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## Principles of factory cost keeping

Edward Preston Moxey

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PRINCIPLES OF  
FACTORY COST KEEPING

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MOXEY

# Principles of Factory Cost Keeping

*With the compliments  
of the author*

BY *B. Moxey*

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## PREFACE

The literature in which an activity finds its expression depends upon the interest in, and the development of, that activity. It is therefore not surprising to find that there is comparatively little literature on accounting at the present time. Charles W. Haskins says: "The literature of accounting is virtually in its infancy, awaiting the fostering care of cultured authorship."

Mr. Haskins' statement is particularly applicable to the subject of cost accounting. Although many valuable articles have been written on different phases of this subject, and while excellent books on costs have appeared from time to time, it is a notable fact that such articles and such books have been either of a highly technical character, or otherwise treating of special systems of costs as actually installed and used by certain manufacturing plants.

As a result of this, there exists in many minds the idea that the principles of cost accounting are more or less mysterious and vague, and that the subject is one for the expert, only to be under-

stood after years of study and experience. This idea is due largely to the lack of a clear and simple presentation of the principles upon which cost accounting rests; and it is to supply this need that the present book has been prepared.

The use of diagrams in illustrating the principles of cost accounting is not new. They were used quite successfully in the early eighties by Garcke & Fels in their book "Factory Accounts"; but the idea has been further developed by the author, and has been made applicable to conditions of the present.

The book is offered to those interested along cost accounting lines, with the hope that it may help to a clearer understanding of the true aims of this important branch of accounting science.

EDWARD P. MOXEY, JR.

October, 1913.

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# PRINCIPLES OF FACTORY COST KEEPING

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## CHAPTER I

### INTRODUCTORY

#### **Development of Accountancy**

Accountancy as a profession has undergone its greatest development within recent years. Accounting records which a few years ago were either unknown or were considered superfluous and unnecessary, are today an integral part of the accounting systems of practically every business. That portion of accounting in which the greatest advance has been made is the ascertaining of factory costs.

Manufacturers used to consider it wholly unnecessary to keep books other than those employed to record the major business transactions. The necessity for an accurate cost system, which is now recognized as imperative for success in

business, was not then apparent. But the demand for greater efficiency in industry, and the keen competition which exists between the various manufacturers in the same line of trade, have rendered necessary more accurate accounting records whereby each may know absolutely and accurately his cost of production.

### **Ends Attained by Cost Keeping**

There are two reasons which warrant the keeping of cost records and which justify the consequent expense involved.

First: Cost keeping furnishes the manufacturer with accurate and reliable information concerning the costs incurred in production, enabling him to fix prices and bid intelligently against others in the same field.

Second: Through his cost accounting department the manufacturer is enabled to detect, locate, and eliminate waste or leakage in materials, labor, and other expenses incident to production.

### **Cost Accounting a Development**

All factory cost accounting is based directly on the principles of double-entry bookkeeping. It is, in fact, a highly specialized development of dou-

ble-entry bookkeeping—which does not, in its usual form, go far enough for cost accounting purposes.

In the ordinary routine of business, money, or its equivalent, is paid in for the purpose of making a profit by increasing its amount through the operation of the business. It is obvious that in order to secure this increase the money must first be expended, the expenditure being always made with the expectation that there will be produced something which can be sold to the consumer for an amount greater than the cost to the producer. The difference between the costs of production added to the other expenses of the business and the amount received from sales represents profit.

But a system of accounting that did not go beyond this elementary presentation of facts would not furnish information sufficient or accurate enough for the requirements of modern business. Some classes of expense are not of a temporary nature. The use of certain articles in production—such as machinery—extends over a series of years. It is not right to charge the original cost of such purchases to profit and loss in the period in which they are made, for they will figure in the manufacture of hundreds of subsequent lots of goods.

### **Temporary and Permanent Expenditures**

For cost accounting purposes, therefore, a first distinction—considering expenditures only for the present—must be made between expenditures for assets of a more permanent type—generally known as fixed assets, and comprehended in the term “Plant”—and those of a more or less temporary character, known as “Profit and Loss” items, or those comprehended in the general class of “Nominal Accounts.”

### **Classification of Merchandising Expenditures**

Following this a more detailed classification becomes desirable. Taking a merchandising concern for the sake of illustration, we find that “Profit and Loss” expenditure is divided into two parts, the distinguishing feature being the difference between payments for that which is dealt in, classified under the heading “Merchandise,” and payments for services and other items necessary to the proper conduct of the business, known as “General Expense.”

A further subdivision of “General Expense” must then be made to show the items which make up its total amount. Two subheadings, known respectively as “Trading Expense” and “Adminis-

trative Expense," are usually employed. The former covers the detailed expense accounts which go to make up the cost of distributing the goods, including salesmen's salaries and expenses, rent of the store in the case of a merchandising house, costs of advertising and of the delivery service; while the latter includes those accounts which show the cost of managing the financial and business affairs of the concern, including all administrative salaries and general office expense, such as, for example, office supplies.

On the other hand, "Merchandise," being entirely too general in its character, is also subdivided. The first distinction is that made between purchases and sales. The sales may also be divided into classified sales accounts, while in the division of the purchases we find the first signs of detailed costs.

### **Analysis of General Ledger**

The following analysis of the general ledger of any typical merchandising business, from the standpoint of expenditures, will serve to present diagrammatically the discussion up to this point:

FACTORY COST KEEPING

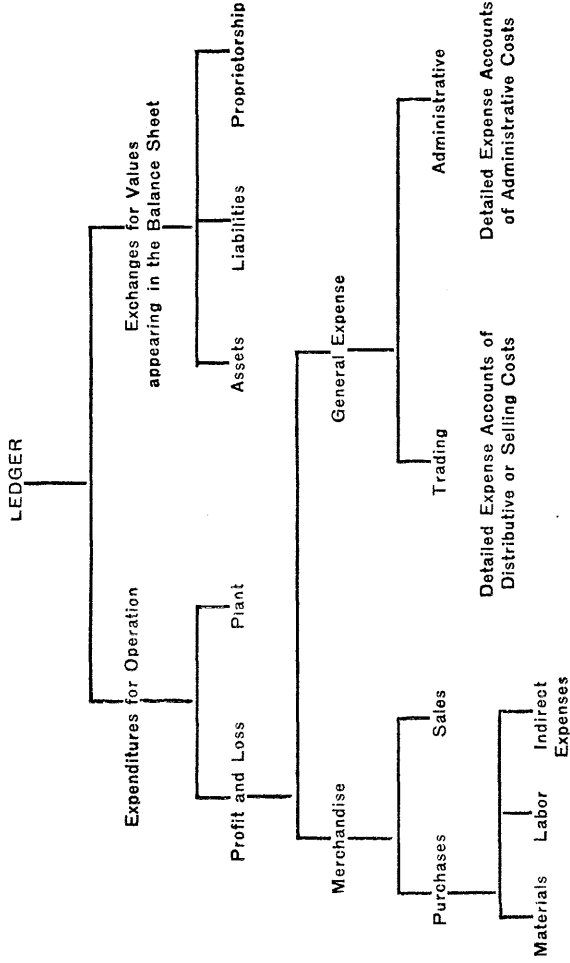


Diagram 1. Analysis of General Ledger

## Elements of Manufacturing Cost

If, instead of purchasing the goods ready for sale, as we have presumed heretofore, a manufacturing plant is erected or leased and the goods are produced, it becomes necessary to split up the expenditures directly involved in the production of these goods into their component parts, which together compose manufacturing costs. These component parts of manufacturing cost may be grouped under three headings:

- (1) Materials
- (2) Labor used directly in production
- (3) Indirect expenses, or overhead costs

The details of manufacturing or production cost, composed of the classes of expenses stated above, are shown by the factory cost books. The costs appearing in detail in the cost books are entered in total, at stated periods, in the general ledger.

## Process of Cost Keeping

The main steps in manufacturing for which an accurate accounting must be made are as follows:

- (1) The purchase and storing of materials and supplies and their issuance to the producing departments as required.

(2) The manufacturing processes through which the product must pass, the accounting for which involves not only the cost of materials consumed, but also the direct labor cost, and a certain amount of the indirect expenses, applied to each unit of production.

(3) The storage and issuance of finished stock.

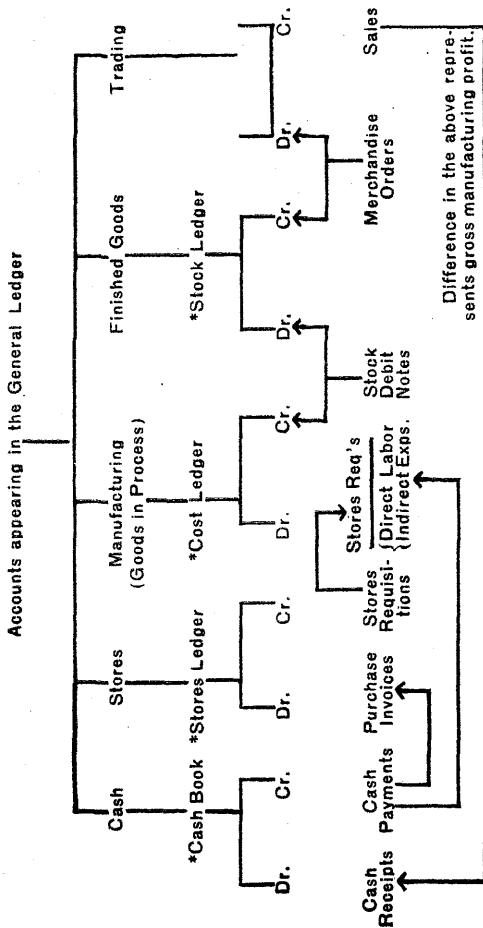
### Relation Between Cost and General Books

Corresponding to each of these divisions, we have certain factory cost books, *i. e.*, the "Stores Ledger," the "Cost Ledger," and the "Stock Ledger." The relation of these cost books to the general commercial books is shown by the diagram on page 15.

In explanation of this diagram and to illustrate the operation of the books, let us suppose that a certain sum of money is disbursed for the purchase of materials, labor, and other supplies and services connected with the production of the goods. This, in the ordinary journal form, would be represented by the entry:

Materials	}	Dr.		
Labor				
Indirect Expense				
			To Cash	Cr.





*Diagram 2. Relation of Cost Books to Commercial Books.*

By this entry the accounts costing the business value are debited, and the account which has produced value, viz., cash, is credited. In a small business this method of accomplishing the result might be satisfactory. In a large business, however, there are numerous transactions involving these accounts which occur every business day. If these were to be separately recorded in the journal, the work required and the expense involved would be out of all proportion to the results obtained. To avoid this labor, transactions of a similar nature, when there are many of them, are brought together in one subsidiary record, and the totals only are posted to the ledger. Thus there is usually a book devoted to the detailed recording of cash receipts and payments, while the general ledger cash account is concerned merely with the totals. Likewise the "Stores Ledger" contains a number of accounts—usually kept upon cards for convenience in handling, or else in loose-leaf books—whose totals appear in a general ledger "Stores" account. If, then, a certain amount of money should be paid out for the purchase of stores, the cash book entry expressing such transaction is as follows:

Stores or Materials, Dr.

To Cash Cr.

Both the stores item and the cash item find their way to the general ledger in totals. The stores item also appears in the stores ledger in detail, being taken from the original purchase invoices. When the stores purchased, after having been received and placed in the storeroom, are requisitioned and delivered to the producing departments, there must be a credit to the Stores account for the value of the quantity delivered. This credit is offset by a debit to the general ledger account which controls the costs of goods in process—designated on the diagram as “Manufacturing Account.”

In the course of a day, the stores issued to the producing departments will be consumed on many orders in process, so that from the factory standpoint it will be necessary to make entries in each of the individual cost accounts representing the orders in process. The aggregate of the material costs so assigned appears in the general ledger in the Manufacturing account, for it must be borne in mind that, generally speaking, a system of factory accounting does not reach its highest efficiency unless there is this control exercised by the general ledger over the balances of the subsidiary ledgers.

When the goods are finished they must be

transferred on the books to the finished stock department. This is conveniently accomplished through the medium of a voucher designated as "Stock Debit Note." There will, of course, be many orders continually passing through the manufacturing processes into the finished stock department. The subsidiary book entries which record the finished orders so transferred serve to credit the cost account representing each order in the cost ledger, and to debit in the stock ledger the particular finished goods account to which the goods belong.

As in the case of the issuance of stores, so in the case of the transference of finished stock from the factory, there must be an entry on the general books to record such transfer. This entry deals with the totals of the corresponding entries in the subsidiary books, and its effect is to debit Finished Goods account in the general ledger, and credit Manufacturing account.

All finished goods on hand are usually available for sale. As soon as an order is received from a customer for the delivery of a certain kind and quantity of goods, entries must be made in the stock ledger crediting the account to which the goods were charged when they were placed in finished stock, and a similar entry—in totals—crediting Finished Goods

account in the general ledger. The goods which have been sold are debited to an account in the general ledger which may be designated as "Cost of Sales."

Accompanying each shipment of goods there is a "Sales Invoice," on which appears the price at which the goods are charged to the customer and the total amount of the sale. A record of each sale is made in a sales book, debiting the account of the customer and crediting the Sales account—in totals—with the selling price. The difference between the cost of goods sold and the amount charged to customers as shown by the Sales account must therefore be the gross manufacturing profit. When money is received from the customer in payment of his account, there is a debit to cash for the amount paid, offsetting a credit to the customer's account.

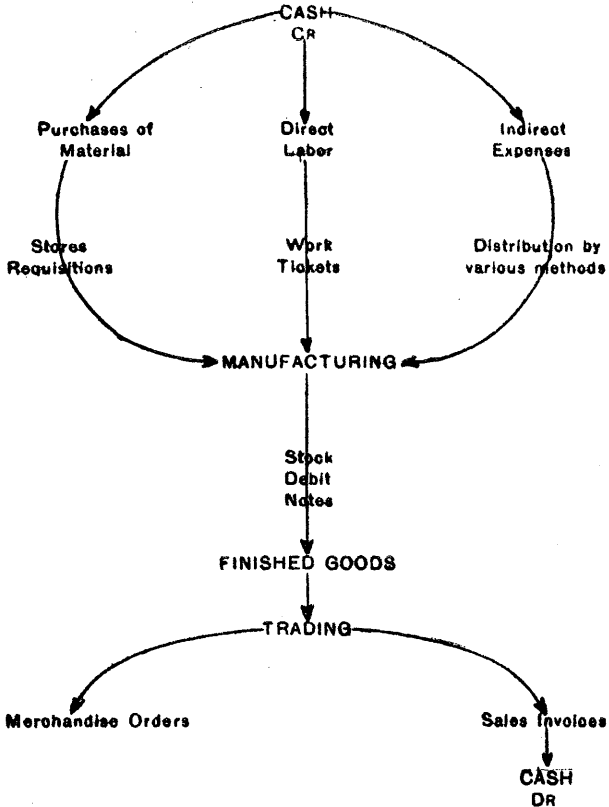
### **Conversion of Values in Manufacturing**

The progress of factory work as it appears in the books may be illustrated by the diagram on page 20, which shows the operation of a factory cost system from the time payment of cash is made to begin production until the goods have been completed and are available for sale.

### **Advantages of Cost System**

The manufacturer who has his factory cost system

## FACTORY COST KEEPING



**NOTE**—The difference between the total Merchandise Orders appearing on the Debit side of the Trading Account and the Sales Invoices represents gross manufacturing profit.

*Diagram 3. Operations of a Factory Cost System.*

arranged on this general plan is in a position enabling him to adjust his selling prices so as to bring to him the largest amount of profit.

He possesses a cost system organized along the same lines as his system of factory management; a system economical of operation, accurate in its results as to current operations, and one from which estimates or bids on future work can be accurately and quickly made. By a subdivision of his sales account into the different classes or grades of goods manufactured, and by carrying corresponding cost accounts, he can accurately determine the cost of producing each line of goods and the profit or loss on each grade sold.

We have seen that the factors which enter into the manufacturing cost of any product can be grouped under the main headings of "Stores," "Direct Labor," and "Indirect Expenses." We are now in a position to take up each of these in the order given, and to show the method of determining the amount and value of each. At the same time, we shall see how to detect and prevent waste and leaks, which are important items to the manufacturer from the standpoint of profits.

## CHAPTER II

### ACCOUNTING FOR STORES

#### Stores Records

Subsidiary records constitute one of the distinctive features of a really effective system of cost accounting. The difference between modern systems of factory cost keeping and a system of accounts not including subsidiary cost records, can be clearly shown by the respective methods of handling stores.

In a business which does not keep stores records, the inventory at the beginning of the period is used as a starting point in order to find the cost of materials consumed. To this amount is added the cost of the purchases during the period, which gives the total amount available for that period. If from this amount there is deducted the value of the materials on hand at the end of the period—ascertained through actual inventory of the stock on hand at that time—the difference is supposed to be the cost of the materials consumed. Whether this is true or not depends on the accuracy of the inventories, and



on the absence or presence of leaks resulting in shortages of material during the period. It is as if a man starting out with \$100 in money, and receiving during a given year \$1,200 more—having thus \$1,300 to spend—should keep no account of his expenditures, but, taking count of his money at the end of the period, and finding that he has on hand \$300, should conclude that he has paid out \$1,000 during the year. Certainly \$1,000 has gone in some way; but whether he has actually spent that amount and received value for it cannot be determined—it can only be inferred. Under this method there is no means whatever of knowing whether or not any moneys have been stolen or lost.

An accurate cost system, however, does not work on a basis of conjecture or inference. Starting with the inventory at the beginning of the period, the cost of all purchases is added to this, and a careful account is kept of the consumption during the same time. The balance of the accounts at the end of the period then shows the amount which should be on hand, and whether or not this is actually so can be ascertained through a physical inventory. If the “book inventory” and the actual inventory do not agree, something is wrong, and it must be traced down. If they do agree, the presumption is that there have been no leaks or other losses.

The difference in the two methods can be shown by the same illustration which we gave before. If our man starting out with \$100 at the beginning of the year should receive during the year \$1,200, and should, during the same period, actually account for payments of \$1,000, then, by a count of the money on hand at the end of the year, he can ascertain whether or not the amount called for by his record (viz.: \$300) is in agreement with the actual money on hand. If it is, he knows there have been no leaks. If it is not, he is immediately put upon inquiry.

### **Relation of the Stores Records to the Commercial Books**

If we keep in mind that any system of accounting for stores must provide an accurate method of measuring not only the purchases but the amount of stores consumed, we can better understand the relation of the stores records to the general commercial books, which is shown by Diagram 4. This differs from Diagram 2 in showing the stores records only and giving these in much greater detail.

### **Receiving Stores**

The accounting methods employed in receiving materials, as graphically shown in Diagram 4, can be illustrated as follows:

Starting from the purchase invoice which accom-

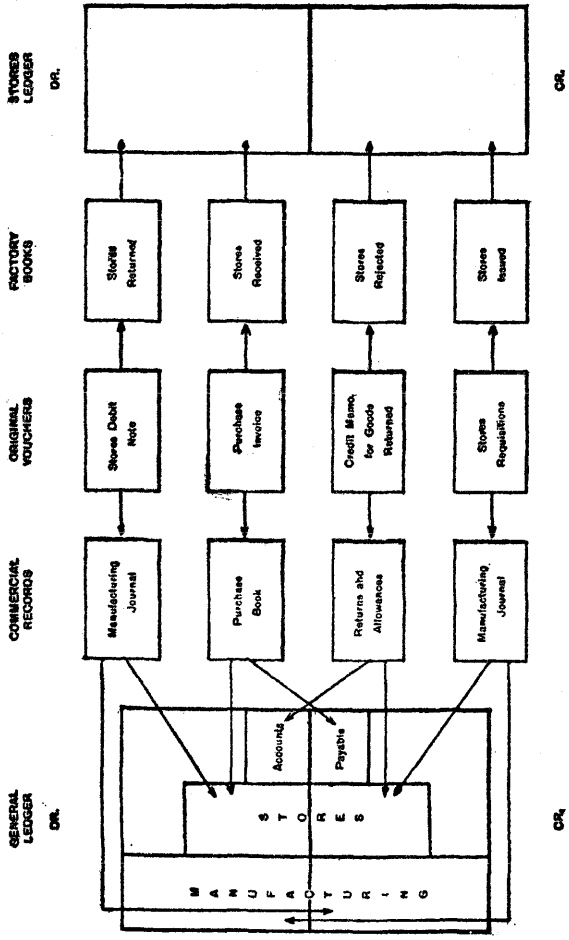


Diagram 4. Relation of Stores Records to Commercial Records

panies all goods received, an entry is made in the purchase book, or in its equivalent, the voucher register—according to the character of the record kept—the ultimate effect of which is to debit the general ledger account of “Stores” and give credit to the party from whom the goods have been purchased. Of course there would be no economy in keeping the purchase book if every purchase were posted to the general ledger as soon as it had been recorded therein, so the bookkeeper usually waits until the end of the month. He then makes his postings by totaling the columns of the purchase book, and posting to the debit side of the Stores account in the general ledger the total cost price of all goods purchased during the month, an equivalent credit at the same time being posted to the “Accounts Payable” account, which in like manner controls the individual accounts of the creditors—kept in a creditors’ ledger, not shown on the diagram. The creditors’ ledger, which is subsidiary to the general ledger, is posted daily from the purchase and cash books. The reason for this is that the bookkeeper is enabled thereby to ascertain at all times the exact status of each creditor’s account, without the necessity of posting the general ledger.

In the stores department, each purchase invoice—after being checked up with the goods which it

accompanies—is entered in a “Stores Received Book,” from which it is posted to the debit side of its proper account in the “Stores Ledger.” Often-times it happens that the materials received are not up to the required standard, so that some of them must be returned to the vendors. In such a case it is better to allow the original invoice to go through in the ordinary way, and then, on the basis of a “credit memo. for goods returned,” to make a record through both commercial and factory books, reversing in part the entries made at the time of purchase. On the commercial side, an entry is made in a “Returns and Allowances Book,” the effect of which is to debit the account of the creditor and credit the “Stores” account. In the stores department, an entry is made in the “Stores Rejected Book,” from which it is posted to the stores ledger as a credit to the material accounts concerned.

### **Issuing Stores**

Having traced the materials coming in from and returning to outside parties, let us now take up the materials as they are issued from stores for use in the producing departments. The vouchers on which all stores are issued originate in the producing departments, or else in the cost office. They are known by several different names, but “Stores

Requisition" is a common term. A specimen of such requisition is submitted on page 29.

As the stores requisitions are presented to the storekeeper, he issues the materials called for, ascertains the price of the goods, and extends the amount on the requisition. Entry is then made by him in the "Stores Issued" book, from which postings are made to the credit side of the various stores accounts involved. At stated periods, generally monthly, the storekeeper renders his report to the general office, showing the numbers of the stores requisitions honored by him during the period, together with the money value of the stores issued on each. The total of this report is the basis for a journal entry which debits Manufacturing account and credits Stores account in the general ledger.

### **The Production Order**

A "Production Order" is a formal written or printed order used by manufacturing concerns to authorize definitely the manufacture of the specified goods or articles. To ascertain accurately the cost of each order or lot of goods, a production order account is opened in the cost ledger for each and every order. These accounts are usually designated by numbers corresponding to the numbers of the production orders.

**COST DEPARTMENT  
STORES REQUISITION**

No .....

Use this Requisition to report stores withdrawn or returned to store-room, blacksmith store or any other shop store.

PIECES	MATERIAL	DESCRIPTION OF ARTICLES OR WORK	WEIGHT	PRICE	AMOUNT

Material Received by .....

Order No. ....

Material Delivered by .....

Date

Credit .....

Charge .....

Charge .....

..... Stock Clerk.

*Diagram 5. Stores Requisition.*

As the work of manufacturing progresses, all materials requisitioned for a particular order are charged to its account, as is also all labor expended on it, and its proportionate part of the overhead charges. Thus it is possible, when the goods are finished, to tell their cost by the debit balance in the corresponding production order account.

### **Stores Debit Notes**

It happens sometimes that stores are issued in excess of the requirements of the order. In such cases it would not be right to use the surplus on another order without first making the necessary adjusting entries on the books. Otherwise it is plain that the original order would be charged with more than its share of the material cost. Therefore, to keep the records in agreement with the facts, a "Stores Debit Note," or similar device, is used to return to stores such materials as may have been issued in excess of the requirements of any one order in process. These notes are turned in to the storekeeper and are entered by him in a "Stores Returned Book," from which they are posted to the debit side of the stores ledger accounts involved. The general effect on the storekeeper's records is to increase the amount of material shown to be on hand in the accounts affected by the returns. On the commer-



cial side a journal entry is made—usually covering all notes issued during a month—which debits “Stores” and credits “Manufacturing” in the general ledger.

### **Designating and Arranging Materials**

In devising a system of accounts for a storeroom it is of prime importance that some method of designating goods subject to requisition be adopted which shall be short and accurate, and at the same time provide a means of quickly finding the various accounts in the stores ledger. In order to accomplish this, various systems of account numbers are used, so as to avoid a long detailed description of each kind of material handled, special numbers or letters being associated with each stores account.

One of the best systems of account numbers in use is that known as the decimal system, which is the invention of Melvil Dewey, formerly Director of the New York State Library. As the name of the system implies, it is founded on the use of the decimal point. All figures to the left of the point refer to the various major classes of materials handled. For instance, if the plant uses not more than nine main classes of materials, then to each class is assigned a single place number. If there should be more than nine general classes, then the

numbers indicating them should run from 1 to 99, two places instead of one being assigned to the main classification. Numbers to the right of the decimal point indicate the size, grade, etc., of the material called for by the number to the left. As there is a possibility that the point may be omitted or overlooked in posting, some manufacturers use an o in its place.

In those cases where the kinds of materials are so many that they cannot readily be covered by a series of numbers, a modification of the decimal system may be used. This modification consists in assigning letters to the major classes of materials, and indicating the character of such materials by numbers to the left of the decimal point or cipher, while numbers to the right are devoted to the size, grade, etc.

To illustrate the working of this system, suppose the letter "A" is used to indicate a general class of iron, while the number "3" represents the subclass of rivets. Then, if we indicate the length of the rivet by the first number to the right of the decimal point or cipher, while the second number shows the thickness, and the third number the character of the head, we can represent iron rivets, two inches long by five-eighths of an inch thick, with round heads, by the following simple number: A30642. Here we

use 0 in place of the decimal point, and do not use the figures to the right in their ordinary numerical significance, but according to a prearranged code. The advantages of such a system can hardly be overestimated. It saves time and space, and avoids, in great measure, clerical errors. The system as outlined is elastic, and can be used in cases where the material is divided into a few classes, as well as in those where the material is very complex and the number of classes is consequently enormously increased.

If, finally, the material is arranged in the store-room in a definite order, corresponding to the account numbers, the economy is apparent in the promptness with which it can be found and issued when called for, and the ease with which an inventory can be taken.

### **The Stores Ledger**

Having our material properly arranged and the account numbers assigned, the form of the stores ledger account is next to be considered. In speaking of the stores ledger we must not have in mind a bound book with ruling similar to that of the ordinary double-entry ledger, but a loose-leaf file, or more frequently a card ledger. A typical stores ledger sheet or page is illustrated by the following:



It will be noticed that space is provided for the account number—or, as it is sometimes expressed, the stores symbol—also for the description of the article, together with the quantity to be kept on hand. This latter varies with the demands of the business, and is determined by the purchasing department. In some industries it is necessary, in order to provide properly for work in advance of the demand, that certain materials be apportioned or set aside out of stores. In cases of this kind a stores apportioned column is used, and as stores are apportioned they are deducted from the available stores, and placed in the apportioned column. The several columns of the account will then show at all times the balance of stores ordered and not yet delivered, stores on hand in the storeroom, stores apportioned, and stores available. A reading of the instructions appearing at the top of the stores sheet will give a good idea of the method of handling materials received and issued.

### **The Tally Card**

In connection with the stores ledger card or sheet the “tally card” is used. This is a card or tag which is attached to each shelf or bin containing materials, one card being devoted to each kind of material. As material is placed in the bin or on the shelf, notation

should be made on the tally card, and as material is taken out note should also be made. The balance of the tally card, which is kept by quantities only, should be in accord with the stock on hand, and also in balance with the quantities called for by the stores ledger account.

### **Bill of Materials**

In order that the storekeeper shall have on hand sufficient materials for issuance to the producing departments when requisitions are presented, he should be informed in advance of the probable requirements. In some concerns, as soon as an order is received which calls for production, a bill of materials is prepared showing the total requirements from stores. A copy of this is sent to the storekeeper so that he may have opportunity, through requisition on the purchasing department, to provide any materials lacking.

### **Keeping Up Stores**

As regards the handling of stores Mr. John R. MacNeille\* says: "When the business is well established and the sales are fairly closely estimated as to their quantity, it is possible to establish an 'order quantity' for the material used in the factory toward

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\* *Business World.*

the production of the finished product. This order should designate specifically a certain quantity to be ordered of the material in question at each order period, or at any time when the stock in question reaches a minimum, or reaches the order limit. Some concerns designate it as the 'low' limit. In cases where it is possible to establish an 'order quantity,' record should be made of this on the tally record and on the ledger card, which should also indicate the low limit of the stock of that particular shelf or bin. Under these conditions ordering becomes very simple, the storekeeper having only to make out the requisition on a list or an individual slip, or the standard order, whenever stock on hand, as shown by the tally card and as verified by the quantity on the shelf or in the bin, approaches the low or minimum limit.

"Where it is impracticable to establish arbitrary amounts for reordering, it is always desirable, and, generally speaking, practical, to establish low limits or minimums of material in stock. In such case the storekeeper will ascertain from the tally cards and from the office ledger cards, if he has ready access to them, the rate of consumption during the time which has elapsed between the ordering of the material and its receipt, and any special requirements in view of needs for any specifications received for

jobs in process. With this as a basis he uses his own judgment and discretion in the ordering of a new supply of material, which he estimates will last a certain length of time, as shown by the record of the preceding period of months. It is rather hard to generalize, because in some systems the storekeeper will receive, as soon as an order is placed in the works, a detailed requisition for the material that is required for that order, and he can then readily ascertain if the material required as per the specifications in hand will drain his present stock below the minimum limit after this material has been taken out and is used for the production of the finished product.

“Some systems will keep on the ledger card a record of what material the storekeeper has ordered and when he has ordered it, so that on consulting the ledger card there is information concerning not only the present stock on hand, but also the date and quantity of the order that has been previously placed for the replenishment of that stock.”

### **Inventories**

Closely connected with the operation of the store-room is the important matter of the inventory. The agreement of the actual inventory—determined by a physical inspection, count, weight or measure of



the materials on hand—with the book inventory, determines whether or not there have been any leaks in stores, due to theft or other loss, or to the failure to make proper record of materials received or issued.

The accounts carried in the stores ledger aim to show by their balances the quantity and value of all material on hand at any given date. The trial balance of this ledger is known as a book inventory, and sets forth the quantities and value of all material on hand.

The advantages of a continuous book inventory over an actual one taken at stated times are more apparent in those cases in which the keeping of the stores or material records is an integral part of the accounting system. In such cases the expense connected with the preparation of a book inventory is obviously less than that connected with the taking of an actual one. The taking of an actual inventory is attended with many troubles, first in getting a record of the materials and supplies on hand, and afterward in looking up prices and making the necessary adjustments.

On the other hand an actual inventory is less liable to clerical error; also some material is not covered in a book inventory. For instance, it is not customary to carry materials of great bulk, such as

coal, stone, etc., in a book inventory. Also an actual inventory will cover many miscellaneous supplies, parts of machinery, etc., which are not ordinarily found in a book record.

The liability to clerical error which exists in a book inventory should be minimized as far as possible by comparison of the book inventory with an actual inventory at frequent periods during the year. The best time for such verification of the stores ledger accounts is when the minimum limit of the stock which must be kept on hand is approached. Not only is the taking of the inventory lighter at this time, but an actual inventory serves to determine accurately whether or not a new order for more material shall be placed.

### **Reconciling Inventories**

Very often the actual inventory will not agree with the book record. In many cases the reason for this can be traced to the breaking up of bulk packages in order to issue to the producing departments the exact amounts called for by their requisitions. For instance, in the manufacture of paper large quantities of sulphur are used. The amount shown by the stores requisitions to have been delivered to the manufacturing departments is usually much less than the quantity actually de-

livered, largely because of the loss in breaking up bulk shipments. Part of such differences is usually due to evaporation, deterioration, loss of weight or damage in handling, etc. Again, in the case of a keg of nails, the stores requisition will show that 140 pounds of nails have been used, whereas 150 pounds have actually been withdrawn from the stock. The difference is due to the small overweight or surplus which is almost inevitably added to each pound weighed out.

In view of these differences a book adjustment of some kind becomes necessary. In those cases where the difference is small the best method is to make the necessary adjustment on the tally card, by correcting the quantity to correspond with actual conditions. At the same time the quantity item in the stores ledger account is similarly corrected as to quantity, but no change is made as to the book value of the stock on hand. Any quantities withdrawn after this adjustment has been made will therefore be charged to the production order at a slightly higher unit cost than formerly prevailed. Thus, for example, an account with a certain type of bolts, the purchase price of which is 1 cent apiece, shows, before the correction is made, 100,000 bolts with a book value of \$1,000. The actual inventory, however, shows

that there are on hand only 99,600 bolts. The quantity on hand is corrected, therefore, to read 99,600, but the book value remains as formerly, at \$1,000. If 1,000 bolts are now withdrawn by requisition, they will be billed, not at \$10, as formerly, but at \$10.04. It will be noticed that the correction of the inventory by this method involves no changes on the general books.

In the case of a large difference, however, it is not advisable to use the above method. Any difference involving large quantities should be looked up immediately and investigated, for there is a possibility that instead of having been due to a clerical error or a difference occurring through an honest mistake, it may have been caused by stealing on the part of dishonest employees.

Pending an investigation, the discrepancy—if it represents a loss—should be taken out of the stores ledger through a commercial journal entry, crediting stores for the amount involved, in order to adjust the stores account, and debiting an account called "Inventory Adjustment." An entry is made at the same time in the stores ledger to the credit of the stores account involved. The balance of the Inventory Adjustment account in the general ledger will show at any time the amount of money paid for materials, for which

there is nothing to show. At the end of the fiscal year this balance is closed out to profit and loss as an item of general expense. It has no place as a cost of production. If it were to be considered as a cost of production, then there would be no use whatever in attempting to ascertain costs by a record of material consumed. It would be as if we took stock, and charged the difference between purchases plus previous inventory and the results disclosed by subsequent stock taking as the cost of materials consumed, with no assurance that such really had been the case.

## CHAPTER III

### ACCOUNTING FOR LABOR

Under the discussion of stores, it was shown how any lack of adjustment between the book inventory and the actual inventory was corrected by means of the general ledger "Inventory Adjustment Account." A similar comparison must be made to show the difference between the labor paid for and that actually expended on goods in process.

#### **Materials and Labor Compared**

One great difference between the handling of materials and the handling of labor must be borne in mind in order to understand thoroughly the difference in the methods employed to record their costs. All materials, from a bookkeeping standpoint, are paid for as soon as they are received. That is to say, when materials come into a plant, the entry recording their receipt is a debit to

"Stores" and a credit to cash—or to the party from whom they have been bought. This credit represents a giving of value, for it is a liability of the purchaser for the amount of the purchase. As regards labor, however, the rule is different. Labor is never paid for until it has been consumed by the employer, nor is there a liability shown on the books for wages due until some work has been performed by the wage earner. Consequently there is no inventory of labor, such as we have in the case of stores. The cost of all labor, as rendered, is charged to the cost of goods in process of manufacture. Therefore there is no stock record of labor on hand.

### **Methods of Recording Time**

The chief problem in the accounting for labor is the formulation of a system which will give an accurate record of the labor time consumed in production.

Until recently, in many factories, the watchman or gatekeeper, stationed at the entrance to the factory, kept a record of the employees as they arrived in the morning and departed at night, each workman being known to him personally. Under this system, if an employee were late, even if only as much as a minute, he was docked a half

hour's time. Any labor cost less than half an hour did not figure in production costs. The gatekeeper's record was amply sufficient for payroll purposes, as well as for the determination of costs of production in the aggregate.

Under another system of time keeping each laborer was assigned a number. A series of brass checks, numbered to correspond to the workmen's numbers, were hung on a board at the gatekeeper's lodge or outside the watchman's office, and as the men entered in the morning each one would take his own check off its hook and drop it into a box kept for that purpose at the watchman's office. The board on which the checks were hung, being arranged on a pivot, was turned around when the beginning whistle blew so that the side containing the checks faced into the office. Any man who was late must then pass through the watchman's office before he would receive credit for having been at the plant. This scheme worked well as long as the watchman was careful not to let any man drop the check of a comrade at the time that he dropped his own.

The weakness of both these systems lay in the fact that there was no check whatever on the time the men actually spent at work. A man might register for an absent comrade, or he might record



his own arrival and then take his departure from the plant by climbing over the back fence, returning by the same route at noon in order to pass out through the gate. By this means he would receive credit for having worked a full half day, when as a matter of fact he had rendered no service whatever to his employer.

In order to prevent such practices, which even today are not infrequent in plants which do not have a thorough system for checking labor time, it was found necessary to employ departmental timekeepers, whose duty it was to make a tour of the plant to ascertain whether each man was at his appointed task.

It was soon recognized that a knowledge of the exact time spent by each man on a piece of work handled by him was not only desirable but necessary, in order to determine accurately the labor cost of each unit of product. This was accomplished by the timekeeper getting from each workman a statement of the time spent on different pieces of work; and the results of these rough guesses were used to compile the labor cost of work in process.

The employment of departmental timekeepers was an added expense to the operation of the plant. It was not long, therefore, before this

work was shouldered onto the foremen of the various divisions of the factory. This was, in many cases, putting too much work on the foremen, and seriously impaired their efficiency as superintendents of men and as overseers of the work. The next development was to have the men themselves keep their record of time spent on each piece of work. The results were set forth on slips which were turned into the office, where the time as shown was posted to the accounts of the various orders to which it belonged. This, as can well be seen, was a loose system, for the reason that the workman's sense of time was frequently not well developed, and there was neither incentive nor necessity for accuracy. Since there was no definite check on the workman's movements, his record would often show that he "knocked off" at 12:30 P. M., when as a matter of fact he quit work at 12:20 P. M., and loitered around the toilet room or engaged in conversation with other workmen for the extra ten minutes which had been charged by him to the work just finished.

These difficulties have been largely overcome by the use of mechanical devices for the recording of time. One record is made of the total time on duty, which serves as the basis for the pay-roll, and a second record is kept of the time actually

expended on work performed, which serves as the basis of the charges to manufacturing cost.

The time on duty is obtained from a time card record, while the time on work in process appears on work tickets or job cards. The total time on duty should agree with the total time expended on goods in process, plus any lost time.

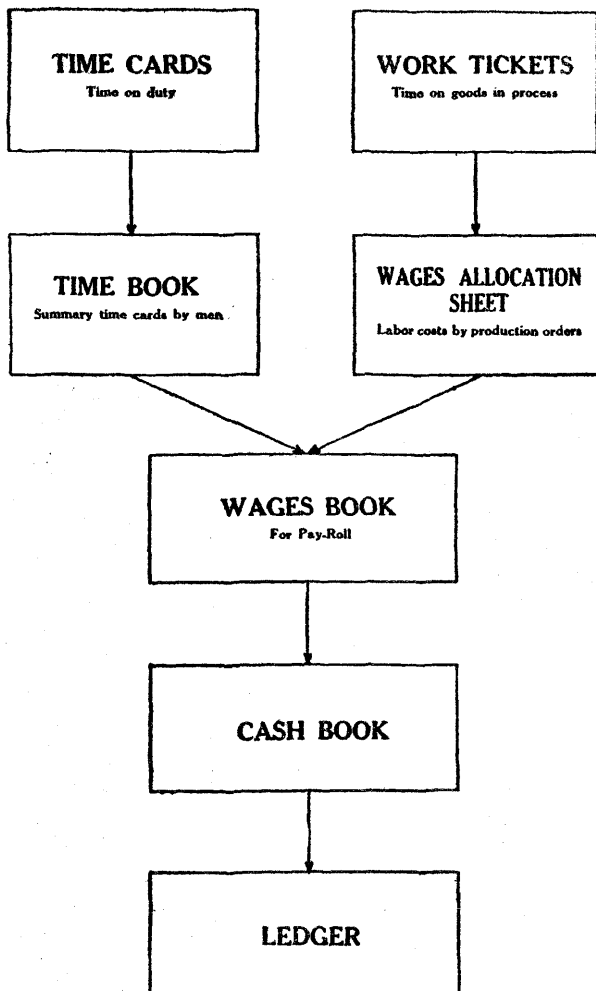
Expressed diagrammatically the relation of the time cards to the work tickets is shown on page 50.

### **Piece Work**

While the modern system of recording labor costs is a great advance, "soldiering"\* is still entirely possible, and cannot be prevented unless there is some limit placed on the amount of time within which a certain amount of work must be performed. It is obvious that soldiering under a time system leads to direct loss to the employer, because the labor cost to do a given piece of work is higher than it should be. To prevent this loss, the piece work system of payment was devised. This eliminates the undue labor costs, but it does not completely solve the problem, for loss is still incurred by the employer if his employee "soldiers." This is due to the fact that a large

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\* **Soldiering** is a term used to express the loafing of a workman over his work.



*Diagram 7. Relation between Time Cards, and Work Tickets.*

part of the cost of manufacture is made up of other costs, as for instance power costs and interest on the investment where machinery is operated by the workman. If the employee dallies, the machine time required to complete a given job is considerably lengthened, thereby increasing the proportionate charge for the use of the machine which must be made against the particular job in question. It is easily seen that the greater the volume of work obtained from a machine, the smaller will be the proportion of interest, rent and maintenance which will have to be charged to each unit of output.

### **Towne-Halsey Plan of Wage Payment**

There are several plans for determining the proper time limits for regular work, among which may be mentioned the Towne-Halsey plan. Under this plan a record is obtained of the quickest time in which a job has been done, and this is fixed as a standard for similar work.

If the workman succeeds in accomplishing his assigned task within a shorter time than the standard limit, he is paid the same hourly rate as before, and in addition receives a premium consisting of a percentage of the difference between the wages actually earned and the amount which

would have been paid if he had taken the full time allowed. Let us suppose, for instance, that a workman receives 20 cents an hour; that he is assigned to a piece of work whose standard limit is two hours; that by working fast the job is finished in one hour, and finally that the premium is 50 per cent. Under these conditions he would receive for his hour's work the regular rate of 20 cents plus 50 per cent of the one hour earnings under the standard limit, or a total of 30 cents for his work of one hour. The weakness of this system is that after it has been installed and the workmen become familiar with the plan, the inducement to soldier on any new work which may be undertaken is great. By loafing over the new task, a longer time limit is secured as a standard, and the workman is thereafter enabled to earn higher wages with moderate effort.

### **Taylor Premium Plan of Wage Payment**

A better system for determining time limits is that devised by Frederick W. Taylor, of Philadelphia. His system aims to have the time standard determined with scientific accuracy, and for this purpose he divides any given piece of work into its elements. The time which is consumed in performing each operation is measured by a stop

watch. Suppose we take, for example, a man loading brick on a wagon. Each component part of the operation is first timed. The time consumed in stooping over to pick up the bricks or to arrange them in a pile for carrying, the length of time spent in piling them, or even the length of time it takes to lay one brick in a pile, may be taken as a unit of time. Then a compilation is made of the time consumed in lifting the bricks after they have been piled, the time per foot of carrying them on a level piece of ground, or the time it takes to make one step on level ground. Also the time it takes to throw down the bricks, or to arrange them in the wagon, if this is done, is ascertained. Finally the time of returning to the place of starting for another pile is determined. From a total of the time of the various units can be obtained an accurate time limit for the operation as a whole.

If the time so ascertained be taken as the basis for loading brick on a wagon, then for work of this character there is a definite amount of time within which it is possible to load a certain number of bricks. To the actual time thus determined should be added about 10 per cent to allow for unavoidable delays, and the result will give the time to be insisted on in all cases.

The advantage which Mr. Taylor's system has over the Towne-Halsey plan is that if any new work is assigned to the men, a knowledge of the unit cost of such work can be had in advance and the standard time can be accurately calculated therefrom. To refer again to our illustration of the man engaged in loading brick on a wagon. If he had to walk 50 feet farther, on a new job, it is possible, by knowing the length of time that it takes to walk a given number of feet, to readily calculate the additional time which should be allowed to do the work required.

The inducements to work under Mr. Taylor's system can be summarized under two headings: first, the increased amount which a workman can earn, if he is thoroughly efficient, by cutting down the time assigned and thus earning a premium; and, second, dismissal of the workman who, within a given time, cannot earn the minimum rate. In one large manufacturing plant in Philadelphia it takes the workman about two weeks to secure the necessary proficiency to earn the minimum rate, and if the rate is not reached in that time the man is discharged. This plant, after installing the Taylor system of time limits, increased its output over 100 per cent without any increase in labor costs.



### **Time Recording Devices**

Having based our labor system upon a series of time limits, let us now see how it will operate in practice. One of the best mechanical devices for recording time is a card time clock. Not only does it give a complete record but its capacity is not limited, as are the clocks arranged for a specified number of employees. The best location for such a clock is in the workroom. In large concerns one clock, with complete equipment, ought to be provided for each department. This prevents any loafing on the way from the factory entrance to the department in which the employees work.

The equipment of a card time clock for purposes of cost keeping should include four card racks, two located on either side of the card clock itself. To the right of the card clock should be the "OUT" racks, while the "IN" racks are placed to the left. One of the "OUT" racks is arranged for the pay-roll or time cards of the men when not at work, while the other contains the work tickets for jobs ahead. One of the "IN" racks is used to contain the pay-roll or time cards of the men actually at work, while the other is used for the work tickets representing jobs in operation. To the left of the clock and below the "IN" racks

should be placed a "Job Ticket" box, which is provided with a glass front and a slotted cover. This box is divided into two parts, one for suspended jobs and the other for finished jobs.

As a practical illustration of the operation of a card time clock, we will assume that such a device, together with its equipment as described above, has been installed in a department which employs 20 men. On the day previous, the foreman has filled out one or more job tickets for each employee in the department. These tickets show the workman's name and number, and specify what particular work is to be performed by him on the job, which is indicated on the ticket by its production number. These job tickets are placed, one for each man, in the "OUT" rack in the portion placarded "Pay-Roll Cards." A similar ticket for the next job on which each man is to work is placed in that portion placarded "Jobs Ahead."

Along with the job tickets which have been placed in the pay-roll card portion of the "OUT" rack, each workman finds upon his arrival a weekly time card. When workman Jones, for instance, arrives in the morning, he takes his time card and the job ticket, which he finds in the pocket bearing his number in the "OUT" rack, as above set

forth, and records his time of arrival on both tickets by placing them in the clock and "ringing in." The time card is then placed by him in that portion of the "IN" rack devoted to the pay-roll cards, while his job ticket is placed in the "Jobs in Operation" rack, as soon as he has ascertained just what is required of him in connection with that particular job.

Upon the completion of the operation specified on his job ticket, Jones goes to the recorder and "rings out" on the job ticket in question. He then places the completed job ticket in the "Job Ticket" box, in the portion headed "Finished Jobs." He then takes from the "Jobs Ahead" rack his next job ticket, rings it in, and carries on the operation as called for until he either completes it or goes to lunch. In the former case he proceeds as already outlined, while in the latter case he will ring out on both the job ticket and the time card, and place them in the "OUT" rack until his return.

The foreman keeps in touch with the progress of the work in the department by noting the cards which have been placed in the "Job Ticket" box. Such tickets are removed by the foreman and placed in his office in a special cabinet, in which all job tickets are arranged according to the work-

men's numbers. An examination of the tickets in the "Job Ticket" box indicates to the foreman the workmen for whom new jobs should be supplied. The "Jobs Ahead" rack is accordingly replenished by the foreman from the supply of job tickets kept by him in his office.

Should it become necessary, for any reason, to suspend operations on a job, the workman will ring out on his job ticket and place it in the "Job Ticket" box through the slot designated "Suspended Jobs." Upon its removal by the foreman, he can again place it in the "Jobs Ahead" rack for the workman in question, or can transfer the job to another employee, at his discretion. In the latter case he will fill out another ticket, bearing the number of the employee who is to perform the work indicated on the job ticket.

As above mentioned, the "Finished Jobs" cards, as collected by the foreman, are filed by him according to the workmen's numbers. At the end of each day representatives from the cost department compare the total time of each man as recorded on the job cards with his time as shown by the time card. These, of course, should agree. In case a difference exists, the cause can be easily traced either to neglect on the part of the foreman to provide work in advance, or to a failure

to credit the workman for work performed. In either case it is not just to the work in process to charge such lost time as an item of production cost.

### **Recording Labor Costs**

The method of recording labor costs on the books, so that any discrepancy between the work paid for and the cost of work actually performed can be easily shown, is accomplished as follows:

After the comparison of the job cards with the time cards, the former are taken to the cost department, where they are sorted according to the production orders worked upon. The daily totals, after being summarized on a summary card, or sheet, are posted to the debit side of the various cost accounts in the same way that materials consumed are posted from the stores requisitions. A statement is then prepared showing the total amount of labor costs for the day in all departments. At regular intervals—usually monthly—this total is entered in the journal and then posted to the ledger as a debit to Manufacturing account, which, as we have seen, is the controlling account of the cost ledger, showing the total cost of goods in process at any given time. The offsetting credit is made to Labor, or Pay-roll ac-

count. This latter account shows the **amount** owing to laborers for work performed.

### **Paying the Workmen**

At the end of each week the weekly time cards are collected, and the amount of pay for that period in the case of each man is calculated and extended. From these cards the pay-roll is made up; and the cards are returned to the racks on pay day so that the men may get them for pay-roll purposes, and may at the same time have opportunity to see that the extensions have been properly made. Each workman signs his name on the back of his card and presents it at the paymaster's window, where he receives his pay.

In the meantime the total as shown, by the pay-roll, which has been certified to by the superintendent, forms the basis for a cash book entry crediting cash for the check drawn on the bank for pay-roll purposes, and debiting, in the ledger, Labor, or Pay-roll account, which previously has been credited with the total of the work tickets showing the amount of labor charged to the goods in process.

The method of paying the men just described is usually regarded as the best in use, embodying as it does all the approved checks on the amount

paid, including receipts from the men for the moneys received. As stated, the workman signs the time card for the amount of his last week's work which is shown thereon, and presents it at the window to be cashed, in the same way that a check is presented for cashing at a bank. He thus gives his receipt for his money, and at the same time can see whether the money received is the amount he has receipted for. Under such circumstances he can have no subsequent claim for alleged shortages, as sometimes occurs under the envelope system. The envelope system, even at its best, must be hedged about with so many safeguards that it is liable to produce increased expense.

### **General Ledger Labor Account**

It can be readily seen that after the pay-roll has been made up and the entries posted from the commercial side—that is to say, the cash book—and the factory side—the manufacturing journal—into the "Labor" account in the general ledger, both sides of this account should be in balance. If, however, any difference should exist as between the amount of labor paid for and the amount of labor charged to goods in process, such balance will show up directly in the general ledger "Labor" account. Many

manufacturers do not like this account to show this balance continuously, so a transfer is made to a "Labor Adjustment Account" which shows by its balance the loss in labor.

This is exactly the same as in the handling of any difference in materials, as before shown. An inspection, therefore, of the balances of the Inventory Adjustment account and the Labor Adjustment account will show at a glance the amount of any loss in stores and in direct labor respectively.



## CHAPTER IV

### ACCOUNTING FOR INDIRECT EXPENSES

We have now to consider the third factor entering into the production cost of a manufactured article. This factor is variously designated as indirect expenses, overhead charges, expense burden, etc., and includes all costs entering into the production of a finished article, other than the direct labor and material expended upon it. Examples of indirect expenses are: insurance, rent, taxes, power, interest, depreciation, etc.

#### **Importance of Indirect Expenses**

In the early days of factory accounting manufacturers did not concern themselves with anything but prime costs, or, in other words, direct material and labor cost. All other production expenses were provided for in the amount of profit which they received over and above this cost. It soon became necessary, however, to do more than ascertain prime cost, for the general improvement in manufacturing, together with the enormous increase in the number and kinds of machines taking the place of hand

labor, steadily increased the amount of factory indirect expenses. Again, it became evident as competition increased that the results which were arrived at by taking only material and labor costs, without considering the other expenses, did not furnish adequate information for the fixing of prices. The manufacturer who sold at, or slightly above, cost figures in which indirect expenses were not considered was in reality losing money. Therefore, in order to arrive at the true cost of production, manufacturers began to distribute the indirect cost over prime cost.

### **Methods of Distributing the Expense Burden**

There are many plans by which production can be more or less equitably charged with the overhead expense, and in each plant the manufacturer has to decide which plan is best adapted to the peculiar needs of his business. Five methods of distributing expense, with minor modifications, are commonly employed. Under these expense is distributed as follows:

- (1) As a certain percentage of direct labor cost.
- (2) As a certain cost per direct labor hour.
- (3) As a certain percentage of material cost.
- (4) As a certain percentage of prime cost.
- (5) On the basis of machine rates.

Each of these methods will be taken up in turn and its operation studied.

(1) DIRECT LABOR COST.—The first method of distribution requires that the total amount of the indirect expenses be found for a given fiscal period, say one year. Next, the percentage is ascertained which this total bears to the total pay-roll of the producing laborers for the same period. To the prime cost of goods, *i. e.*, cost of materials and labor, there is added this ascertained percentage of the labor cost to produce the complete cost figures for the period. The cost of any particular article is found by first ascertaining its labor and material cost, and then adding to this a corresponding percentage of the labor cost to cover overhead expense.

This method has few advantages, and many disadvantages. The chief advantage is found in the fact that almost certainly the calculations made upon this basis will absorb the whole expense in a given time. Its weaknesses are, however, manifold. In the manufacture of many articles there is one operation dependent upon hand labor, and many other operations performed almost entirely by machinery. If the indirect expenses are distributed by a percentage of the labor cost, it is readily seen that the process dependent upon hand labor is charged far

more heavily than is the process involving machinery. This is a serious error; for the process requiring machinery, or any producing agent other than direct labor, ought to bear a higher proportion of the indirect expenses than that using little or no machinery.

But the error extends further. It exists even where hand work is entirely eliminated. The manufacture of rivets will furnish a good illustration. Two types of machinery may be used in their production. In the first type of machine, each revolution of the fly-wheel produces a perfect rivet. The second type—called a four-hammer machine—requires four revolutions of the fly-wheel to produce the same rivet. The labor cost in operating the two machines is substantially the same; yet it stands to reason that the indirect cost on the second machine is higher than that on the first because of the greater use of power and time.

A more striking illustration of the insufficiency of the percentage-on-labor-cost plan can be seen in those cases where operations of a different character are brought into contrast. A drill-press operator, receiving 23 cents an hour, completes a given piece of work in two hours. The direct labor cost is therefore 46 cents. Now if the percentage for the distribution of the indirect expenses be 50 per cent

of the labor cost, indirect expenses will be 23 cents. In contrast to this, take an operator employed in looking after a group of five automatic gear-cutting machines. The wages of such a man would be considerably less than those of the drill-press operator, say 12 cents an hour. For two hours of work our cost of labor would be 24 cents, and indirect expenses would be 12 cents, whereas the actual indirect expense is much greater than in the first case cited.

(2) DIRECT LABOR HOUR.—Under the second method for the distribution of indirect expense, the total producing hours of labor are reduced to a per man-hour basis. Assume, for example, that a plant employs 160 workmen, each of whom averages 2,700 hours per year; the total time of the entire working force will be 432,000 man-hours. If we divide this time into the total indirect expenses for the year the result will be the indirect expense per man-hour.

To the prime cost of any piece of work is added the per man-hour rate, determined as above, multiplied by the number of producing man-hours spent upon the job. The result is the total manufacturing cost.

This method is better than the percentage-on-labor-cost plan, because the greater the number of

hours devoted to the work, the higher is the amount charged for the indirect expenses, irrespective of labor cost. It frequently, however, does not furnish accurate results.

Referring again to the illustration of the "press hand," if a 23-cent man is working on a drill press for two hours, and the hourly rate for the distribution of indirect expenses is 30 cents, then the cost of labor and indirect expense for the two hours will be \$1.06. On the other hand, the man in charge of the five automatic gear-cutting machines earns 12 cents an hour, and for two hours the labor and indirect expense cost will amount to 84 cents, or considerably less than the cost of the product on the drill press. Such ought not to be the case, however, as the indirect expenses in the latter case are obviously greater than in the former, owing to the greater amount of machinery used.

(3) MATERIAL COST.—The third method for the distribution of indirect expenses provides that to the cost of material used during a given period there shall be added a certain percentage of this cost which, from past experience, is believed to be sufficient to cover the total amount of the indirect expenses. This method is the one usually adopted where the amount of machine work on each unit of production is substantially the same, whether such

unit be pounds, tons, or pieces. In all industries, however, where there is a difference in the amount of mechanical work required, or where there are different grades of product, this method will not prove satisfactory.

The manufacture of bolts and nuts furnishes us with an excellent illustration of the inadequacy and inaccuracy of this method as applied to such a business. A bolt is made by heating the end of a bar of iron or steel and inserting this in a four-hammer machine which forms the head. The bar is then cut off at the proper point, and the half-finished bolt is then inserted in a thread-cutting machine, which completes it. The total machine work required is very much less than that required in the production of a nut.

The first step in the production of a nut is the insertion into the machine of a heated iron or steel rod. From the end of this pieces are cut, and holes are punched through them for subsequent threading. After the rough blanks have been cooled they are put through a second machine, which trims them down to the right size. They are next passed through another machine, to gauge their thickness, and then sent to a drum for polishing and cleaning. They pass finally to a thread-cutting machine which turns them into finished nuts.

If we were to apply the percentage-of-material-cost plan for the distribution of indirect expenses to the manufacture of bolts and nuts, the result would be to charge the manufacture of bolts, in which the material cost is high, with an amount of indirect expense wholly disproportionate to the machine use required. In the manufacture of nuts, on the other hand, because the amount of material used is small, the indirect expenses charged will be ridiculously inadequate as a true cost basis.

But this method is unsatisfactory for other reasons. Under its operation the large-sized bolts bear a heavier amount of expense than would bolts of the smaller sizes, in which the amount of material used is considerably less. The machine work for the production of different sized bolts is, however, exactly the same.

(4) PRIME COST.—Under the fourth method indirect expense is distributed by adding to the prime cost, *i. e.*, the combined labor and material cost of the product, a certain percentage, which will in the course of a year equal the overhead expenses for that time. This method can be applied to some advantage in those businesses where the indirect expenses are more or less constant. It is subject, however, to the same objections as the methods



already discussed, in that the basis for the charge has no connection with the amount of plant and machinery used.

(5) MACHINE RATES.—The best, and at the same time most equitable, method of distributing indirect expenses is that frequently designated as "Machine Rates." This method requires the distribution of indirect expenses upon the basis of a machine, a department, or a process; and the hardest problem connected with its use is the ascertaining of the proper rate to be assigned to each machine, department, or process. This can always be done, however, if a scientific analysis is made of the various items composing the indirect costs.

### **Classification of Indirect Expenses**

For the purpose of distribution by the Machine Rate method, indirect expenses can be classified as follows:

#### **I. The Cost of Floor Space**

1. Interest on the investment in the land and buildings
2. Depreciation on buildings
3. Cost of repairs and maintenance
4. Taxes on property
5. Insurance on buildings

**II. Power Cost**

1. Interest on investment in the power plant
2. Depreciation of the power plant
3. Cost of repairs and maintenance
4. Taxes
5. Insurance
6. Fuel
7. Wages of engineers and firemen
8. Oil, waste and miscellaneous supplies

**III. Machine Cost**

1. Interest on investment in machinery
2. Depreciation of machinery
3. Cost of repairs and maintenance
4. Insurance
5. Miscellaneous supplies

**IV. Non-Productive Supervising Labor**

1. Superintendents' salaries
2. Foremen's wages

**V. Miscellaneous Expenses**

1. Crane expense
2. Watchmen's and caretaker's wages
3. Supplies and sundries

**Floor Space**

Let us now take up each of the classes of indirect expenses separately, beginning with the cost of floor space. The first item composing the cost of factory

floor space is the interest on the investment. Opinions differ as to whether or not this item should be included as a portion of the manufacturing cost. Many leading authorities, however, hold that rent ought to be included in the cost of production, as it represents an amount paid to supply the necessary instruments (of production), and if rent is included as a cost of production, it follows logically that interest on investment should also be included therein.

To illustrate, a landlord owning a factory building will require from the lessee a rent to cover not only the expense of upkeep, and all amounts expended for taxes and insurance, but also an adequate return to him on the amount of his investment. If a manufacturing company holds the dual position of operator and owner of its plant, this fact does not alter the relation as to landlord and tenant. If the manufacturing company owns its plant, the manufacturing department is in this instance the tenant, while the administrative organization occupies the position of landlord. In figuring the charge against the manufacturing department for the use of the advantages extended to it, interest on the investment ought properly to be included as an item of manufacturing cost.

This can be more easily understood if we assume

a case in which borrowed money plays an important part. A manufacturing company borrows \$100,000, of which it invests \$50,000 in its buildings and ground. The company on its administrative side pays the interest on the \$100,000 it borrowed, and if the item of interest on the \$50,000 invested in the buildings and land is not considered as a manufacturing cost, the result will be to burden the administrative side of the business with the liability for the total amount of the interest charged. The manufacturer who is content to exclude from his costs the item of interest on the investment in his property, and who, in close competition with others in the same line of business, is selling his goods at or near his final cost figures, will soon be in a condition of insolvency. Assuming, however, that the manufacturing costs do include the item of interest on the investment, the logical result is that the administrative side of the company, instead of bearing the whole interest on the \$100,000, is relieved of one-half of this burden, which is properly charged as a manufacturing cost to the producing departments.

Most of the other items included in the cost of factory floor space do not require description. It is obvious that the cost of maintenance and repairs, the amount of taxes, the cost of insurance, ought all to be included as items in the total floor space cost.

This leaves depreciation on buildings to be considered. Depreciation has been defined as: "A shrinkage in value which, in the ordinary course of events, may be expected to take place, as being a necessary consequence of the possession and enjoyment of the asset; it consequently is a charge against revenue. Fluctuation, on the other hand, arises from causes entirely outside the scope of the business, and may affect the value of its assets either adversely or favorably."

Depreciation of buildings is distinctly an element of floor space cost. The manufacturer who does not provide a certain amount out of revenue against wear and tear of his plant is overstating his profits; for at the end of the producing lifetime of his plant he finds himself under the necessity of replacing it and has no reserves for the purpose. If his book profits have been paid out to the stockholders, the result is an impairment of capital which will subsequently mean a loss of income and principal to those having funds invested in the business.

Having ascertained by the experience of prior years, or by careful estimate, the total cost of floor space for a given period of time, the manufacturer has to adopt a method for the distribution of this cost over the producing departments, or the producing agents within the department.

The unit of floor space is the square foot; and the cost per square foot may be determined in one of two ways. The first method consists in assigning to each floor in a manufacturing plant its estimated share of the floor space cost. For instance, a manufacturing building with four stories may charge the department located on the ground floor with a smaller cost than that assigned to the departments using the second, third or fourth floors. In some cases this method of assigning floor space cost is equitable; but more often we find that it is unjust to those departments which, through accident of construction, are located in the less desirable portions of the plant.

The second method for the determination of the square foot rate of cost is obtained by dividing the total floor space area of the building into the total cost of furnishing floor space, and thus arriving at the average cost per square foot. By this method no one department is preferred above any other; and regardless of special advantages of location the square foot cost is the same throughout the entire structure.

### **Distributing Floor Space Costs**

Each machine is "assessed" according to the floor space actually occupied. In order to do this equita-

bly, careful measurements must be made. The area of the floor space assignable to each machine must not be reckoned as the space actually occupied by that machine, but must include sufficient working room, as well as a certain portion of the aisle space.

Having ascertained the total square foot area occupied by each machine in a given plant, the floor space cost per machine can be arrived at by multiplying the square foot cost by the area occupied. Where departments use no machinery, the area occupied by the entire department is ascertained and this is then multiplied by the square foot cost.

### **Power Cost**

We now turn to the second general division of the indirect expenses. Power costs are made up of eight items, as stated in our general classification, the first five of these being: (1) interest on investment in power plant, (2) depreciation of power plant, (3) costs of repairs and maintenance, (4) taxes, and (5) insurance; all of which are determined according to the rules already laid down and discussed in the case of floor space. The new points are those involved in the last three items; namely, fuel cost, the wages of engineer and firemen, and oil, waste and miscellaneous supplies. These three items

represent the outlays made for the actual operation of the power plant.

These two general classes of expense, though of different nature—the first covering the return on the investment and the amount of money necessary to perpetuate it, and the second the necessary expense for producing the required amount of power—are, however, united in a single charge for power based on the horse-power consumed. If a company purchases its power from a power company, the charge is usually made according to contract rates. The basis for charging is the amount of horse-power consumed during a given period. In case the plant uses electricity, the charge would be based upon the number of kilowatt hours.

Let us take a simple illustration. A certain plant consumes an average of 2,000 kilowatt hours per day; that is to say, there are 2,000 K. W. H. of energy delivered to the mill from the powerhouse. A certain amount of this energy is lost at the motor, while still more is consumed in the friction of the shafting and the loss due to slipping of belts. Thus an actual test shows that the machinery receives and consumes only 1,900 K. W. H. of energy. In determining the cost, however, the accounting department will take the



actual consumption of power by the machinery and divide this into the total power bill. This gives an actual power cost per unit in excess of the rate charged by the power company, for each machine is directly charged with its proportion of the loss of energy. The total power expense will now be apportioned among the various machines, according to the relation which their power consumption bears to the total power consumption of all the machinery.

In case the manufacturing company produces its own power, this system of apportioning the power cost will need but little modification. The various items going to make up the expenses chargeable to the power department are ascertained, just as though they were the expenses of an independent business. The amount of horse-power consumed by the various machines is then determined and the rate per horse-power is secured by dividing the total consumption into the total expenses of the power department. The distribution over each machine then becomes an easy matter.

Some concerns do not follow the practice of including the power cost as an item in the machine rate, but consider it as a separate cost unit. Where this system is followed the power cost is

carried as a separate item, and in determining manufacturing cost the power cost must be added to the cost of the product as it comes from the machine. This system is advantageous in those cases where the power consumption of any large group of machines is irregular, so that the amount of power likely to be consumed is difficult to estimate in advance.

### **Machine Cost**

The third group of indirect expenses gives the accountant little trouble in apportioning, as machinery costs are figured on the basis of each individual machine.

### **Non-Productive Supervising Labor**

The fourth group deals with non-productive labor. The main items here are the salaries of the superintendent and foremen. These expenses are not apportioned upon the basis of the machinery, as in the case of others, but according to the number of men employed in the various departments. The superintendent, or foreman, is a manager of men, not of machinery, and it is therefore proper to prorate his time on the former basis rather than the latter. As regards the dis-

tribution to machines, therefore, the number of operators on each furnishes the basis of the charge. For instance, a lathe requiring the services of one man will be charged with the same non-productive labor cost as will a group of three automatic screw machines located in the same department and operated by one man. The cost per machine, however, will in the latter case be only one-third the cost chargeable in the case of the former.

### **Miscellaneous Expenses**

The final item in indirect expense cost is composed of the miscellaneous expenses which for illustrative purposes are listed in the classification as "crane expense," "watchmen's and caretaker's wages," "supplies and sundries." These vary with every industry, and cannot be subdivided except on more or less arbitrary bases. The accountant usually uses his judgment as to what will secure the most accurate results in the distribution of miscellaneous expenses and completes his system accordingly.

### **Distribution of Costs Over Output**

The total expenses properly chargeable to each machine during a year are ascertained by adding

together the several group costs, and when this has been done the accountant proceeds to reduce these to such a basis that they may be apportioned over the work turned out by the machines. The usual method of accomplishing this is to divide the costs on an hourly basis. The accountant finds out how many hours during the year the machine has been or will be employed, as nearly as this can be done. The total number of hours is then divided into the total expenses assignable to the machine, and the result is the hourly rate.

There has been much controversy about the best method to pursue in determining the normal operating time of machinery. Some accountants claim that the machinery should be divided into classes, the first containing those machines whose operation is continuous throughout the year; the second, those which are not in continual use, being required only for special work; and the third, that class of machines not of the highest efficiency, but held in reserve to meet emergencies. The best method, however, is to figure the normal operating time of each machine, or group of machines of the same kind.

The following illustration shows the fixing of the hourly rate for three Hartford Automatic

Screw Machines costing \$1,382.24, which would normally run 2,619 hours in the year:

DISTRIBUTION OF INDIRECT EXPENSES

Cost of floor space.....	\$193.52
Power cost.....	383.69
Machine cost, including tool expense .....	961.88
Non-productive labor (superintendence, with one operator running the group).....	93.80
Miscellaneous expenses.....	16.32
	<hr/>
	\$1,649.21

\$1,649.21 divided by 2,619 hours equals approximately 63 cents, the hourly rate for the group, or 21 cents for each machine.

This hourly rate is usually stamped on a metal plate affixed to the machine.

**Idle Time Supplementary Rate**

The end sought by the cost department is to apportion to each piece of work, in an equitable manner, such a sum as will give, approximately at least, its cost, and—in the aggregate, at the end of the year—the total amount of indirect expense

actually incurred. Thus, the system of calculating and distributing indirect expenses is obviously not complete unless some provision is made for keeping track of the idle hours of machines. When this is not done, the total cost of a piece of work is figured according to the hourly rate stamped upon the machine, and if it takes four hours to complete, the cost department figures the cost by taking four times the hourly rate of the particular machine involved. The hourly rate, however, is nothing but a somewhat arbitrary sum which has been fixed to make easier and more accurate the compilation of the cost, and while the plan works satisfactorily so long as a machine is constantly employed, it fails when the machine is intermittently idle.

Referring to our illustration of the Hartford Automatic Screw Machines, the indirect expenses were \$1,649.21. The hourly rate of 21 cents is accurate only so long as the machine is employed 2,619 hours. But let us suppose that the plant encounters a period of depression during which it is impossible to secure orders to keep the machines employed more than half the time. To be exact, the cost department figures that the annual business, upon which it has to calculate its indirect expenses, is enough to keep the machines busy exactly 1,300 hours. Now let us see how this will alter the indirect

expenses in the case. The 1,300 hours, at the normal rate of 21 cents per hour, will amount to \$273 for each machine, or \$819 for the three. The indirect expenses for the year under these abnormal conditions will not vary much from those incurred under normal operating conditions, but less than half of the indirect expenses chargeable to the machines has been provided for. There will then be a deficiency equal to the difference between \$819 and \$1,649.21, or \$830.21. In order properly to apportion this amount, a supplementary rate is frequently used, by which this expense is distributed as an additional cost. In our illustration the supplementary rate would be 21.3 cents; and in making the calculation on this basis the normal rate of 21 cents would be used and the supplementary rate of 21.3 cents would be added.

### **Idle Capacity Account**

The distribution of indirect expenses upon the supplementary rate plan is exceedingly unjust and generally unsatisfactory. The calculations are based, in the first place, upon the ability of the company to gauge in advance the number of hours during which the plant is likely to be operated. Under conditions of uncertain demand this is almost impossible. A better method is to provide for the

charging of idle time to an Idle Capacity account, whose balance at the end of the year is charged to profit and loss. Let us suppose that we take a machine which on a nine-hour day will have an indirect expense rate of 20 cents an hour. On a certain day this machine is used only six hours on productive work, being idle the remaining three hours. At the normal rate the indirect expenses would be equal to six times 20 cents, or \$1.20; but this would leave the three idle hours still unaccounted for. Therefore, the Idle Capacity account is charged for three hours of idle time at the regular hourly rate; and the idle charge on this particular machine for this day is 60 cents. The journal entries for the day could be summarized as follows:

Manufacturing Account.....	\$1.20	
Idle Capacity Account.....	.60	
To Indirect Expense.....		\$1.80

These entries could then be posted to the three general ledger accounts involved. The Indirect Expense account in the general ledger represents the total expenses as shown in the indirect expense ledger. This ledger is a subsidiary book, sometimes called a "Machine Rates Ledger," and generally contains all the various accounts already outlined which go to make up the indirect expenses.



One of the best *indicia* of the efficiency of a plant is the comparative size of the Idle Capacity account; for its ratio to the total amount of indirect expenses is an index of the manager's success in keeping his machinery employed.

One of the main offices of cost keeping is to show leakage. In the case of materials we have seen that any leaks in stores are set forth in the "Inventory Adjustment Account," while the balance of the "Labor Account" will show any waste in productive labor. This same principle is adhered to in the case of the indirect expenses, for the "Idle Capacity Account" is the gauge which reflects the extent to which the capacity of the plant is not utilized.

## CHAPTER V

### SUMMARY

As a last step in our study of factory accounting, let us see how the work of cost keeping is actually carried on. The basis for calculating the cost of any piece of work is furnished by the manufacturing or production order, which also gives the authorization for the various departments to proceed with the execution of the work.

The manufacturing order can be used in an industry turning out a uniform product or a specialized product, in one organized under the department system, whereby the department is made the basis for all cost charges, or in one operated under the contract system, whereby the contract is made the basis for the cost charges.

The usual origin of the manufacturing order is with the customer, who gives instructions for the production of a certain commodity. To illustrate,

let us assume that the customer comes in with plans and specifications for a traveling crane. He presents the plans and calls for an estimate upon its production. The estimate will be submitted to him, and if satisfactory the order is placed. Thereupon a manufacturing order is transmitted to the shops, directing the manufacturing departments to produce the designated article. The manufacturing order, numbered to correspond with its account appearing in the cost ledger, will be the basis for all charges entering into the production of the crane.

We have already discussed the handling of the storehouse, which takes care of all materials from the time they are received until given out to the manufacturing departments. We saw that the work of the storehouse keeper was threefold; first, keeping a record of materials received; second, keeping a record of materials issued; third, guarding against the accumulation of materials in the storeroom.

It has been shown that the storehouse ledger is the subsidiary ledger for the recording of stores received and issued, being controlled by the Stores account in the general ledger. When we take up the operating departments, we meet another set of similarly controlled accounts. In other words, we have a manufacturing account in the general ledger

controlling the factory cost ledger. The same control exercised by the Stores account in the general ledger over the stores ledger is found in the case of the Manufacturing account in its control of the cost ledger. In the stores ledger the debit side is for materials received, the credit side for materials issued. In the cost ledger we record on the debit side of each account all costs entering into the production of the order. Included in this cost are materials, labor, and indirect expenses.

The voucher upon which materials are issued from stores to the operating departments, which is usually termed the "stores requisition," is posted to the credit of the proper material account in the stores ledger. The offsetting debit is posted to the account of the manufacturing order in the cost ledger, as showing the charge to the production order upon which the materials have been issued.

To the material cost there must be added the other expenses incurred in producing the finished article, in order to give the total cost of goods in process. Labor costs are chargeable to the various orders in process from the work tickets of the producing laborers, while the indirect expenses are charged from the same voucher, which should specify the numbers of the machines employed on the work. The following is a specimen of the

summary entries which are made at stated intervals in the general books :

Manufacturing  
Idle Capacity  
    To Stores  
        Labor  
        Indirect Expenses

The Manufacturing account, as above, comprises all the items of production cost chargeable to goods in process. Referring to the illustration of the traveling crane, the amount of its cost would be included as one of the items in the makeup of the amount charged to manufacturing.

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The principles of factory accounting are always the same, though their application may vary widely. This must be kept constantly in mind by the accountant and manufacturer, as the ability to adapt the principles of cost accounting to the requirements of a plant is an important factor in securing its economic handling, and in securing therefrom the best results.

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