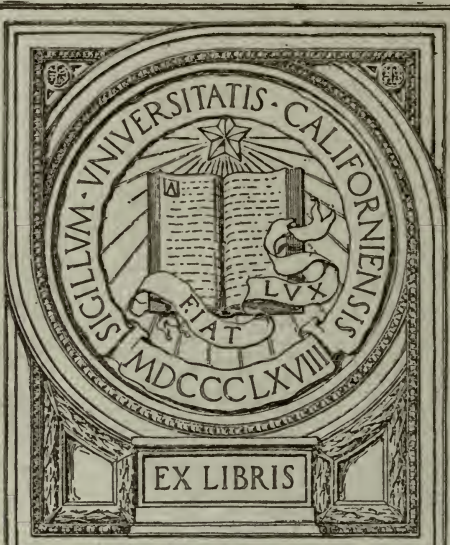

FOUNDRY COST ACCOUNTING

PRACTICE AND PROCEDURE

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CLEVELAND, OHIO

1919

PREFACE

Several excellent books have been written within the past ten years on the subject of cost accounting; and while the principles have been set forth more or less clearly and may be said to be of general application, yet the cost accountant with limited experience ordinarily has difficulty in applying them to a particular industry. There are many industries that are peculiarly different and where it is difficult and sometimes impracticable to apply the conventional cost accounting principles and procedure. This is particularly true in the foundry industry.

In this volume, therefore, the aim has been:—

(1) To set forth in a simple and direct manner, for the guidance of the foundry cost accountant, practical principles of accounting that are applicable to the foundry industry, and to show methods of collecting the cost data and of accurately determining production costs.

(2) To impress upon the executive and the management the importance of an accurate knowledge of costs and the dangers of a price policy that is not founded on production costs.

No attempt has been made to present all that might be said on the subject of foundry costs. On the contrary, the aim has been, while omitting no essential details, to be brief and concise and to reduce to a minimum the description essential to a clear presentation of the principles.

Every principle of cost accounting set forth herein is not only applicable to foundry practice but is being used in a thoroughly practicable manner and is giving satisfactory results.

It is not claimed that the procedure outlined is exactly suitable to all foundries. The claim is made, however, that

with minor adaptations, the principles, the forms, the classifications of accounts, the methods of distributing overhead expense, and the procedure in determining the cost of individual jobs or classes of work, can be used in a satisfactory manner by practically every foundry.

While a small proportion of the more successful foundries of the country have excellent cost systems and determine their costs accurately and make use of the information, yet the majority do not have systems worthy of the name and if this volume is the means of aiding in the improvement of the cost accounting practice of the latter class, it will have served a useful purpose.

THE AUTHOR.

October, 1919.

CONTENTS

FORMS, TABLES AND DIAGRAMS

FOUNDRY COST ACCOUNTING

Practice and Procedure

CHAPTER I

IMPORTANCE OF AN ACCURATE KNOWLEDGE OF COSTS

Value of Cost Information

To foundrymen, the subject of costs is not of general interest for the reason that only a small proportion appreciate the importance of the term. They do not realize what the term "cost of production" really means to them in their business, they fail to appreciate that an accurate knowledge of cost of production generally spells success, and that ignorance of true costs usually denotes failure.

About two years ago when Edward N. Hurley was chairman of the Federal Trade Commission, an attempt was made to learn from the two large commercial rating houses (both of which report on the cause of business failures) just what was the percentage of failures among manufacturers who actually knew the cost of each product they manufactured. A number of the best informed agents of these two commercial rating companies were interviewed and they reported that only in rare instances did the concerns know their costs of production and that in a large percentage of cases it was the absence of exactly such information that lead to the business failure.

It would be interesting to know the percentage of failures that have resulted from selling castings without the knowledge of their actual cost of production. Without question, failures due to this cause have been numerous.

It is not uncommon, even today, to find foundries making an interest return on their investment, but making almost

every penny of their profit on as little as 25% of the total volume of their business. That condition is the result of the absence of a knowledge of what it costs to produce each class of castings going through the foundry. It is a condition that is not healthy to say the least. It is dangerous to the individual and demoralizing to the industry. And there is only one solution to the problem, and that is to know the cost of each class of castings you manufacture. You are then in a position to price each class individually and to know your returns on each class.

The progressive foundries of today have the satisfaction of knowing that they are making a profit on each class of work they produce and that a fairly uniform rate of profit is made on each class. This is the result, in a large measure, of campaigns for better cost accounting. Within the past few years there have been installed in a large number of the foundries of the country uniform cost accounting systems, that today are making themselves felt in stabilizing conditions.

In those foundries uniform fundamental principles of cost accounting are recognized and followed with the result that costs are built up in a like manner and that they include like elements of cost. In competing with one another these companies can feel that they are competing on an equal basis and have the satisfaction of knowing that they will not be called upon to meet a ridiculous price that has been based upon a widely different cost determined in an entirely different manner.

The day of being guided solely by an average cost is rapidly passing. In a foundry, an average cost for all work is sadly misleading. In some respects, such information is worse than nothing for if one is guided by it, they are sure to go wrong. To say that a casting which a molder can produce but 150 pounds per day costs little more per pound than a casting which he can produce 900 pounds is an acknowledgment of misinformation; and to say that the profit per pound on the 150-pound job need be no greater than on the

900-pound job is an acknowledgment of an entire disregard of the fundamental principles upon which prices should be based.

An Accurate Cost—the Only True Price Basis

Accurate cost information is undeniably the only true basis upon which to make prices, and arbitrarily naming a price irrespective of what the product costs almost invariably produces bad results—bad results not alone to the individual company but to the industry as a whole. The foundryman's most dangerous competitor and the industry's greatest menace is the fellow who does not know what his different kinds of castings cost him to produce. Competitive conditions are seriously disturbed where losses on one or more kinds of work are recovered from profits on other kinds of work. It is obvious that one should know the cost to produce each kind of work he manufactures.

The man who produces, say, four different classes of work, two of which he sells at a profit and two at a loss, unknowingly, causes a lot of trade disturbance. In the first place, his ignorance is undermining his own success, and in the second place, he is not playing fair with his competitor who may be better located and equipped to manufacture the lines, which the other unknowingly has been selling at a loss. Is it fair competition to be obliged to meet a price that is made upon a guess, a price that may be less than the actual cost of maufacture? It is the exception and not the rule to find foundrymen fortified with a knowledge of the cost of each product they manufacture.

Businesses are conducted in order to make money, and the only way to make money is to sell the product for more than it costs. The essential then is to know the cost. It cannot be disputed that the small margin of profit existing in so many of our industries is due to the ignorance on the part of manufacturers of what their goods actually cost to produce. This ignorance causes them to make unprofitable

prices which the manufacturer who does know his cost is very largely forced to meet.

Advantages of Modern Cost Methods

Practically all foundrymen recognize the importance of accurate and dependable technical information in the management of their plant; of determining scientifically the constituents and properties of their iron, and of melting under strict laboratory control; the advantage of paying labor on the piece-rate and bonus basis over the old-fashioned day rate basis; the advantages of molding machines over hand molding; the importance of modern methods of handling and conveying materials, etc. While they admit that the foundry adopting the more modern technical and physical methods has an advantage, they are extremely slow to admit that a foundry can have an equal advantage in modern office and business methods—methods by which the operating efficiency of the plant can be watched and by which true costs of the product can be determined. No matter how modern and improved may be the technical end of the business, its successful conduct is not assured unless the cost of the various classes of product is known and the product disposed of at a figure in excess of cost. The successful conduct of any business depends upon selling the product at a profit, and in order to be sure one is selling at a profit the accurate cost of what he is selling must be positively known.

Experience has demonstrated over and over that in the production of castings it is not safe to base a selling price on an average cost. In a jobbing foundry the cost of the work of no two customers is the same; the cost of no two patterns of castings is the same. With almost every order, conditions vary, and the cost of production always varies with the conditions. The variations in cost should be known, studied, analyzed and watched. To enable one to watch his costs and thereby to know the results of his business he must have practical, up-to-date accounting and office methods.

Government Urging Improvement in Cost Methods

The Federal Trade Commission, the Tariff Commission, the Forestry Service, and other Federal and state governmental bodies have been urging business men to give the subject of costs the attention it deserves.

The Chairman of the Federal Trade Commission, Wm. B. Colver, in a recent address on the subject "Standardized Accounting Systems Recommended" stated that:

"The business world, well aware of the extent to which defective cost accounting methods prevail, is alert to promote reforms. A few years ago the Federal Trade Commission initiated an effort to be helpful in this direction and applied to Congress for funds to carry it on. As these were not given, the movement lagged, but as a result of the Commission's enforced studies and as a by-product of its war work, that effort may well be profitably and economically resumed. If the earlier effort of the Commission could have gone forward before the war, the government would have been repaid many times over during the war through making it possible to ascertain costs much more expeditiously and cheaply.

"In the immediate future the question of costs will be especially critical for the nation's business in arriving safely at postwar readjustments. The matter is important to the individual producer, to his banker, to industry, and to the public at large.

"From its experience of cost-finding the Commission stands for:

"Standardized accounting systems, suited to the various industries.

"Cost and profit accounting for individual products.

"Reasonable standardization of products and elimination of excessive costs due to unnecessary multiplication of styles and types.

"Compilation and issue of current basic trade information.

"Conferences between industries and government for the exchange of proper and useful views and information."

Investigations by the Federal Trade Commission have shown that a majority of our business failures can be attributed to poor accounting and inadequate business information. It has been found that bad office methods, inadequate and unreliable costs of production and distribution cause a great deal of unfair competition and a heavy business death rate.

With better accounting many of the bad business practices in the foundry industry would be brought to light and promptly curbed. When accurate results are known conditions never become so bad, as good accounting gives reliable information and timely warning.

The industries of the country that are strong industrially, commercially and financially are the ones where attention has been given to the recording of adequate business information, where costs are known, studied, and analyzed, and where prices can be made intelligently. A prominent manufacturer, in speaking of his cost department, said, "It costs me eighty thousand dollars a year to run this room but it is worth all it costs for it gives me the inside details of my business so that I know what I am doing." The experience of this manufacturer is no different from that of others who know what they are doing and why they are doing it.

Costs—an Index of Operating Efficiency.

Accurately kept costs, apart from being the only logical, safe and sound basis for pricing a product, are an index of operating efficiency. With properly prepared costs, the relative efficiency of the various departments of a plant can be watched and compared. The current results obtained in each department can be checked against those obtained in the past, thereby showing increases in efficiency, or the reverse, and the results of improvements in plant practice. The judicious use of accurately prepared costs will bring to light poor and inefficient management, and will enable standards

to be set for the less efficient departments, based on what has actually been done in departments that are being properly and efficiently administered. In this way, a complete and properly kept cost accounting system will be found to exercise the important and productive function of lowering costs and holding them at the lowest possible level.

It is a fact, too little realized, that correct cost keeping is fundamentally related to manufacturing efficiency. Modern accounting is the means by which a business is analyzed and the efficiency of its different operations weighed and measured. It enables valuable comparisons to be made and in this way weakness and inefficiency are exposed.

As most foundries are of a size which renders personal supervision by an executive impossible, the only reliable way, therefore, by which the executive can judge of the efficiency of his organization is through a system of periodical cost and statistical reports. These reports can only be accurately obtained when a good cost system is in operation. Correct cost accounting, properly administered, is a prime requisite to the full growth of any business.

To the foundrymen who have profited from the information their cost systems have given them, the writer urges them in the interest of their industry to be free to point out to their competitors that a well developed cost practice has enabled them to price their product intelligently and to increase their efficiency because it has helped them to know more about their business.

Objections to Installing a Cost System

Foundrymen who have not installed cost systems ordinarily have a number of reasons for not doing so. One of the objections is the feeling that exists in the minds of many that their particular business is so unique and so

different from any other that no system which could be operated in a practical manner would give them true costs. It is unquestionably true that some lines of production lend themselves more readily to the determination of costs than others, but it is also true that no line is so complicated but that a system can be devised and operated in a thoroughly practicable manner which will give reasonably accurate results.

The most common objection is that of the expense of operation. Many foundrymen are of the opinion that a cost system means an interminable amount of detail and red tape and the employment of a number of additional clerks. It is true that some extra labor may be required, but not to the extent that most foundrymen believe. There is in nearly every office that is not systematized, and where costs of production are not determined, sufficient unnecessary work done to cut down the extra labor to a minimum. In many cases, where the office force has been systematized, and where pay roll work and cost work have been unified, it has not been necessary to employ any additional help at all.

Then, there is a certain class of foundrymen who without any cost records whatever are of the opinion that they know what their castings cost. One may, from their knowledge of the work, have an approximate idea of what their castings cost them to produce, but at best the information is no better than a guess and guesswork is always unsafe and poor business practice.

Cost System an Investment, Not an Expense

A system will not run itself; neither will it in itself reduce costs nor increase efficiency. This is strictly up to the foundryman himself. A system will give him information, and if this informtaion is properly used, he will unquestionably find that his system is not an item of expense, but a very valuable investment.

If old and antiquated equipment is replaced by modern equipment before the old is worn out it is replaced because it is expected that the amount expended will increase profits either from a reduction in costs or from an increase in production. Money spent in this way is considered an investment and not an expense. Office methods have been improved to quite as large an extent as has foundry equipment, and an investment in improved office methods will produce a return just as great as an investment in improved machinery.

CHAPTER II

UNIFORM COST FINDING METHODS AND THE EFFECT ON COMPETITION

Fundamental Principles of Accounting

In the manufacture of castings, uniform cost-finding methods or fundamental principles of cost accounting can be laid down and can be satisfactorily followed by all manufacturers. There are no essential differences in the processes of manufacturing castings, whether grey iron, malleable iron, steel, bronze, brass, or aluminum, that distort a uniform cost practice. Only occasionally does one find local conditions that are peculiar to individual companies and it is rare to find local conditions that materially affect the introduction of uniform cost-finding methods.

An examination of the cost accounting systems of different foundries, where no attempt has been made to adopt uniform methods, shows that a variety of widely different methods are used to ascertain the cost of producing castings. This is particularly true in the matter of determining the cost of producing different patterns of castings, the cost of producing the work of a given customer, or the cost of particular jobs. Cost classifications of all conceivable arrangements are found while hardly any two companies treat the same elements of cost in a like manner. Important and appreciably large elements of cost are found to have been overlooked entirely by some companies. The result is extremely wide differences in costs which are not true differences but differences, to a very large extent, due to variation in methods of ascertaining costs. It is a condition that is adverse to sound trade relations and to the best interests and welfare of the industry.

Healthy trade conditions throughout the foundry industry demand that each manufacturer know his costs, that he know his profitable and his unprofitable work, and that he obtain

a fairly uniform profit on each line of work he produces. Remember, in figuring costs, you want to know the truth; you want to ascertain at what price you should sell your product, and the danger line below which you should not sell. Intelligent competition in the foundry industry, as in all other industries, depends upon a general knowledge of costs, upon intelligent estimates, and upon each member of the industry arriving at his costs and his estimates in a uniform and similar manner.

Co-operation in Cost Work

Every industry has problems which can be best solved through co-operation; many of our trade problems can be solved only through co-operation. One of these problems, and an important one, is co-operation in securing adequate business information through the adoption of standard principles of accounting with uniform terminology and procedure.

Obtaining an accurate and adequate knowledge of costs of production throughout an industry so that prices can be made intelligently is a most important and commendable phase of co-operative work, and one that has proven wonderfully productive.

The advantages accruing to the individual, to an industry, and to the public, of a uniform method of recording and reporting costs are many. Where methods are uniform, costs can be compared and intelligently discussed, differences can be analyzed, inefficient methods can be corrected, waste can be eliminated, costs can be reduced and prices can be made in an intelligent manner. The benefits to be derived from a mutual education and knowledge of costs of production and distribution are twofold—economies in operation, and intelligence in quoting prices. The best known price tonic is an educated competitor.

It is within the power of an individual business man to know his own costs of production and the prices he receives but without co-operation and the interchange of cost and price

data it is impossible for him to accurately gauge either average costs in his industry or general market conditions. Market conditions, so far as price is concerned, are the prices competitors are getting. And on this point it is unfortunate that false reports as to prices quoted by competitors are so widely current. Often false price reports are given credence and prices are met which never existed. This practice in the aggregate has a disastrous effect on our commercial health. The remedy is co-operation which insures fair and honorable competition.

No large corporation today would attempt to conduct its business without a comparison of costs and prices at different plants. It is imperative that this be done as only in this way can the relative efficiency of the different plants be determined. If inefficiency is disclosed through this method in a large corporation, the same benefits will accrue to an entire industry by the use of similar methods.

The time has come when it is realized that it is good business to extend a helping hand to a competitor. If he can be shown ways and means whereby he can arrive at an accurate knowledge of his own business, the whole industry is benefited. An intelligent competitor is one not to fear. It is the unintelligent competitor, whose only weapon is a cut price based on ignorance, who is so disastrous to the prosperity of an industry.

Cost Uniformity Needed

There is urgent need of better information and greater uniformity in a number of the branches of the iron and steel industry. In certain branches of the foundry industry there are a multitude of cost methods—nearly as many methods as there are foundries. There is no good excuse whatever for such widely different methods and practices. Even the excuse of small sized business is not a good one, for uniform accounting does not mean the adoption of identical books of account; it does not mean that the smallest foundry must keep as an

elaborate expense classification as the largest. It simply means that the same general cost divisions be followed, the same cost units, and that the overhead expense be distributed on the same basis. Costs then are built up in a like manner, and when this is the case it is surprising to see how small the true differences in costs are. By far the greater part of the big differences in costs we hear about are not true differences. They arise, to a very large extent, from differences in methods of determining costs.

Intelligent Competition Depends Upon a Knowledge of Costs

There is a certain form of competition to which the manufacturer can not well object, and that is the competition of the man who knows exactly what his goods cost and whose prices, if low, reflect advantages actually secured through volume or by reason of efficient methods of production. The form of competition which is most dreaded, however, is that of the man, who, having no proper knowledge of cost, sets prices which preclude the possibility of there being an adequate profit in the business for anyone.

This question of costs is not one of merely academic interest. It is, as a little thought will show, a matter of real concern, for if costs are to be utilized to the greatest extent as price and profit guides, the cost of each product must be determined sufficiently accurately to reflect its individual status as a profit earner.

The manufacturer of today faces the combination of advancing costs on material, labor, and expense, together with keenest competition in the selling end of the business. Under such circumstances prices would undoubtedly be only reasonably profitable if all competition were based on an exact knowledge of costs. In the absence of such knowledge it is not surprising that conditions are far from desirable.

From the standpoint of the manufacturer, the adoption of uniform cost methods mean the survival of the fittest, or, in other words, the survival of the efficient. With a logical

basis on which to operate, and the knowledge that if a competitor is underselling, it is because he is a better executive and has a more efficient plant, the manufacturer finds himself with something tangible to work upon. It then behooves him to study his own costs and determine just where he is lacking.

Sound trade conditions and living prices throughout the foundry industry invariably follow in the wake of a knowledge of costs. Where costs are known there usually is a profit, even though small, in every product manufactured. This is as it should be for an unwarranted price for certain work and too low a price for other work not only affects the success of the individual company but it has a marked effect on competition and one that is decidedly injurious.

Weakness of the Foundry Industry

The steel industry—rolled steel products—is in the foreground when it comes to improved accounting methods and business practices. Panics and depressions have given way to price stability. But the members of many of the allied industries are very lax when it comes to knowing what their product costs them to produce, and they are consequently suffering therefrom.

It is entirely safe to say that not one-third of the jobbing foundries of the country know definitely where they are making money, if they are making it, or where they are losing it, if they are losing it. About two-thirds of them are either guessing or their costs are so incomplete and unreliable that the information is no better than a guess. It is a condition that, from a competitive standpoint, cannot be said to be a healthy one. Their ups and downs in the past attest it. Lean years have resulted to a very large extent from foolish prices based on foolish costs.

The writer's work as cost accountant of the Federal Trade Commission and as cost accountant of the American Malleable Castings Association has acquainted him with the profits of a great many foundries and he can state, without fear of contra-

diction, that the companies at the present time and in the past that know and have known their business, that know and have known definitely their profitable and their unprofitable work are the companies that are making and have made the best profit showing. There are a few exceptions, but as a rule, guessing has proven poor business, and the proof is the showing of the Profit and Loss Account.

Work of Trade Associations

Members of many trade associations assemble year after year to listen to papers of great technical and professional interest. Matters which relate to the prosperity of all are discussed with frankness until it comes to the word "costs." A lot of business men think that there is something sacred about costs and that any discussion would destroy the very foundation of their business. They probably will discuss a great many things concerning trade conditions but the real thing which concerns the permanence of their investment is not discussed. Each man continues to bid for business largely upon misinformation and in actual ignorance of general conditions. In other words, they are playing the game blindfolded. Their salesmen send in reports of competitive prices; unscrupulous buyers give them hints or partial information; and out of this conglomeration of rumor, report and part facts, they individually and severally base their sales policy.

A number of our trade organizations, however, are working along sound lines and are rendering a valuable service to their members and to the public. My observation has been that the associations that are making the greatest progress, that are accomplishing the most, in a legitimate way, are those associations that have taken up cost work, plant practices, and the exchange of ideas and experiences.

It has been my pleasure to have met with a number of trade organizations within the past few years where both cost information and trade views and experiences were exchanged most freely, and there is no question as to the benefits accru-

ing therefrom, not alone to the individual but to the industry and to the public. It appears to me that co-operative work of this character is essential to the economic and financial strength of our industries and to the full development of our domestic and foreign trade.

In many of our industries certain manufacturers are, and have been for years, interchanging cost data, efficiency methods, trade views, etc., and the result has been unquestionably beneficial to every participant. If certain manufacturers within an industry can profit from an interchange of ideas and operating results, why cannot all do likewise through the medium of their trade association?

Several of our progressing trade associations are alive to the value of a free and frank exchange of experiences, operating results, views and observations and they are in this way strengthening themselves, they are protecting their customers, they are eliminating trade abuses, they are bettering labor conditions and keeping labor employed more steadily at a better wage. More can be accomplished through the efforts of associations in establishing fairness, frankness, and sound business policies based upon adequate business information than in any other way.

Better Competitive Spirit

It is encouraging to know the change of heart on the part of business men that has taken place in the last few years. Distrust is giving way to confidence. Secrecy is yielding to publicity. Business men are coming out in the open, laying their cards on the table, and dealing more fairly with one another. As a result, competition is undergoing a change. Under the new order of things, forms of competition are rapidly changing. The relentless suppression of the weak and the triumph of the strong is giving way to competition on terms of fairness and equality. Laws are being passed to enforce fair and just competition. Unjust price discrimination, secret rebates and the like which profited one set of men

at the expense of another are things of the past. Newer and more modern trade practices are taking their places.

Business men are getting a broader view of business and a more comprehensive grasp of industry as a whole. They are not centering all their energy and attention upon their own particular establishment. They are realizing more and more the fact that their plant is but a part of a great industry, and that their individual welfare depends very largely upon the welfare and progress of the whole industry in general.

Both business men and the Government today realize that there is a very useful field of co-operative effort among business men in improving cost accounting methods and business practices, in gathering adequate business information, in the standardization of processes and products, and in many other phases of industrial activity which tend toward more complete information and greater efficiency.

CHAPTER III

EXAMINATION OF PLANT PRACTICES AND OPERATING CONDITIONS

Reasons for Examination

While the fundamental principles of cost accounting throughout the foundry industry are essentially the same and are applicable to all foundries, nevertheless, in almost every plant there are operating conditions that are peculiar to that particular plant which have a direct bearing on the methods. For this reason, when a foundry adopts literally a cost system of a concern manufacturing a similar line of product, it does not, as a rule, work out satisfactorily.

A cost system, in every case, should be made to fit the operating conditions of the plant and not the plant to fit the cost system, and before attempt is made to install a cost system a careful examination of the plant practices should be made. With only a little work in making a physical examination of plant practices and operating conditions the fundamental cost accounting principles applicable to the industry can be readily applied to any foundry. It is obvious that if a complete cost system is installed the examination must be more thorough than if the accountant is merely to make suggestions for improvement in existing methods. However, in the latter event, it is always advisable to make a fairly close examination of plant operating conditions. In this way suggestions for improvements that are impracticable because of peculiar plant or operating conditions can be avoided.

Raw Materials

An examination of a plant should begin at the point of receiving and storing the pig iron, fuel, brick, sand, and other raw materials and supplies. Special attention should

be given to the method of unloading, of storing, of issuing same, and the means of conveying them to the places of consumption. The manner of issuing materials and the accounting therefor has a most important bearing on the gathering and on the accuracy of cost information.

If a stock system is not in use, and if carelessness exists in the handling of materials and supplies it will have a very decided bearing on the gathering of dependable information. It may be absolutely necessary that the plant practice in this respect be corrected. The correction would be the use of an up-to-date method of storing and issuing supplies, namely, the stores system, for there is no place in the foundry where carelessness, inefficiency and waste are more liable to exist. Stock is only another form of money and the stores system bears the same relation to stock as the cash book does to money and should be kept with the same degree of care.

Operating Departments

Step by step each stage of production in its proper sequence should be carefully analyzed. One of the first things to be taken into consideration is the division of the plant into its logical operating departments. Each department, as far as possible, should be restricted to a single operation in order that departmental costs can be procured for comparative and control purposes. Departmental cost divisions are desirable not only for the purpose of cost comparisons but for purposes of plant economy and efficiency. They afford a ready means of locating, for inspection and control, any unusual or abnormal increase in cost.

The general arrangement of the operating departments and the location of the machinery and equipment should be noted in order to ascertain the extent of overlapping, the use of machinery and equipment in common by two or more departments, improper routing of the product, etc. Special consideration should be given to the use of tram-

ways, industrial tracks, cranes, etc., which serve two or more departments.

Operating Conditions

Consideration, as affecting cost work, should be given to the method of molding, whether bench, machine, or floor molding prevails; to the process of cleaning—tumbling, sand-blasting, etc.; to the facilities for determining the weight of metal, fuel, and flux charged into the furnace or cupola; to methods of obtaining weights of castings finished and of those shipped, and in the case of malleable iron castings, the weight of hard iron castings, as well as the weights of finished castings and of those shipped.

Class of Product

For the purpose of applying cost methods, the class of product or classes of product of the particular concern should be carefully noted. This will determine whether it is advisable to record job costs, class costs, or tonnage costs. If the output is of a special nature the cost accounting principles applicable to the general run of foundry work might have to be modified materially.

In addition to the class or nature of the product, information should be secured as to the distribution of production and of sales throughout the year as this is an important cost consideration in plants producing principally seasonal products.

Power, Heat and Light

The general arrangement of the power plant and the method of generating power should receive attention, as well as the consumption of power by the different operating departments. Each department should stand the cost of the power consumed by it. If separate motors furnish power to the machinery of the different departments it is an easy mat-

ter to fairly accurately determine the department's power consumption without the use of department meters. In this connection, however, the few foundries that have installed department meters are highly satisfied with the results, as in this way they are able to keep an accurate tab on the power consumption and thus to eliminate waste as well as affording a means of checking the measurement of the supply company's meter.

The matter of heat and light requires special attention and consideration in order to effect an equitable departmental distribution of the cost thereof.

Elimination of Waste

Slightly apart from the introduction of cost methods, a watchout should be kept for the detection of possible leaks and the possibility of increasing plant efficiency. In every foundry, as in every other kind of business, leaks are bound to occur, either of material, supplies, labor or expense. If provision is made for statistics to show the amount of material necessary to do certain classes of work, the labor cost, and the overhead expense, an increase in any of these items will be revealed by a comparison and the executive will be in a position to take the matter up for investigation. It is hardly necessary to say that after a few of those matters have been taken up a little more care will be exercised. A cost system with forms properly designed for giving statistical information is of the greatest aid to plant efficiency.

From an examination and discussion of plant practices and operating conditions that have a bearing on cost records it is sometimes possible to offer suggestions of value pertaining to wage system, plant arrangement, routing of the product, avoidance of congestion in different departments, handling of supplies, etc., which result in elimination of waste and in increased operating efficiency.

Plant Order

One may think that the order in which a plant is kept has no bearing on cost work but it has a great deal to do with the successful operation of a cost system. To satisfactorily collect cost data there must be a recognized order of things so that proper and accurate records can be kept.

The stocks of pig iron, fuel, sand, and of all other materials and supplies must be kept in as good an order as possible so that accurate charges for materials used can be made as well as proper credits for materials returned to stock. Any and all scrap iron, fuel, brick, bad castings, etc., should be promptly returned to stock and not piled where it is convenient to do so without any means of keeping track of it. "A place for everything and everything in its place," is just as essential to good management in a foundry as elsewhere.

CHAPTER IV

INSTALLING AND OPERATING A COST SYSTEM

Co-operation of Management Needed

A cost accounting system, if it works smoothly and satisfactorily, must not only be entirely practicable and co-ordinate with plant practices but it must have the full co-operation of the management. When the introduction of a cost system is regarded with suspicion and fails to receive the co-operation of the management the making of any appreciable headway is up hill business. In order to produce the best results the co-operation of the whole force is needed, particularly that of the superintendent and foremen. If a system is going to be regarded with suspicion and criticism on the part of the superintendent and foremen and fails to receive their co-operation it is useless to install it. The want of co-operation has resulted in the abandonment of many an excellent cost system.

Foremen very often look upon cost finding methods as an invasion of their prerogatives and thus fail to lend any aid in carrying out the part they should play in the systematic arrangement of work and in the gathering of information that would be useful to them as well as to the management. Shortsighted and inefficient foremen are exactly right in their views, as a cost system provides a reliable means of examining their work and measuring their efficiency in a way that cannot be done by personal supervision no matter how careful and thorough the personal supervision may be.

It is not unusual to find foremen careless with the use of material and also with the time of the men. Time clocks often show that men were present, say, 1,000 hours during the week, while the reports of time spent on jobs amount to but 900 hours. Wherever time slips are made up showing the time spent on different operations or jobs they should either

form the basis of the workman's pay or else be reconciled with the time clock records. In gathering costs, and in keeping a watchout for inefficiency, the cross checking of time reports and clock records should never be omitted, and if a difference exists the foreman should be called upon to explain.

Accounting in the Foundry Industry Not Difficult

Cost accounting in the manufacture of castings is not difficult. Not nearly as difficult as in most manufacturing industries, but while the work is not especially difficult, it is, however, more than an office boy's task. As a general rule, the foundries that are keeping costs have very good talent in their cost department, but there are, on the other hand, a number of foundries that are trying to get along with inefficient help, help that is neither familiar with foundry practice nor with cost accounting principles. Efficient help in the office, as in the plant, is the cheapest in the long run. It is almost futile to attempt to introduce an adequate cost system in a foundry where the help is incapable of operating it, and this is very often the case even though the system is very elementary, and has been designed with the end in view of enabling inexperienced help to handle it.

In devising and introducing a system, it is always a mistake for the system to be limited to the cost clerk's capability. It should always be founded on good accounting principles and business practices and should provide the management with the information it needs to successfully administer the affairs of the business.

Modifying an Existing Cost System

Nearly every foundry gathers, more or less accurately, a certain amount of cost information and has records with which the plant is familiar that generally, with minor modifications, can be made to fit in and form a good part of the information needed to build up an accurate detailed cost. The task of

changing over an existing cost system to conform it to modern and approved methods, or to uniform principles of cost finding adopted by an industry, is ordinarily not at all a difficult one, and the time required to do so is surprisingly little.

In modifying an existing cost system the principal things are, (1), an arrangement of the cost accounts by departments; (2), a proper division and handling of direct and indirect charges; (3), a seperate overhead rate for each department, and (4), the use and application of the correct method of distributing the overhead of each department. While these are the principal considerations yet there are matters of less importance that have an indirect bearing on the accuracy of the cost information that should also receive attention, such as the method of receiving and issuing of materials and supplies, the form of pay roll records, the handling and distribution of inter-departmental charges—power, depreciation, taxes, etc.—the form of the cost records and of the cost reports and the relation of the general accounts to the cost accounts.

Expansion of Cost Practice

It is not necessary that a system be introduced and carried out in its entirety from the first. If it is founded on good accounting principles that are applicable to the foundry business it can be developed and expanded as the force is able to handle the work and as existing conditions make an expansion desirable. For instance, in introducing a system in a plant that is not accustomed to gathering cost data, it is a mistake to undertake too much from the start in compiling job costs. The system should be so designed that the cost of only a few of the more important jobs or classes of work could be had without in any way interfering with the successful operation of the system. Then, as the force becomes more familiar with the work and adept in handling it, they can add to its scope until the whole field of cost gathering has been covered and the costs of the entire production have been ascertained.

Avoidance of Unnecessary Detail

While a cost system should be fully adequate to the needs of a business it should not be top heavy. All unnecessary detail and red tape that does not justify itself with practical results should be at once eliminated, making room for information that can and will be used.

In almost every foundry there are data that no one makes any practical use of, information that is difficult and troublesome to collect, and in the form in which it is made up cannot be used practicably by either the foundry or the office. Needless to say, all such information should give way to that which is needed and which is practicable to use for it is rare to find a foundry but what could make good use of a greater amount of practical information than it possesses.

A very common mistake in cost work is going into exacting refinements—carrying out small items of cost to such a degree that the results are not worth the time spent thereon, and in making and applying to each item of cost complicated and varied bases of distribution, when one departmental basis, to all practical purposes, gives just as good results. A foundry recently visited by the writer was using three bases to distribute the indirect expense of the molding department when a single basis was found to give more dependable results and would thus have saved two-thirds of the time spent on that particular operation.

Application of Cost Principles

A theorist should not be entrusted with the installation of a cost system; neither should a practical foundryman unless he is well grounded in the principles of cost accounting. The practical man with a knowledge of accounting usually does the better work because he has constantly in mind the question, "Is it practicable?" The constant aim should be to make the system thoroughly practicable in its operation. It is possible to determine costs with a great degree of accuracy but it is not always practicable to do so. A lot of neatly ruled forms

look very nice, but are they all necessary and is not work being done that serves no well defined purpose? Every figure that has no practical use represents a loss. A great part of the criticism raised against cost systems is because of their impracticability. Too much theory is used in designing them and too little common sense and practical experience.

In the installation of a cost system, considerable skill is required in applying the principles to the conditions as they exist. Almost every plant has peculiarities that have a direct bearing on cost methods. The successful installation, therefore, is where the correct principles have been applied to the manufacturing conditions as they exist.

Preparation of Reports

In the preparation of cost reports, the designer of them should always bear in mind the object and purpose. The design of the forms necessarily depends upon the nature of the information and the use to which the information is to be put. If the cost information is for the purpose of measuring efficiency, the form in which it is compiled and presented will of necessity have to be different than if it is to be used for quoting prices. The former is largely a matter of arranging the data for comparative and analytical purposes, and it may comprise only the operation of a particular department and form only a part of the total cost, while if it is for the purpose of quoting prices, the information must, of course, cover the total production and selling costs. Usually, the sales management is interested in total costs only, while the plant management is vitally interested in detail information for analytical and comparative purposes.

The completeness of the information for the use of the plant management depends, of course, upon the completeness of the cost system. The cost system should be sufficiently complete to enable the accountant to furnish the plant management with any cost information needed. A well arranged cost report serves as an efficiency key which gives the management positive knowledge of the facts as they exist.

Design of Forms

Forms for gathering cost information should be designed with the view of collecting just the information that is desired, and securing it with the least disturbance to the foundry routine that is consistent with accuracy. However, in designing forms it is always well to have in mind possible future needs and to make provisions for them even though the data were not especially needed at the time the form was designed. Often too, a single form can be designed with a view of collecting information that is needed or can be used for two or more purposes. When this can be done it is nearly always advisable to do so for the number of forms in use should be kept down to the minimum. For instance, a time card can be used for cost keeping purposes as well as for the purpose of paying the workman.

Uniform Forms Not Essential

Uniform cost methods do not require the keeping of identical forms of records nor the preparation of statements in a similar manner, although it is desirable in many ways that there be substantial uniformity. In any event, the forms of records and of statements should be such as to gather and exhibit the results with the minimum amount of clerical labor, and with a ready means at all times of verifying the accuracy of the work.

Cost System Should Not be Independent of General Books

A cost system should not be merely a statistical or estimating system and operated independently of the general financial accounts but should form a direct part of and balance to a cent with the books. If there is not a balance, or a reconciliation, the costs of production, as a rule, are not dependable.

The starting point in cost determination is that so much money has been spent for pig iron, sand, and other material,

so much for labor, and so much for overhead, and all of this must be accounted for. A cost system is merely the method of following these expenditures from the receipt of the raw material to the finished castings, and the accountant whose costs do not "tie up" with the ledger is in danger. The situation is analogous to that of a paying teller who fails to balance his cash.

The argument is sometimes met that a cost system in a foundry cannot be balanced with the books because it is necessary to know the cost of certain jobs as soon as they are completed, and as the overhead must be based on past experience the costs cannot agree with the books. While this is true in a sense, it is also true that any method of arriving at costs in advance of the facts is not a cost but an estimate. The direct labor and material costs may be actual at the time the job is completed but any overhead applied previous to the close of the month, cannot be more than an estimate. The correct overhead chargeable to the particular job cannot be definitely determined until all the expenses for the month are obtainable and apportioned over the various jobs. As will be explained in a later chapter, direct costs should be applied directly to the job, and the actual indirect costs for the month should be distributed at the close thereof upon the best obtainable factor, taking into consideration that the factor varies with the nature of the expense.

CHAPTER V

ACCOUNTING PRACTICE AND RECORDS

Introduction

The accounting practice, and procedure, pertaining to the purchase and recording of materials and supplies and the recording of labor costs will now be taken up briefly. Methods of arriving at the inventory of materials and supplies on hand

PURCHASE REQUISITION

.....Department

No.....

Date.....

To.....
(Purchasing Agent)

Please place an order for the following supplies:

QUANTITY	DESCRIPTION
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....

Signed.....

for purposes of determining periodical costs when the stores system is not in use will also be described.

Purchase Requisition

Under the "stores" system, the stores clerk should prepare purchase requisitions for replenishing stocks of foundry supplies. He will be guided by the maximum and minimum quantities to be carried as indicated on the stock record cards (see page 51). The minimum quantity is the limit below which it is not safe to allow the stock to go for fear of exhaustion before a new stock can be acquired, while the maximum quantity is the limit beyond which it is generally inadvisable to go either on account of the idle capital involved or deterioration of the stock.

Purchase Order

The purchase order, as the name implies, is a definite order to the seller for the purchase of supplies. It should be made out in triplicate, the original copy going to the firm from whom the material is purchased, one carbon copy going to the receiving clerk, the other carbon copy retained by the issuing office. A serial number should be given the purchase order and the company from whom the material is purchased should be requested to enter the number of the purchase order on its invoice as a ready means of identification.

The copy of the purchase order going to the receiving clerk can be used by him as a material receiving record. This copy should be made with a short carbon, omitting both quantity and price. The party receiving the material is then obliged to count or measure the goods received and thus cannot shirk his duty by using, without verification, the quantity figures on the purchase order in reporting to the office. In the office, the copy with the material received notations is checked against the invoice. If this practice is followed, shortages and consequent overcharges cannot escape detection.

Material purchased for the account of a customer should be charged directly to the customer and not taken into stock.

PURCHASE ORDER

THE A. B. FOUNDRY COMPANY
Cleveland, O.

No.....

To..... Date.....

Address .....

You are hereby authorized to furnish the following material to be shipped to.....via.....

Quantity	Description	Price	

Place our order number on all invoices.

The A. B. Foundry Company

Per.....

Invoices From Creditors

Before invoices are approved they should be carefully checked with the purchasing and receiving records with respect to quality, quantity and price. The mathematical calculations should then be verified. To make sure that all invoices have been properly checked before they are passed for entry and payment, it is often advisable to stamp each invoice as it is

received with a blank form for recording the O. K. of the parties who verified the quantity, the price, and the extensions.

Stores

Only a small proportion of the foundrymen of the country keep within a separate enclosure the numerous operating supplies that are required in a foundry and have an orderly system of receiving, storing and issuing same. It is a phase of the plant management that is usually lax and one subject to a lot of abuse with consequent leaks and inefficiency.

When the subject is brought to the attention of officials one is met with the response that the extra expense of a storekeeper would not be justified. The expense of such a person, it seems, is something tangible and readily grasped while the loss from theft, carelessness, and the loss of time and inefficiency resulting from not having a place for everything and everything in its place, is something that cannot be so readily judged, although it may amount, and usually does, to several times the expense of a storekeeper, assuming that the entire time of a storekeeper would be required which is rarely the case. As essential as it is, the proportion of foundries that have an orderly and well managed storeroom is unfortunately very small.

The smaller foundries, as a rule, can handle their stores in an orderly and efficient way without incurring any appreciable amount of additional expense. If it is the practice of the plant to procure supplies, as nearly as practicable, at a stated time or times of the day, the time required of the person in charge of the stores is reduced to a minimum and often one of the office force can be delegated to issue the supplies without entailing any additional expense whatever.

Broadly speaking, "stores" in a foundry, are divided into two general classes:

1. Raw materials: Pig Iron, Scrap, Coal, Coke, Brick, Limestone, Sand, Lumber, Etc.

ARTICLE

LOCATION

UNIT OF MEASURE

STOCK RECORD

Maximum Quantity . . .

Minimum Quantity .

Purchased From	Received					Deliveries					Balance on Hand			
	Date	Order No.	Quantity	Price	Amount	Date	Req. No.	Quantity	Price	Amount	Date	Quantity	Price	Amount

2. Supplies: Facings, Partings, Shovels, Riddles, Oil, Waste, Files, Emery Wheels, Wire, Etc.

The location of the store room is important. It should be as nearly central as possible so that it will be equally accessible from all parts of the foundry.

All of the material for which the storekeeper is responsible should either actually or constructively pass through the store room.

Stores Record

Proper records should be made of the receipt of material and it should be issued only upon requisitions signed by a department foreman regardless of whether a perpetual inventory is kept with each kind of material. When it is advisable, as in most cases it is, to run a perpetual inventory with each kind of stock carried the form shown on the preceding page will be found to serve the purpose well.

The chief purpose of a stores system is that of having and preserving order in receiving, storing and issuing supplies; in reducing waste from extravagance and thefts; and finally, to ascertain the cost of the supplies consumed for purpose of arriving at periodical costs of production.

The accuracy of stock records depends in a very large measure upon the precautions taken to prevent any but properly authorized persons from removing material from stock. No material should be allowed to be taken from stock without a requisition therefor so that the proper record can be made.

From time to time the stock records should be verified by actual count, weight, or measurement so that any discrepancy may be located. Verifications should be made somewhat frequently and preferably at times when the stock is low.

Stores Requisition

For the purpose of ascertaining the supplies consumed and their cost the following simple form of requisition will suffice:

The information as to the material desired and the quantity is filled in by either the workman or the foreman and the requisition is signed by the department foreman or superintendent as authority to issue the supplies.

STORES REQUISITION

No.....

Storekeeper:

Date.....

You are authorized to issue the.....Department, the following:

Material	Quantity	Price		Amount		Account to be Charged

Foreman..... Superintendent.....

The return of stock to the storeroom can be taken care of through the use of a credit slip, or preferably, by using the same form of stores requisition of a different color. Where practicable, the credit slip or requisition should be attached to the original requisition and if the cost of the entire material withdrawn has been charged to a particular department, or job, proper credit should be given for the material returned. At the end of the month the office sorts

the cards by departments, makes the extensions and a recapitulation by department account numbers. "Stores" account is then credited with the total cost of supplies issued and the proper cost accounts of the respective departments debited.

The above requisition will be found to serve the purpose for cost accounting even if postings to a stock record are not made. While it is advisable in the larger foundries to keep stock records of all supplies in order to ascertain the amount on hand, it is not so essential in the smaller foundries that a perpetual inventory of all supplies be kept.

Stores System Not Essentially Required for Cost Accounting Purposes

The fact that "stores" are not kept need not interfere with the full and proper operation of a cost system provided that an inventory of the cost of the supplies on hand at the end of the month can be obtained. For the smaller foundries, the cost of supplies on hand at the end of the month can generally be determined by the inventory method with a fair degree of accuracy.

Where it is known for what purpose materials are purchased, supply expense columns can be provided for in the voucher record corresponding to the departments and postings can be made directly from the Voucher Record to the department supply accounts.

It is often the case that supplies purchased for one department and charged to that department will be used in part by another department. This situation can be easily taken care of by a system of transfer slips on which should be reported transfers of supplies. These slips can be summarized and the cost of the supplies charged to the department using them, crediting the department from which they were transferred.

The cost of the supplies consumed during the month is then arrived at by taking into consideration the opening and closing inventories. Under the inventory system, the accuracy of the month's cost of such items as sand, brick, lumber and

foundry supplies which are usually received in considerable quantities is contingent upon the care taken to ascertain the stock remaining on hand at the end of the month.

Inventory of Pig Iron

To arrive at the quantity of pig iron on hand at any time and its cost is not difficult. It is usual to keep a perpetual inventory of iron by charging the account with the quantities and the cost of receipts and crediting the account with the quantities and the cost of the iron consumed. The quantity consumed is always known as the iron is weighed as it is charged into the cupola or furnace.

It is a general practice also, particularly among malleable iron foundries, to pile separately in rows, each carload of iron, the weight of which is of course known. The inventory, therefore, can be determined very accurately each month by listing the weights of both the unbroken and the broken lots and deducting the weight of the iron used from the broken lots. A number of foundries determine the inventory of iron on hand at the end of each month in this way with very satisfactory results.

The following procedure in handling and recording pig iron will insure an accurate record of the iron on hand as well as the cost of the iron consumed.

1. Pile each carload separately.
2. Mark the pile with the car number, thus "B. & O. 48620."
3. As iron is taken for the melt, report weight and car number.
4. At end of month compute the actual cost of the iron used, i. e., invoice cost with freight and unloading labor added.
5. Make but one debit and one credit entry to Pig Iron Account monthly.

6. Check and reconcile consumption weight of each carload of iron with billed or invoice weight.

A record, in the following form, of the receipts of iron, invoice cost, freight and unloading labor, and of quantities consumed of each carload lot will be found to be convenient for both cost accounting and inventory purposes:

RECORD OF IRON CONSUMED

Car No.	Weight	Cost per Ton				Used	
		Invoice Cost	Freight	Unloading Lab.	Total Cost	Weight	Month
B.&O. 48620	80,000	$24.00	$1.00	$0.25	$25.25	60,000 20,000	Jan. Feb.
PRR 41760	60,000	25.00	1.20	.25	26.45	10,000 40,000 10,000	Jan. Feb. Mar.

Inventory of Coke

In the production of grey iron castings, where the iron is melted in a cupola, coke is almost exclusively used as a fuel,

and it is the practice to weigh either all of the coke charged into the cupola or to make frequent tests of the coke consumption per ton of iron melted. The former practice, with care in weighing, is to be recommended as it gives accurate consumption costs and reliable inventory information at all times; the latter practice, when frequent tests are carefully made, will give fairly satisfactory results in arriving at the cost of the fuel consumed as well as the inventory on hand.

Inventory of Coal

Coal is used very largely as a melting fuel in the production of malleable iron castings as an air furnace is used to melt the iron instead of a cupola, as in grey iron practice. Coal is also generally used for annealing. In the malleable iron branch of the industry, to arrive at the inventory of coal in order to prepare monthly cost statements is more or less difficult depending up the practice of the plant. If it is the practice to store separately melting and annealing fuel and to weigh it as it is used, it is, of course, not difficult to determine monthly inventories. When the coal is not weighed regularly but only at times when practice tests are made, the results of the tests can be used to arrive at the coal consumed and the inventory on hand with fairly satisfactory results. There is usually little difficulty experienced in malleable iron practice in arriving at the coal consumption by departments as generally different grades of coal are used for melting and for annealing.

Where coal is handled by crane it is not usual to weigh each individual bucket but to record the number of buckets charged and to apply thereto the average bucket weight. As the buckets are of a standard size and can be fairly evenly filled the application of an average weight gives very satisfactory results.

A number of foundries store their coal in bins of known

contents and determine by measurement, the inventory at the end of each month.

Inventory of Fire Brick

But little difficulty is encountered in determining the inventory of fire brick as the quantity on hand at any time is not ordinarily large and as they are subject to piling in a way in which they can be readily counted.

To facilitate recording and verifying, each carload of brick should be piled separately the same as in the case of pig iron.

Inventory of Sand

While a considerable stock of sand is usually carried, the cost is not great as the commodity is a cheap one. Therefore, even if a monthly inventory can not be had with exacting accuracy, the effect is not serious.

It is not the general practice to either weigh or measure sand as it is issued to the foundry, to the core room, or to the sand blast cleaning apparatus, although some do measure it by crane buckets, by wheelbarrows, or otherwise. The general practice makes it impossible to keep a perpetual inventory record. The next best thing then, is to determine the contents of the sand bins and ascertain the quantity on hand at the end of each month in this way. This method will be found to be both practicable and reasonably accurate.

Inventory of Partly Finished and Finished Castings

The cost accounting systems of certain foundries are designed for keeping the inventory or the cost of castings in process as well as the cost of finished castings on hand. Invariably, considerable difficulty is encountered in foundry practice to keep an account of the cost of work in process and of the cost of finished castings on hand. While a perpetual inventory of partly finished and finished work is thoroughly practicable in most manufacturing lines, it is not so practicable in a jobbing foundry, even with good bookkeeping talent. It can be done, and a few are doing it, but at the expense

of a lot of time and a considerable amount of uncertainty as to the accuracy of the results.

The most practicable manner of determining the cost of the inventory of partly finished and finished castings at the end of the month is to start with the cost of the physical inventory at the beginning of the year, add thereto the total costs of production for the month following and deduct the cost of the month's shipments, taking as the cost of the shipments during the month the average cost of the month's production of finished castings. The cost of the month's shipments can nearly always be taken at this figure as the practice of foundries is to ship work promptly and the accumulation of stock is rarely of any considerable importance.

Under the method outlined above it is not necessary to keep a work in process account nor an account with finished castings to show the cost of those shipped, both of which are the two most troublesome accounts with which the bookkeeper has to contend.

Annual Physical Inventory

A careful physical inventory of materials, supplies, partly finished and finished work, should be taken at least once each year. Especially designed inventory sheets should be ruled or printed in order that the lists may be made out methodically and in a form in which they can be preserved.

Inventory time is essentially a season when facts should be looked squarely in the face. It is poor judgment to try to fool one's self as to the state of their affairs. The inventory should be taken as thoroughly and as systematically as possible and when the task is ended the company should know exactly where it stands.

Basis of Physical Inventory

The object of taking a physical inventory is not so much to ascertain the quantity of stock on hand as it is to ascertain

its value in order to arrive at how much profit has been made through the conduct of the business during a certain period of time. Therefore, in order to accurately determine the amount of profit, the inventory must be taken carefully and at cost, and not, in any case, at market value, unless the market value is less than cost. When market values are used, when in excess of cost, profits are anticipated to the extent of the difference between the market value and the cost. Anticipated profits should never be taken on the books. A profit should not be recorded until it has been definitely realized.

Accounts Payable Voucher

Every foundry, no matter the size of its operations, as a matter of safety, should employ the use of an Accounts Payable Voucher. Its purpose is to provide a methodical, reliable and accurate method of paying invoices, to avoid duplicate payments, to indicate to the creditor the invoices which the particular payment covers, to furnish a means of providing for a complete history of the particular transaction, and to list and classify all expenses incurred, whether for material, labor, expense, or plant additions. The voucher is the first step to correct and dependable accounting.

The form should provide for recording the number of voucher, date, description, amount of invoice, allowances, the invoice or invoices which the payment covers, and the carbon copy should show the distribution of the expense by account number. This distribution forms the original cost accounting entry and is the basis of all other entries and classifications.

It is still the practice of quite a few companies to send the voucher to the creditor along with the check for signature as evidence of the receipt of payment, but the better practice is to retain the voucher and consider the endorsement of the check as a sufficient receipt.

The invoice from the creditor should be attached to the voucher and also a copy of the purchase order, and the cancelled check after it is returned from the bank. A complete

history of the purchase transaction can then be had from reference to the voucher.

A separate voucher should be made out for each creditor but not for each invoice. When payments are made monthly, and there are several invoices from a given creditor, a single voucher should be made out covering them all.

A voucher should be prepared for the pay roll, attaching thereto the pay roll distribution.

Likewise a voucher should be prepared for withdrawals of cash to cover petty cash expenditures for the month, indicating thereon the classifications of the expenses.

All vouchers are posted to or entered, according to the distribution noted thereon, for summarizing purposes, in the voucher record.

Voucher Record

The voucher record is the book of account in which the accounts payable vouchers are entered for purposes of summarization. The vouchers are entered numerically according to date of issue.

The voucher and the voucher record are both modern labor saving devices and are big time savers over the old fashioned method of journalizing and individual ledger postings. The saving is in eliminating the necessity of keeping individual ledger accounts with creditors and in making individual postings of expense items to the ledger. By providing a column for each classification of expense, postings can be made in total at the end of the month and at the same time the voucher record provides a control of accounts payable, inasmuch as the aggregate amount due to creditors at the end of each month is always known.

The form of the voucher record varies according to whether "Stores" are kept and material and supplies for cost purposes are issued on requisition, or whether the charge to expense is made when the material is received.

VOUCHER CHECK

No. 973

THE A. B. FOUNDRY COMPANY

CLEVELAND, OHIO

Pay to the order of _____ $ _____

_____ DOLLARS

To the **FIRST NATIONAL BANK,**
Cleveland, Ohio

The A. B. Foundry Company

By _____

IN PAYMENT OF THE FOLLOWING INVOICES:

Date	Description	Amount of Invoice	Cash Discount	Freight	Amount of Check

The Attached Check is in Full Payment of the Above Items, and Your Endorsement will be Considered an Acceptance as Such.
If Correct, Detach Statement for Your Reference.
If Incorrect, Return Check Explaining Difference.

THE A. B. FOUNDRY COMPANY

ACCOUNTS PAYABLE VOUCHER

(Carbon of Voucher Check)

OFFICE VOUCHER

THE A. B. FOUNDRY CO.

Cleveland, Ohio

No. 973

Pay to the order of

Date	Description	Amount of Invoice	Cash Discount	Freight	Amount of Check

DISTRIBUTION			
Amount		Verified By	
Account No.		Approved By	
		Entered By	

Left hand page

VOUCHER RECORD

Date	Vo. No.	Favor of	Description	Accts. Pay-able	Date Paid	Metal			Melting						
						10–1	10–2	10–3	22	23	24	25	26	27	28	29

VOUCHER RECORD

Finishing and Shipping						General Expense				Pattern Shop				Carpenter Shop			
61	62	65	66	67	68	70–1	70–2	70–3	70–4	101	102	105	103	111	112	115	118

VOUCHER RECORD

Molding							Coremaking							Cleaning and Chipping				
31	32	35	36	37	38	39	41	42	43	45	46	47	48	52	55	56	57	58

VOUCHER RECORD

Right hand page

Blacksmith Shop				Fixed Plant Charges								Sundry Accounts		
122	123	125	128	138	148	158	168	178	188	198	208	Amt.	L. F.	Acct. Title

If requisitions are issued the cost of the materials and supplies used can be arrived at in this way and there is no necessity for providing for sundry departmental supply expense accounts in the voucher record. In case, however, requisitions are not issued for material and supplies as they are used, it is necessary in order to arrive at the cost of the quantities used by the different operating departments, to provide a supply expense column for each operating department, or for each class of materials and supplies, in which all purchases are entered. The inventory at the beginning of the month, plus the purchases during the month, less the inventory at the end of the month gives the cost of the supplies consumed during the month.

The preceding form of voucher record is suitable for a foundry where materials and supplies are not issued on requisition. If the "Stores" system is employed and requisitions issued, the accounts under each operating department for materials and supplies can be omitted, having in their stead two or three controlling accounts only. The account numbers correspond with those used in the classification of accounts shown on page 128.

The big advantages of the use of a voucher record are that it dispenses with keeping ledger accounts with creditors and that it classifies expenditures with but one posting monthly for each expense account for which a column is provided.

At the end of the month the total of the column marked "Accounts Payable" is posted to the credit of that account in the general ledger. The account at the end of the month, after it is debited in total from the cash book with payments to creditors, and discounts taken, will show the aggregate of accounts payable.

The totals of each operating expense column are posted monthly to the debit of the respective columns in the general ledger.

There will be no entries in the departmental fixed plant charges accounts 28, 38, 48, 58 and 68, except through transfers

at the end of the month from accounts 108, 118, 128, 138, 148, 158, 168, 178, 188 198 and 208. In these latter accounts will be entered the fixed plant charges as they are incurred irrespective of departments. Then at the end of the month the proper departmental distribution will be made and the former accounts charged and the latter ones credited in red, thus balancing them. The advantage in making the transfer on the Voucher Record is that the book then shows total departmental costs.

Under the column "Sundry Accounts" will be entered expenditures pertaining to property accounts, plant additions, etc., and not expenditures incurred in connection with operations.

Pay Roll

In preparing a pay roll two objects should be constantly borne in mind; namely, to arrive at the correct earnings of the workmen during the pay period, and, to classify, for cost accounting purpose, the earnings in a way in which the labor costs by departments can be obtained. The two objects, at the same time, can be attained very easily if the pay roll record is properly designed.

Whether the pay period is one week, two weeks, or a month is not material in cost work. However, where monthly statistics are prepared, as they should always be, the preparation of the monthly statements is greatly facilitated if the pay periods correspond to the period covered by the statement. This saves the work of splitting the labor cost shown by the pay roll. Pay periods should not be every two weeks but twice a month instead.

The following form of pay roll, which is designed to classify the labor costs by department account numbers, will be found to be a convenient one.

If the pay period is the first half of the month a line is drawn through the numbers 16 to 31, and if the pay period is

DEPARTMENTAL PAY ROLL

.....Department For Period Ending.....19 .

Name of Employee	Employees' No.	Dept. Acct. No.	1 16	2 17	3 18	4 19	5 20	6 21	7 22	8 23	9 24	10 25	11 26	12 27	13 28	14 29	15 30	31	Hours	Total Hrs.	Rate	Department Account Number						Total Amt.
																						32	52	62				
		32	2	2	2	2		1	2	2	2	1	2			2	1		21			8 40						
Doe, John	46	52	8	8	8	4		6	8	8	4	4	8		6	4	2		78				31 20					
		62				4		3			4				2	4	6		23					9 20				
																				122	40c							48 80

the second half of the month a line is drawn through the numbers 1 to 15.

Names of the workmen and their numbers are filled in at the office after which the sheets are turned over to the foremen of the respective departments, a sheet for each department. The five divisions into which each man's space is divided is for recording the time spent on work for other departments, the department being indicated by the department labor account number. The columns to the right are for distribution of the time by departments which is made in the general office, the department labor account numbers in the distribution columns corresponding with the department labor account numbers entered by the foreman.

The time and earnings of all workmen should be carried to the pay roll, including molders and coremakers, the total of which then gives the full amount of the entire plant pay roll.

For recording the time and earnings of molders and coremakers, however, a different ruling of sheet should be used. The form of the sheet should be such as to record the molding and coremaking direct labor costs by pattern numbers or job numbers as well as to arrive at the total earnings of the employe. Forms of molders' time sheets are shown on pages 84 and 86 and of coremakers' time sheets on pages 100 and 101.

Pay Roll Distribution Sheet

From the pay roll, which indicates the labor cost by department labor account numbers, the results by account numbers are carried to a pay roll distribution sheet. A voucher is then made up for the total amount of the pay roll to which the pay roll distribution sheet is attached for purposes of making the proper classification in the voucher record.

The pay roll distribution sheet should carry all of the labor accounts provided for in the classification of accounts. It is advisable to have the account numbers and titles printed in.

PAY ROLL DISTRIBUTION SHEET

Period Ending.....19.....

Acct. No.	Title of Account	No. of Employees	Hours Worked	Amount	
Total					

Record of Employees

It is the general practice of most manufacturing companies in other lines of business to keep a ready reference record of past and present employees, their name in full, nationality, birth date, single or married, occupation, date employed, date left, rate of pay, etc. In the foundry industry, however, only a very few companies keep a record of their employees and the absence of information of the above nature is often badly felt.

The following simple card filed alphabetically, can be used by a foundry with good results:

RECORD OF EMPLOYEES

Name _____ Number _____

Address _____ Married / Single

Date of Birth _____ Nativity _____ No. in Family _____

Occupation _____ Dept. _____

Date Employed	Rate	Date Left	Rate	Remarks

Employe's signature _____

CHAPTER VI

OPERATING DEPARTMENTS and DEPARTMENT RECORDS

Introductory

Practically every manufacturing business is run by departments, and business men can better appreciate the importance of cost records when the accounting structure is arranged to show how the departments compare one with another as to operating results, expenses and efficiency. Cost records that do not follow proper departmental lines do not serve the full purpose for which they are intended.

In a foundry, the operations naturally divide themselves into the following departments:

Melting.
Molding.
Coremaking.
Cleaning.
Trimming and Inspecting.
Annealing.
Finishing.
Shipping.

The operations in each department will be described briefly as well as the forms commonly used to record the departmental operations.

While a sharp departmental line can be drawn with respect to most expenses, yet in every foundry, as in every business, there are certain operating expenses such as power, heat and light, depreciation, taxes and insurance, that have to be divided departmentally more or less arbitrarily. Meth-

ods of distributing such expenses are shown in Chapter VII as well as convenient forms for showing the distribution.

Melting Department

The melting department of a foundry is that part of the plant in which the iron is melted. In a grey iron foundry, it is the cupola, in a malleable iron foundry and in a steel foundry, the melting furnace.

The use of a cupola in the manufacture of malleable iron castings is practically obsolete, it having been replaced by the air furnace—both natural and forced draft—and the open-hearth furnace. The uncertainty of the results obtained by cupola melting makes the air furnace preferable for the manufacture of malleable iron castings, although the cost of melting, both as far as fuel consumption and repairs and maintenance are concerned, is very much less in the cupola than in either the air furnace or the open-hearth furnace.

In addition to the cupola or furnace, as the case may be, the melting department should include all equipment and shops that serve the cupola or furnace, such as the blacksmith shop for repairing grate bars, pokers, etc.; the laboratory for analyzing the iron and testing the product; the slag mill for separating the iron from the slag, etc.

Departmental Line

The departmental line for cost determining purposes is delivering the molten metal at the spout of the cupola or furnace into the ladle.

The costs of the melting department include all material, other than iron, used in melting, and all costs of handling the material—iron, coke, coal, fuel oil, flux, etc.—from point of storage to furnace or cupola, as well as the costs of repairs,

insurance, taxes, and depreciation on the melting equipment.

Record of Heats

A record of each charge or heat should be kept showing the weight of metal charged, scrap recovered, weight of good castings, melting loss, weight of fuel used and ratio to metal charged.

The following form of daily heat report will give the plant manager a summary of the heats with their results:

DAILY HEAT REPORT

DATE.....19..

	Pounds	Pounds
Metal Charged:		
Pig Iron	36,000	
Foreign Scrap	4,000	
Home Scrap	10,000	
Total Metal Charged		50,000
Less Scrap Returned		12,000
Total Weight to be accounted for		38,000
Total weight good castings	33,000	
Melting Loss	5,000	
		38,000
Coke Used 10,000 lbs.		
Per ton of metal charged 400 lbs.		

Blacksmith Shop

The greater part of the work done in the blacksmith shop is for the melting department and the molding department, and it is not difficult to charge the costs of operating

it to the department getting the benefit of the work and this should be done in every case.

The following form of record will answer both for a time record of the employee and for a cost classification record:

BLACKSMITH SHOP

Shop Order No.....

Name of Workman..... Date.....19..

Nature of Work	No. Made	Kind of Matr'l Used	Q'n'ty of M't'l Used	Hours Worked	Labor Cost		Material Cost		Acct. to be Charged

Correct.....
FOREMAN

The workman records, or it is recorded for him, the nature of the work on which he is engaged, the amount of work he turned out, the kind of material used and the time during which he was engaged. A separate ticket is made each day. The cards can be used for pay roll purposes and for purposes of cost classification of both labor and material, the account number being indicated in the last column.

Slag Mill

The slag mill operations call for no separate records or reports. The operating costs, however, should not be mixed

PIG IRON ANALYSIS RECORD

Date	Car Initial	Car Number	Brand	Pile Number	Weight (pounds)	SHIPPER'S ANALYSIS					CHEMIST'S ANALYSIS				
						Carbon	Silicon	Sulphur	Phos.	Mang.	Carbon	Silicon	Sulphur	Phos.	Mang.

with other melting cost items. It is important that all of the operating expense—labor, repairs, depreciation, etc.—be treated as an expense of the melting department and not as a general overhead expense.

Laboratory

It is not all foundries that look upon their laboratory expense as an expense of the melting department, but nevertheless there is where it belongs whether the work is analyzing iron or analyzing and testing the finished product. Experimental laboratory work, however, is of a different nature and is more properly treated as a special cost item.

A record of the analysis of each car of iron should be kept and the form shown on page 77 will be found to be a convenient one for that purpose.

Molding Department

The molding department of a foundry is not only that part of the plant in which the molds are made but the shops directly serving the molders, such as Pattern Shop, Carpenter Shop, etc., and the term "molding cost," properly, embraces all the direct and indirect costs of molding, the costs of operating the pattern shop, carpenter shop and all other shops serving the molders or the molding department.

The breaking or the cutting of gates should be considered an expense of the molding department. In the production of grey iron and malleable iron castings, the gates, risers or feeders, are broken off by hand, while in the production of steel castings they have to be cut off, usually a power cutting machine being employed. The costs of operating the cutting machines—labor, supplies, power, repairs and depreciation—should be separately shown, but as far as a cost distribution is concerned they should be treated as a molding department

indirect expense. It is not ordinarily practicable to treat these costs as direct charges.

Departmental Line

The departmental line for cost determining purposes is when the castings with gates removed have been delivered to the Cleaning Department, and the scrap returned to the furnace or stockpile.

Production Order

Prompt and efficient service is generally recognized as directly contributing to success in the industry. This being the case, it is highly important that there is an efficient system of handling orders and correspondence pertaining thereto.

The medium of handling orders and tracing production is the "production order.". Upon the receipt of an order from a customer, a production order should be made out for the guidance of the plant management and as a means of readily tracing or locating the work in the foundry. The order should be numbered serially, thus affording a ready means of identifying the work in any stage of production, and show as well the customer's order number, the date of issue, the name of the customer, the pattern number and the number of pieces ordered of each pattern. About six copies should be made of the order. The original should be retained in the office; a copy should go to the pattern clerk as his instructions to get the pattern off of the shelf and to fill out the production order tag which he attaches to the match, which is then laid out preparatory to starting production (if it is a new job an order should be issued to the patternmaker as authority to make the patterns); a copy should go to the coreroom foreman for the production of the cores if the job takes cores; a copy should go to the foundry foreman as his information in assigning work; a copy should

go to the trimming and inspecting room foreman for his information as to what is coming through the plant; and a copy should go to the finishing and shipping room foreman with shipping instructions.

A production order form is shown below:

PRODUCTION ORDER

Customer..... Shop Order No.....

Date.....

Customer's Order No.....

Delivery.....

No. of Pieces	Pattern Number	Description	Remarks

Issued by.....
General Manager

Production Order Tag

A production order tag, referred to above, is made out by the foundry or pattern clerk from the information contained on the production order, and attached to the pattern preparatory to turning over to the molder to run. The tag is for the purpose of informing the molder of the pattern number, the number of molds he is to make, and the price per mold

he is to receive for molding. When the required number of molds have been made the tag is again attached to the pattern and returned with the pattern to the pattern clerk.

The following is a good form of production order tag:

PRODUCTION ORDER TAG

Date Ordered Order No.

Customer

Pattern No.

No. Pcs. ordered	No. Pcs. in mold	No. molds	Price per mold	Weight

Molder's Name

Date in sand Date finished

Castings made over this order will not be paid for.
Return this tag with pattern.

Shelf No.

Molder's Daily Production Card

Each day the molder is given a production card on which he records, or it is recorded for him by the foundry clerk, his number, his name, the date, the pattern number on which he is working, the number of molds poured, pieces in a mold and the number of hours spent in molding.

A card form is shown on the following page.

The card at the close of the day is handed in or collected by the trimming room clerk who later enters on the card, from the trimmer's count, the number of pieces good, the number of pieces broken or core blown, and the number of pieces bad. The card is made out in duplicate, one copy of which goes to the molder and is retained by him for his information and the other copy, after the weight is entered, is turned in to the general office where the data is summarized on a Molder's Summary Production Card.

MOLDER'S DAILY PRODUCTION CARD

Molder's No.....Name.....Date.....19

Pattern No.	Molds Poured	Pieces in Mold	Pieces			Pounds Good	Hours Molding	Balance Due
			Good	Broken or Core Blown	Bad			
X23	90	2	160	4	16	640	8¾	1840

Molder's No.....Name.....Date.....19

Pattern No.	Molds Poured	Pieces in Mold	Pieces			Pounds Good	Hours Molding	Balance Due
			Good	Broken or Core Blown	Bad			
X23	90	2	160	4	16	640	8¾	1840

If the number of molders warrant, the clock system for recording the molder's time should be used. The form of record need not differ from the preceding one. Under the clock system of recording the molder's time, the molder's clock number, name and date are filled in the day previous, the card being deposited at night in the rack. The molder, upon his arrival in the morning, removes the card from the rack, inserts it in the clock, or punches in, and takes the card with him to the molding floor. The molder enters on the card the pattern number on which he is working, molds poured, pieces in the mold, and molding hours if working

on more than one pattern during the day. At night the molder takes the card with him to the clock and punches out and deposits card in rack. The cards are then ready to enter the pieces good and pieces bad which completes the information.

The principal advantage of a card over a sheet in gathering information as to molder's number, molds made, customer, pattern number, etc., is the flexibility of a card. Cards can be readily sorted by molder's number for pay roll purposes and then by customers and pattern number for cost entry purposes. It requires much less time to classify the cost data before making the entries than to attempt to classify the work after the entries have been made.

The molder, generally, is relied upon to enter daily the number of molds poured. He is not paid upon this count alone, however, as the Trimming and Inspecting Department verifies the number through an actual count of the number of pieces received by that department.

Without exception, every casting poured should be accounted for either as good or bad, the bad ones listed as to the nature of their imperfectness, such as miss-run, core blown, etc. Molders, sometimes try to cover up poor or careless work by throwing bad castings with the sprue which, if permitted, is not only bad plant practice but seriously interferes with accurate and systematic accounting.

Molder's Summary Production Card or Sheet

The data from the molder's daily production card is carried to either a summary card or sheet and is summarized for the pay period which serves both as a pay roll record and a cost record.

Forms of both a card record and a sheet record are shown.

MOLDER'S SUMMARY PRODUCTION SHEET

NAME NO.

Customer																		
Pattern No.																		
Pieces Ordered																		
Pieces in Mold																		
Rate per Mold																		
DATE			P. W. Hrs.	D. W. Hrs.	Hrs.	Molds Poured	Good Pieces	Brok-en	Bad	Pounds Good	Hrs.	Molds Poured	Good Pieces	Brok-en	Bad	Pounds Good		
		16																
	1	17																
	2	18																
	3	19																
	4	20																
	5	21																
	6	22																
	7	23																
	8	24																
	9	25																
	10	26																
	11	27																
	12	28																
	13	29																
	14	30																
	15	31																
Total																		
Good and Broken																		
Molds																		
Amount																		

Cost entries from either the card record or sheet record are made directly to the cost record of the individual job, form of which is shown on page 230.

Most of the information at the right hand side of the card shown on page 86 is filled in at the time the order is booked, the card being held awaiting the time of starting the job and the receipt of the daily production data from the trimming room.

MOLDER'S SUMMARY PRODUCTION SHEET—*Continued*

PAY ENDING

Extended

Checked

Hrs.	Molds Poured	Good Pieces	Brok-en	Bad	Pounds Good	Hrs.	Molds Poured	Good Pieces	Brok-en	Bad	Pounds Good	Hrs.	Molds Poured	Good Pieces	Brok-en	Bad	Pounds Good	SUMMARY	

Shifting

When men from the Cleaning, Trimming, and other departments, are called upon at heat times to assist in pouring and shifting, the time so spent should be charged to the Molding Department. This is a fairly large and important item of cost in malleable and light grey iron practice. The time spent by departments can be readily recorded by the use of a pay roll record similar to that shown on page 68.

MOLDER'S SUMMARY PRODUCTION CARD

CUSTOMER A. B. & Co. Pay Ending.....19..

Pattern No. X23 " " .....19..

Date	Molds Poured	Pieces Good	Pieces Broken or Core Blown	Pieces Bad	Pounds Good	Molding Hrs.
1	90	160	4	16	640	8¾
2	102	195	3	6	784	9
3	110	190	4	26	760	9
4	105	180	5	25	728	9
5	100	175	3	22	700	9
6						
7	110	192	4	24	760	9¼
8	108	190	1	25	756	9
9	101	186	2	14	740	9
10	106	192	5	15	764	9
11	112	196	3	25	780	9
12	111	201	2	19	804	9
13						
14						
15						
Total	1155	2057	36	217	8216	99

Good Molds 1047 Amount $62.82

Date	Molds Poured	Pieces Good	Pieces Broken or Core Blown	Pieces Bad	Pounds Good	Molding Hrs.
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						

Good Molds..... Amount $.....

Molder's Name	Doe
Molder's No.	120
Bench	✓
Floor	
Machine	
Shop Order No.	
Customer's No.	
Pcs. Ordered	2,000
Wt. per Piece	4.0 lbs.
Wt. per Mold	8.0 lbs.
Wt. per Mold with Gate and Sprue	12.0 lbs.
Lbs. Metal Poured	13860
Price per Mold	6c
Total Pieces Made	2310
Total Pieces Good	2057
Total Lbs. Good	8216
Molding Direct Labor Cost	$62.82
Molding Hours	99

SUPERINTENDENT'S DAILY PRODUCTION REPORT

Date.....19.....

Customer and Pattern Number	Total Pieces Poured	Pieces Bad			Per-cent Bad	Total Pieces Good	Total Weight Good (Lbs.)	Average Weight per Casting (Lbs.)	Molding Hours	Production per Molder Per Hr. (Lbs.)
		Trimming Room Defectives	Shipping Room Defectives	Total Pieces Bad						
A. B. & Co. X23	180	20		20	11.1	160	640	4.0	8¾	75

Superintendent's Daily Production Report

The superintendent, for his information and guidance, should have daily a summary, by pattern numbers, of the total pieces cast in the foundry, the number of pieces good, number of pieces bad, and percentage bad, weight of good production, molding hours and production per molder per hour. This information can be readily collected on the form shown on the preceding page and will be found invaluable for comparative and efficiency purposes.

Matches

It is not ordinarily necessary or usual to issue an order to the matchmaker for authority to make the match. The

MATCHMAKER'S DAILY REPORT

Date.....19..

Name of Workman.....

Name of Customer	Pattern No.	Hard	Soft	Time

This Report Must Show the Actual Time Consumed in Making Each Match

usual practice is to take the pattern, to which is attached a tag indicating the customer, pattern number, and number of pieces ordered, to the matchmaker to make the match. Ordinarily it is left to the judgment of the matchmaker whether to make a soft or hard match. A soft match is usually made for short orders. However, where there is a likelihood of a repeat order it is usually advisable to make a hard match for the pattern even if a soft match would suffice for the immediate order at hand.

The matchmaker, on his daily report, should indicate the name of the customer, and pattern number for which the match was made, whether a soft or hard match, and the time spent in making it.

Pattern Shop

In the pattern shop, an accurate record should be kept of the cost of production of all patterns. Whether the expense is borne by the foundry or is a charge directly to the customer should have no bearing on the manner of determining the initial cost. The only difference is in the method of charging the costs. If the expense is borne by the foundry, it should be charged against the particular job, and if the expense is borne by the customer, it should be charged directly to the customer's account.

When the pattern expense is borne by the customer, care should be taken to see that the book cost of the pattern production is really a true cost. Very often either no pattern overhead expense is charged or else an insufficient charge is made. In jobbing foundries where patterns are made at the expense of the customer the pattern shop should always be self supporting.

The pattern shop record should show the full history of every pattern—for whom made, its number, kind, weight and cost of material used, and time spent in making it.

The following form provides a complete and practical record:

PATTERN SHOP

Shop Order No.....

Name of Workman..... Date.....19..

Nature of Work	Pattern No.	No. Pcs.	Kind of Matr'l Used	Wt. of Matr'l Used	Hrs. Worked	Labor Cost		Matr'l Cost		Acct. to be Charged

Correct.....
FOREMAN

The workman enters, or it is entered for him, the nature of the work, the pattern number, the number of pieces in the pattern, the kind and weight of material used and the hours worked. The labor and material cost is, of course, computed in the office.

Customer's Pattern Cost Record

When patterns are made for and at the direct expense of the customer, as is often the case, it is usual to bill the customer at a fixed labor rate per hour and at a fixed material rate per pound. In some cases the labor and material rates cover a part of the pattern shop overhead expense while in other cases a straight overhead rate is charged. Whichever is the practice, the actual labor and material cost and the invoice

CUSTOMER'S PATTERN COST RECORD

NAME..

ADDRESS......................................

DATE	NATURE OF WORK DONE	PATTERN NO.	NO. PIECES	KIND OF MAT'R'L USED	WEIGHT MAT'R'L USED	HOURS WORKED	HOURS CHARGED	ACTUAL LABOR COST	ACTUAL MATERIAL COST	INVOICE LABOR	INVOICE MATERIAL

labor and material price should be carefully recorded in order to see that the patterns have been invoiced at a price sufficiently high to cover the actual cost of labor, material, and pattern shop overhead expense.

The form on page 91 can be used to record this information by customers, a separate sheet being used for each.

Pattern Vault Card

In the pattern vault, needless to say, there should be a place for every pattern and every pattern in its place. As fundamental as this seems to be, yet in many foundries a great deal of time is wasted in locating patterns on hand, as well

PATTERN VAULT CARD

Number					Customer								Shelf Number	
Cores to One Casting					Owner	Bench	Molder's Mark	Date	Price	Pcs. in Mold	Gates Plates	Pcs. per Gate or Plate	Material	
A	B	C	D	E		Floor								
						Mach.								
F	G	H	I	J	Description						Master	Rec'd	Ret'd	Shelf
K	L	M	N	O				Date Received		Date Returned			Shipped to	
Core Boxes														
Alum.														
Brass														
Iron														
Wood														

as in tracing patterns returned to the customer or shipped elsewhere.

It is highly essential for ready reference and for locating that a pattern record card be carried for every pattern in the vault as well as for patterns withdrawn.

There is only a small percentage of foundries that have an up-to-date and dependable record of their patterns. The pattern vault system of most foundries is extremely poor, while on the other hand there are a few with exceptionally good

PATTERN SHOP REPAIR ORDER

.....19....

PATTERN DEPARTMENT:

Repair Pattern for.....No.....
as follows:

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Order issued by.....

Hour..... Date and hour completed.....

All patterns that require more than fifteen minutes to repair must pass through the hands of the pattern clerk, coming and going, and receive his signature after order is first issued.

Checked.....

Extraordinary care must be taken in regard to any radical changes, all of which must be referred to the General Superintendent.

records. The form of pattern vault card shown on page 92 is a very complete one.

On the back of the card a record of orders received with date and number of pieces ordered can be shown to good advantage.

Pattern Shop Repair Order

It is not good practice to allow the pattern shop to make repairs without proper authority, when any considerable amount of time is required to make the repair. It is the practice of a number of foundries to require the authority of the pattern clerk for the repair of all patterns that require more than fifteen minutes to make the repair. It is usual also to have

CARPENTER SHOP

Shop Order No.....

Name of Workman..... Date.....19..

Nature of Work	No. Made	Kind of Matr'l Used	Q'n'ty of M't'l Used	Hours Worked	Labor Cost		Material Cost		Acct. to be Charged

Correct.....
FOREMAN

the pattern clerk report to the superintendent any radical change requested to be made in the pattern before authority is given to make the repair.

Carpenter Shop

Ordinarily, most of the work in the carpenter shop is for the molding department and consists of making and repairing flasks, jackets, bottom boards, match boxes, etc.

The authority for carpenter shop production is the shop order, described below, which indicates the account to which the cost should be charged. In all cases where the equipment is of a special nature and for a particular job the cost thereof should invariably be charged to the job. This is true not only of the making of new equipment but of the repairing and renewal of old equipment. The cost of any special equipment to run a job is just as much a direct charge as is the labor to mold the job.

The form of carpenter shop report shown on the preceding page will conveniently serve as a cost record.

Shop Order

As authority for making patterns, flasks, bottom boards, etc., as well as authority for making repairs to equipment and buildings, and as a means of charging the cost of such parts and repairs to the department and to the job where they belong, the practice of using a shop order should be followed. An order should be issued for all new parts, repairs to equipment and buildings, etc., when the time required to make the parts or repairs exceeds one-half day's time.

The shop order should give a description of the work to be done and provide for recording the time spent and the material used, or any other information needed in order to charge the cost of the work to the department or to the job getting the benefit thereof.

Coremaking Department

The coremaking department is that part of a foundry in which the cores are molded, baked and stored.

Usually, the core department is a clean cut and well defined department and there are no important auxiliary shops or parts of the plant serving it. In addition, it is rare that help is drawn from the core department to temporarily assist in other departments, such as, shifting, pouring, cleaning, etc. Department costs, therefore, are easily and definitely determined.

Foundry practice, with respect to the operation of the Core Department, differs markedly both in operating practice and in accounting procedure.

In quite a large proportion of foundries it is the practice to pay the coremaker upon the basis of the cores used by the molder. That is to say, if a molder puts up during a weekly pay period 500 molds using four cores per mold the coremaker is paid for producing 2,000 cores of that particular pattern. Under this practice the coremaker is obliged to stand the loss in baking and the loss in handling and delivering to the molder as well as the loss of those discarded by the molder as being slightly imperfect though fit for use. Then, too, there are cases where the molder, knowing the coremaker, willingly wastes cores knowing that the coremaker's pay is affected thereby. Another objection to this system of payment is that the pay of the coremaker is often tied up due to no fault of his through a delay in the foundry.

The practice of other foundries, which seems to be a much fairer one to the coremaker and at the same time facilitates more accurate accounting is to count the perfect cores as they are molded and to pay the coremaker upon that count. In other words, the company stands the loss of cores spoiled in baking as well as those broken in delivering them to the molder. The coremaker, in justice, should be paid for his good production and should not be called upon to stand the loss in baking and delivering, operations over which he has no control what-

ever. The piece rate under this latter practice can be less than under the former practice without affecting the earnings of the coremaker and at the same time more nearly meting out justice and avoiding discontent and dissension with employes.

Departmental Line

The departmental line for cost determining purposes is when the cores have been delivered to the molding department.

Production Order

The authority for producing cores should originate from the office through a production order, either a copy of the general production order already referred to (page 79), or a separate core production order. In either case the order should give the pattern number, the date to start production, the total number of cores wanted, the number wanted daily and the molding price per core or per hundred cores.

Core Production

The number of cores ordered should be reasonably in excess of the number of castings to be made to provide for losses of both cores and castings. The loss can be predetermined fairly closely upon past experience. On light core work there is usually a loss of about 5% in baking and handling, dependent, of course, upon the intricacy of the core and the care given it.

Core Loss

The loss on all kinds of core work should be watched closely, for in many foundries there is a serious drain that exists due to the fact that the magnitude of the loss is not realized. The coreroom foreman should be held strictly accountable for the loss that takes place in his department, while the foundry foreman, strictly speaking, should be held

responsible for the loss of cores in the foundry through bad work. Properly, the cost of all cores spoiled in the foundry through the production of bad castings is a molding department expense but it is rarely practicable to so consider it.

The loss accountable by the coreroom foreman can best be shown by recording in parallel columns, by pattern numbers, the number of green cores made and the number of good dry or baked cores delivered to the molders, the difference representing the loss in baking and in handling.

Core Delay

When core production is delayed for any reason, there should be a systematic manner of notifying the molding department in writing and not merely an oral communication as in this way too many misunderstandings result.

CORE DELAY REPORT

Date.....

TO THE FOUNDRY FOREMAN:

Cores will not be ready as per schedule on:

Pattern No.....

Customer.....

Reason.....

.....

Signed.....

Core Ticket

The coremakers' time, or the number of cores made, for pay and cost purposes is gathered in different ways. A good method, in fairly general use in the production of light cores, is for the coremaker to fill out a core ticket which is

placed on every plate of cores and which shows the name of the customer, pattern number, number of cores made, and the coremaker's name or number.

CORE TICKET

Order No.....

Customer..... Date.....

Pattern No.....

Letter.....

No. Cores Made.....

Coremaker.....

Place one of these Tickets on Each Plate of Cores

.....

The count is checked by a clerk or forelady and the tickets are taken up by the oventender just before placing them in the oven. Postings are made to a Coremaker's Summary Production Card.

Coremaker's Summary Production Card or Sheet

The principal record of the core department is that with labor, and it is advisable to have but one labor record to serve for both pay roll purposes and job cost purposes, whether a job card record or a pay sheet record is used. The greater part of the labor in the core room is direct producing labor in molding cores and is therefore chargeable to the job.

In recording the direct producing labor of the core department, the writer prefers a card record with a card for each pattern number where the patterns running are not so extremely numerous. The advantages of a card are its flexibility of arrangement whether by coremaker, by number, or by customer, and ease and convenience in filing for reference. The disadvantages of a card in the case of short

COREMAKER'S SUMMARY PRODUCTION CARD

Customer A. B. & Co.

Pattern No. X23 — Shop Order No.....

Coremaker Doe — Customer's Order No.....

Cores Wanted 2400 — Pay Ending.....19..

Rate per cwt. 75c — Pay Ending.....19..

Date	Hours	Cores Made	Balance	Date	Hours	Cores Made	Balance
..				16			
1		420	1980	17			
2		440	1540	18			
3		410	1130	19			
4				20			
5		460	670	21			
6		470	200	22			
7		200		23			
8				24			
9				25			
10				26			
11				27			
12				28			
13				29			
14				30			
15				31			
Total		2400		Total			

Amount $18.00 — Amount $.....

COREMAKER'S SUMMARY PRODUCTION SHEET

EXTENDED..... CHECKED.....

PERIOD ENDING CORE MAKERS No. NAME AMOUNT $

Customer		A. B. & Co																					
Pattern No.		X23																					
Core Ordered		2400																					
Rate per cwt.		75c																					

Date		P.W. Hrs.	D.W. Hrs.	Hrs.	Cores	Hrs.	Cores	Hrs.	Cores	Hrs.	Cores	Hrs.	Cores	Hrs.	Cores	Hrs.	Cores	Hrs.	Cores	Hrs.	Cores	Hrs.	Cores	Hrs.	C'rs
Jan.	16				420																				
1	17				440																				
2	18				410																				
3	19				460																				
4	20				470																				
5	21				200																				
6	22																								
7	23																								
8	24																								
9	25																								
10	26																								
11	27																								
12	28																								
13	29																								
14	30																								
15	31																								
Total					2400																				
Amt.					18.00																				

running jobs are the number of cards required and the added difficulty of arriving readily at the coremaker's pay.

Illustrated forms of both a card record and of a sheet record are shown, which are self explanatory.

In connection with the use of the latter form, the coremaker is given a card at the time the job is started, on which he enters the date, and the number of cores made daily. From that record postings are made to the above summary pay sheet record.

The column "hours" on both the Coremaker's Summary Production Card and the Coremaker's Pay Sheet Record is to enter the time of day workers.

Core Stock Record

It is not usual for jobbing foundries to produce cores for stock, although a few foundries on long running jobs, make the cores far in advance of the time they will be needed. On all jobs a stock of cores for at least one day's production should always be available in order that the temporary absence of the coremaker may not tie up the foundry production.

A daily core production should be scheduled for long running jobs so as not to accumulate an unduly large stock and at the same time provide an ample working margin for safety.

It is usual to produce about 10% more cores than are called for by the number of good castings wanted to provide for losses through breakage, blows, bad and broken castings.

All unused cores, or imperfect ones, if delivered to the molding department should be returned at once to the core department, preserving the good ones for future orders. For this purpose an accurate record should be kept of surplus stock. Any reasonable surplus, however, should be charged to the job even though it is placed in stock with a possibility of applying on a repeat order.

Foundries that produce specialties, or work that is made for stock in advance of orders, usually produce cores, more or less intermittedly and often considerably in advance of the time they are used. In such cases an accurate stock record should be kept showing the date and number of cores put in stock and the date and number taken out of stock for consumption. The cost of the cores taken out of stock for use should enter into the month's cost of castings produced and not the cost of the cores produced and put in stock.

CORE STOCK RECORD

RACK.....

PATTERN No..... CUSTOMER..... SHELF.....

Order Date				
Pcs. Ord'd				
Core-maker				

Date	Cores In	Cores Out	Date	Cores In	Cores Out	Date	Cores In	Cores Out	Date	Cores In	Cores Out

Cleaning Department

The Cleaning Department is that part of the foundry in which the castings are tumbled or sand-blasted to remove the molding sand adhering to them.

In the manufacture of grey iron and steel castings there is but one cleaning operation while in the manufacture of malleable iron castings two cleaning operations are required—the first, to remove the molding sand adhering to the casting, and the second, after the annealing process, to remove the scale and adhering packing material. Accordingly, in the manufacture of malleable iron castings, there are two separate and well defined cleaning departments and the operating costs of each should be separately and accurately kept. These two operations are known as Hard Iron Cleaning and Soft Iron Cleaning.

A great many foundries, particularly the smaller ones, do not separate departmentally their costs of cleaning and of trimming and inspecting. The practice is a bad one for the reason that the costs are of a very different nature and cannot be equitably distributed to the job upon the same basis. (See pages 220 and 221. Apart from this, all advantages of departmental costs, for comparative purposes to determine plant efficiency, are lost.

Usually there are no shops or auxiliary parts of the plant, other than the power plant, serving the cleaning department and the accounting is not complicated.

There are no special records needed by the cleaning department. The operating costs of the department are principally labor and burden consisting of repairs, depreciation, power, etc.

Tumbling

As stated above, castings are cleaned either by tumbling or sand-blasting. Hand cleaning and pickling have become almost obsolete. "Tumbling" is simply placing the castings in a revolving steel barrel in which is also placed stars or other

small pieces of hard metal to assist in wearing off the sand and scale through surface contact. There are a number of different types of tumbling barrels or mills, some of which are of large size and in which very heavy castings can be cleaned. It is the most common and cheapest method of cleaning, although not the most efficient.

Sand-Blasting

Sand-blasting is the most efficient method of cleaning castings, especially where intricate core work is to be cleaned or a surface absolutely free from scale and sand is desired. While the ordinary method of tumbling is cheaper, the finish imparted by the sand-blast process is so much superior, it is often considered worth the additional cost.

Sand-blasting can be divided into two general classes, hand blasting and automatic blasting.

Hand blasting is the most efficient. This is due to the fact that the sand and scale on a casting is harder in some spots than in others, and a more intensive application of the blast can be applied on the harder parts.

For light work, there are several types of automatic machines, the most common and efficient is the sand-blast tumbling barrel of which there are several types. For simple flat work, such as stove plate, the automatic rotary table is frequently used. For special work, such as radiators, special machines are designed.

For medium-size castings, weighing from 50 to say 500 pounds, which are too large to be handled in tumblers or automatic machines, the rotary-table type of sand-blast room has recently become very popular.

For the general run of large work which cannot be handled on the so-called automatic machines, various special sizes and types of sand-blast rooms are designed. The most common is one constructed of heavy steel into which the work is conveyed on cars or trucks operating on industrial tracks or by an overhead monorail or crane.

Under present conditions, and with modern equipment, the cost of sand-blasting is about ¼c per pound or $5.00 per ton in excess of the cost of tumbling.

While this is probably a fair average of the apparent total additional cost of sand-blasting, yet in sand-blasting there is another important cost factor that should not be overlooked. A casting that is sand-blasted will show a far greater number of minor defects than one that is tumbled, and as the defects are more apparent, rejections are heavier, thereby increasing considerably the cost of the castings retained by the customer. In some cases the loss resulting from a larger rejection is nearly as great per ton as the actual cost of sand-blasting.

Due to the weight and intricacy of most steel castings it is necessary to sand-blast them. However, in the case of small plain steel castings they are tumbled the same as light grey iron and malleable iron castings.

Separate Costs of Tumbling and Sand Blasting

When both tumbling and sand-blasting are used as a cleaning process, as is usually the case, the accounts of the department, if practicable, should be so divided as to show separately the costs per ton of tumbling and of sand-blasting, subdividing the latter where possible into hand blasting and automatic blasting. There is a marked difference between the costs of the two cleaning processes and castings that are required to be sand-blasted should bear the added cost. Power is the big item of cost in sand-blasting and it is the one most difficult to determine accurately as usually the air is drawn from a compressor serving other departments of the foundry as well. The cost of the power consumption, however, can always be readily determined fairly accurately. Depreciation is another important item of cost in sand-blasting, and, ordinarily, it is heavier than in tumbling.

Departmental Line

The departmental line is when the castings have been delivered to the Trimming and Inspecting Department or to the Finishing and Shipping Department, as the case may be.

Trimming and Inspecting Department

The Trimming and Inspecting Department is the part of the foundry in which the castings, after they are cleaned, are trimmed and inspected. The trimming operation consists of knocking off the lugs, fins, gates and rough parts of the casting so that it will conform in outline strictly to the pattern. On most castings the greater part of the trimming work is that of knocking off the gate close up to the casting. When two or more castings are molded together the gate through which the metal runs from one casting to the other does not always break off close up to the casting, which makes a trimming operation necessary.

Rigid Inspection, an Important Cost Factor

In malleable iron practice a very careful and rigid inspection should be made at the time the casting is trimmed, as bad and defective work can be thrown out at that stage of production and save the added expenses of annealing and recleaning a casting that would ultimately have to be treated as defective and remelted.

Inspection Report

After the castings have been trimmed and inspected they are counted and notations made of the number and weight of both the good and bad pieces.

The first form shown below is more suitable to grey iron and steel practice, while the second form is more particularly applicable to malleable iron practice.

TRIMMING DEPARTMENT REPORT (Grey Iron and Steel)

Date.....

Molder's Name	Pattern No.	Customer	Shop Order No.	No. Pieces in Mold	No. Molds	Total Pieces	Good Castings		Bad Castings			Total Weight
							Pieces	Pounds	Co. Loss	Molder's Loss	Pounds	
J. Brown	X50	A. B. & Co.	601	2	110	220	204	1020	2	14	80	1100

TRIMMING DEPARTMENT COUNT

Date.....

Customer.....

Pattern No.....

Weight.....

Pieces Good.....

Pieces Bad.....

No.

In explanation of the second form, the inspector enters the pattern number and the number of pieces, both good and bad. Then, when the castings are ready to be weighed, the ticket is turned in to the Trimming Room office where the weight is entered. One copy of the ticket serves as a posting medium to the molder's daily production card and another copy is placed on and remains with the castings until they are packed in the annealing oven.

Oven Record

As the castings are packed a notation is made on the card of the oven in which they were packed and of the set number, i. e., the position of the oven in which they were placed.

The first four items of information on the trimming room ticket and on the annealing room ticket are filled in at the same writing.

OVEN RECORD

Date.....

Customer.....

Pattern No.....

Weight.....

Pieces.....	Packed	Set No.
Oven No.....	.....	.....
Oven No.....	.....	.....
.....	.....	.....
No.		

Trimming Department Report

The inspector should also make a report to the trimming room clerk of the number of pieces bad, core blown, broken, etc., by pattern numbers. This data should be tabulated for the information of the foundry foreman as it is most essential to the successful operation of the molding department.

Elimination of the Hard Iron Weight

Practically every malleable iron foundry of the country makes a careful weight of the good hard iron castings in the trimming room after they are inspected and just before delivering to the annealing department. Then, in order to arrive at the weight of good finished castings, the shipping room defective castings, or those castings found to be bad after the annealing process, are deducted, as well as a further deduction in weight to represent the loss through oxidation that has taken place during annealing, usually running around 1%.

A few companies have eliminated, with a considerable saving in labor, the hard iron weight for production and cost purposes and use in its stead the weight of finished cast-

TRIMMING DEPARTMENT REPORT (Malleable Iron)

DATE.....

Pattern No.	Bad	Core Blown	Broken				Cracked	Slag	Shifted	Good	% Good
			Miss Run	Trim. Room	Foundry	Miscel.					

ings found by multiplying the number of good pieces produced by the finished weight of the casting, the shipping room foreman reporting from time to time the finished weight of each pattern of casting produced.

The practice not alone saves the time of the weigher at the hard iron scales but saves a considerable amount of time in the handling of the castings in the trimming and inspecting room, as the castings do not have to be kept separately by pattern numbers as it is necessary to do when the hard iron weight is obtained.

From the standpoint of obtaining accurate costs, the plan has a great deal in its favor for the shipping weight is the actual weight and the weight upon which the castings are sold. The hard iron weight is from 1% to 2% greater and when used as a divisor gives a cost of from 1% to 2% under the true cost of production.

In the case of new work, costs per unit cannot be computed as promptly as when the hard iron weight is used as a divisor, but the added accuracy of the costs based upon the weight of the finished castings more than justifies a delay of the time required to anneal and reclean.

Departmental Line

The departmental line for cost determining purposes is the point of delivering the castings to the Annealing Department.

Annealing Department

The Annealing Department is that part of a malleable iron foundry and of a steel foundry in which the castings are prepared and packed for annealing, annealed, dumped and stored awaiting delivery to the Soft Iron Cleaning Department, if malleable iron castings, or to the Finishing and Shipping Department, if steel castings.

Steel castings are both annealed and unannealed. In cases where they are annealed the process is very dissimilar to

the process of annealing malleable iron castings. Steel castings are usually placed in the oven loose and not packed in pots as are malleable iron castings and the time to anneal steel castings is only a fraction of the time that is required to anneal malleable iron castings.

While the cost to anneal steel castings is materially less than the cost to anneal malleable iron castings, yet the exact cost in steel practice should not be lost sight of and all expenses pertaining thereto should be separately classified and not thrown with the operating costs of other departments.

It is always best in malleable iron practice, for comparative purposes, not to confuse annealing costs and soft iron cleaning costs, although there is a tendency to do so. There is no advantage to be gained in combining the costs of the two operations. It is not as serious, however, to throw together costs of annealing and soft iron cleaning as it is to combine costs of hard iron cleaning and trimming and inspecting for the former can be properly distributed over the work going through the plant on the same basis while the latter cannot.

Pots and Bottoms

In the manufacture of malleable iron castings, it is usual to pack the castings in cast iron pots about two feet square before they are placed in the annealing ovens to protect them from the gases of the oven. "Bottoms" are low stools on which the pots, which are without tops or bottoms rest.

Most malleable iron foundries make their pots and bottoms from surplus molten metal, i. e., metal in excess of the quantity required to fill the molds on the floor. Some foundries have provided cupolas in which to melt iron of a cheaper character for making pots and bottoms while still other malleable iron manufacturers buy their pots and bottoms.

In the event that pots and bottoms are purchased, they are handled exactly the same as other material, the cost thereof being charged to the Pots and Bottoms Account.

When the iron for making pots and bottoms is melted in a cupola and molded on a floor separate from the foundry proper there is usually no difficulty in recording accurately the production costs of the pots and bottoms as all the costs of the cupola and of molding are separate and distinct from the operating costs of the main foundry. Even the pig iron used is ordinarily bought for that purpose, consequently, there is no confusing of pig iron costs.

Where the pots and bottoms are made from surplus molten metal, however, the treatment of the account is one of the most troublesome in malleable iron practice. The difficulty is that it is not always practicable to handle all the costs as they should be handled. This is particularly true of the melting costs and of the overhead molding costs. The costs of the metal used in making pots and bottoms and the direct labor cost of molding can be charged to the pots and bottoms accounts with no particular difficulty and all malleable iron foundries should at least ascertain the direct costs of producing their pots and bottoms which becomes an operating expense of the Annealing Department.

The following treatment of the accounts will give effect to this with only a few minutes time at the end of the month. Credit the Pig Iron account at the end of the month with the cost of the iron used in making Pots and Bottoms, the weight of the pots and bottoms produced being assumed to be 90% of the weight of the iron used, and charge the Pots and Bottoms account. The direct labor cost of molding can be charged to the Pots and Bottoms account directly whether it is piece work or day work.

Strictly, the cost of producing pots and bottoms should bear their share of the melting cost and carry a part of the molding overhead expense, but this is a refinement that savors of some unnecessary detail. There is, of course, no objec-

tion, other than the additional clerical labor, to getting a more accurate cost of pots and bottoms than that represented by the items of metal and molding.

Regardless of whether pots and bottoms are manufactured or purchased, the costs thereof should be charged to a Pots and Bottoms account and handled the same as all other material accounts. It is wrong to have the metal account represent both the metal used in the manufacture of salable castings and in the manufacture of pots and bottoms which are necessary for use in the manufacture of salable castings. Likewise, it is wrong to have the molding direct labor account represent both the direct labor of molding salable castings and the labor of molding pots and bottoms. The mixing of costs in this way seriously distorts the costs not only of the annealing department but of other departments as well.

Annealing Oven Report

An accurate report of castings packed in the anneal should always be available for purposes of plant management, the reports showing the name of the customer for whom the work is made, the pattern number, the quantity and the weight.

It is a good practice to furnish the customer with a copy of such a report for his information as when to expect shipment. About three carbon copies should be made, one for the annealing department, one for the shipping department, and one for the general office. The form shown on the following page will be found to be very suitable for this purpose.

Departmental Line

The departmental line for cost determining purposes is when the castings have been delivered to the succeeding department.

ANNEALING OVEN REPORT

THE JOHN DOE FOUNDRY COMPANY

Cleveland, O.....19..

To.....

.....

We beg to advise that the following castings, applying on your orders as listed below, were today packed in Annealing Oven number.....
Barring accidents, or causes beyond our control, shipment will be made about .....19..

	Pattern No.	Pieces	Weight	Will Be Applied On Order No.

The John Doe Foundry Company

Per.....

Finishing and Shipping Department

In all cases where finishing and shipping operations are handled in separate departments, the costs should be separately recorded. In the case of many foundries, however, it is not practicable to draw a line between the two operations and for this reason the costs have to be treated as falling within a given department.

Finishing Room

The finishing room is that part of the foundry in which the castings receive such finishing operations as chipping, grinding, straightening, drifting, painting, galvanizing, etc. Usually it is necessary to do a considerable amount of sorting in the finishing room.

Air Chipping

Chipping is done both by hand and by air. Where air chippers are used the cost of producing the air consumed as well as the up-keep of the air apparatus should be charged to the finishing department. The distribution usually cannot be made accurately but sufficiently accurately for all practical purposes. While air chipping is not used very extensively in the production of malleable iron castings, it is employed more generally in the production of grey iron and steel castings.

Time Record

Time slips should be made out for all finishing operations showing the nature of the operation, customer's name, pattern number, and time spent on the work, if day work, or pieces finished, if piece work, so that the cost of the operation can be treated as a direct charge and not as a general overhead expense. It is manifestly wrong to burden castings not requiring any finishing with a part of such costs.

If a workman is engaged during the day on the work of different customers, it is best generally to make out but one card as in this way his entire time is on a single card and from which he can be paid. While this necessitates a recapitulation being made for cost posting purposes, it nevertheless, generally proves more satisfactory than making out a card for each job on which the workman was engaged.

Two forms of time records are shown below. The first one is more applicable to steel and malleable practice and the latter one to grey iron practice where more extensive finishing operations are performed in the way of machining.

FINISHING DEPARTMENT TIME RECORD

Clock No.	Name of Workman					Date		
Customer	Operation	Pattern No.	Time			Pieces	Rate	Amount
			From	To	Lapsed			

FINISHING DEPARTMENT TIME RECORD

Date.....

Name of Workman..... Clock No.....

Machine No.	Order No.	Operation	Description	Pieces	Weight	Man's Time	Rate per	Amount		Remarks
LIST ALL	DAY WORK	BELOW THIS	LINE							

Shipping Room

The Shipping Room is that part of a foundry in which the castings are sorted by pattern numbers, finally inspected, weighed, packed or bagged and placed in the cars for shipment.

Shipping Record

The principal records of the shipping room are the daily record of shipments and the summary record of shipments.

SHIPPING RECORD

Customer..... Date Shipped.....19..

Address..... Via.....

No. Pieces	Pattern No.	Shop Order Number	Customer's Order Number	Gross Wt.	Tare	Net Wt.	Total Wt.	Price	Amount

Checked..... Shipped by.....

Invoiced..... Number of Invoice.....

SUMMARY RECORD OF SHIPMENTS

Customer
Ship to
Address
By

When Ship

Customer's Order No.	Date Ordered
Pattern No.	**Pieces Ordered**

SHIPMENTS			Total Pieces	SHIPMENTS			Total Pieces	SHIPMENTS			Total Pieces
Date	Pieces	Weight		Date	Pieces	Weight		Date	Pieces	Weight	

White Copy - Office
Pink Copy - Shipping
Goldenrod Copy - Sup't

The daily record of shipments from which the billing is made should give full information as to the castings shipped, name of customer, date, number of pieces, pattern number, shop order number, customer's order number, gross weight and net weight. The shipping clerk enters all of the information at time of shipment except the price and amount which the general office enters.

For long running jobs, and where shipments are frequent and only partially cover the quantity ordered, it is necessary to summarize the individual shipments in order that the total may not exceed the quantity ordered. At the same time a record of this nature affords information both for the general office and the superintendent as to when the order has been entirely filled.

INVOICE

The A. B. Foundry Company
Cleveland, Ohio

....19

Sold to

Shipped to

By

TERMS—Net cash tenth of month after date of invoice.
All claims for allowances must be made promptly upon receipt of goods.

ORDER NO.	NO. OF PIECES	DESCRIPTION	WEIGHT	PRICE	AMOUNT

The name of the customer, his order number, date of order, pattern number, pieces ordered, and shipping instructions are filled in at the time the order is made out and entered on the books. The form then goes to the shipping room, and as the shipments are made they are summarized from day to day.

It is best to make the order in triplicate, and when the order has been filled to send one copy to the office, one to the superintendent, and to retain one in the shipping room.

Needless to say there should be an exact and strictly accurate record of everything going out of the shipping room. Inaccuracy and carelessness in the shipping department and in billing, are most likely to be sources of large losses and extreme care should for this reason be taken in the selection of shipping room employees and billing clerks.

Returned Castings

Foundries, as a rule, are extremely careless about recording and checking up castings returned by their customers as defective. Immediately upon receipt of returned castings, they should be classified by pattern number, recording the number of the pieces of each pattern and the weight. Should any of the castings be found to be of another's make, as is sometimes the case, an entry to this effect should be made as few care to allow credit for the bad work of other foundries. Unless the returns are carefully examined this can very easily be the case.

The recording of castings returned by customers is seldom such as to give accurate cost results, particularly for monthly periods. It is the practice of many companies, upon the return of castings to simply charge Sales Account and credit the customer, thus losing sight of the cost to produce the defectives, as well as their value as scrap. Furthermore, exceptionally heavy or exceptionally light returns will seriously distort monthly profit and loss statements.

Where returns are at all heavy the best practice is to provide therefor by setting up at the end of each month a

RECORD OF RETURNED CASTINGS

From..... Date.....

Address.....

Bags..... Bbls..... Cases..... Bdls..... Bill of Lading No.....

Order No.	No. Pcs.	Pattern Number	Price	Defective (Lbs.)	Reanneal and Return (Lbs.)	Not Made By Us (Lbs.)	Returned Scrap (Lbs.)	Total Weight (Lbs.)

reserve sufficient, based upon past experience, to fully take care of the invoice price, less scrap value, of the castings returned. The entries required would be the following:

Defective Returns	$1,000	
To Reserve for Defectives		$1,000

$2.00 per ton on January production

Purchased Scrap	$100	
Reserve for Defectives	900	
To Customer		$1,000

Return of 5 tons defectives at $200.00 per ton.

The above treatment distributes equally month by month the defective returns, records the scrap value of the castings and provides the credit to the customer.

Properly, the account "Defective Returns" should be treated as a sales deduction in accordance with accepted accounting practice, but in the foundry industry where returns are exceptionally heavy, particularly in certain branches, the better practice seems to be to charge the amount set up monthly to represent defective returns to cost of production. In this way it gets in the general overhead expense and therefore is not overlooked in estimating. In a sense, castings found defective by the customer do not differ from those found defective before shipment, and both should be treated similarly, namely, as a cost item.

CHAPTER VII

CLASSIFICATION AND DEFINITION OF ACCOUNTS

Introductory

While it is highly desirable commercially, that the members of an industry adopt substantially the same basic principles of cost accounting, it is not necessary that they adopt and follow identical cost accounts as long as they observe the general cost principles and divisions.

Companies that care for but little detailed information can follow the scheme of a classification of accounts by consolidating the accounts under a given head while companies that want and make use of a greater amount of detailed information than that shown by a given classification of accounts can further divide them. When general heads, or cost divisions, are observed by different companies, even though the accounts thereunder in number and in name differ, the results for group total still afford a true comparison. Standard classifications should be observed at least as far as the cost divisions or general heads go.

Three separate classifications of accounts are shown, one for grey iron foundries, one for malleable iron foundries and one for steel foundries. The only difference in the classifications is in the departmental arrangement, which result from differences in the processes.

Both account numbers and account names are shown. The system of numbering the accounts is such that the number identifies both the department and the nature of the expense. For instance, account

Number 31 is direct labor, molding department.
Number 41 is direct labor, coremaking department.
Number 61 is direct labor, finishing department.

In every instance the first number indicates the department and the second number the nature of the expense.

Classification of Accounts for Grey Iron Foundries

METAL:

10-1 Pig Iron,
10-2 Scrap.

MELTING DEPARTMENT:

22 Indirect Labor,
23 Fuel,
24 Flux,
25 Supplies and Tools,
26 Repair Labor,
27 Repair Materials,
28 Fixed Plant Charges,
29 Laboratory Expense.

MOLDING DEPARTMENT:

31 Direct Labor—
  31-1 Direct Labor—Bench Molding,
  31-2 Direct Labor—Floor Molding,
  31-3 Direct Labor—Machine Molding,
32 Indirect Labor.
35 Supplies and Tools,
36 Repair Labor,
37 Repair Materials,
38 Fixed Plant Charges,
39 Special Pattern and Flask Expense.

COREMAKING DEPARTMENT:

41 Direct Labor,
42 Indirect Labor,
43 Fuel,
45 Supplies and Tools,
46 Repair Labor,
47 Repair Materials,
48 Fixed Plant Charges.

CLEANING AND CHIPPING DEPARTMENT:

52 Indirect Labor,
55 Supplies and Tools,
56 Repair Labor,
57 Repair Materials,
58 Fixed Plant Charges.

FINISHING AND SHIPPING DEPARTMENT:

61 Direct Finishing Labor,
62 Indirect Finishing and Shipping Labor,
65 Supplies and Tools,
66 Repair Labor,
67 Repair Materials,
68 Fixed Plant Charges.

GENERAL EXPENSE:

70-1 Office Salaries,
70-2 Office Expense,
70-3 Selling Expense,
70-4 Misc. General Expense.

RETURNS AND ALLOWANCES:

80 Returns and Allowances.

PATTERN SHOP:

101 Direct Labor,
102 Indirect Labor,
105 Materials, Supplies and Tools,
108 Fixed Charges.

CARPENTER SHOP:

111 Direct Labor,
112 Indirect Labor,
115 Materials, Supplies and Tools,
118 Fixed Charges.

BLACKSMITH SHOP:

122 Indirect Labor,
123 Fuel,
125 Materials, Supplies and Tools,
128 Fixed Charges.

FIXED PLANT CHARGES:

138 Power, Heat and Light,
148 Fire Insurance,
158 Taxes,
168 Depreciation,
178 Medical and Hospital,
188 Liability Insurance,
198 Supt., General Foreman, and Misc. Yard Labor.
208 Misc. Plant Expense.

Definition of Accounts for Grey Iron Foundries

METAL

10-1 PIG IRON:

To include the cost of all pig iron used, freight, and labor in unloading.

10-2 SCRAP:

To include the cost of all purchased scrap, freight, and labor in unloading.

MELTING DEPARTMENT

22 INDIRECT LABOR:

To include all labor identified with the melting of the iron—handling and conveying iron and fuel to the cupola; charging; cranemen; slag mill labor; foreman; etc.

23 FUEL:

To include the cost of all melting fuel, freight, and labor in unloading.

24 FLUX:

To include the cost of all flux, freight, and labor in unloading.

25 SUPPLIES AND TOOLS:

To include the cost of all supplies and small tools used in the melting department.

26 REPAIR LABOR:

To include the cost of all labor in connection with the up-keep and maintenance of the cupolas and their equipment.

27 REPAIR MATERIALS:

To include the cost of all materials used in connection with the up-keep and maintenance of the cupolas and their equipment—brick; fire clay; sand; limestone; etc.

28 FIXED PLANT CHARGES:

To include a proportion of such costs as power, heat and light; insurance; taxes; depreciation; salary of superintendent, general foreman and miscellaneous yard labor; medical and hospital; and such other costs of a general nature that are more or less fixed and that cannot be directly charged to any one department.

See definitions of the above accounts for methods of distributing them departmentally.

29 LABORATORY EXPENSE:

To include salary of chemist; laboratory expenses; labor and expense incurred in testing materials and product; etc.

MOLDING DEPARTMENT

31 DIRECT LABOR:

To include all labor of molders and helpers in putting up molds; operating molding machines; green sand core work; etc., that is traceable, without pro-rating to a pattern number.

If practicable, separate into
31-1 Direct Labor, Bench Molding.
31-2 Direct Labor, Floor Molding.
31-3 Direct Labor, Machine Molding.

32 INDIRECT LABOR:

To include all labor in the foundry or for the foundry, other than that of putting up molds and special pattern and flask labor—cutting sand; shifting; breaking gates; delivering castings to the cleaning and chipping room; gathering up scrap; lining ladles; cleaning up department; foreman; etc.

35 SUPPLIES AND TOOLS:

To include the cost of all supplies and small tools used in molding—sand; facing; pasting; chaplets; molders' tools; etc.

36 REPAIR LABOR:

To include the cost of all labor in connection with the up-keep and maintenance of the foundry equipment, other than that of a special nature—patterns; flasks; jackets; bottom boards; match boxes; core boxes; etc.; also labor for repairing molding machines, molding benches, etc.

37 REPAIR MATERIALS:

To include the cost of all materials used in connection with the up-keep and maintenance of the foundry equipment, other than that of a special nature—patterns; flasks; jackets; bottom boards; match boxes; core boxes; molding machines; etc.

38 FIXED PLANT CHARGES:

To include a proportion of such costs as power, heat and light; insurance; taxes; depreciation; medical and hospital; and such other costs of a general nature that more or less fixed and that cannot be charged directly to any one department.

39 Special Pattern and Flask Expense:

To include the cost of all labor and materials used in making and repairing patterns, flasks, jackets, bottom boards, match boxes, core boxes, rigging up molding machines, etc., that is of a special nature, and is traceable, without pro-rating, to a pattern number.

COREMAKING DEPARTMENT

41 Direct Labor:

To include all labor of coremakers and helpers in making and assembling cores, and in operating core machines, that is traceable, without pro-rating, to a pattern number.

42 Indirect Labor:

To include all coreroom labor other than that of actually making cores—sand mixers; sand wheelers; oven tenders; inspectors; delivering cores to the foundry; cleaning up department; etc.

43 Fuel:

To include the cost of all core fuel, freight, and labor in unloading.

45 Supplies and Tools:

To include the cost of all supplies and small tools used in the coreroom—core sand; core binders; wire; nails; tools; etc.

46 Repair Labor:

To include the cost of all labor in connection with the up-keep and maintenance of the coreroom equipment—ovens; racks; trays; etc.

47 Repair Materials:

To include the cost of all materials used in connection with the up-keep and maintenance of the coreroom equipment—ovens; racks; trays; etc.

48 FIXED PLANT CHARGES:

To include a proportion of such costs as power, heat and light; insurance; taxes; depreciation; salary of superintendent; general foreman; and miscellaneous yard labor; medical and hospital; and such other costs of a general nature that are more or less fixed and that cannot be charged directly to any one department.

See definitions of the above accounts for methods of distributing them departmentally.

CLEANING AND CHIPPING DEPARTMENT

52 INDIRECT LABOR:

To include all labor in the cleaning and chipping department—loading and unloading mills; operating sand-blast barrels, tables and hose; chipping; inspecting; sorting; cleaning up department; foreman; etc.

55 SUPPLIES AND TOOLS:

To include the cost of all supplies and small tools used in the cleaning and chipping department—sand-blast sand; hose; stars; jacks, chipping hammers and other small tools; etc.

56 REPAIR LABOR:

To include the cost of all labor in connection with the up-keep and maintenance of all cleaning and chipping equipment—repairs to mills, sand-blast apparatus, dust arresters, etc.

57 REPAIR MATERIALS:

To include the cost of all materials used in connection with the up-keep and maintenance of all cleaning and chipping equipment—repairs to mills, sand-blast apparatus, dust arresters, etc.

58 FIXED PLANT CHARGES:

To include a proportion of such costs as power, heat and light; insurance; taxes; depreciation; salary of super-

intendent, general foreman, and miscellaneous yard labor; medical and hospital; and such other costs of a general nature that are more or less fixed and that cannot be charged directly to any one department.

See definitions of the above accounts for methods of distributing them departmentally.

FINISHING AND SHIPPING DEPARTMENT

61 DIRECT FINISHING LABOR:

To include all direct labor in the finishing department that is traceable, without pro-rating, to a pattern number, such as grinding, punching, drifting, drilling, reaming, scaling, etc.

62 INDIRECT FINISHING AND SHIPPING LABOR:

To include all indirect labor in the finishing and shiping department—sorting, trucking; inspection; foreman; etc.

65 SUPPLIES AND TOOLS:

To include the cost of all supplies and small tools used in finishing and shipping department—emery wheels; press supplies; tapping and threading machine supplies; chisels and hammers; oil and waste; sacks; twine; needles; etc.

66 REPAIR LABOR:

To include the cost of all labor in connection with the up-keep and maintenance of the finishing and shipping room equipment.

67 REPAIR MATERIALS:

To include cost of all materials used in connection with the up-keep and maintenance of the finishing and shipping room equipment.

68 FIXED PLANT CHARGES:

To include a proportion of such costs as power, heat and light; insurance; taxes, depreciation; salary of super-

intendent, general foreman and miscellaneous yard labor; medical and hospital; and such other costs of a general nature that are more or less fixed and that cannot be charged directly to any one department.

See definitions of the above accounts for methods of distributing them departmentally.

GENERAL EXPENSE

70-1 Office Salaries:

To include the salaries of clerks and of all general officers.

70-2 Office Expense:

To include all expense incidental to the office, other than selling.

70-3 Selling Expense:

To include the salaries and expenses of salesmen, and all expenses incidental to selling, such as advertising, collection, commissions, etc.

70-4 Misc. General Expense:

To include all forms of miscellaneous expense of a general nature that cannot be included elsewhere, such as membership dues, donations, etc. Charges to this account should be made sparingly.

RETURNS AND ALLOWANCES

80 Returns and Allowances:

To include a charge of an amount per ton of castings produced sufficient to cover the invoice price of castings returned by customers, less the scrap value thereof.

Credit an account "Reserve for Returns and Allowances." As castings are returned charge the reserve account and credit the customer, making a memorandum entry on job cost card.

PATTERN SHOP

101 DIRECT LABOR:

To include all labor in making and repairing patterns, core boxes, match boxes, etc., that is traceable, without pro-rating, to a pattern number. The balance of this account should be absorbed at the end of month either through transfer to account No. 39 or by direct charges to customers' accounts.

102 INDIRECT LABOR:

To include all pattern shop labor that is not practicable to trace to a pattern number.

105 MATERIALS, SUPPLIES AND TOOLS:

To include the cost of all materials, supplies and small tools used in making and repairing patterns, core boxes, match boxes, etc. The greater part of the balance of this account should be absorbed, at the end of the month either through transfer to account No. 39 or by direct charges to customers' accounts.

108 FIXED CHARGES:

To include such costs as power, heat and light, insurance, taxes and depreciation, and other costs of a similar nature that are more or less fixed.

CARPENTER SHOP

111 DIRECT LABOR:

To include all labor in making and repairing flasks, jackets, bottom boards, etc., that is traceable without pro-rating, to a pattern number. The balance of this account should be absorbed, at the end of the month, either through transfer to account No. 39 or by direct charges to customers' accounts.

112 INDIRECT LABOR:

To include all carpenter shop labor that is not practicable to trace to a pattern number.

115 MATERIALS, SUPPLIES AND TOOLS:

To include the cost of all materials, supplies and small tools used in making and repairing flasks, jackets, bottom boards, etc. The greater part of the balance of this account should be absorbed at the end of the month either through transfer to acocunt No. 39, or by direct charges to customers' accounts.

118 FIXED CHARGES:

To include such costs as power, heat and light, insurance, taxes, and depreciation and other costs of a similar nature that are more or less fixed.

BLACKSMITH SHOP

122 INDIRECT LABOR:

To include all blacksmith shop labor—making and repairing pokers, grate bars, etc.

123 FUEL:

To include the cost of all blacksmith fuel, including freight and labor in unloading.

125 MATERIALS, SUPPLIES AND TOOLS:

To include the cost of all materials, supplies and small tools used in the blacksmith shop.

128 FIXED CHARGES:

To include such costs as power, heat and light, insurance, taxes and depreciation, and other costs of a similar nature that are more or less fixed.

FIXED PLANT CHARGES

138 POWER, HEAT AND LIGHT:

To include the cost of all purchased current; all costs of labor, materials, supplies and expense in producing power; labor and materials in repairing boiler and engine room equipment, including air compressors, accumulators,

pumps, generators, transformers, etc., located in engine room; boiler insurance, etc.

Distribute the balance of the account at the end of each month to the several operating departments in accordance with the measured or approximated consumption of power.

148 FIRE INSURANCE:

To include all premiums for fire insurance and all costs of fire protection.

Charge the account monthly and credit "Prepaid Insurance" account, the entry being one-twelfth of the annual expense.

Distribute the balance of the account at the end of each month to the several operating departments on the basis of the approximate book value of the department investment.

158 TAXES:

To include all tax payments and assessments on both real and personal property.

Charge the account monthly and credit "Accrued Taxes" account, the entry being one-twelfth of the annual expense.

Distribute the balance of the account at the end of each month to the several operating departments on the basis of the approximate book value of the department investment.

168 DEPRECIATION:

To include charges to cover the deterioration in the value of the buildings and equipment due to wear and tear and obsolescence.

Charge the account monthly and credit "Plant Depreciation Reserve" accounts, the basis being one-twelfth of the annual expense.

Distribute the balance of the account at the end of each month to the several operating departments on the

basis of the approximate book value of the department investment.

178 MEDICAL AND HOSPITAL:

To include all forms of medical and hospital expense; personal injury payments when not covered by liability insurance, and legal expenses in connection therewith; etc.

Distribute the balance of the account at the end of the month to the several operating departments on the basis of the total departmental labor.

188 LIABILITY INSURANCE:

To include monthly premiums on employer's liability insurance policies.

Distribute the balance of the account at the end of each month to the several operating departments on the basis of the total departmental labor.

198 SUPT., GENERAL FOREMAN, AND MISC. YARD LABOR:

To include the salary of the superintendent, general foreman and all miscellaneous yard labor.

Distribute the balance of the account at the end of each month to the several operating departments on the basis of the total departmental labor.

208 MISC. PLANT EXPENSE:

To include all forms of miscellaneous plant expense of a general nature not included elsewhere, such as water rent; employees' welfare; etc. Charges to this account should be made sparingly.

Distribute the balance of the account at the end of each month to the several operating departments in an equitable way, the bases depending upon the nature of the expense.

Classification of Accounts for Malleable Iron Foundries

METAL:

10-1 Pig Iron.

10-2 Malleable Scrap.
10-3 Steel Scrap.

MELTING DEPARTMENT:

22 Indirect Labor.
23 Fuel.
25 Supplies and Tools.
26 Repair Labor.
27 Repair Materials.
28 Fixed Plant Charges.
29 Laboratory Expense.

MOLDING DEPARTMENT:

31 Direct Labor.
  31-1 Direct Labor—Bench Molding.
  31-2 Direct Labor—Floor Molding.
  31-3 Direct Labor—Machine Molding.
32 Indirect Labor.
35 Supplies and Tools.
36 Repair Labor.
37 Repair Materials.
38 Fixed Plant Charges.
39 Special Pattern and Flask Expense.

COREMAKING DEPARTMENT:

41 Direct Labor.
42 Indirect Labor.
43 Fuel.
45 Supplies and Tools.
46 Repair Labor.
47 Repair Materials.
48 Fixed Plant Charges.

HARD IRON CLEANING DEPARTMENT:

52 Indirect Labor.
55 Supplies and Tools.
56 Repair Labor.

57 Repair Materials.
58 Fixed Plant Charges.

TRIMMING AND INSPECTING DEPARTMENT:

62 Indirect Labor.
65 Supplies and Tools.
66 Repair Labor.
67 Repair Materials.
68 Fixed Plant Charges.

ANNEALING DEPARTMENT:

72 Indirect Labor.
73 Fuel.
74 Pots and Bottoms.
75 Supplies and Tools.
76 Repair Labor.
77 Repair Materials.
78 Fixed Plant Charges.

SOFT IRON CLEANING DEPARTMENT:

82 Indirect Labor.
85 Supplies and Tools.
86 Repair Labor.
87 Repair Materials.
88 Fixed Plant Charges.

FINISHING AND SHIPPING DEPARTMENT:

91 Direct Finishing Labor.
92 Indirect Finishing and Shipping Labor.
95 Supplies and Tools.
96 Repair Labor.
97 Repair Materials.
98 Fixed Plant Charges.

GENERAL EXPENSE:

110-1 Office Salaries.
110-2 Office Expense.
110-3 Selling Expense.
110-4 Misc. General Expense.

RETURNS AND ALLOWANCES:

120 Returns and Allowances.

PATTERN SHOP:

121 Direct Labor.
122 Indirect Labor.
125 Materials, Supplies and Tools.
128 Fixed Charges.

CARPENTER SHOP:

131 Direct Labor.
132 Indirect Labor.
135 Materials, Supplies and Tools.
138 Fixed Charges.

BLACKSMITH SHOP:

142 Indirect Labor.
143 Fuel.
145 Materials, Supplies and Tools.
148 Fixed Charges.

FIXED PLANT CHARGES:

158 Power, Heat and Light.
168 Fire Insurance.
178 Taxes.
188 Depreciation.
198 Medical and Hospital.
208 Liability Insurance.
218 Supt., General Foreman, and Misc. Yard Labor.
228 Misc. Plant Expense.

Definition of Accounts for Malleable Iron Foundries

METAL

10-1 PIG IRON:

To include the cost of all pig iron used, freight, and labor in unloading.

10-2 Malleable Scrap:

To include the cost of all purchased malleable scrap used, freight, and labor in unloading.

10-3 Steel Scrap:

To include the cost of all steel scrap used, freight and labor in unloading.

MELTING DEPARTMENT

22 Indirect Labor:

To include all labor identified with the melting of the iron—handling and conveying iron and fuel to the furnace; charging; skimming; firemen; cranemen; slag mill labor; foreman; etc.

23 Fuel:

To include the cost of all steel scrap used, freight, and labor in unloading.

25 Supplies and Tools:

To include the cost of all supplies and small tools used at the melting furnace.

26 Repair Labor:

To include the cost of all labor in connection with the up-keep and maintenance of the melting furnaces and their equipment.

27 Repair Materials:

To include the cost of all materials used in connection with the up-keep and maintenance of the melting furnaces and their equipment—fire brick, fire clay, furnace sand, etc.

28 Fixed Plant Charges:

To include a proportion of such costs as power, heat and light; insurance; taxes; depreciation; salary of superintendent, general foreman, and all miscellaneous yard labor; medical and hospital; and such other costs of a gen-

eral nature that are more or less fixed and that cannot be directly charged to any one department.

See definitions of the above accounts for methods of distributing them departmentally.

29 Laboratory Expense:

To include salary of chemist; laboratory expenses; labor and expense incurred in testing products; etc.

MOLDING DEPARTMENT

31 Direct Labor:

To include all labor of molders and helpers in putting up molds; operating molding machines; green sand core work; etc., that is traceable, without pro-rating, to a pattern number.

If practicable, separate into:—

31-1 Direct Labor, Bench Molding.
31-2 Direct Labor, Floor Molding.
31-3 Direct Labor, Machine Molding.

32 Indirect Labor:

To include all labor in the foundry or for the foundry, other than that of putting up molds and special pattern and flask labor—cutting sand; shifting; breaking gates; delivering castings to the hard iron cleaning room; gathering up scrap; lining ladles; cleaning up department; foreman; etc.

35 Supplies and Tools:

To include the cost of all supplies and small tools used in the foundry—molding sand; facing; pasting; chaplets; molders' tools; etc.

36 Repair Labor:

To include the cost of all labor in connection with the up-keep and maintenance of the foundry equipment, other than that of a special nature—patterns; flasks; jack-

ets; bottom boards; match boxes; core boxes; etc.; also labor in repairing molding machines, molding benches, etc.

37 Repair Materials:

To include the cost of all materials used in connection with the up-keep and maintenance of the foundry equipment other than that of a special nature—patterns; flasks; jackets; bottom boards; match boxes; core boxes; etc.; also material for repairing molding machines, molding benches, etc.

38 Fixed Plant Charges:

To include a proportion of such costs as power, heat and light; insurance; taxes; depreciation; salary of superintendent, general foreman, and all miscellaneous yard labor; medical and hospital; and such other costs of a general nature that are more or less fixed and that cannot be charged directly to any one department.

See definitions of the above accounts for methods of distributing them departmentally.

39 Special Pattern and Flask Expense:

To include the cost of all labor and materials used in making and repairing patterns, flasks, jackets, bottom boards, match boxes, core boxes, rigging up molding machines, etc., that is of a special nature, and is traceable, without pro-rating, to a pattern number.

COREMAKING DEPARTMENT

41 Direct Labor:

To include all labor of coremakers and helpers in making and assembling cores, and in operating core machines, that is traceable, without pro-rating, to a pattern number.

42 Indirect Labor:

To include all coreroom labor other than that of actually making cores—sand mixers; sand wheelers; oven

tenders; inspectors; delivering cores to the foundry; cleaning up department; etc.

43 FUEL:

To include the cost of all core fuel, freight and labor in unloading.

45 SUPPLIES AND TOOLS:

To include the cost of all supplies and tools used in the coreroom—core sand; core binders; wire; nails; tools; etc.

46 REPAIR LABOR:

To include the cost of all labor in connection with the up-keep and maintenance of the coreroom equipment—ovens; racks; trays; etc.

47 REPAIR MATERIALS:

To include the cost of all materials used in connection with the up-keep and maintenance of the coreroom equipment—ovens; racks; trays; etc.

48 FIXED PLANT CHARGES:

To include a proportion of such costs as power, heat and light; insurance; taxes; depreciation; salary of superintendent, general foreman, and all miscellaneous yard labor; medical and hospital; and such other costs of a general nature that are more or less fixed and that cannot be charged directly to any one department.

See definitions of the above accounts for methods of distributing them departmentally.

HARD IRON CLEANING DEPARTMENT

52 INDIRECT LABOR:

To include all labor in the hard iron cleaning department—loading and unloading mills; operating sand-blast barrels, tables and hose; delivering castings to the trimming room; cleaning up department; foreman; etc.

55 Supplies and Tools:

To include the cost of all supplies and small tools used in the hard iron cleaning department—sand-blast sand; hose; stars; jacks; small tools; etc.

56 Repair Labor:

To include the cost of all labor in connection with the up-keep and maintenance of all hard iron cleaning equipment—repairs to mills, sand-blast apparatus, dust arresters, etc.

57 Repair Materials:

To include the cost of all materials used in connection with the up-keep and maintenance of all hard iron cleaning equipment—repairs to mills, sand-blast apparatus, dust arresters, etc.

58 Fixed Plant Charges:

To include a proportion of such costs as power, heat and light; insurance; taxes; depreciation; salary of superintendent, general foreman, and all miscellaneous yard labor; medical and hospital; and such costs of a general nature that are more or less fixed and that cannot be charged directly to any one department.

See definitions of the above accounts for methods of distributing them departmentally.

TRIMMING AND INSPECTING DEPARTMENT

62 Indirect Labor:

To include all labor in the trimming and inspecting room—trimming; inspecting; counting; sorting; delivering castings to the annealing department; cleaning up department; foreman; etc.

65 Supplies and Tools:

To include the cost of supplies and small tools used in the trimming and inspecting department—chipping hammers; chipping benches; etc.

66 Repair Labor:

To include the cost of all labor in connection with the up-keep and maintenance of the trimming room equipment.

67 Repair Materials:

To include the cost of all materials used in connection with the up-keep and maintenance of the trimming room equipment.

68 Fixed Plant Charges:

To include a proportion of such costs as power, heat and light; insurance; taxes; depreciation; salary of superintendent, general foreman, and all miscellaneous yard labor; medical and hospital; and such other costs of a general nature that are more or less fixed and that cannot be directly charged to any one department.

See definitions of the above accounts for methods of distributing them departmentally.

ANNEALING DEPARTMENT

72 Indirect Labor:

To include the cost of all labor in the annealing department—packing; filling and emptying ovens; opening and closing oven doors; shaking out castings and delivering to the soft iron cleaning department; hauling in coal and removing ashes; firemen; disposition of old pots and bottoms; cleaning up department; cranemen; foreman; etc.

73 Fuel:

To include the cost of all annealing fuel, freight and labor in unloading.

74 Pots and Bottoms:

To include the cost of all purchased pots and bottoms; also the direct costs of producing pots and bottoms.

75 SUPPLIES AND TOOLS:

To include the cost of all supplies and small tools used in the annealing department—packing materials; department and oven tools; etc.

76 REPAIR LABOR:

To include the cost of all labor in connection with the up-keep, and maintenance of the annealing ovens and their equipment—including repairs to cranes, oven trucks, etc.

77 REPAIR MATERIALS:

To include the cost of materials used in connection with the up-keep, and maintenance of the annealing ovens and their equipment—fire brick; bungs; etc., including repairs to cranes and oven trucks.

78 FIXED PLANT CHARGES:

To include a proportion of such costs as power, heat and light; insurance; taxes; depreciation; salary of superintendent, general foreman, and all miscellaneous yard labor; medical and hospital; and such other costs of a general nature that are more or less fixed and that cannot be charged directly to any one department.

See definitions of the above accounts for methods of distributing them departmentally.

SOFT IRON CLEANING DEPARTMENT

82 INDIRECT LABOR:

To include all labor in the soft iron cleaning department—loading and unloading mills; operating sand-blast barrels, tables and hose; delivering castings to the finishing room; cleaning up department; foreman; etc.

85 SUPPLIES AND TOOLS:

To include the cost of all supplies and small tools used in the soft iron cleaning department—sand-blast sand; hose; stars; jacks; small tools; etc.

86 Repair Labor:

To include the cost of all labor in connection with the up-keep and maintenance of all soft iron cleaning equipment—repairs to mills, sand-blast apparatus, dust arresters, etc.

87 Repair Materials:

To include the cost of all materials used in connection with the up-keep and maintenance of all soft iron cleaning equipment—repairs to mills, sand-blast apparatus, dust arrestors, etc.

88 Fixed Plant Charges:

To include a proportion of such costs as power, heat and light; insurance; taxes; depreciation; salary of superintendent, general foreman, and all miscellaneous yard labor; medical and hospital; and such other costs of a general nature that are more or less fixed and that cannot be charged directly to any one department.

See definitions of the above accounts for methods of distributing them departmentally.

FINISHING AND SHIPPING DEPARTMENT

91 Direct Finishing Labor:

To include all direct labor in the finishing department, that is traceable, without pro-rating, to a pattern number, such as grinding, punching, drifting, drilling, reaming, scaling, etc.

92 Indirect Finishing and Shipping Labor:

To include all indirect labor in the finishing and shipping department—sorting; loading; trucking; inspection; foreman; etc.

95 Supplies and Tools:

To include the cost of all supplies and small tools used in the finishing and shipping department—emery

wheels; press supplies; tapping and threading machine supplies; chisels and hammers, oil and waste; sacks; twine; needles; etc.

96 Repair Labor:

To include the cost of all labor in connection with the up-keep and maintenance of the finishing and shipping equipment.

97 Repair Materials:

To include the cost of all materials used in connection with the up-keep and maintenance of the finishing and shipping equipment.

98 Fixed Plant Charges:

To include a proportion of such costs as power, heat and light; insurance; taxes; depreciation; salary of superintendent, general foreman, and all miscellaneous yard labor; medical and hospital; and such other costs of a general nature that are more or less fixed and that cannot be charged directly to any one department.

See definitions of the above accounts for methods of distributing them departmentally.

GENERAL EXPENSE

110-1 Office Salaries:

To include the salaries of clerks and of all general officers.

110-2 Office Expense:

To include all expense incidental to the office, other than selling.

110-3 Selling Expense:

To include the salaries and expenses of salesmen, and all expenses incidental to selling, such as advertising, collection, commissions, etc.

110-4 Misc. General Expense:

To include all forms of miscellaneous expense of a general nature that cannot be included elsewhere, such as membership dues, donations, etc. Charges to this account should be made sparingly.

RETURNS AND ALLOWANCES

120 Returns and Allowances:

To include a charge of an amount per ton of castings produced sufficient to cover the invoice price of castings returned by customers, less the scrap value thereof.

Credit an account "Reserve for Returns and Allowances." As castings are returned charge the reserve account and credit the customer, making a memorandum entry on job cost card.

PATTERN SHOP

121 Direct Labor:

To include all labor in making and repairing patterns, core boxes, match boxes, etc., that is traceable, without prorating, to a pattern number. The balance of this account should be absorbed at end of month either through transfer to account No. 39 or by direct charges to customers' accounts.

122 Indirect Labor:

To include all pattern shop labor that is not practicable to trace to a pattern number.

125 Materials, Supplies and Tools:

To include the cost of all materials, supplies, and small tools used in making and repairing patterns, core boxes, match boxes, etc. The greater part of the balance of this account should be absorbed at the end of the month either through transfer to account No. 39 or by direct charges to customers' accounts.

128 FIXED CHARGES:

To include such costs as power, heat and light, insurance, taxes, and depreciation, and other costs of a similar nature that are more or less fixed.

CARPENTER SHOP

131 DIRECT LABOR:

To include all labor in making and repairing flasks, jackets, bottom boards, etc., that is traceable without prorating to a pattern number. The balance of this account should be absorbed at the end of the month either through transfer to account No. 39 or by direct charges to customers' accounts.

132 INDIRECT LABOR:

To include all carpenter shop labor that is not practicable to trace to a pattern number.

135 MATERIALS, SUPPLIES AND TOOLS:

To include the cost of all materials, supplies and small tools used in making and repairing flasks, jackets, bottom boards, etc. The greater part of the balance of this account should be absorbed at the end of the month either through transfer to account No. 39, or by direct charges to customers' accounts.

138 FIXED CHARGES:

To include such costs as power, heat and light, insurance, taxes, and depreciation and other costs of a similar nature that are more or less fixed.

BLACKSMITH SHOP

142 INDIRECT LABOR:

To include all blacksmith shop labor—making and repairing pokers, grate bars, etc.

143 FUEL:

To include the cost of all blacksmith fuel, including freight and labor in unloading.

145 MATERIALS, SUPPLIES AND TOOLS:

To include the cost of all materials, supplies and small tools used in the blacksmith shop.

148 FIXED CHARGES:

To include such costs as power, heat and light, insurance, taxes and depreciation, and other costs of a similar nature that are more or less fixed.

FIXED PLANT CHARGES

158 POWER, HEAT AND LIGHT:

To include the cost of all purchased current; all costs of labor, materials, supplies and expense in producing power; labor and materials in repairing boiler and engine room equipment, including air compressors, accumulators, pumps, generators, etc., located in engine room; boiler insurance, etc.

Distribute the balance of the account at the end of each month to the several operating departments in accordance with the measured or approximated consumption of power.

168 FIRE INSURANCE:

To include all payments for fire insurance and all costs of fire protection.

Charge the account monthly and credit "Prepaid Insurance" account, the entry being one-twelfth of the annual expense.

Distribute the balance of the account at the end of each month to the several operating departments on the basis of the approximate book value of the department investment.

178 TAXES:

To include all tax payments and assessments on both real and personal property.

Charge the account monthly and credit "Accrued Taxes" account, the entry being one-twelfth of the annual expense.

Distribute the balance of the account at the end of each month to the several operating departments on the basis of the approximate book value of the department investment.

188 DEPRECIATION:

To include charges to cover the deterioration in the value of the buildings and equipment due to wear and tear and obsolescence.

Charge the account monthly and credit Buildings and Equipment Depreciation Reserve accounts, the basis being one-twelfth of the annual expense.

Distribute the balance of the account at the end of each month to the several operating departments on the basis of the approximate book value of the department investment.

198 MEDICAL AND HOSPITAL:

To include all forms of medical and hospital expense; personal injury payments when not covered by liability insurance, and legal expenses in connection therewith; etc.

Distribute the balance of the account at the end of each month to the several operating departments on the basis of the total departmental labor.

208 LIABILITY INSURANCE:

To include monthly premiums on employer's liability insurance policies.

Distribute the balance of the account at the end of each month to the several operating departments on the basis of the total departmental labor.

218 Supt., General Foreman and Misc. Yard Labor:

To include the salary of the superintendent, general foreman, and all miscellaneous yard labor.

Distribute the balance of the account at the end of each month to the several operating departments on the basis of the total departmental labor.

228 Misc. Plant Expense:

To include all forms of miscellaneous plant expense of a general nature not included elsewhere, such as water rent; employes' welfare; etc. Charges to this account should be made sparingly.

Distribute the balance of the account at the end of each month to the several operating departments in an equitable way, the bases depending upon the nature of the expense.

Classification of Accounts for Steel Foundries

Metal:

10-1 Pig Iron.
10-2 Steel Scrap.
10-3 Cast Scrap
10-4 Turnings.
10-5 Ferro-Manganese.
10-6 Ferro-Silicon.
10-7 Spiegeleisen.
10-8 Aluminum.
10-9 Misc. Metals.

Melting Department:

22 Indirect Labor.
23 Electric Current (or Fuel).
24 Electrodes.
25 Supplies and Tools.
26 Repair Labor.
27 Repair Materials.

28 Fixed Plant Charges.
29 Laboratory Expense.
For the converter process, separate accounts should be kept for melting and for conversion.

MOLDING DEPARTMENT:

31 Direct Labor.
31-1 Direct Labor—Bench Molding.
31-2 Direct Labor—Floor Molding.
31-3 Direct Labor—Machine Molding.
32 Indirect Labor.
35 Supplies and Tools.
36 Repair Labor.
37 Repair Materials.
38 Fixed Plant Charges.
39 Special Pattern and Flask Expense.

COREMAKING DEPARTMENT:

41 Direct Labor.
42 Indirect Labor.
43 Fuel.
45 Supplies and Tools.
46 Repair Labor.
47 Repair Materials.
48 Fixed Plant Charges.

CLEANING AND TRIMMING DEPARTMENT:

52 Indirect Labor.
55 Supplies and Tools.
56 Repair Labor.
57 Repair Materials.
58 Fixed Plant Charges.

ANNEALING DEPARTMENT:

62 Indirect Labor.
63 Fuel.
65 Supplies and Tools.
66 Repair Labor.

67 Repair Materials.
68 Fixed Plant Charges.

FINISHING AND SHIPPING DEPARTMENT:

71 Direct Finishing Labor.
72 Indirect Finishing and Shipping Labor.
75 Supplies and Tools.
76 Repair Labor.
77 Repair Materials.
78 Fixed Plant Charges.

GENERAL EXPENSE:

80-1 Office Salaries.
80-2 Office Expense.
80-3 Selling Expense.
80-4 Misc. General Expense.

RETURNS AND ALLOWANCES:

90 Returns and Allowances.

PATTERN SHOP:

101 Direct Labor.
102 Indirect Labor.
105 Materials, Supplies and Tools.
108 Fixed Charges.

CARPENTER SHOP:

111 Direct Labor.
112 Indirect Labor.
115 Materials, Supplies and Tools.
118 Fixed Charges.

BLACKSMITH SHOP:

122 Indirect Labor.
123 Fuel.
125 Materials, Supplies and Tools.
128 Fixed Charges.

FIXED PLANT CHARGES:

138 Power, Heat and Light.
148 Fire Insurance.
158 Taxes.
168 Depreciation.
178 Medical and Hospital.
188 Liability Insurance.
198 Supt., General Foreman, and Misc. Yard Labor.
208 Misc. Plant Expense.

Definition of Accounts for Steel Foundries

METAL

10-1 PIG IRON:

To include the cost of all pig iron used, freight, and labor in unloading.

10-2 STEEL SCRAP:

To include the cost of all steel scrap used, freight, and labor in unloading.

10-3 CAST SCRAP:

To include the cost of all cast scrap used, freight, and labor in unloading.

10-4 TURNINGS:

To include the cost of all turnings used, freight, and labor in unloading.

10-5 FERRO-MANGANESE:

To include the cost of all ferro-manganese used, freight, and labor in unloading.

10-6 FERRO-SILICON:

To include the cost of all ferro-silicon used, freight, and labor in unloading.

10-7 SPIEGELEISEN:

To include the cost of all spiegeleisen used, freight, and labor in unloading.

10-8 ALUMINUM

To include the cost of all aluminum used, freight, and labor in unloading.

10-9 MISC. METALS:

To include the cost of all miscellaneous metals used, freight, and labor in unloading.

MELTING DEPARTMENT

22 INDIRECT LABOR:

To include all labor identified with the melting of the iron—handling and conveying iron and fuel to the furnace; charging; cranemen; slag mill labor; foreman; etc.

23 ELECTRIC CURRENT:

To include the cost of all electric current consumed.

24 ELECTRODES:

To include the cost of all electrodes used.

25 SUPPLIES AND TOOLS:

To include the cost of all supplies and small tools used at the melting furnace.

26 REPAIR LABOR:

To include the cost of all labor in connection with the up-keep and maintenance of the melting furnaces and their equipment.

27 REPAIR MATERIALS:

To include the cost of all materials used in connection with the up-keep and maintenance of the melting furnaces and their equipment—fire brick; fire clay; sand; limestone; etc.

28 FIXED PLANT CHARGES:

To include a proportion of such costs as power, heat and light; insurance; taxes; depreciation; salary of superintendent, general foreman, and miscellaneous yard labor;

medical and hospital; and such other costs of a general nature that are more or less fixed and that cannot be directly charged to any one department.

See definitions of the above accounts for methods of distributing them departmentally.

29 Laboratory Expense:

To include salary of chemist; laboratory expenses; labor and expense incurred in testing products; etc.

MOLDING DEPARTMENT

31 Direct Labor:

To include all labor of molders and helpers in putting up molds; operating molding machines; green sand core work; etc., that is traceable, without pro-rating, to a pattern number.

If practicable, separate into—

31-1 Direct Labor, Bench Molding.
31-2 Direct Labor, Floor Molding.
31-3 Direct Labor, Machine Molding.

32 Indirect Labor:

To include all labor in the foundry or for the foundry, other than that of putting up molds and special pattern and flask labor—cutting sand; shifting; cutting gates; delivering castings to the cleaning and trimming room; gathering up scrap; lining ladles; cleaning up department; foreman; etc.

35 Supplies and Tools:

To include the cost of all supplies and small tools used in the foundry—molding sand; facing; pasting; chaplets; molders' tools; etc.

36 Repair Labor:

To include the cost of all labor in connection with the up-keep and maintenance of the foundry equipment, other than that of a special nature—patterns; flasks; jack-

ets; bottom boards; match boxes; core boxes; etc.; also labor for repairing molding machines, molding benches, etc.

37 Repair Materials:

To include the cost of materials used in connection with the up-keep and maintenance of the foundry equipment, other than that of a special nature—patterns; flasks; jackets; bottom boards; match boxes; core boxes; etc.

38 Fixed Plant Charges:

To include a proportion of such costs as power, heat and light; insurance; taxes; depreciation; salary of superintendent, general foreman and miscellaneous yard labor; medical and hospital; and such other costs of a general nature that are more or less fixed and that cannot be charged directly to any one department.

See definitions of the above accounts for methods of distributing them departmentally.

39 Special Pattern and Flask Expense:

To include the cost of all labor and materials used in making and repairing patterns, flasks, jackets, bottom boards, match boxes, core boxes, rigging up molding machines, etc., that is of a special nature, and is traceable, without pro-rating, to a pattern number.

COREMAKING DEPARTMENT

41 Direct Labor:

To include all labor of coremakers and helpers in making and assembling cores, and in operating core machines, that is traceable, without pro-rating, to a pattern number.

42 Indirect Labor:

To include all coreroom labor other than that of actually making cores—sand mixers; sand wheelers; oven tenders; inspectors; delivering cores to the foundry; cleaning up department, etc.

43 FUEL:

To include the cost of all core fuel, freight and labor in unloading.

45 SUPPLIES AND TOOLS:

To include the cost of all supplies and tools used in the coreroom—core sand; core binders; wire; nails; tools; etc.

46 REPAIR LABOR:

To include the cost of all labor in connection with the up-keep and maintenance of the coreroom equipment—ovens; racks; trays; etc.

47 REPAIR MATERIALS:

To include the cost of all materials used in connection with the up-keep and maintenance of the coreroom equipment—ovens; racks; trays; etc.

48 FIXED PLANT CHARGES:

To include a proportion of such costs as power, heat and light; insurance; taxes; depreciation; superintendent, general foreman and misc. yard labor; medical and hospital; and such other costs of a general nature that are more or less fixed and that cannot be charged directly to any one department.

See definitions of the above accounts for methods of distributing them departmentally.

CLEANING AND TRIMMING DEPARTMENT

52 INDIRECT LABOR:

To include all labor in the cleaning and trimming department—loading and unloading mills; operating sand-blast barrels, tables and hose; trimming; inspecting; sorting; cleaning up department; foreman; etc.

55 SUPPLIES AND TOOLS:

To include the cost of all supplies and small tools used in the cleaning and trimming department—sand-blast sand; hose; stars; jacks; small tools; etc.

56 Repair Labor:

To include the cost of all labor in connection with the up-keep and maintenance of all cleaning and trimming equipment—repairs to mills, sand-blast apparatus, dust arresters, etc.

57 Repair Materials:

To include the cost of all materials used in connection with the up-keep and maintenance of the cleaning and trimming room equipment—repairs to mills, sand-blast apparatus, dust arresters, etc.

58 Fixed Plant Charges:

To include a proportion of such costs as power, heat and light; insurance; taxes; depreciation; salary of superintendent, general foreman, and miscellaneous yard labor; medical and hospital; and such other costs of a general nature that are more or less fixed and that cannot be charged directly to any one department.

See definitions of the above accounts for methods of distributing them departmentally.

ANNEALING DEPARTMENT

62 Indirect Labor:

To include the cost of all labor in the annealing department—packing; filling and emptying ovens; delivering to the finishing and shipping department; cleaning up department; cranemen; foremen; etc.

63 Fuel:

To include the cost of all annealing fuel, freight, and labor in unloading.

65 Supplies and Tools:

To include the cost of all supplies and small tools used in the annealing department—packing materials; department and oven tools; etc.

66 Repair Labor:

To include the cost of all labor in connection with the up-keep and maintenance of the annealing ovens and their equipment, including cranes, oven trucks, etc.

67 Repair Materials:

To include the cost of all materials used in connection with the up-keep and maintenance of the annealing ovens and their equipment, including cranes, oven trucks, etc.

68 Fixed Plant Charges:

To include a proportion of such costs as power, heat and light; insurance; taxes; depreciation; salary of superintendent, general foreman, and miscellaneous yard labor; medical and hospital; and such other costs of a general nature that are more or less fixed and that cannot be charged directly to any one department.

See definitions of the above accounts for methods of distributing them departmentally.

FINISHING AND SHIPPING DEPARTMENT

71 Direct Finishing Labor:

To include all direct labor in the finishing department that is traceable, without pro-rating, to a pattern number, such as grinding, punching, drilling, reaming, scaling, etc.

72 Indirect Finishing and Shipping Labor:

To include all indirect labor in the finishing and shipping department—sorting; trucking; inspection; foreman; etc.

75 Supplies and Tools:

To include the cost of all supplies and small tools used in the finishing and shipping department—emery wheels; press supplies; tapping and threading machine supplies; chisels and hammers, oil and waste; sacks; twine; needles; etc.

76 Repair Labor:

To include the cost of all labor in connection with the up-keep and maintenance of the finishing and shipping room equipment.

77 Repair Materials:

To include the cost of all materials used in connection with the up-keep and maintenance of the finishing and shipping room equipment.

78 Fixed Plant Charges:

To include a proportion of such costs as power, heat and light; insurance; taxes; depreciation; salary of superintendent, general foreman, and miscellaneous yard labor; medical and hospital; and such other costs of a general nature that are more or less fixed and that cannot be charged directly to any one depeartment.

See definitions of the above accounts for methods of distributing them departmentally.

GENERAL EXPENSE

80-1 Office Salaries:

To include the salaries of clerks and of all general officers.

80-2 Office Expense:

To include all expense incidental to the office, other than selling.

80-3 Selling Expense:

To include the salaries and expenses of salesmen, and all expenses incidental to selling, such as advertising, collection, commissions, etc.

80-4 Misc. General Expense:

To include all forms of miscellaneous expense of a general nature that cannot be included elsewhere, such as

membership dues, donations, etc. Charges to this account should be made sparingly.

RETURNS AND ALLOWANCES

90 Returns and Allowances:

To include a charge of an amount per ton of castings produced sufficient to cover the invoice price of castings returned by customers, less the scrap value thereof.

Credit an account "Reserve for Returns and Allowances." As castings are returned charge the reserve account and credit the customer, making a memorandum entry on job cost card.

PATTERN SHOP

101 Direct Labor:

To include all labor in making and repairing patterns, core boxes, match boxes, etc., that is traceable, without prorating, to a pattern number. The balance of this account should be absorbed at end of month either through transfer to account No. 39 or by direct charges to customers' accounts.

102 Indirect Labor:

To include all pattern shop labor that is not practicable to trace to a pattern number.

105 Materials, Supplies and Tools:

To include the cost of all materials, supplies and small tools used in making and repairing patterns, core boxes, match boxes, etc. The greater part of the balance of this account should be absorbed at the end of the month either through transfer to account No. 39 or by direct charges to customers' accounts.

108 Fixed Charges:

To include such costs as power, heat and light, insurance, taxes and depreciation, and other costs of a similar nature that are more or less fixed.

CARPENTER SHOP

111 DIRECT LABOR:

To include all labor in making and repairing flasks, jackets, bottom boards, etc., that is traceable, without prorating, to a pattern number. The balance of this account should be absorbed at the end of the month either through transfer to account No. 39 or by direct charges to customers' accounts.

112 INDIRECT LABOR:

To include all carpenter shop labor that is not practicable to trace to a pattern number.

115 MATERIALS, SUPPLIES AND TOOLS:

To include the cost of all materials, supplies and small tools used in making and repairing flasks, jackets, bottom boards, etc. The greater part of the balance of this account should be absorbed at the end of the month either through transfer to account No. 39 or by direct charges to customers' accounts.

118 FIXED CHARGES:

To include such costs as power, heat and light, insurance, taxes, and depreciation and other costs of a similar nature that are more or less fixed.

BLACKSMITH SHOP

122 INDIRECT LABOR:

To include all blacksmith shop labor—making and repairing pokers, grate bars, etc.

123 FUEL:

To include the cost of all blacksmith fuel, including freight and labor in unloading.

125 MATERIALS, SUPPLIES AND TOOLS:

To include the cost of all materials, supplies and small tools used in the blacksmith shop.

128 FIXED CHARGES:

To include such costs as power, heat and light, insurance, taxes and depreciation, and other costs of a similar nature that are more or less fixed.

FIXED CHARGES

138 POWER, HEAT AND LIGHT:

To include the cost of all purchased current; all costs of labor, materials, supplies and expense in producing power; labor and materials in repairing boiler and engine room equipment, including air compressors, accumulators, pumps, generators, transformers, etc., located in engine room; boiler insurance, etc.

Distribute the balance of the account at the end of each month to the several operating departments in accordance with the measured or approximated consumption of power.

148 FIRE INSURANCE:

To include all payments for fire insurance and all costs of fire protection.

Charge the account monthly and credit "Prepaid Insurance" account, the entry being one-twelfth of the annual expense.

Distribute the balance of the account at the end of each month to the several operating departments on the basis of the approximate book value of the department investment.

158 TAXES:

To include all tax payments and assessments on both real and personal property.

Charge the account monthly and credit "Accrued Taxes" account, the entry being one-twelfth of the annual expense.

Distribute the balance of the account at the end of each month to the several operating departments on the basis of the approximate book value of the department investment.

168 DEPRECIATION:

To include charges to cover the deterioration in the value of the buildings and equipment due to wear and tear and obsolescence.

Charge the account monthly and credit "Plant Depreciation Reserve" accounts, the basis being one-twelfth of the annual expense.

Distribute the balance of the account at the end of each month to the several operating departments on the basis of the approximate book value of the department investment.

178 MEDICAL AND HOSPITAL:

To include all forms of medical and hospital expense; personal injury payments when not covered by liability insurance, and legal expenses in connection therewith, etc.

Distribute the balance of the account at the end of each month to the several operating departments on the basis of the total departmental labor.

188 LIABILITY INSURANCE:

To include monthly premiums on employer's liability insurance policies.

Distribute the balance of the account at the end of each month to the several operating departments on the basis of the total departmental labor.

198 SUPERINTENDENT, GENERAL FOREMAN AND MISC. YARD LABOR:

To include the salary of the superintendent, general foreman and all miscellaneous yard labor.

Distribute the balance of the account at the end of each month to the several operating departments on the basis of the total departmental labor.

Diagram of Accounts for Large Grey Iron Foundries

- Operating Costs
  - Metal
    - 10-1 Pig Iron
    - 10-2 Grey Iron Scrap
    - 10-3 Malleable Iron Scrap
    - 10-4 Steel Scrap
    - 10-5 Home Scrap
  - Melting Department
    - 22. Indirect Labor
      - 22-1 Chargers and Helpers
      - 22-2 Slagmen
      - 22-3 Making up Heats
      - 22-4 Charging
      - 22-5 Operating Slag Mill
      - 22-6 Supervision (foreman and assistants)
    - 23. Fuel
      - 23-1 Coal
      - 23-2 Coke
      - 23-3 Gas
      - 23-4 Fuel Oil
    - 24 Flux
      - 23-5 Wood
    - 25 Supplies and Tools
    - 26 Repair Labor
    - 27 Repair Materials
    - 28 Fixed Plant Charges
    - 29 Laboratory Expense
      - 29-1 Labor
      - 29-2 Materials and Expense
    - 31 Direct Labor
      - 31-1 Bench Molding
      - 31-2 Floor Molding
      - 31-3 Machine Molding
    - 32 Indirect Labor
      - 32-1 Gate Breakers, Cleaning Up Gangway and Floors and Delivering Castings to Cleaning Department
      - 32-2 Flask, Board, and Chill Men
      - 32-3 Sand Cutters
      - 32-4 Ladle Liners
      - 32-5 Hauling Molding Sand to Molders' Floors
      - 32-6 Shifting
      - 32-7 Iron Carriers
      - 32-8 Supervision (foreman and assistants)

- **Operating Costs**
  - **Molding Department**
    - 35 Supplies and Tools
      - 35-1 Sand
      - 35-2 Facings
      - 35-3 Chaplets
      - 35-4 Oil
      - 35-5 Molasses
      - 35-6 Compound
      - 35-7 Parting
      - 35-8 Molders' Tools
    - 36 Repair Labor
    - 37 Repair Materials
    - 38 Fixed Plant Charges
    - 39 Special Pattern and Flask Expense
      - 39-1 Labor
      - 39-2 Material
      - 39-3 Expense
  - **Coremaking Department**
    - 41 Direct Labor
      - 41-1 Bench Division
      - 41-2 Machine Division
    - 42 Indirect Labor
      - 42-1 Sand Mixers (also cleaning up department)
      - 42-2 Oven Tenders
      - 42-3 Wire Straighteners
      - 42-4 Inspectors (also pasting)
      - 42-5 Core Carriers
      - 42-6 Supervision (foreman and assistants)
    - 43 Fuel
    - 45 Supplies and Tools
      - 45-1 Sand
      - 45-2 Core Oil
      - 45-3 Compound
      - 45-4 Wire
      - 45-5 Rods
      - 45-6 Miscellaneous Supplies
      - 45-7 Miscellaneous Tools
    - 46 Repair Labor
    - 47 Repair Materials
    - 48 Fixed Plant Charges

Diagram of Accounts for Large Grey Iron Foundries—*Continued*

- **Operating Costs**
  - **Cleaning and Chipping Department**
    - 52 Indirect Labor
      - 52-1 Hand and Air Chipping
      - 52-2 Sand Blasting
      - 52-3 Wire Brushing
      - 52-4 Tumbling
      - 52-5 Pickling
      - 52-6 Cleaning Up Department
      - 52-7 Supervision (foreman and assistants)
    - 55 Supplies and Tools
      - 55-1 Sand
      - 55-2 Stars
      - 55-3 Acid
      - 55-4 Misc. Supplies and Tools
    - 56 Repair Labor
    - 57 Repair Materials
    - 58 Fixed Plant Charges
  - **Finishing and Shipping Department**
    - 61 Direct Finishing Labor
      - 61-1 Grinding
      - 61-2 Filing, etc.
    - 62 Indirect Labor
      - 62-1 Sorting, Inspecting, Packing, Loading
      - 62-2 Supervision and Clerical
    - 65 Supplies and Tools
    - 66 Repair Labor
    - 67 Repair Materials
    - 68 Fixed Plant Charges
  - **General Expense**
    - 70-1 Officers' Salaries
    - 70-2 Office Salaries
    - 70-3 Office Expense
    - 70-4 Selling Expense
    - 70-5 Misc. General Expense
  - **Returns and Allowances**
    - 80 Returns and Allowances
  - **Pattern Shop**
    - 101 Direct Labor (charge account)
    - 102 Indirect Labor
    - 105 Materials, Supplies and Tools
    - 106 Repair Labor
    - 107 Repair Materials
    - 108 Fixed Charges

- **Operating Costs**
  - **Carpenter Shop**
    - 111 Direct Labor
    - 112 Indirect Labor
    - 115 Materials, Supplies and Tools
    - 116 Repair Labor
    - 117 Repair Materials
    - 118 Fixed Charges
  - **Blacksmith Shop**
    - 122 Indirect Labor
    - 123 Fuel
    - 125 Materials, Supplies and Tools
    - 126 Repair Labor
    - 127 Repair Materials
    - 128 Fixed Charges
  - **Fixed Plant Charges**
    - 138 Power, Heat and Light
      - 138-1 Labor
      - 138-2 Fuel
      - 138-3 Supplies
      - 138-4 Repair Labor
      - 138-5 Repair Materials
      - 138-6 Heating System
      - 138-7 Electrical System
    - 148 Fire Insurance
    - 158 Property Taxes
    - 168 Depreciation
    - 178 Medical and Hospital
    - 188 Liability Insurance
    - 198 Supt., General Foreman and Misc. Yard Labor
    - 208 Misc. Plant Expense

Diagram of Accounts for Large Steel Foundries

- **Operating Costs**
  - **Melting Dept.**
    - **Metal**
      - 10-1 Pig Iron
      - 10-2 Steel Scrap
      - 10-3 Cast Scrap
      - 10-4 Turnings
      - 10-5 Borings
      - 10-6 Ferro-Manganese
      - 10-7 Ferro-Silicon
      - 10-8 Spiegeleisen
      - 10-9 Aluminum
      - 10-10 Vanadium
      - 10-11 Other Metals
      - 10-12 Home Scrap
    - 22 Indirect Labor
      - 22-1 Melters and Helpers
      - 22-2 Making up Heats
      - 22-3 Charging
      - 22-4 General Furnace Labor
      - 22-5 Operating Slag Mill
      - 22-6 Supervision (foreman and assistants)
    - 23 Fuel
      - 23-1 Coke
      - 23-2 Charcoal
      - 23-3 Coal
      - 23-4 Gas
      - 23-5 Fuel Oil
      - 23-6 Electric Current
    - 24 Electrodes
    - 25 Supplies and Tools
    - 26 Repair Labor
    - 27 Repair Materials
    - 28 Fixed Plant Charges
    - 29 Laboratory
      - 29-1 Labor
      - 29-2 Materials and Expense
  - 31 Direct Labor
    - 31-1 Bench Molding
    - 31-2 Floor Molding
    - 31-3 Machine Molding

- Operating Costs
  - Molding Department
    - 32 Indirect Labor
      - 32-1 Sprue Cutting, Cleaning up Gangway and Floors and Delivering Castings to the Cleaning and Trimming Department.
      - 32-2 Flask, Board and Chill Men
      - 32-3 Sand Cutters
      - 32-4 Ladle Liners
      - 32-5 Hauling Molders' Sand to Molders' Floors
      - 32-6 Shifting
      - 32-7 Iron Carriers
      - 32-8 Sprue Cutters
      - 32-9 Supervision (foreman and assistants)
    - 35 Supplies and Tools
      - 35-1 Sand
      - 35-2 Facings
      - 35-3 Chaplets
      - 35-4 Oil
      - 35-5 Molasses
      - 35-6 Compound
      - 35-7 Partings
      - 35-8 Molders' Tools
    - 36 Repair Labor
    - 37 Repair Materials
    - 38 Fixed Plant Charges
    - 39 Special Pattern and Flask Expense
      - 39-1 Labor
      - 39-2 Material
      - 39-3 Expense
  - Coremaking Department
    - 41 Direct Labor
      - 41-1 Bench Division
      - 41-2 Machine Division
    - 42 Indirect Labor
      - 42-1 Sand Mixers (also cleaning up department)
      - 42-2 Oven Tenders
      - 42-3 Wire Straighteners
      - 42-4 Inspectors (also pasting)
      - 42-5 Core Carriers
      - 42-6 Supervision (foreman and assistants)
    - 43 Fuel
    - 45 Supplies and Tools
      - 45-1 Sand
      - 45-2 Core Oil
      - 45-3 Compound
      - 45-4 Wire
      - 45-5 Rods
      - 45-6 Miscellaneous Supplies
      - 45-7 Miscellaneous Tools
    - 46 Repair Labor
    - 47 Repair Materials
    - 48 Fixed Plant Charges

Diagram of Accounts for Large Steel Foundries—*Continued*

- Operating Costs
  - Cleaning and Trimming Department
    - 52 Indirect Labor
      - 52-1 Hand and Air Chipping
      - 52-2 Sand-Blasting
      - 52-3 Wire Brushing
      - 52-4 Tumbling
      - 52-5 Pickling
      - 52-6 Cleaning up Department
      - 52-7 Supervision (foreman and assistants)
    - 55 Supplies and Tools
      - 55-1 Sand
      - 55-2 Stars
      - 55-3 Acid
      - 55-4 Misc. Supplies and Tools
    - 56 Repair Labor
    - 57 Repair Materials
    - 58 Fixed Plant Charges
  - Annealing Department
    - 62 Indirect Labor
    - 63 Fuel
    - 65 Supplies and Tools
    - 66 Repair Labor
    - 67 Repair Materials
    - 68 Fixed Plant Charges
  - Finishing and Shipping Department
    - 71 Direct Finishing Labor
      - 71-1 Grinding
      - 71-2 Straightening
      - 71-3 Filing, etc.
    - 72 Indirect Finishing and Shipping Labor
      - 72-1 Sorting, Inspecting, Packing, Loading
      - 72-2 Supervision (foreman and assistants) and Clerical
    - 75 Supplies and Tools
    - 76 Repair Labor
    - 77 Repair Materials
    - 78 Fixed Plant Charges

- **General Expense**
  - 80-1 Officers' Salaries
  - 80-2 Office Salaries
  - 80-3 Office Expense
  - 80-4 Selling Expense
  - 80-5 Misc. General Expense
- **Returns and Allowances**
  - 90 Returns and Allowances

- **Operating Costs**
  - **Pattern Shop**
    - 101 Direct Labor (charge account)
    - 102 Indirect Labor
    - 105 Materials, Supplies and Tools
    - 106 Repair Labor
    - 107 Repair Materials
    - 108 Fixed Charges
  - **Carpenter Shop**
    - 111 Direct Labor
    - 112 Indirect Labor
    - 115 Materials, Supplies and Tools
    - 116 Repair Labor
    - 117 Repair Materials
    - 118 Fixed Charges
  - **Blacksmith Shop**
    - 122 Indirect Labor
    - 123 Fuel
    - 125 Materials, Supplies and Tools
    - 126 Repair Labor
    - 127 Repair Materials
    - 128 Fixed Charges
  - **Fixed Plant Charges**
    - 138 Power, Heat and Light
      - 138-1 Labor
      - 138-2 Fuel
      - 138-3 Supplies
      - 138-4 Repair Labor
      - 138-5 Repair Materials
      - 138-6 Heating System
      - 138-7 Electrical System
    - 148 Fire Insurance
    - 158 Property Taxes
    - 168 Depreciation
    - 178 Medical and Hospital
    - 188 Liability Insurance
    - 198 Supt., General Foreman and Misc. Yard Labor
    - 208 Misc. Plant Expense

Diagram of Accounts for Large Malleable Iron Foundries

- Operating Costs
  - Metal
    - 10-1 Pig Iron
    - 10-2 Malleable Scrap
    - 10-3 Steel Scrap
    - 10-4 Home Scrap
  - Melting Department
    - 22 Indirect Labor
      - 22-1 Firemen
      - 22-2 Slagmen (taking out slag and cleaning ashpits)
      - 22-3 Skimming
      - 22-4 General Overhauling
      - 22-5 Coal Men
      - 22-6 Charging
      - 22-7 Making Up Heats
      - 22-8 Operating Slag Mill
      - 22-9 Supervision (foreman and assistants)
    - 23 Fuel
      - 23-1 Coal
      - 23-2 Fuel Oil
      - 23-3 Gas
    - 25 Supplies and Tools
    - 26 Repair Labor
    - 27 Repair Material
    - 28 Fixed Plant Charges
    - 29 Laboratory Expense
      - 29-1 Labor
      - 29-2 Materials and Expense
  - 31 Direct Labor
    - 31-1 Bench Molding
    - 31-2 Floor Molding
    - 31-3 Machine Molding
  - 32 Indirect Labor
    - 32-1 Gate Breakers, Cleaning Up Gangways and Floors and delivering castings to the Hard Iron Cleaning Department
    - 32-2 Flask, Board and Chill Men.
    - 32-3 Sand Cutters
    - 32-4 Ladle Liners
    - 32-5 Hauling Molding Sand to Molders' Floors
    - 32-6 Shifting
    - 32-7 Iron Carriers
    - 32-8 Supervision (foreman and assistants)

- Operating Costs
  - Molding Department
    - 35 Supplies and Tools
      - 35-1 Sand
      - 35-2 Facings
      - 35-3 Chaplets
      - 35-4 Oil
      - 35-5 Molasses
      - 35-6 Compound
      - 35-7 Parting
      - 35-8 Molders' Tools
    - 36 Repair Labor
    - 37 Repair Materials
    - 38 Fixed Plant Charges
    - 39 Special Pattern and Flask Expense
      - 39-1 Labor
      - 39-2 Material
      - 39-3 Expense
  - Coremaking Department
    - 41 Direct Labor
      - 41-1 Bench Division
      - 41-2 Machine Division
    - 42 Indirect Labor
      - 42-1 Sand Mixers
      - 42-2 Oven Tenders
      - 42-3 Wire Straighteners
      - 42-4 Inspectors (also pasting)
      - 42-5 Core Carriers
      - 42-6 Supervision (foreman and assistants)
    - 43 Fuel
    - 45 Supplies and Tools
      - 45-1 Sand
      - 45-2 Core Oil
      - 45-3 Compound
      - 45-4 Wire
      - 45-5 Rods
      - 45-6 Miscellaneous Supplies
      - 45-7 Miscellaneous Tools
    - 46 Repair Labor
    - 47 Repair Materials
    - 48 Fixed Plant Charges

Diagram of Accounts for Large Malleable Iron Foundries—*Continued*

- Operating Costs
  - Hard Iron Cleaning Dept.
    - 52 Indirect Labor
      - 52-1 Tumbling
      - 52-2 Sand-blasting
      - 52-3 Cleaning Up Department
      - 52-4 Supervision (foreman and assistants)
    - 55 Supplies and Tools
      - 55-1 Stars
      - 55-2 Sand
      - 55-3 Misc. Supplies and Tools
    - 56 Repair Labor
    - 57 Repair Materials
    - 58 Fixed Plant Charges
  - Trimming and Inspecting Department
    - 62 Indirect Labor
      - 62-1 Trimming
      - 62-2 Inspection
      - 62-3 Cleaning Up Department
      - 62-4 Supervision (foreman and assistants) and Clerical
    - 65 Supplies and Tools
    - 66 Repair Labor
    - 67 Repair Materials
    - 68 Fixed Plant Charges
  - Annealing Department
    - 72 Indirect Labor
      - 72-1 Packing
      - 72-2 Shaking Out and Delivering to Soft Iron Cleaning Dept.
      - 72-3 Emptying and Filling Ovens, Building Up and Taking Down Doors
      - 72-4 Oven Firemen
      - 72-5 Coal and Ash Men
      - 72-6 Other Misc. Labor
      - 72-7 Supervision (foreman and assistants) and Clerical
    - 73 Fuel
      - 73-1 Coal
      - 73-2 Fuel Oil
      - 73-3 Gas
    - 74 Pots and Bottoms
    - 75 Supplies and Tools
    - 76 Repair Labor
    - 77 Repair Materials
    - 78 Fixed Plant Charges

- Operating Costs
  - Soft Iron Cleaning Department
    - 82 Indirect Labor
      - 82-1 Tumbling
      - 82-2 Sand-Blasting
      - 82-3 Cleaning Up Department
      - 82-4 Supervision (foreman and assistants)
    - 85 Supplies and Tools
      - 85-1 Stars
      - 85-2 Sand
      - 85-3 Misc. Supplies and Tools
    - 86 Repair Labor
    - 87 Repair Materials
    - 88 Fixed Plant Charges
  - Finishing and Shipping Dept.
    - 91 Direct Finishing Labor
      - 91-1 Chipping
      - 91-2 Grinding
      - 91-3 Straightening
      - 91-4 Punching and Reaming
    - 92 Indirect Finishing and Shipping Labor
      - 92-1 Sorting, Loading, Inspecting, Packing
      - 92-2 Supervision (foreman and assistants) and Clerical
    - 95 Supplies and Tools
      - 95-1 Finishing Supplies and Tools
      - 95-2 Packing Materials and Supplies
    - 96 Repair Labor
    - 97 Repair Materials
    - 98 Fixed Plant Charges
  - General Expense
    - 110-1 Officers' Salaries
    - 110-2 Office Salaries
    - 110-3 Office Expense
    - 110-4 Selling Expense
    - 110-5 Misc. General Expense
  - Returns and Allowances
    - 120 Returns and Allowances

Diagram of Accounts for Large Malleable Iron Foundries—*Continued*

- Operating Costs
  - Pattern Shop
    - 121 Direct Labor (Charge Account)
    - 122 Indirect Labor
    - 125 Materials, Supplies and Tools
    - 126 Repair Labor
    - 127 Repair Materials
    - 128 Fixed Charges
  - Carpenter Shop
    - 131 Direct Labor
    - 132 Indirect Labor
    - 135 Materials, Supplies and Tools
    - 136 Repair Labor
    - 137 Repair Materials
    - 138 Fixed Charges
  - Blacksmith Shop
    - 142 Indirect Labor
    - 143 Fuel
    - 145 Materials, Supplies and Tools
    - 146 Repair Labor
    - 147 Repair Materials
    - 148 Fixed Charges
  - Fixed Plant Charges
    - 158 Power, Heat and Light
      - 158-1 Labor
      - 158-2 Fuel
      - 158-3 Supplies
      - 158-4 Repair Labor
      - 158-5 Repair Materials
      - 158-6 Heating System
      - 158-7 Electrical System
    - 168 Fire Insurance
    - 178 Property Taxes
    - 188 Depreciation
    - 198 Medical and Hospital
    - 208 Liability Insurance
    - 218 Supt., General Foreman and Misc. Yard Labor
    - 228 Misc. Plant Expense

Distribution of Fixed Plant Charges

In a foundry, as in all other businesses, there are certain plant charges or expenses of a more or less fixed nature that are not applicable in whole to any one department but which are common to all departments. Such charges, therefore, have to be or should be distributed over the several operating departments according to the extent each department incurred or shared in such expense. The expenses referred to under this head are those commonly known as fixed plant charges and consist of Power, Heat and Light, Depreciation, Taxes, Insurance, Medical and Hospital, Liability Insurance, Superintendent, General Foreman, Misc. Yard Labor, etc.

Power, Heat and Light

The costs of Power, Heat and Light should be distributed over the several operating departments in accordance with the consumption of power by each.

If department meters are in use the accurate consumption of power by departments is known, and it is a simple task to distribute the power cost in proportion to the consumption.

If department meters are not in use the consumption of power in each department can be obtained approximately by ascertaining the average horse power hours of the department motors. That is to say, if in a given department there are two 20-horse power motors estimated to run on an average at three-fourths capacity for 8 hours per day, the horse power hours per day would be 240. The power cost is thus distributed over the several operating departments on the basis of the departmental horse power hours.

An accurate distribution of heat and light is a little more difficult. This cost, however, is not great and the difference in results between using a method which is scientifically correct and one approximately so is not sufficient to justify

spending much time on determining an exact basis of distribution. With a knowledge of actual conditions a distribution which will give fairly accurate results can usually be made in a very arbitrary manner. Heat, ordinarily, can be distributed roughly on a floor space basis and light on a consumption basis as determined by the watts of the lights in use.

A distribution of the monthly charges for Power, Heat and Light can be readily made in the manner shown on page 190. The percentages determined at the beginning of the year, based on consumption, can be used throughout the year or until such time as a charge in operating conditions takes place.

Depreciation, Taxes and Insurance

As depreciation, taxes and insurance on the foundry buildings are distributed departmentally on the same basis, namely, floor space occupied, all three items of cost can be apportioned by using the same deepartmental factor. The factor is the proportion of floor space that a given department occupies of the total.

Depreciation on the foundry equipment, however, bears no relation to floor space and a lump sum provision should not be distributed on a floor space basis. This method, which is followed by some, is neither sound in principle nor does it give reasonably accurate results. Equipment depreciation should be computed departmentally on the basis of value and probable life of each kind and type of equipment.

At the beginning of each year an apportionment by departments of the estimated depreciation, taxes and insurance on foundry buildings for the ensuing year should be made. If to this total is added the depreciation on the equipment the monthly department charges for the entire amount of depreciation, taxes and insurance can be obtained in one sum. The apportionment and summary of these charges can be made very readily in the form shown on page 192. Information compiled in this form, apart from its value as a departmental distribution, will be found to be of special value for pur-

poses of ready reference in all matters arising with respect to past charges for depreciation, taxes and insurance.

Medical and Hospital, Liability Insurance, Superintendent, General Foreman, Misc. Yard Labor, and Misc. Plant Expense

Expenses such as medical and hospital, liability insurance, superintendent, general foreman, miscellaneous yard labor and miscellaneous plant expenses, which to a large extent are of a fixed nature and not chargeable to any one department, and which bear a close relation to the direct departmental labor or the pay roll of the several departments, can be distributed to an advantage in a lump sum, the basis being the total department labor cost. The basis found to exist during the first month of the calendar or fiscal year ordinarily can be used throughout the entire year with fairly accurate results.

All fixed charges which are distributable on a labor basis can be apportioned in one lump sum in the manner shown on page 191.

Recapitulation of Monthly Fixed Plant Charges

The minimum amount of clerical labor and the maximum amount of accurate cost data result from summarizing by departments the costs of power, heat and light, depreciation, taxes and insurance and other charges of a similar nature.

In the tabular statement shown on page 194 these charges are summarized using for illustration the figures shown in the preceding forms.

Monthly Journal Entries to Distribute Fixed Plant Charges Departmentally

When a recapitulation is made of the fixed plant charges in the form shown above but one monthly journal entry is needed to close the accounts on the ledger and to distribute the amounts to the proper operating cost accounts of the several departments.

The following entry closes the fixed plant charges accounts and distributes the costs to the several operating departments:

Account	28	$1,384.00	
	38	3,648.00	
	48	743.00	
	58	609.00	
	68	317.00	
	78	1,962.00	
	88	609.00	
	98	778.00	
To Account	158		$ 600.00
	168		400.00
	178		800.00
	188		5,250.00
	198		900.00
	218		1,500.00
	228		600.00

The account numbers conform to those of the classification of accounts shown on page 140.

Interest on Investment

If it is desired to treat interest on investment as an item of cost the amount should be considered a fixed charge and handled similarly to other fixed charges enumerated in this chapter.

To provide in the accounts for interest on investment the form illustrated on page 192 can carry a column to distribute interest on the investment in the foundry buildings on the floor space basis, and interest on the investment in foundry equipment on the basis of the value of the equipment.

The question of whether interest on capital invested is a proper charge against cost of production is one on which there is a marked difference of opinion.

In the foundry industry, very little, if anything, is gained from a cost accounting standpoint by charging interest on investment. The cases where it seems desirable to include interest in cost may be grouped under two heads:

1. Where materials have to be stored for long periods while a seasoning process is being completed.

As seasoned material has a higher value than when first purchased, it is apparent that the interest on the capital locked up during the seasoning, forms in a sense a direct part of the cost of the material. If the material were purchased in a seasoned condition, a higher price would have to be paid, and this price would at least include interest and other carrying charges.

2. Where, as between different processes of maufacture, it is desired to show the effect of variations in the amount of capital employed and the term of employment..

As some manufacturing processes require the use of expensive equipment, or take a longer time to complete the product, both of which tie up capital, while other processes require neither the equipment nor the time, it is impossible to get true relative costs unless consideration is given to interest on the capital employed.

Many accountants, however, take the ground that interest is not an item of cost and that to include it in cost results in an inflation of inventory values and an anticipation of profits. It is true that including interest in cost does inflate the inventory, and is an anticipation of profit by exactly the amount of interest charged to the cost of the goods on hand. In arriving at inventory values, however, the approximate interest which has been charged to the cost of the goods on hand can be ordinarily readily determined.

Where interest on the investment is treated as an item of cost the interest charged to the goods on hand should be eliminated from inventory values, and, in preparing profit and loss statements the amount of the interest charged to costs during the period should be returned to Income under the specific caption "Interest on Investment."

DISTRIBUTION OF POWER, HEAT AND LIGHT, 19 .

Month	Total Cost of Power, Heat and Light	Department							
		Melting	Molding	Core Making	Hard Iron Cleaning	Trimming and Inspecting	Annealing	Soft Iron Cleaning	Finishing and Shipping
Proportion		35%	15%	2½%	15%	2½%	5%	15%	10%
January	$600 00	$210 00	$90 00	$15 00	$90 00	$15 00	$30 00	$90 00	$60 00
February									
March									
April									
May									
June									
July									
August									
September									
October									
November									
December									
Total									

Distribution of Medical and Hospital Expenses, Superintendence, Misc. Yard Labor, and Misc. Plant Expenses, 19 .

	Medical and Hospital Expenses	Supt., General Foreman and Misc. Yard Labor	Misc. Plant Expense		Total	DEPARTMENT							
						Melting	Molding	Core-making	Hard Iron Cleaning	Trimming and Inspecting	Annealing	Soft Iron Cleaning	Finishing and Shipping
Dept. Labor for Jan. 19..	.....	.....	.....	.....	$40,000.00	$2,000.00	$22,000.00	$4,000.00	$1,000.00	$2,000.00	$4,000.00	$1,000.00	$4,000.00
Proportion of Total	.....	.....	.....	.....	.....	5%	55%	10%	2½%	5%	10%	2½%	10%
January	$ 900 00	1,500 00	$ 600 00	— —	$3,0000 00	$ 150 00	1,650 00	$ 300 00	$ 75 00	$ 150 00	$ 300 00	$ 75 00	$ 300 00
February	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —
March	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —
April	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —
May	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —
June	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —
July	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —
August	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —
September	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —
October	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —
November	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —
December	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —
Total													

DISTRIBUTION OF DEPRECIATION, TAXES AND INSURANCE, 19..

	BUILDINGS					
	Floor Space Occupied (Square Feet)	Percent of Total Floor Space	Building Depreciation	Building Taxes	Building Insurance	Total
For Year			$12,000 00	$4,800 00	$2,400 00	$19,200 00
For Month			1,000 00	400 00	200 00	1,600 00
Melting Dept.	2,000	5	$ 50 00	$ 20 00	$ 10 00	$ 80 00
Molding Dept. *	20,000	50	500 00	200 00	100 00	800 00
Coremaking Dept.	2,000	5	50 00	20 00	10 00	80 00
Hard Iron Cleaning Dept.	3,000	7½	75 00	30 00	15 00	120 00
Trimming and Inspecting Dept.	1,000	2½	25 00	10 00	5 00	40 00
Annealing Dept.	6,000	15	150 00	60 00	30 00	240 00
Soft Iron Cleaning Dept.	3,000	7½	75 00	30 00	15 00	120 00
Finishing and Shipping Dept.	3,000	7½	75 00	30 00	15 00	120 00
Total	40,000	100	$1,000 00	$ 400 00	$ 200 00	$ 1,600 00

*Including Pattern and Carpenter Shop.

DISTRIBUTION OF DEPRECIATION, TAXES AND INSURANCE, 19..—*Continued*

	EQUIPMENT						Monthly Dept. Charges for Depn. Taxes and Insurance
	Value of Equipment	Percent of Total Value	Equipment Taxes	Equipment Insurance	Equipment Depreciation†	Total	
For Year	.....	.....	$4,800 00	$2,400 00	$51,000 00	$58,200 00	$77,400 00
For Month	.....	.....	400 00	200 00	4,250 00	4,850 00	6,450 00
Melting Dept.	$120,000 00	24	$ 96 00	$ 48 00	$ 800 00	$ 944 00	$ 1,024 00
Molding Dept.*	90,000 00	18	72 00	36 00	1,000 00	1,108 00	1,908 00
Coremaking Dept.	40,000 00	8	32 00	16 00	300 00	348 00	428 00
Hard Iron Cleaning Dept.	20,000 00	4	16 00	8 00	300 00	324 00	444 00
Trimming and Inspecting Dept.	10,000 00	2	8 00	4 00	100 00	112 00	152 00
Annealing Dept.	160,000 00	32	128 00	64 00	1,200 00	1,392 00	1,632 00
Soft Iron Cleaning Dept.	20,000 00	4	16 00	8 00	300 00	324 00	444 00
Finishing and Shipping Dept.	40,000 00	8	32 00	16 00	250 00	298 00	418 00
Total	$500,000 00	100	$ 400 00	$ 200 00	$ 4,250 00	$ 4,850 00	$ 6,450 00

* Including Pattern and Carpenter Shop.

† Shown here summarization only. Equipment depreciation should be computed departmentally on the basis of value and the probable life of each kind and type.

RECAPITULATION OF MONTHLY FIXED PLANT CHARGES

	Total	Department													
		Melting		Molding		Core-making		Hard Iron Cleaning		Trimm'g and Inspecting		Annealing		Soft Iron Cleaning		Finish'g and Shipp'g	
January:																	
Power, Heat and Light....	$600	00	210	00	90	00	15	00	90	00	15	00	30	00	90	00	60	00
Depn., Taxes and Ins.....	6,450	00	1,024	00	1,908	00	428	00	444	00	152	00	1,632	00	444	00	418	00
Medical, Supt., Yard Labor, etc.....	3,000	00	150	00	1,650	00	300	00	75	00	150	00	300	00	75	00	300	00
Total.....	10,050	00	1,384	00	3,648	00	743	00	609	00	317	00	1,962	00	609	00	778	00
February:																		
Power, Heat and Light....																		
Depn., Taxes and Ins.....																		
Medical, Supt., Yard Labor, etc.....																		
Total.....																		

CHAPTER VIII

MONTHLY STATEMENTS

Introductory

Careful thought has to be given to the necessary statements and to the form of the statements in which the cost results appear, if the cost system is to measure plant operating efficiency. To show the results as they should be shown calls for comparative detailed cost statements at the end of the month. Often it is advisable to chart the costs, as then the variations can be seen at a glance. Many a manager and superintendent who seem to be unable to read figures are able to read a chart and to get readily in that way the story that the figures tell.

The manager or superintendent should be able to put his finger on any variation in cost and to either know the cause or to be able to investigate and discover it. This can be done largely through the intelligent use of properly designed statements of labor costs, material costs, and expense items.

In the foundry industry, where the product is varied and complicated, manufacturing errors are bound to occur, but very often the errors can be easily detected through detailed comparisons of monthly cost exhibits.

The comparison, however, should be prompt enough to avoid the repetition of the same mistakes the following month or period. It is not necessary to wait until the end of the month for a lot of vital cost information such as direct labor cost comparisons, comparative earnings of employes, production per molder per day, percentages of good and bad work, etc.

MONTHLY STATEMENT OF LABOR COSTS

PRODUCTION:

Current Month..... 740 Tons.
Same month last year..... 680 Tons.

	Labor Cost Per Ton of Good Castings Produced			
	Current Month		Same Month Last Year	
MELTING:				
Indirect Labor	2	44	2	12
Repair Labor		28		19
Total	2	72	2	31
MOLDING:				
Direct Labor	16	37	14	13
Indirect Labor	12	04	10	20
Repair Labor		26		28
Total	28	67	24	61
COREMAKING:				
Direct Labor	2	60	2	15
Indirect Labor	1	58	1	40
Repair Labor		08		10
Total	4	26	3	65
HARD IRON CLEANING:				
Indirect Labor	1	47	1	20
Repair Labor		22		18
Total	1	69	1	38
TRIMMING and INSPECTING:				
Indirect Labor	2	40	2	20
Repair Labor		05		03
Total	2	45	2	23
ANNEALING:				
Indirect Labor	4	98	4	60
Repair Labor		22		18
Total	5	20	4	78

MONTHLY STATEMENT OF LABOR COSTS—*Continued*

	Labor Cost Per Ton of Good Castings Produced			
	Current Month		Same Month Last Year	
SOFT IRON CLEANING:				
Indirect Labor	1	40	1	18
Repair Labor		09		06
Total	1	49	1	24
FINISHING and SHIPPING:				
Direct Finishing Labor	5	03	6	10
Indirect Finishing and Shipping Labor		26		18
Repair Labor		16		09
Total	5	45	6	37
Pattern Shop Direct Labor	1	20	1	10
Pattern Shop Indirect Labor		34		24
Carpenter Shop Direct Labor	1	36	1	53
Carpenter Shop Indirect Labor		18		16
Blacksmith Shop Labor		31		29
Power Plant Labor	2	40	2	10
Superintendent and General Foreman	1	47	1	42
Misc. Yard Labor		30		28
. . . . .				
. . . . .				
Total Labor Cost	59	49	53	69
Average Production Per Molder Per Day (lbs.)	670		610	
Average Weight of Castings Per Piece (lbs.)	1.65		1.70	
Average Earnings of Common Laborers Per Hour (cents)	.37		.30	
Average Earnings of Molders Per Hour (cents)	.60		.54	
Average Earnings of all Plant Employees Per Hour (cents)	.42		.39	

MONTHLY STATEMENT OF TOTAL COSTS

Month.....19..

Good Hard Iron Castings Produced	510 Tons.	Metal Charged	920 Tons.
Good Finished Castings Produced	500 Tons.	Molten Metal	830 Tons.
Shipped	480 Tons.	Melting Loss	90 Tons.

	Cost for the Month	
	Amount	Per ton good finished castings produced
METAL:		
Pig Iron	$16,600.00	$ 33.20
Steel Scrap	.....	.....
Malleable Scrap	1,810.00	3.62
Total	18,410.00	36.82
MELTING:		
Indirect Labor	1,270.00	2.54
Fuel	1,720.00	3.44
Supplies and Tools	90.00	.18
Repair Labor and Materials	450.00	.90
Fixed Plant Charges	545.00	1.09
Laboratory Expenses	160.00	.32
Total	4,235.00	8.47
MOLDING:		
Direct Labor (Molding Hrs. 13,225)	7,890.00	15.78
Indirect Labor	4,600.00	9.20
Supplies and Tools	180.00	.36
Repair Labor and Materials	450.00	.90
Fixed Plant Charges	930.00	1.86
Special Pattern and Flask Exp	480.00	.96
Total	14,530.00	29.06
COREMAKING:		
Direct Labor	2,355.00	4.71
Indirect Labor	1,530.00	3.06
Fuel	195.00	.39
Supplies and Tools	125.00	.25
Repair Labor and Materials	45.00	.09
Fixed Plant Charges	225.00	.45
Total	4,475.00	8.95
HARD IRON CLEANING:		
Indirect Labor	980.00	1.96
Supplies and Tools	20.00	.04
Repair Labor and Materials	55.00	.11
Fixed Plant Charges	125.00	.25
Total	1,180.00	2.36
TRIMMING AND INSPECTING:		
Indirect Labor	1,200.00	2.40
Supplies and Tools	55.00	.11
Fixed Plant Charges	50.00	.10
Total	1,305.00	2.61

MONTHLY STATEMENT OF TOTAL COSTS—*Continued*

ANNEALING:		
Indirect Labor	2,460.00	4.92
Fuel	1,010.00	2.02
Supplies and Tools	70.00	.14
Repair Labor and Materials	410.00	.82
Fixed Plant Charges	550.00	1.10
Pots and Bottoms	750.00	1.50
Total	5,250.00	10.50
SOFT IRON CLEANING:		
Indirect Labor	965.00	1.93
Supplies and Tools	15.00	.03
Repair Labor and Materials	50.00	.10
Fixed Plant Charges	130.00	.26
Total	1,160.00	2.32
FINISHING AND SHIPPING:		
Direct Finishing Labor	3,105.00	6.21
Indirect Finishing and Shipping Labor	1,250.00	2.50
Supplies and Tools	165.00	.33
Repair Labor and Materials	55.00	.11
Fixed Plant Charges	105.00	.21
Total	4,680.00	9.36
GENERAL EXPENSE:		
Office Salaries and Expense	3,625.00	7.25
Selling Expense	240.00	.48
Misc. General Expense	195.00	.39
Total	4,060.00	8.12
RETURNS AND ALLOWANCES:		
Returns and Allowances	1,000.00	2.00
TOTAL COST OF GOOD FINISHED CASTINGS PRODUCED	60,285.00	120.57

Metal Cost per 100 lbs. Good Finished Castings Produced	$ 1.841
Melting Cost per 100 lbs. of Molten Metal	$ 0.255
Molding Indirect Costs, Trimming and Inspecting Costs, Finishing and Shipping Indirect Costs and General Expense to Molding Direct Labor	166.0%
Coremaking Indirect Costs to Coremaking Direct Labor	90.0%
Hard Iron Cleaning, Annealing, Soft Iron Cleaning, and Provision for Returns and Allowances per 100 lbs. Good Finished Castings Produced	$0.859

	Tons	Per ton	Value
Inventory of Castings at Beginning of Month	190	$90.00	$17,100.00
Cost of Good Finished Castings Produced, as above	500	120.57	60,285.00
Total	690	.....	77,385.00
Less Inventory of Castings at End of Month	210	90.00	18,900.00
Cost of Castings Shipped During Month	480	121.85	$58,485.00

Comparative Statement of Total Costs

	Jan.	Feb.	Mar.	Oct.	Nov.	Dec.	Avg.
Tons Good Hard Iron Castings Produced							
Tons Good Finished Castings Produced							
Tons Shipped							
Tons Metal Charged							
Tons Molten Metal							
Tons Melting Loss							
METAL:							
Pig Iron							
Steel Scrap							
Malleable Scrap							
Total							
MELTING:							
Indirect Labor							
Fuel							
Supplies and Tools							
Repair Labor and Materials							
Fixed Plant Charges							
Laboratory Expenses							
Total							
MOLDING:							
Direct Labor							
Indirect Labor							
Supplies and Tools							
Repair Labor and Materials							
Fixed Plant Charges							
Spec. Pattern and Flask Exp.							
Total							
COREMAKING:							
Direct Labor							
Indirect Labor							
Fuel							
Supplies and Tools							
Repair Labor and Materials							
Fixed Plant Charges							
Total							
HARD IRON CLEANING:							
Indirect Labor							
Supplies and Tools							
Repair Labor and Materials							
Fixed Plant Charges							
Total							

Comparative Statement of Total Costs—*Continued*

TRIMMING AND INSPECTING:							
Indirect Labor							
Supplies and Tools							
Fixed Plant Charges							
Total							
ANNEALING:							
Indirect Labor							
Fuel							
Supplies and Tools							
Repair Labor and Materials							
Fixed Plant Charges							
Pots and Bottoms							
Total							
SOFT IRON CLEANING:							
Indirect Labor							
Supplies and Tools							
Repair Labor and Materials							
Fixed Plant Charges							
Total							
FINISHING AND SHIPPING:							
Direct Finishing Labor							
Indirect Finishing and Shipping Labor							
Supplies and Tools							
Repair Labor and Materials							
Fixed Plant Charges							
Total							
GENERAL EXPENSE:							
Office Salaries and Expense							
Selling Expense							
Misc. General Expense							
Total							
RETURNS AND ALLOWANCES:							
Returns and Allowances							
TOTAL COST OF GOOD FINISHED CASTINGS PRODUCED							

Metal Cost per 100 lbs. Good Finished Castings Produced.
Melting Cost per 100 lbs. of Molten Metal.
Molding Indirect Costs, Trimming and Inspecting Costs, Finishing and Shipping Indirect Costs and General Expense to Molding Direct Labor.
Coremaking Indirect Costs to Coremaking Direct Labor.
Hard Iron Cleaning, Annealing, Soft Iron Cleaning, and Provision for Returns and Allowances per 100 lbs. Good Finished Castings Produced.

PRODUCTION STATEMENT

MONTHLY AND COMPARATIVE

Month.....19..

	CURRENT MONTH		SAME MONTH LAST YEAR		CURRENT YEAR TO DATE		SAME PERIOD LAST YEAR	
	TONS	%	TONS	%	TONS	%	TONS	%
Total Castings Made.....	560.45	100.0	.....	.....	.....	.....	.....	.....
Less—Trimming Room Rejects	41.09	7.3	.....	.....	.....	.....	.....	.....
—Shipping Room Rejects.	14.36	2.5	.....	.....	.....	.....	.....	.....
—Cleaning and Finishing Loss.....	5.00	.9	.....	.....	.....	.....	.....	.....
Total.....	60.45	10.7	.....	.....	.....	.....	.....	.....
Total Good Castings Made.....	500.00	89.3	.....	.....	.....	.....	.....	.....

PROFIT AND LOSS STATEMENT

Month.....19..

	Current Month		Same Month Last Year		Current Year to Date		Same Period Last Year	
	Amount	Per ton	Amount	Per ton	Amount	Per ton	Amount	Per ton
Castings Shipped (Tons)	480							
Gross Value of Castings Shipped	$69,600.00	$145.00						
Less—Freight	401.12	.84						
—Discount	.....							
—Allowances	18.00	.04						
Total Deductions	419.12	.88						
Net Value of Castings Shipped	69,180.88	144.12						
Cost of Castings Shipped	58,485.00	121.85						
Net Operating Profit	10,695.88	22.27						
Other Income:								
Interest and Discount	24.10							
Income from Investments	840.00							
Miscellaneous Income	10.20							
Total Profit	11,570.18							
Less Interest Charges	260.00							
Net Profit	11,310.18							

CHAPTER IX

PRODUCT COSTS

Introductory

The product of grey iron foundries, of steel foundries, and of certain malleable iron foundries varies to such an extent that it is practically impossible to outline in detail a method to determine product or job costs that would apply to every foundry. While the fundamental principles may be the same, it is often necessary to apply them differently, depending upon the nature of the product and the class of the work of the particular foundry. This is especially true of grey iron and steel foundries that specialize in particular classes of work.

Costs, throughout the foundry industry, divide themselves into four classes or kinds, namely, tonnage costs; class costs; customer's costs (the cost to produce the entire work of a given customer); and job costs.

Tonnage Costs

Tonnage costs are averages per ton to produce the entire output of the plant for a stated period. They are arrived at by dividing the amount of the several cost items by the output in tons. The result is nothing more than an average cost of all work for the month or period and for price making purposes is only little better than no information. An average cost in the hands of some executives is worse than no cost information for it is always unsafe to be guided by it in making quotations. Tonnage costs should always be known but they are not determined and should not be

used for the purpose of price making, the primary object for which class and job costs are determined.

Class Costs

Class costs are a refinement of tonnage costs. That is to say, instead of determining the average cost for the entire production of the foundry the cost of the product divided into classes is determined. If the product is subject to classification and it is practicable to determine with a fair degree of accuracy the cost of each class, the method of recording class costs is a dependable one and entails the least amount of clerical labor. However, where a customer's entire work, consisting of different classes, has been taken at a flat price and where it is difficult to separate work by classes it is not advisable to attempt to record class costs.

When class costs are kept, the classification should be one of weight, separating the work as to plain and cored castings. For grey iron and steel castings, the following weight classification for both plain and cored work will generally be found to be sufficient to reflect difference in costs due to differences in weights:

Class	Castings weighing
A	Over 10,000 lbs.
B	Over 5,000 to 10,000 lbs.
C	Over 2,000 to 5,000 lbs.
D	Over 1,000 to 2,000 lbs.
E	Over 500 to 1,000 lbs.
F	Over 250 to 500 lbs.
G	Over 100 to 250 lbs.
H	Over 50 to 100 lbs.
I	Over 25 to 50 lbs.
J	Over 15 to 25 lbs.
K	Over 10 to 15 lbs.
L	Over 5 to 10 lbs.
M	Over 2 to 5 lbs.
N	Over 1 to 2 lbs.
O	1 lb. and under

For light work, that falling under say the last five classes, a further classification by weight per mold will be found

necessary in order to determine representative costs of each class. For instance, the cost to produce a two-pound casting with but two in a mold is vastly different from the cost to produce a two-pound casting with four in a mold. The cost of molding light work is very largely dependent upon the weight per mold instead of the weight of the casting.

For malleable iron castings, which as a whole are considerably lighter than either grey iron or steel, the following weight classification, for both plain and cored work, is recommended:

Class	Castings weighing
A	**Over 25 lbs. per casting**
h	Over 60 lbs. per mold
m	Over 35 to 60 lbs. per mold
l	Over 25 to 35 lbs. per mold
B	**Over 15 to 25 lbs. per casting**
h	Over 30 lbs. per mold
m	Over 20 to 30 lbs. per mold
l	Over 15 to 20 lbs. per mold
C	**Over 7 to 15 lbs. per casting**
h	Over 15 lbs. per mold
m	Over 10 to 15 lbs. per mold
l	Over 7 to 10 lbs. per mold
D	**Over 2 to 7 lbs. per casting**
h	Over 8 lbs. per mold
m	Over 5 to 8 lbs. per mold
l	Over 3 to 5 lbs. per mold
vl	Over 2 to 3 lbs. per mold
E	**Over 1 to 2 lbs. per casting**
h	Over 7 lbs. per mold
m	Over 4 to 7 lbs. per mold
l	Over 2 to 4 lbs. per mold
vl	Over 1 to 2 lbs. per mold
F	**Over .5 to 1 lb. per casting**
h	Over 5 lbs. per mold
m	Over 3 to 5 lbs. per mold
l	Over 1 to 3 lbs. per mold
vl	Over .5 to 1 lb. per mold
G	**.5 lb. or less per casting**
h	Over 5 lbs. per mold
m	Over 3 to 5 lbs. per mold
l	Over 1 to 3 lbs. per mold
vl	From 0 to 1 lb. per mold

The class characters h, m, l, and vl are designations, respectively, of heavy, medium, light, and very light weights per mold.

Customer's Costs

Where all of the work of a customer, consisting of a variety of similar or dissimilar patterns, has been taken at a flat price, which is often the case in both grey iron and malleable iron, and to some extent in steel castings, it is usual to treat the customer's entire product as the cost unit. If the price covers the whole of the customer's business the cost of production should be known covering the same quantity. If different parts of the work take different prices the cost to produce the work taken at the different prices should be the cost unit or cost division.

When there is but one price covering a number of patterns of castings the information as to the cost of each is of little value for cost and price comparisons but it is of vital value in spotting the patterns that are made at a loss or at an inadequate profit. The fact that certain patterns are run at a loss, as some almost invariably are under a flat price, should be of particular interest. Even though the entire work of a customer is the cost unit, the system should be so designed to make it possible to readily determine the cost of any particular pattern.

Job Costs

In the foundry industry, owing to the multitude of patterns produced by most concerns, a greater amount of clerical labor is required to ascertain job costs than is required to ascertain either class costs or customer's costs. The fact, however, that the cost of no two patterns is the same is sufficient reason for ascertaining job costs and for demanding a price on each pattern based upon its true cost. This is the only sound and logical way of pricing castings. For foundries that produce any considerable quantity of castings of a given pattern or that produce difficult heavy castings it is most essential that the cost of each pattern be known and that each pattern carry its own price.

Undeniably, a job cost, or a cost on each and every job, is far more accurate, dependable and scientific than any other kind of cost and it is the only cost for price making purposes that is safe to recommend.

In ascertaining job costs, a job cost record of suitable size and design should be employed to record both the direct and indirect costs of each pattern, the indirect costs or overhead rates being computed at the end of the month upon the determination of the exact overhead rates for the month. On long running jobs, a job cost summary card should be made out showing in summary form the essential information from month to month. The forms of the Job Cost Record on page 230 and of the Job Cost Card on page 233 should be studied and analyzed carefully as they comprise the completed structure of a cost system.

Flexibility of Cost System

While the cost units for determining class costs, customer's costs, and job costs, are different, a cost system can be and should be made sufficiently flexible to readily change from one to another at any time without destroying the value of cost information for analytical and comparative purposes. The fundamental principles of accounting under each are the same, the classification of accounts can be the same, and the methods of distributing overhead expense can be the same. The principal difference is that of classifying. The forms of Job Cost Record and Job Cost Card, referred to above, can be used in recording customer's costs, class costs, or job costs.

Direct Charges

All costs divide themselves into two parts, namely, direct costs and indirect costs. Direct costs, or charges, are those that can be located as being incurred on or for a particular

piece of work or job and where it is practicable to charge the cost or expense directly to the particular work or job.

The direct costs that are common to all foundries are the following:

Metal.
Melting.
Molding direct labor.
Special pattern and flask expense.
Coremaking direct labor.
Finishing direct labor.

Metal

The cost of the metal used can be considered a direct charge inasmuch as the metal cost per pound of good castings produced can be applied directly to the production of each class or of each job. The cost of the metal per pound of good castings is the same in all kinds of work irrespective of fluctuations in melting and other cost items.

A large number of foundries make the mistake of throwing together for cost purposes the cost of metal and of melting. This is a bad practice both for purposes of determining operating efficiency and for the purpose of determining individual costs. It is especially bad for the reason that the costs of metal and melting cannot be equitably distributed over different kinds of work on the same basis. The cost of the metal, apart from melting, in a pound of good castings is the same irrespective of the kind of casting and irrespective of whether it took three pounds of molten metal to get one pound of good castings or whether but 1½ pounds of molten metal were required to get a pound of good castings. The only exception that can be reasonably taken to the above statement is that there is a slight additional metal loss when scrap and sprue are remelted, but as a matter of practice practically all the slag is eliminated on the first melt and the metal loss on the remelt is not large.

Melting

The cost of melting the iron, as noted above, should always be separate from the cost of the metal itself as the melting cost is a variable item depending upon the quantity of the remelt—gates, sprue, risers and bad castings. It is contended by some who have not given the matter much thought that the difference in melting cost between a casting weighing say 10 pounds for which 24 pounds of molten metal had to be poured and one of the same weight but requiring only 12 pounds of molten metal would not be great, but on second thought it becomes evident that the cost is just twice as great for it costs just as much to remelt sprue and bad castings as it does pig iron. The cost is even greater for the sprue and bad castings cannot be handled as economically as pig iron. A casting with a heavy remelt is always an expensive one to produce even apart from the cost of melting which without question should be distributed on the weight of molten metal poured and not on the weight of good castings produced.

Where the product of the foundry is varied, consisting of various classes of work, as is the case in nearly all jobbing foundries, it is dangerous to disregard the difference in the scrap recovered as between different classes of work, so far as the melting cost is concerned, and use inaccurately an average of the metal and melting cost per weight of good castings produced.

To illustrate:

Example 1, Automobile Hub:

120 lbs. molten metal at say 1½c	$1.80
Cost of melting, 40c cwt	.48
	2.28
Less 20 lbs. scrap recovered at 1½c	.30
Cost of metal per 100 lbs. good castings	1.98

Example 2, Harness Buckle:

800 lbs. molten metal at 1½c	12.00
Cost of melting, 40c cwt	3.20
	15.20
Less 700 lbs. scrap recovered at 1½c	10.50
Cost of metal per 100 lbs. good castings	4.70

In the case of the hub, the cost of the net metal in the good castings is $1.98 per cwt., and in the case of the buckle, $4.70 per cwt., or nearly two and one-half times the cost.

While the above two examples probably illustrate extremes, yet there are many jobs that nearly approach the difference in cost shown above. Disregarding the cost to remelt the greater quantity of scrap in the example of the buckles, and using in each case the average cost of metal per weight of good castings, namely, $3.34 per cwt., might easily give a difference between the false book cost and the true cost as great as the expected profit added to the incorrect cost.

In other words, the foundry that inaccurately computed its cost of buckles might conceivably secure enough buckle orders to financially embarrass it while it could not compete for hub orders on the showing of its misleading cost information.

The $3.34 average cost referred to above is often inaccurately arrived at in the following manner:

Example 1, Automobile Hub:

120 lbs. molten metal at say 1½c	$1.80
Less 20 lbs. scrap recovered at 1½c	.30
	1.50
Cost of melting	1.84
Cost of metal per 100 lbs. good castings	3.34

Example 2, Harness Buckle:

800 lbs.. molten metal at 1½c	12.00
Less 700 lbs. scrap recovered at 1½c	10.50
	1.50
Cost of melting	1.84
Cost of metal per 100 lbs. good castings	3.34

If the melting cost is $3.68 to produce 920 pounds of molten metal it is entirely obvious that the cost to produce 120 pounds of molten metal to yield 100 pounds of hubs is not as great as the cost to produce 800 pounds of molten metal to yield 100 pounds of buckles. The majority of foundries, nevertheless, overlook this fact and erroneously distribute their melting costs on the basis of good castings produced.

The cost of melting can be considered a direct charge inasmuch as the melting cost divided by the quantity of molten metal poured will give a cost per pound of molten metal which can be applied directly to the pounds of metal poured for each job. The aggregate pounds of metal poured for each job is ascertained by multiplying the number of molds made by the average weight of metal per mold, i. e., castings, gate and sprue.

When a pattern is first put in the sand weight say a half dozen molds before breaking off the castings in order to get an average weight. While the variation in weight will be but slight, an average will be found more dependable than the weight of a single mold. After the weight is obtained it becomes a matter of record and there is no need of even making a weight test until a change has been made in the pattern or in the gating at which time a new weight of the mold should be secured.

At first thought, to obtain gross weights, may seem like red tape, but if accurate and dependable costs are to be secured the difference in melting cost is a point that must be taken into consideration. The only foundries that will experience any difficulty in distributing the melting costs as they should be will be the small foundries that run on short orders or use "hatch gates," i. e., two or more different patterns in a mold.

Where there is a well founded objection to ascertaining by actual weight the gross metal weight per mold, a standard table of weights for risers, heads, gates, etc., can be used with fair results.

For checking purposes, the aggregate quantity of molten metal poured during the month can be ascertained by adding to the production of good castings the weight of gates, sprue, risers and bad castings produced. In most cases, the weight of scrap used (own), which is always known, can be taken as the weight produced as it is ordinarily used up as fast as produced.

Molding Direct Labor

The direct labor costs of molding can be readily applied directly to class costs, customer's costs or job costs. Foundries almost without exception treat molding labor as a direct charge even though no other items are so considered.

Special Pattern and Flask Expense

Unfortunately, only a small proportion of foundrymen consistently charge to the individual job, the special pattern and flask expense incurred in connection therewith. All pattern, flask and rigging expense of a special nature, should in all cases, be considered a direct charge and applied directly to the individual job. The initial cost of a special nature to rig and to run a job is a direct charge to the job and should be borne by it.

Coremaking Direct Labor

The direct labor costs of coremaking can be readily applied directly to class costs, customer's costs, or job costs. There is no particular difficulty in treating all labor in making cores as a direct charge.

Finishing Direct Labor

All direct labor costs of finishing, such as grinding, straightening, punching, drilling, reaming, gauging, etc., should be charged to the job or work requiring the additional opera-

tion. It is manifestly unfair to burden work not requiring a finishing operation with a share of such costs, and to lighten the burden of work requiring a finishing operation by charging a part of the cost thereof to work not requiring finishing. This is the result when all finishing labor is treated as an overhead expense.

It is practicable in almost every foundry, no matter what the plant practice is, to charge the direct labor spent on finishing operations to the particular work or job receiving the finishing operation. There are three practical ways by which these costs can be determined. One method is to have the workman report the pattern number of the castings on which he worked and the time spent thereon, if day work, or the number of pieces, if piece work. From these time reports, the workman's pay is calculated and postings are made to the job cost record. The disadvantage of this method is that it places more clerical work on the workman than some of them are entirely willing to do, particularly where they are changing patterns frequently, while at the same time the amount of clerical work in the smaller plants is not sufficient to justify the employment of a clerk to do it.

Another method in use, although not one to be generally recommended, is to have the finishing room foreman report to the office the pattern numbers of the castings on which finishing work was performed. The office then from the records of the weights of such castings produced, ascertains the total weight of castings receiving finishing work and divides the finishing labor cost by the total weight to ascertain the cost per pound or per 100 lbs. This rate is then applied as a direct finishing charge to such castings as received a finishing operation. While this method gives better results than are obtained when the finishing costs are distributed as an overhead expense over all work irrespective of whether the work required finishing, yet it is not to be generally recommended for the reason that the weight of the castings and the time required to finish them bear no direct relation.

The most practicable and accurate method, when the workmen are not on piece work, is to have the finishing foreman report both the pattern number of such castings as received finishing work and an average finishing time per piece determined by a time observation. Then, in the office, a finishing cost per piece by pattern numbers is ascertained and the rate applied to the total number of pieces produced of each pattern. This latter method works out very satisfactorily both as to accuracy and as to the clerical labor involved.

Indirect Charges

In every manufacturing plant there are certain items of cost that cannot be charged directly to the different products, classes of work, or jobs, for the reason that the expense was not incurred for any one product or job in particular but for all products or jobs in common. This is true in all plants and in every industry, for such items of cost as superintendence, supplies, power, heat, light, insurance, taxes and depreciation. In a foundry, in addition to such items as the above, there are a great many other items which form a part of production costs that cannot practicably be charged to individual products or jobs.

Ordinarily, in most industries, practically all or at least the greater part of the labor costs are direct charges inasmuch as the cost can be charged directly to the job on which the workman was engaged, but this is not true in the production of castings. As a general rule, practically all labor, other than that of molding and coremaking, is indirect as it cannot be charged to the product or job and therefore has to be distributed over the product or jobs produced on a basis by which each product or job shares in an equitable manner that part of the expense that should be borne by it. Other plant expenses which have to be similarly distributed are relatively heavy.

The proportion of expense in the foundry industry that has to be treated as an overhead and distributed on some fixed or variable basis is considerably larger than in most manufac-

turing industries. This fact, however, is no good argument for not determining product or job costs, for the reason that there are certain bases for distributing the overhead plant expense which will give a reasonably accurate cost of each and every product or job, at least as accurate as in the majority of other industries. It is most important, however, that the bases be the correct ones, otherwise the results will be misleading.

Methods of Distributing Indirect Charges

There are, in the foundry industry, four bases by which the indirect charges can be distributed, namely, (1) Molding direct labor basis; (2) Molding man-hour basis; (3) Molding machine-hour basis, and (4) Tonnage basis.

Molding Direct Labor Basis

This method of distributing indirect charges is based on the principle that the expenses are incurred in proportion to the direct molding labor. The amount of the indirect charges is divided by the amount of the molding labor, which gives the percentage the indirect charges bear to the direct charges. This percentage is then applied to the direct labor cost of the particular job.

Molding Man-Hour Basis

This method is based on the principle that the indirect expenses are incurred in proportion to the time spent in molding. The amount of the indirect charges is divided by the total hours spent in molding, which gives an hourly overhead rate. This rate is then applied to the molding time of the particular job.

Molding Machine-Hour Basis

This method is based on the principle that the indirect expenses are incurred in proportion to the number of hours

the molding machines were in operation. The amount of the indirect charges is divided by the total machine hours which gives an hourly machine overhead rate. This rate is then applied to the total number of machine operating hours required to produce the particular job.

Tonnage Basis

This method is based on the principle that the indirect expenses are incurred in proportion to the weight of castings produced. The amount of the indirect charges is divided by the tonnage produced which gives a tonnage overhead rate. This rate is then applied to the weight of the particular job.

There are certain indirect expenses that bear a more constant, closer, and truer relation to the molding direct labor than to any other factor or basis and such costs should be distributed on that basis. Then again there are certain items of overhead expense that go with time and space occupied which should be distributed on the molding hour basis, or, if air molding machines are used extensively, the machine hour basis is probably the best. Then there are expenses that are incurred in direct proportion to weight and which should be distributed on the basis of the weight of good castings produced.

The indirect expense by departments will now be considered in relation to the basis of distribution which will give, in most foundries, the most accurate and dependable results.

Molding Department

A considerable part of the expense on the molding floor as well as the expense incurred in making, changing and repairing equipment for the molders cannot be practicably charged to the work or job on which the molder is engaged. It is necessary, therefore, to distribute such expense

over the jobs on the floor in a manner which will insure that each job gets the share that should be borne by it.

It is evident to the practical foundryman that the expense incurred on or for the molding floor such as for sand and all miscellaneous foundry supplies, indirect labor in shifting, in shaking out castings, in delivering them to the cleaning department, in gathering up sprue, in cutting sand, in making, changing and repairing equipment, etc., cannot be equitably distributed on a basis of weight of castings produced. For generally, the molder with a daily output of but 250 pounds of light or rangy castings will require practically as much sand and just as many supplies and his work on the floor may require as much time to shake out and gather up the castings and sprue as in the case of a molder with an output of 750 lbs. of a more bulky type. When such expenses are distributed on a weight basis, the basis often found in use, the 750 pound output would be charged with three times as much molding overhead as the 250 pound output, whereas the latter should in all probability stand an equal share of the expense.

In the majority of foundries, the most equitable and practicable way by which the indirect expense on the molding floor can be distributed is on the basis of the molding direct labor. The molding direct labor, usually piece work, will be found to bear a fairly true relation to the indirect expense. The relation is by far a closer one than weight and generally closer than the molding hours. The molding hour, as a basis, however, in a number of foundries proves a fairly good one. Ordinarily, the molding hour is not as good a basis as the molding direct labor to distribute the overhead expense on the molding floor for the reason that the greater part of the expense bears a more direct relation to what a molder produces, and is paid for, than to the time spent in molding.

The basis, to a large degree, depends upon the molding equipment. For bench, hand machine, and floor molding, the molding direct labor basis is almost without exception the best, while for air driven machine molding the machine-hour basis is

ordinarily the best. Where there is both bench molding and machine molding, as there usually is, it is a good practice to make two divisions of the molding floor—a bench molding division and a machine molding division, recording separately the operating costs of each division. In the bench molding division, the molding direct labor basis could be used, while in the machine molding division, the machine-hour basis could be used. In this way machine jobs would carry, as they should, the entire burden of the cost of power, repairs, depreciation of machines, and other expenses incurred only by the machines.

Coremaking Department

The indirect expense of the core department, which is usually all the expense of the department other than labor spent in actually making and assembling cores, is usually most equitably distributed on the basis of the core-making direct labor. The basis of weight of castings produced is not in the least a true one while the time spent in making cores, which is not usually recorded, as most of the work is piece work, would not be as satisfactory a basis as is the coremaking direct labor.

The practice of a small proportion of foundries is to treat core mixtures as a direct charge by determining the weight of the mixture used per casting and the cost per pound of the particular mixture used. It is advisable to handle the mixture cost in this way when it can be done practicably. The mixtures are sometimes divided into classes, say four, with a unit cost of each.

Cleaning Department

In all cases where the cleaning is done in rattlers or tumbling-barrels, no part of the cost of cleaning is direct in the sense that it can be charged to the work or job on which the expense was incurred. It is necessary, therefore, to prorate or distribute the entire expense of the department. The

most equitable basis is the weight of castings rattled or cleaned. A number of foundries use the molding direct labor as a basis but it is not a good one as the cleaning costs and the molding labor bear no relation. The only possible relation is in the case of light work on which the molding direct labor cost bears some relation to the added cost of handling a greater number of pieces in the cleaning department. In most foundries, however, small pieces are handled differently than heavy pieces which substantially equalizes the cleaning cost per pound of light and heavy work. Thus, light castings are shoveled and dumped into the rattlers while the heavier ones must be handled individually by hand. Furthermore, a tumbling barrel holds approximately an equal weight of small or large castings and ordinarily there is no difference in the time required to clean them. The weight of castings tumbled, or the weight of good castings produced is the most equitable basis that can be used to distribute the expense of the cleaning department.

Where frail or difficult heavy work is produced, which necessitates cleaning by sand-blast, the costs, where it is practicable, should be treated as direct charges.

Trimming and Inspecting Department

In malleable iron foundries, the costs of the Trimming and Inspecting department, principally labor, by right, should be a direct charge as the costs vary greatly as between different classes of work. Plant practices and plant arrangement, however, make it impracticable in many foundries to attempt to charge directly to the job or to the work of each customer the labor costs of trimming and inspecting. Where there is considerable variation in the labor cost as between different kinds of work, and where the trimming and inspection labor is on a piece basis, or on a tonnage basis with different rates for different classes of work, it is usually practicable to treat trimming and inspecting costs as a direct charge and to have the work or job reflect the exact difference in cost.

However, as noted above, it is not always practicable to treat these costs as direct, and when this is the case, it has been found that the molding direct labor affords the most equitable basis by which these expenses can be distributed. The molding direct labor basis proves a remarkably true one because light work costs more per pound to mold than heavy work and it invariably costs more to trim and to inspect. A number of tests in different foundries have proven that by using the molding direct labor as a basis of distribution the results are not materially different from those obtained by carefully and laboriously keeping track of the cost of trimming and inspecting each particular kind of work.

The cost of trimming cored work, it will be found, bears a fairly close relation not only to molding labor but to the coremaking labor. With an increase in cores there is an increase in trimming as there is a greater amount of fins to break off. The decrease in the number of pieces the molder is able to produce, however, due to the setting of cores, compensates for the increased trimming per piece. In other words, the trimmer in handling the molders daily output has a greater amount of work to do per piece but fewer pieces to handle.

Annealing Department

There is only one satisfactory basis to distribute the costs of annealing, and that is the weight basis. While it is true that light and rangy work requires more time to pack than does heavier work and the weight that can be packed in a pot is less, yet neither the difference in time nor in weight is ordinarily great. Light work is usually packed with heavy cored and rangy work to save packing material and in this way the costs are fairly well equalized.

Finishing and Shipping Department

In quite a few foundries the plant practice is to keep the operations of finishing and shipping separately. When this is the case it is advisable to have the accounting follow

the plant practice and to provide cost divisions for finishing and shipping. In a great many foundries, however, the operations of finishing those castings that require grinding, straightening, punching, etc., and of sorting and bagging for shipping, or loading on cars, are so intermingled that it is futile to attempt to follow departmental lines and to separate the purely shipping costs from those of finishing.

Whether the costs of finishing and shipping are stated separately or combined, the direct labor costs of such operations of finishing those castings that require grinding, straight-gauging, etc., should be charged to the job or work requiring the additional operation. It is manifestly unfair to burden work not requiring finishing operations with a share of such costs, and to lighten the burden of work requiring finishing operations by charging a part of the cost thereof to work not requiring finishing. In a few foundries it is practicable to provide an overhead finishing rate to apply to the direct finishing labor cost, but as a rule is it rarely practicable, so that a small amount of cost that should by right go with the finishing labor has to be applied as a general overhead.

All finishing and shipping costs, therefore, other than the finishing direct labor, generally have to be prorated in some manner over the work produced. At first thought it would seem that a weight basis here would be an equitable one, but on an analysis of the situation it becomes evident that the indirect costs of finishing and shipping are not in relation to weight, but more nearly in relation to the molding direct labor, or the molding hours. For instance, the time required to sort, count and inspect a given weight of light work is a great deal more than for the same weight of heavy work. Careful examination and time study at a great number of foundries demonstrated that the indirect costs of finishing and shipping bear a remarkably close relation to the time spent in molding and to the molder's earnings.

Occasionally, on certain types of castings, it is more economical to drill than to core, and when this practice is

followed the finishing department, in a sense, performs the work of the core department. If, in such cases, the cost of drilling is distributed as a general overhead expense it is evident that the cost of the individual job in respect to both the core cost and the finishing cost is inaccurately stated. It is the practice of certain foundries, in such cases, to treat the drilling labor cost as coremaking direct labor, and where finishing work is not treated as a direct charge this practice is to be recommended. However, if all finishing work of the nature of drilling, punching, reaming, grinding, straightening, etc., is treated as a direct charge, as it should be in every case, there is nothing gained by considering drilling as a core expense.

Either the molding direct labor basis or the molding hour basis should be used to distribute the indirect expenses of the finishing and shipping department.

General Expense

A great deal can be said both for and against any reasonable basis that might be suggested for distributing general overhead expense of the nature of office salaries and expense, selling expense and the various expenses of a business of a general nature.

The basis most generally used is that of weight. Some use molding direct labor, and in rare cases, the molding hour basis is used.

The expenses under this head, to a very large extent, are fixed and cannot be curtailed when the volume of business is reduced. For this reason, they vary per ton markedly according to the production of the plant. Such costs per unit of production can be said to vary directly with the output. The costs will be high with a low output, low with a high output, and normal with a normal output. Evidently, then, for purposes of comparisons and quotations, all general expenses of a fixed nature should be figured on a normal output. If, in times of depression and small output, costs were

figured on the current production, they would be too high to obtain business, and, in times of large production, they would be too low to be safely followed for price-making. Therefore, using a normal output as a basis tends to equalize both costs and profits.

A normal state of business should be reckoned with, regardless of the basis used to distribute the general expense over the different classes of work produced. If the tonnage basis is used, the factor is a normal production; if the molding direct labor basis is used, the factor is a normal molders' pay roll; and if the molders' hour basis is used, the factor is the normal molding hours.

Generally, the molding hour basis gives the most accurate results as it places on light work the burden it should carry. On a weight basis, work on which the output is small does not receive the share of overhead expense that it should with the result that the apparent profit is considerably in excess of the true profit.

The molding direct labor basis is equally as good as the molding hour basis when the earnings of molders, as between different classes of work, are substantially the same.

Summary

While the bases of distribution are not invariably the same for all foundries, it will be found that as a rule conditions are substantially similar and the same standard or uniform bases can be used with good results for the individual company and excellent results for the particular branch of the industry as a whole.

Summarizing, the most equitable and practicable bases of distribution applying generally are:—

1. Distribute molding indirect costs on the basis of the molding direct labor.
2. Distribute coremaking indirect costs on the basis of the coremaking direct labor.
3. Distribute cleaning costs on the basis of the weight of good castings produced.

4. Distribute trimming and inspecting costs on the basis of the molding direct labor.
5. Distribute annealing costs on the basis of either the weight of castings annealed of the weight of good finished castings produced.
6. Distribute finishing and shipping indirect costs on the basis of the molding direct labor.
7. Distribute general expense on the basis of either molding hours or molding direct labor.

Importance of an Equitable Distribution of Overhead Expense

Many executives do not appreciate the effect and influence that different bases of distributing overhead expense have on the cost of the product. In plants where different kinds of work is produced, which is usually the case, the basis of distribution has a marked effect on costs and if the costs are correctly stated the basis must be a proper one.

As previously noted, the basis of weight, where both light and heavy work is produced, does not give accurate results. This is illustrated in the following tabulation, which gives costs, using different bases, of 10 jobs, five of which were selected at random at each of two different plants:

COMPARATIVE COSTS, USING DIFFERENT BASES TO DISTRIBUTE OVERHEAD EXPENSE

Job No.	Average Weight of Casting (Lbs.)	Average Production per molder per day (Lbs.)	Total Cost per 100 lbs. of good castings		
			By distributing overhead on a weight basis	By distributing overhead on a molding hour basis	By distributing overhead on a molding direct labor basis
1	16.0	1210	$4.89	$4.51	$4.65
2	19.7	1029	5.15	4.83	4.92
3	4.8	974	5.77	5.49	5.52
4	28.1	922	5.13	4.89	5.06
5	12.5	894	5.55	5.22	5.34
6	1.3	551	5.34	6.36	6.06
7	1.1	225	6.87	10.66	10.31
8	.3	223	6.45	11.01	9.88
9	.4	216	8.61	13.11	12.75
10	.1	201	7.74	13.65	13.38

It will be noticed that for the heavy work, ranging in output per molder per day from 1210 lbs. to 894 lbs., there are no large differences in cost under the weight basis, the molding hour basis, or the molding direct labor basis, although the costs on the weight basis are somewhat higher than on either the molding hour basis or the molding direct labor basis. The costs of the heavy work on the weight basis are really overstated, due to the inequality of the basis, while the costs of the light work are sadly understated.

On the light work, ranging in weight from 1.3 lbs. to 0.1 lb. per piece, and in output per molder per day from 551 lbs. to 201 lbs., there are no large differences in cost between the molding hour basis and the molding direct labor basis, although the cost under the weight basis is decidedly less. On job No. 7, for instance, the cost on the weight basis is $6.87 per 100 lbs., while on the molding hour basis it is $10.66, and on the molding direct labor basis $10.31, differences amounting to 55% and 50% respectively. On the still lighter work, jobs Nos. 8, 9 and 10, the differences are even considerably greater.

It will be noticed also that on the light work the cost on the molding hour basis is slightly greater than on the molding direct labor basis. This is due to the fact that at the two plants at which tests were made the earnings of molders on light work were less than on heavy work. On jobs Nos. 8 and 10, for instance, the average labor cost per hour for molding was 46.9c and 47.3c respectively, while for jobs Nos. 1 and 2, it was 57.9c and 56.9c, respectively.

The fact that in many foundries molders on light work earn less than those on heavy work makes the molding hour basis, to that extent, a better basis for distribution of overhead than the molding direct labor as the former gives a higher cost to the light work, the cost of which throughout the industry is understated and underestimated.

While the costs shown by the table of light work on either the molding hour basis, or on the molding direct labor basis,

are considerably greater than on the weight basis, the cost of the light work on the former bases is still sadly understated from the standpoint of yielding the same return on the investment as the heavy work if the same per cent of profit were added to the cost of each.

For instance, the cost of job No. 1, on the molding direct labor basis, is $4.65 per 100 lbs. If a profit of 20% were added, the profit would be 93c per 100 lbs. or $11.25 on the 1210 lbs. average output per molder per day.

In contrast, the cost of job No. 10, on the molding direct labor basis, is $13.38 per 100 lbs. A profit of 20% would amount to $2.67 per 100 lbs., but only $5.36 on the 201 lbs. average output per molder per day—a rate of profit on the investment of less than one-half that realized on the heavier work on which the molder was able to get out a larger production.

Job Cost Record

A form of cost record which is equally suitable to record class costs, customer's costs, or job costs is shown on page 230. The record was designed for and is in use by a large number of malleable iron foundries and with a slight modification is also suitable to grey iron and steel foundries. Figures are inserted to illustrate the form and to show the relation to preceding records of original entry as well as methods of distributing overhead expense.

The cost accountant should study and analyze the cost record most carefully and get clearly in mind its relation to the Statement of Monthly Costs, or the statement from which the overhead rates are obtained.

The name of the customer, the pattern number, the molding hours, the pounds of metal poured, the total pieces made, the pieces good and pounds good, as well as the molding direct labor, are filled in from the molder's summary production card, an illustrated form of which is shown on page 86.

The information as to shipping room defectives, both pieces and pounds, is filled in from the shipping room reports. The entry of 82 pounds inserted over the weight of the defectives is assumed to represent (in malleable iron practice) the annealing and finishing loss which is one per cent of the weight of good hard iron castings produced and is approximately what the loss runs in practice.

The cost of the metal used is determined by applying to the weight of good finished castings, 8,006 pounds, the metal cost per 100 pounds of good finished castings, namely $1.841, shown at the bottom of the Monthly Statement of Total Costs, page 199.

The melting cost is determined by applying to the weight of metal poured, 13,860 pounds, the melting cost rate per 100 pounds of molten metal, namely $0.255, shown at the bottom of the Monthly Statement of Total Costs, page 199.

The coremaking direct labor is filled in from the coremaker's summary production card, an illustrated form of which is shown on page 100.

The special pattern and flask expense and the finishing direct labor come from the reports of the pattern shop and the finishing department, respectively.

The molding overhead charge is determined by applying to the molding direct labor the molding overhead rate, namely 166.0% shown at the bottom of the Monthly Statement of Total Costs, page 199.

The coremaking overhead charge is determined by applying to the coremaking direct labor the overhead rate of the coremaking department, namely 90.0%, shown at the bottom of the Monthly Statement of Total Costs, page 199.

The tonnage overhead charge is determined by applying to the weight of good finished castings, 8,006 pounds, the tonnage overhead rate, namely $0.859 per 100 pounds, shown at the bottom of the Monthly Statement of Total Costs, page 199.

JOB COST RECORD

Customer A. B. & Co.

Pattern Number	Molding Hours	Weight per Casting	Weight per Mold	Pounds Metal Poured	HARD IRON CASTINGS PRODUCED			DEDUCT Ship'ng Rm. Defectives Annl'g and Finish'g Loss		Good Finished Castings Produced		Metal		Melting	
					Total Pieces Made	Total Pieces Good	Total Pounds Good	Pieces	Pounds	Pieces	Pounds				
X23	99	4.0	8.0	13,860	2,310	2,057	8,216	32	82 128	2,025	8,006	147	39	35	34

JOB COST RECORD—*Continued*

Month.....19..

DIRECT COSTS										INDIRECT COSTS										TOTAL COST		COST PER 100 LBS. GOOD FINISHED CASTINGS	
MOLDING DIRECT LABOR		SPECIAL PATTERN AND FLASK EXPENSE		CORE MAKING DIRECT LABOR		FINISHING DIRECT LABOR				MOLDING OVERHEAD CHARGE		CORE MAKING OVERHEAD CHARGE		TONNAGE OVERHEAD CHARGE									
62	82	20	40	18	00	12	24			104	28	16	20	68	77					485	44	6	06

The total cost, in amount, is found by a cross addition, and the cost per 100 pounds of good castings by dividing the amount by the weight of good finished castings produced.

Job Cost Card

The production of good finished castings by months, by pattern numbers, should be summarized in card form for the ready information of the executive. The executive, or the sales department, is interested only in the final results, namely, production in pieces and pounds, cost, profit, and rate of profit. The rate of profit can best be shown in terms of profit per molder per day or per unit of molding floor space.

The production cost of each pattern of casting, throughout the year, or for any longer period desired, can be conveniently shown on a card. A record of this nature should be prepared for the use and guidance of the executive and if it gives for each pattern the information shown by the following form, namely, pieces and weight of good castings produced, returns or rejections, cost, price, and profit per 100 pounds, and profit per molder per day, it contains all of the vital information that the busy executive really needs. A record of this character for each and every pattern of casting produced will be found to be invaluable.

JOB COST CARD

Customer A. B. & Co. Year.....

Pattern No. X 23

PERIOD	GOOD FINISHED CASTINGS PRODUCED		RETURNS MEMORANDUM		COST PER 100 LBS.	PRICE PER 100 LBS.	PROFIT PER 100 LBS.	PRODUCTION PER MOLDER PER DAY (LBS.)	PROFIT PER MOLDER PER DAY
	PIECES	POUNDS	POUNDS	%					
JANUARY	2,025	8,006	80	1.0	6.06	7.25	1.19	728	$8.66
FEBRUARY									
MARCH									
APRIL									
MAY									
JUNE									
JULY									
AUGUST									
SEPTEMBER									
OCTOBER									
NOVEMBER									
DECEMBER									

CHAPTER X

DEPRECIATION

Depreciation Inevitable

Depreciation, which is shrinkage in value due to exhaustion, wear and tear, is taking place in some form or another in buildings and equipment of every description, more rapidly and perceptibly in some, slower in others. Their value and usefulness is being gradually reduced until the time will come when they must be cast aside as no longer fit for use. The equipment that today represents the highest type of efficiency is gradually but inevitably wending its way to the scrap heap, regardless of the efforts that may be taken to preserve it through repairs.

Some manufacturers contend that if their equipment is kept in good repair it does not depreciate, and as long as their output is maintained as to quality and quantity the equipment retains its value to the concern. However, depreciation, to a large extent, is unavoidable and waste cannot be entirely offset by repairs no matter how extensive. Repairs, it is true, offset to a certain extent physical deterioration and lengthen the period of serviceability, but no matter how extensive they may be, it is impossible through repairs to fully maintain plant and equipment values.

Causes of Depreciation

Depreciation may be due to several causes—use, lapse of time, obsolescence, inadequacy. The most common form of depreciation is that occasioned through use. The depreciation, due to wear and tear incident to use, is always present. It is more or less continuous and if unaccompanied with other causes can be fairly accurately reckoned.

Depreciation also takes place though the equipment remains idle. Property may deteriorate even more rapidly when idle than when in use. Depreciation arising from idleness is very frequently overlooked but it is present nevertheless.

Another form of depreciation is that of obsolescence. The termination of the life of a melting furnace, an annealing oven, a molding machine, may be due to the discovery of some better method for doing the same work which makes it uneconomical and expensive to continue under the old method.

Depreciation due to obsolescence is hard to estimate because the progress in inventions and changes in methods are uncertain. In the foundry industry, due to somewhat stable conditions, the liability to obsolescence is less than in some other industries, but every progressive foundryman should be alert to the fact that although his equipment may now be the best obtainable it may be rendered of less value at any time by inventions and changes in methods.

Methods of Providing for Depreciation

An arbitrary deduction of an estimated lump sum amount to cover depreciation on the entire buildings and equipment, apart from poor accounting practice, is poor business policy and usually totally inadequate to show even reasonably true results. At best, the degree to which machinery or other equipment lessens in value in a stated period is a matter of estimate. It is necessary, therefore, in order to arrive at an estimate, as nearly actual as possible, that a suitable classification of the equipment be made to enable an intelligent conclusion to be reached as to the amount of depreciation that has actually taken place.

The first step necessary to provide for proper depreciation is to departmentize building and equipment values. The next step is to take each kind of building and equipment and figure its proper depreciation. The rates will, of course, vary, depending upon the life of the property, the life being dependent

upon its character, the use to which it is put, and the conditions under which it is used. In a foundry, a large part of the equipment is subjected to exceptionally hard usage and consequently has a short life.

There are several methods of providing for depreciation. One method that is unqualifiedly condemned but which is extensively used, is to wait until the end of the year, and then if the profit and loss statement shows that a good profit has been earned, to charge a part of this profit to depreciation. If, on the other hand, the profit and loss statement shows little or no profit nothing is charged for depreciation. It is difficult to see how any practical business man can take the view that his plant and equipment have not depreciated because he has not made a profit and have depreciated when he has made a profit.

The practice of writing off round sums for depreciation in an arbitrary manner depending, in a very large measure, upon the earnings of the year has been fostered through the inclination of boards of directors to make as good a profit showing as possible in bad years. No board of directors has the right, nor is it fair to stockholders to deceive them in this way. And when the deficiency is made up the following year, the offense is not lessened, for it is impossible at that time to know whether the next year will be better or worse. Directors resorting to this practice often put themselves in the position of declaring dividends not out of profits but out of capital.

Straight Percentage Method

This method is to estimate the scrap value and deduct it from the initial cost. The remainder is then divided by the estimated number of years of usefulness and the result is the annual depreciation. This method is free from complications and is always practicable of application.

Reducing Balance Method

Under this method, a percentage is determined which, when applied to the initial cost, will leave only the scrap value of the particular piece of equipment on the books at the expiration of its estimated life. To illustrate, if the initial cost is $1,000 and the estimated scrap value is $200, with an estimated life of 10 years, then $800 would be charged into cost during that period. To attain this end, a rate of 15% would be necessary, which would make the depreciation 15% on $1,000 or $150 the first year, 15% on $850, or $127.50, the second year, and so on. The advantage of this method, in the interest of normal costs, is that the decrease in depreciation charges is ordinarily offset by an increase in repairs. It also throws the heaviest depreciation charges upon the first few years when the efficiency and economy of the asset is the greatest. The method though is somewhat complicated and considerably more difficult of application than the straight percentage method.

Combined Depreciation and Maintenance Method

Another method of providing for depreciation which is generally used with good results is to add to the initial cost of the equipment the estimated cost of maintenance during its life before fixing the depreciation rate. For example, if the initial cost is $1,000, scrap value is $200, and the estimated maintenance cost during its life (10 years) is $400, the total cost of the machine, after salvage, would be $1,200, or 120% of the initial cost. Dividing this percentage by the estimated life of the machine (10 years) gives 12%, which is the rate at which the machine depreciates and is the charge to manufacturing cost covering depreciation and maintenance. The advantage of this method is that it does not become necessary to differentiate between depreciation and maintenance which must be done under either of the first two methods mentioned. In a foundry, it is oftimes very difficult to draw the line and this method, therefore, has a great deal to commend it.

Repairs and Their Treatment

The question as to whether certain expenditures are of the nature of repairs or are proper charges against a depreciation reserve is one that often puzzles. The expenses that are necessary to maintain buildings and equipment in an efficient working condition vary from minor repairs to heavy and extraordinary repairs, such as, renewing roofs of buildings, replacing parts of engines, etc., involving considerable outlay.

The general principle to follow is to charge all minor repairs, that are of fairly constant occurrence and which do not appreciably prolong the life of the property, to costs of production for the period in which they are incurred. Such expenditures as roofing a building, replacing boilers, relining tumbling barrels, etc., or those that do appreciably prolong the life of the property and are not fairly chargeable against the period in which incurred, should be charged to the depreciation reserve, as such replacements restore to that extent equipment values and reduce the accrued depreciation.

Repairs and Replacements

In many foundries no differentiation is made between repairs and replacements, and both ordinary repairs and complete replacements or renewals are treated as repairs and charged to current operating costs.

While this practice is a conservative one from the standpoint of financial accounting it is not, however, in accordance with good accounting principles and practice.

Replacements and renewals restore plant and equipment values, and to that extent they are depreciation negatives, or offsets, and the cost thereof should be charged not to repairs but to the depreciation reserve account. The depreciation already provided for has been set up for this very purpose and through the replacements and renewals plant and equipment values are restored and the accrued depreciation thereon has been reduced.

The effect of treating replacements and renewals as repairs is to materially increase the repair accounts and to reduce the depreciation charge. The depreciation provision then applies solely to that equipment or that part of the equipment the value of which cannot be restored through replacements.

It is true that the final results in the long run will be the same whether replacements and renewals are treated as repairs, thus reducing the depreciation charge, or as replacements, thus increasing the depreciation charge. It is not results in the long run, however, for which we are looking. We are looking for, and urgently need, current operating statistics for analytical and comparative purposes, as only in this way can we be sure that the plant for the current period is operating as efficiently as for the past period. When extensive and costly replacements which are incurred only occasionally and quite intermittently are treated the same as ordinary repairs which are incurred in a marked degree of regularity, the effect is to badly distort costs, not only for comparative and analytical purposes, but for price-making purposes.

Very often it is the case that labor costs only are used for purposes of judging of the operating efficiency of the various departments, omitting from consideration all other items of cost. This is due to the fact that items other than labor for given periods are not comparable, and the reason that they are not comparable lies in the faulty handling of the expense items. There is no reason but that expense items can be handled just as satisfactorily and as accurately as labor costs, and a comparison and analysis of expense items is just as productive of results as a comparison and analysis of labor costs. Wastage, leaks and inefficiency are as often found with respect to material, supplies, repairs and other controllable items of cost as with respect to labor.

Rates of Depreciation

While it is true the life of property depends upon its character, the use to which it is put, and the conditions under which it is used, it is also true that within an industry the rates at which equipment depreciates are fairly applicable to all manufacturers. In a number of industries appreciable progress has been made in establishing uniform rates and the members are following them with most satisfactory results.

Standards can be followed in the foundry industry with very satisfactory results. There is an urgent need in the foundry industry for greater uniformity. The results would be felt in stabilizing trade conditions and in a more equitable distribution of income taxes. Without reliable industry standards, the matter of depreciation rates and their effect on taxes is left largely to the tax inspectors of the several districts. Rates that one inspector will pass as only adequate will be disallowed by another inspector as grossly excessive. When more or less standard rates, proven and borne out by experience as fair, are used quite generally throughout an industry, the question of a proper or an improper charge can be readily determined.

It has been found to be the experience of a large number of foundrymen and of appraisers and accountants familiar with foundry practice that the following annual rates for depreciation for the principal kinds of foundry buildings and equipment are necessary to fully maintain plant and equipment values:

BUILDINGS:

	Per Cent
Concrete	2½
Brick—Steel Frame	3
Brick—Wood Frame	3½
Sheet Iron—Steel Frame	5
Wood	7½

MELTING DEPARTMENT EQUIPMENT:

	Per Cent
Cupolas and Apparatus	5
Air Furnaces and Apparatus	7½
Open Hearth Furnaces and Apparatus	10

Electric Furnaces and Apparatus	10
Crucibles	7½
Sprue Mill and Slag Washer	15
Laboratory Equipment	10
Tensile Testing Machines	5
Traveling Cranes	7½
Hand Trucks	10

MOLDING DEPARTMENT EQUIPMENT:

	Per Cent
Flasks—Steel	15
Flasks—Grey Iron	33 1/3
Flasks—Malleable Iron	33 1/3
Flasks—Aluminum	20
Air Molding Machines	20
Hand Squeezers	15
Benches, Tables, Racks, Etc.	10
Sand Mixers	15
Pattern Shop Equipment	10
Carpenter Shop Equipment	10
Hand Trucks	10

CORE DEPARTMENT EQUIPMENT:

	Per Cent
Core Ovens and Apparatus—Steel	7½
Core Ovens and Apparatus—Brick	10
Core Machines	15
Oil Separators	7½
Sand Mixers	15
Benches, Tables, Racks, Trays, Etc.	10
Hand Trucks	7½

CLEANING DEPARTMENT EQUIPMENT:

	Per Cent
Tumbling Barrels, with Motor, Shafting and Belting	15
Sand Blast Barrels and Tables, with Motor, Shafting and Belting	25
Exhaust System	10

TRIMMING AND INSPECTING DEPARTMENT EQUIPMENT:

	Per Cent
Benches, Scales, Trucks	10
Emery Wheel Stands, with Motor, Shafting and Belting	10

ANNEALING DEPARTMENT EQUIPMENT:

	Per Cent
Annealing Ovens and Apparatus	7½
Annealing Trucks—Steam, Air and Electric	20
Traveling Cranes	7½
Pyrometers	10

FINISHING AND SHIPPING DEPARTMENT EQUIPMENT:

	Per Cent
Emery Wheel Stands, Drop Hammers, Lathes, Drill Presses, Air Chippers, Milling Machines, etc., with Motor, Shafting and Belting	10
Automobile Trucks	20
Sorting Tables, Trucks, Scales, etc	10

POWER PLANT EQUIPMENT:

	Per Cent
Steam Boilers	5
Electric Generators and Switch Boards	7½
Waste Heat Boilers and Apparatus	10
Air Compressors	7½
Steam Separators	10
Steam Piping	5
Electric Wiring and Fixtures	7½
Engines, Steam and Gas	5
Heating System, Steam	5
Brick Stacks	5
Pumps, Steam and Hydraulic	5
Industrial Electric Trucks and Tractors	25
Truck and Tractor Trailers	15
Sprinkler System	5
Sewers	2½
Fences—Wooden	10
Fences—Wire	7½
Office Furniture and Fixtures	10

Experience has proven the above depreciation rates to be conservative, and it is very doubtful if the foundryman who is not providing for depreciation at substantially the rates noted above is fully maintaining his plant values.

Replacements Restore Plant Values and Reduce Accrued Depreciation

The amount provided to represent the deterioration in plant and equipment values due to wear and tear and obsolescence should be charged monthly to cost of production and credited to Buildings and Equipment Depreciation Reserve accounts. Against the reserve accounts should be charged all expenditures in the nature of complete renewals and replacements which to that extent restore plant values and reduce

the accrued depreciation. Current repairs and partial renewals of an inextensive nature should be charged directly to cost of production.

Until within the past few years, many foundrymen neglected to systematically provide for depreciation. Their practice was to charge all repairs and replacements to costs and then in years with good profits, a round sum would be charged off. In later years, however, the high income and excess profits taxes have resulted in a much fairer distribution of depreciation charges by having the operations of each year stand on their own merits irrespective of the profits before providing for depreciation.

Where a foundry has been in the custom of charging all or practically all replacements to current operations and has changed over from a hit and miss rule in providing for depreciation to a more logical and conservative basis by applying definite depreciation rates, caution should be taken not to overprovide by continuing to charge all replacements to costs. If this is done there is a doubling up in the depreciation charge for the reason that the depreciation rate reflects the rate of deterioration and when the deterioration is made good, or partially so, the cost of the replacement should be an offset to the depreciation set up and not a charge to current operations. For example, the normal life of an air molding machine may be five years and if one-fifth of its cost is written off each year for five years and during the fourth and fifth years most of its important wearing parts are replaced and the cost thereof is charged to current operations instead of the depreciation set up, the result is an overcharge to costs to the extent of the expense of the replacements. In other words, the machine through the renewals may last for another five year period and upon the books it will stand as completely written off. The replacements make good the depreciation that has taken place, or a large part of it, and the cost of making the replacements is a charge to the accrued depreciation set up.

Patterns, Flasks, Tools and Small Equipment Items

The foregoing list of foundry equipment, with normal rates of depreciation set opposite, covers only such equipment that has a going value and a life of three or more years. In a foundry, there is a long list of smaller equipment consisting of wood flasks, mold jackets and bands, patterns, hand tools, etc., the entire cost of which should be charged directly to current operations and not be charged to capital for the reason that the life of such equipment is so uncertain that it is not safe to charge any part thereof to capital. In equipping a new plant, however, the initial cost of such minor equipment should be charged to capital but thereafter all costs for replacements should be charged directly to current operations.

Depreciation of Pattern Equipment

The pattern account on the books of many foundries reflects a value far in excess of the realizable value of the pattern equipment and even in excess of what the pattern equipment is reasonably worth to the company as a going concern. A pattern is an asset that should be valued most conservatively, and the safe procedure in the case of new patterns is to charge to the pattern capital account, only the scrap value of the metal used therein. It is not generally practicable nor is it considered good accounting to capitalize the cost of pattern equipment and then depreciate it annually. The cost of all pattern equipment, other than the scrap value of the metal, is a direct production charge to the cost of the product.

Equipment Inventory Sheet

As already noted, in order to arrive at proper and adequate depreciation it is necessary that equipment be departmentized and individual depreciation rates applied to the separate items of equipment. To accomplish this the equipment should be listed and the amount of the annual depreciation applicable to each item shown.

Ledger accounts can either be kept for each item of equipment or for the entire department equipment, and likewise for the depreciation reserve accounts. A depreciation reserve account for each operating department is usually preferable to separate accounts. It is always better to set up depreciation as a reserve rather than to write down the property account.

The form of equipment inventory sheet shown on the following page can be used ordinarily with good results.

When records are prepared in this or in a similar form the following information is always available:

(a) The book value of equipment by departments.
(b) The annual amount of depreciation provided by departments.
(c) The total accrued depreciation, or the ledger balance of the depreciation reserve account, by departments, as well as in total for the entire plant.

The following equipment inventory statement calls for but a single depreciation reserve account for each operating department. The total amount of the annual depreciation covering the entire department equipment being credited to the depreciation reserve account and the cost of all replacements as made during the year being charged to the account.

A disadvantage of this procedure is that the nature of the replacement is sometimes lost sight of and because of this some executives and accountants prefer a more detailed equipment record along the lines shown below.

Detailed Equipment Record

This form of record gives a complete history of the equipment and the value of the data will be found to be well worth the additional time required to record it.

The value of a detailed record of this kind is that you always have before you a history of the performance of any piece of equipment in addition to having a record of its original cost, the depreciation provided annually, the date, nature and cost of

EQUIPMENT INVENTORY SHEET

Date.....

	Book Value of Equipment	Annual Rate of Depreciation	Amount of Annual Depreciation	Balance of Accrued Depreciation Reserve Account	Total Accrued Depreciation
Melting Department Equipment:					
Melting Furnaces and Apparatus	$40,000	7½%	$3,000		
Sprue Mill and Slag Washer	3,500	15	525		
Laboratory Equipment	2,500	10	250		
Traveling Crane	3,600	7½	270		
Trucking Cars	1,800	10	180		
	$51,400		$4,225	$12,260	$16,485
Molding Department Equipment:					
Flasks—Steel	2,400	15	360		
—Cast Iron	4,500	33⅓	1,500		
—Aluminum	1,200	15	180		
Hand Squeezers	4,000	15	600		
Air Molding Machines	12,000	20	2,400		
Sand Mixer	2,000	15	300		
Benches, Tables, Racks, etc.	4,800	10	480		
Pattern and Carpenter Shop Equipment	6,000	10	600		
	$36,900		$6,420	$4,890	$11,310

replacements, and the probable depreciated value of the particular piece or kind of equipment at any time. It is information that an executive would not think of doing without once he is in a position to judge its value.

EQUIPMENT RECORD

Article: 6 Universal Tumbling Barrels. Department: Cleaning

Year	Book Value (Original cost)	Depreciation for year		Less Charges during year to Depreciation Reserve Account	Accrued depreciation at end of year	Depreciated Value
		Rate	Amount			
1916	$6,000	15%	$900	.....	$ 900	$ 5,100
1917		15%	900	$ 225	1,575	4,425
1918		15%	900	1,410	1,065	4,935

(Card Record—face)

REPLACEMENTS

Date	Vo. No.	Description	Amount
1917			
Oct. 10	241	New Shell	$ 225
1918			
Feb. 20	860	New Drive Cog Wheels	380
Dec. 5	1020	New Shells	1,030

(Card Record—back)

CHAPTER XI

ESTIMATES AND QUOTATIONS

Importance of Reliable Estimates

In quoting on new work, most foundrymen appreciate the vital importance of reliable estimates of costs of production. And while the majority of them make an earnest effort to quote intelligently on new work, it cannot be denied that the practice of guessing at what the selling price should be is all too prevalent. No matter how earnest may be the desire of the foundryman to arrive at a quotation in an intelligent manner, it is almost impossible for him to do so unless he has an adequate cost system from which the overhead expense ratios can be clearly and definitely determined.

Advantages of Preparing Estimates in Uniform Manner

No one can dispute the advantages to an industry if estimates could be and were arrived at in a uniform manner. There is no question but what a standard system of estimating could be evolved and which could be followed by foundrymen generally.

Of course, uniform estimates, or a standard system of estimating, presupposes substantial uniformity in cost methods, particularly in the classification of accounts and in the methods of distributing indirect or overhead expense. In industries where uniform principles of cost accounting are generally recognized and followed there can be and there is substantially uniformity in arriving at estimates, and the benefits accruing therefrom are recognized and appreciated.

In the absence of uniform fundamental principles of cost accounting, however, it is practically impossible for any two foundrymen to arrive at even approximately the same quotation

for new work although their costs on which the estimates are based, had they been arrived at on the same basis, would not have been materially different.

Only a very small proportion of the foundries of the country figure in advance the probable cost to produce the widely different types and designs of castings on which they are called upon to quote prices. The majority of them either do not systematically prepare estimates or else delegate the work to some one not in touch with the information necessary to prepare an intelligent estimate. In the few foundries where estimates are carefully prepared there is naturally a wide variance of methods and the need for the establishment of some standard system of estimating on new work is plainly evident.

Preparing and Preserving Estimates

Before quoting on new work, an estimate should be orderly and carefully prepared and religiously preserved so that the estimate, item by item, can be checked against the cost record after a cost on the work has been established. A comparison in detail is of special benefit in disclosing items either overlooked or regularly underestimated, both of which are very common. If the estimator failed to reckon with such items as special rigging, pattern and flask expense, finishing labor, rejections, etc., a comparison of the estimate and of the cost will at once disclose the omission. Often, too, the molding direct labor is underestimated which is most vital because so many of the succeeding items of cost are logically based on the molding labor, and if the molding labor is understated the discrepancy is multiplied as the cost compilation progresses.

Form of Estimate Sheet

The form of estimate sheet shown on page 252, in which the cost accounting principles outlined in the preceding chapters are observed, is suitable to most foundries.

Explanation of Estimate Sheet

METAL—The following Estimate Sheet shows the total weight of castings to be 42,000 pounds, found by ascertaining the finished weight per piece of each pattern of casting and multiplying by the number of pieces required. If the melting loss is 10% in weight, the order would require the use of 46,200 pounds of iron. Assuming a prevailing market price of $1.50 per 100 pounds gives a metal cost of $693.00.

MELTING—By multiplying the number of molds required to produce the pieces desired of each pattern by the weight per mold with gate and sprue gives the total weight of molten metal required; or in other words, the weight of the molten metal that would have to be poured into the molds if all of the molds were good. In the instance cited above it is 59,000 pounds. The melting cost per 100 pounds of molten metal is obtainable from the Monthly Statement of Total Costs. (See page 199). At the melting cost rate of 25.5 cents per 100 pounds of molten metal gives a melting cost of $150.45, if all the molds were good. Assuming a foundry loss of 10% would add $15.05, making a total melting cost of $165.50.

MOLDING DIRECT LABOR—Particular care should be taken in arriving at the estimated cost of molding as the amount of direct molding labor is used as a basis to distribute a large part of the indirect costs. In order to arrive at a reliable and satisfactory estimate for molding labor it is necessary to ascertain, for each pattern of casting, the number of castings that can be handled in a mold, the number of molds required, and the price that will be paid for molding, based upon the number of molds that can be put up in a day's time. The price per mold, or per 100 molds, times the molds required gives the molding direct labor. For the above order it is estimated that the molding direct labor would amount to $270.00.

ESTIMATE SHEET

BLANK MALLEABLE IRON CO.

Party Quoted.....

Date of Inquiry.....

Drawing, Sample or Pattern	Pattern No.	Pcs. Required	Wt. per Piece	No. Pcs. in Mold	No. Molds	Wt. per Mold with Gate and Sprue	Wt. of Castings	Wt. of Molten Metal	MOLDING			
									Price per 100 Molds	Direct Labor	Special Pattern and Flask Expense	Molding Days 10 hrs.
			(Lbs.)			(Lbs.)	(Lbs.)	(Lbs.)				
Pattern	T24	2,000	5	2	1,000	15	10,000	15,000	$ 6 00	$ 60 00	$ 10 00	10
"	T46	2,000	10	1	2,000	12	20,000	24,000	5 00	100 00	30 00	18
"	T60	4,000	2	4	1,000	14	8,000	14,000	6 50	65 00	....	12½
"	T72	4,000	1	4	1,000	6	4,000	6,000	4 50	45 00	....	8
							42,000	59,000		270 00	40 00	48½

ESTIMATE SHEET—*Continued*

Date of Estimate..... Date of Order.....

COREMAKING			FINISHING	
No. in Mold	Price per 100	Direct Labor	Price per 100 Pcs.	Direct Labor
2	$ 0 90	$ 18 00	$ 0 75	$ 15 00
1	75	15 00	1 00	20 00
8	50	40 00	.....	.....
.....	.....	.....	.....	.....
		73 00		35 00

COST ESTIMATE SUMMARY

Metal, 42,000 lbs. @ $1.50 cwt.	$ 630 00
Melting Loss, 10%	63 00
Melting, 59,000 lbs. @ 25.5c cwt.	150 45
Foundry Loss (bad castings) 10%	15 05
Molding Direct Labor	270 00
Special Pattern and Flask Exp.	40 00
Coremaking Direct Labor	73 00
Finishing Direct Labor	35 00
Molding Overhead Charges, 166.0% of molding direct labor	448 20
Coremaking Overhead Charges, 90.0% of coremaking direct labor	65 20
Tonnage Overhead Charges, 85.9c. per 100 lbs. castings	360 78
Total Estimated Cost	2,150 68
Estimated Cost per cwt.	5 12
Estimated Output per Molder per day (lbs.)	866

Special Pattern and Flask Expense—It is estimated that the order would require an expenditure of $40.00 for patterns and flasks of a special nature.

Coremaking Direct Labor—The coremaking direct labor estimate is arrived at by multiplying the number of cores required for each pattern of casting by the price that would be paid for making them. For the above order, it is estimated that the coremaking direct labor cost would amount to $73.00.

Finishing Direct Labor—It is assumed that two of the patterns of casting would require grinding for which it is estimated the piece rate would be 75 cents and $1.00 per 100, respectively, making a finishing direct labor cost of $35.00.

Molding Overhead Charges—Assuming that the monthly cost statement shows that the indirect expenses of the plant that are distributable on the basis of the molding direct labor, namely, molding indirect labor and expense, trimming and inspecting, finishing and shipping indirect expense, and general expense, amount to 166.0% of the molding direct labor, there should be added under the above head, $448.20.

Coremaking Overhead Charges—If the coremaking overhead expense, based on the coremaking direct labor, amounted to 90.0%, there should be added for coremaking overhead charges, $65.20.

Tonnage Overhead Charges—Assuming that the monthly cost statement shows that the indirect expenses of the plant that are distributable on the basis of weight, namely, costs of cleaning, annealing and provision for returns and allowances, amount to 85.9 cents per 100 pounds of good castings, there should be added under the above head, $360.78.

Summary—The above items of estimated cost give a total of $2,150.68, or a cost of $5.12 per 100 pounds. The estimated output per molder per day is 866 pounds.

An estimate carefully and accurately prepared along the above or similar lines, taking into consideration the average output per molder per day, is the only reliable basis upon which a price can be safely and intelligently made.

Market Price of Iron Should be the Iron Quotation Basis

Quotations should be on the basis of the price of pig iron prevailing at the time of the quotation. It is not considered good business practice to quote on the basis of the cost of iron on hand or on the basis of purchases extending over a considerable period of time, if such purchases are under the prevailing market price.

Using the cost of iron as a quotation basis invariably has the tendency to lower the price of castings and to stimulate unhealthy competition for the reason that cost will be used as a basis when it is under the prevailing market price and never used when it exceeds the market price. The foundryman, therefore, is in the position of constantly passing along to his customer the benefit of profitable speculative purchases and bearing the losses of unprofitable speculative purchases. The effect of giving customers the profit from speculative buying is not alone adverse to the interests of the individual foundryman but the practice has the tendency to depress prices and in the aggregate has a decidedly injurious commercial effect.

CHAPTER XII

PROFITS

Profit Ideas

Foundrymen seem to be substantially in accord as to what constitutes a safe and reasonable rate of profit on their investment. As the investment, per ton of output, of plants producing a given class of work is not ordinarily materially different, it would not seem that there should be such wide differences in quotations, and if all foundries knew accurately the cost to produce each job or each class of work they handled there would not be such extremely wide differences in quotations.

The trouble is that most foundrymen do not know their costs. They may add to their supposed cost a rate of profit which may be seemingly equal to what others are charging, but the expected rate of profit is never realized. On some work, where costs are not accurately known, the expected rate of profit may be more than realized, while on other work there may be a serious loss instead of a profit. Wide differences in prices quoted are not as a rule so much the result of different ideas of profit, or different actual costs, but of different ideas of cost.

Profit on Light and Heavy Work

While foundrymen seem to be substantially in accord as to what constitutes a fair rate of profit on investment, nevertheless their views differ widely on the profit that should be realized on different kinds of work, particularly on light and heavy work. Many feel that their heavy work is the most profitable even though their records are inadequate to prove it.

It is a serious fact that with most companies light work is the least profitable and the heavy work the most profitable; and heavier work is ordinarily decidedly the most profitable.

By the term "light work" is meant not necessarily castings light in weight but where the output per molder per day is low due to the nature of the castings, that is, rangy with thin sections. A good output per molder per day is often obtained for light solid castings where a number of them can be gated.

There is no reason why light work should not be just as profitable as heavy and foundrymen should exert every effort to make it so. The fact that light work is unprofitable as compared with heavy work has arisen from the practice of so many foundrymen of applying one general percentage of profit to the cost, as they figure it, of both light and heavy work. They forget that in the foundry business a general percentage of profit on the cost of both light and heavy work will not give the same return on the investment, unless investment and output factors are taken into consideration. The facts are that the output factor is generally overlooked with the result that the cost of light work is understated and that the percentage of profit on the investment is ordinarily materially less when the plant is running on light work than when running on heavy work.

Production Per Molder Per Day, the Profit Factor

The factor, therefore, that should be constantly borne in mind in testing the accuracy of cost work, and the adequacy of the profit margin, is the average production per molder per day. As the pound is the unit, the output per molder per day in pounds, the cost, the price and the profit per pound should go hand in hand. The profit per pound on an output of 500 pounds per molder per day should be twice as great as on an output of 1,000 pounds per molder per day. Otherwise, the low production work will not yield as high a return on the investment as will the high production work. It is almost invariably the case in foundry practice that the months in which light work predominates, the profit showing is materially less than during the months when the heavier work predominates. If a fairly uniform return is made on all work going through a

plant it is necessary to have the profit per pound follow the average output per molder. Thus, if the output per molder per day is 866 pounds, and the cost is $5.12 per 100 pounds, as is assumed on page 253, and a net profit per molder per day of $5.00 is needed to yield the desired return on the investment, the profit should be $0.58 per 100 pounds, making the price $5.70 per 100 pounds. The rate of profit on cost in this case would be 11.3%. If the output per molder per day had been but 433 pounds, or only one-half as great, the profit would have to be $1.16 per 100 pounds in order to yield the same return on the investment. The rate of profit on cost in this latter case, however, should not be materially different from 11.3% if the relative true costs of producing the 866 pound job and the 433 pound job were known.

Profit Rate Verification

Even with the best cost system and cost practice, there are occasional jobs on which it is extremely difficult to secure an accurate cost. There are conditions and elements of an extraordinary nature that enter into the cost of the job which a system cannot reflect, or which it is not practicable to have it reflect. This condition often results in leading foundrymen to believe they are making a fair profit on particular work, when as a matter of fact, they are not.

The fact that a loss is incurred, or that the margin of profit is not sufficient, can be determined by checking the profit in dollars per output per molder per day against the rate of profit shown by the production cost. For example, we will assume that for a particular intricate job the cost as shown by the records is 10 cents per pound and the average output per molder per day is 167 pounds. At a price of 12 cents per pound, the profit seemingly is 20% on cost and may be considered very commensurate and be above the average rate of profit, nevertheless, in reality it may be far less than the average. We will assume that the records for the preceding month for the entire plant show the following:

Tons produced	1,000		
Selling price per ton		$115.00	
Cost per ton		100.00	
Profit per ton		15.00	
Rate of profit on cost			15%
Molding days of 8 hours each	3,000		
Average production per molder per day (lbs.)	667		
Average profit per molder per day		$5.00	

While the apparent rate of profit on the special job is 20% as compared with an actual profit of 15% on the entire output, nevertheless, the special job yields an actual profit of but two-thirds of the average rate. This is evidenced by the fact that a production of 167 pounds at a profit of 2c per pound gives a profit per molder per day of $3.34 as compared with an average profit per molder per day of $5.00 for the entire plant.

It is an excellent practice, therefore, in drawing conclusions as to the profitableness of work, or in making price adjustments, to compute the profit not only in percentage on cost but in dollars per molder per day. If the profit per molder per day is not satisfactory the price is not sufficiently high even though the percentage of profit on apparent cost is satisfactory.

Profit Per Day Per Unit of Molding Floor Space

In computing profit, the production per molder per day should be in terms of units of molding floor space. If in a given foundry there are 100 productive units of molding floor space of equal size and if each unit of floor space were occupied by a molder, it is evident that the day's production should be divided by 100 to obtain the average production per molder per day or per unit of floor space. It is also evident that if a profit of $5.00 per day per unit of molding floor space is needed to yield a fair return on the investment that each molder and each unit of floor space must produce a profit of $5.00. If,

however, the nature of a particular job were such that a molder needed two units of floor space, the day's profit on his particular work should be $10.00, otherwise that particular job would be only half as profitable as the jobs that could be handled on one productive unit of floor space and which produced a profit of $5.00 per day. Therefore, the profit should be in terms of production per day per unit of molding floor space. To give effect to this on the records, all that is necessary is to show the number of molding hours per unit of floor space. That is to say, if for a particular floor job a molder and a helper occupied three units of floor space, working eight hours per day, the job should be charged with twenty-four hours molding time, or three units of molding floor space. If the production per day of the two men were 2,000 pounds and the profit were ½c per pound, the profit per day per unit of molding floor space would not be $5.00, but only $3.33.

The true relation between production per day per unit of molding floor space and the rate of profit per hundred pounds at rates of from $5.00 to $10.00 per day per unit of floor space is shown in the following table:

PROFITS IN RELATION TO PRODUCTION

Production Per Day Per Unit of Molding Floor Space	Required Profit per 100 Lbs. to Produce a Profit per Day per Unit of Molding Floor Space of					
	$5.00	$6.00	$7.00	$8.00	$9.00	$10.00
(lbs.) 2,000	$0.25	$0.30	$0.35	$0.40	$0.45	$0.50
1,900	.264	.316	.368	.421	.474	.526
1,800	.278	.333	.389	.444	.50	.555
1,700	.294	.353	.412	.471	.529	.588
1,600	.313	.375	.438	.50	.563	.625
1,500	.333	.40	.467	.533	.60	.667
1,400	.357	.429	.50	.571	.643	.714
1,300	.385	.462	.539	.615	.692	.769
1,200	.417	.50	.583	.667	.75	.833
1,100	.455	.545	.636	.727	.818	.909
1,000	.50	.60	.70	.80	.90	1.00
900	.555	.667	.778	.889	1.00	1.111
800	.625	.75	.875	1.00	1.125	1.25
700	.714	.857	1.00	1.143	1.286	1.429
600	.833	1.00	1.167	1.333	1.50	1.667
500	1.00	1.20	1.40	1.60	1.80	2.00
400	1.25	1.50	1.75	2.00	2.25	2.50
300	1.667	2.00	2.333	2.667	3.00	3.333
200	2.50	3.00	3.50	4.00	4.50	5.00
100	5.00	6.00	7.00	8.00	9.00	10.00

INDEX

A

B

C

D

E

F

J

L

M

O

P

R

S

T

U

V

W