centralized master records and control combined with decentralized issue or departmentalized storage and issue have been found most satisfactory.

The type of the product and kind of industry will influence the nature of balance records kept. The balance of stores sheet must be designed to fit and aid the particular type of production. Replenishment governed by the amount on hand in the storeroom is suitable only where there is a uniform rate or flow of materials. Replenishment on schedule is desirable where requirements for a considerable period in the future are known. Replenishment regulated by the amount available is effective in most plants where materials have a fluctuating rate of use.

In connection with material control, purchasing policies must be decided upon. Small factories will, no doubt, place all purchasing in the hands of one person. Larger organizations find it more desirable to distinguish between purchasing routine items, small in quantity and stable in price, and items which fluctuate in price, delivery, and sources of supply. The latter group present the problem of the extent of speculative purchasing that the concern will do. In case traffic conditions, price movements, sales tendencies, supply and demand, labor market, or the finances of the company indicate a change, a decision must be made as to whether the purchasing agent will be permitted to buy heavily or vice versa. It is also well to lay down in advance the extent to which the concern is going to do a merchandising business in addition to manufacturing, if at all.

#### 6. Tool Control

The tool control problem is very similar to that of materials. The size of the plant, type of product and kind of machinery will largely determine the form of records and how they will be kept and where the tools will be stored, issued, replenished, maintained, designed and constructed. In small plants in which processes are simple a centralized system will suffice; however, when the plant is large or the products diversified and technical, very little advantage, if any, can be secured from centralization. If real standardization of tools is required it is much more easily attained and maintained under centralized control than under decentralized.

It is now obvious that no one system of production control can be applicable to all plants and industries. Each plant has its individual peculiarities and needs. The production system that serves a plant adequately must be designed and used according to the requirements of the particular plant. The general plan of attack is first to find out the facts of the business. Certain of these are permanent and others may be modified. In the light of these facts each problem or possibility of control can be decided upon and the proper methods developed.

## III. What is Production Control?

PRODUCTION control is the preparation and administration of Work in Process.

The object of control is to secure the maximum use of facilities so as to satisfy the needs of sales, production, and finance. Through proper control, sales are materially aided since delivery dates can be specified accurately; production flow is regulated and made more continuous; delays are avoided, progress recorded, balances of work ahead kept, and in assembling industries the parts brought together at the proper time. All these factors aid in lightening the financial load by reducing work in process and costs, and among other things foster and form the necessary ground-work for better industrial relations.

### A. The Work of Control

The general limits and requirements of production as well as those of sales and finance are outlined in the master plans. They will show which articles must be manufactured during a given period of time, the proper quantity and the design. These master plans are then broken down into detailed production plans, schedules, and budgets. From this point the work of production control starts.

The work of production control is divided into four functions. They are:

1. Development and preparation of plans.
2. Scheduling.
3. Dispatching and production.
4. Inspection and costs.

This division of work is typical of that used in the more progressive industries, and all of those functions in any event must be carried out by some one in every factory.

### B. Bases of Control

"Control" implies predetermination of events before they occur. Such plans cannot be accurately made in advance and modified as work proceeds without having the proper foundation upon which to work. A factory cannot start manufacturing until it has equipment; neither can management plan and control production properly unless certain prerequisites for control are developed.



Too much emphasis cannot be placed upon the necessity of rigid standardization if economical control of any industrial undertaking is to be expected. The best way of performing work and enforcing it in practice until a better way be found must be determined. As a result most economical methods as regards time of operation, efficiency of operator, maintenance and standardization of work places and tools, and the elimination of unnecessary fatigue are developed.

Besides these bases the internal layout of the plant should receive considerable attention. The grouping, sequence, position, and general arrangement of buildings, departments, machines, and equipment individually and in relation to each other is desirable. Methods of storing, moving, and transporting materials besides methods of communication obviously must be predetermined if proper control is to be developed. All accounts and charges should be classified in a logical, systematic, and orderly arrangement. Control is made surer if the lines manufactured are reduced to as few fixed types and sizes as practicable. Economical power and its distribution to work places are also essential. However, an organization does not have to be completely standardized and controlled before securing any of the resultant advantages. Even a plant with a non-standard product can establish definite methods of processing and have some control over work in process. As these methods are developed many benefits will be secured long before standardization of the product is, if ever, attempted. Real production control and its benefits, however, will not be secured until all the bases of control are firmly established and maintained.

#### 1. Development and Preparation of Plans

The development and preparation of plans demands the determination in advance of what to make, how to make it, where to process it, and when in general to do the work. The products which are selected by the master plans are designed in detail, and material specifications are drawn up with the ideas of simplification and standardization foremost in mind. To transform these materials into the finished articles the sequence of processing operations on each part must be outlined, and tools and machines best fitted for the performance of each of these operations indicated. Without labor properly selected and trained for these performances, no plan is of value. Having provided for the product, materials, labor, and tools, the planners must decide so far as possible upon the quantities or lot sizes in which the individual products are to be manufactured. When economical units of manufacture are scientifically determinable they are a boon to the industry if properly used and adhered to.

The layout of the plant will determine broadly where production will take place. However, in planning, departmental balance must be taken into account. If certain divisions have too great a number of operations or products to make, a slight revision will often relieve the overburdened sections. Also, besides picking out the best machines and work places, alternate machines and work places may be indicated. When the groups of product should be finished is determined by the master plan, but considerable leeway is given the production group in outlining the sequence in which the individual operations, lots, and products can be manufactured. Proper sequence brings with it many benefits. The master plans will be satisfied if items are completed when specified, and customers pleased by prompt or agreed-upon delivery. Equipment is used to its maximum capacity so far as work is available. Labor is systematically handled when plans are predetermined; last minute rushes are avoided or minimized; and more steady employment is provided.

In order properly to perform the function of development and preparation of plans the men responsible for planning must have considerable information. From the master plans, budgets and schedules are secured. The engineering department supplies the bills of material, drawings, specifications, and tools, and assists those planning to work out the operations, sequences, machines, and alternate machines. The planners must also know the capacity of the individual machines and departments, raw and other material required, character of labor, i. e., skilled, unskilled, or what proportion of each, relation of each part to the assembly, when inspections should be made, and the percentage of spoilage.

It is the duty of the preparation group to collect and use the data to determine what products to make first, how to make each, where to process them and when in general to do the work. From the master plans, which give the limits of money and time that can be used, the general schedule of manufacture is laid out. Together with the engineering department the preparation group has worked out the best methods and proper sequence so they are properly equipped to de-