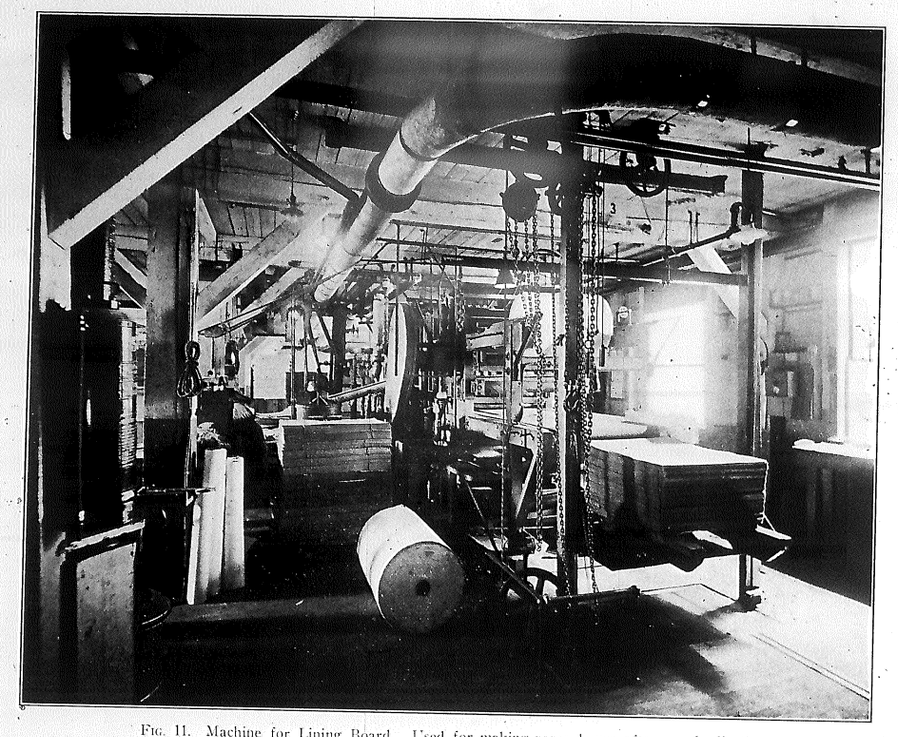

FIG. 11. Machine for Lining Board. Used for making paper boxes after standardization.

the same—or at least used for the same purpose, which were gathered up in a shop in which each man ground his own tools. At the bottom of each photograph is shown a standard tool. It does not take a machinist to understand or appreciate this illustration.

In a plant winding small magnet coils, somewhat similar to those which you have all seen in electric bells, our time studies showed that the operator had to use during the operation, a pair of scissors, a small knife, and a soldering iron. These tools proved to be an important source of lost time and variation in output. The scissors and the knife had always been provided by the operator and there was the greatest possible variation in type, size, quality and condition. No regular provision had been made for keeping them sharp. Our studies enabled us to establish a standard of type, size and quality; from there on the company supplied them and systematically kept them in first-class condition.

While the soldering irons had been supplied by the company, no standard had been established; some of them were about six inches long over all and weighed about half a pound; and from this they ranged in size and weight up to about twelve inches long and two pounds in weight. Imagine a girl using the latter to solder together the ends of a wire $\frac{1}{64}$ of an inch in diameter! Furthermore, it was found that the points of the soldering irons were in many cases badly in need of dressing. Here again we developed a standard of size and shape of the point, and provided for their being inspected at sufficiently frequent intervals and dressed when it was found necessary.



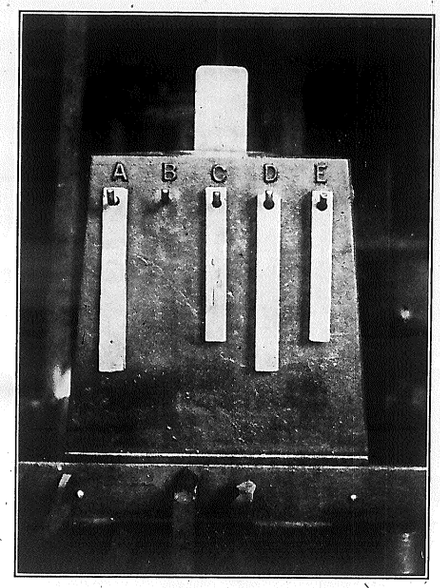


FIG. 12. Height Gauge and Standard Packing Pieces, for facilitating the setting of lathe tools in tool post. (The graduations on the gauge indicating packing pieces to be used do not show clearly.)

Another source of variability in output and of lost time and effort was due to there being provided no regular or suitable place for the operator's tools. This was overcome by providing a board, conveniently located, having a place to hold each of the tools so that when wanted the operator could put her hand on them without even looking. This was only one of the things which enabled the production to be more than doubled, with less effort and less annoyance for the operators, and incidentally enabling her to earn considerably more than she had made on piece work under the old unstandardized conditions.

### III STANDARDIZATION OF MACHINES

The most general lack of standards will be found in the speeds at which machines are operated. In a mill in which literally thousands of identical machines were engaged on exactly the same work, variations of over ten per cent were found in the speeds of line shafts driving different groups. In view of the fact that these were continuous process machines, the importance of the loss from this single source will be evident.

In a handkerchief factory, when we started to make time studies, preparatory to putting the operation of machine ironing on task and bonus, we found that the machine speeds varied sixty per cent between the lowest and the highest. With other conditions standardized the higher speed was found to be satisfactory. It was also found that no particular attention was paid to the pressure of the steam supplied for heating the machines, and consequently it fluctuated over a wide range during the day with a corresponding fluctuation in the temperature; some of the machines were equipped with traps for removing any water from the steam and some were not. These did not seem to be matters of any importance while the work was being done on ordinary day work; some of the girls produced less than others, but that was regarded as inevitable; "some operators are good and some not so good" was the accepted explanation. After standardizing these conditions—as well as the preceding operation, that of dampening—the production was increased one hundred per cent, the operator's earnings increased one hundred sixty per cent, while their work was made easier and more agreeable.

The studies and work required to accomplish this extended over a period of more than six months. They involved the determination of laws governing the absorption and evaporation of moisture by each of the wide variety of fabrics from which handkerchiefs are made, the development of a special machine for controlling the amount of water supplied to the handkerchiefs, and of a "damp closet" in which they were stored to permit even diffusion of the water by capillary attraction and to prevent excessive evaporation while stored at the machine waiting to be ironed. Figure 9 shows the machine for "dampening" and Figure 10 a standardized mangle or ironing machine with its "damp closet" and standard trucks for receiving the work as ironed and transporting it to the next operation.

In a paper box factory similar studies and the establishment of standards in connection with a board lining machine—i. e., a machine for covering pasteboard with white paper—resulted in increasing the output one hundred and fifty per cent and enabling two men to operate the machine instead of three, as well as in effecting a considerable saving in indirect labor cost.

This is one of the best examples of machine standardization resulting from real elementary time study