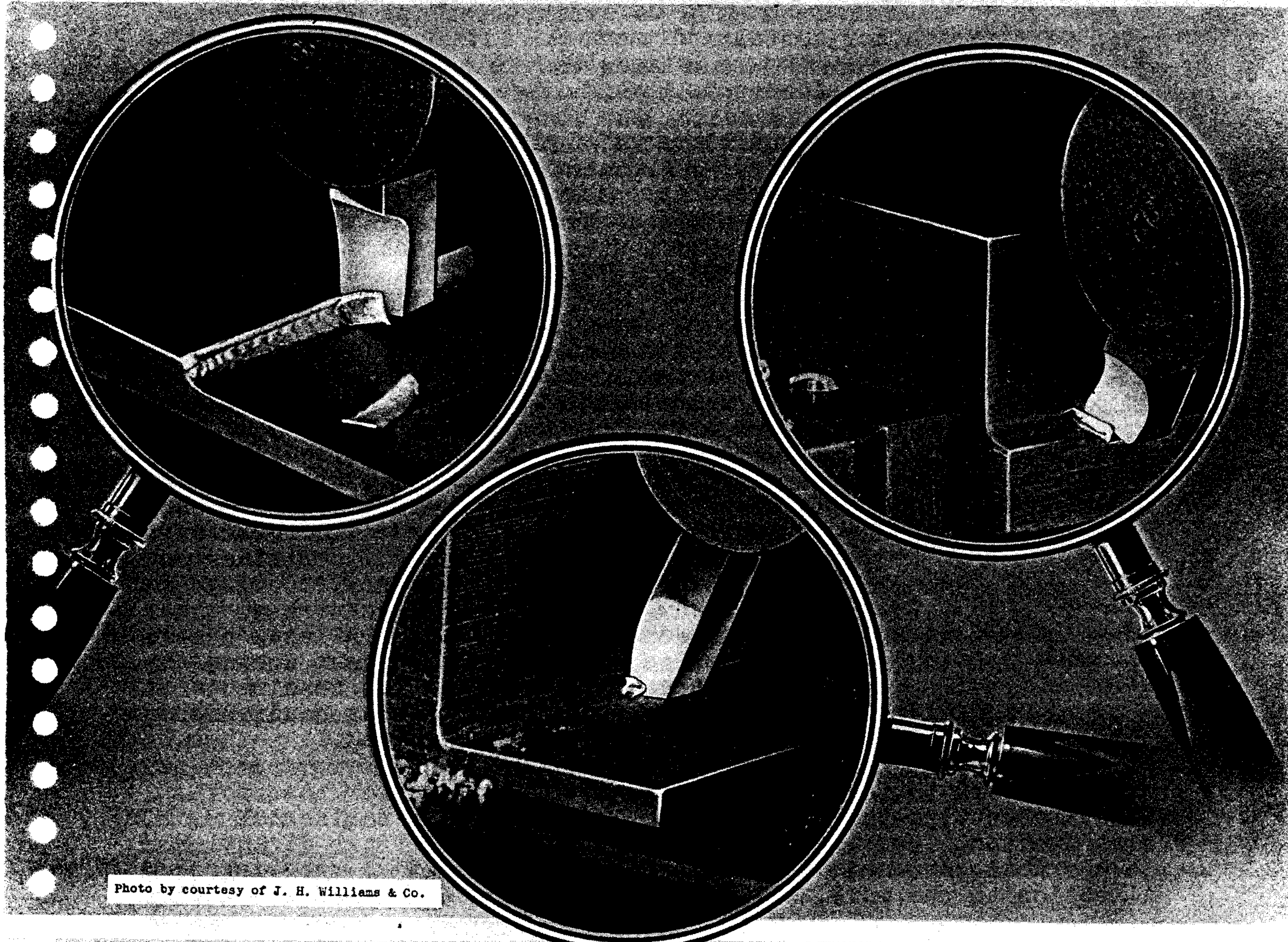
DESCRIPTION OF HORIZONTAL, VERTICAL AND COMBINED CUTS

Unit 1-T53(A) Pages 173 to 188



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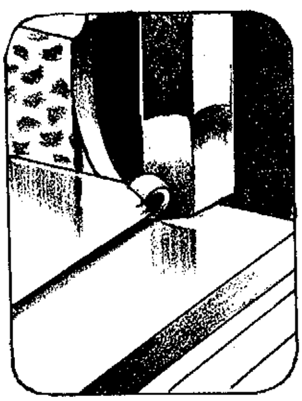
UNIVERSITY OF THE STATE OF NEW YORK
STATE EDUCATION DEPARTMENT
BUREAU OF INDUSTRIAL AND TECHNICAL EDUCATION

DESCRIPTION of HORIZONTAL, VERTICAL and COMBINED CUTS

OBJECTIVES OF UNIT

1. To describe horizontal and vertical cuts.
2. To describe shoulder cuts.
3. To point out the requisites of a good setup.
4. To discuss the factors which affect surface finish.

INTRODUCTORY INFORMATION



Most of the work performed in the shaper consists of machining flat surfaces on work held in one or another of the devices already described.

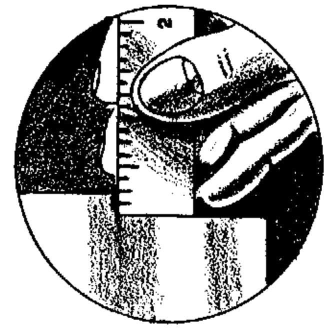
A single-point tool, so called because it has one cutting edge, does the cutting. It moves back and forth over the work with a reciprocating movement, cutting during the forward stroke only. During each return stroke either the work or the tool is advanced (fed) more or less, preparatory to removing another cut during the next forward stroke. The feeding is continued automatically, or by hand, until a surface of the desired width has been machined.

When the work is fed in a horizontal direction under the reciprocating cutting tool, the surface produced is a horizontal flat surface. But when the work is fed in a vertical direction to the tool, or when, instead, the tool is fed in a vertical direction to the work, a vertical flat surface is produced.

The vertical surface or step joining one horizontal surface with another horizontal surface which is somewhat higher or lower is referred to as a shoulder. Both horizontal and vertical shaping are required to form a shoulder when the distance separating the horizontal surfaces is considerable.

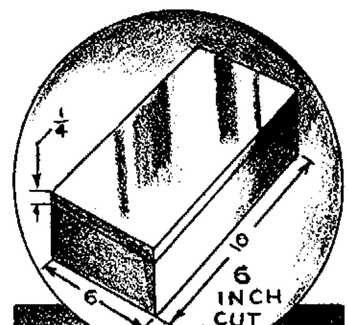
The surface finish attained depends on such factors as the shape of the tool, the depth of cut, the rate of feed, and the material being machined.

DEFINITION OF CUTS

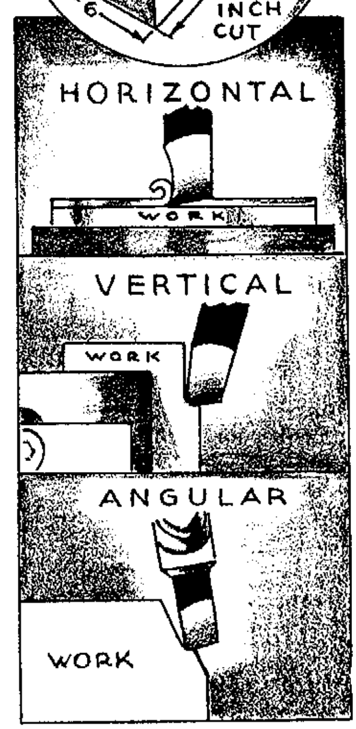


In the subsequent description of shaper operations, the word "cut" recurs frequently. The same meaning, however, is not attached to this word in each instance, as the following examples will indicate.

The most common usage of the word has reference to the thickness of the metal which the tool removes from the surface of the work and indicates the depth of the shoulder which is made by the tool when it is cutting the metal. For example, when, according to instructions, a 1/4-inch cut is to be made, 1/4" of metal is removed from the surface, and the thickness of the work is reduced a corresponding amount. During the cut the tool forms a shoulder one-fourth-inch deep as indicated by a measurement taken from the finished surface to the uncut surface of the work.



The term "cut" is used in another sense in calculating the time required to machine a given area. In this instance, "cut" refers to the width of the surface from which the metal is removed, for the work is usually placed in the shaper lengthwise. Then, with the feed per stroke known, the width of the surface determines the number of strokes required to take a cut off the surface. For example, if one-fourth inch of metal is removed from a surface 6" wide and 10" long, and the work placed in the machine lengthwise, the width of the surface would be referred to as a 6-inch cut, for the tool would be required to feed a total of 6" to finish the surface. The number of strokes required to machine the surface depends upon the rate of feed.



The word "cut" is used in still another sense to designate the plane of the surface from which the metal is removed. For example, when the surface requiring machining lies flat, and the work is fed under the tool in a horizontal direction, the tool is said to take a horizontal cut.

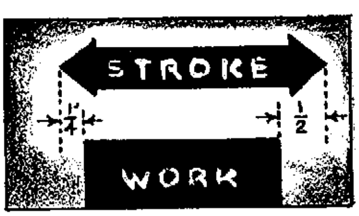
The same procedure is followed in referring to metal removed from a surface located in a vertical or an angular plane. Thus, when the tool is fed down or the work is fed up at right angles to the top of the table, the cut is said to be a vertical cut. When the tool head is swiveled from its 90° location, and the tool is subsequently fed to the work by means of the down-feed screw, the result is an angular cut.

THE HORIZONTAL CUT

The horizontal surface, as produced in the shaper, is the result of a series of cuts made with a single-point cutting tool during the forward stroke of the ram and the accompanying movement (feeding) of the work in a horizontal direction during each return stroke. Alternate cutting and feeding are continued until a surface of the desired width has been machined, the feeding being either automatically or manually controlled. During the cutting process, the work is clamped rigidly in a vise, in a fixture, or to the surface of the table, its only movement occurring together with the movement of the table on the cross rail, when the cross-feed screw is turned.

With the exception of unusual conditions which require that the feeding mechanism operate at the beginning of the cutting stroke instead of during the return stroke, the length of stroke should be set only about three-fourths of an inch longer than the work. One-half inch of this extra length should come at the beginning of the stroke in order that the clapper block may seat properly before the tool engages the next cut; the remaining one-fourth inch should come at the end of this stroke.

PLACEMENT OF THE STROKE



When, for one reason or another, the feed has been adjusted to operate at the beginning of the stroke, the tool must be allowed to run beyond the back end of the work a somewhat greater distance than usual, and obviously the stroke too must be made correspondingly longer. The additional space is required at the beginning of the stroke under these conditions in order that all feeding of the table will have been completed before the tool engages the metal; otherwise the feed mechanism will be subjected to the heavy pressure needed to force the tool into the metal, a pressure which the mechanism never was intended to withstand.

Although it is essential that the ram stroke be somewhat longer than the work and that the stroke be placed so that the cutting tool clears both ends of the work, the tool, nevertheless, is idle (non-cutting) as it passes through this extra space, inasmuch as it removes no metal at this time.

For economy of time, therefore, it is important that the stroke-length be held to the minimum required for proper functioning of the tool, and, moreover, that the work be placed in the shaper, whenever practicable, in a manner intended to reduce the non-cutting or waste time of the tool to a minimum. Despite the desire for economy of time, however, the stroke should not be shortened to the extent that the feed mechanism is caused to operate after the tool has entered the cut.

PLACEMENT OF THE WORK

Since it is necessary for the tool to overrun the work for the same distance, whether the stroke used is long or short, it becomes apparent that the job should be placed in the machine in the position requiring the fewest strokes, for less time will then be wasted. Thus, when a surface may be planed either crosswise with a short stroke or lengthwise with a longer stroke, the longer one should be selected. For example, a job which can be machined by placing it in the shaper either lengthwise or crosswise has been shown in Fig. 254. If this job is placed in the shaper crosswise the non-cutting area traveled by the tool will be twice as great as that which the tool would travel if the job were placed in the machine lengthwise. The non-cutting area for the crosswise cut is represented in grey; for the lengthwise cut it is represented in black.

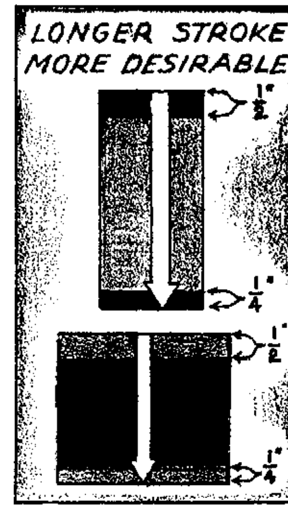


FIG.254

In conformity to the practice recommended, that of placing the work in the shaper lengthwise whenever practicable, the work held in the vise should be gripped by its longer sides and the vise jaws should be set parallel with the ram as shown in Fig. 255. Narrow work should not be held in the vise as shown in Fig. 256 since it is likely to turn under the cutting pressure.

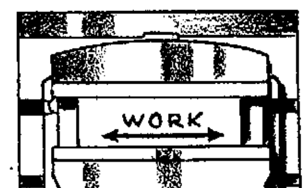


FIG.255

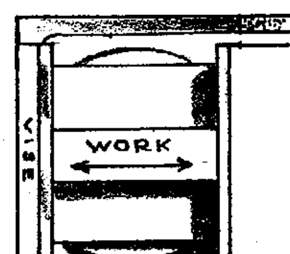
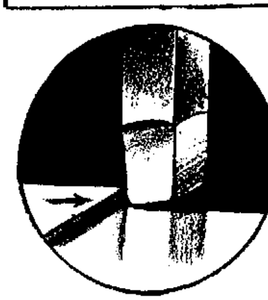


FIG.256

All work, however, cannot be planed with a lengthwise stroke. It is often expedient when extremely heavy cuts are being taken and when the work has only a small gripping surface, to set the vise jaws at right angles to the ram and to use a shorter crosswise stroke. With this arrangement, the work is less likely to slip in the vise, for the thrust of the tool during the cut is taken up by the vise jaw.

TOOLS FOR THE HORIZONTAL CUT



Tools of various shapes and tools for various cuts and materials have been described and illustrated in the section entitled, <u>Description of Shaper Tool Holders and Shaper Tools</u>, beginning on page 151.

For horizontal cuts intended to remove excess metal when the surface finish is of minor importance, one of the round-nosed roughing tools illustrated on page 166 in the above section will prove very satisfactory. When the selection is made, both the material in the job and the direction of the feed must be taken into consideration. The material to be cut influences the top- and side-rake angles of the tool particularly, and the direction of the feed determines whether a tool having its cutting edge on the right side, or one having its cutting edge on the left side will be used. The cutting edge, obviously, should be on that side from which the work approaches the tool during the cut. For example, a tool ground approximately like the one in Fig. 248 should be used for roughing out a horizontal surface of cast iron, and the work should be fed to the tool from the left side, since the cutting edge is on the left side of the tool.

Either a solid tool, forged and then ground to the recommended shape, or a tool bit ground to a similar shape and held in a suitable tool holder, can be used. For extremely heavy cuts, the solid tool is preferred.

REQUISITES OF A GOOD SETUP

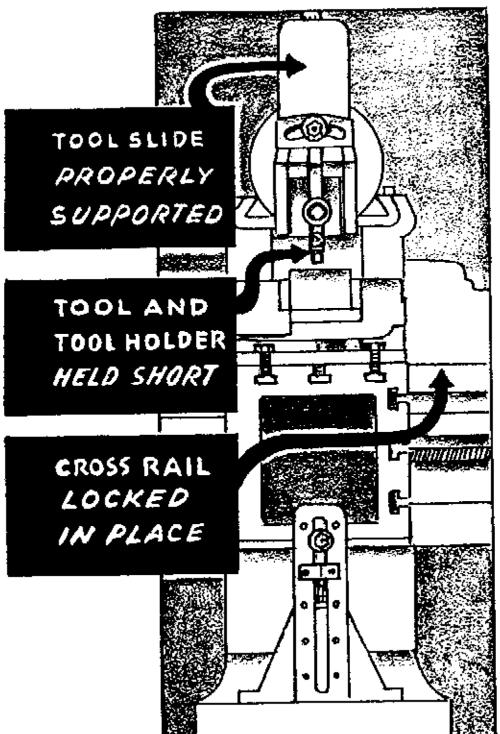


FIG.257

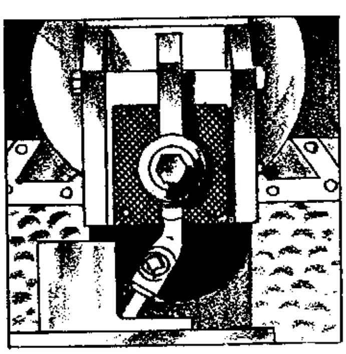


FIG.258

Rigidity of both the machine and the cutting tool is essential for the taking of heavy cuts and for the production of accurate work in the shaper. One of the requisites for attaining a rigid setup is the proper placement of the cross rail on the column; another has to do with the placement of the cutting tool, and a third with the position of the tool slide on the head (Fig. 257).

Whenever practicable, the cross rail should be moved up on the column so that the surface to be planed is about two inches below the ram. Of course, the binder bolts which clamp the rail to the column and also those which clamp the table support must be loosened before the rail is adjusted and, likewise, after the rail has been relocated, these bolts should be tightened again.

The tool bit, if one is used, should extend from its holder only far enough to allow the cut to be made without interference between the work and the tool holder. The tool holder, also, or the forged tool, whichever is used, should be clamped in the tool post with its cutting end fairly close to the tool head so that it will be well supported.

Moreover, the tool slide should be kept well up on the tool head where it too will be properly supported. Incidentally, allowing the slide to extend more than 1-1/2 inches beyond the head is considered extremely hazardous since it is likely to break from the pressure of the cut. Too great an extension of the tool slide and the hazards which accompany it, however, are likely to occur only when the admonitions regarding the location of the rail on the column and the clamping of the tool in the tool post have been disregarded. If both the rail and the tool are located as suggested, it will be practically impossible to move the slide too far down on the head during the cut.

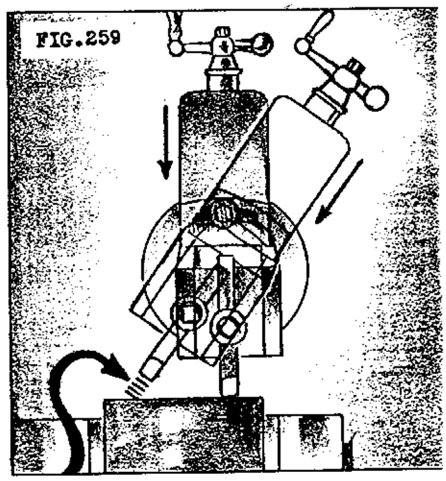
When, for one reason or another, the surface to be planed cannot be raised so that it is close to the ram, the extra space should be provided for in the setting of the tool; that is, the tool should be extended from the tool post, rather than the tool slide from the head (Fig. 258).

When a cut is taken from a horizontal surface, the tool head, the clapper box, and the cutting tool are usually placed in a vertical position, that is, perpendicular to the surface to be planed.

The only reason for setting the head vertically, that is, with the 90° graduation on the swivel block in line with the zero on the ram, is that with the head in this position, vertical movement of the tool coincides exactly with that registered on the micrometer dial located on the down-feed screw.

On the other hand, if the head is set at an angle other than 90°, the actual vertical movement of the tool will be somewhat less than the distance indicated on the graduated dial, inasmuch as the tool is then moved toward the work in an angular direction instead of in a vertical direction when the down-feed handle is turned (Fig. 259).

FIG. 259



ADDITIONAL DISTANCE SLIDE MUST TRAVEL TO REACH SURFACE —

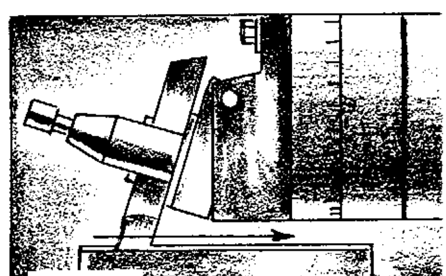
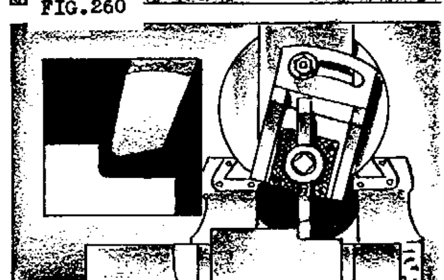


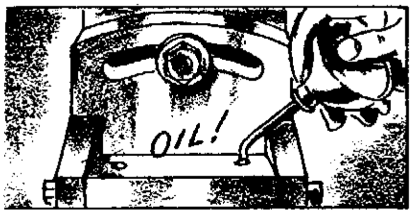
FIG. 260



POSITION OF THE CLAPPER BOX

The function of the clapper box is to permit the tool to lift during its return stroke and thereby prevent severe rubbing of the tool on the metal and the consequent dulling of its cutting edge. The clapper box is usually set square with the head during horizontal cuts, although for heavy cuts it may be desirable to swing its upper end away from the cut in order to relieve the tool from excessive drag. When the clapper box is swiveled, the tool not only lifts but also swings out from the work during the return stroke. The manner in which this action takes place has been more fully explained on page 186 in connection with vertical shaping.

If the clapper block is to function as intended, it



must be maintained in good operating condition by keeping it clean, properly adjusted, and well oiled. The lubrication will assure the block's lifting freely during the return stroke, and cleanliness, together with careful adjustment of the taper pin on which it hinges, will assure proper seating of the block during the cutting stroke.

PLACEMENT OF THE TOOL HOLDER AND THE TOOL

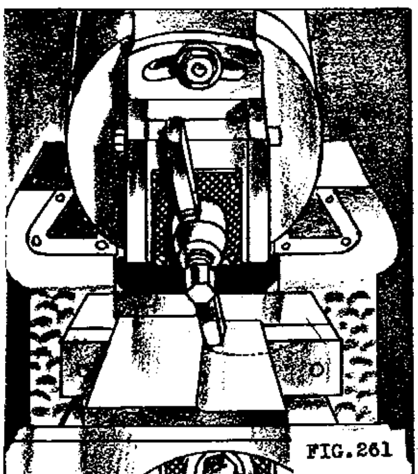


FIG.261

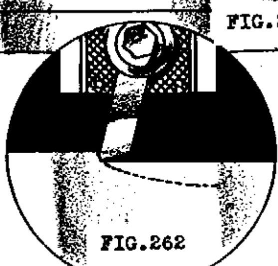


FIG.262

The cutting tool should be clamped securely in the tool post in a vertical position approximately square with the surface to be planed. During heavy cuts when the pressure of the metal on the tool is likely to move the tool sidewise, the tool should be set at a slight angle away from the work, so that if by any chance the tool moves, it will be in a direction away from the work as shown by the arc in Fig. 261. If the tool is pointed toward the work and cutting pressure moves it sidewise, its movement will be in the direction indicated by the arc in Fig. 262. The cut then, obviously, will become deeper and, if unobserved, this downward movement of the tool may result in planing below the finish line and thus cause the work to be spoiled. When, for any reason, the tool must be pointed into the cut, it must be watched very closely in order to detect, immediately, any slippage which might occur. The farther the tool extends from the tool post, the greater becomes its likelihood of moving because the pressure on its end increases in proportion to its extension from the tool post. For most work, the tool need not extend more than 1-1/2 inches below the tool block.

DIRECTION OF THE FEED

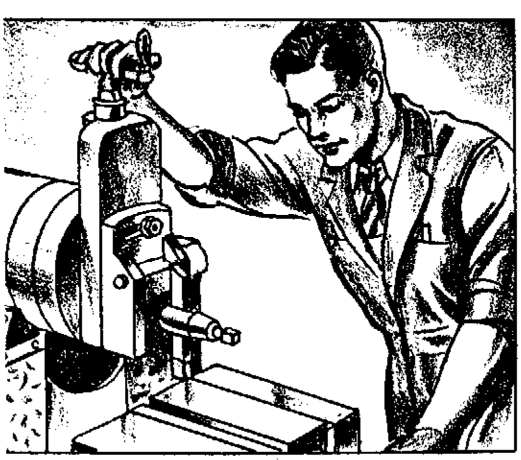


FIG.263

During the operation of the shaper, the operator usually occupies a position at the right-front side of the machine. From this position most levers and handles which are used for setting up the job and the machine, as well as levers and controls used for subsequently operating the machine during the cut, are accessible to the operator without his moving any appreciable distance.

The logical place to start the cut, therefore, is from the right side of the work, that is, from the side nearest the operator. From his usual place, the operator is then able to observe the depth of the cut and the cutting action of the tool during the cut. A tool with its cutting edge on the left side must be used for cuts started on the right side of the work. The tool is set to the depth of cut desired by means of the down-feed handle, and this depth of cut is indicated in thousandths of an inch on the micrometer dial adjacent to this handle (Fig. 263).

The work is fed to the tool by hand until the cut has been started and until its correct depth has been established; only then is the power cross feed engaged (Fig. 264).

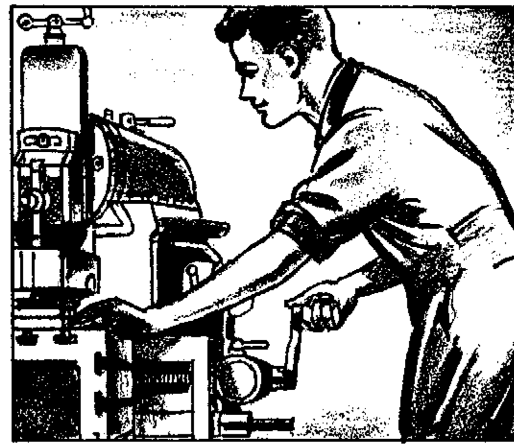


FIG.264

THE ROUGHING CUT

A <u>roughing cut</u> is one made primarily for the purpose of preparing the surface of the work for the final or finishing cut, the appearance of the surface being of minor importance.

Roughing cuts may consist merely of removing one or two cuts in order to remove scale and irregularities found especially on the surface of castings, with the idea of making the surface fairly straight and level preparatory to taking the finishing cut.

They may, on the other hand, consist of taking several heavy cuts when considerable excess metal is to be removed prior to finishing the surface.

In either case, to avoid rapid dulling of the cutting tool, the first cut taken from a casting should be sufficiently deep to get under the scale, provided a cut of this thickness can be made without cutting the work undersize.

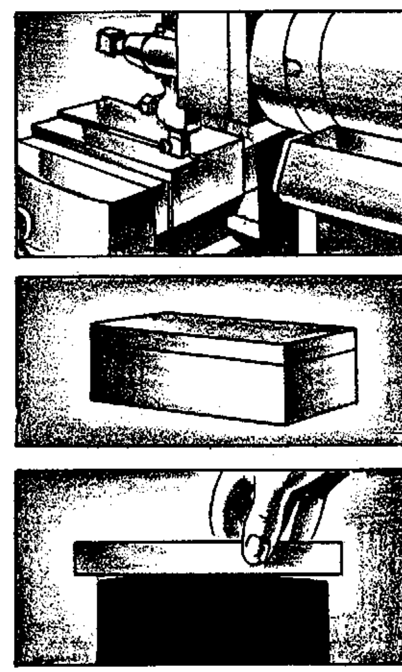
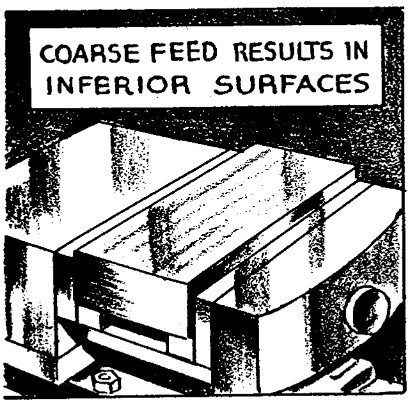


FIG.265

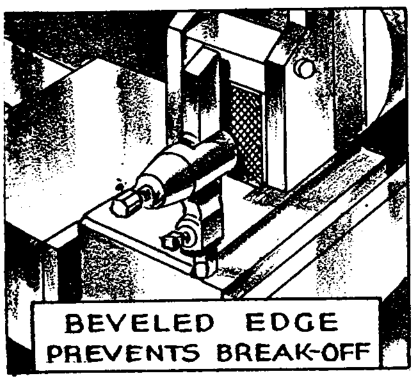
If the job requires no great accuracy or fine finish, one cut made with a moderate rate of feed may suffice. Since the surface of a rough casting is seldom straight or level, the cut will not be of uniform thickness throughout, but the tool will remove a thick chip from high points on the casting and a thin chip from the low spots. This variation in the depth of the cut is reflected to some extent in the machined surface, for the tool springs more when taking a heavy cut than it does when making a light cut, and, as a result, produces a surface on which high and low spots are quite apparent when the surface is checked with a straight edge.

Therefore, whenever the final surface is to be straight, a second

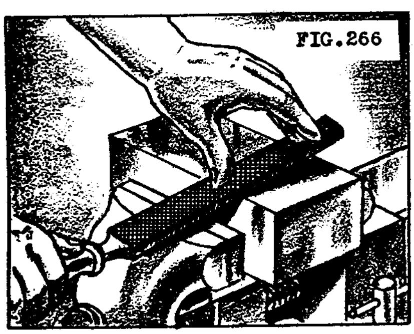


roughing cut is recommended, and approximately 1/16" of metal should be allowed for this cut in addition to the amount usually allowed for the finish cut.

When considerable metal is to be removed, the depth of the roughing cut and the rate of feed should be combined to remove as much of the surplus stock during a single cut as the shaper is capable of removing, always subject to the condition that the job, the method of holding it, and the size of the tool can withstand the pressure exerted by a heavy cut and a coarse feed.



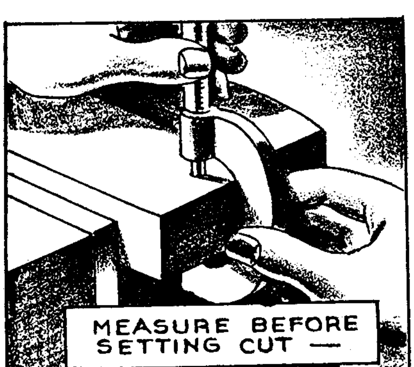
Roughing cuts for removing a given amount of surplus metal can be made by using either a very coarse feed and less depth of cut or by using a heavy cut and less feed per stroke. The deeper cut with less feed is usually preferable, inasmuch as the wide spacing of the feed marks and the greater tear in the metal which accompany the very coarse feed, result in an inferior surface which consequently requires a greater number of finish cuts to produce a smooth surface of good appearance.



As a general rule, it is best first to set a rate of feed which will result in a surface having the desired finish, and then to set a depth of cut suitable to the job, the tool, and the power of the machine.

The edge at the end of the cut, especially on cast materials, is likely to break off, leaving the edge ragged. This undesirable condition can be avoided by beveling the edge about 45°, approximately to the depth of the intended cut, using a file, or a cold chisel if considerable material is to be removed.

THE FINISHING CUT



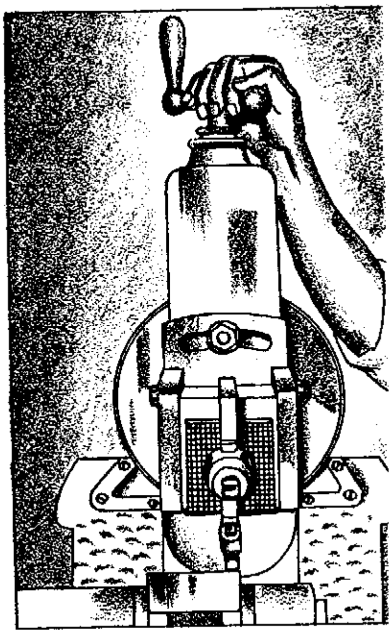
A finishing cut is one made for the purpose of cutting the work to size and at the same time giving it a smooth surface of good appearance.

The amount of material which must be removed to produce the required finish on a job is dependent upon the surface produced during the last roughing cut. Ordinarily, the feed marks and tears caused by the roughing tool can be removed from the work if between ten and fifteen thousandths are allowed for the finishing cuts. If, however, the feed used during the final roughing cut was exceptionally coarse or if the tears caused by the tool during this cut are unusually deep, the amount of material allowed for the finishing cuts must be increased, provided the size of the job is to be accurately maintained.

The number of finishing cuts required will be determined largely by the kind of finish desired and by the degree of accuracy demanded, and not by the amount of metal which is to be removed.

For example, when neither the final dimensions nor the finish specified on the job are too exacting, one finish cut made with the same tool used for roughing, but with the feed reduced somewhat, may produce the desired results. On the other hand, several cuts will be required if the surface is to be perfectly true and if the dimensions are to be extremely accurate at the same time.

The tools used for roughing cuts made on steel and cast iron are quite similar in shape, although different side- and top-rake angles are recommended for tools used for each of these materials. The tools used for finishing these materials, however, differ considerably and should not be used interchangeably. (Refer to page 166.)



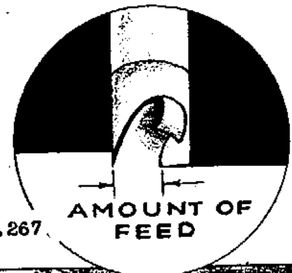


FIG.267

The tool best suited for finishing cast iron has a rather broad and flat cutting edge ground at right angles to the stroke of the ram. This cutting edge must be set parallel with the surface of the work so that a feed approximately one-half the width of the cutting edge may then be used. In this way, one cut overlaps the next considerably and produces a smooth surface (Figs. 267 and 268).

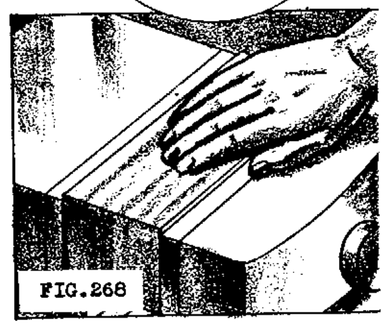


FIG.268

When broad surfaces on cast iron are being finished, it is not unusual to use a tool having a cutting edge 3/4" to 1" in width. Because of its broad contact with the work, however, "chatter" and "digging in" are likely to occur. These objectionable consequences can be eliminated by setting the cutting edge of the tool directly under, or, preferably, a short distance behind the fulcrum A. In solid tools, this is accomplished by shaping the tool as shown in Fig. 269. This tool is known as a spring tool and for obvious reasons also as a "gooseneck" tool. The same effect (spring) can be obtained with certain kinds of tool holders by placing them in the tool post as shown in Fig. 205 on page 155.

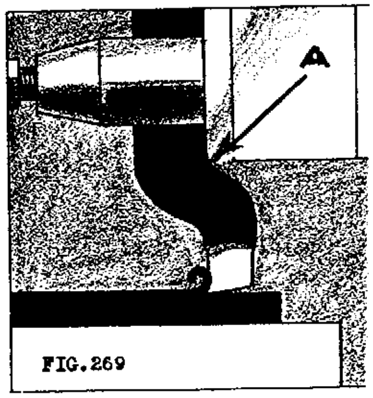
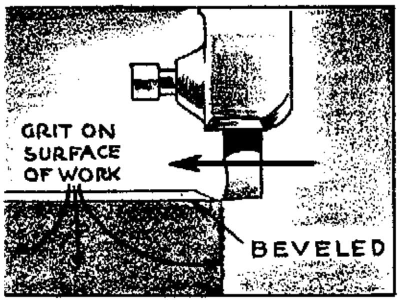
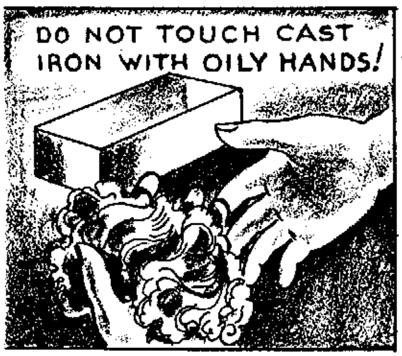


FIG.269

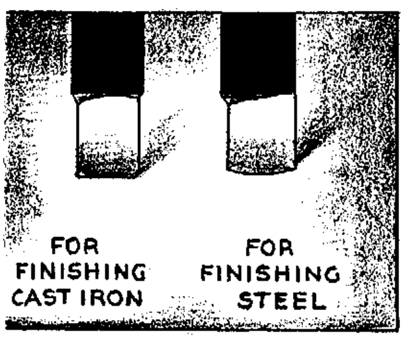


Finishing tools used on cast iron will remain sharp for a longer period if the edges of the castings are beveled slightly so that the tool will not come into contact with the sand and scale usually present on their surfaces.

Oil, too, should be kept from cast iron, especially during finishing cuts, for when oil is present the tool glazes the surface and, as a result, slides over the metal instead of penetrating it.



Steel offers a greater resistance to cutting than does cast iron, and for this reason the broad-nosed tools and the coarse feeds generally used in the finishing of cast iron, cannot be used for finishing steel, for these tools tend to gouge or "dig" into the surface.



The width of the flat cutting edge, therefore, is considerably less on a tool used for finishing steel than on one used for finishing cast iron. Furthermore, in contrast with the cutting edge of the tool used for cast iron, the cutting edge of a finishing tool for steel should be ground so that it approaches the work at an angle, and takes what is known as a shear cut. A shear tool produces a very smooth surface if used with a fine feed and a suitable cutting lubricant. Moreover, if the cutting edge is set behind the fulcrum as has been suggested for the cast-iron finishing tool, all possibility of its "digging in" can be eliminated. (Refer also to page 166.)

THE VERTICAL CUT

Vertical cuts are used for squaring the ends of long work, for squaring shoulders, for cutting slots and keyways, and for planing other work of a similar nature.

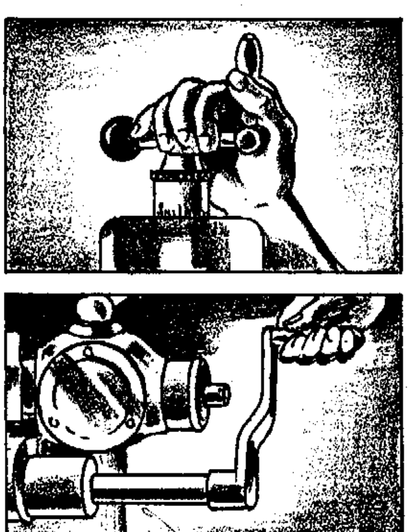


FIG. 270

There are two ways in which a vertical surface can be planed in the shaper. In the first, and by far the most frequently used method, the tool is fed to the work in a downward direction by means of the downfeed screw and under the guidance of the tool slide.

In the second method, the work is fed to the tool in an upward direction by means of the elevating screw — the cross rail, the table and the work being moved up on the ways of the column as a unit (Fig. 270).

In order that the operator may be fairly certain that an end or a shoulder will be machined square with both a side and the base of the job, these two locating surfaces must have a definite relationship with the stroke of the ram and with the upper surface of the machine table, respectively. For example, the side which is to be square with the end must be located at right angles to the stroke, and the base must be parallel with the top of the table.

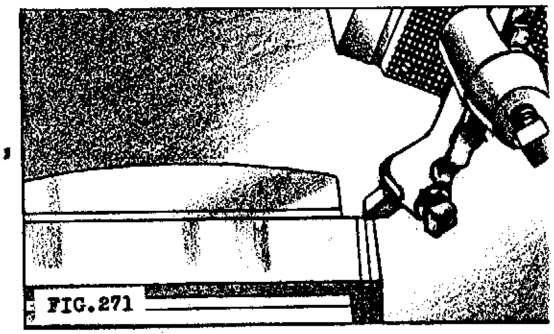


FIG.271

To meet these requirements, the work can be placed either on parallels in the machine vise having its jaws set square across, or it can be placed crosswise on the machine table and squared with the side of the table. Moreover, as a precaution against cutting into the vise or the table, the work should be extended at least one-eighth inch farther beyond the side of the work-holding device than is necessary for cutting the work to length (Figs.271 & 272).

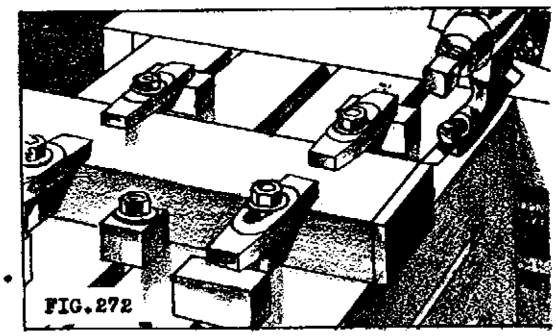


FIG.272

In order to complete the setup for planing an end or a shoulder, the tool slide, the tool, and the clapper box must be correctly adjusted also. When the down-feed method is used, the tool slide must be set square with the table, for this setting determines the direction of the tool during the cut. When, however, the vertical cut is made by feeding the work to the tool by raising the table, the setting of the slide is of minor importance, inasmuch as the work is guided vertically by the ways on the column.

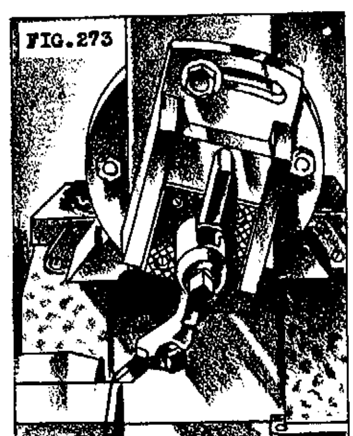


FIG.273

Either a straight or an offset tool holder (or a solid tool) can be used with equal facility for vertical cuts, provided that the tool bit used in each of these holders is ground accordingly and that the tool holder is held in position correctly in the tool post.

Best results are achieved when the cutting edge of the tool is set in an approximately horizontal plane. In order to obtain this condition when a straight tool holder is used, the cutting edge must be on the end of the tool bit and the tool holder must be set at a slight angle in the tool post so that it will clear the work when the tool is fed down (Fig. 274).

FIG.274

On the other hand, when an offset tool holder is used, the cutting edge must be on the side of the tool bit instead of on the end, if the cutting edge is to approach the work horizontally (Fig. 275).

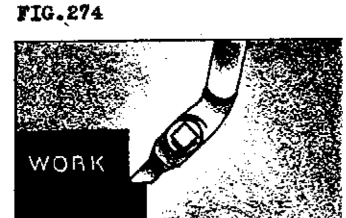
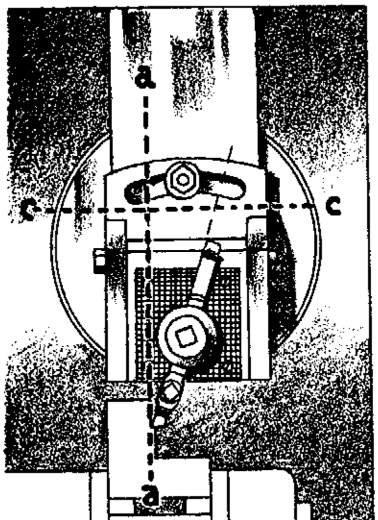
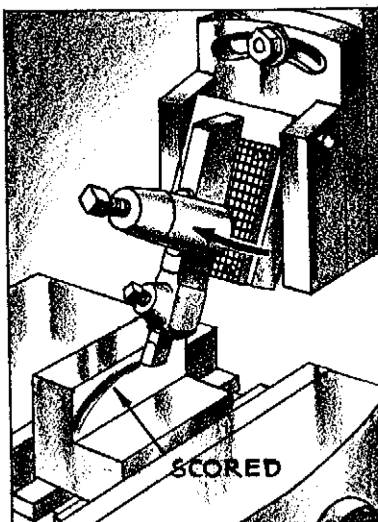


FIG.275



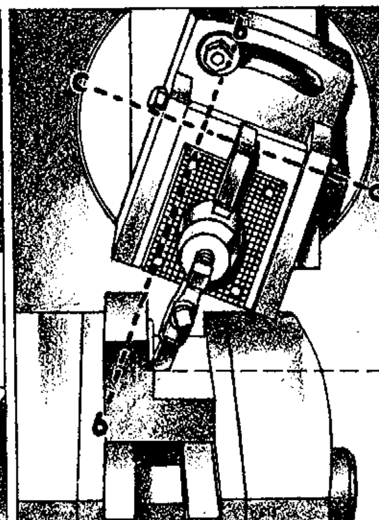
TOOL SWINGS UPWARD ON HINGE PIN IN A PLANE a-a WHEN CLAPPER BOX IS VERTICAL —

FIG.276



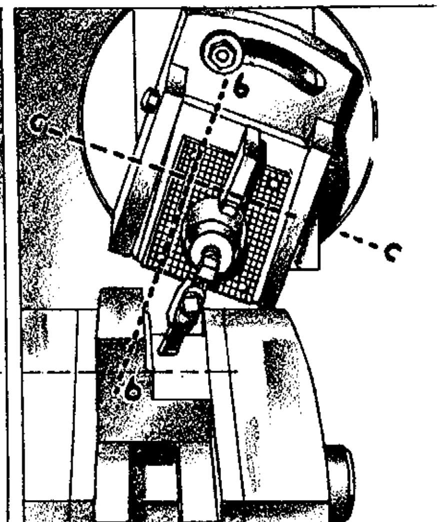
THIS FORCES TOOL TO RIDE UP ON VERTICAL SURFACE AND CAUSES SCORING —

FIG.277



TOOL SWINGS UPWARD ON HINGE PIN IN A PLANE b-b WHEN CLAPPER BOX IS SWIVELED TO RIGHT —

FIG.278



THIS CAUSES THE TOOL TO SWING AWAY FROM THE VERTICAL SURFACE DURING RETURN STROKE —

FIG.279

FUNCTIONING OF THE CLAPPER BOX

For all vertical and angular cuts, except slots and similar operations, the clapper box must be set at an angle from its vertical position, either to the right or to the left, depending upon the location of the shoulder or the end which is to be squared.

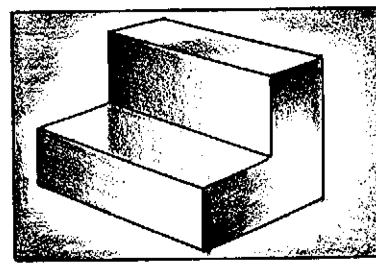
The adjustment is made to prevent the tool from dragging over the planed surface during the return stroke, at which time, as explained on page 16, the tool, together with the tool block, swings forward and lifts slightly on the hinge pin.

When the clapper box occupies a vertical position, as is usual when horizontal cuts are being taken, the tool point swings upward in a plane a—a (Fig. 276) during the return stroke of the ram, and, if the clapper box is not changed from this position for the vertical cut, the tool will drag over the finished surface, causing it to become scored (Fig. 277).

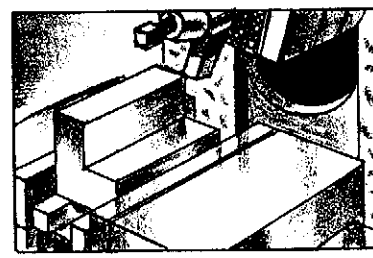
It is for the purpose of overcoming this objectionable condition of scoring that the clapper box is set in an angular position, for when the clapper box is in this position, the tool point swings in a plane b—b at right angles to the axis of the hinge pin c—c, on which the tool block swivels. Since the plane b—b is not parallel with the surface of the work, the tool point moves out from the finished surface (to the right) as soon as it swings upward and, as a result, does not score the planed surface. Obviously, the outward movement of the tool would be in the opposite direction if the clapper box were swiveled to the left (Figs. 278 and 279).

Correct location of the clapper box is assured if the upper end of the clapper box is moved in a direction away from the vertical or angular surface which is to be planed. In other words, the upper end of the clapper box must be swung to the right (Fig. 278) for squaring shoulders and ends on the right side and vice versa for vertical cuts on the opposite side. Moreover, the cutting tools must be ground accordingly for both roughing and finishing cuts.

COMBINED HORIZONTAL AND VERTICAL CUTS



A shoulder comprises a vertical surface which extends upward from a horizontal surface perpendicularly. Cuts in both a horizontal and a vertical direction are necessary, generally, to square a shoulder of any appreciable height, that is, for squaring a shoulder more than one-half inch high.

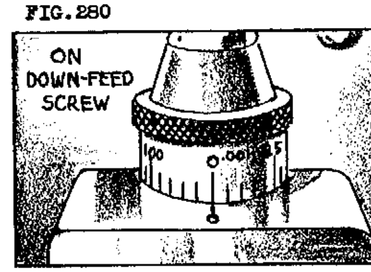


The only new element involved in machining a shoulder is that of forming the corner where the horizontal and the vertical surfaces meet. Aside from this, squaring a shoulder simply combines in one job, two operations which were described separately heretofore — horizontal and vertical shaping.

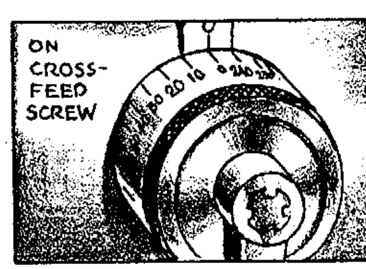
Work of this kind should be roughed out rather close to the layout lines, or close to the dimensions specified if a layout has not been made. The job should be placed in the machine to best advantage and a series of horizontal cuts should be made with a round-nosed tool having a small radius.

FIG. 280

Since the horizontal cuts do not run entirely across the work, but, instead, end somewhere on its surface to form a shoulder which becomes increasingly higher as each succeeding cut is made, the clapper box should be adjusted as for vertical cuts as explained in the preceding section.

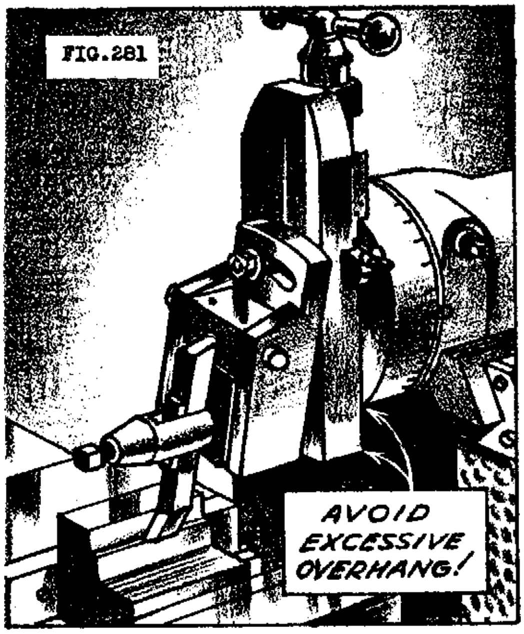


After the job has been roughed out, the horizontal surface should be finished to size first, and this should be followed by finishing the vertical surface with a suitable tool. (Refer to page 166.) When the vertical cut is being made, care must be exercised that the tool is not fed below the horizontal surface (Fig. 280).



If the corner is to be square, a tool shaped like the one in Fig. 316 should be used to remove the fillet left by the round-nosed tool. Micrometer control of the amount of metal removed is afforded in both directions — vertically by the micrometer

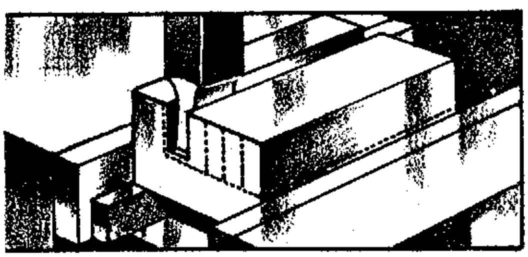
FIG. 281



collar on the down-feed screw; horizontally, by a similar collar on the cross-feed screw.

The length of the vertical cut which can be made on any shaper varies with the size of the machine. It is inadvisable, generally, to plan on using this entire distance for a vertical cut, for when the slide is fed down this distance, it will extend beyond the swivel block considerably. In its extended position, the slide is supported inadequately by the tool head, and, as a result, it is likely to break (Fig. 281).

It is good practice, therefore, when planning a vertical cut, to have the slide high enough at the start, and thus avoid this hazardous condition as far as possible. If for any reason the slide must be used in its extended position, the cuts must be light, and care must be used when feeding the tool, that it does not get caught in the metal.



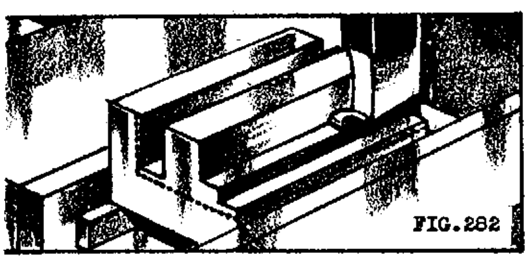


FIG. 282

For jobs on which the shoulder is not very high — not over one-half inch — a square-nosed tool such as has been shown on page 276, Fig. 457, can be used, not only for squaring the shoulder but also for planing the entire job. Its use saves changing tools, for this type of tool can be fed down to cut the shoulder and to remove most of the remaining metal. It can also be fed crosswise for taking a light cut to finish the horizontal surface (Fig. 282).

Moreover, whenever the height of the shoulder makes the use of a square-nosed tool practicable, the clapper box need not be swiveled, but instead it can remain in its usual position during both the vertical and the horizontal cuts.

S E L E C T E D   R E F E R E N C E S

Barritt, J. W. — Care and Operation of Machine Tools

Burghardt, Henry D. — Part II, Machine Tool Operation

Turner, William P. — Machine Tool Work