CHAPTER IV

Grinding Wheels and How to Select Them

Grinding wheels are made of crushed abrasive or cutting grit held together by a substance known as the bond.

Abrasive. The most common abrasives are aluminum oxide and silicon carbide.

Aluminum oxide crystals, though not particularly hard, are tough and hence are usually preferred for grinding materials of high tensile strength such as alloy and high-speed steels. This abrasive is known by such trade names as Borolon, Aloxite, Alundum and others.

Silicon carbide crystals are very hard but quite brittle; hence wheels of this material are used in grinding easily-penetrated materials such as copper, rubber and celluloid, and hard materials of low tensile strength such as cast iron and cast bronze. This abrasive is known by the trade names Electrolon, Carborundum, Crystolon and others.

Bond. Differences in bond give the grinding wheels varied characteristics.

Vitrified clay is the bond most commonly used. Wheels of this type are usually preferred for general production and toolroom grinding, for they are unaffected by heat, cold, water and oils and have many other advantages. They are usually not as strong as wheels of other bonds, however, and have practically no elasticity; consequently it is not advisable to attempt a heavy side cut with wheels of this type.

Silicate or semi-vitrified wheels (bonded with sodium silicate) as a rule cut smoothly and with little heat, hence are suitable for work requiring a delicate edge such as cutter or tool grinding.

Shellac forms a strong bond, and very thin wheels made of it are safe. These wheels produce a smooth finish and deep side cuts can be taken.

Rubber forms a bond of great strength, and wheels bonded with this material are used to cut grooves and for similar work.

Grain. This term refers to the size of the particles of abrasive used in the wheel. A 46-grain wheel, for example, is one made of abrasive that will just pass through a 46-mesh screen (that is, a screen having 46 meshes or openings per linear inch).

Several sizes of abrasive are often combined to produce a wheel of special characteristics. Such a wheel is called a *combination* wheel.

The grains commonly used for surface grinding range from 46 to 80. For rough grinding, when the finish is not important, coarse-grain wheels are used. When the finish is more important or the surface to be ground is narrow and requires a sharp edge, fine-grain wheels are used. Combination wheels usually cut fast yet leave a good finish.

Wheel Structure. This term refers to the spacing between the abrasive particles in the wheel. Since the chips produced from soft, ductile materials will be relatively large, a wheel of open structure is needed in order to give enough chip space to prevent the wheel from becoming loaded; while hard, brittle materials, yielding smaller chips, are ground most efficiently with a wheel of denser structure. In most cases a wheel of medium structure will be satisfactory, although a change in structure may often result in better grinding and longer wheel life.

Grade. Wheels from which the grit is readily torn are known as soft bond or soft grade wheels, while those that strongly retain the grit are called hard bond or hard grade. Note that the term *grade* refers to the breakdown resistance of the wheel and not to the hardness of the abrasive.

The grade of grinding wheels is designated in different ways by the various manufacturers. In most cases it is indicated by letters, though some makers employ a numerical system.

In general, hard grade wheels are used in grinding soft steel and similar metals and soft grade wheels are used on the very hard metals. If coolant is used, the wheel used should be of harder grade than if the job were ground without coolant. Also, the greater the contact between work and wheel the softer the grade should be. The faster a wheel runs, the harder it will act.

Selection of Grinding Wheels

As indicated above, a most important consideration in the selection of grinding wheels is the nature of the material to be ground. Surface speeds of wheel and work, amount of material to be removed, and accuracy and quality of finish desired are also matters to be considered.

The abrasive, grain, structure, grade and bond of the wheel regularly furnished with the Brown & Sharpe No. 510 Surface Grinding Machines are such as to suit this wheel to general-purpose grinding. However, the material, finish requirements or volume of work may often make desirable the use of a wheel more perfectly suited to the particular job at hand. The various wheel manufacturers publish literature which will be of particular help in selecting grinding wheels of their own make; or, if desired, all details of the grinding operation may be submitted to the wheel manufacturer for advice and recommendations.

CHAPTER V

Maintenance

Installing or Relocating the Machine

In lifting or moving the machine it is recommended that the rope be rigged as shown in Figs. 29 and 30. Place wooden blocks or protective material between the rope and the machine wherever the rope is liable to damage any part.

The machine should be located on a level foundation or floor, a solid vibrationless foundation being essential where the finest finish must be produced. If the machine must be set on a wooden floor, locate it over a beam and on a portion of the floor which is free of vibration. In case the foundation or floor unavoidably transmits vibration to the machine, set the machine on a shock-absorbing pad.

With the machine in position, test the surface of the table both longitudinally and transversely with a precision spirit level and drive a wooden shingle under any corner or corners that may be low. Make sure that all four corners are supported; then tighten the lag screws, test the level of the table surface again in both directions and readjust if necessary.

The subject of connecting to the power supply is covered on page 27. CAUTION: To avoid damage, be sure to check direction of motor rotation as explained on page 27 before running the machine.

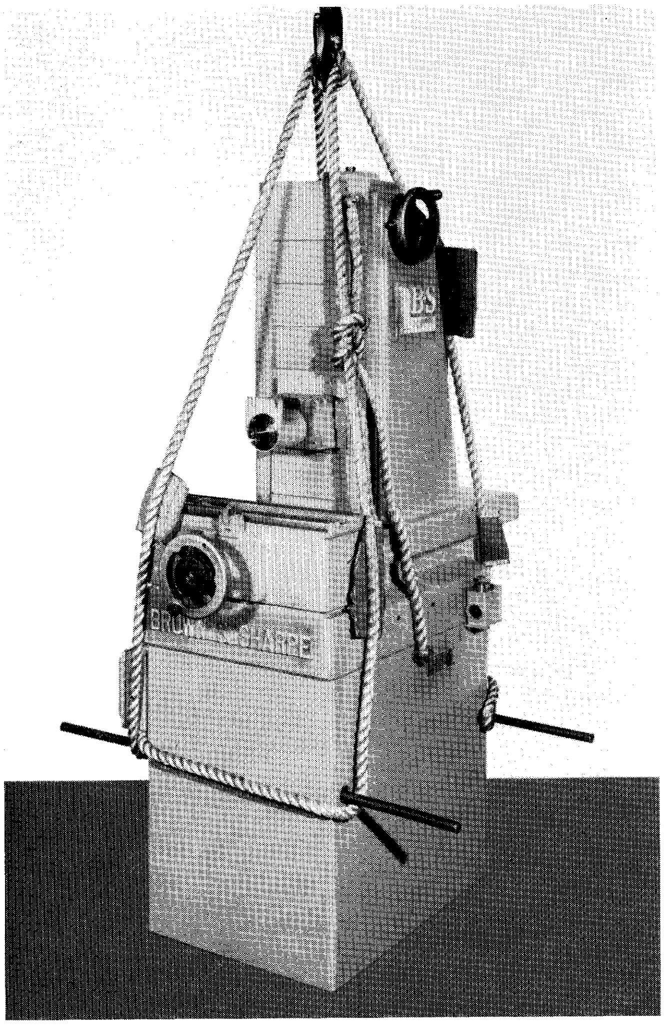

Fig. 29. Proper method of rigging machine.

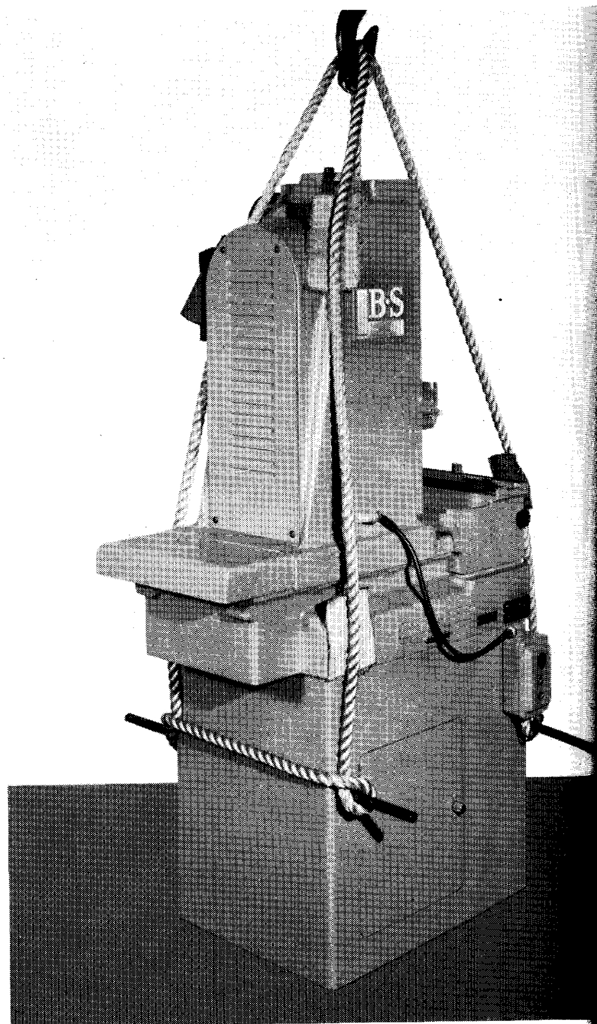

Fig. 30. Rear View of Machine.

Lubrication

A "one shot" oiler lubricates all moving machine parts and is mounted on the right side of machine towards the rear. (Fig. 31).

Before starting a machine, be sure the oil reservoir is filled to the level of the spillway with a good grade, high lubricity table way oil having a viscosity of 300 S.S.U. at 100° F. Use Gargoyle Vacuoline No. 1409 (Socony-Vacuum Oil Co.) or an equivalent table way oil.

Lubrication of the plain-bearing wheel spindle is covered below and on page 24. Never start a new plain-bearing spindle without first filling the oil reservoir.

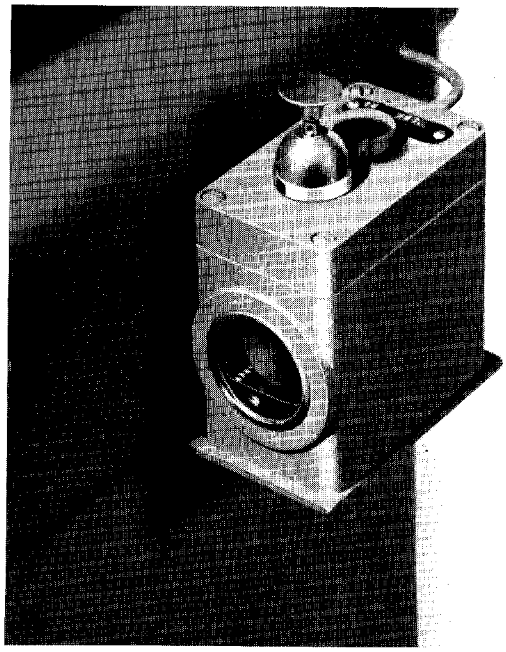

Fig. 31. "One Shot" Oiler lubricates entire machine.

Wheel Spindle

Wheel Spindle. Machine is equipped with a super-precision antifriction-bearing unit with a choice of either Oriflex drive (through 5 "O" rings) or Direct motor drive. Either drive is from 1 H.P. motor. They are removable unit type construction and are interchangeable.

The wheel sleeve furnished takes wheels up to ½″ thick and an available sleeve (at extra cost) takes wheels up to 1″ thick.

A plain-bearing spindle unit is available at extra cost (with Oriflex drive only).

A grinding machine spindle may be properly classified as a high-precision tool. The accuracy of construction required will be realized from the fact that a variation of one hundred-thousandth of an inch (0.000,01″) in a ground flat surface will be visible to the naked eye as a wheel mark. Consequently, the best results can be obtained only if the spindle is treated with the consideration due to any fine precision instrument. *Hammering on the ends of the spindle, dropping it on the floor or work bench, or any other undue application of force or impact must be carefully avoided* if the spindle is to be kept in proper running condition.

If eventually a spindle should need repair or adjustment, we recommend that it be returned to our factory for reconditioning. By installing an extra spindle unit kept on hand for such contingencies, production can continue with little interruption; for it is a quick and simple matter to change spindles on these machines. If necessary, however, detailed instructions for the plain-bearing spindle on the following page will frequently permit the required work to be done successfully in the customer's shop by a careful workman having adequate skill and equipment.

Removing Spindle Unit from Machine

Unclamp the wheel guard and remove from the Spindle Unit. Next take off the grinding wheel using the wheel sleeve puller. Then take out the four clamping screws in the spindle unit flange.

If equipped with Oriflex drive remove the guard at the rear of the upright and pull the spindle unit towards the front approximately an inch and lift the five "O" rings away from the spindle pulley. Draw out the spindle unit from the front of the machine.

For direct drive follow the instructions in the first paragraph and loosen the knurled spindle head screw. Remove the guard at the rear of the upright, disconnect motor cable and draw out the spindle unit from the rear of the machine.

Antifriction-Bearing Spindle Unit

This spindle unit has the spindle mounted on super-precision, preloaded ball bearings at both front and rear. Grease lubrication is used and the spindle's cool running temperature is quickly reached. The unit is sealed and requires no additional lubrication after it leaves our factory. As dirt cannot enter past the seal this spindle has a long trouble-free life.

Lubrication. All the spindle bearings are packed with a special grease at the factory and the unit requires no further lubrication.

Maintenance. Because of the extreme care required in disassembling and reassembling this spindle, we strongly recommend that any antifriction-bearing spindle unit which needs repair be returned to our factory for reconditioning.

Plain-Bearing Spindle Unit

The spindle in this unit has small clearance in its boxes, which practically eliminates radial play and cuts spark-out time to a minimum. The light spindle oil used results in low running temperature, quickly reached after starting. (Provision is made for quickly removing end play without removing the spindle unit, through spring take-up controlled by a screw clamp which serves as a positive lock.)

Lubrication. Automatic lubrication is provided by a rotating pump unit integral with the spindle. A constant level oiler (Fig. 32) supplies oil to a reservoir in the spindle unit.

To fill the spindle reservoir, tilt the constant-level oiler bottle down and fill it through the spout, then tip it back into working position. When the reservoir is empty, fill the bottle twice to bring the oil to the required level. Never start a spindle without oil showing in the oiler bottle.

Take particular care to keep the oil clean. Use a clean oil can, and always wipe the oiler bottle and adjacent parts before tilting the bottle for filling. Preventing grit and dust from reaching the oil space will increase the life of the spindle bearings materially.

Correct Height of Oiler. To assure proper height of oil in the spindle reservoir, the vertical distance from the shorter side of the diagonally-cut spout to the top edge of the cup (with bottle swung down) must be 3/8″ (see Fig. 32).

Disassembling and Repairing the Plain-Bearing Spindle Unit

Removing the Spindle. Remove the spindle unit from the machine as described on page 23, grip it securely in a horizontal position between the soft (leather or brass) jaws of a vise, and proceed as follows:

1. Take out the screws A and B (Fig. 32) that holds the driving pulley on the spindle. In removing the pulley use the wheel puller.

2. Remove the spindle rear box nut C (Fig. 32).

3. Take off the spindle bearing sleeve cover D and remove teated screw E.

4. Remove the screws in the dust guard F; then pull off the spindle dust guard F unless the dowels are so tight as to make this difficult.

5. Tap the rear end of the spindle to free the thrust collar G, oil slinger J and (if necessary) spindle dust guard F. Use a soft hammer for this, and be careful not to use any more force than is necessary.

6. Pull out the spindle and place the loose parts on a clean cloth or sheet of paper.

Checking Oil Space in Boxes. The taper in the front and rear boxes is a continuous one—that is, the two boxes are like one long taper box with a section cut away in the middle. The thickness of the oil space is governed by the thickness of the spindle front box thrust washer K and should be 0.000,11″.

With the spindle boxes properly scraped, the correct thickness of washer K is determined as follows:

1. Leave the spindle sleeve clamped horizontally in the vise, strap it to a plate or otherwise secure it against endwise movement.

2. Insert the spindle with washer K in place but leaving off all other parts. (It makes no difference if the washer is too thick for a fit.)

3. Fasten a dial indicator so it cannot move with relation to the spindle unit and set the point of the indicator on the rear end of the spindle.

4. Push the spindle in so that washer K is well seated and set the indicator to read zero.

5. Remove the spindle, take off washer K and put the spindle back in the sleeve. Push the spindle into the boxes with a force of approximately 6 lbs. to get metal-to-metal contact, and note the indicator reading. Be careful to use only enough pressure to bring the spindle in contact with the boxes; for excessive pressure will distort the spindle and boxes, causing a faulty indicator reading and resulting in too small an oil space.

6. To determine the required thickness of washer K, subtract the indicator reading from the measured thickness of the washer and add 0.005″. Bring the washer to the required thickness by grinding and lapping, working to the limits plus 0.000,25″ minus 0.000,00″.

Repairing a Stuck Spindle. A spindle which has stalled or become stuck in the boxes will project quite noticeably at the front box thrust washer K. This looks like a much more serious condition than it actually is; for if the spindle should be held away from the boxes by as little as 0.000,5″ on a side, the space at the front washer would be increased by about 1/32″ due to the small angle of taper of the boxes.

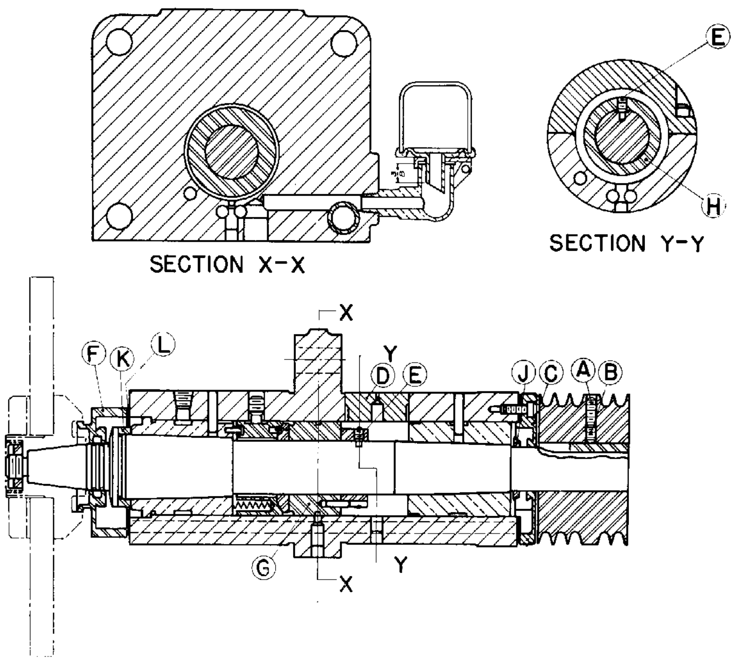

Fig. 32. Plain Bearing Spindle Unit.

Disassemble the spindle as instructed and examine the bearing surfaces in both boxes. If there are just a few high spots in one of the boxes they can usually be removed by careful scraping, using the spindle as a test plug. Carefully clean the spindle of any adhering foreign matter and make sure that all fine chips or dust of bronze are cleaned out of the boxes before testing. In removing the high spots, continue the scraping until the spindle goes into the boxes with the original washer bearing against the end of the front box. After completing this operation it is advisable, even if only a few spots were scraped, to check the thickness of the oil space as described above.

If the bearing surfaces have become badly scored a thorough rescraping job will be required, again using the spindle as a test plug. Watch the alignment as shown by the bearing on both boxes, and scrape the seized box or boxes so that the spindle will center properly in both boxes as the scraping nears completion. After completing the scraping, clean all parts thoroughly and correct the thickness of the front box thrust washer K to give the proper oil space as described on page 24.

Reassembling the Plain-Bearing Spindle Unit

First make sure that all parts are perfectly clean and that dirt or dust will not get into the spindle sleeve during reassembly. Then, holding the spindle sleeve between brass or leather vise jaws, proceed as follows:

1. Put the front box thrust washer K on the spindle and insert the spindle in the boxes, slipping the thrust spring retainer (with springs in place), the central thrust washer and the thrust collar H onto the spindle in that order as shown in Fig. 32.

The thrust collar G is made a wringing fit on the spindle, and the hole must *not* be enlarged to make it fit more freely.

2. Fasten the thrust collar G in position. The teated screw E engages one of three radial holes spaced 120° apart around the spindle and at different distances from the spindle end. When the front box thrust washer K is at full normal thickness (3/16″ or more), located thrust collar G so screw E will engage the hole nearest the rear end of the spindle. When washer K is between 3/16″ and 1/8″ thick, put screw E in the middle hole; and when washer K is 1/8″ thick or less, put screw E in hole nearest the front of the spindle. This maintains proper pressure of the thrust springs as the spindle is brought inward.

3. Replace the spindle bearing sleeve cover D. Since this cover must be oil tight, lightly coat the horizontal clamping surfaces and fill grooves in the sides of the cover D with a sealing compound. To help keep the sealing compound out of the spindle unit, take care not to coat the side surfaces of the cover other than to fill the grooves.

4. Replace the spindle dust guard F.

After the front box thrust washer K has been reduced in thickness about $\frac{1}{16}''$ in connection with rescraping the spindle, the spindle dust guard F (which does not drop back with the spindle) may begin to interfere with the wheel sleeve. To prevent this, remove about 1/16″ from rear surface L of the dust guard into proper relation with the grooves in the spindle. In doing this, be careful to keep surface L square with the sides of the dust guard. Fasten the dust guard in place and check with a feeler gage to see that there is clearance all around between the spindle and dust guard. If the guard touches the spindle, scrape it at that point just enough to clear the spindle.

5. Replace the oil slinger J locating it within $\frac{3}{32}''$ of the end of the rear box to make sure that nut C will not come in contact with it.

6. Replace the spindle rear box nut C and the driving pulley or coupling, thus completing the spindle assembly.

Replacing Spindle Unit in Machine.

If spindle unit is used with Oriflex Drive, insert spindle unit in the spindle head at front of machine. From the rear of the upright pull the spindle towards the rear until the Spindle pulley is directly over the motor pulley. Install the five "O" rings in their corresponding grooves on both pulleys. Replace guard at rear of upright. At the front of machine clamp on the spindle unit flange with the four flanged screws. Tighten the four screws in rotation using a wrench on the screwdriver to bring the flange up tight.

If spindle is used with direct-driven motor, insert spindle unit in the rear of the machine upright. Connect motor cable and replace guard at the rear of upright. Next, tighten the knurled spindle head screw and clamp on the spindle unit flange, tightening the four screws in rotation using a wrench on the screwdriver to bring the flange up tight.

Possible Sources of Grinding Trouble

Work shows wheel marks (chatter finish)

Chatter may be due to poor choice of wheel for the material being ground (see page 21).

The grinding wheel may be out of balance. If so, it should be balanced or replaced (see page 8).

The condition may be due to vibration of the floor or foundation on which the machine is located. If this is the case, the situation may be improved by using a shock-absorbing pad between the floor and the machine.

Excessive oil space in a plain-bearing spindle or loose bearings in an antifriction-bearing spindle will result in a chatter finish.

If the grinding wheel is not securely clamped to the wheel sleeve, repeated starting and stopping may shift the position of the wheel, resulting in chatter finish.

Spindle runs too hot or stalls

Using the wrong kind of oil will cause this. Use only an extra-light, high-quality spindle oil having a viscosity of 60 Seconds S.U.V. at 100° F. for the plain-bearing spindle.

May be due to insufficient oil. With the plain-bearing spindle, check the vertical position of the constant-lever oiler (see page 25).

Plain-bearing spindle leaks oil

This may be due to flooding of the spindle reservoir as a result of improper filling. The correct method of filling the reservoir is described on page 25 under "Lubrication".

Air may be leaking into the oiler bottle, resulting in too high an oil level in the spindle reservoir. In this case it is usually best to replace the oiler.

Table and Cross Feed Mechanisms

These mechanisms seldom require adjustment or replacement, and their relatively simple construction will enable any competent maintenance mechanic to do the necessary work without difficulty.

The illustrations in the Repair Parts section will prove helpful in working on all parts of the machine.

Electrical Controls

Connecting to Power Supply. The machine should be connected to the power line and properly grounded. The lines from the power source should be connected to the manual starter, mounted on the left side of machine.

Checking Motor Rotation. Press the manual starter "start" and observe the direction of spindle rotation. The spindle should rotate clockwise as seen from the front of machine. If direction of rotation is counterclockwise, transpose two line wires at the manual starter.