Business Accounting

VOLUME III

COST ACCOUNTING

By

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EDITORIAL PREFACE

Ten years ago almost any contribution to the literature of accountancy would have been welcomed. Today, however, with the increasing number of excellent publications, it is incumbent upon one who puts forth a new accounting work to justify his action. Much more is it necessary to explain the publication of a set of accounting books. Hence it is desirable to state at the outset the purpose of "Business Accounting" and to outline its scope and general methods of presentation.

While many books have been published on accounting topics, in almost every case they are unrelated volumes. In some few instances, a volume on accounting has logically followed another by the same author, but with these few exceptions every one published has been written without connection with, or adjustment to, any of those already existing. Under these conditions, the student of accounting, to get any connected and logical knowledge of his subject, must find one of his books here, another there, a third somewhere else, and bridge over the gaps between them as best he may. The process is difficult, and the accounting knowledge he obtains is not always well co-ordinated and logically developed.

The volumes of "Business Accounting" are intended to meet this situation. They cannot, it is true, provide a course of study in the sense that prescribed readings are recommended, written answers to questions required, and personal instruction given. Neither do they con-

stitute an encyclopaedia of unconnected and isolated articles. Rather are they an attempt to present in simple, non-technical language the basic principles of account-keeping and their application to various lines of business, together with general directions for preparing, analyzing, and interpreting accounting statements.

One who starts at the beginning of Volume I and works faithfully through to the end of Volume IV, and then solves the problems and examines the solutions of Volume V, should acquire some real understanding of the theory and practice of accounts—a knowledge that, supplemented by experience, should enable him successfully to stand the test of practical work in any ordinary business office and furnish a foundation for going as much further into the study of accountancy as he may desire.

It may be noted in passing that the volumes of "Business Accounting" have been indexed in such a way as to provide many of the features of an encyclopaedia, so that the person desiring the practice on a particular point or accounting ideas of suggestive value in particular lines of industry will be able to use the set to advantage.

Taking up the volumes of the set in order—Volume I presents the fundamental principles of account-keeping and statement preparation. Upon these basic principles all systems of account are built. Volume II explains the principles governing the development of the simple accounting procedures described in Volume I to meet the needs of more complicated and more extensive systems of financial accounting. Volume III explains in much the same way how the basic principles

have been applied to factory or cost accounting. Having thus traced the fundamental principles into more elaborate financial and cost accounting procedures, Volume IV treats accounting principles and practices which are more advanced than the basic ones described in Volume I. These advanced principles are in most cases subject to differences of opinion, as to their nature or application, among persons qualified to deal with them, and it is for this reason that their discussion is confined to Volume IV. Supplementing the illustrations of accounting principles and statement preparation, there follows in Volume IV a practical discussion of the methods of verifying accounts and statements and of their interpretation and analysis.

The set closes with Volume V, which gives a number of problems of a practical nature, together with their solutions. The working of these problems will not only clarify the reader's ideas but in many cases will provide models upon which he can base accounting procedures and build statements to meet concrete situations arising in his own work.

The readers to whom this set will appeal most strongly may be divided roughly into two classes. There will be, on the one hand, business and professional men, bankers, office managers, and other executives who feel the need of understanding in a general way the methods of modern account-keeping and statement preparation. There can hardly be excuse nowadays for them to consider bookkeeping methods and accounting statements as too complicated to understand or of such slight importance as to merit no attention. They need a grasp of the subject so that they may judge for themselves

whether bookkeepers and other persons who keep accounts for them and render statements to them are giving information which is accurate, adequate, and presented in the most intelligible form. The entire tendency of modern business and civic life is toward more exact accounting, of which the accounting requirements of the present income tax legislation are but one indication. Any person having substantial interests at stake should be able to appraise intelligently the stewardship of those to whom his interests are intrusted and the volumes of "Business Accounting" will give him the technical information this demands.

The other class of persons to whom "Business Accounting" will appeal is composed of those whose duty it is to keep accounts and to prepare statements. They should find in this set an inspiration and an aid to more intensive study, which in turn will result in improved accounting ability and an enhanced wage. The careful and intelligent use of these books will lead beyond question to increased power of service to employer and community.

HAROLD DUDLEY GREELEY,
Editor, Business Accounting Set.

New York City,
April 1, 1920

PREFACE

More interest is shown in cost accounting today than ever before, especially in the United States. On every hand, groups of manufacturers and merchants are discussing methods of figuring costs, devising uniform cost systems, and seeking the best way of ascertaining their manufacturing and selling expenditures. The rapid growth and increasing complexity of modern business and the requirements of competition have rendered a good cost system a necessity.

The manufacturers of clay products in Ohio and Virginia are continually discussing in their association the methods of figuring cost. The manufacturers of newsprint paper in the northwestern part of the United States and in Canada are spending much time in attempting to solve their cost problem satisfactorily. The makers of furniture in Michigan and northern New York met recently to discuss the best system of cost-finding for certain specific articles of furniture. The publishers of the Middle West at their recent convention discussed a cost system for newspapers. In Providence and the Attleboros, the jewelry manufacturers have formed a special cost committee to work on their problems. The associations of the Portland cement manufacturers, the horticulturists, the printers, implement makers, woolen and worsted manufacturers, and the makers of leather belting, barrels, and boxes have all adopted so-called uniform systems of cost accounting.

There is scarcely a trade paper, whether it be the *Bakers' Weekly, Textiles, or Printing Art,* which does

not carry articles on cost accounting. The convention number of practically every such paper devotes a large amount of space to cost reports. As a whole, the trade papers of the United States have devoted more space to articles on cost systems during the last ten years than has ever been given to the subject in books and other literature. More than twenty colleges give courses devoted entirely to cost accounting, thus recognizing the subject as worthy of separate treatment in the curriculum.

The aim of this book is to present those features of cost accounting which are essential to every cost system and to connect them in such a way that the student can obtain the greatest amount of information with the least "lost motion." Beginning with the structure of the general accounting system and the interlocking of the cost accounts with the financial accounts appearing on the balance sheet, the student is carried along to the details of accounting for material, labor, and overhead expense, and finally to the assembling of the elements of cost necessary to ascertain the cost of a unit of the product. For all this the author has drawn on his lecture material at the College of the City of New York and his experience as a cost accountant during the past fifteen years in various industries throughout the United States. Sufficient illustrative examples are given and forms presented to make clear the plan of operation.

While this work is intended primarily for students of cost accounting, it is also designed for the use of the busy executive who may wish to learn what a cost system is, what it accomplishes, and how it looks in operation.

Not all cost problems can be solved within the scope

of a single volume. The author will gladly endeavor to answer, however, any specific questions on costs which his readers may wish to ask. He will also appreciate any comments, criticisms, or suggestions that may be helpful in preparing revisions of the present volume.

D. C. EGGLESTON

Mount Vernon, New York
April 1, 1920

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General Principles

CHAPTER I

COST ACCOUNTING IN MODERN BUSINESS

1. Importance of Cost Accounting

Accurate and efficient records are quite as important to a business as are the charts and compass to a ship at sea. They, too, show the location of the rocks which menace disaster, and also the channels in which the water is deep and safe, and they point surely and steadily the course to be followed. In any large and successful business the accounting department is looked upon as one of the most important factors of success. The larger the operations, the greater is the care that must be taken in maintaining an adequate and effective system of accounts. In manufacturing undertakings this is especially true.

Among the accounts of the manufacturer none are of more importance than those that show his production costs. From these he learns the how and the why of factory expenditures and is enabled to judge whether they are normal or excessive, and, if excessive, to discover leaks and reduce expenditures intelligently. In addition to this, they supply him with a basis for fixing selling prices and thus give him a mastery of his own business that nothing else can furnish.

2. Definition

Cost accounting, as the term is ordinarily used, is the method and process of determining the cost of

manufactured products. A cost accounting system is a series of factory records which, when properly adjusted to the general scheme of factory organization, enable the manufacturer to ascertain the production cost of his goods and the elements which go to make up that cost.

Strictly speaking, the definition just given is too narrow. Cost accounting as a means of determining operation costs is applicable to any line of business. In the present volume, however, cost accounting, unless otherwise stated, refers to factory cost accounting, or the determination of production costs.

3. Distinction Between Cost and Commercial Accounting

Cost accounting is a branch or development of general or commercial accounting. Though the methods and procedure in keeping cost accounts and records are peculiar and distinctive, nevertheless these cost accounts and records are merely a detailed analysis of the accounts kept on the general books. The accounts of the business are classified on the general ledger and among these are the purchase expenditures by kinds—so much for supplies, rent, taxes, wages and salaries, and so on. The general ledger accounts with their classifications are maintained in order that the condition of the business and the amount of the net profit or loss for the period may be determined; and when this is done the factors which have gone to make up this profit or loss may be analyzed in any desired detail.

Cost accounting analyzes the accounts kept on the general books in such a way as to show how the net profit or loss has been made—so much profit or loss on the manufacture, handling, and sale of certain kinds of

goods. This involves the "departmentalization" of the accounts, i.e., the distribution or division of the general accounts so as to show the cost of operating each department of a business and the cost of the productive work carried on therein.

4. Function of Cost Accounting

The chief function of cost accounting is to ascertain and record the actual cost of each job or unit of product. In doing this under any effective system the following supplementary functions are performed:

1. A cost basis is established upon which selling prices can be fixed with intelligence and safety.
2. The comparative profits of different lines of manufacture are clearly indicated, thus enabling the manufacturer to establish a sound selling policy.
3. Comparative costs for different periods are obtained, standards of work are established, and any actual losses of labor or material are disclosed. A standard of efficiency for workmen, machines, and the factory organization as a whole is laid down, and the changes necessary to increase efficiency and to decrease production costs are indicated.
4. Perpetual inventories of raw material, work in process, and finished goods are set up and maintained, and in this way the factory investment in material and also labor are controlled.

5. Costs as an Aid to Price-Fixing

Bad results are to be expected and usually follow when the selling price of a product is fixed without accurate knowledge of its cost. A price based on guesswork or "practical experience" is almost sure to be either too high or too low. In one case it is unfair to customers, in the other to competitors. In either case wrong prices are ultimately injurious to the man who makes them, and not infrequently lead to disaster. Every business man, therefore, whether he be a manufacturer or a merchant, owes it to himself, to those interested in his business, and to the trade he represents, to know the costs of his products before fixing their selling prices.

It is not generally realized how injurious to the prosperity of a particular trade may be the ignorant competition of manufacturers who do not include every element of cost in their selling price. During a time of commercial depression a manufacturer may deliberately resort to price-cutting in order to secure the business required to keep his organization intact. He must perhaps operate for a time without profit in order to operate at all. In such case he does so with intent and a full knowledge of what he is doing. Not infrequently, however, ruinous competition comes from a manufacturer who cuts prices below those of his competitors because he does not know what his costs are. Then he not only loses money himself but he becomes a menace to the entire trade.

6. The Cost System as an Indicator of Profitable Lines

Manufacturers who do not keep accurate costs sometimes manufacture lines which yield little or no profit

or which entail actual losses. Not infrequently, also, they push less profitable or unprofitable lines because they do not know that other lines are more profitable. The lack of departmentalization in the accounts permits general averages to hide weak spots. The result of this is that the profitable departments or lines carry the unprofitable ones. Experience shows that this is today the greatest source of leakage in many businesses. Losses may be occurring daily through the sale of unprofitable lines, but until every line is made to stand on its own feet, the management may be in complete ignorance of the fact.

Such an instance is exemplified by the experience of a well-known manufacturer of food products—a concern dealing in candied citron and lemon and orange peel. The candied citron sold much more easily than the other lines and finally, as a measure of supposed efficiency, the sales force was instructed to push the "easy seller" and to let the candied peels go as they would. At the end of the year the profits were so unsatisfactory that a cost accountant was asked to make an investigation. An analysis of cost showed that while the peel was sold at a good profit, the citron was sold at a narrow margin, for the reason that a larger portion of the fruit was lost in manufacture than had been supposed. A new scale of prices was then introduced, and all the products were pushed, with the result that the narrow margin was soon turned into a good profit.

7. The Cost System as an Aid to Efficiency

All things are relative, even in business. There can be no absolute standard of measurement. We cannot

say absolutely that a workman can turn out so many pieces per hour and no more. At any time a quicker workman may surpass the record, or a better workman may devise more efficient methods. The efficiency of workmen, or of departments, or of plants is therefore measured solely by comparing present performances with those of the past, or by comparing one workman or department or plant with another, or with those of rival enterprises.

A properly devised cost system enables such comparisons to be made. Thus, for example, a company operating a number of silk mills closely scrutinizes the cost per yard of producing Georgette crêpe in all its mills to see that the figures are approximately the same. Again, if a workman in a shoe factory does not turn out so many soles from a side of leather, or cut so many parts for uppers from a hundred square feet of calfskin as previous records prove to be possible, an investigation is made. It may be that the cutter is careless, or the purchasing department may have been negligent in its selection of calfskin. The record of past performances establishes a standard by which to measure present performances. If the present performance exceeds the past, a new standard may be established.

Throughout all factory operations involving purchasing, stores-keeping, the use of material, the utilization of labor, the control of expense, and so on, similar standards are necessary to measure "performance." Without them the yield obtained from material may decline, the labor cost of production may rise, or the operating expense may be too high. "Preventable waste" may occur at every point.

It is an axiom of factory management that 100% efficiency is never attained in any plant. In spite of vigilance and ceaseless efforts, losses arise in every manufacturing enterprise from waste of material and labor, as well as from failure to utilize space and machinery to the best advantage. It is the function of a cost system to trace these leakages to their sources.

The ideal in every plant, of course, is the elusive 100% efficiency just referred to, which implies that the plant is being operated to capacity at the lowest possible cost. To approximate this ideal as nearly as possible, every producing unit and every productive operation must reach a certain standard day by day and expenses must be kept down to the lowest practicable mark. This requires the specific and accurate information that only a good cost system can supply. Its records show what is being done in every department of the factory at any time, and the figures it provides can be presented in such detail and in such combination that they show any desired phase of operation. The efficiency of the plant can be measured period by period, either as a whole or in detail, by individuals, by departments, or by processes. The combinations are limitless and can be made to furnish any operating figures that may seem desirable to the management.

8. The Perpetual Inventory, Its Uses and Advantages

An essential feature of any accurate system of cost-finding is a perpetual or going inventory. This is an inventory or record of stores or any other property on which additions or withdrawals are noted at the time they are made, so that the stores or other property on

hand at any time are revealed by the records without the actual count of a physical inventory. Where such inventories are maintained, the cost accountant can tell just what stores are on hand, just what work is in process, and just what finished goods are in stock awaiting sale or other disposal, without turning from his books. The perpetual inventory, in showing this, shows many other things of importance such as the monthly consumption of stores, the cost value of work in process, the monthly output of finished goods, etc.

The advantages of the perpetual inventory are notable. In addition to those enumerated it permits the closing of the books at the end of each month without the necessity of taking a physical inventory until the end of the fiscal year. This short cost period (Chapter II, § 5) permits of monthly statements which give a knowledge and close touch of the business that can be secured in no other way.

As illustrating the practical value of the perpetual inventory an experience of two very large corporations manufacturing a common product may be cited. Each of these in turn was asked to state the earliest date on which delivery could be made on a large rush order. One concern lacked a modern system of records. Although it got at once into telephonic communication with its different plants, and had its whole corps of superintendents on edge looking up data and reporting conditions, two days elapsed before it was able to give a positive reply. The second concern, equipped with a modern accounting system, had merely to consult its inventory record. Ascertaining in this way the conditions in each of its plants, it gave a decisive reply within half an hour

from the time the inquiry was made, and secured the order before its competitor had worked out a delivery date.

A perpetual inventory system makes it possible to operate the plant efficiently with a smaller investment in material, thereby reducing carrying charges, and at the same time it furnishes a valuable aid to intelligent purchasing in that the consumption of material is accurately recorded. It makes a check on material accounts possible, and enables costs to be proved. The chief advantage of the perpetual inventory, however, when it is part of an effective modern system of cost accounting is that it enables the office at all times to keep in close touch with the factory and to control it—a wonderful advantage under any circumstances, but particularly valuable when a business is under the stress of competition.

9. When the Cost System Is Necessary

In a small factory a formal cost accounting system may be of no great importance if the proprietor can keep in close personal touch with every detail of administration and carry all necessary data as to costs in note form. There will come a time, however, in any growing concern when its operations pass beyond the direct individual observation and control of any one man. Then, whoever is in control, if he is to keep himself properly informed, must depend upon a system of periodic reports which will summarize and present the operating data of the factory in such form that any deviation from economical and efficient production is clearly shown. Such reports are possible only when a reasonably effective cost system is in operation.

A cost system is necessary also to enable the individual manufacturer to compare his cost figures with the average or standard figures in his trade or industry. It is to this end that more than thirty leading manufacturers' associations have adopted uniform cost systems. When members in the same line formerly tried to compare costs, wide variations were found in their figures due to different methods of calculating costs. Thus, the tendency is not only for every business of any size, whether manufacturing or mercantile, to adopt a cost system, but for cost-keeping methods of each industry and each line of business to become more and more uniform.

10. Process Method of Cost-Finding

While simple in theory, the practical determination of costs becomes increasingly difficult as the processes employed increase in number and complexity and as manufacturing variations take place. A factory engaged in the production of ice illustrates a simple method of finding costs. Here it is only necessary to charge the factory with the material and labor consumed, and overhead for a given period; to keep a record of the tons or blocks of ice produced during the same period; and to divide the total cost of production by the number of tons or blocks of ice produced to determine the cost of each unit. As one ton or block of ice is exactly like another, an average price accurately represents the cost of a single unit. Here the method is simple because the product is simple and homogeneous, and the procedure is known as the "process" method of cost-finding, because the cost of the process as a whole

is recorded on the books and records. (See Chapter IV on this subject.)

11. Job Order Method of Cost-Finding

Assume, however, that a factory is engaged in the production of many different kinds of candies and sweetmeats; that the costs of the ingredients range in price from a few cents to several dollars per pound; that some are wrapped in tin-foil and packed in expensive ribbon-tied boxes, while others are put up in simple cartons. It is clear that the division of the total factory expenditures by the number of pounds that expenditure produced, while giving the average price per pound, would result in a meaningless figure so far as the cost of any particular lot is concerned. To ascertain this cost with accuracy, it is necessary to follow the various lots through the factory, keep separate records of the material and labor consumed in the manufacture and packing of each, and charge each lot with sufficient overhead to insure the equitable apportionment over production of the total overhead for the period. Given the cost of a lot of a certain kind of product, the cost per pound can be readily determined. This procedure is known as the "production order," or "job order" method of cost-finding because production is divided into a number of different jobs or orders the cost of each of which is shown separately on the books. (See Chapters IV, V.)

12. Complexities of Cost-Finding

If, now, the factory is charged with all current expenditures and credited with the cost of the various lots produced as recorded on the individual lot records, it

follows that the debits exactly equal the credits if it is assumed that there were no debit balances at the beginning of the period and that all expenditures for the period have been consumed in completed manufacture. In practice, however, this is never the case as no factory can be operated continuously with profit on a hand-to-mouth policy. Raw materials and supplies must be purchased often far in advance of present requirements, a quantity of partly finished product must always be in process (unless the factory "cleans up" and closes down), and expenditures for rent, taxes, insurance, coal, and a hundred and one items of supplies are made not for current needs as they arise but sometimes for a year or more in advance. All this makes for complexity. Not only must the disposition, i.e., the consumption, of these expenditures and the value of the inventory items be clearly and correctly shown on the books, but the accounts must be kept in such a way that after all expenditures have been debited to the factory work in process and subsequently transferred to the finished goods after completion of operations, the accuracy of the figures may be proved by comparing the book inventories with the values of the stores, goods under way, and finished stocks on hand.

The simple principle of charging the factory with all expenditures arising from manufacture and crediting it with the cost of the finished goods underlies the method of keeping the accounts in every cost system. It will, however, readily be seen that the system of cost accounting may vary from a few simple accounts kept to classify the factory expenditures into their elements, to a complex method of apportioning numerous items of

expenditure among a hundred or more departments and over several thousand articles, orders, or jobs.

REVIEW QUESTIONS

1. What is the difference between cost accounting and financial accounting?
2. What one characteristic is peculiar to the accounting system of nearly every enterprise where a cost system is in operation?
3. What motives usually actuate a business man in introducing a cost system?
4. Why is it that the average manufacturer or business man cannot determine his costs accurately?
5. What are some of the ills that may result from ignorance concerning costs?
6. Why should competitors use a uniform basis for their cost determinations?
7. How can a cost system indicate leaks in a business enterprise?
8. Give an illustration of how a cost system helped to bring to light a leak.
9. How can cost records serve as an aid to increased efficiency?
10. What purpose do perpetual inventories serve?
11. At what stage in the development of a manufacturing enterprise should a cost system be installed?
12. What is the difference between the process and job order method of cost-finding?

CHAPTER II

ELEMENTS AND PRINCIPLES OF COST ACCOUNTING

1. Elements of Production Cost

In every manufacturing operation, three elements of cost are involved:

1. Material
2. Labor
3. Expense

Material and labor together constitute what is known as "prime cost"; material, labor, and expense, the total cost. No matter what the product may be, these three elements of cost enter in.

A gold ring is to be fashioned for a lady's finger, or a steam shovel is to be constructed to cut a canal. In either case, material must first be provided: gold for the ring; iron, steel, and wood for the steam shovel. Labor must then be engaged—the skilled services of the goldsmith for the ring; workmen of every grade from the apprentice helper to the expert metal-worker for the steam shovel. In addition, for both, manufacturing space must be provided; tools must be furnished; records must be kept; and light, heat, power, and many other incidental requirements must be supplied—all these constituting expense.

As already stated, the essential function of a factory cost system is to furnish complete information as to the

cost of each of these elements of production as consumed or employed in the manufacture of the product, and to apportion this cost against each unit of the product.

2. Direct and Indirect Charges

In the manufacture of any article or product, most material and labor and occasionally some of the expense items are consumed so directly in the make-up of that particular article or product that the cost of these may be determined and charged direct to that particular article or other product with much accuracy. Such charges are termed "direct charges." On the other hand, there are certain material and labor charges as well as many expenses which are so general in their nature that they cannot be charged directly to a specific article or product, but must be apportioned over the output, the charges to each unit being only approximately accurate. Such items are known as "indirect" charges and form the third element of factory cost, i.e., expense.

Direct and Indirect Material Charges. The wood and hardware used for trimming which go to make a desk can be charged directly to the order for that particular desk, and are therefore a direct material charge. The manufacture of the desk, if carried on within a wood-working plant, involves the use of coal to heat the plant and to supply power, oil to lubricate the machinery, and nails, screws, varnish, etc., for the proper finishing of the product. Such material cannot be charged readily against any one desk and is, therefore, usually treated as indirect material or supplies and as such charged to the product as "expense." It is sometimes the case, however, that a manufacturer prepares

schedules—based on tests if necessary—showing the quantities of miscellaneous materials or supplies used on particular products, in which case such items are figured as a direct charge.

Direct and Indirect Labor Charges. In the manufacture of this same desk certain workmen are employed in cutting, planing, and finishing the lumber of which it is made. This work is directly applied to the product and as such is "direct labor." Certain other workmen are employed in keeping the factory buildings clean, firemen and engineers are necessary for the operation of the machinery, and foremen and superintendents are engaged to direct and supervise. This labor cannot be charged directly to a particular desk, and is therefore "indirect labor."

Direct and Indirect Expense Charges. Direct expense seldom arises and is of little importance in cost-keeping. The following case will illustrate. Workmen are sent out from the factory to install a heavy piece of machinery in a city a hundred miles away. They arrive at their destination but find that parts of the mechanism have been so injured in shipment that they have to be replaced. The parts are shipped, but pending the arrival of these new parts the men can do nothing, yet their time runs on and their expenses must be paid. This lost time and the expenses connected therewith are charged direct to that particular job as direct expense even though the greater part of it represents labor time.

Indirect expense charges, on the other hand, occur in every manufacturing operation, and their equitable distribution over production is always difficult. Some common examples are as follows:

INDIRECT CHARGES

Indirect Material:	Indirect Expenses:
All material that cannot be charged directly	Rent
Supplies	Interest
Small tools, etc.	Taxes
Indirect Labor:	Insurance
Watchmen, janitors, etc.	Maintenance
Supervision	Depreciation
Inspection	Light
Factory clerks	Heat
Experimental work, etc.	Power
	Oil, etc.

Indirect charges are also termed overhead, burden, or merely expense, and include every manufacturing cost properly chargeable against production with the exception of direct material and direct labor.

3. Cost Determination

The cost of any manufactured article, as stated, is made up of the cost of the three elements—material, labor, and expense which includes all indirect charges.

Direct material costs are usually simple, requiring only the charge for material actually consumed. Labor costs, while still comparatively simple, are more difficult of determination, owing to the fact that labor does not go into the specific order in the clean-cut way in which material usually does. Thus, a single order may pass through many different processes and departments and through many different hands. It may be worked on steadily until completed, or it may be continued at many different times. It may be worked on alone, or in connection with other jobs, or it may fill in time between

jobs. All this makes for complexity. Under any of these circumstances, however, the problem is usually merely one of careful timekeeping, and is therefore capable of accurate solution.

It is in the determination and distribution of expense that the chief inaccuracies and most of the difficulties in both the theory and practice of cost-finding occur. Expense comprises a large part—sometimes the greatest part—of manufacturing costs. It is always present in results, but is not easily traceable itself; it is multifarious in its origin but united when applied as a burden on production costs.

4. Illustrative Items of Cost

The following chart of cost accounts* is a further illustration of the complexity of the expense charge. This shows the items composing the manufacturing cost in the paper pulp industry, these items being classified under the three heads of material, labor, and expense. It is interesting as showing the very great preponderance of expense items.

CHART OF COST ACCOUNTS

I. Direct Material	II. Direct Labor
Wood	Manufacturing labor only
Sulphur	
Pyrites	
Limestone	
Lime	
Soda	

(I + II = prime cost)

* Adapted from the report of the Tariff Board on the Pulp and News Print Paper Industry.

III. Expense

1. Works Expense:
   - (a) Supplies
     - Pulp stones
     - Felts (wood, canvas)
     - Wires, belting
     - Screen plates
     - Lubricants
     - Fuel (coal, wood)
   - (b) Water Power
   - (c) Repairs and Maintenance (materials, labor)
   - (d) Direct Labor
   - (e) Administrative Expense chargeable to Manufacture
   - (f) Miscellaneous Operating Expenses
   - (g) Accident Insurance
   - (h) Hauling and Stable

2. Fixed Charges:
   - (a) Depreciation
     - Buildings (annual rate)
     - Depreciation and Obsolescence of Machinery (annual rate)
   - (b) Fire Insurance
   - (c) Taxes (excluding federal corporation tax, as this is a direct tax on profits and not a manufacturing cost)

(I + II + III = total cost in bulk at works)

The determination of the material and labor cost per pound of paper pulp produced during a given period is a simple procedure. Records are kept of the quantities of the six kinds of raw material listed above withdrawn from the stores-room for the manufacturing needs of the current period. The purchase price of these materials (plus the cost of delivery to the factory) divided by the number of pounds of pulp produced gives the material cost per pound. The total pay-roll for the period divided by the same production figure gives the labor cost per pound.

The expense or overhead cost is not so readily ascertained. The value of the supplies consumed during the period, like the value of the material, is readily arrived at. A nice discrimination is required, however, to determine in what proportion the administrative expense is chargeable to the cost of manufacturing and to the cost of selling; or what charge should be made to production for the wear and tear on buildings, machinery, and equipment; or how major repairs, made as much for the benefit of future production as for present, should be treated. The expenditures to date for these numerous items of expense must be clearly shown. Furthermore, the books must show both the proportion consumed in factory operations and the departments or divisions of the factory which are responsible for or benefit from the expenditure. While all this adds to the difficulties, yet the division and subdivision and departmentalizing of accounts is imperative if the cost accounting is to serve its dual function of ascertaining and *controlling* costs. Obviously, the greater the detail in which the causes which lead to or create expenditures are analyzed, the greater the degree in which they can be controlled.

5. The Cost Period

Accurate cost accounting to give cost information as and when it is wanted is a modern development. In former years the manufacturer waited until the end of the fiscal year in order to determine his costs and his profits. At that time an inventory was taken and the cost of the product was determined with more or less inaccuracy. Such procedure does not meet modern requirements. If production costs vary, the fact must be

known, and known quickly, and the cause of the variation must be discovered. Accurate, up-to-date costs are necessary as a basis for price-fixing—whether competitive or otherwise—and price-fixing cannot wait on annual inventory-takings.

To meet these requirements the annual cost period has been replaced by a much shorter period in modern accounting, usually a monthly or a four weeks' period. At the end of the period accounts are balanced, and from them a statement is prepared in such detail as is required, showing the stores on hand, the work which is still in process and the costs which have accumulated thereon, the work which has come out of process as finished goods and the cost of the work. A statement of loss and gain and a balance sheet are then prepared, showing just what has been accomplished during the period. The advantage of this short period with its frequent complete showing of factory conditions is obvious.

It is highly desirable that the cost periods be adjusted so as to coincide with the pay-roll periods. The most approved practice when employees are paid weekly is to have the calendar year divided into quarters of thirteen weeks each, beginning with a five-week period followed by two four-week periods, or to have the year divided into thirteen periods of four weeks each.

6. Stores—Work in Process

The term "stores" covers supplies and material of every kind used in the factory. When material is taken from stores to be used in the manufacture of any product or article and work is begun on this material, it becomes "work in process" or "work in progress." As work in

process passes through the factory, labor is expended on it, more material may perhaps be used in it, and expenses of various kinds are incurred in connection with its transformation from raw material into the finished article or product. As long as any factory operations are required for its completion, it is still "work in process."

7. Finished Product—Finished Parts

When work in process is completed, i.e., when it has gone through all the factory operations necessary to convert it into the desired article or product, it becomes finished product or finished goods. It is then ready for sale, and, if not sold at once, is transferred to stock. The factory, as such, loses interest in it from the moment it passes out of the work in process stage.

Finished parts are those which are fully completed as parts but which are used in the manufacture or assembling of a complete article, as the parts of a watch or a sewing machine. These finished parts may be manufactured for sale to other concerns which assemble the complete machine, in which case they are, when ready for sale, treated as "finished goods." If they are to be used or assembled within the establishment, they are, when completed, regarded as material and placed in stores, just as they would be if purchased outside.

8. Manufacturing and Trading Costs

The records of purchases in a trading business in which the unit costs of the goods may be ascertained from the invoices are obviously much simpler than the records of production in a manufacturing business in

which many more factors need to be taken into account. Methods which might be adequate for a mercantile or a trading business are entirely inadequate for a manufacturing concern. The difference between the cost problems in the two cases becomes evident when the selling price of an article is analyzed into its constituent parts, as follows:

1. Materials	Prime Cost	Total Factory Cost	Total Cost of Making and Selling
2. Direct Labor			
3. Manufacturing Overhead Expense			
4. General Administrative Expense			
5. Selling Expense			
6. Profit			

A mercantile business is not concerned with the factory cost, because it buys its merchandise in a manufactured state. The accounts of the trading business have therefore to deal with but four elements in determining its selling price, i.e., cost of merchandise purchases, general administrative expense, selling expense, and profit, and are obviously much simpler than those of a manufacturing business which must deal with six.

REVIEW QUESTIONS

1. What is the main function of a cost system?
2. Differentiate between direct and indirect charges.
3. Name several items properly chargeable to indirect expense.
4. What purpose is served by a minute classification of the items making up the cost of a commodity?
5. In what way is a monthly financial statement related to a cost system?
6. Does a trading concern need a cost system?

Part II
Cost Accounting Procedure

CHAPTER III

ROUTINE OF COST ACCOUNTING

1. The Cost Mechanism

The routine of cost-keeping will vary in almost every factory. Differences in product, in conditions, and in methods make it impossible for one plant to adopt successfully the procedure of another. Through it all, however, there runs a thread of uniformity. Where costs are kept at all, there must be a certain essential cost mechanism which in a more or less complete form functions as a part of every manufacturing operation, whether for repairs, construction, or the conversion of material into finished product. The more important elements of the cost mechanism in a job order factory are given below. The formalities found in a job order plant in connection with issuing production orders and drawing material on requisitions are to a large extent dispensed with in a process factory.

1. An authorizing order, technically known as the "Production Order," which starts work, i.e., puts the particular job "in process."
2. The "Material Requisitions," which are orders for the material needed and on which are recorded the cost of the material as a charge against the particular job.
3. The "Time Tickets," which record the cost of labor as a charge against the particular job on which it is expended.

4. The "Expense Distribution Sheets," on which are brought together the overhead expenses of the factory so that a calculation can be made of the amounts to be distributed to non-productive and productive departments and finally over each job.
5. The "Cost Sheets," on which the costs of the material, labor, and expense of each job are brought together and combined to secure the total cost of that job.

Other auxiliary forms and records are used in cost-finding but those given are the essential records of the cost accounting mechanism for a job order factory. In a small repair shop, for instance, where formalities are reduced to a minimum, most of these records are found in some form. For example, an umbrella is brought into a repair shop to have the old cover replaced. The proprietor may perhaps turn it over to a workman, telling him what to do. These instructions constitute a production order.

Possibly, on examining the umbrella, the workman finds a rib broken and the ferrule missing; also he may not have the proper quality of silk to replace the cover. He makes a memorandum of what is required and hands it to the proprietor. This is a simple form of material requisition.

When the work is finished, the workman hands the proprietor a memorandum of the time he put in on the job, which is in effect a time ticket. To the cost of this time, the proprietor adds the cost of material and, if he is at all experienced in costs and price-making, adds a percentage adequate to cover overhead expense. The

cost data so secured give him, in effect, a cost sheet, and the costs of labor, material, and expense added together, plus an allowance for selling expense and profit, give the proprietor the selling price—in this case his charge for repairing the umbrella.

2. Production Orders

The call for factory operations may spring from different sources. Perhaps the factory operates steadily, the output being sold as fast as it is turned out, perhaps the customers or salesmen send in their orders and the product called for must be made to order; or certain lines of stock may be nearly exhausted and a fresh supply is necessary; or some new design or new line of manufacture is about to be undertaken.

Whatever may be the nature of their origin, however, all productive factory operations in a job order factory are set in motion by means of written orders, termed "Production Orders." Certain other forms of factory activity, such as the care of buildings and repairs, which do not go directly into production, are in many factories started or authorized by means of "Standing Orders," or, as they are sometimes called, "Standing Expense Orders."

A production order is a written order authorizing and giving more or less complete instructions for the manufacture, usually within a stated time, of a certain number and kind of articles, as 100 automobiles of a particular type and size, or for some specific job, as the printing of a catalogue or poster.

There is no uniformity of practice as to who authorizes the production order. In a small plant the proprie-

tor, or superintendent, or foreman might initiate it. In a larger concern some one of the corporate officials may control factory operations and authorize production orders, or this control may rest with the board of directors, while the actual order would probably be issued by the planning department or a planning clerk.

OPERATORS CHARGE TIME TO NO. _____

MANUFACTURING ORDER SLIP

Date of M.O.S. _____ Completed _____

Source of Order _____

Customer _____

Description
Layout
Cutting
Ruling
Composition
Job Press
Cylinder Press
Bindery
Outside

IMPORTANT

Three samples must be filed in this envelope when order is complete.

SHIPPING INSTRUCTIONS

Form 1. Production Order—Job-Printing House

The form of the production order differs materially in different factories. In some it is little more than a brief order to produce certain articles. In others it gives full details as to the required product and its con-

struction. Sometimes it specifies the materials required. Sometimes manifold orders are so arranged that one copy is a production order, another copy a requisition for material, while a third copy becomes ultimately the final cost sheet. A simple form of production order used in a job-printing house is shown in Form 1.

Several copies of the production order are usually prepared. One copy is retained in the accounting department; one goes to the factory—probably to the superintendent or to the foreman of the department in which the production activity begins; one will go to the clerk who keeps the cost sheets. If the article or product is to go through several departments, a copy may be sent to each of the department heads.

Production orders are numbered consecutively and by means of this number manufacturing costs are easily charged to the proper order. Every requisition for material, every cost sheet, time card, and all other records or reports relating to the particular order will always bear the order number so that the accumulating costs involved may be properly charged thereto.

In the ordinary "job order" factory, the foreman usually has a number of "issued" production orders on hand waiting to be put "in process," and, unless some higher authority has prescribed to whom they are to go and the order in which they are to be taken up, he may use his discretion as to which workman or workmen he will give a particular production order and just when work shall begin. Before giving the production order to the workman, the foreman will probably note the material required and make out the necessary requisition.

He may then turn over to the workman both the order and the requisition.

3. Requisition for Material

The "Requisition for Material" (Form 2) is an order for material required for a particular job. The requisition always bears the number of the production order for which it is issued. In some cases where the items of material required are numerous, or where detailed instructions as to material are necessary, the requisition takes the form of a "Bill of Material," which is a detailed statement of the material required for the particular job (see page 135).

STOCK
POSTED
ISSUED BY

REQUISITION No._____

New York, _____ 19__

Ex.S.S. _____

Deliver to _____ For _____

MARKS	QUANTITY	UNIT	ITEM	WEIGHT	PRICE	AMOUNT	

Ex. _____ And oblige,

Storage and Ins. Expires _____ THE WOODS BROTHERS COMPANY

To be Weighed by _____ Per _____

Form 2. Requisition for Material

When the workman receives his production order and requisition for material, he procures the necessary material from the stores-keeper, usually surrendering

his requisition in exchange. He is then ready to begin work. Further requisitions for material may be needed from time to time as the work progresses. These he usually procures from the foreman, again securing the requisite material from the stores-keeper. All the material used is charged against the job, the requisition furnishing the needed information as to quantity and cost, and supplying the number of the order to be charged.

4. Time Tickets

The "Time Ticket," "Time Card," or "Time Report" (Form 3) is a more or less detailed statement of the manner in which the workman has expended his time. The method of keeping time varies materially in

Order No.	Operator's No.	Date	Approved by
Quantity	Description		
OPERATION			

6	¼	½	¾	7	¼	½	¾	8	¼	½	¾	9	¼	½	¾	10	¼	½	¾	11	¼	½	¾	12
12	¼	½	¾	1	¼	½	¾	2	¼	½	¾	3	¼	½	¾	4	¼	½	¾	5	¼	½	¾	6

	Hours	Pieces	Rate	Value

Form 3. Simple Form of Time Ticket

different factories. In some cases the "in and out" records of a time clock are sufficient. In other cases, where the workman devotes his time to several different jobs

in the course of the day, such a record would be inadequate. A more detailed statement of how his time has been expended then becomes essential to accurate cost-keeping. Again, individual job cards may be used to report the time expended on each order, or one time ticket may show the time put in on several jobs. In all cases, however, the time ticket should show the number or numbers of the job or jobs upon which the workman's time has been expended.

On the accuracy of the time report depends the accuracy of the labor costs. The time tickets should show the actual number of hours expended on each order or chargeable to some expense classification. From these tickets are obtained the information necessary for making up the pay-roll, the data for figuring the labor cost on each job, and also the amount chargeable to overhead expense for indirect labor. To sum up, the time tickets turned in by any one workman should give his complete time history so far as the factory is concerned.

5. Expense Distribution

The expense items which cannot be charged directly against a particular product are distributed over the production departments, which in their turn charge the products passing through them or upon which they work, in proportion to the amount of work done. The distribution of expense over departments, and of the department expense totals over the product, is one of the most technical phases of cost accounting, and is discussed in detail in subsequent chapters. For the present it is sufficient to say that the distribution of the overhead expense items over departments is made on an "Ex-

FACTORY DEPARTMENTAL ANALYSIS SHEET

Month of _____ 19__

DATE	REFERENCE	ITEM	DEPARTMENTS							
			1	2	3	4	5	6	GENERAL	TOTAL

Form 4. Simple Form of Expense Distribution Sheet

pense Distribution Sheet" (Form 4) and that the method of distributing the department totals over product is determined by the circumstances in each case. The expense distribution sheet furnishes the necessary analysis of the expense as a basis for calculating the charges to product.

The expense distribution sheet is kept either by the cost clerk or by the accounting department. The items entered on it are derived from various sources—from material requisitions for indirect material, such as brooms, dust-cloths, soap used for washing windows, and tools for general use; also from time tickets for indirect labor, such as janitor service, trucking, and general clerical assistance. Other items such as rent, depreciation, and taxes come from the general books of account.

6. Cost Sheets

The cost sheet is individual to the particular job, i.e., each order must have its own cost sheet bearing its number and showing the charges accumulated against it. The cost sheets—often called the "cost ledger"—are usually kept by the cost clerk in the accounting office. After a job is finished, the cost sheet for it is summarized and at the end of each month a total is made of the cost of all jobs finished. The cost sheets in a process factory, which are operated in connection with the general bookkeeping system, analyze the factory expenditures each period according to kinds of product.

A simple form of cost sheet used in a jewelry factory is shown in Form 5.

As requisitions for material come in showing the

COST CARD

No. Made Order No.

Description

Enameling

Metal and Finish

Description	Cost of Order	Cost per Dozen
Labor		
Factory Expenses		
Coloring		
Material and Supplies		
Total Manufacturing Cost		
Selling Expenses		
Die		
Total Cost		
Profit %		
Billing Price Article Die		

LABOR

Operation	Time	Rate	Amount
Blank			
Stamp			
Press			
Set-up			
Solder			
Scratch Brush			
Wriggle			
Charge			
Stone			
Polish			
Pin Stem			
Swedge			
Engrave			
Stone Set			
Design			
Paint			
Print			
Flux			
Total Labor			

Form 5. Cost Sheet—Jewelry Factory (face and reverse)

material used on a particular order, and as time tickets accumulate showing the time expended on this order, the cost clerk enters these items on the cost sheet bearing its order number. To these charges he adds the proper expense charge based on rates determined from previous experience. When the operations on the particular order are completed and all charges against it are entered on the cost sheet, he totals the detailed charges to find the manufacturing cost of the product.

When the manufacturing operations on an order are completed, the "work in process" becomes "finished goods." The cost of these finished goods is taken from the cost sheet, and the figures thus obtained are charged off the factory records and entered on the stock books under "Finished Goods," "Stock," or "Finished Material."

REVIEW QUESTIONS

1. Name the main features of any cost system.
2. What function is served by production orders?
3. How is production usually set in motion?
4. How is the issue of material controlled?
5. What time records are needed in a job order cost system?
6. In what way is the pay-roll system related to the time tickets used for cost work?
7. From what main sources does the information regarding overhead expense come?
8. How is a cost sheet operated?
9. What is the accounting procedure when the manufacture of the goods is finished?

CHAPTER IV

COST ACCOUNTING METHODS—SIMPLE PRODUCTS

1. Order and Process Methods

For cost accounting purposes, as already stated, manufacturing methods may be broadly divided into two classes:

1. The order method, or job order method, under which goods are made in distinct units or lots so that an order may be followed through and identified from start to finish.
2. The process method, under which production is in bulk and operations are almost continuous, one lot of the product following another so closely that the lots cannot be distinguished.

There is a marked difference in the finding of costs under these two methods. Under the order method a record is kept for each order throughout the manufacturing process, and the costs are charged against the order as they are incurred.

Under the process method this cannot be done because there are no distinguishable units other than the output for the run or for the cost period. Therefore the only practicable method of finding unit costs is to divide the cost of the run or the period by the output of the run or the period, in pounds, barrels, or whatever the unit may be.

The output of a printing plant or of a clothing factory illustrates the manufacture of goods under the job order method. A production order is made out in the first case for each order for printing; in the second case for each lot of coats, trousers, vests, or overalls. In both cases the orders give full manufacturing instructions, and in both instances several hundred orders may be in process and in various stages of completion at any particular time. In its journey through the plant or factory, the identity of each one of these orders must be preserved so that the instructions relating to its production may be followed. This continuous identification enables the costs incurred by each order to be charged against that order as the work on it proceeds.

On the other hand, when work is handled in bulk, as in a copper smelter, or in a factory making twine or breakfast food, there is generally a steady inflow of material and an equally steady output of finished product. It is obviously impossible to tell where one lot ends and another begins. The identity of any particular lot of ore, bale of hemp, or bushel of wheat is lost in the mass. Costs cannot be charged against any unit of product but only against the total production for the period. These various charges for the period must be lumped together and divided by the total product to give the unit costs. If, for instance, the total smelter costs on copper ore for a month were $13,500 and 150,000 lbs. were produced, the smelter production cost, ascertained by dividing the period cost by output, is found to be 9 cents per lb.

It may be noted that the determination of costs under the job order method involves the use of "overhead rates." These rates are used to compute the expense or

overhead to be charged by each department to the product worked upon in that department. Rates exist only in order factories because only under the job order conditions of manufacture is it necessary to figure the overhead cost on each production order. In a process system the overhead, like the labor cost, is the same for each unit of production per process. Usually when a manufacturer speaks of his overhead as being a certain rate, one knows that an order cost system is in operation. But when a manufacturer talks about the overhead cost per ton, barrel, pound, or other unit, it is evident that he uses a process cost system.

2. Process Costs—Routine Processes

Where a factory makes but one kind of product and this product passes through more or less routine processes, the work proceeds automatically and the cost records are few and simple.

For instance, in a flour, paper, or cotton-weaving mill, where but one kind of flour, paper, or cotton cloth is made, the same kind of work goes on day after day and month after month; the duties of the workmen are clearly understood and each man knows what he has to do without waiting to be told; the material is uniform and the quantity used is sufficient to keep the mill operating to the desired capacity; also all labor in a department is devoted to the processes of that department. In such cases it is obvious that formal production orders are not needed, material requisitions may be dispensed with, and labor reports may be in total.

Where such conditions prevail, production is usually controlled by means of production reports submitted at

regular intervals. A report of this kind is illustrated by Form 6, the weekly production report of the spinning department of a cotton mill. This report gives a summary of the departmental pay-roll for the week, the output, in pounds of yarn produced, and the amount of waste. Expenses chargeable against the department are not included in the report but are taken from the general records. The sum of these two costs, labor and expense, divided by the number of pounds of yarn produced during the week, gives the "conversion cost" per unit which is the manufacturing cost alone, exclusive of the cost of raw material. The addition of material cost per unit to conversion cost obviously gives the total cost of the product per unit.

This production report, combined with a statement of the number of bales of raw cotton used, gives all the information the manufacturer needs to judge of the efficiency of the spinning department. The same kinds of reports are used in other departments of the mill. When such reports are dated, numbered, and placed on file with the cost sheets on which are summarized the total costs, they constitute a most valuable comparative statement of the production costs of different periods.

The same simplicity of routine is found in mining and similar extractive industries where the ordinary accounting records, with certain additional information, furnish most of the cost data. Here again, no formal production order is necessary and the reports of output and material cost, together with the labor and expense charges incurred by each department or process, as shown by the ledger accounts, cover all the requirements of a process cost system.

SPINNING DEPARTMENT PRODUCTION REPORT

For Week Ending_____

SUMMARY OF PAY-ROLL

Number of Employees	Occupations	Hours Worked	Amount Earned	Remarks
	Overseer			
	Second Hand			
	Roving Man			
	Oiler			
	Elevator Man			
	Spinners			
	Doffers			
	Spooler Tenders			
	Twisters			
	Warpers			

YARN PRODUCED

Spun	Spooled	Twisted	Warped
TOTAL			

WASTE

Waste	Lbs.	Remarks
Spooling		
Twisting		
Warping		
Sweepings		
Lapping and Roving		

By_____

Overseer

Form 6. Weekly Production Report—Process Costs

The manufacture of bricks illustrates the simplicity of process costs. Operations begin with the digging of clay from a clay bank or pit. No production order is necessary. The men working under the direction of a foreman dig each day as much as they can. Those into whose hands the clay comes after it is dug know what to do with it without the instructions of a production order. If more clay is wanted, the foreman is notified and more men are put at work in the clay pit. Reports of the quantity of clay dug and the wages paid enable the progress of production to be followed daily and weekly, and these reports together with any other cost expenses taken from the ledger give the cost department all the data needed to compute the cost per ton of the clay dug. The cost of molding the clay into bricks and baking it in a kiln is arrived at in connection with a report of production by an equally simple segregation of the corresponding costs on the books. In short, whenever production is carried on in bulk by processes, the homogeneity of the output makes production orders with detailed instructions unnecessary and the routine of production with its attendant cost records is corresponding simple.

3. Process Costs—Varying Processes

Whenever the output is of such a nature that special instructions are needed as to kind or quantity, foremen must be notified in writing, and, if more than one kind of product is made within a cost period, a system of records must be installed to compute the cost of each kind. Assuming, for example, that the spinning machines of a cotton mill are occupied now with one kind of cotton yarn, and now with another, every time a

change is made it will be necessary to notify the foremen of the kind and quantity of the new product required—such notification usually being made by means of a numbered production order. Under these conditions the records are still comparatively simple, because only one kind of product is made at a time and all the factory activities during that time are concentrated on the one thing.

4. Process Method vs. Order Method

Where the runs of an output such as yarn occupy less than the cost period, it is obvious that costs might be found by the order method, using a cost sheet and all other order records for each lot of yarn. It is, however, usually simpler to employ the process method where it is practicable, since all that is then required for the determination of the conversion costs is a statement of wages paid, expenses incurred, and the output of the different products during the period, together with a record of the time each was in process. The total wage and expense costs for the period divided among the various products in proportion to the time each occupied the manufacturing machinery gives the total conversion cost of each kind produced. The total conversion cost of any product divided by the number of units produced gives the unit conversion cost. Under such conditions no special cost records are required to show with what work employees have been occupied, or for what purpose raw material has been withdrawn from stores, since all labor payments and all material withdrawn during the time that any particular kind of product is in process are chargeable against that particular product.

5. Combined Order and Process Method

As stated, where production flows on in an endless stream the process method is usually employed, often without any formal production order. While a record is kept of all expenditures that affect costs, these costs are not determined or applied to the product until "after the event," or, in other words, at the end of the cost period. On the other hand, under the order method production is strictly controlled by means of orders of various kinds which are issued before the work begins, and the cost incurred by each order follows that particular order so closely that its actual cost to date may readily be determined at any stage of its progress.

In an order system, however, goods are sometimes manufactured under conditions which closely approximate those of a process factory — the similarity of method being due to the large quantity of goods of the same kind covered by the production order. In such cases costs are found by the process method. For example, in the manufacture of bolts, screws, nuts, and similar articles, the product is turned out by the million by means of automatic machinery. Because of frequent changes made in the kind and size of the products, production is controlled by means of the usual production order, but because of the quantity and homogeneity of the lots, the cost of the product is usually determined by the process method.

A product of this kind, e.g., a standard size of screw or bolt, is generally a stock product and is rarely if ever made in quantity on a customer's order. The foremen of the screw machine departments are furnished with production schedules showing the number of thousand

gross of each article that must be delivered to the stockroom during a certain period of time—usually from five to ten days. The foremen report on the output from day to day so that the superintendent can see whether the factory is keeping up to its schedule of production and decide when to change the kind of product. Naturally, the length of time for which a department is kept running on any particular production order depends upon the current demand for that particular product.

Costs for the order are figured for the period during which the screw machines or any part of them have been occupied with that order. Under these conditions of manufacture, one operator usually attends to half a dozen machines and his labor in reality forms part of the overhead of the department. Where all machines in a department are engaged on one product, the labor cost for the period, plus expense, divided by the output, gives the unit conversion cost. When screws of two or more kinds are being made on the various machines, the expense must be distributed among the machines so as to ascertain the proportion applicable to the different products. This distribution presents no difficulty when, as is usually the case, the screw machines in any department are all of the same type. The resulting figures are of course only the conversion cost, and to this must be added the cost of the material to give the total cost of the finished product.

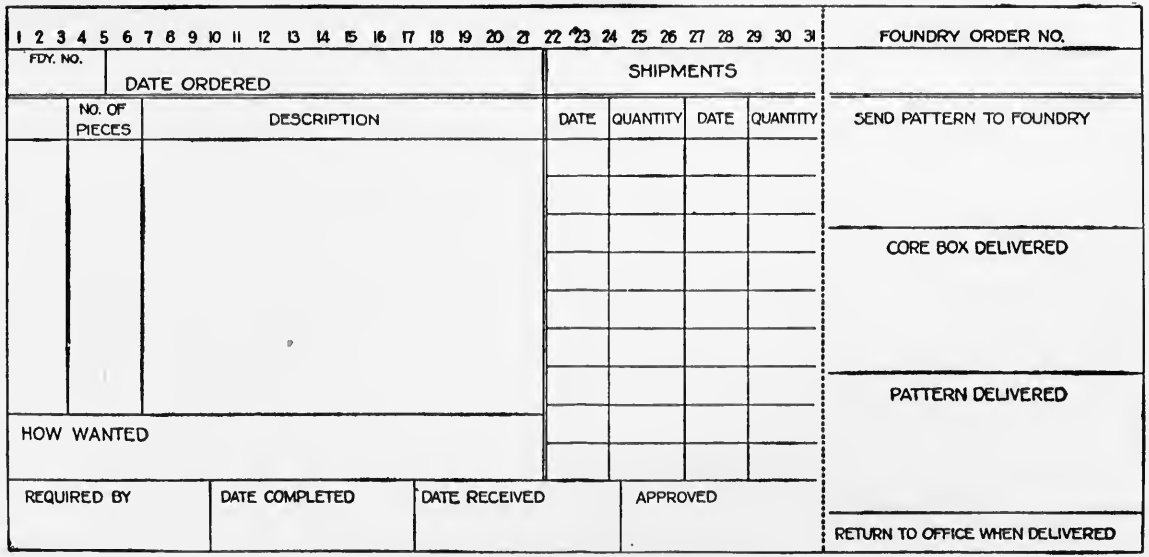
6. Order Method of Production

The routine of production grows in complexity as the product varies in substance, weight, design, and the number of its parts. Process products are usually uni-

form and for the most part of one substance. Paper pulp is transformed into rolls or sheets, clay into bricks, cotton into yarn, sisal into rope, and if the units of a run or of the whole output for any period are of the same size, shape, and substance, one cannot be distinguished from another. All such units can then with safety be considered to have consumed an equal quantity of material, labor, and expense, per process, and costs are merged and distributed equally over production.

The routine of production begins to take on the nature of an order system, with its special material and labor records, when the product, though still of the same substance, begins to vary in weight and design. The output of a foundry furnishes a good example. The same casting metal flows from the cupola but the castings may vary in both weight and shape. Production orders are now required to indicate to the foremen how many castings of a certain kind and weight are to be made. If the only difference between the various castings is in their weight, cost-finding is still simple, for the cost of each order can readily be found by multiplying its weight (in pounds) by the cost per pound of the cupola charge and adding the foundry cost. This foundry cost is obtained by dividing the cost of molding and core work by the pounds of good castings produced.

It frequently happens, however, that some castings are more intricate in design than others and in consequence more time is required to prepare the cores and molds. At once the production system becomes complicated, not only by the necessity of recording the differences in the core-maker's and the molder's time as applied to different orders, which must be charged to the



Form 7. Production Order—Foundry

orders accordingly, but also by the necessity of charging orders with overhead expense in proportion to the length of time each occupies the operating activities of the foundry. This elaboration of routine and records involves the keeping of job time tickets and the computing of an hourly expense or overhead rate in the core-making and the molding departments, so that direct wages can be charged to the different orders and expense be distributed over them equitably.

The method by which the manufacturing details of such orders are taken care of in a foundry is shown on the production order of Form 7. This production order is sent first to the foreman of the pattern room to inform him of the kinds and numbers of the patterns wanted and when they are required. It then goes to the foundry where the patterns are to be delivered. The date of delivery of the patterns appears on the coupon attached to the production order. This coupon is torn off when the core box and the patterns reach the foundry, and is returned to the office as notice that the order is about to be put into process. This comparatively simple type of production order furnishes every instruction which is required by the foundry up to the shipping point of the order.

REVIEW QUESTIONS

1. Distinguish between the two methods of cost-finding.
2. Give three examples of industries where the process system is applicable and three to which the order system is best adapted.
3. What kind of cost system is best suited to the requirements of the extractive industries?

4. What kind of cost system is best adapted to the needs of a shoe factory; paper box factory; lithographing establishment; barrel factory; sole leather tannery?
5. How is production controlled in a process factory?
6. Illustrate how costs are figured in a process factory.
7. What kind of cost system is suited to a foundry?
8. What kind of cost system would you install in a laundry, a green house?

CHAPTER V

COST ACCOUNTING METHODS—COMPOUND PRODUCTS

1. Order Cost Accounting

The cost accounting methods so far outlined and briefly considered are used in connection with the manufacture of products in which the raw material is, for all practical purposes, but a single substance, as cotton, paper, pulp, iron, and the like or substances of like kinds and uniform quality. The procedure becomes more complex when the finished product requires the use of different kinds or qualities of material. It becomes still more so when the product itself varies, as where different kinds of soap, paint, or fabrics are made, or where the production details of each job or lot may vary, as in a machine shop or a furniture factory.

Under such conditions production must be started by the issue of a production order giving in more or less detail all the needed working instructions; material must be withdrawn from stores by requisitions; labor must be closely tied up to the order to which it belongs; expense must be equitably prorated over the various jobs of the cost period, and for each job these costs must be combined to find its total production cost. To accomplish all this, the routine of production must be expanded to include a complete cost-keeping system. The so-called mechanical and assembling industries belong to the order class.

2. Combination Production Orders

In some simple types of industry the instructions of the production order indicate with sufficient clearness the materials required; or if the materials to be used are few in number and capable of concise description, the details may be entered on the production order as a guide when requisitioning material.

When the cost requirements of the product are simple, the office copy of the production order is sometimes so arranged that not only material used but its cost as well may be entered thereon. In addition, provision is made for entering labor costs as they accrue against the job, and finally for the entry of the expenses chargeable to that order. This office copy of the production order then shows the complete cost history of the job it puts in process and becomes in effect a cost sheet.

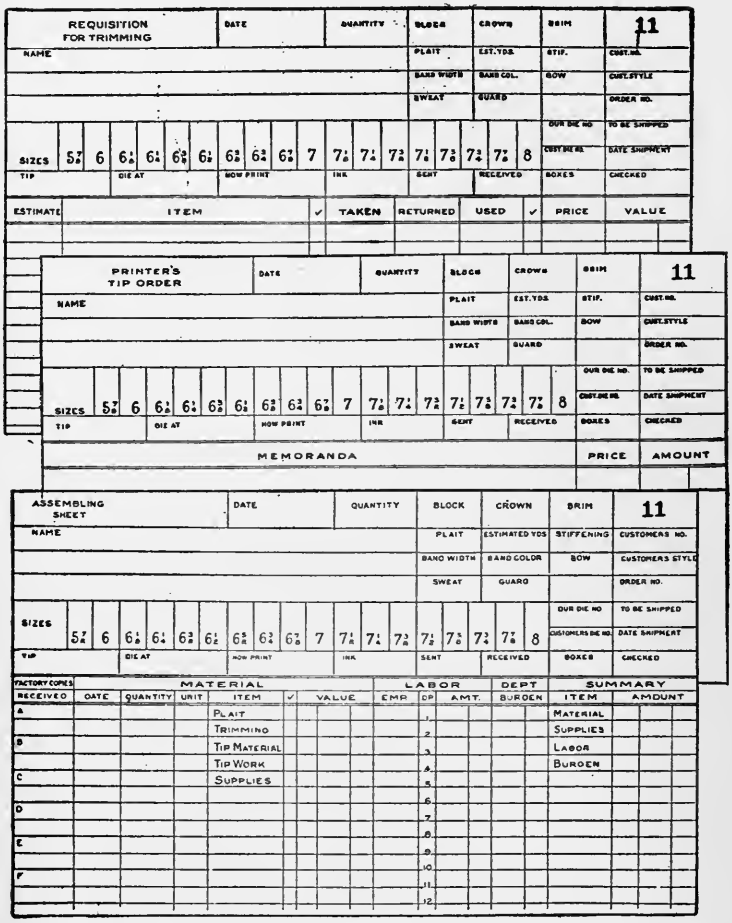
3. Combined Production Order and Cost Sheet

A factory making men's straw hats furnishes a good example of the method of combining the essential cost instructions and records with the production order. Allowing for the general differences in sizes and shapes, the straw hats sold by one hatter look much like those sold by every other. If it were possible to manufacture each shape and size in sufficiently large lots to enable customers' orders as they come in to be filled from the stock on hand, both cost and production routine would be greatly simplified. Almost every retail hatter, however, has his own special requirements. One wants his hats with a distinctive sweat band or lining; another wants his name stamped on the band and has his own ideas about width of brim, height of crown, etc. These differing require-

ments entail the manufacture of a large number of lots differing only in details. Under such conditions it is a problem to co-ordinate properly the production and the cost system while at the same time employing the fewest possible number of forms compatible with clearness and accuracy of instruction and record.

Varying forms are used by different establishments to accomplish this end. The combined production order and cost sheet shown in Form 8 is a good example. To make the production order which carries working instructions to the different departments serve also as the vehicle for collecting costs, five copies of the order—duplicates as to the upper part—are issued under the same production order number. Three of these are shown in Form 8. The two forms omitted serve a purpose similar to that of the requisition (Form 8a), which requisitions specified material from stores, with provision for the return of any not used and a statement of the cost of that consumed. Though at the first view the forms may seem complicated, the entries which furnish the cost of an order are in fact simple.

When a customer's order is received, all necessary working instructions are typewritten on the five forms at one operation by means of carbon paper—the necessary details as to quantity, size, style, etc., being entered in the various blank spaces in the headings provided for this purpose. The detailed instructions are of a more or less technical character and are omitted from the forms shown here. The upper part of each form tells the operatives of each department exactly what to do, exactly what materials are required, and serves also to requisition the material from stores. The



REQUISITION FOR TRIMMING | DATE | QUANTITY | BLOCK | CROWN | BRIM | 11
NAME | PLAIT | EST. YDS. | STIF. | CUST. NO.
BAND WIDTH | BAND COL. | BOW | CUST. STYLE
SWEAT | GUARD | ORDER NO.
OUR DIE NO. | TO BE SHIPPED
SIZES 5⅞ 6 6⅛ 6¼ 6⅜ 6½ 6⅝ 6¾ 6⅞ 7 7⅛ 7¼ 7⅜ 7½ 7⅝ 7¾ 7⅞ 8 | CUST. DIE NO. | DATE SHIPMENT
TIP | DIE AT | HOW PRINT | INK | SENT | RECEIVED | BOXES | CHECKED

ESTIMATE | ITEM | ✓ | TAKEN | RETURNED | USED | ✓ | PRICE | VALUE

PRINTER'S TIP ORDER | DATE | QUANTITY | BLOCK | CROWN | BRIM | 11
NAME | PLAIT | EST. YDS. | STIF. | CUST. NO.
BAND WIDTH | BAND COL. | BOW | CUST. STYLE
SWEAT | GUARD | ORDER NO.
OUR DIE NO. | TO BE SHIPPED
SIZES 5⅞ 6 6⅛ 6¼ 6⅜ 6½ 6⅝ 6¾ 6⅞ 7 7⅛ 7¼ 7⅜ 7½ 7⅝ 7¾ 7⅞ 8 | CUST. DIE NO. | DATE SHIPMENT
TIP | DIE AT | HOW PRINT | INK | SENT | RECEIVED | BOXES | CHECKED
MEMORANDA | PRICE | AMOUNT

ASSEMBLING SHEET | DATE | QUANTITY | BLOCK | CROWN | BRIM | 11
NAME | PLAIT | ESTIMATED YDS | STIFFENING | CUSTOMERS NO.
BAND WIDTH | BAND COLOR | BOW | CUSTOMERS STYLE
SWEAT | GUARD | ORDER NO.
OUR DIE NO. | TO BE SHIPPED
SIZES 5⅞ 6 6⅛ 6¼ 6⅜ 6½ 6⅝ 6¾ 6⅞ 7 7⅛ 7¼ 7⅜ 7½ 7⅝ 7¾ 7⅞ 8 | CUSTOMERS DIE NO. | DATE SHIPMENT
TIP | DIE AT | HOW PRINT | INK | SENT | RECEIVED | BOXES | CHECKED

FACTORY COPIES | MATERIAL | LABOR | DEPT | SUMMARY
RECEIVED | DATE | QUANTITY | UNIT | ITEM | ✓ | VALUE | EMP. | OP. | AMT. | BURDEN | ITEM | AMOUNT
A | PLAIT | MATERIAL
TRIMMING | SUPPLIES
B | TIP MATERIAL | LABOR
TIP WORK | BURDEN
C | SUPPLIES
D
E
F

Form 8. Combination Production Order, Requisition, and Cost Sheet—Hat Factory. (a) Requisition for Material. (b) Outside Work Order. (c) Combined Production Order and Cost Summary.

lower part of each form, on the other hand, is conveniently arranged for assembling the costs of the order as they accrue.

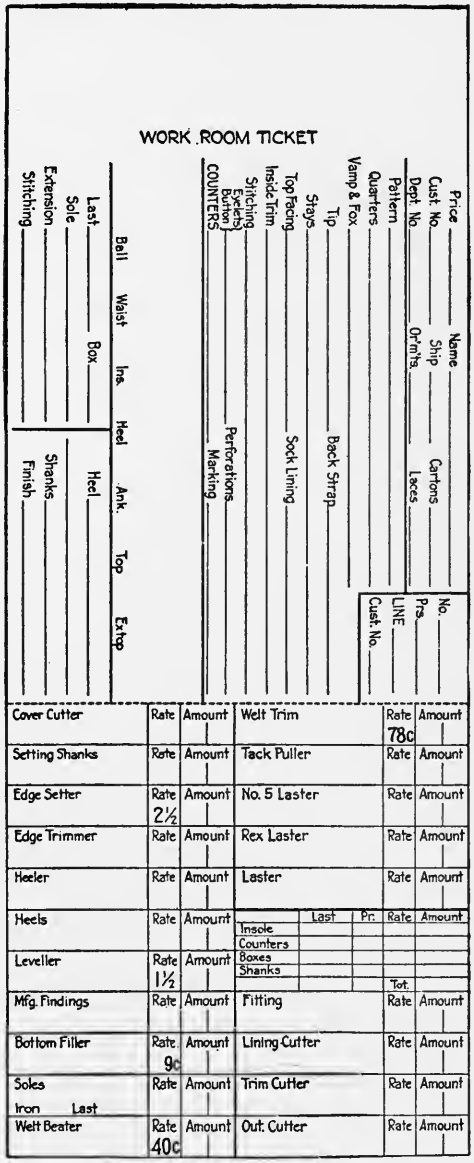
The cost of the material used for "plait," "trimming," and "tip," as required by the cost summary sheet (Form 8c), is taken from the three copies of the order which serve as requisitions for material. The "tip work" which is done outside the factory is priced on its own sheet (Form 8b). The labor on the various operations through which a straw hat passes in the making is paid for at piece rates, while the burden or expense is distributed in accordance with the method used in the particular factory. In this way the cost summary sheet collects the cost of the whole order and totals it in the summary column.

The special feature of the manifold system above described is the provision for giving at one writing the data of the production order on the various forms used.

4. Production Controlled by Coupon Order

The routine of production in a shoe factory represents a further stage of complexity occasioned by the difficulty of computing the cost of material and by the numerous processes through which the product passes. A pair of shoes is said to undergo more manufacturing operations than any other machine-made article sold within its range of price.

When a customer's order is received, say for twenty cases of shoes of various kinds, a production order, known in the industry as a "Shoe Tag" (Form 9a) is made out for each case of shoes wanted. The upper part of the tag or "Workroom Ticket" gives full details as



WORK ROOM TICKET

Price
Cust. No.
Dept. No.
Pattern
Quarters
Vamp & Fox
Tip
Stays
Top Facing
Inside Trim
Stitching
Eyelets
Buttons
COUNTERS
Last
Sole
Extension
Stitching
Bell
Waist
Ins.
Box
Heel
Ank.
Top
Extop
Shanks
Finish
Heel
Perforations
Marking
Back Strap
Sock Lining
Name
Ship
Cartons
Ord'rs
Laces
LINE
Cust. No.
No.
Prs.

Cover Cutter	Rate	Amount		Welt Trim		Rate 78c	Amount
Setting Shanks	Rate	Amount		Tack Puller		Rate	Amount
Edge Setter	Rate 2½	Amount		No. 5 Laster		Rate	Amount
Edge Trimmer	Rate	Amount		Rex Laster		Rate	Amount
Heeler	Rate	Amount		Laster		Rate	Amount
Heels	Rate	Amount		Last	Pr.	Rate	Amount
			Insole				
			Counters				
Leveller	Rate 1½	Amount	Boxes				
			Shanks			Tot.	
Mfg. Findings	Rate	Amount		Fitting		Rate	Amount
Bottom Filler	Rate 9c	Amount		Lining Cutter		Rate	Amount
Soles Iron Last	Rate	Amount		Trim Cutter		Rate	Amount
Welt Beater	Rate 40c	Amount		Out Cutter		Rate	Amount

Form 9. (a) Production Order with Coupons (face of Shoe Tag)

	No.	DATE	PAIR
Office Examined			
Cutter			
Trimming Cutter			
Fitted			
Last Picker			
Laster			
No. 5 Laster			
Tack Puller			
Welter			
Welt Trimmer			
Shanks			
Bottom Filler			
Sole Layer			
Rounder			
Stitcher			
Loose Nailer			
Leveller			
Heeler			
Heel Trimmer			
Edge Trimmer			
Finisher			
Cleaning			

Form 9. (b) Labor Summary (reverse of Shoe Tag)

to style, the quantity being understood to be one case for each ticket. The lower part of the ticket consists of coupons—a coupon for each operation in its due sequence.

Most of the productive labor in the making of shoes is paid for at piece rates—a definite rate being paid for each operation performed on a given number of parts or semi-finished shoes. Therefore, the coupons attached to the workroom ticket serve three useful purposes:

1. Furnish operatives and manufacturer with a record of work done.
2. Serve as vouchers for the payment of wages.

3. Serve as a record of the labor cost to be charged to orders.

Furthermore, as the tag accompanies the work and as a coupon is detached for each operation finished, the foreman is kept informed of its progress, since the number of coupons still attached to the tag represent the operations that have yet to be performed before the order is completed. The piece-work prices are entered on the coupons attached to the tag.

The back of the ticket, as illustrated in Form 9b, provides a place for the operatives to enter their clock numbers, dates, and pairs worked on, at the time they tear off coupons. This information is needed for the benefit of the foreman when investigating defective work.

5. Procedure under Coupon Order Method of Production

Ordinarily each shoe tag or workroom ticket (Form 9a) calls for one case of shoes and as many tags are made out as there are cases in a customer's order. The reason for thus splitting up production is to make the work flexible, so that each department can be supplied with the right number of tags to keep it busy. After the tags are prepared by the production clerk, they are placed in a box or holder where they await the attention of the superintendent of the factory, whose business it is to issue them.

The "uppers" of the shoes are prepared in one department, the soles in another, the two are combined in a third, the heels are attached in a fourth, and so on. Each morning the superintendent selects sufficient or-

ders for a full day's work for all departments; the production capacity of each, measured in cases, being approximately the same. This is designedly so, as unequal capacity would result in unbalanced operation, some departments lacking work while others would be overcrowded.

When the day's orders have been selected, they are entered on a "Day's Work Sheet," representing one day's work for all departments. This is made out in manifold so that each operating department may have a copy.

The work laid out goes to the department performing the first operation and must be completed that day, so that the following day it may be passed on to the next department. If at the end of the day a department has failed to finish its schedule, either it must be completed by overtime work, or the uncompleted orders are struck off that department's day's work sheet and added to the sheet of the next day. After all the tags or orders on a department's work sheet are finished and checked off, the sheet and tags—with the coupons belonging to that department detached—are returned to the superintendent's office.

In this way a close watch can be kept on the progress of orders day by day, by departmental operations and as a whole, and work can be fed to the departments in quantities equal to the maximum capacity of the factory. Should any department fall behind in its working schedule, this fact is automatically brought to the attention of the management. This scheme of scheduling production can be used to advantage in almost any standard product factory.

6. Estimated Costs

An interesting feature of shoe manufacture is the method of ascertaining the material charge—a method which is in general use in industries where the material cost of the same product may fluctuate, sometimes widely, on different orders. The accurate calculation in advance of the actual cost of the leather to be used in any particular lot of shoes is practically impossible, as the skins vary in size and price and any carelessness in cutting, or work spoiled from other causes, at once adds materially to the cost of material and falsifies the calculation. To meet this situation, the shoe patterns are measured and in this way the approximate quantity of leather required for a certain number of pairs of shoes of a given size is obtained. The cost of this leather is estimated at an average price based on experience and a knowledge of leather prices, and this estimated cost is charged against the order regardless of the actual cost of the leather used.

This method gives a standard uniform price for material upon which prices to customers may be based with a fair degree of safety. It also gives a check against waste of material and against any carelessness or inefficiency in the cutting up of the skins, since the requisitions for material will at once show the real cost of the leather and enable a comparison to be made between the real and the estimated costs.

The estimated cost of the leather may or may not equal the actual cost of the leather used, but the variation, so far as the particular case of shoes is concerned, is not important. Its selling price was fixed when the customer's order was accepted and cannot be varied to

meet fluctuations in the price of materials. For this reason, it is not important to charge any variation of material cost against a particular case of shoes.

But differences cannot be ignored. The requisitions for materials will show just what the leather costs. A cost which is higher than the estimate but which is clearly due to a rise in the price of skins, does not directly concern the factory. If the higher price is permanent, the price of the shoes must be advanced or the margin of profit will be lessened, and the problem is one for the management. If, however, the higher price of the shoes is due to waste of material or to spoilage, it of course indicates carelessness and inefficient work in the factory.

As the material cost is estimated and the labor cost (based on piece rates) is also known in advance, the cost department can figure the total cost of any order as soon as the specifications are drawn. When the shoe tags and material requisitions relating to a particular order are received in the office, the actual figures can be compared with the estimated figures. Any rise or fall in actual cost can be noted and, if it is an increase, it is easily traced either to the higher price paid for material, to defective material, to accidental losses, or to inefficiency in handling material.

Any difference between the estimated cost of material and the actual cost as shown by the requisitions for material is adjusted at the end of the cost period on the general ledger by means of a "Loss and Gain on Estimate" account, which is debited with the actual material cost and credited with the estimated cost of the material used. Any excess on the credit side of the account shows the amount charged in excess of actual cost, while any

excess on the debit side shows the amount by which the actual charges have increased above the estimated cost.

7. Estimating Cost Systems

There are many industries in which the routine of production corresponds in its essential features to that of shoe manufacturing. The "needle" industries, for example, pay for at least part of the work at piece rates and find it practicable to estimate the material costs from the cutting patterns before production begins. Similar methods are used in industries where the small intrinsic value of the product makes it impracticable to find the costs on orders or lots of goods separately—the cheap jewelry, notion, and leather goods industries being cases in point. In these trades most of the productive work is paid for by the piece, and this cost as well as the material cost can be estimated with fair accuracy. Instead of splitting up production into a number of small units, as in the shoe industry, costs are first estimated on large quantities and records are kept of the actual material and labor cost incurred in manufacturing these quantities. This method controls wastage and encourages efficiency by setting standards above which costs are not expected to rise. Incidentally, this method greatly reduces the work of the cost department.

The limitation of the system of estimating costs is found in the fact that as costs are usually obtained by groups or classes and not by items, the unit costs cannot be analyzed and it becomes difficult to trace the cause of fluctuations to individual costs if the actual cost of a group or class proves to be higher than the estimated cost. (See Chapter XXVI.)

8. Cost-Finding for Multiple Parts Products

The manufactured articles so far considered, though they may vary in substance, weight, and design, have one thing in common—in their finished state either they consist of one piece or they are made into one permanent article by the assembling of a few simple parts. This simplicity of design permits instructions to be issued for their manufacture as a whole. When, however, an article is made up of several distinct parts, the cost of each part or lot of parts is usually obtained separately, as the utility of the figures so obtained is far greater than if only the cost of the article as a whole were found.

A machine, for instance, may contain hundreds of parts, some of these parts may be forged, others cast, others cut from the bar or sheet, and on each of these parts many kinds of machine and hand operations may be performed. If a production order were issued for a dozen such machines, it would be comparatively simple to find their cost if no effort were made to determine the cost of the different parts. Cost-keeping requirements could then be covered by recording the value of all stores withdrawn for the order, the amount of direct labor chargeable against it, and the proper proportion of overhead expense. This would give the total cost of the dozen machines from which could be determined the cost price of each machine, and if the machines were sold at a reasonable advance over this cost a satisfactory profit on the dozen machines would result.

But suppose it is found that the machine cannot be sold at a profit because its cost is altogether too high. The "lump sum" cost figures would then be comparatively worthless in determining the possibility of cutting

down the manufacturing cost. The labor cost may be $500, but fifty workmen may have been engaged in the manufacture of the machine; some of them may have been inefficient, but this cannot be determined from the record. The material may have cost $400, but the record does not show that the many different materials were bought at a fair price, or that there was no undue waste or misappropriation.

Moreover, if the cost of one of these machines is compared with that of another made in a former period, there exists no adequate basis for the comparison. The machine of the first period may perhaps have cost $900 and that of the later period $1,000, but it would be impossible to say just where and why the higher cost of the second machine was incurred. It might be found, on investigation, that the difference was in the labor charge, but the mere fact that the labor cost was $500 on the first machine and $600 on the second, though of value in itself, would not give the detailed basis for determining the labor cost differences that the situation requires. For this the detailed cost of each component part is essential.

9. Component Parts Orders

When parts are made in quantity and placed in stores for later use in assembling complex mechanisms, they are manufactured under an independent production order and when completed are placed in general stores or "finished parts" stores. When the more complex mechanism is to be assembled or constructed, its production order is issued and the finished parts are secured by regular requisition.

When, however, a complex mechanism is to be manufactured in lots—the component parts manufactured and the machine assembled—a main or master production order is issued for the mechanism as a whole and suborders are issued for the component parts. These component parts orders bear the same order number as the main production order. When the parts are completed, instead of going into stores, they are routed to the assembling room where they take their place in the make-up of the complex mechanism.

During production the shop routine through which one of these component parts orders passes is exactly the same as that involved in the manufacture of any single-part product. The cost of each different part or lot of parts is found separately on its own cost sheet, and the total cost of the complex mechanism is arrived at by adding together the cost of its parts. It is obvious that under this plan any desired detailed statement of the cost of any of its parts or any combination of parts can be obtained without difficulty.

10. Complex Production

In a factory manufacturing a complicated mechanism, such as an automobile, the number of parts runs far up into the hundreds or even thousands, and a score or more of supplementary records may be needed to control the flow of material and the parts of processed work from one department to another and to regulate production as a whole. All this, together with the keeping of detailed costs, involves a bewildering complexity of records. Through it all, however, are always to be found in some form the factory production orders, giving the

necessary working instructions; stores requisitions or material sheets, giving the required material and its cost; shop time tickets or piece-work slips, giving the labor cost; expense sheets, distributing general overhead; and a job cost sheet summarizing the total cost of the particular order.

REVIEW QUESTIONS

1. What kind of production and cost system best meets the needs of a hat factory?
2. Outline a good method for checking piece-work.
3. How is the production of each day's work controlled in a shoe factory?
4. How are leather costs estimated on shoes?
5. How are variations in material costs controlled in shoe factories?
6. What purpose is served by estimating costs?
7. How can cost estimates be controlled?
8. What is the production routine in assembly industries?
9. How are costs figured in assembly factories?

Part III

Relation Between General Ledger and Cost Accounts

CHAPTER VI

FINANCIAL AND COST ACCOUNTS

1. Financial Accounting and Cost Accounting

The comprehensive term usually applied to the accounting for a trading concern is "financial" accounting; that applied to the accounting for a factory is "cost" accounting. As a matter of terminology the distinction is not accurate, because a non-manufacturing business can and should determine certain costs, e.g., cost of purchases, cost of selling, and cost of administering the business; and the manufacturing business must keep the usual financial records as well as its cost records. The distinction would be more clearly defined by terming the cost records of factory activities, "manufacturing cost accounting."

The cost accountant employs the usual double-entry method of recording. In the case of both financial and cost accounting, ordinary accounting principles and procedure are adapted to the special needs of the particular business. If a particular kind of article is purchased for a mercantile establishment, its accounts merely record the facts in regard to the purchase and sale of the article. If, however, raw material is purchased for a manufacturing concern, the cost accounts go much further. They show the stock on hand, how much has been used in the production of a definite quantity of goods, and in which departments it has been consumed. How necessary this kind of information is for

the proper management of a business and how complex the keeping of cost accounts becomes, will be realized from the fact that in one well-known and highly organized industrial plant of this country, there are 158 distinct departments, in each of which accounts are kept, the total of these departmental accounts aggregating over 3,000.

2. Cost Accounting for Trading Concerns

Most trading organizations run their accounts without an attempt to charge and distribute costs to definite units of goods sold or on the basis of service given. Nevertheless, an examination of their profit and loss statement when the accounts have been kept on the double-entry basis, will show that a fairly accurate cost analysis may be made. When this analysis is developed to a point where it shows the cost of securing, handling, or selling a certain unit of merchandise, it becomes cost accounting as truly as if the enterprise were a manufacturing company.

3. Manufacturing Cost Procedure

The cost, or factory records are only an adjunct to the general books of account. They are kept for the purpose of analyzing the production costs. Materials are sent from the stores into the factory. An inventory record of them, which may be designated as an "in process" record, is kept both in the factory and in the general office. The record in the general ledger controls that of the factory ledgers. The goods which result from the manufacturing processes consist of a certain amount of material that went into process, plus

a certain amount of labor and expense. A record must be made of the labor costs incurred at each step or stage in the process of manufacture, and a fair proportion of the overhead must be added to the material and labor costs, so that when the selling price is fixed the complete costs will be taken into consideration. A finished goods inventory record both in the factory (in detail) and in the general office (in total) is made after the manufacturing processes are completed.

The whole matter of the control of the cost accounts on the general ledger hinges upon the proper maintenance of running inventories, each representing the cost value of goods on hand in various stages of completion in the factory, so that at any time by closing the records the true financial condition may be ascertained without the necessity of a physical inventory. A physical inventory is still taken periodically for the purpose of checking the accuracy of the book inventories and for the purpose of preparing annual financial statements.

4. Factory Records Controlled by the Ledger

As already stated, the manufacturing cost of every product consists of the cost of the raw material used in its production, the cost of the labor expended upon it, and all expenses incident to the transformation of the raw material into the finished product. Raw material is the beginning, and finished goods the end of factory operations.

In the routine of production between the beginning and the end the material is worked upon in various ways or, as technically stated, is "in process." While in proc-

ess, its value is enhanced by labor, power, heat, tools, equipment, supervision, etc., expended upon it, and until it emerges as "finished goods" these active charges steadily add to its cost. When the work in process is finally transformed into "finished goods," the only further costs that accrue against it are the charges for storage, insurance, etc., until the goods are sold, when the final charges for selling and delivery complete its active accounting history.

Material is thus found in three stages in the routine of manufacture as:

1. Raw material
2. Work in process
3. Finished goods

Corresponding to these three stages the factory records are divided into the following three groups or classes:

1. Those which present an inventory record of raw material and supplies.
2. Those which present an inventory record of work in process.
3. Those which present an inventory record of the finished product.

There is usually a factory ledger in each of these groups, each ledger being controlled by an account on the general ledger. These ledgers are:

1. The stores ledger, which records the receipt and the withdrawal of the various kinds of material.
2. The cost ledger, which records the income and

outflow of work in process and shows the charges accumulated on this work while it is in process.

3. The stock ledger, which records the income and outgo of finished goods.

The stores and stock ledger forms are illustrated by Forms 10 and 11. These ledgers generally consist of files of index cards so that the items of stock may readily be referred to and classified in any desired way. The cost ledger is usually composed of the file of current job cost sheets on which the charges for material, labor, and overhead are entered as incurred and subsequently summarized.

There may, of course, be many accounts in each of these ledgers. A hundred or more kinds or qualities of raw material may be carried in stock, and an account must be kept with each; many different orders may be in process at the same time, and each must have its own individual cost sheet; the kinds of finished articles may be numbered by the score, and each kind must have its own account.

5. General Ledger Controlling Accounts

If the factory accounts were kept only on the factory ledgers and not coupled with and kept in check by controlling accounts in the general ledger, they would be little more than memoranda—very useful and even necessary, but falling far short of their full utility. Accordingly, in every modern cost system, controlling accounts are maintained on the general ledger which summarize the detailed accounts kept in the factory ledgers.

Article _____ Maximum _____ Bin No. _____

Class No. _____ Minimum _____

RECEIVED					ISSUED				BALANCE			
Purchase Order No.	Date	Quantity	Price	Value	Date	Quantity	Value		Date	Quantity	Value	

Form 10. Stores Ledger Card

Article _____ Maximum _____

Stock No. _____ Minimum _____

PRODUCED					SOLD				BALANCE			
Job Order No.	Date	Quantity	Price	Value	Date	Quantity	Value		Date	Quantity	Value	

Form 11. Finished Goods Stock Record

Both sets of accounts record the transformation of raw material and supplies into work in process and then into finished goods.

The controlling accounts in the general ledger which correspond with and summarize the accounts of a process or job order factory are as follows:

1. Stores account (termed also "Raw Material" or "Material") which summarizes the receipt and withdrawal of material and supplies during the period.
2. Work in Process account which records for the period work coming into process, the charges accumulated on work in process, and work going out of process in the shape of finished goods.
3. Finished Goods account which records for the period the receipts (from the factory) and withdrawals (by sale or otherwise) of finished goods.

These three inventory accounts summarize and control the accounts of the three factory ledgers mentioned above. When these general ledger accounts are closed, their balances give respectively the value of all raw material and supplies, of work in process, and of finished goods on hand at the end of the period. As these balances represent current assets, their figures are included in the balance sheet or financial statement of assets and liabilities under the head of inventories.

Periodically the balances to each of the various stores accounts must be checked by means of a physical inventory in order to prove the book figures.

REVIEW QUESTIONS

1. Distinguish between financial and cost accounts.
2. What relation do the perpetual inventory records bear to the cost and financial accounting system?
3. Name three subsidiary ledgers in a cost system. How are they controlled?
4. What entries are made when material is used in a factory on the regular product?
5. What entries are made when goods are finished in a factory and delivered to the finished stock clerk?
6. What entries are made when goods are sold?

CHAPTER VII

ENTRIES TO GENERAL LEDGER CONTROLLING ACCOUNTS

Order Method

1. Raw Material

Debits: At the beginning of the cost period, the total value of the inventory of raw material and supplies, which may be obtained by taking the balances of all the accounts upon the stores ledger, must agree with the total balance of the controlling Raw Material and Supplies accounts in the general ledger (comprehensively termed "stores accounts"). This inventory might, of course, be taken by actual count, weight, and measure, but unless this physical inventory is desired for the purpose of checking, the inventory used is merely the sum total of the balances of the stores ledger accounts or the balance of the controlling stores account or accounts, as the case may be, in the general ledger.

The method of securing the respective debits to the stores ledger and general ledger stores accounts is simple. As invoices of goods purchased are approved for payment and are entered in the voucher record, or on the purchase journal,* all that pertain to raw material and supplies are entered in one or more "Raw Material" or "Supplies" columns and the monthly totals shown by

* For discussion of voucher records see Volume I, Chapter XXII, and Volume II, Chapter XI of "Business Accounting." For purchase journal, see Volume I, Chapters XVIII and XXI.

the footings of these raw material columns are posted directly to the debit of the controlling stores account or accounts in the general ledger. Meanwhile the details which make up these monthly totals for the general ledger are taken from the invoices covering purchases as these invoices come in and are entered, item by item, on the subsidiary stores ledger. If the work is accurate, the purchase items entered daily on the factory stores ledger must, of course, when totaled, equal the charges made in total to the controlling account from the voucher record or the purchase journal at the end of the accounting period.

In addition to the cost of the goods, the accounts with stores on both the stores records and the general ledger must be debited with the freight charges on incoming goods.

Credits: When raw material is requisitioned and issued for manufacturing purposes, it enters the work in process stage and on the cost sheet of the factory ledger is debited against the order, the process, or the department in which it is to be used. On the stores ledger it is credited at once to the proper raw material account. At the end of the month, or other cost accounting period, a summary of the withdrawals for manufacturing purposes is compiled from the stores requisitions and this total is credited on the general ledger to Raw Material and debited to Work in Process controlling account or accounts.

At the end of the cost period after the postings have been made, the balance of the general ledger account with stores represents the value of material and supplies on hand and must, if the entries have been made accu-

rately, equal the total of the detailed balances in the factory stores ledger.

The following illustrative entries show concisely the various debits and credits to a general ledger Raw Material controlling account.

RAW MATERIAL

Jan. 1		*Jan. 31*	
Balance (Inventory at beginning of period)	$ 6,000.00	Work in Process	$12,968.64
Jan. 31		Balance (Inventory at end of period)	9,200.00
Purchases	15,600.00		
Freight and Express (on incoming material)	568.64		
	$22,168.64		$22,168.64

2. Work in Process Account

Debits: Work in process incurs charges for material, labor, and expenses of various kinds. In the job order method the cost sheets in the cost ledger are used for the purpose of collecting these charges. The source of the figures for the material charge is, as already stated, the stores requisitions for the period which also furnish the corresponding credit to the controlling stores account. The source of the labor charge is a summary of the time expended by the factory workers on orders as recorded on individual workers' time tickets. Methods of recording time are treated in Chapter XV.

Overhead expense, owing to its general nature, cannot be debited directly to the cost sheets of work in process as can the direct wages paid and the direct materials used on orders. It is obviously impracticable to charge

directly such items as taxes, payments for janitor service, or the cost of removing ashes from the boiler room. These must be collected in overhead or expense accounts, be distributed on some equitable basis over departments, and then allocated to the work in process by means of department overhead rates. The methods of doing this are discussed in Chapter VIII, "Indirect Expense Accounts."

Credits: The credits to the controlling Work in Process account or accounts consist of the totals of all completed cost sheets which may represent either finished goods or manufactured parts. These totals are computed at the end of the cost period, at which time all the finished goods cost sheets are transferred from the cost ledger file to the finished stock ledger file. When the finished goods are sold or disposed of in some other way, their cost sheets are withdrawn and permanently filed away. When manufactured parts are completed they are usually treated as parts stores pending the time when they are withdrawn for assembly. The cost sheets give the cost of manufactured parts. Unless transferred to a parts stock account, the parts are included in the work in process inventory. In an automobile plant, for example, the balance of the Work in Process account would represent the parts, partial assemblies, partially erected cars, and partly finished automobiles. In short, every article which has left the raw material stores-room and which has not reached the shipping department is "in process."

The following account illustrates the entries to a Work in Process controlling account under the job order method:

MANUFACTURING OR WORK IN PROCESS ACCOUNT

Jan. 1		*Jan. 31*	
Inventory at beginning of period	$10,000.00	Finished Goods Produced	$30,000.00
Jan. 31		Manufactured Parts Produced	6,000.00
Materials used during period	7,500.00	Balance	7,000.00
Manufactured Parts (used)	5,000.00	(Representing the cost of all work in process at the end of the period, i.e., inventory of work in process.)	
Direct Labor	10,000.00		
Factory Overhead:			
Dept. A	5,000.00		
Dept. B	3,000.00		
Dept. C	2,500.00		
	$43,000.00		$43,000.00

3. Finished Goods Account

The general ledger account with finished goods is simple, its primary purpose being to record the cost value of the completed goods on hand. It is debited with an opening inventory, with goods finished during the period, and also with any goods returned by customers. It is credited at cost with all finished goods sold during the period. Its balance, therefore, is the cost of the goods on hand and should equal the total balances of the detailed accounts kept in the finished goods ledger. The Finished Goods account represents all of the stock which has left the operating departments and is ready for shipment. Thus in a straw hat factory the orders are received several months in advance of the shipping dates and so the goods have to be prepared and held as finished stock.

The following outline entries illustrate the operation of a controlling Finished Goods account:

FINISHED GOODS

Jan. 1		*Jan. 31*	
Inventory at beginning of period	$ 5,000.00	Cost of Goods Sold to Customers	$30,000.00
Jan. 31		Balance (Representing the cost value of finished goods on hand at end of period, i.e., the inventory of finished goods.)	6,000.00
Goods Manufactured during period	30,000.00		
Goods Returned by Customers	1,000.00		
	$36,000.00		$36,000.00

4. Finished Parts

Finished parts, when manufactured for assembling into a multiple-parts product, are, like finished goods, credited to Work in Process. Instead, however, of being debited to Finished Goods accounts, they are charged to a suitable inventory or stores account such as "Manufactured Parts" and taken into stores. They are then requisitioned when needed and charged to jobs at their cost of manufacture in the same manner as any other kind of material.

PROCESS METHOD

5. Raw Material Costs

In recording on the general ledger the cost of manufacture for the period and the values on hand of materials, work in process, and finished goods, the procedure under the process method is much simpler than under the job order method. In many process plants or mills it is unnecessary to requisition each lot of material consumed, as its cost per unit of product can be

readily ascertained at the end of the cost period without the requisition data.

In a brick plant, for example, the raw material consists of the clay dug from a pit or bank and the cost of this clay is collected in a Cost of Clay account on the general ledger. The number of tons dug during the cost period divided into the cost of clay for the period as shown by the Cost of Clay account gives the cost per ton. The amount of clay required for a given number of bricks is readily ascertained. If, then, it costs 50 cents to take out a ton of clay, which figure is assumed to include labor, royalties (if these have to be paid to the owner of the clay bank), and all other expenses, and if 2 tons of clay are used in the production of 1,000 bricks—the unit of measurement in the trade—then $1 should be charged for the cost of the raw material.

For obvious reasons, to take the clay into "stores" when dug, and control its issues by means of requisitions would not be worth the labor involved. A sufficiently accurate check on the cost of digging can be obtained by comparing the actual tonnage of bricks produced with the actual tonnage of clay consumed over a considerable period of time. If at the end of any cost period the amount of clay reported consumed were in excess of the proper proportion for the bricks manufactured, the discrepancy would call for investigation.

The procedure for determining material costs in a brick yard illustrates the general principle of handling process accounts on the general ledger. The raw material cost is worked out "per unit" as a separate computation—in a flour mill, for example, the quantity of

grain used in producing a hundred barrels or sacks of flour, or in a cement plant the value of the limestone, clay, and other material used in producing a hundred barrels or bags of cement, is separately computed. The cost of the various processes through which the raw material passes, known as the "conversion cost," is worked out in the same way.

6. Supplies Account

Under manufacturing conditions where no controlling account with materials appears on the general ledger, there is usually a controlling stores account which checks the consumption of the supplies used in the different departments for manufacturing purposes. The operation of a mine, a mill, or an open air plant of any size entails the consumption of tools, lumber, coal, and stores of many different kinds, the cost of which constitutes a large item of expense. This expense is checked by keeping an account on the stores ledger with each item of supplies. The stores ledger, in turn, is controlled on the general ledger in the way already described.

7. Labor

The recording on the general ledger of the labor cost chargeable to the process accounts of a continuous process factory merely requires that employees be classified on the pay-roll so far as possible by departments. This is usually practicable because of the way in which the work is carried on. Team-work is essential to the smooth operation of a process plant, and a gang of workmen under its own foreman will do the same kind

of work regularly day by day. Therefore, the division of the pay-roll into gangs or departments is all that is required to collect the labor cost of each process day by day. At the end of each week the Labor Pay-Roll or Wages account is debited and Cash credited with the check drawn for wages. At the end of the month the Labor or Wages account is credited with the charges to departments as shown by an analysis of the pay-roll. If the cost period coincides with the pay-roll period and therefore no wages have accrued, the departmental debits should exactly equal the total wages and salaries of the period.

8. Overhead Expense

The recording on the general ledger of the general overhead chargeable to the process accounts is covered by the departmental distribution of the administrative and general expenses—that is, items such as taxes, insurance, office salaries and stationery, general repairs, and the like which are a charge to the factory as a whole and not to a particular department. The distribution is made upon the "Expense Analysis Sheet" discussed in Chapter XXI.

If the sum of the amounts charged to departments equals the total current overhead, this equality establishes the fact that the current overhead has been absorbed in the manufacturing cost of the period.

9. Department Process Account

The following account illustrates in condensed form the entries to a controlling department process account kept on the general ledger:

WORK IN PROCESS—DEPARTMENT A

Jan. 1		*Jan. 31*	
Inventory at beginning of period	$1,000.00	Finished Goods	$8,000.00
Purchases	1,500.00	(Found by deducting "inventory" from the costs for the period plus the opening inventory.)	
Labor	2,000.00	Inventory at end of period (Estimated cost of work still in the departmental process.)	1,500.00
Overhead	5,000.00		
	$9,500.00		$9,500.00

The details of the entries shown in the foregoing Work in Process account would appear in the cost ledger under as many accounts as are required to furnish a detailed analysis of costs. Thus the general ledger accounts of a paper mill might show the total costs of operating the machine, coating, plate finishing, calendering, sorting, and trimming departments; while the cost ledger would contain detailed accounts showing the cost of power, chemicals, felts, repairs, mill expense, etc., and the distribution of these costs to the material, labor, and expense accounts kept with each department.

10. Closing the Work in Process Account

In a job order system the total cost of the current completed orders, i.e., the total cost of finished goods for the period, is credited to the Work in Process account, the balance of the account then representing the cost value of the work still in process.

In a process system, in each department the cost of the work still in process at the end of the period is estimated and this estimated cost is deducted from the costs

of the period—plus any beginning inventory—to determine the cost value of the goods finished during the period.

The cost of the finished work for the period might, of course, be estimated, and if this were entered as a credit the balance would give the cost of unfinished work or the inventory of work in process, as in the job order method. In practice, however, the work in process is usually much the smaller in quantity and it is therefore much simpler to reverse the job order plan and appraise the cost of the work still in process.

In process cost-finding, the charge to Finished Goods account with offsetting credits to the departmental process accounts would include the sum of all the departmental charges, provided the end of the cost period conveniently coincided with the completion of *all* work in *all* process departments. In mining and other extractive industries, and in plants where the product is produced in separate batches or runs which are completed within the cost period, as in the manufacture of prepared cocoanut, all the costs accumulated on the debit side of the process accounts would be charged against the output for the period. Where the output is continuous or covers more than one cost period, however, as in the manufacture of binder twine, cotton cloth, etc., some work may remain in a partly finished state in some of the process departments; this partly processed material has obviously incurred some of the labor and expense charges debited to the department at the close of the period. Under these circumstances, to charge the total costs of the department to finished goods would burden the current completed

product with the cost of the partly processed and unfinished product and thus vitiate the cost figures.

The difficulty is overcome—as a study of the illustrative account will show, and as stated above—by taking up each process department in turn and estimating the cost value of any unfinished product remaining therein; i.e., the inventory value of work in process. This value is credited to the process account and the balance in each case then represents the cost of that process for the period which is to be charged against the cost of the finished goods.

11. Finished Goods Account

The Finished Goods account differs in no way under the process method from the similar account kept under the job order method. At the beginning of the cost period the controlling account on the general ledger is debited with the inventory of goods on hand. At the close of the period it is debited with the cost value of goods finished during the period and with the cost value of any goods returned by customers; it is also credited with the total cost value of all goods sold during the period, the balance showing cost value of goods on hand.

12. Direct Distribution of Manufacturing Costs

If the product turned out by a process plant is a simple one, involving only one important factory process, as in the case of cement making or flour milling, there is of course no necessity for distributing the expenditures to departments. In such a case, labor and expense may be distributed over production direct, as in the statement of conversion cost which follows:

STATEMENT OF CONVERSION COST

(Production for Period, 100,000 Barrels of Flour)

	Total Cost	Operation cost per 100 Barrels	Dept. or Process cost per 100 Barrels
Grain Handling:			
Elevator Men	$ 822.00	$ 0.82	
Depreciation	775.00	.77	$ 1.59
Manufacturing:			
Foreman and Second Man	1,575.00	1.57	
Oilers and Sweepers	500.00	.50	
Packers	1,700.00	1.70	
Warehouse and Loading Labor	1,500.00	1.50	
Incidentals, Paper, Brooms, etc.	610.00	.61	
Depreciation	2,700.00	2.70	8.58
Power:			
Engineer, Fireman, and Watchman.	1,275.00	1.28	
Coal	5,827.00	5.83	
Lubricants, Boiler Compounds, etc.	464.00	.46	
Depreciation	1,500.00	1.50	9.07
Administration and General Expense:			
Manager's Salary	2,400.00	2.40	
Office Force	3,000.00	3.00	
Stationery and Office Supplies	307.00	.31	
Postage, Telegraph, and Telephone.	1,775.00	1.78	
Unclassified Expenses, Dues, Manager's Expense, Legal, Charity, etc.	1,593.00	1.58	
Taxes	1,560.00	1.56	
Insurance	1,800.00	1.80	
Interest on Borrowed Money	3,000.00	3.00	15.44
Total	$34,683.00	$34.68	$34.68

Conversion cost per 100 barrels: $34.68.

The headings in the above statement represent the four process accounts opened on the general ledger to

collect the conversion cost for the period. "Grain Handling" represents the cost of receiving and warehousing the grain and delivering it to the mill as required; "Manufacturing" is the cost of milling the grain; "Power" and "Administration" expenses are self-explanatory.

13. Control of Labor Costs

In both the job order and process methods of cost-finding, labor costs are summarized on the general ledger in an account which is variously termed "Labor," "Pay-Roll," or "Wages." The Pay-Roll account is debited with the amount of the current pay-roll and it is credited with the amounts of direct labor charged to jobs (or process departments) and the amounts of indirect labor charged to the various factory departments. An analysis of the pay-roll as a means for distributing the labor to different departments and thus controlling labor costs is an important part of the routine of every cost system.

An illustrative labor account is shown below as it might appear upon the general ledger of a small manufacturing concern. The method of compiling the credit entries for indirect labor is discussed in the following chapter which deals with the distribution of overhead. The source of the credit entry covering direct labor charged to work in process is a summary of the time tickets on which the productive hours charged against jobs are extended. The method of summarizing the labor charges so as to establish the fact that the total pay-roll for the period has all been charged to production is discussed in Part V.

LABOR

Jan. 31		*Jan. 1*	
Total Pay-Roll	$11,384.56	Balance	$ 400.00
Balance (Accrued Wages)	1,373.58	*Jan. 31*	
		Work in Process	8,889.34
		Building Expense	370.00
		Power	600.00
		Repairs	712.80
		General Factory Expense	185.20
		Factory Overhead—	
		Dept. A	493.00
		Dept. B	502.40
		Dept. C	371.40
		Shipping	234.00
	$12,758.14		$12,758.14

14. Comparison of Job Order and Process Methods

As already stated, the manufacturing cost of job orders is usually summarized on the general ledger in the three controlling accounts, Material, Work in Process, and Finished Goods. Though this method is apparently simple because of the small number of controlling accounts, the work of compiling the entries which make up the manufacturing cost of the period is much more complicated than under the process method. In the latter case, *all* costs are departmentalized and the sum of the departmental figures gives the total manufacturing cost of the period.

In the case of the job order system of cost-finding the total manufacturing cost for the period is the sum of the charges to orders for material, direct labor, and expense, and these charges may relate to a score or more of different kinds of material, they may be spread over a thousand different jobs, and they may represent a

hundred or more different kinds of finished goods. Yet they must be so compiled as not only to check the value of the inventories of material, work in process, and finished goods on hand but also to establish the fact that the materials and supplies withdrawn from stores, the total of the pay-roll, and the expense for the period have all three been charged out to orders. This check is obtained by compiling the summary totals from different sources, one set of figures checking or proving another.

Under the process method the proving of the total material, labor, and expense charges debited to the department process accounts with the total charges to product is not so necessary because the charges for the period are all applicable to and absorbed in the cost of the completed or semi-finished product. In this case the problem is the simple one of insuring the complete distribution to departments of that portion of the expenditures applicable to the period under review. Assuming the accuracy of the clerical work involved in making this distribution to departments, the general ledger and the process cost ledger must be in balance.

Under the job order method the proving of the total material, labor, and expense charges debited to Work in Process account with the amount charged to production, i.e., completed orders and work still in process, is effected by comparing the total debits of this account. which are derived, as already explained, from original factory documents, with a summary of the cost ledger taken from the file of current completed and uncompleted cost sheets.

REVIEW QUESTIONS

1. How are the cost accounts opened at the beginning of an accounting period?
2. Prepare a pro forma Raw Material, Work in Process, and Finished Goods account.
3. How does the accounting procedure in a process factory differ from that in a job order factory in relation to the controlling cost accounts?
4. Illustrate the cost calculation for a flour mill.
5. How are the cost accounts closed at the end of an accounting period (a) in a process factory, (b) in a job order factory?

CHAPTER VIII

INDIRECT EXPENSE ACCOUNTS

1. Recording Indirect Expense

To collect and distribute the indirect charges for expense under either the job order or the process method, expense accounts are opened as follows:

1. To record the current charges to departments or production centers, together with any accrued expense chargeable in that period, such as rent, taxes, or depreciation.
2. To record the charges to departments or production centers of prepaid expense chargeable in that period, such as insurance paid in advance, or supplies taken into stores, only part of which is applicable to or consumed within the current period.
3. To apportion over the operating departments the expense of operating the non-productive centers of factory activity, such as the power plant, the stores department, the factory offices, or the administrative branch of the business.
4. To record the distribution over the product of the total overhead expense of each operating department for the period.

Under the job order method these current overhead expense totals as distributed should be charged to Work in Process controlling account, and to cost sheets for the

details; under the process method these totals are charged to the operating department accounts, as shown in the illustrative accounts in the preceding chapter.

In a manufacturing business of small size, all these expense accounts are frequently kept in the general ledger in a section devoted to manufacturing. Columns opened in the voucher record or purchase journal collect the current expenditures for the various items described under heads 1 and 2 and a ledger account is opened for each department.

Overhead expense accounts are opened not only with operating departments but with non-productive departments as well. Such departments are charged with a fair proportion of each kind of expense. Thus the power plant must be charged with its proportion of taxes and rent, all coal used for power purposes, and a fair charge for depreciation. The distribution of the expenditures to the non-productive departments, under 3 above, is usually worked out on an expense distribution sheet or schedule. Such a sheet shows the amounts of the charges of expense, under 1 and 2 above, applicable to each department. On this sheet are often given the statistics used as a basis for apportioning non-productive departmental services such as power, space, supervision, and so on. After certain expenses have been distributed to non-productive departments, they are in turn apportioned to operating departments and added to the expenses of such departments. Thus it is seen that the expense of an operating department includes both direct expense charges and a proportion of the expense of non-productive or service departments. Journal entries are made to effect the distribution deter-

mined by these schedules. Finally the expenses of all operating departments are debited to Work in Process or departmental process accounts.

In a large organization the manufacturing accounts kept on the general ledger would probably be limited to the three controlling accounts—Stores, Work in Process, and Finished Goods.

The operation of each class of expense accounts mentioned above will be considered separately. The current charges to departments are entered direct on the departmental accounts and are discussed in connection with those accounts.

2. Accrued Expense Account

Each department must absorb its proportionate amount of the accrued expenses for the period. This amount is worked out in schedule form on an expense distribution sheet. (See Forms 35 and 36, pages 235, 250, and 251.) A journal entry is then made debiting each department with its proper share and crediting the account kept with the particular item of expense. In general, the accruals consist of depreciation, rent, insurance, and taxes—provided the last two items are not prepaid. Depreciation on equipment is prorated over departments on the basis of the machinery and fixture valuations. Depreciation on the building and permanent fixtures is chargeable to the building expense account. The purpose for which each part of the plant is used indicates to what accounts the depreciation charge should be made. Rent and taxes are debited from the proper column in the voucher register. The following illustrative entries show the operation of an accrued expense

account such as rent when the item is not paid in advance.

RENT (Accrued Expense)

Jan. 1		*Jan. 31*	
Rent for month.....	$490.00	Power Dept.....	$ 86.00
(Charged from voucher register or purchase journal when invoice is received and set up on the books.)		Office "	24.00
		Stores "	30.00
		Administrative Dept.....	20.00
		Dept. A (Productive).....	150.00
		" B "	180.00
	$490.00		$490.00

Other examples of an accrued expense account will be found frequently. Thus in a factory where leased machinery is used for making shoes, it is necessary to set up the amount of unpaid royalties as a liability at the end of each period.

3. Prepaid Expense Account

Prepaid expenses are of two kinds: (1) those representing such charges as insurance, rent, water, etc.; and (2) those representing the purchase of an article which can be taken into stores and issued to departments. The proportion of a prepaid expense for service such as insurance, which is chargeable in some measure to each department, is worked out in the form of a schedule of charges. The cost of articles or supplies withdrawn from stores, which are chargeable to a department as expense, is ascertained by means of stores or supplies requisitions classified by departments responsible for their withdrawal. At the close of the period the departmental distribution is made by journal entry, the credits to a prepaid account being as follows:

INSURANCE (Prepaid Expense)

Jan. 1		*Jan. 31*	
Accounts Payable.....	$600.00	Power Dept.:	
(Insurance premiums paid to date per total taken from voucher register.)		Building ..... $ 8.00	
		Machinery 10.00	$ 18.00
		Office Dept.:	
		Building ..... $ 5.00	
		Furniture 2.00	7.00
		Dept. A (Productive):	
		Building $12.00	
		Machinery 5.00	17.00
		Dept. B (Productive):	
		Building $14.00	
		Machinery 12.00	26.00
		Balance undistributed.....	532.00
	$600.00		$600.00
Feb. 1			
Balance	$532.00		

4. Non-Productive Department Accounts

The non-productive departments comprise the factory divisions not directly engaged in production—such as the power plant, the stores department, and the office department. Each is charged with the expense of its own maintenance, consisting of labor, purchases or repairs expressly made for it, and a fair proportion of the prepaid and accrued expenses. Non-productive departments are also charged with a proportion of the expense of operating any other non-productive departments from which they derive benefit or service. Thus the stores department incurs a share of the general of-

fice and administrative expenses; the power department incurs a share of the same expenses, as well as a share of the expenses of the stores department. At the close of the accounting period an expense distribution sheet (see Chapter XXI) is drawn up showing the distribution of the various items of expense over departments. These items are then journalized to effect the distribution to the various department accounts.

The following is an example of a non-productive department expense account:

POWER EXPENSE (Service Department)

Jan. 31		*Jan. 31*	
Expenses Charged Direct:		Dept. A	$180.00
Purchases (Coal, etc.)	$250.00	Dept. B	220.00
Repairs to Building	20.00	Dept. C	300.00
Repairs to Machinery	30.00	(Distribution as expense chargeable to productive departments in proportion to power used in each.)	
Labor and Salaries	200.00		
Accrued or Prepaid Expenses:			
Depreciation and Interest Accrued	15.00		
Rent and Taxes	20.00		
Water and Light	25.00		
Proportionate Share of Other Depts.' Expense:			
General Expense	76.00		
Office "	24.00		
Stores "	10.00		
Administrative Expense	30.00		
	$700.00		$700.00

5. Productive Department Expense Accounts

The productive and non-productive departments share in proper proportion those general items of expense, such as rent, taxes, etc., which are chargeable

to all departments. When this distribution has been made, the entire expense of operating the non-productive departments for the period is distributed in due proportion over the productive departments. The overhead distribution is made on the distribution sheet referred to in the preceding section; then the various items are journalized in order to bring the departmental charges on the ledger.

An illustrative productive department expense account is given below.

OVERHEAD—DEPARTMENT A

Jan. 31		*Jan. 31*	
Expenses Charged Direct:		Work in Process (as applied through the predetermined rates.)	$1,550.00
Purchases	$ 250.00		
Repairs to Building	40.00		
Repairs to Machinery	60.00		
Indirect Labor and Salaries	350.00	or	
Accrued or Prepaid Expenses:		Dept. A (Operating accounts, process method)	
Depreciation and Interest (Accrued)	38.00	(Being the amount distributed over product as the departmental burden for the period.)	
Rent and Taxes (Accrued or Prepaid)	40.00		
Water and Light	25.00		
Proportionate Share of Other Depts.' Expense:			
General Expense	210.00		
Office "	75.00		
Stores "	86.00		
Administrative Expenses	96.00		
Power	180.00		
Profit and Loss	100.00		
	$1,550.00		$1,550.00

The foregoing outline accounts are intended to illustrate in a general way the nature of the entries which

make up the expense totals debited to the controlling accounts. A detailed discussion of the subject of expense distribution and the distribution of the burden over the product will be found in Part VI.

REVIEW QUESTIONS

1. From what sources are the charges to expense accounts obtained?
2. How would rent and taxes be included in the expense accounts if bills had not been received?
3. How would insurance paid in advance be apportioned to the expense account for the current period?
4. How would supplies purchased in a prior period but not consumed until the current period be included in the expense account?
5. How are the operating departments charged for light, heat, and power service?
6. What becomes of the expense charges at the end of a period?

CHAPTER IX

CLOSING THE CONTROLLING COST ACCOUNTS

1. Journal Entries for Controlling Cost Accounts

The following journal entries illustrate the entries to the controlling accounts with material, labor, and expense—as outlined in the foregoing chapters of Part III. The job order and the process systems are placed side by side so that points of divergence may be clearly seen.

Job Order Method		Process Method
1. To record the purchase of raw materials and supplies:		
Raw Materials..... $.....		The entries are the same as for job order method.
Supplies		
Power Plant, etc...		
Department A, etc.		
To Accounts Payable	$.....	
2. To record the value of all supplies taken from stores during the month, such supplies not being a direct charge to particular orders or processes:		
Power Plant, etc... $.....		Entries same as for job order method.
Department A, etc.		
To Supplies.....	$.....	
3. To record the value of material taken from stores, chargeable direct to orders:		3. To record the value of material taken from stores and placed in process in the respective departments:
Work in Process... $.....		Department A, etc. $.....
To Raw Materials	$.....	To Raw Materials $.....

Job Order Method	Process Method
4. To distribute to the various non-productive and productive department expense accounts the pay-rolls for the month or other accounting period, charging to Work in Process account all labor which can be allocated directly to the individual orders:	4. To distribute to the various non-productive and productive department expense accounts the pay-rolls for the month or other accounting period:
Power Plant, etc... $..... Department A, etc. ..... Work in Process... ..... To Pay-Roll (accrued wages).. $.....	Power Plant, etc... $..... Department A, etc. ..... To Pay-Roll (accrued wages).. $.....

5 To charge all productive and non-productive departments with their proper proportion of the various accrued or prepaid expenses, only a portion of which is applicable to the current period:

Power Plant, etc... $..... Department A, etc. ..... To Rent, Insurance, Taxes, Depreciation, Repairs, etc..... $.....	Entries same as for job order method.

6. To charge each productive department with its proportion of each non-productive department expense, such as power, heat, general factory expenses, etc.:

Department A, etc. $..... To Power Plant etc. ..... $.....	Entries same as for job order method.

7. To charge Work in Process with the amount of burden spread over orders in each department:

Work in Process... $..... To Department A, etc. ..... $.....	No entry under process method.

Job Order Method	Process Method
8. To transfer all goods completed and placed in stores during the month or other accounting period, closing out the corresponding orders on which these goods were manufactured:	8. To transfer the net cost of operating each department for the month or other accounting period, to the account for the respective commodity produced, recording both quantity and value:
Finished Goods.... $..... To Work in Process ..... $.....	Inventories of Partly Finished Goods $..... Finished Goods..... ..... To Department A, etc. ..... $.....

After the entry charging Accounts Receivable and crediting Sales with the selling price of goods sold has been made, the following additional entry is required to record the cost of goods sold:

Cost of Goods Sold..... $.....
To Finished Goods..... $.....

2. Closing Balances

After the cost of goods manufactured has been transferred from Work in Process to Finished Goods account, balances will usually be found in the following manufacturing controlling accounts:

Raw Materials Supplies Finished Goods	Representing the total value of the stocks on hand, the underlying factory stock records covering the details of each class of goods.
Work in Process account or Partly Finished Goods account	Representing the unfinished orders or the partly finished processes, the details of which are recorded in the factory cost ledger in which an account is kept covering each order or each process.

In the non-productive department accounts there should be no balances.

In a productive department, a credit balance represents an excess burden charge made to production; a debit balance indicates an insufficient charge. The burden rates may be either increased or decreased during the subsequent cost period, as the case requires, to dispose of these balances, or the balances may be transferred to Profit and Loss.

3. Profit and Loss Account—Manufacturing Section

Manufacturing costs end when finished goods are taken into stock or delivered to the shipping department. Methods of accounting for the sales of a manufacturing concern differ in no way from those of a mercantile house which buys goods at wholesale for resale. The factory accounts give the cost at which the finished product is charged on the Finished Goods accounts; this cost then takes the place of the cost of purchases in a business which buys its stock-in-trade. In most cases the lines of a manufacturing house are much less varied than those of the wholesaler or jobber who is buying from several factories, and therefore the sales accounting problem of the manufacturer is proportionately simple.

At the close of the financial period when the activities of the business are summarized for six months or a year as the case may be, a section of the profit and loss statement is devoted to the activities of the factory under the heading "Manufacturing." By summarizing and presenting the data as illustrated below, the prime cost (i.e., the cost of material and labor) and the total

cost of manufacture for the period under review are shown. This total cost is transferred to the trading section, where it is increased by the amounts of the various trading costs and is offset by the amounts of the trading proceeds. The net balance (usually representing a profit) shows the result of operations.

The accounts included in the manufacturing profit and loss statement are kept in the manufacturing section of the general ledger. The total figures of each account shown may be accompanied by supporting documents giving the analysis and distribution thereof in any desired detail. For presentation to stockholders or to the public, the profit and loss statement is a more desirable form than the profit and loss account, since it may be interpreted by one unfamiliar with accounting more easily than the detailed profit and loss account. (See Volume I, Chapter IX.)

STATEMENT OF MANUFACTURING AND PROFIT AND LOSS

For the year ended December 31, 1919

Manufacturing Section

PRIME COST:		
Raw Material Inventory, January 1, 1919		$ 6,000.00
Material Purchases	$78,000.00	
Freight Inward	2,700.00	
	$80,700.00	
Less Returns	1,000.00	
Net Purchases		79,700.00
		85,700.00

Raw Material Inventory, December 31, 1919.....		8,500.00
Material Cost.....		$77,200.00
Factory Labor.....		36,300.00
Goods in Process Consumed:		
Inventory, January 1, 1919.....	$2,500.00	
Inventory, December 31, 1919.....	1,000.00	1,500.00
Prime Cost		$115,000.00
FACTORY OVERHEAD:		
Depreciation:		
Plant (10% of $25,000).....	$ 2,500.00	
Tools (25% of $4,000).....	1,000.00	
Insurance $1,000.00		
Less Unexpired Insurance 250.00	750.00	
Taxes	450.00	
Rent	3,500.00	
Fuel	2,500.00	
Machinery Repairs.....	600.00	
Salaries	6,000.00	
General Expense.....	4,600.00	
Factory Overhead.....		21,900.00
Dept. A..... $6,800.00		
Dept. B..... 8,750.00		
Dept. C..... 6,350.00		
MANUFACTURING COST.....		$136,900.00

REVIEW QUESTIONS

1. What entry is made under the job order method of cost-finding to charge Work in Process account for overhead expense at the end of an accounting period?

2. What adjustment is sometimes required to make the operating expense accounts balance?
3. How are the cost accounts closed under the process method of cost-finding?
4. What do the balances of the inventory accounts represent?
5. How are the cost accounts set up on the profit and loss statement?

Part IV
Material Costs

CHAPTER X

STORES AND THE STORES DEPARTMENT

1. Definition of Stores

The word "stores" is sometimes loosely employed to designate only such manufacturing supplies as the coal, oil, and waste used in non-productive work, while at other times it is employed to designate all articles or commodities used for manufacturing purposes. In its proper significance stores covers materials and supplies of every kind which are first stored and then consumed in factory operations and the word is so used in this book. Thus cardboard, paper, and glue constitute the stores in a paper-box factory.

Manufactured parts are considered stores and are handled as stores when they are turned back to the stores-room to be subsequently used in the manufacture or assembly of the finished product.

2. Stores Routine

It must not be assumed that stores routine invariably follows the lines indicated in the following chapters or that the forms and rulings of the books used for stores records are always the same. On the contrary, records and procedure vary widely with circumstances and conditions. It is obvious that in a silk-throwing mill with but one item of raw material and few supplies,

the stores routine would be simple and the stores records few as compared with the stores routine and records of a factory manufacturing aeroplanes with hundreds of parts and a variety of materials.

While this is true, the variation is only in detail and the general principles and the essential records are much the same in any stores department of any degree of complexity. If these general principles of routine and essential records are clearly grasped, the necessity and purpose of variations to meet special conditions are easily understood.

3. Purchasing Department

The cycle of manufacturing operations usually commences with the ordering of material and supplies by the purchasing department. The accounting routine when recording and controlling purchases is, however, the same in a manufacturing as in a mercantile business and has been discussed in a preceding volume.* Moreover, the organization and functions of a purchasing department belong rather to the subject of office organization and administration than to cost accounting proper. For these reasons the purchasing department is not considered in detail in the present volume.

When installing a cost system the cost accountant may find it necessary to devise suitable purchase requisition and purchase order forms and to see that the work of the purchasing department is properly organized and linked up with that of the stores department; but after this is done, his task, so far as the purchasing department is concerned, is virtually finished. It should,

*See Volume II, Chapters XI and XII.

however, be remembered that the record of purchases furnishes one of the main sources of cost information.

4. Stores-Room Arrangement

The first requirement of a well-planned stores-room is adequate facilities for handling and storing the required supplies and materials. In a large plant the number of items of stores will sometimes run into the thousands. The equipment and the arrangement of the department are also important factors in its efficiency, the chief consideration being the storing and recording of its stock on hand in such a way that it may be properly cared for and maintained and may be issued without loss of time and with a minimum of handling. To this end it is necessary that the department be fitted with bins, racks, and other containers so that there is a definite place and suitable receptacle for each kind of material and supply where it may always be found and may easily be counted, weighed, or measured for inventory purposes.

In addition to racks, bins, and containers the stores-house should be equipped with weighing and counting machines, when required, as well as with trucks, hoists, and any other necessary equipment. Orderliness and accuracy can be attained only when the necessary mechanism exists, and for this reason parsimony in the equipment of the stores-room will prove a costly policy. Many a cost system breaks down at its starting point because of the short-sighted economy which fails to equip this department properly so as to preserve supplies from unnecessary handling and from misappropriation, or needless deterioration.

When many items are stored, some system of numbering, lettering, or arranging the receptacles or containers of material is necessary so that any desired item may be readily found. The methods of classifying stores are discussed in Chapter XIII.

5. The Stores-Keeper

A stores-keeper who knows the stores requirements of the business and who combines method and neatness with the ability to keep the records required by the accounting department should be placed in charge of the stores department. Circumstances will, of course, determine how much of the clerical work in connection with stores is done in the main office and how much in the stores department. A detailed record of stores received and issued should always be kept in such a way that at the end of the cost period it may be readily balanced, and the stores-keeper should be responsible for this clerical work.

The stores-keeper's position as to material is analogous to that of a cashier as to cash. He must check up incoming material to see that it is what it purports to be in quantity and kind; he must account for it while in his possession, and he must issue it only in response to proper authority; also the records under his charge must be so kept that the issues deducted from receipts, will give the balance on hand at any time, either of any particular kind of stores, or of all stores.

6. The Perpetual Inventory

The accuracy of cost figures depends in a large measure upon the means employed for recording the

receipt and issue of stores. Stores represent as real a value as does cash itself and their consumption frequently represents an expense even greater than wages paid. Cash is always rigidly accounted for and stores should be handled with equal accuracy. Unless there is a rigid system for recording the receipt and issue of materials and supplies, it is possible for serious leaks to occur, unnoticed or unheeded, in both the stores-room and the factory.

The perpetual stores inventory which results from a properly kept stores ledger, whereby the value of materials and supplies on hand can be ascertained at any time, is a form of protection which a manufacturer can no more afford to dispense with than he can afford to dispense with his cash book. The one gives him the amount of cash on hand at any time; the other the amount of stores on hand at any time. The clerical expense of controlling stores in this way is usually much more than offset by the actual savings effected, for there are many important advantages in this closer control.

The stores ledger cards or sheets give this perpetual inventory of stores for each item of stores, so that a close watch can be kept on the quantities of materials and supplies in stock and replenishment can be made when required and not until required. This means that a smaller reserve of stores is needed, which in terms of cash means a smaller investment in stores with a correspondingly smaller carrying charge. Moreover, the absolute check of the perpetual inventory usually results in a decided saving through the elimination of theft and of waste and in the smoother operation of the factory.

The maintenance of the stores ledger or perpetual

Priced_____
Extended_____
Ext Approved_____
Footed_____
Footing Approved_____

Inventory Dept. No. _____

SMALL TOOL INVENTORY

Foreman_____ Dept. No. ____

LIST ONLY TOOLS WITHOUT NUMBER

LEAVE THIS SPACE BLANK	NUMBER ON HAND			NAME OF TOOL	PRICE EACH NEW VALUE	TOTAL VALUE	NUMBER ON HAND			NAME OF TOOL	PRICE EACH NEW VALUE	TOTAL VALUE
	No Value	Half Value	Good As New				No Value	Half Value	Good As New			
				Broaches, all sizes						Files, American		
				Clamps, steel, C No.1 opens 1¼"						8" all cuts and shapes		
				" " 2 " 2¼"						6" " "		
				" " 3 " 3¼"						Files, Swiss		
				" " 4 " 4½"						10" all cuts and shapes		
				" " 5 " 6½"						8" " "		
				Clamp Dogs, all sizes						6" " "		
				Counterbores, 0–1" incl.						4" " "		
				" 1⅛" up						3" " "		
				Countersinks, 0–⅛" incl.						Files, Saw, all sizes		
				" ⅛"–½" "						Figures, Stamping, 1" sets		

Form 12. Inventory Sheet—Automobile Factory

inventory renders the taking of a physical stores inventory unnecessary when the books are closed at the end of the cost period. The actual physical inventorying of the various stores items should, however, not be entirely neglected. Such inventories are advisable as a check on the stores ledger and as an indication of the care—or lack of care—with which stores are handled and their issues recorded.

Under the perpetual inventory plan the physical check-up of stores can be made at leisure—a few bins or items at a time—and in place of the general upheaval which is the result of taking stock in all departments at once, a methodical routine of check and control is established. This attains the same end but without the expense and interruption to business incident to a general stores inventory.

Form 12 illustrates an inventory sheet used in an automobile factory. The classification and printing of the items and the ruling of the sheets greatly facilitate the clerical work.

REVIEW QUESTIONS

1. What is meant by stores in cost work? Is work in process a part of the stores?
2. How should a stores system be organized?
3. What is the relation of the purchasing agent to the stores-keeper?
4. Describe a good arrangement for stores.
5. What function does a stores-keeper fulfil?
6. Describe the operation of a perpetual inventory. What are its advantages?

CHAPTER XI

STORES ACCOUNTING AND RECORDS

1. Subdivisions of Stores

Stores are generally subdivided on the books of account into "raw material," which covers all articles or parts used directly in the production of finished goods; and "supplies," which cover all articles used indirectly in the productive process. Separate controlling accounts are at times kept on the general ledger with each class and with subdivisions of each class. The advantage of keeping separate controlling accounts with the various kinds of material, and with supplies and with finished parts when these are treated as stores, is found in the fact that it facilitates the location of clerical errors and gives the general office a closer check on the storesroom; on the other hand, it increases clerical labor and complicates the financial accounts and, further, it is not always easy to distinguish between stores which are materials and those which are supplies.

As a matter of convenience and to save time, the major classifications of stores purchased as recorded in the columns of the purchase journal should conform to the classification of the accounts on the general ledger, since the footings of these columns are posted direct to the corresponding general ledger accounts.

To simplify the discussion in the following chapters, it is assumed that there is but one stores account in the

general ledger, which controls all subsidiary records relating to raw materials, supplies, and such finished parts as may be carried as stores.

2. Importance of Accurate Stores Accounting

An agreement of the controlling stores figures of the general ledger with the subsidiary figures of the stores ledger is rarely if ever secured where lax methods of stores handling or accounting are permitted. In such a case when a physical inventory is taken and compared with the book figures, wide discrepancies are usually found. The accurate control of stores is an essential feature of every cost system, and, as already stated, unless the same care is given to the record of their receipt and withdrawal as would ordinarily be given to the record of cash transactions, stores are not under proper control and the accuracy of the whole cost system is threatened.

Where many hundreds or even thousands of stores items are handled, trifling inaccuracies are likely to creep into the clerical work which will prevent the agreement of the figures. The pricing of stores on the ledger cards and requisitions, for example, is not only troublesome because of the care and accuracy required, but because of the difficulty which sometimes exists in identifying items. Prices may vary with each consignment. Also each of a series of bolts or screws may differ only minutely from one another and yet have individual prices.

The stores symbol or number is a simple means of identifying stores when requisitions or other orders affecting them are made out. For example, a requisition

for "100 bolts, No. 5" would designate the stores required with absolute accuracy and with a minimum of description.

Accuracy in pricing can be assured by assigning the work to a clerk who is thoroughly familiar with the stores and their symbols and is at the same time careful and systematic in his procedure. Even then his work should be checked from time to time. Promiscuous pricing by a number of employees is fatal to accuracy.

3. Stores Received Book

Stores control begins with the receipt of goods purchased. One copy of the purchase order,* with details as to prices and quantities omitted, is usually sent to the receiving clerk of the stores department. On receipt of the goods the clerk checks them up, counting, weighing, or measuring them, and enters the data as to quantity on his copy of the purchase order, which is then returned to the purchasing department. The purchasing clerk, after checking the receiving clerk's quantities with those on his own invoice and reconciling any differences, adds the price of the goods on the receiving clerk's copy of the purchase order, which is again sent to the stores department, stamped "O K."

The purchase order now becomes the basis for an entry in the stores received book (Form 13). In this official record of the receipt of stores, the items are arranged according to date, one item to the line. This book also furnishes the data for the charges made to the stores ledger as explained in the following section.

The ruling of the stores received book in the form

*See Volume II, Chapter IX.

STORES RECEIVED BOOK

DATE	ORDER NO.	SHIPPER	DESCRIPTION	STORES NO.	QUANTITY	PRICE	VALUE		STORES LEDGER CARD NO.

Form 13. Stores Received Book

shown provides columns for date, number of purchase order, shipper's name, description of goods, stores symbol or number, quantity, unit price, total value, and number of the stores ledger card to which the item is posted. If a loose-leaf book is used instead of ledger cards the page number of the stores ledger to which the item is posted appears in the last column, under the heading "Stores Ledger Page."

4. Stores Ledger

The stores received book is the book of original entry in which the debit entries to the stores ledger are chronologically listed before posting. The stores ledger itself is rarely, if ever, a bound book such as the term "ledger" commonly suggests; in the great majority of cases it is composed of cards, though in some cases it may be in loose-leaf form. The precise form of the book does not matter as its function is the same in all cases—to record, on cards or sheets, the receipt and withdrawal of stores, one of these cards or sheets being allotted to each article or kind of material kept on hand. (See Forms 14 and 15.)

When the stores items run into the hundreds and even thousands, as they sometimes do, the stores ledger cards or sheets must be so listed and arranged that any required one may be readily found. When items are numerous or frequently changing, a card ledger kept on the card index plan has obvious advantages over any other form of record. When items are few in number and receipts and withdrawals over long periods of time are to be shown, sheets may serve the purpose better than cards. In any case the unbound form is adhered

to because of its flexibility in the arrangement of the records.

The size of the cards or sheets will depend upon the number of entries which they are to contain and the amount of information they are to record. Usually a 5 x 8 card will suffice but no arbitrary rule can be laid down. The essential thing is for the stores ledger to record the receipt and issue of material and supplies in a convenient form for handy reference so that the quantity of any item on hand can be readily ascertained at any time.

The exact form of the stores ledger card or sheet will vary with conditions. It should record, however, the quantity and value of receipts in columns to the left and similar data as to withdrawals to the right, with a further column or columns to the right to record the quantity, and also the value when necessary, of the material on hand. As receipts are in bulk and issues are in small quantity, more space should be allotted to withdrawals than to receipts. As shown in Form 14, a column under "Receipts" gives the number of the purchase order which authorizes the purchase of the material; also, if this does not appear in the heading, a column may be added for the unit price at which current withdrawals are to be taken. The heading of the card usually shows the name of the article or material entered, its number or symbol, location, unit price, minimum stock below which it should not be allowed to fall, and the quantity to order when the minimum is approached.

For withdrawals the stores ledger card should provide columns for the number of the requisition which

authorizes the withdrawal and for the quantity withdrawn. Columns for the quantity left and its cost value are also provided and this quantity and value are usually entered in the balance columns after every third withdrawal. When, however, the withdrawals of any item are numerous and are made in small quantities, it

Article _____ No. _____
Bin No. _____
Minimum Stock _____ Quantity to Order _____

RECEIPTS				ISSUES						BALANCE			CURRENT UNIT PRICE	DATE
Date	Quan.	Value	Order No.	Req. No.	Quan.	Req. No.	Quan.	Req. No.	Quan.	Quan.	Value			

Form 14. Stores Ledger

is not always necessary to figure on the stores ledger card the value of the balance until the end of the accounting period. It is, however, necessary to place on the stores requisition against which the issue is made the value of the material withdrawn, so that it may be properly charged against the product in which it is used. (See Form 14.) Reference to the "Current Unit Price" readily enables this to be done.

As different lots of the same material may vary in price, the current price must be changed from time to time to agree with the purchase price, if the value of receipts is to balance the value of corresponding withdrawals. Such change must not be made, however, until the material purchased at the former price is completely exhausted. In other words, material must always be "charged out" at the same price at which it has

No. or Size		Article				Unit Price	Where Stored		Max. / Min.	
DATE	ORDER NO.	QUANTITY	DATE	RECEIVED	DELIVERED	BALANCE	DATE	RECEIVED	DELIVERED	BALANCE

Form 15. Stores Ledger

been brought in. No alteration in the unit price is ever made until the material issued is taken from a lot which bears a different price from the preceding one. Prices may go up or down, but this does not affect the card ledger prices until material has been bought and used at the new price. If the price changes materially this change may be reflected in the selling price of the manu-

factured product before any of the raw material is bought at the new price, but this is a question of price-making and does not affect the stores ledger cost price. (See Chapter XII.)

It is always possible, of course, to keep the stores ledger by quantity only without regard to price. In such case, however, the current price should appear on the stores ledger card for use in calculating the cost value of withdrawals and the value of balances at the end of the cost period. Values must be found when the balances of the stores ledger are to be compared with that of the controlling Stores account of the general ledger.

When the quantity of any item kept in stock reaches the minimum point, the stores-keeper notifies the purchasing agent, usually by means of a purchase requisition which calls for the specified "Quantity to Order." A purchase order is then placed for this quantity, which, when received, replenishes the item of stores up to the maximum requirements of the factory.

5. Control of Stores Ledger

A general proof of the clerical accuracy of the entries in the stores ledger is afforded by the agreement between the total of its balances and the balance of the controlling Stores account on the general ledger. The entries in the stores received book correspond with those in the stores column of the purchase journal or voucher register. The debit entries of the stores ledger are posted from the stores received book. The total of the stores column of the purchase journal is posted at the end of the cost period to the debit of the

general ledger controlling Stores account. Therefore, as the source of the debit entries in each case is the same, and assuming the equality of the opening inventory balances, the debit footings should agree.

The credit entries of the stores ledger are posted from the individual requisitions; these same requisitions are summarized in the stores issued book and the total of this summary is posted to the credit of the controlling Stores account at the end of the period. Therefore, as the source of the credit entries in each case is the same, the credits in the controlling Stores account must equal the total credits on the subsidiary ledger if the clerical work is correct and, both debits and credits being equal, in the general ledger and the stores ledger, their balances also must agree. This agreement is the basis of all proper stores control and should be found in every cost system.

6. Control of Issues

The keeping of the stores issued book insures the proper accounting for all stores issued, either as a charge to production or to expense, and when necessary to a particular department. Under the process method of cost-finding the departmental classification of issued stores is all that is required. Under the job order method it is necessary to go more into detail and to record the issue of materials on cost sheets. The requisitions classified or grouped by items and entered in the stores issued book show the kinds of stores used. The same requisitions classified or grouped by order number show the stores which have been used on each job.

An important feature of stores control when goods are made to order is the verification of the fact—if it is a fact—that the various kinds of stores withdrawn for manufacturing purposes have been used on orders and properly charged to them. This verification is arrived at by comparing the total debit to the controlling Work in Process account with the total material charges entered on the current cost sheets. As the entries in both cases are taken from requisitions chargeable to production, they should agree, and thus check the accuracy of each other.

7. Bin Tag as a Means of Stores Control

Bin tags, the use of which is suggested by their name, are often used as a further means of controlling stores by recording each issue on the spot, *at the time it is made.* If a tag such as is illustrated in Form 16, is placed on the bin itself, or in a receptacle attached to the shelf or rack on which the article to which the tag refers is stored, there is no excuse for any omission in recording the movement of stores.

Bin tags are only memoranda kept as an additional check on the issue of stores. If entries are accurately made, the record on the bin tag should agree with the material in the bin or on the shelf, as shown by actual count, weight, or measure. Should any serious discrepancy between the controlling Stores account and the subsidiary stores ledger arise, the data entered on the bin tag can be checked with the entries on the stores ledger card. If the figures on the tag agree with the actual count, weight, or measure, but not with the stores ledger card, the presumption is that a posting has been

omitted from the ledger which should be adjusted accordingly. If the bin tag figures agree with those of the ledger card, but not with the physical inventory, something obviously is wrong—probably a failure to enter an issue, or a misappropriation. Of course, in either case the cause of the discrepancy should be investigated.

ARTICLE _____

ARTICLE NO. _____ LOCATION _____

MINIMUM STOCK _____

DATE	QUANTITY		DATE	REQ. NO.	QUAN. DISTRIB.	DATE	REQ. NO.	QUAN. DISTRIB.	DATE	REQ. NO.	QUAN. DISTRIB.
	On Hand	Received									

Form 16. Bin Tag

8. Stores Requisition

A withdrawal from stores is authorized by means of a "Stores Requisition" or "Requisition for Materials" (Form 17). Under the process method this specifies to which department the charge is to be made. Under the job order method it gives the number of the job order against which the charge is to be made.

The usual requisition form gives the date, quantity, description, and value of the stores desired, and indicates the use to which they are to be put—that is, whether they are to be charged to production or to expense. In the column headed "Charge to" is entered the number of the production order or expense order against which the stores withdrawn are to be charged.

Stores Requisition _____ Dept. No. _____

Date	Quantity	Stores Item	Charge To	Price	

Issued by _____ Received by _____

Form 17. Stores Requisition

The several purposes of a stores requisition may be summarized under the following heads:

1. To authorize the issue of stores.
2. To distinguish between stores which are to be charged against orders and those which are to be charged to an expense account.
3. To supply the material cost on the order against which it is to be charged.
4. To serve as a voucher for the entries to the withdrawal columns of the stores ledger.
5. To furnish information regarding material issued for entry in the stores issued book.

9. Bill of Material

In many factories the materials and finished parts needed to make up a particular order can be accurately determined in advance by referring to blue-prints and specifications. The common practice in such a case is to specify the stores required for a particular order on a "Material Sheet" or "Bill of Material." The general

Job No. 405 BILL OF MATERIAL

Description 100 Oak Tables - Flat Top Date January 3, 1919

Quantity	Dimensions	Kind of Lumber	No. of Bd. Ft.	Price per M Feet	Amount
100	1½" × 2½' × 6'	Quartered Oak	2250	$ 100 00	$ 225 00

Form 18. Bill of Material

purpose of this form is indicated by its name. This record takes the place of the ordinary stores requisition. Its advantage lies in the fact that it collects the material cost of an entire order on a single document, thus saving clerical labor and insuring accuracy.

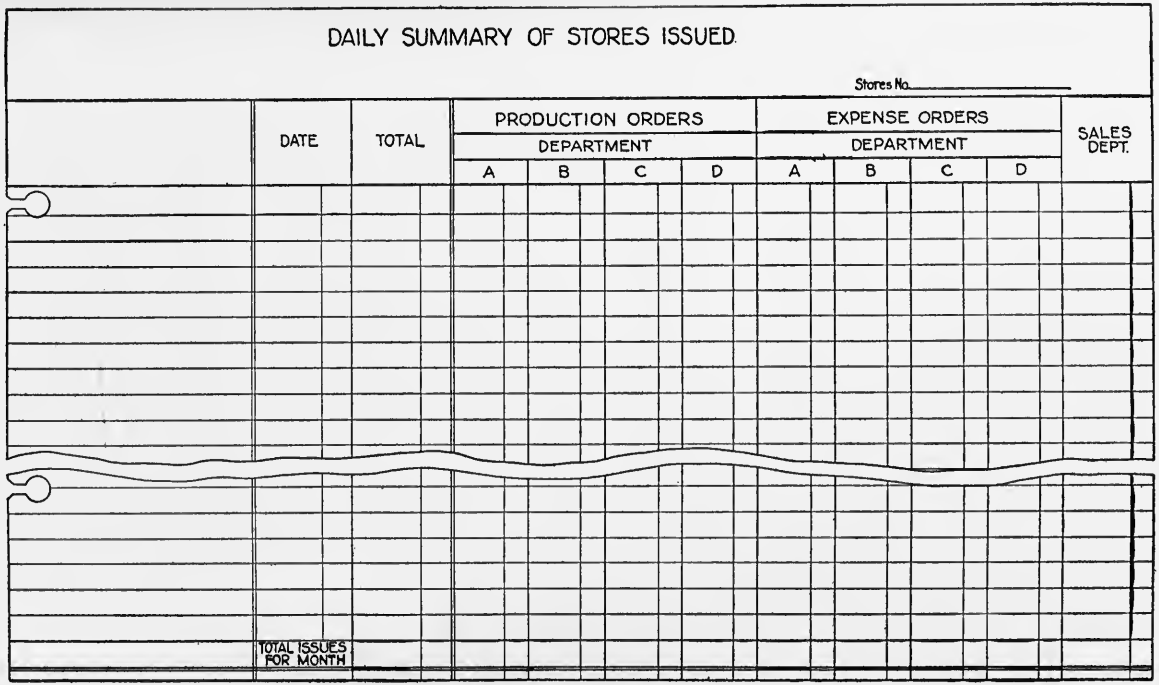
The bill of material illustrated in Form 18 is used in a furniture factory. It is made out in the office from

the blue-print and specifications for the job. The original is the cutting list given the mill, while the duplicate is the bill of material for the cost department. Similar forms are used in clothing factories for the purpose of instructing the cutting department as to the amount of material to cut, and of supplying cost clerk with data for figuring the material used on a job. In assembling industries where articles are made up from standard parts the bill of material consists of a list of the parts required. In this case the bill of material may be sent to the stores-room as a requisition.

10. Stores Issued Book

A "Stores Issued Book" bears much the same relation to the issued or credit side of the stores ledger that the stores received book bears to the received or debit side. As a rule, issues of stores are numerous and should be recorded on the stores ledger in detail and on the stores issued book in summary day by day. These summaries are made up from the requisitions. These requisitions should be classified for posting purposes according to the type of order under which they fall ("production" or "expense"), and then, under the department from which they are issued.

Form 19 suggests the ruling of a stores issued book. The total value of withdrawals for the month is summarized in the first column and in the remaining columns the issues are classified by departments and as charges to production or to expense. At the end of the period, the total in the first column is posted in the general ledger to the credit of the controlling Stores account. The corresponding debit is to:



Form 19. Stores Issued Book

1. Production orders in process:
   Under the job order method of cost accounting, a summary of all stores issued against production orders is charged to Work in Process account.
   Under the process method, individual debits aggregating the total of the production orders column are made to the proper productive departments.
2. Expense orders:
   Summaries aggregating the total of the expense orders columns are debited to the departments which have withdrawn the stores.

The stores issued book should contain at the close of the period a daily and monthly record of the value of the stores withdrawn, so classified as to distinguish between stores chargeable to production and those chargeable to expense; and this classification should further show under each head the departments for the needs of which stores have been withdrawn. Under the process method the charge is made to the department only. Under the job order method the charge is made in total to the Work in Process account and is entered in detail on the cost sheets for the production orders.

11. Material Returned to Stores or to Vendor

It has heretofore been taken for granted that stores when once issued are completely consumed in manufacture. As a matter of practice, this is not always the case. More material is frequently requisitioned than is

needed for a particular job, in which case a portion must be returned to stores. Sometimes defects or differences in material show themselves after its withdrawal, making it necessary to return the material to the party from whom it was purchased.

The return of invoiced goods to the vendor after they have been taken into stores follows the usual accounting procedure—the reversal of the entries made in both the general ledger and the stores ledger. Such entries, however, are not often made, since defects in goods of sufficient gravity to warrant their complete rejection are generally discovered before the invoice is recorded and passed for payment.

The return to the stores-room of material requisitioned in larger quantity than is needed is usually adjusted through the factory journal, reversing the figures on the books and making the entries in red ink to indicate the nature of the transactions. Under manufacturing conditions where returns to stores are numerous and unavoidable they should be segregated in a separate "Stores Returned Book." "Stores Returned Notes" must then be used as supporting documents for the book entries. As the book and notes simply reverse the operations which have been fully described, no further description of their use and their relation to each other is needed here.

12. Periodical Adjustments

It must be admitted that, however carefully stores may be handled and values recorded, it is impracticable to keep the records with the absolute accuracy of cash records. Items of small intrinsic value, frequently re-

quisitioned, are sometimes overlooked and the trifling inaccuracies of scales will in time cause some discrepancy. Shrinkages will sometimes occur and a certain amount of spoilage and waste is unavoidable in the handling of certain stores. If, after all due allowance has been made for these causes of discrepancies, any considerable difference is revealed between the actual balance on hand and that which should be on hand as shown by the ledger, it will be due probably to one of two causes—failure to post one or more requisitions, or the withdrawal of stores without authority.

If a comparison of the aggregate balances of the stores ledger cards with the controlling balance reveals a larger balance in the stores ledger, the figures in the controlling Stores account in the general ledger will probably be the true accounting balance. The discrepancy may be caused by omitting to post one or more stores issues—assuming that the clerical accuracy of the postings and balances has been verified.

If there is any serious deficiency in one or more articles or items of stores, as shown by a physical inventory, while the balances in the stores ledger agree with the controlling balance, this difference may safely be attributed either to the issuing of stores without authority or to misappropriation. Assuming no malpractice, all that can be done to rectify the omission is to consider it as a charge to production which has been omitted and to debit it to general expense, by which means it will be distributed over production in the form of burden.

A higher degree of care is, of course, exercised in keeping stock records of precious stones and metals than in accounting for low-priced stock.

REVIEW QUESTIONS

1. How can stores accounts be controlled?
2. What is a good method to use for identifying stores?
3. How should the receipt of stores be handled?
4. How is a stores ledger operated?
5. What check is there on the balances shown on the stores ledger?
6. When the price of an article of stores varies from time to time, what price is to be used when such stores are issued?
7. How are bin tags used?
8. What records should be kept of stores issued?
9. To what accounts are stores issues charged?
10. How should discrepancies in stores ledger balances be adjusted?

CHAPTER XII

STORES PROBLEMS

1. Complications in Determination of Material Costs

When the quantity of raw material entering into a unit of production or consumed in its manufacture can be accurately measured and the price is known, material cost can readily be ascertained. Equally simple should be the calculation when a specific quantity of material is withdrawn from stores for a specific job or process designated on the stores requisition. In practice, however, the figuring of material cost is not always so free from complications. As noted in Chapter XI, prices fluctuate widely, material sometimes loses or gains in weight or in volume from atmospheric or other causes, and after it is requisitioned, may prove defective, or be wasted or spoiled by careless workmanship. Also by-products and scrap frequently result from the processes of manufacturing. The causes of the fluctuations in value or cost or quantity used may be inevitable, intentional even, or they may be accidental, but whatever their origin they occasion many baffling cost problems which need careful handling if exact material costs are desired.

2. Fluctuations of Price

Many kinds of raw material fluctuate widely in price—sometimes changing with every lot purchased. The rule in cost accounting is to withdraw stores at

cost, but their fluctuating prices sometimes render the observance of this rule difficult. This is the case especially when goods are purchased in bulk and it is impracticable to keep one lot separate from another. When the fluctuations are so frequent and so great as to require special methods, the problem may be solved in one of three ways.

The first and simplest method is to take an average price based on the figures of a number of years and to compute the material cost accordingly. This is a rough and ready method which at best is applicable only to those products in the manufacture of which wages and overhead form a much larger item of cost than material.

The second method is to use the material price of a particular lot and to adhere to it until a quantity equal to the particular lot has been withdrawn. This method is simple, as it eliminates the necessity of identifying a specific consignment of goods with any one job or process. When material is uniform and is received in bulk or in large consignments, this method furnishes sufficiently accurate cost figures.

A third method is to keep each new lot of material by itself and price each item issued at its exact cost. Under the job order method this is usually a simple matter. Under the process method of production it involves the use of different plans of handling according to the nature of the stores. Thus in a tannery, a lot number is allotted to each consignment of hides, which is stored by itself. As material is requisitioned the number of the lot from which it is drawn is entered on the requisition by the stores-keeper and the price extended accordingly.

The third method is clearly the most accurate of the three as the material cost is the actual invoice price of the material used plus such charges as freight, cartage, and handling.

3. Fluctuations in Weight or Volume

It has been noted above that materials frequently undergo changes in weight or volume due to atmospheric or other conditions. These changes are in some cases very considerable and the unit price at which the material is "charged in" must be changed to meet the new conditions. Thus, if a certain kind of dyestuff costing $50 weighs 100 pounds when taken into stores and loses 10 pounds in weight before it is requisitioned, it must be priced for withdrawal purposes at $.55½ per pound ($50÷90). Or again, a warp costing $1 a yard and measuring 300 yards before weaving may shrink 15 yards during the process, the yield amounting to 95 per cent. The cost of the warp should then be increased proportionately and figured at approximately $1.053 per yard after weaving, to arrive at the exact material cost of the cloth per yard.

Under such conditions the calculation of material cost is sometimes simplified by computing the physical changes which material may undergo in terms of percentages. For example, when material loses weight, the amount of the loss is expressed as a percentage of the original weight. If a number of lots of cotton weighing, say, 300 pounds before "picking" average 285 pounds after the operation, the percentage of loss is 15÷300 or 5%. This standard percentage once determined is then deducted from the weight of all lots

going through the operation to give the weight of the picked product.

4. Waste of Material

Wastage of material in the course of its conversion into finished product is frequently a necessary resultant of the manufacturing processes. This means that having paid so much for a given quantity, weight, or length of material, some of this value disappears in the course of manufacture. The waste may be caused by inevitable conditions. In this case it is one of the legitimate costs of manufacture and requires no special attention save to guard against its exceeding the necessary wastage percentage. It may, however, be the result of carelessness, inferior skill, and poor workmanship, in which case it is a preventable loss that should be avoided. In the clothing and shoe industries, for example, in cutting the raw material an unavoidable waste results which may be very greatly increased by lack of skill. The task of the cost accountant is to determine whether the waste in any given instance is greater or less than may reasonably be expected.

To check unnecessary waste, standards should be established, so that any serious increase over this normal may be promptly detected. By the establishment of these standards the amount of any loss due to a preventable cause is ascertained and a measure of efficiency is set, below which a department or an individual worker is not permitted to fall without investigation. If such a preventable loss occurs, however, it should not be treated as a legitimate material cost but it should be charged to a special "Wastes" account and be handled

as an expense item. Thus the direct material costs are not affected by variations in the skill of workers or by carelessness in processing. Furthermore, losses due to such causes are quickly discovered and the fact that they are occurring is emphasized by their inclusion in the waste charge.

5. Defective and Spoiled Material

Defective and spoiled material presents a much more complex problem than wastage. Defects may be discovered and spoilage may take place after considerable expenditure has been incurred in wages and overhead, and thus the cost of the original material is only a small part of the total loss.

Under the job order system, if the spoiled work consists of an article or product complete in itself up to the point when spoilage occurs, the total costs can be debited to a Spoilage account, which is also credited with the scrap value, if any, of the rejected product. The work is then started again. If the spoiled work consists of some part or parts required to complete a more complicated product, the accounting problem is solved by issuing a "Replacement Order." This is virtually a duplicate production order which authorizes the manufacture of a similar part or parts up to the point where the rejection took place. When the workman reaches this point he turns in the order and resumes work on the original production order. By this means the cost of replacing the spoiled work is ascertained with fair accuracy and is, of course, charged to the Spoilage account.

This plan is obviously not applicable to the process method of cost-finding. In bulk production a certain

percentage of spoiled work is often unavoidable and is perhaps not discovered until the finished product is inspected. In foundry work, for instance, castings frequently show defects after the molten metal has cooled, and these castings are then rejected. Here the defective material can be used again, and the simplest way of dealing with the spoilage is to ignore the defective product and base the cost on the perfect output. Thus, if twenty tons of metal are poured from the cupola, resulting in nineteen tons of perfect and one ton of defective castings, the total cost—less the material cost of the defective castings—is distributed over the nineteen tons to give the unit price per ton or pound. This is virtually treating the cost of the operations on the defective castings as overhead, which is the usual method of disposing of the cost of spoiled product—less any salvage value—under any system.

6. Scrap and By-Products

Scrap consists of the remnants or remainders of requisitioned material too small in size or value to be turned back to stores. Its accounting treatment depends on whether or not the scrap is of sufficient value to affect appreciably the cost of the product. If it is, the value of the scrap, less any cost of preparing it for sale, is usually deducted from the material cost of the production order or process on which it applies.

If the pieces of scrap are small and cannot be identified as coming from the material used on particular orders, their value should be credited to general factory expense, thereby reducing the overhead on the product.

Methods of handling and accounting for by-products are determined largely by the nature and value of the particular by-product and vary with the conditions of manufacture. In some cases, notably in the chemical industry, by-products have little or no similitude to the main product. Glycerine, for example, though a by-product in the manufacture of soap, is at the same time a separate and distinct product. For this reason, instead of being treated as an offset to the cost of material, it is considered as a manufactured article and is credited to the Work in Process account or to the account with the operating department in which it is produced, usually at its cost for material.

In wood-working industries scraps of lumber are often worked up into toys, in which case the toy department is usually charged with the pieces of lumber used at what is considered the market value.

7. Material Used "as Needed"

The material cost calculation is simplified when every item is drawn from stores on a requisition and can be charged at once to its own job order number. In some cases, however, operating conditions are such that requisitions cannot be used for all material. Thus, where material is exceptionally heavy or bulky as in the case of the material for heavy castings, it would be obviously impossible to requisition the exact amount required, and in such a case a report of material used takes the place of the requisition. In other cases it may be impossible to estimate the amount of material that will be used in the course of the day's work because much depends upon the speed of the operator. In other in-

stances it is impossible to estimate with any degree of accuracy because defects are liable to develop in the material in the course of manufacture. In such cases the operative should measure the quantity of the material used as work progresses and report this quantity on a suitable form, which as a rule is a combination time and material record. This is the usual practice in paper-box factories.

8. "Loss and Gain on Estimates" Account

When the quantity of material which will actually be used on a particular order cannot be determined in advance and must be estimated, an account termed "Loss and Gain on Estimates" is opened to show any difference between the estimated material required for individual jobs and the value of the material which is actually used.

Thus in a shoe factory, when a sample line is prepared at the beginning of the season, the quantity of calfskin required to make the upper leathers of the different styles of shoes is estimated by spreading the patterns over a calfskin and measuring the number of square feet they cover. The price of the skins is also estimated by taking an average price based on experience and a knowledge of leather prices. These estimates are used throughout the season as the basis of the material cost calculations. If, for example, a production order is issued for a certain number of cases of shoes of a particular style requiring calfskin uppers, the required number of calfskins are requisitioned from stores. But, in practice, the area of the calfskins actually issued is sometimes more and sometimes less than the estimated area

of skin required on an order, their cost varies from time to time, and careless cutting may increase the amount of skin used, so that the actual cost charged on the stores requisition rarely agrees exactly with the estimated cost of the skins. This difference is adjusted by debiting the Loss and Gain on Estimates account with the actual stores value of skins issued and crediting it with the estimated value plus the value of any pieces of calfskin returned to stores. Its balance, representing the difference between the actual and estimated cost of material, is ordinarily closed out to the expense of operating the stores department, i.e., Stores Expense or Material Burden account. (Chapter V, § 6.)

9. Material Wastage and Handling Expense

A problem which is sometimes met with in calculating the cost of material is where it undergoes changes before it can be used—changes which are sometimes so great that the purchase price bears little or no relation to the charge which must be made to the orders. The woodworking and the steel industries afford good examples of such conditions and of the methods by which they are met.

Thus lumber is purchased at so much a thousand feet and various charges, such as freight and hauling, are incurred in its delivery. Expenses are again incurred in sorting and stacking it, and before it can be used in the factory it must, as a rule, be kiln-dried and sawed into stock sizes. This results in considerable expense and wastage before the raw product is really taken into the factory stores.

The charges for freight, hauling, kiln-drying, saw-

ing, and so on, incurred before the lumber is ready to be delivered to the factory for manufacturing purposes, are easily handled. Their total is found and their sum divided by the total number of thousand feet of all kinds of lumber actually received. In this way a cost per thousand feet may be determined and added to the cost of lumber delivered to the factory.

The cutting of lumber into stock sizes before it is delivered to the factory results in a certain amount of waste. To determine the amount of waste a tally is kept of the number of pieces of each size cut. At the end of the cost period the total amount of material of all sizes cut from a particular kind or grade of timber is obtained. The difference between this total and the amount of lumber purchased gives the wastage for the cost period. The total amount of material cut is the net amount of lumber available for factory purposes and, when divided into the total cost of lumber, including all costs of freight, handling, drying, cutting, etc., gives the price per foot at which the lumber goes into the factory.

REVIEW QUESTIONS

1. What information is needed in order to make a calculation of the cost of material in a unit of the product?
2. What is the best method to use for pricing material which has been withdrawn from stores when several lots of the same kind of material have been mixed together?
3. What effect does an increase or decrease in weight due to atmospheric conditions have on the price?
4. How is waste material which is the result of manufacturing operations best handled when making cost calculations?

5. What procedure is followed in handling the cost of defective material which has been rejected during the process of manufacture?
6. What disposition should be made of the revenue received from the sale of scraps of material, such as cuttings in a garment factory?
7. What is the purpose of a Loss and Gain on Estimates account? Give an example showing the operation of such an account.
8. How is the wastage which results from the cutting of lumber applied to the cost of the factory product?

CHAPTER XIII

CLASSIFICATION OF STORES

1. Relation to Cost Accounting

Though the classification of stores and equipment belongs more to the sphere of factory organization and management than to that of cost accounting proper, the accountant is interested in the subject because success in the operation of a cost system is largely dependent upon the accuracy with which stores are accounted for. In a large plant where items of stores run into thousands, mistakes in handling and recording issues are certain to occur unless stores are so classified and symbolized that any one of the several thousand items can be accurately designated and described.

2. Necessity for Stores Classification

The necessity for some system of stores classification is perhaps most apparent in the mechanical industries where, without it, confusion, if not chaos, would inevitably occur in the handling of stores. A hundred or more different parts, scores of tools, and many kinds of supplies may be needed on a moderately complex mechanical job. To designate each of these by a distinctive and descriptive name would be so burdensome and result in so many errors that an easier and more accurate method is essential.

Even in industries where the need for classification is less obvious some attempt at it will always be found.

A walk through any manufacturing plant will show that though the stores-keeper may know little or nothing about the subject of classification, he still follows its first principles by arranging and grouping stores in natural divisions to facilitate handling and counting. Thus in a foundry and machine shop the lumber is usually stored in a shed near the pattern-making shop and classified as to kind and size; the pig iron is in the yard near the foundry, arranged in piles to facilitate counting; the castings are stored in the same fashion near the machine shop; in the general stores-room, commodities, such as screws, bolts, and nuts are arranged, according to size, in separate bins in a section devoted to each kind; oils and inflammable materials are placed in a separate fireproof building; and so on. Here we have a careful arrangement of stores to suit special conditions and in this way the principles of classification are applied.

3. Advantages of Classification

In addition to the obvious fact that the classification and symbolizing of stores and equipment save time and trouble in keeping stores records, a further advantage lies in the fact that the use of symbols compels accuracy in description and thus assists in pricing; reference to the stores ledger file is facilitated and when items are withdrawn for manufacturing purposes, or when an inventory is taken, there is no excuse for vagueness or guesswork in describing the article required.

If the foreman or other employee requisitioning stores is compelled to designate articles by their symbols, he must, before making out a requisition, first con-

sult the stores catalogue or other list to ascertain the symbols of the things wanted. Thus he selects precisely what he needs and describes the item with such precision that no mistake need arise in issuing it or in recording the issue on the books. In the same way, when an entry needs to be made on the stores ledger and one out of perhaps several thousand cards has to be picked out of the file, the card can be found much more quickly and accurately under its number than if referred to first within a class and then under a name within the class.

4. Systems of Stores Classification

There are two broad systems of stores classification —by means of numbers and by means of letters. Under both methods items of the same kind or class are first arranged in general groups to which a key number or letter is allotted. The number or letter which always stands as the first unit in a symbol of several numbers or letters indicates the group to which the item belongs. The remaining numbers or letters of the symbol designate the precise item in a subdivision of the group. Letters are sometimes combined with numerals, thus securing the advantages of both methods. In such a code the letters as a rule refer to the type and kind of article, and the numerals to its location or to its size, shape, or other physical characteristic.

A numerical code possesses one advantage over a letter code in that a number is to most persons more definite. Its position is more easily fixed, it can readily be found in a file or on a bin, and, if out of place, it is more likely to attract attention than a disarranged letter or combination of letters. On the other hand, a code

composed of letters is easier to memorize than a numerical code and for this reason is often used in small plants in which the items of stores are comparatively few in number, and a stores catalogue or other printed list is therefore unnecessary.

5. Numerical Classification Code

What is known as the "block" system of classification is the simplest of all numerical codes. Blocks or series of numbers are assigned to each main class for the purpose of numbering the items within that class. Thus, the numbers 1 to 999 may be allotted to office supplies. Within this block 1 to 99—or as many of these numbers as necessary—may indicate various kinds of plain paper, 100 to 199 the firm's stationery, 200 to 299 desk stationery supplies other than paper, and so on.

The limitation of this method is that as the blocks of numbers are assigned to broad divisions and items within a class are arbitrarily numbered, the mind does not readily associate any number with a particular article. When certain numbers are used to describe certain generic groups—as in the method to be described in the following section—this limitation is not found.

6. Dewey Decimal Code

The Dewey decimal system of classification as used in many public libraries is an elaboration of the block system. Its special feature is the adaptability of the code to new numbers. Because of this elasticity and the clearness with which it designates an article as belonging to a certain generic class, it is finding favor in plants where numerous items of stores are kept in stock.

To explain the operation of the system, it may be assumed that in the stores-room of a wholesale hardware concern many kinds of hand tools and implements are kept in stock and that the number "5" is allotted to the entire class of hand tools. The first broad division designates the general type of tool; that is to say, the first figure in the symbol "5" stands for any kind of hand tool. The second figure narrows the field of a thousand or more possible hand tools by indicating their use, e.g., 51 for the pounding hand tools (the 5 designating a hand tool, the figure 1 its character); in the same way 52 may indicate boring and piercing hand tools, and so on. Having by the use of the symbol 51 narrowed the field to a tool used for the purpose of pounding, the third figure may indicate the kind of pounding tool—511, for example, standing for all classes of hammers. Having arrived at the type of article, the next step is to describe one of a particular kind. This is done by the introduction of a decimal point and the use of further numbers; 511.1, for instance, may stand for tack hammers, 511.2 for claw hammers, while 511.11 may indicate a special size of tack hammer, and so on. It should be noted, however, that there can be no more than nine main groups, no more than nine subdivisions of each main group, no more than nine divisions of these sub-groups, etc. This difficulty may be met by using letters after the ninth item—for instance, 511.9 may be followed by 511.A, 511.B, etc.

The construction of such a code is illustrated in the following example:

500 Hand tools, and implements

510 Pounding tools

520 Tools for dividing and trimming solids (axes, saws, chisels, scissors, clippers, scythes, and other cutters)
530 Shaping, planing, surfacing, molding, sharpening, filing, and thread-cutting tools
540 Boring and piercing tools
550 Tools for holding and manipulating solid bodies (frames, wrenches, screwdrivers, keys, hooks)
560 Tools for scooping, shoveling, and digging (spoons, shovels, forks, rakes, scoops, and diggers)
570 Tools for blowing, pumping, directing, sifting, and stirring (except shovels, spoons, scoops, and brushes)

The complete code for hammers might read as follows:

500 Hand tools, utensils and implements
510 Pounding tools
511 Hammers
511.1 Tack hammers
511.2 Claw hammers
511.3 Sledge hammers

A key must first be used to operate the code until familiarity with the numbers is acquired. With practice the mind quickly identifies particular groups, and classes within the group, with certain numbers. The feature of this system is the association of certain types of articles, not only with specific numbers, but with the position of the number in the code.

7. Mnemonic System of Letter Classification

A classification code made up of letters which so far as possible are mnemonic, i.e., suggestive of the name to which they refer, can only be used with advantage when the main classifications on the list do not exceed in number the letters of the alphabet. A symbol when associated with a particular article by means of its initial letter is easily remembered, and reference to a key or catalogue list soon becomes unnecessary.

In making up a mnemonic code a base sheet is first prepared. This consists of the letters A to Z, with I and O omitted because they resemble numerals. To each letter is allotted the name of a main class; thus if "S" stands for "Stores," a symbol in which S appears as the first letter would denote some item of stores. The next step is to prepare a secondary sheet or list of different kinds of stores. For example, the classification of stores in the kitchenware department of a wholesale hardware concern might be:

A	Aluminum	M	Enamel and agate ware
C	Chinaware	N	Nickel ware
E	Earthenware	P	Copper ware
F	Fibrous ware	R	Rubber goods
G	Glassware	S	Steel and iron ware
H	Hardware	T	Tinware
K	Crockery	V	Stoves
L	Lighting fixtures	W	Wooden ware

It will be noticed that in twelve out of the sixteen items listed the initial letter of the word is used; in the

remaining cases the initial is suggested by the sound of the word.

To carry the classifications a step further, in codifying, say, chinaware, B may be used for bowls, C for cups, P for pitchers, S for saucers, T for platters, and so on, with numbers to designate the particular kinds of pitchers, bowls, etc., carried in stock. Thus, the complete symbol for a special pitcher carried in the chinaware section of the stores department may be S C P 10. Such a symbol is much more easily impressed on the mind than one composed wholly of numerals.

8. Combination Code

Numerals are sometimes combined with letters to furnish information according to their position in the code. Suppose, for example, that a large concern operates a number of stores-rooms in different parts of its plant. In such a case requisitioning is simplified if the stores-rooms are numbered and the numbers are introduced in the symbol after the letter "S" to indicate the location of the particular item referred to in the code. Thus, to take the preceding example, if kitchenware is stored in room 5 the symbol for pitchers becomes S^5 C P 10, the number being smaller in size than the letters and printed above the line. Numbers are frequently used in this way to indicate different brands and sizes of the same article.

9. Important Points in Devising a Code

The system of classification to be simple and logical should be based upon the physical characteristics of stores and equipment. Where many thousand items

are to be classified, study will reveal that many of these have qualities in common, allowing logical grouping into main and sub-classifications. Unless the code is logically arranged and easy to understand, workmen are apt to shirk its use and in consequence mistakes occur. The main object of symbolizing is to furnish an abbreviated means of accurately designating any article. Therefore, the ideal code is one that condenses specific information within a brief symbol which is easy to memorize and which cannot be confused with another symbol.

Whatever the code adopted, it should be definite enough to prevent any article finding its way into more than one class and complete enough to include all stores and every piece of equipment; it must be elastic so that additional items of stores and equipment can be inserted as they come into stock without disturbing the arrangement of the articles already classified. The dumping of unclassified items into a miscellaneous section should be avoided.

10. Stores Catalogue

After all main and sub-classes of the code have been decided upon and after a symbol has been assigned to each article within a class, the final step is to prepare a catalogue which will serve as an index to the stores classification. Confusion is apt to arise in the handling of items because of slight differences between two articles of the same kind which are hard to describe or because sizes are not clearly specified or because the proper designation of a particular item may not be known. Such confusion is obviated by the use of a catalogue of stores which furnishes a correct description of every item of

material and supplies carried in stock, so grouped and arranged that reference to its code number requires but a moment.

REVIEW QUESTIONS

1. What purpose is served by a classification of stores?
2. What is meant by the numerical system of stores classification? What are its advantages and disadvantages?
3. What is the mnemonic system of stores classification? What are its advantages and disadvantages?
4. What is the block system?
5. What is the Dewey decimal code? Illustrate.
6. What is a combination code? Illustrate.
7. What purpose is served by a stores catalogue?

Part V
Labor Costs

CHAPTER XIV

RECORDING THE COST OF LABOR*

1. Labor Cost Problems

As labor is always an important element of cost and often constitutes the largest item in the cost of manufacture, the importance of accurate labor records cannot be emphasized too strongly. Without such records there can be no accurate cost accounting, nor as a rule can there be economical production. If labor is wrongly reported, the cost records will be meaningless or misleading; some jobs may show too high a labor cost and others too low. If labor is lost or frittered away, the cost records should disclose the fact and point the way to such investigations and action as will prevent its recurrence.

The computation of the direct labor cost of a product is comparatively simple and there is no reason why it should not be accurate. A predetermined wage is paid for either the productive time of workers or for the number of pieces produced and these wages are always a matter of record on the factory books, whether or not a cost system is in operation. For cost purposes it is only necessary to apply these wages to the product upon which the labor has been expended.

Under the process method the procedure for obtaining labor cost is simple, requiring little, if any, special mechanism. Under the job order method the procedure

*See Volume II, Chapter XXVI, "Labor and Salaries."

is more complex. Special forms are required to connect the wages of the individual workers with the different orders on which they may have been engaged during the cost period. The forms used and the routine followed vary with conditions.

2. Labor Costs under the Process Method

The labor records of a cost system have a dual purpose: (1) to supply pay-roll data upon which the wage payments to employees may be based, and (2) to supply information as to where or how the services of employees are expended, so that proper charges may be made against the product.

Under the process method, the same pay-roll which records the wages and the salaries of the employees can also be made to show the labor cost on processes and thus the labor cost of the product. This result is secured by the segregation or grouping on the pay-roll of the names of employees by departments. The total of wages and salaries of each department is taken from this pay-roll and charged to the proper departmental process accounts at the end of the period. It is unnecessary to distinguish between productive and non-productive labor. The clerk, the foreman, and the floor-sweeper on the pay-roll of a process department are considered for accounting purposes as essential to production as the workmen who do the actual productive work in the department. The salaries of the administrative officers, superintendent, inspectors, time clerks, watchman, and others who are not directly connected with any particular department should be charged to general expense.

If only the labor cost of the unit of production is desired, the labor cost of each department or process divided by the total output for the period gives the labor cost per unit for each department, and these departmental labor costs added together give the total labor cost for each unit of output. Or the sum of the labor costs of all processes or departments for the period divided by the total output for the period will likewise give the total labor cost for each unit of production.

3. "In and Out" Time

Where labor is paid for on a time basis, as is usually the case under the process method, the original factory document from which the time chargeable to each department is entered on the pay-roll is the "gate" record, on which is registered the time when the employee enters and when he leaves the factory or his department. This time card or ticket bears the same relation to the pay-roll that an invoice bears to the purchase journal. The pay-roll classifies purchases of interior personal service, as the purchase journal classifies purchases of goods and exterior service—in both cases the allocation, so far as possible, being to departments.

The gate record is commonly kept by means of a time clock. The superiority of this method in comparison with the old-fashioned check system is so obvious, and time-recording mechanism of one form or another is now so universally used, that a detailed description of the method is unnecessary. The gate record presents documentary evidence of the hour and minute when employees enter and leave the premises and gives an authoritative basis for labor charges, incidentally distin-

guishing between those employees who are late and those who are punctual.

4. Job Order Labor Costs

A clock of the type used to record gate time indicates the hours of arrival and departure. This meets the requirements of a process cost system—particularly if departmental time clocks are used—but is not adequate for a job order system, as a record based on gate time obviously does not indicate how time is spent within departments. For job order purposes the gate time record, if kept, must be supplemented with time cards or some similar means of showing in detail the disposition of the employee's time and the amount of wages to be charged to each order.

Whatever the system of time-keeping employed, the pay-roll in a job order cost system should classify the employees by departments to determine the departmental labor cost, and in addition should be so ruled as to separate direct and indirect labor. When this is done the totals of the current payments for direct labor chargeable to orders—which must, of course, equal the sum of the detailed labor charges to orders for the same period—can be taken from the pay-roll, as can also the indirect labor charges for the departmental expense accounts. Under this method, the payments to workmen who fashion the product appear in one column as a direct labor charge, while the time of superintendents, foremen, and general utility men appears in another column as a charge to general expense or the expense account of some operating or service department, as the case may be.

5. Time-Work

Productive labor is paid either on a time basis, or by piece-work, or by some bonus or premium plan which is a combination of both time- and piece-work. When time rates are complicated by the payment of premiums or bonuses for production above the established standards, the computation of labor costs is sometimes a matter of difficulty.

Where direct labor is paid for at different hourly rates based on the grade and skill of the worker, the amounts to be charged to orders and entered on the pay-roll are obtained through the medium of individual time records. Here the forms used will be determined by the conditions of manufacture, the object in all cases being to show on which orders an employee has worked and the time devoted to each order day by day.

In recording time, it is important to obtain an exact agreement between the pay-roll totals of productive labor and the various amounts charged to the different orders. Thus, if a workman arrives at eight in the morning and leaves at noon, his total time for the forenoon as shown by the gate record is four hours and the record in the shop should also show four hours of labor—less any lost time. These four hours may have been devoted to one job or may perhaps have been divided among a number of jobs according to the conditions. To ascertain whether or not this agreement exists, the daily total hours charged to orders in each department, as taken from the workman's time tickets, should be compared with the daily gate time and any differences recorded. The gate time thus serves as a check on the accuracy of the shop time. The time records for each day

should be checked up on the morning of the following day and any discrepancies should be immediately inquired into while the details are fresh in the memory of all concerned. These discrepancies may arise from many causes. Sometimes mistakes are made in entering time on the tickets, or odd quarters and half hours lost by tardiness are not deducted on the time tickets.

When the gate and shop records agree, the time on the individual time tickets is extended in terms of money. The time tickets are then classified by order number, entered on the cost sheets of the orders to which they apply, and passed on to the pay-roll department. Here they are sorted by clock numbers—which appear on the time tickets as well as on the gate record—and the amounts representing wages due to productive workers are entered on the department pay-rolls. By checking day by day the total number of hours charged to orders and to expense (see Chapter XV) with the gate time, and by using the shop time records as the source of both the pay-roll and the cost figures, an agreement between the total amount of wages for the period and the wages charged to orders and department expense can be obtained daily, weekly, or monthly, as required.

6. Piece-Work

The forms of time tickets or other records used for computing the labor cost on orders naturally vary with the conditions of manufacture and shop routine. Where labor is paid for by the piece the time record usually takes the form of a piece-work slip or ticket (Form 26, page 186), the purpose of which is to record the quantity produced, the wages to be paid, and the number of

the production order to which the wages are to be applied.

One difficulty in piece-work is the verification of the quantity produced. Where articles are made to be turned into stores, the stores-keeper's record of the quantity received may be taken as proof of the correctness of the piece record. In many factories, however, work passes from hand to hand—as in a jewelry factory. Here the numerous operations performed on the product are often paid for by the piece. Since the number of pieces may diminish as defects develop, or as work is spoiled in processing, the stores-keeper's record is no longer a safe check on the piece-work records. The verification of the quantities shown on the individual records under such circumstances will vary with the conditions and falls more within the province of shop management than that of cost accounting. The cost accountant is chiefly concerned with the labor pricing of the pieces produced, with the entry of the wage amount on the pay-roll, and with the proper charging of this amount to the order by means of its cost sheet.

It is clear that if all work on an order is paid for at piece rates, a summary of the piece cost slips or tickets belonging to this order will give its productive labor cost. It is clear also, that if a summary of the productive labor for the period as entered on the pay-roll is made, the figures should agree with the summary of the current piece cost slips which are debited to the controlling Manufacturing or Work in Process account. This agreement establishes the fact that the current productive wages recorded on the pay-roll have been in one way or another charged to orders.

7. Pay-Roll Form and Procedure

The precise form of the pay-roll is immaterial so long as it classifies the total wages of the period by departments and, in a job order factory, so long as it distinguishes between productive and non-productive labor within the operating departments. When the cost period does not always coincide with the pay period, as where the cost period is a month and wages are paid weekly, the cost accountant's work is simplified by showing the amount of wages due to each worker—whether on an hourly, weekly, or salary basis—day by day. The pay-roll columns can then be footed and posted at any time.

The general procedure in entering up the pay-roll is as follows: As checks are drawn for wages and salaries at the end of each pay period, the account kept with wages and salaries in the general ledger is charged with the amount. At the end of the cost period the amounts thus accumulated (plus any wages accrued should the cost period not coincide with the pay period) are closed out in accordance with the classification of wages and salaries shown on a pay-roll analysis sheet. In other words, under the process method, Wages and Salaries account is closed out to departments; under the job order method direct labor is closed out to the controlling Manufacturing account or accounts, and indirect labor and salaries to the departmental expense accounts.

Whether one controlling Manufacturing account or separate productive department Work in Process accounts are used to record the cost of manufacture, the only difference in the procedure is in the closing entries

to Pay-Roll (or to Salaries and Wages account) which under the process method shows the distribution to the several departments. The following journal entry which summarizes the labor operations of a woolen mill is typical:

Stock in Process (Dye House)	$.....	
Mixes in Process (Picker Room)	.....	
Yarn in Process (Carding and Spinning)	.....	
Cloth in Process (Weaving)	.....	
Cloth in Process (Finishing)	.....	
Maintenance and Building Up-keep	.....	
General and Office Expense	.....	
To Pay-Roll		$.....

To distribute pay-roll charges.

8. Accuracy of Records

The accuracy of the entry to the Manufacturing account (or accounts) may be tested by summarizing both the current shop time tickets or sheets and the current charges for labor on the cost sheets. The three totals should be in agreement. The accuracy of the totals of indirect labor charged to the various department expense accounts can be tested by comparing the total indirect labor for the period with a summary of the indirect wages entered on the current standing expense orders—the operation of which is explained in Chapter XVIII.

As the labor cost is usually a very large part of the value of a product, the time spent on any job should be kept with the strictest accuracy. Moments wasted here and there, particularly when beginning and quitting work, may seem of no importance, but in a large factory they amount in the aggregate to a serious item of cost.

Such waste is caused by lack of discipline. To maintain discipline reasonable rules should be prepared and enforced and employees should be impressed with the importance of economy in the use of time and of exactness in recording it.

REVIEW QUESTIONS

1. How is the labor cost applied to the products in a process factory, such as a flour mill or a tannery?
2. How is labor cost distributed in a job order factory where operators are paid by the hour, as in a sheet metal or novelty goods establishment?
3. How should the pay-roll be analyzed in a job order factory?
4. What internal check do labor cost records afford on the pay-roll?
5. How is the labor cost applied where operators are paid by the piece, as in shoe, glove, and clothing factories?
6. To what accounts is the pay-roll charged in process factories?
7. What entry is made to distribute the pay-roll in a job order factory?

CHAPTER XV

TIME AND PAY RECORDS

1. Individual Job Tickets and Time Reports

There are two general methods of recording the productive time chargeable to orders. The first method requires the use of an individual time card or other form of time ticket to report the time expended on each order number. In this case any time which elapses between the finishing time of one job and the beginning time of another is not shown on the two time tickets used because they record only the actual time worked; the interval between the jobs is lost time. The second method is to record on a single time card or sheet the complete disposition of each man's daily time; in this way any idle time or time devoted to unproductive labor appears upon the time report as the worker must account for his full time thereon.

The advantages of the individual order number card are its flexibility and the ease with which labor can be calculated by classifying the cards under orders and operations. A disadvantage is the liability to error where the record is made on separate cards, the tendency being to charge more time to orders than is actually worked, especially when operations are frequently changed. When the disposition of the total hours worked is made upon a single report form there is no loophole for odd quarter- and half-hours to be charged to two orders. A drawback to the use of time reports

of this nature is that the time spent on orders cannot be so readily determined when one report relates to several orders as it can when each time card relates to its own particular order.

The first method is generally used when it is desired to ascertain the cost of different hand or machine operations performed upon a particular piece, as in machine work. The second method is commonly employed in shops where the operations are not sharply defined and where the same kind of work may be done by men paid at different rates. In such a case any man competent to do a certain class of work does it regardless of his rate of pay and the cost charge for such work—as in the composing room of a printing plant.

2. Making the Time Record

The safest time report is that in which the beginning and finishing time is recorded by a time clock or stamp. It is usually impossible for employees to tamper with a mechanical time recorder and its use effectually precludes the falsification and evasion so easily possible when the time records are made by hand.

If mechanical time recorders are not employed, reports must be made out by hand, the method varying according to the conditions. In some shops the men themselves make the time record. In others, a timekeeper circulates among the men and records the time of each job. In some cases the foreman is the official timekeeper and enters the time as the workmen report to him. None of these plans is entirely satisfactory. Almost invariably when the men report to a timekeeper they make a pencil memorandum of the time to be re-

ported and, if the workman's memorandum is depended upon at all, it might better be the final entry than a preliminary note. It may also be said generally that it is not conducive to accurate records to require shop hands to do clerical work. The time entries are better made by the mechanical recorders which do the "accounting," thus requiring of the workmen only the actuating impulse.

A certain amount of "filling in" is, of course, necessary with any kind of time card. The body of the card is best made out by a clerk or the foreman of the factory, leaving only the starting and stopping time to be filled in by the workmen. If a time recorder is used, the entry of this starting and stopping time is a purely mechanical act on the part of the workmen.

3. Non-Mechanical Daily Time Cards

Form 20 shows how the time of operators in a machine shop is recorded against a particular order. The employee's number, the date, and the order number are entered at the top of the ticket. A description of the job follows, the operation to be performed is punched at the side, and the time when the operation begins and ends is punched at the bottom of the card, the day being divided into intervals of a quarter of an hour each. The elapsed time is entered on this card and is extended at the operator's rate in order to determine the labor cost chargeable to the job.

A summary of the time recorded on all cards bearing the same job number, classified by operations, gives the direct labor cost on the job by operations. A further classification to show the cost of hand work as distin-

Assembling	Employee No.____ Date____ 19	Laying Out
Boring	Shop Order No.____	Milling
Boxing	— FOR HAND WORK PUNCH OPERATION TWICE —	Painting
Centering	Description ____	Planing
Drilling	____	Shaping
Facing	____	Tapping
Filing	____	Testing
Fitting	____	Threading
Grinding	Quantity____	Turning
Keyseating	Hours____ Rate____ Amount $____	

7	¼	½	¾	8	¼	½	¾	9	¼	½	¾	10	¼	½	¾	11	¼	½	¾	12	¼	½	¾
1	¼	½	¾	2	¼	½	¾	3	¼	½	¾	4	¼	½	¾	5	¼	½	¾	6	¼	½	¾

Form 20. Time Card—Machine Shop

Operator No.	GENERAL	Order No.
Name	Date	
Quantity	Description	

				7		X	¼			½			¾			8			¼	
		½			¾			9			¼			½			¾			
10			¼			½			¾			11			¼			½			
	¾			12		0		¼			½			¾			1			¼	
		½			¾			2			¼			½			¾			3			¼			½	
	¾			4			¼			½			¾			5			¼			½			¾	
6			¼			½			¾			7			¼			½			¾			8			¼
		½			¾			9			¼			½			¾			10							

Time	Piece	Approved Foreman	Hours	Rate	Value

Form 21. Time Card, showing Five-Minute Intervals

guished from machine work is secured if the instruction, "For hand work punch operation twice," be observed.

If operatives work on only two or three jobs each

day, the use of a card which is divided into quarter-hour intervals gives good results.

When greater precision in the time record is desired, the hour may be divided into smaller fractional parts, as in Form 21. Here the empty squares between the quarter-hour periods represent five-minute intervals. An operative who begins work at 7: 10 A.M. makes an "X" in the second space after 7, and if he finishes at 12: 05, makes an "O" in the first space after 12, as shown on the card. The requirements of each case must, of course, determine into what intervals it is advisable to divide the hour.

The ticket illustrated in Form 22 shows a "ready reckoning" method of keeping time on jobs in a brick plant where the day is divided into six-minute units. Mechanics and members of the machine gang report time on each job by marking the starting time with an "X" and the finishing time with an "O." For example, if the time ticket is "crossed" at 8: 12 and "circled" at 3: 36, the number of hours is counted downward, amounting in this case to 6, the noon hour being omitted and the number of tenths is counted across, giving in this case .4. Adding these gives 6.4 hours as the elapsed time on the job. The reading of such a time ticket is so simple that it can be done almost as readily as if the figures were written out.

4. Mechanical Time Recorder

As already stated, where an accurate record of the time spent on jobs is a necessary part of the cost system, the use of time clocks within the shops is to be recommended. Such a method of recording time elimin-

DIRECT LABOR TIME CARD

Indicate starting time with a cross (X)
Indicate stopping time with a circle (o)

NAME _____ NO. _____

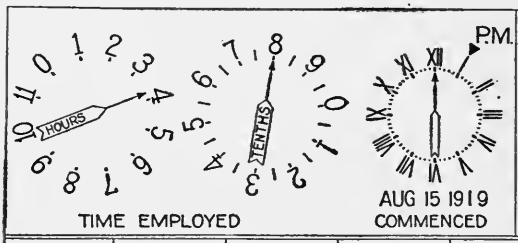
7	7.06	7.12	7.18	7.24	7.30	7.36	7.42	7.48	7.54	ARTICLE
8	8.06	8.12	8.18	8.24	8.30	8.36	8.42	8.48	8.54	
9	9.06	9.12	9.18	9.24	9.30	9.36	9.42	9.48	9.54	
10	10.06	10.12	10.18	10.24	10.30	10.36	10.42	10.48	10.54	SIZE
11	11.06	11.12	11.18	11.24	11.30	11.36	11.42	11.48	11.54	12
1	1.06	1.12	1.18	1.24	1.30	1.36	1.42	1.48	1.54	JOB NUMBER / BLUEPRINT OR DRAWING NO.
2	2.06	2.12	2.18	2.24	2.30	2.36	2.42	2.48	2.54	
3	3.06	3.12	3.18	3.24	3.30	3.36	3.42	3.48	3.54	
4	4.06	4.12	4.18	4.24	4.30	4.36	4.42	4.48	4.54	○ Check here if Job NOT finished
5	5.06	5.12	5.18	5.24	5.30	5.36	5.42	5.48	5.54	6 USE SEPARATE SLIP FOR EACH JOB

Hours	Tenths	Quantity Done	Rate	Noted	
				FOREMAN	DATE

Form 22. Time Card—Brick Plant

ates not only human fallibility and fraud but any charge of favoritism on the part of the foreman as well, while its records are quickly made and are beyond dispute.

Form 23 illustrates a convenient method of measuring by mechanical means shop time spent on jobs. It differs from the ordinary clock card which gives the beginning and finishing time, inasmuch as it gives the number of hours and minutes actually spent on the job. Of



Boring	Drilling	Grinding	Planing	Tapping	Time Allowed
Chipping	Facing	Milling	Roughing	Threading	Premium Credit
Cutting Off	Filing	Mounting	Shaping	Turning ✓	Foreman

Quantity _____ Total Time 3.8 Rate 30 Cost _____

Form 23. Mechanical Time Card

the three "dials" shown on the face of the card, the one to the right records by means of the triangular-shaped wedge the time the operation begins. This record is stamped on the card by inserting it in the clock and pulling a lever. After the "commenced" time is stamped in this way, a reverse pull on the lever prints the two dials over "time employed" *but without showing the arrows.* When the work is finished the card is inserted again and a pull of the lever prints in the arrows, showing in hours and tenths of an hour, the time the opera-

tion has occupied. Form 23 shows that employee number 54 began work at 1 P.M. on August 15, 1919, that he performed a turning operation on job 125, and that he worked 3.8 hours, the dial in the center recording the time by tenths of an hour.

The object of indicating time by hours and tenths of hours in this way is to facilitate the computing of the labor cost. For example, it is much easier to multiply 3.8 by 30 cents per hour and obtain $1.14, than to apply the hourly rate of 30 cents against 3 hours and 48 minutes. Such a card as this simplifies the task of making up the pay-roll and insures reports for the full time spent on particular jobs.

5. Daily Time Sheet

Under some conditions, as previously stated, the disposition of each man's daily time may be more conveniently recorded on a single sheet than on a number of tickets. Such a sheet is illustrated in Form 24. The feature of this record, which is used in the composing room of a printing establishment, is the ease with which time may be charged against orders. Its operation can readily be understood by a study of the form. Assume that work on order No. 100 begins at 5: 12 P.M. and ends at 6: 30. Lines are drawn under the nearest six-minute interval to the beginning and ending times and carried across beneath the figures in the next column. The first column gives the beginning and ending time; the second column by a simple calculation gives the elapsed time. This time in hours and tenths is determined by deducting the figures opposite the starting time in the second column from those opposite the

TIME SHEET NAME _____ HOURS ___.___

Use an X in the column that shows the kind of work done and draw a line through time across the page

ORDER NO.	CUSTOMER OR PUBLICATION	NAME OF ADVERTISER	SIZE OF ADV.	PROPORTION SET	COMP	CORRECTIONS Hand	CORRECTIONS Lino.	CORRECTIONS Mono.	ALTERATIONS Hand	ALTERATIONS Lino.	ALTERATIONS Mono.	WORKING TIME		MAKE-UP	Lock-Up	Lock Fdy.	Dist.	MISCELLANEOUS For Register or Corrections on Press, Smash, Handling Cuts, Etc.	FOR OFFICE USE Charge-able	FOR OFFICE USE Non-Charge-able	IN - NIGHT
												5.00									
												5.06	0.1								
												5.12	0.2								
												5.18	0.3								
												5.24	0.4								
												5.30	0.5								
												5.36	0.6								
												5.42	0.7								
												5.48	0.8								
												5.54	0.9								
												6.00	1.0								
												6.06	1.1								
												6.12	1.2								
												6.18	1.3								
												6.24	1.4								
												6.30	1.5								
												6.36	1.6								
												6.42	1.7								
												6.48	1.8								
												6.54	1.9								
												7.00	2.0								
												7.06	2.1								
												12.30	7.5								
												12.36	7.6								
												12.42	7.7								
												12.48	7.8								
												12.54	7.9								
												1.00	9.0								
												1.06	8.1								
												1.12	8.2								
												1.18	8.3								
												1.24	8.4								
												1.30	8.5								
												1.36	8.6								
												1.42	8.7								
												1.48	8.8								
												1.54	8.9								
												2.00	9.0								

OUT - LUNCH

OUT - FINAL OR BEGINNING OVERTIME - (INDICATE WHICH)

TOTALS

GROSS

WORKING HOURS
6.00 P.M. TO 10.00 P.M.
10.30 P.M. TO 2.00 A.M.

NIGHT

USE OVERTIME TICKET FOR ALL OVERTIME

PLEASE READ CAREFULLY AND OBSERVE INSTRUCTIONS ON REVERSE SIDE

Form 24. Individual Daily Time Sheet—Printing Plant

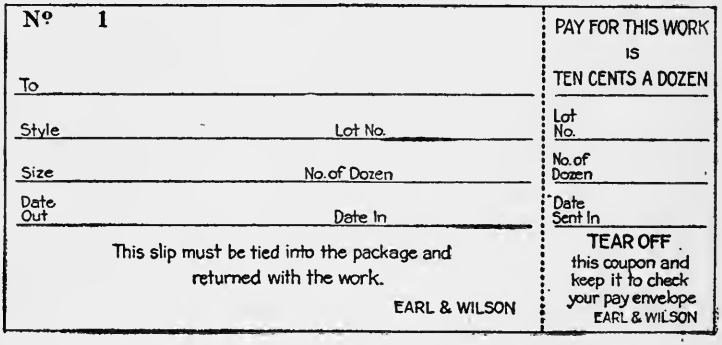
ending time. Thus 0.2 deducted from 1.5 gives 1.3 hours to be charged to order No. 100 for composition — as would be checked in the column so headed.

In the spaces provided on the right side of the form the gate time is stamped by means of a clock stamp and the total hours worked are entered in the space at the right-hand upper corner. Thus the time to be entered on the pay-roll, which can be seen at a glance, is distinguished from the time chargeable to orders, and one entry checks the accuracy of the other.

By changing the headings in the columns of Form 24 this time sheet can be adapted to meet the conditions of almost any job order establishment.

6. Piece-Work Records

Forms for recording the labor cost of piece-work cannot be standardized to the degree possible with time-keeping records. The conditions under which piece-work is carried on, and the method of inspection and payment to some extent determine the design of the forms used. In many cases a piece-work card or slip,



Form 25. Piece-Work Slip

recording quantity and price, may also be designed to serve as a receipt for work done or even as a voucher for payment of wages to the employee. For this purpose the piece-work slip or card is made in coupon form. The coupon is detached when the work is completed and retained by the employee as a receipt for work done and as a check on the amount in his pay envelope.

A simple form of piece-work slip is shown in Form 25. The information it records is self-explanatory and the convenience of the coupon feature is equally apparent. The body of the card goes to the accounting department for use in making up the pay-roll and in determining the labor charge to orders. The coupon is retained by the employee as a receipt for work done, to be used in case of any question as to the wages due him.

A more elaborate use of the coupon feature is shown in Form 26. This type of record is especially suitable for a factory routine in which the unit of production passes through a number of hands before the round of operations performed upon it is completed. The form shown is used in the cloak and suit industry and represents a tag which is attached to a garment when operations are paid for by the piece. The operations are listed and numbered from the bottom upward in their sequence of manufacture and in coupon form, so that the coupons when detached and checked by the foreman in charge serve as a voucher for the payment of wages. The numbered squares in the center of the tag are used to place responsibility for defective work—by the simple expedient of entering the clock numbers of the workers in the squares which correspond in number with the coupon for the operations performed.

EMPLOYEE'S PIECE-WORK COUPON

THE A.B. CO. Date _____

Buttonholes			Soft Roll		
D.S. $\frac{1}{4}$ $\frac{3}{8}$ $\frac{1}{2}$		Lap Seam $\frac{1}{4}$ $\frac{3}{8}$ $\frac{1}{2}$	S.S. $\frac{1}{16}$ $\frac{1}{8}$ $\frac{1}{4}$		
Style			Silk		
1	5	9	13	17	21
2	6	10	14	18	22
3.	7	11	15	19	23
4	8	12	16	20	24

As each workman detaches the coupon corresponding with the operation which he performs he must also enter his clock number in the proper space above.

24 Basting Puller	23 Buttonhole Presser
22 Edge Stitcher	21 Finisher
20 Collar Maker	19 Collar Sewer
18 Collar Shaper	17 Collar Presser
16 Armhole Baster	15 Armhole Presser
14 Sleeve Sewer	13 Lining Baster
12 Edge Baster	11 Sleeve and Tape Presser
10 Tapes	9 First Baster
8 Shaper	7 Canvas Baster
6 Pocket and Seam Presser	5 Pocket and Collar Maker
4 Canvas and Lining Presser	3 Lining Maker
2 Sleeve Maker	1 Trimmer

Form 26. Piece-Work Tag—Suit and Cloak Industry

7. Pay-Roll Records

The form of the pay-roll is determined by the length of the pay period, the system of paying wages (by the time or by the piece), and the details to be entered. Form 27 is a loose-leaf sheet designed to record both time and piece rates in an establishment manufacturing underwear, where the larger part of the work is paid for by the piece. The daily time is entered in the columns under "Day of Week." Overtime and piece-work appear in the next columns. Wages are distributed in the columns showing the manufacturing classifications, and from the total for the week any necessary deductions are made as indicated on the form. In the columns to the right of the form provision is made for calculating the different denominations of money needed to fill the pay envelopes. Non-productive labor is usually calculated on a separate pay-roll analysis sheet.

The feature of Form 28 is the use of one permanent or "master" sheet and a number of shorter sheets so designed as to dispense with the rewriting of names week after week. The names of the workmen are written on the long sheet, which remains in the binder until the end of the year, or until changes among the employees necessitate its rewriting. A short sheet is inserted weekly. At the end of the year the binder is emptied and its contents are bound for future reference.

Form 29 simplifies the pay-roll record by omitting names and listing merely employees' numbers and amounts due under the heads of productive and non-productive work in each department. The entries are made by means of an adding machine. This simplification of the pay-roll work can be carried out with safety

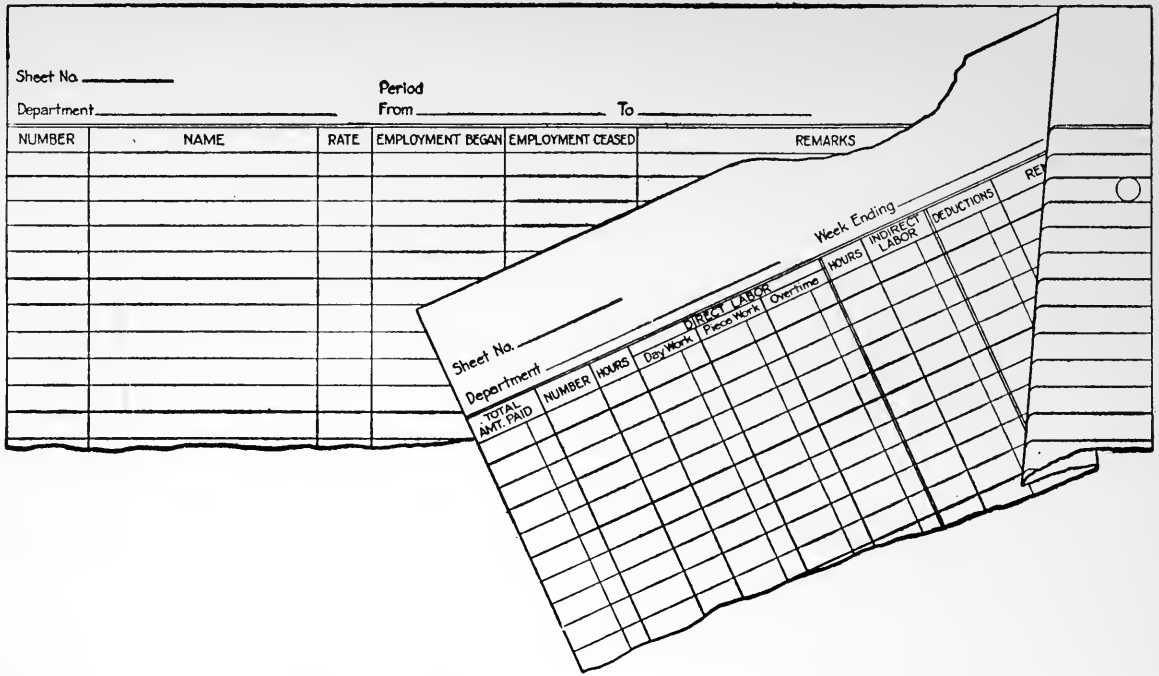
TIME AND PAY-ROLL

FOR THE WEEK ENDING _____

○	NAME	DAY OF WEEK						TOTAL HOURS	EXTRA OR DAY TIME	PIECE-WORK	UNDERWEAR	MITTENS	SUS-PENSORIES	SHIELDS	TOTALS
		Mon.	Tue.	Wed.	Thur	Fri.	Sat.								

LATE	RENTS	MISC.	BALANCE	EXTENSION							
				5	2	1	50	25	10	5	1

Form 27. Pay-Roll Record



Form 28. Pay-Roll Record (master sheet and short weekly sheet)

either under the process method or when shop time tickets are used as the basis of the record and shop time is checked in detail and in total against gate time and

PAY-ROLL

Week Ending _____ Department _____

	NON-PRODUCTIVE		PRODUCTIVE		TOTAL	
	No.	Amount	No.	Amount	No.	Amount

Form 29. Pay-Roll Record—Simple Form

against the current cost sheets as outlined in Chapter XIV, § 5.

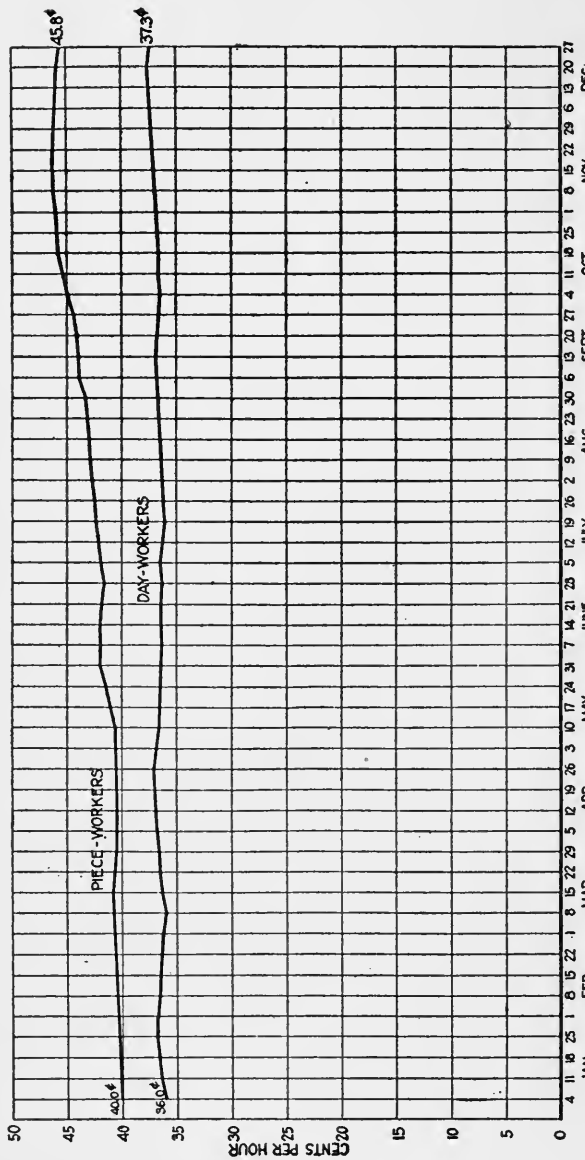
8. Pay-Roll Statements and Graphs

The work of the cost accountant should include statements showing variations in cost as they occur from period to period. This is especially true when the factory is separated from the main office so that conditions

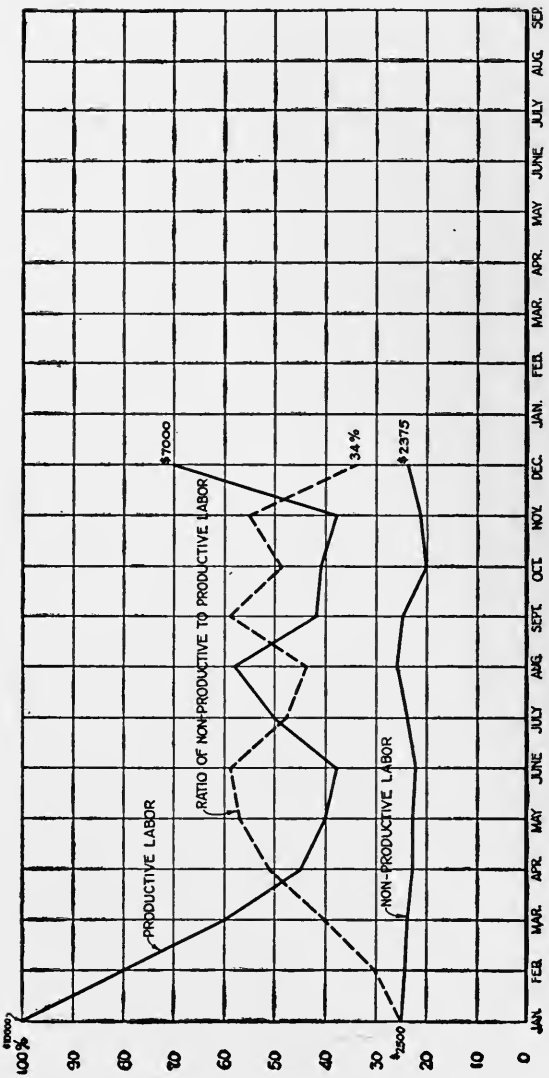
cannot be observed daily by the chief executives. The precise form of the statistical work will obviously be determined by the phases of the business in which the management at the time is most interested. There are, however, certain reports which should always be a matter of record in every business to which they are applicable. Thus, where the output is uniform it is always desirable to compile a statistical report at the close of each period showing the average labor cost per unit in each department, for comparison with corresponding records of previous periods.

Graphs are frequently the best means of keeping the management informed of the current trend of factory operation or overhead. Form 30, for instance, shows by means of a graph a comparison between the average hourly rates earned by piece-workers and day-workers in a plant. An upward trend in the earnings of piece-workers up to November 22 is indicated on the chart. after which the piece-work begins to fall off.

The graph shown in Form 31, which gives the ratio of non-productive to productive labor, is another valuable statistical record. Every factory has a dead line above which this ratio should not be allowed to pass. The changes from month to month or during any other period can be shown more quickly and more forcibly in the form of a graphic chart than in any other way. A study of the curves on the chart shows the monthly rise and fall of productive and non-productive labor. The points of particular interest to the management are the extent of these fluctuations and their comparison with those of former periods and especially the relation between the non-productive and productive labor.



Form 30. Chart showing Average Hourly Wage for Piece-Workers and Day-Workers



Form 31. Chart showing Productive and Non-Productive Labor and Ratio of Non-Productive to Productive Labor

REVIEW QUESTIONS

1. What methods are in use for obtaining a record of the elapsed time spent on jobs in job order factories?
2. What mechanical aids can be introduced to assist in obtaining accuracy in time records?
3. Describe the procedure for obtaining the labor costs on jobs in a composing room of a job printery where compositors are paid by the day.
4. What is meant by the decimal system of time reporting? What are its advantages and disadvantages?
5. Describe a suitable form for checking piece-work payments.
6. What use can be made of pay-roll statistics?

CHAPTER XVI

WAGE SYSTEMS

1. Variations in Wage Systems

Though the connection between a study of wage systems and cost accounting may not at first be apparent, sooner or later in the operation of every cost system the existing method of wage payment will be closely scrutinized and criticized with a view to its improvement. Especially is this so if the method in vogue is the old-time "day rate." A primary object of every cost system is to increase production and lower costs, and to this end some incentive must be offered to workers. Under the day-rate method of wage payments, standard hourly and daily rates are paid for certain classes of work, the rates depending partly on the skill called for and partly on local labor conditions. But as the same rates are usually paid for the same class of work, regardless of differences of skill among men doing the same work, no incentive is offered to increase production. The man who works hard, who does his best, and shows more than average energy and productive capacity, receives the same reward as the man who works in a leisurely fashion and whose output is just sufficient to enable him to "hold his job."

That there are grave defects inherent in the use of the day-rate method of wage payment may be assumed from the fact that all recent methods of wage payment have been devised with a view to avoiding its worst fea-

ture—the "lack of incentive." An incentive to do more and better work is offered to workers in various ways, ranging from the straight piece-work method of paying for quantity of output at a fixed rate, to the more complex premium systems which offer rewards on a sliding scale and on different bases for the quantity produced within a given time. It is necessary for the cost accountant to become familiar with the operation and comparative advantages of all these various modern methods of wage payment.

Theoretically, the day-rate method should be used only in the case of routine workers when to be "on the job" during certain hours is of more importance than to do a set task or complete a certain amount of work. Foremen, inspectors, firemen, watchmen, and all workers who are engaged more in work of the nature of "minding" or "tending" than in producing, must be paid by the day or week because of the nature of their occupation. In all other cases, where workers are occupied in producing something, means should be devised to increase the output of individuals by basing the payment on the output.

2. Labor Costs under Day-Rate System

It is not generally realized how widely output varies among men occupied with similar tasks when wages are paid on the dead level of the day-rate plan. The following calculation, which is based on an experimental investigation made in a plant about to change from day rates to a premium plan, shows that differences in labor cost of as much as 50% may exist where the day-rate plan is used.

EARNINGS UNDER THE DAY-RATE PLAN

Operative	Actual Time	Rate per Hour	Amount Earned	No. of Pieces Produced	Cost per Piece
No. 1	100 min.	30 cts.	50 cts.	10 pcs.	5.0 cts
2	90 "	30 "	45 "	9 "	5.0 "
3	80 "	30 "	40 "	7 "	5.7 "
4	70 "	30 "	35 "	6 "	5.8 "
5	60 "	30 "	30 "	6 "	5.0 "
6	50 "	30 "	25 "	4 "	6.2 "
7	40 "	30 "	20 "	4 "	5.0 "
8	30 "	30 "	15 "	2 "	7.5 "

Maximum cost per piece.....7.5 cents
Minimum " " " .....5.0 "

Such a table as this illustrates the value of keeping a time record when practicable on jobs done under the day-rate system of payment. A comparison will show where the leaks are occurring and will make it possible to detect and weed out the inefficient operatives.

3. Piece-Rate Method

The straight piece-work plan of payment is one of the simplest to apply. The payment per piece for each article or part produced is fixed by agreement between workers and employer. The plan is easily understood by the operatives, and computations incident to making up the pay-roll are not difficult. The experience of manufacturers who have changed from the day-rate to the piece-rate plan is that the output in nearly all cases increases. When workers receive a fixed sum per day for an average production and no incentive is offered to increase the output, they naturally work at a leisurely pace. When a change is made to piece rates, it is not uncommon for the production to be doubled and even

trebled, usually to the surprise of those responsible for establishing the rates.

A seeming advantage of the piece-rate plan is that it entails less supervision because idle operatives are automatically penalized. In practice, however, additional inspection is often required to see that no defective work is paid for. Care must be taken also to check the piece-workers' earnings in order to avoid paying twice for the same work. Inspection by foremen can sometimes be reduced by making each workman responsible for any defective work received from another. In this way each operative checks the work as he receives it and a final inspection only is needed.

A further advantage of the plan is that the manufacturer knows his labor cost before the goods are made. When he is asked to quote on a job, or when he is about to place a new article on the market, he can fix the selling price of the product with great accuracy. A contrasting disadvantage is that until experience has shown the actual capacity of an average willing workman, it is difficult to determine a rate which will be fair for all concerned—the employee, the employer, and the consumer.

4. Fixing the Piece Rates

A common experience in fixing piece rates is that of a certain hardware manufacturer. He no sooner had put into practice a straight piece-work system than he realized that he had fixed the rates too high. He explained his position in this way: "I fixed the rates with the expectation that employees would earn from a third to a half more. Before the rates had been established a

month, some employees had doubled their previous output and others, I learned, would have equalled them if they had not thought that the rate would be cut."

Thus the adoption of piece rates often places the employer in a dilemma. To make the change from day- to piece-work the rate must be acceptable to the majority of employees. If the rates in the first instance are set sufficiently high to make them acceptable to all workmen, including the laggards and the inefficient, the skillful and industrious operative frequently receives compensation that the employer considers disproportionate to the class of labor he is called upon to perform. If the rates are cut, employees naturally become dissatisfied and lose confidence in their employer's good faith. The practice of reducing piece rates because of increased production has become so common that union workmen are often opposed to this plan of payment; or, where it prevails, they carefully restrict the output to some standard set by themselves. Yet experience shows that piece rates, when carefully fixed in the first instance, give good results under proper supervision. Home work is usually paid for at piece-work rates.

"If the employer wishes to approximate maximum production, he must be prepared and willing to pay more than the previous day rate; and no piece-work plan will attain its object unless he takes that stand. If he can afford to pay a certain amount for the making of an article now, he can surely afford to pay the same amount per article when a larger number are produced per day; especially since the indirect expenses are increased comparatively little for an increased production in the same time, while, as these expenses are dis-

tributed over a larger number of articles produced, the cost of each article is proportionately decreased."*

The determination of piece rates presupposes a knowledge of the technicalities of the trade and is thus outside the province of the cost accountant. In some industries the rates are established in conference between the manufacturer and the trade union representatives of employees. The price for a job is usually set from previous records and an average is struck between the capacities of the slowest and the most rapid workers.

5. Differential Piece Rates

A simple modification of the straight piece-rate plan is the "differential" piece rate by which varying degrees of skill and energy as reflected in different performances are recognized and rewarded. A standard of performance is set, and if this is attained and passed, the scale of pay ascends for every piece or dozen pieces made, as the case may be—as illustrated in the following section. The standard is based on the quantity that a conscientious worker of average skill may be expected to produce in a day. When an operative fails to reach this standard, the rates are so set that his pay is slightly less than he would have earned had he been working on a time or hourly basis. When, however, he reaches and passes the standard, the reward is liberal, gradually rising to 50% in excess of the possible earnings under the day rate. The more efficient the worker, the greater his reward, while the manufacturer can afford to pay on an ascending scale for increased production because by so doing he saves on indirect costs.

*"Cost Accounting," by Nicholson and Rohrbach, page 102.

"The differential piece-rate plan is specially devised to speed up production where the indirect expenses are high in proportion to material and labor costs. To get the best results in such a case the productive capacity must be made as effective as possible, even at a higher payment for labor cost. What is lost on the high piece rate will be more than made up by the distribution of the large amount of indirect expenses over an increased output.

"The point of great importance in the differential piece-rate plan is the making of a fair rate at its introduction. An ill-judged rate at this time may be fatal and the utmost skill and judgment are necessary to guard against such a mistake. The plan also calls for a well-organized supervising corps, the actual increase of cost for this depending entirely on local conditions, the nature of the shop, and the organization."*

6. Calculation of Differential Piece Rates

The following tables show the ascending scale of pay per piece when the minimum of 5 pieces within the hour is attained, for which the rate of pay is 3.5 cents per piece. The rate per piece rises one-tenth of a cent for each additional piece made within the hour.

The rate per hour and the amount earned when 10 pieces are made within intervals of time varying from 100 to 30 minutes is shown below. It will be seen that the workman producing 10 pieces an hour is paid 4 cents for each piece or 40 cents an hour; a man turning out 10 pieces in 30 minutes or 20 pieces an hour receives 5 cents apiece or $1 an hour.

*"Cost Accounting," by Nicholson and Rohrbach, page 103.

EARNINGS UNDER THE DIFFERENTIAL PIECE RATE

No. of Pieces per Hour	Rate per Piece	No. of Pieces per Hour	Rate per Piece
6 pcs.	3.6 cts.	14 "	4.4 "
7 "	3.7 "	15 "	4.5 "
8 "	3.8 "	16 "	4.6 "
9 "	3.9 "	17 "	4.7 "
10 "	4.0 "	18 "	4.8 "
11 "	4.1 "	19 "	4.9 "
12 "	4.2 "	20 "	5.0 "
13 "	4.3 "		

EARNINGS UNDER THE DIFFERENTIAL PIECE RATE

Operative	Actual Time	No. of Pieces Made	Rate per Piece	Amount Earned	Rate per Hour
No. 1	100 min.	10 pcs.	3.6 cts.	36 cts.	21.6 cts.
2	90 "	10 "	3.7 "	37 "	24.6 "
3	80 "	10 "	3.8 "	38 "	28.5 "
4	70 "	10 "	3.9 "	39 "	33.4 "
5	60 "	10 "	4.0 "	40 "	40.0 "
6	50 "	10 "	4.2 "	42 "	50.4 "
7	40 "	10 "	4.5 "	45 "	67.5 "
8	30 "	10 "	5.0 "	50 "	100.0 "

7. Premium Wage System

A premium differs from a differential rate of pay in that the computation of the amount earned is based on time instead of on the quantity produced. The worker is rewarded in proportion to the time saved on a specific job or operation. The various premium systems in vogue differ in their mode of computing the value of the time saved, but the fundamental principle in all cases is the same, viz., to reward the efficient worker with a proportion of the value of the time saved. The saving in overhead should exceed the amount of the premium.

As an example of the working of the premium system, assume that job number 1 would ordinarily be in the shop 20 hours and be assessed for overhead at a uniform hourly rate of 50 cents, making the burden on the job $10. Assume that in addition to the regular wage of 50 cents an hour, a premium of 25 cents an hour is offered for each hour saved under the standard time of 20 hours.

Under a day-rate system of 50 cents an hour the operator would finish the work in 20 hours and receive $10, and the employer would incur an overhead charge of $10. The total cost would thus be $20. Now assume that under the premium system the job is finished in 15 hours. The labor cost is then $7.50 plus a premium of, say, 25 cents for each of the 5 hours saved, or a total of $8.75. The overhead (at 50 cents an hour) is reduced from $10 to $7.50, making the total labor and overhead $16.25 instead of $20, although wages are raised from 50 cents to 58 1/3 cents an hour—an increase of 16 2/3%.

8. Calculation of Premium Wage System

The accompanying tables show the computation of earnings when a premium of either 50% or 33 1/3% of the value of the wages saved is added to the operative's regular hourly rate.

These wage tables illustrate the effect on the cost per piece when the value of the time saved is shared in different proportions by employer and employees. Unless the overhead of a department amounts to much more than the direct labor cost, it is financially impracticable to divide the time with the employee on a 50% basis. To

do so would be to increase the cost of production in favor of the employee. In departments where the overhead is low, only moderate rates of premium can economically be offered as incentives to efficiency.

EARNINGS UNDER THE 50% PREMIUM SYSTEM

Time allowance, 100 minutes. Rate per hour, 30 cents. Number of pieces produced, 10.

Operative	Actual Time	Time Saved	50% Premium	Total Earnings	Rate per Hour	Rate per Piece
No. 1	100 min.	0 min.	0 cts.	50 cts.	30.0 cts.	5.00 cts.
2	90 "	10 "	2.5 "	47.5 "	31.6 "	4.75 "
3	80 "	20 "	5.0 "	45.0 "	33.8 "	4.50 "
4	70 "	30 "	7.5 "	42.5 "	36.4 "	4.25 "
5	60 "	40 "	10.0 "	40.0 "	40.0 "	4.00 "
6	50 "	50 "	12.5 "	37.5 "	45.0 "	3.75 "
7	30 "	60 "	15.0 "	35.0 "	52.5 "	3.50 "
8	40 "	70 "	17.5 "	32.5 "	65.0 "	3.25 "

EARNINGS UNDER THE 33 1/3% PREMIUM SYSTEM

Time allowance, 100 minutes. Rate per hour, 30 cents. Number of pieces produced, 10.

Operative	Actual Time	Time Saved	33 1/3% Premium	Total Earnings	Rate per Hour	Rate per Piece
No. 1	100 min.	0 min.	0 cts.	50 cts.	30.0 cts.	5.00 cts.
2	90 "	10 "	1.6 "	46.6 "	31.1 "	4.66 "
3	80 "	20 "	3.3 "	43.3 "	32.5 "	4.33 "
4	70 "	30 "	5.0 "	40.0 "	34.3 "	4.00 "
5	60 "	40 "	6.6 "	36.6 "	36.6 "	3.66 "
6	50 "	50 "	8.3 "	33.3 "	40.0 "	3.33 "
7	40 "	60 "	10.0 "	30.0 "	45.3 "	3.00 "
8	30 "	70 "	11.6 "	26.6 "	53.2 "	2.66 "

9. Task and Bonus System (Gantt System)

Under the wage payment plans so far described, the incentive of extra earnings is so graduated that more

than the minimum wage can be earned without much effort. Under the task and bonus method a standard of attainment is set and no extra reward is paid unless it is reached. If it is attained the bonus then increases as the time set for the task is further reduced. The feature of this plan is that it offers a strong incentive to reach a predetermined standard of efficiency and surpass it, while at the same time it offers the man who fails only his regular hourly rate.

EARNINGS UNDER THE TASK AND BONUS SYSTEM

Bonus 40%. Rate 30 cents per hour. Number of pieces produced, 10. Standard time, 100 minutes.

Operative	Actual Time	Bonus	Total Earnings	Rate per Hour	Labor Cost per Piece
No. 1	170 min.	0 cts.	85 cts.	30 cts.	8.5 cts.
2	160 "	0 "	80 "	30 "	8.0 "
3	150 "	0 "	75 "	30 "	7.5 "
4	140 "	0 "	70 "	30 "	7.0 "
5	130 "	0 "	65 "	30 "	6.5 "
6	120 "	0 "	60 "	30 "	6.0 "
7	110 "	0 "	55 "	30 "	5.5 "
8	100 "	20 "	70 "	42.0 "	7.0 "
9	90 "	23 "	68 "	45.3 "	6.8 "
10	80 "	26 "	66 "	49.5 "	6.6 "
11	70 "	29 "	64 "	54.8 "	6.4 "
12	60 "	32 "	62 "	62.0 "	6.2 "
13	50 "	35 "	60 "	72.0 "	6.0 "

In the table above the set task is 10 pieces in 100 minutes. For this the operative receives a 40% bonus in addition to his hourly rate and the bonus is paid at increasing rates as the time set for the task is lowered. As an example of the operation of the table, when operative No. 8 reaches the standard of 10 pieces in 100 min-

utes his regular rate of 30 cents an hour is increased by 40%, to 42 cents an hour. It will be observed that as soon as the standard is attained by the production of 10 pieces in 100 minutes, the labor cost per piece rises slightly—to fall again as the time in which 10 pieces are produced is decreased. The standard of attainment is usually fixed so high that an operative cannot earn more than a 40% premium. The slight increase in cost due to the bonus paid when the task is attained, is more than offset by the saving in overhead.

10. Graduated Premium Wage System

Instead of paying a round sum of either one-third or one-half the value of time saved, the premium can be so graduated that its rate increases in proportion to the time saved. The chief merit of this system is its flexibility and its justice to both employer and employee. Experience shows that it offers ample incentive to the worker to reduce the cost of production while the employer is protected by the fact that he receives full value for wages paid.

The following table shows how earnings are computed. It will be noted that the worker who completes an operation in 80 minutes when the standard time is 100 minutes receives a premium of 20%. That is, if the standard rate is 30 cents an hour his earnings will be at the rate of 36 cents an hour. If he completes the job in 50 minutes, or half the standard time, he receives a premium of 50%, or an hourly rate of 45 cents. As the hourly rate increases the cost per piece decreases, as shown in the table. High rates of pay are thus offset with proportionately low production costs.

EARNINGS UNDER GRADUATED PREMIUM SYSTEM

Time allowance, 100 minutes. Rate per hour, 30 cents. Number of pieces produced, 10.

Operative	Actual Time	Time Saved	Wages	Premium	Total Earnings	Rate per Hour	Cost per Piece
No. 1	100 min.	0	50 cts.	0 cts.	50.0 cts.	30 cts.	5.00 cts.
2	90 "	10%	45 "	4.5 "	49.5 "	33 "	4.95 "
3	80 "	20%	40 "	8.0 "	48.0 "	36 "	4.80 "
4	70 "	30%	35 "	10.5 "	45.5 "	39 "	4.55 "
5	60 "	40%	30 "	12.0 "	42.0 "	42 "	4.20 "
6	50 "	50%	25 "	12.5 "	37.5 "	45 "	3.75 "
7	40 "	60%	20 "	12.0 "	32.0 "	48 "	3.20 "
8	30 "	70%	15 "	10.5 "	25.5 "	51 "	2.55 "

11. Summary

From the foregoing description of different wage systems, it will be seen that in offering a bonus or premium as an incentive to efficiency it is necessary to establish two standards—a low one which can be attained by the conscientious workman of average skill, and a high one which no worker is expected to exceed. The premium is graduated to correspond with the workman's approach to the high standard. A flat piece rate or a premium for completing a given task within a set time does not offer the same incentive as an increasing hourly rate of pay for increased production. If the plan of wage payment results in lowering the cost of labor and overhead on the product while it increases wages, both employer and employee are satisfied. Whatever plan is put into operation, the workmen must be satisfied that it is fair and that it does not impose too severe a task upon them.

REVIEW QUESTIONS

1. What is the day-rate system of wage payment?
2. What is the piece-work system? What are its advantages and disadvantages?
3. How are piece-work rates fixed?
4. If an operative receives 30 cents per hour and under the most favorable conditions can do one piece in four minutes, what would the proper piece-work rate be? Allow 10% of each hour for rest. Increase hourly rate one-third.
5. How does the differential piece-work system operate? Illustrate. What are its advantages and disadvantages?
6. What are the peculiar features of the Gantt system of paying wages?

Part VI
Indirect Expense

CHAPTER XVII

GENERAL CONSIDERATIONS OF EXPENSE *

1. Problem of Expense Distribution

An indirect expense represents a factory purchase or expense of some kind which cannot be charged directly to the cost of manufacture because there is no direct relation between the cost of the article produced and the consumption of the thing purchased or the expense incurred. The difficulty is overcome by charging the article or each lot of the product with a certain amount of the factory "overhead" or "burden," this burden comprising all the indirect expense incurred during the period.

The opening and closing of expense accounts and the mechanism employed in the distribution of expense form perhaps the most perplexing phase of cost accounting. Rarely is the matter handled in exactly the same way in two different factories. In some cases an analysis of great refinement is required for the purpose of controlling expense in all its details; in other cases the saving of clerical work is a consideration and an exact allocation is not attempted; while in still other cases the nature of the product and the size of the factory determine the expense accounts to be operated. In all cases, however, the distribution of expense involves the following steps:

*See also Chapter VIII.

1. Charging actual monthly overhead to productive, non-productive, and miscellaneous departments by means of distribution sheets, according to different bases.
2. Monthly closing of the overhead of non-productive and miscellaneous departments into productive overhead accounts.
3. Application of predetermined overhead rates—derived from past experience—on the cost basis for each productive department, which may be direct labor cost, direct labor hours, or machine hours, etc., at which time the Work in Process account is charged and the proper departmental overhead account is credited.
4. Any difference between actual overhead charges during the month and applied overhead is, if small, closed into the monthly Profit and Loss account, or held in suspense until the end of the year. If the balance remaining in the overhead expense account is relatively large, it means that the inventory must be refigured in order that a correct balance sheet and profit and loss account may be made up.

In order to illustrate the practical application of the foregoing principles, reference is made to the chart of expense account classifications for a worsted mill (Form 32). On this chart are listed three operating departments and several miscellaneous or service departments. Under each departmental heading is given the source from which the information pertaining to the expense

charge is obtained. It will be noticed that in all cases the pay-roll, purchases, and stores have been allocated to the various accounts. The miscellaneous accounts, such as power and general and office expense, are closed out to the operating department accounts. The total expense for the current period is now segregated under the various operating departments. The last step in handling the expense accounts is, of course, to apportion the departmental expenses to the product and make an entry charging the Work in Process account and crediting the operating accounts. This is, of course, typical of the procedure followed in nearly all factories where several departments are operated.

2. Classification of Expense

For purposes of discussion the expenditures which are, or may become, chargeable as expense, may be divided into those for:

1. Supplies.
2. Plant machinery and equipment.
3. Outside service such as taxes, insurance, telephone, gas, and the like.
4. Inside services which include all clerical and factory indirect labor.

The expenditures for items 1 and 3 are recorded in the purchase journal or voucher register, in which the classification of the invoices under the head of expense first begins. The employment of inside services is first entered on time tickets and from there is recorded on the pay-roll which, when properly arranged, serves for the classification of direct and indirect labor.

			Acct. No.
SUPPLIES		Fuel, Dyestuffs, Drugs, etc.....	1
OPERATING DEPARTMENTS EXPENSE ACCOUNTS	Operating Dept. A Expense	Carding and Combing Department	
		Current Charges:	
		Pay-Roll—Indirect Labor....	10
		Purchases	11
		Stores—Supplies	12
		Repairs	13
		Power	14
		Building and Occupancy Exp.	15
		General and Office Expense...	16
		Dyeing	17
		Prepaid and Accrued Charges:	
		Depreciation	18
		Insurance	19
		Taxes	20
		Waste Credits	21
	Operating Dept. B Expense	Drawing and Spinning Department	
		Current Charges:	
		Pay-Roll—Indirect Labor ...	30
		Purchases	31
		Stores—Supplies	32
		Repairs	33
		Power	34
		Building and Occupancy Exp.	35
		General and Office Expense..	36
		Prepaid and Accrued Charges:	
		Depreciation	37
		Insurance	38
		Taxes	39
		Waste Credits	40
		Twisting Department	
		Current Charges:	
		Pay-Roll—Indirect Labor ...	50
		Purchases	51
		Stores—Supplies	52
		Repairs	53
		Power	54
		Building and Occupancy Exp.	55
		General and Office Expense..	56
		Prepaid and Accrued Charges:	
		Depreciation	57
		Insurance	58
		Taxes	59
		Waste Credits	60

Form 32. (a) Chart showing Classification

			Acct. No.
OPERATING DEPARTMENTS EXPENSE ACCOUNTS (*Continued*)	Operating Dept. C Expense	Weaving Department	
		Current Charges:	
		Pay-Roll—Indirect Labor	
		Warp Preparation (Spooling, Warping, Beaming, Slashing, Drawing-in)	70
		Filling Preparation (Winding)	71
		Weaving—Day-Work	72
		Purchases	73
		Stores—Supplies	74
		Repairs	75
		Power	76
		Building and Occupancy Exp.	77
		General and Office Expense..	78
		Prepaid and Accrued Charges:	
		Depreciation	79
		Insurance	80
		Taxes	81
		Waste Credits	82
		Cloth Room	
		Current Charges:	
		Pay-Roll—Indirect Labor	90
		Purchases	91
		Stores—Supplies	92
		Repairs	93
		Power	94
		Building and Occupancy Exp.	95
		General and Office Expense..	96
		Prepaid and Accrued Charges:	
		Depreciation	97
		Insurance	98
		Taxes	99
		Finishing Department	
		Current Charges:	
		Pay-Roll—Indirect Labor	110
		Purchases	111
		Stores—Supplies	112
		Repairs	113
		Power	114
		Building and Occupancy Exp.	115
		General and Office Expense..	116
		Dyeing	117
		Prepaid and Accrued Charges:	
		Depreciation	118
		Insurance	119
		Taxes	120

of Expense Accounts—Worsted Mill

		Acct. No.
MISCELLANEOUS ACCOUNTS Closed Out to Operating Departments A, B & C Expense	Dyeing Department	
	Pay-Roll	130
	Purchases	131
	Stores—Supplies	132
	Repair Department	
	Pay-Roll	140
	Purchases	141
	Stores—Supplies	142
	Power	
	Pay-Roll	150
	Fuel	151
	Oils	152
	Purchases	153
	Stores—Supplies	154
	Repairs	155
	Building and Occupancy Expense	
	Rent	160
	Light	161
	Purchases	162
	Stores—Supplies	163
	Repairs	164
	General and Office Expense	
	Current Charges:	
	Pay-Roll	170
	Purchases	171
	Stores—Supplies	172
	Repairs	173
	Samples	174
	Seconds	175
	Prepaid and Accrued Charges:	
	Depreciation	176
	Insurance	177
	Taxes	178
PREPAID AND ACCRUED ITEMS	Reserve for Depreciation	180
	Insurance Prepaid	190
	Taxes Accrued	200
PAY-ROLL		210

Form 32. (b) Chart showing Classification of Expense Accounts—Worsted Mill—(*Continued*)

3. Purchase Journal Analysis

The accounting principle has been explained in Chapter VIII, that, if only part of an expense purchase is applicable to current operations, the purchase is charged to a ledger account (prepaid expense) which at the close of the period is credited with the portion applicable to that period, the corresponding debit being to an appropriate expense account. If the whole of the expenditure is chargeable to the period, it constitutes a charge to the expense of operation, i.e., to the department or departments which benefit from it.

The application of this principle to the analysis of expense purchase invoices necessitates their classification into those for the needs of the factory as a whole, and those for the current needs of particular departments. Expenditures for such assets as machinery or supplies, or such deferred asset items as prepaid insurance, are made for the factory as a whole, and some of the items or some part of the items may not be consumed in manufacture and not be applicable to costs until an ensuing period or periods. Expenditures for current needs should be departmentalized at their source by classification under suitable departmental expense account headings. For example, an advertising department may be continually ordering electros, printed matter of various kinds, and frequently inserting advertisements in newspapers and magazines. Obviously, the only practical way to classify such items is under the head of "Advertising Expense." The same observations apply to the classification of other invoices, such as those covering the cost of operating a power plant, the factory offices, the stores and receiving rooms, and so on. In short,

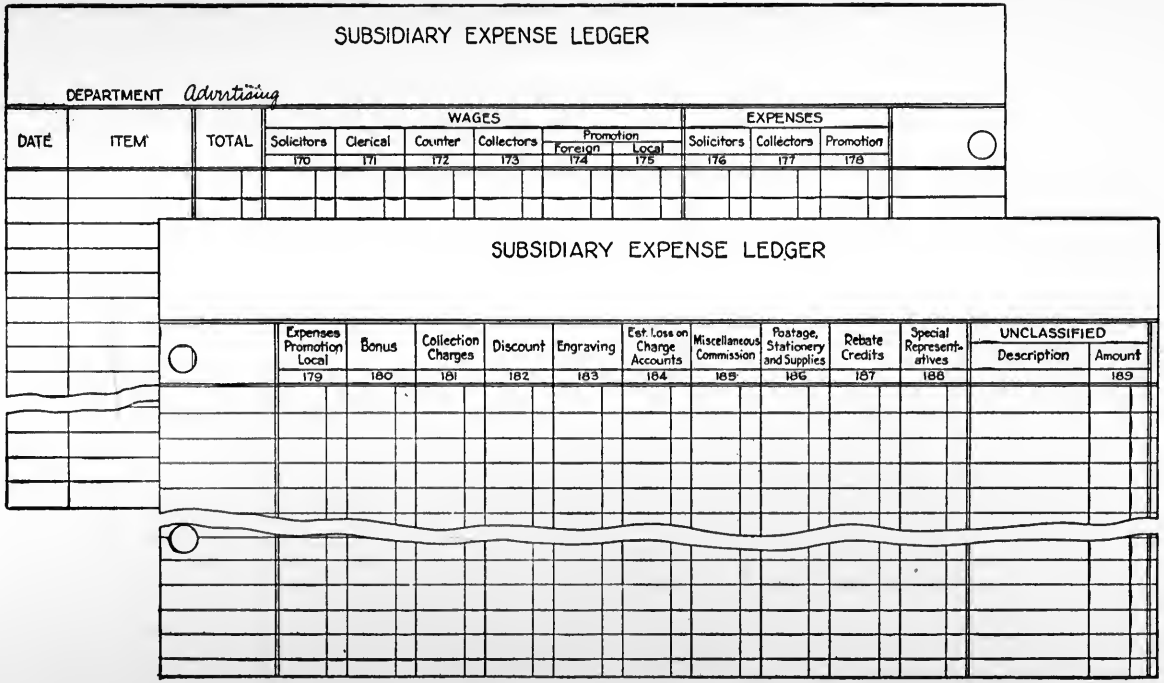
whenever numerous expense purchases have to be made for the needs of special departments, because the nature of their work does not permit the filling of their requirements through stores, separate departmental expense accounts are opened and a column is allotted in the purchase journal to each department.

Not all invoices, however, can be classified under the foregoing heads. Some payments will represent expenses incurred for the factory as a whole, such as telegrams, legal fees, etc. Invoices of this character are usually classified and posted to appropriate general expense accounts on the ledger. These ledger accounts are ultimately closed out by distribution over departments.

4. Subsidiary Expense Ledger

One of the first requirements of a cost system is the analysis of expense as far as it is worth while. As the grouping of miscellaneous invoices under department headings in the purchase journal does not always afford this analysis, it is frequently the practice to supplement the department journal column with a subsidiary expense ledger on which payments are analyzed in any desired detail.

This analysis of expense is primarily the function of the purchase journal or voucher register. This journal or register has, however, its limitation, which is the number of columns it can conveniently handle. To supplement the purchase journal analysis, while all stores purchased for the factory are grouped under the heading "Stores" in the journal, as already explained, the details of the invoices are shown in the stores ledger; in the



Form 38. Subsidiary Expense Ledger

same way the details of the plant column total are shown in the plant ledger. This principle may also be applied to the analysis of power, advertising, office, or any other department expense total. In all these cases, instead of the analysis being shown in a number of accounts on the general ledger, it is shown on a subsidiary ledger.

Thus while the purchase journal column may show the total expenditures for advertising, period by period, and reference to the Advertising Expense account shows the total amount for the year, reference to the subsidiary expense ledger will give the details of this total advertising expense—so much for newspaper and magazine advertising, for printing circulars, for postage, salaries, rent, supplies, etc.—month by month and year by year as the monthly entries accumulate. Kept in this way the subsidiary expense ledger is a very valuable record for administrative purposes.

In a small organization, a single columnar sheet, as shown in Form 33, may be employed for the purpose of classifying expenses, instead of a separate sheet for each department.

5. Expenditures—Inside Expense Service

The services within the factory which are to be treated as overhead comprise all those factory activities which have no direct relation to the making of the product. The pay-roll shows the payments made in each department for both direct and indirect labor. This classification, however, does not go far enough for cost purposes. While it informs the management as to the total amount of the payments for indirect labor, it does not give the details of these payments.

Thus, in every factory, floors must be swept, windows cleaned, walls and ceilings painted and kalsomined, machines and fixtures repaired, boys employed to run on errands, clerks employed to make up the pay-roll, take care of stores, receive and ship goods, and so on. Unless the cost of such activities is ascertained from period to period, they cannot be properly controlled and serious leakage may result. Moreover, these activities involve expenditures in addition to the wages entered on the pay-roll. Materials are consumed in repairs and painting, clerks use stationery, desks, desk-room, and so on. Therefore, when it is desired to ascertain the cost of such activities separately, functional expense accounts are opened, such as "Window-Cleaning," "Repairs to Machinery," "Messenger Service," etc., and each account is charged with all expenditures made for the purpose of carrying on its particular activity. The method of obtaining the charges to these accounts is explained in the following chapter.

It will be readily seen that the more detailed the analysis of the expenditures for services inside the factory, the more readily can such expenses be controlled. It is equally evident, however, that this analysis makes for complexity in that every expense account opened must also be closed out by distributing the current total over the departments which benefit from the activity represented by the account.

6. Supplies Chargeable to Expense

As explained in Chapter X, items of raw material which can be readily handled and thus delivered to departments as required are taken into stores to be issued

against requisitions; also, as stores represent an asset, their total value is controlled in a general ledger account the detail of which is recorded in the stores ledger. The same treatment is applied to stores which will be chargeable to expense and to which the term "supplies" is applied to distinguish them from raw material items. The supplies used plus the labor employed in using them represent the expenditures for the non-productive activities of window-cleaning, repairs, and so on referred to above.

Sometimes material which is directly applied to the product is treated as a supplies expense. The screws, nails, and glue, for example, used in making furniture and the pigments and coloring materials used in the pottery trade are cases in point. Here practicability rather than theory governs. It is a common practice to treat such materials as a supplies expense, because it is difficult to compute the precise cost of the small amount consumed in a given case. However, manufacturers sometimes make tests to ascertain the quantity of certain materials—such as glue, paint, and varnish—required to cover a given surface. Then in making a cost calculation, the estimated quantity is used as a basis for charging such items direct to the cost of the job.

7. Plant, Machinery, and Equipment

Theoretically an item of plant, whether it be a building, a power engine, or a piece of office furniture, represents a purchase for the needs of the factory, which is gradually consumed in production or in work which is an aid to production. The precise amount of wear and tear of a building, of the power plant, or of an office desk has no direct relation to the thing produced, yet

it steadily continues from period to period and is a proper charge to production. Supplies can be readily counted, weighed, or measured and their value thus determined. The wear and tear of plant and equipment can only be estimated and at best is an approximation.

The methods of figuring depreciation and its accounting are discussed in Volume IV of "Business Accounting." The principles of depreciation are briefly presented in Chapter XX of the present volume. Here it may be noted that the total depreciation for the cost period is charged to an expense account, with an offsetting credit to Depreciation Reserve; and that the difference between the asset account and the offsetting Depreciation Reserve represents the value of the asset.

The details of expenditures for plant are entered in a subsidiary plant ledger controlled by one or more accounts on the general ledger, the number of these accounts depending upon the subdivisions of the plant and equipment. The depreciation of each plant item is charged to production, period by period, each department receiving its proper proportion.

8. Summary of Expense Analysis

The discussion thus far has covered the first phase of all systems of expense distribution, i.e., the setting up of expense accounts the debits to which include *all* the overhead of the current period. These charges comprise:

1. Current purchases for particular departments or for the factory as a whole, credited usually to Cash or Accounts Payable.

2. The portion of the prepaid and accrued expense items for the current period credited to the respective ledger accounts.
3. Depreciation charges credited to Depreciation Reserve accounts.
4. Indirect labor credited to Pay-Roll account.
5. Stores-room supplies credited to stores ledger accounts.

The books or forms, i.e., the original factory documents, whereon the totals indicated by the numbers above are collected, are as follows:

1. The purchase journal or voucher register.
2. Schedule of fixed charges.
3. Schedule of depreciation charges.
4. Standing expense orders } Summarized on distribution sheets.
5. Supplies requisitions }

The purchase journal totals are charged direct to the department to which they belong, or any general expenditure to suitably designated expense accounts, from which they are distributed over departments. The schedules of fixed charges and depreciation furnish the journal totals for charging the departments with their proportion of insurance, taxes, depreciation, and any other expense of a fixed character.

The distribution sheets for standing expense orders and supplies referred to above, furnish the journal totals for charging each department with its indirect labor and supplies expense. After these and the foregoing entries are posted, all the expense for the period has been departmentalized. It should be noted that the posting of the

totals collected on the above schedules and distribution sheet constitutes the internal distribution of the expenditures recorded in the purchase journal and pay-roll. The aim of this distribution, as heretofore stated, is:

1. To ascertain the expense of conducting every important factory activity.
2. To charge each productive department with a fair proportion of every non-productive expenditure until all such expenditures have been merged in those of the productive or operating departments.
3. To distribute the overhead expense totals of the productive departments (which together form the total factory burden) over the product, either by proportionate charges to work in process under the job order method, or by equal charges to the total output of a process department under the process method of cost-finding.

REVIEW QUESTIONS

1. What are the main sources from which expense charges come?
2. What items can be charged to expense when the purchase is made?
3. What items have to be held in abeyance and not charged to expense until an ensuing period?
4. What items have to be anticipated and charged to expense before the time comes for meeting the liability?
5. What is the best form to use for analyzing expense?
6. What is meant by the departmentalization of expense?
7. What purpose is served by a schedule of fixed charges?

CHAPTER XVIII

INDIRECT LABOR AND SUPPLIES

1. Indirect Factory Activities

Certain items of service requiring outside payments, such as rent if the buildings be leased, taxes, insurance for fire and accident protection, water, gas, and the like, are so clearly expense charges that as soon as the amounts chargeable to the fiscal period are ascertained, no mistake is likely to be made in allocating them equitably to departments—when once a just basis of allocation is determined.

Other items of service paid for within the factory are not always so clearly an expense charge, nor can they always be so readily allocated to departments. A proper analysis of the pay-roll and stores requisitions is required as a means for determining which items are a part of the prime cost and which are a charge to overhead expense for supervision, inspection, light, heat and power, cleaning, repairs, etc. Yet none of these latter activities can be charged *direct* to goods or orders. Their cost, therefore, as part of the overhead expense must be clearly distinguished from the cost of material and labor which are a direct charge to orders. To this end some system must be adopted which will separate the two and will show to which class a particular kind of service activity is to be charged.

2. Standing Expense Orders

The segregation of indirect labor is conveniently and readily accomplished by the use of a simple system of "standing orders." Though neither the term nor the mechanism it designates is in general use in all factories, the simplicity and advantages of this metbod of recording the expense of the "floating" factory labor and the supplies used by this labor are such as to recommend its use in all cases where the accurate classification of expense is desired.

As the name implies, a "standing order" is a form of instruction or order to carry out certain routine work, such as cleaning, painting, or repairing, and charge its cost to a standing or permanent number given the particular standing order. As these standing orders collect the expense cost of purely routine activities which recur with regularity, it is only necessary to indicate once and for all the standing order number which is to apply to each kind of non-productive work. This is done by listing and numbering the various expense activities on a sheet, as shown by Form 34b (page 230). Copies of this sheet are posted on bulletin boards or communicated to employees in some other way—such as printing the list of standing orders on the back of a time sheet, time card, or stores requisition.

3. Standing Order Time Tickets and Supplies

Repair men, laborers, and other employees who perform different kinds of indirect labor, or productive workers who are temporarily doing non-productive work, charge their time to standing order numbers by means of a weekly time ticket, shown in Form 34a.

As a rule, the class of labor that performs promiscuous jobs around the factory cannot be trusted to carry out even the simplest of clerical work. Therefore the weekly time ticket should be filled out by the foreman, or by the timekeeper to whom the men report at the close of the day or when jobs are changed. As will be noted by reference to Form 34a, at the end of

Name _____ Week Ending _____

Check No. _____ Wage Rate _____

Charge to S.O. No.	Kind of Work	Department Where Employed	Hours						Total Hours	Total Wages
			Mon	Tue	Wed	Thur	Fri.	Sat		

Form 34. (a) Standing Order Time Ticket

each week a record is available of the kind of work performed by each non-productive worker. Such a record might also be made out on daily cards or on different cards for each kind of indirect labor performed, thus simplifying the classification of the time chargeable to expense, either by kinds of work performed or by departments. The kind and extent of the analysis required must determine the procedure to be followed in a particular case.

Supplies used on standing order work may be dis-

tinguished as a charge to expense by entering on the stores requisition the proper standing order number. Time tickets and requisitions which cover indirect charges may be readily distinguished from those which are a direct charge to orders, by the use of forms of distinctive colors, either as to paper or printing. Thus "direct" orders and requisitions may be printed on white paper, standing orders and requisitions on red, or both may be on white paper but the former be printed in black ink and the latter in red or other distinctive color.

4. Numbering of Standing Orders

The numbering of standing orders is so arranged as to simplify the distribution and insure the accuracy (so far as concerns localization) of the departmental expense charge. First a list is made of the activities or expenses the cost of which it is desired to segregate. These expenses will include repairs to the building and to the equipment and machinery; the cost of oiling and attending to the machinery—usually done by general utility men; the sweeping and cleaning of the various departments at regular intervals, and painting or kalsomining as required; the renovating of fixtures, fittings, and so on; the supplies used in these various non-productive activities; and the salaries of clerks, foremen, and other non-productive workers whose wages cannot be strictly departmentalized on the pay-roll.

This list will vary with the circumstances and with the degree to which the analysis of expense is to be carried. When all service activities which it is desired to include within the system of standing order numbers have been listed, they are given key numbers, each item

on the vertical list being assigned a consecutive number. At the top of the sheet the departments are listed horizontally, as shown in Form 34b, beginning with the non-productive departments—each in its order of allocation over the operating departments. The departments as shown are also allotted key numbers, by hundreds, beginning with 100.

LABOR AND SUPPLIES TO BE CHARGED TO	KEY NUMBERS	GENERAL	ADMINISTRATIVE	OFFICE	STORES	POWER	DEPT. A	DEPT. B	DEPT. C	DEPT D	DEPT. E
		100	200	300	400	500	600	700	800	900	1000
REPAIRS TO BUILDINGS (LABOR)	1	101	201	301	401	501	601	701	801	901	1001
" " (MATERIAL)	2	102	202	302	402	502	602	702	802	902	1002
" TO MACHINERY (LABOR)	3	103	--	--	--	503	603	703	803	903	1003
" " (MATERIAL)	4	104	--	--	--	504	604	704	804	904	1004
" TO FURNITURE & FIXT. (LABOR)	5	105	205	305	405	505	605	705	805	905	1005
" " (MATERIAL)	6	106	206	306	406	506	606	706	806	906	1006
TRUCKING & HANDLING (LABOR)	7	107	--	--	407	507	607	707	807	907	1007
CLEANING & JANITOR SERVICE	8	108	208	308	408	508	608	708	808	908	1008
POWER PLANT LABOR	9	--	--	--	--	509	--	--	--	--	--
GENERAL SUPPLIES	10	110	210	310	410	510	610	710	810	910	1010
OFFICE SUPPLIES	11	--	211	311	411	--	--	--	--	--	--

Form 34. (b) List of Standing Order Numbers

To illustrate the operation of the system, take the stores department which stands fourth on the list (Form 34b). All expense connected with its operation is charged to the key department number 400. The key number of the expense is found by consulting the vertical list. Thus, if a carpenter has been engaged in repairing a scale in the stores department, the standing

order sheet shows that repairs to furniture and fixtures are number 5, and that the key number of the stores department is 400. He therefore numbers his standing order time card 405.

An operator who has no productive work ahead of him for the moment may be sent to department A to repair a machine, and he withdraws supplies from stores, such as extra parts and the like, for repair purposes. Repairs to machines are standing order No. 3 and the department in which the machine is repaired is No. 600. Therefore, he numbers both his standing order time ticket and his stores requisition 603. If furthermore, the machines are numbered and we assume that the machine in question is number 96, then the symbol 96/603 entered upon a standing order time ticket or a stores requisition would indicate to the cost department that the vouchers in question related to repair work done on machine 96 in department 600 or to repair supplies withdrawn for the same purpose.

5. Advantages of Numerical Arrangement

The advantages of analyzing non-productive activities in the way outlined is apparent. When the standing order time tickets and stores requisitions are classified by their operation key numbers and the total of each class is run off on an adding machine, the resulting figure in each case is the total expense of that particular kind. When the same tickets and requisitions grouped under an operation number are again classified by department key numbers, the resulting totals are the comparison of like expenses between departments, becharges to departments for that particular expense. A

tween one cost period and another and between different years, furnishes the management with the information needed to control and reduce that portion of the overhead expense which is usually the most difficult to reduce to a minimum. If the expense of window-cleaning or floor sweeping or repairs to machinery over a long period seems to be greater in a particular department or in the factory as a whole than in previous periods, the increase calls for investigation. It may then be found that men are loafing on their jobs, or that the routine of work is badly organized, or possibly that the pay-roll is padded. The analysis also enables information to be furnished daily, when necessary, to foremen and others responsible for the factory routine.

REVIEW QUESTIONS

1. What is the purpose of a system of standing expense orders?
2. How can the time of a repair department or of general utility help be distributed?
3. Suggest a good classification code to use for segregating expense charges.
4. What kind of code would you use for classifying expenses in a factory with many operating and service departments?

CHAPTER XIX

FIXED CHARGES—RENT, TAXES, INTEREST, ETC.

1. Fixed Charges

The class of indirect expense to which rent, insurance, taxes, water, gas, and electricity belong, represents outside services paid for at a fixed rate. The first three charges mentioned are not necessarily affected by changes in the volume of output, and the second three —unless they are used intermittently for manufacturing purposes—only slightly so. For this reason, this class of expense is sometimes referred to as "fixed charges."

2. Schedule of Fixed Charges

The problem of the departmental distribution of fixed charges differs from that involved in the distribution of charges for indirect labor and supplies, and requires a different mechanism. Services represented by wages, salaries, or fees are not usually paid for until rendered, and thus the actual amounts disbursed can be shown on the books when the accounts are closed. On the other hand, services represented by fixed charges are sometimes paid in advance and sometimes allowed to accrue for months before payment is made. Insurance must be paid in advance, rent may be so paid, but taxes, gas, and electricity are items which are usually allowed to accrue for short periods. In all cases, to secure accurate costs, it is necessary to determine the amount of

each charge applicable to the period, to set up this charge on the books, and to distribute it equitably over departments. All this may be effected conveniently by means of the "Schedule of Fixed Charges" shown in Form 35.

The charge for the period is based usually on the annual charge divided by the number of cost periods in the year. The figure for the current period represents, for the expense considered, the credit to be made to the ledger expense account kept with such expense and the total of the various debits to departments, as shown in the schedule of fixed charges. For example:

Work in Process (Dept. A)	$29.00	
To Insurance Prepaid		$29.00
Work in Process (Dept. A)	58.00	
To Taxes Accrued		58.00

The schedule illustrated in Form 35 shows a common method of apportioning fixed charges. It will be noticed that the rental expense of the plant is prorated on the basis of floor area, while taxes and insurance are spread on the basis of plant valuations. Liability insurance is distributed to departments according to the average number of employees. Water, gas, and electricity are charged to departments on the basis of the estimated percentage used by each. Nearly every plant has similar fixed charges to prorate periodically and the method illustrated is applicable to almost all cases.

Depreciation is not always included in the schedule of fixed charges, as its calculation and distribution may require a lengthy tabulation. A depreciation schedule is shown in Form 36 (pages 250, 251).

SCHEDULE OF FIXED CHARGES

CHARGE. CURRENT	CHARGE. ANNUAL	LED. FOL.	FIXED CHARGES	BASIS OF DISTRIBUTION									
				PLANT VALUE		$ 500	10,000	15,000	14,500	10,000
				SQUARE FEET		5,000	10,000	10,000	10,000	15,000
				NO EMPLOYED	20			10	100	120
				UNIT RATE	GENERAL	OFFICE	STORES	POWER	DEPT. A	DEPT. B
500 00	6000 00		Rent (or Maintenance of Building)	Sq. Feet 50,000	$ .01	50 00	100 00	100 00	100 00	150 00
200 00	2400 00		Taxes	Plant Value $50,000	.04	2 00	40 00	60 00	58 00	40 00
100 00	1200 00		Insurance	"	.02	1 00	20 00	30 00	29 00	20 00
62 50	750 00		Employers Liability	No. of Employees 250	.25	5 00		2 50	25 00	30 00
25 00	300 00		Water	Estimated						
60 00	720 00		Gas	"						
75 00	900 00		Electricity	"						
			etc.							
			CR. Total DR.							

Form 35. Schedule of Fixed Charges

Some of the more important fixed charges are discussed in the following sections.

3. Rent

When factory buildings are rented, insurance, taxes, repairs, and so on devolve upon the landlord and a single charge for rent replaces the numerous items which make up the building expense. Instead of being a variable expense, the amount of which has to be computed period by period, as discussed in § 4, the occupancy of the leased premises usually involves nothing more than the fixed rental charge distributable period by period and included in the list of items on the schedule of fixed charges. (See Chapter VIII, § 2, for illustrative Rent account.)

The basis of distribution for all rent charges is the productive or used square foot of floor space. By "used" floor space is meant that which is actually in use, excluding stairways, passages, elevator space, and idle or unused space. The total used square feet of the plant or factory divided into the total rent or building expense charges gives a "unit rate" or charge per used square foot. This rate multiplied by the area used in each department gives that department's proportion of the total rent expense. For example, assume that a calendar month constitutes the cost period, that the rental charge is $500 a month, and that the used factory floor space is 50,000 square feet. The rate per square foot per month would then be 1 cent and departments would be so charged according to their area, the total of all department charges absorbing the total rent expense of the plant.

An exception to this rule occurs where the rental value of the different floors varies. Thus, if stores were kept in a cellar, practically unusable for other purposes, while the various manufacturing departments were in bright, light, specially arranged ground-floor rooms, a larger rental charge per square foot would properly be made against the manufacturing departments. If one part of the plant is of better construction, this would require that higher space rates be charged for that part.

4. Building Expense

If the factory building is owned by the manufacturer, an account "Building Expense" may be opened to collect the many expenses incident to maintaining the building in repair and rendering it useful for manufacturing purposes by supplying it with heat, light, elevator and janitor service, water, and so on. The operation of this account is precisely the same as that of a non-productive department account, such as "Power," for example. That is, in addition to the charges already enumerated which are peculiarly its own, it is charged with the taxes and insurance applicable to the building for the period and with depreciation and the cost of ordinary repairs.

Instead of opening one departmental account for building expense, a number of accounts may be opened, one for each item included in the term "building expense."

The pro forma account shown on the following page makes clear the operation of the Building Expense account.

BUILDING EXPENSE

Labor	$185.00	General Factory Expense...	$ 76.29
Power (Heat and Light)..	84.10	Factory Overhead:	
Insurance	12.00	Dept. A.....	101.72
Taxes	20.00	Dept. B.....	127.15
Depreciation	40.00	Dept. C.....	101.72
Repairs	65.00	Shipping	50.86
Elevator Expenses.....	58.00	General Expense (Office)..	50.86
Water	16.50		
Miscellaneous Materials...	28.00		
	$508.60		$508.60

5. Insurance and Taxes

Fire insurance and taxes, with the exception of those which are a charge to Building Expense, should be distributed on the basis of the actual net value of the plant or stock. For instance, assuming that the total expense of fire insurance on equipment is $100 for the period, and that the value of all equipment is $50,000, of which the value used in the power department is $10,000, this department should be charged with one-fifth of the insurance expense for the period, or $20.

Boiler insurance is a direct charge to Power Expense and as such does not need to be distributed on the schedule.

Accident insurance against employer's liability may be treated in either of two ways. Preferably it is shown on the schedules and distributed over departments operating machinery in which accidents are likely to happen, on the basis of the number of employees engaged in each department. Thus, if the premium for the period is $100; if the factory force of the departments in which accidents are liable to occur is 500; and

if 50 of these employees are engaged in Department A, this department should be charged one-tenth of the total —$10 as its proportion of the accident insurance premium. The alternative method is to charge factory liability insurance to general factory expense, in which case it is, of course, not shown on the schedule of fixed charges.

Taxes on real estate and plant may be made chargeable against departments direct or by way of the Building Expense account. Taxes on finished goods in stock and franchise taxes are usually charged to general expense, while an income tax is a direct charge to Profit and Loss.

6. Water, Gas, and Electricity

The method of handling expenditures for water, gas, and electricity depends upon the conditions under which they are incurred. If water, gas, and electricity are used merely as a general service to the establishment as a whole, their consumption will be fairly constant. If, on the other hand, they are used intermittently in manufacturing, their consumption will fluctuate.

Under the conditions first mentioned, the average consumption for the period is distributed over departments on the schedule of fixed charges, perhaps by way of the Building Expense account, on the basis of the number of faucets, or gas burners, or electric lamps used in each case. Thus, a department with 50 gas burners or 50 lamps of 32 candle-power would be debited with double the amount charged to a department using 25 burners or 50 lamps of 16 candle-power. Though the consumption of gas and electricity for purposes of illu-

mination is greater during the winter than during the summer months, the general practice is to average the estimated expense charges for the year. These period charges are credited to the accounts with gas and electricity at the close of each period. The actual payments for gas and electricity are debited to the respective accounts as they accrue or are paid. If at the close of the financial year any considerable debit balance is accumulated in the ledger account, this shows that the estimate was too low and the balance may be distributed by means of a supplementary department charge and the rate for the next period adjusted. A credit balance shows that the estimated cost was too high and may be disposed of by reducing the charge to departments.

When the consumption fluctuates, as where water, gas, or electricity is used for manufacturing purposes, the expense is no longer treated as a fixed charge but as an expense directly related to production and as such it is distributed on the expense distribution sheet. In such a case the charges to departments are invariably based on meter readings, and these must be taken before the charges can be made.

7. Interest on Investment

Interest on investment is sometimes included among the fixed charges. Opinions differ as to whether or not a charge should be made to production for the use of capital invested in land, buildings, equipment, and inventories. The arguments in favor of treating interest as a cost of production are that it is just as necessary to have buildings, machinery, and materials as it is to have workmen for manufacturing a product, and, therefore,

these factors should be considered in ascertaining costs. When buildings and machinery are leased, rent must be paid. And if rent is a proper charge to production, as it is generally held to be, equally so is an interest charge on the investment in buildings and machinery.

Objection is made to treating interest as a part of the cost of manufacture on the ground that interest should not be regarded as an addition to costs but as a deduction from profits. To include interest in costs, it is urged, leads to their inflation, and profits, which will not be realized until the product is sold, are in consequence anticipated.

It must be admitted that the matter is technically debatable and that there are good arguments both for and against the inclusion of interest in costs. At the same time it should be recognized that under certain conditions of manufacture the accuracy of the cost figures may be impaired unless they include the element of interest. Compare, for example, a piece of printing done on a small job press costing a few hundred dollars with the same work done on a rotary press costing many thousands of dollars. Obviously, where wide differences exist in the capital value of machinery and equipment, jobs on which the expensive machinery is used will not be charged with their true cost unless interest is included.

Though the arguments against the inclusion of interest have, from the standpoint of sound accounting theory, much in their favor; from the standpoint of practical accounting an equally strong case can be made out for the inclusion of interest. More than a score of trade associations which have adopted uniform cost systems

have stated that an allowance to cover interest on investment should be included in the cost calculation. The practical reason most commonly advanced in favor of the inclusion of interest in costs is that it is impossible for the manufacturer who owns his own plant to compare his costs with those of a competitor who rents his premises, unless the former charges production with interest on his investment as an offset to the rent paid by the latter.

8. Interest as a Cost Factor

The method followed in charging interest to production is precisely the same as that used for rent or depreciation. After the rate (usually 5% or 6%) is determined, a special interest schedule may be worked out, although the fixed charges schedule will be found sufficiently accurate to be used for the purpose. Departments are debited with interest on the capital values which they represent and Interest account is credited and closed out to Profit and Loss when the financial statement is drawn up. In the final summing up interest is thus shown both as an element of manufacturing cost and an additional income earned by the capital invested in the plant.

REVIEW QUESTIONS

1. What items of expense are covered by the term "fixed charges"?
2. What is meant by the departmentalization of fixed charges?
3. Show by means of a pro forma account how the building expense or power expense account should be operated.
4. What is the basis for the apportionment of rent?

5. In apportioning rent how is the space used for entrance halls, passage ways, and main aisles treated?
6. How are insurance and taxes prorated?
7. How is light best distributed?
8. What use is made of a schedule of fixed charges?
9. How may interest be included as an element of cost?

CHAPTER XX

DEPRECIATION*

1. Wasting Assets

When a purchase is made of an item of stores, such as copper sheeting, or of a service, such as insurance, or of an addition to the plant, such as a machine, an asset is acquired. There is actual property in the copper sheeting, actual property in the right to enjoy service, and actual property in the machine. The purchase price is debited to an appropriate asset account, the account is credited with the amount consumed, and any debit balance represents the amount unconsumed.

The quantity and amount of the copper consumed in manufacture can be determined, and the cost of service can be calculated, and the proper charge made to the cost of production in either case. However, it is not so easy to measure the consumption, i. e., the wear and tear, of the machine; nor is it possible to foretell the length of time the machine will serve the purpose for which it was bought. Yet the wear, tear, and wastage of the machine and of every other plant asset carried on the books, whether fittings, fixtures, tools, power plant, or buildings, are just as absolute and just as much a charge to production as is the consumption of the copper sheeting, or the insurance service used.

*See Chapter XXIX in Volume I on depreciation for general presentation of subject, and Chapter XII in Volume IV for methods of figuring depreciation.

The same is true with all material assets. Though a building may serve its original purpose for many years, sooner or later it becomes so ill-adapted to changed conditions that extensive structural changes become necessary. Perhaps it may then prove better economy to pull the building down and build anew, in which case the value of the building will have been entirely consumed in production. A machine may prove serviceable for half a century, but if so it is just as necessary to charge one-fiftieth of its original cost to production year by year, as it is to charge against the monthly costs one-half the value of a furnace which is burned out in sixty days. At first sight the long life of a building or a heavy machine might seem to indicate that the wasting of the assets is not a factor which need be taken into consideration when calculating current costs. Yet, although the consumption or depreciation is so slow as to be almost imperceptible and for this reason is difficult to appraise, it is none the less as legitimate a charge to costs as is the consumption by furnace of the coal with which the furnace is heated. There is no difference, from a cost accounting point of view, between an item of plant used in manufacture and an item of stores consumed in manufacture. Both must be charged to costs concurrently with their consumption.

2. Obsolescence

Another form of wastage or shortening of life to which machines of a certain type are liable is that of obsolescence. A new and improved type of machine may be placed on the market of so marked a superiority over the old type that the latter at once becomes uneco-

nomical to operate in competition with the new type, and has no longer any value except as scrap. Developments in the engineering field have in the past afforded many examples of the rapid obsolescence of gas-driven and oil-driven engines, and similar tendencies are today seen in the gradual replacement of many forms of hand-manipulated machines by machinery of the automatic type. Unless a machine is of a standard utility type, which is little subject to change, such as mechanisms for turning, boring, and the like, the possibility of its becoming obsolete before it is worn out should always be considered and the depreciation rate be fixed so as to cover this possibility. An example of equipment carrying a high depreciation rate due to obsolescence is matrices used for stamping out phonographic records.

3. Depreciation of Auxiliary Equipment

The liability to depreciation and obsolescence is very great in such mechanisms and equipment as molds, patterns, jigs, and the like. Auxiliary equipment of this kind often represents a large item of cost in the production of a machine-made article and the difference between profit and loss may depend upon correctly charging production with this cost. Not infrequently a number of expensive patterns or jigs may be manufactured or purchased for a special order. The investment is perhaps made in the expectation of similar work in the future, and so only a small part of its cost is charged to the original order. The repeat orders which have been expected fail to materialize. The auxiliary equipment then becomes, like unsalable stock, a dead loss, and may make a heavy inroad on profits.

4. Depreciation Rates

Since the wastage of a plant asset is in most cases so gradual as to be practically imperceptible as it occurs, the proportion chargeable to current production cannot be determined with the same accuracy as can the value of stores or services consumed. When an item of stores is issued it can be weighed or measured, and, as the record of its purchase price is available, production can be charged with its actual cost. When a machine is purchased or a building is constructed, its cost is equally well known. But it cannot be said that such and such a job has used up one dollar's worth of the machine or is directly connected with the gradual depreciation and the slowly advancing obsolescence of the building. It is necessary to estimate the diminished values of machines and buildings and to charge production with amounts based on these estimates. This is frequently done by dividing the present estimated value of the asset, less its future scrap value, if any, by the number of years of expected service. Thus, if a building costs $20,000 and its estimated life is 40 years, with no "scrap value," the depreciation rate is 2½%, the annual depreciation charge $500, and the monthly charge $41.66. Other and more complex methods of figuring depreciation are discussed in Volume IV.

Such depreciation rates are calculated for every item of plant carried on the books as a capital asset. Thus separate rates are often used for the building, power plant, machinery, fixtures, etc. At the end of each period a summary is made of the amounts chargeable to departments for the service or use of the various plant assets.

5. Fixing Depreciation Rates

It is clear that the life of a plant asset will vary with its nature, the use to which it is put, and the care with which it is handled. A building which is estimated to be serviceable for 60 years, and a motor truck which it is estimated will have to be sold for its scrap value in 6 years, must obviously be charged to production at very different rates. If the building cost $60,000 and the motor truck $6,000, the annual "write-off" for depreciation in both cases—disregarding scrap values—would be $1,000, but the depreciation rate in the first case would be 1.66%, and in the second case 16.66%.

It will thus be seen that a depreciation charge is not a definite and known quantity, but a matter of experience and expert estimate. Technical experience is needed in the business for which depreciation rates are to be estimated before the charges can be determined with even approximate accuracy. Moreover, these charges, however carefully determined, frequently require adjustment from time to time as the asset depreciates more rapidly or more slowly than was at first estimated.

The causes which may make these adjustments necessary will be readily seen if a case in point is cited. Assume that the life of a machine costing $2,000 is, under normal working conditions, expected to be 10 years, and that its scrap value will merely cover the cost of its removal. An annual charge of $200 for depreciation is thereupon made to the overhead expense account of the department in which it is installed. Under pressure of business the necessity arises of working double shifts and overtime. The machine in consequence is operated

almost continuously, and the minimum amount of attention is given to its cleaning and adjustment. Overstrained in this way, its life is bound to be shortened. Under such abnormal conditions, it may either have to be scrapped in 5 years or require such extensive repairs as to cost almost as much as a new machine. Under these circumstances the original depreciation charge of $200 should be readjusted to cover the unexpected wear and tear; i.e., the charge to production should be increased sufficiently to absorb the entire cost of the machine in the diminished number of years of service.

The difficulty of determining fair depreciation rates on auxiliary equipment can often be simplified by adopting some average rate and applying this uniformly to similar classes of articles, assuming that any underdepreciation in one case will be offset by over-depreciation in another. Since the problems here involved are also of a more or less technical nature, the rates should not ordinarily be determined by the cost accountant, whose interest in them is usually confined to the procedure for charging them to production, but by those technically trained and experienced in the demands of the particular trade.

6. Depreciation Schedule

For depreciation purposes the life and scrap value of each plant asset must be first estimated. The depreciation rates are then determined, and from these estimates a schedule (Form 36) is drawn up for the purpose of working out the monthly charges and the individual charges to departments. The schedule consists primarily of a list of the plant assets. In a plant of any

DEPRECIATION AND

DATE		VENDOR	DESCRIPTION	COST	
Dec.	27	Globe Wernicke	Furniture	67	25
	27	B. Schurr	Tables	42	50
	27	Singer Sewing Machine Co	Machines	285	00
	27	E. C. Fuller Co.	Cutter	260	00
	28	E. Klein & Bros.	Elec. Fixtures	404	00
	31	Hall Marvin Safe Co.	Safe	150	00
	31	J. K. Krog	Cutting Board	43	20
	31	K. Mainia Co.	Cutter	208	00
Jan	2	Shotwell Elec. Co.	Motor	36	00
	3	P. Prybil Machine Co.	Saws	200	00
	4	Clark & Gibby	Furniture	406	50
	4	Abr. Bauman	"	110	00
	4	Ernest Klein & Bro.	Elec. Fixtures	172	00
	6	Smith of New York	Blueing Eq.	144	72
	10	P. Prybil Mch. Co.	Saws	3	00
	14	" " "	Cutter	70	00
	14	Forest Box Co.	Bins	37	44
	15	" " "	"	98	37
	15	Globe Wernicke	Tables	311	00
	20	Singer Sewing Machine Co.	Machine Parts	1	65
	20	" " "	" "		25
	31	Petty Cash		80	65
	31	M. L. James	Partitions	1660	85
	31	Globe Wernicke	Tables	186	60
Feb.	4	" "	Furniture	133	70
	11	Underwood Typewriter Co.	Typewriter	120	00
	27	M. Aaronson	Plumbing	125	00
Mar.	1	Prybil Mfg. Co.	Saws	4	00
	18	Letterhead Mfg. Co.	Trunks	125	00
Apr.	9	Durand Steel	Lockers	120	00
	9	M. L. James	Partitions	148	32
	15	Singer Sewing Machine Co.	Machines	590	00
	30	Forest Box & Lumber	Bins	120	46
	30	Smith of New York	Blueing Fix.	34	00
	30	Petty Cash		14	94
May	19	Artloom Rug Co.	Rug	37	40
	24	Eastman Machine Co.	Cutter	300	00
	30	Forest Box & Lumber	Bins	38	98
	30	Petty Cash		18	50
	30	" "	Stands	45	00
		Total		6945	98
		Depreciation 10% per year		694	59
		Depreciation per month		58	71

Form 36. Depreciation

EQUIPMENT RECORD

GENERAL AND OFFICE	MANUFACTURING			SHOW ROOM
	GENERAL	A	B	C	SALES
67 25					
					42 50
			285 00		
		260 00			
404 00					
150 00					
			43 20		
			200 00		
		36 00			
		200 00			
406 50					
					110 00
172 00					
		144 72			
		3 00			
		70 00			
	37 44				
	98 37				
					311 00
			1 65		
			25		
					80 65
1660 55					
					186 60
133 70					
120 00					
125 00					
		4 00			
					125 00
	120 00				
148 32					
			590 00		
	120 46				
		34 00			
					14 94
					37 40
		300 00			
	38 98				
					18 50
					45 00
3387 32	415 25	1051 72	1120 10		971 59
338 73	41 52	105 17	112 01		97 16
28 23	3 46	8 76	9 33		8 93

Schedule

size, the asset items are usually classified under the heads of buildings, machinery, power plant, electrical machinery, furniture, fittings, and the like, so that the total depreciation on any one class of assets is summarized on its own separate sheet, or part of a sheet.

The operation of the depreciation schedule is simple. The book value of each item of plant is recorded and the depreciation rate is shown, as well as the annual amount of depreciation, and the charge applicable to each cost period.

If the asset belongs to one particular department, the total depreciation for the cost period is entered in the column devoted to that department, as shown.

The totals of the depreciation charges for the period are entered on the expense analysis sheet on which the final departmental distribution is made. (See Chapter XXI.)

REVIEW QUESTIONS

1. Define depreciation.
2. What is the difference between obsolescence and wear and tear?
3. What is a wasting asset? Give two examples.
4. How would depreciation rates be affected by a rising market for machinery and equipment?
5. What plan would you suggest for fixing upon a depreciation rate for the copper matrices used to stamp out phonograph records, in view of the fact that the master matrix may cost a thousand dollars, on the one hand, and the so-called musical hit may be short-lived, on the other?

CHAPTER XXI

EXPENSE DISTRIBUTION

1. Sources of Expense Charges

As stated in Chapter XVII, the sources whence the departmental expense charges are obtained are as follows:

1. The schedule of depreciation (Form 36, pages 250, 251).
2. The schedule of fixed charges (Form 35, page 235).
3. Time tickets covering indirect labor (Form 34a, page 228), and the pay-roll of salaried employees.
4. Stores requisitions for expense supplies (Form 17, page 134).

These factory documents together with the record of current purchases chargeable directly to expense show what proportion of the expenditures recorded on the books is chargeable each period to overhead. From these documents and the purchase journal an itemized statement for overhead expense is made out by departments. The sum of these amounts will represent the total expense burden for the period, which is to be distributed ultimately over the product. With the charging of the overhead against the operating departments, the accounts kept with the non-productive departments

OVERHEAD DISTRIB

CR. WATER AND GAS	CR. STORES	CR. SALARIES	CR. WAGES	CR. TAXES	CR. INSURANCE	CR. RESERVE FOR DEPREC.	CR. SPOILAGE	SOURCE OF CHARGE	EXPENSE ITEM
								Depreciation Schedule	DEPRECIATION On Buildings
								"	On Machinery
								"	On Furniture and Fixtures
								Fixed Charge Schedule	INSURANCE On Buildings
								"	On Machinery
								"	On Equipment
								"	TAXES
								"	WATER
								S.O. Time Tickets	BUILDING REPAIRS Labor
								Stores Req'ns.	Material
								S.O. Time Tickets	MACHINERY REPAIRS Labor
								Stores Req'ns.	Material
								S.O. Time Tickets	FIXTURES REPAIRS Labor
								Stores Req'ns	Material
								S.O. Time Tickets	LABOR Trucking & Hauling
								"	Cleaning & Janitor
								"	Power Plant
								Stores Req'ns.	GENERAL SUPPLIES
								"	OFFICE SUPPLIES
								As charged on %	SPOILAGE
								"	TELEGRAMS AND TELEPHONES
								Pay-roll	SALARIES
								TOTALS	Allocation on Basis of
									"
									"
									"

Form 37. Overhead

UTION SHEET

NON-PRODUCTIVE DEPARTMENTS					PRODUCTIVE DEPARTMENTS					
GENERAL	ADMINISTRATIVE	OFFICE	STORES	POWER	DEPT. A	DEPT. B	DEPT C	DEPT D	DEPT E	DEPT F
101	201	301	401	501	601	701	801	901	1001	1101
102	202	302	402	502	602	702	802	902	1002	1102
103				503	603	703	803	903	1003	1103
104				504	604	704	804	904	1004	1104
105	205	305	405	505	605	705	805	905	1005	1105
106	206	306	406	506	606	706	806	906	1006	1106
107			407	507	607	707	807	907	1007	1107
108	208	308	408	508	608	708	808	908	1008	1108
				509						
110	210	310	410	510	610	710	810	910	1010	1110
	211	311	411							
Pay-roll										
No. of Employees										
Value of Stores Withdrawn										
Estimated Power Consumption										
TOTAL EXPENSE										

Distribution Sheet

are closed so far as they are applicable to the period. The productive department expense accounts, which are now open, show the operating expense and the spreading of this expense, by means of predetermined rates, over the product.

2. Expense Distribution Sheet

An expense distribution sheet, examples of which are shown in Forms 37, 38, and 39, is the mechanism usually employed to departmentalize the expense for the period. From the data entered on this sheet the journal entries may be prepared, crediting the items of expense and debiting the department overhead accounts. As will be readily seen, when schedules and other documents from which the data are taken are once prepared, the work of making up the expense distribution sheet reduces itself to a simple clerical task.

So far as concerns depreciation and the fixed charges, the preparation of the expense distribution sheet is merely a matter of transferring a set of figures from one sheet to another. The posting from the standing orders and stores requisitions is facilitated by entering the standing order or requisition number on the expense distribution sheet in the space to which a summary of the documents bearing that number is to be posted. In a large organization with a hundred or more departments, several thousand standing order items may require distribution at the end of each cost period.

The overhead distribution sheet of Form 37 is given to illustrate the general principle of overhead distribution to departments. The expense analysis sheet of Form 38 shows the same principle adapted to the re-

quirements of a machine shop which rents the building and buys light and power. At the top of the form are assembled the data required for the distribution of rent and light, depreciation, power, and general expense. It should be noted that insurance, taxes, and building maintenance expense are absorbed into the general expense, which is then distributed over all the productive departments on the basis of, or in proportion to, the direct labor plus expense in each case. This matter of determining department overhead rates is more fully discussed in Chapters XXII and XXIII of this volume.

The expense analysis sheet shown in Form 39 illustrates the analysis of the overhead in a plant where the distribution is made over the manufacturing and selling departments. The data given in the column at the left shows on what basis general expense is apportioned. In the lower part of the form the department percentages of manufacturing expense to productive labor are given. These percentages determine the rates used in figuring the overhead expense on job costs. Selling expense is charged to Profit and Loss.

3. Allocation of Non-Productive Department Expense

After the overhead has been apportioned over *all* departments, it is necessary to prorate the total expense charged against each non-productive department over productive departments in proportion to the demand made in each case by these productive departments upon the services of the non-productive departments. The basis of the allocation must necessarily vary with the different classes of expenses and can be decided only

ANALYSIS OF EXPENSE
EXHIBIT

PRODUCTIVE AREA IN SQ. FT.			3686	12.78%	3638	12.12%	4054	13.38%	1213	4.04%	1058	3.52%
COST OF EQUIPMENT	23950	17.87%	32300	24.57	19000	14.17	5000	3.73	9200	6.87	8000	5.82
HORSE POWER			26	34.23	10	13.14	5	6.58	5	6.58	5	6.58
DIRECT LABOR AND EXPENSES			7677.57	37.95	1336.34	6.50	1434.03	6.97	740.81	3.60	355.10	1.67
	GENERAL		TOOL		POWER PRESS		PAINTING AND TRIMMING		SCREW MACHINE		MILLING	
NON-PRODUCTIVE LABOR	4478	80	576	00	56	00	224	80	124	80		
RENT AND LIGHT			117	88	716	35	128	45	38	78	32	79
DEPRECIATION	161	92	222	60	128	38	33	79	62	24	52	72
POWER			97	09	39	61	18	99	18	99	18	99
GAS												
AUTOMOBILE	106	91										
INSURANCE	319	19										
TAXES	137	44										
MAINTENANCE OF BUILDING	613	10										
GENERAL	1859	74										
SUB-TOTAL	7677	10	1013	57	340	34	406	03	244	81	105	50
GENERAL EXPENSES			2913	41	499	01	535	10	276	37	128	21
TOTAL EXPENSES			3926	98	839	35	941	13	521	18	233	71
PRODUCTIVE HOURS			8584		2704		3328		1040		324	
EXPENSE PER HOUR			45.7	¢	31.0	¢	28.2	¢	50.4	¢	72.2	¢
PRODUCTIVE LABOR			666	00	996	00	1028	00	496	00	249	60
RATIO OF EXPENSE TO PRODUCTIVE LABOR			58.9	%	84.2	%	91.5	%	105.0	%	93.7	%

Form 38. (a) Expense Analysis Sheet—Machine Shop (left half)

S FOR APRIL 19 L
B

1044	348%	1,819	6.06%	5,534	18.47%	1450	4.80%	2175	7.25%	2175	7.25%	2175	7.25%	30020	100%
350	0.26	10,000	7.46	4840	3.46	3500	2.61	4000	2.91	6000	4.47	8000	5.80	134140	100
0		2	263	2	2.63	2	263	9	11.84	5	6.58	5	6.58	76	100
1806.05	8.79	1340.37	6.52	3074.53	14.53	363.30	1.76	342.22	1.66	807.46	3.93	1257.19	6.12	20534.97	100
SOLDERING		INSTRUMENT MAKING		ASSEMBLING		DRILL PRESS		PLATING		FILING AND GRINDING		TRACK AND SHEAR		TOTAL	
72	00	200	00	142	00					128	00	88	00	6090	40
33	40	58	16	178	31	46	07	69	58	69	58	69	58	959	93
2	35	67	58	31	43	23	64	26	36	40	49	52	62	906	12
		7	59	7	54	7	59	34	28	18	99	18	99	288	70
166	30													166	30
														106	91
														319	19
														137	44
														613	10
														1859	74
274	05	333	33	359	33	77	30	130	22	257	06	229	19	11447	83
674	82	500	55	1115	48	135	12	127	44	301	71	469	88		
948	87	833	88	1474	81	212	42	257	66	558	77	699	07	11447	83
3328		2080		11024		832		416		1664		3328		38652	
28.5¢		40.0¢		13.4¢		25.5¢		62.0¢		33.5¢		21.0¢		37.3¢	
1532	00	1007	04	2715	20	286	00	212	00	550	40	1028	00	16764	24
61.9%		82.2%		54.3%		74.1%		111.1%		101.5%		67.9%		68.2%	

Form 38. (b) Expense Analysis Sheet—Machine Shop (right half)

after the facts are known. Thus, both general and administrative expense might in some cases be equitably distributed on the basis of the pay-roll. If, for example, the total direct labor pay-roll for the period is $100,000, and the wages paid in one department amount to $1,000 and in another to $5,000, the departments might be charged with 1% and 5% of the general expense respectively.

Stores expense, i.e., the cost of operating the stores department, can be charged with fairness only on the basis of the use of the stores-room facilities, and in most cases this use is indicated with sufficient accuracy by the total issues to each department as shown on the stores issued book. Thus, if the total issues for the period are $10,000, and the issues to one productive department total $1,000 while those to another are $2,000, the one should be charged 10% and the other 20% of the cost of operating the stores department.

Power expense can be allocated in various ways. When a meter can be installed in each department, this is the most satisfactory method of distributing power costs. If this is not practicable, a meter can sometimes be installed in the various departments using power long enough to ascertain the average amount of power consumed by each during a normal period. If the meter measurement is unobtainable, a fairly accurate estimate of consumption can be made by adding the horse-power rating of the power units in each department and then distributing the power cost among departments in proportion to horse-power requirements. Such an estimate, however, is reliable only when the machinery in all departments is in constant operation.

When machines are used intermittently, records should be kept in each department of the number of hours that each machine is operated. The h. p. of each machine is then multiplied by the operating hours it is used and the total resulting figures give the number of "h. p. hours" by departments. The h. p. hours for all departments divided into the total power cost gives a rate per h. p. hour which, multiplied by the h. p. hours for each department, gives the power cost in each case. Thus, if the h. p. of all the machines in one department is 200 and the machines are run for 1,000 hours, its h. p. hours are 200,000. If the h. p. hours for the whole of the factory are 2,000,000, the department referred to should be charged 10% of the total power cost. This last method has almost the accuracy of a meter measurement and can readily be used when the method of burden distribution requires that a record be kept of the hours of each machine's operation.

While the examples given illustrate the general principles which govern the allocation of the expense of one department over those to which it is tributary, or which it serves, methods vary with circumstances and in large organizations can be applied only by someone thoroughly acquainted with the physical and operating conditions. In an engineering plant, for example, there might be a pattern department operated in conjunction with the foundry in which patterns were both made and stored. Pattern-making would usually be treated as a charge to a pattern plant account and absorbed by depreciation charges, whereas pattern storage should be charged to foundry expense. Foundry expense might be charged direct to orders or to the departments to

ANALYSIS OF EXPE

	GENERAL						MANUFAC			
	ADMINISTRATION		RECEIVING AND SHIPPING		TOTAL		GENERAL		A-BOX MAKING	
NON-PRODUCTIVE LABOR	797	32	290	33	1087	65	95	50	216	50
RENT			37	18	37	18	41	12	106	31
INSURANCE	78	10			78	10				
DEPRECIATION	28	23			28	23	3	46	8	76
POWER										
PURCHASE JOURNAL	145	71			145	71	143	89		
TOTAL	1049	36	327	51	1376	87	283	97	331	57
RECEIVING AND SHIPPING										
⅓ Manuf'g., ⅔ Selling							109	17		
ADMINISTRATION										
½ Manuf'g., ½ Selling							524	68		
TOTAL							917	82	331	57
MANUF'G. GEN'L. DISTRIBUTED										
ON BASIS OF PROD. LABOR									355	20
TOTAL									686	77
PRODUCTIVE LABOR									1690	83
RATIO OF MANUF'G. EXP.										
TO PRODUCTIVE LABOR									40.6	%
									STATI	
FLOOR SPACE			520	25%			580	9.4%	1480	24.3%
PRODUCTIVE LABOR									1691	38.7%

Form 39. Expense Analysis

NSES FOR MAY 19—

TURING						SELLING							
B-MACHINE OPERATING		C-HAND SEWING		TOTAL		DESIGNING		SALES		TOTAL		GRAND TOTAL	
99	66	86	66	498	32	312	00			312	00	1897	97
76	56	65	62	289	61	10	06	100	65	110	71	437	50
												78	10
9	93			21	55			8	93	8	93	58	71
34	45			34	45							34	45
				143	89			780	97	780	97	1070	57
220	00	152	28	987	82	322	06	890	55	1212	61	3577	30
				109	17			218	34	218	34		
				524	68			524	68	524	68		
220	00	152	28	1621	67	322	06	1633	57	1955	63	3577	30
293	71	268	91										
513	71	421	19	1621	67					1955	63	3577	30
1399	73	1282	66	4373	22								
36.7	%	32.9	%	37.1	% (AVER)								
STICS													
1035	17.5%	920	15.0%			140	2.3%	1400	23.0%			6075	100%
1400	32.0%	1283	29.3%									4374	100%

Sheet—Novelty Goods Factory

which deliveries of castings have been made, on the basis of the weight of the good castings delivered. In the same plant there might be a dozen or more stores-rooms operated for the needs of special departments, and the expense of each would be a charge against its special department. On the other hand, the cost of operating a tool storage room in close proximity to a number of machine shops and serving them all, would be prorated over them on the basis of the number of requisitions received from each, or on such other basis as the conditions might indicate.

Again, in a small machine shop the power might be purchased from outside and a sufficiently lengthy record of its cost be kept to furnish accurate data for averaging. Power expense might then be listed on the schedule of fixed charges and so distributed. On the other hand, the power plant of a big locomotive concern might represent such a large capital expenditure as to warrant its treatment as a separate undertaking. Power expense would then be charged to each shop in proportion to consumption for manufacture, crane work, lighting, and heating.

Though the departmental divisions of almost every factory differ in some ways and the proper method of distributing expense among them can be determined only when the facts of the case are known, yet the same fundamental principle is applicable in all cases, i.e., distribution should be as nearly as possible on the basis of "value received." When the manufacturing conditions of a particular plant are known, no difficulty should be experienced in allocating departmental expense on a simple and equitable basis.

4. Merger of Minor Department Expense

The non-productive or service departments listed on the expense distribution sheets (Forms 37 to 39) are presented merely to illustrate expense distribution and not because they represent the customary classification of service departments or the order of their allocation over operating departments. The service departments actually entered on the expense distribution sheet will depend upon the conditions. In a large factory, for example, operating a hundred or more productive departments, there might be many service departments. To allocate each of these separately over the productive departments on some approved basis would be a tedious business involving considerable clerical work with no compensating advantage. For these reasons, in organizations of any considerable size it is customary on the distribution sheet to merge the expenses of the service departments until their total expenses are, perhaps, shown under not more than a half dozen general heads. Thus, "Administration" in a large organization would usually cover numerous activities and might include all expense incurred in the administration of the following departments:

1. Factory manager and the cost of operating his office.
2. Factory superintendent and the cost of operating his office.
3. Planning and dispatching departments.
4. Employment department.
5. First aid.
6. Welfare work.

7. Cost and factory accounting.
8. Miscellaneous administration expenses.

In the same way stores expense might include the following:

1. Purchasing
2. Receiving
3. Stock and stores-room expenses
4. Testing and inspecting materials
5. Delivering materials

As already stated, the distribution of the cost of all these different activities separately over the operating departments is not usually worth while, and yet it may be very advisable to show on the books the cost of operating each of them. In such a case the total collected on the distribution sheet under "Administration," for example, serves only as a controlling total debited to Administration account on the general ledger, while the details of this total are found in an expense ledger in which accounts are kept with the minor departments comprised within the term "Administration."

5. Allocation of Expense to Minor Departments

When some or all of the service departments appearing on the expense distribution sheet are composed of a number of minor departments, the depreciation and fixed charges schedules and also the standing order cost sheets must be arranged to meet this condition.

So far as the schedules are concerned, this is a simple matter. All that is required here is a column for each of the minor departments. The totals for these minor or sub-departments are combined under the proper

headings when the transfer is made to the expense distribution sheet. Thus, if the depreciation on furniture in the manager's office, the superintendent's office, the planning and other departments listed under "Administration," amounts to $150 for the period as shown on the depreciation schedule, this total is entered on the expense distribution sheet (Form 37) under the heading "Administration" and on the line "Depreciation of Furniture and Fixtures." The detailed amounts shown on the depreciation schedule are, however, entered in detail in the accounts kept with each subsidiary department on the expense ledger and the total of these accounts must equal the corresponding totals entered on the distribution sheet.

The standing order numbers also must be so arranged as to permit the ready classification of the routine expenses incurred by the minor departments. This can be done by adding a letter to the standing order number representing the department as a whole to distinguish the expense of one minor department from that of another. For example, while all standing order cost sheets bearing the number 205 would be a charge to administration (space 205 on the distribution sheet) for the labor cost of repairs done in the offices, the cost sheets 205A might refer to the manager's office, 205B to the superintendent's office, 205C to the planning office, and so on. The cost sheets numbered 205A would then be charged to the manager's department account, 205C to the account recording the expense of the planning office, and so on in the expense ledger, while, as just stated, all requisitions numbered 205 would be charged to repairs under "Administration" on the dis-

tribution sheet. They would also be charged to the Administration controlling account on the general ledger.

6. Stores Expense "Short-Cut"

Instead of distributing the cost of operating the stores department over the productive departments and through the productive departments over the product, direct jobs are sometimes charged, by means of burden rates, with the expense of operating the stores department. If the total stores expense is compared with the total value of all material issued on jobs during a given period, the percentage of stores expense to material used can be determined. Every item of material used on a job is then "loaded" with this percentage. For instance, if stores expense for the period is $3,000 and the value of the material used during the period is $100,000, all material withdrawn from stores should be charged 3% of its value to cover the cost of operating the stores department.

This method of distributing stores expense is commonly employed in plants where the cost of handling and storing material is relatively high in proportion to its value because of the heavy or bulky nature of the stores. The subject is treated more fully in Chapter XXIV.

7. Department Expense Accounts under Job Order Method

Under the job order method, when the expense distribution sheet shows the non-productive department expenses in sufficient detail (as would usually be the case in an organization of not over twenty depart-

ments), the only advantage of opening accounts on the ledger with the expense of the non-productive departments is that of convenience in analyzing the expense of a particular non-productive department at a later date.

On the other hand, it is always necessary, under the job order method, to open an expense account on the ledger with each operating department. The operating department expense totals cannot be closed into the controlling manufacturing account direct from the distribution sheet, because the actual current expense of a department may not equal the estimated expense charged to orders and summarized in the expense debits to the controlling manufacturing account. Therefore, operating department expense accounts are opened on the expense ledger which are debited with the details shown on the distribution sheet and credited with the departmental charges made to orders. The method of adjusting any difference between the department expense as taken from the distribution sheet and the department burden applied to orders is considered in Chapter XXII.

8. Expense Accounts under Process Method

When computing process costs the accounts can be divided into two classes: (1) operating accounts kept with each process, the details of which are recorded in subsidiary accounts kept in a cost ledger; and (2) service expense accounts which are closed out to the process accounts. Theoretically, it is unnecessary when calculating process costs to open any expense accounts on the ledgers, as the service expenses can be computed on the expense distribution sheet and closed out to the

process accounts by journal entry. In practice, however, the service expense charges to each process account are recorded in separate accounts so as to show the detail on the books in more permanent form than on working distribution sheets. When it is desired to make out a financial statement of expense covering a long period of time, reference to a number of unwieldy working sheets cannot be so conveniently made as to accounts in which the details are summarized and clearly shown.

REVIEW QUESTIONS

1. Name the sources from which expense data are obtained.
2. What kind of a form is best suited for making an apportionment of expense?
3. How should general expense be apportioned to operating departments?
4. What is the most satisfactory basis for distributing power to departments?
5. Name the accounts to which power expense would be closed out in (a) a job order factory with two manufacturing departments, (b) a process plant with two manufacturing departments. Discuss your reasons for the procedure recommended.
6. Is the expense of supervision or administration best apportioned to operating department expense accounts on the basis of (a) direct labor in each department, or (b) the sum of direct labor and expense charges to each department? Give the reasons for your answer.
7. If the expense of the stores department is not added to the material consumed as a burden, what becomes of the stores expense?
8. How should the time of executives be divided as between manufacturing and selling departments?

CHAPTER XXII

EXPENSE DISTRIBUTION OVER PRODUCT

1. Overhead Rates

In process cost-finding, expense is merged with other costs in the operating department accounts, the totals of which are averaged over the production of the period to ascertain the cost of each unit produced. This averaging is feasible because each unit of production makes the same demand upon the services of men and machines. But as soon as more work (whether of men or machines or both) enters into the production of one lot of articles or one job, as compared with another, the averaging of the total cost or of expense alone over the product no longer gives accurate costs. A job worked upon by ten men for ten weeks in one department must obviously bear a much greater expense charge than a job which is completed by five men in two days in the same department.

To meet this condition, in job order cost-finding, an expense or "burden" rate is determined for each department; that is, having determined the overhead expense of a department for a given period of time, an overhead expense rate is calculated, to be charged against the product. This rate may be based upon any one of the following:

1. The cost of the labor expended upon the job.
2. The labor time expended upon the job.

3. The machine time spent in processing the job.
4. The total cost (labor and overhead) of the services of the department.

Two other methods of distributing overhead over product—the material cost method and the prime cost method, i.e., direct labor and material cost—are sometimes employed as the basis of expense distribution. These two methods are, however, of limited application and use, and cannot be regarded as standard systems of expense distribution.

2. Methods of Distributing Expense over Product

Corresponding to the first four bases mentioned above, there are four general methods of determining and distributing overhead rates known as:

1. The percentage of labor method
2. The productive-hour method
3. The machine-hour or machine-rate method
4. The sold-hour or service-hour method

These are merely different modes of distributing expense over job orders and do not in themselves constitute basic methods of cost determination. Operating conditions frequently vary so greatly in different departments of the same factory that the same method of burden distribution cannot be employed throughout, and two or even three methods may sometimes be used in the different departments of a single establishment.

3. Percentage of Labor Method

The distribution of burden as a percentage on labor is more generally used than any other method of dis-

tributing expense over product, because of its simplicity and the ease with which the calculations can be made. The principle upon which it is based is that there is a direct relation between the cost of labor and the factory overhead, and as the product increases in value with the cost of the labor expended upon it, so must the expense of supervising this labor and the other overhead expenses of conducting the business rise in proportion. Therefore, if the ratio between the average cost of the direct labor and overhead of a department during a previous period is first ascertained, the percentage thus obtained when applied to the direct labor cost charged to any particular job in that department will give an equitable and complete distribution of the departmental burden over the product.

As an example, if the direct labor cost of a department averages $3,000, and its overhead expense averages $1,500 for each cost period, it is clear that the overhead equals 50% of the direct labor cost. The burden rate of the department is then said to be 50% of its labor cost. If the shop time tickets of a certain job show that its labor cost amounts to $30, 50% of this amount, or $15, is charged against it to cover overhead expense.

The attractive feature of the percentage of labor method is its simplicity. The rates are easily computed, no records are required of the number of productive or machine hours applied to jobs (as under the three other methods), and the overhead cost on jobs can be readily calculated. In case a department rate is found to be too high or too low it can readily be changed and adjusted until it absorbs the department overhead period by period with fair accuracy. The clerical work involved

is less than that arising from any other method of burden distribution, and, when wages paid are fairly uniform and the men work under the same general conditions and with similar equipment, the method gives satisfactory results.

4. Applicability of Percentage of Labor Method

Because of the simplicity of the percentage of labor method there is a temptation to employ it under conditions where the overhead is not an unvarying percentage of the labor cost, and where accordingly a charge on the basis of such a percentage does not always represent the fair overhead cost of the job. To fit the case perfectly, wages should be fairly uniform and there should be some uniformity in the processing of the product. If, for example, machines of the same type are used within a department and wages for the same kind of work are the same or nearly the same, the percentage method gives an equitable distribution of overhead. Likewise, if the department is one in which the work is done mostly by hand and if there is a fair equality as to wages, it is equally applicable.

These conditions, while frequently found in single departments—as in the cutting room of a shoe or garment factory, or the assembly floor of a heavy machine plant—rarely exist throughout a manufacturing plant. The percentage method becomes less accurate and even misleading if used where these conditions do not exist. If, for example, a department contains machines of widely different types, some costing more, using more power and requiring more space, repairs, and supervision than others, a percentage rate charged to all jobs

on the basis of labor costs would penalize those done on the smaller and less expensive machines. Again, if a low-priced man operates an expensive automatic machine and a high-priced man works at a comparatively low-priced machine where skill amounts to more than running expense, any percentage on wages charged as indirect expense would not only be inaccurate but might actually reverse the proper charges. That is to say, a job making a heavy demand upon the department equipment might be charged less than a job making a relatively small demand. The limits within which the method may be advantageously applied are therefore fairly well defined.

To sum the matter up. it may be stated generally that where the department overhead is less than 50% of the direct labor cost and most of the work is done by hand, or where machinery of similar types is used, with wages fairly uniform, the percentage of labor method can be adopted with the assurance that it will result in a fairly equitable distribution of the burden.

5. Productive-Hour Method

This method is based on the principle that the time spent on a job is often a truer index of the demand the job makes on the department overhead service than is its labor cost. The clerical work connected with each employee on the pay-roll, the insurance against accident, the heating and maintenance of the building for his benefit, the supervision each employee requires—these expense factors cost no more in the case of one employee than they do in the case of another, no matter what the difference in their wage rates may be. It is apparent

that when the product is paid for by the piece or when premiums are offered for increases of output, a rise in the earnings of employees indicates an increase in production, while most of the overhead charges, as rent, heat, light, etc., remain the same, and there is therefore a decrease in the overhead cost per unit produced. To distribute overhead as a fixed percentage of the earnings of employees under these circumstances would be practically to continue the same overhead per unit, but to charge it on a greater number of units; and thus the burden charges would increase with output—an obviously incorrect practice. Therefore, when wages for the same class of work vary, where premium rates are used, or where apprentices are employed, overhead is more equitably distributed on the basis of the *time* spent on jobs than on the basis of their labor *cost.*

In computing a productive-hour rate, a record is kept of the number of hours worked on jobs by productive workers during the cost period and these "productive" hours are divided into the departmental expense for a preceding period to give an hourly burden rate. This rate is then charged to jobs for each hour of productive labor spent upon them within the department.

For example, if the department overhead is $4,000 for the period, and the number of productive hours, i.e., the total of all hours worked on jobs, is 3,000 for a cost period, a rate of $1.33 1/3 should be charged to jobs for each hour of direct labor spent upon them.

6. Applicability of Productive-Hour Method

In departments where the overhead tends to equal or exceed the direct labor cost, the productive-hour

method of burden distribution is to be preferred to the percentage of labor method. Especially is this the case where premium methods of wage payment are in vogue and where in consequence the labor cost on jobs of the same kind fluctuates with the skill of workers. There is then less likelihood of penalizing some jobs and of favoring others. In departments, also, where the work is largely done on machines and where in consequence the overhead may be more than the direct wages, an hourly charge for production can with safety be made if the machines are of the same type, or if the department consists of a series of machines through which all the product must pass. If, however, the machines do not constitute a chain and some of them are larger and more expensive to operate than others, the same hourly charge covering all jobs will obviously favor the jobs done on the heavy expensive machines and penalize those done on the less costly equipment. Under these conditions the productive-hour method is inapplicable and the machine-rate method—discussed in the next section—under which separate hourly rates are calculated for the different classes of equipment, gives more accurate results.

7. Machine-Rate Method*

If the machinery of a department varies greatly in its cost, size, and power consumption, or if certain heavy machines require the services of cranes and other special transport facilities, or if other material inequalities exist, a blanket hourly rate covering the services of the department as a whole will no longer be a satisfactory method

*See next chapter for full discussion of subject.

of distributing burden. Under such conditions, accurate cost-finding requires further departmentalization. Expense should be localized at least to departments so that an accurate charge can be made for the services rendered. But if it is found that within a natural departmental division such as the testing department of an electrical engineering plant, the services rendered by the various kinds of equipment vary greatly in character and cost, the departmental division of the factory should be carried still further, for purposes of expense distribution, until each machine or each group of like machines becomes a separate department. When this is done and the hourly cost of operating these has been determined, each will have its own "machine rate."

8. Calculation of Machine Rate

The machine rate is calculated by dividing the number of operating hours for a previous period of one or a group of like machines into the expense of operating during the same period. The result is a "machine-hour" rate which is charged to orders in proportion to the number of hours during which they occupy the particular machine or group of machines for which the rate has been calculated. The operating expense is compiled in the same way as the expense of a department. That is to say, a machine or a "production center" consisting of a group of like machines is charged with taxes, floor space, depreciation, and the like just as if it constituted a separate department.

The machine rate is perhaps the most scientific and accurate of the methods of distributing overhead over product. For this reason the method is merely outlined

here and the next chapter is devoted entirely to a detailed discussion of the methods of finding and applying the machine rate.

9. Sold-Hour Method

The sold-hour method is based on the fact that when the cost of the overhead of a department for a previous cost period is added to its productive labor cost for the same period and then divided by the number of productive hours worked by the department under normal conditions, the result is an hourly rate at which the services of the department can be "sold" and cover cost. Thus, if the department wages are $3,000, overhead $2,000, and the number of productive hours worked in a cost period are 4,000, this last sum divided into the sum of the overhead and wages gives a sold-hour rate of $1.25. This rate is charged to orders for each productive hour worked upon them. Approximately the same number of hours should be devoted to like orders if the charge is to be correct or if the actual cost of an order is to equal the estimated figures. The accuracy of this method depends upon a fairly constant pay-roll and the assumption that overhead does not fluctuate to any serious extent from one period to another.

10. Applicability of Sold-Hour Method

The sold-hour method of burden distribution has a more limited range of applicability than any of the methods previously described. Yet under suitable conditions it is simple and fairly accurate and gives a ready means of estimating the cost of orders when prices must be quoted in advance. This estimate can later be com-

pared with the actual cost and the promise compared with the performance. It would, of course, be equally possible to estimate on orders by means of any of the methods already described. But the feature of the sold-hour plan is that by combining labor with overhead a composite rate is ascertained which is simple in operation and under suitable conditions gives satisfactory results with the least clerical work.

In small jobbing factories or in printing establishments where bids as a rule are requested on orders and where the pay-roll and overhead are usually fairly uniform within each department, the sold-hour method is very generally used because it covers the peculiar needs of these types of business better than any other plan. It is also the method generally adopted in the cardboard box-making industry, because here again bids are usually asked for on orders and the working conditions are such that the sold-hour method gives satisfactory results. The method is useful also in a machine shop where experimental work is carried on, and where perhaps any of the machinists employed are capable of handling the work as it comes in and the first man at liberty takes up the next job on the list.

Under any of these circumstances, the sold-hour method will distribute the burden over the different jobs with fairness. But where different rates of pay are paid for different rates of skill in the same department, or where the work done on machines varies on different jobs, the method is not usually satisfactory, though even here the difficulty can often be met by subdividing the department into homogeneous groups of workers and machines and computing separate sold-hour rates.

11. Material and Prime Cost Methods

In considering different ways of distributing burden, brief reference should be made to both the material cost method and the prime cost method, though their applicability is very limited and they are not to be classed among the standard methods of distributing burden over product.

The material cost method uses the cost of material as a basis for overhead distribution. Speaking generally, there is no real relation between the cost of material used and overhead and there are but few cases when the method can be used.

The prime cost method, as its name implies, combines the elements of prime cost—direct labor and material—and divides the result into the department overhead to give a ratio of distribution which represents the overhead rate. Thus, if direct labor, material, and expense average in each case $2,000, the expense will be one-half the prime cost. Therefore, 50% of the labor and material cost of a job should be added to it to cover the burden charge.

12. Applicability of Prime Cost Method

The prime cost method is sometimes used when the material cost bears a reasonably constant ratio to the labor cost; i.e., when the amount and cost of labor rises and falls with the amount and cost of materials used. The method can be correctly employed only when products of a more or less standardized type are produced, in which the use of so much material presupposes a certain labor cost, and where overhead is likewise fairly proportionate to the amount of work turned out.

For example, the method is applicable to a plant manufacturing large steel ingots or structural material. In such a case the quantity of material entering into the product largely determines the cost of processing it.

The prime cost method is used also in the construction of freight cars and in the carriage and automobile body industry because here again the products are more or less standardized and the value of the material used is an index of the labor cost required. In all these examples the material is of a bulky nature and the cost of its conversion into the finished product is recognized as one of the factors that give rise to indirect expense.

If the method is used where the foregoing conditions do not exist, the burden charges will fail to reflect the true overhead cost and will be unreliable.

13. Overhead Adjustments

Department burden rates are computed in advance for the purpose of distributing the overhead expense of the period over orders in amounts proportioned to the services rendered. It is apparent that the total overhead charges made to orders concurrently with their manufacture by any uniform method will rarely if ever exactly equal the actual expense totals computed at the close of the period, because the volume of production and the conditions can never be exactly the same from one period to another. The fixed expenses of rent, depreciation, and the like, which constitute the greater part of the overhead are not materially affected by variations in output. Therefore, when a fixed rate is employed and overtime is worked, there will be an overdistribution, and when production falls below the nor-

mal, an under-distribution of burden. The adjustment of such differences is usually made in one of two ways:

1. By opening a Reserve for Overhead account, the balance of which is closed out to Profit and Loss.
2. By charging work in process, finished goods, and sales (if any have been made) at the end of the period with their proportion of the overhead expense which still remains to be distributed.

These two methods of adjusting overhead are discussed in the following sections.

14. Reserve for Overhead Account

The operation of the Reserve for Overhead account is a simple matter. It is debited with any departmental under-distribution and credited with any over-distribution, and the balance, if desired, is closed out to Profit and Loss. If the balance of the reserve account is trifling it may be carried from one period to another. If this is done, it is probable that in process of time a slight under-distribution of one period will be wiped out by the over-distribution of another—as when diminishing expenses of the summer months compensate for increased expenses of the winter months. But if an under-distribution is large enough to affect appreciably the Profit and Loss figures, it should be shown either as a deduction from the Profit and Loss, or as an additional charge to orders. Any over-distribution is preferably carried on the books as a reserve against slack periods of production until the financial year is closed.

15. Overhead Adjustment by Flat Percentage Charge

A large amount of undistributed burden might conveniently be disposed of by carrying it in a Reserve for Overhead account and distributing it over the orders of the next or subsequent periods by means of a higher rate. To do this, however, would vitiate the facts as to the cost of production during both periods. A preferable course, especially when the price of the product is based on the actual cost of making and selling it, is to charge the under-distribution to current orders by means of a flat percentage rate. The cost sheets of work in process and of finished goods are charged with this rate and the Cost of Sales account is debited with the difference between the underestimated cost of any goods sold and their proper cost.

For instance, in a department distributing overhead by the percentage of labor method, assume that the period's expense totals $13,000 and that only $12,000 is distributed, leaving an undistributed burden of $1,000. The direct labor charge for the period is $8,000 and an analysis of the cost records shows that $2,000 of this is for work in process, $2,400 for finished goods in stock, and $3,600 for goods sold. The proportions, therefore, in which the under-distribution of $1,000 should be charged to production are: 1/4 or 25% to work in process, 3/10 or 30% to finished goods, and 9/20 or 45% to cost of sales. The labor charges to cost sheets are increased by their proper percentages and the proper additional charges are made against the controlling accounts.

When burden is distributed as a percentage of labor or as a rate per productive hour, any excess burden

charge to cover under-distribution can be most readily applied in the way shown—as an addition to the labor cost or time. But when overhead is distributed by means of machine rates, any excess charge should be made by means of a supplementary rate based on machine time and not on labor cost, as discussed in the next chapter.

REVIEW QUESTIONS

1. In a job order factory what methods may be used to distribute expense over the product as a burden when figuring costs?
2. What are the advantages and disadvantages of distributing expense as a percentage of direct labor?
3. How is the percentage expense rate calculated? Give an example.
4. What are the advantages in using an hourly rate?
5. In a plant where piece-work prevails and the overhead expense is relatively high, what system of expense distribution gives the best results?
6. How is the machine-hour rate system operated?
7. Explain what special feature of the sold-hour method differentiates it from the other methods.
8. How can expense be distributed on the prime cost as a basis?
9. In a job printing establishment where operators are paid at time and a half and at double time rates for overtime, what system would you recommend for distributing overhead expense as a burden on the product? Discuss what effect the paying of a bonus for working overtime on a job has on the cost.
10. What method of handling overhead is best suited to meet the needs of the following factories:
    (a) Small factory making art goods, pillows, boxes, etc., sold in the gift shops of large emporiums. Em-

ployees paid by hour; small investment in equipment.

(b) Machine shop making electrical toys. Employees paid by the piece and hour; large investment in machine tools and equipment.

(c) Iron foundry, using bulky material. Employees paid by hour; small investment in tools.

CHAPTER XXIII

MACHINE-HOUR RATES

1. Departments and Production Centers

In factories where the overhead is more than 100% of the direct labor cost, it will usually be found that in some or all departments the work is largely done by means of machines. In such case the organization may be considered to center around the machinery and the departments should be built up on the basis of machines.

A machine rate is the measure of the cost of operating a machine or group of machines for a given period of time. This grouping of machines is based on the segregation of equipment of the same character. Thus machines of the same type should be grouped in one department or "production center," as such a subdivision of an operating department is usually termed; any especially important machine may constitute a department or production center in itself; benches, where hand-work is paid for at a certain rate, are also considered as a production center; an assembly area, if such exists within a department, becomes a production assembly center; and so on. The overhead expense of each production center is then separately determined in the same way that the overhead of any other operating department is determined.

2. Departmental and Production Center Charges

As machine rates are merely one of the several methods of distributing the departmental burden, it follows

that the distribution of expense to departments is precisely the same as that heretofore described. After any operating department as a whole is charged with its proper proportion of the various elements of expense, each of the charges is in its turn apportioned among the machines or other production centers into which the department is subdivided. The basis of apportionment to production centers is exactly the same as when allocating expense to operating departments, and every principle governing the distribution of indirect expense is applicable to the charges to be made against production centers.

Thus, the fixed charge of rent should be distributed to production centers on the basis of floor space occupied, power expense on the basis of power consumption, stores expense on the basis of material values requisitioned, and so on. In short, all the expense factors which have been charged to any department must in their turn be charged to machines or other subdivisions of a department in the way that seems most equitable when the nature of the charge is considered. When expense is localized in this way it becomes in effect a direct charge to production. The accuracy of any system of cost-finding increases as the indirect distribution of burden decreases.

3. Computing the Machine Rate

An hourly machine rate is computed by dividing the expense of a production center for a full year by the number of hours of productive work, whether of machine operation, bench work, or other productive activity. The rates are charged to orders according to the

number of hours the services of different machines or production centers are occupied. If the rate for a production center composed of three similar machines were $1.50 an hour, the charge for one hour's work on one machine would obviously be $.50. If the rate for benchwork were $.50 an hour, this should be charged to jobs for each productive hour worked upon them.

When computing the charges and the number of hours of operation, the figures in both cases should be based on normal operating conditions. Exceptional periods, when machines are operated beyond their normal running time or when they stand idle, and when in consequence expense is subject to erratic fluctuation, should be eliminated from the calculation. Some of the items, such as insurance, depreciation, and taxes are, of course, computed annually and are unaffected by fluctuations of work and output. But items such as the cost of heating, lighting, and power rise and fall with the month of the year or the volume of production. A selected month, therefore, or a cost period during which expense and production are normal will not furnish such accurate figures for computing the rate as those based on twelve months' factory operation.

Such in broad outline is the method of computing a machine rate. Some of the factors which make up the rate are considered in detail in the following sections.

4. Building Expense or Rent Factor

When charging a production center with rent or building expense the total productive area of the factory is first ascertained. The unit cost per square foot of this productive space is then computed by dividing

the total productive area into the total building or rent expense. The productive floor space occupied either by a single machine, or by a group forming a production center, is then measured. The unit cost per square foot multiplied by the productive space occupied gives the building expense or rent factor to be charged to that machine or production center.

5. Power Factor

To compute the power charge against a machine, records should be kept of the quantity of power generated in the power house, and the consumption of each machine should be estimated, or, better, measured by actual test. The method of making a test is usually to drive the machine or group of machines by an electric motor for an hour and measure the current consumed. The result of this test can be recorded either in kilowatt hours or in horse-power.

The total power cost in the power house divided by the total horse-power produced gives the cost per unit of power. This unit cost multiplied by the number of units consumed by a machine or group of machines gives the power charge to the production center.

6. Depreciation, Insurance, and Taxes on Machinery

Depreciation, insurance, and taxes are charged against the production centers on the basis of investment value. Instead of separately charging production centers with each of these fixed charges based on the value of the plant assets, an alternative method frequently employed is to ascertain the ratio of all three combined to the investment in machinery and then to

distribute them to each machine in proportion to its cost. Thus in a department where the machine equipment cost $100,000 and the annual charge for depreciation, insurance, and taxes on machinery amounts to $12,000, the rate for these three factors of expense would be 12% per annum.

7. Tools and Repairs

Other factors of expense in the up-keep of machines which must be considered are repairs and a requisite supply of small tools. The charges for repairs are determined by keeping a separate repair account for each machine on the back of its plant item card—a card which records the cost and gives a complete description of the particular piece of equipment. The charges for tools and supplies are obtained by dividing the total cost of tools and supplies among those machines for which they are requisitioned in common.

8. Administrative and Sundry Expense

The administrative expenses of a department must as a rule be distributed over production centers on some arbitrary basis. Perhaps as equitable a method as any is to ascertain the total hours of machine operation of the center and the total hours of productive work of the department as a whole, and then to charge each production center proportionately. Thus, if the total operating hours of a machine are 2,000 and those of the productive centers within the department are 80,000, while the department administrative expense is $800, the machine should be charged 1/40 part of this expense or $20. Sundry expense, which as used here includes supplies

and all other items not covered by the factors already mentioned, can be distributed on the same basis as administrative expense.

9. Schedule of Machine Rate

An example is given below of the calculation of an hourly rate for a group of six universal milling machines. Machines of the same type though of different makes can be classed together when they are of the same size and occupy the same amount of space. The data for computing the expense factors are as follows:

1. The space occupied by the six machines is 1,750 square feet at an annual expense of $.35 per square foot.
2. The power absorbed by the six machines is 23,000 kw. hours per year at $.03 per kw. hour.
3. The cost of the six machines in total is $3,575, and the annual charges for depreciation, insurance, and taxes amount to 16% of this cost.
4. The tools expense account shows that $475 a year is the average charge against the six milling machines.
5. Administration expense amounts to $50 for the six machines.
6. The apportionment of all other expense results in a charge of $320 to the six machines.
7. The normal hours of operation, based on operating statistics for prior years, are 2,000 for each machine per year.

ANALYSIS OF MACHINE RATE OF SIX UNIVERSAL MILLING MACHINES

Rent, 1,750 square feet at $.35	$ 612.50
Power, 23,000 kw. hrs. at $.03	690.00
Fixed Charges, $3,575 at 16%	572.00
Tools Expense, 6 machines	475.00
Sundry Expense, 6 machines	320.00
Administration, 6 machines	50.00
Total for 6 machines	$2,719.50
Total for 1 machine	$ 453.25
Hours operated, 2,000	
Rate per hour for 1 machine, $.22 2/3	

It will be noted that the total running time is based on the average for a year for each machine (2,000 hours) and the charges are those incurred during the full year. A production center might be operated quite infrequently so that its normal running time would not exceed, say, 200 hours annually. Obviously, its hourly rate would then be extremely high as compared with a similar production center in constant use.

10. Charging the Machine Rate

The machine or production center time spent on orders is reported on the time tickets of operators and transferred to a cost sheet when the tickets are received in the cost department. To insure that the time reported on tickets is charged at its proper rate, each machine, bench, assembling space, or other production center should be numbered in accordance with a classification code. The number of the machine or production center where work is done is entered on the time tickets so that the cost clerk can make the correct charge to cost sheets

by referring to a list of rates fixed for the various machines or centers. At the close of the month the machine time charged to cost sheets for completed jobs and to work still in process is totaled and credited to the overhead account of the department to which the machines belong. Whether or not this credit equals the actual expense for the period as shown on the debit side of the department account depends upon (1) the accuracy of the machine rate, (2) whether the total hours reported on time tickets equal the total estimated running time.

11. Checking the Machine Rate

Assuming that the machine rates have been correctly fixed, it is apparent that an exact distribution of the department overhead is contingent on every machine working the normal number of hours. If some of them have been operated for only part of their normal running time, part of the burden which should have been distributed over orders will still remain undistributed and the credit to the department overhead account will in consequence be less than its debits. If a calculation is made of the value of the machine hours during which the equipment has been standing idle when it should have been in use, and it is found that the value of the idle time approximately equals the debit balance to the overhead account, the rates can be accepted as correct. But if the debit balance in the overhead account is greater than the value of the idle machine time, the rates are too low because had all machines run full time the charges made to orders would still have failed to equal the charges to overhead account. Loss due to idle capacity on account of shut-downs is charged to Profit and Loss.

12. Idle Machine Time—Supplementary Rate

When production falls off through lack of orders or other causes, some of the expenses such as power and non-productive labor, though not falling off in proportion, will still be reduced sufficiently to make the estimated expense (i.e., the normal running time of each machine multiplied by its rate) but slightly greater than the actual expense. A certain elasticity in the figures must necessarily be allowed and small variations may occur without seriously affecting the accuracy of the distribution. If, for example, overtime is occasionally worked, there will be a small amount of over-distribution which may be carried in a reserve account (see Chapter XXII, § 14) as a set-off to any under-distribution. Where, however, there is a considerable amount of under-distribution due to machines standing idle for an appreciable portion of the period, the balance has to be removed from the department overhead account and the problem arises as to its disposal.

The simplest method of disposing of idle machine time is to charge it against Profit and Loss. This method throws into relief the wasted manufacturing capacity of the factory. In some cases this procedure is undesirable. If the demand upon the manufacturing capacity of the factory fluctuates with the seasons as in a canning industry, or if orders are received infrequently and irregularly as in the manufacture of armor plate, the loss due to the temporary idleness of machines is part of the cost of manufacture which must be recovered in the selling price of the product.

This recovery is usually made by means of a "supplementary machine rate," which is expressed as a per-

centage of the machine earnings. Thus, with overhead totaling $6,000 and the value of the machine hours when extended at their proper rates amounting to $4,000, the idle time causes an under-distribution of $2,000 (50% of $4,000). This percentage is added to the machine charges already made on the cost sheets, a column being provided for the entry of the supplementary rate. The total so charged is credited to the department overhead account at the end of the period, thus extinguishing the balance in that account.

13. Machine Expense Account

In the more highly organized mechanical industries cost-finding can be simplified and its accuracy increased by dividing all departments in which machines are employed into production centers and then considering the factory itself as one large machine department. In such a case a controlling Machine Expense account is opened on the general ledger, which is charged for supplies, repairs, fixed charges, etc., and into which all service departments are closed. The debit side of this account thus accumulates the overhead cost of operating all the production centers into which the factory is divided, while its credit side shows the burden charges distributed over orders by means of the various rates charged to jobs for the use of the production centers. Any debit balance due to a considerable amount of idle machine time is covered by a supplementary rate. Any credit balance may be written off to Profit and Loss.

When the factory is subdivided in this way, "service" rates are usually worked out for each type of machine. That is to say, annual charges for rent, taxes,

power, and all other items of expense are first computed and then the unit rate of each factor is calculated so that when a new machine is installed it is a simple matter to compute its proper rate. The advantages of this method will be readily seen when applied in a large organization where the installation of new machinery is a matter of frequent occurrence. The rates are, of course, revised from time to time when the installation of new machines makes necessary the adjustment of the charges for floor space, power, insurance, and so on.

14. Summary

Of all forms of cost determination, the production center plan gives the most accurate results so far as concerns the distribution of expense. The subdivision of the factory into machine centers composed of a single machine or of a group of similar machines enables the service cost of operation to be charged to orders with almost the accuracy of a direct labor charge. This charge varies for each center with the cost of its power, floor space, tools, and other items of expense, and eliminates the possibility of any inequalities between jobs which to some extent exists when a productive hour or percentage of labor rate is applied to an entire department in which the product is treated in different ways. Machine-hour rates do not ordinarily include stores overhead expenses, which are applied direct to material as a burden. (See pages 268 and 302.)

The large amount of clerical labor involved in the machine-rate method is sometimes urged against it, but when it has once been established, the clerical work required to operate it compares favorably with that of any

other job order cost system. When, moreover, the whole factory is divided into production centers, one comprehensive Machine Expense account may replace a number of department overhead accounts. Into this account the service accounts can be closed directly, thus short-circuiting the allocation of service expense to operating departments. This saving in clerical labor offsets the labor involved in the periodical revision of the machine rates charged to production centers which must of necessity be made when a substantial addition to the equipment, or some variation in expense vitiates the existing rate.

REVIEW QUESTIONS

1. What system of expense distribution is best suited to the needs of machine shops?
2. What are the advantages of fixing separate expense rates for individual machines?
3. Illustrate the calculation of an hourly machine rate.
4. How is machine expense assessed as a burden on jobs?
5. What is meant by a supplementary machine rate?
6. How is machine expense controlled?

Part VII
Representative Systems

CHAPTER XXIV

PRODUCTION-CENTER JOB ORDER COST SYSTEM

1. Preliminary Statement

The purpose of the present chapter is to show the working of a job order cost system, particularly as to the machine-rate method of distributing burden over product. The method of calculating production-center rates and of charging them to orders has already been explained in Chapter XXIII. The forms and the account classifications presented are those actually used by an electrical goods manufacturing company. The journal and ledger entries are purely hypothetical. For the sake of simplicity, it is assumed that all the accounts shown are carried in the general ledger. A lesser or a greater number of accounts might be employed under different conditions and their titles might, of course, vary from those given here.

It will be noted that the forms, and the information they contain, are comparatively simple in character. This is due to the fact that production consists of the manufacture of component parts which are standardized and symbolized with a number, and for which complete working instructions are issued in blue-print form. This is the procedure throughout the mechanical industry. The use of symbols and the subdivision of work greatly simplify the complexities of the manufacture of a compound product and reduce to a minimum the data that must be entered on the forms.

2. Cost Formula

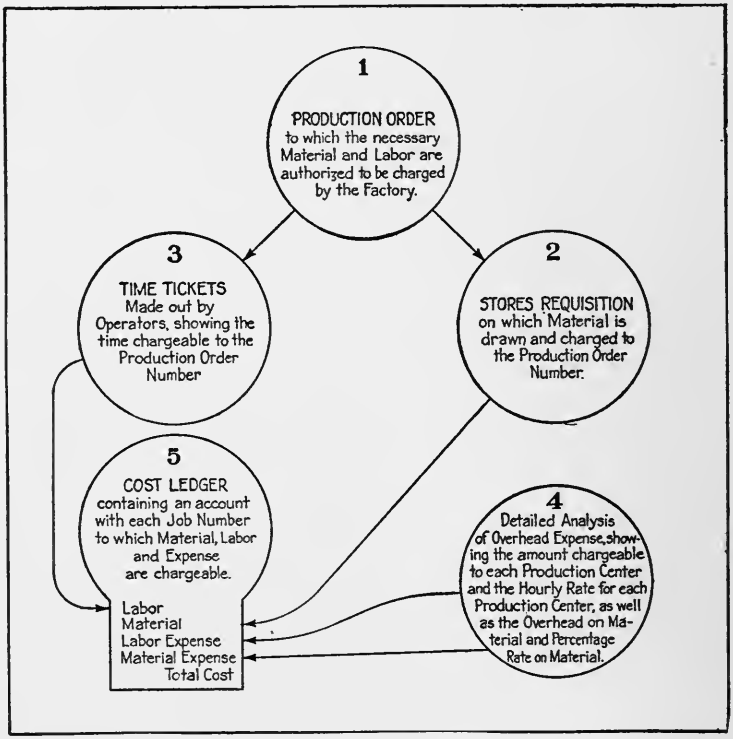
The distinguishing feature of production-center cost-finding is the application of overhead expense to the jobs by means of machine-hour rates. Since all of the equipment may not be actually machines, it is customary to speak of the manufacturing units as production centers. A production center may be one machine or a group of similar machines, or a work-bench, or an oven.

Under the production-center plan, the analysis of factory overhead expense must be carried far enough to segregate each element of expense by production centers, for each of which an hourly rate is determined as explained in the preceding chapter. As raw material passes through the various manufacturing processes, or production centers, the overhead expense is absorbed by means of the rates per hour which the job pays for the use of the equipment.

Inasmuch as the up-keep and operation of the stores-room have nothing to do with the manufacturing processes, the stores overhead expense is separated from that applicable to the production centers, and is applied to the raw material used on the job by means of percentage rates. Thus it is seen that the cost of a job consists of the following elements:

1. Direct labor.
2. Overhead expense applied as a burden to the job by means of hourly rates for the use of the equipment.
3. Material, to which must be added stores expense, which is applied as a burden to material by means of percentage rates.

The operation of a cost system in one of the mechanical industries where production-center rates are used requires a procedure that will obtain the cost of each job on the one hand, and control the cost calculations on the



Form 40. Chart showing Routine of Cost-Finding in a Job Order Cost-System under the Production-Center Method

other. The general procedure followed in arriving at the cost of each job is illustrated by the chart shown in Form 40.

The production order and cost forms used for any job order cost system must be devised to meet the re-

quirements of each factory. There are, however, certain general features which are common to every system of cost records. A typical system will be explained such as one finds in a large machine shop having a great variety of machines, tools, and miscellaneous equipment.

3. Stock Lists

A characteristic feature which the cost accountant must consider in connection with the operation of a sys-

STOCK LIST No. 7010

Description Akron Pliers

Quantity	Number	Item	Quantity	Number	Item
1	A 3001	Long Jaw			
1	A 3002	Short Jaw			
1	A 3003	Lever			
1	A 3004	Handle			
4	A 3005	Rivets			
1	B 5000	Spring assembly			

Note: A parts are individual parts needed by the assembly foreman.
B parts are partial assemblies needed by the assembly foreman.
C parts are blanks for making parts.

Form 41. (a) Stock List

tem of cost records in a machine shop, or any factory turning out even a simple mechanism, is the large number of parts entering into the construction of the product. In order to make the issuing of production orders to the factory as simple as possible, it is customary to prepare

stock lists, such as the one shown in Form 41a, containing a schedule of the various parts, or quantities of raw material required on an article. These lists are furnished to the foremen of the various manufacturing departments so that when they get an order to make article No. 7010, they will at once know the kinds and number of parts required. When a production order is issued, all the instructions necessary for the foreman can be put in a few brief lines.

For purposes of classification it is often the practice to divide the parts carried in stock into three groups as follows:

A. Individual parts
B. Partial assemblies
C. Blanks for parts

The parts are carried in stock under these classifications. The letter prefix and the number of the particular part are used together in order clearly to identify the part required. Blue-prints containing drawings of each part are filed under the part number for ready reference.

4. Production Orders

Under the conditions prevailing in most machine shops it is the practice to make out a production order (Form 41b) in triplicate so that the foreman, stores-keeper, and office can each have a copy. In case two or more foremen are to work on the same order, additional copies can, of course, be prepared. The stores-keeper uses his copy for a guide as to what requisitions for material may be expected.

THE AKRON COMPANY
PRODUCTION ORDER

No. 407

Department 105 Date Jan. 7, 1919

Make:
1000 Akron Pliers, Stock List No. 7010

Draw Material from Parts Store No 32

Deliver finished goods to Merchandise Store No 51

Signed John Lane
Superintendent

Important: Charge all time and material to above order number.

Form 41. (b) Production Order

5. Material Cost

In accordance with the plan of procedure indicated on the chart shown in Form 40, stores are drawn out of the stock-room on a requisition and charged to the proper production order number. Either the foreman or his clerk usually makes out the requisition. The requisitions are entered on the subsidiary stores ledger (as explained in Chapter XI), priced, and extended. Stores expense for handling is added, if desired, and the requisitions sent to the cost ledger clerk where they are posted to the proper job cost sheet.

6. Labor Cost

As already explained, operatives who work under the job order system make out time tickets showing how

THE AKRON COMPANY

STATEMENT OF EXPENSES

For Month of_____19 _

		Building Expense	Power Expense	Administration Expense	Lighting Expense	Tools Expense	Fixed Charges	Sundry Expense	Stores Expense	Drafting Expense	Selling Expense
	Purchases										
	Stores (Supplies)										
	Repairs										
	Insurance										
	Taxes										
	Depreciation										
	Non-Productive Pay-roll										
	Total										

Form 42. (a) Statement of Expenses—Production-Center Job Order Cost System

long they have worked on the particular job, and indicating the machine or equipment which they have used by means of numbers or symbols. The time and the labor cost are entered on the cost ledger. The material and labor chargeable to the job have now been entered and the overhead expense can be taken up.

7. Statement of Expenses

The expenses chargeable to each period are distributed under the various classifications shown in the column headings of the statement of expenses (Form 42a). After the columns have been footed, the next step is to ascertain the unit costs for floor space, power, supervision, etc., to be used in calculating the hourly production-center rates. Thus, if rent is 25 cents per square foot, power $2 per horse-power, supervision $25 for a certain period, and so on, it is an easy matter to calculate the cost per hour for the machine or machines of any production center, as the space they occupy, the power they use, etc., have already been determined. The last element of cost to be entered on the job cost sheet is that of overhead expense as shown by the chart in Form 40. The sum of the material, labor, and expense gives the total cost as shown by Form 40.

Drafting expense is closed out to the Finished Goods account, and selling expense to Profit and Loss account.

8. Cost Summary Form

A typical cost summary sheet is presented in Form 42b. The cost of 1,000 Akron pliers is shown figured in accordance with the cost formula for the production-center method, and is found to be $1.22½ each. The

expense charges are based on the experience of preceding periods. At the end of an accounting period the overhead expense applied to material and labor is expected to absorb the actual expense charges against the factory for that period. If it does not, or too much has been absorbed, an adjustment is made. (See page 284.)

THE AKRON COMPANY
COST SUMMARY
1,000 Article Akron Pliers No. 7010 Date Jan. 20, 19__

Department No.	Material	Material Expense	Labor	Labor Expense	Total
105	250.00	25.00	475.00	475.00	1225.00

Charge Merchandise 1225.00
Credit Work in Process 1225.00

Form 42. (b) Cost Sheet

9. Routine of Procedure

Even in the largest factory the procedure is simple under this plan of cost-finding. In case a part is made and put in stock to be later drawn out of stores and assembled, the cost is figured just the same as that of any other article, but the cost is charged to a parts account and when the article is requisitioned, its cost is credited to Parts Stock and charged to Work in Proc-

ess account. In the case of a very large job, such as a central office switchboard for the telephone exchange of some city, there would, of course, be a great many requisitions and time tickets, so that their posting, the application of the overhead, and the final determination of cost would take considerable time. Nevertheless, the process is the same. When the jobs are finished they are credited to Work in Process account at cost and charged to Finished Goods account. This entry takes them out of the manufacturing section of the ledger and transfers them to the trading section.

10. Cost Accounts

In putting a production-center job order cost system into operation, it is necessary to place the costs under complete accounting control. The accounts required for this are shown in the chart of cost accounts (Form 43). Accounts 1 to 5 inclusive are inventory accounts. Account 6, Machine Expense, comprises the overhead expense applicable to production centers, which are for the most part machines. This is shown subdivided according to groups of machines. By means of this subdivision the total cost of each group is determined. Before the total cost of a group can be determined, however, the various service accounts or miscellaneous cost accounts must be closed into Machine, Stores, Drafting, and Selling Expense accounts. The reason for this is that when operating a production-center cost system it is not possible to make a distribution of expenses such as coal, supplies, and non-productive labor directly against machines; such charges have to be debited to miscellaneous accounts such as shown on

chart in Form 43. Thus the various groups of expenses or service charges are assembled. Then it is a problem to find a satisfactory basis on which to make an apportionment of the balances in these miscellaneous accounts to the production centers. For example, administration expense, which covers the cost of supervision, can be distributed on the basis of the number of operators working at each group. Building Expense is divided up between machine groups on the basis of space occupied, power expense according to horse-power used, and so on, as explained in previous chapters of Part VI.

11. Journal Entries

The following entries and accounts illustrate the characteristic bookkeeping procedure in the production center method. The first three journal entries distribute the supplies, repairs, depreciation, insurance, taxes, and indirect labor to the proper cost accounts in accordance with the chart of cost accounts (Form 43). The fourth and fifth entries close the miscellaneous expense accounts out to production-center or machine expense as called for by the chart. The sixth entry transfers the material and drafting expense to the proper accounts as shown. Following the journal entries are the corresponding ledger accounts. From these entries and accounts the interlocking of the costs with the general ledger inventory accounts may readily be seen. Purchases are distributed on the purchase journal from which they are posted to the proper ledger accounts at the end of each accounting period.

To simplify as much as possible the description and

1. Raw Material
2. Piece Parts
3. Manufacturing (Work in Process)
4. Supplies
5. Finished Goods
6. Machine Expense
   - Class A Machines
     - Building Expense
     - Power
     - Lighting
     - Fixed Charges
     - Tools
     - Sundry
     - Administration
   - Class B Machines
     - Building Expense
     - Power
     - Lighting
     - Fixed Charges
     - Tools
     - Sundry
     - Administration
   - Class C Machines
     - Building Expense
     - Power
     - Lighting
     - Fixed Charges
     - Tools
     - Sundry
     - Administration
   - Etc., etc.
7. Stores Expense
   - Purchases
   - Depreciation
   - Insurance
   - Taxes
   - Pay-Roll
   - Building Expense
   - Lighting
8. Drafting Expense
   - Purchases
   - Supplies
   - Pay-Roll
   - Rent
   - Lighting
9. Selling Expense
   - Purchases
   - Sundries

Form 43. Chart of Cost Accounts for a

MISCELLANEOUS COST ACCOUNTS
Closed Out to Machine, Stores, Drafting, and Selling Expense Accounts

- 10. Building Expense
  - Purchases
  - Supplies
  - Repairs
  - Depreciation
  - Insurance
  - Taxes
  - Pay-Roll
  - Power
- 11. Power Expense
  - Purchases
  - Waste
  - Oils
  - Coal
  - Belting
  - Repairs
  - Depreciation
  - Insurance
  - Taxes
  - Pay-Roll
  - Building Expense
  - Lighting
- 12. Lighting Expense
  - Purchases
  - Waste
  - Repairs
  - Depreciation
  - Insurance
  - Taxes
  - Pay-Roll
  - Power
- 13. Fixed Charges on Machinery
  - Depreciation
  - Insurance
  - Taxes
- 14. Tools Expense
  - Purchases
  - Waste
  - Belting
  - Repairs
  - Pay-Roll
  - Rent
  - Lighting
- 15. Sundry Expense
  - Purchases
  - Depreciation
  - Taxes
  - Pay-Roll
- 16. Administration Expense
  - Purchases
  - Stationery
  - Pay-Roll
  - Building Expense
  - Lighting

Production-Center Job Order Cost System

illustration of the principles involved, the journal entries have been condensed and the accounts limited to the fewest possible number. Expense can readily be analyzed in great detail by opening the requisite accounts in a subsidiary ledger. Building maintenance, for example, may be subdivided into care of land, maintenance of office building, warehouse building, power plant building, factory building, and the like; superintendence may be divided into factory and general administration; part of the last-named expense may be charged to sales; and so on. No method can be devised to suit all requirements, nor can any particular method be applied without intelligent modification. But with a clear conception of the framework which must be constructed before financial expenditures can be shown on the books as manufacturing cost and expense, no difficulty should be experienced in analyzing expense in any degree that seems practical and worth the clerical labor involved.

The explanatory matter follows each entry in order to make the procedure clear.

No. 1

Building Expense		$ 1,200.00
Supplies for Cleaning	$ 200.00	
Repairs to Building	1,000.00	
Power Expense		15,750.00
Supplies—Waste	250.00	
Oils	600.00	
Coal	12,000.00	
Belting	900.00	
Repairs to Power Plant	2,000.00	
Lighting Expense		260.00
Supplies—Waste	50.00	
Repairs to Lighting System	210.00	

Tools Expense		1,800.00	
Supplies—Waste	100.00		
Belting	1,200.00		
Repairs to Machine Tools	500.00		
Administration Expense		500.00	
Supplies—Stationery	500.00		
Drafting Expense		1,600.00	
Supplies—Photographic	800.00		
Blue-Print	300.00		
Drafting	500.00		
To Supplies			$17,400.00
" Manufacturing			3,710.00

Distribution to the factors of expense of the various kinds of supplies used and repairs made, the sources of the entry being supplies requisitions and standing order cost sheets.

No. 2

Building Expense		$1,590.00	
Depreciation	$1,000.00		
Insurance	300.00		
Taxes	290.00		
Power Expense		2,850.00	
Depreciation	2,000.00		
Insurance	500.00		
Taxes	350.00		
Lighting Expense		265.00	
Depreciation	200.00		
Insurance	25.00		
Taxes	40.00		
Fixed Charges on Machinery		5,880.00	
Depreciation	4,000.00		
Insurance	1,000.00		
Taxes	880.00		

Sundry Expense		175.00	
Depreciation	100.00		
Insurance	50.00		
Taxes	25.00		
Stores Expense		1,050.00	
Depreciation	700.00		
Insurance	250.00		
Taxes	100.00		
To Depreciation			$8,000.00
" Insurance			2,125.00
" Taxes			1,685.00

Distribution to the factors of expense of fixed charges for depreciation, taxes, and insurance on buildings, machinery, and equipment, per schedule of fixed charges and statement of expenses.

No. 3

(*Direct Labor,*		
Manufacturing	$50,000.00	
(*Indirect Labor*)		
Building Expense	10,000.00	
Power Expense	2,000.00	
Lighting Expense	300.00	
Tools Expense	100.00	
Sundry Expense	300.00	
Administration Expense	3,000.00	
Stores Expense	600.00	
Drafting Expense	2,000.00	
Selling Expense	3,000.00	
To Pay-Roll		$71,300.00

To show the productive labor charged to product and the non-productive labor charged to expense, per pay-roll analysis.

No. 4

Building Expense		$ 100.00	
Power Expense	$ 100.00		
Power Expense		180.00	
Building Expense	110.00		
Lighting Expense	20.00		
Lighting Expense		900.00	
Power Expense	900.00		
Tools Expense		25.00	
Building Expense	20.00		
Lighting Expense	5.00		
Administration Expense		3,500.00	
Building Expense	3,000.00		
Lighting Expense	500.00		
Stores Expense		1,150.00	
Building Expense	1,000.00		
Lighting Expense	150.00		
Drafting Expense		320.00	
Building Expense	300.00		
Lighting Expense	20.00		
To Building Expense			$4,430.00
" Power Expense			1,000.00
" Lighting Expense			695.00

To show the proportion of the charges for building maintenance, power, and light applicable to each of the factors of expense.

No. 5

Machine Expense		$50,000.00
Building Expense	$12,600.00	
Power Expense	20,335.00	
Lighting Expense	1,050.00	
Fixed Charges on Machinery	5,880.00	
Tools Expense	1,960.00	
Sundry Expense	675.00	
Administration Expense	7,500.00	

To Building Expense		$12,600.00
" Power Expense		20,335.00
" Lighting Expense		1,050.00
" Fixed Charges on Machinery		5,880.00
" Tools Expense		1,960.00
" Sundry Expense		675.00
" Administration Expense		7,500.00
Manufacturing	53,000.00	
To Machine Expense		50,000.00
" Stores Expense		3,000.00

Showing the accumulation of expense for the period and charging it to production.

No. 6

Manufacturing	$ 55,000.00	
To Raw Material		$ 30,000.00
" Piece Parts		25,000.00
Piece Parts	20,000.00	
To Manufacturing		20,000.00
Finished Goods	125,000.00	
To Manufacturing		120,000.00
" Drafting Expense		5,000.00
Cost of Sales	140,150.00	
To Finished Goods		140,150.00
Finished Goods	10,150.00	
To Cost of Sales		10,150.00

To charge finished goods with the raw material and piece parts used, and the drafting expense for the period, and to transfer to stock the value of the piece parts made.

12. Ledger Accounts

In the ledger accounts shown below, the numbers of the journal entries are given in the folio columns.

BUILDING EXPENSE

No. 1

Date 1920	Item	Fol.	Charge	Balance	Credit	Fol.	Item	Date 1920
Jan. 31	Purchases	85	$ 4,140		$ 4,430	4	Sundries	Jan. 31
	Supplies for Cleaning.	1	200		12,600	5	Machine Expense	
	Repairs to Building...	1	1,000					
	Depreciation	2	1,000					
	Insurance	2	300					
	Taxes	2	290					
	Pay-Roll	3	10,000					
	Power Expense.....	4	100					

POWER EXPENSE

No. 2

Date 1920	Item	Fol.	Charge	Balance	Credit	Fol.	Item	Date 1920
Jan. 31	Purchases	85	$ 655		$ 1,000	4	Sundries	Jan. 31
	Waste	1	250		20,335	5	Machine Expense	
	Oils	1	600					
	Coal	1	12,000					
	Belting	1	900					
	Repairs	1	2,000					
	Depreciation	2	2,000					
	Insurance	2	500					
	Taxes	2	350					
	Pay-Roll	3	2,000					
	Building Expense.....	4	110					
	Lighting Expense.....	4	20					

LIGHTING EXPENSE

No. 3

Date 1920	Item	Fol.	Charge	Balance	Credit	Fol.	Item	Date 1920
Jan. 31	Purchases	85	$ 20		$ 695	5	Sundries	Jan. 31
	Waste	1	50		1,050	4	Machine Expense	
	Repairs	1	210					
	Depreciation	2	200					
	Insurance	2	25					
	Taxes	2	40					
	Pay-Roll	3	300					
	Power Expense	4	900					

FIXED CHARGES ON MACHINERY

No. 4

Date 1920	Item	Fol.	Charge	Balance	Credit	Fol.	Item	Date 1920
Jan. 31	Depreciation	2	$4,000		$5,880	5	Machine Expense	Jan. 31
	Insurance	2	1,000					
	Taxes	2	880					

ADMINISTRATION EXPENSE

No. 5

Date 1920	Item	Fol.	Charge	Balance	Credit	Fol.	Item	Date 1920
Jan. 31	Purchases	85	$ 500		$7,500	5	Machine Expense	Jan. 31
	Stationery	1	500					
	Pay-Roll	3	3,000					
	Building Expense.....	4	3,000					
	Lighting Expense.....	4	500					

STORES EXPENSE

No. 6

Date 1920	Item	Fol.	Charge	Balance	Credit	Fol.	Item	Date 1920
Jan. 31	Purchases	85	$ 200		$3,000	5	Manufacturing	Jan. 31
	Depreciation	2	700					
	Insurance	2	250					
	Taxes	2	100					
	Pay-Roll	3	600					
	Building Expense.....	4	1,000					
	Lighting Expense.....	4	150					

TOOLS EXPENSE

No. 7

Date 1920	Item	Fol.	Charge	Balance	Credit	Fol.	Item	Date 1920
Jan. 31	Purchases	85	$ 35		$1,960	5	Machine Expense	Jan. 31
	Waste	1	100					
	Belting	1	1,200					
	Repairs	1	500					
	Pay-Roll	3	100					
	Building Expense.....	4	20					
	Lighting Expense.....	4	5					

SUNDRY EXPENSE

No. 8

Date 1920	Item	Fol.	Charge	Balance	Credit	Fol.	Item	Date 1920
Jan. 31	Purchases	85	$200		$675	5	Machine Expense	Jan. 31
	Depreciation	2	100					
	Insurance	2	50					
	Taxes	2	25					
	Pay-Roll	3	300					

MACHINE EXPENSE

No. 9

Date 1920	Item	Fol.	Charge	Balance	Credit	Fol.	Item	Date 1920
Jan. 31	Building.	5	$12,600		$50,000	5	Manufacturing	Jan. 31
	Power Expense.....	5	20,335					
	Lighting Expense.....	5	1,050					
	Fixed Charges.....	5	5,880					
	Tools	5	1,960					
	Sundry Expense.....	5	675					
	Administration Exp...	5	7,500					

PAY-ROLL

No. 10

Date 1920	Item	Fol.	Charge	Balance	Credit	Fol.	Item	Date 1920
Jan. 31	Cash	471	$17,000		$71,300	3	Sundries	Jan. 31
	"	182	18,000					
	"	190	16,500					
	"	204	19,800					

RAW MATERIAL

No. 11

Date 1920	Item	Fol.	Charge	Balance	Credit	Fol.	Item	Date 1920
Jan. 1	Inventory		$ 5,000		$30,000	6	Manufacturing	Jan. 31
31	Purchases	85	32,500	$7,500				

PIECE PARTS

No. 12

Date 1920	Item	Fol.	Charge	Balance	Credit	Fol.	Item	Date 1920
Jan. 1	Inventory		$16,500		$25,000	6	Manufacturing	Jan. 31
31	Purchases	85	10,000					
	Manufacturing	6	20,000	$21,500				

MANUFACTURING

No. 13

Date 1920	Item	Fol.	Charge	Balance	Credit	Fol.	Item	Date 1920
Jan. 1	Inventory		$15,710		$ 3,710	1	Repairs	Jan. 31
31	Pay-Roll	3	50,000		20,000	6	Piece Parts	
	Machine Expense.....	5	50,000		120,000	6	Finished Goods	
	Stores Expense.....	5	3,000					
	Raw Material.....	6	30,000					
	Piece Parts.....	6	25,000	$30,000				

SUPPLIES

No. 14

Date 1920	Item	Fol.	Charge	Balance	Credit	Fol.	Item	Date 1920
Jan. 1	Inventory		$ 7,400		$17,400	1	Sundries	Jan. 31
31	Purchases	85	11,500	$1,500				

FINISHED GOODS

No. 15

Date 1920	Item	Fol.	Charge	Balance	Credit	Fol.	Item	Date 1920
Jan. 1	Inventory		$ 30,000		$140,150	6	Cost of Sales	Jan. 31
31	Manufacturing	6	120,000					
	Drafting Exp.....	6	5,000					
	Cost of Sales.....	6	10,150	$25,000				

DRAFTING EXPENSE

No. 16

Date 1920	Item	Fol.	Charge	Balance	Credit	Fol.	Item	Date 1920
Jan. 31	Purchases	85	$1,080		$5,000	6	Finished Goods	Jan. 31
	Photographic Supplies.	1	800					
	Blue-Printing Supplies	1	300					
	Drafting Supplies.....	1	500					
	Pay-Roll	3	2,000					
	Building	4	300					
	Lighting	4	20					

COST OF SALES

No. 17

Date 1920	Item	Fol.	Charge	Balance	Credit	Fol.	Item	Date 1920
Jan. 31	Finished Goods.....	6	$140,150		$ 10,150 130,000	6	Finished Goods Loss and Gain	Jan. 31

To make up the balance sheet and profit and loss statement at the close of the period, the balances of the inventory accounts are set up on the balance sheet and the Cost of Sales account is closed out to the Profit and Loss account.

REVIEW QUESTIONS

1. What is the production-center method of cost-finding? How does it differ from other methods?
2. What purpose is served by the machine expense account?
3. Of what factors is machine expense composed?
4. How is drafting expense handled?
5. How is overhead expense apportioned to jobs under the production-center method of cost-finding?
6. Show the pro forma expense accounts affected by a distribution of expense in a production-center cost system.
7. Is the production-center system adapted to an automobile manufacturing plant? If so, why?

CHAPTER XXV

PROCESS COST SYSTEM—CLAY PRODUCTS

1. Account Classification

Cost-finding in all process plants or factories is based on the simple principle of segregating costs by processes. Department accounts are opened on the general ledger to collect the cost of those phases of productive activity which it is desirable to show separately in the financial or other periodical statements.

In a plant or mine of considerable size the details of the general ledger accounts are usually recorded in a cost ledger in which separate accounts are, as a rule, opened to analyze and show in detail the items making up each general ledger account. Thus, to take an example from one of the extractive industries, the cost of copper mining is usually segregated on the general ledger under the heads of Underground Expense, Surface Expense, Hoisting, Transportation and Hauling, Stamping, Construction Work, and so on. "Underground Expense" in its turn is divided on the subsidiary ledger into Sinking, Drifting, Stoping, Timbering, and other technical mining operations. "Surface Expense," "Hoisting," and other expense items are similarly divided. Thus, the cost of any phase of the work is recorded in summary form in the general ledger and in detail in the cost ledger.

The foregoing classification is used by an enterprise

with expenditures totaling millions of dollars annually and with hundreds of accounts. A small organization, of course, would not find it necessary to subdivide its accounts in this way. The subsidiary ledger might be dispensed with and entries be made direct to the general ledger process accounts from the purchase journal and pay-roll. Supporting documents to show the distribution of the fixed and other prepaid or accrued charges would then be all that was required to segregate costs by processes.

2. Preliminary Information

To illustrate the general method of process cost-finding, a system used in the clay products industry is presented in detail.* This system has been selected both because it is typical of the simple procedure of process cost-finding employed in the extractive industries and at the same time embodies the features of manufacturing as well as of mining.

The operation of the system of cost-finding is complicated by the fact that, while the major part of the product is composed of a regular 9-inch brick, the cost of which can easily be averaged, orders are occasionally received for bricks of a special kind, the cost of which has to be separately computed. As it is impossible to keep the cost of the special kind separate from that of the common kind of brick through all the stages or processes of manufacture, means have to be devised to estimate this cost. Of course, if an order for a special type of product is large enough to employ the entire services of the plant for a definite period of time, as a week or

*The system presented is substantially that used by the American Face Brick Association.

more, the complication referred to no longer arises. But usually these special orders are included in the regular flow of production. The method of calculating the cost as shown here will be found suggestive as to the means to be employed in solving the chief and perhaps the only difficult problems of process cost-finding.

3. Production Details

The bricks regularly produced by the plant under consideration are made from clay and a certain proportion of broken bricks (technically known as "bats") which are crushed and ground in the proportions of 3 or 2 of clay to 1 of bats, depending upon the grade of brick required. The clay is extracted from a clay pit or bank and the cost of this process is worked out on the ton basis. If the pit is leased a royalty per ton is usually paid; if owned by the manufacturer a depletion charge replaces the royalty charge.

A certain amount of breakage takes place during the drying and burning processes, but the quantity of broken brick thus secured is not as a rule sufficient for the needs of the plant and therefore purchases are made from outside. An average cost per ton of the bats used in manufacture is figured from month to month and is shown separately in the final cost calculation.

The cost of crushing and grinding is also computed on the ton basis, while the cost of the remaining processes (consisting of molding the regular bricks by machinery, or the special kinds by hand, and drying them in the tunnel preparatory to setting and burning them in the kiln) is computed per thousand bricks handled.

When an order is received for bricks of a special

kind, the cost of making the molds and molding the bricks by hand has to be computed separately, after which the cost of drying and burning the green brick is found by measuring the proportion of space occupied by the special brand on the floor of the drying tunnel and within the kiln.

To illustrate, a standard size of kiln holds 140,000 9-inch bricks. Assuming that the kiln is charged with 120,000 9-inch bricks, that the cost of burning is $1,400 for the period, and that the rest of the space is occupied by 4,000 special bricks of a much larger size, these should obviously be charged with one-seventh of the burning cost—that is to say, with $200 which represents the cost of burning 20,000 9-inch bricks.

4. Daily Time Slip

Despite the fact that bricks are sometimes made to meet special requirements, no formal production orders are issued. Foremen are instructed as to what is required and thereafter the progress of production is reported day by day on the time slips shown in Form 22 (page 180).

The mechanics who make the molds record their time against each job on these slips, crossing the starting time when they receive the job, and circling the stopping time when the job is finished. This furnishes the cost department with accurate information as to the length of time required to make molds which are to be charged to the customer, and also enables the proper amount of time to be charged against any particular shape for which special molds are being made.

Hand molders also use one of these time slips

for each job. The quantity produced is recorded in the space for that purpose at the bottom of the slip. The slip shows the article or brand that is worked upon, together with the size. If a special job, its number as well as that of any blue-print or drawing is noted on the slip. The foreman of a machine gang uses one slip for all the men included in his gang. On the front he notes his own number and indicates the work which the gang is doing; on the back he notes the numbers of the workmen.

This time slip enables the cost department to file the actual time consumed on either special or regular work and provides a record from which it is possible to bring out accurate individual costs on any shape of brick, no matter how difficult, and regardless of whether or not this particular shape has been made before. The quantity produced is in every case recorded in the proper space at the bottom of the form so that time can be checked with production. The production figures are used in making up daily and monthly production records for the use of the cost department.

5. Setting and Drawing Reports

Form 44 is a daily report of the number of bricks "set," that is, placed in the kiln, and this report is handed in by the foreman of each setting gang. It records the name of the brand and other designations of the particular bricks set, the number of "green" or new pieces set, the number of imperfectly baked pieces which have been reset, and the date and hour when the gang started work. If it takes longer than one day to set the kiln, which happens in most cases, a report is handed in daily and on the last report is given the time finished.

SETTING REPORT

No. _____

Record	Date	Hour
Started Kiln		M
Finished Kiln		M

Date _____

Foreman _____

Brand	Name	Green Pieces Set	Pieces Reset

Form 44. Brick Setting Report

DRAWING REPORT

No _____

Record	Date	Hour
Started Drawing		M
Finished Drawing		M

Date _____

Foreman _____

Brand	Name	Good Pieces	Resets	Broken

Form 45. Kiln Drawing Report

After the bricks are burned and the gang starts drawing a kiln, a drawing report (Form 45) is operated in the same way as the setting report. These two reports are used to make up the kiln record, which, as will be shown presently, summarizes the production results of each kiln. These records do not enter into the cost accounting scheme, being purely administrative records.

6. Daily Record of Production

The gross production for the cost period is compiled on daily records of production (Form 46) which in their

DAILY RECORD OF PRODUCTION.

Date_____

No.	Employee or Gang	Brand.	Designation	No. Pieces	Weight	Equivalent

Form 46. Daily Brick Production Record

turn are summarized on a monthly report. The daily record is made up from the quantities reported by hand and machine molders on the daily time slips, as already explained. The monthly record summarizes the same

information as to the number of pieces and the weight of the different brands.

7. Daily Record of Broken Bricks

The net production of bricks for the period is determined by deducting from the gross amount, as obtained from the daily record, the quantity broken during that

RECORD OF BROKEN BRICKS

Class	Total Burned	Broken	Gross Cost Broken	Charge to Bats	Net Cost Broken	Cost per 1000
9" Hand						
Machine						
Class "A"						
" "B"						
etc.						

Form 47. Daily Record of Broken Bricks

period. This quantity is computed day by day on Form 47. At the end of the month the daily records are summarized on a similar monthly record which becomes the basis for computing the net cost per thousand to be charged, for breakage, to the cost of the good bricks produced—as will be shown in the final cost calculation.

The gross cost of the broken bricks is computed by

multiplying the number of thousands by the price per thousand of perfect bricks (as shown later on the final cost sheet). This price includes material, labor, and expense up to the point where the bricks are set in the kiln. Obviously, the broken bricks are not worth their manufacturing or gross cost when used again as "raw material," for the reason that bats can be purchased in the market at much less than the manufacturing cost of the broken brick. Therefore, from the gross cost is deducted the proper value of the broken brick—a value based on the price that would have to be paid for bats of the same grade if purchased from outside sources. This leaves the "net cost of broken" as shown on the form. This net amount, which is manifestly one of the items of cost chargeable to the good bricks, is divided by the number of thousands of good bricks produced during the period to give the "breakage cost" per 1,000 as shown on the final cost sheet. Thus the business sells back to itself at a fair price the broken bricks, and charges production with the difference between the selling price of the by-product and the manufacturing cost incurred in its production.

8. Record of "Bats"

The price at which bats are charged in the final cost calculation is worked out in Form 48. This record states, in terms of tons, the quantity and value of the bats purchased from outside sources during the month and of the broken brick derived from manufacturing. To these figures any freight incurred and the cost of handling are added and the average cost per ton is figured for the month and to date. The average cost is

then used as the price for bats, as will be shown in the final cost figures later.

BATS RECORD

	JULY, 19__			TO DATE			AUG	
	Tons	Amount		Tons	Amount		Tons	
Bats Purchased	240	240	00	1254	1254	00		
Freight		2	00		17	00		
Own Bats Credited	100	150	00	1741	2616	50		
Handling Labor		5	00		31	20		
Total	340	397	00	2995	3918	70		
Average Cost per Ton		1	17		1	31		

Form 48. Monthly Bats Record

9. Kiln Record

As the setting, burning, and drawing reports are handed in, they are summarized on Form 49. This record serves several useful purposes. The difference between the "total equivalent in" and the "total equivalent out" represents the number of broken bricks resulting from the operation of this particular kiln. As the same men usually work on the same kiln, the records reflect the capacity of different gangs. The record serves also as a check on production in that the totals for all kilns must agree with the aggregate totals of the subsidiary records. Finally, brands of an irregular size, i.e., a

KILN RECORD

KILN NO. _____

CAPACITY 9" EQUIVALENT _____ TOTAL SET 9" EQUIVALENT _____ % _____

IN								OUT					
Setting	Date	Time		Burning	Date	Time		Drawing	Date	Time			
Began Setting			M	On Fire			M	Began Drawing			M		
Finished Setting			M	Off Fire			M	Finished Drawing			M		

Brand	Kind	Number of Pieces Green	Number of Pieces Reset	9" Equivalent per Piece	Total Equivalent In	Number of Pieces for Reset	Number of Pieces Good	Total Equivalent Out	9" Equivalent Broken	%	

Form 49. Kiln Record

size other than the standard 9-inch, are reduced to their equivalent in the regular 9-inch size and shown in the "total in," "total out," and "broken" columns. The figures thus indicate whether or not the kiln has been operated to its full capacity and how one burning compares with another in efficiency.

10. Financial Records

The forms so far described which are peculiar to the brick manufacturing industry are used primarily for the purpose of gathering information concerning the kind and quantities of brick produced. As to financial records, there are two which are common to all industries and which play an important part in segregating costs by processes. These are the pay-roll and the voucher record or purchase journal.

A very simple kind of pay-roll is all that is required in the ordinary brick plant. Form 50a is usually sufficient. Three columns are ruled to show the weekly wage, piece-rate earnings, and total pay of employees. Names are listed by departments. The salaries of officials and clerical employees who cannot be allocated to any particular department come under the head of administrative expense, the distribution of which will be shown later. At the end of the cost period the Pay-Roll account is credited with the labor charges to departments.

The standard form of voucher record is used ordinarily in brick plants and is an important feature of the cost system. So far as is practicable, expenditures are classified at their source by allotting one column in this record to every department which has been made a cost

PAY-ROLL

FROM_____ TO_____

NO.	NAME	RATE	DAY-WORK	PIECE-WORK	TOTAL PAY	DEDUC-TIONS	NET PAY	REMARKS

Form 50. (a) Pay-Roll Record—Brick Manufacturing Plant

division. Expenditures which cannot be departmentalized on the register, such as taxes and insurance or the purchase of a plant asset, are entered in a "Sundry" column. The operation and ruling of the voucher register and the purchase journal have already been explained in Volume I of "Business Accounting." The point to note here is that all expenditures other than those for wages and for items paid for in cash or its equivalent are first recorded in the voucher record.

11. Fixed Charges Sheet

An illustration of a fixed charges schedule is given in Form 50b (page 342). The left-hand page of the form shows an analysis of the investment in lands, buildings, and equipment and the apportionment of their values among departments. Only in the case of rent or the maintenance and up-keep of building is the apportionment based on floor space; in the other cases values are taken into consideration. Thus, while the crushing and grinding department occupies 4% of the floor space of the plant, it is assigned only 1% of the value of the buildings by reason of its being located in an inexpensive frame structure. Appraised values as well as the actual space occupied are thus taken into consideration.

The distribution of the fixed charges is shown on the right-hand page. The percentages of depreciation estimated for each department are applied to the appraised values shown in the left part of the form. Taxes are apportioned according to the percentages worked out in the column headed "Total Buildings and Equipment"; insurance is distributed according to the percentages shown under the headings "Buildings" and

FIXED CHARGES SHEET

ANALYSIS OF INVESTMENT

DEPARTMENTS	FLOOR SPACE		BUILDINGS		EQUIPMENT		TOTAL BUILDINGS AND EQUIPMENT		LAND		TOTAL INVESTMENT	
	Square Feet	% of Total	Book Value	% of Total	Book Value	% of Total	Book Value	% of Total	Book Value	% of Total	Book Value	% of Total
AMOUNTS TO BE DISTRIBUTED	$50,000	100%	$100,000	100%	$200,000	100%	$300,000	100%	$ 8,000	100%	$308,000	100%
Crushing & Grinding	2,000	4.	1,000	1.	500	0.3	1,500	0.5	320	4.	1,820	0.6
Machine Dep't.	8,000	16.	9,000	9.	14,000	7.	23,000	7.7	1,280	16.	24,280	8.
Tunnel Drying	20,000	40.	45,000	45.	80,000	40.	125,000	41.7	3,200	40.	128,200	41.6
Hand Molding 9"	5,000	10.	10,000	10.	20,000	10.	30,000	10.	800	10.	30,800	10.
Hot Floor Drying	10,000	20.	30,000	30.	84,000	42.	114,000	38.	1,600	20.	115,600	37.5
Shape Molding	5,000	10.	5,000	5.	1,500	0.7	6,500	2.1	800	10.	7,300	2.3
Total												

FIXED CHARGES SHEET

APPORTIONMENT OF CHARGES

DEPARTMENTS	DEPRECIATION					TAXES	INSURANCE			INTEREST	TO BE CHARGED		
	BUILDINGS		EQUIPMENT			(Town & Country)	BLDGS.	EQUIP'T.		(On Investment)			
	%	Amount	%	Amount	Total	Amount	Amount	Amount	Total	Amount	For Year	4 Weeks	5 Weeks
AMOUNTS TO BE DISTRIBUTED		$3,700		$14,620	$18,320	$ 5,000	$ 8,000	$ 4,000	$12,000	$15,400	$50720	$3,901.54	$4,876.92
Crushing & Grinding	3	30	5	25	55	25	80	12	92	92 40	264 40	20 34	25 42
Machine Dep't.	3	270	8	1,120	1,390	385	720	280	1,000	1,232 00	4,007 00	308 23	385 29
Tunnel Drying	3	1,350	5	4,000	5,350	2,085	3,600	1,600	5,200	6,406 40	19,041 40	1,464 72	1,830 91
Hand Molding 9"	3	300	5	1,000	1,300	500	800	400	1,200	1,540 00	4,540 00	349 23	436 54
Hot Floor Drying	5	1,500	10	8,400	9,900	1,900	2,400	1,680	4,080	5,775 00	21,655 00	1,665 77	2,082 21
Shape Molding	5	250	5	75	325	105	400	28	428	354 20	1,212 20	93 25	116 55

Form 50. (b) Schedule of Fixed Charges—Brick Manufacturing Plant

"Equipment," and interest on investment according to the percentages shown under "Total Investment." After the annual department charge is worked out in this way the charge for a cost period of any length can readily be determined. In the last column of Form 50b the fixed charges are shown for periods of four and five weeks.

12. Cost Ledger

The cost ledger is composed of loose-leaf sheets so ruled as to show the figures for the current month and the cumulative figures for the year. (See Forms 51-53.) Each sheet contains a sufficient number of columns for six months. The distribution of the two service departments, administration and power—as illustrated by Form 51—is worked out for each month; and the "cost per ton" or "per thousand," as the case may be, is figured below the entries on the process cost sheets. This book therefore contains in great detail all the information as to costs required by the management.

Accounts on the general ledger are carried with each process department for the purpose of charging Finished Goods account with the cost of the production for the period. In the process accounts on the general ledger the comparative figures and other details shown on the cost ledger are, of course, omitted. The control of the cost ledger is effected by comparing the cost of the finished goods as shown on the general ledger with the figures derived by multiplying the current cost of brick per thousand (as worked out in the final cost calculation in § 15) by the number of thousand bricks produced during the period.

13. Service Departments

In the average brick plant, power and administrative expenses cover the services rendered production.

Administrative	Month of July	Year to Date
Executive Salaries	$500.00	
Office Salaries	150.00	
Office Expense	41.50	
Telephone and Telegraph	23.40	
Postage	35.10	
Miscellaneous	5.25	
Insurance and Taxes on Office	9.75	
Depreciation on Office	3.00	
Total Monthly Expense	$768.00	
Less Charge to Distributing 25%	192.00	
Charge to Works	$576.00	
Administrative	$576.00	
Superintendent	200.00	
Watchman	65.00	
Total to Works	$841.00	
Distribution:		
Crushing and Grinding 10%	$ 84.10	
Machine-Made Brick 10%	84.10	
Tunnel Drying		
Hand Molding, 9 inch 20%	168.20	
Shape Molding 25%	210.25	
Hot Floor Drying		
Setting 10%	84.10	
Burning 10%	84.10	
Shipping and Labor 15%	126.15	

Form 51. Cost Ledger—Administrative Account

Unless it is desired to subdivide office and other miscellaneous expenses under different heads, all such items are charged to the administrative department. A portion of this expense is usually allocated to the selling or distributing department (as shown on page 344) if the manager and office force devote part of their time to this end of the business. The total works expense for the period is apportioned over the process departments on the basis of the number of men employed in each. The cost ledger entries on pages 344 and 346 illustrate the customary procedure.

Power expense is handled in the same way but the distribution, of course, is made only to the departments utilizing power and in proportion to their estimated consumption.

14. Process Accounts

The process accounts on the cost ledger are debited with their share of the fixed charges as shown on the schedule of fixed charges (Form 50b), with the labor as shown on the pay-roll, with purchases of supplies and repair parts as taken from the voucher register, and with the estimated cost of heat or power. These entries cover all the items of cost. In a small brick plant, or any process factory of small size, minor repairs are usually carried out by the "handy man" of the department, or perhaps by a mechanic from the power house; major repairs are turned over to an outside agency. In the latter case, repair expense can be charged direct from the voucher register. In the same way, supplies can be charged either to the department requisitioning them or, if they are for the general use of several depart-

ments, the invoice cost can be proportionately divided. In a large organization it would be necessary to operate stores and repair departments, and allocate the expense by means of stores requisitions and standing order cost sheets.

Cost of Clay	Month of July	Year to Date
Royalties	$ 10.40	
Labor	149.40	
Miscellaneous Supplies	10.20	
Freight	48.10	
Hauling	41.90	
Total Cost	$260.00	
Total Tons Clay	1,040	
Cost per Ton	$ 0.25	

Machine Dept.	Month of July	Year to Date
Labor	$320.00	
Repairs to Machines	31.20	
Supplies	11.50	
Share of Administrative	34.10	
Share of Power	150.00	
Share of Fixed Charges	385.29	
Total Operating Cost	$932.09	
Production	700,000	
Cost per 1,000	$ 1.33	

Form 52. Cost Ledger—Process Accounts

As one process cost account is much like another, two examples will suffice to illustrate their operation—one showing the cost per ton of the clay produced and the other the cost per thousand of the machine process of brick molding. It is apparent that until the clay and bats are crushed and ground, and take form and shape, the cost cannot be computed in thousands. For this reason some processes are computed by the ton and others by the thousand.

15. Summary of Cost

The make-up of the final cost calculation is simple. As already noted, the unit of production is 1,000 9-inch bricks and 4,000 of these weigh approximately one ton. Therefore, when computing the final cost, the 3 tons of clay and the 1 ton of bats composing the 4 tons of clay and bats—the raw material of the product—are priced at their unit costs, and these costs are entered on the page of the cost ledger devoted to an analysis of the cost of brick. The unit or basic costs of the remaining processes are added thereto to give the "works cost" which is also the price at which broken brick shall be charged back to the factory. To this price are then added the expenses of handling and shipping the product and the expense incurred by breakage, giving the total factory cost per thousand as shown on page 348.

The correctness of these figures, as already stated, can be proved by multiplying the number of thousand bricks produced during the period (irregular shapes being reduced to their 9-inch equivalents) by the total factory cost. The result should equal the amount deb-

Total Cost of 9-Inch Machine Brick	Month of July
3 tons Clay at 25 cents	$ .75
1 ton Bats at $1.31	1.31
Crushing and Grinding, 4 tons at 49 cents	1.96
Machine Dept.	1.33
Tunnel Drying Dept.	2.74
Setting Dept.	.34
Burning Dept.	.90
Works Cost (Price of Broken)	$ 9.33
Shipping and Labor	.51
Breakage Cost	.24
Total Factory Cost	$10.08

Form 53. Cost Ledger—Summary of Costs

ited to Finished Goods account on the general ledger. The cost of special brands of an irregular shape can be proved by multiplying their equivalent in 9-inch bricks (as shown on the kiln record, Form 49) and comparing the result with the sum of the cost of the various processes.

REVIEW QUESTIONS

1. What type of cost system is adapted to extractive industries?
2. What system of cost-finding is best suited to meet the needs of a manufacturer of clay products?
3. How is time kept on work in a brick-making plant?
4. What records of production should be kept in a brick factory?
5. What process accounts are required in a brick-making plant and how are they operated?

CHAPTER XXVI

ESTIMATED COSTS

1. Nature of Estimating Cost System

An estimating cost system is a modification of a job order system. Instead of calculating costs on one or a group of *like* articles, costs are computed by lines or groups of *different* articles. The total costs of the group are then compared with those based on an estimate of the cost of each article or group of articles in the line. In other words, instead of separately computing the cost of each job, a number of jobs are combined. Total costs are then controlled by comparing them with those based on a careful analysis, made in advance, of what the components of the combination ought to cost. The estimated figures are based, when possible, on past performances. Sometimes the system is spoken of as predetermined job costs.

The chief merit of the estimating method of cost-finding is that in certain cases satisfactory results can be obtained with much less clerical work and fewer forms than are needed to compute job order costs. While the estimated figures do not give the exact cost of each article made, this, as will be seen later, is unnecessary in certain lines of business. All that the system aims to do is to show the manufacturer how much profit (or loss) he has made on certain lines or groups as a whole, and the reason for any rise or fall in their cost of production. If the manufacturer wants more

than this, if he desires to know the actual cost of certain articles in a particular line, he must apply the mechanism of a job order system to those particular articles. The estimating system is thus incomplete and is to be commended only under certain conditions, as discussed in the next section.

2. Application of Estimating Cost System

Cost-finding by means of estimates is in many instances the only practicable plan. The intrinsic value of the product may be so small, or one article may differ so slightly from another in the same line that the expense of figuring costs for each article becomes prohibitive. Take for example the manufacture of cheap jewelry. The lines, consisting of badges, scarf pins, rings, brooches, pendants, and the like, may be made in thousands of different styles and sold at hundreds of different prices. In such a case, detailed costs on each article are impracticable and unnecessary. The manufacturer is interested in the profit on a line as a whole, or on a number of new styles in a line. The cost of any single article is so small a fraction of the whole that it is not worth considering in detail. Also the selling price may be based as much upon appearance and popular demand as upon cost.

Another example is the manufacture of notions. In this and analogous instances only the simplest of methods is practicable. The office staff will in many cases consist of a bookkeeper with possibly an assistant and one or two stenographers. These employees will have neither the time nor the necessary qualifications to attend to a complete cost system. Predetermined esti-

mates meet the needs of such a case equally as well as they meet the needs of a large manufacturing business producing a variety of styles in which the clerical expense of figuring costs in detail would be disproportionate to the value of the product.

3. Use of the Estimating Cost System

The estimate and test plan of cost-finding—as the estimating system is frequently called—gives satisfactory results only when productive labor is either paid for at piece rates or can be approximately calculated in advance, and when overhead expense does not vary widely from one period to another. Starting with these essential conditions (which are usually found in the industries just cited) the time tickets and other records generally handled by foremen or employees are dispensed with and costs are recorded directly on the books. To this end the output of the factory is divided into lines and accounts are opened with each line to collect the cost of material, labor, and overhead.

The division of the product into lines must be determined from the facts of the case. The greater the similarity between the articles which compose a line, the more closely can the cost of any one article be estimated. Wide ranges in cost and selling price within a line may lead to the sale of some of the articles at a loss which has to be recouped by the profit made on other goods.

It may be noted that as each new line involves the opening of three ledger accounts and the devising of means to keep the material, labor, and indirect expense of each line separately—expense is handled as a percentage of labor—the limits are soon reached at which

practical results can be obtained by the use of an estimating cost system.

4. Basic Principles

It is apparent that the manufacturing expenditures made during a given period plus the beginning inventory and minus the closing inventory represent the cost of the goods sold during the period if both inventories are priced at the same figures. If now a count is kept of the quantities of goods produced by items and these items are priced at figures estimated to be their actual manufacturing cost, the opening inventory plus the expenditures for the period should equal the estimated cost of the quantities sold plus the closing inventory—if the estimated prices are correct. To illustrate, if the estimated cost of several lots of goods sold during a period totals $1,000 and the opening and closing inventories are alike, then the estimated cost of each lot may be considered to be correct if it is found that the manufacturing cost also equals $1,000 when the books are closed at the end of the period. If the manufacturing cost is more than $1,000, then the estimates were too low; if less, they were too high.

The estimate and test plan of cost-finding is based on the foregoing simple principle. To condense the description of the method and to explain the book entries required in its operation, four schedules showing the sources of the figures for journalizing are given in the present chapter. For the sake of simplicity, figures and entries for one line only are given, it being of course understood that exactly the same procedure is followed when the output is divided into two or more lines.

5. Estimate of Cost

Much of the value of cost figures lies in a comparison of performances. When lines of goods closely resemble each other, past experience enables a close estimate to be made of the probable cost of a new line and past performances enable a close watch to be kept on the current cost of old lines. In this way standards are established and any serious deviation from them calls for instant investigation.

In controlling costs by means of estimates the first step is to prepare an itemized statement of all expenses for the year and ascertain the proportion applicable to each cost period. As the figures are for the factory as a whole, this is a simple matter. The pay-roll is then analyzed to find the average cost of the productive labor for a given cost period and from these two sets of figures the average ratio of expense to direct labor can be determined. In factories producing lines of small intrinsic value the overhead will be comparatively low, ranging from 20 to 60%. In the illustrative schedules which follow, expense is assumed to be 50% of the direct labor cost.

With this ratio determined, estimates can be compiled of the cost of each article in the different lines made. If work is paid for at piece rates the labor cost can be very closely estimated; but if paid for on hourly rates foremen must be consulted and asked to figure on this element. The material cost estimate should present no difficulty. The purchase price of material is a matter of record and therefore by weighing, or determining in some other way, the quantity of material used in the production of a certain number of articles and allowing

for any scrap, a close estimate can be made. With the foregoing figures as a basis, a schedule is made out as shown below, giving each article or style in the line:

Cost per Dozen Pairs of Line No. 1

Style No.	Material	Labor	Indirect Expense
100	$1.00	$ .50	$0.25
110	1.25	.60	.30
120	1.50	.70	.35
130	2.00	1.00	.50
145	2.50	1.20	.60
160	3.00	1.40	.70

It should be noted that the above estimate is based on the unit of manufacture which may be a dozen, a gross, so many hundreds, or any other measure. It does not indicate the quantity to be manufactured. It merely gives the details of what is expected to be the material, labor, and overhead cost of certain articles in line No. 1 which are designated by their style number. These estimates are the backbone of the system and should be made with the greatest possible care.

6. Opening Inventory

Having estimated the cost of the items in the line, an inventory is taken for the purpose of opening the three ledger accounts kept with that line. The opening figures are obtained by extending and adding the estimated costs of the goods on hand of the line to be manufactured. Any work in process should be taken as representing a certain quantity of finished goods—if one-third finished, one-third the quantity; if one-half finished, one-half; and so on. Any raw material on hand of the kind used in the manufacture of the line,

should be valued and added to the footing of the material price column. In the example given, it is assumed for the sake of simplicity that there is no raw material on hand.

OPENING INVENTORY

Quantity Dozen Pairs	Style No.	Material		Labor		Indirect Expense	
		Dozen Pairs	Total	Dozen Pairs	Total	Dozen Pairs	Total
1,000	100	$1.00	$ 1,000	$0.50	$ 500	$0.25	$ 250
2,500	110	1.25	3,125	.60	1,500	.30	750
500	120	1.50	750	.70	350	.35	175
2,000	130	2.00	4,000	1.00	2,000	.50	1,000
1,200	145	2.50	3,000	1.20	1,440	.60	720
900	160	3.00	2,700	1.40	1,260	.70	630
			$14,575		$7,050		$3,525

After the extensions are made the price columns of material, labor, and expense are footed. The information thus obtained is journalized for the purpose of opening the factory ledger accounts and the general ledger controlling account as shown:

Material	$14,575.00	
Labor	7,050.00	
Indirect Expense	3,525.00	
To General Ledger Account		$25,150.00

(Opening inventory.)

7. Actual Manufacturing Cost

At the close of the period the expenditures for the three elements of manufacturing cost are summarized and debited to their proper accounts by journal entry as shown below. The sources of the figures are as follows: Assuming that work is paid for at piece rates,

the mechanism used in computing wages will serve also in segregating on the pay-roll the direct labor cost of the different lines. If wages are paid for at hourly rates, either productive employees must be segregated on the pay-roll by lines of work and foremen instructed to report the transfer of workers from one line to another, or a simple system of time-keeping must be devised to classify productive work by lines.

The classification of raw material purchases by lines should be an equally simple matter. If, for example, materials of a certain kind, size, or quality are exclusively used in the manufacture of certain articles, these articles might with advantage be grouped into a separate line. The material cost of the various lines could then be classified at its source by allotting a column to each line in the purchase journal or voucher register.

Overhead is charged to each line in proportion to the total labor cost at the percentage rate applied to the estimated figures. The following journal entry illustrates the bookkeeping procedure:

Material Purchases	$153,825.00	
Direct Labor	74,445.00	
Indirect Expense	37,447.50	
To General Ledger Account		$265,717.50

8. Closing Inventory

At the end of the period a closing inventory is prepared which in no way differs from the opening inventory excepting, of course, that the quantity of goods varies according to the tally. The following schedule and journal entry make clear the bookkeeping procedure:

CLOSING INVENTORY

Quantity Dozen Pairs	Style No.	Material		Labor		Indirect Expense	
		Dozen Pairs	Total	Dozen Pairs	Total	Dozen Pairs	Total
800	100	$1.00	$ 800	$0.50	$ 400	$0.25	$ 200.00
1,200	110	1.25	1,500	.60	720	.30	360.00
250	120	1.50	375	.70	175	.35	87.50
500	130	2.00	1,000	1.00	500	.50	250.00
1,000	145	2.50	2,500	1.20	1,200	.60	600.00
750	160	3.00	2,250	1.40	1,050	.70	525.00
			$8,425		$4,045		$2,022.50

General Ledger Account	$14,492.50	
To Material		$8,425.00
" Labor		4,045.00
" Indirect Expense		2,022.50

(Closing inventory.)

9. Cost of Goods Sold

So far three accounts—material, labor, and expense—have been charged with the current manufacturing cost of the line and the value of its opening inventory; they have also been credited with the value of the closing inventory. The balances of these accounts therefore represent the actual cost of the goods sold during the period, divided into its elements of material, labor, and expense. If now the estimated material, labor, and expense cost of the items of this line sold during the period is computed and the three accounts are then credited with the estimated figures, a credit balance in one or more of these accounts would indicate that the estimated elements of cost were too high; a debit balance would indicate that they were too low.

To furnish the necessary figures for these credit entries the quantity of each item sold is extended at its estimated price and the resulting figures are credited to their respective accounts, the offsetting debit being to the Cost of Goods Sold account. The accompanying schedule and journal entry illustrate the method:

COST OF GOODS SOLD

Quantity Dozen Pairs	Style No.	Material		Labor		Indirect Expense	
		Dozen Pairs	Total	Dozen Pairs	Total	Dozen Pairs	Total
10,000	100	$1.00	$ 10,000	$0.50	$ 5,000	$0.25	$ 2,500
20,000	110	1.25	25,000	.60	12,000	.30	6,000
5,000	120	1.50	7,500	.70	3,500	.35	1,750
25,000	130	2.00	50,000	1.00	25,000	.50	12,500
15,000	145	2.50	37,500	1.20	18,000	.60	9,000
10,000	160	3.00	30,000	1.40	14,000	.70	7,000
			$160,000		$77,500		$38,750

Cost of Goods Sold	$276,250.00	
To Material		$160,000.00
" Labor		77,500.00
" Indirect Expense		38,750.00

10. Factory Ledger

After the foregoing journal entries have been posted to their proper ledger accounts, adjusting (i.e., closing) entries are made debiting or crediting, as the case may require, the Cost of Goods Sold account. If in making the adjustment it is necessary to charge material, this indicates that the cost estimates for material are too high. A corresponding credit adjustment is made to the Cost of Goods Sold account. If the adjust-

ment calls for a credit to the Material account, this indicates that the estimates of material have been too low. A charge is then made to the Cost of Goods Sold account. The Labor and Indirect Expense accounts have to be adjusted in like manner and the amount of the adjustment shows to what extent the cost estimates are incorrect. When discrepancies from month to month indicate that the estimates of any elements of cost are too high or too low, they should be revised accordingly.

After the adjustments have been made, the debit balance to Cost of Goods Sold account, into which the manufacturing accounts are closed, will obviously represent the total cost of all the articles of one particular line which have been made during the period. This balance is closed out to the Cost of Goods Sold account.

FACTORY LEDGER ACCOUNTS

MATERIAL

Jan. 1		*Jan. 31*	
Inventory	$ 14,575.00	Cost of Goods Sold	$160,000.00
Jan. 31		Inventory	8,425.00
Purchases	153,825.00		
Adjustment	25.00		
	$168,425.00		$168,425.00

LABOR

Jan. 1		*Jan. 31*	
Inventory	$ 7,050.00	Cost of Goods Sold	$77,500.00
Jan. 31		Inventory	4,045.00
Direct Labor	74,445.00		
Adjustment	50.00		
	$81,545.00		$81,545.00

INDIRECT EXPENSE

Jan. 1		*Jan. 31*	
Inventory	$ 3,525.00	Cost of Goods Sold	$38,750.00
Jan. 31		Inventory	2,022.50
Indirect Expense	37,447.50	Adjustment	200.00
	$40,972.50		$40,972.50

COST OF GOODS SOLD

Jan. 1		*Jan. 31*	
Material	$160,000.00	Adjustment on Material	$ 25.00
Jan. 31		Adjustment on Labor	50.00
Labor	77,500.00	General Ledger	276,375.00
Indirect Expense	38,750.00		
Adjustment on Indirect Expense	200.00		
	$276,450.00		$276,450.00

The following journal entry is all that is necessary to effect the necessary adjustments in the accounts:

Material, Adjustment	$ 25.00	
Labor, Adjustment	50.00	
To Cost of Goods Sold		$ 75.00
Cost of Goods Sold	200.00	
To Indirect Expense, Adjustment		200.00

11. General Ledger Account

In an organization large enough to warrant the employment of a cost clerk, the manufacturing and expense accounts would as a rule be kept in the factory ledger controlled by one general ledger account. In a small organization all the accounts might be kept in the general ledger. In either case the general ledger account summarizes the costs of the line and controls the

figures. As has been seen, this account is credited with the costs for the period when the manufacturing accounts are charged, and is debited with the value of the closing inventory. Therefore, its credit balance represents the actual cost of the goods made and sold and after the necessary adjustments have been made, should be in agreement with the debit balance of the Cost of Goods Sold—as shown below:

GENERAL LEDGER ACCOUNT

Jan. 1		*Jan. 31*	
Inventory	$ 14,492.50	Inventory	$ 25,150.00
Jan. 31		Purchases, Material	153,825.00
Cost of Goods Sold	276,375.00	Indirect Labor	74,445.00
		Indirect Expense	37,447.50
	$290,867.50		$290,867.50

12. Summary

It will clearly be seen that the estimating method of cost-finding can be applied as readily to the manufacture of several lines as to the output of a small factory making only one line. In the first case the purchase journal and the pay-roll form must be arranged to analyze the material and labor cost; in the second case this analysis will not be necessary. In either case the simplicity of the system lies in the fact that it is not necessary to follow jobs (with their accompanying records) through the factory, or to segregate expense by departments for the purpose of computing separate burden rates.

If at the close of the period the cost of goods sold is found closely to approximate the actual costs, the

estimates of the cost of each unit in the line can be accepted as correct. The object of the system is, of course, not so much to ascertain unit costs as to control the elements of cost of different lines so that an increase of any kind will at once be noted. When, for example, overhead is estimated for the ensuing period, item by item, and actual expenditure is compared with estimated expenditure at the close of the period, this comparison constitutes an important check. A rise in overhead which cannot be explained indicates waste or inefficiency. The same consideration applies to material and labor costs. What the figures ought to be can be estimated very closely and with this estimate as a standard of performance effort can be directed to further improvement.

REVIEW QUESTIONS

1. What is an estimating cost system? Under what conditions can good results be obtained from estimated costs?
2. Would an estimating cost system be adapted to the requirements of the needle industry, generally speaking? If so, why? State your reasons fully.
3. How is the estimate of cost made?
4. What relation do the opening and closing inventories bear to an estimating cost system?
5. Set up pro forma ledger accounts for an estimating cost system.

CHAPTER XXVII

TEXTILE COSTS—MANUFACTURE OF YARN

1. Nature of Problem

While the general principles which underlie the determination of costs in the textile industry are the same as in other industries, such costs merit separate discussion because of their seemingly complex character. On analysis this complexity will be found to be more apparent than real. In some departments costs are found by the process method, and in others by the job order method because of the diversity of the productive operations. Certain processes or groups of processes are carried on as distinct industries, the product of one department becoming the raw material of another. Finally, the general operating conditions are fairly similar in all plants and the manufacturing processes are quite uniform throughout the different textile trades notwithstanding the different kinds of raw material used and many varieties of fabrics woven. All this makes for simplicity and thus the study of a representative system of textile accounts is all that is required to explain the cost problem. Such a system of textile accounts is presented in this and the two following chapters.

2. Manufacture of Yarn

The numerous processes involved in textile manufacture may be divided generally into:

1. The making of yarn
2. The weaving of cloth
3. Knitting

Cloth fabrics and knit goods of all kinds are made out of yarn, the raw material of which, for purposes of classification, may be divided into: (1) short fibres, (2) long vegetable fibres, and (3) silk. Cotton and wool are included in the first class; linen, hemp, and sisal under the second class; and silk is in a class by itself. In all except silk mills, raw fibres are first twisted together to form yarn "in singles," i.e., single-ply yarn. From these singles two- or three-ply yarns are made. Three-ply yarns when twisted together form cabled yarns such as sewing thread and rope. Ply yarns only are used in the processes of weaving and knitting.

Raw silk consists of the filaments of silk wound from the cocoon of the silk-worm in continuous strands. These strands are twisted together to make "thrown," i.e., spun silk which is used in subsequent manufacturing processes. As the making of yarn is in all cases a series of continuous processes, the cost of the different processes is computed by means of the process method.

3. The Weaving and Knitting of Fabrics

In order to follow clearly the nature of the operations for which costs are computed, the following brief technical description is necessary.

Weaving. Fabrics are woven by interlacing filling yarn, i.e., yarn which runs across the fabric, with warp yarn, i.e., yarn which runs the length of the fabric. The loom weaving entails three operations known as: (1)

shedding, (2) picking, and (3) beating up. Some of the warp yarns are raised and others depressed (depending upon the pattern of the fabric) by the harness of the loom across which they are stretched so as to make a "shed" through which the shuttle containing the filling yarn passes. The second operation—picking—consists in driving the shuttle through the shed, each passage of the shuttle adding one pick to the fabric. The third operation consists of "beating up" the pick into its place so as to make a compact fabric. After the above cycle of operations is completed, the front beam of the loom holding the woven portion of the fabric winds up and the back beam holding the warp unwinds. The cycle is repeated until the loom run is completed.

The number of picks per inch in the filling and number of ends per inch in the warp measure the fineness of the fabric. Each piece of fabric is woven in a special design and may be as long as required. Ordinarily the weaving of one warp constitutes a job for which a production order is issued and therefore costs in the weaving department of a textile mill are found by the job order method.

Knitting. The process of knitting fabrics consists in looping a continuous strand of yarn together by means of either spring or latch needle machines and the operation is almost automatic. In computing the cost of knit goods such as hosiery or underwear, the unit cost per garment or per yard is found by dividing the cost of operating the machine or battery of knitting machines by the number of garments or yards produced. This method of cost-finding thus combines the features of both machine-hour and process costs.

4. Dyeing and Finishing Processes

Woven fabrics are finished in various ways by being dyed, bleached, mercerized, printed, and so on. The cost of each of these processes is departmentalized and distributed over the production to give the unit cost.

The process of dyeing may be carried out in the raw, i.e., before the wool or cotton is made into yarn; or the yarn or cloth may be dyed. Many textile mills are equipped only to manufacture and dye yarns and others only to throw silk. Dyeing, whether of yarn or fabrics, may also be carried on as a separate industry. But a large-sized modern textile mill usually includes all processes within its walls.

5. Departmental Divisions

The accounts to be presented are those of a woolen mill, the productive departments of which are divided into:

1. Dyeing
2. Picking
3. Carding
4. Spinning
5. Weaving
6. Knitting

Operations 2, 3, and 4 consist of the yarn manufacturing processes.

The non-productive departments of the mill for which accounts are opened on the books consist of:

1. Light, heat, and power
2. Building maintenance
3. General expense

4. Office expense
5. Boarding house expense

The cost of operating the stores-room is a comparatively small item of expense, and so is included among the general expense items. The expense of running a boarding house is part of the general operating expense.

6. Material and Supplies Account

In the system under consideration the raw material purchases are few in number and consist of different grades of wool, shoddy and waste, and dyestuffs and chemicals. These materials are kept in a stores-room, controlled by a stock record kept on the principle of the stores ledger. The raw materials are drawn upon as required by the picking and carding departments, the foremen of the departments making out the requisitions by which the issues are controlled. At the end of the cost period the requisitions are classified under the heads of: (1) raw materials, (2) supplies, and (3) dyestuffs and chemicals, and the total in each case is posted to the controlling ledger account bearing the same name. The pro forma account which follows illustrates the operation of the Raw Material account.

7. Waste Account

In every textile mill an appreciable portion of the raw material charged to departments is returned to stores in the form of waste of some kind. Most of the waste, technically known as "card strippings" and "grey headings," occurs in the making of yarn. Some of this waste is sold but a large part of it can be reworked. The

RAW MATERIAL (WOOL, SHODDY, AND WASTE)

1 Inventory:			
Webb, Lot 8512	10,000 lbs.		$ 7,500.00
Anthony, " 1000	10,000 "		7,000.00
	20,000 lbs.		$14,500.00
31 Purchases:			
Anthony, Lot 1211	10,000 lbs.		7,700.00
" " 1220	10,000 "		8,000.00
" " 1240	10,000 "		8,200.00
Freight on Purchases:			
30,000 lbs. at 2 cents			600.00
	50,000 lbs.		$39,000.00

31 Issues (Per summary of daily reports):			
Webb, Lot 8512	10,000 lbs.		$ 7,500.00
Anthony, " 1000	10,000 "		7,000.00
" " 1211	10,000 "		7,900.00
(Including freight)			
	30,000 lbs.		$22,400.00
31 Inventory:			
Anthony, Lot 1220	10,000 lbs.		8,200.00
" " 1240	10,000 "		8,400.00
(Including freight)			
	50,000 lbs.		$39,000.00

WASTE (TO BE SOLD OR REWORKED)

1 Inventory:			
Card strippings	5,000 lbs.		$ 500.00
Grey headings	5,000 "		700.00
	10,000 lbs.		$1,200.00
31 Manufactured:			
Card strippings	10,000 lbs.		1,000.00
Grey headings	10,000 "		1,400.00
	30,000 lbs.		$3,600.00

31 Issues:			
Card strippings	6,000 lbs.		$ 600.00
Grey headings	5,000 "		700.00
	11,000 lbs.		$1,300.00
31 Inventory:			
Card strippings	9,000 lbs.		900.00
Grey headings	10,000 "		1,400.00
	30,000 lbs.		$3,600.00

simplest method of accounting for it is to credit the departments with the approximate value of the waste returned to stock and debit them with issues as made. The sum of the returns and issues is controlled as shown on the pro forma account on page 368.

8. Stock in Process in Dye House Account

This account collects the cost of operating the dye house and is charged with the various items which make up the debit side of the account given below. At the end of each accounting period, the inventory of work in process is credited to this account. The difference between the total charges to the account and the closing inventory is the cost of the product of the dye house for the period, which is also credited to the account.

If but a single product is made during the period, such as, for example, khaki, it is obvious that the cost of production is equal to the total cost of the output, as shown by the account divided by the number of pounds produced. Thus, if the production were 30,000 lbs. of khaki, the cost would be 93 cents per lb. as shown in the illustrative figures.

9. Mixes in Process (Picker Room) Account

In the manufacture of yarn certain quantities of different grades of wool, waste, or shoddy are mixed together in the picker room for the purpose of producing yarn of a definite weight and grade. Whenever a mix is to be made, an order is issued to the mixing department. This order gives the mix number and the pounds required, together with the ingredients. Generally, mixes are made in 2,000, 5,000, or 10,000 lb. lots.

STOCK IN PROCESS IN DYE HOUSE

1	Inventory:		
	Webb, Lot 8,000	10,000 lbs..	$ 7,500.00
	Anthony " 500	10,000 " ..	8,000.00
		20,000 lbs..	$15,500.00
31	Input (Per summary of daily reports):		
	Anthony, Lot 1,000	10,000 lbs..	7,000.00
	" " 1,211	10,000 " ..	7,900.00
	Waste	11,000 " ..	1,300.00
	Supplies from Stock		500.00
	Dyestuffs		3,000.00
	Chemicals		4,000.00
	Purchases:		
	Supplies		500.00
	Repairs		200.00
	Pay-Roll		2,000.00
	Fixed Charges:		
	Depreciation		500.00
	Insurance		100.00
	Taxes		50.00
	Transfers:		
	Light, Heat, and Power (part)		200.00
	Maintenance and Up-keep of Building (part)		100.00
	General Expense (part)		100.00
	Boarding House (part)		50.00
	Office Expense (part)		50.00
		51,000 lbs..	$43,050.00

31	Output:		
	Khaki issued to Picker Room at 93 cents per lb.	30,000 lbs.	$28,030.00
31	Inventory:		
	Anthony, Lot 1,000	10,000 lbs..	7,000.00
	" " 1,211	10,000 " ..	7,900.00
	Waste	1,000 " ..	120.00
		51,000 lbs..	$43,050.00

MIXES IN PROCESS (PICKER ROOM)

1 Inventory:		
Webb, Lot 7,000	10,000 lbs..	$ 8,000.00
Khaki from Dye House	10,000 " ..	9,000.00
	20,000 lbs..	$17,000.00
31 Input:		
Webb, Lot 8,512 (Per daily reports)	10,000 lbs..	7,500.00
Khaki from Dye House (Per Dye House reports)	30,000 lbs..	28,030.00
Purchases:		
Stock from Other Mills	10,000 lbs..	8,000.00
Supplies		100.00
Repairs		100.00
Pay-Roll		2,000.00
Fixed Charges:		
Depreciation		500.00
Insurance		100.00
Taxes		50.00
Transfers:		
Light, Heat, and Power (part)		200.00
Maintenance and Up-keep of Building (part)		100.00
General Expense (part)		100.00
Boarding House (part)		50.00
Office Expense (part)		50.00
	70,000 lbs..	$63,880.00

31 Output (Per summary of Mixing Department requisitions):		
Lot 283, Mix 91	10,000 lbs.	$ 9,000.00
" 284, " 1005	5,000 "	4,500.00
" 285, " 1013	5,000 "	4,500.00
" 286, " 1014	5,000 "	4,500.00
" 287, " 1015	5,000 "	4,500.00
" 288, " 91	10,000 "	9,000.00
" 289, " 1005	5,000 "	5,785.00
" 290, " 91	10,000 "	9,000.00
	55,000 lbs.	$50,785.00
31 Inventory:		
Webb, Lot 8,512	5,000 lbs.	3,750.00
Khaki from Dye House	10,000 "	9,345.00
	70,000 lbs.	$63,880.00

In calculating the cost of mixes produced during any period, it is necessary to distribute over the different mixes the total cost of production as shown by the debit to the ledger account given on page 371.

This Mixes in Process (Picker Room) account is charged with the opening inventory of work in process, with all raw material issued to the picker room and all stock received from the dye house. In case mixed stock is delivered direct to the picker room from another mill, it is charged directly to this account through the purchase journal. Supplies and repair parts, the pay-roll, and lastly, a pro rata part of the fixed charges, maintenance, and up-keep of building, and general expense, are included in the Mixes in Process (Picker Room) account. At the end of each accounting period, the inventory of work in process in the picker room is credited to this account. The difference between the total debits to this account and the closing inventory gives the cost of the various mixes produced during the period which is credited to the account.

10. Cost of Mixes Made

In determining the cost of the different mixes produced during the period, the procedure is to figure the cost of material in each mix number by referring to the mixing department orders, which show the ingredients in each case. The labor and expense for the period can be apportioned over the different mixes on a pound basis. A columnar sheet should be used for making the calculation, arranged as shown below. As many columns will be needed as there are mixes produced during the period. It will be noticed that the column headings

COST OF MIXES MADE IN PICKER ROOM

Lot No.		283		284		285		Etc.	
Mix No.		91		1005		1013			
Pounds	55,000	10,000		5,000		5,000			
	Total	Amount	Per Lb.	Amount	Per Lb.	Amount	Per Lb.	Amount	Per Lb.
Raw Material									
Supplies									
Repairs									
Pay-Roll									
Depreciation									
Insurance									
Taxes									
Light, Heat, and Power									
Maintenance and Up-keep of Building									
General Expense									
Boarding House									
Office Expense									
Total	$50,785.00	$9,000.00	$0.90	$4,500.00	$0.90	$4,500.00	$0.90		

YARN IN PROCESS (CARDING AND SPINNING)

1 Inventory:					
Lot 281,	Mix 91,	Run 200	4,000 lbs..		$ 3,000.00
" 282,	" 96,	" 175	5,000 " ..		4,000.00
* " 721,	" 91,	" 140	4,000 " ..		.....
			13,000 lbs..		$ 7,000.00
31 Input (Per summary of Mixing Dept. requisitions):					
Lot 283,	Mix 91		10,000 lbs..		9,000.00
" 284,	" 1005		5,000 " ..		4,500.00
" 285,	" 1013		5,000 " ..		4,500.00
" 286,	" 1014		5,000 " ..		4,500.00
" 287,	" 1015		5,000 " ..		4,500.00
" 288,	" 91		10,000 " ..		9,000.00
" 289,	" 1005		5,000 " ..		5,785.00
" 290,	" 91		10,000 " ..		9,000.00
Card Clothing					500.00
Purchases:					
Supplies					100.00
Repairs					100.00

31 Output (Per summary of daily Spinning Room reports):					
Lot 281,	Mix 91,	Run 200	3,500 lbs..		$ 4,051.82
" 282,	" 96,	" 175	4,500 " ..		5,352.00
" 721,	" 91,	" 140	3,500 " ..		729.53
" 283,	" 91,	" 156	9,000 " ..		11,251.12
" 284,	" 1005,	" 156	2,000 " ..		2,717.50
" 284,	" 1005,	" 200	1,500 " ..		1,962.50
" 284,	" 1005,	" 120	500 " ..		712.00
" 285,	" 1013,	" 120	4,500 " ..		5,852.00
" 286,	" 1014,	" 120	4,500 " ..		5,852.00
" 287,	" 1015,	" 120	4,500 " ..		5,852.00
" 288,	" 91,	" 160	4,000 " ..		5,433.70
" 288,	" 91,	" 200	4,000 " ..		5,233.83
Waste Credits					.....
			46,000 lbs..		$55,000.00

Pay-Roll:		
Carding		4,000.00
Spinning		5,000.00
Fixed Charges:		
Depreciation—Card Room	$500.00	
Depreciation—Spinning Room	500.00	
		1,000.00
Insurance		500.00
Taxes		100.00
Transfers:		
Light, Heat, and Power (part)		300.00
Maintenance and Up-keep of Building (part)		200.00
General Expense (part)		100.00
Boarding House (part)		50.00
Office Expense (part)		50.00
	68,000 lbs.	$69,785.00

*Yarn in process handled for an outside party.

31 Inventory:			
Lot 289, Mix 1005, Run 160	5,000 lbs.		5,785.00
" 290, " 91, " 160	10,000 "		9,000.00
Invisible Waste	7,000 lbs.		
	68,000 lbs.		$69,785.00

provide for showing the amount chargeable to each mix and also the cost per pound. Thus in the illustrative case presented, the cost of making 10,000 lbs. of mix No. 91 is $9,000, or 90 cents per lb.

11. Yarn in Process (Carding and Spinning) Account

After the raw wool has been mixed it is carded, or if a fine textile is to be made it is also combed preparatory to spinning into yarn. To obtain the cost of these two processes an account termed Yarn in Process (Carding and Spinning) is opened. The charges to this account are much the same as to the other process accounts. The method of determining the credits, i.e., the cost of the different lots of yarn spun, involves a technical explanation to be taken up in the following section. An example of a Yarn in Process account is given on page 374.

12. Calculating the Cost of Yarn

Yarn is made from different mixes in different sizes, and what is technically known as the "run" system of numbering woolen yarns is used for the purpose of estimating the carding and spinning cost. If one pound of one-run yarn contains 1,600 yards, and one pound avoirdupois contains 7,000 grains, it follows that:

1 lb. of	1	run	=	1,600	yards;	50	yds.	= 218 gr.
1 "	" 2	"	=	3,200	"	50	"	= 109 "
1 "	" 3	"	=	4,800	"	50	"	= 72 "
1 "	" ¾	"	=	1,200	"	50	"	= 291 "
1 "	" ½	"	=	800	"	50	"	= 437 "
1 "	" ¼	"	=	400	"	50	"	= 875 "

In the mill under consideration the grains per 50

yds. of yarn designate the run. Thus, the yarn produced is known as a 200-run, a 160-run yarn, and so on. This is equivalent to saying that the mill is making 1.1 run (218÷200=1.1), 1.38 run, and so on. From the foregoing table it is seen that the length of one pound of yarn varies directly with the run number. For cost purposes it is assumed that the cost of conversion (labor and expense) in the carding and spinning rooms is also proportional to the run number and on this basis labor and expense are apportioned to the various sizes of yarn.

Suppose, for example, that the labor and expense for a certain period are $12,000, and that five runs of yarn have been produced as shown in columns 1 and 2 of the table given below. The method of apportioning the $12,000 over the different runs is then to multiply the pounds by the run number and prorate the amount over the product as shown.

TABLE SHOWING THE METHOD OF CALCULATING THE CONVERSION COST (LABOR AND EXPENSE) FOR EACH RUN OF YARN

Run (1)	Pounds Yield (2)	Product (1) and (2) (3)	Multiplier (4)	Product (3) and (4) (5)	Labor and Expense Per Lb. (5) ÷ (2) (6)
1.1	5,500	6,050	.16684	$ 1,009.38	$ .1835
1.25	3,500	4,375	.16684	729.93	.2086
1.4	6,000	8,400	.16684	1,401.46	.2336
1.5	9,000	13,500	.16684	2,252.34	.2503
1.8	22,000	39,600	.16684	6,606.89	.3003
	46,000	71,925		$12,000.00	

$12,000 ÷ 71,925 = .16684

71,925 ÷ 46,000 = 1.563 run average

$12,000 ÷ 46,000 = $.261 per lb. of run 1.563

$.261 ÷ 1.563 = $.1668 per lb. of run 1

COST OF YARN CARDED AND SPUN

Lot No.		281		282	
Mix No.		91		96	
Run		1.1		1.8	
Pounds Mixed	53,000	4,000		5,000 Etc.	
Yield	46,000	3,500		4,500	
	Grand Total	Total	Per Lb.	Total	Per Lb.
Cost of Raw Material	$43,000.00	$3,000.00	$ .8571	$4,000.00	$ .8888
Card Clothing	$ 500.00				
Supplies	100.00				
Repairs	100.00				
Pay-Roll—Carding	4,000.00				
Pay-Roll—Spinning	5,000.00				
Depreciation—Card Room	500.00				
Depreciation—Spinning Room	500.00				
Insurance	500.00				
Taxes	100.00				
Light, Heat, and Power	300.00				
Maintenance and Up-Keep of Building	200.00				
General Expense	100.00				
Boarding House	50.00				
Office Expense	50.00				
Conversion Expense	$12,000.00	$1,051.82	$ .3004	$1,352.00	$ .3004
Total Cost	$55,000.00	$4,051.82	$1.1575	$5,352.00	$1.1892

From the table on page 377 it is seen that 1.1-run yarn costs $.1835 per lb. for labor and expense. As each run is made from a certain mix number, the cost of material is obtained from a sheet showing the cost per pound of each mix number. Reference to the sheet on page 378 shows that the cost of run 1.8 is made up of raw material, labor, and expense. As many columns are employed for the purpose of ascertaining the cost of each run as may be required.

Yarn making is often carried on as an isolated industry in mills specially equipped for the purpose; and even in textile mills which do their own spinning the cost of yarn is segregated from other costs. Yarn then becomes the raw material to be used in the weaving of cloth and the knitting of fabrics. The methods of determining the cost of these processes are described in the following chapter.

REVIEW QUESTIONS

1. What is the necessity for departmentalizing labor and expense in a textile mill?
2. What are the typical cost accounts required in a woolen mill?
3. How should the labor and expense in the picking department be distributed?
4. How should the cost of yarn be calculated?
5. What is meant by the "run" system for numbering woolen yarn and how are the run numbers used in cost calculations?

CHAPTER XXVIII

TEXTILE COSTS—WEAVING AND KNITTING

1. Cloth in Process (Weaving) Account

To ascertain the cost of woven cloth produced, a manufacturing or work in process account called Cloth in Process (Weaving) account is opened and is charged with the inventory at the beginning, with the yarn used —whether received from the spinning room or purchased from outside mills—and the pay-roll of the weaving department, which department includes the operations of spooling, dressing, drawing-in, weaving, and burling. Finally the Cloth in Process (Weaving) account is charged with a pro rata part of the fixed charges, maintenance and up-keep of the building, and general expense.

At the end of each month this account is closed with an inventory of the cloth in process. The difference between the total debits and the closing inventory gives the cost of the woven fabrics produced during the period.

The usual plan, as already stated, is to treat the weaving end of the mill as an entirely separate enterprise. If the yarn mill sells to the weaving mill, it should be credited for its product at cost, and the yarn should also be charged to the weaving mill at cost.

The general form and the usual entries in the Cloth in Process (Weaving) account are shown on pages 382 and 383.

To calculate the cost of each woven fabric produced during the period and thus determine the credits to Cloth in Process account, it is necessary to apportion the total cost of production, as shown by the debit side of Cloth in Process (Weaving) account, among the different styles woven. To this end a record is kept of the output of the weaving department during each period.

Thus, assume the production during the month to be as follows:

Style	Loom Lbs.	Finished Lbs.	Loom Yds.	Finished Yds.	Pieces
115	125,485	96,461	59,749	48,119	1196
112	3,276	2,561	1,946	1,764	40
123-1				37	1
124-1				37	1
Samples					

The problem now is to make an apportionment of the cost of weaving during the period among the different styles. The construction of a fabric determines what warp and filling is used. Thus, style 115 cloth is made up of 60% warp yarn (mix 91, run 160) and 40% filling yarn (mix 91, run 160). The cost of the yarn is obtained from the yarn cost sheets.

Spooling labor is paid for at the rate of 16.07 cents per 1,000 yds. for a $1\frac{3}{8}$-run yarn, on which basis a charge for spooling can be made to each fabric for spooling warp yarn. Dressing labor is paid for by the day and can be distributed on the basis of the number of warps dressed. Drawing-in is paid for at the rate of 48.4 cents per 1,000 ends in the warp, on which basis the individual styles can be charged. Weavers on fabrics

CLOTH IN PROCESS (WEAVING)

1 Inventory:			
YARN (WARP)			
Lot 278, Mix 91, Run 200 (not spooled)	5,000 lbs..		$ 3,000.00
" 279, " 96, Run 156 (spooled)	5,000 " ..		3,500.00
" 280, " 1013, Run 120 (spooled)	5,000 " ..		3,300.00
YARN (FILLING)			
Lot 277, Mix 91, Run 200	4,000 " ..		2,500.00
WARPS DRESSED ON FLOOR			
Style 115, —— cuts, Pc. nos. ——	.....		1,000.00
WARPS IN LOOM			
Style 115, —— cuts, Pc. nos. ——	.....		2,000.00
CLOTH ON FLOOR			
Style 115, —— cuts, Pc. nos. ——	.....		3,000.00
			$18,300.00
31 Input (Per summary of daily Spinning Room reports):			
Lot 281, Mix 91, Run 200	3,500 lbs..		4,051.82
" 282, " 96, " 175	4,500 " ..		5,352.00
" 283, " 91, " 156	9,000 " ..		11,251.12
" 284, " 1005, " 200	1,500 " ..		1,962.50
" 284, " 1005, " 120	500 " ..		712.00
" 285, " 1013, " 120	4,500 " ..		5,852.00

31 Output (Per summary of Weaving Department reports):		
Style No. 115		
No. of Pieces Woven.....	4	
Yards Woven	334	
Pounds Woven	690	
Cost	$880.28	
Style 115 (other patterns).....	.....	
Etc. ——	.....	
Style ——	.....	
Etc. ——	.....	
Total Cost of All Woven Fabrics..		$69,000.00
31 Waste Credits:		
1—Spooling		20.00
2—Dressing		20.00
3—Weaving		10.97
		$69,050.97
31 Inventory:		
YARN (WARP)		
Lot 287, Mix 1015, Run 120 (spooled)..		5,000.00
" 288, " 91, " 160 (")..		5,000.00
YARN (FILLING) None		

Lot 287, Mix 1015, Run 120	4,500 lbs..	5,852.00
" 288, " 91, " 160	4,000 " ..	5,433.70
" 288, " 91, " 200	4,000 " ..	5,233.83
Purchases:		
Supplies		2,000.00
Repairs		100.00
Special Outside Labor		500.00
Pay-Roll:		
Spooling, P. W. Warp Yarns		1,000.00
Dressing, D. W. Warp Yarns		1,000.00
Drawing-in, P. W. Warp Yarns		1,000.00
Weaving, Day		3,000.00
Weaving, P. W.		5,000.00
Burling, D. W.		500.00
Fixed Charges:		
Depreciation		2,000.00
Insurance		500.00
Taxes		100.00
Transfers:		
Light, Heat, and Power (part)		500.00
Maintenance and Up-Keep of Building (part)		500.00
General Expense (part)		300.00
Boarding House (part)		100.00
Office Expense (part)		50.00
	55,000 lbs.	$82,150.97

Warps Dressed on Floor	
Style 115, —— cuts, Pc. nos. ——	13,000.00
Warp in Looms	
Style 115, —— cuts, Pc. nos. ——	100.00
	$82,150.97

COST OF CLOTH WOVEN

Style No.	115
Ends	2,304
Picks	24
No. of Pieces (7 cut per warp)	4
Yards Woven	334
Pounds Woven	690
YARN	
Warp, Mix 91, Run 160, Lbs. 60%	414 lbs.
Filling " 91, " 160, " 40%	276 lbs.

COST OF MANUFACTURING	TOTAL	AMOUNT	PER LB.	AMOUNT	PER LB.	AMOUNT	PER LB.
Yarn—Warp 414 at $1.1681		$483.59					
Yarn—Filling 276 at 1.1681		322.39					
Total Cost of Yarn		$805.98					
Direct Labor:							
Spooling, Warp Yarn, P. W. at 88c. per lb.		$ 3.64					
Dressing, Warp Yarn, D. W.		1.12					
Drawing-in, P. W., 48.4c. per M.		.65					
Weaving, P. W. at 8.8c per yd.		29.39					
Burling, D. W.		1.00					
Total Direct Labor		$ 37.15					
Overhead:							
Supplies							
Repairs							
Weaving Day Labor							
Depreciation, Ins., Taxes							
Light, Heat, and Power							
Maint. and Up-Keep of Bldg.							
General Expense							
Boarding House							
Office Expense							
Overhead, 100% of Direct Labor		37.15					
Total Cost		$880.28					

with 24 picks per inch receive 8.8 cents per yard, on which basis weaving labor can be charged to the different styles. Burlers are paid by the day and so their time can be apportioned on a yardage basis.

In addition to the direct labor above mentioned, other items to be charged to each style are the general weaving room labor, the fixed charges, a pro rata share of the maintenance and up-keep of the building, and general expense. The basis to use in making the apportionment is the direct labor charge. The total cost of the yarn, direct labor, and overhead in the weaving department gives the cost of the woven fabric.

The tabulation on page 384 illustrates the method of calculation. In case the weaving department of a mill only works on one style during a period, the cost calculation is a very simple matter.

2. Cloth in Process (Knitting) Account

This account, as presented on the following page, is operated in the same way as the Cloth in Process (Weaving) account. The stock produced as shown on the credit side is of two kinds—spring needle and latch needle—and the cost problem is to ascertain the unit cost of each style of fabric produced. To this end a record is kept of the yards and pieces knit of each style.

The manufacture of a knit fabric usually requires but one size of yarn, as the process consists in continually looping together the yarn until a sufficient quantity of goods has been produced. This is, of course, very different from the condition in a weaving mill where many kinds of yarn may be interlaced in order to make the fabric.

CLOTH IN PROCESS (KNITTING)

1 Inventory:		
SPRING NEEDLE STOCK		
Lot 276, Mix 91, Run 160	5,000 lbs..	$ 3,000.00
Cloth, Style 1010	1,000 " ..	1,000.00
LATCH NEEDLE STOCK		
Lot 277, Mix 91, Run 160	4,000 lbs..	4,000.00
Cloth, Style 1055	2,000 " ..	2,100.00
	12,000 " ..	$10,100.00
31 Input (Per summary of daily Spinning Room reports):		
Lot 284, Mix 1005, Run 156	2,000 lbs..	2,717.50
" 286, " 1014, " 120	4,500 " ..	5,852.00
Purchases:		
Supplies		2,000.00
Repairs		500.00
Pay-Roll—Winding at 5 cents per spool		500.00
Knitting—Labor:		
Spring Needle Machines		1,000.00
Latch Needle Machines		1,000.00
Mending		500.00
Supplies:		
Needles, Spring		100.00
" Latch		100.00
Fixed Charges:		
Depreciation		500.00
Insurance		100.00
Taxes		50.00
Transfers:		
Light, Heat, and Power (part)		100.00
Maint. and Up-Keep of Bldg. (part)		100.00
General Expense (part)		50.00
Boarding House (part)		20.00
Office Expense (part)		10.00
	18,500 lbs..	$25,299.50

31 Output (Per summary of Knitting Department reports):		
SPRING NEEDLE STOCK		
Style 1010, 2,500 pcs.	—— lbs..	$10,182.00
LATCH NEEDLE STOCK		
Style 1055, 3,514 pcs.	—— " ..	12,117.50
Waste Credits	.....	.....
		$22,299.50
31 Inventory:		
SPRING NEEDLE STOCK		
Lot 284, Mix 1005, Run 156		1,000.00
Cloth, Style 1010, —— lbs.		1,000.00
LATCH NEEDLE STOCK		
Lot 286, Mix 1014, Run 120		500.00
Cloth, Style 1055, —— pcs.,—— lbs.		500.00
	18,500 lbs..	$25,299.50

3. Cost of Cloth Knit

The method of calculating the cost of cloth knit is shown in the table on page 388. The cost of yarn can be ascertained from the yarn cost sheets and a proper charge made accordingly. Labor in the winding department is paid for at the rate of 5 cents per spool, and mending is paid for at the rate of 3 cents per yard, on which basis a charge can be made to each style. It is assumed that the pay-roll of the spring needle section is chargeable to style 1010 and that of the latch needle section to style 1055. The indirect expense of the knitting department is divided between styles in proportion to the direct labor charge.

4. Cloth in Process (Wet and Dry Finishing) Account

The fabrics which have been either woven or knit are charged to the Cloth in Process (Wet and Dry Finishing) account. This account is also charged with all labor and expenses incurred in connection with the finishing operation. At the end of each accounting period the cost of the finished fabrics is calculated and credited to this account, leaving a balance equal to the inventory value of unfinished fabrics, as shown on page 389.

5. Calculating the Cost of Finished Cloth

The next step is to apportion the cost of the production of the wet and dry finishing departments over the different styles. This can be done on a columnar sheet as illustrated in the example given on page 390. The cost of the material is obtained from the weaving and knitting department cost sheets. Labor and expense are apportioned on a yardage basis, as shown.

COST OF CLOTH KNIT

Style		1010		1055	
No. of Pieces		2,500		3,514	
No. of Pounds		10,000		12,300	
No. of Yards		4,583		6,000	
	TOTAL	AMOUNT	PER PC.	AMOUNT	PER PC.
Material	$15,669.50	$ 7,000.00		$ 8,669.50	
Pay-Roll:					
Winding	$ 500.00	$ 225.00		$ 275.00	
Knitting—Spring Needle	1,000.00	1,000.00			
Knitting—Latch Needle	1,000.00			1,000.00	
Mending	500.00	215.00		285.00	
Total Pay-Roll	$ 3,000.00	$ 1,440.00		$ 1,560.00	
Overhead Expense:					
Supplies	$ 2,000.00				
Repairs	500.00				
Needles—Spring	100.00				
Needles—Latch	100.00				
Depreciation	500.00				
Insurance	100.00				
Taxes	50.00				
Light, Heat, and Power	100.00				
Maintenance and Up-Keep of Building	100.00				
General Expense	50.00				
Boarding House	20.00				
Office Expense	10.00				
Overhead Expense	$ 3,630.00	$ 1,742.00		$ 1,888.00	
Total Cost	$22,299.50	$10,182.00		$12,117.50	

1	Inventory:	
	WOVEN	
	Styles ——, —— yds., —— lbs.....	$ 2,000.00
	KNIT	
	Style 1055, —— lbs.....	2,000.00
		$ 4,000.00
31	Input:	
	WOVEN	
	Styles ——, —— yds., —— lbs.....	69,000.00
	KNIT	
	Style 1010, —— pcs., —— lbs.	10,182.00
	" 1055, —— " —— "	12,117.50
	Purchases:	
	Supplies	1,100.00
	Repairs	250.00
	Pay-Roll:	
	1—Wet Finishing.....	500.00
	2—Dry Finishing.....	500.00
	Sewing	200.00
	Fixed Charges:	
	Depreciation—Wet Finishing.....	300.00
	" —Dry Finishing.....	200.00
	Insurance	100.00
	Taxes	50.00
	Transfers:	
	Light, Heat, and Power (part).....	500.00
	Maintenance and Up-Keep of Building..	400.00
	General Expense (part).....	200.00
	Boarding House (part).....	100.00
	Office Expense (part).....	20.00
		$99,719.50

31	Output (Per Finishing Department reports):	
	WOVEN	
	Style 115, —— yds., ——lbs.....	$72,815.00
	KNIT	
	Style 1010, 2500 pcs., —— lbs.	10,679.25
	" 1055, 3514, " —— "	13,225.25
	Waste Credits	.....
		$96,719.50
31	Inventory:	
	WOVEN	
	Style 115, —— yds., —— lbs.....	1,500.00
	KNIT	
	Style 1055, —— lbs.	1,500.00
		$99,719.50

COST OF CLOTH FINISHED

Style		115		1010		1035	
Yards Finished		30,000		4,500		5,500	
Pounds Finished		67,500		9,500		11,000	
Pieces		400		2,500		3,514	
	TOTAL	AMOUNT	PER PC.	AMOUNT	PER PC.	AMOUNT	PER PC.
Material	$92,299.50	$69,500.00		$10,182.00		$12,617.50	
Labor:							
Wet Finishing	$ 500.00						
Dry Finishing	500.00						
Sewing	200.00						
Total Labor	$ 1,200.00	$ 900.00		$ 135.00		$ 165.00	
Overhead Expense:							
Supplies	$ 1,100.00						
Repairs	250.00						
Depreciation	500.00						
Insurance	100.00						
Taxes	50.00						
Light, Heat, and Power	500.00						
Maintenance and Up-Keep of Building	400.00						
General Expense	200.00						
Boarding House	100.00						
Office Expense	20.00						
Overhead Expense	$ 3,220.00	$ 2,415.00		$ 362.25		$ 442.75	
Total	$96,719.50	$72,815.00		$10,679.25		$13,225.25	

FINISHED CLOTH

1 Inventory:		
WOVEN		
Style 115, 32 oz., Melton, —— pcs., —— yds.	$ 5,000.00	
KNIT		
Style 1010, 4 lbs., O. D. blankets, 66″ x 84″	5,000.00	
Style 1055, 3½ lbs., Gray blankets, 62″ x 84″	5,000.00	
	$ 15,000.00	
31 Finished Production (Per Finishing Department reports):		
WOVEN		
Style 115, —— yds., —— lbs.	72,815.00	
KNIT		
Style 1010, —— pcs., —— lbs.	10,679.25	
" 1055, —— " —— "	13,225.25	
	$111,719.50	
31 Cost of Goods Sold:		
WOVEN		
Style 115, Melton, —— pcs., —— yds.		$ 72,815.00
KNIT		
Style 1010, —— pcs., —— lbs.		12,679.25
" 1055, —— " —— "		14,505.75
		$100,000.00
31 Inventory:		
WOVEN		
Style 115, Melton, —— pcs., —— yds.		5,000.00
KNIT		
Style 1010, 4 lbs., O. D. blankets, 66″ x 84″		3,000.00
Style 1055, 3½ lbs., Gray blankets, 62″ x 84″		3,719.50
		$111,719.50

6. Finished Cloth Account

This account is charged with the production shown in Cloth in Process (Wet and Dry Finishing) account. The closing balance in this account represents the cost of goods sold. The manner of operating the account is shown on page 391.

REVIEW QUESTIONS

1. What is the general procedure followed in calculating the cost of a woven fabric?
2. How are the labor and expense of the finishing department apportioned over the output?
3. To what account is the finished fabric charged?

CHAPTER XXIX

TEXTILE COSTS—GENERAL EXPENSE

1. Expense Accounts

In addition to the operating department accounts referred to in the preceding chapter, various expense accounts are opened to distribute the charges for heat, light, power, depreciation, taxes, etc., to departments. The schedules of distribution are given when required, to show the basis on which the charges are computed. With the exception of Shipping Expense which is closed out to Cost of Sales account, all the other expense accounts are closed out to the various manufacturing departments and to Shipping Expense.

SHIPPING DEPARTMENT EXPENSE

31	Pay-Roll	$500.00	31	Cost of Goods Sold	$895.00
	Supplies	200.00			
	Repairs				
	Misc. Expense				
	Fixed Charges:				
	Depreciation	50.00			
	Insurance	20.00			
	Taxes	10.00			
	Transfers:				
	Light, Heat, and Power	50.00			
	Maintenance and Up-Keep of Building	25.00			
	General Expense	20.00			
	Boarding House	10.00			
	Office Expense	10.00			
		$895.00			$895.00

LIGHT, HEAT, AND POWER

31 Purchases	$1,350.00	31 Stock in Process (Dye House)	$ 200.00
Depreciation	500.00	Mixes in Process (Picker Room)	200.00
		Yarn in Process (Carding and Spinning)	300.00
		Cloth in Process (Weaving)	500.00
		Cloth in Process (Knitting)	100.00
		Cloth in Process (Wet and Dry Finishing)	500.00
		Shipping Department Expense	50.00
	$1,850.00		$1,850.00

The distribution of horse-power in the mill is reported to be as follows:

	H. P.
Dyeing	45
Picking	70
Carding	160
Spinning	125
Weaving	123
Knitting	45
Finishing	420
Total H. P.	988

This is the basis to use for apportioning all power purchased if each department in the mill runs the same number of hours. If otherwise, the distribution of power must be in proportion to the product of the horse-power and hours run.

MAINTENANCE AND UP-KEEP OF BUILDINGS

31 Purchases	$ 25.00	31 Stock in Process (Dye House)	$ 100.00
Pay-Roll	500.00	Mixes in Process (Picker Room)	100.00
Depreciation	800.00	Yarn in Process (Carding and Spinning)	200.00
Insurance	50.00	Cloth in Process (Weaving)	500.00
Taxes	50.00	Cloth in Process (Knitting)	100.00
		Cloth in Process (Wet and Dry Finishing)	400.00
		Shipping Department Expense	25.00
	$1,425.00		$1,425.00

The floor space used by productive departments is as follows:

	Sq. Ft.
Dye House	5,892
Picking	5,440
Carding	25,210
Spinning	25,440
Weaving	16,880
Knitting	4,840
Wet Finishing	9,385
Dry Finishing	6,600
Shipping	3,460
Total Sq. Ft.	103,147

In the foregoing tabulation all non-productive area is omitted, such as space used for entrance halls, superintendent's office, elevator shafts, stairways, etc.

GENERAL EXPENSE ACCOUNT

31 Purchases	$270.00	31 Stock in Process (Dye House)	$100.00
Pay-Roll	400.00	Mixes in Process (Picker Room)	100.00
Depreciation	200.00	Yarn in Process (Carding and Spinning)	100.00
		Cloth in Process (Weaving)	300.00
		Cloth in Process (Knitting)	50.00
		Cloth in Process (Wet and Dry Finishing)	200.00
		Shipping Department Expense	20.00
	$870.00		$870.00

This account is closed out on the basis of the productive labor pay-roll.

BOARDING HOUSE ACCOUNT

31 Purchases	$180.00	31 Stock in Process (Dye House)	$ 50.00
Depreciation	200.00	Mixes in Process (Picker Room)	50.00
		Yarn in Process (Carding and Spinning)	50.00
		Cloth in Process (Weaving)	100.00
		Cloth in Process (Knitting)	20.00
		Cloth in Process (Wet and Dry Finishing)	100.00
		Shipping Department Expense	10.00
	$380.00		$380.00

OFFICE EXPENSE ACCOUNT

31 Purchases	$ 40.00	31 Stock in Process (Dye House)	$ 50.00
Pay-Roll	100.00	Mixes in Process (Picker Room)	50.00
Depreciation	100.00	Yarn in Process (Carding and Spinning)	50.00
		Cloth in Process (Weaving)	50.00
		Cloth in Process (Knitting)	10.00
		Cloth in Process (Wet and Dry Finishing)	20.00
		Shipping Department Expense	10.00
	$240.00		$240.00

This account is closed out on the basis of the productive labor pay-roll.

TABLE SHOWING APPORTIONMENT OF DEPRECIATION BY PERIODS

	Annual Depreciation	4 Weeks	5 Weeks	13 Weeks
Dye House				
Picker Room				
Carding				
Spinning				
Weaving				
Knitting				
Finishing				
Shipping				
General				
Building and Permanent Fixtures				

NOTE: The five-week periods are December, March, June, and September. The other periods are four weeks each. Each quarter has thirteen weeks (one five-week and two four-week periods).

ESTIMATE OF DEPRECIATION ON PLANT

	Cost	Scrap Value		Balance	Life in Years	Annual Depreciation
		% of Cost	Amount			
Dye House						
Picker Room.....						
Carding						
Spinning						
Weaving						
Knitting						
Finishing						
Shipping						
General						
Permanent Fixtures.						
Construction						
Total						

Insurance Prepaid Account

31 Purchases	$2,470.00	31 Stock in Process (Dye House)	$ 100.00
		Mixes in Process (Picker Room)	100.00
		Yarn in Process (Carding and Spinning)	500.00
		Yarn in Process (Weaving)	500.00
		Cloth in Process (Knitting)	100.00
		Cloth in Process (Wet and Dry Finishing)	100.00
		Shipping Department Expense	20.00
		Maintenance and Upkeep of Buildings.	50.00
		Balance	1,000.00
	$2,470.00		$2,470.00

Taxes Accrued Account

31 Purchases	$ 60.00	31 Stock in Process (Dye House)	$ 50.00
Balance	400.00	Mixes in Process (Picker Room)	50.00
		Yarn in Process (Carding and Spinning)	100.00
		Yarn in Process (Weaving)	100.00
		Cloth in Process (Knitting)	50.00
		Cloth in Process (Wet and Dry Finishing)	50.00
		Shipping Department Expense	10.00
		Maintenance and Upkeep of Buildings	50.00
	$460.00		$460.00

Pay-Roll Account

7	Cash	$ 7,000.00	31	Stock in Process (Dye House)	$ 2,000.00
14	Cash	7,000.00		Mixes in Process (Picker Room)	2,000.00
21	Cash	7,000.00		Yarn in Process:	
28	Cash	9,200.00		1. Carding	4,000.00
				2. Spinning	5,000.00
				Cloth in Process (Weaving):	
				1. Spooling	1,000.00
				2. Dressing	1,000.00
				3. Drawing-in	1,000.00
				4. Weaving—Day	3,000.00
				5. Weaving—P. W.	5,000.00
				6. Burling	500.00
				Cloth in Process (Knitting):	
				1. Winding	500.00
				2. Knitting—Spring Needle	1,000.00
				3. Knitting—Latch Needle	1,000.00
				4. Mending	500.00
				Cloth in Process (Wet and Dry Finishing):	
				1. Wet Finishing	500.00
				2. Dry Finishing	500.00
				3. Sewing	200.00
				Maintenance and Up-Keep of Building	500.00
				General Expense	400.00
				Office Expense	100.00
				Shipping Dept. Expense	500.00
		$30,200.00			$30,200.00

REVIEW QUESTIONS

1. What is the best basis for apportioning power to the various departments?
2. How should the up-keep and maintenance of buildings be distributed to the factory departments?
3. What items should be included under the head of General Expense, and how should the General Expense account be distributed to the various departments?
4. What plan is best adapted to a textile mill for calculating the amount of depreciation applicable to each period?

Part VIII
Graphic Presentation of Cost Data

CHAPTER XXX

USE OF GRAPHIC CHARTS

1 Graphs vs. Statements

The control of present, and the planning of future, business activities must to a great extent be based on the comparison of present with past performances. For this reason an important part of the work of the cost accountant should be the compiling of cumulative statistics covering the past operations of the business and the presentation of these statistics in such a way that the vital facts as to the activities of the business are brought forcefully to the attention of executives. The more detailed the records, and the more clearly the relation between costs, expenses, and output are shown, the more effectively can activities be guided and controlled.

When statistics are presented in the form of statements and tabulated figures, close study and some calculation are usually required before their significance is grasped. The columns of figures of one statement must be carefully scrutinized and cross-reference made to the corresponding figures of other statements to trace the causes of increases and decreases.. Some better, clearer method of presentation is needed. This is found in the graphic chart when it is required to show clearly the relation between two sets of figures derived from different sources; or when increases, decreases, and ratios are, as it were, to be thrown into relief, graphic charts possess

many material advantages over statements and tabulated figures.

The great superiority of the chart form over the statement form for certain kinds of presentation lies in the ease, the vividness, and the completeness with which statistical information, comparisons, and results attained can be shown by the former. The value of the chart form for such purposes is well known to engineers, who make use of it, particularly for comparative purposes, whenever practicable. But the full value of the chart method of presentation for comparative purposes is not yet generally realized by accountants, as their experience has usually been limited to graphs designed to show differences and not ratios.

2. Difference and Ratio Charts

The charts most commonly employed are termed "difference" charts and show arithmetical increases or decreases only. Their function, when used in cost work, is restricted to showing rises and falls in prices, unit costs, and so on. Ratio charts show the ratio of increase or decrease, i.e., the *distance* upward or downward represents the percentage of increase or decrease, depending upon the scale used.

3. Difference Charts

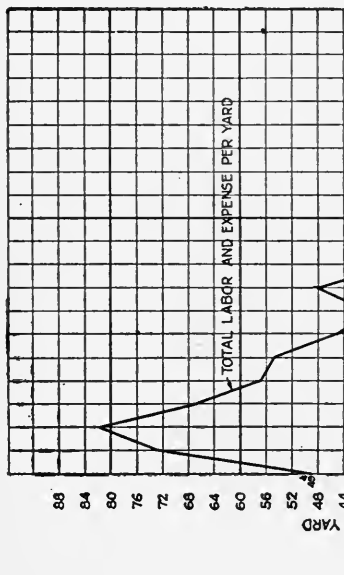
A difference chart is usually drawn on a sheet of cross-section paper, technically known as "co-ordinate" paper. When this paper is used, both vertical and horizontal lines mark off the units of measurement. Thus, for cost work, each division upward may represent one dollar, ten dollars, a pound, a ton, ten gallons, or any

other unit; while the divisions from left to right usually mark off the daily, monthly, or yearly periods depending upon the length of time which the chart is intended to cover. The units of measurement are usually indicated on the left-hand side of the chart, and, to make the calculation and reading of the figures easy, every tenth line—both vertical and horizontal—is frequently more heavily ruled than the others. The periods of time indicated by the vertical lines are also shown—usually at the bottom of the chart—in some distinctive way. When all this is done, the plotting of data on the charts is a simple matter. In difference charts, the zero line is always shown, and is made very heavy.

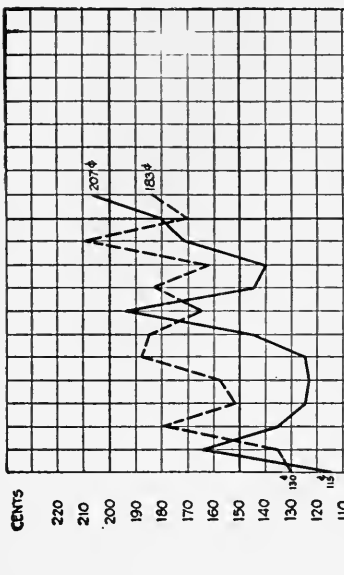
4. Illustrative Difference Charts

For the purpose of showing the construction and the field of utility of difference charts, two illustrations are given on page 408. It should be noted that the base line is zero and that the charts are read from left to right.

Form 54 is a graph used in actual practice in a silk mill. The curves show the fluctuations in the labor and expense per yard of silk woven during the year. The distances between horizontal lines represent four cents a yard. The months are read from left to right as indicated. It will be seen that the total labor and expense per yard has fluctuated during the year between $.82 and $.30 per yard. The high peak culminating in March was caused by a partial strike which more than doubled the cost of production. The peak in September was caused by an increase in general expense due to extraordinary repairs. The chart as a whole shows a marked drop in the unit cost of labor and expense, especially



Form 54. Chart showing Labor and Expense per Yard—Silk Mill



Form 55. Chart showing Average Selling Price and Average Cost of Sales per Pound—Silk Mill

during the last half of the year, caused mainly by increased production.

Form 55 shows how the average selling price per pound compares with the average cost of sales per pound in a silk-throwing mill. The trend of selling prices and costs is upward and on several occasions costs have actually exceeded selling prices. This increase was due to old contracts outstanding and a steadily rising price for raw silk. Manufacturers sometimes fail to realize that sales are being made below cost, when such is the case, until the matter is presented to them in graphic form.

5. Limitations of Difference Charts

Difference charts are best adapted to the comparison of unit costs, or for showing the trend in prices over a period of years. The scale used must, of course, be adapted to fit the data and the size of paper.

When two or more sets of figures are to be compared, the use of difference charts is limited to the presentation of figures which have the same unit as their common base; that is, comparisons must be made between different quantities of the same unit, as dollars, or pounds, or tons, and so on. If, for instance, the production of a silk mill in pounds is to be compared over a period of several years, the difference charts are suitable. When different units are to be compared, these charts do not give good results. Thus if it is desired to compare the pounds of silk sold with the amount (dollars) received for them for corresponding periods, the scale that fits the pounds does not fit the dollars. If two scales are provided, the presentation becomes complex.

Another limitation of the difference chart is that the rise and fall of the curves which represent two sets of figures may convey little meaning when fluctuations in a relatively small item of cost are compared with the fluctuations of a large item. The curve of the latter may show pronounced valleys and peaks, while the curve of the former, though the ratio of differences is quite as great, may show only slight undulations.

6. Ratio Charts

Ratio charts are constructed by marking off the field into main divisions, each line in a division representing a geometrical progression, that is, a multiple of the same line in the division below. The base number may be 1, 10, 100, and so on. Each main division is the same height, and the number of the divisions needed depends upon the lowest and the highest numbers to be compared. Thus, if the lowest number in the table of data to be plotted is 100, and the highest 1,000,000, the chart would be divided into four main divisions, as follows, reading from the bottom up:

1,000,000
100,000
10,000
1,000
100

In a ratio chart the base line is never zero. The distance between the main divisions may be any number of inches, the number depending upon the degree of accuracy required in measuring the scale.

To illustrate the purpose of dividing the chart in this

way, assume that the spaces between the divisions representing the scales 10, 100, 1,000, 10,000, 100,000 are each one inch. It will be seen that a curve rising from 10 to 100 represents a tenfold increase and moves upward *one inch.* Or again, suppose the curve moves from 10,000 to 100,000. This also represents a tenfold increase and moves just *one inch* upward. In the first case the arithmetical difference is 90, while in the latter case it is 90,000. Nevertheless, the ratio of increase for the period is 900% in each case.

7. Use of Ratio Charts

Ratio charts have a wider field of utility than difference charts in that they make possible the comparison of large numbers with small numbers and vice versa, so that the relation between them and the percentage of increase or decrease can readily be seen. That is, magnitudes are usually shown instead of unit prices or costs.

Suppose, for example, it is desired to compare the total pay-roll disbursements over a period of months with the total hours worked and the average rate of pay per hour. When comparisons such as this by means of ratios are desired, the scale of numbers does not mean dollars, or hours, or cents, but ratios or percentages, and so one scale answers for all. An increase in the pay-roll from $100,000 to $110,000 is a 10% increase and would be represented by the same increase in the vertical movement as an increase from 50 cents to 55 cents, or 10% in the wage rate. In order to tell whether the increase in pay-roll hours is inclined to be greater than that of wage rates, all that is necessary is to note the angle taken by the lines. The line which goes up at the sharpest angle

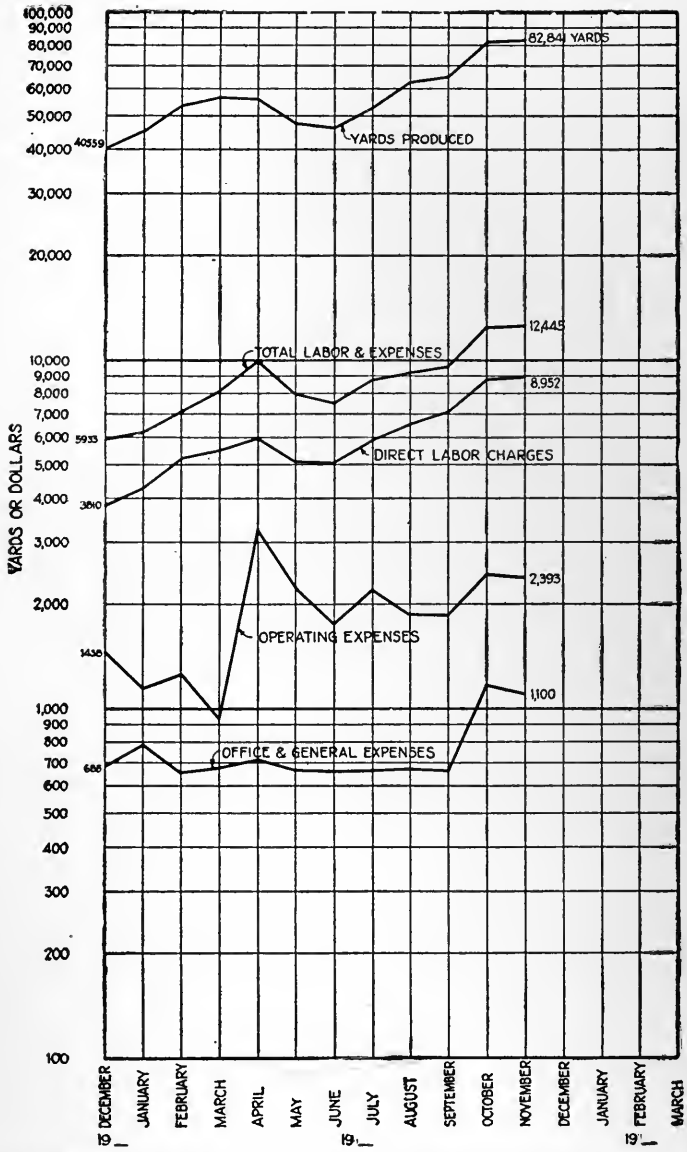
means that the item is increasing at the fastest rate. Thus an increase in the number of pay-roll hours may be accompanied by a decrease in wage rates or vice versa. Many useful comparisons can be made in this way.

An interesting feature of the ratio charts is that compound interest curves when plotted or drawn on ratio paper result in straight lines. That is, if the amount of $1 at 10% compound interest be shown at the end of each year for, say, ten years, the line which connects the points would be absolutely straight. The explanation of this fact is that a straight line indicates a fixed rate per cent of increase or decrease. Assume, for example, that an operating expense curve rises throughout the year in an approximately straight line, and it is desired to ascertain the per cent of increase each month. Assume again that the curve starts on January 1 at $10,000 and on February 1 passes through the $10,100 line. $10,100—$10,000=$100. $100 is 1% of $10,000. Therefore, the operating expense increased during January at the rate of 1% and continued at that rate throughout the year because the line was straight. On January 1 of the ensuing year the expense would be $11,268.

8. Illustrative Ratio Charts

The accompanying charts and the statement figures from which the curves are plotted are taken from the actual practice of a textile mill. It is interesting to note and compare the clearness and simplicity of the information furnished by the charts with the seeming confusion and intricacy of the statement of figures.

In studying the charts it should be borne in mind



Form 56. Ratio Chart showing Production, Labor, and Expense—Silk Mill

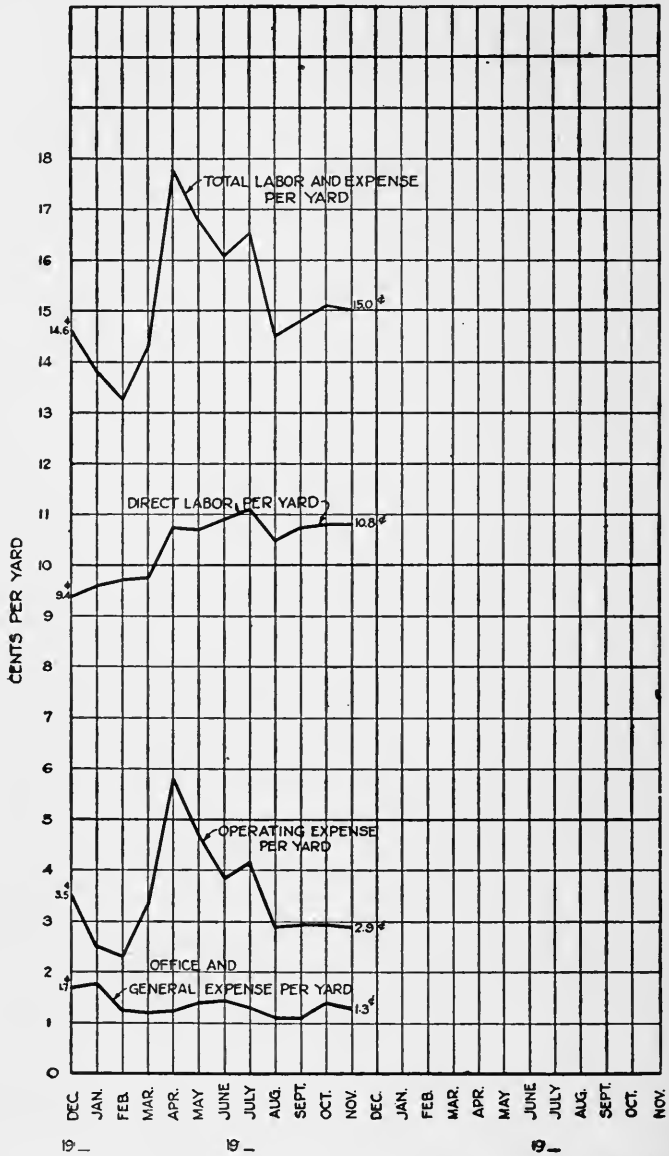
STATISTICAL TABLE SHOWING THE DIRECT LABOR CHARGES AND FACTORY EXPENSES AS PLOTTED IN CHART 56

	Yards Produced	Direct Labor Charges	Operating Expenses	Office and General Expenses	Total	Per Yard
19—						
December	40,559	$ 3,810.10	$ 1,437.87	$ 685.09	$ 5,933.06	14.630c.
19—						
January	45,162	4,273.66	1,129.74	795.95	6,196.35	13.720c.
February	53,499	5,199.42	1,241.18	648.72	7,089.32	13.252c.
March	56,472	5,511.43	927.48	676.28	8,115.19	14.368c.
April	56,071	5,986.07	3,257.70	710.43	9,954.20	17.749c.
May	47,702	5,086.84	2,220.01	662.86	7,969.71	16.705c.
June	46,071	5,040.01	1,738.28	656.17	7,434.46	16.135c.
July	52,862	5,889.61	2,198.12	660.77	8,748.50	16.547c.
August	62,755	6,543.57	1,866.00	666.23	9,075.80	14.461c.
September ..	65,073	7,069.50	1,853.51	662.25	9,585.26	14.730c.
October	81,889	8,784.48	2,430.25	1,157.90	12,372.63	15.106c.
November	82,841	8,952.14	2,392.64	1,100.48	12,445.26	15.020c.
Totals	690,956	$72,146.83	$23,692.78	$9,080.13	$104,919.74	15.184c.
Average per month	57,579	$ 6,012.23	$ 1,974.39	$ 756.67	$ 8,743.31	
Percentage of total		68.76%	22.58%	8.66%	100.00%	

that the curves approximately indicate all the figures shown on the accompanying statement at the close of each month; that is, the statement could be reconstructed from the charts to the nearest unit of 100, 1,000, etc., depending upon the division in which the curve is plotted. For the sake of exactitude and convenience the precise figures shown on the statement for the last month under review are entered on the chart shown in Form 56. As month by month the curve is extended, the figures of the preceding month are erased and those for the last period are substituted.

In reading these charts the executive is primarily interested in the curves for the last month and only a glance is required to ascertain whether operations as a whole are satisfactory. Form 56, for example, plots the productive labor and expense for the period. The executive at once sees that the production of the preceding period has not only been maintained but increased, for the curve showing the number of yards produced has risen one-tenth of the space, or 1,000 yds., or an increase of approximately 1% over the preceding period. On the other hand, the operating and general office expenses have both dropped approximately one-twentieth of the space or one-half of 1%. Direct labor and total labor and expense tend to rise slightly as would be expected from an increase in production, but the percentage of their rise is slightly less than the percentage of increase in the yards produced—a satisfactory condition. The spaces shown in the ratio charts illustrated are usually subdivided in practice.

Without going into the discussion of logarithmic theory, it may be stated here that the ratio chart depends



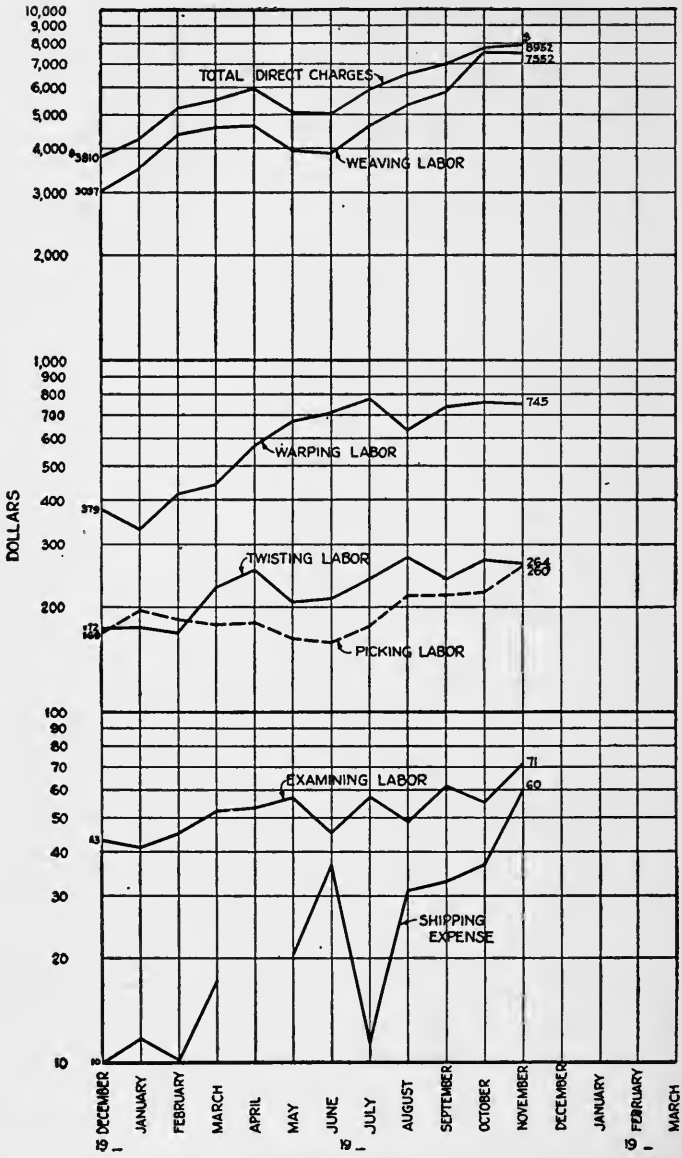
Form 57. Chart showing Labor and Expense per Yard—Silk Mill

on the principles of logarithms. It will be noticed that in Form 56 lines are interpolated between the main divisions. The placing of these lines is done by referring to a table of logarithms or by taking the distances from the scale on an engineer's slide rule. The distances between the lines are proportional to the logarithms of the numbers marked on the chart. Paper can be purchased already ruled for making ratio charts.

Form 56 gives the "perspective" view of production costs to the nearest $100, $1,000 or $10,000, as the case may be. Form 57 is a difference chart going more into detail and showing to what element of cost a rise or fall in the production cost per yard is due. Any violent fluctuations in the curves of this figure indicate unusual conditions and call for instant investigation.

The curves of Form 58 are plotted from a cost statement showing the distribution of direct labor and shipping expense for the months to date. On comparing, for instance, the cost of the examining labor with the number of yards produced (Form 56), it is found that production from the beginning of the year to date has increased more than 100%, whereas the cost of examining labor has increased less than 75%. The shipping expense curve reveals violent fluctuations in the expenditures for freight and express, due to bills being held up for auditing purposes and therefore not always entered at the end of each month.

The full value of the above charts can, of course, be appreciated only by the management in control of the activities which they depict. They serve, however, to illustrate the simplicity and value of this method of compressing and presenting statistical information.



Form 58. Ratio Chart showing Direct Labor and Shipping Expense—Silk Mill

REVIEW QUESTIONS

1. What advantages does the graphic means of presentation have over ordinary statements?
2. What two types of graphic charts are best adapted to meet the needs of the cost accountant? What are the advantages and disadvantages of each type?
3. For what purpose are difference charts best adapted? Give two illustrations.
4. Upon what principle are ratio charts based?
5. Which type of chart is best suited for making comparisons between pounds produced and cost of production?
6. Which type of chart is best suited for making a comparison of the hourly earnings of piece-work operators with those of week workers?
7. How can one tell what the percentage of increase or decrease is in a ratio chart without making an arithmetical calculation?
8. If a line for operating expense on a ratio chart is straight, what does it indicate?
9. From the data contained in the following table make charts on ordinary cross-section paper.

COST PER POUND IN CENTS

	Dyeing	Picking	Carding and Spinning	Weaving	Knitting	Finishing
January	3.00c.	2.00c.	8.13c.	22.74c.	13.14c.	13.27c.
February	1.97	1.12	8.28	14.49	8.04	11.12
March	1.92	1.19	7.91	13.92	6.86	8.49
April	1.71	1.51	8.28	15.48	7.57	9.54
May	1.45	1.61	7.47	12.88	6.42	10.65
June	1.75	1.99	7.55	13.76	6.15	10.66
July	1.77	1.80	7.75	13.93	6.30	12.51
August	2.33	2.12	8.84	21.48	7.68	12.13
Sept.	2.22	2.24	10.16	24.06	8.28	12.05
October	2.14	2.85	10.26	25.33	7.45	13.36

10. From the data contained in the following table prepare a ratio chart.

THE STAR NEWSPAPER

Month	Number of Papers Printed	Net Circulation Revenue	Aver. Net Circ. per M Papers
January	5,191,233	$33,654	$6
February	4,200,085	47,142	11
March	4,666,063	55,464	12
April	5,049,523	59,624	12
May	5,291,188	64,002	12
June	5,205,762	63,393	12
July	5,234,624	65,486	13
August	4,922,141	65,361	13
September	4,802,616	63,119	13
October	5,507,916	71,208	13
November	5,242,746	68,238	13
December	4,702,274	60,860	13

11. From the data contained in the following table prepare a ratio chart.

THE STAR NEWSPAPER

Month	Number of Columns of Advertising	Net Advertising Revenue	Average Revenue per Column
January	1,353	$78,742	$58
February	1,088	66,237	61
March	1,396	82,858	60
April	1,517	93,847	61
May	1,433	86,818	60
June	1,222	73,803	60
July	1,066	63,669	60
August	928	57,543	62
September	1,390	84,671	61
October	2,050	136,495	62
November	1,747	109,213	63
December	1,760	113,478	64

12. From the data contained in the following table prepare a ratio chart.

THE STAR NEWSPAPER

Month	Number of Papers Printed on 8-Page Basis	Lbs. of Paper Used	Number of lbs. Used per M 8-Page Papers
January	9,427,802	1,214,000	129
February	7,963,124	1,032,000	131
March	10,028,743	1,350,000	135
April	10,713,524	1,416,000	132
May	10,433,271	1,404,000	135
June	9,751,259	1,244,000	128
July	8,956,809	1,172,000	131
August	7,806,503	974,000	123
September	8,873,164	1,142,000	129
October	12,017,490	1,544,000	128
November	11,207,081	1,418,000	128
December	10,497,696	1,318,000	126

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