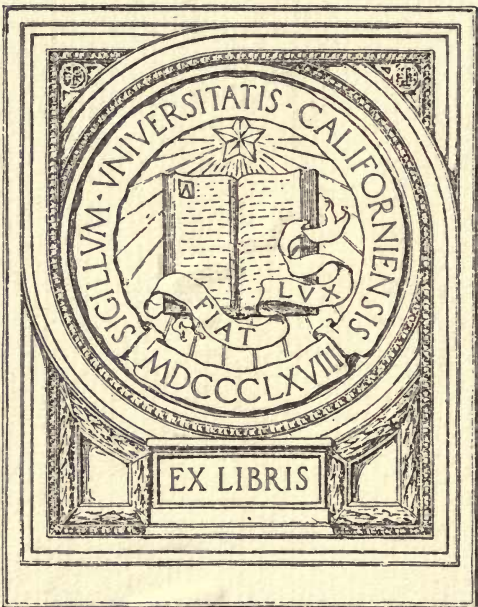


UC-NRLF



5B 95 607



EX LIBRIS



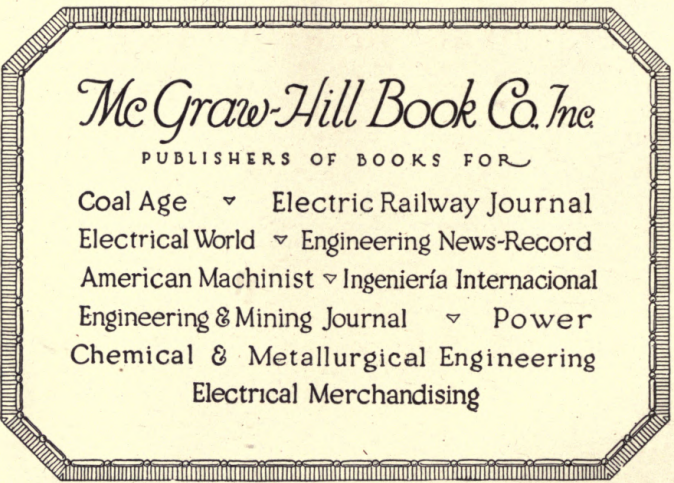








**FACTORY STORESKEEPING**



*McGraw-Hill Book Co. Inc.*

PUBLISHERS OF BOOKS FOR

Coal Age   ▽   Electric Railway Journal  
Electrical World   ▽   Engineering News-Record  
American Machinist   ▽   Ingeniería Internacional  
Engineering & Mining Journal   ▽   Power  
Chemical & Metallurgical Engineering  
Electrical Merchandising



LIBRARY OF  
COLUMBIA

# FACTORY STORESKEEPING

The Control and Storage of Materials

BY

**HENRY H. FARQUHAR**

ASST. PROFESSOR OF INDUSTRIAL MANAGEMENT, HARVARD GRADUATE SCHOOL OF  
BUSINESS ADMINISTRATION; CONSULTING MANAGEMENT ENGINEER

FIRST EDITION

McGRAW-HILL BOOK COMPANY, INC.

NEW YORK: 370 SEVENTH AVENUE

LONDON: 6 & 8 BOUVERIE ST., E. C. 4

1922

HF6345

F3

COPYRIGHT, 1922, BY THE  
MCGRAW-HILL BOOK COMPANY, INC.

THE MAPLE PRESS YORK PA



## FOREWORD

Great managers are primarily concerned not with today, but with to-morrow. This is true because they have taken advantage of the possibility of standardizing those features of their work which lend themselves to standardization so that they are left free to give their personal attention where it is really most needed—to matters which cannot be systematically controlled. The administration of any industrial enterprise may be broadly divided into the management of *men*, and the management of *things* such as plant, equipment, and materials. The former constitutes the art in management, while the latter is susceptible to a more scientific regulation. If the administration of industrials is to become less of an art and more of a science, a sharp division must be made between those matters which from their very nature must remain largely in the realm of art—the functions of dealing with human beings and with intangible questions of policy—and those which may be controlled through predetermined and systematic procedure.

Even where the effort has been made to develop the scientific side of management, however, the popular imagination has been caught by that part of it which deals with shop planning and incentive payment, and more than its share of the average manager's serious attention is absorbed by the actual *making* of goods. The fact that such planning and payment to be truly effective must be based on unspectacular standardization of equipment and materials has not been sufficiently stressed, and the fact that no part of the business can function to best advantage until all parts function to good advantage is just beginning to be appreciated.

Thousands of dollars are lost in hundreds of factories through unorganized handling of materials. Although the cash statement is scrutinized with fatherly care, once part of this cash is converted into materials, which are of considerably greater potential value than an equivalent amount of money, this form of wealth tends thenceforth to be neglected and the attention remains centered in the cash drawer. The fact is that the interests of the cash drawer are best served by management so organized and controlled as to serve directly production needs, and good industrial relations in the factory are well-nigh impossible without control not only of materials but also of all other controllable features of the work. It is for this reason that the attempt has been made in this volume to show how one of these functions of management may to a considerable extent be removed from among the ever-present troubles of the manager.

As used, the term materials will be understood to include *stores* or raw materials and factory supplies, and *worked materials* or work in process and partly or completely finished parts. The book deals with the replenishment, storage and disbursement of these two classes of materials, but excludes the administration of work while in process, after it passes from storage to the shop, which is known as routing and which does not fall within the scope of this volume. Unless otherwise stated, the discussion applies to both stores and worked materials; and the viewpoint is that of the manager of production of the medium sized plant engaged in manufacturing a variety of articles both to stock and to order. No attempt is made to outline a "system" for any specific type of factory, since local variations necessitate local adaptations; rather the guiding principles of effective material control which are applicable alike to all types and kinds of production are emphasized and illustrated by examples of detailed procedure which has been found effective in numerous instances.



The object of this book, then, is to outline the principles and methods by which one of the problems of industrial management—the handling of materials—may be standardized and cheapened through scientific regulation, in the hope that the time and energy of the manager may be thus released for the task of Management in the highest sense, that of bringing about the very best conditions for everybody concerned.

HENRY H. FARQUHAR.

BELMONT, MASS.,  
May, 1922.





## ACKNOWLEDGMENT

To the late Frederick W. Taylor, whose pioneer work in formulating principles of management and developing sound methods by which those principles were made effective, I am indebted for the general viewpoint as well as for whatever in the following pages is sound in theory and effective in practice.

I wish to express appreciation of the help and advice received in the preparation of this volume from my wife, Elizabeth Holton Farquhar; from L. Herbert Ballou; from Charles R. Howard; from Harlow S. Person, and from Hugo Francke.

My thanks are due also for forms and materials supplied by the Lewis Manufacturing Company, Walpole, Mass.; by the Bethlehem Steel Company, Bethlehem, Pa.; by the Russell, Burdsall and Ward Bolt and Nut Company, Port Chester, N. Y.; by the Universal Winding Company, Providence, R. I.; and by the W. H. Griffin Shoe Company, Manchester, N. H.

H. H. F.





# CONTENTS

	PAGE
FOREWORD . . . . .	v
CHAP.	
I. RELATION BETWEEN MATERIAL CONTROL AND PRODUCTION . . . . .	1 ✓
II. THE MATERIAL CYCLE. PREREQUISITES TO CONTROL . . . . .	15
III. PERSONAL ORGANIZATION. LOCATION OF DEPARTMENTS . . . . .	26
IV. THE BASES OF MATERIAL REPLENISHMENT. . . . .	38
V. THE MATERIAL BALANCE SHEETS . . . . .	53
VI. THE PURCHASING DEPARTMENT AS RELATED TO MATERIAL CONTROL . . . . .	70 ✓
VII. TRAFFIC, RECEIVING AND INSPECTION DEPARTMENTS . . . . .	85 ✓
VIII. THE STORE ROOM LAYOUT, EQUIPMENT STORAGE AND PROTECTION. MAINTENANCE STORES . . . . .	98 ✓
IX. CLASSIFICATION AND SYMBOLIZATION OF MATERIALS. . . . .	140 ✓
X. MATERIAL ACCOUNTING; INVENTORIES; STATISTICS. . . . .	159
APPENDIX. . . . .	175
INDEX . . . . .	177





# FACTORY STORESKEEPING

## THE CONTROL AND STORAGE OF MATERIALS

### CHAPTER I

#### RELATION BETWEEN MATERIAL CONTROL AND PRODUCTION

**SUMMARY:** *The Functions of a Manufacturing Plant.* All Contribute to Production. *Standardizing for Material Control.* Simplification. Specifications. Maintenance of Quality. Determination of Quantity. Methods of Administrative Control.—*The Ideal Material System.* Knowledge Required to Secure it. Speculative Purchasing.—*Relation between Manufacturing Efficiency and Material Control.* All Costs are Costs of Production. Storage and Handling Costs must be Low as Possible. Some Typical Cases.—*Summary of Material Losses.* Lack of Standards of Variety and Quality. Excessive Supply. Deficient Supply. Faulty Management.

**The Functions of a Manufacturing Plant.**—A manufacturing establishment, as the name implies, exists primarily for the purpose of turning out a product for sale at a profit. This fact curiously enough seems sometimes to be overlooked. Activities other than production proper are of course necessary in order that the main purpose for which the plant exists may be accomplished, and it is necessary in order to avoid a lack of balance in management that each activity be seen in its true perspective without misleading lights and shadows. The main functions in the administration of any manufacturing undertaking are:

The Financial and accounting, or the raising and regulation of funds by which the business is carried on.

The Engineering or technical, which determines the design and composition of the product.

The Production, the prime function of transforming raw material into a salable product.

Selling, which creates a demand for and disposes of what is manufactured.

Personnel, which has to do with the policies and practices grouping themselves about the human element.

All minor activities of the plant may be grouped under one or another of these broad major functions, and all, it must be remembered, spring from and must primarily serve production since this is the activity for which the whole establishment was founded. Looking at the matter in this light, the Production function really embraces finance, engineering, selling and personnel, but deals more specifically with activities in turning out a product through the use of land and buildings, equipment, organization, materials, production and cost systems, and so on. Now, if we have learned anything from the great amount of careful work which has been done in an attempt to reduce the management of industry to less of an art and more of a science, it is that it is just as necessary to control one of these variables with which the manager must deal as it is to control any other and that the business must be looked upon as being organic and not as a series of disjointed and unrelated activities. This viewpoint brings home at once the fact that none of these production activities can continue unless selling provide a market, that machines are useless unless power be available to drive them, that men are useless unless they be provided with work to do and with facilities to do it, and that in turn all of these activities must cease unless *materials* are supplied as needed. It is only through the conduct of manufacturing operations that the material problem in the strictly manufacturing business arises—eliminate the production activity and the need of materials, aside from miscellaneous office supplies and the like, disappears.

One of the major functions of production, then, is that of providing its needs in materials and of standard-



izing material activities so that these needs may be adequately met. The function of material supply, instead of being relegated to the background and considered as a "necessary evil," must thus take its place beside those ordinarily given greater consideration. Only by so doing may a balanced management be brought about; only when material regulation has been standardized may it be pushed to the background to make room for some of its brothers which are less amenable to control.

**Standardizing for Material Control.**—Constant emphasis is placed throughout this volume upon the importance of standardizing the various features of the whole material problem of the factory, with special emphasis upon certain phases of such standardization. As applied to material problems, standardization embraces the following:

1. *Simplification*, or the reduction of the variety of different kinds of material dealt with.

2. *Specifications*, or the determination of requisite quality of each item of material to be carried.

3. *Maintenance of Quality*, or the measures necessary to see that materials actually received conform to predetermined specifications.

4. *Determination of Quantity*, or the question of ascertaining and regulating how much and when to buy various materials under different conditions.

5. *Methods of Administrative Control*, or the measures by which the whole material cycle is brought under systematic operation.

The major emphasis in the present volume is given to the last two topics, that is, to the regulation of inventory and the methods of coordinating and controlling the whole material procedure from beginning to end—both aspects of factory storeskeeping of vital importance entirely out of proportion to the attention they usually receive, yet the fundamentals of which must be grasped by the men responsible for materials in the factory

if this function of production is continuously to play its part in the struggle for high output and low costs. It is because of the comparatively little serious attention usually given to these two phases of material handling as contrasted with that usually devoted to questions of variety and quality, that these problems of quantity and control have been given right-of-way in this book. Before passing to these in detail, however, it is necessary to get a clear picture of the relation between them and simplification, determination of specifications, and maintenance of quality.

*Simplification.*—Reduction of variety of materials necessary under given conditions may ordinarily be accomplished without a corresponding reduction in the number or variety of products manufactured, desirable as the latter is in many instances. But without touching the question of the number of products to be made, it is usually possible through careful investigation, to eliminate many items heretofore carried through analyzing exact needs and rigorously eliminating needless frills and varieties, and by making parts interchangeable so far as possible.

The necessity of conserving manufacturing facilities for strictly military needs during the war gave a tremendous impetus to reduction of variety, substitution of standard or interchangeable parts, and elimination, of all materials for which there was not a real need. The War Industries Board did notable work in this connection, and it is significant that much ground gained at that time has been held and that the work of simplification is progressing steadily in almost every industry fostered by the Department of Commerce.

As a result, many instances of remarkable financial savings in various lines of work through centering attention upon essentials only, might be cited, and the effort to cut down the number of articles with which the factory supply service must deal is one of the essentials of good



material management. Many storerooms contain upwards of 25,000 different items; a reduction of even a fraction of this number is usually worth all its costs, through saving storage space, interest on investment, labor of handling and keeping inventory correct, balance sheet work and all of the clerical operations necessary to put through any transaction in requisitioning, purchasing, receiving and inspecting, storing, issuing and accounting for any item of material. The degree of control which may be exercised over material routine generally, varies inversely with the number of items between which attention must be divided; it is therefore essential to reduce these to the very minimum consistent with successful operation of the plant.

*Specifications.*—The determination of the specifications or the requisite quality of each item of material to be retained after simplifying our needs is a technical matter of the utmost importance. It would be out of place to attempt to treat a subject of this size and importance in a volume devoted primarily to a different purpose. No manufacturing undertaking, however, can be successfully carried on until raw material specifications, in the form of standards of composition, of dimension, of strength, of finish, of color, and so on, have been determined, and a strict regulation of quantity is predicated upon a predetermination of quality because the very act of setting a strict limit on the *amount* of goods to be carried necessitates being sure that each item of this supply be suitable for the uses to which it is to be put.

*Maintenance of Quality.*—Standard specifications may prove to be a positive harm, however, unless means be taken to put them to constant and effective use, for unless this be done the specifications themselves lend a false feeling of security as to quality. On the one hand, in setting specifications it should be remembered that “good enough is best;” on the other hand once necessary

quality has been determined by those who know, it becomes the imperative duty of those entrusted with inspection of quality to see that no material not up to these minimum requirements be passed for use. The safeguards which must be thrown around the technical inspection work itself, therefore, are here dealt with as one of the essentials of current material handling upon which adequate regulation rests.

It will thus be seen that there is a very intimate relation between simplifying varieties, determining standards of quality, inspection to enforce conformity to those standards, determination of quantity and standardization of methods of material management. These five must go hand in hand if ideal results are to be secured.

**The Ideal Material System.**—From a material standpoint the fundamental idea upon which war is conducted is so to organize and manage that the man at the front is enabled to keep his mind continuously on his main duty—the defeat of the enemy—without handicapping him in any way with questions of supplies of any kind. He should be able absolutely to forget material. Ideally and actually he should be able to reach his hand behind him at any time and receive exactly what he needs—no more, no less—at the moment. An over supply will impede his action, consume his time and attention and result in waste; a deficiency either in quantity or in quality will render him helpless. That is the basis upon which the supply service of the army is organized—material and ration supply should be automatic and governed absolutely by current needs.

For the man at the front substitute the man at the machine, and the above ideal becomes that of the supply service in the factory, for the same reasons and to be attained through similar methods.

To make this supply automatic in either case, we must first know the requirements; we must know the original outfit in quality and in quantity that a man



needs when he takes up his work and the probable rate of use of each article while on the job. Then, if we are to send forward the right quantity of the right materials to him just when wanted, many other things are necessary. We must know how long it takes to secure the goods ourselves from our supplier, and how long it takes us to forward them from ourselves to the man who is to use them. It is necessary to know how much of the goods are on hand in the store room, how much has been ordered to be shipped, how much has been promised for specific uses and therefore not available for filling subsequent requests, and from this how much is still available for future demands. Besides these things, to make the supply reliable, there must be a definite location for each article of goods in stock, knowledge as to exactly where and how much of each is on hand, and ability to get them in and out quickly. This, of course, requires that means be taken to safeguard materials while in storage and to keep accurate records of amounts. Accuracy in handling, is essential, all items should be checked all the way down the line as far as is possible consistent with speed and with the personnel employed. Theoretically no goods may pass out of one's hands without a receipt: this, of course, is not always possible in war, or necessary in war or industry. But efficient transportation and sufficient checks at each stage are necessary; therefore, proper identification of the goods is required so as to enable anyone into whose hands they pass to know what the goods are and for whom they are intended. In addition to all these considerations of quantity and time, in both war and industry there are considerations of quality, and in addition to this in industry the further consideration of cost, by which is meant not simply the original purchase cost, but the final use or time cost considering the effectiveness and durability of the particular item in actual use.

These are a few of the many details to be brought

under control in well-regulated material handling. They are not matters to be looked after by an inexperienced clerk. Neither does the answer lie in devising a material "system" and thereafter leaving it to run itself or to be supervised by otherwise preoccupied officials or those who, because their duties do not bring them face to face daily with production troubles, may not realize the vital dependence of manufacturing efficiency upon material control. There is, strictly speaking, no such thing as a material function in itself in the manufacturing business, and those manufacturers who, in addition to producing, deliberately indulge in the buying of materials for re-sale and "playing the market" are by so much engaging in a separate line of business as distinct as possible from that for which presumably their investment in plant and equipment was made—a dangerous speculative business in which they would in most cases do better not to indulge. Even though a conscious buying for re-sale be not permitted, there are many plants which are even worse off because, lacking this definite policy, they have yet failed to substitute the proper one of governing purchase from the standpoint of manufacturing needs. The tendency in the best plants today is to look upon the control of material as a production function and to govern the replenishment of materials in accordance with the requirements for production during a reasonable future period. One of the oldest, largest, and most progressive manufacturing plants in this country adheres steadfastly to this policy, and has done so for a number of years.

**Relation between Manufacturing Efficiency and Material Control.**—The vital dependence of manufacturing efficiency on the strict regulation of materials is realized most by those closest to and responsible for production. Although a blunder on the part of the purchasing agent, for example, may result in just censure of that individual, it is after all production which has to bear the cost



of the blunder, for the cost of what he buys, as well as the cost of his failure to buy when he should, alike must eventually be borne by the cost of the product turned out.<sup>1</sup> Production must, therefore, suffer, in addition to leaks, any evils of over- or under-stocking; and curiously enough both of these losses are most often encountered in the same plant simply because insufficient attention is paid to material problems in general. The only economic justification for storing materials in quantity is that through this reservoir production may be regularized and thus cheapened. It therefore follows that the cost of the product must not be unduly increased through storing too much nor through failure to store enough, for in either event production is not securing the benefit of storage to which it is entitled. There are but two ways in which materials may be sold at a profit: they may be re-sold in the condition in which they were bought at higher than the purchase price, or they may be processed to a finished or partly finished state and sold for more than the cost of raw material plus manufacture. Obviously excess materials cannot be processed, which leaves us only the first alternative of re-sale—as before stated, a questionable policy for a manufacturing concern.

The now classic case of a government establishment may be recalled in this regard. There was here, of course, no element of speculation, but the loose methods of regulating materials then prevalent and still common were in use. Upon the initiation of changed methods of management, the stores situation was thoroughly overhauled. Among other things which came to light was a

<sup>1</sup> This regardless of the cost methods used, for even where a so-called "Standard" or predetermined cost of material entering the product is used (any excess over this cost being charged to Profit and Loss), the balance sheet must yet show that articles produced are sold at more than all costs of producing them (blunders included) or the business must eventually discontinue. We are only obscuring the approach of the evil by absorbing such losses in a separate account.

supply of materials above current needs amounting to more than \$122,000.

This occurred in a government institution, however, for which allowances may be made. Let us look at some happenings in private plants. The author vouches for the accuracy of these stories, although, of course, names cannot be mentioned. In a machine shop, upon a similar round-up 40 tons of idle stock was unearthed from around the machines, under the benches, and on the floor of one department. This consisted of raw stock cached by the workman, excessive amounts delivered to the machine and not disposed of, partly worked parts sidetracked for "rush" jobs, and so on. There was no speaking acquaintance between material regulation, either purchasing or issuing, and production needs.

In another plant the purchasing agent bought only for current needs as judged from comparison of reports of materials on hand and sales orders which were furnished him. From this placing of responsibility for such matters and from the methods in use, his ability to do so was questioned although he surpassed the average purchasing agent in capability. An actual investigation showed more than \$50,000 worth of excess miscellaneous items on hand. Any of those items could have been secured in 3 weeks; some were on hand in sufficient quantities to last 10 years. The intent was good in this case, but human limitations and faulty detail made its accomplishment impossible.

The purchaser for one medium-sized factory was a bargain hunter—one of the most costly and tenacious diseases to which purchasing agents are heir. Responsibility for designation of how much to buy had, up to this time, never been clearly defined, and was usually exercised by the purchasing agent alone; he originated and approved replenishment orders unless some special occurrence made consultation necessary. One morning he beamed into the office with the news that there had



just been delivered 18 months' supply of a certain item which he had obtained at an "exceptional reduction in price." The works manager replied that they had just discontinued the use of that particular item altogether. In this case the material was immediately re-sold (at a lower price than was paid for it), but such "bargains" often form very considerable portions of the excess supplies shown up when materials on hand are measured against requirements.

A somewhat elaborate "stores system" had been installed for keeping track of partly worked parts in another factory. Due to a multiplicity of detail whereby the main requirements of successful stores management had been, however, missed, the difference in inventory as shown on three supposedly accurate interlocking records was surprising, and \$15,000 worth of material, as per the book records (in this case under the control of the cost department), could not be physically located or otherwise accounted for. Those entrusted with the work of record-keeping did not realize the importance of it and had no particular incentive to keep it accurate; the cost man regretted that it became necessary to "write off" such a loss, but otherwise attached no particular significance to the matter.

Akin to this is the case in another plant where the works manager in all important cases must send a personal representative to the store room to check the accuracy of the book balance reported to him from the balance sheets. These again are under the control of the cost office.

A case came to light in an otherwise exceptionally progressive factory where, because of fairly uniform production requirements, it was thought to be unnecessary to apportion, or reserve on the books, material for each manufacturing order in advance of its disbursement. Instead, the average consumption over a period of weeks was determined, to which was added a liberal factor for

safety, and the resulting quantity was specified as the "minimum" below which goods *on hand* should not be allowed to fall without issuing a replenishment order. This minimum was entered on the balance sheet for the item, and book balances were carefully checked with bin contents from time to time. To give added assurance, over the minimum quantity in the bin was placed a red cloth as a signal to the storekeeper, before touching the minimum stock, to remind the balance clerk to issue a replenishment order. This procedure seemed to the manager to be water-tight, but after a few months' operation a costly shortage occurred on the item. Upon investigation it was found that recent demands had so far exceeded average demands (upon which the "minimum" was based) that stock became exhausted. Rather than increase the minimum limit to cover such exceptional demands and thereby increase the inventory of idle material during all times of normal consumption, the firm was persuaded to adopt the common sense policy of looking ahead in these matters and apportioning all such material immediately the need became known.

No, efficiency in production cannot be obtained under such handicaps. Money is carefully guarded and checked to the penny; materials are potentially of far greater importance to the manufacturing business than an equivalent amount of money. They should be as carefully guarded and controlled.

#### **Summary of Material Losses.**

*A. Lack of Standards of Variety and Quality.*

*B. Due to Excessive Supply.*—Excess materials, not disposed of, cause any one or all of the following losses:

1. *Loss of Interest on Investment.*—The money which is spent for material in excess of what is needed for production during a reasonable period might otherwise be loaned at interest or reinvested profitably in the business, thus producing more money; or it may be used to obviate the necessity of borrowing, thus producing a



direct saving; invested in idle material, however, it adds a cost of doing business—the cost of the loss of interest on money needlessly spent.

2. *Loss of Insurance on Goods.*—A heavy inventory imposes a heavy insurance cost, or a heavy loss in case of fire, usually both.

3. *Excess Storage Space.*—Every cubic foot of storage space has a rental value. Taxes, insurance, depreciation and repairs on the building, interest on investment, heat, light, cleaning—all such costs for any space throughout the plant must be charged against what occupies that space, be it an operating machine or dead stock, and this charge must eventually appear against the cost of the product which the space is supposed to benefit. In the former case the product of the machine may offset or more than offset these rental charges: in the latter case the charges go to swell expenses which ordinarily can not be returned by the excess materials themselves and which therefore add to the burden which must otherwise be shouldered.

4. *Deterioration.*—In few cases do materials of any kind retain their original quality during the passage of time. Deterioration, depreciation or obsolescence will sooner or later cause a loss in idle stock.

5. *Reduced Stock Turnover.*—During normal times of the buying and selling markets the ideal condition as regards storage in the manufacturing business would be that in which no storage whatever is necessary. Imagine a factory where, immediately upon receipt, raw material is delivered to the machine, processed at once and immediately shipped upon completion. Such a factory would have a stock turnover limited only by the time necessary for the longest operation on the product. The cost of material entering into the product under such conditions would obviously be less than that in which storage is necessary, for in storing we have the fixed costs mentioned previously, the cost of added delivery, handling

and transportation charges, and possibly deterioration or obsolescence in the materials themselves. No matter for how short a period we store, therefore, the cost of the stored article issued to the shop is actually greater (whether it show on cost records or not) than is the cost of a non-stored article. The profit on the finished product is therefore less; or, if the same, that part of it which pertains to the materials occurs fewer times per year. It is more profitable to make 2 per cent per transaction six times a year than it is to make 13 per cent only once a year. This is a point overlooked in innumerable manufacturing and other concerns.

6. *Additional Handling and Confusion.*—Except under fortunate conditions of ample and well arranged storage space, a supply of material in excess of normal needs almost inevitably results in shifting locations, additional piling, unpling and transporting, additional record keeping, lack of definite identification and consequent confusion and difficulty in finding materials quickly.

*C. Due to Insufficient Supply.*—The losses which may and do result from a failure to have on hand just the article desired in sufficient quantity when needed are too frequent and obvious to merit rehearsal. A warning may be thrown in here, furthermore, to the effect that when a policy of governing materials strictly by production needs is determined upon, ample safeguards are necessary to insure against a shortage. One such occurrence may offset many times the cost of an excessive supply.

*D. Due to Misplaced Responsibility and Faulty Routine.*—Some typical instances of such losses were given in preceding paragraphs, and since the causes may be innumerable no summary will be attempted. It is largely the petty annoyances and little leaks, however, in themselves often insignificant, which in the aggregate amount to infinitely more than it would cost to remedy them.



## CHAPTER II

### THE MATERIAL CYCLE. PREREQUISITES TO CONTROL

SUMMARY: *Classes of Materials—The Material Cycle—Sources of Information—Forms and Functions of Each—Prerequisites to Control—The Fundamental Principle; Rules for Material Regulation.*

In Chapter I the points were brought out that effective manufacture is absolutely dependent upon effective regulation of materials, that ideal material management provides a regulated movement of supplies according to actual needs, that either an excess or a deficiency is bad, and that constant vigilance is necessary to guard against these and other losses, and finally since production is the activity most directly interested in and affected by these matters that the regulation of them should rest squarely upon this function of the business.

**Classes of Material.**—It is necessary to define exactly what we are talking about when we use the word "material." Material may be divided into

- I. *Stores*, or
  - (a) Raw materials, and
  - (b) Factory supplies
- II. *Worked Materials*, or
  - (a) Partly worked, and
  - (b) Finished parts

*Raw materials* are those intended for use in the product which are still in the condition in which we bought them. They may thus be finished product to our supplier and raw material to us.

*Factory Supplies* include all stationery, forms, maintenance and power supplies, spare parts of machines, lavatory equipment and similar miscellaneous articles of general factory use.

*Worked materials* on the other hand, consist of raw materials on which some processing work has been performed in our plant looking toward the conversion of them into the finished product. They may be partly or completely finished parts or products; in the latter case they are often referred to as "stock," and they may be salable in both conditions.

Looking at *Stores* from a slightly different angle, we have:

A. *Classified Stores* or those which we ordinarily keep on hand in quantity and to which naturally we desire to give greatest attention. They are, as the name implies, carefully classified and strictly regulated in every way since they form the foundation of manufacture; and

B. *Unclassified Stores* or those which are not regularly stocked but are ordered for special purposes. Here would fall items such as chairs, desks, typewriters, special orders of lumber and similar items not carried regularly in the store room.

Such subdivisions provide not only a convenient means of identification of the various items in the store room, but are desirable for accounting and other purposes to distinguish those parts which we buy from those which we make.

Although this volume deals primarily with *stores*, and particularly with *classified stores*, many of the considerations in governing this class of material apply with equal force to worked materials. In the case of worked materials, although a manufacturing order on one of our production departments is issued to renew the supply instead of a replenishment order on the purchasing agent, and although thereafter there are similar differences in treatment, yet in each case the same principles of control apply and the same general sequence of operations must be gone through.



**The Material Cycle.**—The series of activities in securing, storing, and disbursing material run about as follows:

1. The determination of what is needed, when, and in what quantities.

2. The placing of the request to purchase—hereafter called the replenishment order, often called purchase requisition—with the Purchasing Agent.

3. The securing and filing of information concerning sources of supply.

4. The securing of bids or quotations for the article desired; the decision as to price and suppliers.

5. The placing of the order to buy—hereafter called the purchase order.

6. The follow-up of outstanding purchase orders to insure delivery when needed.

7. The receipt of the goods.

8. The count and inspection.

9. The transportation and receipt into stores.

10. The storage, safeguarding and accounting for the goods while in stores.

11. The placing of the request to issue—hereafter called the stores or worked material issue—with the storekeeper.

12. The disbursement of the goods.

13. The accounting work at each stage of the transactions—the recording of what has been ordered, what received; balances on hand; amounts reserved and amounts still available; the checking and paying of the bill; costs and the charging into and out of stores; the maintenance of inventory records.

The phases of this cycle are very far from being a series of disjointed transactions—they are a series of interdependent acts, a false step in any one of which may produce disastrous production consequences.

**Sources of Information—Forms and Functions of Each.**—The various forms and methods used in material

routine will necessarily differ in individual factories. For the sake of clearness in following subsequent discussion, the names and functions of the more important sources of information as here used may be summarized. They are listed in the order in which chronologically they usually come into play in actual operation.

The more important forms are illustrated in the following chapters. Those shown are samples only, and the reader is cautioned that for his own particular needs very different forms may be required. The fact should be emphasized also that too great variety in colored paper on which these various forms are printed should be avoided, but forms of the same size at least should be printed on paper sufficiently different to avoid confusion.

*Bill of Material—Parts List.*—A list made out by the engineering department showing drawing and pattern numbers, quantities, description, and composition or reference to specifications, of each part of the product which is to be made in our plant. Various other sorts of information are sometimes shown according to circumstances. If the bill be extended to include not only worked materials but all raw parts, and all stores entering into the product, it is usually referred to as a List of Parts.

The bill of material is thus the basis of all needs for manufacturing material, and the bill itself or abstracts from it may serve for making these needs known to the persons whose duty it is to see that these materials are supplied.

*Purchase Specifications*—made by the engineering or other technical department, show complete information as to the characteristics of all material used by the establishment, drawn up for use of the purchasing agent and the inspection department. Specifications may vary all the way from elaborate detailed physical and chemical characteristics with instructions as to manufacture and for testing the finished product, down to the simple



designation of a well-known trade name of an article of standard quality.

*Classified Stores Balance Sheet (or Card)*—the most important single source of information in the stores system. It is the central means by which most questions regarding the status of material are answered and the principal mechanism by which systematic material routine is controlled. One such sheet for each item shows the name of the item, the time necessary to renew the supply, the symbol, the limits for replenishment, often the location in the store room, with columns for entering complete information as to material outstanding on purchase orders, material issued and balance still on hand in the store room, with the value of such supply, with the addition if necessary of columns showing amount of material apportioned or reserved for specific uses, and amount still available for apportionment to other uses. Through the balance sheets must flow a constant stream of information whereby they may be kept up to the minute in record of transaction, and from the balance sheet originate all requests upon the purchasing agent to renew the supply for classified stores when a predetermined low point has been reached.

*Worked Material Balance Sheet.*—Similar in function and operation to the classified stores balance sheet.

*Unclassified Stores Balance Sheet.*—Similar in purpose to the classified stores sheet, but much simpler in operation—since on it are recorded only transactions dealing with articles ordered especially for some specific purpose, ordinarily to be issued out for that purpose immediately upon their receipt at the plant.

*Replenishment Order. (Purchase Requisition).*—A requisition on the purchasing agent to buy a specific article or service. Replenishment orders theoretically may originate with any one in the employ of the concern; practically, however, their use is usually limited to the heads of departments and the balance clerk, the former

for unclassified items only, the latter for either classified or unclassified. In all cases replenishment orders should pass to one of the higher authorities for approval.

*Purchase Order.*—The formal document made out and signed by the purchasing agent and dispatched to the vendor as notice to him that we desire to purchase. When accepted, it becomes a contract. It must therefore be entirely complete in description and unambiguous in language. It is ordinarily made out in several copies, such as the balance clerk's copy, the receiving clerk's copy, the purchasing agent's copy, the purchasing agent's copy by serial order number, the auditor's copy, the foremen's copy, the purchasing agent's tickler copy, with others where necessary.

The purchasing agent's tickler copy of the purchase order is a carbon copy of the purchase order used in the purchasing agent's office as a means by which the progress of delivery of goods ordered may be followed. (See Chap. VI.)

*Freight Register.*—Made out by traffic department or other representatives of the firm who receive packages from the railroad or other transportation agents. It shows number of package, number of packages received, from whom received, weight, transportation charges, and information as to condition. It serves as a summary of receipts, and for entering transportation charges against particular items.

*Notification of Receipt.*—When packages are received from the transportation agent, they are unpacked and contents checked. For each such shipment a notification of materials received is made out by the receiving clerk as notice to everyone interested that materials are on hand. This serves particularly to inform the balance clerk of this fact so that appropriate entries may be made as to receipt on the proper material balance sheet, and is the means by which the vendors' invoice is checked with goods actually received.

*Material Inspection Report.*—All incoming goods must



be inspected for quality. Notice of decision in this respect may be provided on the notification of receipt form, or a separate form may be used for the purpose. If so, it should accompany the notification of receipt in its travel through the plant.

*Returned Goods Report.*—When any of our products are returned by one of our customers a report must be made out showing what has been received, supported by an inspection showing what if anything is the matter with the goods. It is then necessary for someone to designate what disposition shall be made. The report may then be returned to the receiving clerk as his authority for disposition of the goods. This report serves an important function in providing a systematic means of disposing of articles which have a tendency to lie around and clutter up valuable space.

*Bin Tag.*—A tag attached on or near each bin of material. Whenever material is put into or taken out of the bin, a notation to this effect is made on the proper bin tag for the material, showing date, amount put in or taken out, and account to which the transaction is to be charged. The bin tag furnishes one important means by which accuracy of perpetual inventory is maintained.

*Overflow Bin Tag.*—In case the regular bin provided for a certain material is insufficient to hold all of it, it becomes necessary to store the remainder in an "overflow bin." In this case, it is necessary to have a cross reference between the two bins, so that the overflow bin tag is placed on the regular bin with a notation on it as to where the overflow bin may be found, and on the overflow bin is placed the regular bin tag on which, as additions to or withdrawals of stock from the bin are made, proper entries are recorded.

*Bin Label.*—A label to be attached to each bin or other container of material, showing just what this particular bin holds as designated by whatever system of identification is employed.

*Stores Issue.*—The means by which stores are secured from the store room. Issues are made out by the person desiring goods, approved if necessary by the proper official, sent to the storekeeper as his authority to disburse goods, and must contain information showing exactly what and how much is needed. When desired goods are removed from the bin, entry is made on the bin tag, goods are delivered by messenger or by special transportation men to whomever is to receive them, his signature secured for receipt, and the stores issue is then passed to the balance clerk for entry, thence to the cost department for accounting purposes.

*Worked Material Issue.*—This serves the same purpose for worked materials as the stores issue does for stores.

*Stores Credit.*—This is the reverse of the stores issue and is used where goods are returned to the store room after being once issued. The function and general procedure is the same as with the stores issue.

*Worked Material Credit.*—A similar form for returning unused worked material to stores.

In order to distinguish transactions readily, forms used for worked materials should be printed with different colored inks from those used for stores. Stores forms are usually printed in black, and worked materials in red ink.

*Move Order.*—A request on the transportation men to move materials or other objects from one designated place to another. It may be used to follow and record the movement of material throughout the plant.

*Identification Tag.*—The tag attached to each article or lot of articles in transit throughout the plant, showing what the articles are and for whom they are intended. It corresponds to an address on an envelope sent through the mail.

*Worked Material Received in Stores.*—When raw material is issued to the manufacturing department, it is done upon the authority of a stores issue. After processing



it may be returned to the store room for further safeguarding, when it must be accompanied by a worked material received in stores, which in this case would perform the same function as a notification of receipt. It is information to the storekeeper, to the balance clerk and to the cost clerk whereby their respective entries may be made.

*Stores Count.*—The only absolutely certain way to maintain perpetual inventory is by an actual physical count of goods on hand. This form provides a means for the storekeeper or his representative to report back to the office exactly how many articles of various kinds are now in the bins.

**Prerequisites to Effective Material Control.**—In the previous chapter it has been indicated that the problem of material resolves itself into that of having on hand at exactly the right time just the right materials in just the right quantity at the lowest cost consistent with quality. This is the one underlying principle of material control. Some of the more important measures to be effected in putting this principle into operation were also indicated. Without presuming to make the list complete, these may be reviewed and supplemented, and finally a set of working rules presented by which they may be enforced in practice. The prerequisites to adequate material handling are:

1. Definite requirements in materials of all kinds. This presupposes standardization of quality and knowledge of rate of use.
2. Knowledge of time necessary to renew.
3. Minimum cost consistent with quality.
4. Record of amounts ordered, on hand, apportioned and available.
5. Count and inspection upon receipt.
6. Definite location.
7. Adequate storage and safeguarding.
8. Strict control of issue, inventory and accounting.

9. Quick and efficient transportation.
10. Definite identification.
11. Classification and symbolization.
12. Centralization of authority and responsibility of the whole material function proper and of each phase of it.
13. Checks and balances in routine, enforced through thorough supervision.

**Rules for Material Regulation.**—For the purpose of energizing the principle, and of enforcing in practice the requirements for material control, certain rules are necessary. They are here listed seriatim without comment or explanation since the various considerations necessary to make them effective in operation will be outlined in some detail in the following chapters:

1. Replenishment of material must be governed strictly by requirements for production during a reasonable future period.
2. There must be predetermined specifications for each article purchased.
3. All replenishment orders must be in writing and may be issued only by specified persons.
4. All replenishment orders must be approved before they may be honored by the purchasing agent.
5. All purchase orders shall be in writing and must be systematically followed up.
6. All persons concerned directly in the transaction must receive copy of the purchase order.
7. There must be a careful count and inspection of all goods received before they may be stored or released for use.
8. Notice of receipt of materials must be given immediately.
9. Responsibility for storage and issue must be centralized.
10. Storage other than in the store room must be reduced to a minimum.



11. The store room must be accessible only to authorized persons.

12. Materials must be stored and indexed according to a systematic scheme.

13. Movable, interchangeable storage units must be used as far as possible.

14. Double-binning must be used whenever possible.

15. A perpetual inventory must be maintained on all goods.

16. Balances of materials must be kept on bin tags and on balance sheets with constant independent checks between them.

17. No materials must be issued except for authorized purposes upon written requests signed by specified persons.

18. All materials—raw, worked, and factory supplies—should be carefully classified and preferably mnemonically symbolized.

19. Organization for material control must be carefully formulated and made effective by intelligent and persistent supervision.

## CHAPTER III

### PERSONNEL. ORGANIZATION. LOCATION OF DEPARTMENTS

*SUMMARY: Duties and Qualifications of Material Personnel.—Relation between Departments. Responsibility for Quality, Quantity, Time, Cost—Administrative Organization Chart.—Physical Location of Offices.*

**The Members of the Personnel—Duties and Qualifications.**—The personnel concerned with material handling must necessarily differ both in quantity and quality, as well as in organization, with the particular factory dealt with. It must never be forgotten that no material system will run itself—real men are needed in addition to best methods. In any strictly regulated material procedure, however, whatever be the type of industry, or character of personnel, the following duties must be performed regardless of whether or not the exact titles used below are employed or not, or of whether, as in the smaller plants, several of these duties may be combined in one person. The duties and qualifications here summarized are confined to those relating to material handling.

*Engineering Department.*—The function of ascertaining the proper quality of goods, considering the uses to which each article is to be put. The results are written up in purchase specifications, which are repeated or referred to on the balance sheet. The function of inspecting and testing materials upon receipt to see whether they conform with these specifications.

The person in charge of this work must in many cases possess technical knowledge of a high order, he must possess firmness, backed by sound judgment, and he therefore requires intimate knowledge of production



needs. He may often be assisted to good advantage by various advisory committees appointed for the purpose.

*Purchasing Agent.*—Responsible for purchasing all goods, as and when called for, at the lowest price consistent with quality. Responsible for the follow-up of all outstanding purchase orders, and for seeing that delivery is made when promised. It is his duty to report at once to the proper person any change in conditions in the market or in transportation which may affect the time or amount of an order of goods.

The purchasing agent should possess shrewdness and tact, technical knowledge is an advantage, and he must possess common sense and ability to hold his own in an argument.

*Balance of Stores (or Worked Materials) Clerk.*—Called also stock clerk, material clerk, material record clerk, etc. The general function of a central clearing house, as embodied in the balance sheets, for all information in regard to material on hand, material outstanding on order, material which has been apportioned or reserved to manufacturing or other needs, and material which may be further apportioned or which is considered available. It is the duty of the balance clerk to keep the balance sheet for each item up to date by posting any one of the above transactions when it occurs, to see that perpetual inventory is accurately maintained, to requisition materials for stock as necessary. His function in general is similar to that of the personal ledger bookkeeper in a bank.

*The Qualifications of a Balance Clerk.*—A whole lot of common sense. Accuracy absolutely essential. Foresight. Persistence, and constant watchfulness.

First-class people should be used for balance sheet work. Bookkeeping is more or less mechanical, but balance work requires an alert mind. Much money may be lost or made at the balance sheets. The effectiveness of the balance clerk's work, or indeed of much of the

whole material routine, depends to a considerable extent upon the proper functioning of the planning department, upon which he is dependent for much of the information which he must use.

*Works Manager.*—Besides his general supervisory duties, it is specifically his duty as regards material regulation to approve all replenishment orders before they may be honored by the purchasing agent, or to delegate this authority to other officials.

*Traffic Manager.*—An important duty of the traffic manager is to keep those responsible for the ordering of materials fully informed as to traffic conditions, so that ample allowance may be made for embargoes or other transportation upsets. Ordinarily this information should be reported to the purchasing agent who should then be held responsible for interpreting this and other relevant information into an allowance affecting the time or amount of ordering goods. It is the traffic manager's duty also to receive all goods from the transportation agent, to see that the packages correspond with the descriptions on the way bills or other descriptive documents, to certify the transportation charges to the auditor, and in general to conduct all dealings with transportation agencies.

*Receiving Clerk.*—Unpack all packages and check contents against his copy of the purchase order; make out a notification of receipt and send it immediately to persons interested. This notification or an accompanying form must contain information showing acceptance or rejection by the engineering department or other inspectors.

*Transportation Men.*—Move materials and apparatus into and out of store room and to other designated places as per directions issued by move orders.

*Storekeeper.*—Responsible for the receipt into stores, arrangement and stowage, custody, and issue from stores of all goods; systematic counts to insure accuracy



of perpetual inventory; reduction of spoilage and deterioration.

*Auditor.*—Checks invoice against notification of material received and notifies purchasing agent to secure adjustment for rejected materials. Pays for those goods passing inspection, or if the policy of taking all cash discounts immediately upon receipt of invoice be followed, pays invoices upon presentation.

*Cost Department.*—Sees that proper charges and credits are made and summarized for all material issued or returned, and that these transactions are properly taken up in the books of account.

Besides these functions, we have that of requesting material for use, exercised by various persons throughout the plant, and finally that of planning, which, while not absolutely prerequisite to partial material control is yet the center of production activities and is necessary for the accurate forecasting of material needs. The existence of an effective planning department is assumed throughout these discussions.

Naturally, depending on the size and complexity of the business, these functions may not be exercised by persons as listed above. Fewer persons may be required, or many more may be necessary in larger plants. For instance, there may be one head material man, under whom would come several storekeepers, several balance clerks, special transportation men and so on. Similarly, the receiving department may be very large in itself, consisting of several men and several stenographers; or on the other hand the storekeeper may in smaller plants serve also as receiving clerk, although this practice is open to considerable danger. Regardless of the number of persons required, however, the functions to be performed remain the same, and ordinarily it is a mistake to split responsibility for any one function between different persons; thus special considerations may require the usually unsatisfactory resort to several detached

store rooms each with its own storekeeper; these should all report, however, to one man who heads the storage function.

**Relation between Departments.**—It is obvious that responsibility for the material routine rests with many officials of the plant. It therefore becomes necessary in individual cases to determine carefully just what the relation of material regulation shall be to each of the departments affected, as well as the relation among the members of material personnel themselves, so that there may be no overlapping of functions. Although no general rule can be laid down which will suit all cases, there are certain necessary relationships which should not be lost sight of in the distribution of functions in any case. On the one hand, a too great concentration of authority and responsibility in certain hands may lead to fraud or careless work due to a lack of independent checks; on the other hand, by a too sparsely scattered arrangement work may be so slowed up as to be insufferable. The problem lies in choosing the middle ground between these two extremes. An illogical arrangement of functions, furthermore, may lead to complications quite as distressing as a too broad or a too narrow subdivision. Consider first the four major elements (quality, quantity, time, and cost) into which material handling has been divided:

**Responsibility for Quality.**—It would seem axiomatic that responsibility for quality of all goods should be centered in the engineering or other technical department. To this department, in the final analysis, must be referred all questions of quality of raw material or workmanship which affect the serviceability of the product which this department has designed. Since this technical department specifies in the beginning the quality of what is to enter into the finished product, it would seem only right that in it be centered responsibility for the inspection of incoming goods to determine



whether they be suitable for use in the product. Where a simple count and observation is all that is necessary, as is usually the case with most factory supplies, authority for inspection may be delegated by the engineering department to the receiving clerk. Responsibility, nevertheless, for this particular work of the receiving clerk must still be centered in the engineering department. There is here no occasion for divided or ambiguous responsibility in the receiving clerk's work, since quality inspection is a function which may be clearly set off from his other duties and for which he may therefore report without confusion to whomever it seems desirable. "Divided responsibility" becomes dangerous only when two persons are responsible for the *same* function or duty. The necessity for central responsibility in inspection work was illustrated in one plant where it was perfectly well understood that all technical inspection was to be done by the engineering department, but where it had been tacitly assumed that this office was not interested in or responsible for inspection of materials which did not have to go to the testing laboratory, such material having been customarily passed by the receiving clerk without specific directions for him to do so. This lack of a clear definiteness of authority caused the loss of many dollars and delayed completion of work because unsuitable goods were passed for storage.

**Responsibility for Quantity.**—The determination of what quantity of material to buy usually rests with the production department, and in any event, must be determined through a consideration of production requirements. As indicated previously, and as will be discussed in detail further on, there are two kinds of purchasing—speculative and routine. Speculative purchasing, however, when it is done for a manufacturing establishment, should be limited in amount and in time by dictates of manufacturing needs. A safe rule to follow in this respect is that when the purchasing agent is permitted

to depart from reasonably immediate needs of production in his purchases, the burden of proof must be distinctly upon him. In routine purchasing the purchasing agent is governed much more strictly by current replenishment orders.

**Responsibility for Time Element.**—The time element must be similarly divided between production and purchasing—the one specifying when to renew for all items as per material balance sheets (production requirements), the other to be responsible for the time necessary to secure the article and for seeing that it be secured in this time.

**Responsibility for Cost** rests of course with the purchasing agent. In practically all cases which I have encountered where losses were frequent due to poor material management, the underlying cause was directly traceable to an illogical or to an ambiguous delegation of these four functions. Too often, indeed, they were all thrown upon the shoulders of one man: the purchasing agent.

**Administrative Organization.**—As regards the administrative subdivision between the various members of material personnel, there exists considerable difference of opinion. Accepting the concept that materials in the sense in which we use the word exist solely for the benefit of production, it would be logical that the balance of stores (or worked material) clerk, the receiving clerk, and the storekeeper should all be under Production. This arrangement is not at all universal, however, probably the most common departure being that in which the storekeeper is under the purchasing agent. This has the disadvantages referred to previously of placing a department—the store room—which vitally affects production, under a man whose primary interest lies elsewhere, an arrangement which at times has led to serious consequences.

The ideal arrangement both for purposes of safeguards



and for incentive to quick and accurate action would seem to be to have the storekeeper directly under the works manager and the balance clerk directly under the production superintendent or the head of the planning department. Here again practice differs, for instance the balance clerk frequently reports to the head of the cost department. Since the average cost accountant does not ordinarily appreciate the vital relation between manufacturing efficiency and material control, such an arrangement again almost always works out disadvantageously. With the arrangement suggested, and particularly in the smaller plants with the receiving clerk under the traffic department, which may in most instances report to the works manager, informed and energetic action as well as ample safeguards against collusion and fraud are provided. Clerical errors, furthermore, are much more readily caught where one department is working against another in this respect. It must be emphasized, however, that these relations must vary with cases; that they are presented only as an arrangement which has been put in effect with excellent results in several different types of plants and which probably furnishes maximum checks with minimum labor and routine. A skeleton organization chart of this arrangement of the material personnel would therefore be as follows:

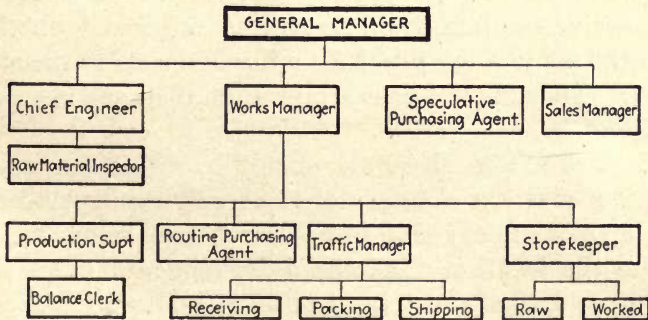


FIG. 1.—Typical organization of personnel concerned with material handling.

**Physical Location of Offices.**—The organization chart, Fig. 1, shows one arrangement satisfactory under a wide variety of conditions of the administrative relations between persons concerned with material routine, yet even with a satisfactory organization it is always necessary to consider in addition the physical location of offices so that as a whole there may be a convenient working relation between them. The layout of the room ~~room~~ proper is dealt with in Chap. VIII, but since many cases of faulty work-relationship have come to light due simply to an improper physical location of the persons themselves, it may be useful to indicate some of the considerations which should govern the placing of these various functions.

In many cases the location for any specific department will be self-evident; for instance in the case of the traffic department or at least that part of it which receives and ships packages, obviously it should be placed immediately contingent to the railroad tracks and trucking platforms. This is both for the incoming and outgoing shipments, and necessarily the packing and shipping department should be immediately adjacent to this office, whether or not these departments be under one head.

For convenience in the physical handling of packages, as well as for the transaction of the necessary paper routine, the receiving department should also be immediately adjacent to the traffic department. Here goods are received in bulk from the traffic, unpacked, checked with the copy of the purchase order and sent to the store room. They should pass a minimum distance from one to the other.

The store room, therefore, should be within reasonable truck or elevator distance of the receiving department. This is particularly true of a central store room, and of course the location of detached departmental or subsidiary store rooms must be carefully chosen with regard to delivery of incoming and outgoing goods.



Many cases have been encountered of faulty operation of the balance of stores function due simply to the location of the balance sheets relative to the other departments with which the balance clerks deal. I considered it absolutely fundamental for effectiveness that the administrative authority for balance sheets be centered in a production official. Whoever be intrusted with the supervision, however, there is but one logical location for the material balance sheets themselves:—immediately next to the planning manager's elbow or whoever the official may be whose duty it is to look ahead and plan production and material needs. He is the one who has constantly to put future requirements for production against the amount of material on hand, on order, and assigned, and his work is very much handicapped unless balance sheets are instantly accessible. This would seem almost axiomatic, and yet numerous cases have been encountered in which there was a great deal of lost motion on the part of the production manager in sending or phoning to another department for information about material—information which should have been right under his thumb. The balance sheets, moreover, should not be too far from the store room, even where adequate automatic carriers are provided. There is much work in connection with stores handling and checking which cannot be done either by the regular factory mail system, by telephone, or by pneumatic tube service, but must actually be done in consultation between the storekeeper and the balance clerk. These and similar considerations point to the conclusion that the planning or production office should be situated just as close to the manufacturing departments and as centrally located relative to them as is possible. Follow-up will thereby be made not only easier but also much surer and more systematic.

For similar reasons the cost department (as distinct from the general accounting department) should be not

only under the supervision of the works manager or the production superintendent but should be physically located close to the manufacturing department, and therefore close to the balance sheets. No matter how smooth a working system we may have, there are always innumerable questions which arise in regard to the correctness of time or job tickets, stores or worked material issues and credits, inspection slips and numerous other sources of information which have to be adjusted in consultation between the storekeeper, the balance clerk, the cost clerk, and the foreman. Here again, any sort of communicating service will serve only for a portion of the adjustments—ordinarily they must be made in person. When one has but to step out of his door as it were, to adjust some small matter, he is very much more likely to do so, and certainly can be much more readily held to account for not doing so, than would be the case where this adjustment necessitated a long trip.

The general accounting offices, on the other hand, may be located wherever convenient, and it is somewhat customary to find them in a large city many miles distant from the factory itself. There is no direct connection between general accounting and the shop, and most of the means by which costs are tied into the general accounts through reports of the cost office to the general accounting office and back again, should be worked up in the form of exhibits for the guidance of administrative officers anyhow, so that the general accounting offices may be located wherever desirable without great inconvenience.

The location of the purchasing agent's office similarly may be wherever desired, although ordinarily this should be much closer to the works than is the case with the general accounting office, because of the constant necessity of consultation and the constant passage of papers between the purchasing agent and numerous other officials of the plant.



It will be understood that the above considerations apply to the plant of medium size. With increasing size, the problem of securing a balanced arrangement between various departments becomes increasingly difficult until in a plant of very large size decentralization becomes desirable. We then get back in considering individual units to the problems of the moderate sized plant just discussed. In every case, however, administrative relationships and the physical layout must be arranged so as to secure the greatest serviceability between related departments.

## CHAPTER IV

### THE BASES OF MATERIAL REPLENISHMENT

*SUMMARY: The Market as a Basis.—Production Requirements as a Basis.—Regulation through Amounts on Hand.—Regulation through Amounts Available. Requirements of Balance Sheet. Installation of Balance Sheet; Determining Limits. Replenishment Orders.—Regulation through Schedule.*

There are two bases, other than the whims of the purchasing agent, upon which the routine for replenishing materials rests: I. the market; II. production requirements.

**I. The Market.**—For those manufacturers who deem it wise to govern the purchase of materials by the market, little discussion will be given, since such operations fall within the realm of merchandising with which I am not concerned. As indicated previously, I am convinced from experience that the business of buying and selling materials in the raw form with a view to profit is no part of the manufacturer's business and should be engaged in only after very thorough consideration of each transaction. I do not refer in this to those industries, such as the textile, where speculative or anticipatory purchasing is inherent in the business, but only to speculative buying as an end in itself and for its own sake. It is, of course, true that some manufacturers have made large amounts of money on the side, as it were, by speculative purchasing and re-sale on a rising market particularly during the continuous rise in prices following the war. It is equally true, however, that fortunes have been similarly lost, and conditions during the war are no criterion for the government of current production.

**II. Production Requirements.**—For the replenishment of supplies according to production needs, certain



definite and convenient working rules may be laid down among which, incidentally, is that concerning the state of the market. In this case, however, so far from the market's being a governing consideration, it is but one of a number of factors which must be taken into account. As will be pointed out in the next topic, there are several means by which replenishment may be controlled for the benefit of production. In all, however, the aim is to have on hand just sufficient materials of the right kind actually needed at a particular time for a particular purpose, no more and no less. Considering the cost of the articles themselves, and the cost of the work involved in handling them, there should, in other words, be a constant flow of supplies to the point of use, with a minimum but always sufficient reservoir as a safeguard. To accomplish this purpose storage is of course usually necessary.

There are three broad kinds of production which give rise to three corresponding types of material replenishment problem. The first arises in plants which run along continuously on an even keel for long periods at a predetermined rate of production. In this case, as illustrated by the sugar mill for instance, material needs are known and the rate of use remains constant throughout the run. The second arises in plants which move up and down in production with actual orders received from time to time. In this case, under which the great majority of our plants fall, as illustrated by the average machine shop or other plant which manufactures partly to stock and partly to order, material needs cannot be known accurately before the order is received, but on the other hand, delivery cannot always await the purchase of parts specially for each order. The problem then is to keep inventory as low as is consistent with quick delivery. The third kind of production arises in plants which are not so fortunate as the first nor so unfortunate as the second, but which may set definite

schedules for production of specific lines during given periods, this schedule being of course subject to change but resulting in a revised schedule as definite as the first. In this case, illustrated by the shoe factory or the specialty contract shop, material needs may be foreseen with definiteness equal to the schedule.

Each of the problems in material replenishment imposes its own particular mechanism, for it would be poor business to go to the detail in records and routine necessary in the second case, when in reality our problem deals only with the first and simplest case. Resulting from these three kinds of problems, we get three distinct plans by which material replenishment may be governed:

*Plan A.*—The ordering of materials governed by the *amount on hand* in the store bins. This ordinarily presupposes a constant rate of use with the determination of a “minimum” amount, which when reached *in the bin*, dictates the issuance of a replenishment order, and which is supposed to serve all needs up until the new order is received.

*Plan B.*—The ordering of materials governed by a *book balance available* obtained through keeping a minimum reservoir of materials on hand and looking ahead and apportioning on the books materials to known production or other needs. This provides a safeguard where the rate of use fluctuates, since replenishment orders are governed by a so-called “low limit” which is set and used so as to dictate the issuance of a replenishment order according to actual *future* needs, whether these be more or less than past averages.

*Plan C.*—The ordering of material governed by a *schedule* of anticipated production worked out for a period as far in advance as possible. This presupposes a known production during a given period, such as that of the shoe factory or the plant manufacturing entirely to stock.

The plant is fortunate which can work under Plan A



or Plan C, since in these cases material requirements are definite, and lend themselves to a comparatively simple routine. There is nothing more fatal, however, than to fool ourselves into believing that we may operate under Plan A or C when as a matter of fact our requirements do not lend themselves to quite such automatic regulation. This mistake is particularly common as regards Plan A, and to the writer's knowledge many serious losses have occurred through reliance on this simple system when a more complicated one was needed. This point, as well as a consideration of the other plans, will be brought out in the following topics. It frequently happens of course that more than one of these plans may be needed in any one factory—raw materials may require Plan B, while stationary and supplies can be handled through Plan A.

*Plan A. Governing Replenishment by Amount on Hand.*—A case occurred in one factory where after considerable statistical study it was found that the average rate of use during the past year for a certain item was 300 pieces per month. It took on the average 1 month to renew the supply. Adding 33 per cent for safety, they obtained a "minimum" of 400 below which the supply in the bin should not fall without the issuance of a replenishment order for an amount necessary to bring balance on hand up to a "maximum." This, the manager thought, was being extremely conservative, as indeed it was for the ninety-nine cases. The one-hundredth case caused a serious loss, however, when requirements rose during a given month to 450, when only 400 had been ordered upon reaching the minimum.

The same sort of thing occurred in a neighboring plant when a succession of orders was received calling for the same material. Upon receipt of each order, an inspection of the bin showed that sufficient materials were on hand to supply it. This information was obtained at different times by different persons, and no record

of each of their needs was made, since none was provided for. As a matter of fact, there was sufficient material on hand for only the first three orders, the remaining customers being required to wait until the shortage was made good.

These occurrences do not prove that this is not a perfectly good plan of re-ordering material provided conditions are such as to make its use effective. It does indicate, however, that it is effective only under conditions where the rate of use is reasonably constant. For instance, this method is satisfactory in the case of most factory supplies. Where the rate of use is not constant, this method can be made effective only through the expensive alternatives of making the minimum limit high enough to cover all exceptional demands when for 10 months out of the year a much less supply on hand might be adequate, or through eternal vigilance in the revision of minimum limits—a vigilance impossible of fulfilment where any considerable variety is stocked or where changes in rate of use are frequent. On the other hand, if the minimum is based on the 10 months' average, it is almost impossible to guard against such shortages.

In addition, in considering the inappropriateness of Plan *A* where rate of use is not constant, it must be remembered that this "minimum" on the balance sheet or a red rag or other marking of the minimum in the bin which dictates issuance of replenishment order, results in ordering a new supply of the particular item whether it is actually needed in the future or not. Plan *B*, on the other hand, reorders only according to actual seen or foreseen needs.

*Plan B. Governing Supply by Amount Available.*—Where the rate of use fluctuates or where future needs cannot be foretold for a considerable period, Plan *B*, or that of re-ordering materials by the book balance available after all known needs are provided for instead of the



actual amount in the bin, should be used. This is by far the most complicated method and yet nine times out of ten it is the method needed in the average factory for all major supplies, and is the simplest one which can adequately safeguard supply and yet keep the reserves to a minimum. The only other sure method in this case, which is a cumbersome and expensive one, is a physical apportionment—a physical setting aside of material as needs become known. The detailed operation of such a balance sheet will be given in the next chapter, only the general basis of its operation being outlined here.

Such operation implies, of course, that we shall have an accurate, up-to-date record or balance sheet for each item of material we carry. The balance sheet under this plan is the governor and safety-valve combined for the whole material routine. Out of experience, the following list of factors for such a balance sheet has grown:

Each balance sheet for each item must show:

1. Material outstanding on purchase orders.
2. Material now on hand in the store room.
3. Material apportioned, reserved, or scheduled to manufacturing orders now in our hands but not yet in process, or for other purposes.
4. Material available for apportionment to future needs.
5. A current measurement of successive requirements against amounts still available.
6. A predetermined but flexible *Low Limit* below which the amount available for apportionment shall not fall before a replenishment order is issued. This figure is based on:
  - (a) Probable rate of use during time necessary to renew.
  - (b) Time necessary to renew.
  - (c) Allowance for safety, considering the importance of the article to the business.
  - (d) How far the planning department may work ahead of the shop.

7. A predetermined but flexible *Amount to Order* when the low limit is reached. This figure is based on:
- (a) The low limit as above. Making the amount to order equal to the low limit would require another replenishment order immediately it is received. This would ordinarily cause unnecessary additional labor, so that the following tend to raise the amount.
  - (b) How often it is desirable to issue orders for it.
  - (c) The present price.
  - (d) The probable future price movement.
  - (e) Economical unit of purchase.
  - (f) The space available for storage, or the cost of rented space.
  - (g) The money available or expedient for the investment.
  - (h) The probable depreciation or obsolescence of the item.
  - (i) Necessity of curing or aging different materials.

Without becoming involved in detail at this point, it may be explained that the basis upon which the operation of such a balance sheet is built up, is that through a proper setting of the low limit, together with the advanced apportionment of material to orders, the quantity called for on a replenishment order may be considered as being available for apportionment (not issue) the moment the replenishment order is written. All amounts outstanding on purchase orders are therefore considered thus available. Materials on hand in the store room also form a part of this available reservoir.

For the operation of the sheet, we therefore get the amount on order, add to it the amount on hand in the store room and subtract from this sum the requirements



of manufacturing or other orders in our hands. The difference then becomes the amount available for apportionment to future orders.

This apportionment is exactly similar to reserving or setting aside in advance from next month's salary check a sufficient amount of money to meet an insurance bill which we know will be due. The balance of the check plus what we may already have unassigned at the time, will then be available for other uses.

By setting aside on the sheet or apportioning the needs of an order in advance, and obtaining an amount available which includes both the amount in the store room and the amount on order, we are thus not only working ahead of actual issue requirements during a period which theoretically is covered as regards issue in the setting of the low limit, but also by working definitely to known needs we are keeping the amount of inventory to the lowest possible point consistent with safety. The word "theoretically" is used in the last sentence, as even under such a method, it is of course not impossible to have a shortage of material, and the further we can look ahead the less danger there is of shortage. If a strict follow-up as regards traffic conditions and sources of supply and other related items is maintained, however, shortages under such a method of operation become exceedingly rare, and with a proper tickler system for following a purchase order, as will be explained, supplemented by frequent inventory checks and current measurement of amounts on hand (col. 2) against amounts apportioned (col. 3) such shortages may always be known several days in advance of the time materials will actually be needed.

*Steps in Initiation of Plan B.*—How is such a control set up and maintained, and how are replenishments governed by it? The steps are as follows:

1. The engineering department must furnish specifications for all articles to be purchased. Responsibility

MATERIALS DATA SHEET

REVISED TO *Sept. 30 1922*

Spec. Treatment *	A	B	C	D	E	F	G	H	J	K	L	M	N
	Item Now on Hand or to be Ordered	Symbol	Containers-Kind, Dimensions and Capacity	Pres. Inventory	Wks. Req'd. To Renew	Aver. Cons. During Renewal	Low Limit Allow. %	Amount to Order at One Time	H-No. of Weeks Supply Based on E & F	Best Method of Storage	Space Required to Store "H" + $\frac{1}{2}$ " "G"	Proper Bin to Store Quantity in Col. "M"	Remarks
	<i>Nd. H. Carr. Bolt 5/8"x2 3/4"</i>		<i>Various</i>	<i>3500</i>	<i>2</i>	<i>500</i>	<i>62 1/2 %</i>	<i>1000</i>	<i>4.0</i>	<i>Loose Double Binned</i>	<i>135" x 90" x 75"</i>	<i>#2</i>	<i>Each half holds about 1150 this size.</i>

\* Check items such as Explosives, Perishable Goods or Those Requiring Treatment out of the ordinary

\*\* To be supplied by the Purchasing Agent

\*\*\* Considering Price Trend, Frequency of Purchases, Space and Finances Available, Etc.

FABRIC

Fig. 2.—Materials data sheet, for recording various sorts of information about each item of materials.



for quality, in general, should be centered in the engineering or other technical department; every item and every requirement should be systematically scrutinized and, after consultation with interested persons, useless varieties discarded.

2. After standardizing what is to be carried in stock the second step is to secure all information about each article, including the consumption in the past, the probable future consumption, the kind and size of containers, the most economical amount to buy, and similar information.

3. From the purchasing agent and the traffic department working in conjunction secure in writing the time necessary to renew the supply from the receipt of the replenishment order in the purchasing department to the delivery of the goods at the factory door, including necessary time for securing bids, settling the conditions of sale, drawing up the contract, necessary purchasing office clerical work, and so on.

4. To this time add the necessary time for the clerical work in the production department, between the knowledge of what is wanted and the arrival of the replenishment order in the purchasing department; also the time for receiving, unpacking, inspecting, and delivering to stores or to the shop upon receipt of shipment.

5. Determine percentage for safety. This per cent will naturally vary with conditions of the market and of transportation, and also with the accuracy of estimates on the above items. Ordinarily, from 15 to 25 per cent margin on consumption during time to renew is ample, although during times of emergency these figures may have to be doubled or even quadrupled, and in any event constant vigilance and much judgment is necessary in regulating these allowances.

The form, Fig. 2, has been found extremely useful in listing and classifying these various sorts of information.

6. Set low limit. For instance:



Suppose the total time necessary to renew supply be.....	3 weeks
And probable consumption per week	300 units
Then consumption during time to re- new: $300 \times 3$ .....	900 units
Allowance for safety, say 10 per cent.	90 units
Low Limit.....	990 or 1,000 units

If we are planning say 9 weeks ahead of the shop ( $3 \times$  time to renew) we are approaching conditions applicable to Plan *C* described below, but if we are planning from hand to mouth, the low limit in this case would be accordingly raised.

#### 7. Set amount to order:

Using the illustration in the last topic, it will require approximately 1,000 units (allowing 10 per cent for contingencies) to serve production during the time the purchase order is outstanding—3 weeks. Thus if we had 1,000 units in the bin when the purchase order is issued, these would normally be exhausted just after the new shipment were received. Had we ordered only 1,000, or only a 3 weeks' supply, since it takes 3 weeks to renew, we should immediately upon receipt be forced to issue a new purchase order. Following this procedure it would mean that a purchase order would have to be issued approximately every 3 weeks. Cut the amount in half or to 500 units and a purchase order would correspondingly have to be issued every 10 days, and so on.

The amount to order, therefore, affects directly the frequency of issue of purchase orders, or looking at it the other way, the frequency with which we wish to issue purchase orders is of course one of the factors to be considered in setting amounts to order. On page 44 are listed various other considerations in determining how much we should buy when we do buy. For instance, trade custom may make advantageous or even necessary the purchase of the article in 10 gross lots, so that in

this case instead of 1,000 the "amount to order" would be 1,440 and we would purchase this quantity at one time. Considerations regarding any one of these factors may similarly affect the answer and nothing would be gained by following the method further here since in each case it is a matter to be determined in consultation between those who may be entitled to a judgment in this matter.

8. Enter on the balance sheet all information called for as explained in detail in the next chapter.

<b>REQUISITION</b>					
<b>LEWIS MANUFACTURING CO.</b>					
					No 1597
DEPARTMENT _____					
TO THE PURCHASING AGENT				DATE _____ 191__	
PLEASE ORDER THE FOLLOWING MATERIAL.					
SYMBOL	DESCRIPTION	CHARGE	WANTED	P.O.No.	ORDER FROM
APPROVED _____ SIGNED _____					
DATE ORDERED NO. _____ DAY _____ 191__					
PURCHASE ORDER WRITTEN BY _____				PER _____	
PURCHASING AGENT					

FIG. 3.—Replenishment order, for requesting purchasing agent to buy materials.

We are now prepared to establish accurate regulation of replenishment. It should be unnecessary to state that these measures in themselves will not give control. Accurate control of material or in fact of any work in a factory depends upon many features and upon the cooperation of many persons. In many cases, for instance, the first thing to do is to block out a more definite or logical division of authority and responsibility, or to lay out and rearrange the whole physical store room or other departments (see Chap. III and VIII). New forms may have to be drawn up and new procedure established. All of such auxiliary measures are here taken for granted because of the unfortunate



necessity of discussing one thing at a time. To continue the story at this point, it is necessary only to recall that when the low limit is reached, a replenishment order, Fig. 3, for the predetermined amount is sent to the purchasing agent via the proper official for approval.

This replenishment order must provide for:

1. The serial number. This is for purpose of identification of the replenishment order itself, and for entry on the purchase order and other records of the transaction.
2. The point of origin of the order, or the department or person who makes the request to purchase.
3. The date of issue of the replenishment order.
4. For what use the articles are desired, whether to replenish stock or for some other specific purpose.
5. The symbol or other short designation of article required.
6. The quantity, size, weight, length or other dimensions as per the balance sheet, amount to order, and the specifications.
7. Concise but accurate description with reference to the specifications.
8. When wanted; this is particularly important. The follow-up routine of the purchasing agent is based on this date, and it is of course unreasonable to expect him to give discriminating attention to orders unless he be informed of relative needs. As explained previously, this time must allow the purchasing agent ample opportunity for all of the operations which have to be performed in this office.
9. A place for entering the purchase order number when this is issued.
10. Preferably a space for a suggestion on the part of the maker of the replenishment order as to where the article may best be purchased. It must be understood, of course, that the purchasing agent is bound in no manner whatever to follow this advice, since otherwise it would not only be usurping the function of the purchasing

agent but would also open the way for undue discrimination or pave the way for collusion between vendors and various persons within the plant. Its use is usually confined to special or unclassified articles which may have to be made to order or which may be manufactured and obtainable from only one firm—facts which the requisitioner is often in a position to furnish the purchasing office.

11. The signature of the requisitioner. The purchasing agent should have a list of all persons (ordinarily only heads of departments) within the plant authorized to sign replenishment orders. No replenishment order should be honored even when approved by a higher authority, unless so signed, because the approving office should not be burdened with who requests, but only with what and how much is requested.

12. The approval of the works manager, production manager, or other official entrusted with this duty. This may seem a trivial matter to throw upon the shoulders of the works manager, and of course, this particular official does not ordinarily assume this duty in the larger plants, where it would be shifted to the production superintendent, or to the head material man. No procedure will work of itself, however; constant supervision is necessary to insure effective results and this requirement definitely places in one man, whomever he may be, the responsibility for exercising supervision and using his judgment in regard to revision of the various factors affecting low limits and amounts to order enumerated above.

In the case of speculative purchasing the decision should ordinarily rest with no single man, but should be reached in conference by the sales, financial, and production officials.

Any change in traffic or other conditions affecting the time and the amount in which an article should be ordered must be reported to the man held responsible.

He is also responsible for stopping replenishment orders inconsistent with probable future production requirements, for the utilization of substitute or slow-moving articles where possible, and in general for keeping low limit and order points revised up to date in accordance with production requirements. Some one official, furthermore, should be held definitely responsible, and of course given commensurate authority, for the upkeep of the whole material mechanism and these details may well be combined in one man. He must necessarily, therefore, be in close touch with production.

The replenishment order must be made at least in duplicate, the original going to the purchasing agent, the duplicate to be retained by the requisitioner; other copies may be made if required. Any number of dissimilar items may be entered on the same replenishment order without confusion or additional work in the purchasing office. The only requirement here is to see that forms be provided with the necessary cross-reference spaces between replenishment and purchasing orders and that these cross references be systematically made.

*Plan C. Schedule.*—Little need be said in regard to this method of controlling replenishment, for if future requirements for production may be definitely determined, material procedure can be systematically regulated accordingly. The whole supply may be contracted for at once and successive shipments thereafter regulated through Plans *A* or *B* on the balance sheets similar to Figs. 4 or 5, or the balance sheet described under Plan *C* in Chap. V and illustrated in connection with Fig. 6, page 65, may be used in order to govern replenishment orders. Another alternative is to keep "Schedule" (Plan C, Fig. 6, page 65) in the front office ordering from manufacturing orders released from there as per this schedule.



## CHAPTER V

### THE MATERIAL BALANCE SHEETS

*SUMMARY: Choice of Balance Sheet.—Sheet for Regulation through Amounts on Hand.—Sheet for Regulation through Amounts Available. Information Necessary. Procedure to Provide this Information.—Sheet for Regulation through Schedule.—Worked Material Sheet.—Unclassified Stores Sheet.—Balance Record Files.*

**Choice of Balance Sheet.**—The material balance records, as has been indicated, form the heart of the supply service of the factory through which material control is secured, but they should be more than this, for they should serve both production and accounting, if properly set up and regulated, in furnishing quick and accurate information as to the material status at any time—information of increasing value and reference as the business expands.

In order that production may be adequately served, it follows that the balance sheet must be designed and used according to the need of the particular type of production which it is to aid. It would be just as much folly to accept a balance sheet, wished upon you by an accountant simply because it may fit into his pet accounting scheme, regardless of whether or not it was suitable for the needs of the production manager, as it would be to copy your neighbor's shop committee system or his forms and production plan. On the other hand, elaborate forms and systems have been painfully worked up to meet so-called special conditions when as a matter of fact there was nothing very special about them and when tested, simpler means, modified perhaps with an appreciation of underlying principles and of the purposes to be served, would have been much more satisfactory in every way.

Three general types of balance of stores sheets became necessary to meet the three types of production calling for a control of replenishment under one of the Plans *A*, *B*, or *C*, outlined in the preceding chapter. Each of these three general types is found in various forms, embodying different arrangements of columns designed to provide various sorts of information. No attempt will be made to present or discuss all of the possible or existing arrangements since the variety is infinite and the particular typography is a matter largely of choice and of comparatively little moment; only the considerations necessary to the effective use of each will be discussed, illustrated by one example of each type of sheet.

**Balance Sheet for Plan A.**—*Replenishment Governed by Amount on Hand in the Store Room.*—This is the simplest form of sheet in set-up and in operation. It need provide only two main columns: (1) For data relating to material on order, providing sub-columns for date and number of requisition, number of purchase order, amount received and amount outstanding, and (2) for amount on hand in the store room, with sub-columns showing amounts issued, on what date and to what order issues are made, total value and value per unit. If the operation of the balance sheet presented and described under Plan *B* be thoroughly understood, the operation of this simpler sheet illustrated by Fig. 4 will need no explanation; no further description will therefore be given.

It must be emphasized again that such a method of regulating material has limited applicability. It is entirely safe only when the *average* rate of use employed in ascertaining the minimum stock to be kept on hand is the *actual* rate of use throughout the year; in other words, where there is an entirely uniform rate or flow of materials. Such a balance sheet must not be expected to prove satisfactory under conditions for which it is not fitted.

**Plan B.**—*Replenishment of Material Regulated by Amount Available.*—The balance sheet here presented,

SF 7 AP ARTICLE	DESCRIPTION  <b>BALANCE OF STORES</b>	PURCHASE TIME												WHEN QUANTITY ON HAND FALLS TO _____ ISSUE ORDER FOR _____ DATE _____ PER _____	\$								
		DATE OF CONSUMPTION		MONTH		RATE OF CONSUMPTION		MONTH		RATE OF CONSUMPTION		MONTH		RATE OF CONSUMPTION		SPECIAL INSTRUCTIONS:							
		JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	UNIT OF ISSUE _____									
														UNIT OF PURCHASE _____									
														AVERAGE MONTHLY RATE OF CONSUMPTION _____									
		ON ORDER												ON HAND									
DATE REC'D	REL. NO.	ORDER NO.	QUANTITY	DATE REC'D	REL. NO.	ORDER NO.	QUANTITY	DATE REC'D	REL. NO.	ORDER NO.	QUANTITY	DATE REC'D	REL. NO.	ORDER NO.	QUANTITY	DATE REC'D	REL. NO.	ORDER NO.	TOTAL COST	UNIT COST	TOTAL COST	UNIT COST	

Fig. 4.—Two column balance of stores sheet for Plan A.



Fig. 5 (page 61) and a method of control similar to that here described is the one needed for major materials in the overwhelming majority of manufacturing plants since most factories have a fluctuating rate of use. It has been in operation in many plants for a number of years, has proved entirely satisfactory under conditions to which it is adapted, and its use is rapidly increasing. In the particular form here presented it is unnecessary to state that the sheet is not suitable as it is for all manufacturing plants, although it has proved of very wide applicability. Comparatively slight modifications will adapt it to almost any type of industry, however, and I know of cases where it has been installed with success in mercantile establishments. The only situation where its use is unnecessary is when we have conditions described in Plan *A*, and sometimes *C*—conditions encountered only in special continuous types of production. This balance sheet is, moreover, suitable for use under Plan *A*, since all that is necessary in such a case is to use only the first two columns; and, as illustrated at the end of this chapter, with certain additions it is suitable for use under Plan *C*.

Before considering the details of this particular recommended sheet, it is well to review its general function in material regulation. A satisfactory regulation of materials under this plan of operation presupposes the ability to answer almost immediately the following questions. Such information may and should be embodied in one central place, the balance sheet. For each item—

1. How much has been ordered?
2. When was it ordered?
3. The replenishment order number?
4. The purchase order number?
5. How much has been received, and when?
6. How much is still outstanding on purchase order?
7. How much does balance sheet show is now in the

bin, and how does this compare with the amount actually in the bin?

8. What has been issued, and for what purpose and when was it issued?

9. What has been returned as credit, and what order or account was credited and when with amount and value of return?

10. The total value of material on hand (including transportation charges where practicable).

11. The unit value of material on hand (including transportation charges where practicable).

12. What has been apportioned or set aside for manufacturing or other needs?

13. When was it so apportioned?

14. For what purpose is it apportioned?

15. How much, if any, has already been issued against this reservation?

16. The balance still on apportionment?

17. How much is still available for apportionment to other orders?

18. When did it become so available?

Besides furnishing answers to these questions, the balance sheet must:

(a) be easy to operate.

(b) be up to the minute in record of transactions.

(c) provide an easy means of tracing each transaction.

(d) enable compilation of statistics covering rate of use, time necessary to renew supply, cost, and other information.

(e) provide a means for checking clerical accuracy of entry and balances.

In order that answers to these questions may be instantly available, around the balance sheet must revolve the following procedure: The topics are numbered to correspond with and answer the preceding list of questions:

1, 2 and 3. Replenishment orders must be originated by or

pass through the balance clerk for entry. Besides showing the amount ordered, on the sheet must also be noted the date replenishment order is issued and the replenishment order number for identification.

4. Upon issuance of the purchase order, a copy must be sent to the balance clerk showing amount actually ordered; this must be checked with the amount ordered as per the replenishment order, and any necessary adjustments made, the purchase order number must also be entered for identification.

5. Upon receipt of a shipment, a notification of materials received must be sent to the balance sheet. This must be identified with the purchase order, and must show the amount actually received, and, if convenient, also the amount passed and the amount rejected upon inspection, although this information may be sent forward later. It is important that the notification of materials received go forward just as promptly as possible after the shipment is in since requests for the issuance of material not on hand lodge with the balance clerk until they may be filled.

6. Notification of cancellation of purchase orders or of parts of purchase orders so that in conjunction with notation of orders and of receipts a running balance of amounts still due may be kept.

7. Stock count: The result of an actual physical count by the store keeper or his representative for the item, made entirely independently of any knowledge of balance as shown on the balance sheet for that item. This is one of the means by which accuracy of the perpetual inventory may be maintained, and such count may be made on a few items daily so that in the course of at least four or five months the whole store room may be covered, when the process is repeated, or the same object may be accomplished in one of the other ways discussed under INVENTORIES, Chap. X.

8. Stores and worked material issues which have



been filled, showing amount actually taken from the store room and issued to the shop or other department. These may show also, if desirable, the remaining balance in the bin after such issues have been subtracted as an additional current check on inventory.

9. Stores and worked material credits showing the amount of goods actually returned to the store room as a credit to some previously debited charge account.

10 and 11. Original or duplicate invoice, showing purchase price of the goods.

Record of express or freight, or other transportation charges against the shipment. Dividing total cost including these transportation charges by number of units on hand, gives unit cost.

12-14. Bills of material, manufacturing orders, stores issues, worked material issues, or other forms of information, showing what materials and how much will be needed in the future for manufacturing or other needs. This information is for the purpose of apportioning such demands against the material. Such information must include, for entry on the sheet: The date of these requests, and the account number or symbol to which supplies are to be charged when finally issued.

15. From the issues mentioned in 6 above, after passing through the store room for issue, is obtained and entered what has actually been issued for this use.

16. By subtraction we obtain the total outstanding on apportionment after deducting this particular issue.

17-18. By subtraction and notation of date.

To make such a record intelligible:

(a) The sheet must be so arranged as to be readily understood and followed.

(b) There must be a continuous flow of such records currently through the balance sheet.

(c) Each transaction must be complete in itself and so entered, complete identification of each entry being insisted upon.

(d) The balance sheet must form a permanent record.

(e) The balance of amount ordered, plus the amount on hand, minus the amount apportioned, must equal the amount available at any time.

In order to conform to all of these requirements, the balance sheet must have a minimum of four columns; one for entries relating to orders, the second for entries relating to amounts on hand, the third for amounts apportioned, and the fourth for amounts available. Although extremely common, the four column balance sheet is by no means universal for this purpose, and various numbers of columns from four to possibly a dozen are encountered. The features embodied in the more elaborate and clumsy sheets usually can be incorporated in the four-column sheet, and for clearness, small amount of clerical work, and general ease of operation, it is usually to be preferred. The objection most usually made to it is that it does not provide separate columns for entry of amount received, amount issued and amount still on hand, for ease in tabulation. As will be seen on the sheet itself, however, each of these entries may be readily picked out by paying attention to the respective date entries which identify each transaction in the different columns.

A review of the preceding summary of transactions necessary to the operation of this balance sheet will immediately emphasize the point so often made that the balance clerk is the hub of the material procedure. Hardly a transaction of importance occurs from replenishment to issue which does not spring from or lead to the balance sheets, and if they are properly used they constitute an encyclopedia of information to anyone who desires to know anything about the state of materials. It should be unnecessary to add that such work should not be intrusted to an inexperienced clerk, and that the most beautiful *records* in the world will not of themselves prevent material shortages.





The detailed operation of this sheet may be more readily seen by following the typical transaction shown on the sample sheet. These transactions are entered on Fig. 5.

## EXPLANATION OF ENTRIES

For examples on 4-Col. Balance of Stores Sheet, Fig. 5

- Opening*
1. *Inventory April 20, 1920; 250' On Hand; Value \$1000.00*  
(Obtained by physical count of bin contents)  
COL. 1-2 *Date Rec'd.:* 1920, 4.20, Inv.  
COL. 2 *Quantity:* 250  
*Total Cost:* 1,000.00  
*Cost per unit:* 4.0000
  2. *Apportion April 20; 50' to Order A*  
(Obtained from manufacturing office)  
COL. 3 *Date Appor.:* 4.20  
*Quantity:* 50  
*Order No.:* A
  3. *Determine Amount Available* ( $1 + 2 - 3 = 4$ ; or  $250 - 50 = 200$ )  
COL. 4 *Date:* 4.20  
*Quantity:* 200
- Transactions*
4. *Apportion April 25; 15' to Order B*  
(Obtained from current manufacturing orders going through)  
COL. 3 *Date:* 4.25  
*Quantity:* 15; enter sum 65  
COL. 4 *Quantity:* 15; enter difference 185  
*Date:* 4.25  
Check to see that  $1 + 2 - 3 = 4$ , in this case  $250 - 65 = 185$
  5. *Apportion May 1; 40' to Order C*  
COL. 3 *Date Appor.:* 5.1  
*Quantity:* 40; enter sum 105; make full check opposite previous balance 65  
*Order No.:* C  
COL. 4 *Quantity:* 40; enter remainder 145  
*Date:* 5.1

This reduces balance available (145) below the order point indicated at top of sheet "When Quantity Available Falls To," (150), so that replenishment order must be issued at once on the purchasing agent for the quantity indicated in the "Issue Order For" (300). Therefore: (see transaction #6)

6. *Order May 1; 300; Requisition #1052*  
 COL. 4    *Quantity: 300; enter sum 445*  
           *Remarks: Req. #1052*  
           *Date: 5.1*  
 COL. 1    *Date of Req.: 5.1*  
           *Req. No.: 1052*  
           *Quantity: 300*  
           Check 1 + 2 - 3 = 4
7. *Copy of Purchase Order #2 is received from purchasing agent.*  
 COL. 1    *Pur. Order No.: 2*
8. *Issued May 2; 50' for Order A*  
 (Obtained from properly signed stores issue from the store room)  
 COL. 2    *Quantity: 50; enter remainder 200*  
           *Date Issued: 5.2*  
           *Issued For: A*  
           *Total Cost: 200.00 (50@ \$4.00 each)*  
 COL. 3    *Quantity: 50; enter remainder 55; make full check opposite original apportioning entry (top line) and opposite previous balance 105, since these are now dead figures.*

This leaves 55 still outstanding on apportionment; the breaks in the vertical check show that 15 of this was reserved for Order B on April 25, and 40 for Order C on May 1.

*Order No.: A*  
*Date Issued: 5.2*

Check 1 + 2 - 3 = 4

9. *Issue May 10; 15' for Order M*

Since this has not been previously apportioned it must be subtracted both from amount on hand and amount still available:

COL. 2    *Quantity: 15; enter remainder 185*  
           *Date Issued: 5.10*  
           *Issued for: M*  
           *Total Cost: 60.00*

COL. 4    *Quantity: 15; enter remainder 430*  
           *Date: 5.10*

Check 1 + 2 - 3 = 4

10. *Issue May 15; 30' for Order C*

COL. 2    *Quantity: 30; enter remainder 155*  
           *Date Issued: 5.15*  
           *Issued for: C*  
           *Total Cost: 120.00*

COL. 3    *Quantity: 30; enter remainder 25; since this issue was for 30 whereas the original apportionment for Order C called for 40, draw a ½ vertical check opposite original apportioning entry to show that part (10)*

## FACTORY STORESKEEPING

of this apportionment is still outstanding;  
draw full check opposite previous balance  
55, and the entry just made for the issue 30.

Order No.: C

Date Issued: 5.15

Check 1 + 2 - 3 = 4

11. Received Shipment May 20; 300' on Purchase Order #2,  
Requisition 1052; cost \$250 per lb., plus \$3.00 expenses.

Quantity: 300; enter balance out-  
standing on order 00; make full check down  
to and including this balance.

COL. 1-2 Date Rec'd.: 5.20

COL. 2 Quantity: 300; enter sum 455

Total Cost: 1,430.40 (at 1.83 lb. per foot, this  
gives 549 lb., which at \$2.60 per lb. =  
\$1,427.40 cost of steel  
3.00 express

---

\$1,430.40 total cost for 300 ft.

Enter sum \$2,050.40

Cost per Unit: \$4.5064 (total quantity on  
hand 455', divided into total value  
\$2,050.40). Future issues are made at this  
new unit price.

Check 1 + 2 - 3 = 4

12. Credit May 22; 5' to Order C

(Obtained from properly signed stores credit from the  
store room)

COL. 1-2 Date Rec'd.: 5.22

COL. 2 Quantity: 5; enter sum 460

Issued for: C Credit

Total Cost: 22.53; enter sum \$2,072.93

(5 Pieces at new unit price of \$4.5064)

COL. 4 Quantity: 5; enter sum 435

Remarks: Credit C

Date: 5.22

Check 1 + 2 - 3 = 4

13. Cancel May 23 balance apportioned to Order C - 10'

(Obtained from cancel notice from manufacturing office)

COL. 3 Quantity: 10; enter difference 15; complete  
half check previously made opposite origi-  
nal apportionment; make full check opposite  
previous balance 25, and entry just made 10.

This leaves 15 still outstanding on apportionment. The break in the  
vertical check shows that this was reserved for Order B on April 25.

Order No.: C Cancelled

Date Issued: 5.23



RECEIPTION		Until Balance of Schedule is Lost, Requisition is Quantity of _____												Symbol _____		
BALANCE OF STORES		When Quantity is Issued, Subtract from Columns 3 and 4. When Quantity is Received, Add to Columns 1, 2, and 4, and Subtract from Columns 3 and 4, and, if issued to Non-scheduled Order, Add to Column 5.												Location in Storehouse _____		
INSTRUCTIONS FOR POSTING		NOTE: In All Columns, Bring Down Balance With Each Entry and Verify That the Sum of Columns 1a and 2 Equals the Sum of Columns 3 and 4.														
Date of Req'y	Requisition Number	1-ORDERED NOT YET RECEIVED		2-ON HAND				3-AFFORTIONED TO ORDER, NOT YET ISSUED				4-ON HAND I. E. ON ORDER AND ON HAND		5- SCHEDULE		
		Proc'd No.	Quantity on Each Order	Date Rec'd	Quantity	Date Issued	Charged to Order in Issue Number	Total Cost	Cost per Unit	Date Approp'ed	Quantity	Date Issued	Order Number	Date Available	Quantity	Date

Fig. 6.—Schedule balance of stores sheet for Plan C.

Description _____		BALANCE OF WORKED MATERIALS											Location in Stores _____		WKS			
		SYNSCL _____											ORDER LIMIT _____		LOT SIZE _____		MFG. TIME _____	
Assembly Parts _____																		
DATE OF MFG. ORDER	LOT NO.	QUANTITY REC'D	DATE REC'D	LOT NO.	QUANTITY	DATE ISSUED	UNIT COST	CHARGED TO	3-AFFORTIONED		4-AVAILABLE		5-ASSEMBLY		6-SALES			
									DATE ISSUED	ORDER NO.	DATE ISSUED	QUANTITY	"M"	"W"	"K"	"N"	MACH ASSEMBLY PARTS	DOMESTIC

Fig. 7.—Balance sheet for worked materials.

## FACTORY STORESKEEPING

COL. 4    *Quantity:*    10, enter sum 445  
           *Remarks:*    Cancel Balance C  
           *Date:*         5.23

Check  $1 + 2 - 3 = 4$

14. *Bin tag received May 25, hand count shows 460' on hand*  
 COL. 1-2    Make full check down to and including book balance of 460, since the two agree. If they do not agree, find out why and make necessary adjustment in accordance with instructions for such cases.

COL. 4    Check to see that balances  $1+2-3=4$ , and if so make full check to and including last balance 445.

**Plan C.—Replenishment on Schedule.**—Once requirements in materials for a considerable period in the future

UNCLASSIFIED										
CONSECUTIVE NO.	CHECK	DESCRIPTION OF ARTICLE	DATE OF REQ. 1919	REQUISITION NUMBER	PURCHASE ORDER NUMBER	COST PER UNIT	RECEIVED AND ISSUED			
							DATE	NUMBER	CO-T	CHAR-E
S 561		5 Typewriter Chairs	1-1	100	A	1-5	3	36 <sup>00</sup>	Stores	
						1-5	2	24 <sup>00</sup>	X(A)P F	
S 562										
S 563										
S 564										
S 565										
S 566										
S										
S										

FIG. 8.—Unclassified stores sheet.

are known, there are several ways in which the desired flow may be secured. Where plans may be followed without variation, the simplest method is to list or put on

ticklers the dates when the various purchases are to be made. This method, however, provides for no follow-up in case production becomes more or less than planned, and in such cases the balance sheet described for Pan A may be satisfactory where production is not too irregular or that illustrated in Fig. 6, may be more serviceable where we can look ahead a long time, but where rate of production is not predictable. This sheet is similar to that of Plan B, with the addition of a "schedule" column.

**Worked Material Balance Sheets.**—The balance of worked materials sheet, in design and operation may in many cases be very similar to that of stores. In other

STORES												
BALANCE AND ISSUED				BALANCE AND ISSUED				BALANCE AND ISSUED				
DATE	NUMBER	COST	CHARGE	DATE	NUMBER	COST	CHARGE	DATE	NUMBER	COST	CHARGE	
1-5	1	11/33		1-15	2	22/67		1-20	1	11/34		
1-10	2	22/27										
1-15	1	11/33	X(BC)F	1-20	1	11/33	X(AM)F					
TRANSACTIONS												
1-19: Ordered on Reg. #100 PO #A 5 Chairs												
1-5: Rec'd. 3 Chairs Cost \$30 <sup>00</sup> or \$6 <sup>00</sup> Frt.												
1-5: Issued 2 to Planning Dept.												
1-10: Rec'd. 2 Chairs Cost \$20 <sup>00</sup> or \$2 <sup>00</sup> Frt.												
1-15: Issued 1 to Cost Dept.												
1-20: " 1 to Maintenance Dept.												

cases the need is felt for two additional columns, which are shown and explained in Fig. 7.

**Unclassified Stores Balance Sheets.**—Little need be said in regard to the balance sheet for unclassified stores,



since its operation will be entirely clear from the sample sheet shown in Fig. 8. This is used only for items which are not regularly stocked, but which are ordered for special purposes and ordinarily issued for those purposes just as soon as received. This sheet should be inspected from time to time to catch recurring items which may be transferred to the classified list and kept regularly in stores.



FIG. 9.—Balance record files, containing over 5,000 separate material balance sheets.

**Balance Record File.**—Although loose cards of various sizes instead of sheets are frequently found in use, it is felt that in general the use of the latter is much safer and more satisfactory. The danger of misplacing a card where there are possibly thirty thousand items in the store room, each requiring at least one card, is very considerable and causes extreme annoyance when it occurs. Loose-leaf binders of this number of sheets, however, also have the disadvantage of taking up a great deal of room and of being either heavy or involving a great number of volumes. Some of the improved card-filing devices remedy both of these defects quite satis-

factorily, giving a maximum number of sheets or cards in a minimum space, making it impossible to misplace a card, and avoiding the lifting of heavy volumes since entries are made in position. Figure 9 shows a compact arrangement accommodating over 5,000 separate balance sheets.

## CHAPTER VI

### THE PURCHASING DEPARTMENT AS RELATED TO MATERIAL CONTROL

SUMMARY: *Importance.*—*Speculative Purchasing.*—*Routine Purchasing.*—*The Purchase Order.* Distribution of Copies.—*Follow-up of Orders.*—*Other Purchase Records.*

**The Importance of the Purchasing Office in Material Routine.**—The regulation of material is logically and necessarily the job of the production department. There is no more important function in material work, however, than that performed by the purchasing department, since irregularities here will destroy the effectiveness of an otherwise perfect stores routine. In modern business it is no longer the exceptional and spectacular transactions which make one plant stand out above another—it is largely the pennies saved here and there which go to form dividends. Such savings may be accomplished only through a well rounded and balanced organization, and since material routine heads into purchasing at so many points it is essential to take the viewpoint that “material control” includes all officials who in any way are responsible for or deal with this part of the business. From this viewpoint, therefore, purchasing forms a most important link in this chain. It does not follow that the purchasing agent must in all cases report to production from an administrative standpoint (see Chart of Organization, Chap. III, page 33).

The purchasing office has a chance to affect profits at every turn, and at many times the difference between dividends and bankruptcy may rest upon the transactions of this department. One instance will illustrate



the directness of this effect, where, by a decrease of 6.37 per cent in the cost of the raw materials themselves the *net profit* was increased 9.7 per cent.

TABLE I

	ORIGINAL PER PIECE	NEW PER PIECE	
Material.....	\$ .63	\$ .59	Decrease of 6.37 per cent
Labor.....	.10	.10	
Overhead.....	.05	.05	
Total cost.....	\$ .78	\$ .74	
Selling price.....	\$1.40	\$1.40	
Profit.....	\$ .62	\$ .66	
Per cent of cost.....	79.5	89.2	Increase of 9.7 per cent

It is not with technical purchasing, however, that this chapter deals. This part of the work of the purchasing office in the average plant is conducted extremely well, for the modern purchasing agent has been trained to the specific duty of securing suitable material at the best price, and various works upon the subject may be found in any library. The more routine part of his work, however, has not been sufficiently emphasized particularly as it affects the degree of control which may be exercised over functions other than buying proper. Many purchasing agents can really be lifted out of the rut into which they have fallen through standardizing the many little irregularities which distract so much attention from the work which constitutes their main interest. The importance of the many points of contact between the purchasing office and the rest of the organization dealing with materials, and some of the means by which this contact may be made more effective in practice, should become clear from the following discussion.

After the engineering department has furnished lists and specifications of material to be kept on hand, after the traffic and purchasing departments have in conjunction furnished time necessary to renew, to which has been added other allowances for clerical work and for necessary

delays, and after the material balance sheets have been put in operation through a passage for entry of all necessary papers, the replenishment order originating from the balance sheet or otherwise sets the purchasing machinery in operation. The characteristics and requirements for such a replenishment order were treated in Chap. IV. It is not strictly the purchasing agent's province to originate requests for material, although it is his duty to notify the production department or the specific man responsible for material control routine, as to any probable changes in the market or other factors which in his judgment make purchase desirable, and in the case of speculative purchasing he may originate replenishment orders. In general, however, his duties start with the receipt of replenishment order, and on this authority all of his future actions are based. It therefore follows without argument that no oral requests for replenishment must be acted upon by the purchasing agent unless they be immediately followed with a written confirmation on the proper form properly approved. A relaxation in this respect will soon put the purchasing agent on the defensive if he has not the replenishment order to fall back upon.

The discussion up to this point applies equally to speculative and to routine purchasing. Upon the receipt of the replenishment order, however, the procedure varies until the contract is closed. It is therefore necessary to treat this intermediate stage under two divisions.

**1. Speculative Purchasing.**—Whether or not both kinds of purchasing are done by one man or by different men, the only difference in procedure between speculative and routine purchasing is that in the former case the amount of any item in the speculative class called for on the replenishment order must be looked upon simply as indicating production's actual needs for the time being and not as a hard and fast amount which must be bought. In other words, the purchasing agent is not governed so

strictly by amount called for on the replenishment order as he is in the case of routine purchasing; depending on the state of the market and other factors, he may order either more or less, at a given time, than there called for. The replenishment order, however, is production's best judgment as to how much of any material should be ordered, and if the purchasing agent wishes to depart from this judgment in any specific case, he may (1) consult the production department or possibly the general

<u>APPROVAL TO CHANGE AMOUNT REQUISITIONED</u>	
To Mr. _____	
A replenishment order # _____ for _____ of _____	
(description of Article)	
has been received from the balance clerk. It is recommended that the amount to be purchased on this requisition be changed to _____ for the following reasons	
(revised quantity)	
_____ _____ _____	
Signed _____ (Purchasing Agent)	
<u>Action:</u>	
Signed:	

FIG. 10.—Approval for purchasing agent to change amount of material specified on replenishment order.

manager, or both, or (2) have blanket authority to increase by a definite amount or a certain percentage the amount called for on the replenishment order, or (3) he may if desired be required to secure written approval for each transaction, on a form similar to that shown in Fig. 10.

In any event, however, it must be made perfectly clear to the purchasing agent that it is not only his privilege but his duty to take up such cases as he thinks desirable, since production is not infallible in these matters, and since any one of the following factors may, in the purchasing agent's opinion, justify buying more or less than the quantity called for:

1. Traffic conditions. A freight embargo which gives appearance of lasting any considerable period would



immediately call for an adjustment upward of the amount to order. Here cooperation with the traffic department is called for.

2. The supply and demand for the particular article to be purchased. The purchasing agent should keep informed as to the state of production in each article and as to the probable demand throughout the country for it.

3. The probable price movement—particularly in articles which are subject to stock market speculation or which are particularly sensitive to business conditions.

4. Sales tendencies for the product in which the article is to be used. Is the demand increasing or diminishing, and is production able to keep up with or ahead of any increase? In such matters, guidance from finance, sales, and production is necessary, but such conditions must not be overlooked by the purchasing agent, and keen insight into vagaries of the business cycle is necessary to relate purchases to price and sales trends.

5. The labor market. Is an ample supply of labor available? Here again this is primarily production's concern, and yet the purchasing agent from his contact with traveling salesmen and others is in a position to furnish production accurate and current information in regard to such conditions.

6. Storage considerations. Have we sufficient room to store all that we would like, and if not, where and at what cost may adequate accommodation be secured? Will the additional cost of such storage counterbalance any probable saving due to buying in quantities far in excess of known production needs?

7. The state of the finances of the company. Is money available for buying an excess of material, no matter how desirable, and will the loss of interest on such idle money counteract any price reduction from buying in quantity?

Since most of these matters are largely questions of

judgment, the only safe procedure is for the purchasing agent to be furnished the regular replenishment orders emanating from the balance sheets. This will back up production, and in order to back up the purchasing agent, he may secure the written approval of the general manager or some other official when the amount called for on the replenishment order is departed from. In times of hand-to-mouth buying, the replenishment order will assist in preventing overstocking; on a rising market where long contracts may be placed it may still serve to secure deliveries in accordance with production needs. It may, therefore, serve a useful purpose at all times. As indicated previously, the purchasing agent is expected to initiate action even before receipt of replenishment order if, in his judgment, conditions appear to require or render advisable immediate or heavy purchase.

After a decision to purchase is made and approval secured, technical purchasing then comes into play until the terms are made and the contract closed. The procedure from then on is identical under both speculative and routine purchasing, and it is therefore continued under:

**2. Routine Purchasing.**—It may be objected that such a division of work and responsibility is limiting the purchasing agent and giving him a smaller place within the organization than that to which he is rightfully entitled. Such, indeed, is almost the invariable reaction when such a reorganization is proposed to an existing purchasing agent. That the reverse is actually true, however, in that the purchasing agent is given a much better opportunity to measure up to his responsibilities would seem to be proved by the number of plants and purchasing agents who have found such an arrangement entirely satisfactory. By such a clear definition of duties according to functional lines and abilities, assisted and controlled through a logical and simple routine, many purchasing agents have found that they could give more attention

REQUISITIONER  PURCHASE REQ. NO.  <input type="radio"/> STORES SYMBOL	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="font-size: small;">SF 25P</td> <td style="text-align: center;">CO. _____ COMPANY</td> </tr> <tr> <td style="text-align: center;">_____ MASS., _____</td> <td style="text-align: right;">161</td> </tr> <tr> <td colspan="2" style="height: 40px;"></td> </tr> <tr> <td style="font-size: small;">SHIPPING DIRECTIONS SHIP TO THE COMPANY AT _____, MASS. SHOW No. 5 ORDER THIS ON EACH PACKAGE NUMBER WANTED _____ VIA _____</td> <td style="font-size: small; vertical-align: top;">                             No. 5                               PUT THIS NUMBER ON YOUR INVOICES RENDER INVOICES IN DUPLICATE                         </td> </tr> <tr> <td colspan="2" style="font-size: small; text-align: center;">                             PLEASE FURNISH SUPPLIES LISTED BELOW, SENDING SHIPPING RECEIPT TO US ON DATE OF SHIPMENT.                         </td> </tr> <tr> <td colspan="2" style="text-align: right; padding-top: 10px;">                             _____ PURCHASING AGENT                         </td> </tr> </table>	SF 25P	CO. _____ COMPANY	_____ MASS., _____	161			SHIPPING DIRECTIONS SHIP TO THE COMPANY AT _____, MASS. SHOW No. 5 ORDER THIS ON EACH PACKAGE NUMBER WANTED _____ VIA _____	No. 5  PUT THIS NUMBER ON YOUR INVOICES RENDER INVOICES IN DUPLICATE	PLEASE FURNISH SUPPLIES LISTED BELOW, SENDING SHIPPING RECEIPT TO US ON DATE OF SHIPMENT.		_____ PURCHASING AGENT	
SF 25P	CO. _____ COMPANY												
_____ MASS., _____	161												
SHIPPING DIRECTIONS SHIP TO THE COMPANY AT _____, MASS. SHOW No. 5 ORDER THIS ON EACH PACKAGE NUMBER WANTED _____ VIA _____	No. 5  PUT THIS NUMBER ON YOUR INVOICES RENDER INVOICES IN DUPLICATE												
PLEASE FURNISH SUPPLIES LISTED BELOW, SENDING SHIPPING RECEIPT TO US ON DATE OF SHIPMENT.													
_____ PURCHASING AGENT													
<input type="radio"/>	BALANCE CLERK  No. 5												
<input type="radio"/>	RECEIVING DEPARTMENT  No. 5												
<input type="radio"/>	PURCHASING AGENT  No. 5												
<input type="radio"/>	ORDER FILE  No. 5												
	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center; padding: 5px;">PURCHASE TICKLER</td> <td style="text-align: right; padding: 5px;">No. 5</td> </tr> <tr> <td style="padding: 5px;">TICKLE _____</td> <td style="padding: 5px;">_____</td> </tr> <tr> <td style="padding: 5px;">COMPLETED _____</td> <td style="padding: 5px;">_____</td> </tr> </table>	PURCHASE TICKLER	No. 5	TICKLE _____	_____	COMPLETED _____	_____						
PURCHASE TICKLER	No. 5												
TICKLE _____	_____												
COMPLETED _____	_____												
ACK'D _____  _____	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 50%; font-size: x-small;">URGED</th> <th style="width: 50%; font-size: x-small;">PROMISED</th> </tr> </thead> <tbody> <tr><td style="height: 15px;"></td><td></td></tr> <tr><td style="height: 15px;"></td><td></td></tr> <tr><td style="height: 15px;"></td><td></td></tr> <tr><td style="height: 15px;"></td><td></td></tr> <tr><td style="height: 15px;"></td><td></td></tr> </tbody> </table>	URGED	PROMISED										
URGED	PROMISED												

Fig. 11.—The purchase order, in this case made out in 6 copies. The last one is the *Tickler*.



to those features of the work for which they have long desired more time, can stand absolutely within their own ground as defined, and yet have ample chance to influence others with whom their work is connected. It is simply a further logical extension of the modern sub-division in administrative duties whereby each man may become a real specialist in his own particular line, unhampered by irrelevant or distasteful routine, or wrongly placed responsibility.

**The Purchase Order.**—After decision to purchase is reached, therefore, the formal purchase order, Fig. 11, is issued.

This must provide for.

1. The serial number of the purchase order. This gives a cross index between replenishment order and purchase order, since when the latter is made out its number must be entered to the replenishment order and the replenishment order number entered to the purchase order. In case one replenishment order calls for several articles requiring several corresponding purchase orders, care must be taken to see that these cross reference entries be completed.

2. The name of the company who is making the purchase.

3. The date of the order.

4. The name of the vendor from whom the purchase is to be made.

5. The quantity and description of the goods ordered. This should be specific, so that if there is any mistake in the goods the vendor cannot lay it to our lack of definiteness or detail.

6. The date delivery is wanted. This again is just as important on the purchasing order for the information of the vendor as it is on the replenishment order for the guidance of the purchase agent.

7. Shipping and billing directions. Much trouble is caused in every receiving department because incoming

packages are improperly marked. The necessity of marking all packages on the outside with the purchase order number should be emphasized in a prominent place on the face of the purchase order.

8. The symbol or other short designation of the article ordered. This is for definiteness and to save clerical work in writing and re-writing long names.

9. The name of the requisitioner.

10. The department or person for whom ordered.

11. The replenishment order number (see use under 1 above).

12. The signature of the purchasing agent.

The matter listed under numbers 1, 2, and 7 as far as standard shipping and billing directions go, may of course, be printed on the form when it is set up.

The purchase order must be made in varying numbers of carbon copies according to circumstances and procedure. Ordinarily there should be the following:

1. The original to be mailed to the vendor.

2. A copy for the requisitioner.

3. A copy for the purchasing agent's office to be filed by serial number of the purchase order.

4. A copy for the purchasing agent's office to serve as a follow-up tickler.

5. A copy for the balance and receiving men.

In addition to these, various other copies may be needed; for instance one for each department foreman who is to work upon the material ordered, one for the auditor, and the commitment record, and so on. Ordinarily, however, the five copies listed serve as a simple and effective basis for strict control and follow up. These will be commented upon in the next topic in the order in which they usually come into use.

**The Follow-up of Outstanding Purchase Orders.**—The purchasing agent's obligation should by no means cease with the dispatch of the purchasing order. Upon him falls the duty of specifying time necessary to renew;

his responsibility, therefore, commences with the receipt of the replenishment order and, together with that of the traffic department, continues until the goods are laid down at the factory door in the time set. It therefore behooves him not only to allow himself plenty of margin in quoting such delivery time, but also to notify the production department immediately if for any reason he receives a replenishment order calling for delivery at a date which he knows cannot be lived up to, for his acceptance of this date throws upon him the responsibility of having the goods on hand at the time set provided the request is made within the allowable time.

In order that all data in regard to each transaction be readily available, and that adequate supervision of outstanding orders be possible, it is necessary first that an automatic follow-up of each order be secured, second that complete information covering the articles ordered themselves and amounts of various articles outstanding with any vendor be obtainable, and third that adequate files of catalogs, specifications, quotations and similar material be readily available.

The use of the copies of the purchase order enumerated above by which this follow-up of each order is obtained follows:

1. *The Original*.—This goes to the vendor and should leave no doubt in his mind as to exactly what and how much is wanted, when shipment is desired and how it is to be made, and terms of purchase.

2. *Requisitioner's Copy*.—Upon receipt of this copy it is the requisitioner's duty to check its accuracy and to report back immediately to the purchasing agent if it is not satisfactory in every way. His failure to do so throws back upon him responsibility for mistakes in the order itself, since the purchasing agent becomes relieved of this responsibility by forwarding a duplicate copy of a correct transcription of the replenishment order. This



copy carries back to the requisitioner the only notification he has of the purchase. It must bear the purchase order number so that this number may be given the purchasing agent when requesting information as to the transaction.

3. *The Purchasing Agent's Copy by Purchase Order Number.*—This copy should be made out on paper suitable for permanent filing in a loose-leaf binder, where each new order should be filed by serial number when issued. On this copy should be entered all notations of action taken in the case, so that a summary of all transactions may be instantly available. If the terms of purchase are modified after the original order has been mailed, if a new delivery date has been agreed upon, or in fact if anything has occurred to modify the original agreement, notation to this effect should be made on this copy. Progress of fulfilment of the contract should appear here, and when it has been completed this copy should be so stamped. It remains as the permanent purchasing office record of the transaction, supplemented by correspondence and other matter in the letter file.

4. *The Purchasing Agent's Tickler Copy.*—Every purchase order sent out should have a delivery date indicated on it. This date may be of vital concern or of comparatively little moment as the case may be; nevertheless some date must appear. This date, moreover, must go out with the expectation that the vendor will live up to it or notify us to the contrary immediately upon its receipt or when he finds it impossible to do so. The burden of the follow-up, however, must rest upon the purchasing agent, since no one will look after our business for us if we fail to do our part. Depending upon the urgency of the order, therefore, the purchasing agent will enter a date on the tickler copy when he wishes the transaction brought to his attention. The date of delivery may be, say, August 1, and since it is imperative that the goods be received not later than that date it is desir-

able to follow up the order on July 25. This date, July 25, would then be entered as the tickler date, see Fig. 11 (page 76). The tickler copy would then be filed in a special tickler cabinet with drawers or guides for each month

Form No. SF 5 AR

.....192

Gentlemen:

Please advise by return mail, when our order No.  
 date and wanted will be shipped.

LEWIS MANUFACTURING COMPANY  
 MAKERS OF **Curity** PRODUCTS  
 WALPOLE, MASS.

Address reply to Purchasing Department.

FIG. 12A.—Postal Follow-up: for requesting shipment date of outstanding purchase orders.

.....192 .

Gentlemen:

Your Order No. will be shipped  
 from on  
 by Freight  
Express  
Parcel Post

Signed .....

FIG. 12B.—Postal Follow-up: for vendor to report shipment date of outstanding purchase orders.

of the year and folders for each day of the month. When July 25 arrives, the clerk will remove all papers in that folder, which may contain not only this copy of the purchase order but also any other matters to which the purchasing agent desires his attention called on this date. The tickler copy will be laid on the purchasing

agent's desk, when he will take such follow-up measures as he deems desirable. Figure 12 has been found satisfactory for this purpose, and results in a considerably higher percentage of replies than where the routine formal letter, requiring on the part of the vendor the repetition of information identifying the order, is used.

When delivery of an outstanding order is delayed, or when the purchasing agent obtains information that it will be delayed, he must immediately notify the requisitioner to this effect. It may of course not be considered necessary to follow up every order before shipment is due from vendor, for to do so entails much additional work. On the other hand, some plants find it advisable to follow up systematically all orders 3 or 4 days before they are due. Such procedure is recommended particularly during upset traffic conditions. In any event, however, the purchasing agent is not ordinarily in a position to, and should not be expected to differentiate between those articles for which there is urgent need and those which may come along somewhat after the date promised, so that if receipt is to be delayed he must immediately send to the requisitioner a notice to that effect. Then, according to the requisitioner's reply as to urgency of delivery, he may deal with the exceptions only, letting the shipment go for a few days or bringing all possible pressure to bear for quick delivery as the particular case demands.

After the follow-up is obtained and a new delivery date is set, another follow-up date is entered on the bottom of tickler copy and it is again filed under that date and when shipment is complete it may be destroyed or otherwise filed as desired.

5. *The Receiving Clerk's Copy.*—This copy of the purchase order may first pass through the balance clerks for posting to the proper balance sheet, either classified or unclassified. It then goes to the receiving man who posts it temporarily for the inspector to note and then



files it by name of vendor, or a separate copy may be made for information and retention by the balance clerk.

It is well to let the inspector look over the receiving man's copy of the purchase orders as soon as they are received, particularly in the case of large orders, so that he may make arrangements for inspection himself, delegate this work to another, or give any necessary directions for it.

**Other Purchase Records.**—Before taking up the final stages in the receiving of goods, the other records necessary to adequate purchasing regulation may be pointed out. We have described so far the following records:

1. Original replenishment order. After the resulting purchase order is made out, this replenishment order is filed by date of requisition.

2. Copy of the purchase order filed by serial number.

3. Requisitioner's copy of purchase order.

4. Tickler copy of purchase order.

5. Balance and receiving clerk's copy of purchase order.

In order to conform to the requirements listed on page 79, it is necessary further that the purchasing departments have records as follows:

6. Alphabetical letter file for correspondence with various vendors. This file should be supplemented by a tickler file.

7. A card index or other record by material. These may be filed either by name of material, or preferably by symbol if symbols be used. In any event, this form should show description of material, date of various replenishment and purchase orders, from whom purchased, quotation and delivery. Such extensive data is unnecessary in smaller plants and I have found some purchasing offices conducted perfectly satisfactorily where this record shows only name of article and changes in price.

8. Vendor's file, showing name and address of each vendor with whom we deal, articles purchased, terms and deliveries. This record again may be unnecessary in smaller plants.

9. Catalog file. Some systematic method should be adopted for filing catalogs, since in the average purchasing office constructive use is not made of them due simply to their inaccessibility. A system of numbering at least each catalog should be employed, and a card index by article should refer to every catalog in which this article is described. Another card index by manufacturers should show the file number of each manufacturer's catalog.

Depending on the type of balance sheet used and the information which is summarized on it, some of the above records can be eliminated. For instance, suppose it is desired to find the names of the various vendors from whom we have ordered a certain article during the past year; instead of the purchasing agent's being required to keep such data, a request to the balance clerk to give us from the proper balance sheet the purchase order numbers for each purchase of this article will enable us to turn at once to the copy of the purchase order filed by serial number. Similarly information covering delivery times may be obtained from the balance record. No attempt is made here to specify what shall and shall not be kept in each case, since this is a question to be determined in each instance and depends on various factors. With these records, however, or with suitable combinations or substitutes, any question in regard to material, vendors, prices, or follow-up may be readily ascertained.

## CHAPTER VII

### TRAFFIC, RECEIVING AND INSPECTION DEPARTMENTS

*SUMMARY: Importance—Function in General—Place in the Organization—Traffic Function—Receiving Function—Inspection Function—Checking Invoice and Paying for Goods.*

**Importance.**—In considering one after another the various departments upon which the adequacy of material handling depends, there is a temptation to say as regards each that its function is “particularly important.” The statement in each case, however, is literally true, for as emphasized previously the material cycle consists of interdependent operations, a weak link in any one of which may neutralize exceptional carefulness in all of the others. The work of receiving and inspecting incoming materials is often performed in a perfunctory manner, with the result that we sometimes accept what was not ordered, we pay for more than was actually received, or we think some item has not been received when it may actually be on hand, or vice versa.

A case in point may be mentioned: In one factory the apparently harmless fact that the receiving department, a large room on the lower floor of the storehouse, had two entrances instead of one, caused trouble until one of them was permanently locked. Receiving customarily was done through the front entrance, but on one occasion a strange driver left some much needed material just inside the side entrance, gave a whistle, and departed. A frantic search some days later revealed the parts, but only after three machines had been shut down for 2 days. All the care in establishing limits, in accuracy of inventory and in keeping correct balance sheets is of no avail along side of some of these “tremendous trifles.”



**The Function of Traffic and Receiving Departments.**—

Some comments on the administrative relationship of the Traffic and Receiving Departments will be found in the next topic. Whether these two departments, together possibly with packing and shipping, be concentrated in one department to whom each of the men in charge should report, does not concern us as regards the general functions of this part of the process. For convenience, traffic and receiving functions are summarized together, followed by discussion of some of the details of the work of each office.

The duties devolving upon these departments are as follows:

1. Unload cars quickly, and check for accuracy of way-bill and transportation charges, and for condition of packages.
2. Unpack packages promptly and check for amount of goods actually received.
3. Check for quality of goods actually received (by regular inspector when necessary).
4. Notify the proper authority as to unacceptable goods.
5. Dispose of rejected materials as directed.
6. See that all goods delivered are properly recorded, notify the proper person of receipt, and forward accepted goods as directed to the store room or elsewhere.
7. Report embargoes or other traffic upsets.
8. Trace shipments as requested, and conduct all business with the railroad or other transportation agents.

The various considerations necessary to making these operations effective in practice will be taken up in succeeding pages, but before doing so the general background of this work as related to the other departments concerned with material, may be touched upon.

**The Place in the Organization of the Traffic and Receiving Departments.**—In order that the officials charged with carrying out the requirements listed above

may be free to exercise this function to the best advantage without vexatious restrictions of red tape or personalities on the one hand, and with due regard for disinterested supervision and sense of responsibility on the other hand, it is necessary in each case to consider carefully just how these functions are to be lined up.

Almost every conceivable arrangement of personnel is found in practice, varying all the way from those which would seem suitable for almost any business to those which unquestionably are unsuitable for even the business where they are in operation. In the latter class would fall cases where the storekeeper acts also in the capacity of traffic manager, conducting all transactions with transportation agencies, and in the capacity of receiving clerk, opening, inspecting, and recording all goods actually received. This arrangement violates a cardinal principal of organization—balance—in that there is a too great concentration of authority in one subordinate's hands leading not only to the possibility of fraud but also to a minimum amount of automatic checks in clerical errors or other mistakes. There is ordinarily no objection to having both kinds of receiving—that is receiving from the railroad in bulk, and the receiving which constitutes the detailed count—in one man's hands, or in two person's hands both of whom report to one man, since the two operations deal with distinct items in that one is entirely in bulk and the other entirely by piece. This arrangement is frequently found and is not nearly so bad as that in which the storekeeper is asked to perform all these functions.

An arrangement which has been found satisfactory in numerous cases is to concentrate all inspection of incoming materials in the engineering department; to have the traffic manager, under whom falls bulk receiving, packing and shipping, reporting, except in the larger plants, to the works manager, the storekeeper being also under the works manager; while the balance

clerk is removed from the influence of the storekeeper and reports to the production superintendent. Although this arrangement naturally is not to be recommended indiscriminately for all cases, it serves to illustrate the breaking up of responsibilities so that adequate supervision and checks may be provided for. This arrangement is shown in the chart in Chap. III, page 33.

**The Traffic Function.**—It should be the duty of some one official in the plant, who should be held responsible for the proper exercise of his duties, to conduct all dealings with transportation agents, certifying to charges, unloading cars promptly so as to avoid demurrage charges, certifying as to condition of packages upon receipt, keeping interested persons informed of the traffic situation generally, and tracing shipments, both incoming and outgoing, as requested. Where detailed receiving comes under traffic, he would also be responsible for the other activities listed at the beginning of this chapter; these, however, are treated under the receiving functions below.

The details of the procedure in the traffic department will be touched upon only so far as necessary to get a clear idea of its part in the whole material routine and the duties here listed are by no means inclusive of its whole function. When the car or other load of incoming goods arrives at the receiving platform, it is the duty of the traffic department to unload all packages, reporting car and seal number to the traffic manager. If seals or packages are broken or missing this fact is noted and the seal or package number recorded. A record of all packages unloaded is made by the receiving crew foreman. This record, or freight register, shows the date, the shipper, the point of shipment, a description of the packages, with case numbers if any, the weight, the charges where these are known, the way-bill number, the car number and initial, with time of placing, un-



loading and releasing. It may also provide for notation as to charges against which cost of material shall be made. The original of the freight register should be sent to the traffic manager, who may add transportation charges, whence it goes to the balance clerk for entry of such charges on the balance sheet. It may then be returned to the traffic office for filing.

Similarly, express and parcel post matter as well as periodic trucking charges, may be entered on the freight register if desired. Any claims for damages, shortage, and so on, are taken up later by the traffic manager.

**The Receiving Function.**—The general function of this department is to unpack all packages and check amount of goods actually received against goods ordered; to see that an inspection for quality is made by the proper person in accordance with inspection instructions; to send a notification of receipt to the proper person; to report upon unacceptable goods and to dispose of them as directed, and to forward all accepted goods for storage or use.

In order that this work may be performed expeditiously and accurately, it is important that the receiving clerk be furnished with a complete copy of the purchase order. Some firms refuse to tell the receiving clerk the quantity ordered, but by using a short carbon above the receiving copy omit the record of quantities expected under the supposition that his count will be more carefully made, and that there is less chance for mistakes or fraud when he has no knowledge whatever of the quantity due. This practice in general is not to be commended. Depending on the type of personnel available, and the character of goods handled, there may in some instances be an excuse for thus leaving the receiving clerk to work in the dark, but ordinarily a man of proper caliber should be secured for these duties, allowed to work in the most expeditious manner possible, and held strictly accountable through other means. To avoid

unnecessary loss of motion through a double handling of papers at both ends, he really needs this information so that he may make an immediate recount, which the proper type of man will make of his own accord, in case his first count does not agree with the quantity called for on the purchase order, without having to report back to the purchasing agent and make the recount only some hours later after that official requests it. He often needs it to identify each item received with the corresponding item on the purchase order, and if inspection is to be expedited, the quantity as shown on the purchase order and on the receiving slip should be brought into agreement before goods are forwarded to the inspector. An additional copy of the purchase order, furthermore, must be made for the balance clerk's check of quantity ordered in case the receiving clerk's copy cannot be used for this purpose. On the other hand, the practice of forwarding complete information must be surrounded with ample safeguards.

One of these copies of the purchase order, then, should be forwarded to the receiving clerk, and as indicated, this may, if desired, go *via* the balance clerk for notation on the balance sheet of purchase order number and amount ordered, and then be forwarded to the receiving clerk. In case separate copies are furnished receiving and balance clerks, the balance clerk would file his copy according to vendor until notification of receipt reaches him, the receiving clerk filing his copy by name of vendor.

Packages are delivered from the traffic department to the receiving clerk, together with an accompanying copy of the freight register when it is considered necessary to secure an additional check by having the receiving clerk see that all bulk items on the register are accounted for—a precaution necessary only in very large plants. It then becomes the duty of the receiving clerk immediately to unpack each package, check actual contents with his

copy of the purchase order, and for each purchase order make out a Notification of Materials Received. This notification must show the name of the vendor, the number of the purchase order, the date received, the name or symbol of each article, the quantity received, and the quantities accepted and rejected, the last two items being filled in by the inspector where necessary. Besides the signature of the receiving clerk, therefore, the form must provide for the signature of whoever does the inspection, and finally, if the notification is to accompany

SF LAB CO.	<b>NOTIFICATION OF MATERIAL RECEIVED</b>							No. _____		
From _____										
On Purchase Order No. P. _____, I have this day received the										
Following Total Quantities _____					Signed _____			Date _____		
Storekeeper or his Representative										
SYMBOL	Total Ques Received	Kind of Units	Net Weight	Quantity Accepted	Quantity Rejected	Weight of Rejected	Total Cost	REMARKS		
I have inspected the above material and find them as stated										
Signed _____ Date _____ Inspector or Requisitioner										
I have entered the accepted quantities on Store Tags										
Signed _____ Date _____ Storekeeper or his Representative										
I have entered the accepted quantities on Balance Sheets, including the price \$ _____										
Plus \$ _____ for Freight Express Mail Signed _____ Date _____ Balance Clerk										

FIG. 13.—Notification of receipt.

the goods themselves, for the signature of the storekeeper when goods are delivered to him. This notification of material received may take any convenient form, and for illustration Fig. 13 shows an example of one found satisfactory under many different conditions.

The notification of receipt must always be made in at least two copies, sometimes in more depending on the exact procedure decided upon. If bin tags for each item are in use in the storeroom, as I believe they should almost invariably be, two copies of the notice of receipt will serve; one to be sent immediately to the balance clerk, the duplicate to be filled according to vendor in receiving clerk's file, and the bin tags after being made out



by the receiving clerk are forwarded with the goods, after they have been inspected, to the storekeeper who must see that tags and materials agree. As goods are counted by receiving clerks his copy of the purchase order is checked to show full or partial receipt, and if shipment is complete for this purchase order it is so stamped and attached to the original of the notification of receipt and forwarded with the goods to the inspector thence to the balance of stores clerk; if partial receipt, it is so checked and refiled until the full shipment arrives.

In addition, a summary of receipts may be found useful. A report of all items received is sent daily to the purchasing agent so that he may more quickly follow up his outstanding purchase orders. If this report was not made to him, he would undoubtedly get into considerable difficulty as the copy of the notification of material received which is eventually sent to him is often held up at the balance cards for a few days waiting for the invoice.

**The Inspection Function.**—It is the duty of the person responsible for inspection to see that all incoming goods are suitable for the respective uses to which they are to be put. The designation of the quality of the goods, where such designation aside from trade names is necessary, should and ordinarily does fall to the engineering department; for that reason concentrating under the authority of the engineering department the final determination of whether any particular item conforms to the original specification, is recommended.

There are two general classes of specifications: First, for those materials which it is necessary to define in detailed technical terms and which may have to pass inspection other than that usually given to incoming material, or which may be subject to special laboratory tests; second, for those materials for which there exists well recognized standard commercial trade names and qualities. For the first class of materials, specifications must be carefully

drawn up, reduced to writing and rigidly maintained. Judgement, however, must be exercised to prevent over-refinement, and care must be taken to see that some special qualifications are not inserted when an existing trade article would as well serve the purpose. In the latter class, the standardization may often stop with a simple designation of a few standard kinds which are to be thenceforth carried. Even in this case, however, every item and every use should be scrutinized in an effort to reduce just as far as possible the varieties to be retained. Upon such a house cleaning, it is not uncommon to find the number of varieties cut in half.

Depending on the type of industry, and the resulting type of materials, much of the work of inspection can be delegated to others; for instance, the receiving clerk can inspect (really count) much of the stationery and factory supplies. He should be delegated to sign the inspection report in the name of the engineering department for this part of his work. It is customary in many plants to put upon the purchasing agent the determination of quality. Aside from the fact that this places upon that official a function for which the engineering or other technical department may reasonably be considered better trained to perform, it has the same objection that entrusting inspection of work in process to the foreman or production superintendent ordinarily has, in that it is a concentration of inconsistent functions under one head; the foreman and production manager on the one hand are held for *volume* of production and *low cost*; the purchasing agent on the other hand is held for securing specified articles in the specified time at a proper cost. Although neither the production nor the purchasing officials can consider their work properly done unless quality is maintained, it nevertheless follows that the main part of their attention must be directed elsewhere than to quality, and that it is leaving in the hands of interested persons the determination of a

factor upon which it is difficult for them to give an unbiased opinion where it may reflect upon their own competence in handling their main function; in cases of doubt they are too likely to accept materials which should be rejected. Inspection is often the weakest link in the material cycle; only by entrusting it to disinterested officials operating under a systematic routine may it be brought to the state of effectiveness necessary for strict material regulation. To insure systematic handling of this important work of inspecting incoming goods and definitely to fix responsibility in case of delegated inspection, the inspector may use a rubber stamp which, when placed on the receiving man's copy of the purchase order, serves as a record of the inspector's having noted the order, as directions for the man who is to make the inspection, and for what kind of an inspection is necessary, and serves to fix responsibility in case defective materials are passed.

It is necessary not only that inspection be done thoroughly and systematically, but that it be done promptly. Losses in production due to the lack of the necessary material on hand are all too common. Losses due to improper materials put into work in process without inspection are also common. The longer the time elapsing between receipt of goods and final disposition in the storeroom or other department, the more chance there is for confusion and for unnecessary storage. In case of defective material, furthermore, the vendor must be notified within a reasonable time if claims for adjustment are to be entertained. Everything consistent with thorough work should be done to shorten the time between arrival of goods and completion of inspection.

Inspection consists of several types, differing considerably in the amount and character of work necessary. Inspection for superficial surface defects, scratches, atmospheric action and so on, is of the simplest type



and ordinarily may be cared for by the receiving clerk. The second type of inspection, that of passing upon quality, size, finish, texture, color, and so on, is usually of a more technical nature, and should be entrusted to a representative of the engineering or other technical department. The third type of inspection, that of the determination of composition and tensile properties, similarly must be left to the technical department through its testing laboratory.

Similarly the time and place of inspection may vary according to the circumstances. Inspection of certain classes of work may more readily be made in the maker's plant than in our own receiving room. Thus, in the maker's plant we may have our own representative to pass on the quality of goods during manufacture. Again, such inspection may be made at the maker's plant when the goods are finished, or samples may be forwarded to our own testing laboratory before the goods are shipped to us. In cases where inspection is made prior to receipt in our receiving room, a certificate of inspection should accompany the goods, which certificate will then be attached to the notification of material received and serve the same purpose as the inspector's signature on the notice.

**Checking the Invoice and Paying for Purchases.**—As soon as the notification of receipt has been properly filled in and signed by the inspector, the original copy together with receiving clerk's copy of completed purchase order, should be forwarded as promptly as possible to the balance clerk. Either before or after the goods themselves are actually received the invoice may arrive at the purchasing agent's desk. This invoice preferably should be rendered in duplicate, one copy being sent by the purchasing agent immediately to the auditor for payment so as to secure any cash discount, the other copy going to the balance clerk. If the copy of the invoice arrives at the balance clerk's desk before the

notification of receipt, the invoice is filed by name of vendor. In case the notification of receipt arrives first the entry as to amount may be made on the balance sheet and actual issues against goods may be made. Since there is no price available in such cases, all such issues have to be held at the balance clerk's desk, upon their return from the storeroom after materials have been disbursed, for later entry of issue price before they are finally forwarded to the cost department. This allows one to proceed with the work for which the goods are needed but holds up the final closing of the books in the cost department until the invoice is received and the stores issues are priced, unless an estimated or standard price be entered on the issues so as not to hold them up. As soon as both invoice and notification of receipt are received the balance clerk checks goods billed on the invoice against goods received for on the notice of receipt, returns duplicate invoice to purchasing agent for adjustment in case of discrepancy in amounts, enters the actual amount in the received column of the balance sheet, adds transportation charges (obtained through the freight register)<sup>1</sup> to the invoice price and obtains new unit price for issue. Any stores issues for goods previously issued may then be withdrawn, priced and forwarded to the cost department. The notification of receipt and receiving copy of purchase order, together with duplicate invoice should then be immediately forwarded to the purchasing agent who should independently check all invoices and notices of receipt. Notation of all adjustments or other transactions with the vendor should be made on copy of purchase order filed in the purchasing agent's file by serial purchase-order number. The receiving clerk's copy of purchase order may then be forwarded to the auditor (with or without notification of receipt, as seems desirable), but finally the original

<sup>1</sup> Monthly bills for trucking charges may either be carried through the freight register, or taken to an overhead account.

notification of receipt together with receiving copy of purchase order and duplicate invoice are filed in the purchasing agent's office by name of vendor. In case we are dealing with vendors where we are not sure that satisfactory adjustment will be readily made, it is necessary, of course, to hold voucher for payment of invoice till notification of goods actually received has arrived.



## CHAPTER VIII

### THE STORE ROOM—LAYOUT, EQUIPMENT STOWAGE AND PROTECTION. MAINTENANCE STORES

**SUMMARY:** General Requirements—*Layout:* Location and Responsibility. Centralization vs. Decentralization. Responsibility. Departmental Supplies. Arrangement. Indexing.—*Equipment:* Racks and Bins. Double Binning. Minor Equipment—*Stowage:* Definitions. Rules for Stowage—*Protection:* Fire and Explosion. Rust. Deterioration. Pilfering. *Maintenance Stores:* Supplies and Spare Parts. Tools and Fixtures.

As is true of most other phases of material handling, the details of the arrangement and operation of the store room must naturally be developed to meet local needs. The store room, however, serves the same purpose in the factory that the bank vault does in the storage and safeguarding of money, and no material procedure can be considered complete unless a thorough study of needs as regards the store room has been made and unless its operation has been systematically tied into the rest of the routine.

The requirements for the storage of different materials in different types of industry may vary tremendously. Thus, in some cases much material may be stored in the open and under such conditions it would be money wasted to build a house for its accommodation. Other supplies may be stored out-of-doors provided a roof be erected to keep rain and snow from coming into direct contact with the material. In other cases, however, adequate housing must be provided if losses are to be guarded against, and it is with particular reference to this latter class of goods that the following remarks apply, although the problems of storage outside or inside are in many respects similar.

**Layout.—Location and Responsibility.**—In considering the physical location of the one or more store rooms which may be necessary and the responsibility for the operation of each one, a great many different things have to be taken into account. On the one hand, the obvious benefits of centralization in one storage place have got to be weighed carefully against the offsetting cost of transportation and the often less efficient service to the departments where materials are needed if complete centralization is in effect. A careful study of floor plans and of the paths of travel of materials must be made to give the best location, all things considered, for the store room, and at best in any large factory this question is a perplexing one.

Somewhat akin to the foregoing considerations are those affecting the determination of whether raw materials and partly worked or finished parts are to be stored in the same room. Are factory supplies, furthermore, such as clean cotton waste, oils, lubricants etc., to be kept in the same store room with raw materials? Are special stores used only in one department to be stored in or contiguous to that department or in the central store room? If, through considerations of service to the departments concerned, departmental supplies are to be stored in the department, how is accurate control of inventory and of receiving and issuing in general, to be obtained? On the other hand, if such supplies are to be kept in the central store room because of concentration and more accurate control possible through such arrangement, how is the procedure to be arranged so that service to departments be not sacrificed?

The same questions arise as to the storage and responsibility of spare parts for machines and for all the miscellaneous items of supplies used in the maintenance department. Since the latter department is itself strictly a service department for the whole establishment, very careful consideration must be given to the storage and

handling of maintenance supplies so that this department and therefore the rest of the plant may not be handicapped through restrictions in the material supply.

One may not safely generalize in answer to such questions. On the other hand, however, there are certain considerations which must not be overlooked in the answer to any one of them under given conditions, and the following observations may assist in avoiding some of the mistakes frequently encountered in practice because of superficial attention to the various points involved.

*Centralization vs. Decentralization.*—There are many undoubted advantages of centralizing the storage of all materials in one place. Serious consideration, particularly in small and medium-sized plants, should be given to this possibility. Foremost among these advantages is that of being able to fix responsibility for all functions which a store room is supposed to perform. Supervision under such circumstances may be much more easily obtained and of a stricter and more detailed nature than is possible with scattered storage. Inventory, furthermore, may ordinarily be kept not only more accurately but also at a lower figure through the avoidance of the duplication almost inevitable with several store rooms. Better space utilization may, for the same reason, be secured, and clerical help needed in store room attendance and in balance sheet and all other clerical operations may be lessened.

As opposed to these advantages are the disadvantages of additional transportation and a less intimate knowledge of local departmental needs and customs on the part of the central storekeepers.

*Responsibility.*—Whether centralized or decentralized storage is decided upon, the responsibility for all receipts into stores, storage, custody while in stores, and issue from stores, should be strictly centralized. If there are subsidiary store rooms, they should be all definitely



placed under the supervision of a head material man for the whole establishment. In no other way can the uniformity in practice necessary to strict control be secured. There may be one storekeeper required on full time for each subsidiary store room, possibly more, but all of the storekeepers and assistants should look up to one man, who in turn is held responsible by the manager for the upkeep of the whole material end of the business. Just so far as possible the same routine in receiving, accounting for, and issuing materials should be followed throughout all store rooms.

*Departmental Supplies.*—In general it has been my experience that whether we have departmental store rooms from which articles are issued to the workplace, or whether we have no departmental store room but everything centralized, the best way to handle departmental supplies is to issue to the department (whether to the workplace itself or to the subsidiary departmental store room) only enough supplies to last a reasonable length of time, say from one to two weeks, the main reservoir of material for this department being retained in the central store room. Depending furthermore upon the type of material used in the department, after supplies have been forwarded from the central store room no further paper records of the transaction are necessary when these supplies are put to use; for instance, nails, bolts, tacks, and similar articles may be issued to the department in considerable quantities, being charged at the time simply to departmental supplies and issued thereafter, without additional paper work, to the workmen as needed. Or, where it is desirable from a cost-finding standpoint to charge each job with its exact amount of material used, it is necessary to require a store issue for each lot of material furnished. In this case the original stores issue made out when the materials were transferred from the central to the departmental store room may serve simply as records for the balance

sheet, and the stores issues made out in the department when goods are issued to specific orders form the basis of cost records. Additional discussion of this question will be found at the end of this chapter under *Maintenance Stores*.

The important point in this connection, however, is that a simple yet sufficient procedure be worked out and standardized to the end that responsibility may not be lessened through having as many different "systems" as there are persons concerned with the handling of materials.

*Arrangement.*—The requirement of the store room as regards varieties of articles to be stored and therefore as regards the size and exact arrangement of aisles, bins, and other store room equipment, are so varying that it is out of the question to indicate any arrangement which will be best under all circumstances. Some general points in regard to the arrangement of the store room will be discussed before the question of equipment is taken up in detail.

The location and layout of a store room is in many respects analogous to the location and layout of a modern city. When the location is decided upon, after taking into consideration maximum accessibility to the various lines of travel, it is necessary to have an internal layout which will best serve the needs of the travel and the general convenience of articles to be accommodated. In the store room there must be a definite and preferably only one point of ingress for all material. There must be provided broad avenues for the heavy traffic back and forth from the various "streets," and a systematic method of numbering racks and bins is just as necessary as in numbering streets and houses, and it should be just as easy for a stranger in the store room to find a given item by knowing its index location as it would be for him to find a particular room number in a given house number on any street in a city. Adequate

provision must be made for plenty of receiving and unpacking room, for office space, and for all auxiliary equipment needed in the transaction of business. Adequate protection must be insured through the exclusion of combustible material, through sprinklers, fire extinguishers and similar measures, and through all other precautions against damage by fire, and means must be taken to see that unauthorized persons be excluded from the store room, and that the whole place be adequately lighted and heated. Cleanliness and neatness are imperative.

After information covering these numerous points has been collected, and after the requirements in kinds and amounts of store room equipment have been determined, the actual process of arranging all of these in proper relation begins. For this purpose, accurate floor plans on a scale of one inch equaling, say, 10 feet, should be prepared on which are carefully located all permanent obstructions such as columns, stairways, elevator shafts and the like, as well as all windows and doorways. On the same scale on another tracing, so that templates may later be cut out, are drawn plan views of each different kind of equipment to be used, such as standard racks and bins, bar stock racks, belting racks, trucks and all other movable apparatus. As many templates of each of these should be provided as there are actual pieces of each to be used. On floor plans showing permanent obstructions, these templates are arranged tentatively and held in place by pins, being shifted experimentally to obtain finally the best possible arrangement. Necessary width of aisles, and location of equipment relative to windows must be carefully considered, the general object of course being to get maximum equipment suitably arranged in minimum floor space. A little ingenuity in arrangement will often save many square feet of floor space. When the final layout has been worked out on paper, the templates may be securely fastened to floor plans and



this paper layout used as a basis for the actual moving. The transition from the existing to the new arrangement may then actually occupy as long or as short a time as seems desirable to prevent disrupting continuous and effective service to the shop.

✓ *Indexing.*—Figure 14 illustrates a method of indexing which will be found convenient under many conditions.

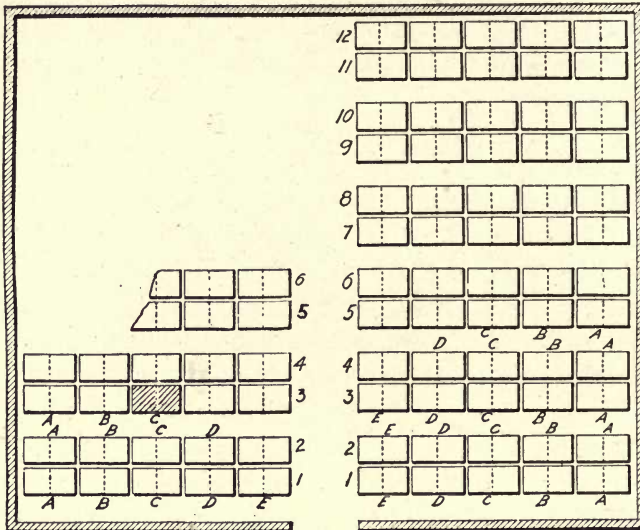


FIG. 14.—Indexing method to give flexibility in case of rearrangement of store room.

It will be noticed that the following general principles are taken into consideration:

1. Use letters and numbers alternately.
2. Use letters for those things of which there are fewest to designate (different buildings, different portions of the store room, different rows of racks along shortest dimensions, etc.).
3. Use numbers for those things of which there may be many to designate (Number of store room, different rows of racks along longest dimensions, etc.).
4. Start lettering and numbering from permanent obstructions and floors and proceed outward and upward

in lines of probable expansion. This allows the addition or elimination of racks and bins on the end or on top without confusion due to vacant designations for missing positions.

Thus the shaded area in Fig. 14 represents, in plan, the area occupied by one section of a standard rack, corresponding to one house of several stories on a street. Its index is B 3 C (side B of the store room, row 3 down the main aisle, row C out from the wall).

This rack may be four stories high, then the location of an article in a bin in the second story from the floor

SYMBOL	<b>S</b>
NAME	

FIG. 15.—Bin label.

would be B 3 C 2. It is well to have such designation on the bins themselves; and on the balance sheet for each article of material, the location, in case it is reasonably permanent, should be entered. Where locations are constantly changing it may not be practicable to keep the balance sheets posted for locations, but the permanent index should be on the bin and the storekeeper required to keep a current card file showing just where each article may be found, so that a new man can immediately locate any article in the room.

Where a good system of stores and worked material symbols is in use, it will often be found that the most satisfactory method of storage is alphabetically by symbol (see Chap. IX on Classification). With standard interchangeable racks and bins such arrangement, particularly in the metal-working store room, is easily maintained, and aside from the symbols which are with and identify each article no other indexing scheme is necessary although even in this case a card index of

location by name of article is often good insurance against lost time on the part of a new attendant or where the symbol does not appear on the issue slip. With mnemonic symbols, however, the symbol of one item may be SV-SS, the next SV-ST, the next SV-SW and so on. Each of these items would be placed alphabetically in the bins exactly as their symbols would appear in a dictionary and when the symbol appears on the issue slip the attendant may readily locate the article called for. Such a systematic arrangement by symbol is not always possible for all items nor desirable for all portions of the room, however, and common sense must govern in assigning locations and indexing. It would be foolish, if not impossible, to store bar stock in long lengths between screws and nuts, for instance, just because its symbol might fall between the symbols of these articles, nor would one logically store heavy, much used castings away back from the door or elevator. Exceptions can readily be made in such cases without destroying the advantages of storage by symbol where this seems otherwise desirable. In such cases, the rows of racks, the individual racks themselves, and the separate compartments within each rack must be numbered and lettered with a cross index for each item, according to some such definite plan as that outlined.

**Equipment.**—*Racks and Bins.*—The prime requisite as regards the equipment of any store room is *flexibility*. It is impossible to foresee all the ups and downs of inventory, the exact space required for different articles, the best arrangement and placing of each item to be stored. Continual rearrangements, particularly in individual racks and bins, are desirable or necessary in most store rooms, and not infrequently the whole store room must be picked up bodily and moved to another location. The ease with which such changes may be made depends directly upon the character of the racks and bins used.

The ideal store room, other things being equal, would



be one on wheels. This being impracticable in most cases, the next best thing is to have only movable, interchangeable storage units just so far as possible. Racks and bins should very seldom be built-in or permanently attached in any way to floor, walls, or ceilings, but on the contrary should consist of standard racks of appropriate size which may serve as shelves where no bins are required, and which in such cases may be constructed without backs and so placed as to give shelves double the width of each rack. Into all standard racks, however, must fit interchangeably individual bins just as one file drawer may be swapped with another in a block of uniform letter file cabinets. The dimensions of the racks do not matter so long as a suitable and convenient standard be determined upon and adhered to, and similarly the bins or individual storage compartments which fit into these racks may be of various shapes and dimensions as long as any bin or serviceable combination of bins may be fitted into any standard rack. The racks illustrated in the following drawings each have main divisions  $24\frac{1}{2}$  in. square by  $18\frac{1}{2}$  in. front to back inside dimensions, and the bins are correspondingly dimensioned to fit with ample play into these racks in various combinations, and are typical of those commonly used in metal-working store rooms. The exact dimensions are unimportant, however, and I know of one satisfactory arrangement where the main divisions of such racks are 36 inches on all inside dimensions, with bins to correspond. In some instances packing cases may be used for racks, with similarly cheap construction for the bins; sturdy construction is necessary, however, where heavy articles are stored.

Figure 16 shows a standard wooden rack, which may be four or more stories high by two wide, the inside dimensions of each story being  $24\frac{1}{2}$  in. wide,  $24\frac{1}{2}$  in. high and  $18\frac{1}{2}$  in. deep.

These racks form the storage space for the whole store room for all binned items, or the racks without bins or

backs may be used where this is desirable. Into any story of any such rack may be fitted the individual bins shown in Figs. 17 to 21. Thus, one story or compartment may contain one bin #1 (Fig. 17); another compartment two bins #4 (Fig. 19); another two bins #5 (Fig.

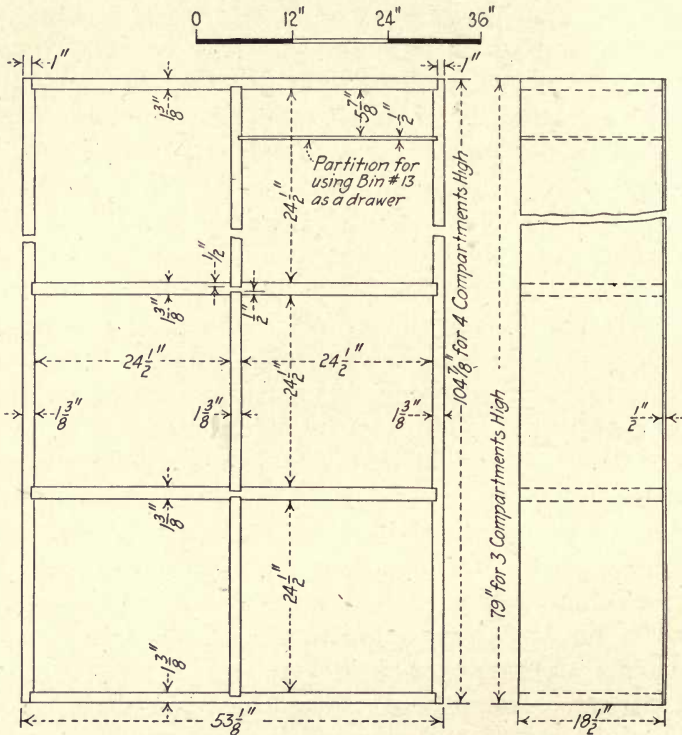


FIG. 16.—Drawing of standard rack into which fit interchangeably separate bins as illustrated in Figs. 17 to 21.

20); another one bin #5 and two bins #8; while another will accommodate eight bins #10, and so on. A typical arrangement is shown in Fig. 22.

The advantage of such equipment is obvious. Not only may the whole rack with bins be picked up and removed to a new location, but as is more often necessary any one of these bins with or without its contents may be

pulled out and replaced by a different arrangement. Thus, double bin 5, for example, which now accommodates

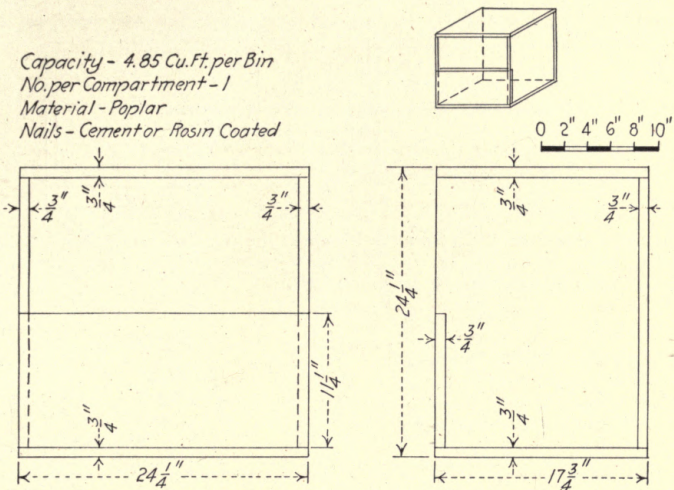


FIG. 17.—Bin No. 1. One such bin occupies one compartment of the standard rack shown in Fig. 16.

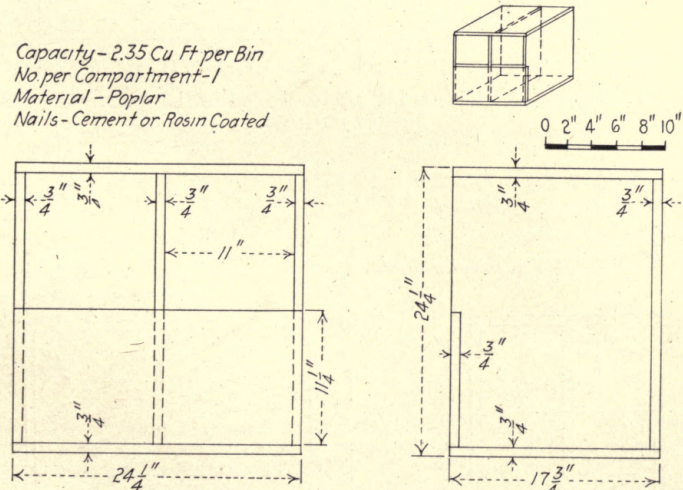


FIG. 18.—Bin No. 2. This is bin No. 1 divided in the middle for double-binning purposes.

about 500  $\frac{5}{8}$  by 2 in. carriage bolts in each half, may be insufficient when it is decided to raise the limits



Capacity - 2.25 Cu. Ft. per Bin  
 No. per Compartment - 2  
 Material - Poplar  
 Nails - Cement or Rosin Coated

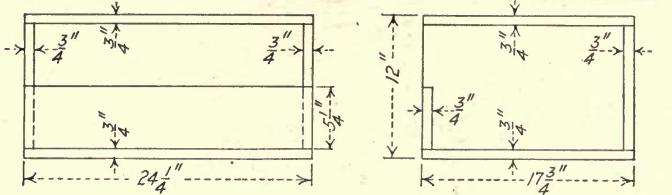


FIG. 19.—Bin No. 4. Two such bins will occupy one compartment of the standard rack shown in Fig. 16. Or one of these and, say, two bins No. 8 (Fig. 21) may be used in one compartment.

Capacity - 1.08 Cu. Ft. per Bin  
 No. per Compartment - 2  
 Material - Poplar  
 Nails - Cement or Rosin Coated

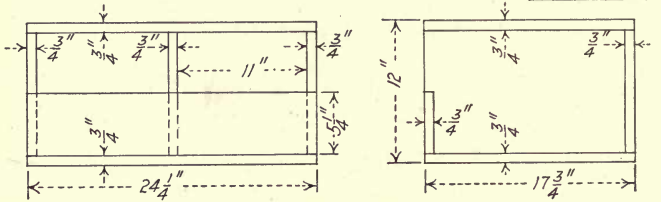


FIG. 20.—Bin No. 5. This is bin No. 4 divided in the middle for double-binning purposes.

Capacity - 0.56 Cu. Ft. per Bin  
 No. per Compartment - 4  
 Material - Poplar  
 Nails - Cement or Rosin Coated

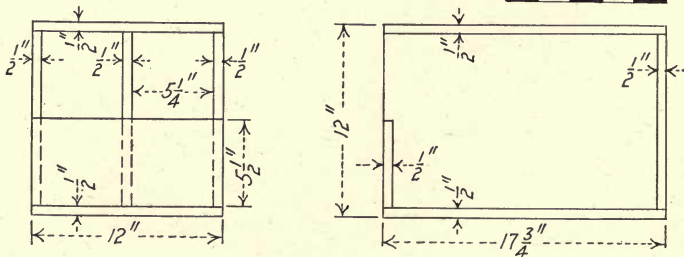


FIG. 21.—Bin No. 8. Four such bins will occupy one compartment of the Standard Rack shown in Fig. 16. Or various other bins may be used with this one in the same compartment.

on this item to store say twice as many as heretofore. In this case either one double bin 2 or two single bins 4 may be used, and usually a slight rearrangement of bins will enable the storekeeper to use one whole compartment

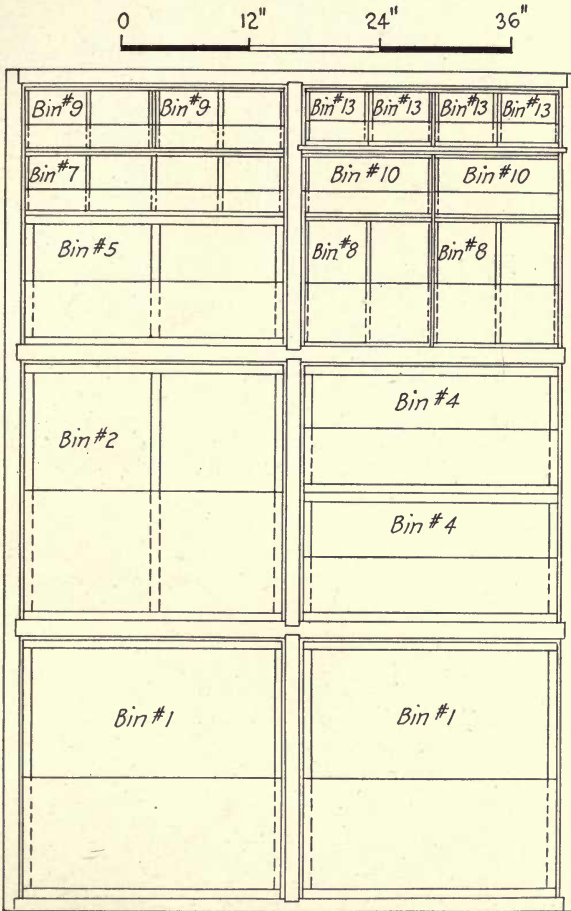


FIG. 22.—Typical arrangement of various interchangeable bins in one standard rack. Many other combinations are possible, so that rearrangement of storage units is an easy matter.

of the rack so that all of this size bolts will be kept together in adjacent bins.

In many store rooms, due to the inflexibility of equipment, such rearrangement would be made only with the



*(Courtesy Universal Winding Co.)*

FIG. 23.—Standard rack with interchangeable bins.



*(Courtesy Universal Winding Co.)*

FIG. 24.—Storage of bar and plate stock.



greatest difficulty, if indeed it would even be attempted. More commonly the increased supply would be dumped into some vacant bin not within speaking distance of the existing supply, thereby increasing the troubles of the storekeeper. Only through interchangeable storage units may all of each different item be kept together without excessive space reserve.

Installation and proper operation of such equipment has been known to cut down by more than half the amount of storage space required for a given number of articles. The reason for this is readily seen. Under most conditions of storage, where rearrangements are not easily made, the storekeeper plays safe by leaving quantities of vacant space in which additions to stock may be absorbed. It is the exception where the garden varieties of bins are found more than half filled, with the result that space utilization is only 50 per cent of what it should be. The waste of head room, moreover, is frequently enormous. With racks and bins of the type described, however, the storekeeper may fill each bin completely, knowing that with the contracting and expanding requirements of the business he can readily shift bins to meet current needs, keep all of any one item together, secure maximum space utilization and largely prevent "overflow" bins.

Occasions arise, however, where *overflow* bins should be used rather than undertake the rearrangement necessary to provide for out-of-the-ordinary expansion. When it is known that the increase in amount to be carried is temporary, the permanent storage space may be completely filled and the temporary excess placed in an overflow bin (which may be simply an extra supply of these standard racks and bins left vacant for the purpose) located at any convenient point. In this case a cross-reference overflow bin tag (see Fig. 25, page 114) on the permanent bin tells the location of the overflow bin for that item, and on the overflow bin the regular bin tag (Fig. 30, page 119) is placed. No bin tag, but only the

cross-reference tag, should be on the permanent bin, and no issues must be made from this bin as long as the other is in use, so as to insure that all issues be made from the excess (overflow) stock in order that it will be disposed of first, releasing this space and leaving eventually only the permanent bin to be looked after. The only exception to this procedure would be where the material is subject to deterioration and the overflow (usually the most recent shipment received) must therefore wait until the older shipments have been used up.

SF 20 AS  
L. M. Co.

CROSS REFERENCE CARD  
FOR BALANCE

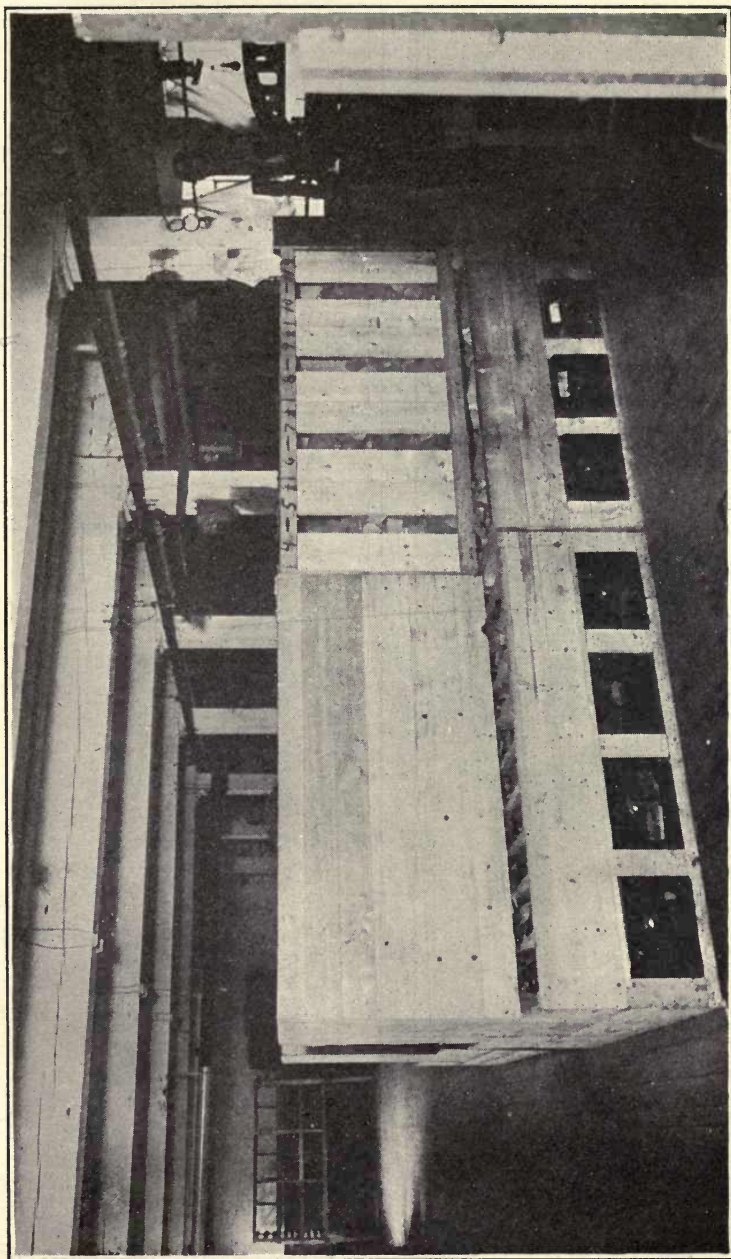
SYMBOL

See tag in bin

FIG. 25.—Overflow cross-reference bin tag. This card is placed on the regular issuing bin, and refers the storekeeper to location of everflow stock which must be disbursed first.

Except where requirements may be very accurately foretold it is best not to plan in the original layout of the racks and bins on using every bin of every rack, but a vacant bin or compartment at regular intervals should be left. This is for the purpose of making rearrangements more easily through the ability to utilize this space in case a bad guess is made or in case increased room for one or more articles becomes necessary. Just what proportion of space should be left depends on the accuracy with which needs may be and have been predetermined and on the room available for storage; ordinarily one-half of one compartment of every standard four-story rack (Fig. 16, page 108) is sufficient with reasonably careful original layout. This is equivalent to a space reserve of 6 per cent—much less than is usually found necessary where flexibility in equipment is not provided.

The racks and bins here illustrated are made of wood.



(Courtesy W. M. Griffin Shoe Co.)

FIG. 26.—Hopper bin for storing soles in a shoe factory.



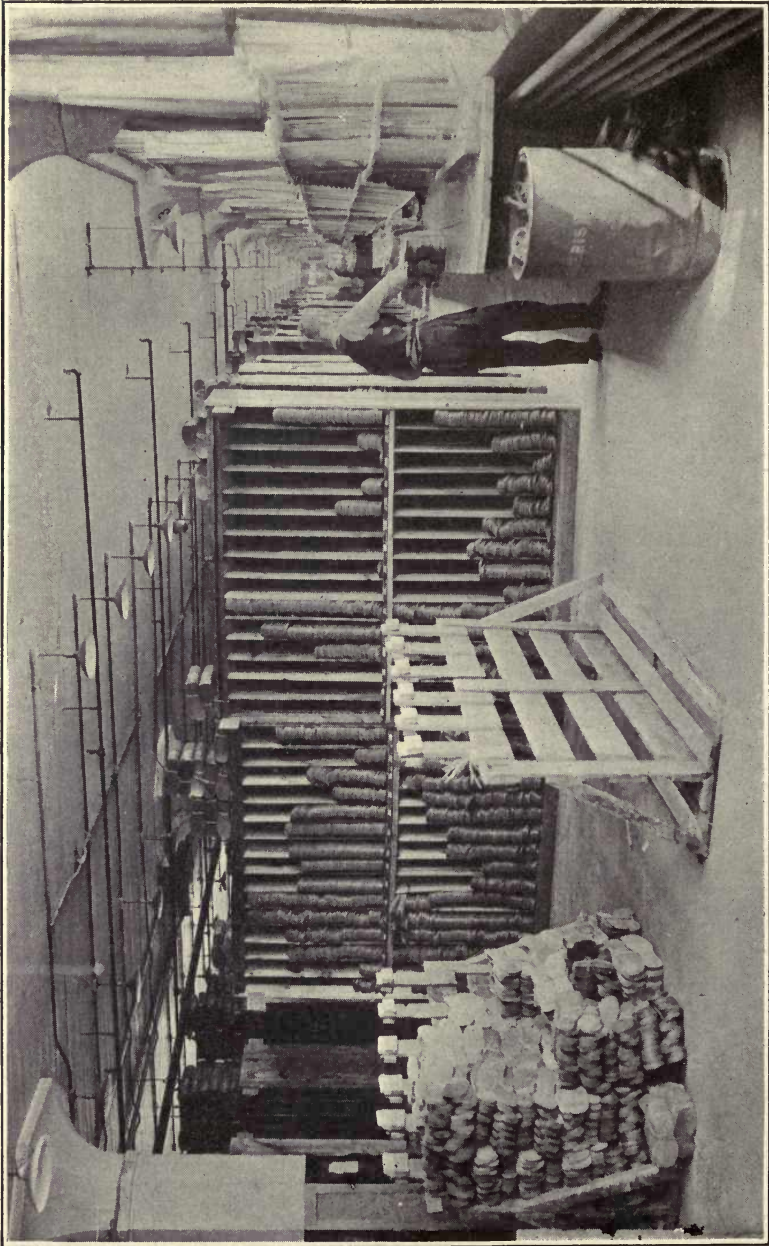


FIG. 27.—Vertical racks for storing soles in a shoe factory.

Depending upon the type of material to be stored, various other types of racks and bins may be found serviceable. For instance, the hopper bin illustrated in Fig. 26 (page 115) has been found useful in some cases,



FIG. 28.—Vertical stowage of lumber in sizes up to 2 by 12 in. by 16 ft.

and of course for handling bar stock, castings, barrels and such non-binned items, suitable storage facilities would have to be provided in addition to the standard racks and bins described.



It may be well at this point to mention the advisability of providing a "morgue" or definite storage place for semi-obsolete material which it is not desired to keep with the active items. This may be a special part of the regular store room devoted to the purpose, or a separate room may be provided where less attention need be given to systematic arrangement, storage, and handling. The same sort of provision for temporary storage

of strictly departmental and personal articles has been found extremely useful in keeping the departments clean and at the same time providing a definite and known storage place for all such miscellaneous articles.

SE-7-AB  
U. W. Co.

PARTIAL RECEIPTS ON

PURCHASE ORDER P \_\_\_\_\_

WHICH CALLS FOR \_\_\_\_\_ OF

---

**S**

DATE	LOT NO.	QUANTITY RECEIVED	TOTALS

FIG. 29.—Incoming bin tag placed on receiving bin where double-binning is used, for recording receipts only.

*Metal Racks.*—There is little question that racks and bins constructed of metal offer many possible advantages over wooden equipment, even though the original cost be somewhat greater.

It is hoped that eventually metal equipment embodying the same degree of flexibility and interchangeability as the wooden units described will be placed upon the market.

*Double Binning.*—In choosing the types of racks and bins and in laying out the store room very careful consideration should be given to the question of "double binning." This practice consists theoretically in dividing each bin into halves by a partition, and thereafter using one half as a receptacle for all incoming lots and making all withdrawals for issue from the other half, reversing the process when the latter becomes empty. On each bin is a bin tag, the incoming tag, Fig. 29, for



recording in totals the amounts received from time to time,<sup>1</sup> and the outgoing tag, Fig. 30, for entering each withdrawal as it occurs and bringing down the balance in this bin. Or should the unusual case occur where the incoming bin becomes filled before the outgoing bin is empty and overflow space is not available, the matter may be handled in a number of ways according to the store-keeper's judgment. For instance, a hand count may be made of what is left in the outgoing bin, the new shipment put in this bin with the old stock on top, and the amount added to this tag, and future issues made from this bin as before. This will result in the new lot being issued before the older material in the incoming bin, which may or may not be serious; if it is, the same procedure as described may be followed

except that the tags are reversed and issues are made from the previous incoming bin.

The principle of double binning may be used with a great deal of profit in almost every store room and it should be incorporated wherever possible. I say the *principle* of double binning, for the method described may be followed where the material is not binned at all but piled or stacked on the floor or placed on trucks, or put in racks as is the case with bar stock. One of the two outstanding results secured through double binning is *accuracy of inventory*—a consummation usually

SF1AS U.W.CO.		
121		
DATE RECEIVED		STORES SYMBOL
MONTH	DAY	S
DESCRIPTION		
LOCATION		PURCHASE ORDER NO.
QUANTITY RECEIVED		KIND OF UNIT
DATE ISSUED	QUANTITY ISSUED AND BALANCE ON HAND	CHARGE TO
CONTINUED ON BACK		

FIG. 30.—Issuing bin tag placed on issuing bin where double-binning is used, for recording issues only. This tag serves also with single bin method.

<sup>1</sup> A separate tag may be made out for each shipment received if desired, and in many cases this is the best practice.

worth all its costs, It is secured in this way: Recognizing that there is one and only one way to be sure of what our inventory is—through an actual and careful physical count at the bin—the requirement is set up that whenever an issuing bin for any item becomes empty, or whenever a new shipment is received, a hand count must

S.F. 3AS STORES SYMLOL CO. S			CREDIT TO C			
LOCATION	QUANTITY	BAL. ON HAND	KIND OF UNIT	UNIT PRICE	TOTAL VALUE	
FOR _____						
STORES ISSUE STOREKEEPER: Please issue above stores				MONTH	DAY	YEAR
					Written	19
					Wanted	19
					Issued	19
TO _____						
APPROVED _____			RECEIVED _____			
APPORTIONED	TAG	BALANCE SHEET	COST SHEET	STORES DESCRIBED ABOVE HAVE BEEN ISSUED		
				SIGNED BY STOREKEEPER OR REPRESENTATIVE		

FIG. 31.—Stores issue. When properly filled in and signed this constitutes storekeeper's authority to issue stores. It serves also as a record of the transaction and for cost purposes.

be made of the amount actually on hand. Whenever a bin tag becomes exhausted either because it is filled with entries or because zero amount has been reached, it must be sent at once to the balance clerk so that balance on the proper balance sheet may be checked. Therefore when the issuing bin becomes empty the balance on its bin tag should be zero, thus dictating a physical inven-

tory of the incoming bin. The result of this count is entered on the regular issuing tag or on the existing incoming tag; Fig. 29, which accompanies the bin tag, and the two are sent to the balance clerk for checking, one of whose duties is to see that such counts are made regularly and accurately. It will be seen that this procedure results in the taking of inventory every time the issuing

S S.F. 4AS CO.			CREDIT TO C			
LOCATION	QUANTITY	BAL.ON HAND	KIND OF UNIT	COST PER UNIT	TOTAL VALUE	
PLEASE CREDIT WORKED MATERIALS ORDER NO. _____						
WITH _____						
AND CHARGE BACK TO STORES.						
NOTE: IF THIS IS A TRANSFER TO ANOTHER ORDER, THIS CREDIT MUST BE ACCOMPANIED BY A REGULAR STORES ISSUE AGAINST SUCH ORDER.						
STORES CREDIT				MONTH	DAY	YEAR
I HAVE RECEIVED THE ABOVE STORES AND HAVE ENTERED THE QUANTITY RECEIVED ON STORES BIN TAG.						
TAG	BAL. SHEET	COST SHEET			SIG. OF INSP. WHO DELIVERS G'DS TO STORES	
SIGNED BY STOREKEEPER OR HIS REPRESENTATIVE						

FIG. 32.—Stores credit. Used for returning unused stores; the reverse of the stores issue shown in Fig. 24.

bin becomes empty and always for each item when there is least on hand.

Another partial check between bin contents and book balance may be secured currently between these physical inventories. When a bin tag becomes exhausted, even though the issuing bin is not yet empty, the amount on hand in the incoming bin (obtained simply from the entries on the incoming tags) may be added to the bal-



ance on the outgoing bin tag and the sum entered on the tag before it is sent to the balance clerk. This is simply a paper check which may be used between the actual physical count. Additional discussion of inventory keeping will be found in Chap. X, under Inventories.

SF & AP CO.			
Ret'd		C	
Iss'd			
MOVE THIS MATERIAL AS DIRECTED:	LOCATION		
	JOB NO.		
FROM _____ BUILDING ON _____ FLOOR			
TO _____ BUILDING ON _____ FLOOR			
WRITTEN BY _____ DATE _____ 19__			
RECEIVED BY _____ DATE _____ 19__			
ROUTE SHEETS	PAY SHEET	COST SHEET	I HAVE MOVED THE MATERIALS AS SPECIFIED ABOVE  Signed _____

FIG. 33.—Move order.

The second, and in many cases equally important advantage of double binning arises through the enforced *turnover of goods on hand*. With the double-binning method of storage it is impossible to let steel parts, for instance, lie undisturbed in the bottom of a bin longer than it takes to use what the bin holds. I have seen iron washers dumped from the bottom of single bins so completely rusted as to be quite worthless; they had simply remained there while issues were made from the top of the pile, or in other words from the supply most

recently purchased. The necessity of thus turning over stock arises with all materials which rust easily or which, like rubber, are subject to deterioration in other ways. The only way to *enforce* turnover is to make it automatic. The double binning principle gives this automatic feature, whereas the use of a red rag or board over the "minimum" amount in the bin, besides other shortcomings, leaves this important matter to the carefulness or whim of the storekeeper.

The fortunate thing about double binning or piling is the fact that it ordinarily requires little more space than does single binning. If we start with a single bin holding a maximum of 8,000 bolts of a certain size and wish to double-bin them, we would put a partition in the middle with 4,000 on each side, and start issuing from one of these halves. So far we have used no more space than originally, but since it is desired to keep new shipments out of the issuing bin, the vacant space which is constantly increasing in this bin is not available for storage, so that if the maximum received at any time exceeds the capacity of the incoming bin (in this case 4,000) additional space becomes necessary. Unless resort to overflow bins be constantly made, this means a larger bin capacity than that required with single bins. With a well arranged store room, however, the additional space thus required for binned items does not ordinarily exceed 25 to 35 per cent; for piled or racked materials where overhead space cannot be so effectively utilized, the percentage would be higher. This additional space in all cases, however, may ordinarily be secured in the average store room through attention to a more effective layout and a better space utilization, particularly of overhead room.

*Minor Equipment.*—As regards office equipment, scales, ladders, trucks, tote cans and other minor equipment of the store room little need be said, not because such equipment is unimportant but because there is

already a great body of descriptions and illustrations of these things, because the investment in them forms a comparatively minor element ordinarily, and because the various dealers in them are ready to help in selecting from the great variety offered the particular type of equipment which best suits varying local needs.

It is undeniably convenient to have the latest counting and weighing machines, automatic conveyors and similar labor-saving equipment on hand when they are needed, but on the other hand the cost of the use of these facilities must be compared with the cost of their absence. In very large store rooms there is little question that the very best in such equipment is none too good and is a safe investment; on the other hand, I have found many cases where expensive tiering machines, counting and weighing machines, scales and the like remained covered with dust for long periods. The cost of having them on hand for the few times they were needed far exceeded what would have been the cost of using the good old strong-arm methods during the exceptional times when the latter became necessary. Just because these various pieces of apparatus are on the market and in use in many store rooms is no guarantee that they would be a profitable investment for our particular conditions. If we have only two or three men in the store room anyway, all of the labor saving devices in the world might not enable us to release one of them or to give much better service. On the other hand, nothing should be sacrificed to accuracy and speed in the receiving, storing, and disbursing of materials, and in keeping inventory figures correct, and if an otherwise overworked storekeeper is kept busy an hour hand-counting items which could be accurately machine-counted in 5 minutes it would be niggardly not to supply him with scales for the purpose; and so on. The layout of the store room and the provision of interchangeable standard racks suited to the business, as discussed previously are matters for very



careful consideration because these features of the work run quickly into thousands of dollars and vitally affect the long-time efficiency of operation of the department; mistakes, furthermore, once made are not easily or cheaply rectified; as regards the minor equipment the matter is ordinarily not so serious and conservatism is the best policy until the need in any particular case is fully proved.

There is a certain minimum of equipment, however, which it would be foolish not to adopt forthwith in any store room. In the case of trucks, it is frequently found that not only are insufficient quantities of trucks provided, but that they have been poorly selected for the purpose to which they are to be put, and that they consist of miscellaneous kinds. It is always necessary to provide a minimum of trucks in any given case. To this minimum should be added a sufficient number so that the work of the store room is not held up for lack of a truck or while the storekeeper goes elsewhere to hunt one up. In this connection pains should be taken to see that trucks be properly loaded and expeditiously despatched and that empty trucks be systematically returned to designated stations. The type of truck best adapted to our particular business should be carefully ascertained, although the tendency to stock up with special trucks not suitable for miscellaneous moving must be guarded against.

The same considerations apply to tote boxes and other containers used for moving material on trucks or by hand. A slight additional investment for a supply of such equipment in addition to what the average store room has on hand will save the storekeeper and transportation men much time during the course of a few days.

An ample supply of suitable ladders will repay the investment in them. These should be made with a broad base, wide step, and plenty of room at the top on which to set tote boxes or lay individual articles.

They should be light and provided with substantial casters whereby they may be quickly and readily moved from place to place.

Finally in the list of necessities comes the question of stowage "on wheels" for all materials where this method is suitable. This refers to the stowage on elevating truck platforms of items which are ordinarily piled, such as paper, leather, shooks, cloth, box cartons in the flat state, and similar items. With most of such materials much unnecessary handling, both in the store room and in the shop, may be avoided by providing a sufficient number of platforms either with or without specially constructed racks as found necessary, on which materials may be piled instead of on the floor. In most cases with the exercise of a little ingenuity these platforms may be used to pile material to a considerable height; and in some cases, above the practicable platform piling height, a permanent storage rack is erected under which sits the platform with its pile of material. Most advantage will be secured in this method of storage if standard lots may be determined upon as the amount to be piled on one platform, so that no counting is necessary when a withdrawal is made, the elevating truck being simply run under the platform, raised, the load withdrawn, transported to the point of use, deposited, and the truck withdrawn for another load. The possibilities in saving handling expense in the shop are very great with such platforms. I have counted no less than seven unnecessary handlings of materials in process through different machines, due to the unloading from the garden variety of trucks to the floor, picking it up and putting it through the various machines, piling it on the floor again, loading it to the truck for transportation to the next machine, and finally unloading to the floor beside this machine. Much of such handling, moreover, was done by the mechanic who left his machine idle, although there was plenty of work to be processed.

**Stowage.**—The physical arrangement of goods in stores, including the placement, removal, and general rules for handling. The following definitions are given in order that the terms used in succeeding discussions may be clear. The illustrations, Fig. 34, show the same thing graphically

I. *Definitions:*

1. *Article.*—Any one kind of material, as *Machine Bolts*.

2. *Item.*—Any one size or variety of an article, as *Hex Head Machine Bolts, U. S. Standard,  $\frac{1}{2}'' \times 3\frac{1}{2}''$* .

3. *Unit or Piece.*—Any single piece as *one bolt* (as above).

4. *Package.*—A quantity in original container, as 1 *box* of bolts (as above), 12 in a box.

5. *Lot.*—A quantity received and stored at any one time, as 1 *gross bolts* (as above) 12 *boxes*, 12 *in a box*.

6. *Standard Lot.*—A quantity determined upon as most suitable for our particular conditions of use, as 50 *bolts* (as above).

7. *Column.*—A number of units (or packages) in vertical arrangement, one wide, one deep, two or more high.

8. *Row.*—A number of units in fore and after arrangement, one wide, two or more deep, one high.

9. *Course.*—A number of units in left and right arrangement, two or more wide, one deep, one high.

10. *Section.*—A number of rows in vertical arrangement, one unit wide, two or more deep, two or more high.

11. *Tier.*—A number of rows in left and right arrangement, two or more units wide, two or more deep, one high.

12. *Block.*—A number of courses in vertical arrangement, two or more units wide, one deep, two or more high.

13. *Stack.*—A number of tiers in vertical arrangement, two or more units wide, two or more deep, two or more high.

14. *Wedge Stack.*—An arrangement of units in the form of a wedge, as illustrated by the storing of shells, cans and other cylindrical bodies.



15. *Pyramidal Stack*.—An arrangement of units in the form of a pyramid as illustrated by the storing of cannon balls and other spherical bodies.

16. *Pile or Heap*.—An irregular mass of pieces such as a *pile of coal*.

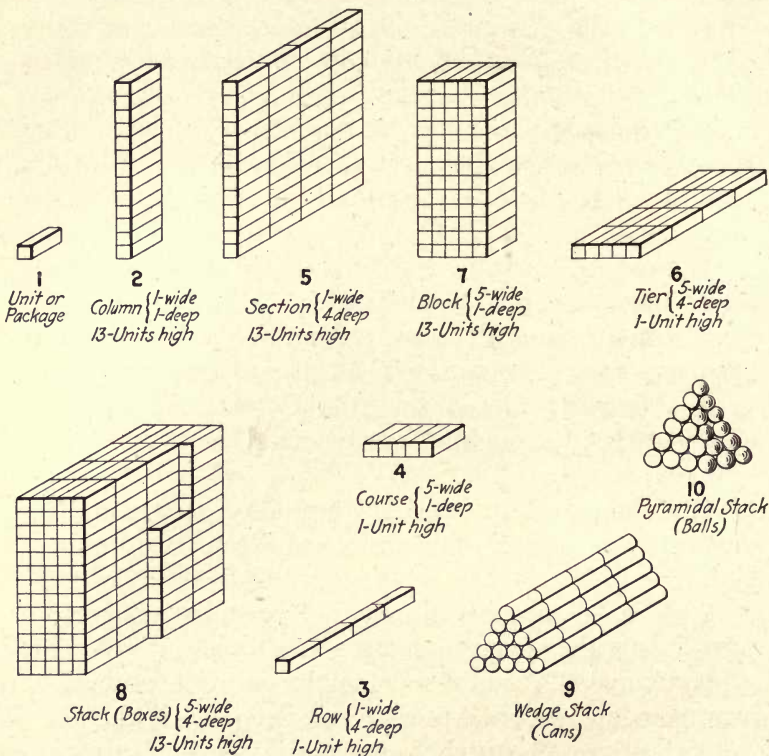


FIG. 34.—Stowage units, illustrating the text on this subject.

II. *Instruction for Stowage*.—A few cardinal rules for the stowage of materials, strictly observed, will facilitate handling and taking inventory of stores.

1. *Have a Designated Stowage Place for Each Item*, and so far as possible keep all of that item and no other in that place, properly stowed. When it becomes necessary to place different articles or items, or different lots of the same item, in the same stowage space, separate the piles

or stacks by at least 2 inches, if in bins, and by at least 5 inches if on platforms or in piles on floor between aisles. Be sure that this arrangement is such that it never becomes necessary to remove one item to get at another.

2. *Arrange Items for Maximum Facility in Taking Inventory.*—In other words, as you face the stowage area from the aisle, commence piling at the back left-hand corner and complete this column to the top, then in front of this build the next column and so on, completing the left-hand section. Similarly complete the next section to the right, each column being completed so that no vacant spaces will remain hidden, before a new one is started, only the last column remaining incomplete as shown at Fig. 34, No. 8. Place all labels facing the aisle where possible.

In taking inventory, multiply number of packages or units per block by number of full blocks, and add to this the number of packages in the incomplete section.<sup>1</sup> Or for a wedge stack, number in block equals:

*Wedge stack:*

$$\frac{\text{number on bottom course } X \text{ (No. of courses } + 1)}{2}$$

*For a pyramidal stack:*

$$\frac{\text{number on bottom course (No. of courses } + 1)(2 \times \text{No. of courses } + 1)}{6}$$

3. *Provide for Securing Turnover of Stock.*—The method of doing this will vary somewhat as between single and double binning, stacking, or piling:

A. *Single Stacking.*—Always issue from the right hand side of the stack, starting with the incomplete

<sup>1</sup> In some cases stowage may be arranged so that the taking of inventory is even quicker than this. It is often possible with articles which occupy space in direct proportion to quantity, to establish a scale or gauge at the side of the stack, bin, carboy or other container which at a glance indicates sufficiently accurately the quantity on hand. Familiar examples of such scales of quantity are found in coal bins and in lumber sheds, and the general method is applicable to the measurement of many other materials if a suitable measure be devised.

section (see Fig. 34) and working in the opposite direction (to the left) from that in which the stack was built up. Remove each column and section complete before another is disturbed. (If stacks tend to topple over, it may be necessary to remove items by tiers, leaving the top of the stack instead of the right hand section incomplete, and modify procedure accordingly. This, however, is more wasteful of stowage space and should not be done unless necessary.) When a new lot of the same item is received, pile it (as directed in 2 above) to the left of present lot, removing the left hand sections of the latter and putting these packages on the right hand side as it becomes necessary to provide the necessary room. The new lot may be placed flush with the old in single stacking unless it is desired for identification purposes to keep the two lots physically separate. Leave odd packages on the right hand section of new lot where separation of lots is necessary, or use more of the old lot to fill in new stack complete where stacks are to be flush throughout. Where it is impracticable or too expensive to move the old lot to make way for the new, the latter may be piled to the right of the present lot as described in the next topic.

*B. Double Stacking.*—Where double stacking is practiced, it is necessary always to have space for two stacks, one from which all issues are made, the other to which all receipts are added. Each stack is built up as explained in topic 2 above, and between the two, a vacant space of not less than 5 inches should ordinarily be left. Withdrawals are made from right to left of issuing stack as explained, and when issuing stack is exhausted start issuing from the previous incoming stack, and put future receipts in space just left vacant. Here again procedure will have to be modified as suggested (3-A preceding) where it is desired to keep each lot separate. Which stack or lot is outgoing and which incoming at any particular time is indicated by the difference in bin tags, or by a marker, if desired.



4. *Establish Standard Lots for Stowage and Issue of Materials Where Practicable.*—It is, unfortunately, seldom possible to make the trade container, box, keg, carton, etc., at once our unit of purchase, stowage and issue throughout, although this should be done where possible. In such cases the container need not be opened (except for inspection and possible treatment against rust) until it reaches the point of use. Clerical work in such cases is much simplified, since the transactions relate to a few packages containing many units.

Where this is not possible, however, it will facilitate issuing and quick service if at the time of inspection instead of putting the units back in original containers or storing them loose in bins they are divided off when being counted into predetermined standard amounts which are suitable for delivery as separate lots to the point of use. Such items as bolts and nuts, screws, special castings and so on may always be needed for assembly of a standard product in certain definite quantities; this quantity would be sorted into suitable boxes or put into strong bags and stored as a standard lot ready for issue without further counting.

Again, the method of storing in bulk and issuing by units described below under "Maintenance Stores" (page 35) will cut down the clerical work incident to book entries and to inventory taking.

5. *Utilize Available Stowage Space to Utmost Capacity.* Study your requirements in each material and try to have just enough and not too much space for each article. By providing standard racks and interchangeable bins, together with leaving vacancies every so often at the start and providing overflow bins when necessary, one may afford to be very miserly in allotting space for the various items without fear of later confusion in case his estimate was wrong. Readjustments in such cases may readily be made.

The great obstacle to more effective space utilization

is the lack of data showing how much space a given number of any item will occupy, or how many may be stored in the given space which is available. A start has been made in the collection of such information and some sample values are shown in the Appendix.

**Protection.**—*From Fire and Explosion.*—Since in the normal factory the equivalent of more money is held within the four walls of the store room than in any other part of the establishment, it follows that every precaution should be taken to insure against loss. The store room should of course be of fireproof construction if practicable. In any event, certain precautions must be observed to prevent loss through explosion or fire.

No inflammable material, such as gasoline, powder, dynamite, and so on, should ever be allowed in the store room itself. Such material should be stored in an isolated position away from all buildings.

Within the store room itself, cleanliness should be absolutely insisted upon. Oily waste, paper, burlap, and all materials subject to spontaneous combustion, or which readily serve to feed an incipient blaze, should be rigorously excluded from the store room except as they may be brought there, or accumulate temporarily, pending prompt disposal.

All aisles must be kept absolutely clear of permanent obstructions. The only obstruction which should be permitted in any aisle is that caused temporarily by men and trucks actually in process of delivering goods. When a truck has been emptied or filled, it must not be allowed to clog up the aisle, but should be taken immediately to designated positions. The possibility of controlling a fire should not be lessened through unnecessary obstructions.

It goes without saying that the most modern overhead sprinkler system should be installed. Particular care must be taken, furthermore, to see that the sprinkler has a chance to perform properly through having plenty

of room between sprinkler head and piles of material. Having determined the minimum head room which should be left, constant vigilance through systematic inspection is necessary to prevent store room attendants from encroaching upon this space.

An ample supply of hand fire extinguishers should be provided at convenient points. An incipient blaze may be extinguished through the use of such extinguishers before it has become sufficient to start the sprinkler heads.

As an extra precaution, a hose connected to a head different from that to which the sprinkler system is attached should be provided.

As to the use of wood instead of steel storage racks and bins little can be said as regards insurance rates because conditions vary so widely, making individual appraisals necessary in each case. For instance, the difference in rates in any given case between sprinklered and unsprinklered store rooms is very materially in favor of sprinklers, and this holds true in general regardless of what kind of storage equipment is used. In unsprinklered store rooms the use of metal equipment might amount to as much as 20 per cent saving in rates over wood equipment in some cases, whereas in others the savings would be negligible. With the use of sprinklers, however, which is the only safe way, there appears ordinarily to be little choice as against metal and wood as far as insurance rates go.

*Rust.*—All material subject to deterioration through rust must be treated by some one of the numerous preparations available for this purpose. It must be remembered that the chemical decomposition of metals takes place much more rapidly during the warm humid days of summer, and particular attention is necessary at this time. Parts which are to be held in storage more than a week should be given a coating of rust preventative.



Specifications, tests and prices of the various rust preventing agents may be obtained from the vendors, as may also the machines and solutions by which they may be readily removed. Care must be taken to secure an agent which does not readily evaporate and which does not corrode or otherwise injure the surface of the metal.

In the discussion of double-binning methods, it was emphasized that one of the prime advantages to be derived through this method was the insurance of a turnover of stock. Even with double-binning, however, the turnover may be insufficient to prevent rust and this method must be looked upon as a supplement to, and not a substitute for, the use of rust preventing agents.

*Hardening, Evaporation, and Similar Deterioration.*—In the case of materials such as rubber which hardens and becomes useless with age, and in the case of certain oils which solidify if left standing too long, the double-binning principle comes fully into its own. The provision of one bin or aisle for all incoming material, its brother being used for all issuing, as explained under the discussion of double-binning (pages 118 to 123) is the only sure way to provide automatically and systematically for a regular turnover of stock. Since double-binning requires somewhat more space than single-binning, the principle may be used of course for the storage of this kind of goods, while those not subject to rapid deterioration may be single binned. The only loss in the latter case is the loss of accuracy of inventory, a sufficiently important consideration, however, in all cases.

*Dust.*—The prime prerequisite here is to keep the store room thoroughly cleaned and to provide dustproof racks for such articles as stationery, which would be ruined should they become the least bit dirty. The standard racks and bins described and illustrated previously are entirely adaptable to closed cabinets and many such racks are in use today for the dustproof storage of many different articles.

*Pilfering.*—The success with which so many plant activities may be controlled hinges at many points on the accuracy of the inventory. Consequences have at times been very distressing when 100 pieces were supposed to be on hand when there were actually only 85. Accounting statements, furthermore, are misleading unless inventory of materials and work in process be correct. Primarily, in order that any semblance of control may be maintained, and only secondarily because some of us have the habit of pocketing what does not belong to us, a locked store room is necessary. The psychological effect, furthermore, is excellent.

The temptation to petty theft is particularly strong in the case of such handy household articles as tacks and hammers, electric light globes, ink, paper, mucilage, and similar items. If such articles are left where they may handily be slipped in one's pocket for home consumption it is inevitable that that is what will happen to many of them. Such temptations should be removed. This does not mean, however, that we are to be parsimonious in furnishing supplies, or even that we may not adopt a liberal policy in supplying at cost such articles as the individual employees may desire. With the locked store room and a tight rein generally, accompanied by a judicious amount of what workmen are usually pleased to regard as "red tape" most of the needless requests and petty takings will disappear of themselves and a liberal policy in these respects may neutralize what might otherwise be considered irksome system. It simply means knowledge at all times where we stand and that insistence must be placed upon the locked store room, the written requests, and the approval of some responsible official before articles are furnished for private consumption.

*Maintenance Stores.*—The adequate handling of supplies used in the upkeep of plant offers peculiar problems and difficulties because of the emergency nature

of much of the maintenance work. Some factories have made great strides in standardizing current inspection and repairs, and in planning and even paying a bonus on the operations performed by this department, but there is an irreducible minimum of hurry-up jobs which places the retention of "system" in the maintenance store room constantly to severe tests. On the one hand, to maintain any semblance of control of inventory and issue a certain amount of systematic routine must be insisted upon; on the other hand a few seconds delay when a steam pipe or water main bursts is not to be tolerated. The question is how to secure control and avoid delay.

Reference is made to preceding discussions of such matters as organization, layout, the provision of adequate equipment including standard interchangeable racks and bins properly indexed with cross references, and operated by double binning methods—all features of good store-room management doubly important in this case. In addition to these matters I wish simply to suggest briefly means by which the work of the maintenance department may be speeded up and yet controlled in two features of its work which ordinarily cause most concern—the handling of supplies and spare parts, and the checking in and out of tools.

*Supplies and Spare Parts.*—It is needless to emphasize the fact that the regulation of replenishment, follow-up, inspection, storing, and balance sheet control previously described is doubly important in the case of items which have such potential possibility of causing disaster through an insufficient or unsuitable supply as have most of the articles carried in the maintenance store room. Because of their nature it also follows that a liberal policy as regards amount of inventory must be adopted and that this policy must be reflected in the setting of low limits and amounts to order, and to such a plentiful allowance must be added constant vigilance to anticipate extraordinary requirements.



Previously in this chapter, under Departmental Supplies, two alternatives in charging, or allocating cost of materials issued to the proper account, were indicated:

1. Charging departmental supplies simply to departmental expense, to be taken up in overhead.

2. Charging departmental supplies to specific jobs where desirable from a cost-finding standpoint.

In the case of maintenance department supplies both methods are usually desirable—the first for small inexpensive items, the second for expensive or special materials which the particular job served should carry. In cases where the reserve supply of those items which are stocked is kept in a central store room from which small current supplies are issued, the procedure described under Departmental Supplies above, is applicable.

Where this is not the case, but the whole supply of such parts as are needed for maintenance is stored in the maintenance store room, a slightly different procedure is necessary, in order that best results as a whole may be obtained and the desired charges made between those to be charged to departmental expense and those to be charged special.

For those to be charged to *departmental expense* when issued to the workman, the following will be found an effective procedure:

A reserve supply will be kept in one bin, in original package or in other standard lot as is desirable. On this supply the regular procedure described for the central store room will operate—in other words for each such item there will be a balance sheet which controls replenishment and records all transactions, and a bin tag at the bin will be operated as described. Back to back or alongside of this main bin will be another smaller bin which is used for direct issue to the workman. When the latter becomes empty, a transfer in bulk will be made from the main bin, and at that time a stores issue will be made for the quantity transferred, charging the

amount to departmental supplies. The articles will be placed loose in issuing bin, from which issues may be made without further record. This procedure allows immediate issue, gives accurate control of inventory of main bin (upon which replenishment is based) and assists in a turnover of stock.

For materials to be charged to *specific job number*, either those purchased specially or those of considerable value, the proper charge is unknown until the use is known. Where this use may be ascertained previous to issue the stores issue may be filled out and placed

SF 7 AS L. M. CO.			
<b>CHECK NO.</b> _____		_____	
QUANTITY WANTED		SYMBOL OF TOOL WANTED	
_____			
DESCRIPTION OF TOOL WANTED			
_____			
Month	Day	Year	Signed by man receiving tools.
NOTE. ONLY ONE KIND OF TOOL CAN BE ISSUED ON THIS CARD. BUT SEVERAL OF THE SAME KIND.			

FIG. 35.—Tool check.

aside with the article until called for, which will expedite action in delivery, but on a hurry-up job there is nothing to do but give out the material as called for and attend to the issues later. By following the procedure indicated, however, the paper work at time of issue may be reduced solely to rush jobs—a small proportion of the work in well-run maintenance departments.

*Tools and Fixtures.*—A similarly simple procedure covering tools will give the speed and definiteness essential for effective work. Each tool, of course, must have its own location, which must be so indexed and cross indexed as to make it possible for an entire stranger to find any tool in a very few moments, no matter whether it is in its rack or in the hands of some mechanic at the other end of the plant.

This may be accomplished in the following way:

The tool racks must be plainly lettered according to a systematic scheme. A card index of each tool refers to the rack where it is stored. When a mechanic desires a tool he comes to the window, fills out and signs the tool check shown as Fig. 35, the attendant issues him the tool, files the check by tool symbol, and in a compartment with the mechanic's number on it files a tag on which this tool's symbol is stamped. The whole transaction should take but a moment. Looking at the file of checks one may see just who has any particular tool and where he has gone with it (in case recall is desired in a hurry), and looking at the man's compartment, one may see just what tools are now in his possession. When the tool is returned the mechanic is given his check, the tag is replaced under tool symbol, and the tool returned to its pigeonhole.



## CHAPTER IX

### CLASSIFICATION AND SYMBOLIZATION OF MATERIALS

**SUMMARY:** *Classification:* Rules for Making—*Symbolization:* Rules for Symbols—*Basis of Industrial Classification*—*Basis of Mnemonic Symbols*—*The Base Sheet of Mnemonic Classification*—*Classification of Charges*—*Classification of Product*—*Classification of Stores*—*Other Classifications.*

A poor classification or a poor set of symbols is much worse than none at all, while a sound classification with suitable symbols is a remarkably effective tool. The subject is too large for complete treatment in such a volume as this, but at the risk of becoming somewhat didactic I wish to point out how to avoid some of the pitfalls as well as how to get a start in the classification and symbolization of materials along lines which have proved sound.

**Classification.**—First, the difference between classification and symbolization should be kept in mind. *Classification* is nothing more nor less than segregating those things with which we deal into like and unlike according to various bases—kind, purpose, effect and so on. Classification is of course necessary for scientific progress, and it is significant that little real progress was made with any of our sciences until satisfactory classifications had been developed. The difference between empirical and scientific knowledge is largely a matter of classification, and it should be looked upon in the nature of providing a pigeonhole for each new detail or fact as it is unearthed. To be of lasting service a classification need conform only to the following requirements:

*Rules for Classification.*—*First.*—The classification

must be logical and utilitarian—on a basis proper to its effective use,—and it must be consistent in adherence to this basis.

*Second.*—It must proceed consistently from the general to the specific.

*Third.*—It must be capable of being indefinitely and consistently expanded.

*Fourth.*—It must be inclusive up to the present state of knowledge.

*Symbolization.*—A *symbol* on the other hand is simply a sign, letter, emblem or character of some kind which is used to represent another, usually a longer, expression. After a given classification is determined upon, the next step is to assign to each component of the classification a symbol which will appropriately represent it, so that the act of symbolizing naturally succeeds and must logically conform to the classification. Although symbols are not indispensable they are exceedingly useful if properly made, and we need only turn to the symbols of chemistry as an example *par excellence* in this respect. The requirements for an adequate system of symbols may be stated:

*Rules for Symbolization.*—*First.*—The symbol system must fit the classification. It must be elastic, and easily and consistently expanded. The degree of subdivision in the symbol should correspond exactly with the degree of subdivision of the classification; that is, guard against choosing a method (such as the decimal) which makes necessary calling “Physics” 570 while the coordinate item “Chemistry” must be 580.1, for example. In other words provide for the maximum number of subdivisions at any one stage; thus there are *twenty six letters* but only *nine numerals* available for use in any one position.

*Second.*—Symbols must be *definite and clear*. One symbol must mean but one thing, and any one thing must have but one symbol. A dropped symbol should not be again used for at least a year.

*Third.*—Symbols preferably should be capable of being *easily learned and easily remembered*—mnemonic and suggestive. Thanks to Berzelius, we are not likely ever to forget that C stands for carbon, H for hydrogen, and so on; few of us can remember for any length of time that 598.761 represents a certain make of carbon steel or that 500.16 indicates a departmental charge for miscellaneous supplies furnished the machine shop.

*Fourth.*—Symbols preferably should be as *simple and as brief* as is consistent with clearness and definiteness. It is not only more mnemonic but much simpler and briefer to write C instead of Dalton's hieroglyphic for carbon. It is, moreover, perfectly clear and perfectly definite. It may, on the other hand, be simple to write H65 for ten-penny wire nails, but it is neither definite, clear, nor mnemonic.

*Fifth.*—Symbols preferably should be as *foolproof* as it is possible to make them. It should be difficult to make and easy to catch mistakes in the writing and interpretation of symbols. Thus, if we use both capital letters and numerals in our symbol system, we must omit the letters I (because it resembles the numeral 1), O (resembles zero), Q (resembles 2), and preferably U (resembles letter V when hurriedly written).

Again, if we use letters at all we must preferably use either all capital block or all small letters, because of the resemblance as frequently written, of capital and small A, C, E, J, M, N, O, S, U, V, W, X, and Z.

Transposition of numbers, furthermore, is ordinarily much harder to detect than is the case with letters. If the symbol should be 7854.3, but is written 7845.3 by mistake, there is nothing in the symbol itself to show that the latter is wrong; on the other hand if instead of SVSTR we should write SVTSR it would be detected at once because we remember there is no such combination as SVTSR in our symbols; or, if there be such, the context in which it is used will in most cases tell whether it is



properly used. An observance of the foregoing rules I believe will assist in avoiding the confusion so frequently found in industrial symbol systems.

*Basis of Industrial Classification.*—In order that the basis and details of the method of classifying and symbolizing materials to be described may be clear,<sup>1</sup> it must be kept in mind that all components of the business—charges (both capital and revenue); tools, machines, equipment, operations and functions, as well as materials (both raw and worked) are tied together into one logical system on one fundamental basis. This basis is *costs*—the cost of doing business. Every piece of material we buy, every piece of equipment we purchase, every hour of labor we pay for—every step we take in other words—costs us money, and through tying the classification on to the dollar mark as a basis it is pretty sure to be inclusive and of the utmost practical utility. The general ledger accounts, therefore, serve as our starting point, the base sheet of the classification comprising the broad general subdivision of things for which money is paid out.

Thus:

Capital investment in land and buildings.

Capital investment in machinery and equipment.

Cost of raw materials and supplies to run the business.

Cost of labor and material chargeable directly to the product.

Cost of overhead expense for:

Direct manufacturing departments.

Commercial (or sales) department.

Business (or general office) departments.

Auxiliary manufacturing departments.

<sup>1</sup> This method of classification and symbolizing, which meets industrial requirements much more satisfactorily than any other which the writer has encountered, was originally invented by Oberlin Smith of the Ferracute Machine Co., and subsequently amplified by Henry R. Towne, F. W. Taylor, Carl G. Barth, and others.

Each of these primary groups of charges is then subdivided and re-subdivided to any degree we desire. From the raw material group above is derived the details of the stores classification.

**Basis of Mnemonic Symbols.**—The basis of the make-up of the symbols themselves is as follows:

*First.*—The symbol consists of a combination of capital block letters (omitting I, O, Q, U), and numerals.

*Second.*—The groups, division, subdivisions, etc., are represented by letters, these letters being assigned so far as possible to give maximum suggestiveness (S for stores, D for direct manufacturing departments, and so on). The significance of any letter depends upon its position in the symbol (just as is true of our decimal system of numbering); a letter refers to and limits only that part of the whole symbol which precedes it, it includes that part which follows it.

*Third.*—Numbers are used in all cases for designating an individual unit (inserted ordinarily just before the last letter of the symbol); for dimensions (inserted ordinarily near the beginning of the symbol); for lot numbers (written after the last letter of the symbol); and for other purposes which need not be described here.

The base sheet is as follows:

BASE SHEET (ON COST BASIS)

- |  |   |                     |
|--|---|---------------------|
| A. Auxiliary Departments Expense                                     | } | Expense or Overhead |
| B. Business (or general operating) Depts. Expense                    |   |                     |
| C. Commercial (or selling) Depts. Expense                            |   |                     |
| D. Direct Manufacturing Depts. Expense                               |   |                     |
| E. Erection (if in customer's plant)                                 |   |                     |
| F. Product (worked materials) which we manufacture                   | } | Product             |
| G. Products (worked materials) which we manufacture—Grinders         |   |                     |
| H. Product (worked materials) which we manufacture                   |   |                     |
| J. Product (worked materials) which we manufacture                   |   |                     |
| K. Product (worked materials) which we manufacture                   |   |                     |
| L. Product (worked materials) which we manufacture—Milling Machines  |   |                     |
| M. Product (worked materials) which we manufacture—Molding Machines  |   |                     |
| N. Product (worked materials) which we manufacture                   |   |                     |
| P. Product (worked materials) which we manufacture                   |   |                     |
| R. Product (worked materials) which we manufacture                   |   |                     |
| S. Stores, or raw materials and supplies                             |   | Stores              |
| T. Product which we manufacture                                      | } | Product             |
| V. Product which we manufacture                                      |   |                     |
| W. Product which we manufacture                                      |   |                     |
| X. Part construction—Light equipment and tools                       |   | Part Capital        |
| Y. Machinery and motive power—Heavy equipment and tools—Construction | } | Capital             |
| Z. Land and Buildings—Construction                                   |   |                     |



Each of these general ledger accounts is then subdivided. For instance, the Auxiliary Departments Expense would naturally be next subdivided into the different departments considered directly auxiliary to producing, thus:

*Classification of Charges*

*Auxiliary Departments Expense A*

- AE. Engineering Department Expense.
  - AH. Heat—Light—Power Department Expense.
  - AK. Worked Material Store Room Expense.
  - AM. Maintenance Department Expense.
  - AP. Planning Department Expense.
  - AS. Stores Room Department Expense.
- and so on.<sup>1</sup>

At this stage the symbol designates the particular department itself and furnishes the first subdivision of Auxiliary Expense for cost collection purposes in properly allocating overhead expense.

The next step is of course to separate out the different kinds of overhead expense which are properly chargeable, for instance to the Stores Room, thus

*Store Room Expense AS*

- ASA. Miscellaneous Labor and Expense.
- ASF. Furniture, Fixture and Apparatus-maintenance.
- ASR. Reclamation of errors of this department.
- ASS. Stores and Supplies used in Store Room.
- ASW. Wages and Salaries of Store Room personnel.
- ASZ. Building Repairs to this Department.

Thus, when a table used by the storekeeper is repaired, the charge symbol for this work would be ASF which

<sup>1</sup> In practice, one sheet should be reserved for one step in the subdivision, and all letters of the alphabet (except I, O, Q, and U) put down in order. They may be needed later.

at once tells the accounting folks that the cost of this work is an Auxiliary overhead expense (A) to be entered against the Store Room (AS) for furniture maintenance (ASF). Similarly, stationery supplied the storekeeper would be charged to ASS, and so on, the totals of the AS- charges giving the total overhead expense of AS. Likewise for each other Auxiliary (A) Dept., the total of all such departmental charges constitute the total A expense for the period. The individual and total B, C, and D overhead expenses are secured in like fashion, when they may be distributed to the product in any one of a number of ways.

*Classification of Product.—Worked Material Classification.*—The same sort of subdivision of each product provides a pigeonhole for collecting direct charges incident to manufacture. Thus M, molding machines, may be subdivided into those types of machines which we produce.

#### *Molding Machines—M*

M-C Core Ramming Molding Machines

M-H Hand Ramming Power Draft Molding Machines

M-R Plain Power Ramming Molding Machines

then each of these further subdivided until we get down to individual parts, which gives the worked material classification, for designating the worked materials with the operations on each, and for allocating charges against each separate product.

These illustrations have been given before taking up the stores classification partly to familiarize the reader, through simple examples, with the general method of subdividing the classification and assigning symbols, and partly that he may see the tie-in between the stores and the other parts of this whole mnemonic classification. This relation will become clearer later on.

*Classification of Stores.*—In subdividing the general ledger account S Stores, we at once see that in those items

which we carry regularly in stock, known as "classified stores," there are two main classes, *viz.*

1. those used for a specific purpose.
2. those used for various purposes.

Those stores used for specific purposes may be for

- (a) some one of the departments
- (b) some one of the products
- (c) some special use which it may be desirable to differentiate, such as forms for office use.

The first step in classifying stores, therefore, is to set down under S the letters of the alphabet (always omitting I, O, Q, and U) and see that these specific purposes are given a pigeonhole in accordance with the previously devised symbol for each. Thus



*Stores—S*

- SA Special classified stores for Auxiliary (A) Departments only
- SB Special classified stores for Business (B) Departments only
- SC Special classified stores for Commercial (C) Departments only
- SD Special classified stores for Direct Manufacturing (D) Departments only.
- SE
- SF<sup>1</sup> Printed forms of all kinds
- SG Special classified stores for Grinders (G) only
- SH (Reserved for other products)
- SJ (Reserved for other products)
- SK (Reserved for other products)
- SL Special classified stores for Milling Machines (L) only
- SM Special classified stores for Molding Machines (M) only
- SN (Reserved for other Products)
- SP (Reserved for other Products)
- SR (Reserved for other Products)
- SS Office supplies, exclusive of Printed Forms SF
- ST (Reserved for other Products, or sometimes used for Tools<sup>2</sup>)
- SV<sup>1</sup> Classified Stores used for a Variety of Products
- SW (Reserved for other Products)
- SX Part Construction (X) supplies, such as chairs, typewriters, etc.
- SY
- SZ

<sup>1</sup> May be used here only when not previously used to designate a product, in which case it must be used to designate stores used only on that product (as in the case of SG, SL, etc.).

<sup>2</sup> Small tools purchased and stored in bulk in the store room under symbol ST, disbursed in units and thereafter identified by symbol T.

Subdividing the first four of these classes—SA, SB, SC and SD, or those stores which are used in some specific department only and which for the sake of definiteness may as well be classified under that department—we of course go back to the various individual departments under Auxiliary, Business, Selling and Direct Manufacture, respectively, as listed above under “Classification of Charges.” Thus, subdividing SA, or the special classified stores for Auxiliary (A) Departments only:—

*Stores for Auxiliary Departments—SA*

SAA

SAE Stores for Engineering Department (AE) only

SAH Stores for Heat—Light—Power Department (AH) only.

SAK Stores for Worked Material Store room (AK) only.

SAM Stores for Maintenance Department (AM) only.

SAP Stores for Planning Department (AP) only.

SAS Stores for Stores Room (AS) only.

The same subdivision is made for SB, SC and SD; for instance:

SDF Stores for Foundry (DF) only.

SDM Stores for Machine Shop (DM) only.

and similarly for other D, C, and B Departments.

The next step is to indicate the particular stores used only in each of these departments, so that in the case of the Power Department (AH), for instance, we have

*Stores for Heat—Light—Power Department only—SAH*

SAH-A

SAH-B Boiler Compounds

SAH-C

SAH-F Fuel

SAH-L Lubricants used only by Heat-Light-Power Department (for lubricants used in other Departments as well as in this one, see SVL-, pages 155-6).

This brings us to the general class of store, and the next and final step in this case is to designate the particular item in each class. This, as was indicated previously, is done by the use of a numeral before the last letter of the symbol, thus:

*Lubricants used by Heat-Light-Power Department only—*  
SAH-L

SAH1L Cylinder oil

SAH2L Crankcase oil—heavy

SAH3L Crankcase oil—light

SAH4L Graphite—powdered

SAH5L Etc.

SAH6L

Because of the variety and quantity of forms customarily required in the factory, it is convenient to group all printed forms under SF, or in some other suitable place, separate from other miscellaneous office supplies (which may be placed under SS or less conveniently under SV). The subdivision of SF, however, usually presents diffi-



culties, in that there are many forms which do not pertain solely to a particular department but travel around from one to the other. The general rule is to pigeonhole a form in the department which originates it where this is possible, placing under the general office (see SFBN below) those forms which may originate in any one of a number of departments. This is illustrated below:

*Printed Forms of All Kinds—SF*

SFA Auxiliary Department (A) Forms only

SFAA

SFAE Engineering Department (AE) forms, only

SFAH Heat-Light-Power Department (AH) forms,  
only

SFAP Planning Department (AP) forms, only and  
so on.

SFB Business (or general office) department forms only

SFBA

SFBC Cost Department (BC) Forms only

SFBN General Management (BN) Forms only

Then taking the forms used only (or originated) in the Planning Department SFAP, we get by the use of numbers as before, in this case used to designate the specific form:

*Printed Forms for Planning Department—SFAP*

SF1AP Balance of work

SF2AP Master Route Card

SF3AP Piece Route Sheet

SF4AP

SF5AP

SF6AP Etc.

Continuing down the stores base sheet, the next item is SG, or Special Classified Stores for Grinders (G on main base sheet, page 145) only, then comes SL or Special Classi-

fied Stores for Milling Machines (L) only, and SM for Molding Machines (M) only. Subdividing the latter by way of example, we get S followed by the symbol of the machine as explained above under "Classification of Product," page 147, thus:

*Special Classified Stores for Molding Machines  
Only—SM*

SMA

SMC Special Stores for Core Ramming Machines,  
(M-C) only.

SMH Special stores for Hand Ramming Power Machines  
(M-H) only.

SMR Special Stores for Plain Power Ramming Machines  
(M-R) only.

Continuing the subdivision of each of these as suggested under Classification of Product there is provided a pigeonhole for such raw materials as are used in any particular group or division of any product we manufacture. Thus the symbol SM-R1B may designate a special sand guard used on an M-R (Plain Power Ramming Machine) only, B showing that it is part of the Base Group of these machines and the numeral 1 designating the specific part. It must be remembered that any article designated by *S* is a *raw material* upon which no work has been done in our plant, and that therefore a symbol SM-R1B, SM-R2B and so on must not be used to designate a part which we have manufactured. If we manufactured this sand guard, the *S* in the symbol would drop out, leaving it M-R1B in accordance with the worked material classification. This point may be further explained in this way: if this sand guard (special to this machine) were made in our shop through process-

ing a casting purchased outside especially for the purpose, the casting itself (being raw material to us) would take the symbol SM-R1B, and it would retain this symbol as long as it remained in the raw state. When we have worked it, however, and made the finished sand guard of it, the symbol of the guard would be M-R1B.

The next subdivision of S is SV or Classified Stores used for a Variety of Purposes. Into this miscellaneous pigeonhole should be placed only those articles remaining after everything special to any department or product or use has been placed. It is a catch-all, voluminous at best; it should not be made unnecessarily so through the inclusion of articles which may be more definitely placed elsewhere. A few illustrations of this part of the Stores Classification will show the general method.



*Classified Stores Used for Various Purposes—SV*

- SV-A Miscellaneous stores not elsewhere classified.
- SV-B Brass and Copper and products made chiefly from same
- SV-C Cast iron and products made chiefly from same
- SV-D
- SV-E
- SV-F
- SV-G
- SV-H
- SV-J
- SV-K
- SV-L Liquids and semi-liquids (see also SAHL for those used only in the Heat-Light-Power Department).
- SV-M
- SV-N
- SV-P
- SV-R
- SV-S Steel, wrought iron and products made chiefly from same
- SV-T
- SV-V
- SV-W Wood and products made chiefly from same
- SV-X
- SV-Y
- SV-Z Fastening devices—bolts, nuts, screws, etc.

Under SAHL (page 151) was listed lubricants used only in the Power Department, such as cylinder oil, (SAH1L), heavy crankcase oil (SAH2L) and so on. To bring out the difference in cases of this kind, the following illustration may be serviceable.

*Liquids and Semi-liquids used for Various Purposes—*  
SV-L

SV-LA Adhesives  
SV-LB  
SV-LD Disinfectants  
SV-LG Gasoline  
Etc.

*Liquids and Semi-liquids—Adhesives—SV-LA*

SV-L1A Glue  
SV-L2A Cico  
SV-L3A Library Paste

As a final explanation of this part of the classification we may take steel (SV-S) as best serving to illustrate the finer subdivisions sometimes desirable and to show designation of dimensions, makes, composition or other information which may be necessary under particular conditions:

*Steel, Wrought Iron and Products—SV-S*

SV-SA Angles  
SV-SB "I" Beams  
SV-SC Channels, "U" Bars  
SV-SD Band Iron  
SV-ST Tool Steel

*Tool Steels—SV-ST*

SV-STA  
SV-STB  
SV-STC Octagonal Stock  
SV-STD

SV-STE

SV-STH Hexagonal Stock

SV-STN Rectangular Stock

SV-STR Round Stock

*Round Tool Steels—SV-STR*

SV-ST1R Jessops-carbon

SV-ST2R Bethlehem H. S.

SV-ST3R Atha-carbon

SV-ST4R Allen's—air hardening

SV-ST5R

Insert dimensions between SV and S thus:

SV1 $\frac{3}{4}$ ST2R Bethlehem High Speed Tool Steel,

Round, 1 $\frac{3}{4}$ " diameter.

Finally, in cases where it is desired to keep each shipment of this or other material separate and designate it as such, it may be given a serial lot number and stored separately. In this case, as was indicated previously, the lot number would appear at the end of the symbol, so that the complete symbol for lot number 35 of this steel would be

SV1 $\frac{3}{4}$ ST2R35

Purchase specifications, data relating to tests, and all other information as regards Bethlehem high speed round tool steel would be filed in the office under the symbol SV-ST2R. The same is true in the case of all other articles. The balance sheets for each article would of course also be arranged alphabetically by symbol, and where practicable the articles themselves would be located in the store room alphabetically by symbol.

**Other Classifications.**—Besides the classifications illustrated briefly in the preceding pages—the Charging, Worked Material, and Stores Classifications—as part of this composite mnemonic classification are also the Tool, the Machine Equipment and Work Place, the



Functional, and the Real Estate and Buildings classifications, the complete story tying together into one interlocking system all components of the business. As such, it is in use today in a great many different industries adapted of course to meet the special requirements of each, but conforming extremely closely to the basic elements as presented. Its principal value is realized only when it is used in its complete form, although the justification of this necessarily piecemeal presentation lies in the fact that the Stores Classification may be used alone with considerable benefit in definiteness and in the saving of clerical work.

## CHAPTER X

### MATERIAL ACCOUNTING; INVENTORIES; STATISTICS

SUMMARY: *Material Accounting.* Fundamentals of Accounting. Opening Entries. Collecting Costs. Closing Entries. Summary of Transactions—Method of Securing Perpetual Inventory—Pricing Materials for Issue—*Inventories:* The Periodic Physical Inventory—The Perpetual Inventory. Supplementary Checks on Book Balances.—Inventory Adjustments—*Statistics.*

**Material Accounting.** *Fundamentals of Accounting.*—Adequate accounting is as essential to material control as is proper storage, replenishment and regulation of issue, and the basis of such accounting is to *tie the cost figures into the general accounts.* This means that:

I. Every expense incurred during the period must eventually show on the books against Product, against Plant, or against Profit and Loss, and

II. A perpetual book inventory of material, checked frequently with material actually on hand, must be maintained.

A summary of the accounting transactions for materials through which these objects are accomplished is:

I. The cost of all purchases of material must be debited when bought to:—

(a) General Ledger (controlling) account *Stores* and

(b) Subsidiary account by item purchased (on individual balance sheets).

Such cost may or may not include transportation charges, according to whether these are added to the specific article affected, which is the more accurate way, or taken to an expense account.

II. The cost of all material disbursed must be debited to a specific charge account (plant, product, or expense) and credited to

(a) Subsidiary account by item issued (on individual Balance Sheets) and,

(b) General Ledger (controlling) account *Stores* (or *Worked Material*). These principles

of accounting of materials may be illustrated by typical book transactions with accompanying discussion and explanation at various stages.

*Opening Entries.*—A purchase order for 300 ft. high speed tool steel  $1\frac{3}{4}$ " diameter has been issued. The cost comes to \$1,430.40 including transportation charges which in this case will be added to the unit cost. (See Balance Sheet, Fig. 5, page 61.) When this bill is paid the following entry is made in the ledger:

I. <i>Stores</i> (G. L. Acct.).....	\$1,430.40
To    ( <i>Cash</i> <sup>1</sup> ).....	\$1,430.40

At the same time this transaction will be entered in the balance sheet (subsidiary account) for this high speed steel, symbol (SV1 $\frac{3}{4}$  ST2R) which adds \$1,430.40 to the book inventory of this particular item of material. Similarly for all other purchases, so that the sum of the amounts on the various balance sheets should equal the total debits to the general ledger account *Stores*. Should some of this material be rejected upon receipt, a corresponding credit slip must be put through to adjust these accounts.

*Collecting Costs.*—Whenever any of this steel is disbursed for any purpose a stores issue showing symbol of material issued, and symbol of charge account, is made out for the number of feet called for, say 30 feet. This issue may first go to the balance sheet for this item to be apportioned, when the material is wanted the issue then

<sup>1</sup> Intermediate entries omitted for brevity, since they illustrate no additional point in this connection.



goes to the storekeeper and the 30 feet are disbursed. The stores issue then goes back to the balance sheet where the clerk multiplies the unit cost per foot, say \$4.00, by the number of feet issued and enters the transaction on the proper balance sheet, showing what account is charged, say Shop Expense, symbol DMS. This subsidiary account (balance sheet SV1 $\frac{3}{4}$  ST2R) thus shows that Shop Expense, DMS, has been charged with \$120.00 worth of steel, and that the inventory value of the steel itself as shown on its balance sheet has been reduced by this \$120.00, or to \$1,310.40.

The value as shown on this issue slip (together with others which follow the same procedure) then goes to the general books where the entry is made:

II. <i>Shop Expense DMS</i> .....	\$120.00
<i>To Stores</i> .....	\$120.00

The procedure is exactly the same for all other disbursements—thus instead of an issue of steel to be charged to Shop Expense DMS, we may have \$100.00 worth of this steel (25 feet) issued for use on product L, Milling Machines; the issue will pass through exactly the same transaction except that the amount will be charged to L instead of the DMS thus:

III. <i>Work in Process: Milling Machines L</i>	\$100.00
<i>To Stores</i> .....	\$100.00

Or again a worked material part for Molding Machines, symbol M, made previously for stock at a cost of \$50.00 and charged to Worked Material in Stores M, may be issued for use on product Grinders, G-. In this case work in Process G must be charged and Worked Material in Stores M—credited:—

IV. <i>Work in Process: Grinders G</i> .....	\$50.00
<i>To Worked Material in Stores: Mold-</i>	
<i>ing Machines M</i> .....	\$50.00

Where material has been issued in excess or is otherwise to be turned back to the store room after having been charged out, a credit slip is made, showing again the symbol of material and the account (originally charged to) which should be credited: thus \$5.00 worth of the above worked material M- may not be needed on product G-. This credit passes through the same routine as the issue described except that the entries are reversed so that the quantity and value returned are added on the proper balance sheet M-, the slip then passing to the general books where:

V. Worked Material in Stores M- is debited \$5.00 and Work in Process G- is credited. Similarly for other credits.

*Closing Entries.*—Actually of course each slip does not pass directly to the general books for individual entry, but after clearing through the balance clerk they are filed by charge symbol, allowed to accumulate for a few days or a week, and from time to time those on hand are summed and entered on cost collecting cards from which at the end of the period summary statements are sent to the general books. Some of these statements follow:

The original debit to *Stores* is made from the invoice. For subsequent transactions, however, the bookkeeper has no way of knowing what credits should be entered to *Stores* or other accounts, or what accounts should be charged with the issues unless he is told by the cost clerk who receives, files, and summarizes the stores and worked material issue and credit slips. At the end of the period, therefore one summary statement is sent to the bookkeeper showing the total stores disbursements chargeable against various accounts. This is simply a summary of stores issues less stores credits against each charge symbol:—

*Distribution of Stores for Period Ending—192—*

A.....	\$1,000.00	
B.....	500.00	
C.....	300.00	
D.....	120.00	(See transaction II above)
G.....	800.00	
L.....	100.00	(See transaction III above)
M.....	3,000.00	
T.....	50.00	
Y.....	1,500.00	
	<hr/>	
	\$7,370.00	

This total amount of \$7,370.00 would thereupon be credited to *Stores* by the bookkeeper as is illustrated by the single entry in transaction II above, and at the same time the *Work in Process* accounts (G, L, M and T) as well as the expense (A, B, C and D) and construction (Y) accounts would each be debited for its respective amount, as illustrated in transaction III.

Where some of the product turned into the store room is either partly finished or may be used on products other than that whose symbol it bears and for which it was originally made, it is necessary to transfer material and values between these accounts and to present a statement of these transfers so that they may be taken up on the general books. This case is illustrated in transaction IV above where \$50.00 worth of parts previously placed in stores for product M- were issued to make product G-, in transaction V an unused portion of this being later credited back. The cost clerk must in such cases note from which *Worked Material in Stores* accounts the good were issued (as shown on worked material issues), and the total credit to these must equal the total debits to the *Work in Process* accounts. This statement to the bookkeeper would look as follows:—



*Debit the following Work in Process Accounts*

D.....	\$185.
G.....	45. (See transactions IV and V above)
L.....	75.
M.....	290.
T.....	65.
Y.....	700.
	<hr/>
	\$1,360.

*Credit the Following Worked Material in Stores Accounts*

G.....	\$600.
L.....	90.
M.....	45. (See transactions IV and V above)
T.....	625.
	<hr/>
	\$1,360.

*Summary of Transactions.*—Transactions have been indicated as follows. These will first be shown individually:

I. Purchase 300 feet  $1\frac{3}{4}$  in. high speed tool steel (SV $1\frac{3}{4}$  ST2R) for \$1,430.40, or \$4.77 per foot (here called \$4.00 to avoid decimals):

Stores

Cash.....	1,430.40
-----------	----------

II. Issue of 30 feet SV $1\frac{3}{4}$  ST2R at \$4.00 for Shop Expense DMS.

Shop Expense DMS

Stores.....	120.00
-------------	--------

III. Issue of 25 feet SV $1\frac{3}{4}$  ST2R at \$4.00 for Work in Process L:

Work in Process L-

Stores.....	100.00
-------------	--------

IV. Issue of \$50.00 worth of Worked Material in Stores M-, for Work in Process G:

<u>Work in Process G-</u>	
Worked Material in Stores M-...	50.00

V. Credit of \$5.00 worth of Worked Material in Stores M-, to Work in Process G.

<u>Work in Process G-</u>	
	Worked Material in Stores M-..... 5.00

Each of these transactions would be entered on the respective balance sheet (stores or worked material) for the item in question.

Posting from the statements sent to the bookkeeper and taking a balance of these accounts at this stage (assuming that these are the only transactions) would show:

<u>Cash</u>	
	I. Stores..... \$1,430.40

*Stores*

<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%;">I. Cash..... \$1,430.40</td> <td style="width: 50%;"></td> </tr> <tr> <td style="border-top: 1px solid black; border-bottom: 3px double black;">1,430.40</td> <td></td> </tr> <tr> <td>Balance.....</td> <td style="text-align: right;">1,210.40</td> </tr> </table>	I. Cash..... \$1,430.40		1,430.40		Balance.....	1,210.40	<table style="width: 100%; border-collapse: collapse;"> <tr> <td colspan="2">II. Shop Expense</td> </tr> <tr> <td style="width: 50%;">DMS.....</td> <td style="width: 50%; text-align: right;">120.00</td> </tr> <tr> <td colspan="2">III. Work in Pro-</td> </tr> <tr> <td style="padding-left: 20px;">cess L-.....</td> <td style="text-align: right;">100.00</td> </tr> <tr> <td style="padding-left: 20px;"><i>Balance</i>.....</td> <td style="text-align: right;"><i>1,210.40</i></td> </tr> <tr> <td></td> <td style="text-align: right; border-top: 1px solid black; border-bottom: 3px double black;">1,430.40</td> </tr> </table>	II. Shop Expense		DMS.....	120.00	III. Work in Pro-		cess L-.....	100.00	<i>Balance</i> .....	<i>1,210.40</i>		1,430.40
I. Cash..... \$1,430.40																			
1,430.40																			
Balance.....	1,210.40																		
II. Shop Expense																			
DMS.....	120.00																		
III. Work in Pro-																			
cess L-.....	100.00																		
<i>Balance</i> .....	<i>1,210.40</i>																		
	1,430.40																		

Shop Expense DMS

II. Stores.....	120.00
-----------------	--------

Work in Process L-

III. Stores....	100.00
-----------------	--------



<i>Work in Process G-</i>			
IV. Worked Material in Stores M-.. 50.00  <hr style="width: 50%; margin-left: auto; margin-right: 0;"/> 50.00 <hr style="width: 50%; margin-left: auto; margin-right: 0;"/> Balance..... 45.00		V. Worked Material in Stores M-..... 5.00 <i>Balance</i> .... 45.00  <hr style="width: 50%; margin-left: auto; margin-right: 0;"/> 50.00 <hr style="width: 50%; margin-left: auto; margin-right: 0;"/> Balance..... 45.00	

<i>Worked Material in Stores M-</i>			
V. Work in Proc- ess G..... 5.00 <i>Balance</i> ... 45.00  <hr style="width: 50%; margin-left: auto; margin-right: 0;"/> 50.00 <hr style="width: 50%; margin-left: auto; margin-right: 0;"/> Balance..... 45.00		IV. Work in Proc- ess G..... 50.00  <hr style="width: 50%; margin-left: auto; margin-right: 0;"/> 50.00 <hr style="width: 50%; margin-left: auto; margin-right: 0;"/> Balance ... 45.00	

Summary of Balances:

<i>Stores</i>	
1,210.40	
<i>Shop Expense DMS</i>	
120.00	
<i>Work in Process L-</i>	
100.00	
<i>Work in Process G-</i>	
45.00	
<i>Worked Material in Stores M-</i>	
	45.00

*Stores* thus started with a debit of \$1,430.40 when the steel was bought, then this was reduced by \$120.00 for the benefit of Shop Expense DMS and by \$100.00 for Work in Process L-, leaving a closing balance of \$1,210.40 as the total current inventory of goods on hand. Running through the individual balance sheets we should find the same balance shown there, in this case



the example has been confined to the high speed steel SV1 $\frac{3}{4}$  ST2R which on its balance sheet was originally charged with the \$1,430.40 purchased but which now would show that this value has been reduced to \$1,210.40 through the issues against DMS and L-. In order to make these figures reliable, constant care must be exercised to see that the inventory on the balance sheets agrees with the actual physical inventory in the store room, or to make an inventory adjustment (see topic, page 172) in case they do not agree and cannot otherwise be brought into harmony.

*Method of Securing Perpetual Inventory.*—The method of securing a perpetual inventory of work in process and of worked material in stores is also illustrated in the preceding transactions. To complete this part of the record, at the end of the period the bookkeeper must be sent also a statement showing the cost of each class of product finished or partly finished so that the proper transfer may be made on the books from Work in Process to Worked Material in Stores or to Product, and a statement showing the distribution of direct wages and a statement of miscellaneous charges for similar posting. With these statements, handled in just the same way as those illustrated, a complete running inventory of *Stores* (raw material and supplies), *Worked Material in Stores* (partly worked parts), *Work in Process* (that currently in the shop), and *Product* (completely finished work) is maintained so that the books may be completely closed at any time with greater accuracy than is usually obtained at the annual, semi-annual, or quarterly closing where complete physical inventory must be taken.

*Pricing Materials for Issue.*—In the preceding transactions it was assumed that the price at which materials were "sold" by the store room upon issue, or "bought" back upon credit, was the weighted average cost, including transportation charges, of all of that item of material which had been received: This is but one way. The alternative methods of pricing materials for issue are:

1. Keep each lot distinct and issue each at actual price paid for the lot.
2. Combine lots and issue all at cost or current market price, whichever is lower.
3. Combine lots and issue all at current market price.
4. Combine lots and issue all at weighted average price to date.
5. Issue all materials at predetermined "standard" price, regardless of actual cost except as this may lead to a modification of the "standard."

Each of these methods has its adherents, and much time may be wasted scrapping with different cost accountants as to the theoretical accuracy of one or another. In finally choosing between them, however, certain practical considerations must govern:—

1. A theoretically accurate cost may not be worth the expense of obtaining it. The clerical labor involved must always be considered as must also the chances of wrong results through mistakes in figuring complicated methods.

2. Cost finding and price-making are only distantly related in that many factors other than cost (no matter how accurately determined) must be considered in setting prices. A cost should tell the facts as to what the actual expenses of manufacture were, after which allowances for current fluctuations in material prices and other factors may be considered in setting prices. Do not destroy the possibility of finding actual profits by letting fictitious figures get into costs.

3. The intent at time of purchase should be considered in the distribution of costs—if the purchase was for a long period the costs may well be spread over the whole of that period, and so on.

4. What it is desired that the cost figures show will affect the treatment of expenses. Thus costs obtained through methods 1, 2 and 3 will follow the ups and downs of the market; method 4 will spread these fluctuations out

into a smoother curve; while 5 does neither of these but results in a straight line which tells the truth neither as regards current market fluctuations nor actual average prices paid.

In practice the methods most widely used are 1 and 4, both of which tell the truth but with slightly different emphasis and either of which tells it in a way ordinarily serviceable for all practical cost purposes. Method 4 is advocated in most cases because it requires less clerical work when both current posting and checking periodical inventories are considered, because it results in less "jumpy" material cost figures, and because a direct summing up of outstanding values on the various individual balance sheets checks (or should check, without the necessity of multiplying each lot of each item by its actual cost) with the lump sum inventory balances as shown on the General Ledger. This method (4) may be seen in detail on the balance sheet illustrated in Chap. V, page 61.

**Inventories.**—At various places in the preceding discussions the question of inventory keeping with the resulting book transactions has been touched upon. These loose ends will be gathered together in a summary.

*The Periodic Physical Inventory.*—The periodic physical inventory (annual, semi-annual, or quarterly), with its bustle, confusion and inaccuracies, is no longer tolerated by the best managers, if for no other reason than because modern business demands a more immediate and reliable knowledge of progress than can be secured in this way. The *physical inventory* (the actual counting of stock on hand) is indispensable and the results of this count must be checked with the books, but at the end of twelve, six or even three months is not the time to do it. The manufacturing industry is yet to be found where the *perpetual* inventory is not perfectly applicable, more accurate, cheaper, and of infinitely greater utility than is the periodic. It is simple to initiate, easy to operate,



and, with proper checks, accurate even beyond practical requirements.

*The Perpetual Inventory.*—This may be secured in one or more of several ways, the central idea being simply that the balances on hand, both in quantity and in value of each item, be kept reasonably correct at all times. These ways are as follows:

1. The storekeeper is given each day a few items to count or the balance clerk may make the count, so that

SF& AP L. M. Co.					
<b>STORES INSPECTION REPORT</b>					
Please send an inspection report of the amount of the following goods on hand					
at	hour	month	day	year	To:
Symbol	Description		Quantity on Tag	Quantity on Hand	Quantity on Balance Cards
Signed:					

FIG. 36.—Stores count. The only way accuracy of perpetual inventory records may be assured is through an actual *physical count*. This illustrates one method of reporting the results of such a count.

in the course of say four months every item in the store room will be covered at least once. Such counts may be made whenever work is slack, and consists in actually counting balance on hand in the bin or pile and reporting quantity found to the balance clerk (see Fig. 36). The balance clerk then checks the amount actually in the store room with the balance as shown on the individual balance sheet, making such inventory adjustments as may be necessary upon investigation.

2. When a new lot of any item is received, a bin tag for quantity accepted is made out in the receiving department, this tag accompanying the goods to the store room, where it may be checked by the storekeeper. The storekeeper then counts the balance on hand which

should agree with the balance on the old tag, notes any discrepancy on old tag and sends it to the balance clerk where it is checked with the proper balance sheet. The quantity on hand is entered on the new tag, added to the quantity shown as just received, and new tag and new lot placed in the bin. This procedure allows the count to be made when there is least in the bin.

3. Where a separate bin tag is made out and retained at the bin for each separate lot received, when a tag becomes exhausted or shows zero balance, a count may be made of quantity on hand (including all lots), this checked with the sum of balances as shown on the several tags, the actual quantity on hand entered on the exhausted tag and this returned to the balance sheets for checking.

4. Where all new lots received are entered to one bin tag, when this becomes full a count is made, the result indicated on exhausted tag which is sent to balance clerk and a new tag made for future use.

*Supplementary Checks on Book Balances.*—Intermediate checks may be secured which will aid in keeping the books and the bin contents in agreement between the physical counts. These, however, should be looked upon simply as auxiliary checks, since nothing should be allowed to replace the actual physical count for any length of time. Such checks are:

(a) The balance as shown on the bin tag may be entered on each stores issue after it is filled. This issue, when it reaches the balance clerk provides a current check on book and tag balances (but not on actual goods on hand).

(b) When a tag becomes exhausted the balance, as per this tag, or the sum of the balances on the remaining individual lot tags, may be entered and the tag sent to the balance sheet.

The utilization of one or more of these methods will result in accurate, current knowledge of amounts of material on hand with the least work on the part of the

storekeeper and with no interruption to the regular activities of the shop. Equally important, it will enable a closing of the books as regards inventory at any time without confusion and with maximum accuracy. In this connection it must be remembered that records of inventory, whether periodic or perpetual, must be retained in such permanent form as to enable the auditor to make what checks he desires.

*Inventory Adjustments.*—It has been stated that a physical count is the only way to make book records of inventory dependable. Clerical errors will unavoidably occur in the mere recording of transactions so that the figures themselves will be incorrect; besides this, from various causes the amount actually on hand will be greater or less (usually the latter) than the balance shown on the books even with no mistakes in entry. An accurate count at frequent intervals is necessary to keep the two in reasonable adjustment.

When a discrepancy is discovered an Inventory Adjustment must be made so that the books shall tell the truth. This may be done in one of two ways. Assume that the books show 100 units on hand, total value of \$200.00, or \$2.00 per unit, but that a hand count shows only 98 in the bin and investigation has failed to account for these two missing parts:

1. The value of the missing items may be absorbed by the remaining items, thus:

On Hand	Total Value	Unit Value
100	\$200.00	\$2.00
<hr/>	<hr/>	<hr/>
98 As per count	\$200.00	\$2.041

Future issues would be priced at \$2.041 each. In this case no adjustment is required on the general ledger, since the total value of the inventory has not been changed.



2. The value of the missing items may be charged to an Inventory Adjustment account or taken direct to Profit and Loss thus:

On Hand	Total Value	Unit Value
100	\$200.00	\$2.00
2 Inventory Adjustment	4.00	
<hr/>	<hr/>	<hr/>
\$98	\$196.00	\$2.00

Future issues would be priced at \$2.00 each. In this case *Stores* on the general ledger would be credited and *Inventory Adjustment* debited for the missing \$4.00.

It will readily be appreciated that the first method, (that of covering the loss through absorption by the remaining stock), is not one to be encouraged, although the bookkeeper should not be burdened with a multitude of insignificant adjustments. The middle road consists in establishing maximum amounts which may be absorbed by method 1, supplemented by the requirement that discrepancies (either for any amount or only for amounts above this maximum) be sent to the proper official for approval.

**Statistics.**—In addition to the statistics, quotation summaries, charts, curves and so on which form part of the equipment by which the purchasing agent follows market trends and general business tendencies, much internal information covering material may be systematically gathered for the guidance of various officials. The following table indicates some of the more important reports, who uses them and for what purpose, source of information, how often compiled and best form for presenting data. The classes of information needed in different industries will of course vary and those listed below are intended to be suggestive only.

## SUMMARY OF MATERIAL REPORTS

Sort of information	For whose use	For what purpose	How data obtained	How often compiled	Best form of presentation
Goods ordered by items . . . .	Gen. Mgr. Purch. Agent Works Mgr. Planning Mgr. Rec. Rm. Foreman Head Storekeeper	To provide finances, labor and storage space and to correlate Sales and Production	Purchase Orders	Monthly or every four weeks, or less often	Tabulation
Incoming Shipments. . . . .	Receiving Room Foreman Head Storekeeper	Labor requirements	Material Received report	Currently	Curve
Store room Disbursements.	Head Storekeeper	Labor requirements	Stores and Worked Material Issues	Daily	Curve
Inventory of Raw, Finished Goods, Goods in Process, and Supplies, by items	Gen. Mgr. Works Mgr. Planning Mgr.	To determine turnover and for setting limits	Balance sheets and Manufacturing orders	Monthly, or every four weeks	Tabulation
Finished Stock Report by items	Gen. Mgr. Sales Mgr. Works Mgr. Planning Mgr.	To correlate Sales and Production	Balance Sheets	Weekly (or depending on industry)	Tabulation
Inactive Stock Report by items	Works Mgr. Sales Mgr.	To eliminate inactive lines and for setting limits	Balance Sheets	Monthly, or every four weeks	Tabulation
Inventory adjustments, by items	Works Mgr. Planning Mgr. Head Storekeeper	Accuracy of storeroom and balance clerks and for accounting	Physical count checked with balance sheet	Currently	Current Reports

Courtesy of C. R. Howard.

## APPENDIX

The following table shows the result of a preliminary investigation to determine stowage requirements for different standard articles commonly carried in every metal working store room. The table is presented primarily in the hope that further investigation may be found practicable, in view of the striking similarity of results so far obtained.



STOWAGE CAPACITIES

Bin number.....	1	2	3	5	8	9	12
Inside dimensions.....	$22\frac{3}{4} \times 22\frac{3}{8} \times 16$	$11 \times 22\frac{3}{8} \times 16$	$22\frac{3}{4} \times 10\frac{3}{8} \times 16$	$11 \times 10\frac{1}{2} \times 16$	$5\frac{3}{8} \times 11\frac{1}{4} \times 16\frac{3}{8}$	$5\frac{1}{2} \times 5\frac{1}{2} \times 17$	$5\frac{1}{2} \times 5\frac{1}{2} \times 17$
Net cu. ft.....	4.8 Cu. ft.	2.3 Cu. ft.	[2.2 Cu. ft.	1.07 Cu. ft.	.58 Cu. ft.	.3 Cu. ft.	.3 Cu. ft.
Number of units per cubic foot							
Hex. Nuts: $\frac{5}{16}d \times 1\frac{1}{2}w \times \frac{5}{16}t$ $1\frac{1}{2}e \times \frac{5}{8} \times \frac{5}{8}$ $\frac{7}{8} \times 1\frac{1}{2} \times \frac{5}{8}$	11,000 1,600 920	11,000 1,600 920	11,000 1,600 915	11,000 1,600 920	11,000 1,600 920	11,000 1,600 920	11,000 1,600 920
R'd H'd Carr. Bolts: $\frac{1}{4} \times \frac{1}{8}$ $\frac{3}{8} \times 1\frac{1}{4}$ $\frac{7}{16} \times 2$ 480 $\frac{5}{8} \times 2$ $\frac{3}{8} \times 5\frac{1}{2}$ $\frac{1}{2} \times 7$	4,850 1,635 795 480 350 152	4,850 1,790 795 500 330 152	4,840 1,820 795 512 330 152	4,880 1,840 802 495 368 155	4,850 1,725 812 518 311 155	4,830 1,550 794 517 276 155	4,830 1,550 794 517 276 155
Hex. H'd Mach Bolts: $\frac{1}{2} \times 2\frac{1}{2}$ $\frac{1}{2} \times 3\frac{1}{2}$	835 527	835 525	835 527	836 527	835 526	835 525	835 525
Washers: $\frac{1}{2}$ hole, 1 diam. $\frac{9}{16}$ hole, $1\frac{1}{4}$ diam. 1 $\frac{1}{16}$ hole, $1\frac{3}{4}$ diam.	8,820 3,820 1,830	8,820 3,830 1,830	8,760 3,830 1,830	8,830 4,670 1,830	8,820 3,830 1,830	8,830 3,830 1,830	8,830 3,830 1,830

Examples. - 1. What space is required to hold 5,000  $1\frac{1}{2}e \times \frac{5}{8} \times \frac{5}{8}$  Hex. Nuts? Ans. 5,000 = 3.13 cu. ft.

2. How many  $\frac{1}{2} \times 1$  washers will a bin containing 6 cu. ft. hold? Ans.  $6 \times 8,820 = 52,920$  washers.

## INDEX

### A

- Accounting for materials, 159-69
  - basis of, 159-60
  - charges for materials issued, 8, 101, 137-8, 160, 167-9
  - perpetual inventory control, 167, 171-2
  - pricing materials for issue, 59, 96, 167-9
  - statements, 163-4
  - transactions, 160-7
- Adjustments in inventory, 172-3
- Administrative control of materials, 3, 8, 15, 35, 51-2, 70, 72-5, 99-101
- Allowance in setting low limits, 47
- Amount to order, determination of, 44, 73-5
- Anticipatory purchasing (see *Speculative Purchasing*).
- Apportionment of material needs, 7, 11-12, 43, 45, 57, 59, 62-6
- Approval of replenishment orders, 19-20, 28, 51, 72-4
  - to change amount requisitioned (Fig. 10), 73
- Article, definition, 127
- Auditor, function, 29, 95-7

### B

- Balance clerk, function and qualifications, 27
  - perpetual inventory, 58, 119-21, 170-1
  - sheet for materials, choice of, 53-4
  - files (Fig. 9 and text), 68
  - location, 35
  - use, 19, 54-60
  - see *Classified Stores Balance Sheet*.
- Balance clerk, *Unclassified Stores Balance Sheet*.
  - Worked Material Balance Sheet*.
- Bill of material, use, 18
- Bins, capacities of various, 131-2, Appendix
  - and racks (see *Store Room Equipment*).
- Bin label, sample (Fig. 15), 105
  - use, 21
  - tag, sample (Figs. 29-30), 118-119
    - use, 21, 91-2, 170-2
- Block, definition, 127

### C

- Cancellation of purchase orders, notice of, 58
- Capacities of storage units, 131-2, Appendix
- Cash discount on purchases, 95-7
- Centralized *vs.* decentralized store rooms, 100-102
- Charges for materials issued, 96, 101, 137-8, 160, 167-9
- Classes of materials, 15-6
- Classification, 140-158
  - basis of industrial, 143-6
    - of mnemonic, 144
  - definition, 140
  - of charges, 146
  - of product, 147
  - of stores, 147
  - other, 157-8
  - rules for, 140-1
  - samples of, 140-158
- Classified stores, definition, 16
  - balance sheet, basis of operation, for apportionment, 44-5

- Classified stores, requirements of,  
     for apportionment, 40, 42-52,  
     54-66  
     sample (Fig. 5), 61  
     for minimum limit,  
     40, 41, 54  
     sample (Fig. 4), 55  
     for schedule, 40, 52,  
     66-7  
     sample (Fig. 6), 65  
     steps in setting up, for apportionment,  
     45-52  
     in operation of, for  
     apportionment,  
     57-60, 62-6  
     use, 19  
 Column, definition, 127  
 Contracts, recording changes in  
     purchasing, 80, 96  
 Cost department, function, 29  
     location, 35-6  
 Course, definition, 127  
 Credit memorandum (see *Stores  
 Credit*).  
 Cycle in material handling, 17
- D
- Delivery times and dates, 32, 47,  
 72, 77, 79, 80, 82  
 Departmental store rooms and  
     supplies, 100, 101, 137  
 Departments, location of various,  
     34-7  
 Double binning, bins for, 109-10, 112  
     definition, 118  
     inventory control, use in,  
     119-122  
     operation of, 118-123, 130  
     space required, 123  
     turnover of goods, use in,  
     122-3, 134  
 Dust, protection against, 134
- E
- Engineering department, function,  
 26  
 Engineering department, responsi-  
     bility for quality and  
     inspection, 26, 28, 30-  
     31, 83, 87, 89, 90, 92-5  
     for specifications, 45-7,  
     92  
 Equipment of store room (see *Store  
 Room*).  
 Explosion, protection against, 132
- F
- Factory supplies, definition, 15  
     and spare parts, control,  
     136-8  
 Fire protection, 132  
 Flexibility in store room equip-  
     ment, 106-13  
 Follow-up of outstanding pur-  
     chases, orders, 78-83, 95  
 Forms, size and color of paper, 18  
     use of various, 18-23  
 Freight register, use, 20, 88-9, 96  
 Function of manufacturing plant, 1
- H
- Hand count (see *Physical Count*).  
 Heap, definition, 127
- I
- Ideal material system, 6-8  
 Identification tag, use, 22  
 Importance of material function, 3  
 Indexing store room equipment  
     (Fig. 14), 104  
 Information necessary for material  
     control, 23-4, 45-52, 53,  
     56-60  
 Inspection, function, 92-5  
     kinds of, 94-5  
     report (see *Material Inspection  
 Report*).  
     responsibility for, 26, 28,  
     30-1, 83, 87, 89, 90,  
     92-5  
 Instances of material losses (see  
     *Savings Possible*).



- Interchangeable racks and bins  
(see *Store Room*).
- Inventory, adjustments, 172-3  
control in accounting, 167,  
171-2  
through double binning,  
119-122  
in maintenance dept., 135-9  
periodic physical, 169-70  
perpetual, 58, 119-21, 170-73  
supplementary checks on book  
balances, 171-2
- Invoice, checking and paying, 95-7  
copies, 95-7
- Item, definition, 127
- L
- Layout of store room, 99-104
- Location of various departments,  
34-7
- Losses in material handling (see  
*Savings Possible*).
- Lot, definition, 127
- Low limit, determination of, 43-4,  
47-8
- M
- Maintenance stores, 135-9
- Market as basis of material replenishment, 38
- Materials, accounting for (see  
*Accounting*).
- administrative control, 3, 8,  
15, 35, 51-2, 70, 72-5,  
99-101
- classes of, 15-6
- control, necessary for efficient  
production, 1-14, 17  
rules for, 24-5
- cycle, 17
- data sheet (Fig. 2), 46
- function in manufacturing,  
scope of, 1-3, 17, 23-5,  
26, 30, 34, 39, 53, 70, 85,  
98, 136, 140, 159
- information necessary for control of, 23-4, 45-52, 53,  
56-60
- inspection report, use, 20
- Materials, receipts, summary (see  
also *Notification of  
Material Received*), 92
- regulation, a function of production dept., 8, 15, 35,  
51-2, 72-5
- replenishment (see *Replenishment*).
- rules for control of, 24-5
- simplification of, 3-6, 93
- standardization of, 3-6, 93
- statistics of, 53, 173-4
- system must be adapted, foreword, 18, 26, 29, 30, 33,  
37, 41, 42, 49, 53-4, 56,  
84, 98-100, 102, 107
- system not self-operating, 8,  
36, 60
- theory of supply service, 6-7,  
23
- Metal racks and bins, 118
- Minimum limit, dangers in use of,  
11-2, 41-2, 54  
definition, 40
- Mnemonic classification (see  
*Classification*).
- Modification of purchase contracts,  
recording, 80, 96
- Morgue store room, 118
- Move order, sample (Fig. 33), 122  
use, 22
- N
- Notification of materials received,  
copies of, 91, 95-7  
requirements of, 91  
sample (Fig. 13), 91  
use, 20, 58
- O
- Oral orders, 72
- Order point (see *Amount to Order*).
- Ordering materials (see *Purchase  
Order, Purchasing Dept.,  
Replenishment*).
- Organization for material control,  
29-33, 35, 37, 70, 86-8,  
93, 100-1

- Organization, chart (Fig. 1), 33
- Overflow bins, 113-4  
 bin tag, sample (Fig. 25), 114  
 use, 21, 113
- P
- Package, definition, 127
- Parts list, use, 18
- Percentage for safety in setting low limits, 47
- Periodic physical inventory (see *Inventory*).
- Perpetual inventory (see *Inventory*).
- Personnel dealing with material control, 26-9, 30, 49, 70  
 high grade help necessary, 8, 27, 60, 85
- Physical count (see also *Inventory*), 170  
 form for (Fig. 36), 170  
 inventory adjustments, 172-3  
 location of offices, 34-7  
 necessity of, in perpetual inventory, 58, 120, 170  
 supplementary checks on book balance, 171-2
- Piece, definition, 127
- Pile, definition, 128
- Pilfering, protection against, 135
- Planning department, function, 29, 35  
 location of, 35
- Postal follow-up of purchase orders (Fig. 12A-B), 81
- Production department, function, scope of, 1-2, 35  
 responsible for material control, 8, 15, 35, 51-2, 72-5  
 for quantity, 2, 31, 51, 72-5  
 responsible for time to renew, 32, 47  
 dependent on material control, 1-14
- Production department, requirements as basis of material replenishment, 6, 38-52  
 types of, as related to material replenishment, 39, 54
- Protection of materials, 103, 132-5  
 from deterioration, 134  
 dust, 134  
 fire and explosion, 132  
 pilfering, 135  
 rust, 133
- Purchase order, cancellation of, copies of, 58  
 original, 78, 79  
 requisitioner's, 78, 79  
 purchasing department by  
 serial number, 78, 80, 96  
 tickler copy, 78, 80-2  
 balance and receiving, 58, 78, 82, 89-90, 95-7  
 other copies, 78  
 follow-up of, through tickler, 78-83, 95  
 by postal, 81  
 frequency of issuing, 48-9  
 requirements, 77-8  
 sample (Fig. 11), 76  
 short carbon for receiving, 89-90  
 use, 20  
 requisition (see *Replenishment Order*).  
 specifications, kinds of, 92-5  
 responsibility for, 45-7, 92  
 use, 3-6, 18
- Purchasing, speculative (see *Speculative Purchasing*).  
 indication of where to purchase, 50-1  
 contracts, modifications of, 80, 96  
 department, 70-84  
 function, 70-84, 93  
 location, 36  
 records, 77-84  
 responsibility for cost, 32  
 for time to renew, 32, 47, 72, 77, 78

## Q

- Quality and inspection, responsibility for, 26, 28, 30-31, 83, 87, 89, 90, 92-5
- Quantity, responsibility for, 3, 31, 51, 72-5
- Quantity held in various bins, 131-2, Appendix
- Quantity to order (see *Amount to Order*).

## R

- Racks and bins (see *Store Room Equipment*).
- Raw material, definition, 15
- Receiving department, 86-92, 93  
copies of purchase order for, 89-90  
function, 28, 31, 86-7, 89-92  
location, 34
- Replenishment—bases of, 38-52  
through amount on hand, 40, 41  
sample balance sheet for, 54  
through amount available, 40, 42-52  
sample balance sheet for, 44-5, 54-66  
through a schedule, 40, 52  
sample balance sheet for, 66-7
- Replenishment order, approval of, 19-20, 28, 51, 72-4  
to change amount ordered (Fig. 10), 73  
copies of, 52  
requirements, 50  
sample (Fig. 3), 49  
use, 19, 75
- Reports, 163-4, 173-4
- Requisition (see *Replenishment Order*), *Stores Issue*, *Worked Material Issue*).
- Reservation of material (see *Apportionment*).
- Returned goods report, use, 21
- Row, definition, 127

- Rules for material control, 24-5
- Rust prevention, 133

## S

- Savings possible through material control, 9-14, 30, 31, 34, 35, 38, 40, 41-2, 45, 52, 53, 60, 71, 80, 85, 93, 94, 95, 100, 106, 111-113, 122, 124, 126, 129, 140, 158
- Scheduling material needs, 40, 52, 66-7
- Section, definition, 127
- Short carbon of purchase order for receiving, 89-90
- Simplification of materials, 3-6, 93
- Space reserve in storage bins, 114, 131-2
- Specifications (see *Purchase Specifications*).
- Speculative purchasing, 8, 24, 31-2, 38, 51, 72-5  
approval to change amount requisitioned, 73
- Stack, definition, 127  
pyramidal, definition, 128  
wedge, definition, 127
- Standard lot, definition, 127  
use, 131, 137  
racks and bins (see *Store Room Equipment*).
- Standardization of material, 3-6, 92-3
- Statistics of material, 53, 173-4
- Stores, definition, 15  
classified, definition, 16  
count, sample (Fig. 36), 170  
use, 23, 58, 170-1  
unclassified, definition, 16
- Stores credit, sample (Fig. 32), 121  
use, 22, 162  
issue, pricing, 96  
sample (Fig. 31), 120  
use, 22, 160  
system (see *Material System*).
- Storekeeper, function, 28, 29



- Storekeeper, physical count, 58, 119, 120, 170-71
- Store room, 98-139  
 arrangement, layout, 99-104  
 capacities of various bins, 132, Appendix  
 centralized or decentralized, 100-102  
 equipment, standard racks and bins, 106-123  
 samples (Figs. 16-24, 26-8), 108-112, 115-117  
 minor, 123-126  
 flexibility in equipment, 106-13  
 indexing, 104-106  
 location, 34  
 protection, 132-5  
 requirements, 98, 102  
 space reserve in bins, 114, 131-2
- Stowage, capacities, 131-2, Appendix  
 definition, 127-8  
 rules for, 128-32  
 units (Fig. 34), 128
- Summary of material receipts, 92
- Supplies and spare parts, control of, 136-8
- Supply service, theory of, 6-7, 23
- Symbolization, 140-158  
 definition, 141  
 rules, 141-3  
 examples, 140-158
- System (see *Material System*).
- T
- Tag (see *Bin Tag, Identification Tag, Overflow Bin Tag*).
- Theory of material supply service, 6-7, 23, 39
- Tickler copy of purchase order (see *Purchasing Order, Copies of*).
- Time to renew supply, 32, 47, 72, 77
- Tier, definition, 127
- Tools and fixtures, control of, 138-9
- Tool check, sample (Fig. 35), 138  
 use, 138-9
- Traffic department, function, 28, 86, 88-90  
 location, 34
- Transportation men, function, 28
- Turnover of goods, savings through, 13-14  
 through double binning, 122-3, 134
- U
- Unclassifies stores, balance sheet, operation, 67-8  
 sample (Fig. 8), 66-7  
 use, 19  
 definition, 16
- Unit, definition, 127
- W
- Worked materials, balance sheet, operation, 67  
 sample (Fig. 7), 65  
 use, 19  
 control similar to stores, 16  
 credit, use, 22  
 definition, 15-6  
 issue, use, 22  
 received in stores, use, 22
- Works manager, function, 28, 51-2









14 DAY USE  
RETURN TO DESK FROM WHICH BORROWED

**LOAN DEPT.**

This book is due on the last date stamped below, or  
on the date to which renewed.

Renewed books are subject to immediate recall.

3Jan61 BM

REC'D LD

DEC 18 1960

25May'610A

REC'D LD

MAY 22 1961

LD 21A-50m-4,'60  
(A9562s10)476B

General Library  
University of California  
Berkeley



497540

HF 6345

F3

UNIVERSITY OF CALIFORNIA LIBRARY



