

on the condition of the dies. This afternoon the foreman told me that he found that the dies on one hammer were slightly misplaced, and he was very much worried about it, but that we could fix it in time—a matter that a few weeks ago would not have occasioned any interest at all—and yet it makes the difference between good chain and bad.

We have records on our dies that show the material of which they are made, the proper heat treatment, the date put in service, the length of time that each pair of dies is used, the product from each pair of dies, and so forth, so that we can forecast their lives somewhat and know about when to expect trouble from them.

The relation between maintenance of equipment and task work is referred to in the paper. I had a very interesting case of it at Philadelphia when we introduced task work and bonus to scaling paint. Knowing that there was going to be a great deal of trouble when we got task work under way, I spent a great deal of time getting the equipment ready. We started with the power house and the air compressors and the distribution lines, and the separators to get water out of the air, and the provision of good hose, and good couplings that would not leak, so as to get the pressure and the volume of air at the hammers; and then we fixed the hammers the best we could, and doubled the stock of tools. By time study, we investigated the shape of the chisel. And then, after all that, and after trying to impress on everybody's mind the necessity for having everything right, we started task work, and the next morning the trouble began.

The men who had been repairing hammers did not know what a day's work was in repairing hammers, until they got to working for task workers who had a definite task to do, and where they had to have everything right to do it. I knew it was coming, but we could not get anything under way until we got the task workers to help us.

As to the relation between maintenance and scheduling. The scheduling of work, I have found, is of enormous importance, and we have been developing it. If you count on performing a particular part of the work on a particular machine at a particular time, and the machine will not work when you get ready to use it, it not only upsets that particular job, but a whole lot of other jobs. If by inspection previously you can anticipate those troubles and correct them, it will save time and avert confusion. I don't know how many of us here have really tackled the job of scheduling work—laying it out far in advance of all the men and all the machines in a fair-sized plant. But as soon as you do try it you will find that the knowledge that you can positively rely on the pres-

ence of your tools and of your men and of their all being in good order is of primary importance. You cannot have it unless you make this inspection in order to correct the trouble before it happens.

There are many other things tied up with this—such as the cost of idle equipment, and the reduction of output and hence the reduction of earnings.

MR. ROBERT T. KENT:¹ A suggestion might be offered in regard to the instruction card for the periodic inspection. In inspecting certain lines of equipment there are specific questions which have to be answered in regard to that equipment. These questions should be printed on the report blank. Very frequently a man will over-look some item, unless he has to make a definite mark on a card or on a report. If he is simply told by the instruction card to inspect certain parts, he may pass those parts through carelessness or laziness. But if he has to answer "yes" or "no," or take a measurement and make the entry on a blank that is already provided, and if he is required to fill out every space on that blank, he is very apt to make a full report and look into every item that he is required to inspect.

I don't believe that the importance of inspection and maintenance of equipment is fully realized. I have had the opportunity in the last few months of studying a lot of production time studies. These production studies are time studies extending from one day to several days, and they note every interruption to the manufacture and state the cause thereof. And in examining these production studies which came into my hands I was impressed with the fact that nearly all the delays which occurred were avoidable and preventable. If there had been proper maintenance inspection prior to the operation of the machinery the production and actual output would have been about 20 per cent greater than the studies that I was examining showed.

I think that a paper such as Mr. Hathaway has presented is merely the starter of a whole series of papers of a similar character that should be presented before this Society. What we want is papers dealing not so much with the theory of scientific management—we have lots of text books on that—but we want the practice.

MR. WILLIAM O. LICHTNER:² At the present time the great amount of business which almost all manufacturing concerns have on hand has made it necessary to run all machines to maximum capacity, and in fact, to over-capacity, and naturally this has

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been the cause of a great increase of machinery repair expense. You might say that the easiest thing would be to put on more people to take care of this increase in repairs; but we all know that on repair work it is impossible to put on a big gang of men and expect to get out work in proportion to the number of men put on. Besides this, it is absolutely necessary to have some kind of a follow-up system, just the same as if you were manufacturing a product, in order to get it out at a reasonable cost.

I have been working on this problem of systematizing the repair and maintenance department of several large manufacturing concerns and have gone into this question quite deeply. This field of management work is the one which in even well systematized plants has hardly been considered, with the consequence that we are just now commencing to scratch the surface. It is questionable just how far it is economical to go in systematizing the repair and maintenance department which handles the repairs and maintenance of a shop using a diversified lot of different kinds of special machines. In a great many cases, repairs must be done at a moment's notice so as to put the machine into operation again in the minimum time. It is entirely different from a straight machine problem.

Under the old plan of doing things, anyone can make out an order on the repair and maintenance department for work they wish to have done whether it is absolutely necessary or not, and in due time, some carpenters or machinists arrive on the job. When the carpenters, for instance, get out there, they find that the work the foreman wanted to have done requires some special tools or materials, so one or all of them return to the shop to get them and then, ten chances to one, they will not get all they need and have to send again before completing the job. This plan is not only costly but it holds up production by not keeping the machines in running order. With orders coming in in this way, is there any wonder that we find the repair and maintenance department in a chaotic state and doing the work which is not really needed the most, but the work wanted by some official on account of his authority, or the work wanted by some foreman who is the most persistent. How many concerns could exist nowadays, or could tolerate such a procedure in getting out their regular product of goods?

The plan which I am following in starting on a problem of this kind is first to get out a list of names of parties who can send in orders on the repair and maintenance department where all the orders for work are received. This department, upon receipt of an order, makes out a repair or construction order for the work, provided the cost of the work is not over, say, \$20.00, in which case the signature of an

officer of the company is required before the order is acted upon. An inspection ticket is made out with the order which is given to one of the inspectors who looks up the job and makes a detailed report of what is required, which includes a bill of material, necessary measurements, etc. From this inspection report, the planning department makes out the necessary route sheets, tickets, stores issues, and sends the party who made the requisition a promise as to when the job will be completed. This procedure of course is not followed if the job is an emergency job, in which case the men nearest the breakdown are generally called upon to do the job. I have found in every plant where I have taken over the repair and maintenance department, that of all the repair jobs that came through previous to our installation work, 50 to 75 per cent of them were considered as necessary emergency jobs while now this percentage has been reduced to 5 per cent. The work is assigned to the workmen in the sequence of their importance and finally daily working schedules are laid out for each of the men according to their trades. The repair and maintenance men call for their tickets and instructions and return them upon their completion. The ideal plan would be to not only assign definite work to each man but to have the work done as a task, that is, predetermine the amount of time it should take a man to do the job, and if it is completed satisfactorily in that time, pay him a bonus. This last step has not yet been accomplished to my knowledge but is only a matter of months before some of the firms will have accumulated enough data on this class of work to be able to very accurately predetermine the time for doing new work.

I want to call your attention to a very adequate inspection system to be used with the above.

A. Inspection of Repair Work.

1st. Send an inspector, sometimes called an inspection engineer, to determine materials required for job; dimensions, etc., as cited above.

2nd. Send an inspector to job where workmen are just starting a job to see that the work is started right and that all tools and materials are on job. This ordinarily is the foreman who used to direct his own men and work before the planning department was established.

3rd. Send the inspector under 2nd head to make a final inspection of the work which was finished.

B. Inspection for Maintenance.

An inspection for the maintenance of a plant is the one way for reducing the amount of repair work required to be done in any plant and will make the amount of breakdowns almost negligible. The method of procedure to develop this inspection is to have the master mechanic go over each machine,