for overcoming friction. Again, if it were possible to so arrange the machinery and the work that all loads should restore the water on which they descend into a reservoir, that is to say, should force the exhaust waste previously used in the hydraulic cylinders as power-water into a reservoir, where it would be subjected to yielding pressure or utiilzed to assist the steam engines in pumping, it will be seen that a great gain is possible.

## FORGED CUTTING TOOLS.

It will simplify this heading to look at it from a machinist's point of view, otherwise it may not be perfectly clear what to expect from it.

The small tool department has much to do in machine shop economy, as well as in the success of manufacture, although it is customary to think that when work is completed standard in dimension, it is also standard in every other way. At least whatever be the requirement for the aforesaid standard, the worry and energy of the mechanic are seldom thought of, and these have certainly a commercial value to the manufacturer, and are the all of the workman. The success of a mechanic, next to his stock of natural aptitude, depends upon the facilities he has in doing work and is in direct proportion to these.

Of the many classes into which cutting tools may be divided, those which are made and completed by the smith in the one operation of forging are worthy of attention, such as (in shop language) the diamond point, half diamond point, side tool, round-nosed, etc., which are used almost exclusively in lathe and planer work. With these may be taken the common flat drill—another forge product.

Every shop has its peculiar way of regulating the use and abuse of these small tools. In some it is a rigid system, but such can be very well dispensed with, considering the order of intelligence required in the machinist's trade, combined with the ingenuity which cannot profitably be fettered.

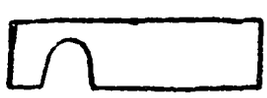
In a few machine works the small tools are all kept in a tool room where the workmen go for them and return them again. Of course under such arrangements the dressing, tempering, and even the grinding are attended to by those who are employed in the tool room, often boys, who have at best a very vague notion of the proper way to prepare a tool for any given job Thus the tool-maker and the tool-user—the principals in regard to the tool question—do not meet at all; consequently no suggestions, no improvement, and generally no satisfaction, especially in the case of the tool-user. Certainly it seems to be an economy to have such a class employed in the tool room, where the best mechanics should be; but against the saving of salary in the case of a few in the tool room, must be considered not only the loss of time, *i. e.*, of salary of the whole force of machinists in the shops, but the loss of their patience and energy in trying to do something well with tools not suited for the purpose.

It seems most reasonable that each machine tool should have its own outfit of cutting tools, and that these should be under the care of the operator of that machine. If he does not do his duty under this arrangement, it is probable that he would be a troublesome character under the tool-room system, and it becomes the foreman's business to look after him. It may seem extravagant that ten lathes or planers of the same size and doing the same class of work, should each have a complete outfit of small tools, yet it is the only successful, as well as the most economical, management in the ordinary machine shop.

Without any more authority for saying so than general practice, the diamond point seems to be the most efficient tool for removing stock. It is a favorite in America, and in some machine works it is often used as a finishing tool, with, of course, a fine feed motion, *e.g.*, in planing a surface. Although such a surface may not be so smooth as if finished with a round or square-faced tool, there is less tendency to spring, and therefore, a more accurate job. The form varies somewhat according to the size of the angle at the cutting-point, the tool for general use being about 75° at the point. When it is to be used on small and fine work, it is mostly made with a small angle at the face, 40° or less; this makes it more serviceable in cutting up to shoulders, or in its adjustment for such places. This form is also greatly used in planer work when a lot of stock is to be removed in taking a deep cut with fine feed.

The half diamond point, right and left, is a modification of the original tool used for same purpose as the acute-angled diamond point, as well as for ordinary side tool work. It has more stability than the common side tool and has over it the same advantage that the acute-angled diamond point has over the common round-nosed tool in respect to top and side rake, for the latter is mostly made almost straight, and whatever rake it has depends on the grinding altogether.

The diamond point of greater than 90° on the cutting face is better adapted for heavy work and hard stock, and after repeated grinding it frequently degenerates into a kind of round-nosed tool. There is a preferable way of forging the diamond point. With ordinary small tool stock, $\frac{1}{2}$ in. x 1 in. or $\frac{5}{8}$ in. x $1\frac{1}{4}$ in., the method of most smiths is to begin by using the fuller, and when the first operation is over the tool that is to be used looks something like this:



The slot thus made is evidently to facilitate drawing out of the *point*, and if the fuller is not driven down to a reasonable depth, there is nothing to be gained by the operation; so that when done the tool has often too great a space between the point and the shank—too long a neck, if it may be called so, and consequently being faulty in design it is weaker than it should be, as well as being unsightly. Granted that when finished it is a good tool practically and theoretically, it is not so economically made as it might be. As a matter of experience the stock can be bent over by the striker, when held over the anvil at the proper inclination by the smith, and the cutting point formed just as easily as when the fuller is used. The advantage is, first, less time required, also less heating of the stock, for as much progress is made by one heat in the second case as by two in the first. The weak point caused by the fuller is perhaps a greater defect when the tool is to be used for planer than for lathe work.

In making large tools, the fuller is allowable—perhaps necessary, but as the scale of work is larger it can be used with better results.

The well known side tool is the only one that can be used in some operations, *e. g.*, squaring the ends of