THESIS

The Principles Involved in a Factory Cost System.

by

Stanley C. Carnahan

Class of Nineteen Hundred and Eighteen

Department of Engineering and Economics.

THROOP COLLEGE OF TECHNOLOGY.

Pasadena, California.

1918.

TABLE OF CONTENTS.

LISTS OF CHARTS

TO THE FACULTY,

THROOP COLLEGE OF TECHNOLOGY,

GENTLEMEN:

This investigation is offered as a THESIS for the degree of Bachelor of Science in Engineering and Economics.

It is the purpose of the following pages to discuss the fundamental principles that enter into Cost Systems for Manufactures.

What is a factory but a laboratory wherein men, methods, materials and machines are given the acid test? In this laboratory, the manager is the master-analysist; the reagents with which he works are many and varied, but the sole criterion of the result, "Does It Pay?" The arbiter, the Cost System, and the whole scheme of operation needs to be arranged so as to permit the obtaining of accurate, detailed costs currently.

The writer takes occasion, at this point, to express his appreciation to Professor Seward C. Simons and Mr. Harry H. Baskerville, whose advice and assistance has been of the greatest value in the preparation of this work.

Respectfully submitted,

Stanley C. Carnahan

Date April 1, 1918.

PART I.

INTRODUCTION.

GENERAL DISCUSSION.

Successful management has been defined as the art of spending money wisely and well. Profits may not be the end and all of business but they are certainly the test of practicality. Everything worth while should pay for itself. One proposal is no better than another, except as in the working-out it yields better results.

To many, a cost system is merely a collection of forms and a routine of operating them, and if through such a system, one is able to account in general for money expended and to know within a few thousand dollars whether they have lost money the past six months or year, they are satisfied.

That is, indeed, one kind of a cost system and if it does no more than that it is not worthy of the name. A far more important function is to show in detail, as well as in total, where money has been

or lost and why, and to turn on the searchlight of investigation so quickly after the event, to permit the prompt apprehension of every concealed foe of efficiency that may be lurking about.

The main purpose and value of a cost system is control. In the hands of a resourceful, discerning executive, the cost system is the chart and the compass by which he is able to steer the good ship of business past every danger straight towards the haven of enduring prosperity.

If the cost system is of the right nature and compiled so as to show the costs in the best form, which may be per unit, per hundred or per thousand units, depending upon the character of the business, the question of a proposed purchase, whether wise or not, can be readily determined. If it is a material, how does it work up, what is the proportion of wasts, are the total costs greater or less than some other material, whose purchase price may be greater or less? Looking only at first costs has lead many a manager astray. Illustration: A furniture manufacturer, thinking to save money, contracted for several carloads of lumber at a figure much lower than he had been paying. But the lot proved to be so full of knotty boards and pieces

with bad ends, requiring much extra saving and entailing a much greater percentage of waste, that the actual cost of the product was increased. Furtunately, he had a cost system that showed up this result very quickly and he was more wary of jumping at a bargain thereafter.

Suppose the purchase is a machine. Several alternative propositions have been submitted, each claimed by its proponents to be the best. The prices quoted varied widely. How is the manufacturer to judge? Again his cost system is capable of furnishing the answer, if it is rightly designed and in the hands of a skillful operator. Ascertain for yourself what each machine can do. But do not decide by mere capacity. Carefully compute the cost expressed in terms of the unit of product. In this cost comprehend every possible element as attendant, labor, power required, space occupied, probable upkeep, depreciation and interest. Then when you decide, you will do so on the basis of facts.

On the other hand departmental expenses are see-sawing up and down in dizzy fashion, and on the whole are trending upwards. In one department, however, they are remarkably uniform, as compared with the rest, and are gradully lowering. Your cost reports, more-over, analyze the figures for you in

detail, so you can see what is being spent for each item, what idle machine time is costing, what broken tools, machine repairs, lamp renewals, power consumption, accidents, labor turnover and so forth. Every expenditure is itemized and the total shown in relation to either machine or man-hours. The variation is astounding. You had not dreamed that conditions were so poor, and the foreman who was your particular pet has the worst expense sheet of all.

You go out and look over the various departments. You are not long in spoting the reasons. It is all too apparent, not that you have come to think of it, why A's department is better than the rest and B's the worst of all. Your righteous indignation rises and you determine henceforth to judge your department heads on their merits - on their ability, and by this method you are able to reduce by more careful management the ratio of expense.

You have arrived at control - the ripe fruit of constructive and scientific cost accounting. You are on the high road to real success as a manager. For you are now judging all things on the solid basis of facts, "And fact-controlled management is scientific management".

PART II.

THE IMPORTANCE OF COSTS.

The prime object of a cost system is to determine costs, to analyze and compare them, and to use them as a basis of making prices. But the uses and advantage go further. A manufacturer from reliable records is able to make a clearer and more intelligent statement to his bank and thereby obtain a larger line of credit than could be obtained without it.

In most every line of business there is some class of work that is done in which the manufacturer actually loses money. This may be due to the high cost of running the plant, or it may be due to some competitor who is either better equipted to manufacture the article, or has a better conception of his costs. A cost system will bring out these facts and will show the manufacturer which lines he should push. If the sales manager is well aware of the accurate costs of the goods he is selling, he will be able to push the most profitable lines and in a short time the result will be appar-

ent in the profit and loss account.

In every manufacturing plant there is bound to occur leaks, either of material, labor or expense. If statistics are kept showing the exact amount of material necessary to do a certain class of work, the amount of labor and the amount of overhead expense, an increase in any of these items will be immediately revealed by a comparison and the executive will be in a position to take up the matter for investigation. It is hardly necessary to say that after a few of these investigations, the factory people will use a little more judgement, not only in the use of material but in the time spent on the job. A cost system, with forms, properly designed for giving statistical information is the greatest aid to factory efficiency.

A cost system is the most valuable price of insurance any factory can have, for this is an insurance against expensive mistakes, and when properly designed and operated the cost in proportion to the benefits is negligable.

In these days of close margins and keen competition, one cannot afford to be ignorant of facts as vital as those concerning the cost of doing business. Some one or more competitors may know his

costs, and once he pits this knowledge against your gesses, he is certain to win in the long run. The beginning of managerial wisdon is the knowledge of costs.

The most evident reason for an accurate cost system is the necessity of covering more than the cost of the product in the selling price. Protect the profits!

I have seen large establishments who started out in a small way branching out, here and there, and thru sheer luck have made a profit, for a good many years. But as competition has come up around them and the margin becomes closer, they soon felt that something must be wrong and an investigation is started. Nine times out of ten it is sifted down to the lack of a cost system. It is quite right that one may wait until the end of the year, and after taking into account the inventories at the beginning and end of the period, and the entire income and expenditures, ~~he~~ may arrives at a conclusion as to whether or not a profit has been made.

In the absence of a cost system, however, such a conclusion relates only to the business as a whole, and does not enable one to know whether any particular line of the product has been sold above or below cost.

A company manufacturing electrical specialities produced a device which sold to the distributor for $100, to be retailed at $150. Four thousand of them were sold before an investigation brought out the fact that it was costing $108 to make each of them. The $100 had been set on a guess. That particular guess cost $32,000 before it was corrected by an accurate knowledge of costs. This loss would have paid several times over the expense of the most elaborate cost system conceivable These are facts, but yet there are men who hold up their hands in horror at the expense of a cost system.

The present coddition of affairs is difficult to explain, as the competition is keen and the American manufacturer is progressive. In many cases the owner or manager has risen from his tools and his success is due to intimate knowledge of the work and his ability to direct shop operations. When the plant was small he figured his own costs, and made his estimates for new work with his ability, and with his intricate knowledge of the work he was able to make his estimates with considerable accuracy. His plant has now grown beyond the one-man stage. The costs are kept by men who have no shop experience, and the estimates are made by men

who neither have the experience or the ability of of the manager and are based on cost records of previous similiar work. The manager is notable to realize that these subordinates cannot, with the same machines, produce the results that he obtained. He also forgets that time has changed and that keen competition requires that his cost records should clearly show him how every penny is expended. In his day in the shops, there were no elaborate cost systems, and can see no need for such systems now. He has been progressive in keeping his plant supplied with up-to-date machine tools; this is his line, and he sees the benefits to be derived from modern plant equipment. He is out of date with his cost system; this is not his line, and he cannot see the benefits to be obtained therefrom. He cannot realize that one is fully as important as the other and would hold up his hands in horror if told that costs were more important than production.

There is a line, faint perhaps, but nevertheless a dividing line between cost keeping and accounting. Cost keeping is only concerned in placing in the most direct way the cost of every element that enters into the total cost of the product. The costs should be so recorded that the

manager can readily discover all excessive costs, whether they be direct costs or an element of the expense burden. Accounting begins where cost keeping leaves off. The preparation and installation of a cost system is the work of an expert who has made a study of the application of simple accounting to shop methods. Scientific shop management cannot exist without accurate costs.

PART III.

THE FACTORY ORGANIZATION.

It is necessary in factory organization to have the lines of "Authority" well defined so that each person will know to whom he is responsible, and from whom he shall receive orders. In many establishments these tests will bring surprising results. It will be found that duties and responsibilities overlap and that few have a clear idea of their own duties or those of officers with whom they each day deal. The general manager will also frequently find that he has difficulty in making a satisfactory diagram of the organization.

In factories where these unsatisfactory conditions exist the first step is to determine the duties and responsibilities of every general and subordinate official, and it should always be borne in mind that responsibility should be accompanied by its corresponding manager of authority. Where the duties of each have been determined they should be clearly defined in writing, not only the information of the official concerned, but for the information of all holding positions

of authority.

A diagram of the organization should also be prepared which will show the general limits of authority and responsibility of each head of a department or division, and will indicate their relations to each other. This should be posted throughout the works in order that everyone in the establishment may know the general scheme of organization, and the limits of authority of all responsible officers.

The organization should be such that dissimilar duties will not be assigned to the same men. Similar duties should, as far as possible, be brought together, to be performed by one man or group of men, and the men selected for these duties should be the ones who are best qualified for the work. There are very few men who excel in many different lines of work. Even with men of great ability, it will be found that they usually excel in only one kind of work, and this is the line to which they have devoted their time and talents, that on which they have specialized.

In the great majority of manufacturing establishments the company officers are far more conversant with the details of financing, accounting, and selling than they are with those of manu-

facturing. From time to time questions of business policy arise which have an intimate connection with cost of production, time of delivery, stock of raw material, stock of finished parts, condition of work in process of manufacture, and similar matters.

At such times many officers realize that whereas in the settlement of questions of financing, accounting and selling had clear-cut records at hand to guide them in forming policies, on the other hand, when it came to questions involving the factory itself, they were dependent wholly upon opinions of superintendents or foremen, these opinions have no firmer foundation than intuition. The realization of their helplessness and the absence of reliable and accurate knowledge or manufacturing conditions has been an incentive to impress officers of manufacturing establishments to devise more thorough systems of the executive control of the factory. More and more it has been appreciated that some graphic method of showing inter-department relations is necessary if responsibility it to be placed.

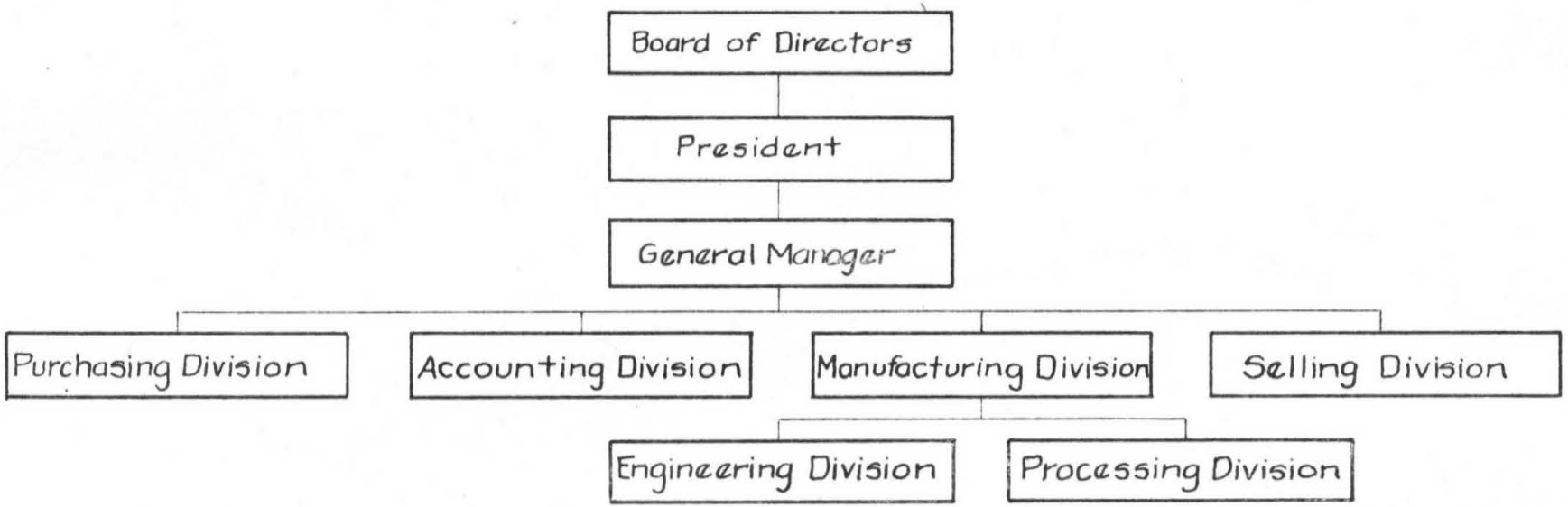
It is not only a good plan to have well defined lines of "authority" but also well defined lines that indicate the flow of reports.

The most successful factory organizations are those in which all departments having to do with production in any manner whatever are subordinate to and responsible to one general head, the works manager, who has a thoroughly competent assistant ready to take the chiefs place at anytime, and who is recognized as the acting works manager of his superior. This form of control is characteristic of most of the successful manufacturing organizations of today. There must be no way in which company officers, or another department, can deal with department responsibility, except thru the works manager.

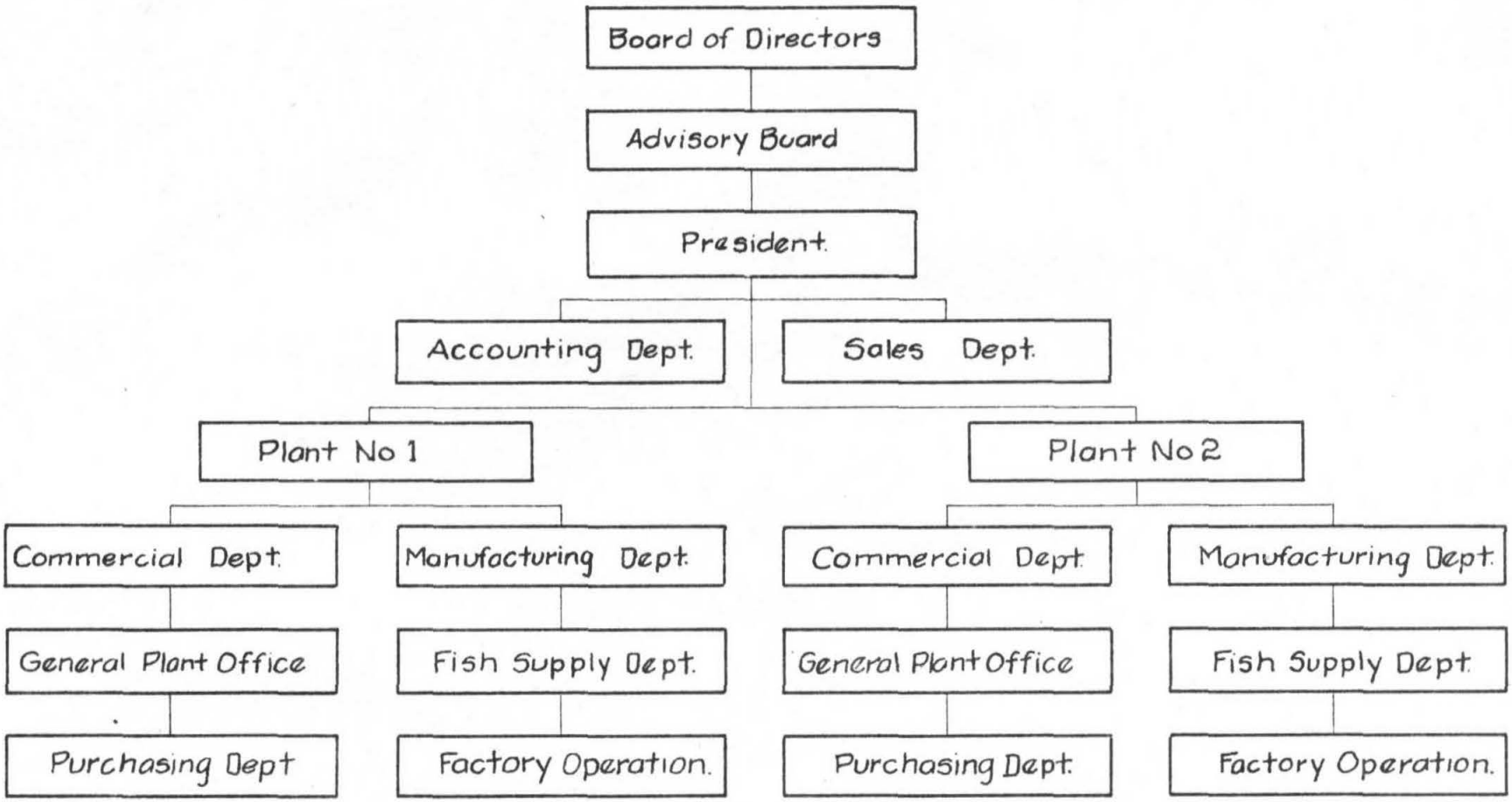
In manufacturing, next in importance to the centralization of executive authority is clearly defined departmental lines, with a responsible head and assistant head for each department. The business which has its factory departments so organized that each department head is directly responsible to the works manager, without any interviewing boss, will be far more free from internal dissensions than one in which this in not the case.

On the following pages are organization charts which show the methods in which an operating organization is formed. The description on the charts show the nature of the business for which the organization chart is characteristic.

General Organization Chart

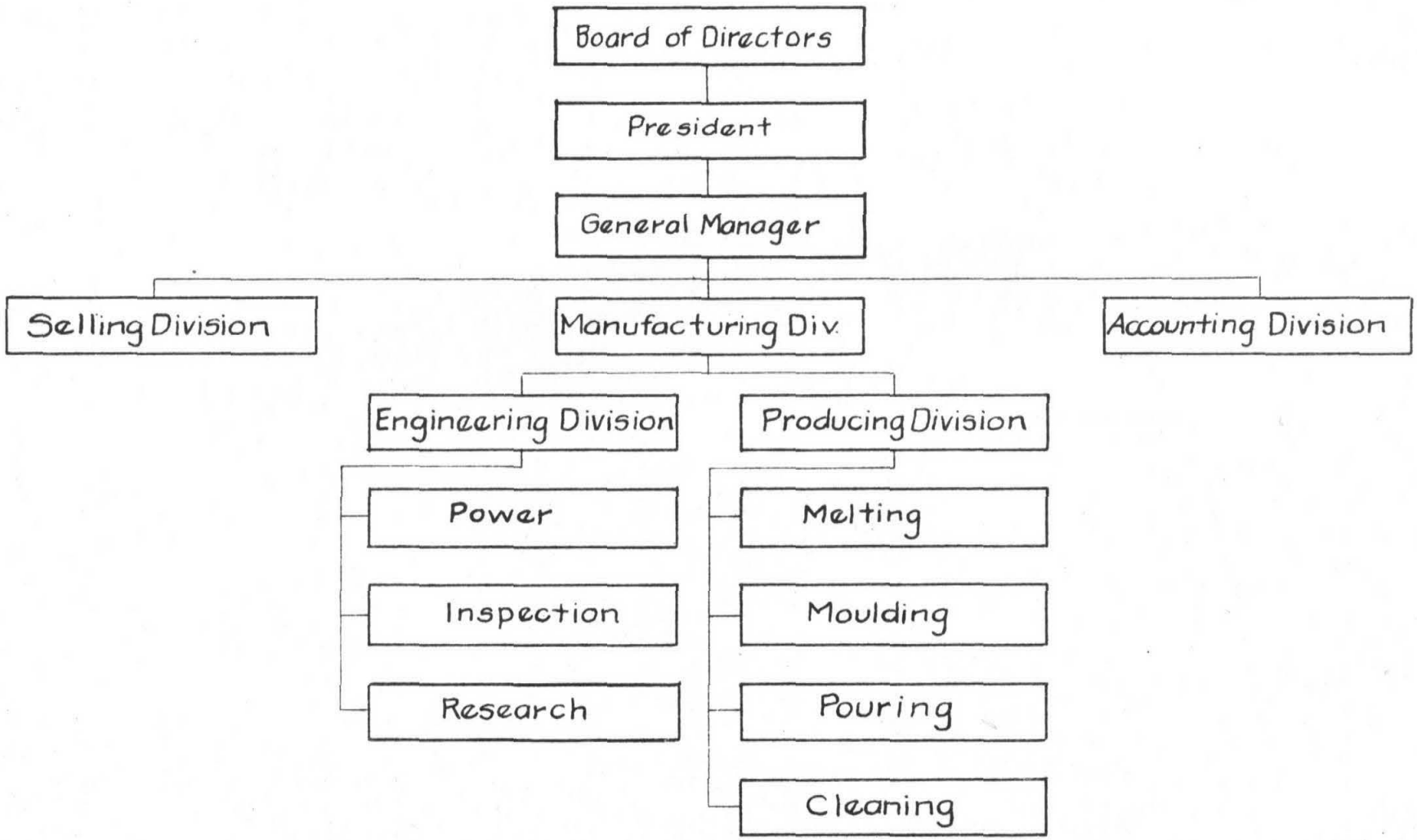


Canning Company — Organization Chart



SCC

Foundry Organization Chart



SCC

PART IV.

ELEMENTS OF COSTS.

Leaving now the general principles of industrial organization by which industrial operations are carried on, we may view the problems of manufacturing as they present themselves to the works manager and study the several elements of these problems from his characteristic point of view. In practice, the process of manufacturing fall naturally into four great divisions. First,- gathering materials of various sorts necessary to the product; second,- operating upon these materials so as to change their condition, combination, location or bulk; third,- distributing again among buyers that,which we have previously gathered and manufactured; fourth,- overseeing, safe guarding and promoting the whole cycle. To put this more briefly, the steps are procuring raw materials, making the product, selling the goods, and managing the business.

Of the four problems of manufacture the whole key to business is "does it pay". What are we

doing all this work for? It is to make money, and to make money we must know what costs are and what they are made up of.

The first distinction between the elements of cost in a manufacturing business should be between cost and selling price. Both the manufacturing and the selling division may be excellently organized and managed, and yet the whole concern may be operating at a loss, and on the other hand either or both division may be very poorly organized and managed, but the concern may be operating at a profit. Only when an absolute distinction is made between them is it possible to place responsibility.

Production cost for each product is commonly divided into four parts:-

1. - Material.
2. - Labor.
3. - Burden.
4. - Miscellaneous.

These may be subdivided into:-

1. - Material
   - (a) Direct.
   - (b) Indirect.
2. - Labor
   - (a) Direct.
   - (b) Indirect.
3. - Burden
   - (a) Direct.
   - (b) Indirect.
4. - Miscellaneous

"Direct Charges" is that element of cost that

can be charged directly to the product. The cost of the substance that enters into the product is the direct material charge; the cost of labor applied directly to the article, that is, to the productive process, is the direct labor cost and any other expense or burden than can be charged directly to the product.

"Indirect Charges" consists of indirect material, such as, factory supplies, which, while used in the process does not enter into the product itself, or enters into the product so as not to be chargeable to any particular article. Indirect labor, such as used in cleaning up, repairing, supervision and handling of materials is not chargeable direct to product or process itself. Indirect expense as used here refers only to those expenses incurred in the manufacturing end of the business which are properly a part of the cost of production, such as, supervision, repairs, light, heat, power and depreciation. Indirect expenses as a class, fall into two divisions, depending upon how they are to be apportioned or distributed in costs. The first division consists of those expenses that can be apportioned to individual products or certain processes, because they are incurred in particular departments of the factory, while the second is made up of expenses which extend over the plant as a whole and must be dis-

tributed over the products as a whole, and which are therefore designated as general operating expenses.

The following list are those items composing indirect expenses:-

1. Indirect Material
2. Indirect Labor
3. Supplies
4. Oil
5. Freight & express inward when not charged to direct material cost.
6. Supervision
7. Inspection.
8. Experimental work
9. Rent.
10. Taxes.
11. Insurance.
12. Interest.
13. Depreciation.
14. Maintenance.
15. Repairs.
16. Power or power plant.
17. Light
18. Small Tools.
19. Over - Short and Damage.

Raw material is purchased, the ultimate destination of it is not known, so stores is debited. A well managed factory will have always on hand a large store of materials in addition to the particular raw material required for its main product. That is to say, a large fish cannery will maintain on hand a stock of lumber, hardware, etc., in addition to its stock of cans, cases, salad oil, etc. The stores account in the general ledger is but a summary of many elaborate details dept elsewhere. Most concerns keep what is called a "Stores ledger", in which is entered every receipt of goods at the storehouse and issue of goods from it. The record must be kept accurate by requiring the

storekeeper to give a receipt for everything, he receives and to obtain a receipt for everything he issues. A stores ledger is so arranged that each kind of material maintained in the stores has an alloted page or pages, so that all supplies and materials can be debited or credited as the case may be. Sometimes they contain separate columns to distinguish between different sizes and lengths. A properly made stores ledger will have a statement as to maximun and minimum stock to be carried, this making it unnecessary for special reports to the superintendent or other officials, in order that they might learn what stock is on hand.

PART V.

DISTRIBUTION OF FACTORY OVERHEAD

Manufacturing expense, or burden, comprises all those items of expenditure which cannot be assessed directly against the unit of production, but must be distributed, or prorated over the direct cost in such a manner that each unit bears its just and proper proportion of the total. It includes fixed charges such as interest, depreciation, insurance, taxes, administration and repairs. These other items are commonly known as the variables or as mentioned in a previous chapter as miscellaneous expenses, of which "Reserve for Contingendies", is such an account. These items vary as the volume of business and cease altogether when the plant shuts down. They are also called "controllables", as distinguished from uncontrollable, or fixed expenses, because in the average case good management can reduce them.

The manner of apportioning the burden against the several orders in progress for productive work has received much study and various plans have been

devised and used with success in suitable fields. One of the largest of these fields is that occupied by factories with labor saving machinery, and the study of the actual cost of operating such machines with due regard to the future, is of great importance.

The data required consists of an accurate expense account ranging over a period of several months of good average business conditions, a plan of the plant with the arrangements of the various tools, and spaces for tool hands, an inventory giving original values and the approximate dates of their construction. Taking such a plan the investigator must mark off floor spaces about each tool sufficient to accommodate the workman and his supply of work in process. If the shop is well arranged, the spaces not actually covered will not be very great, but just sufficient for convenient access to tools and work.

The gound plan can thus be laid off in irregular figures, each occupied by a tool and its contingent equipment. Similar spaces are laid off to provide for the various vise hands, erecting men, and so on. Each space with the equipment pretaining to it is a "productive unit".

It is fair to assume that the monthly expense due to the building and real estate should be paid on a basis of square feet of ground occupied. This general rule may be modified so as to assign to spaces near side walls, if much better lighted than the interior of the building is needed, a larger share of the building expense; while central floor space two stories in height (as in a gallery shop), or spaces having crane service, should be rated higher.

The inventory of equipment is next used to set a value on each "productive unit", whether consisting of a machine and its equipment, a vise and the accompaning files, chisels and other shop tools, or a mere space on the floor where an assembler may work; in all these cases the unit is considered as lying within a definite area of floor space.

In the estimated value of machinery, the cost of its foundation, if any, of transportation to the works and erection in position, and of countershafts with belting and all other attachments belonging exclusively to this tool, should be included.

On the following page will be seen a form which if kept in proper shape, and entries made when necessary, will tell exactly the condition of a

MONTHLY MACHINE INVENTORY CARD

Machine No._____ Builder_____ Price_____

Description_____ Date_____

Year	Investment			Interest			Depreciation			Total Interest & Depreciation	
	Inventory	Auxiliary Equipment	Total	Rate	Amount Year	Amount Week	Rate	Amount Year	Amount Week	Year	Week

Month	Interest & Depreciation Expense	Repairs.			Grand Total	Hours Run		Cost Per Hour		Cost Efficiency %
		Labor	Material	Total		Standard	Actual	Standard	Actual	

SCO

machine at any time. When taking inventory of the equipment all that will be necessary is to take the amounts off the cards. These cards may be filed as to department, or process. Each machine should be numbered with a characteristic number showing just what department it is located, as for example, a lathe in the reppair shop might bear this number, R-12, while a lathe in the machine shop might bear this number M-14. The cost of operating the power plant and of lighting and heating the building may be obtained first by computing the cost of operating the power plant, including space charged, deprecia - tion, fuel and labor costs; then estimating the average horsepower required by each machine when running under average conditions. Then after knowing the number of productive hours that the machine has worked during a certain period you know by multiplying the horsepower required by the number of hours you get the horsepower hours used by this machine for the period. Knowing the total capacity of the power plant in horsepower-hours you can easily distribute the porportional power plant charge to the machine.

The item of general shop expense remains, comprising expense for small tools not already apportioned, labor of helpers, miscellaneous supplies,

loss by defective work and accidents, and expense of office work required for managing shop affairs. This item reduced to monthly or periodical figures may be apportioned according to the number of men employed and each productive unit charged with the share belonging to the workman or workmen attached to the unit.

There is also administrative expense, consisting of salaries of the manager, and the elected officers and general office expense, with whatever other special accounts of a private nature may be carried; and generally a considerable expense for selling the factory product, consisting of advertising, traveling, salaries, commissions, and entertaining.

There are seven or eight standard methods of distributing over head. The aim in every case is to make each job or piece of work bear its due proportion of general expense.

The direct material method may be used where the product is essentially the same, that is, find what per cent of the total materials enters into every product, and if a product consumes a certain percent of the material, charge it with that certain percent of the over head.

Where wages are an important part of the cost and vary greatly the "Percentage on Wages", may be used. Here you find out what part of the total direct wage enters into every product and charge that percent of the over head to the product.

Where all the wages are nearly uniform the direct labor method may be used. Here you find what of the total labor hours enters into every product and if the product consumes a certain percent of the labor, charge the percent of over head to the product.

In a factory that has a great deal of machine work and where machines are the bulk of investment, the labor also being relatively important the "Machine Rate" is the best method. This method required the computing of the machine rate and if this is found to be $.20 per hour and the job takes five hours, the charge of $1.00 for over head is made.

The above method, that is the "Machine Rate," does not take into consideration the idle time. Where this is an important matter the method called "Supplementary Rate" is used. The method of computing this is, determine the machine rate as above,

then subtract over head charged to specific job from the total actual over head, and divide the remainder, which is caused by idle time, into a "Supplementary Rate". If the "Supplementary Rate" for one machine is $.01 and a product uses that machine five hours add $.05 to the amount already charged by "Machine Rate".

Where material and wages are equally important factors in cost, a method known as "Material and Percentage on Wages" can be used. To use this method you find what per cent of both direct material and direct labor enter into the product.

PART VI.

PLANNING THE SYSTEM.

Preliminary Survey.

In order that the plant may get the best results out of its cost system it must be planned so as to meet the peculiarities of the business. A cost system is a intricate piece of special mechanism, and like all other machinery, must be designed carefully and built well, so that it may stand up under service.

It is not enough to inspect the books, for all analysis of accounts cannot give all the necessary data. The extent of the information needed for the planning of the system is a great deal more, and the method fo getting this, is to examine the plant, beginning where the raw materials are received, and ending with the office records. One should follow step by step, each process of manufacture, including the handling of the materials, major and minor activities of the plant as they rise in connection with the operations.

The general type of the industry and peculiar processes has a great deal to do with the type of the system, and one of the first consideration must be to see that the lines are properly drawn between the processes, so as to departmentalize your costs as much as possible.

The necessary information for the installation of a cost system may be divided into four general classifications:

1. Raw Material.
2. Power, machinery and processes.
3. Direct Labor.
4. Indirect labor, supplies and general indirect expenses.

Under raw material it is necessary to see how they are received, checked in and checked out as they are used in the process. If the raw material is scrap, coke, limestone and pig iron to be used in the Cupola furnace, the store yard should be near the furnace, and the material should be economically handled. The material should be placed in bins of known capacity constructed so that by knowing the unit weight of a cubic foot of coke, then by a very little figuring the quanity on hand can be ascertained. Pig iron should be piled neatly in the yard.

The kind of power supplied should be investigated and if there is a separate plant for this

purpose, one should investigate the size, capacity, fuel used and the method of distributing the cost.

The general arrangements of machinery and departments should be noticed and inspected very carefully, so that the process might be made as continuous as possible. Much time and money is wasted in re-handling of material. The operating schedule of the machines should be known so that if there is a large amount of idle time to be delt with it can be considered in working out the system.

In considering the labor problem it is necessary to get the exact number of men working in each department on direct productive labor and those occupied on the non-productive labor. The method of payment, whether by hour, week or month, piece time or a combination wage, as it makes a considerable difference in the design of time cards and in the distribution of indirect expenses.

In addition to the above it is also wise to observe anything which might have a bearing on the efficiency of the plant. Is the organization such as to aid the manager to control? In the inspection of the different departments, the methods by which the operations are controlled with relation to the preceeding and succeeding departments, should be

studied carefully.

A lookout for leaks, wastes both in cutting and spoiled work, shortage of material where shipment is received and not reported, is a way to stop some of the most costly expenses.

It is suggested that the examiner have with him a schedule of questions which will serve both to classify his information and to keep him from overlooking more or less important details. The questions which follow, while suitable for almost any industry are not expected to cover every detail. It is impossible to obtain too much information, and nothing is too unimportant to notice.

Below are a schedule of questions for the examinations of a plant taken from Nicholson, "Cost Accounting".

(1) Purchase Division.

Are purchases made on verbal or written requisitions? Give full particulars.

Is there any one responsible head, or are purchases made by several? Particulars.

Are complete records made of quotations received?

Is any accounting done in this division ? If so, describe it.

Describe filing methods, including catalogues.

Are any orders placed verbally? If so, are they promptly confirmed in writing?

Obtain copies of all forms and books used.

Give office force and duties of each.

Remarks.

(2) Receiving Department.

How are incoming goods handled?

Are there any mechanical appliances? Describe

What records are maintained?

Is there a track scale and a car record kept? If not, how are car-loads received and checked out?

How are partial shipments checked up and reported?

Is trucking equipment owned? What sort?

Obtain copies of report or record forms, books, etc.

If any goods are returned, how is accounting handled?

How are overs, shorts, or damaged goods reported to purchasing department?

Remarks.

(3) Storeroom.

Are storerooms maintained for all raw materials and parts?

How many, and where located?

Do employees have access to stores?

Are heavy goods conveniently arranged as to classes and convenience of handling? Are they properly marked or tagged, and are there signs or other methods for locating classes?

Are there any mechanical devices such as trolleys, tiering machines, cars, etc.? If so, describe.

Are there bins, shelves, racks, etc., of sufficient capacity, and are they arranged to best advantage for economical handling of goods?

Are bin cards used?

Are parts manufactured and carried in stock?

Could any such parts be purchased for less money?

Is raw material carried in stock after passing through a process? If so, describe and state why.

How is the quality of goods tested when received?

What checks are maintained as to correctness of deliveries to manufacturing departments?

How are such deliveries made, and are there tote boxes or other standard devices used?

Are all deliveries covered by requisitions? If not, note exceptions and reasons.

Does storekeeper have copies of all standard bills of material or specifications?

Are factory supplies furnished to departments on requisition? If not, how handled?

Are obsolete parts or surplus stock reported regularly to the management?

How are returnable containers handled and accounted for?

How does storekeeper request purchases?

Is a perpetual inventory maintained, and, if so, how verified?

Does such inventory show quantities only, or values and costs as well?

How many employees, and what are their duties?

Does department appear to be efficiently handled?

How does storekeeper handle excess materials issued and returned to stores?

Obtain copies of every form or record.

Remarks.

(4) Power Department.

Obtain list of equipment, stating number, kind and capacity of engines, boilers, dynamos, pumps, heaters, economizers, traps, condensers, etc.,etc.

Is equipment kept in thoroughly good condition?

How frequently are boilers cleaned?

Is there any reserve capacity?

Is equipment deficient in any respect? If so,

particularize.

Are there any special safeguards against accidents?

Is the power plant in one unit, or in two or more units? Describe each, if more than one.

Is factory heated from central power plant?

Is any record kept of power and heat distribution?

Is any record kept of light distribution?

Is any record kept of air distribution?

Is any record kept of engine efficiency?

Is any record kept of fuel consumption?

Is exhaust steam returned to boilers?

How many employees, and what are their duties?

Obtain forms.

Remarks.

(5) Manufacturing - General.

Obtain list of articles manufactured, or furnish catalogue.

How many plants, and where located? Describe.

Are any other plants controlled by the concern? If so, explain relations and how handled.

Obtain sketch of floor plans of plant being examined and indicate space occupied by each department. Obtain blueprint if possible.

Obtain land area, and how occupied.

Is plant owned or rented?

Could plant be improved as to arrangement without undue expense?

Is any record kept as to maintenance of buildings and machinery?

Does such record apply to buildings and machines separately, or is it in bulk?

Are there special fire hydrants, standpipes and hose?

Are they inspected frequently and kept in good order?

Are there any fire-drills?

Are there ample fire-escapes and exits?

Are they kept clean and readily accessible?

Does superintendent appear to be qualified to handle the plant without interference?

Is he given full authority, or is his authority limited in any way? Give particulars.

Are duties of all foremen and assistants well defined and thoroughly understood?

Are departments properly balanced? If not, give reasons.

Are there any time-clocks, and are employees supervised when they ring in and out?

Are any mechanical devices used for keeping time on jobs? If so, describe.

Is there any special system of interdepartment

conveyance? If so, describe. If not, or deficient, state improvement necessary or desirable.

Is there a good system of shop telephones?

Does production consist of standard lines, special orders, or both? State proportion of both.

Are orders for standard lines put through for considerable quanities of finished product or for parts to be assembled as wanted?

Is there any system of planning work in advance? If so, describe it.

How are orders made out and put in work?

Are sub-orders or tags made out, or does original shop order follow the work?

How are orders numbered or indentified?

What is the sequence of travel or routing from department to department?

Are there any daily reports of progress made? Describe.

How is production reported and verified?

Are completed orders checked with originals to verify instructions or to compare estimates of time and materials?

How are the interdepartment orders handled: i.e., orders for work in form of repairs, or other items not directly concerned with production?

How is experimental work handled?

Are any parts interchangeable, and to what extent?

Is finished product shipped out as completed, or carried in stock?

Are individual records kept concerning late and absent time of men?

Do they have any strikes or other labor troubles of consequence?

How is waste material treated?

Obtain forms and books.

Remarks.

(6) Manufacturing Departments.

Obtain the following information for each department, so far as the questions apply, and supply any additional data necessary to cover requirements fully:

Name of department.

Name of foreman.

Number of employees.

How many piece-workers? How many day-workers?

How many non-productive workers? Obtain any desirable information in this connection.

Does foreman appear to be competent?

Has he any assistants?

Are instructions given to workers verbally or in writing?

Are blueprints or drawings furnished in all

cases where desirable?

Obtain list of machines in this department and their uses where name will not clearly indicate their purpose.

Mention any that are automatic or semi-automatic, and describe groups operated by one person or team.

Are any machines obsolete or inefficient? If so, name them.

Are machines arranged to best advantage for economical operation? Suggest improvements.

Are there any high-speed machines or tools used? If so, indicate them.

Are such machines operated as rated by makers, or have any attempts been made to increase their efficiency?

Are there counters on any machines? If so, indicate them and mention other machines where counters would be useful.

If tempering or heating furnaces are employed, state for what purpose, what kind of fuel used, and describe operations.

Are all machines numbered?

Is there a separate tool-room?

Are tools numbered or catalogued?

Is there a good tool system for checking tools? Describe.

Do workmen keep own tools in repair, or is there a toolmaker employed for that purpose?

Are machines and transmission appliances guarded to protect employees against accidents?

Are there any tool or pattern maintenance records?

Are there any efficiency records in connection with either men or machines?

What sort of power is employed in this department and how distributed; i.e., by individual motors, group motors, a single motor, or direct from line shaft?

Is there any record of power cost either for department as a whole or as applied to machines?

Is natural lighting good? If deficient, explain why and-if possible-suggest improvements.

Obtain complete list of operations performed in this department, indicating hand and machine work. Describe any that are out of the ordinary.

Are operations standardized as to time, machines, speed, tools, etc.?

Report on what may be defective methods of performing operations, suggesting improvements where possible.

Describe timekeeping system.

Is there any lost or idle time? If so, explain why.

Is there any bonus or premium system if force?

How are materials obtained and charged to production?

Is it necessary to issue materials in excess of immediate requirements at times? If so, how is the excess cared for?

How is defective work reported and disposed of?

Are there any methods in vogue to prevent the replacing of materials that have been spoiled?

Do requisitions for replaced material indicate the purpose of the withdrawal?

Is there any undue waste of material or time? If so, is there any apparent remedy?

How is legitimate waste material disposed of? If used again, describe.

Is all work properly tested or inspected?

Is work inspected by operation, or only when completed?

Are there any delays due to faults of other departments? If so, describe them.

Is any attempt made to keep shop in any constant degree of humidity? How is it ventilated?

Is manner of reporting production or progress is this department differs in any way from others, specify how.

How are parts, belonging to repair jobs, stored and marked?

Are any samples made for show-rooms, demonstration or salesmen? If so, how handled as to accounting?

Is there any friction or dissatisfaction of any sort? If so, explain.

Does the department appear to be efficient as a whole, or is there an indication of laxity?

Obtain copies of all forms.

Remarks.

(7) Shipping Department.

How are shipments checked out?

What records are kept and what reports are made to general office?

Are shipments made from own siding or trucked to railroad stations?

How are partial shipments handled?

Any mechanical aids?

How many employees and their duties?

Obtain copies of all forms and books.

Remarks.

(8) Sales Division.

Explain manner of selling product.

Amount of sales annually?

Are sales evenly distributed over the year, or are they made in seasons? Explain.

Are sales classified, and, if so, how?

Are any branch warehouses, offices or agencies

maintained? If so, describe and how handled.

Any mail order business? Explain plan if any.

Any retail department? Describe how handled.

How many salesmen employed-on salary or commission?

Any records of salesmen by territory?

Any records of profits on sales of each man as above?

Are statistics as to sales and salesmen compiled regularly or only at intervals?

Any advertising plan? Describe it and the records kept.

Describe follow-up system, if any.

Give office force and duties of each.

Obtain copies of all forms or books, including route lists, salesmen's reports, expense accounts, quotation records, etc.

Remarks.

(9) General.

Capital stock? Is it common, preferred, or both?

Any unissued or treasury stock?

Any bonded, mortgage or other funded debt? State class.

Give names of officers or members of firm and their duties.

What records are kept by each, aside from those mentioned below?

Give heads of departments in general office and their duties.

What records, if any, are kept by each?

Any friction between officers or heads of divisions? Causes.

Any lack of organization or facilities in general office?

Mail and correspondence - how handled?

Stamps - how handled and controlled?

Filing and card index system, and how handled?

Divisions, number of employees in each and their duties.

Forms and books used in each division, with explanation as to how used.

Methods of accounting, including basis of closing, and ascertaining of profit and loss.

Classification of accounts, with explanations.

Billing system - explain fully.

Collection methods and records.

Stationery records as to costs and manner of issue.

Are any plant, pattern, tool or employes's records maintained? If so, explain.

Pay-roll, how made up? Are receipts taken from

employees? Explain with reference to both office and factory.

Do manufacturing accounts interlock with general ledger?

Is clerical work up to standard and kept up to date?

Is there any cost system in operation? If so, obtain full particulars, especially with reference to methods of distributing shop-burden and general overhead, and method of routine of collecting and tabulating figures to obtain costs.

What objections are offered, if any, against the introduction of improved accounting and efficiency methods?

Remarks.

The method employed to record the information obtained from the physical examination of a plant depends entirely upon the individual conducting the examination; but a convenient plan is for the examiner to spend the forenoon of the day in the examination of one or more departments, making notes of the information received, and in the afternoon to write up in detail the result of the examination. Thus it is possible to review the morning's work while the details are still fresh in mind, and to add any information that may have been overlooked in the first place.