PUNCHING AND SHEARING

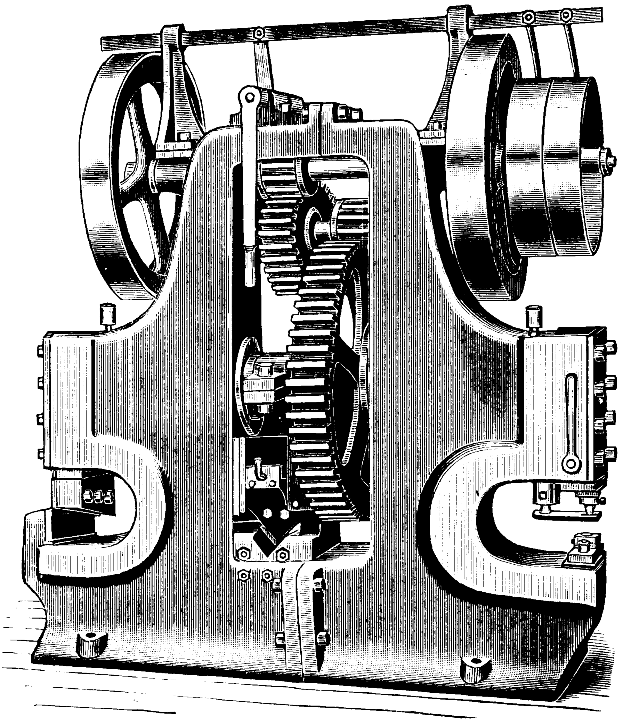


Fig. 248.

PUNCHING AND SHEARING.

To punch is to pierce, to perforate or indent a solid material.

To shear is to clip or cut with a sharp instrument; the act or operation of cutting by means of two edges of sharpened steel, as on the principle upon which shears are operated.

A punch is a tool, the working end of which is pointed or blunt, and which acts either by pressure or percussion—applied in the direction of its length—to drive out or in, or to make a hole or holes, as in sheet or plate iron and steel.

Shears consist of two blades with beveled edges facing each other and used for cutting. There are innumerable forms of these two implements—punches and shears—but this volume has to do only with those actuated by power, hence called "power-punching machines" or "power-cutting machines," etc.

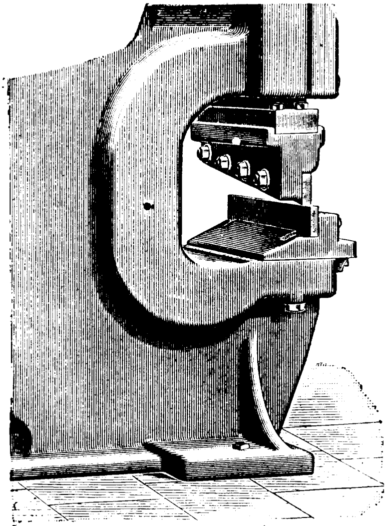
Punching machines are very commonly combined with shearing machines, the work of both being essentially the same. In some cases the construction is such as to allow of the removal of the shear-blades and substitution of the punch, and *vice versa*, as desired. More usually, however, the two contrivances are separate, though arranged in the same supporting frame. Fig. 248 represents a punching and shearing machine. The reason the two are combined in one machine is that it is very usual for both shearing and punching to be needed on the same plate.

Presses used for stamping or forming purposes are properly punches; the term punch includes two very different kinds of instruments; 1, tools whose duty is to indent

PUNCHING AND SHEARING.

the material without absolutely separating or dividing it, 2, tools which, in conjunction with a bolster placed underneath the work, cut or divide it similarly to the action of a pair of shear blades.

Punching machines, as is evident from the flat or obtuse angle of the edge of the punch, do not effect the division of the material by cutting, but by a tearing apart



View of throat, showing tools in position.

Fig. 249.

of the fibre of the material; this is equally true of the upper and lower blades of a shearing machine, as shown in fig. 249; the blades are not cutting edges, but are flat or nearly so.

The operations of both punching and shearing may be regarded as similar, one being done with circular or curved and the other with straight tools. The blades of a shearing machine will pass through a plate an inch and a half in thickness with a rapidity and appearance of ease which give little idea of the power actually used.

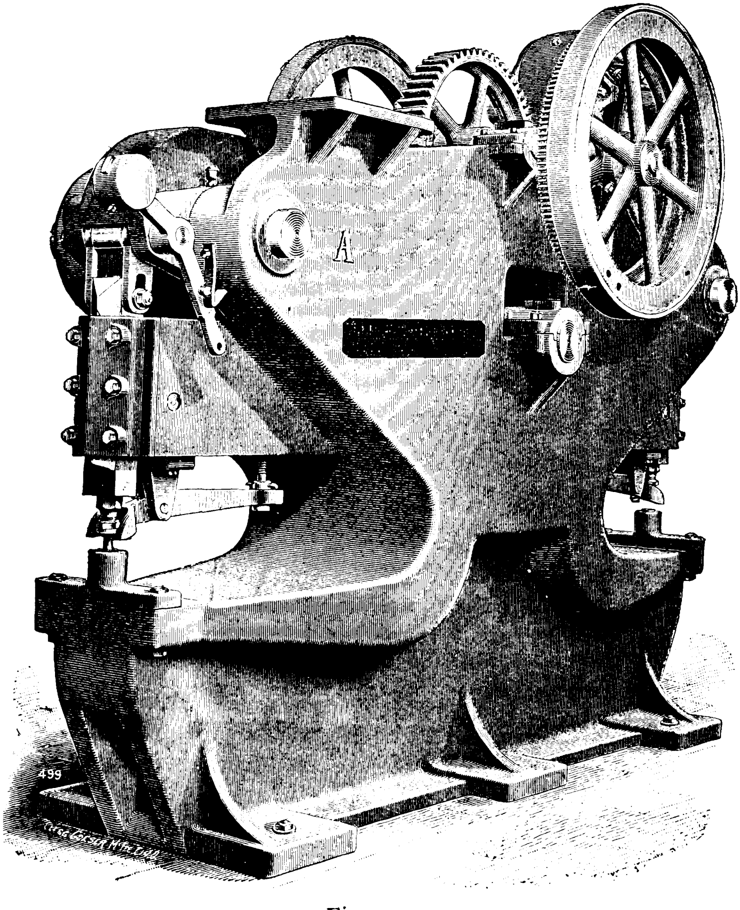


Fig. 250.

Fig. 251 shows an enlarged view of the arrangement of the punch end of the machine illustrated in fig. 248; the operation is that of perforating a hole in a heavy plate;

PUNCHING AND SHEARING.

each portion is named, to more readily convey the idea of the work and the several parts of the machine.

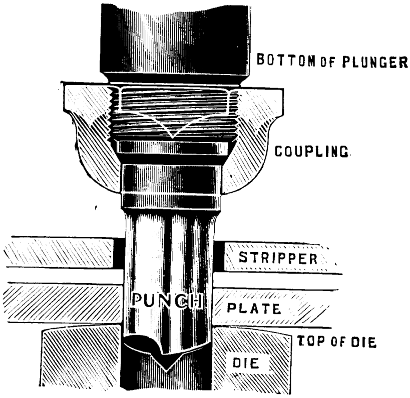


Fig. 251.

The above cut shows the positions of punch, plunger and die; also the positions of the stock, punch and coupling, and the correct position of the stripper relative to the punch and plate, in use, to prevent the plate from binding when the punch is drawn.

In punching and shearing machines the power is applied in many ways: 1, by screw pressure; 2, by hydraulic pressure; 3, by a lever; or, 4, by eccentrics—the latter is the usual method.

A complete set of punching tools includes 1 punch, 1 die, 1 die block, 1 die holder, 1 socket, 1 stripper or pull-off, 1 edge-gauge and wrenches. The die block bolts on to the lower jaw to receive the die holder or the die, and the die holder is made to fit in the die block and is bored to receive the various sizes of small dies. The edge-gauge bolts to the frame of the machine, and its edges serve as a gauge for the edge of the piece being punched. The stripper or pull-off is a pivoted lever whose forward end straddles the punch and strips the sheet as the punch rises; it is adjustable up and down by means of a pin at the rear end of the lever, so as to accommodate different thicknesses of metal.

The capacities of the different machines vary according to the size, and the throats in the same size vary in depth. The distance from the edge of the sheet at which punching or shearing can be done, is governed by the depth of the throat; by the depth of the throat is meant the distance from the center of the punch to the back wall of the throat.

Fig. 248 shows a double-ended eccentric, punching and shearing machine.

This machine is double-geared, the frame cast in halves securely bolted and dowelled together. The driving and eccentric shafts are of steel, and the latter drives the slides through short connecting rods. The slides have large rectangular bearing surfaces, those for the punch and the shears being fitted with stop motions.

Fig. 250 shows a double-ended lever punch of approved design.

This machine is double-geared, and the punch and shear slides are worked by levers which allow the slides to remain at the top of the stroke during half a revolution of the main shaft, thus affording time for adjustment of the plate.

In single-ended machines the punching and shearing are both operated from one slide, the shears being placed at the top.

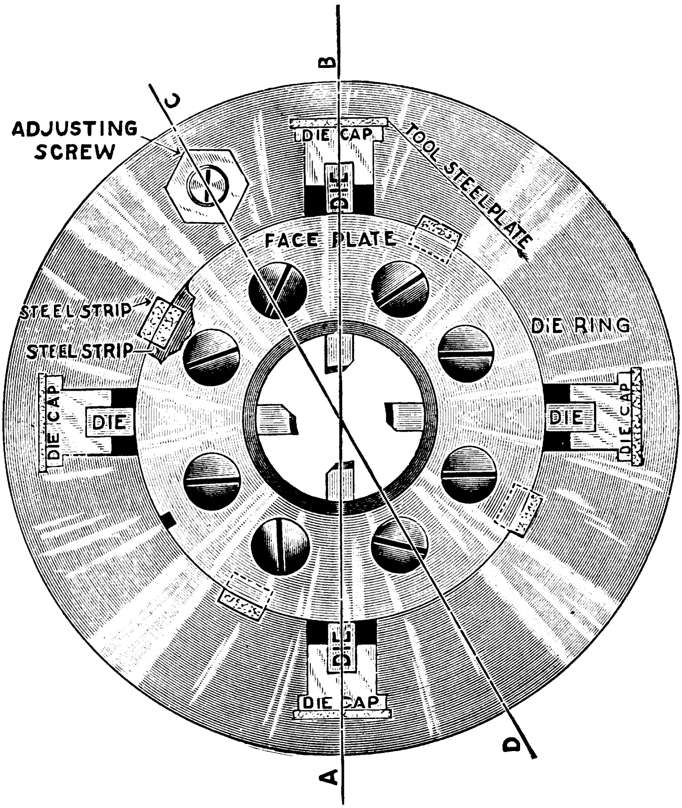

ADJUSTING SCREW
B
C
DIE CAP
DIE
TOOL STEEL PLATE
FACE PLATE
DIE RING
STEEL STRIP
STEEL STRIP
DIE CAP
DIE
DIE
DIE CAP
DIE
DIE CAP
D
A

Fig. 252.

MACHINE BOLT CUTTING.

This subject also properly includes nut tapping and bolt-heading. Bolt-cutters, like most other machines, require additional tools and devices, according to their complication and general construction; an example of this is the special cutting-off tool designed to reduce round rolled iron to the exact length necessary for heading in the heading machine, which is in itself an accessory of the bolt-cutter; another example is the power feed-attachment, designed to be applied to the main machine, to produce coarse bastard threads true to the pitch.

Fig. 254 shows an improved bolt-thread cutter, arranged with gear for screwing large diameters of bolts.

The cutters, four in number, are arranged in a revolving die head; fig. 252 is a front view of same; the carriage is moved to and from the die head by a rack and pinion operated by hand wheel; the lubrication for the dies is supplied by an oil pump of plain plunger type, placed within the column of the machine, and is driven from the cone pulley—the throw of the crank pin can be adjusted to and from the center, thereby decreasing and increasing the stroke of the plunger, and regulating the supply of oil to the cutters.

A substantial metal box frame *A*, provides an oil tank in the base, the top forms the bed and the slides for the carriage; the headstock *B* carries the live spindle *C*, to which is bolted the die head *D*; the hand wheel *F* opens and closes the vise *E*, which slides with carriage *G*, and is operated by hand wheel *H* and the rack and pinion shown;

MACHINE BOLT CUTTING.

the hand lever *I* operates the clutch ring, opening and closing the dies, which is also automatically accomplished

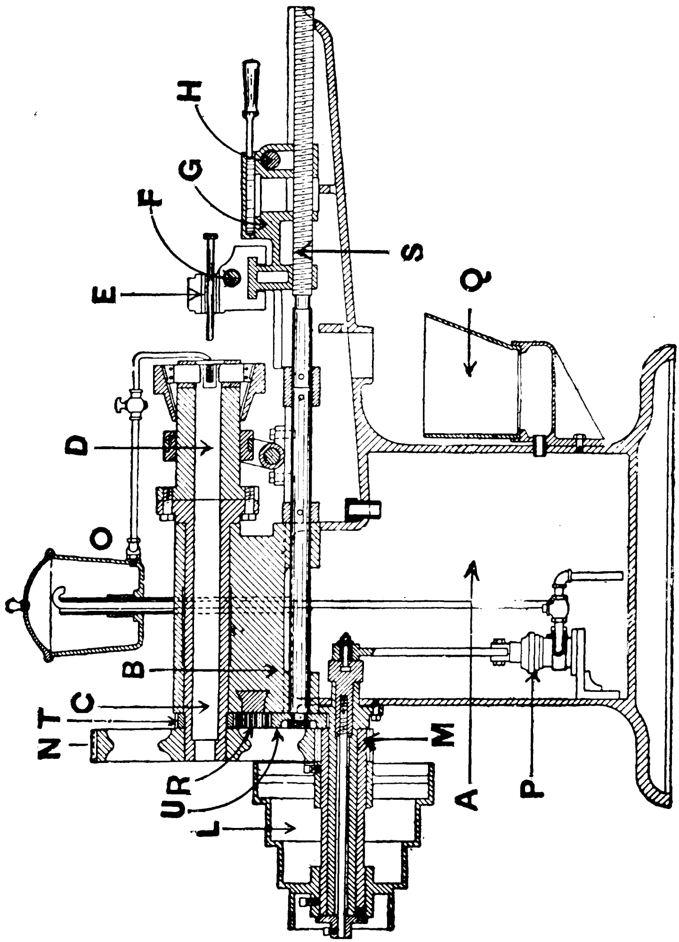


Fig. 253.

by the stop rod *J*, which slides through the vise block, and the stops *K K*, being set to the length of the screw to be cut, are operated by contact with the vise.

MACHINE BOLT CUTTING.

The driving cone *L*, with pinion *M*, gear into wheel *N* on the live spindle; the oil supply *O* is fed by the pump *P*, in the metal box frame, through the center of the overflow pipe; the discharge end is curved downwards slightly below the top of the overflow pipe, which prevents splashing of the oil.

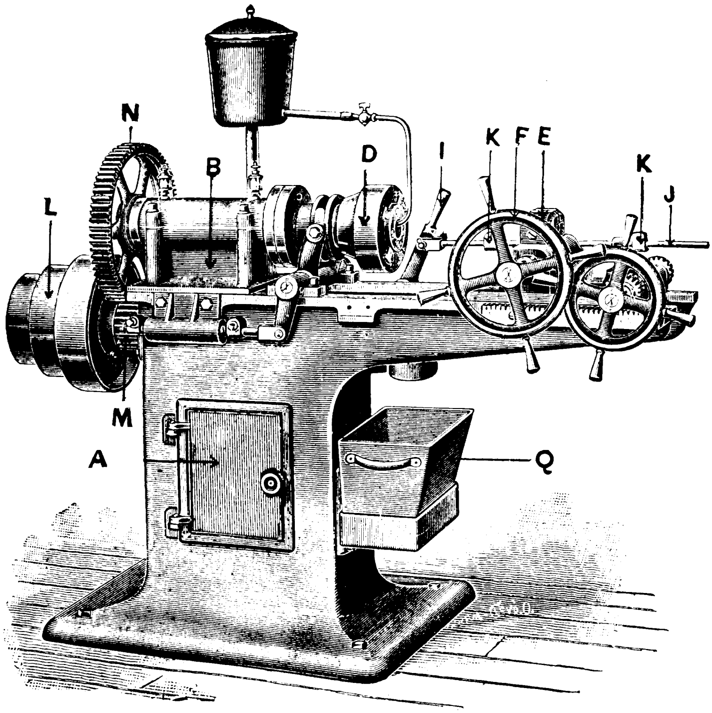


Fig. 254.

The pump is of ample size, so that when running on the slow speed a sufficient supply of oil is discharged into the oil-pot to keep a constant stream on the dies when cutting threads; the removable chip-pan will hold the chips of a day's work.

MACHINE BOLT CUTTING.

Fig. 253 is a section side view of the machine, showing the interior arrangment of the parts and the plunger pump *P;* it also shows a device, a substitute for the rack and pinion motion for travelling carriage, which is not shown in fig. 254, viz., a self-acting lead screw *S*, which is driven from the live spindle by two spur gears, *T* and *U*, and idle or carrier wheels *R*, which reverse the motion for right or left-hand screw cutting.

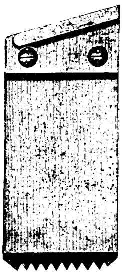


Fig. 255.

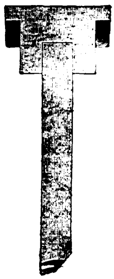


Fig. 256.

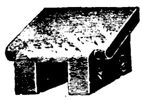


Fig. 257.

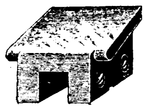


Fig. 258.

The die ring is made of cast iron; this ring controls the movement of the dies radially to and from the center, by means of recesses at an angle to its face; the clutch ring has a phosphor-bronze ring working in a groove and attached to the automatic spring and closing device; the movement of the clutch ring is transmitted to the die ring through the rocking lever and toggle.

The cutters are four in number; fig. 255 is a side view, fig 256 an end view, of the cutter with cast-steel head attached; figs. 257 and 258 show the tool-steel caps; the upper one is for a full-size die. When recut several times, it is needful to use the deeper steel cap, to make up for the shortening of the cutter by recutting.

MACHINE BOLT CUTTING.

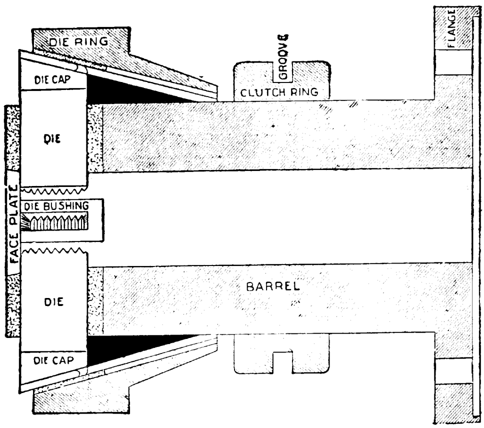


Fig. 259.

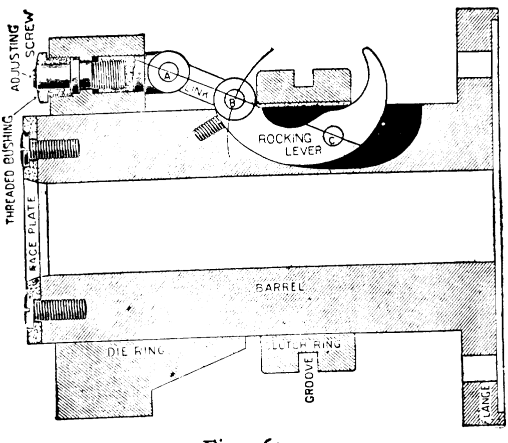


Fig. 260.

MACHINE BOLT CUTTING.

Fig. 261 shows the side view of the die head, which is made of cast iron, turned, milled and bored. To the post end is fastened a face plate, which serves to hold the dies and die bushings in place—see fig. 252; in the outer surface of the barrel, there are four longitudinal grooves milled to within a short distance of the flange, and in these grooves are fitted steel strips, hardened and ground to resist the wear of the sliding die ring.

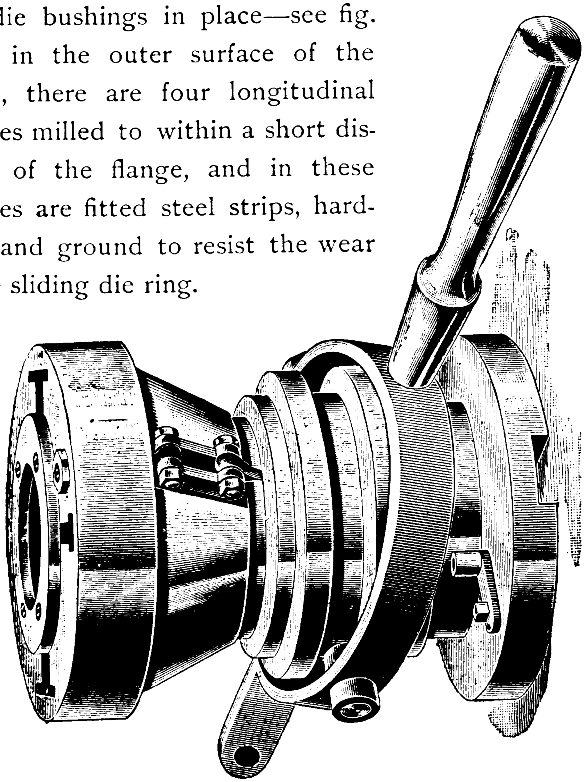


Fig. 261.

A section on line *A B* of revolving die head; figure 252 shows the dies and die caps, etc., fig. 259; a section on line *C D* of the die head—see fig. 260—shows the opening and closing device operated by the clutch ring and the rocking lever and toggle.

Fig. 262 shows a lead screw, and fig. 263 a split-nut; these are required for each pitch cut; the lead screws

MACHINE BOLT CUTTING.

are made short and they can be changed from one pitch to another.; the bronze split-nut fits in the carriage and is opened and closed by means of a cam disc and lever operated by hand.

Fig. 262.

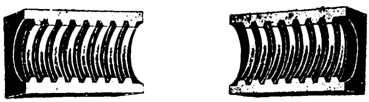


Fig. 263.

The cutting speeds for dies in bolt cutting are as follows:

TABLE.

Diameter of Bolt.	Revolution of Dies.	Diameter of Bolt.	Revolution of Dies.
$\frac{1}{8}$	460	$1\frac{1}{8}$	50
$\frac{1}{4}$	230	$1\frac{1}{4}$	45
$\frac{5}{16}$	188	$1\frac{3}{8}$	40
$\frac{3}{8}$	153	$1\frac{1}{2}$	38
$\frac{7}{16}$	131	$1\frac{5}{8}$	35
$\frac{1}{2}$	115	$1\frac{3}{4}$	32
$\frac{9}{16}$	102	$1\frac{7}{8}$	30
$\frac{5}{8}$	93	2	28
$\frac{3}{4}$	75	$2\frac{1}{4}$	25
$\frac{7}{8}$	65	$2\frac{1}{2}$	22
1	55	$2\frac{3}{4}$	20
		3	18

The usual cutting speed for bolts in machine-shop practice is fifteen lineal feet per minute; the above table is based upon that capacity of work. In tapping nuts, the same number of revolutions of the taps are required.

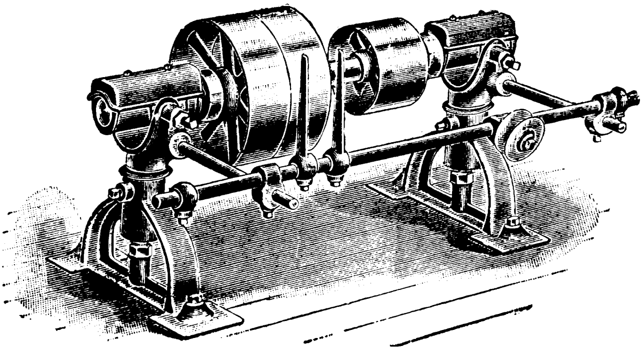


Fig. 204.