of Prod. Center	Prod. Ctr. No.	Cost	Deprec. Rate	Annual Depreciation	Insurance	Interest	Repairs	Sundries	Annual Rate	Hourly Rate
	201		2½							
	202		3							
	203		4							
	204		2							
	205		2½							
	205		3							
	218									
	218		2							
	219		4							
	220		3							
	221		2½							
	222		2							
Total Charge Against Dept.										

FIG. 105.—Schedules for determining individual production center charges.

to be incurred during a normal year. If good records exist these figures can be based on past experience, but if not they must be very carefully worked out.

Cross-totalling of the items gives, as before, the total charge against each machine for the individual machine factor.

Hourly Machine Rate.—If there are no special factors to be determined, as for instance a hydraulic power, or compressed-air factor, the next step is to tabulate all the charges which have been separately determined by means of the foregoing schedules,

Description of Prod. Ctr.	Pr. Ctr. No.	Space Factor	Power Factor	Stores Tpt. Factor	Supervision Factor	Organization Factor	Individual Prod. Center Factor	*	Total Annual Rate for all Factors	Hourly Rate
	200									
	201									
	202									
	203									
	204									
	205									
	206									
	207									
Total Charge against Dept.										

FIG. 106.—Collection of factor and determination of machine rates.

* Additional factors, *e.g.*, tool room service, hydraulic power service, etc., will be present in some plants.

so that they may be combined into a single amount, expressible as an hourly rate for the use of the machine.

Figure 106 shows the Machine Rate Schedule. Its use will be evident from an inspection of the ruling. The amounts (the annual amounts) shown on each factor schedule against, say, machine 200 are transferred to the proper columns in this schedule, and when cross-totalled give a grand total of annual expense chargeable against 200 for all factors. This total divided by the working hours per year, will give the hourly machine rate.

Special Machine Rates.—From what has been explained as to the manner in which machine rates are built up from Standing Order elements, it will be readily understood that machine rates can be constructed to meet all circumstances and several special wants. Thus they can be constructed for plants working double or treble shifts—such rates being, of course, very different from ordinary rates and not in any sense multiples of the latter. They can be arranged to take care of regular but intermittent periods of overtime, and to meet the case of machines which are used only a part of their time. Further, for estimating purposes, machine rates may be made up which eliminate the inclusion of interest (as described here interest has been assumed to be omitted, but it could easily have been included) and even of depreciation. The use of these latter varieties is for what may be called "hard luck" estimating, when the rock bottom price based on actual out of pocket expenses is required to be found. Though these latter varieties are mentioned, it must not be supposed that their use is to be encouraged.

CHAPTER XXI

COSTING ON METHOD C (CONTROL OF FACTORS)

The accuracy of machine rate determination depends on the way in which a large number of small expenses have been carefully analyzed and allotted, so that the resulting errors will be very small individually, and the final result will, therefore, be the closest approximation to accuracy possible.

But it will be obvious that, after all, the machine rate is a standardization of factor cost, and it is, therefore, necessary to set up mechanism by which its accuracy may be tested from time to time, under varying conditions of the business. The machine rate is, in fact, a measure of cost, but everything depends on whether, so to speak, this measure has been correctly graduated.

It will be remembered that each of the factor schedules described in the last chapter was arranged with a column to contain the hourly rate representing the machine charge *for one factor*. All the factors were *combined* to make the hourly rate for the use of the machine. It follows, therefore, that it would be possible to *decompose* any amount charged through machine rates so that the amount could be split up into smaller amounts each representing a charge for one factor.

Though very simple, this is too laborious an undertaking to perform as part of the costing operations every month, nor is it necessary. It will suffice if done occasionally, now for one factor and now for another, and at still longer intervals for all factors together.

The blank, Fig. 107, will be found useful for this purpose. The machine numbers are listed in the first column, and their rates in the second. The third column contains the total hours worked by the machine, and the fourth the total earnings of the machine for the month under examination. The remaining columns are six in number, each pertaining to one factor, and are double—the left-hand portion containing the machine factor rates taken from the factor schedules, and the right-

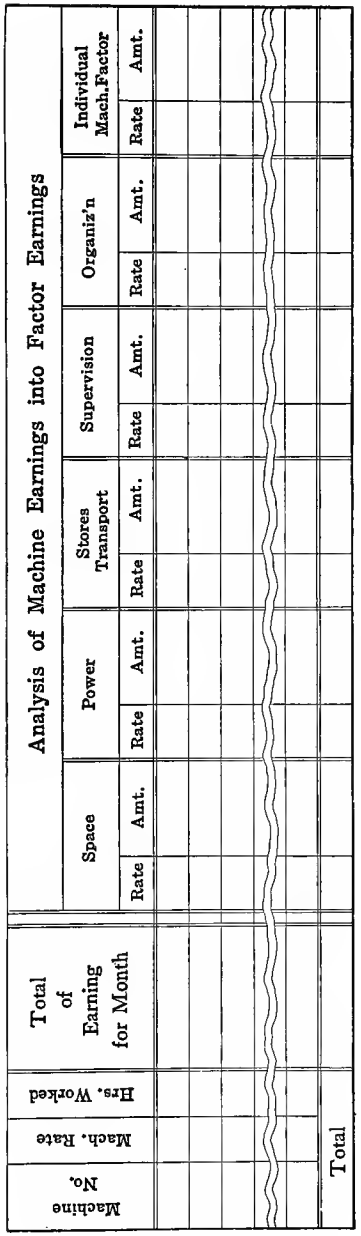


FIG. 107.—Analysis of machine earnings.

hand portion the amount which results from multiplying the hours worked by the machine by this factor rate. The blank may be blueprinted (blue lines on white ground), the machine numbers, machine rates, and factor rates being written in on the negative so as to appear on all copies. The filling out of the blank is then confined to inserting the hours worked, total earnings and making the computations in the factor columns. A Munroe machine will be found useful for this work, as the hours being set on the machine, the alterations necessary in the multiplier for each factor rate are made by turning the handle back and forth till the new multiplier is rung up in the dials. If only one factor is being worked out, the factor hour rate is set on the keyboard, and the hours worked figure rung up on the dial. The amount in total earnings for month column must, of course, agree with the amount as shown in Manufacturing Journal for that month.

Having worked out the earnings for one or all factors we may now compare the figures with the *actual* debits to the Standing Orders which enter into any one factor. *In*

all cases the amount in the factor column must be equal to or less than the actual debits per Standing Orders. In general it will only be equal when the shops are working full time. In all other conditions it will be less. How much less will depend on the condition of activity of the shops.

In the case of the power factor, where power is purchased from outside at a flat rate and the power factor charge has been made on the basis mentioned in the last chapter (where the shop transmission equipment charges are assumed by the power department, and everything is based on a single horsepower-hour rate) it is evident that the decomposition of the machine earnings into factor earnings should show a very close correspondence between the amount distributed by machines and the amount debited to the department under examination. If, on the other hand, the factory maintains its own power plant, the cost of power actually consumed would be higher than allowed for in the power factor, and this balance would properly fall into supplementary rate.

A factor which needs close watching is the individual machine factor, since the amount assigned for repairs to each machine may bear a high ratio to the total factor charge. But in this case, of course, a mere monthly comparison means nothing, since the amount of repairs in so short a period may fluctuate violently as compared with a similar period. The way in which this item can be checked is by keeping a record (through Standing Orders) of the repairs made to each machine, and recording it on the record card (Fig. 42). Machines that have been under-estimated as to their annual repair bill, or *vice versa*, will have their repair allowance modified accordingly.

The yearly examination of amounts charged to the various factors through standing orders, and comparison with the amounts assigned in making up the factor schedules, is the true method of controlling the make up of machine rates. Whatever amount is assigned to a schedule will be distributed by machine rates in strict proportion to the use made of the machines, but if this amount is over- or under-stated, as compared to actual charges, it will mean that supplementary rate (which wipes up all unabsorbed charges at the month end) will have been too high, or too low. This is one reason why supplementary rate balances should not be charged direct to Profit and Loss, unless we are

quite certain, *by experience*, that the factor schedules were correctly made up in the first place.

Verification of factor schedules is, therefore, the main line of control in Method C. Where the shops are working full time, decomposition into factors now and then will give a very close control of the situation, care being taken to consider the influence of unusually heavy repairs or of seasonal items like lighting and heating. A little experience and familiarity with the details in practice will soon enable a close grip on actuality to be attained. It may be remarked also that this frequent scrutiny of burden items in all their ramifications is one of the most beneficial things for the business, quite apart from its importance in controlling the correctness of machine rates.

In examining the resulting figures of any decomposition, the viewpoint will be dependent on the consideration that the factor rates represent the department at its maximum condition of activity (without overtime, unless that was specifically arranged in fixing factor charges). Now any less degree of activity will be productive of idle time, and consequently a lessened absorption of factor expense by machine earnings. It may easily happen that, notwithstanding the lessened activity, no economies in Standing Order items have been effected. In that case, there is no need to decompose the machine rate into factors, since we can compare the actual charges with the factor schedule total, and they will, of course, be about the same.

But if the lessened activity has forced on economies in Standing Order items, *then it is important to observe that the amounts being distributed by machine rates are not more than the new and lessened total of any factor debit.* It general they will be less, because if we face a reduction of say 75 per cent. in shop activity it is impossible to suppose that a 75 per cent. reduction of Standing Order items has been found possible. *Therefore, the amount to be charged as supplementary rate will be the difference between the amount absorbed by machine rates and the lessened total of charges for the month.* A specific instance may make this proposition somewhat clearer.

We will suppose that a given factor schedule was set up with a total annual charge of $7,200, which would be equal to an average of $600 per month. When the shop was working full time, decomposition of the machine earnings would give a total earnings for that factor of $600. This would be obvious without

decomposing the rate to see, because we would know it from an inspection of the factor schedule itself. It would simply be one-twelfth of the factor total on the schedule.

But if we assume that the shop's activity is reduced 25 per cent. and that by strenuous exertions we have managed to reduce Standing Order charges concerned in the factor by $100, this would leave the debit to the factor $500 for the month, Now, the machine earnings under these circumstances would average about 25 per cent. less than normal, due to shutting down of machines, and 75 per cent. of the standard earnings would be charged to machines rates, which being decomposed, would give us factor earnings of $450. This is still $50 less than the reduced factor debit, and supplementary rate would accordingly take up $50. But if we had not economized at all, supplementary rate would then be charged with the difference between $600 debit ot the factor, and $500 factor share of the decomposed machine earnings, or $100 in all.

It is practically impossible that economies can overtake the lessened machine earnings due to idle machines, and this implies that in slack times the amounts distributed through machine rates can never be less than the actual debits either to individual factors, as shown by Burden Journal, or to Burden account as a whole. What is true of individual factors and decomposed machine earnings is also true of burden as a whole and machine earnings as a whole.

The main reliance in controlling the correctness of machine rates must be placed on observing their behavior when the shop is running full time. In this condition, supplemenary rate should approach very closely to zero, and the actual debits to factors as shown by Standing Order costs should agree very closely with the amounts set out on the factor schedules and on which the factor charges to machines were built. Under other conditions, the examinations to be made from time to time will afford security that burden is not being over-distributed, and a little experience and comparison of economies effected, with the amount of various factors as charged through machine rates when decomposed, will go to show that no item of burden is being under-distributed to any noticeable extent.

It must be remembered that the machine rate has a twofold function: First, to distribute the department burden to work; secondly, to distribute it in proportion as it has been spent on

certain machines. These two aims are distinct. If the determination of rates has been carefully made, there will be very little doubt about the successful performance of the latter function. But to insure that the total burden (or the total of each factor or class of burden) has been correctly stated to begin with is a more difficult matter. It is to observe whether this is so that all the above-mentioned precautions are taken. But at the end of any year, this is a particularly easy thing to find out; because the total charged to any group of Standing Orders forming one factor must equal the amount originally set out on the factor schedule when setting the machine rates. That is the last and final proof of correctness. If such amounts are substantially alike, then no fear as to correctness of machine rates need be entertained. If a discrepancy is found, it means that a new factor schedule must be gotten out with the new figures as its basis, and machine rates altered accordingly. Unless the discrepancy is a gross one, no great harm is done when supplementary rate is charged up to Production Orders. It will merely have had the effect of showing true cost a little higher or lower than it ought to be, and inversely affecting the amount shown as supplementary rate. And on any individual order this error should be a small one indeed.

CHAPTER XXII

COLLECTING DEPARTMENTAL COSTS

When costing has been carried out on either of the three methods described in former chapters, the stage at which the costing process has arrived may be summed up as follows:

1. The work in any department will be represented by a set of Production Order Cost Sheets or Component Order Cost Sheets on each of which the cost to date of specific items of the work may be found.

2. The aggregate of the items inscribed on the set of Cost Sheets will be contained in the Manufacturing account. The Cost Sheets are in fact the subdivision or detail of the balance in Manufacturing account, just as we saw in a former chapter the Stores Item Cards were the subdivision of the balance in Stores account.

If there are also Plant Addition Orders, their Cost Sheets will be the detail of the balance in Plant Additions account in the same way.

All these remarks apply to *one* productive department. There may be several such departments, each containing work in process and each carrying the detail cost of such work to date on a set of Cost Sheets, and a balance in their Departmental Manufacturing account corresponding.

Further, cases have been instanced in which material is not charged to departments but to a Material account, the detail being recorded on Material Cost Sheets. In this case material ranks as a department. Material account will contain a balance of which the Material Cost Sheets are the item details.

We have now to consider what happens when an item of work is finished as regards a department, passes out of it, and goes somewhere else. As far as that department is concerned it no longer exists, and steps must, therefore, be taken: (1) to take its value out of the Departmental Manufacturing or Plant Additions account, and charge it to some other account according to what has been done with it; and (2) to withdraw the correspond-

ing Cost Sheet, and send it to some other quarter, where it will become the subdivision of the new account.

Before discussing this further stage of costs, it will be well, however, to obtain a clear picture of the nature of the information contained in the Cost Sheets. From what has been said in the chapters on "Costing," it will be obvious that on all the three methods the costs obtained are in all cases costs of *processes.* The data recorded are based on the time spent on a given order by a man, or by a machine, or by both together, Now the way in which this data can be identified with product will depend on the way in which the *orders* have been issued.

If Production Orders alone have been issued, then in each department, there will be a record *on one Cost Sheet* of all the process work done in that department. If there is only one process, then whatever appears on the Cost Sheet will be the cost of that process. If the order has been issued to several departments we shall have a Cost Sheet in each department showing the cost of the process carried out by each department. If, then, we collect the Cost Sheets belonging to that Production Order, we shall have:

1. *Cost of the whole order, subdivided by departmental cost, viz., one process in each department.*

On the other hand, there may be several processes carried on in each department, and our work may pass through all or some of them. In that case the Departmental Cost Sheet will carry data as to each of these processes, and we shall be able to identify the cost of each individual process by its machine number. If several departments have been engaged on the Production Order, then each Departmental Sheet will carry the cost of the various processes, each identifiable separately. Consequently, if we collect the various Departmental Cost Sheets and summarize them, we shall have:

2. *Cost of the whole order, subdivided by departmental cost, and also by processes within each department.*

This is as far as we can go by means of Production Orders only. The information gives us the cost of work indicated on the order, and of the different *kinds* of work, but it does not give us any information about the cost of different *parts*, should it happen that the product in question consists of parts. It is true that in some cases, even this information can be deduced from the costs of a Production Order, but only if single processes are never

duplicated on different parts. Thus if in a department we have six processes, and two of them are confined to part a, one to part b, and three to part c, then, of course, whenever we see a record of these processes on the Production Order we known that certain parts and not other parts are referred to. In this single case, we may say that Production Order costs give us:

2*a*. *Cost of the whole order, subdivided by departmental cost, and (conditionally) by the cost of process work on parts.*

In general, however, if our product consists of parts which are made separately and subsequently collected and, it may be, assembled or fitted together, it will be necessary to issue orders to cover each separate kind of part. This is effected by the device of Component Orders, each such order dealing with a separate kind of part, although, as in the case of the Production Order, any Component Order Cost Sheet may have a record of several processes on it. When Component Orders are issued, they supersede the Production Order as far as Cost Sheets are concerned, since instead of issuing one Cost Sheet for the whole of a Production Order in any department we issue as many separate Component Orders as there are separate kinds of parts to be made, and each of these has its own Cost Sheet. Consequently, when we collect all the Component Cost Sheets relating to one Production Order, we shall have:

3. *Cost of the whole Production Order. Cost of each separate component. Cost of each separate process on each component.*

This is the ultimate subdivision possible. No more detailed question about costs can be asked than is furnished by this arrangement of Production Orders and Component Orders. Where parts have to be assembled and fitted together, the final Component Order is a "Fitting" or "Assembling" Order, which records the cost of completing the work and erecting the separate components into a completed article. Where "part" or "component" is used above, it does not imply single pieces. A Component Order may be for 1, 50 or 10,000 pieces, but they must be all exactly alike.

Material.—Whether or not the cost of direct material is charged to Department Production Orders (or to Component Orders when these are in use) is a matter of indifference as regards the final result. The principal guiding rule will be the possibility of identifying the material with the final subdivision of cost we make. If the product is not composed of parts, then in general it will be

better to charge material to Material Cost Sheets, which will rank as Departmental Cost Sheets; that is to say we shall have several Departmental Cost Sheets dealing with labor and burden in each department and one Material Cost Sheet dealing with material for the whole Production Order. This arrangement will answer very well, also, when the material used on different parts is of a specific kind, as, for example, upper leather, sole leather, heels, buttons, etc. in shoemaking, because the identification of the cost of the material used in any individual component is plain and not ambiguous. But if brass sheet, steel rod, copper plate, etc. are being issued on an order, and any one of these materials may be used on more than one part or component, then confusion can easily arise, and it is best to charge such material to Departmental Cost Sheets by providing columns for such data. On the other hand, in some machine manufacture everything is so standardized that a Bill of Material can be made up and the material to be used on each individual part specified. In such cases, when the mere filling out of the issue price of the material provides a classified cost of material on parts, it is unnecessary to go to the trouble of charging material to individual Component Cost Sheets. A single Material Sheet, namely, the Bill of Material itself, together with a record of any odd or sundry material that may have been unexpectedly called for, is all that is necessary. In this case the process cost of the components is contained on the Component Cost Sheets, and the material cost on the Material Sheet. Placing one alongside the other, gives the entire cost of the component.

What is true of Production Orders is also true of Plant Addition Orders. Component Orders can be issued in connection with these if required, and in general it is better to do so, since industries making their own equipment will usually be of such a nature as to require Component Orders for production. But if the detailed part cost of such equipment is not required, then a single Production Order worked on in each department will give the total cost of the equipment when all the Departmental Cost Sheets are collected. Material may be issued to a separate Material Cost Sheet or to Component Orders if these are used.

There is in fact no great difference between Production Orders and Plant Addition Orders as far as costing is concerned. They are called by different names, because their ultimate destination is different, and, also, as explained in a previous

chapter Plant Addition Orders do not take supplementary rate on Method C. In other respects a Plant Addition Order *is* a Production Order, only it is production for the plant itself, instead of being for sale. It is, therefore, dealt with differently at the stage we have now reached.

Every month, certain Cost Sheets will be withdrawn from the departmental files, owing to work having been completed on them as far as that department is concerned. These Cost Sheets will contain an amount of detail as to the cost of the Production Orders they represent, according to the way in which orders were originally issued. With this we have no further concern. A Cost Sheet is a Cost Sheet, and represents the cost of a certain definite quantity of work done in the shop on a definite item or items of material. We have now to consider the following steps:

1. The Production or Component Order Cost Sheet must be withdrawn from the department files, and entered on a Finished Department Orders Journal, Fig. 108; and also on the Production Order Cost Summary Sheet, Fig. 112.

2. When all finished orders for the month have been entered on this journal, the Department Manufacturing account will be credited, and a Finished Department Orders account charged.

Total Cost	Description	Comp. Order	Prod. Order	Material *	Dept. 8	Dept. 7	Dept. 6	Dept. 5
	Totals for Month							

FIG. 108.—Finished Department Orders Journal.

3. The Cost Sheet will now be filed in the cost office under its production number. The aggregate contents of this file at any month end will be equal in amount to the balance standing in Finished Department Orders account. They will be in fact the Item Cards of that account, just as, when still in the department, they were the Item Cards of the Departmental Manufacturing account.

Finished Department Orders account will thus represent work which has passed out of certain departments, but which is not yet completed as regards the factory. The actual physical location of the parts represented by the sheets in question will depend on circumstances. In assembling industries, the balance in Finished Department Orders account will virtually represent the value of goods in the assembling stores. In other cases, where the work is passed from one department to another, the goods represented by the balance in this account will be dispersed throughout the plant. It will be obvious that in the

Prod. Order No.	No. of Sheets	Description	Class *A*	Class *B*	Class *C*	Class *D*

FIG. 109.—Finished Goods Journal.

latter case, we could credit the department parting with the goods and charge the department receiving them. This is a practice that is actually followed, but involves complex bookkeeping, and it is often difficult to see what advantage is gained. The increasing cost from stage to stage of manufacture is thus shown, it is true, but so it is by the far simpler method now described. It is chiefly useful when product is salable or purchasable as a departmental product, *e.g.*, castings in a foundry.

On the right-hand side of the large folding general diagram, the operations just described can be followed out. At the top is shown a Cost Sheet representing a piece of work that is finished as far as department 5 is concerned. This Cost Sheet

may be, as already shown, either a Production Order Cost Sheet, or, where Component Orders are in use, it will be a Component Order Cost Sheet. Its entry on its own Production Order Summary Sheet and on the Finished Department Orders Journal is indicated, and from this journal a credit line is traced to the Department 5 Manufacturing Journal, on the one hand, and a debit line to the Finished Department Orders account on the other.

The next stage is reached when all the Cost Sheets connected with a given Production Order number have (summarized on a Summary Cost Sheet, Fig. 112) been passed through in this way to the debit of Finished Department Orders account. The Production Order itself is now wholly completed, and delivered to the selling arm. Consequently, as will be seen from the diagram, all the Cost Sheets relating to the Production Order are collected, and their total cost (as shown also on the Production Order Summary) entered on a Finished Goods Journal, Fig. 109, and charged to a Finished Goods account. There will, in general, be more than one of such accounts, each being devoted to a different line of product.

It will be obvious from an inspection of the general diagram

Dept. 5	Dept. 6	Dept. 7	Dept. 8	Material *	Prod. Order	No of Sheets	Description	Class A Goods	Class B Goods	Class C Goods	Class D Goods

FIG. 110.—Finished Goods Journal used in place of Fig. 109.
* Not required unless material is charged to Material Cost Sheets.

that, if desired, the crediting of the Departmental Manufacturing accounts and the charging of Finished Goods account could take place at one time, thus eliminating the intermediate stage of Finished Department Orders account. The diagram, Fig. 111, shows this short cut. No credits are made to the Departmental Manufacturing accounts until all the Cost Sheets for a Production Order are completed. They are then entered as one item in the Finished Goods Journal (Fig. 110), the amounts charged for departmental work being entered in the departmental columns

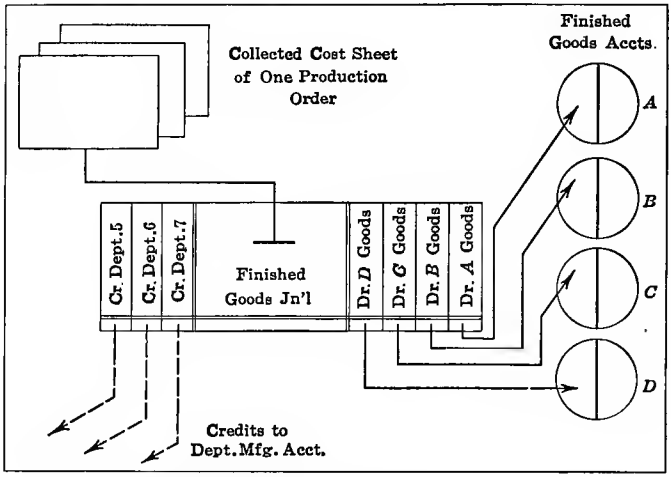


FIG. 111.—Production Order Costs credited to Manufacturing account and charged direct to Finished Goods accounts.

at the right hand, and the total cost of the order charged to the finished goods column on the right hand which represents the class of product that has been made on the order. Credits to the various departmental accounts are then made when the journal is totalled, and correspondingly debits are made to the various Finished Goods accounts.

The disadvantage of this short cut is that Departmental Manufacturing accounts are not cleared as soon as they have finished work on any order. As long as any part of an order is uncompleted, the amounts standing against that order in every departmental journal must remain, even though the department has long ago finished its portion of the order. In some classes of business, this would not be a serious disadvantage, but in other

cases, where work is complex and consists of large numbers of components, it is a great advantage to be able to know at each month end, exactly the value of work in process in each department. If this is increasing, it means that the department is falling behind in its work, whereas if Manufacturing accounts are not cleared until every department has finished, the figures cannot be read in this way.

Plant Addition Orders.—The completed Plant Addition Orders in each department having been charged to a Departmental Plant Additions account, a similar procedure to that described above must be gone through to clear these accounts. The same rulings may be used in the journals allotted to plant additions, except that instead of debiting the cost of completed Plant Addition Orders to Finished Goods accounts, they are charged up to the various Plant, Equipment, Buildings and other main ledger accounts on the left hand of the diagram. In many cases, however, this is not done save at half-yearly or yearly intervals. In this case, a Finished Plant Additions account may be set up, and the cost of Completed

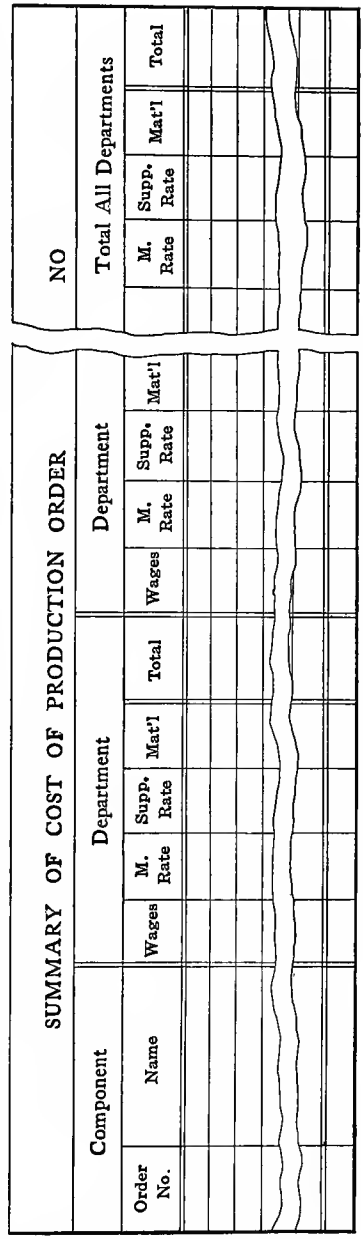


FIG. 112.—Collection of component costs by departments.

Plant Addition Orders charged to it. Then at the end of the financial period the items contained in this account can be transferred to the Plant accounts concerned by means of general journal entries. Plant Orders for auxiliary equipment are sometimes transferred to a Production Order, as when special patterns and tools have been made to carry out a special order (see Chap. X, Part I).

The final stages of costs have now been discussed. The various Departmental Manufacturing accounts have been cleared of finished work, represented in detail by Cost Sheets. When all the Cost Sheets pertaining to an order are collected, Finished Goods accounts are charged with the total cost of the order. These two operations (credit and debit) are sometimes carried out simultaneously but sometimes an intermediate step is intercalated, by which those portions of an order that are departmentally finished are credited to the department and charged to a general Finished Components account until the whole order is completed. Only then is Finished Goods account charged, and, of course, Finished Components account, or as it has been termed above "Finished Department Orders account" is credited. In either case, whether by a shorter or longer path, the general effect is that work done in the shops is credited to the shops and charged up to the selling arm.

CHAPTER XXIII

FINAL REMARKS ON COSTING

The entire routine of costing has now been covered. Commencing with purchases, we have seen how these are transformed into product. The intermediate stages are many and complicated, and, of course, it has been impossible to cover many side issues which constantly arise in practical cost keeping. But it is believed that if the student has acquired a thorough grasp of the detail given, and has been able to understand the reasons for each step that has been described, he will not find great difficulty in applying the same principles to any particular case. The great secret of correct cost keeping is departmentalization. This applies throughout all the operations and not merely to the division into actual departments. Every step in the whole process must have its own clearly defined sphere. It must carry the costing operation from one well-defined point to another. This rule can be applied with advantage in making whatever developments are necessary in particular plants.

Another rule that might advantageously be kept in mind is to set up as few ledger accounts as possible. Ledger accounts are only necessary when they contain balances. Thus, many accountants set up large series of Expense accounts, the use of which is, to say the least, not very manifest. The general idea is to provide a basis for reports and returns, but as long as all figures are locked in with the ledger accounts as they are in all the methods described in this work, then reports can be compiled from the assembled figures in the Standing Order Cost Sheets without charging these to separate ledger accounts for the purpose. Moreover, statistics taken from ledger accounts are usually too stale to be of much service to the technical arm. This aspect of the cost problem will be discussed in Part III, which deals with "Reports and Returns."

Auxiliary Equipment.—From what has been described in former chapters it will be understood that, by the issue of properly arranged orders, the cost of any item of product, and any kind

of expense can be separately recorded. In the case of expense, collected through Standing Orders, the Cost Sheets, representing the different kinds are merged at an early stage of operations in a total of departmental burden, and so disposed of, by being spread over Production Orders.

But Production Orders (with their subdivisions—Component Orders) have two variants: Production Orders proper, representing salable goods, and Plant Addition Orders, representing possibly additions to buildings, new machinery and equipment, etc., but also frequently representing items of auxiliary equipment, the difficulties surrounding which were dwelt on in Chap. X (Part I). Some additional information must now be given as to the way in which auxiliary equipment is charged up to production.

The simplest case is that where such equipment (tools, jigs, patterns, etc.) is going to be used for only one order, after which it will be consigned to the scrap heap. In this case, after the cost of the equipment has been determined through a Plant Additions Order, the cost of the latter is transferred to the former, being credited from Plant Additions account to Finished Goods account, and forming part of the production cost of the order as chargeable against sale price to ascertain gross profit.

Usually, however, no such easy method of dealing with auxiliary equipment will present itself. Its cost must be distributed to production by means of a depreciation rate, and handled through Standing Orders like any other class of expense. Frequently, also, depreciation is not the only charge picked up by such items during their life. Patterns, for instance, require storing in proper buildings, tools and jigs also, and in plants of any size, there will probably be attendants whose work is to take care of the equipment, attend to its issue when wanted, and secure its due return. This amounts to the erection of a department or more than one department devoted to such work. And the cost of this department, like that of any other expense department must be prorated over the departments it benefits. Thus the pattern storage will be charged to foundry expense; tool-room storage will be prorated over the machine shops; but where the industry is a simple one, the depreciation of patterns and auxiliaries with the expense of looking after them and storing them will be charged by classes of goods rather than to any one department. Thus the cost of shoe lasts, printing

rolls, and such like must be distributed over the actual work done with each variety, so that a line of goods requiring no expensive extras, does not get charged with such extras. Or what is more frequently the case, a standard line of goods which will use its auxiliary equipment until it is quite worn out, must not be charged with the cost of special equipment used for a variety of product in limited demand.

Thus is introduced into the accounting scheme what may be termed **class burden,** that is, burden that is confined to certain classes or kinds of product and not, therefore, distributable by any of the methods hitherto described. Where this type of burden exists a separate Class Burden Journal should be set up, similar to the ordinary Burden Journal but collecting those items that are confined to particular classes of salable goods, especially the depreciation on auxiliary equipment of the kind mentioned above. Standing Orders will, of course, be issued and Cost Sheets kept for the monthly record of all such items, and credits will be made to the main accounts where these are concerned, just as in the case of the ordinary Burden Journal, and various productive departments will be charged, but not in one total. The charge to each productive department will be divided up so that so much is assigned to class A product, so much to class B product, and so on. When the Production Orders are listed in the Department Manufacturing Journal, these separate amounts must be distributed over the orders they belong to, making use of a separate class burden column for the purpose.

The subject is such a complicated one and has so many variations in practice that, in an elementary work like this, it is impossible to indicate more than the general lines of its treatment. The principal things to be set up as mechanism in connection with class burden, are:

1. Some originating document recording the use of the auxiliary equipment, the order for which used, and the quantity of product resulting.

2. The Depreciation Schedule should contain the depreciation charge for such item per unit of product as fixed by the technical officers, and thus the correct amount to be charged to the order may be determined and marked on the document.

3. A Class Burden Journal will list these documents, make the necessary credits to Depreciation account, and charge the Burden accounts of the departments using the equipment.

4. In Manufacturing Journals a special column for class burden will be set up, and in this column the individual charges on the originating documents will be entered against the proper order numbers, and on the corresponding Cost Sheets. In this way the class burden will be carried to the debit of Manufacturing account, and Departmental Burden account will be credited.

Depreciation on auxiliary equipment is, of course, a relative term. It does not imply the natural term of life of the appliance, but its *expected* useful life. And as a general rule it is safer to base this on the number of times it will be used, that is on the quantity of product it will turn out, than on ordinary time rate. If we have a set of shoe lasts, and expect to make 1,000 pairs of shoes from them within a year, after which it is practically certain that the pattern will go out of fashion, then the depreciation charge should be made 1/1,000 of the cost for each pair turned out, and no attempt made to bring the one year into the problem at all. And in fixing such a rate, a conservative view should be taken, and if there is any question as to the expected life of the appliance the probable minimum rather than the probable maximum should be taken. But the whole question is a very intricate one, and depends for its successful solution on shrewd judgment on the facts of every particular case.

Departments Using Different Methods.—From what has been said as to the necessity for first departmentalizing all cost, before distributing it to Orders on one of the three Methods A, B, or C, it will be readily understood that we are not obliged to use any one method in all departments. Thus one department may do work that is suitable for costing on A. Another department may contain a set of machines so uniform in character that Method B is quite proper. Others again may contain production centers differing widely among themselves, so that Method C is the only safe costing system. Should it happen that a given Production Order is worked on in all such departments, no difficulty arises, since each department's work appears on a separate Cost Sheet, and provides a complete cost whatever the method of arriving at that cost. The total of all Departmental Cost Sheets will still be the total cost of the Production Order as a whole. Similarly, the work in one department might justify Component Orders, while in others no such necessity might arise. This would simply mean that the latter departments would work to the Production Order number, and pro-

vide on Cost Sheet for all their work on the Production Order; the other department would not work to the Production Order number but to a series of component numbers, and that department would consequently turn in several sheets as representing their work on the Production Order. No difficulty can arise in combining departmental cost data, since each department is absolutely independent of every other.

Spoilage.—From what was said in Chap. IX (Part I) as to Replacement Orders, it will be understood that the column headed "Spoilage" in the Department Manufacturing Journal is intended to take the cost of such Replacement Orders. Their aggregate is then charged to Spoilage account. This account will probably receive debits from all the productive departments, and though the amount standing to its debit at the month end is charged, through Standing Orders and Burden Journal to productive departments, it must not be overlooked that the department *making* any given debit does not necessarily bear the expense of that debit. The department to which it is chargeable is the department *responsible* for the spoilage. Thus a piece or component may have passed through several departments, and finally a flaw is discovered, due to a bad casting. All the cost of the Replacement Order through all departments will be chargeable against the foundry. Similarly, if a mistake made in one department is disclosed only at a later stage, the first department is clearly responsible, and must be charged with the whole cost of the Replacement Order.

Summarizing Production Orders.—A Production Order should in all cases show, in addition to the actual cost of production as collected from the Departmental and Component Cost Sheets, the cost of auxiliary appliances made specially in connection with it, even if not chargeable entirely to the order, and also the cost of spoiled work arising out of the order. A convenient form for summarizing these details, and for assembling the cost of selling alongside that of production, and thus exhibiting net profit will be shown in Part III. Such elaboration is, however, chiefly suitable for industries in which the sold units are large and costly, as in machine-making. It may, however, be modified for any industry, and when applicable is exceedingly valuable.

CHAPTER XXIV

THE INCLUSION OF INTEREST IN COST

Whether or not interest should be included in cost of production is a matter on which authorities are wholly at variance. For this reason, though in many instances, columns have been provided for interest entries in blanks described in former chapters, nothing has been said about the inclusion of interest in burden. When it is included, an Interest Schedule is worked out exactly similar to the Depreciation Schedule, Fig. 43, except that instead of "Depreciation Rate" the words "Interest Rate" would be substituted. In many cases, however, the interest and depreciation rates are combined in one by means of an amortization table. The employment of this method belongs, however, to advanced accounting, and cannot be described here.

Otherwise, whenever the term depreciation has been used in any of the blanks and rulings in former chapters, it may be understood that an interest charge calculated in the same way and for the same items as the depreciation charge, but uniform, say 6 per cent., for all classes of plant and equipment, may be included also, since both are charges for the use of the equipment. Standing Orders would be issued to cover an interest charge on each class of equipment in each department, just as they are issued for depreciation charge. In fact, as said above, depreciation rates can be arranged so as to include depreciation and interest in one rate. When interest is charged, an additional column will be needed in Burden Journal alongside that for depreciation, in order to collect credits to Interest account. Debits will, of course, be made to the different departments precisely as in the case of depreciation. Interest thus passes into department burden and ceases to have any separate existence.

If interest is included, however, the machine rates used in Method C will require an interest charge included for each production factor, including, of course, the individual machine factor. Wherever in Chap. XX (Part II) depreciation charges are mentioned, interest charges would be required also, or a com-

bined interest and depreciation charge. Each machine rate then contains a portion of its total made up of interest, and thus interest is charged to Production Orders in due course.

The writer's preference is for including interest charges on all buildings, plant and equipment, especially when Method C is employed, since on that method a "weighting" of productive processes according to the amount of capital locked up in their equipment is effected when interest is included. Many excellent authorities, however, do not agree with the writer on this point, though it is only fair to state that, on the other hand, many other good authorities recommend the practice.

One objection sometimes made by manufacturers deserves consideration. It is that when interest is charged in costs, it is very difficult to say how much is included in a given order (or rather it is practically impossible) and, therefore, when hard times demand a rock bottom price, it is not easy to make estimates and bids in which the cost of interest is eliminated. This objection is a good one. But, as was pointed out in a previous chapter, machine rates on Method C can be made up in as many variations as desired. One set can be made up with interest for cost use and one set without interest for "hard times" estimating purposes. Even depreciation may also be left out, if desperate measures are necessary, but this is a practice that cannot be recommended, since depreciation is a real cost element, while interest is only a measure of the incidence of capital values.

The term "interest" used in this chapter must not be understood as referring in any way to commercial interest, such as is payable by the firm for money borrowed, either on loans, mortgages or bond issues. Such interest is a purely financial matter, and has obviously nothing to do with the efficiency of manufacturing. Interest as defined for our present purpose is *a charge made to production for the use of capital.* And as capital is used in different amounts by different departments and service, it is only right that a measure of the amount of capital used by each should be included in the cost of its operations, because the firm has to pay interest on that capital, even though it does so under the guise of dividends. And when we come to subdivide production to its ultimate units as we do in Method C then it becomes increasingly important that the use of capital by such units, either directly as a charge for the capital value of the machine or production center, or indirectly by including interest in the

cost of service departments such as the power plant, shall form part of cost.

Otherwise, if we have two alternative processes, one employing little machinery, and the other employing very costly machinery, no real comparison between the two can be made unless we weight them both with their proper share of interest for the relative amounts of capital they employ.

Interest, therefore, to sum up, is a charge made to non-productive and productive departments, through Standing Orders, for the use of capital, and is, of course, in proportion to the amount of capital locked up in various forms as enumerated in the Depreciation or Interest Schedules. It is a matter of option whether it is included in costs; but if it is not, some of the advantages of the more advanced methods of costing are lost. Whether there are disadvantages that counterbalance its inclusion on this ground remains at present a matter of opinion.

PART III

FACTORY REPORTS AND RETURNS

NOTE.—The following pages are the revised substance of a series of articles published in the *American Machinist* in September, 1915. Though primarily applicable to machine shops, and to costing on Method C the data covered in the reports and returns described will be necessary, with modifications, in nearly all manufacturing plants. In some, of course, considerable extension will be necessary, some productive departments requiring specially designed returns to bring out points of technical importance, such as wastes; the proportion of "good" tonnage to total tonnage in foundries; and many others items of a special character. All such returns should be so arranged that they can be placed before the right officials *promptly*, or their value will be greatly discounted.

CHAPTER I

THE NATURE OF REPORTS AND RETURNS

It is not uncommon to find a certain amount of friction existing between the accounting department and the technical officials in a large plant, due to the fact that cost systems have several uses, and are very often not designed to give prominence to more than one of such uses at one time. Thus a system may be quite satisfactory to the president or proprietor of a business, less satisfactory to the superintendent and estimating department, and a mere nullity as regards shop officials. Conversely, some systems with which everyone in the shop is perfectly satisfied, and that give fair satisfaction to the superintendent, may provide results that are quite untrustworthy and inconvenient from the viewpoint of the general accountant, and of the president or executive.

This is because the shop wants its data red hot, and will welcome any method that provides it, while it is quite unconcerned as to the later fate of the statistics or how they are worked up. The higher officials on the other hand do not want to be overwhelmed with detail but want accurate results assembled in a form that their significance can be quickly grasped. The higher the position of the official the more general is the type of information he requires, but also the clearer and more systematic must be the grouping and presentation.

As expenditure on orders, both standing and productive begins in the shops, we shall consider first what the shop foreman wants to know, leaving the other officials till later.

What the Foreman Should Know.—The foreman is concerned, first and foremost, with the *cost of jobs*. A job may be defined as one process on a Production Order, or if Component Orders are in use, as we shall assume they are, then a job is one process on a Component Order. It is the foreman's business to see that jobs are done at a cost not exceeding former or standard cost, and as dozens of jobs are being finished daily some mechanism must be set up to bring to his attention only the *exceptional* job,

which has cost more or less or is costing more or less than was expected.

For this information to be of any use to the foreman he must have it promptly on the completion of the job, or if the job is a long one, on the completion of some allotted portion of it. In practice this means *not later than next day.*

Further, it is most desirable that the information should be in very concrete form. A mere abstract statement conveys little to a busy man surrounded with a multitude of detail. He must be able to see and handle the prime records—the original time notes, slips or cards, and all the information they bear.

With this information before him, and the man at hand who did the job no longer than yesterday, the foreman will be able to lay his finger promptly on the reason for the exceptional cost. Unless he has red-hot data, this will be more and more difficult as time goes on, and his investigation will become merely perfunctory, and he will regard the duty of making it, if it is forced on him under such circumstances, as a nuisance. But with prompt report to him, backed by the original documents in the case, he will have but little difficulty in assigning the correct reason for the exceptional cost.

When the cause has been assigned, it must be recorded for future reference. A register of extra costs classified by causes must be kept up, and this will form the basis of improvement as regards such causes as are remediable either by him, or by some higher authority.

Watching Idle Machines.—The next thing that it is important for the foreman to watch closely is the idleness of machines. From adequate time notes, the working hours of each machine can be obtained by a quick sorting and aggregating. Where machine rates are in use the money value of machine earnings is also easily found. By a simple tabulation on a properly designed blank, a running record is kept of each machine's working time, and by deducting the day's total from standard time and earnings, the day's loss due to idle machinery is made visible to the foreman each morning. This, again, is a kind of information that is particularly useless 2 or 3 weeks or a month after the facts have passed into history. What the foreman wants to know is, "How were my machines occupied yesterday?"—not how they were occupied at some past period. He should be able to cast his eye over their earnings or working

time day by day for the past few days, so that he can see how things are going.

Balance of Work in Hand.—Next, he wants a good idea of how the work is coming on—whether he is keeping up with it or falling behind. Is work piling up half finished in the shop, or is it being carried through in a steady stream? Closely connected with this information is the total of the pay-roll from day to day, and its division into productive and non-productive work.

At the end of each day there will be a certain volume of unfinished jobs (work in progress) in the shop. To this is added today's productive wages, and from it is deducted the wages on jobs finished this day. The resulting amount is the volume of wages on work in hand to be carried forward tomorrow. This figure, representing the volume of work in the shops each night, is of value to the foreman, provided he gets it day by day. If it is going up while productive wages remain steady, it shows congestion of half-finished work. A little familiarity will make this a highly significant figure to the foreman.

But this does not tell him how he stands in relation to orders in sight. This information cannot always be provided in definite form. It can be furnished only in the case of work that is sufficiently standardized to allow the expected or standard cost to be placed against each job as and when it is handed to the shop. When this can be done, then the total expected cost of each day's jobs will be added to the expected cost of all jobs in hand, and each day's completed jobs will be deducted at cost, leaving a balance of unexecuted orders as at each night. Every morning, therefore, the foreman will have a figure representing orders on hand and will be able to take measures as to overtime, extra help, etc., on a basis of actual figures.

Daily Records of Spoiled Work.—Another matter that should be brought to the foreman's attention daily is the "spoiled work." This should receive his attention in the same manner as exceptional jobs, previously mentioned. His opinion as to the cause of each item should be indorsed on the record, and a tabulation by causes posted up against men, bad castings, or other visible causes.

Indirect or Service Expense.—We may now consider indirect-expense items. The foreman is not interested in the large question of expense save at the points at which his responsibility is incurred. A very simple return will, therefore, satisfy all his

needs. He is interested, first, in expense items incurred in his own shop and, therefore, under his own control, and secondly, in expense labor and material charged against his shop by other departments.

A tabular blank should be provided listing all the usual items of expense, including repairs of all kinds, and work done by other departments should be shown separately. Every week the charges against each item should be inserted in the proper column, so that comparison with previous weeks may be easily made. A few minutes' study of this return will suffice to show the foreman how he stands on each item under his control, and whether he is being fairly charged by other departments with work done for him.

Workman's Efficiency Record.—The daily returns of exceptional jobs and spoiled work will contain items that go against sundry workmen. A record should, therefore, be kept for each man, to include reference to all such losses, and also his bonus earnings, late attendance, and other data against him or in his favor. With properly designed methods such a record can be compiled at little expense, and will be first-hand evidence of each man's value.

These are the principal matters with which the foreman is concerned, and which he is entitled to expect from any cost system that pretends to be efficient. He may require more than this in some shops, because the status and duty of a foreman vary a good deal, but in few shops should he be asked to put up with less. We have now to consider the viewpoint of other officials.

What the Superintendent Requires.—The superintendent's viewpoint is quite different from that of the foreman. He is not so much interested in details, but more in broad results. Consequently, he does not require such red-hot and up-to-the-minute information as the foreman. But he wants some of it day by day also.

Just as the foreman is interested in the cost of jobs, so the superintendent is interested in the cost of orders. An order may be defined as a collection of individual jobs or components, such as a machine, erected, or a thousand fittings which have passed through several departments. It is the superintendent's business to see that orders are turned out at an expected or standard cost and that they are not being delayed in their passage through the plant. A proper system of cost accounts should secure these two kinds of information at one and the same time. As every depart-

mental job is finished, it should appear on the superintendent's record and thus vouch for itself as to expected cost and expected date. Just like the foreman, the superintendent is interested only in the exceptional cases, but he is not interested in the same way. The questions he will ask himself are: Is there any serious delay on any item of this order? Is there any serious or general increase of cost on this order?

Control of Orders.—The superintendent's control of orders should be based on a "master schedule" listing all the different components belonging to an order, and against each component all the different processes to be carried out on it. A space will also provide for the weight and cost of castings and forgings and other material against each component. Standard or former costs being stated against each process, the general condition of the order as regards completion and its general standing as regards increase or decrease of cost, will be visible from inspection at any time, provided finished jobs are posted daily to it. He will also see whether components are being hung up for want of material, and whether material has been issued in excess (as, for example, in the case of a spoiled part). As soon as all the spaces are filled up, the cost of the whole order will be known. This should be the day after completion.

Department Service Expenditures.—Apart from cost of individual orders, the superintendent is chiefly interested in the efficiency of departments. It is he who should have a close grip on indirect expense, and he requires, therefore, much more detail than the foreman in this respect. Expense will be of two kinds—Standing Orders—the ordinary items arising from the pay-roll, small repairs, regular issues of stores, etc., and specially authorized items such as extensive repairs that are carried out on special Standing Orders. All expense will be classified according to the purpose for which expended. For example, all expenses relating to buildings will be classed under buildings, all relating to power, including fuel, wages, repairs, etc., under power. Other classes will be handling of stores and shop transport of materials; supervision; organization; operative machinery. This classification will be effected by the schedule of Standing Orders as explained in Chap. XII (Part II).

"Exceptional" Expense Items.—Each Standing Order item will be budgeted or forecasted, and actual expense will be placed alongside each item. Any departure from expected cost of an item

will be called to the superintendent's attention, just as the wages cost of an exceptional job was called to the foreman's attention. This will be done each week, and the items tabulated on a large sheet carrying a series of weekly columns, so that the tendency of any item to increase will come under constant observation.

Departmental Efficiency.—Departmental efficiency in various directions will be the principal remaining item to come under the notice of the superintendent. This may be divided into three classes—(1) as to men, (2) as to machines, (3) as to wastes.

Information as to the first class is tabulated from the finished jobs already scrutinized by the foreman with his indorsement of the reasons for increased cost. Jobs will be tabulated under their reasons, so that the loss or gain for each such reason can be reckoned up in a total. Each item will be recorded on a columnar statement, so that the increase or decrease against each reason can be compared. Thus, we may have a constantly increasing amount under the heading of "Job Interrupted for Urgent Work," which would be unfavorable and demand inquiry, or we might have in one department a much higher ratio of increased cost due to breakdowns. Whatever the classification, scrutiny is applied as to increase or decrease of each item in each shop, and also comparison is made as between different shops each week. When this is done whatever unfavorable conditions may develop cannot escape notice very long.

As regards the second class, the machine-hour value of lost time due to idle machines is tabulated for each shop in weekly columns. Comparison of one shop with another and one week with another is easily made, and any undue increase of this item, not warranted by slackness of business, is kept in view.

In the third class, that of wastes, the superintendent will have a record showing the amount of spoiled work for each shop, classified by reasons. These will also be tabulated in weekly columns, so that different shops can be compared together, and each shop can be observed from week to week.

Power-house efficiency will be the subject of special technical reports, which, coupled with the above segregation of all expenditure on the power plant for whatever cause, should give a close grip on this item of expense.

With these returns made promptly each week, the superintendent will be in a position to turn the searchlight on any point

of weakness that may develop, without losing himself in detail or trying to overlook everything at once.

What the Executive Wants to Know.—The higher we mount the official ladder, the more general become the data necessary and the longer the interval at which tabular statements are required. The executive's interest in Cost accounts, as such, is comparatively small. His viewpoint is that of the financial outlook. He wants to know what is going into the business and what is coming out. Generally speaking, monthly returns will provide all the information he requires. Of course, all the sources of detail information already described are also open to him.

The most satisfactory plan of control is that of the budget. This is, in effect, a forecast of the main operations of the business, month by month, based on previous experience. All principal outgoings such as pay-roll, stores purchases, taxes, insurance and depreciation, are listed, and their expected amount set out in the different monthly columns. Another set of items is expected balances, such as stores in hand, work in process, cash on hand and at bank, accounts owing by the firm and to the firm; while a third set consists of expected sales in each line of goods manufactured, sales expense, including advertising, etc. The main movements of cash in the business are thus scheduled, and against each item the actual amounts expended, received or in hand will be entered each month for comparison. Value of orders received, executed, and balance on hand is also listed.

Undue and unexpected increases or decreases in any item and their amount and significance are thus immediately seen. Thus, if the balance of stores in hand or of work in process is rising, without a corresponding movement in orders received, something is wrong. It can be seen at a glance if collections are falling behind normal, if sales expense bears a just proportion to results, if any line of product is falling off in orders, or is becoming congested in the shops, if indirect expense is increasing, if repairs are unusually high or low—in short all the significant movements of the business are focussed and compared with the experience of previous years.

Under the head of the executive department the question of estimating may be considered. As the records already described under the heads of foreman and superintendent give the ultimate detail possible as to every part manufactured and as to every machine or group of articles made, the basis of estimating will

be full and complete. The only thing to be discussed is the influence of idle time, or half-full shops, on the cost of production and, therefore, on the price which should be quoted to get new business. This, however, is a theoretical matter, or one of policy, and cannot be gone into here. All the necessary data for decision will, on the other hand, be found at hand in the records provided for.

What the Proprietor Wants to Know.—The proprietor, or whoever represents him in a corporate business, is mainly interested in one thing—profits. He is also interested in the condition of his property, its liabilities and the quick and fixed assets that offset this liability. Both these wants are fully met by the provision each month of a full Balance Sheet of assets and liabilities, and a Profit and Loss account. With a system of accounting designed to give the information described, there is no reason why such a Balance and Profit and Loss account should not be prepared every month, at no more expense than the filling in of the figures on a printed form. This is in fact most desirable, for it is the final test of the general accuracy of the returns. Returns that will not balance do not comply with the dictum of "safety first." If the accounts are arranged properly as described in former chapters, each stage should be built up in more and more general terms from detail that was verified at the beginning. The Balance Sheet should thus be the final coping stone that completes the edifice and makes its correctness visible to the eye.

In the remaining chapters some of these arrangements will be described in greater detail.

CHAPTER II

REPORTS AND RETURNS FOR THE FOREMAN

There is probably more than a grain of truth in the suggestion that some of the more highly elaborated modern systems would never have been invented if every foreman had always been provided with what he wanted to know at the time he wanted to know it. By whatever name he is called, there must be somewhere a man who is responsible for operative efficiency, and the more this man is in control of the situation, the more flexible will be the adjustment of the shop to the unexpected. It is not our purpose here to discuss how far "planning" should go.[1] Planning is specifying in advance all that can be specified, but its degree of development must obviously depend entirely on the kind of work that is being done. But specifying in advance is not doing the work, though sometimes spoken of as if it were. Someone has got to see that the work is actually done, has got to nurse and shepherd it, and this man is called, for the purpose of this article, a foreman. Now the question is, What does he want to know, and when?

In a previous chapter this question was very briefly answered. In the present chapter the methods necessary to provide the information will be described. There will be no attempt to describe a complete system of Manufacturing accounts, but only so much of such a system as the foreman is concerned with.

The first step is to provide for recording the time of men and machines on work. There are literally dozens of methods of doing this, some of them involving complex and expensive appliances. The problem, however, is simple. It is to have accurate record of the time at which each job was changed, and to so arrange, first, that the total hours accounted for check up with the gate time for each man, and then, secondly, that the verified details can be rapidly grouped in any way desired. Further, the original records should be assembled so that they

[1] For a discussion of planning and other details of organization, see the author's "Science and Practice of Management" (New York, 1914).

are always available for reference. A simple and effective plan is given here, which has worked well in practice, is easily understood and possesses the advantage of quick results and easy reference to the original record at any time.

Time on Jobs.—In Chaps. XVIII and XIX (Part II), Figs. 84 and 95, were figured two varieties of Time Sheet, one suitable for Method B and the other for Method C. In the ensuing pages we shall assume that Method C is in use. Such Time Sheets should be kept and filled out by a job clerk in telephone communication with the foremen and gang bosses, who give out and pass on jobs at the various machines. Whenever a job is changed, the order number and other details are telephoned to the clerk, who makes the entries, noting the exact time.

This Time Sheet is usually a thin card, and each different class of operation, say turning, milling, shaping, etc., has a different color appropriated to it. The card is divided by thick rules, the space between each corresponding to the record of one job. Such a division is called a "section," because the card is cut up into sections at a certain stage. The smaller division at the top is called a "stub."

The ruling of each section is a matter depending on the nature of the work. The sample shown was used in a plant making heating apparatus and steam fittings, thus including rather heavy pieces and also small pieces in lots up to a hundred in each. In special cases modified rulings are used, as, for example, in pattern shops, core shops, foundries, etc., and for laborers.

At starting work, a blank card is appropriated to each man and his name, check number and machine number are entered on the top section, called the "totaling stub," as this ultimately goes to the pay-roll clerk. Then the time of starting the first job is entered in the space "Began," also the order number and piece number, and when necessary (in some shops) a brief description of the work, such as "facing boss" or "drill and tap for setscrew."

When the job is finished, the job clerk enters the time in the "Finished" space and also in the "Began" space of the next section, and also the order and piece number of the next job. This is all he has to do. Only when the workman proceeds to a new job does he have to make an entry, except that at night he enters the time in the "Finished" space on the last section used.

Whoever passes the work telephones the number of pieces "good" and "bad" to the job clerk, who makes entries in the space provided. This is the signal that the job is finished as far as that operation is concerned. Fig. 113 shows the condition of the card as it leaves the job clerk at the end of the day.

The next morning the shop clerk takes the cards and sorts them into order of the men's numbers. He is provided with two series of small rubber stamps, one giving men's numbers and their wage rates and the other giving machine numbers and their machine rates. These stamps are so made that rates can be

Machine Shop No.1	Man's Name A.Willinms	Check No. 361	Mach No. 26	P.W.		Hrs.	Wages	Mach.
Began 8.00	Order No. 1061	Job Turn Levers	Good 3		Man	Hrs.	Wages	Mach.
Fin. 12.30	Comp No. 7320		Bad 1		Mach.			
Began 12.30	Order No. 1921	Job Turn Pin	Good 1		Man	Hrs.	Wages	Mach.
Fin. 6.00	Comp No. 8263		Bad		Mach.			

Items in Bold Face Type are those Inserted by the Job Clerk

FIG. 113.—Time Card as filled out by job clerk.

changed when necessary without destroying the stamp. Each stamp frame has a pad of different ink, say red for men and green for machines. They give impressions thus:

361—25c. L26—20c.

reading "Man number 361, hourly rate 25 cents" and "Lathe number 26, hourly rate 20 cents." They are so arranged in the holding frame that the figures can be read on the wood tops like lines of print, so that any number can be picked out unhesitatingly.

The clerk takes the first card, picks out the man's stamp corresponding, and stamps the impression, first on the totaling stub and then on all the other sections that have entries on them. This operation is then repeated for the machine concerned. Both these operations take place more quickly than they can be described. Verification is by observing that the impressions on the totaling stub correspond with what the job clerk has written

there. We are then sure that all the other sections on that card have proper rates on them.

Checking Up with the Total Time.—The next step is to make sure that the tale of work as shown by the Time Card does really correspond with the time the man has actually been at work as shown by the gate time. Here again there are all kinds of elaborate arrangements that may be used to ascertain gate time. We cannot discuss this question here. Whatever system is used should be able to do one thing, namely, to permit the gatekeeper, as soon as the last man has passed the gate, to prepare without delay a list of men and the total hours they have worked. The list, of course, may be printed and the time rapidly filled in by the pen. The main thing is to have it done swiftly and accurately the same night, so that a list is ready for each shop clerk early next morning, covering all his men. The same list may be made to last a week or longer, as it is free long before the end of the working day and may be returned to the gateman.

The shop clerk takes his Time Cards, which are already in order of men's numbers, one at a time, adds the hours shown by the sections, and places the total on the totaling stub. Then he compares the total thus shown, with the gate time as shown by the gateman's list. If there is any discrepancy, he goes into the shop and interviews the offender there and then. On first putting such a system into work, many discrepancies will be found, but patience and perseverance will soon improve matters, and the men will get to be careful about odd quarters, usually due to coming late, that they have missed reporting to their foreman or gang boss, when he telephoned the time of commencing the first job to the job clerk.

When this is all done, we are sure that our job time is correct, and the troubles of that day are behind us, as far as time is concerned.

Totaling the Stubs.—The next step is to extend the wages and machine earnings on each section and on the totaling stub. This is best done by means of a "ready reckoner," (see Fig. 51) which should be a small book simply giving a separate hourly rate on each page and a series of figures representing the value of any number of hours and quarters up to the highest likely to be worked in one day. If higher rates are paid for overtime, a separate column can contain these figures also. One reading for each job should be all that is necessary. Such books can be

easily made up by the drafting room and blue-printed. I do not know of any really compact or simple book of the kind on the market. There are many full of unnecessary elaboration and of inconvenient dimensions.

Having extended all the sections on a card, the next step is to verify the total by adding up the working sections on an adding machine and seeing that they agree to a cent with the total on the totaling stub. Usually they will be a cent or so out, due to quarter- or half-hours. One of the sections must be altered so that the total of all-job-time agrees with pay-roll earnings and machine earnings on the totaling stub. This is important, so

Machine Shop No.1	Man's Name A. Williams	Check No. 361	Mach No. 26	P.W. ✓	361-25c / L26-20c	Hrs. 9	Wages 2.25	Mach. 1.80
Began 8.00	Order No. 1061	Job Turn Levers	Good 1	P.W. ✓	Man 361-25c	Hrs. 4½	Wages 1.12	Mach. 90
Fin. 12.30	Comp No. 7320		Bad		Mach. L26-20c			
Began 12.30	Order No. 1921	Job Turn Pin	Good 3	✓	Man 361-25c	Hrs. 4½	Wages 1.13	Mach. 90
Fin. 6.00	Comp No. 8263		Bad 1		Mach. L26-20c			

Note that the Odd Cent in Wages has been Adjusted on the Lower Job

FIG. 114.—Time Card with all entries complete.

that absolute balance can be obtained in the accounts later. When this is done we are sure that job time is locked into gate time and into pay-roll (see Fig. 114).

Record of Machine Time.—Before slicing up the Time Cards into sections it is usually convenient to take off the machine time and tabulate it. A printed list of all machines in the shop, with their normal days work and earnings is provided thus:

Mach. No.	Kind	Rate	Full Hours	Earnings
181	36″ Mill	15	10	1.50

Columns are provided for each day, in which the actual hours and earnings for each machine are entered. Each day's hours and earnings are totalled and compared with standard hours and earnings, showing loss due to idle machines. The individual machines at fault can be indicated by a tick at the time of making

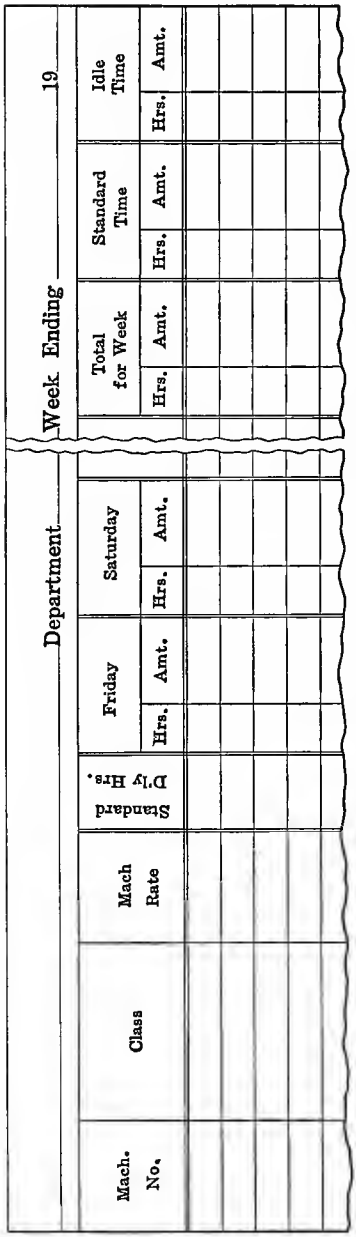


FIG. 115.—Daily record of machine duty and earnings and weekly summary of active and idle time.

the entry. The figures for entering are taken from the totaling stubs where they are already summarized (see Fig. 115).

Grouping the Details.—We are now ready to consider how the details of jobs, which are contained on the sections giving hours, wages and machine charges on each job, shall be most conveniently grouped together, so that all the work on one piece or group of pieces and all the work on various expense jobs or services may meet together. The quickest way of doing this is by dissecting the Time Cards and sorting the sections according to their Production Order numbers, or Standing Order numbers in the case of expense work. This is rapidly done by a paper cutter with a suitable guard. The Time Cards are sliced up into sections, and then these sections are sorted *in properly designed trays*, first to thousands, then to hundreds and later to tens and units. The totaling stubs are sorted out at the first sort, and handed to the pay-roll clerk or department, along with the gate time report, which is returned to the gateman after checking with the stubs. We do not need to follow these stubs further.

All yesterday's work of the shop is now sorted into Production Order numbers, and Standing Order numbers. Each component will be represented by from one to four or five sections. Each Standing Order will be represented in the same way. How shall the information therein contained, which is not only verified information, but also information in the ultimate detail, be made available for reference?

Summary of Wages.—The first step is to add, with a machine, all the sections bearing work order numbers and enter their total

_____ Dept. Week Ending _____ 19__

Item	Thr.	Fri.	Sat.	Sun.	Mon.	Tue.	Wed.	Week Total
Productive Wages:								
Wages, Ordinary								
Wages, Overtime								
Bonuses								
Total Productive								
Expense Wages:								
Building Repairs								
" Cleaning								
" Sundry								
Power Equipment Repairs								
" " Oiling								
Cranes, etc., Repairs								
" " Operating								
Supervision								
Organization (Clerks)								
Machines, Repairs								
To Other Departments								
Total Expense								
Total Payroll								

FIG. 116.—Daily record of wages expended in shop.

NOTE.—The classification of Expense Wages will follow the schedule of Standing Orders.

opposite the lines on the blank Fig. 116; namely, productive wages, ordinary and overtime respectively. Sections reporting bonuses earned, which come from another source to be mentioned presently, are also added together and entered. These three items form the total of productive wages for the day.

Next, the sections bearing Standing Orders are added, each order number separately, and the result is entered opposite the proper line, such as "cleaning buildings," "repairing machines."

The examples given will, of course, be varied according to the actual shop wants and will follow the Standing Order system in use. Amounts charged to other shops will be entered in one sum on this report each day. The total of expense items being added, the grand total will represent total pay-roll for the day.

Watching this simple report daily will give the foreman the closest grip on every cent of expense wages in his shop. Daily familiarity will enable him to tell at a glance whether any increase in any item is legitimate or not. Such expense is thus closely controlled at its source.

Watching the Cost of Jobs.—The next matter for attention is the disposal of the sections which refer to productive work. We know their total, but not their detail. Being already sorted into Production Order numbers, we take each set of sections, and sort them into their Component Order numbers. Each Production Order may have, say, three or four components being worked on at one time in the shop.

Each such component has a Cost Sheet arranged as shown by Fig. 117. It is made large enough to allow of the time sections being *pasted* on to it, thus avoiding the loss of time and danger of inaccuracy arising from posting or copying. As each process or operation is distinguishable by the color of the card, they can be pasted on in any order as they come in day by day. When any process is completed as indicated by the number of pieces appearing on a section, the sections for that process are summarized on a machine and their total entered in the oblong space at top left hand of the Cost Sheet. In the case of standardized work this space will already have been filled out by the production department with a list of operations and their expected or standard cost. Consequently as each process or operation is completed, it will be seen at once if the formen's attention is necessary, and whether it ranks as an "exceptional" job or not.

All the sections are thus rapidly disposed of by pasting on their proper leaves. Each leaf is thus accumulating the history of the piece exactly as it was actually worked on. Every incident is reflected. If the job was interrupted, if part of it was worked overtime, if men were changed while it was on the machine, if some was done at one time and some at another, if the man failed to earn a bonus, or if, on the contrary, the job went through promptly and smoothly—the whole story can be read from a simple inspection of the pasted sections, without a

Operation	Stand. Cost	Actual Cost	+or −
Total			

Dept._____

Component._____

Production Order No.
Component Order No.

Daily Time Sheet Section	Wages	Mach. Earnings	Cost at Machine	Supp. Rate	Total Cost
Time Sheet Sections as Fig. 95 Pasted on					
ditto					
ditto					
Total for all Operations in this Dept.					

FIG. 117.—Component Cost Sheets with Time Sections pasted on. The blank at top left-hand corner is filled out by Production Department where work is standardized, otherwise the column "Actual Cost" is alone used. These sheets are bound in an "album" forming a complete history of the Production Order to which they refer.

particle of additional clerical work or any delay. Moreover, it is not only there, but it is there for all time. Ten years hence, if required, it will be easy to refer back and see what man drilled a particular hole and what it cost for him to do it.

We have shown in considerable detail the steps up to this point, in order to emphasize the fact that the proper place to elaborate detail is at the starting point, in the shop, where alone detail is a matter of daily bread and possesses a live significance wholly missing at either a later stage or at a later date. Detail must be piping-hot, or it is of slender value. The people who make the detail are the people who can use the detail.

Bringing the Detail into Line.—The way in which this detail is brought into line with the rest of the system must now be briefly discussed. As soon as a job is finished, if it is a bonus job, the bonus earned is worked out on the job order given to the

_____ Department Date _____ 19____

Prod. Order No	Comp. Order No	Wages Cost		√	Reason
		Actual	Standard		
Total for Day					

FIG. 118.—Daily return of wages cost of finished operations compared with standard cost. The mark (√) is placed against items requiring foreman's scrutiny.

man (see Fig. 64), and summarized on a stub at the foot of the order. This stub is then detached, credited to the man in his book (see Figs. 85 and 86), and passed to the shop clerk to be included among his sections, as mentioned. It thus finds its way both to the pay-roll and to the Cost-Sheet.

Exceptional Jobs.—When a process or operation is finished, notified by receipt of the bonus stub or, if daywork, by the

"good" and "bad" entries mentioned, the shop clerk, after all his sections have been pasted up, proceeds to add the sections of such finished operations, so as to find its cost. This cost, with the standard or expected cost, is then entered on an Operations Cost Return (Fig. 118). A mark is made against all such jobs as have cost more than standard (or more than an agreed percentage of standard), and these are examined by the foreman, who puts his reason against them. An examination of the pasted sections will frequently explain the reason, such as "interrupted job" or "overtime." In other cases the defaulter may be interviewed for an explanation. Anyway, the foreman's attention is called promptly to all cases of increased cost and to these only.

_____ Dept. Week Ending ____ 19__

Item	Thr.	Fri.	Sat.	Sun.	Mon.	Tues.	Wed.	Total
Productive Wages								
Wages on Fin. Jobs								
Still in Shop								

FIG. 119.—Daily record of balance of work on hand.

Balance of Work in Hand.—The total of finished jobs at actual cost is also used as explained in the last article to give the foreman daily information as to the balance of work in hand in his shop. This is done by the shop clerk by taking yesterday's balance, adding today's productive wages and deducting finished jobs. This gives the new balance to be carried forward to next day. A columnar sheet makes each day's figures comparable with the preceding days (see Fig. 119).

Each day the total loss on jobs (those that are checked on Fig. 118) is classified and summarized under the various reasons for the loss. Fig. 120 shows the ruling for this blank.

Spoiled Work.—Another byproduct of the sections is the matter of spoiled work. The number of parts good and bad are disclosed by the pasted sections, and when the job is being costed these are summarized on the duplicate stub. They are also listed on a special blank for the foreman's investigation and note

as to reasons. These reasons are tabulated as described in the last chapter on a form similar to Fig. 120.

Workman's Record.—Figure 121 illustrates a blank on which is recorded the nature and amount of loss on orders considered to be the fault of the workman. This may be combined on one card with a record of late attendance, bonus earnings, etc., if desired.

_____ Dept. Week Ending _____ 19__

Reason	Thur.	Fri.	Sat.	Sun.	Mon.	Tues.	Wed.	Total

FIG. 120.—Daily return of loss on "Exceptional Jobs." The various causes are listed in the first column. A similar blank is used for recording loss on spoiled work.

Man's Name _____ No. _____ Dept. _____

Date	Order No.	Nature of Loss	Spoiled Work	Other Losses	Total
			$	$	$

FIG. 121.—Record of losses adjudged to be caused by fault of workman.

This is necessarily a description of the method of costing by sections, but anyone familiar with cost will see how it can be modified and extended. It may be mentioned that in some cases the material issues (which are made on suitably ruled

sections and cut up and sorted to numbers after they have been priced out and the day's total of issues taken off) are pasted on the Cost Sheet corresponding to the component which the material is for. In other cases the material sections are entered on a separate Material Cost Sheet and have nothing to do with any shop or department. This depends on the nature of the work.

The method of advising each foreman of the cost of work done by the repair department or other shops is sufficiently obvious not to need description.

Many details not given here will be filled in readily by those familiar with previous chapters of this book. The control attainable over idle machines, over spoiled work, and over the regular progress of jobs will be easily understood, but that over replacements, urgent lots and delayed work will be understood if the central fact that the whole history of each job as it occurred and as it is occurring appears on the Cost Sheet of each order. We have only to pick this up to know all about the order and its present position, and to answer any possible question about it that is within the purview of the shop. I do not know of any other method that answers queries so minutely, and at the same time so authoritatively, as this.

CHAPTER III

REPORTS AND RETURNS FOR THE SUPERINTENDENT

An important part of the superintendent's duties is to insure that the work is carried through the various departments in due sequence and with regard to the time schedule. Closely connected with this is the question of material, of new parts that have to be ordered and made to replace those spoiled at some stage of the work. The routine supervision of these matters will usually be delegated to a production clerk.

Control over the progress of work is attained by means of master schedules, which are sheets on which are listed all the parts or components in an order, and all the departments working on each component, arranged in the sequence in which the work of the departments is to be carried out.

The arrangement of schedules will differ with the nature of the work. They can be made to control either the sequence of work alone or to keep such matters as variation from standard cost, delays and replacements also in view. Fig. 122 represents a portion of a sequence-control schedule used in an English plant about 17 years ago. As each operation was reported finished the symbol representing that operation was blotted out by a rubber stamp. A glance at the schedule was sufficient to show whether operations were being carried out regularly. Each schedule represented an order for one machine, and being mounted on separate carriers, the different orders on hand could be arranged according to due dates. In this way a rather good control over time sequence was obtained, especially considering the very simple form of the schedule.

A more complete master schedule is shown in Fig. 123. This does not record processes *within* departments, but the complete work of each shop on each component. The information is derived from the Component Cost Sheets (Fig. 117) described in the last chapter, which are sent in to the superintendent by each department as soon as completed, but after entry on the Departmental Manufacturing Journal and Departmental Fin-

PRODUCTION ORDER NO. 9374

For 5 Ton Arch Steam Hammer

CYLINDER									
890	Cylinder	(P)	(F)	(In)	(N)	(B)	(T)	P	D
891	Cyl. Cover	(P)	(F)	(In)	(T)	D^1	D^2		
892	P. Rod Gland	(P)	(F)	(In)	P	So	T	D	
893	Ex. Flange	(P)	(F)	In	T	Tp			
894	St. Flange	(P)	(F)	In	T	D			
895	Pv Cover	(P)	(F)	In	T	D			
896	Sv Cover	(P)	F	In	T	D			
897	Pv Tube	(P)	F	In	B	T	D	Sl	
898	Sv Tube	(P)	F	In	B	T			
STANDARDS									
899	Quad. Stand	(P)	(F)	(In)	Pf	Pb	Pt	Df	Dt
900	Plain Stand	(P)	(F)	In	Pf	Pb	Pt	Df	Dt
901	Loose Slides	(P)	F	In	P				
902	Foot Step	P	F	In		D			
BUSHES									
903	Dis Bushes	P	F	In	T	G			
904	Quad Bushes	P	F	In	T	G			
905	Crank Bushes	P	F	In	B	G	T		

FIG. 122.—"Sequence of operation" schedule in use 17 years ago. Printed on long strips and attached to swinging boards so that the orders could be arranged in any desired series. P = Pattern ordered. F = Sent to foundry. M = Casting received. The other symbols refer to machine operations. The circle is a rubber stamp impression showing that the stage in question has been passed.

For 1 Polishing Machine Type BB — Prod. Order No 9163

Comp. No.	Part & Dept.	Material		Labor Cost		Efficiency		M.Rate	Cost at Mach	Supp. Rate	Dept'l Cost
		Wt.	Cost	Stand.	Actual	Loss	Gain				
860	Starting Lever	10 Lbs.	0.12								.12
	Forge			50	55	05		30	85	08	.93
	Mach. Shop			5.02	4.97		05	4.30	9.27	91	10.18
	Temp. Shop			10	11	01		6	17	1	18
	Grinding Shop			25	25			30	55	5	60
861	Side Wing Piece										
	Blacksmith			25							
	Machine Shop			1.60							
	Polishing Shop			30							
862	Front Foot										
860	Main Slide	15 Lbs.	20								0.20
	Forge			60	65	05		40	1.05	10	1.15

(Left-hand side.)

Master Schedule

Total Compt. Cost	No of Pieces		Delay		Date	Cumulative Check Postings					
	Wanted	Made	Due	Late		Mat'l	Wages	M.Rate	Shop Cost	S.Rate	Total
12.01	1	1	Oct.6	2 Days	Oct.5	0.20	0.65	0.40	1.05	0.10	1.55
					6	0.32	1.20	0.70	1.90	0.18	2.40
					8	0.32	6.53	5.36	11.89	1.15	13.36
1.35	1	1	Oct.5								

FIG. 123.—Production Order Master Schedule. (Right-hand side.)

ished Orders Journal, as described in Chap. XIX (Part II). Information as to the material is obtained from Material Cost Sheets in most cases but as previously explained, material is sometimes recorded on Departmental Component Cost Sheets.

Use of the Master Schedule.—The blank schedule contains the names and Component Order numbers of all components, and against each is stated the departments which have to do work on them and also the date at which each stage should be completed. Against each department the standard cost of the labor in that department is also given. Then the Cost Sheets are entered up daily as received, so as to show the weight and cost of material, the actual labor cost, the difference between actual and standard cost, the delay in days, if any, the number of parts good, the reference to the Replacement Order, if any, and the cumulative cost to date.

Inspection of the schedule at any moment will show the condition of the order as regards completion, the degree of delay already incurred, the extent to which the cost is coming out as expected with reference to standard, and the cost to date of all finished parts on the order.

As far as the superintendent is concerned the principle of exceptions applies to the work of controlling orders. As long as the different Departmental Cost Sheets come through without undue delay, and as long as no important increase of actual as compared with standard cost occurs, the superintendent's attention does not need to be called to the schedule. But if anything shows a tendency to go persistently wrong, then he is warned and can make inquiry in the proper quarter. The degree of increase of cost and of delay that needs to be brought to his attention is, of course, a matter of experience in each plant, and may vary from time to time also according to known conditions. Where all orders are behind, and well known to be so, then only extra-bad delays will be reported. The general idea will be quite clear after a little study of the makeup of the schedule, as shown in Fig. 123.

Some explanation may be needful as to the use of the columns on the right hand of the blank headed "Cumulative Check Postings." Only one line per day is used, and that only when a Cost Sheet or Cost Sheets have been received for entry. The first day the whole of the completed Cost Sheets pertaining to, say, Production Order 9,163 are totalled, as regards the different items—

material, wages, etc.—and entered on the first line. The next day the same process is gone through, but instead of entering the day's figures at once on line 2, they are first added to the figures on the previous day's line, thus making *cumulative* totals, or totals to date, for each column of cost data. Consequently, a glance at the sheet will tell us at any time what is the total expenditure on finished parts for that Production Order. In the instance shown, $1.55 had been expended on the first day, $2.40 at the end of the second day, and $13.36 up to the end of the third day. For labor only, these totals are $0.65, $1.20 and $6.53 respectively, and so with the other columns. When the order is completed, the totals of columns on the left hand of the schedule must agree with the totals of the cumulative check postings on the right hand, thus providing a proof of the accuracy of the work.

On completion of all the parts or components shown on the schedule, the Production Order is complete and the figures give the total cost of the order, as well as a detailed record of the cost of each part. Comparison of the totals of the "standard-cost" column with the "labor-cost" column will disclose how far the order as a whole has come up to expectations. If further investigation is desired, the individual departments at fault will be indicated by the loss and gain columns. If then any particular department shows up badly, the fullest detail as to what happened will be found in the Departmental Cost Sheets, which, as shown in the last chapter, contain a detailed history of the work, as shown by the original documents pasted on it.

The Cost "Album."—These Cost Sheets, when the whole order is completed, are then bound into book form, and the master schedule also folded and bound in with them. This collection of documents may be supplemented in some cases by other official papers, such as the report of the testing department on the performance of the machine before delivery. The front cover of this "Album" is a printed blank like Fig. 124 which summarizes all the cost data, and also provides space for entries interesting to the next higher authority, viz., the executive.

Separate master schedules, appropriately ruled, are provided for patterns, tools and replacements in connection with each Production Order. The expenditure on these three heads is summarized on the album cover, the Cost Sheets being withdrawn from the current file when the main Production Order is completed. In a few cases patterns and tools are chargeable to cus-

For _____ Customer _____ Prod. Order No. _____

FACTORY COST		MEMORANDA	COST, SALE PRICE & PROFIT	
Material			Sale Price	
Wages			Factory Cost	
Mach. Rates		Cost of Patterns	Commissions	
Production Cost			Shipp'g Charges	
Add. Supp. Rate			Customs Duties	
		Wages	Sales Expense	
Factory Cost		Material	Total	
		Burden		
Add. if Chargeable		Total	Profit	
Cost of Patterns			% on Sale Price	
Cost of Tools			% on Prod. Cost	
Inclusive Cost			% on Factory Cost	

Comparison with Expected or Standard Cost	Cost of Tools	Customers Name
Production Cost	Wages	
Standard Cost	Material	Address)
	Burden	
Loss	Total	
Gain		Date Ordered
	Spoiled Work	Date Promised
Sales Ledger Fol.	Wages	Date Delivered
Credited to	Material	Delay
Agent	Burden	Reasons for Delay
District	Total	
Class		

FIG. 124.—Summary of cost and profit on a Production Order. (This forms the cover of the "album.")

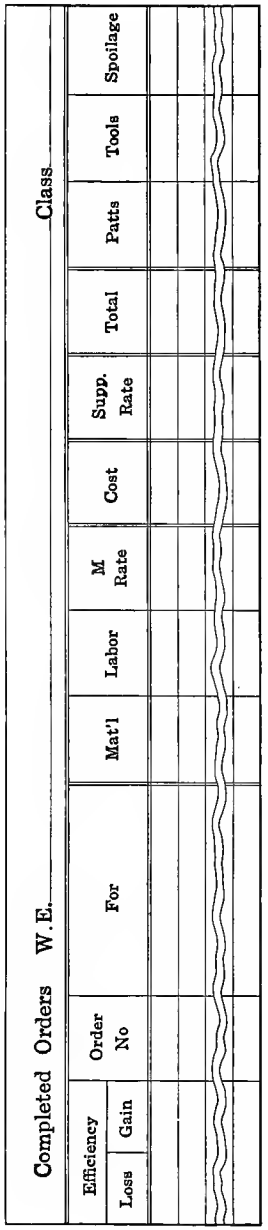


FIG. 125.—Report on completed orders showing loss or gain as compared with standard or expected cost.

tomer, but whether they are or not, these costs are always entered *as memoranda* on the cover, and are charged to their proper accounts at a later stage. The importance of recording such cost figures in conjunction with the cost of the order itself will be readily understood.

As each album cover is filled out, the data as to cost of the main order, and the patterns, tools and spoiled work in connection with it, are entered on a Finished Order list (shown in Fig. 125), which is sent weekly to the executive. It summarizes, of course, by classes the exact value at shop cost of all finished orders, to which is added the supplementary rate representing wasted burden not absorbed by working machines. The difference between expected or standard and actual cost is entered in one of the columns on the left of the blank.

Weekly Reports on Shop Efficiencies.—Having thus acquired a close control over the run of orders and their components through the departments and a detailed knowledge of their expected and actual cost, the superintendent will require figures to show him how the shops are getting on in the matter of certain kinds of efficiencies. These are afforded by what may be termed "reason registers." Their general ruling is shown by Fig. 126.

One of these blanks is devoted to "exceptional jobs" and one to "spoiled work." The information is derived from the weekly totals of

the corresponding shop records (Fig. 120) in the case of exceptional jobs, but in the case of spoiled work it will be necessary to take into account the total loss incurred in the chain

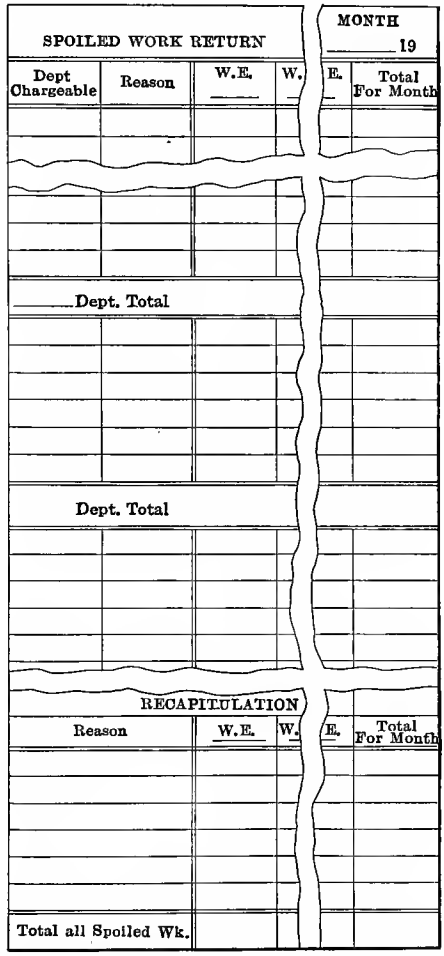


FIG. 126.—Weekly and monthly return of spoiled work by causes. Recapitulation of same by causes for whole plant. A similar blank is used for "Exceptional Jobs."

of production. The reports (Fig. 120) deal only with the loss incurred in a particular department, but as work may have been done by other departments on the piece, and as in any case there is the loss of material to be taken into account, it will be neces-

sary to compile the superintendent's account of loss on spoiled work from other sources. Moreover, the loss incurred in any particular department is not the significant matter from the superintendent's viewpoint; what he is concerned with is the amount chargeable against a department for spoilage, wherever incurred. Thus, if a piece has gone through several departments, and then is wasted owing to a faulty casting, the cost of the whole piece up to that point required to be accumulated and exhibited as a loss against the foundry.

Where Replacement Orders are in use, as they will be in all machine shops and engineering works, these will form the best source for data to be entered on the superintendent's return. It will also be remembered that the cost of such orders is entered in a special column in the Department Manufacturing Journal (Fig. 96). Consequently we have here a precise check on the figures in the return at the month end. If, therefore, as each replacement order is completed, the data are entered on a blank like Fig. 126 the total for the month of all spoiled work must equal the total charge to Spoiled Work account from the Departmental Manufacturing Journals. This blank in fact provides the authority for the distribution of that balance to the departments at fault.

The comparative performance of the different departments from week to week can thus be very clearly grasped. In the case of "exceptional jobs" the reasons assigned may be very instructive. It may be found that a particular shop is running high on account of "interrupted jobs" or "man's fault," or "too much metal." Even if these reasons prove to be the wrong ones, the attention of the superintendent will be immediately directed toward conditions that want altering. Similarly, a general tendency to attribute spoilage to "bad castings" will lead to prompt inquiry and thorough threshing out of the situation. If returns like this are made *weekly*, so that the figures of all exceptional jobs and all losses due to spoilage are brought right under the notice of the superintendent, in such a form as to be comparable by causes and shops with similar items in previous weeks and months, a very close control over the efficiency of operation will be secured.

Production and Expense Reports.—The daily statements of productive and expense wages (Fig. 116) and machine earnings (Fig. 115) made in each shop are also summarized weekly on a

blank similar to that used by the shop, and sent to the superintendent. He will enter the weekly figures on appropriate blanks, similar in form, but columned for weekly instead of daily totals, so that a comparison is set up *for each shop*, covering production (including labor and bonus), expense in one's own shop, expense chargeable to other shops, and total of productive and expense wages. These figures signify nothing for one week, but when placed side by side with a series of previous weeks they give a good rough idea whether the normal proportion between production and expense is being maintained.

Machine Earnings Month of_____ _____ 19 ___

Productive Department	Stand. Week		W.E. ____				4 Wk Average		
	Hrs.	Amt.	Hrs.	Amt.	%		Hrs.	Amt.	%
Forge									
Milling Dept.									
Machine Shop *A*									
Machine Shop *B*									
Polishing Shop									
Total for all Depts									
Amount Below Standard									

FIG. 127.—Weekly totals and monthly average of machine earnings.

The weekly statement of machine earnings is summarized on another comparative blank (Fig. 127), which records, shop by shop, the actual and the standard machine earnings. This is a very important return, as it enables the superintendent to see how far machines are being kept at work. If any shop seems at fault, reference is made to the shop record of machine earnings (Fig. 115), where the actual daily duty of each machine is recorded.

Weekly Balances of Work in Progress.—The labor value of unfinished work in the different shops and the labor value of finished jobs not yet closed out into finished orders are figures that give a good idea of the smoothness or congestion obtaining in the plant. Fig. 128 shows the weekly balances of work in each shop, as posted from the foreman's daily report (Fig. 119), at the end of each week. Below the shop totals the aggregate total of all postings to Production Order master schedules still

in hand is entered. The grand total of these figures shows the labor value of all work in shops and also of all finished components. The former of these figures is checked monthly by comparing the figures for each shop with the balance of labor in Manufacturing Journal, and the latter is checked by comparing it with the balance for labor in the Finished Department Orders Journal. The value of the return is, of course, the facility it affords for comparing the current week's performance of each shop with that of a series of weeks. By this means a very close control is obtained on congestion in shops, inasmuch as a rise

Labor on Uncompleted Work Month of_____ 19__

In Productive Departments	W.E.	W.E.	W.E.	W.E.	4 Week Av.
Forge					
Milling Dept.					
Machine Shop *A*					
Machine Shop *B*					
Polishing Shop					
Total in Shops					
On Schedules					
Total Unfinished					

FIG. 128.—Weekly total and monthly average of balances of work in hand (labor only).

in these figures, if unaccompanied with an increase of the productive pay-roll, means that unfinished work is piling up in the shops. Similarly, an increase in the item taken from the master schedules shows that a mass of finished components is being accumulated and that their transformation into assembled machines is falling behind. Though the return does not show more than the value of labor concerned, it shows this every week, throughout all productive departments and thus provides a significant figure relating to a principal factor of cost.

The Control of Expense.—In the previous chapter the record of expense as far as if affects the foreman was dealt with. The superintendent has, of course, to review the same figures, and he also has to control the economics of the non-productive depart-

ments, such as the power plant, the repair department, the stores, and any others that minister to production only indirectly. Thus in some big plants there may be departments for fuel oil, for powdered coal, for oxy-hydrogen gas, etc. The expenses of these have not only to be watched, but their output has to be costed and then allocated to the productive departments in proper proportion.

The power plant is a good type of these special departments. The returns should deal with it as a separate business. Space does not permit of describing a comprehensive power report, but in a plant of any size the cost should be expressed as a rate per horsepower-hour, and a charge made to each shop on the basis of its actual consumption of power, for lighting, for crane work, and for machinery. Steam for heating should also be made the subject of a similar charge. All such items are collected through Standing Orders.

The control of expense is best attained by the "budget" method, combined with a rigorous segregation of expense items by production factors. Each such item is represented by a Standing Order number as explained in Chap. XII (Part II). In the course of determining machine rates (see Chap. XX, Part II) a careful analysis of the expected expenditure on every Standing Order including power plant and auxiliary departments will have been carried out, and this should be made the basis of a weekly comparative Budget Return, showing on the one hand the *actual* expenses incurred, and on the other, their comparison with *standard or expected* expense. As in the case of the foreman's control of jobs, the superintendent need concern himself only with cases in which the standard expense has been unexpectedly increased. Diminished expense should also be closely watched by the clerk compiling the return, as it will probably imply an error somewhere, unless the reason is already known, as a reduction of staff, a strike, etc.

A blank, Fig. 129, shows how the weekly return of expense is entered. The figures are obtained from a *weekly* addition of the Standing Order Cost Sheets, and when the total for the *month* is brought out, it must agree exactly with the same items as entered on the Burden Journal, thus checking the accuracy of the figures. In some cases, as for example, non-engineering plants, these entries could be taken from the foreman's daily report of Standing Order expense (Fig. 116), but when one shop does work

Weekly Return and Budget of Standing Orders					19	
Standing Order Number	Item	W.E.			Month	
		Standard	Actual	√	Actual	√
Grand Total all Depts.						

FIG. 129.—Budget of Standing Order expense, and record of actual expenditure by weeks, and monthly total.

The (√) column is checked if any item needs superintendent's scrutiny.

for another, it becomes necessary to distribute the charge entered on the foreman's return as chargeable to "other shops," in detail. In such cases it is better to ignore the foreman's return and take the figures direct from the Cost Sheets.

Only those items within the control of the superintendent are included in this return. Such items as rents, insurance, interest, depreciation, etc., are not included, because the superintendent is not responsible for them, and they are, moreover, invariable amounts for the most part, not reducible by anyone.

Summary of Superintendent's Information.—The information provided for the superintendent will now be seen to be divided into three main groups: First, daily information as to the progress of orders is furnished, leading to a complete schedule of weights and costs of each component of an order *and to a summary of the cost of the entire order*, together with the *subsidiary expense for patterns, special tools and jigs*, and spoiled work, which latter items may or may not be ultimately chargeable to the order itself. Secondly, information is supplied as to certain kinds of shop or department efficiencies, namely, the *average loss due to idle time, spoiled work*, and *exceptional jobs, shop by shop.* The *balances of work in hand* at the end of each week in each shop, and in the shape of finished parts and material, are also provided, and can be compared with the total of finished orders, and of orders received. Thirdly, a current comparison of *actual expense, classified by production factors, is maintained*, comparable with the *budgeted* or expected figures for such expense. This enables the superintendent to observe, at once, any increase in expense items in any part of the plant, and if illegitimate, to curb it before it assumes either large or permanent form.

CHAPTER IV

REPORTS AND RETURNS FOR THE EXECUTIVE

The ordinary Profit and Loss accounts and Balance Sheet are derived from mercantile practice, and are much older than modern manufacturing. For this reason they do not commonly present the facts in a strictly logical order, having reference to the actual occurrences which have taken place in a plant during a given period. For the executive's use we require to serve this information in a series of groups, each of which corresponds to the practical distinctions between purchasing, production, selling, credit, and cash. A short discussion as to these natural groupings will be of service.

The operations of a plant have four main features—money has been expended—part of the purchases have been expended on production and part remain on hand. Secondly, the portion expended has gone into the factory and product (finished and partly finished) is a result. These are two clearly defined groups. Next, a certain portion of this product has been sold, by the aid of additional expenditure for salesmen, advertising, etc., and from such sales a profit has resulted. This is also a clearly defined group. If all transactions were for cash, these two groups would only need to be supplemented by an account of cash received, expended and on hand to complete the story of the period. Actually, however, we extend credit to our customers, and the status of this credit—whether our outstandings are increasing or diminishing—must also be recorded. Frequently we take credit ourselves, and if so, the amount of our liabilities must be recorded. These transactions form a fourth clearly defined group. Finally, our disbursements and collections must be tabulated so that the amount of cash we possess is known. This is the fifth and final group in which we are interested.

It will be seen that as regards each of these groups the executive asks the same series of questions, namely: What went in? What came out? What is left in, and in what form is it left?

In all these groups there are not only ingoings and outgoings,

but there is also a remainder or balance of something. In the first two groups we have balances of unused material and of work in process. In the third group we have, in most cases, a balance of goods unsold. In the fourth group we have a balance of collectible accounts, and perhaps of accounts payable by ourselves when we can spare the money to do so. In the fifth group we have the balance of cash in the safe or at the bank.

Though all these transactions and their resulting balances can be read in an ordinary mercantile Profit and Loss and Balance Sheet, their essential independence is not brought out clearly. The fact that they are all entirely separate groups of transactions, however, is most important to emphasize, if the executive is to form a clear mental picture of the result of the operations of the period. Further, it assists to a clear grasp of the situation if certain groups of transactions, such as, for example, those relating to stores, to factory burden and to selling expenses, are presented separately, so that their individual movements can be seen more distinctly and the main story more easily read by their separation from it.

There is also the important consideration, in many plants, that several different lines of product are made, and we may desire to ascertain just how we stand with regard to each of them. The latter information rarely if ever reaches the final Profit and Balance Sheets which go to the shareholders of a corporation; but it is of prime importance to the executive.

If we imagine an executive who has just taken charge of a business and wants to be put into possession of its salient features, we shall have a viewpoint that lends itself to demonstration. But though the first thought of such an executive would be directed to the month's trading results—the profit that had been made—his second thought would be for the general position of the business as regards production; and as profits logically arise from production, and not *vice versa*, we shall develop the series of reports presented to him from the viewpoint of the factory first.

Reports on Expenditure.—Preliminary to the actual story of production will come the reports on the expenditure that makes production possible. First, there will be provided a summary of wages paid, showing its distribution to factory burden, production and equipment (that is, to additions to equipment values, which in many shops are a regular feature of each month's work) and to selling. Next in order is a summary of stores, showing

purchases, issues to burden, production, or equipment, and balance of stores left on hand.

Burden Reports.—The next step is to present the various items of expenditure that go into burden, both factory and sales, and this is presented in two divisions, namely, factory burden and sales burden, or as it is usually called "selling expenses." Consideration of the latter is postponed until the whole question of production has been disposed of.

Production Reports.—The main story of production is now ready to be told. The wages, stores and burden that have gone into product are set against the cost of the finished product, arranged in classes, that has been delivered to the selling department. The burden which has not been taken up by machine rates is reduced to a supplementary rate and, being distributed over productive work done in the factory, appears as part of cost of finished product, and the balance represents work unfinished and still in the factory, thus showing, as in the other cases, what has gone in, what has come out and what still remains in.

A similar return is made for additions to equipment, buildings and to other capital accounts. The wages, stores and machine rates that have gone to the production of new equipment items are placed on one side of the account and the cost of finished items on the other. The balance left is the value locked up in unfinished additions to equipment still in the shops.

The equipment itself is then similarly reported on. Finished additions from the foregoing report appear on one side. Depreciation written off into burden appear on the other, and the balance represents the present value of equipment, buildings and other capital items.

This finishes the story of production. It has been told step by step, from the separate statements of what has gone in to the statement of what has come out in the form of finished goods and of additions to plant. Also the balances of stores, of work in shops on orders, and of work in shops on additions to equipment are clearly set out. Finished additions to equipment are also shown in their relation to capital accounts.

Dealing with Finished Goods.—We have now to deal with finished goods and their sale, and, of course, also with the selling expense. If we have, say, three lines of product, each of these is reported on separately from this stage onward. In most cases finished goods will not be sold straight from the factory to the

consumer, but will be kept in stock ready for delivery. This necessitates intermediate reports, to keep track of the balance of goods on hand. Otherwise finished goods from the production report and selling expense from the sales-burden report would go direct to the trading report. In the present instance, to simplify explanation, we shall assume that this is so, and that all production is on customer's order and goes direct from the factory to the customer.

A separate trading report is provided for each line of product. The ingoings are finished goods and selling expense. On the other side is sale price, the balance between each being profit on that line of goods.

The goods having now been sold and the profit ascertained, we have to consider the question of collecting what is due to us. For this purpose a ledger-balances report is provided. On one side is placed sales for the month and balance brought forward from last month, graded into three classes, namely, accounts due, not due and overdue. On the other side is placed the amount actually collected during the month, also the discounts allowed, and the balance is accounts outstanding, graded, as before, into due, not due and overdue.

Where we do not pay prompt cash for purchases a similar report is made for accounts owing by us. This shows the amount of our liability outstanding at the end of the month.

Finally, the disposal of the cash so collected is reported on. Cash received is set on one side, cash paid on the other, and the balance is cash on hand in safe or bank.

This general scheme is applicable to any manufacturing business, subject to extension in a few cases to cover special circumstances. It will have been seen that it covers all the operations of the plant in distinct stages. In regard to each stage the three questions stated previously have been asked and answered. Certain of the reports, such as administrative expense, serve to show the collection of items and the distribution of their total to other reports. Others contain balances. If all is correctly stated, these balances when brought together, and the capital stock of the business added, will *balance*. In other words, they are verified by a Balance Sheet of the usual kind. Having thus outlined the system of reports, and explained the scope of each, some specimen blanks will be shown. It may be pointed out here that an important feature of the control that such reports give is

ITEMS	JANUARY		TOTAL FOR YEAR	
	Budget	Actual	Budget	Actual
WAGES & SALARIES			Fig. 130	
Salaries, General				
Salaries, Factory				
Factory Wages				
Total In				
To Production				
To Plant Addition				
To Standing Orders				
To Selling Expense				
Total Out				
STORES			Fig. 131	
Balance from Last Month				
Purchased this Month				
Total In				
To Production				
To Plant Addition				
To Standing Orders				
To Selling Expense				
BALANCE FORWARD				
Total Out				
WORKS EXPENSE			Fig. 132	
Balance from Last Month				
Purchases this Month				
Total In				
To Production				
To Plant Addition				
To Standing Orders				
BALANCE FORWARD				
Total Out				

FIGS. 130, 131 AND 132.—Budget and actual expenditure on wages, stores, and works expense.

their arrangement in such shape that each month can be compared with previous months, with regard to each item appearing on the reports.

More than this is also possible. In a business of an established character we can, by using alternate columns on the blank for that purpose, forecast the expected value of each item; or, in other words, we can *budget* all the information, thus setting up a standard, variations from which may be cause for inquiry. In some businesses the value of budgeting is considerable, and in every case it fosters the habit of looking ahead.

Wages, Stores, etc., Reports.—The wages report (Fig. 130) explains itself. As wages are necessarily spent, and cannot be stored, there is no balance in this report. Wages are all distributed to one or other of the later reports.

We begin with a balance of stores in hand (Fig. 131). To these is added the value of purchases during the month. Against this total is placed the issues of stores, and also any purchases that may have been sent back to the supplier. The amounts entered as issues are distributed to one or other of the following reports. But in this case there is left a balance, namely, of materials still in stores and not yet issued. This is carried forward to next month. If desired, this report can be made more detailed by division into classes of stores, such as brass, steel, or castings, wire, etc. The balance in this report must be agreed each month with the balance in the Stores account.

Certain items chargeable as works expense (see Chap. X, Part II) are also reported by means of Fig. 132. It may happen that part of this is held over to equalize distribution between months, so that there will sometimes be a balance to be provided for.

Factory-burden Report.—The executive is probably not interested in the technical details of burden expenditure, which are matters for the superintendent. The factory-burden report (Fig. 133), therefore, gives him merely the total chargeable to the factory, and against this the amount actually charged. The balance "held over" represents the equalization of expense, such as the holding over of part of the cost of heavy repairs. This is the really significant figure of the report. It keeps uncharged expense prominently in view.

Production Report.—The production report (Fig. 134) brings forward the balance of work in hand at the beginning of month.

Items	January		Total For Year	
	Budget	Actual	Budget	Actual
FACTORY BURDEN			**FIG. 133**	
Balance Foreman				
Wages & Salaries on Standg. Orders				
Stores Ditto				
Works Expense Ditto				
Depreciation Factory				
Rents, Insurance etc. Factory				
Interest, Factory				
Total In				
Distributed as Machine Rates				
Distributed as Supp. Rates				
Balance held Over				
Total Out				
PRODUCTION			**FIG. 134**	
Balance (Work in Hand) Fwd.				
Productive Wages, this Month				
Productive Material, this Month				
Productive Works, Expense this Month				
Burden as Machine Rates Ditto				
Burden as Supp. Rate Ditto				
Total In				
Finished Product Class *A*				
" " Class *B*				
" " Class *C*				
Machine Rates on Pl. Addns. *				
Balance (Wk. in Hd.)				
Total Out				

* This Item is Transferred to Plant Addition Budget Report

FIGS. 133 AND 134.—Budgets and actual expenditure on factory burden and production.

adds to it the wages, stores and burden from previous reports expended during the month, and against the total of these two items places the work finished during the month, leaving a balance of work unfinished to go forward. The finished work is classified by products, such as superheaters, steam fittings, condensers, or whatever kinds there may be. A credit is also made here for machine earnings expended on additions to equipment.

Unabsorbed Burden Budget	JANUARY		TOTAL FOR YEAR	
	Budget	Actual	Budget	Actual
DEPARTMENT *A*				
Total Burden Distributable				
Distributed per Machine Rates				
" " % Supp. Rate				
Total Burden Distributed				
Supplementary Rate %				
DEPARTMENT *B*				
Total Burden Distributable				
Distributed per Machine Rates				
ALL DEPARTMENTS				
Total Burden Distributable				
Distributed per Machine Rates				
" " Supp. Rate				
Total Burden Distributed				
Supplementary Rate %				

FIG. 135.—Budget and monthly returns of burden unabsorbed by machine rates and distributed as supplementary rate.

This is usually a small item, and appears here to avoid complexity in the accounts. As shown, the balances of work in hand are not divided into classes of product, but this could be done without much extra work if desired. This report is a very important one, especially if we consider that the vertical columns represent months. The monthly variations in the principal facts of production are, therefore, disclosed by this report, which lends itself particularly to the budgeting method as already explained.

Burden charged to the shops and not absorbed by machine

rates represents, of course, wasted opportunities. If all tne machines had been working to the full there would have been none unabsorbed. In order to get rid of it, one of two plans may be followed: It may be charged off at once to Profit and Loss, since it is simply waste and does not really represent the cost of anything made. But a safer way is to prorate it over the work that has been done. It increases the cost of this, and so reaches Profit and Loss account after all. The unabsorbed-burden report (Fig. 135) keeps in view, month by month, its amount, and the per cent. rate that has been found necessary to get rid of it by prorating. Each month's waste is not prorated over that month's *finished* work. That would produce too violent fluctuations. The balance of all work done in the shop during the month, including the finished work, is taken into account. Thus, work in hand always includes a percentage of supplementary rate. This unabsorbed burden must not be confused with the "held-over" burden in Fig. 133. The latter has already been explained. The significant figure in this report is the percentage of supplementary rate. It is an index to the degree in which the machinery of the plant is being kept at work. In slack times, of course, it tends to rise.

Equipment Report.—The additions to equipment report (Fig. 136) is practically a production report confined to plant additions. It is not included in the production report—first, because it is a class of activity that merits being veiwed separately, and, secondly, because it does not take a supplementary rate. It would be quite illegitimate to charge plant additions with unabsorbed burden due to idle machines. In fact, it would be absurd to do so, since that would mean that such work would cost more in slack times than in busy times. Yet it is in slack times that as much of this kind of work as possible should be put in hand. All equipment is shown in one item in the equipment report (Fig. 136*A*). Subdivision into buildings, machinery, tools, etc., would be desirable in most cases. The general idea would remain the same, namely, to provide a means of showing the present value of the equipment from month to month, after new finished additions have been charged up and depreciation taken off.

Selling Department Reports.—The distribution of sales-burden report (Fig. 137) collects all the items of selling expense and shows its allocation between the various classes of products. This being

determined, the amount chargeable is shown separately for each product or an individual product sales burden report (Fig. 137*a*). This allows a proper amount of the sales burden against each line of product to be charged to the current month, and also allows some portion of it to be held up, as, for instance, when heavy expense for a particular campaign has just been incurred. If so held up, it must of, course, be carried forward to the next month.

PLANT &c ADDITIONS			FIG. 136	
Items	JANUARY		TOTAL FOR YEAR	
	Budget	Actual	Budget	Actual
Balance from Last Month				
Wages this Month				
Stores this Month				
Mach. Rates (from Fig 134)				
Works Expense Items				
Total In				
Additions Finished this Month				
Unfinished Work Forward				
Total Out				
PLANT REPORT			FIG. 136*A*	
Balance Last Month				
Additions Finished as Above				
Purchased this Month				
Total In				
Depreciation this Month				
Equipment Sold				
BALANCE FORWARD				
Total Out				

FIGS. 136 AND 136*A*.—Budget and actual expenditure on plant and equipment.

The *basis* of distributing expense to the various classes of product is not disclosed by the report (Fig. 137). It must be decided on after careful consideration of all the facts. Once this basis is fixed the allocation of the different items of selling expense to the different products is a routine matter, so that all that is needed here is a statement of the fact that they have been so allocated. The "held-up" balance is the most significant figure of the Fig. 137*a* report.

SELLING BURDEN				
Items	JANUARY		TOTAL FOR YEAR	
	Budget	Actual	Budget	Actual
DISTRIBUTION TO PRODUCTS			FIG. 137	
Salaries & Wages				
Stores				
Selling Exp. Sundries				
Depreciation				
Rents, Taxes, Insurances				
Interest				
Advertizing				
Traveling & Commission				
Shipping & Freight				
Total In				
To Product. Class *A*				
" " *B*				
" " *C*				
" " *D*				
Total Out				
A INDIVIDUAL PRODUCT BURDEN			FIG. 137*a*	
Balance from Last Month				
This Month as Above				
Total In				
To Trading Acct. this Month				
Held Up & Carr. Fwd.				
Total Out				
B INDIVIDUAL PRODUCT BURDEN			FIG. 137*b*	
Balance from Last Month				

FIGS. 137 AND 137*a*.—Distribution of selling burden to products, and individual statements of amounts charged and carried forward respectively in regard to each separate product.

Trading Reports.—A trading report (Fig. 138) is made for each class of product. Also a summary, consolidating all the separate product reports in one set of figures, is desirable if there are more than two products. The factory cost of the finished product for the month (including its proportion of supplementary rate) is added to the selling expense for that class of product for the month. Against these items is placed the price of the goods as billed, the difference or balance being the profit on that class of product.

TRADING REPORTS — FIG. 138

Items	JANUARY		TOTAL FOR YEAR	
	Budget	Actual	Budget	Actual
ALL PRODUCTS TOGETHER				
Factory Cost of Sales				
Selling Burden this Month				
BALANCE PROFIT				
Total				
Sale Price of Sales				
PRODUCT *A*				
Factory Cost of Sales of *A*				
Selling Burden on *A* this Month				
BALANCE PROFIT				
Total				
Sale Price of Sales of *A*				
PRODUCT *B*				
Factory Cost of Sales of *A*				

FIG. 138.—Trading budget and actual returns on all classes of product together and each individual product separately.

Collectible Accounts.—The collectible-accounts report (Fig. 139) shows the status of credit. It collects the total collectible and deducts the amounts collected and the discounts, leaving the amount still outstanding at the month end, classified into accounts due, not yet due and overdue.

Products for Own Use.—Where a firm makes subsidiary lines for its own use, such as nuts, bolts, screws, etc., which are transferred to stores on completion, a report like Fig. 136 should be

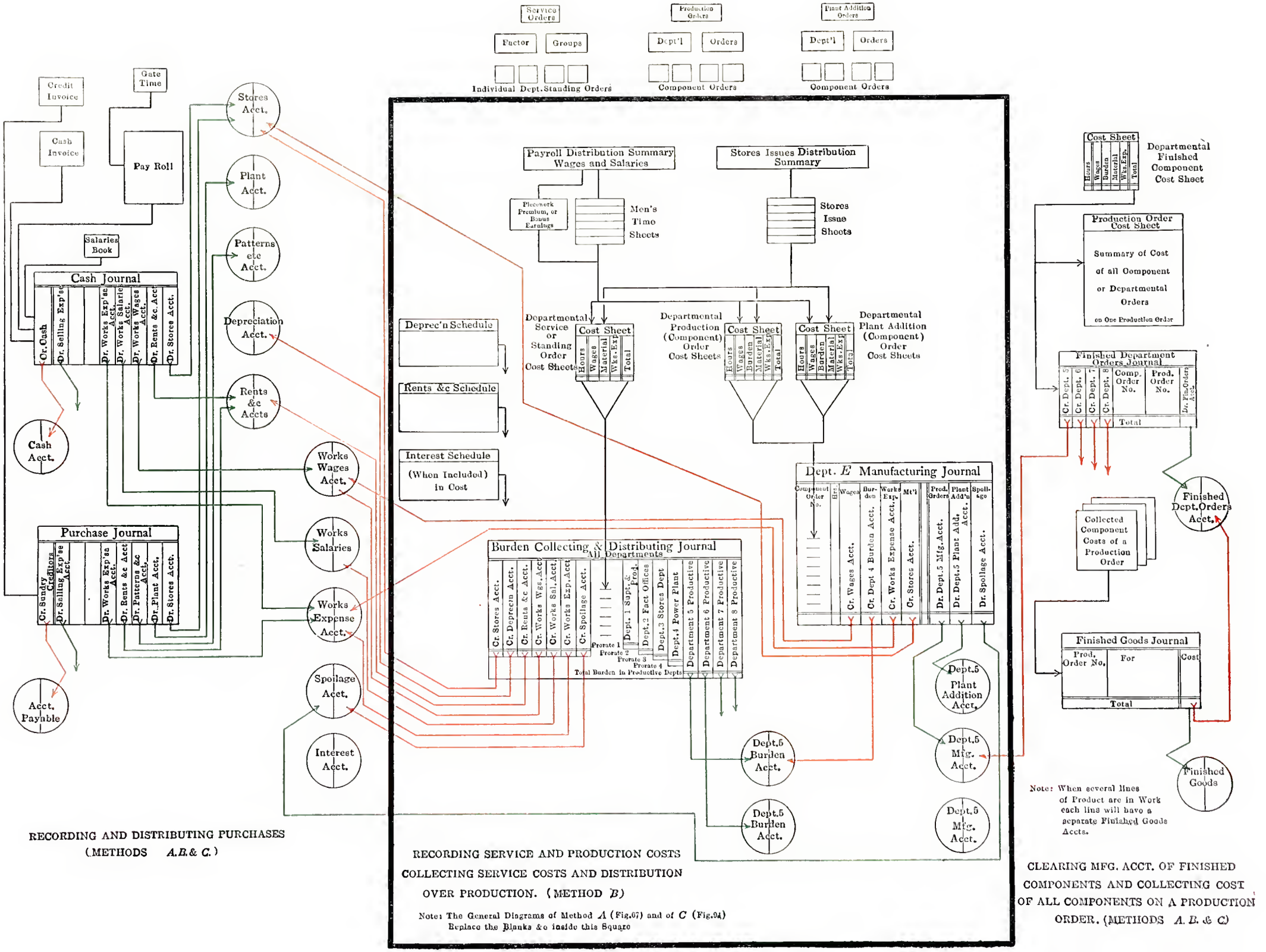
COLLECTIBLE ACCOUNTS								
Item	JANUARY			FEBRUARY			AVERAGE FOR YEAR	
	BUDGET	ACTUAL		BUDGET	ACTUAL		BUDGET	ACTUAL
		ITEM	TOTAL		ITEM	TOTAL		
Bt. Fwd. Accts. Due		*			*			
Accts. Not Due		*			*			
Accts. Over Due		*			*			
Total Brought Forward	*		*	*		*		
Sales this Month	*		*	*		*		
TOTAL IN	*		*	*		*		
Cash Received this Month	*		*	*		*		
Discounts Allowed	*		*	*		*		
Bad Debts Written Off	*		*	*		*		
Carr. Fwd. Accts. Due		*			*			
Accts. Not Due		*			*			
Accts. Over Due		*			*			
Total Carried Foreman	*		*	*		*		
TOTAL OUT	*		*	*		*		

FIG. 139.—Budget and return of collectable accounts. Balances are analyzed into "accounts due," "accounts not due" and "accounts overdue." The stars indicate the spaces in which actual entries are made.

used, and such work separated from ordinary production. The reason is that such work does not take supplementary rate. To charge it with such rate means that the cost of making things for oneself is higher in slack times than in busy times, which is obviously untrue. This is one of the absurdities that have been promoted by the usual percentage burden systems, and many firms have lost and are losing money because they suppose that work for themselves is costing them much more than it really is. The real truth of the situation is that in slack times they *are losing less* by such work than would be the case if they purchased outside, since such work absorbs machine rates which would otherwise go into unabsorbed burden and be wasted.

Nothing has been said as to the cash report, nor as to the ordinary Profit and Loss accounts and Balance Sheet, which will be familiar to everyone. But the method of carrying the items in vertical columns month by month should be extended to the executive's copies of these documents (see Chap. XII, Part I).

INDEX



RECORDING AND DISTRIBUTING PURCHASES
(METHODS *A.B.& C.*)

RECORDING SERVICE AND PRODUCTION COSTS
COLLECTING SERVICE COSTS AND DISTRIBUTION
OVER PRODUCTION. (METHOD *B*)

Note: The General Diagrams of Method *A* (Fig.67) and of *C* (Fig.94) Replace the Blanks &c inside this Square

CLEARING MFG. ACCT. OF FINISHED COMPONENTS AND COLLECTING COST OF ALL COMPONENTS ON A PRODUCTION ORDER. (METHODS *A. B. & C.*)