

of shop, small jobs have a tendency to get side-tracked, forgotten, lose their identity, accumulate ahead of machines, tie up tote-boxes, trucks, and other equipment, use up valuable working room, finally become "urgent," and generally contribute to confusion and delay. All this is due to their very nature of smallness. Incidentally, these small jobs are despised by piece-workers, who deliberately shove them aside as long as other and larger jobs offer.

The shop control mechanisms described by Mr. Taylor are designed to obviate most of these difficulties, and in effect provide the means for establishing and insuring a definite priority and an assured progress of jobs through the plant. None the less, small quantities and short operations are a burden to the life of the Shop Order of Work Clerk, and are a handicap to the efficient and economical use of shop facilities. Where such small jobs amount to a considerable proportion of the total jobs, the efficacy of the whole mechanism of shop control is threatened, and it sometimes seems almost hopeless to endeavor to regulate the shop from the Planning Department bulletin board. The well-known situation in which the Bulletin Board becomes the tail to the dog, or perhaps reaches the dignity of an overworked and outdistanced Recording Angel, quite often has its origin in a glut of small jobs. In this situation the Planning Department and particularly the bulletin board crew, go through a highly complicated and expensive series of useless motions which earn for them only the pitying scorn of the shop.

Combination Routing is an attempt to counteract to the greatest practicable extent the handicap imposed by small quantities and short operations. It can not eliminate this handicap, but it modifies it to a degree that is a welcome relief. It is based on the feasibility of combining for short operations two or more batches that may properly be handled separately for longer operations. Likewise, it capitalizes the feasibility of routing in one batch a number of different products that call for essentially the same operating treatment, and are of the same degree of urgency. A useful feature of this sort of combination is the convenience of routing through the shop together, products intended partly for stock and partly for shipment. The manner in which the combinations are effected is very simple, and merely calls for the same degree of intelligent routing that is expected where combinations are not used.

Perhaps all this will seem less like an academic proposition if I get down to cases, and tell you some

of the salient features of the development of combination routing in a specific plant. The plant I have in mind is that of Herrmann, Aukam & Co., Lebanon, Pa., manufacturers of plain and embroidered handkerchiefs. Early in 1914 the installation was begun of planning and control methods along the lines described in "Shop Management." Mr. Hathaway was in charge of the installation, and was accorded throughout the cordial support and cooperation of Mr. M. C. Herrmann, President, and the able assistance of Mr. Karl Herrmann, the present Works Manager.

The situation presented the small quantity and short operation problem, and it was evident from the beginning that combinations in some fashion were necessary. Under Mr. Hathaway's inspiration the present scheme of combination routing was devised, made effective absolutely as planned, and is working as smoothly as ever, today, seven and a half years later.

At the start, practically all work available for introduction into the shop was in quantity less than what was recognized as providing a desirable job at the principal operations. It was predetermined that our shop-control methods should be those described by Mr. Taylor and patterned in detail after those in operation at the time in the plant of the Tabor Manufacturing Company at Philadelphia. Slight modifications of the printed forms, such as the route sheet, operation orders, move orders, inspection orders, tags, and stores issues, were the only changes required in the physical appliances.

Time study and general observation determined desirable basic batch quantities for the principal operations for the different main varieties of product. Handling facilities were provided in accordance with these determinations, and these facilities in turn fixed the cardinal principle of the scheme of combination routing. This depended on the necessity of a fixed and permanent identity of each of the elements entering into a combination, just as is the case with a time element in an elementary time study. The first rule, then, was that an element of any combination must be indivisible, and must not exceed the basic batch quantity. It could be any fraction of a batch quantity, and preferably, should be exactly that quantity. Trucks and transportation devices were standardized and subdivided into units containing normally fixed quantities, and an effort was made in the routing to make elements (or items, as they were designated) of a combination, multiples of this normal fixed handling quantity. Time study, of course, was the agency that worked out all

these details in consistent fashion.

The permanent identity of any element in a combination was assured by assigning to it an "item number" in the routing, which number appeared on the tag placed on the goods before leaving the storeroom. This designation appeared also, or rather in the first instance, upon the route sheet, where it was necessary in connection with the preparation of the various forms used. The route sheet was designed to show simply and graphically the arrangement of the items in different combinations for successive operations, this being done by the Route Clerk solely for the benefit of the tag writing clerks. Upon this sheet it was possible for the Route Clerk to indicate any desirable combination of items or batches.

There were naturally limitations upon the desirability of combination. For instance, it was normally the rule that there should not be routed on the same sheet, goods requiring different sequences of operation, goods of very different degrees of urgency for shipment, goods of such similar quality and appearance as might accidentally get mixed, and in certain cases, goods requiring different degrees of operating skill. These limitations, however formidable as they may sound, only very slightly restricted the field for combinations, and the vast majority of orders routed were of the combination character.

The second guiding rule for the Route Clerk was to make up full batches. The purpose of this was twofold—to use handling equipment to capacity, and to provide a job of decent length at each operation. The basic batch quantities determined for each operation, for each main class of product, were in the relation of multiples. For example, the batch quantity for the machine-ironing operation might be 150 doz., and the batch quantity for the folding operation either 300 or 450 doz., and for the ribboning operation 150, 300, 450, 600, or 900 doz., depending on the class of goods. Incidentally this arrangement simplified very much the Planning Department work in applying allowed times to the operation orders.

To provide the Route Clerk with the information necessary to enable her to work to the plan described above, involved a very considerable amount of analysis and classification of product with respect to quality, operating sequences, operating times (related to standard batch quantities) and similar information. The net result was the extreme simplification of the routing task.

When the Route Clerk had indicated the combina-

tions to be made, the tags and forms required were prepared by reference to the route sheet, the allowed times entered by the Time Study Department, and the further destiny of the routing passed into the hands of the Shop Order of Work Clerk.

In contrast to the benefits inherent in the consolidation of innumerable small jobs into a reasonable number of larger ones, it might seem that a more than compensatory burden was imposed on the Order of Work Clerk. What I mean by this is simply that with changing combinations to effect, the problem of bringing batches together for assembly may seem to be intensified. For example, if the routing specified four batches at the hand-ironing operation to be combined into one operation at the next succeeding operation of ribboning, the danger of allowing the completion of the four batches at the hand-ironing operation to be spread out over a considerable period, is obvious. If batch No. 1 were completed today, and the last of the four two days hence, the tie-up of goods and facilities would be intolerable. The function of the Order of Work Clerk is to prevent just this sort of situation, and we found that the added necessity of performing this function properly was a good thing, both for the Order of Work Clerk and the Production Clerk, who was kept more closely in touch with the hourly activities of his most important assistant. The avoidance of a flood of petty transactions at the Planning Department bulletin board eliminated confusion and harassing demands on the Order of Work Clerk's time. He was enabled to inspect properly the condition of the bulletin board, to make proper provision for work ahead, and, most important of all, to check frequently, regularly and carefully, the condition of the route sheets in the current file. Means were provided whereby those combinations most likely to be delayed could be easily checked by the Production Clerk or the Works Manager, and it was thus easy to develop in the Order of Work Clerk the habit of keeping on his toes. The exigency bred the remedy.

In the early days of the installation a further check of the Order of Work Clerk's activities was made by means of the regular taking of lists of jobs at the various stations in the shop. These lists were compared with the bulletin board and route sheets, and any wrong conditions brought to the attention of the Order of Work Clerk. Failure on his part to keep combinations moving would also inevitably and quickly tie up handling equipment, and bring complaints from movement and gang-bosses in the shop.