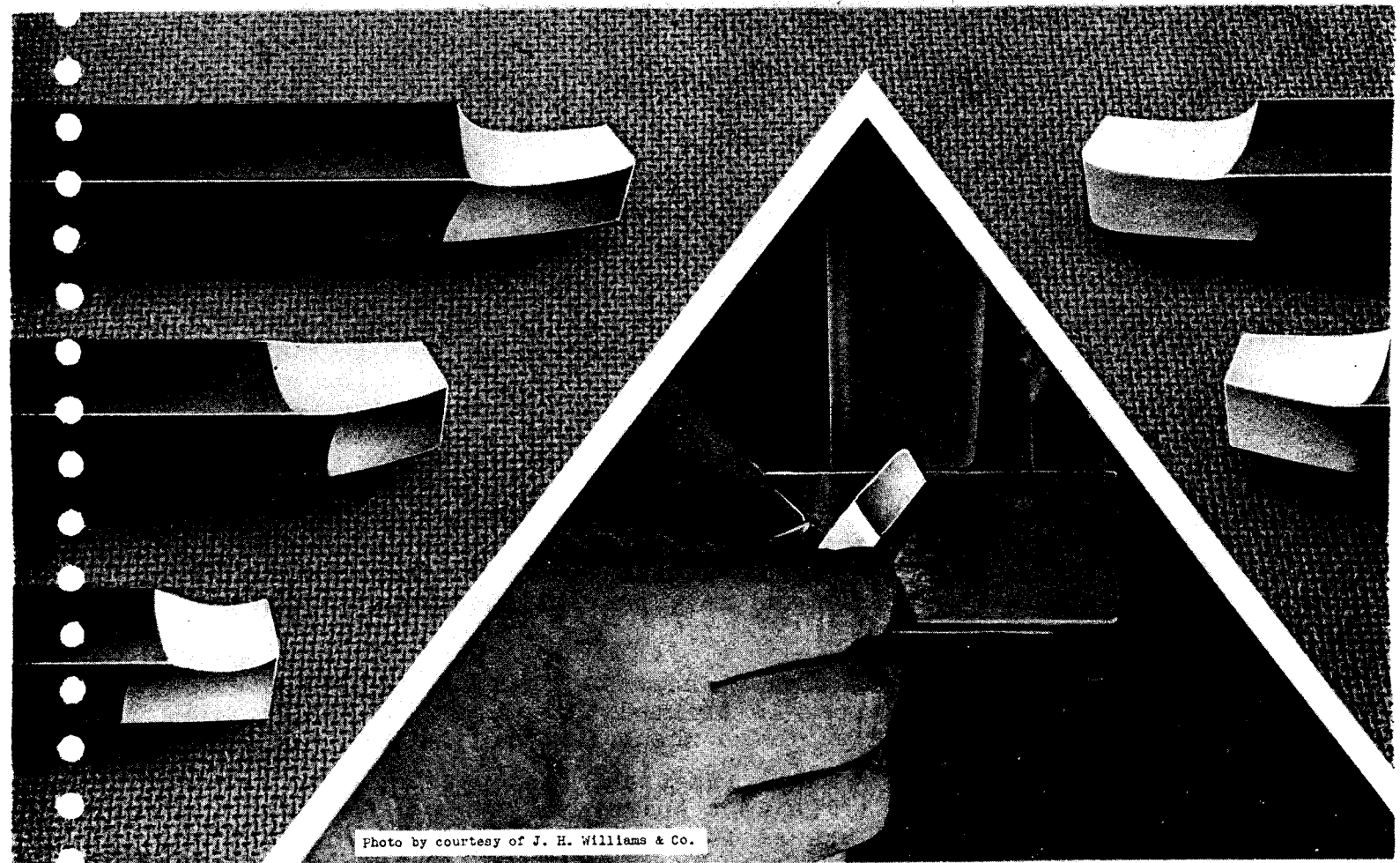


**HOW TO USE *the* BENCH
or FLOOR GRINDER**

**HOW TO GRIND
SHAPER TOOLS**

Unit 1-P54 Parts I and II Pages 315 to 326



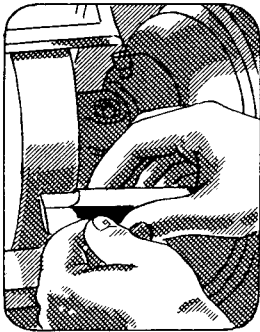
UNIVERSITY OF THE STATE OF NEW YORK
STATE EDUCATION DEPARTMENT
BUREAU OF INDUSTRIAL AND TECHNICAL EDUCATION

HOW TO USE *the* BENCH *or* FLOOR GRINDER

OBJECTIVES OF UNIT

1. To explain how to mount a grinding wheel.
2. To explain how to make preliminary adjustments prior to grinding.
3. To explain how to dress a wheel.
4. To explain how to grind shaper tools.

INTRODUCTORY INFORMATION



Bench and floor grinders are used for all kinds of general grinding and for the sharpening of drills, chisels, tool bits, and other small tools.

This grinding process is often called "off-hand grinding" to distinguish it from cutter- and tool-grinding processes in which the cutter is held in some type of holding device.

All wheels must be tested for cracks and closely inspected before they are placed on the spindle. Great care should be exercised when the wheel is being mounted in order to prevent setting up any undue strains which might cause the wheel to break. A wheel which breaks in use will probably damage the machine and may, possibly, seriously injure the operator.

After a wheel has been mounted, it must be "trued." Truing means, in this case, that the wheel is trimmed to run concentrically on its axis and that the face of the wheel is straightened.

In addition to having the wheel run true, the operator must see that the face of the wheel is kept sharp and in good condition. A wheel that is properly graded for a particular job is considered self-sharpening; that is, when the particles of abrasive that are present on the face of the wheel become dulled, they are dislodged by the pressure of work against the wheel, thereby exposing the new and sharp particles of abrasive. These conditions, however, are not always obtainable when a wheel is used for general grinding purposes. Under these conditions the abrasive particles are often retained on the face of the wheel after they have become dulled, or "glazed," and, in addition, the open spaces between the particles may become "loaded" with small pieces of metal. When a wheel is in this condition, it requires "dressing."

"Dressing" is the process of restoring the sharpness of the grinding wheel by breaking away the dulled abrasive crystals or by removing the glazed, or loaded, surface of the wheel with a dressing tool. Dressing should not be confused with truing which means shaping or trimming the wheel to run true. When a wheel on a bench or pedestal grinder is being dressed, the dressing tool is held against the wheel by hand. The hand steadies the dressing tool but does not hold it in a fixed relation to the wheel. On the other hand, when the wheel is being trued, the dressing tool must be held and guided in a fixed relation to the wheel.

In our school machine shops, truing the wheel is usually considered the responsibility of the instructor, and, therefore, the instructions for truing the wheel are not given in this unit.

Tool-bit grinding is an operation which requires considerable skill and experience. The function of the cutting tool is to remove metal. The tool should do this easily, at maximum speed and feed, and should retain its cutting qualities as long as possible. To enable the tool to do this efficiently, its angles and clearances must be correctly and skillfully ground.

The underlying principles governing the shapes, the cutting angles, and the clearances of tools are described in Unit 1-T52(C), page 157. These principles not only should be thoroughly understood but the angles and shapes also should be clearly visualized so that the operator can grind tools without the aid of too many gages.

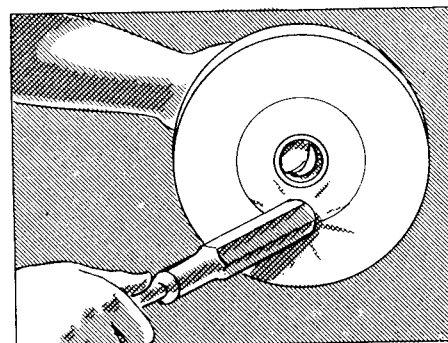
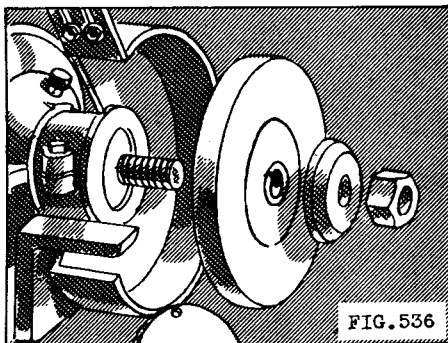
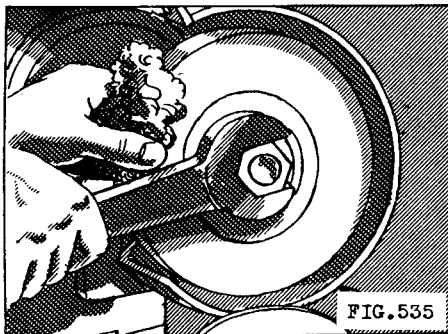
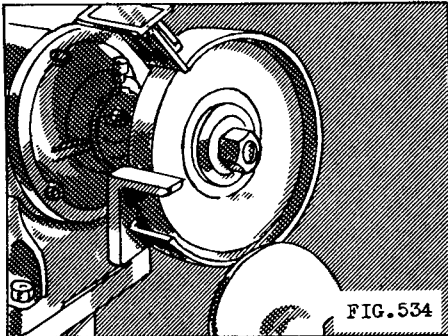
Tools should be roughed out on a coarse wheel and finish ground on a fine wheel. When, however, the tool is required to produce a smooth surface, a further refinement of the cutting edge, termed "stoning," is necessary. "Stoning" is accomplished by hand smoothing the cutting edge of the tool with a fine abrasive stone until the grinding marks of the wheel have been eliminated. A tool ground and then stoned in this manner will, under proper operating conditions, produce an excellent finish.

TOOLS AND EQUIPMENT

Bench or Floor Grinder	Cleaning Cloth
Grinding Wheels	Safety Goggles
Scraper	Grease
Wheel Dressers	Oil Can
Necessary Wrenches	Cloth or Glove
Protractor	Left-Cut Roughing Tool for Steel
Bevel Gage	Grooving or Cutting-Off Tool
Surface Plate	Four 3/8" Tool Bits
Parallel Block	Side-Cutting and Squaring Tool
Sharpening Stone	Round-Nosed Tool for Bronze or Brass

PROCEDURE

HOW TO MOUNT AND DISMOUNT A GRINDING WHEEL



1. Remove or open the sides of the wheel guards.
2. Hold the rim of the wheel, which is located on the right-hand side of the grinder, with the left hand. Use a cloth or glove to protect the hand and to prevent the wheel from slipping (Fig. 535).
3. Loosen the nut by giving the wrench a sharp jerk downwards. If the nut fails to loosen or the wheel slips in the hand, place a wooden wedge between the wheel and the tool rest to hold the wheel securely. The nut then can be loosened easily (Fig. 535). Loosen the nut on the left-hand end of the spindle. Follow the directions given in the two preceding steps, with the exception that the right hand will be used to hold the wheel and the left hand will be used to pull on the wrench.
4. Remove the nuts, the outer flanges, and the wheels from both ends of the wheel spindle. Wheels of this type have blotting-paper washers glued to the sides (Fig. 536).
5. Place the dismantled wheels in a storage rack. Loosen the nuts or screws which hold the tool rests and the spark breakers, and move them out as far as possible from the center of the spindle.
6. Select a wheel to suit the style and size of the grinder, and of the correct grade, grit, bond, and grain. (Refer also to page 314.)
7. Suspend the wheel on the finger (Fig. 537), or, if the wheel is too heavy to hold on the finger, place it on the bench and tap it gently with a light wrench or the handle of a screw driver. If the wheel is sound, it will emit a clear ring; if the sound is flat, examine the wheel for cracks.
8. Inspect the wheel carefully for flaws and imperfections.
9. Be certain that the lead bushing is tight in

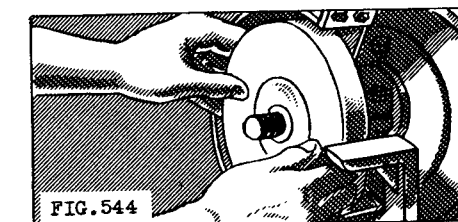
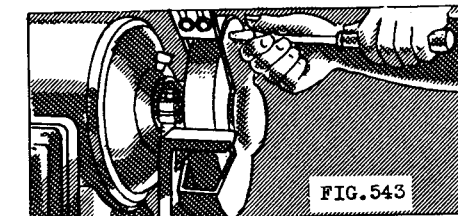
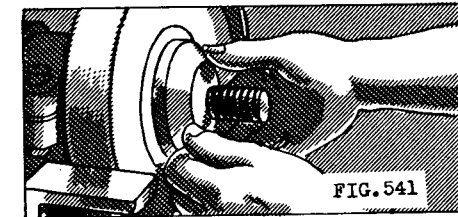
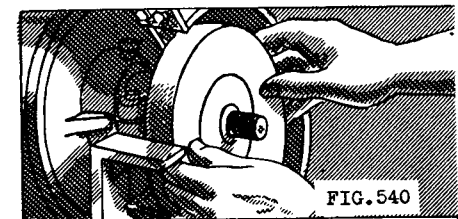
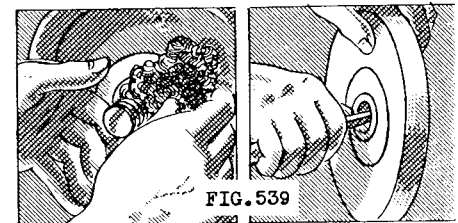
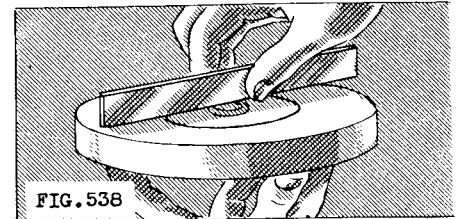
the wheel and that the ends of the bushing do not project beyond the sides of the wheel. This may be easily checked by placing a scale across the ends of the bushing (Fig. 538).

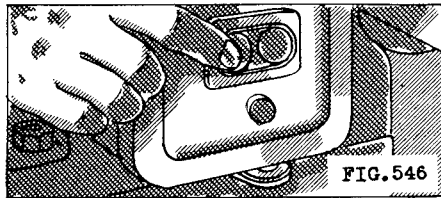
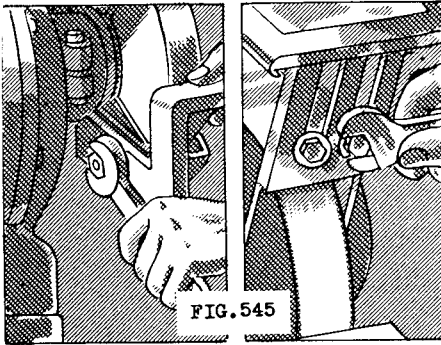
10. Clean the spindle and the face of the flange. The flange which is next to the bearing is a snug fit and keyed on the spindle. Therefore its removal from the spindle is not necessary (Fig. 539).
11. Slip the wheel over the spindle. If the spindle has a tendency to bind in the lead bushing, remove the wheel from the spindle and scrape the inside of the bushing (Fig. 539). Enough metal must be scraped from the hole to allow the wheel to slip freely over the spindle.
12. Clean and replace the outer flange on the grinder spindle, and replace the nut on the spindle end (Fig. 541).
13. Use a cloth or a glove to protect the hand when the wheel is being held.
14. Hold the wheel securely with the one hand and tighten the nut with a wrench held in the other (Fig. 542). The nut must be tight enough to hold the wheel, but not tight enough to crush it.

NOTE: The pressure exerted at the center of the flange by the nut is applied at a greater distance from the center of the wheel by the outer edge of the flange. For this reason, it is not necessary to tighten the nut with the same amount of force as would be required if the wheel were held by a small surface such as a washer near the center of the wheel.

15. Replace the side of the guard (Fig. 543).
16. Mount the wheel on the left side of the grinder.

NOTE: Observe that in order to tighten the nuts, they must be turned in a direction opposite to the rotation of the spindle. Refer also to the description on page 311.





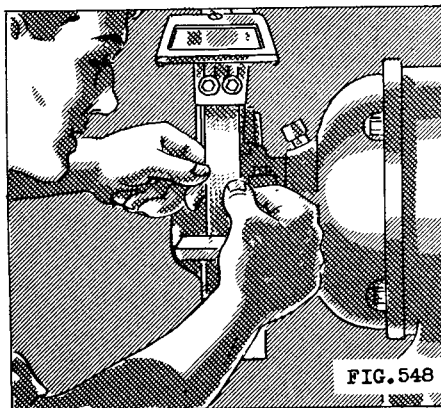
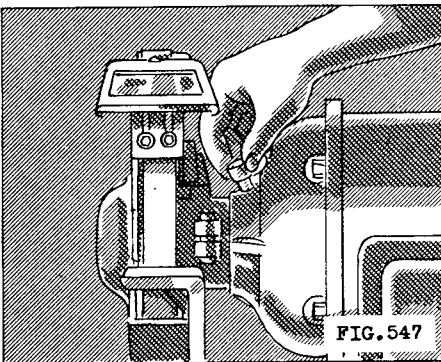
17. Adjust the tool rests and the spark breakers as near to the wheels as possible without touching the wheels (Fig. 545).

CAUTION Be certain that all adjustments are properly made and that the guards are securely in place before starting the machine.

18. Stand clear of the grinder and start the machine.
19. Observe the wheels, and, if they run out, have them trued by the instructor.
20. Finally, check the adjustment of the spark breakers, the tool rests, and the safety-glass shields.

HOW TO ADJUST THE GRINDER PRIOR TO OPERATING

1. Be certain that the grinder is properly lubricated. Follow the manufacturer's instructions or use one of the following procedures.



- a. When the grinder is provided with oil holes, oil the grinder daily.
 - b. When the grinder is provided with oil or grease cups, fill them regularly with oil or grease.
 - c. When the grinder is provided with sealed ball bearings, grease the bearings every six months.
2. Observe the condition of the wheels. The faces should be straight and square with the wheels. The grains in the wheel faces must be sharp and not glazed, and the spaces between the grains must be free of ground material.
 3. Stand to one side of the grinder, start the machine, and observe whether or not the wheels are running true.
 4. Decide whether the wheels need truing or dressing. If the wheels need truing, consult the instructor; if the wheels need dressing, proceed as instructed on page 321.

5. Examine the tool rests and make certain that they are set at the required heights, that they are set as close as possible to the wheels without touching, and that the rests are securely fastened in position (Fig. 545).
6. Inspect the position of the spark breakers and, if necessary, adjust the edge of the breakers as near to the faces of the wheels as possible (Fig. 545).
7. Adjust the safety-glass shields on the grinder to permit a clear vision of the part to be ground and, at the same time, to protect the operator from flying particles (Fig. 549).

CAUTION Wear goggles if the grinder is not equipped with safety-glass shields. Each person should use his own individual goggles as a precaution against the spread of eye diseases and skin infections (Fig. 550).

HOW TO DRESS A GRINDING WHEEL

1. Select a suitable dressing tool from those that are available.

NOTE: Two of the common types of wheel dressers are the abrasive-stick type (Fig. 551) and the star-wheel type (Fig. 552). Usually the star-wheel type with hardened steel circular discs which revolve when pressed against the wheel, is the one most frequently used. The points of the discs tend to pick the metal out of the wheel without dislodging too much of the abrasive from the face.

2. Adjust the glass shields on the machine so that the dressing process can be plainly observed (Fig. 553).
3. Use goggles as an additional protection for the eyes.
4. Use coveralls or a shop coat to keep the dust from the clothing (Fig. 554). (Exhaust outlets are provided on the newer bench and floor grinders; this indicates that the use of exhaust systems for all types of grinding is steadily becoming standard practice.) If

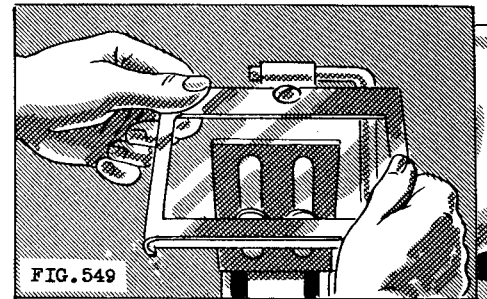


FIG. 549

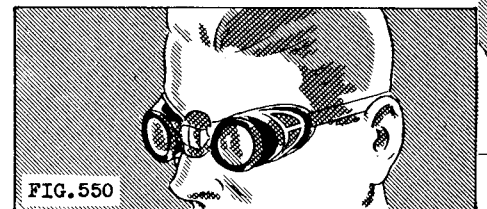


FIG. 550

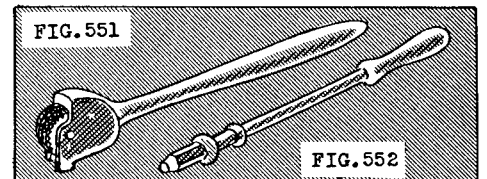


FIG. 551

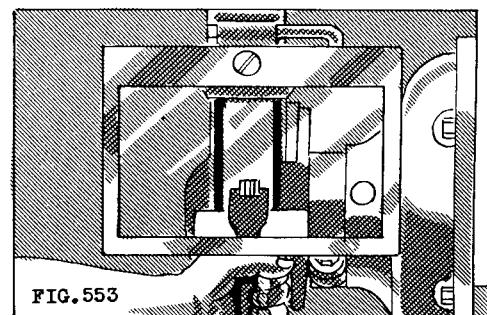


FIG. 553

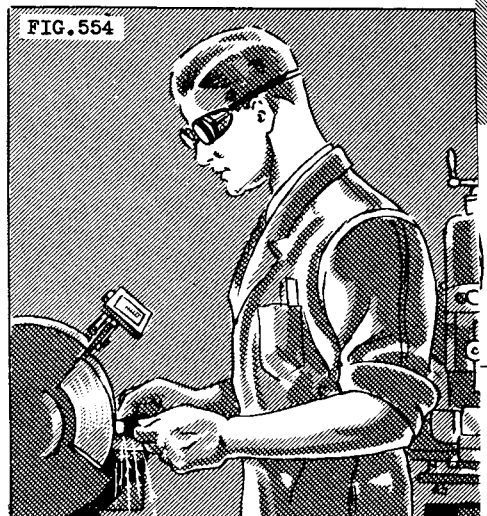


FIG. 554

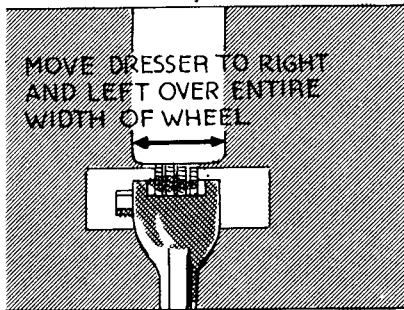


FIG. 555

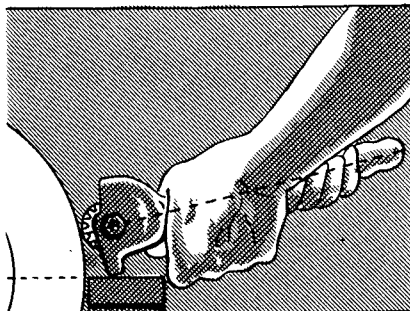


FIG. 556

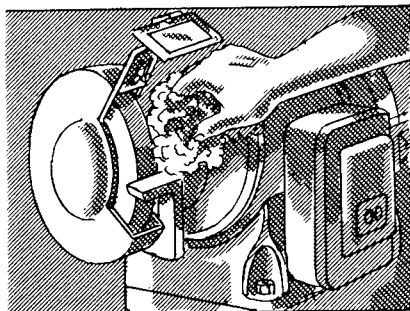


FIG. 557

no exhaust system is used and much dressing has to be done, a respirator may be worn to prevent inhalation of dust.

5. Support the dresser on the tool rest and, if necessary, adjust the height of the tool rest until the point of contact of the dresser is slightly above the center of the grinding wheel. The purpose of this is to prevent the dresser from being drawn into the wheel (Fig. 556).
6. Start the grinder.
7. "Cant" the dresser slightly upward to prevent chatter. Chatter is caused by the tendency of the revolving wheel to force the dresser away from the wheel face and the inability of the hand to maintain an even pressure against the wheel (Fig. 556).
8. Slowly press the dresser against the face of the revolving wheel until it "bites." Then, move the dressing tool back and forth across the wheel to obtain a straight surface. Hold the dresser rigidly to retain the trueness of the wheel when the face is being dressed (Fig. 555).
9. Stop the machine; brush the dust from the machine and clean the safety-glass eye shields; then, finally, check the adjustment of the tool rests. Refer to step No. 5 on page 321.

HOW TO GRIND SHAPER TOOLS

HOW TO GRIND A LEFT-CUT ROUGHING TOOL

GRINDING THE SIDE RELIEF, OR SIDE CLEARANCE

1. Read the description of tools on page 157 in order to become familiar with the shapes and the terminology of shaper tools.
2. Prepare the tool grinder as instructed on page 320.

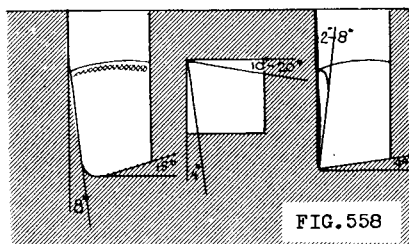


FIG. 558

3. Observe the shape, the angles, and the clearances of the left-cut tool as illustrated in Fig. 558. The angles and clearances are for tools whose bases are held at 90° to the surface being machined. In this case, the tool is held parallel to the base of the tool

holder. (Refer to page 154 for the description of tool holders.)

4. Start the grinder.

CAUTION Stand to one side before starting the grinder.

5. Use the coarse wheel for rough grinding the tool.
6. Hold the tool bit in the right hand and support it with the left hand (Fig. 559).
7. Hold the tool at an angle of about 8° with the face of the wheel to give the necessary side-cutting-edge angle (Fig. 559) and, at the same time, tip the top of the tool outwards from the wheel to produce a side relief, or side clearance, of about 4° (Fig. 560).
8. Press the tool firmly against the wheel and move it back and forth across its face. The purpose of the back-and-forth movement is to wear down evenly the whole width of the face of the wheel.
9. Cool the tool by immersing it in the water pot when it becomes quite warm to the touch.

NOTE: An experienced operator is able to judge with a fair degree of accuracy the shapes, angles, and clearances for tool grinding. The inexperienced operator, on the other hand, should have some method of checking them. Either a correctly shaped tool with the proper angles and clearances may be used for comparing the angles, or the tool angles may be checked with a protractor or a bevel gage which has been set and compared with a protractor.

10. Place the tool and the pattern together and by observation check the ground angle of the tool with that of the pattern (Fig. 560), or check with a protractor set at the correct side-relief angle (Fig. 561).

11. Correct the side-relief angle when the tool is being ground by increasing the pressure with the fingers toward the top if the clearance is too much, and by increasing the pressure toward the bottom if the clearance is insufficient. This

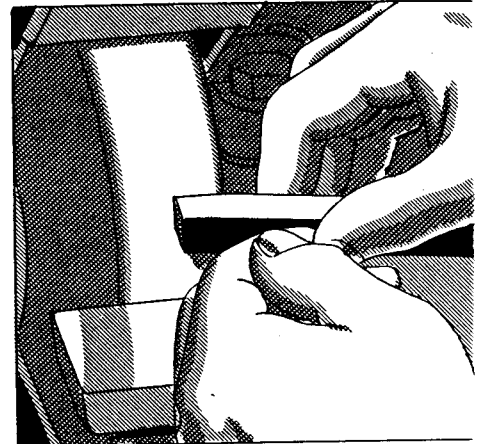


FIG. 559

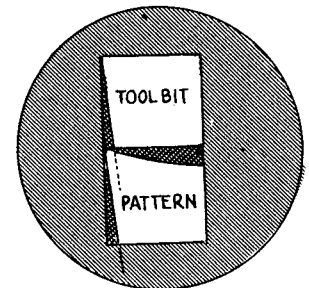


FIG. 560

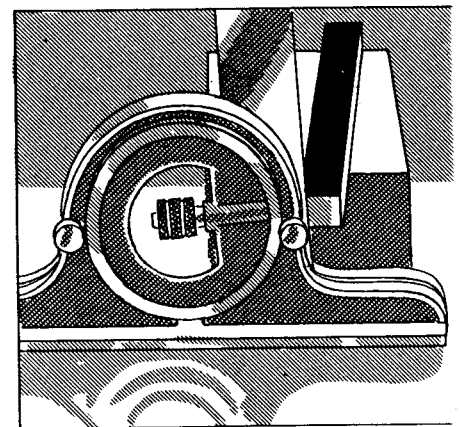
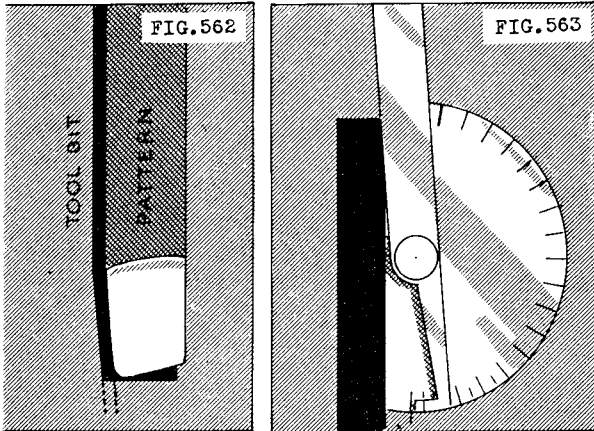


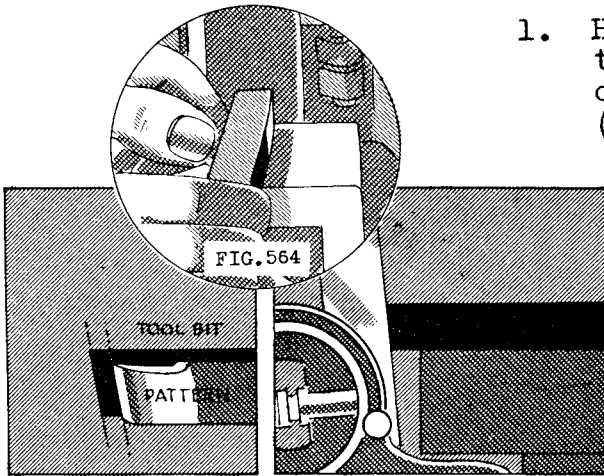
FIG. 561



ability, when the tool is being ground, to judge where the pressure is being applied in order to change the shape or to modify the tool angles, is acquired after a little practice and is called the "feel" of the wheel.

12. Continue grinding until the angle and the length of the ground side compare with those of the pattern (Fig. 562), or check with a protractor (Fig. 563).

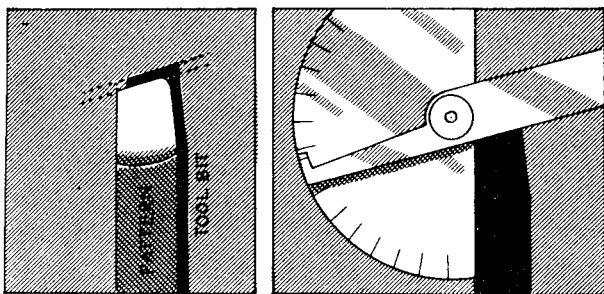
GRINDING THE END RELIEF OR END CLEARANCE



1. Hold the tool at an angle of about 75° to the face of the wheel and incline the front of the tool upward at an angle of about 4° (Fig. 564).

2. Press the tool firmly against the wheel, and, at the same time, move the tool back and forth across the entire face of the wheel.

3. Check by observation the end-relief angle by placing the pattern in front of the tool (Fig. 565), or by using a protractor as illustrated in Fig. 566.



4. Check the end-cutting-edge angle by placing the pattern on top of the tool (Fig. 567), or by using a protractor as illustrated in Fig. 568.

5. Continue grinding the tool until the end-cutting-edge angle is ground to the proper length and to the desired angle. At the same time be certain that the end-relief angle is correct.

CAUTION A tool should be ground carefully because no more metal than is absolutely necessary should be ground away. Unnecessary grinding wastes valuable time and expensive material.

GRINDING THE SIDE AND BACK RAKE

1. Hold the face of the tool at an angle of

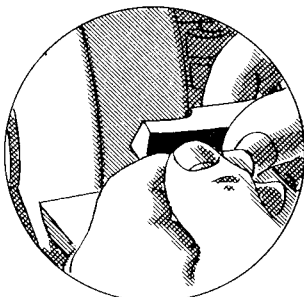
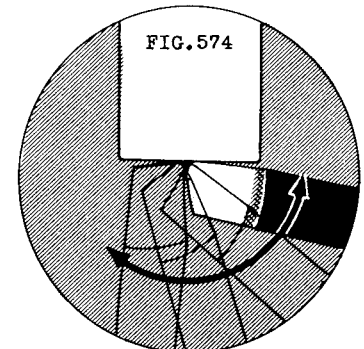
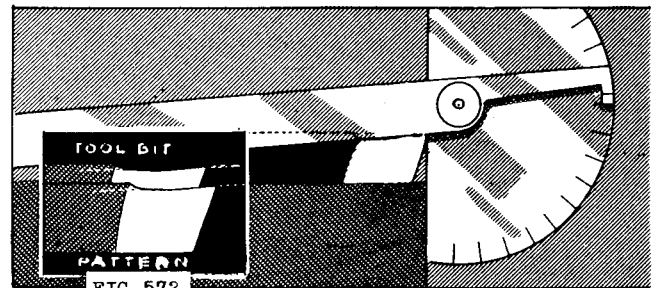
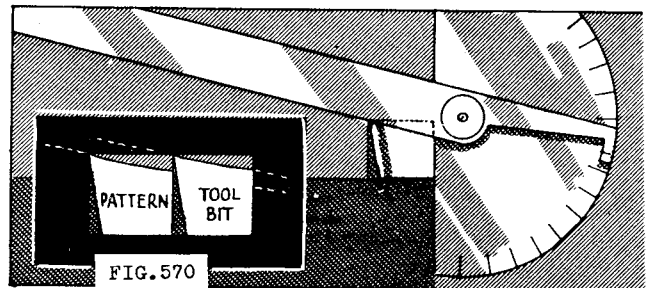


FIG. 569

about 2° to 8° with the face of the wheel, and, at the same time, tip the tool forward to obtain a side slope of 10° to 20° (Fig. 569).

2. Press the tool firmly against the wheel and grind the face of the tool.
3. Place the tool and the pattern together as shown in Fig. 570 and compare the side slope of the tool with that of the pattern, or use a protractor as shown in Fig. 571.
4. Compare also the back slope of the tool with that of the pattern (Fig. 572), or check it with a protractor (Fig. 573).
5. Compensate for any inaccuracy of the side rake by applying slightly more pressure to the top or to the bottom of the tool, whichever is necessary, and, at the same time, correct any inaccuracy of the back rake by increasing the pressure either at the point or at the opposite end.
6. Continue to grind the face of the tool, checking occasionally as the grinding proceeds, until the cutting edge is sharp.



GRINDING THE RADIUS ON THE NOSE OF THE TOOL

1. To grind the radius on the nose of the tool, hold the tool lightly against the wheel, and, while the nose is in contact with the wheel, swing the tool from side to side (Fig. 574). When the desired radius has been obtained, finish grind on the fine wheel the whole area of the point of the tool.

STONING THE TOOL

There are two equally effective methods of stoning the tool which are commonly practiced. Some machinists prefer to rub the tool over the sharpening stone; others find it more convenient to rub the stone over the tool. The following instructions and illustrations show both methods. Whichever method is used, be certain to keep the surface of the tool flat against the stone to prevent rounding of the cutting edges.

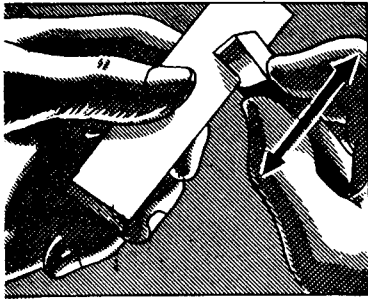


FIG. 575

1. Hold the sharpening or abrasive stone in one hand and rub the tool from side to side until the cutting edge on the face of the tool is smooth (Fig. 575), or hold the tool in the hand and rub the stone over the tool (Fig. 576).



FIG. 576

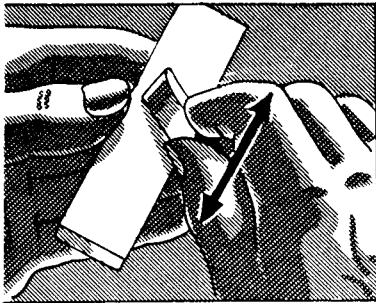


FIG. 577

2. Rub the flank of the tool on the stone (Fig. 577) until the cutting edge on the side is smooth, or rub the stone over the flank of the tool (Fig. 578).

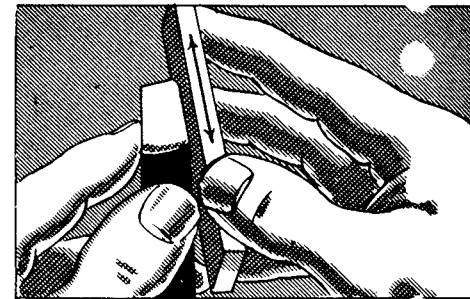


FIG. 578

3. Stone the end of the tool by holding it at a slight angle to the vertical position (Fig. 579) and by rubbing it on the stone until the top edge is smooth, or hold the tool stationary and smooth the edge with the stone (Fig. 580).

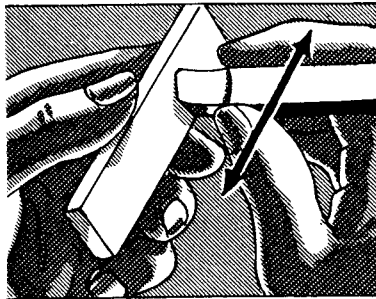


FIG. 579

4. Stone the nose of the tool by holding the tool as illustrated in Fig. 581. Rub the tool back and forth over the stone and at the same time swivel the tool to produce a circular motion at the nose, or move the stone with a circular motion around the nose of the tool (Fig. 582).

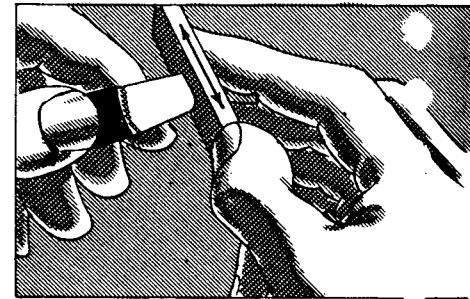


FIG. 580

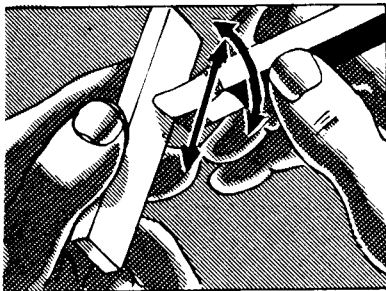


FIG. 581

5. Examine the cutting edge of the tool. Now, if it is properly stoned, the wheel marks will be eliminated at the cutting edge and it will be keen and smooth. It should be noticed that the curve of the wheel causes the ground surfaces to be slightly hollow. This is an advantage when the tool is being stoned, for under these conditions the tendency to round the edges is greatly lessened.

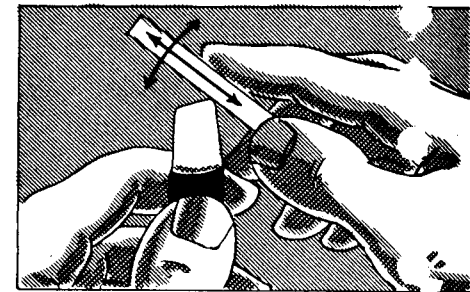


FIG. 582