

HOW TO SHAPE HORIZONTALLY AND VERTICALLY

Unit 1-P53(A) Parts I, II, and III Pages 189 to 224

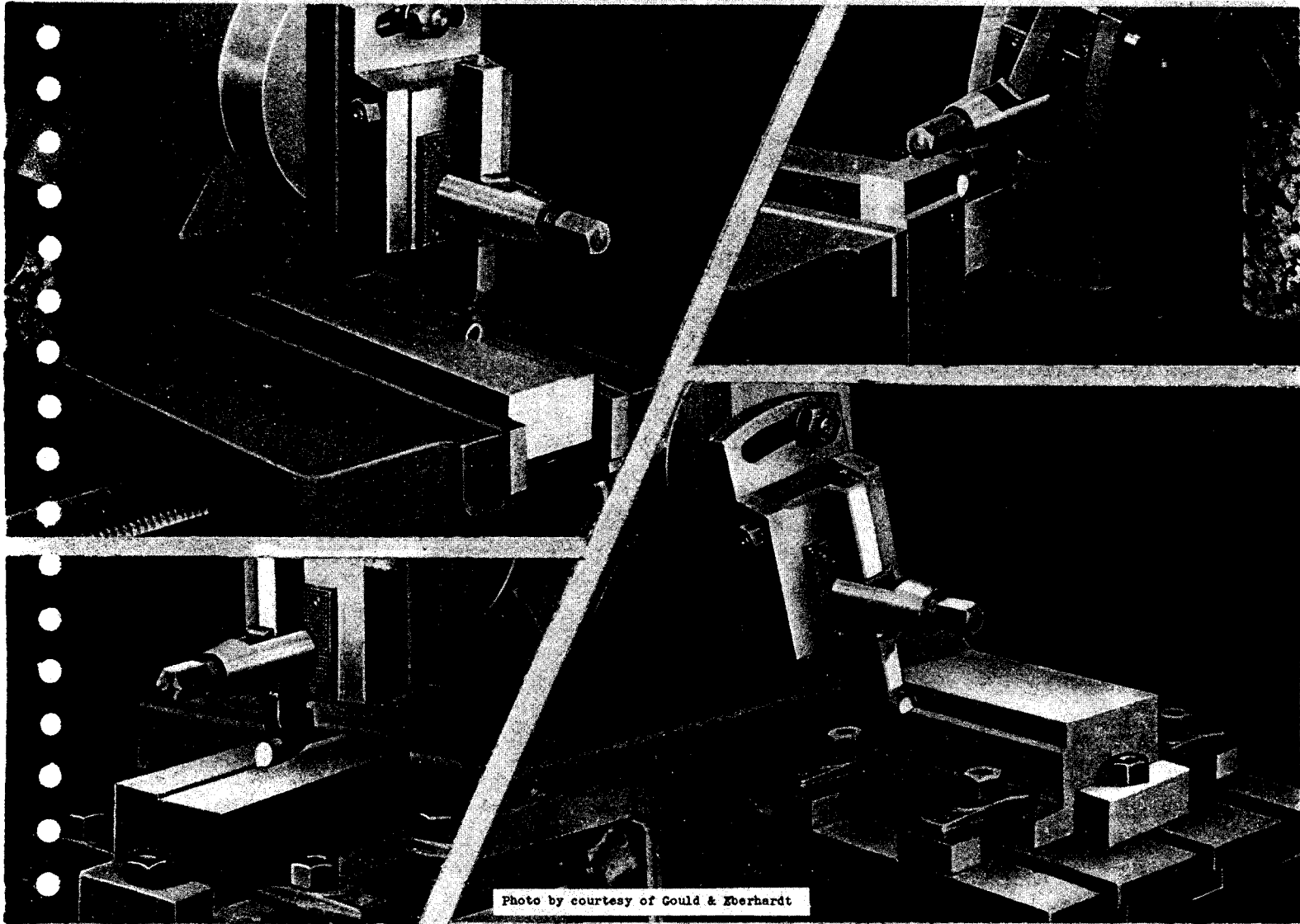


Photo by courtesy of Gould & Eberhardt

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

OBJECTIVES OF UNIT

1. To show how to set up the shaper and how to plane a horizontal surface on work held in the vise.
2. To explain the successive steps in planing the four sides of a square or rectangular piece.
3. To show how to set up the shaper for planing a vertical surface.
4. To show how to square a shoulder.

INTRODUCTORY INFORMATION

The shaper is intended primarily for planing flat surfaces on work usually held in the machine vise. Both horizontal and vertical cuts can be made with equal facility, since the shaper is constructed so that the work can be fed from side to side under the reciprocating tool to produce a horizontal surface, or so that the tool, instead, can be fed down on the work to produce a vertical surface.

Considerable work of a preparatory nature is required, however, before actual cutting is possible. This preliminary work consists of arranging the job, the machine, and the cutting tool, and is referred to as setting up the shaper.

More specifically, setting up includes proper placement of the work in the machine; it includes adjustment of the various parts of the machine, required to establish the proper relationship between the work and the tool, and it also includes other adjustments necessary for setting the length of stroke, the speed, and the feed to meet job specifications. Finally, it includes the selection and the subsequent placement in the machine of the cutting tool which best suits the type of cut to be made and the material in the job. The entire setup should be made with a view to having it as rigid as the construction of the shaper and the nature of the job make possible.

TOOLS AND EQUIPMENT

Crank or Hydraulic Shaper
Swivel Base Vise and Bolts
Lead Mallet
Micrometer
Outside Caliper
Tools and Holders

File
Brush
Chalk
Parallels
Cardboard
Oil Can

Tissue Paper
Wiping Cloth
Surface Gage
Steel Rod
Steel Rule
Try Square

• HOW TO SHAPE HORIZONTAL SURFACES

PROCEDURE

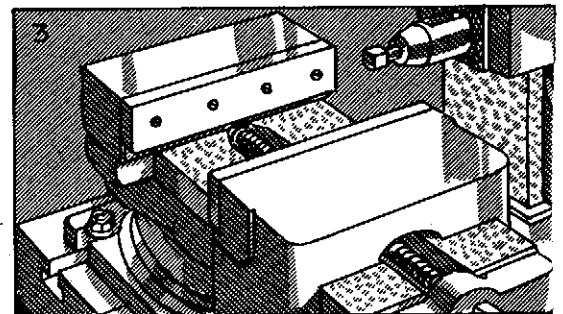
HOW TO MOUNT THE WORK IN THE SHAPER VISE

1. Mount the vise on the shaper, if it is not already in place, noting, first, the type of base on the vise, and then selecting from the several methods described on pages 119 to 121 the one which is appropriate for mounting a vise having this kind of base.

CAUTION

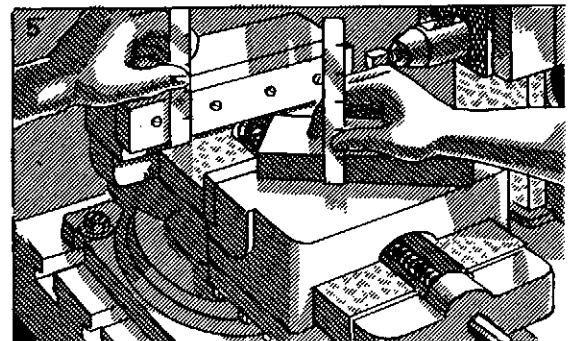
The weight of the vise makes it imperative that assistance be sought when placing it on the shaper.

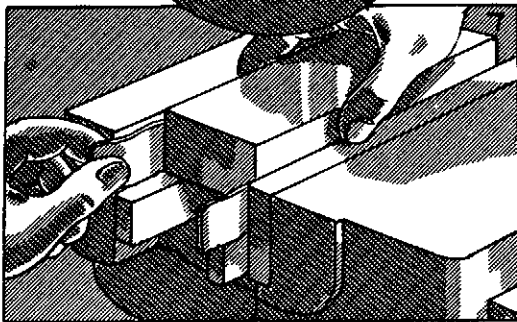
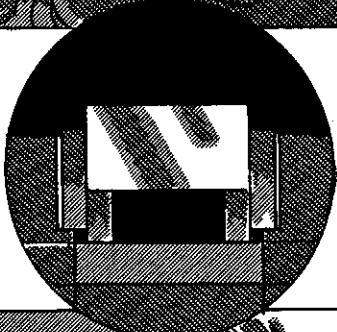
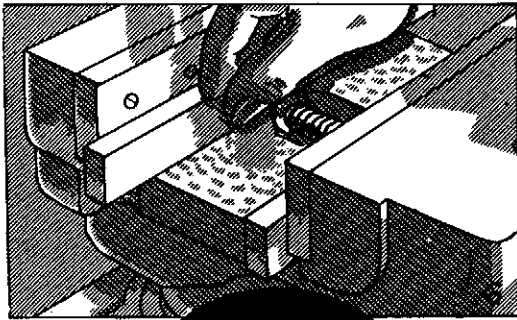
2. Swivel the vise on its base, if necessary, placing the index line on the vise above the 90° graduation on its base so as to set the jaws parallel with the stroke. For approximate settings, follow the directions in How to Set the Shaper Vise with the Aid of the Graduations on the Base on page 124; for accurate settings, follow the directions given in How to Set the Vise Parallel with the Direction of the Stroke with an Indicator on page 132.
3. Open the vise jaws to receive the work, preferably in a position with one of the larger surfaces up when the work is not square in shape.
4. Brush chips and other foreign material from the vise jaws and from the bottom of the vise opening; wipe these surfaces with a clean cloth; and, finally, remove any burrs which will interfere with the subsequent seating of the work.



NOTE: One of the important factors contributing to accurate machine work is cleanliness. To a machinist, cleanliness means not only freedom from chips and dirt, but freedom from burrs as well. Whenever a job is to be set in the machine, the work, the holding device, and the parallels too, if they are used, should be absolutely clean.

5. Measure the depth of the vise jaws and the thickness of the job to ascertain whether or not the layout line indicating the depth of cut will extend above the vise about 1/8" when the job rests on the bottom of the vise opening.
6. Place two identical parallels of correct height under the job, if the work





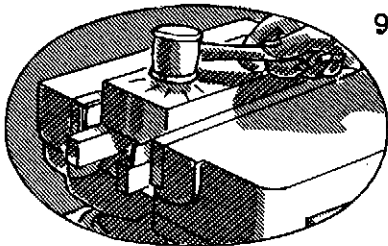
is too low in the vise, spacing the parallels as widely as possible. (Refer to page 104.)

NOTE: Two narrow parallels are usually preferred to a single one of greater width, especially for supporting castings. Inasmuch as a casting seldom has a straight surface, the use of narrow parallels makes it easier to determine whether or not the work has been properly seated, for the narrow parallels contact the work near its outer edges only and thus avoid contact with any high spots likely to be present in the center of the casting.

7. Place cardboard alongside the vise jaws if a casting is to be clamped. It will absorb irregularities on the surface of the casting, and, in doing so, will protect the faces of the jaws. At the same time the cardboard will tend to distribute the pressure of the jaws evenly over the work.

8. Place the work on the parallels, approximately in the center of the vise; then tighten the vise, exerting enough pressure on the vise crank to hold the work securely during the subsequent cuts.

NOTE: When the vise is tightened, the work lifts slightly and, consequently, does not rest on the parallels intended to support it during the cut. The lifting of the work occurs concurrently with that of the movable vise jaw, for when the vise is tightened, the jaw advances until it grips the work; then, as additional pressure is applied on the crank, the jaw, no longer able to advance in its original direction, lifts slightly and carries the work up with it. Lost play between the vise jaw and the body of the vise is responsible for this action. It cannot be eliminated entirely where parts must be free to move on one another.



9. Tap lightly on the work to seat it on the parallels, using a lead mallet or block for such materials as steel and cast iron, and a plastic or leather hammer for softer materials such as aluminum, so that their surfaces will not become dented.

NOTE: A light blow usually is sufficient to seat the work, for if too hard a blow is struck, the work tends to rebound from the parallels. The intensity of the blow required, however, can best be determined by slightly moving a parallel under the work while at the same time delivering

light blows with the mallet on the work. Then, if the parallels are still loose, the intensity of the blow can be increased to the point where the work will be forced down and the parallels can no longer be moved (Fig. 283).

10. Tug on the parallels to see whether or not they are tight under the job, if for any reason the vise requires additional tightening after the work once has been seated on the parallels. The work invariably lifts after each tightening of the vise and, therefore, requires repetition of the seating procedure to place it down on the parallels again.



Oil the shaper as directed in How to Oil the Shaper, beginning on page 47.

HOW TO ADJUST THE CUTTING TOOL AND THE TOOL HEAD

1. Read the description of the horizontal cut beginning on page 176.
2. Set the tool head at right angles to the machine table; that is, place opposite the index line on the ram whichever of the graduations on the swivel block, either zero or 90°, that will cause the head to be square with the table. Refer to How to Adjust the Tool Head on page 91.
3. Set the clapper box in a vertical position for light or medium cuts, but for heavy cuts swivel the upper end of the clapper box in a direction similar to that in which the work is to feed. Refer to the Position of the Clapper Box on page 179.
4. Run the tool slide up on the head so that it will not extend below the swivel block when the tool is set to the work later. (Refer to page 178.)
5. Measure the opening in the tool post so that either a forged tool or a tool holder of the correct size may be selected.
6. Select a straight left-cut forged tool suitably ground for taking a horizontal roughing cut on the kind of material in the job; or, if a straight tool holder is to be used instead, insert a tool bit ground to a similar

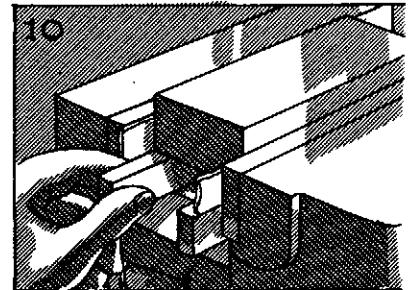
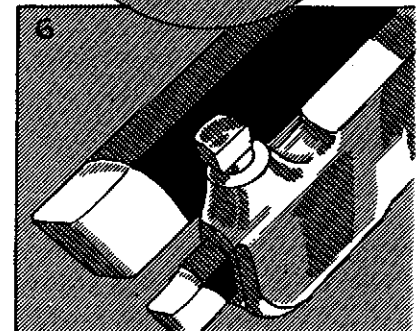
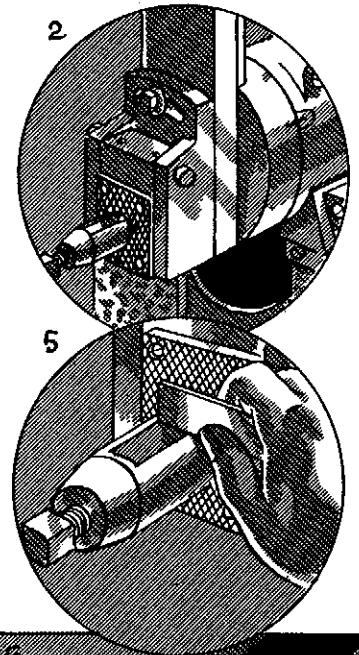


FIG. 283



shape. (Refer to pages 166 and 171.)

CAUTION

Grip the tool bit in the holder as short as practicable for the cut being made.

7. Securely clamp the tool or the tool holder, whichever has been selected, in the tool post in a vertical position, ordinarily allowing it to extend no more than 1-1/2 inches beyond the tool block; but, if the cut is to be heavy, clamp the tool in a position pointing slightly in a direction away from the work. (Refer to page 180, Fig. 261.)

HOW TO ADJUST THE SHAPER PRIOR TO TAKING THE CUT

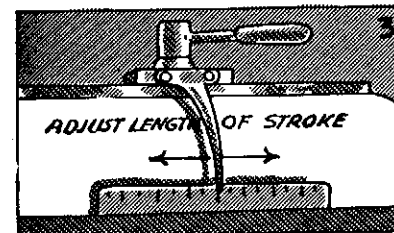
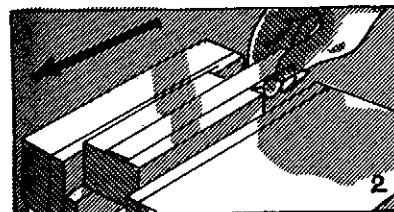
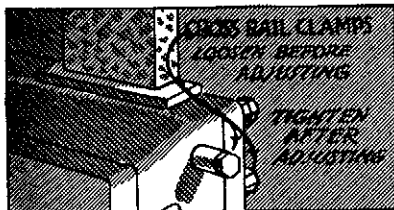
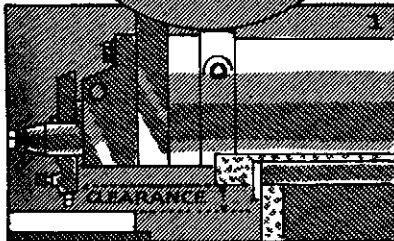
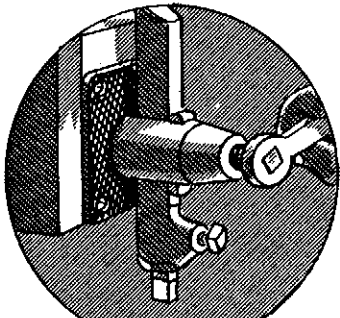
1. Adjust the cross rail on the column so that the surface to be planed is approximately two inches below the ram. Refer to How to Adjust the Cross Rail on page 77.

CAUTION

Make certain that the bolts which clamp the cross rail to the column, as well as those which clamp the table support, have been loosened before attempting to raise or lower the cross rail. It is equally important that these bolts be tightened again, and in the order given on page 77, after the rail has been relocated.

2. Measure the length of the surface which is to be planed; add approximately one inch to this dimension in order to provide for clearance of the work by the cutting tool at both ends of the stroke. (Refer to page 79.)
3. Adjust the ram stroke for a length equivalent to that derived in step No. 2. For adjusting the crank shaper, refer to How to Adjust the Stroke on pages 79 and 80; for the hydraulic shaper, refer to How to Adjust the Stroke and the Position of the Ram on page 92.

4. Adjust the position of the stroke so that the tool covers the entire surface which is to be planed. When using a crank shaper, refer to How to Adjust the Position of the Ram on page 81; when using a hydraulic shaper, use the reference given in step No. 3.



5. Consult the table, Allowable Cutting Speeds — Feet Per Minute on page 308. From this table, determine the cutting speed in feet per minute which is to be used. Base the decision on the kind of material to be planed, and on the type of cut, whether roughing or finishing, which is to be made with a High-Speed Steel cutting tool.

NOTE: Most cone-driven shapers are unprovided with charts such as appear on the direct-driven shapers. For this reason, step No. 5 may be omitted when a cone-driven shaper is used, inasmuch as the cutting speed in feet per minute cannot be determined when the number of ram strokes per minute is unknown. (Refer instead to pages 83 and 84.)

6. Determine the number of strokes per minute which will result in a cutting speed in feet per minute approximately the same as that decided upon in step No. 5.
7. Read page 82; then select from the procedures given for setting the speed on various types of shapers, the one which is appropriate for the shaper being used, and adjust the shaper for the number of strokes per minute decided upon in step No. 6. For setting the speed on a crank shaper, refer to How to Adjust the Speed of the Ram on page 82; for setting the speed on a hydraulic shaper, refer to How to Adjust the Speed of the Ram on a Hydraulic Shaper on page 94.

CAUTION

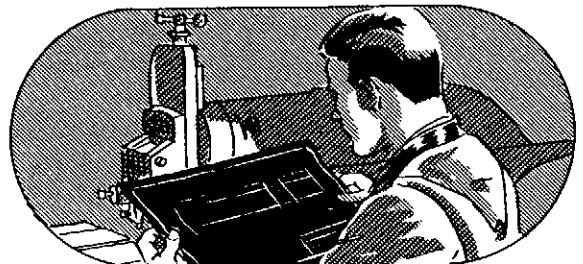
Do not attempt to shift gears while the shaper is in operation.

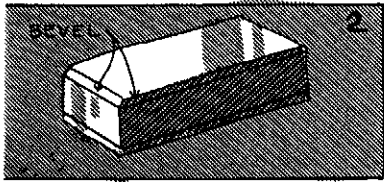
8. Adjust a rate of feed commensurate with the depth of cut to be made and the surface finish desired. For the crank shaper, refer to How to Adjust the Automatic Feed on pages 90 and 91; for the hydraulic shaper, refer to How to Adjust the Cross Feed on a Hydraulic Shaper on page 95.

NOTE: The depth of the cut and the resistance of the material being cut vary to such an extent in different jobs that it is impossible to recommend a rate of feed which will function equally well under all conditions. It is best, therefore, to begin the cut with a light feed, for example, .010" per stroke, and increase the rate when it becomes apparent this can be done to advantage. (Refer to page 304.)

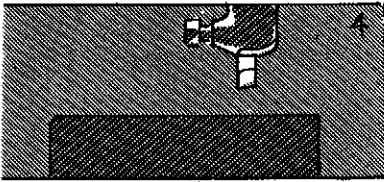
HOW TO TAKE THE ROUGHING CUT

1. Consult the blueprint or the job layout and ascertain therefrom the finished size of the job in order to determine how much material is to be removed in the shaper.

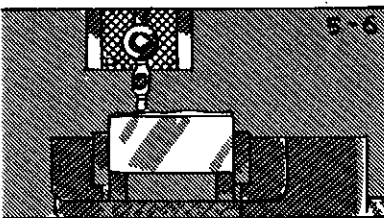




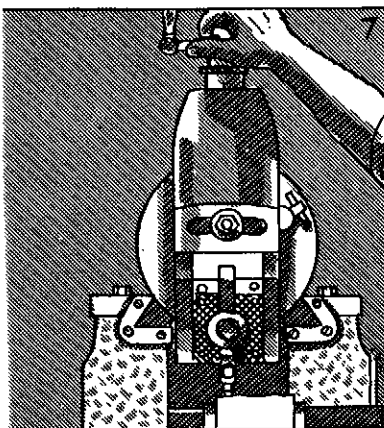
- Plan to remove approximately half the excess material from the top surface and the other half from the opposite side when both these surfaces are to be planed. Refer to The Roughing Cut on page 181.



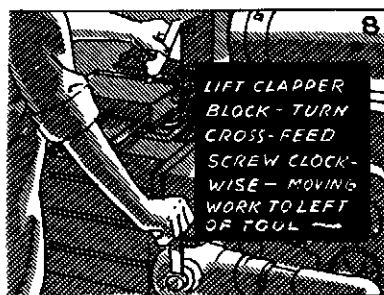
- Bevel the edges of the casting at the ends of the cut to prevent breakage of the corner below the finished surface. (Refer to page 182.)



- Make certain that the tool is higher than the surface of the work and that the ram too will clear any projections which may extend from irregularly shaped work. (Refer to page 178.)



- By means of the cross-feed screw, move the work together with the table, bringing it in line with the cutting tool.



- Place the ram so that the tool comes to some point over the surface to be planed, preferably over the low point on the surface. (Refer to page 206.)
- Move the tool down (with the ram stationary) by turning the down-feed screw in a clockwise direction until the tool just barely touches the work; then adjust the micrometer collar, placing the zero opposite the index mark. (Refer to page 91.)

- To prevent interference with the work, lift the tool together with the tool block on the hinge pin; then move the work to the left of the tool, inasmuch as a left-cut tool has already been placed in the tool post.

- With the aid of the graduations on the micrometer dial, set the tool to the desired depth for the first roughing cut; then lock the tool slide in place. Remove at least 1/16" of metal in order to get under the scale on the casting, provided this amount of metal can be removed without cutting the work undersize.

✓ HAVE ENTIRE SET-UP CHECKED BY YOUR INSTRUCTOR ✓

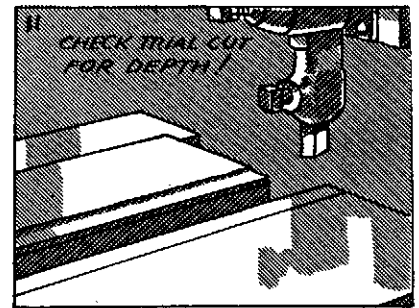
- Start the shaper (Refer to pages 57 and 58.); then feed the work to the tool by hand until the cut is just started and its depth is apparent.

CAUTION Keep the face and the eyes a safe distance from the work, or better still, wear goggles as a protection from flying chips.

11. Stop the shaper and check the correctness of the tool setting. If further adjustment in the depth of the cut is necessary, make it only after the work has been moved from under the tool.
12. Start the shaper again; then engage the automatic feed and complete the cut.
13. Disengage the feed. Bring the table back to the position for starting the cut — with the work to the left of the tool — and take additional roughing cuts if needed, allowing between .010" and .015" for the finishing cut.

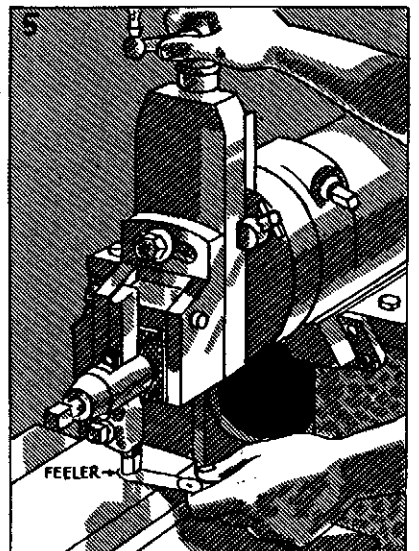
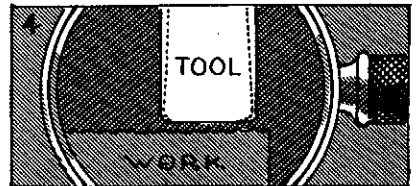
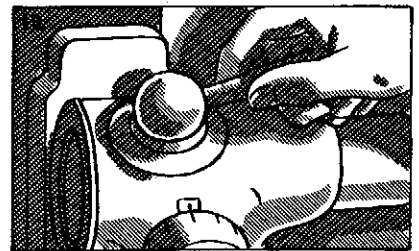
HOW TO TAKE THE FINISHING CUT

1. Stop the shaper and replace the roughing tool with a finishing tool suitably ground for cutting the kind of material in the job. Refer to page 166 for the selection of the tool and to page 182 for a description of the finishing cut.
2. Bevel the edges of castings with a file to prevent the keen cutting edge of the finishing tool from coming in contact with sand and scale.
3. Place the work and the ram so that the tool is again over the machined surface in order that the cutting edge of the finishing tool may be set parallel with the surface of the work.
4. With the tool clamped lightly in the tool post and its lower end close to the work, tap the tool until the cutting edge is exactly parallel with the surface to be finished; then tighten the tool-post screw securely.
5. As an aid in setting the finishing tool to the work preparatory to adjusting it for a cut of the desired thickness, place a piece of paper or the blade of a thickness gage on the work and carefully lower the tool until it barely touches the feeler.
6. Set the graduated collar on the down-feed screw at zero; move the work to the left of the tool,



CAUTION

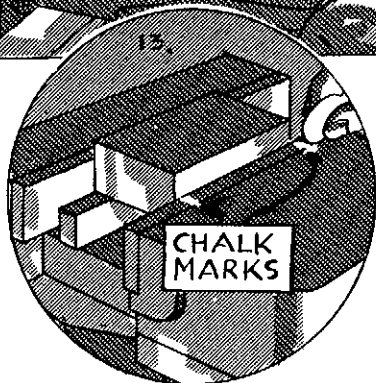
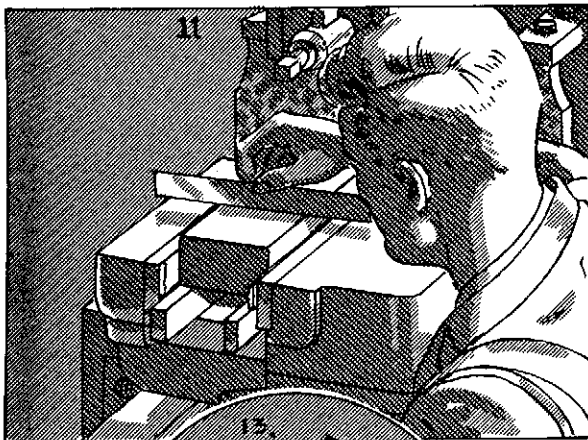
KEEP FINGERS AWAY FROM CUTTING TOOL, WORK AND VISE WHEN SHAPER IS IN OPERATION



and then lower the tool the number of thousandths necessary to take a cut of the desired thickness, taking into consideration also the thickness of the feeler used for setting the tool to the work.

CAUTION When extreme accuracy and a good finish are required, plan to remove the metal allowed for finishing in two cuts or more instead of one, the first cut serving as a trial cut only.

7. Reduce the speed somewhat whenever a finishing tool having a wide cutting edge is used. For round-nosed tools, however, use the speeds recommended in the table — Allowable Cutting Speeds — Feet Per Minute on page 308.
8. Start the shaper and note whether or not the stroke still covers the entire length of the work. Repeat step No. 4 on page 194 if the position of the stroke is incorrect. A change in position is quite likely to occur when the roughing tool has been replaced with a spring-type finishing tool (Fig. 269).
9. Increase the rate of feed so that the tool will move over approximately one-half the width of the flat cutting edge for cast iron; but for steel, use a fairly fine feed per stroke.
10. Engage the automatic feed and take the finishing cut with the tool slide locked in place. (Refer to page 15.)

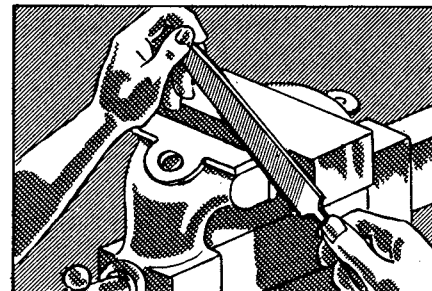


11. Stop the shaper with the ram in its rear position, brush the chips from the work, test the planed surface with a straight edge, and, finally, take measurements to ascertain whether or not the work has been accurately machined.
12. Bring the table back to the position for starting the cut and make further adjustments of the tool with the aid of the micrometer dial, if the work is still oversize.
13. When planing short work, place a chalk mark on the vise at each end of the work to assure its being placed in the vise in the same position for subsequent cuts and thus avoid changing the position of the ram stroke each time the job is removed from the vise.
14. Remove the job from the vise, and file from its edges the burrs produced by the tool,

being careful not to mar the finished surface.

15. Brush all chips from the machine when the job is finished, and return the parallels and other accessories to their proper places in a clean condition.

NOTE: If other surfaces are to be machined, defer step No. 15 until all work has been completed.



HOW TO PLANE THE REMAINING SIDES OF A SQUARE OR RECTANGULAR JOB

NOTE: When several surfaces on a job are to be planed, instead of only one, it is considered good practice to rough out all these surfaces before finishing any one of them, in order to relieve internal strains which are likely to be present, especially in castings. For this job, however, the finishing cut will be made immediately after the roughing cut on each side has been completed.

HOW TO CLAMP THE WORK AND TAKE THE CUT ON THE SECOND SIDE

1. Clean out the vise and make certain that the finished surface on the work is absolutely clean also.
2. Set the work in the vise with the side just finished against the fixed jaw, and on parallels, if they are needed, so that the surface to be planed will be slightly above the vise jaws. Refer to step No. 5 on page 191.
3. Place a round piece of steel horizontally between the movable vise jaw and the work as shown in Fig. 284; then draw the vise up tightly.

NOTE: This steel rod, which should be placed about halfway up on the vise jaw, makes only a line contact with the work and the vise and thus causes the finished surface of the work to be brought squarely against the fixed jaw of the vise, which is assumed to be square with the table.

When the rod is not used and the vise is tightened on the unmachined surface of the work instead (Fig. 285), the finished side of the work is quite likely to

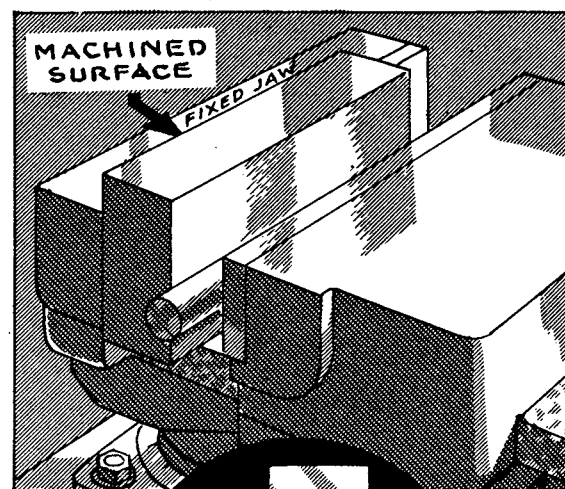


FIG. 284

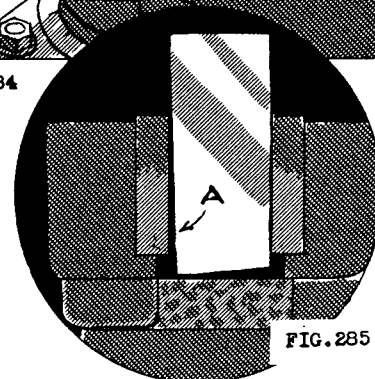
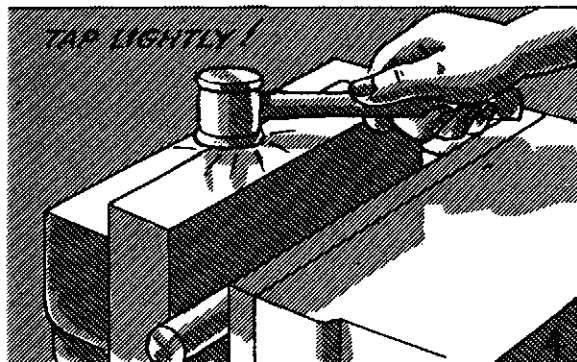
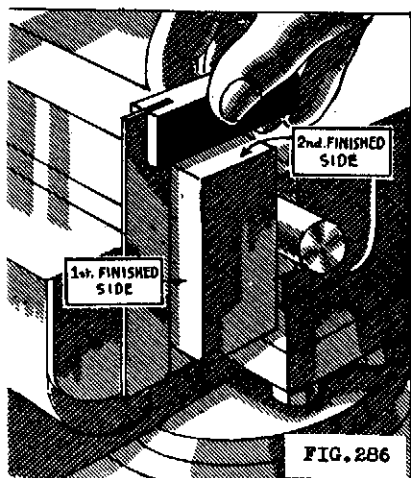


FIG. 285



change its relationship with the fixed jaw as shown at A. As a result of this condition, the side and the top surfaces will not be cut square with each other.

4. Tap the work lightly with a lead mallet to seat it on the bottom of the vise opening or on the parallels, whichever means is used for supporting the work. Refer to the note following step No. 8 on page 192.
5. Remove the finishing tool and replace it with the roughing tool used for shaping the first surface. Refer to steps Nos. 6 and 7 on pages 193 and 194.
6. Make certain that the position of the ram stroke is such that the tool will cover the entire surface of the work, for unless the work has been placed in the vise in the same lengthwise position as before, an adjustment will be necessary. Refer to step No. 13 on page 198.
7. Reduce the rate of feed to that used for the first roughing cut. Refer to step No. 8 on page 195.
8. Proceed to take the roughing cut as directed in How to Take the Roughing Cut beginning on page 195.
9. Take the finishing cut as directed in How to Take the Finishing Cut beginning on page 197.
10. Use a fine file to remove from the corners of the work the burrs produced by the cutting tool; then wipe the two machined surfaces clean.



11. Determine whether or not the finished surfaces are at right angles to each other by placing the beam of a try square against the surface just finished and the blade of the square across the other finished surface (Fig. 286).

NOTE: If all light is excluded from under the square when its beam is held firmly against the surface just finished and its blade has been brought carefully to the other finished surface, then these two sides of the work are at right angles to each other. The remaining sides of the work can then be machined also with the assurance that they too will be square with each other, provided the necessary precautions are observed when the work is clamped in the vise.

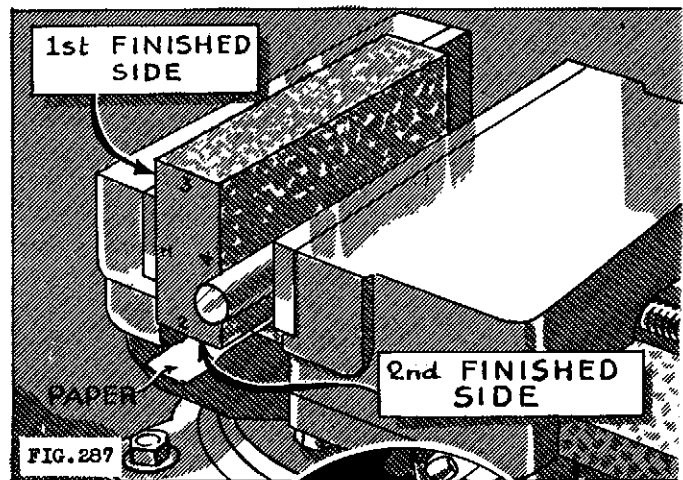
However, if light is visible under the blade, the work is not square, and this condition should be corrected at this time by using one of the methods suggested on page 203.

12. Remove the work from the vise and prepare to plane the third side of the work.

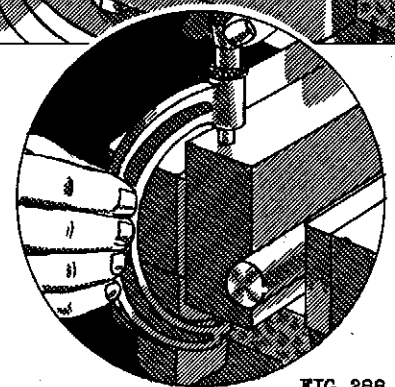
HOW TO CLAMP THE WORK AND TAKE A CUT ON THE THIRD SIDE

1. Make certain that the vise opening and both finished surfaces on the work are absolutely clean and free from burrs.
2. Place the work in the vise with the surface that has just been finished resting on the bottom of the vise opening — or on parallels if needed — and the first side planed resting against the fixed jaw as before (Fig. 287).
3. Place the rod between the movable jaw and the work as for the previous cut; tighten the vise, and, finally, seat the work in the manner used heretofore.

NOTE: In order that it may be known with a certainty that work which does not require the use of parallels has been properly seated in the vise, a piece of tissue paper should be placed under each end of the work and allowed to extend so that it can be grasped with the fingers. Obviously, the work has been properly seated when the paper is tight and cannot be withdrawn from under the work.

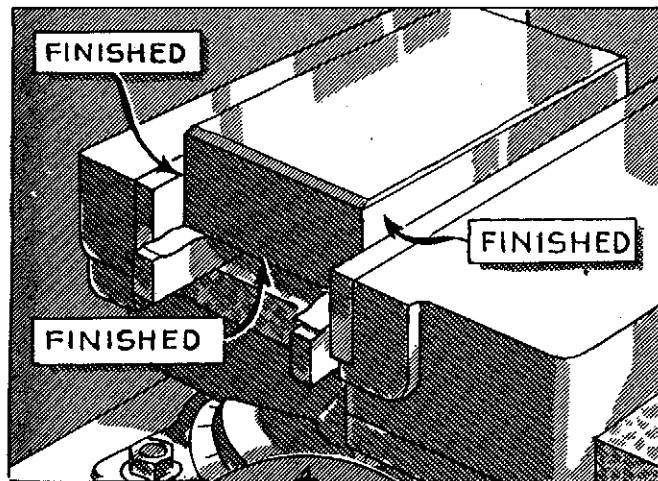


4. Take the roughing cut as directed in steps Nos. 3 to 12 on pages 196 and 197.
5. Remove the burrs from the corners of the work, clean the machined surface, and then check the work with a square (Fig. 286).
6. Take a measurement with a micrometer at both ends of the work to determine whether or not the side just finished is parallel with the side opposite (the underside) and to see also how many thousandths must be removed to cut the work to size with the finishing tool (Fig. 288).
7. Take the finishing cut as directed in How to Take the Finishing Cut on page 197.



HOW TO CLAMP THE WORK AND TAKE THE CUT ON THE FOURTH SIDE

1. Make certain that the vise opening is absolutely clean and that the three sides of the work which already have been machined are clean also, and without burrs.



2. Place the work in the vise with the first side machined down on strips of tissue paper placed in the vise under both ends of the work, or, if the work is supported on parallels, place a strip of tissue paper under each corner of the work (Fig. 289).
3. Tighten the vise, leaving out the rod which was used before; then tap the work with a lead mallet according to instructions given previously.
4. Pull lightly on the paper strips to ascertain whether or not the work has been seated properly.

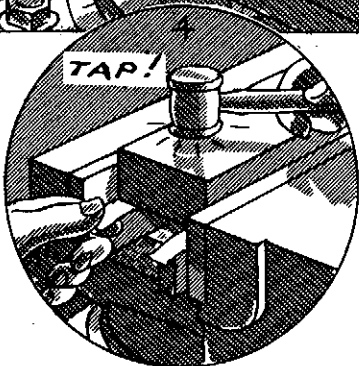


FIG. 289

5. Take the roughing cut as directed in steps Nos. 3 to 12 on pages 196 and 197.
6. Take the finishing cut as directed in How to Take the Finishing Cut on page 197.
7. Give the machine a thorough cleaning, and return all parallels and other accessories to their proper places in a clean condition.

HOW TO SQUARE THE ENDS

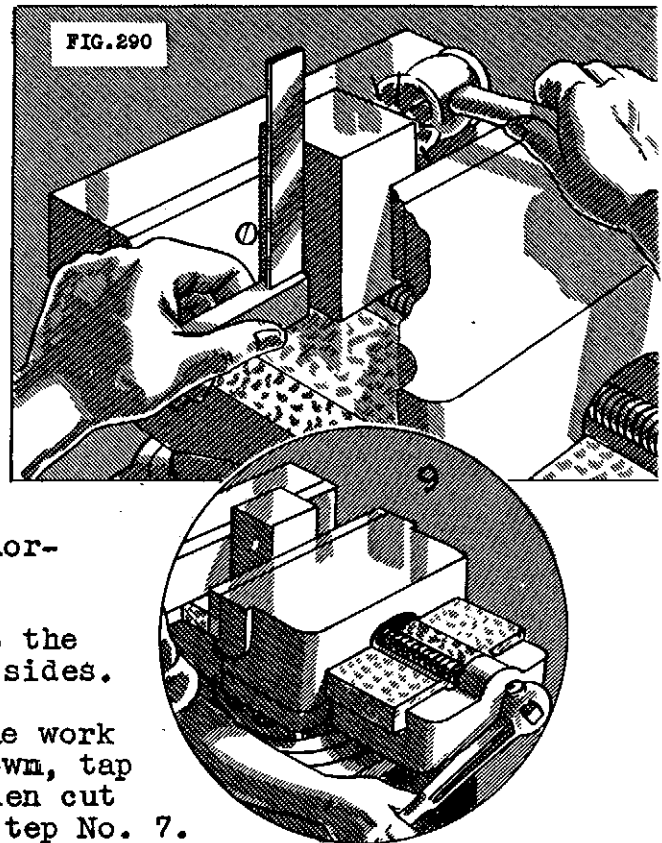
The ends of short pieces may be planed square with their sides by following the directions below for clamping the work and then taking a horizontal cut.

The ends of longer pieces are planed to best advantage, however, by means of a vertical cut. The procedure for this kind of cut has been explained in How to Plane Vertically, beginning on page 210.

1. Swivel the vise on its base so that the jaws are at right angles to the stroke. Refer to pages 124 and 133 respectively for the approximate and the accurate methods of setting the vise.
2. Make sure that the work and the vise are clean and free from burrs.
3. Place the work in the approximate center of the vise with one

end on the bottom or on parallels (Fig. 290).

4. Hold a try square down firmly against the bottom of the vise; then set the side of the work parallel with the blade of the square and tighten the vise lightly.
5. Check the setting of the work with the square, tapping the work on one side or the other, if necessary, to make further adjustments.
6. Tighten the work securely in the vise when it is square.
7. Follow the directions for taking a horizontal cut, beginning on page 193.
8. Use a square to check whether or not the end has been planed square with the sides.
9. To square the opposite end, place the work in the vise with the finished end down, tap the work to seat it properly, and then cut the piece to length as directed in step No. 7.

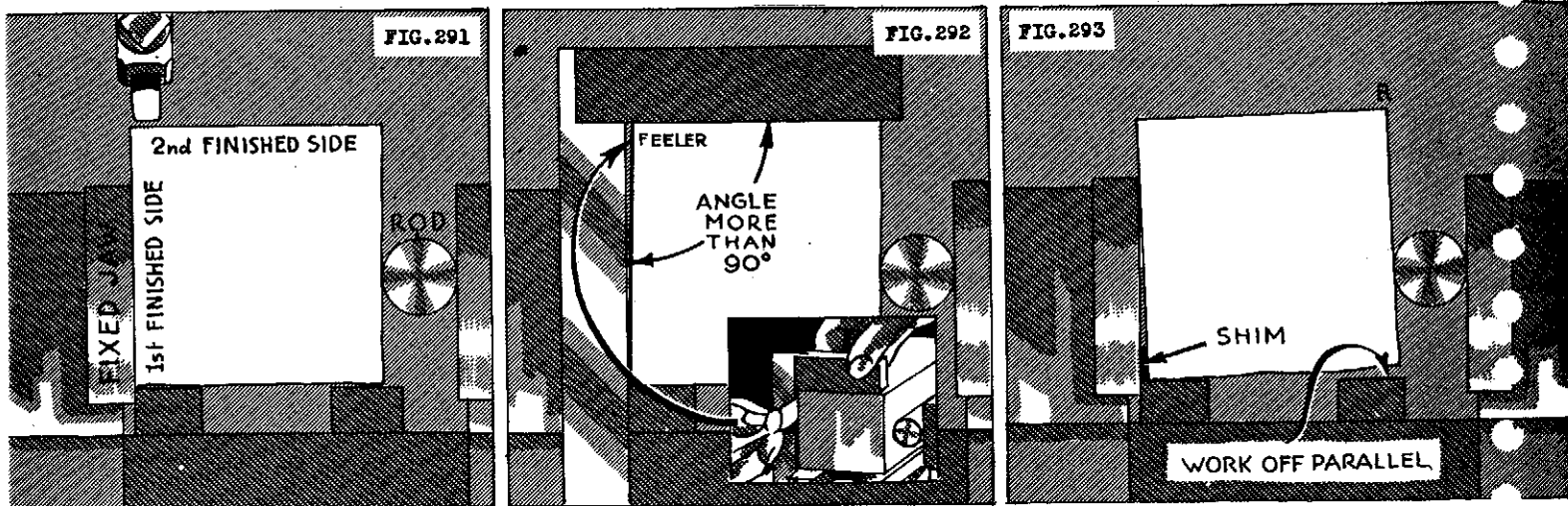


HOW TO CORRECT INACCURACIES BETWEEN ADJACENT SURFACES INTENDED TO BE AT RIGHT ANGLES

Even though the foregoing directions for clamping the work and planing its sides have been followed conscientiously, subsequent testing with a try square may reveal that these sides do not form perfect right angles.

This inaccuracy, evident by light visible under the blade of the square, may be the result of carelessness at the time the work was placed in the vise. On the other hand, it may reflect inaccuracies caused by wear on the vise jaw or wear in the machine. But, regardless of the cause of the inaccuracy, steps a, b, and c, which follow, should be taken first when attempting to correct this undesirable condition so as to eliminate errors resulting from carelessness before attempting to eliminate errors resulting from one of the other causes.

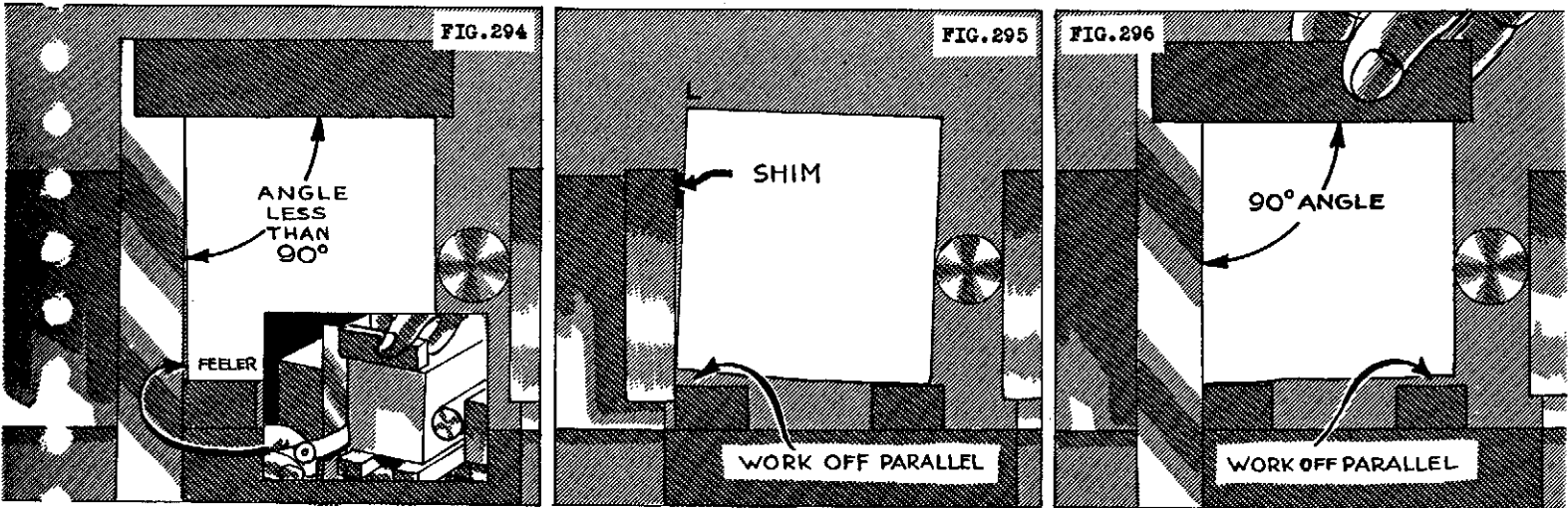
The logical time to make this correction is immediately after a true cut has been taken from the second side of the work and a test with a try square makes it obvious that the surface just planed is not square with the first surface which now rests against the fixed jaw of the vise (Fig. 292).



- a. Thoroughly inspect the work, the vise, and the parallels too, if they are used, and remove foreign material and burrs which may have been overlooked before and may have prevented the proper seating of the work in the vise.
- b. Place the work in the vise again, observing carefully all the precautions regarding cleanliness and proper clamping and seating. Then take a light cut.
- c. Remove the burrs produced by the tool, clean the surfaces of the work, and, finally, check their squareness with a try square, placing its beam on the surface just finished and the blade across the adjacent side (Fig. 292).

NOTE: If the adjacent side is still not square with the upper surface, proceed to correct this condition in the manner explained in How to Test the Fixed Jaw for Squareness with the Aid of an Indicator on page 129, or correct it by using paper shims between the work and the vise jaw instead, as directed below.

1. After the work has been placed in the vise as directed in steps Nos. 2 to 4, page 199, following the planing of the first side, and a true cut has been taken from the second side (Fig. 291), test the work with a try square (Fig. 292).
2. Measure the opening between the blade of the square and the side of the work with a paper feeler or with the blade of a thickness gage in order to determine the approximate thickness of the shim required to correct the inaccurate condition in the work.
3. If the angle formed by the two sides is greater than 90° and the opening occurs at the top as in Fig. 292, place along the bottom of the work a paper shim similar in thickness to



that of the feeler used for measuring the opening between the square and the work. The shim will cause the work to tilt slightly in the vise, raising its right-hand edge, and, as a result, the subsequent cut will remove slightly more material at R (Fig. 293) than at the other side of this surface.

4. On the other hand, if the angle formed is less than 90° and the opening between the square and the work occurs at the bottom (Fig. 294), place the paper shim along the top (Fig. 295). Placing the shim in this place will also tilt the work slightly, but in a direction opposite to that in Fig. 293, with the result that the tool will now remove slightly more material at L (Fig. 295) than at the other end of this surface.
5. If the adjacent sides are not at right angles after inserting the shim and removing a trial cut, replace the shim with one which is proportionately thicker, providing the opening still occurs in the same place as before taking the trial cut, for this indicates that the work has not been tilted sufficiently. A thinner shim, of course, should be used when the opening along the square occurs at the end opposite that at which it occurred before the shim was inserted and a trial cut taken.

NOTE: When a shim has been placed alongside the work in the vise, it will be impossible to seat the work so that both parallels are tight under the job, for with the insertion of the shim, even though it is very thin, the work becomes tilted somewhat, with the result that the bottom of the work is now no longer parallel with the bottom of the vise opening (Fig. 295). Work on which the bottom side is not at right angles with the side placed against the fixed jaw of the vise (Fig. 296) also is incapable of being seated on both parallels. In this instance, however, it is the condition of the work, and not a condition created by the insertion of a shim, which causes one edge of the bottom surface to be higher than the other edge.

HOW TO USE THE SURFACE GAGE ON SHAPER WORK

Even a flat casting is seldom of uniform thickness from end to end or from corner to corner, and, besides, it is frequently warped out of shape. Therefore, when a casting has been placed on parallels or on the bottom of the vise, its underside may be approximately level, but some point on its upper surface may be lower than others.

One use for the surface gage is to find this low point on the casting so that the cut may be set from this point. The assumption is that if the cut is deep enough to remove the scale from this place, the rest of the surface also will be "cleaned up."

Another setup for which the surface gage is frequently used on the shaper is one that requires the upper surface on a casting, instead of the lower one, to be level so that this surface can be planed by taking the smallest cut possible.

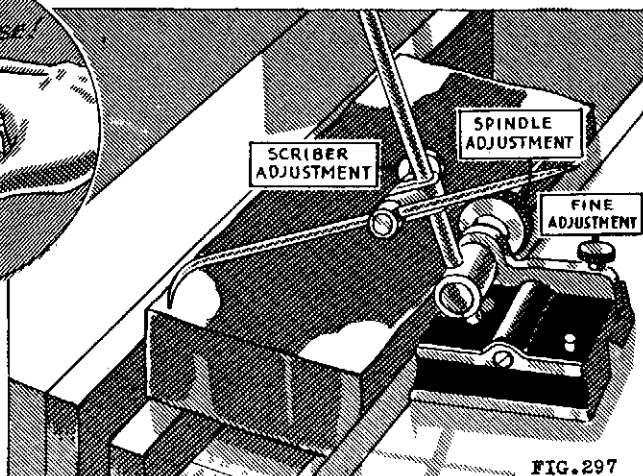
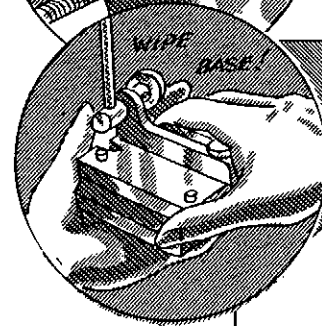
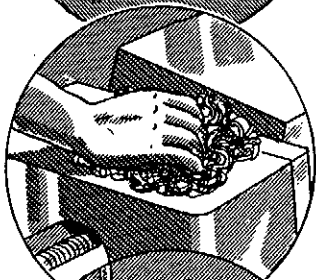
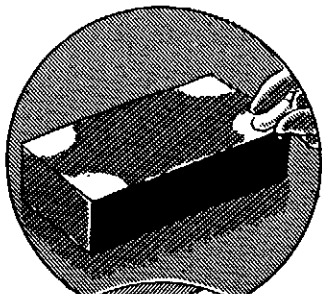
In addition, the surface gage is used for scribing lines parallel with the machine table to show the location of finished surfaces, and for setting up work according to a layout on the job.

HOW TO FIND THE LOW CORNER ON A CASTING HELD IN THE MACHINE VISE

1. Wipe the upper surface of the movable jaw, or the top of the table, whichever is to be used, with a clean cloth; then rub the palm of the hand over that portion of the surface on which the surface gage is to be used.
2. Rub chalk on the corners of the work so that the slightest touch of the scriber will become apparent immediately.
3. Wipe the base of the surface gage clean, then draw it across the palm of the hand to remove any small particles of dirt which may not have been removed with the cloth.

4.

Place the gage on the surface which has been prepared; then adjust the spindle and the scriber (Fig. 297) so that the four corners of the work can be reached with the bent end of the scriber.



5. Move the gage so that the scriber passes over one corner of the work, and, at the same time, turn the adjusting screw (Fig. 298), thereby bringing the scriber to the work gradually. Obviously, the scriber touches the work when it leaves a light line on the chalked corner, but it is also possible to "feel" when the scriber touches.

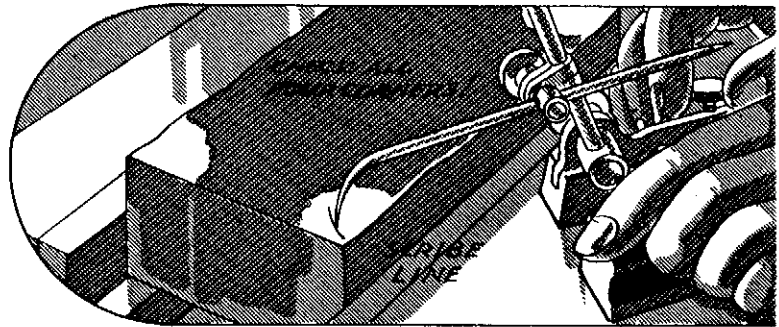
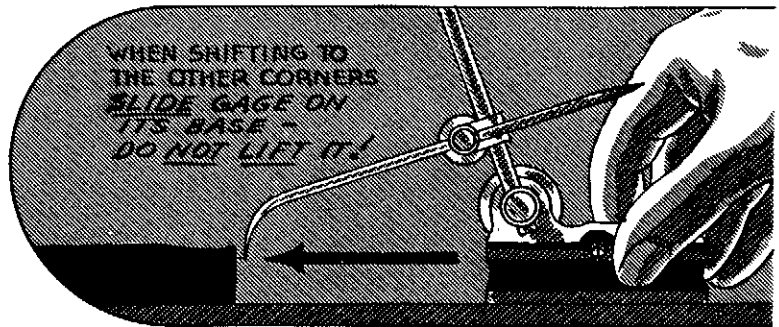


FIG. 298

6. In order to compare the height of the other corners with the one to which the scriber has been adjusted, do not lift the surface gage, but slide it on its base instead. In this way the scriber is brought to the work from the side, and its setting will not be changed if a higher corner is encountered, as might be the case when the surface gage is lifted and the scriber is brought to a higher corner from above.



WHEN SHIFTING TO
THE OTHER CORNERS
SLIDE GAGE ON
ITS BASE -
DO NOT LIFT IT!

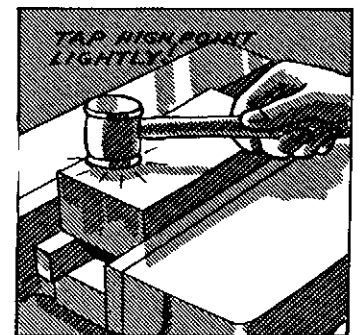
7. Observe which of the corners is the lowest so that the tool may be adjusted to this place for taking the cut.



SET TOOL FOR THE
LOWEST CORNER!

HOW TO LEVEL THE SURFACE ON A CASTING HELD IN THE VISE

1. Place the work in the vise with its upper surface as nearly level as possible; then tighten the vise temporarily, applying only enough pressure on the work to hold it in place while its surface is being leveled more accurately.
2. Repeat steps Nos. 1 through 5 above.
3. Bring the scriber to each corner of the work successively and note which one is the highest.
4. Tap the high corner down to the approximate



TAP HIGH POINT
LIGHTLY!

level of the others with a lead mallet; then check all the corners again.

5. Continue to tap the high corner down after each checking made with the gage until the four corners are as nearly the same height as the condition of the casting will permit.
6. When all four corners of the casting cannot be set level because of its warped condition, set those level which are diagonally opposite each other. In this way a balance will be attained between the high and the low corners, and the casting can then be machined to best advantage.
7. Tighten the vise sufficiently to hold the work during the cut. Recheck the work, however, after tightening it to make certain that its position in the vise has not changed.
8. If the work is likely to move down in the vise as a result of the cutting pressure, place shims under the parts of the job that do not rest on parallels or on the vise. (Refer to page 114 and Fig. 299.)

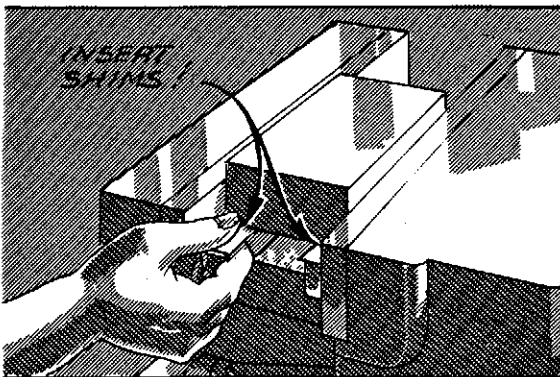


FIG. 299

NOTE: When it is necessary to level a finished surface accurately, instead of leveling a rough surface approximately, a dial indicator can be used on the surface gage in place of a scriber. (Refer to Fig. 300.)

HOW TO SCRIBE LAYOUT LINES ON WORK HELD IN THE VISE

1. Rub chalk on the ends and on the sides of the work.
2. Repeat steps Nos. 1 and 3 on page 206.
3. Hold a scale in a vertical position with one end on a parallel which supports the work, or on the bottom of the vise if the work has been set thereon (Fig. 301).
4. Set the point of the scriber to the dimension on the scale which coincides with the thickness of the finished work.
5. Scribe a line on the side of the cast-

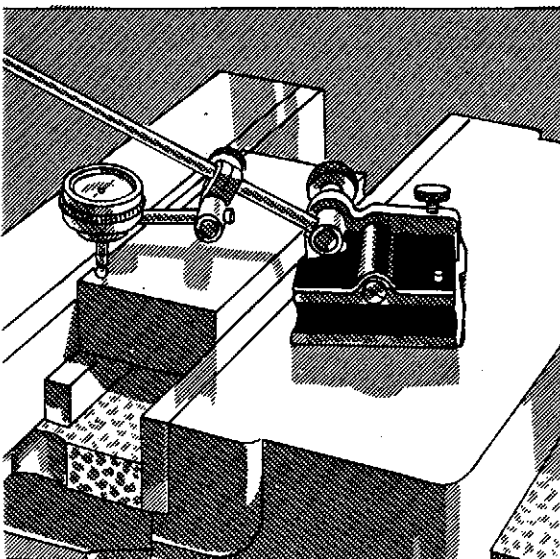


FIG. 300

ing from which the cut is to be started, drawing the base of the surface gage over the top of the vise jaw, and, at the same time, keeping the scriber in contact with the side of the work (Fig. 302).

6. If a line must be scribed on another face of the work which is inaccessible to the surface gage in its present adjustment and location, transfer the gage to another true surface and readjust the scriber point to the first line scribed.

HOW TO SET UP WORK ACCORDING TO A LAYOUT

1. Clamp the work in the vise temporarily with the layout line which indicates the finished surface as nearly level as it is possible to set it by eye (Fig. 303).
2. Follow the instructions given in steps Nos. 1 and 3 on page 206.
3. Place the surface gage on the surface which has been prepared for its use; then adjust the point of the scriber to one end of the layout line (Fig. 304).
4. Slide the surface gage to the opposite end of the layout line and note any variation between the height of the line and the scriber.
5. Tap this end of the work up or down, as required, to bring the layout line level with the scriber point.
6. Continue to check and adjust the work in the same way until there is no apparent deviation in the height of the line from end to end.
7. Tighten the work securely in the vise, and, as a precaution, check it again after tightening it in order to detect any shifting of the work which may have occurred.

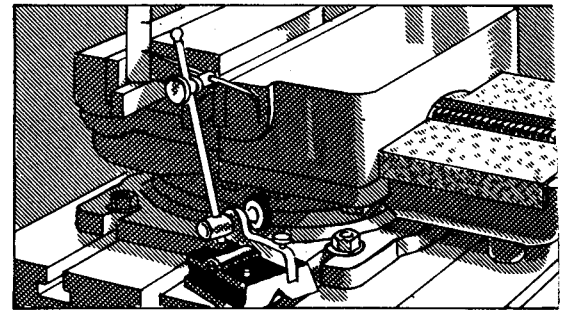


FIG. 301

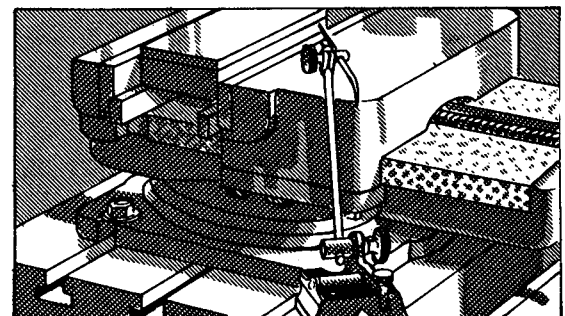


FIG. 302

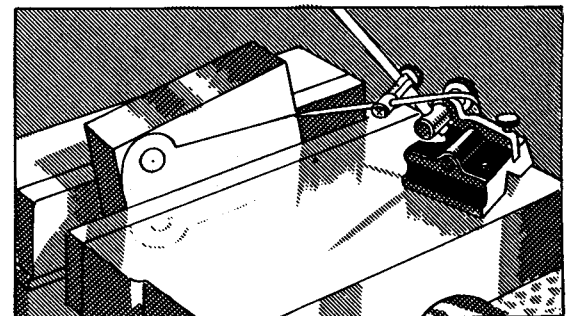


FIG. 303

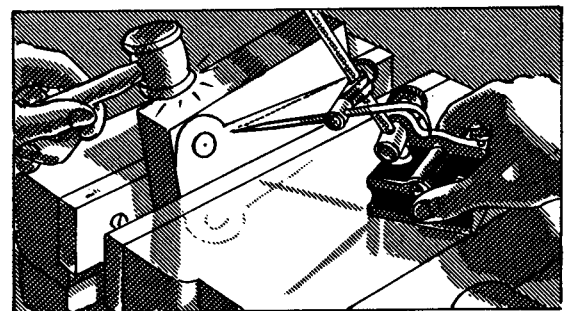


FIG. 304