A K&E Slide Rule for Planer Work

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What is a Planer?

One of the major inventions driving the industrial revolution was a machine tool called a planer. This machine was designed to generate flat surfaces on iron castings, steel forgings and other metal parts. As the capabilities in the production of iron and steel products increased throughout the 19th century the demand for machines capable of rapidly producing these products, as well as reproducing themselves in larger and larger scale and greater and greater accuracy, increased at the same time.

Figure 1 is an illustration taken from the 1912 book, *Treatise on Planers* that shows one of these machines in the process of machining both vertical and horizontal surfaces on the cylinder housings for a steam locomotive. This book was published by the Cincinnati Planer company, one of the foremost US manufacturers of planers.

A planer produces a flat surface by moving a work piece (i.e. the locomotive cylinder housings in Figure 1) past a stationary tool (such as the one the machinist has his hand on in Figure 1) that peels off a predetermined amount of metal with each pass of the work piece. After each pass, as the workpiece returns to start another stroke, the tool automatically advances until it is in position to peel off another shaving of metal on the next pass of the workpiece. To increase productivity, the machine is geared so that the workpiece moves rapidly on the return stroke when no metal is being removed and then more slowly and with greater force on the cutting stroke.

Frederick Taylor's Slide Rule

Along with the industrial revolution came demands to increase the efficiency of the work force as well as the power and efficiency of the machine tools. In the 1908 edition of the *Transactions of the American Society of Mechanical Engineers,* the grandfather of all efficiency experts, Frederick W. Taylor, introduced the idea of using a specially designed, and rather elaborate, slide rule to calculate the time required to perform certain metal cutting operations on lathes and planers. This provided factory managers with a quick and easy way to determine how much time a workman, such as the one in Figure 1, should need to perform various tasks using those machines.

Following Fredrick Taylor's lead, several slide rules were produced for similar purposes. One of these was known as Barth's slide rule and was the product of one of Taylor's co-workers. An example of a Bath's slide rule is one of the few slide rules on display at the Smithonian in Washington, D.C. Another slide rule designed specifically for lathes was the Gisholt Time Computer. It was distributed by the Gisholt Machine Company and was manufactured by George Washington Richardson. (See article in JOS by Robert J. Sauer in the next issue)

The Cincinnati Planer Slide Rule

In 1912 the Cincinnati Planer Company picked up on Frederick Taylor's idea and offered its customers a comparatively simple slide rule that was designed specifically to calculate the time required to perform metal cutting operations on the planers that they manufactured. This slide rule was copyrighted by the Cincinnati Planer Company in 1911 and was manufactured for them by the Keuffel & Esser Company. This slide rule was made entirely of wood with the markings printed directly on the wood. The rule in the author's collection is 10 1/2 inches long, 2 inches wide, and 3/8 of an inch thick. The back of the rule is plain with the exception of a centrally located circular Keuffel & Esser trademark. The number "37" is stamped on the left end of both the slide and the frame. A drawing of this rule is shown in Figure 2.

The speed of the cutting stroke, the speed of the return stroke, the amount that the tool advances with each stroke as well as the length of the stroke and the width of the surface being machined affect the time that will be required to complete a workpiece. The slide rule that was offered by the Cincinnati Planer Company is capable of including all of these variables in one setting of the rule. The rule was capable of handling:

1. Cutting speeds (The speed that the workpiece moved past the tool as a cut was being made.) ranging from 20 to 60 feet per minute.
2. Return speeds ranging from 50 to 130 feet per minute.
3. Advancement of the tool between cutting strokes or "Feed" ranging from 1/16 to 1 inch.
4. The width of the work piece and the distance that the workpiece traveled with each stroke were combined into the product of the two (roughly the area to be machined) ranging from 30 square inches to 3,000 square inches. The instructions caution that this area should include any distance that the workpiece travels beyond the tool at either end of its travel.

Once these variables were entered onto the slide rule the time required to perform the work (anywhere from three minutes to five hours) could be read directly from the scale at the bottom of the rule.

The instructions state that, "It will be found that this rule is very close to the actual figures if the reversing of the planer is prompt." It appears that the "promptness" of reversing the workpiece at each end of its stroke was a variable that was of concern to both the designers and the operators of planers. These planers were driven by leather belts from line shafts, not by electric motors on each machine. (The book did mention some very modern machines with electric motors.) The reversing was accomplished automatically by a device that shifted the leather belts from one pulley to another. The text mentions that excessive amounts of heat would build up on the belts and pulleys when a planer was reversing rapidly to make very short strokes. The book also mentioned that the latest machines used aluminum pulleys to reduce the amount of inertia that had to be overcome on each reversal of the workpiece and the associated machinery.

Some Limitations of the Cincinnati Slide Rule

The slide rule did not give the total time required to process a part on a planer. The rule does not give any indication of the amount of time required to position and secure the workpiece on the machine table or the time required to select and adjust the cutting tools. Also, the slide rule only gives an indication of the time required to make one pass across the workpiece. On most machined pieces, and especially on castings and rough forgings, it was usually necessary to make one or more passes across the workpiece to remove large amounts of metal. This "roughing" pass, or passes, would then be followed by a "finishing" pass that would remove a relatively lesser amount of material and that would leave the workpiece with a much smoother surface than what resulted from the roughing pass. Often a special finishing tool would be used to leave the machined surface as smooth as practical and to achieve dimensional accuracy. If any changes were made in the speed of the workpiece or in the distance that the cutter was advanced after each stroke of the workpiece, a new calculation would have to be made with the slide rule. The total time required would then be the sum of the times for the individual passes.

History of the Planer

According to one source, (Hine, 1950) the earliest planer was built in France around 1751 and was used in the manufacture of the pumps that supplied the water to the fountains at Varsailles. There are slight differences in the reports of who built the first planer in the US. According to the book *Treatise on Planers,* the first planer that was made in the US was manufactured by Gay and Silver in North Chelmsford, near Lowell, Massachusetts in 1832. According to Hine the first US planer was built by Ira and Zilba Gay in New Hampshire about 1830. Both sources agree that the bed of the first machines were made of stone and that the cast iron tables were finished by hand to a flat surface through the use of hammers, chisels and files. The machine that was built by Gay and Silver in 1832 was reportedly still in use in 1912. A photograph of this machine is included in the book *Treatise on Planers.*

The production of planers seems to have reached its peak some time early in the second quarter of the present century. Since then the planer has slowly disappeared from manufacturing plants, being replaced by milling machines that do not have to exert the energy required to accelerate and decelerate heavy workpieces and that can concentrate much greater horsepower on the removal of metal. The large scale introduction of multiple point tungsten carbide cutting tools for use on milling machines at the time of World War II accelerated the demise of the planer.

Bibliography

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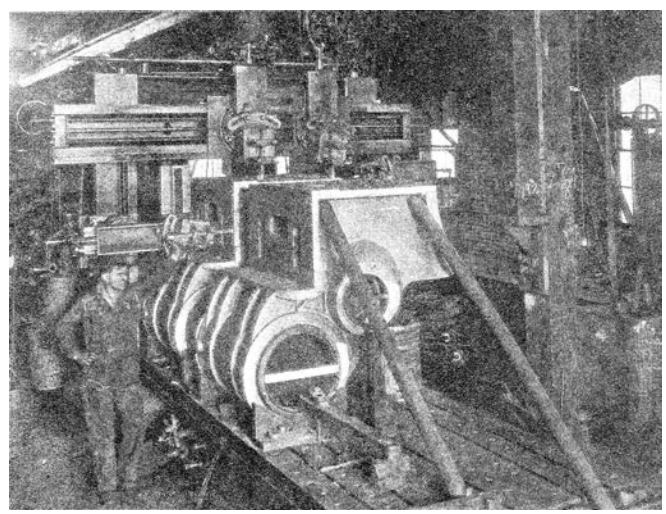

Figure 1.

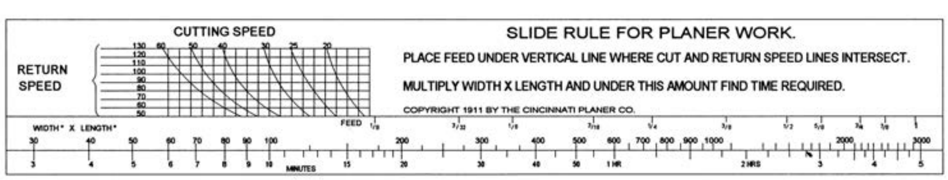

Figure 2.