

do their best in their joint interests. Such a golden vision was not likely to be realized. The men know quite well that if they make too much premium a new method will always be found. The author has been amused to find that the managers of some of the works visited have declared that the rate was never cut. Their responsible assistants, however, have usually acknowledged, on being pressed, that practically the same result was obtained by this plan of "finding a new method." The practical result is that the premium system, after all, requires just as much vigilance as the piece work system. It has the disadvantage of requiring rather more bookkeeping, and of rather more difficulty in adjusting the price when a mistake has been made. If there had never been any cutting, the older firms would have been placed at considerable disadvantage as compared with newer firms, and would find that they had been pioneering for such newer firms, who are enabled to take advantage of the improvements effected and set shorter times to start with. In actual practice, however, it is probable that the greater proportion of the rates fixed, especially in large machine work, are pretty correct and there is not perhaps so much scope for any undue bonus to be earned.

EXPERT CHECK ON TIMES SET.

Where it is considered that the best results are not being obtained, the author is convinced that the only way to improve matters is to have enough expert men who are paid well, and can be relied upon to work in the employers' interest. Such men, for example, may act as rate fixers. One or more of them can work on such of the jobs as seem to require checking, and they will advise on any changes that seem likely to be profitable. In particular, they seek economy in "non-cutting" times. It seems very desirable that the rate fixers should keep their hands in in this way, otherwise some stagnation is probable. Also if some system of remuneration for improvements they effect can be introduced, it will probably yield a very profitable return.

On small work especially the proportion of non-cutting time is sometimes very great. In a certain rather tricky job a very experienced rate fixer set the following time: Cutting, 16 minutes; changing tools, 10 minutes; gauging, 20 minutes; setting up and fixing, 30 minutes. This, of course, was not quite an average job, but in particular the item for gauging is to be noticed.

GAUGING.

There happened to be a number of surfaces to machine, and each to exact dimensions. "Gauging" included the actual measuring and the successive short cuts necessary to get down to the exact depth for the final cut. A little thought will show how antiquated and wasteful are the ordinary methods of doing this. A cheap gauge or micrometer is badly required, which will tell in a second or two to ordinary men just how far they are off the final dimension, and then means are required to set the tool forward just that amount. Micrometer heads on lathe screws are useless without the micrometer or gauge for showing how much remains to be taken off. The introduction of some cheap device of this sort will eas-

ily effect an appreciable percentage economy.

CHANGING BELTS.

With belt-driven machines and cone pulleys the speeds usually change in not less ratio than 1.75 to 1 or even 2 to 1. In the latter case we shall on the average be working at just three-quarters of the correct speed, and the cutting time is increased one-third. This is a very serious loss, and argues strongly the advantage of a gradual speed change device; also of some cheap speed indicator to be applied to the work and show instantaneously the rate of cutting. But in an even simpler way losses constantly occur. It is usually not quite easy to change from one speed to another, and the tired man in particular will not take the trouble to speed up and down as often as perhaps he should. One large firm doing very accurate work, provides a handle which automatically shifts the belt by pressure to right or left. There is no doubt the cost of this has been repaid many times.

QUICK-CHANGE DRILL CHUCKS.

A quantity of work comes under the radial or single spindle drill, and requires fairly frequent change of drills. Quick-change drill chucks, which enable the drill to be changed instantaneously without stopping the spindle, may easily save anything from 10 to 50 per cent.

SETTING WORK IN JIG.

In small and thin work the cutting time is often very little, and the setting and handling of the jig may be a large percentage of the whole. In one shop where the work was all repetition, and large numbers of very expensive jigs were used, the foreman estimated, at a rough guess, 25 to 75 per cent. of non-cutting time, a multiple spindle drill being used, and very good jigs.

PICKING UP TOOLS

In one very accurate and tricky job, requiring a number of operations to be performed from the same setting, and requiring a number of tools in successive use, the author was impressed with the small cutting time, and also with the loss in finding and picking up the exact tool required. A large block, having exactly as many holes as tools and gauges, and with these arranged in suitable groups, will save its cost many times over. A careful study of this particular job enabled the time required for it to be halved, with considerably greater satisfaction in the character of the work turned out, and all by attention to these small details. The above details will sufficiently emphasize the point that there is a large field open at present for improvement to reduce the non-cutting time, as well as the cutting, and that employers may often profitably take obvious opportunities of economizing which lie ready to their hands, instead of looking abroad for new tools.

VISITING CONSULTANTS.

In America, and in a few cases in this country, visiting consultants are called in to examine the works, its lay out, its organization, and to suggest improvements. Such men must have an experience which no one attached to a single works can possibly attain to, and should be able to exercise it without breach of confidence. In any single

concern there must be some tendency to stagnation, and there seems as good reason for the visiting consultant as for the visiting auditor, whose services are now regarded as essential, and taken as a matter of course.

In a general shop having many small jobs in hand at once, it requires a very clever foreman to give times of completion of all work in hand which he can adhere to and yet not have too much labor employed. The author has devised a special indicator for the purpose, which gives the foreman a bird's-eye view of the work in hand and of the capacity for work. It requires that time shall be estimated on all work in detail, whether on the day, piece or premium systems. One or more suitable boards are laid out with horizontal grooves to represent the different men in classes according to employment, wages, etc.; some spare grooves are also allowed to each class. Vertical lines are drawn to scale to represent hours, days and weeks. Fairly narrow strips of card are cut off for each job, of length equal to the number of hours estimated, and marked with the job number and date by which completion is required. These are then set up in the grooves, always to the left of the date marked on them. If there is more work in hand than capacity in men, some cards must go into the spare grooves. The card to the left in each groove is always the job in progress at the time with that man, those to the right being arranged in the order of present urgency. They can be reshuffled later as altered circumstances may seem to require. Thus the foreman or manager can see at a glance what work is likely to be late, what is the present capacity for new work, stock work, etc., what jobs are hanging, and where it is desirable to take on or discharge men. The material laborer can also see what materials, tools, etc. are likely to be required soon and get them ready. The cost of keeping up is small and amply repaid by the advantages.

In conclusion the author would recapitulate a few of the points which stand out most strongly before him: (a) Make it unnecessary for the workman to think or remember what can be committed to writing, and he might forget. (b) Some red-tape is necessary and cheap. Remember that discretion may also mean indiscretion. (c) Use routine books arranged for easy weekly inspection. (d) Give every piece made a carefully-chosen catalogue number, and use this everywhere. (e) Provide an auxiliary stores for each foreman where there is much small work. (f) Make use of the list of material in the numerous ways suggested. (g) Drawings should be divided up, and each detail given a list of operations and tools. (h) Get as many men as economically possible on to each order in progress, and so have as few in hand at any one time as possible, and finish each quickly. (i) Check standard jobs by expert labor, and reward improvements made. (j) Insist on an estimate of the time required for each day work job. (k) For the sake of comfort, as well as for economy, displace day work as much as possible. (l) Keep the attention directed to the "non-cutting" losses, especially with small work. (m) Keep the whole of the work under general view by means of a suitable foreman's indicator.