Operation and Maintenance
(Including Repair Parts)

of the

No. 2 Surface Grinding Machine

and

No. 2B Surface Grinding Machine

With Hand Feeds Only

BROWN & SHARPE MFG. CO.
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FOREWORD

The purpose of this book is to give a thorough practical working knowledge of the Brown & Sharpe Nos. 2 and 23 Surface Grinding Machines.

The Operator and Set-up Man will need to be thoroughly familiar with the information given in Chapter I, which includes a detailed explanation of each set-up adjustment and operating control, instructions on mounting and truing grinding wheels and suggestions on set-up and operation. Many additional practical suggestions are given in the next two chapters, which illustrate and describe typical operations and explain the use of the various attachments; while Chapter IV outlines the points to be considered in selecting grinding wheels.

The Maintenance Man will be particularly interested in Chapter V. This chapter covers installation and maintenance, including instructions on lubrication, disassembling and reassembling the plain-bearing wheel spindle unit and removing the carriage. Familiarity with the facts presented in Chapter I will also prove of value; and the pictures in the Repair Parts section will help in identifying and reassembling the various parts of the machine.

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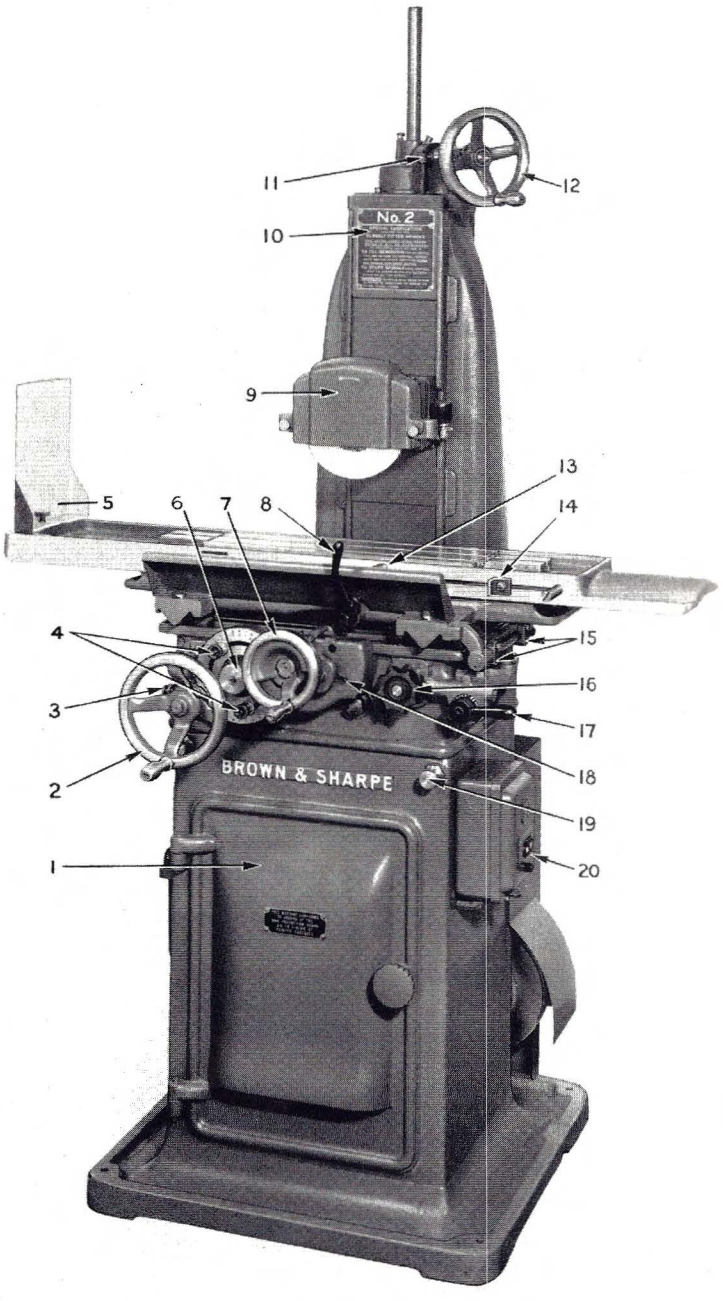
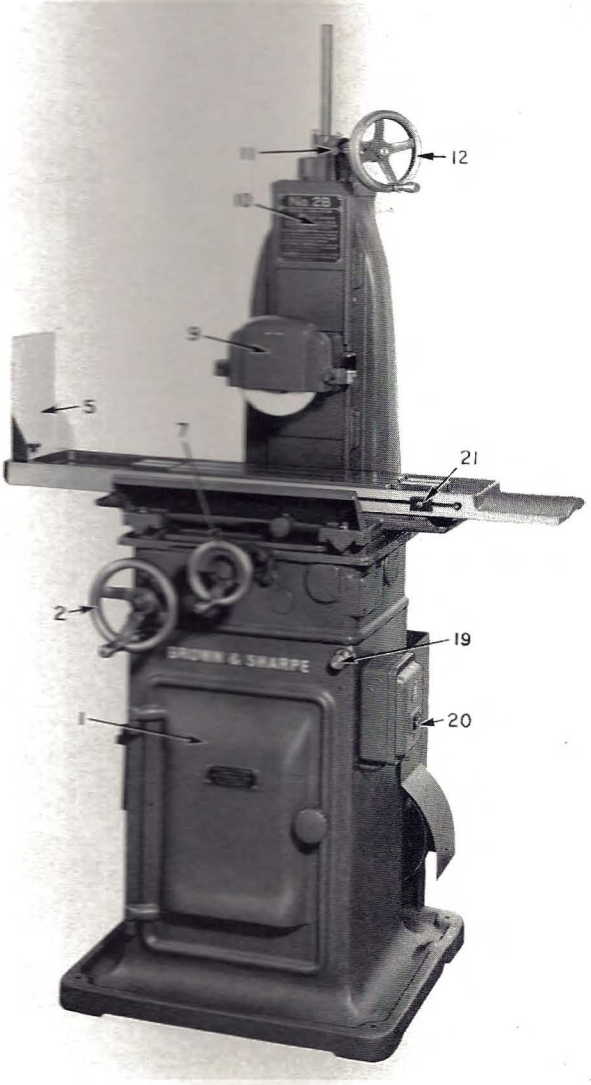
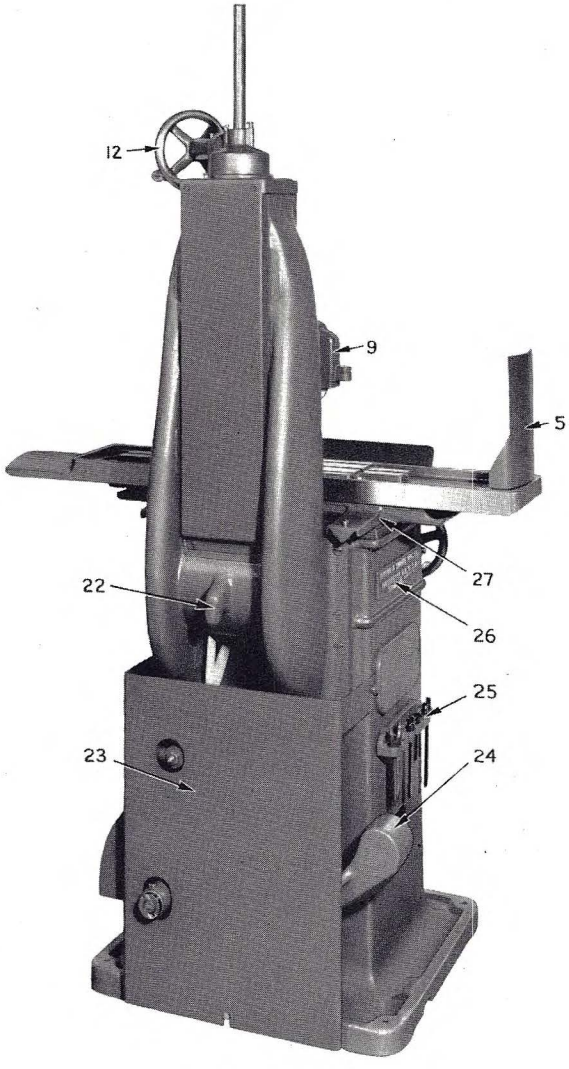
Operating Controls and Principal Parts of the No. 2 and No. 2B Surface Grinding Machines



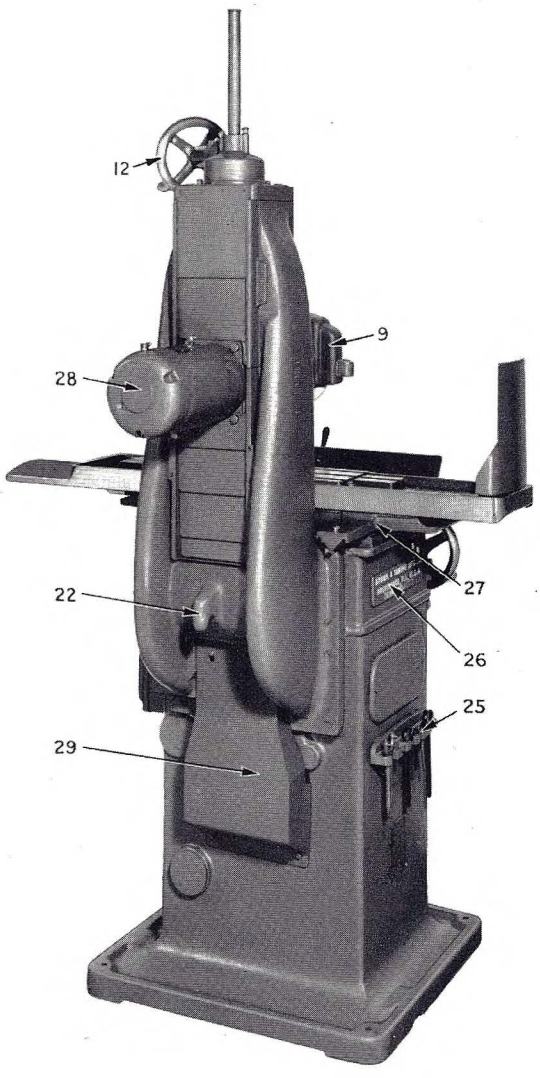
Above — No. 2 Surface Grinding Machine



Right — No. 2B Surface Grinding Machine
(With Hand Feeds Only)



Rear View, No. 2 Surface Grinding Machine

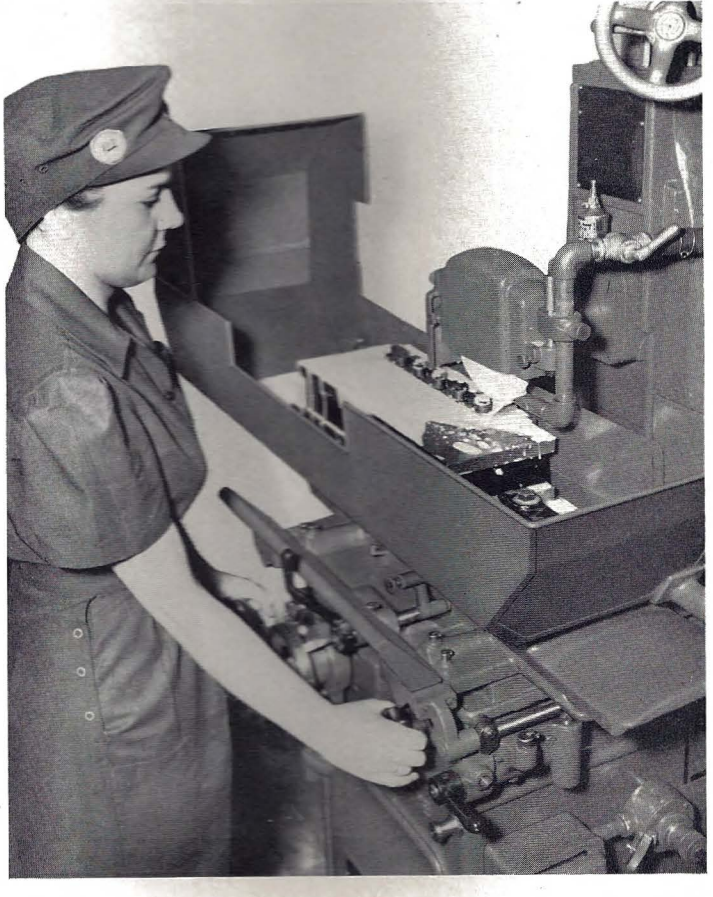


No. 2 Machine Fitted with Motorized Spindle

1 Compartment for motor in base
2 Table handwheel
3 Plunger for positive disengagement of table handwheel
4 Stops for setting amount of power cross feed
5 Removable dust guard
6 Knob for disengaging power cross feed drive
7 Cross feed handwheel
8 Manual reverse lever
9 Wheel guard with removable cover
10 Spindle instruction plate
11 Vertical adjustment clamp screw
12 Vertical adjustment handwheel
13 Dog-operated reverse lever
14 Adjustable table reverse dog
15 Adjustable cross feed trip dogs
16 Table starting knob
17 Table stop lever
18 Cross feed selector lever
19 Stanchion for hoisting rope
20 Start-stop push button and overload relay reset
21 Adjustable table stop (No. 2B Machine)
22 Hook for hoisting rope
23 Driving belts and pulleys (behind guard)
24 Weighted idler pulley arm
25 Wrench rack
26 Bed
27 Carriage
28 Direct-coupled spindle motor*
29 Table drive from motor in base (No. 2 Machine)*

*Machine fitted with motorized spindle.

Two typical set-ups on the No. 2 Surface Grinding Machine. Other operations are illustrated and described on pages 12 to 16.



Choice of hand or power feed permits maximum efficiency of operation. Small areas are ground most rapidly by using hand feed (see illustration above), while power feed facilitates the long-run production job shown at right.

CHAPTER I

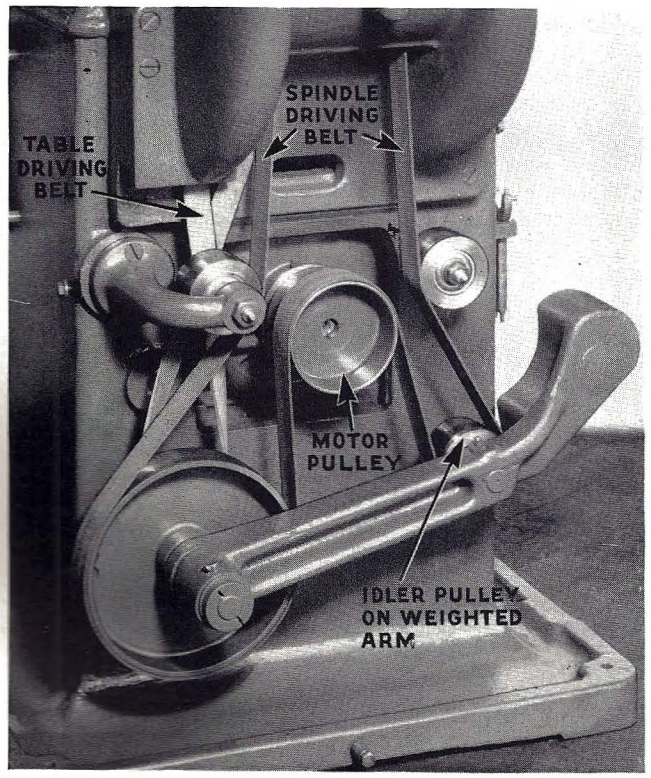
Set-up Adjustments and Operating Controls

This chapter explains the purpose and use of each of the controls and adjustments used in setting up and operating the No. 2 and No. 2B Surface Grinding Machines. In addition, it covers certain points to be remembered in obtaining the best results with these machines. The No. 2 Machine is referred to throughout; but much of the following material also applies to the No. 2B Machine, which is identical to the No. 2 except that power table feeds are omitted in the No. 2B.

Drive. The machine as regularly furnished is belt-driven from a constant-speed motor enclosed in the base (see Fig. 1). A weighted idler pulley maintains proper tension in the spindle belt for all positions of the spindle head. On machines with motorized spindle (Fig. 2), the spindle is driven by a direct-coupled motor on the back of the spindle head, while the table mechanism is belt-driven from a motor in the base.

Drive to the table goes through a reversing clutch, shock-absorber gear and rack pinion shaft to the pinion which drives the table rack; and drive for power cross feed is taken from the front of the rack pinion shaft.

Fig. 1. Arrangement of driving belts on machine with motor in base (guard removed).



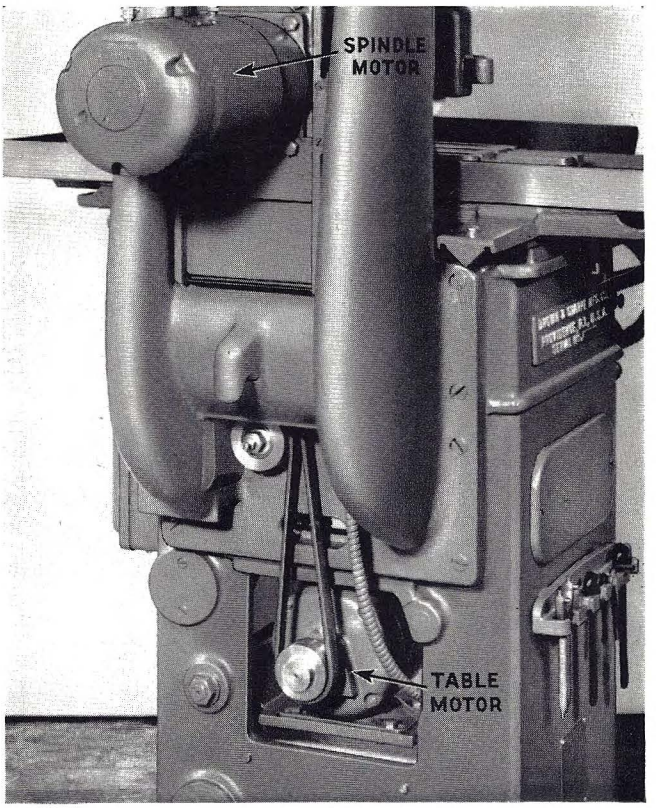


Fig. 2. Spindle and table driving motors on machine with motorized spindle (belt guard removed).

Starting the Machine. The start-stop push button unit in the control box on the right-hand side of the base controls the motor or motors for both table and spindle drives. In starting the machine, follow the instructions given below under the heading of "Starting the Spindle".

Wheel Spindle

Type of Spindle. These machines are regularly furnished with an extremely accurate and close-fitting plain-bearing spindle unit, though an anti-friction-bearing spindle (mounted on preloaded super-precision bearings) is supplied when specified. The spindles are of the removable-unit type and are fastened to the front of the spindle head by four screws through a flange on the spindle sleeve.

Starting the Spindle. When starting a plain-bearing spindle for the first time or after a few days' idleness, press the Start button and almost immediately push the Stop button. Do this three or four times so that the bearings will be adequately lubricated before running the spindle at operating speed.

The antifriction-bearing spindle (when properly oiled) can be started immediately at any time.

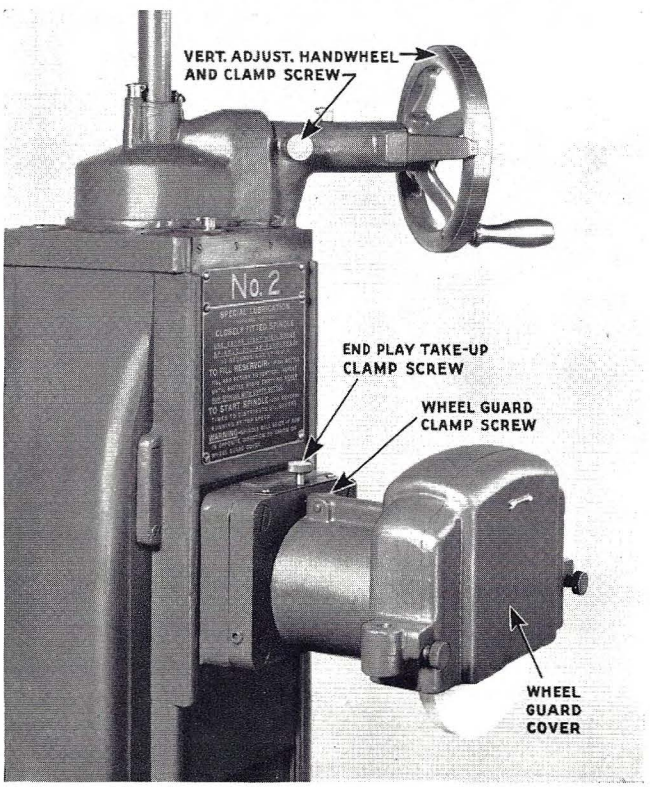
Instructions on oiling the spindle are given on a plate on the front of the upright, and should be followed carefully in operating the machine.

Vertical Adjustment. The vertical adjustment handwheel is at the top of the upright (Fig. 3). Graduations on the handwheel read to .0005", and are widely spaced to facilitate estimating smaller fractions. One revolution of the handwheel moves the spindle head .050", and clockwise rotation raises the head. A knurled clamp screw on the handwheel shaft housing provides for positive clamping of the vertical setting.

End Play Take-up. End play in the plain-bearing spindle is taken up by compression springs which act against a thrust collar in the spindle assembly. (A section drawing of the spindle is shown on page 27.)

In grinding shoulders with the inner face of the grinding wheel, the pressure of the work on the wheel tends to move the wheel outward. To prevent this movement, clamp the thrust collar by tightening the knurled screw in the top of the spindle flange (Fig. 3). To take up end play after doing this, simply release and then tighten the clamp screw. CAUTION: The clamp screw should be tightened only while the spindle is running, and only after it has reached its maximum temperature (½ hour of running).

Fig. 3. Close-up of spindle head and vertical adjustment handwheel showing clamp screws and wheel guard.



Since the clamp screw merely holds the thrust collar in position and does not govern the closeness of adjustment, there is no reason to use excessive clamping pressure.

For normal surface grinding or when grinding shoulders with the outer face of the wheel, the clamp screw can be released, leaving the thrust springs to take up end play automatically.

In the antifriction-bearing spindle, end thrust in both directions is taken by two opposed preloaded ball thrust bearings.

Wheel Speed. With a belt-driven spindle the full-load spindle speed is 3200 r.p.m., giving the wheel a surface or peripheral speed of 5860 ft. per min. for a 7" wheel and 4190 ft. per min. when the wheel is 5" in diameter.

When the spindle is driven by a 60-cycle direct-coupled motor the full-load speed is 3450 r.p.m., giving a peripheral speed of 6320 ft. per min. for a 7" wheel and 4515 ft. per min. when the wheel is 5" in diameter.

Wheel Guard. The wheel guard (see Fig. 3) is in two parts: (1) the guard proper, which fits over and is clamped to the wheel spindle sleeve; and (2) the wheel guard cover, which is fastened to the front of the wheel guard by two thumbscrews. Only the cover is removed in changing wheels.

The wheel guard is usually positioned with its bottom edge horizontal. The clamp screw (at the top near the spindle sleeve flange) can be loosened and the guard tipped either side of horizontal if necessary.

Always make sure that the guard is securely clamped before starting the machine; and never run a wheel without having the guard and its cover in place.

Care and Use of Grinding Wheels

Selecting the Wheel. In order to produce the desired quality of work in the shortest time, real care is necessary in choosing the wheel which is best for the job at hand. The items to consider in making this choice are discussed in Chapter IV (page 23).

Mounting Wheels. One general-purpose grinding wheel and one wheel sleeve are furnished with the machine. When additional wheels are used, extra wheel sleeves should be procured so that each wheel can be kept on its own sleeve. Thus, in changing from one type of wheel to another, the wheel and sleeve can be changed as a unit and will remain concentric, requiring only a minimum amount of truing.

The wheel should fit easily on the wheel sleeve, yet not loosely, for if it is loose it cannot be centered accurately and will consequently be out of

balance. Do not wrap the sleeve with paper etc. to make a wheel fit when the hole is too large. It is better from all standpoints either to discard such a wheel or recast the core.

A wheel that fits a trifle tightly may crack if forced on the sleeve. If the hole is only a little under size it can easily be scraped out to fit.

Before mounting a wheel, hang it in the air on one finger; then lightly tap the edge of the wheel

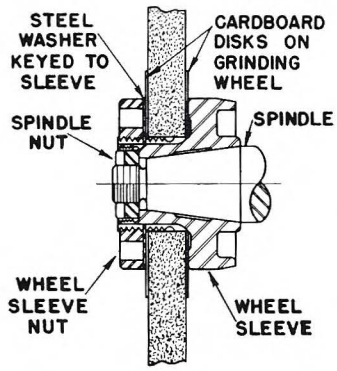


Fig. 4. Proper mounting of grinding wheel.

and see if it gives a clear ringing sound. A wheel that does not ring clear is probably cracked and should not be used.

The inner of the two flanges between which the wheel is mounted is a part of the wheel sleeve (see Fig. 4). The outer flange consists of a steel disk or washer which is keyed to the wheel sleeve to keep it from turning and loosening the clamping nut.

To equalize the clamping pressure, washers of cardboard or rubber should be placed between the wheel and the two flanges. Most wheels of the size used on this machine have a ring of heavy blotting paper on each side, which serves the purpose.

Using the pin wrench furnished, tighten the clamping nut enough to hold the wheel firmly in place on the sleeve. Do not tighten too much, however, as excessive clamping pressure will crack the wheel.

Changing Wheels. In removing a grinding wheel from the spindle, always *use the wheel sleeve puller* (furnished with the machine) to avoid any chance of cracking the wheel or damaging the spindle bearings by pounding. Remove the spindle nut (this nut has a *left-hand* thread) ; then thread the outer member of the wheel sleeve puller into the wheel sleeve and tighten the inner screw against the spindle, thus loosening the wheel sleeve without harmful jarring.

In putting a wheel on the spindle, first see that both the wheel sleeve hole and the spindle end are perfectly clean. Then slip the sleeve onto the spindle, seat it by hand and tighten by means of the clamping nut and wrench.

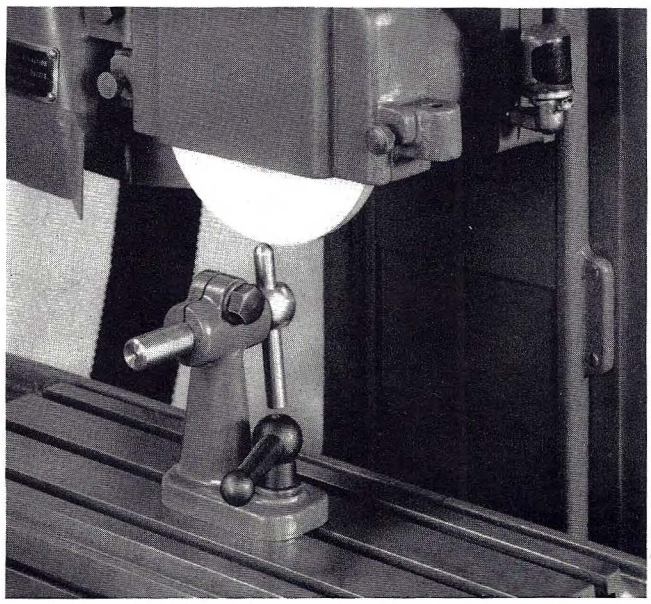
Balance of Wheel. It is essential that the wheel run perfectly true and without vibration. Grinding wheels are balanced by the manufacturer and, in the case of wheels of the size used on this machine, should not require attention in this respect other than truing. A wheel that runs badly out of balance after truing should be discarded or returned to the wheel manufacturer—though in cases of necessity the condition may be corrected by digging out part of the wheel beneath the flange and filling with lead as indicated by a test for static balance.

Wheel Truing. A wheel truing fixture is furnished with the machine. The truing diamond (not furnished) may be applied to the wheel along any line on the lower half of the wheel circumference, though preferably at the bottom of the wheel as shown in Fig. 5. To prevent gouging, the center line of the diamond tool should point slightly beyond the center of the wheel in the direction of movement of the wheel surface.

The wheel should be trued each time it is put on the spindle and whenever it becomes loaded, dull or glazed. Pass the diamond across the wheel with a slow, steady manual cross feed, taking care to avoid any longitudinal movement of the table.

In truing a wheel for rough grinding, take a cut about .0005″ deep in one pass of the diamond across the wheel and finish with a similar cut .00025″ deep. If the wheel is to be used for finish grinding, take two .0005″ cuts; then take two or three additional cuts removing about .00025″ each time, and finally pass the diamond across the wheel once or twice

Fig. 5. Wheel truing fixture in use.



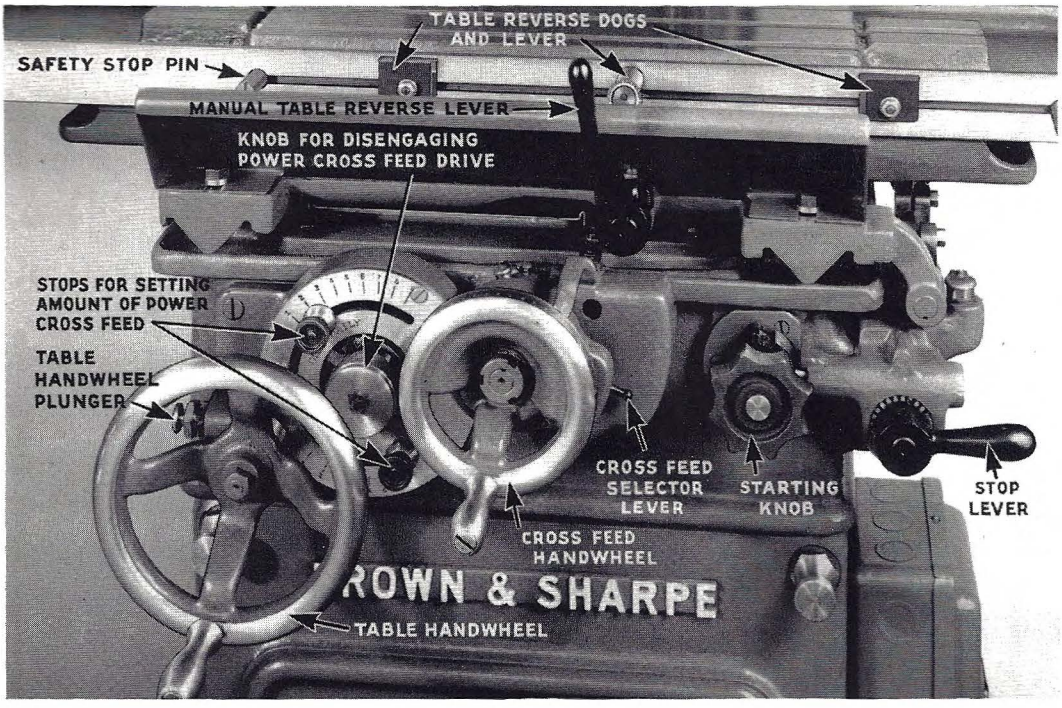


Fig. 6. Controls and adjustments at front of No. 2 Machine.

without further advance of the wheel. The figures stated are approximate and under some conditions should be varied somewhat to give desired results.

The wheel can be trued to a radius or angle and combinations of radial and angular shapes can be obtained by using the Radius and Angle Wheel Truing Attachment described on page 22.

Longitudinal Table Travel

Power Travel. To engage power table travel, turn the starting knob a quarter-turn to the right (Fig. 6) ; and to stop the table, press the horizontal lever at the right of the starting knob.

The table handwheel can be positively disengaged for safety during power operation. Pull out the spring plunger behind the handwheel (Fig. 6), pull the handwheel forward and release the plunger.

The rate of power table travel is regularly 33 ft. per min., though machines are furnished with a table speed of 17 ft. per min. when specified.

Table reversal for power operation is controlled either manually or automatically. The manual reverse lever is shown in Fig. 6.

Automatic reverse is obtained by adjustable table dogs which operate a reversing lever (see Figs. 6 and 7). For convenience in loading and unloading work or for wheel truing, the top of this lever has a plunger which can be withdrawn to allow the table to be moved beyond the limits set by the dogs.

In setting the table dogs for automatic reversal, allow enough over-travel of the work beyond the grinding wheel in both directions to assure the completion of cross feed before the work comes back under the wheel and to permit the machine to become stabilized after reversal.

Hand Table Travel. The table handwheel is located as shown in Figs. 6 and 8. One turn of the handwheel moves the table approximately 2″. On the No. 2 Machine the handwheel is held positively engaged or disengaged by the spring plunger behind the handwheel (Fig. 6).

For continuous manual operation of the No. 2 Machine disengage the power cross feed mechanism by means of the knurled knob in the center of the cross feed dial (Fig. 6). Turn the knob clockwise approximately two and one-half turns until it is tight. Also, withdraw the plunger of the dog-operated reversing lever to prevent the dogs from coming into contact with the lever.

Cross Feed

Power Cross Feed. The amount of power cross feed is selected by two adjustable stops on the graduated plate or dial behind the two handwheels (see Fig. 6). Figures on the dial indicate hundredths of an inch. The upper stop sets the amount of feed at the right-hand end of the table travel, and the lower stop sets the feed at the left-hand end. Any amount of cross feed from .01″ to .09″ is available at each reversal; and if desired, either stop can be set at zero to give cross feed at one end of table travel only.

To engage the power cross feed drive, turn the knurled knob in the center of the dial (Fig. 6) counterclockwise until loose (about two and one-half turns).

Direction of cross feed is selected by the small lever in the oscillating part behind the cross feed handwheel (Fig. 6). For inward cross feed move the lever to the left, and for outward feed move it to the right. A neutral position of the lever disengages power cross feed.

Stop Dogs. Two adjustable trip dogs on the right-hand side of the carriage (Fig. 7) provide for stopping the table and carriage automatically at any desired point in the cross feed. After the machine has been stopped by a trip dog, move the cross feed selector lever to change the direction of cross feed before starting the table again. On resuming operation, hold the starting knob in the engaged position for the first two or three reversals until the trip dog has moved off its plunger enough to permit the knob to remain engaged.

Do not try to force the machine to grind by power cross feed a width greater than the maximum permitted by the trip dogs, for to do so is to risk breaking the cross feed mechanism.

Hand Cross Feed. The cross feed handwheel (Figs. 6 and 8) is graduated to .001". One turn of the handwheel gives ¼" feed, and clockwise rotation moves the work inward.

Before using the cross feed handwheel, put the cross feed selector lever (Fig. 6) in its central or neutral position.

Suggestions on Set-up and Operation

Clamping Work to Table. In clamping workpieces, chucks, vises etc. to the table of the machine, use only enough clamping pressure to hold the part from slipping. Tight clamping is not necessary, since the forces exerted on the work are quite small; and excessively hard clamping might spring the table enough to cause inaccuracies in the work.

Rough and Finish Grinding. In general, it is not advisable to use one machine consistently for heavy hogging cuts and for highest-quality finish grinding as well. If large amounts of heavy roughing work are to be done, it is best to use one machine for that class of work and do the finish grinding on a machine reserved for finish grinding only.

Form Grinding. Under proper conditions of maintenance and by using adequate care in operation, highly accurate form grinding can be performed on these machines.

Spindle Alignment. The contacting surfaces of the spindle head and spindle sleeve flange are scraped at our factory to give a good commercial accuracy of alignment of the spindle with relation to the table ways. For shoulder grinding jobs which demand greater-than-ordinary closeness of parallelism between the side of the wheel and the table travel, the required alignment can be secured by carefully scraping the spindle sleeve flange.

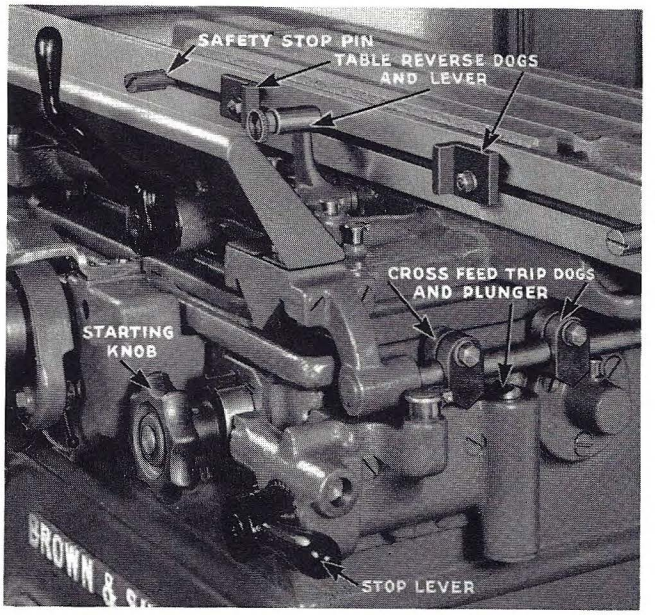
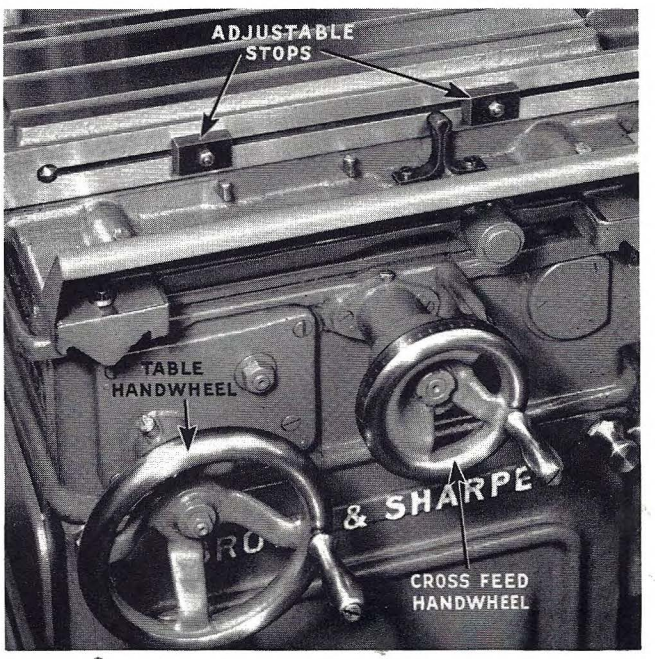


Fig. 7. Power feed controls as seen from right front of machine.

Note that any alteration by scraping should be done on the flange and not on the face of the spindle head; for the spindle head should remain untouched so as to permit other spindles to be used in the machine.

Dry Grinding. In dry grinding operations use an exhauster to protect the operator, the machine itself and neighboring machines from the grit and dust produced. Either connect the machine to a central exhaust system or use an exhaust attachment such as the one described on page 17.

Fig. 8. Table stops and handwheels on No. 2B Machine (With Hand Feeds Only).



CHAPTER II

Typical Operations

The operations shown in this chapter are representative of the various types of work performed on these machines. While no attempt has been made to describe each job in detail, the main features of set-up and operation are outlined as a guide to good grinding practice.

Note that although the No. 2 Machine is shown throughout, many operations can be performed with equal ease and efficiency on the No. 2B Machine (With Hand Feeds Only) — particularly on single-piece or short-run jobs where the workpieces are comparatively small.

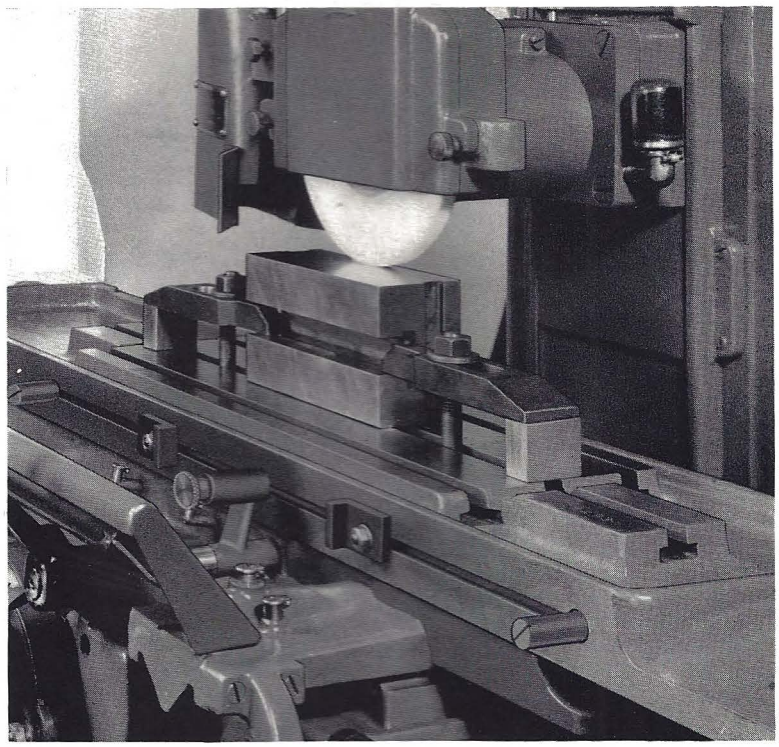


Fig. 9. This is perhaps the simplest and most common type of job performed on these machines — grinding a rectangular flat surface on a piece clamped to the table. Power table travel is used, with the reverse dogs set to give adequate over-run at each end of the work; and power cross feed is used, the cross feed trip dogs being set to stop the table on completion of the desired amount of cross feed in each direction.

Since only small forces are involved in surface grinding, the clamp bolts are tightened only enough to keep the work from slipping, thus avoiding any possibility of springing due to excessive clamping pressure.

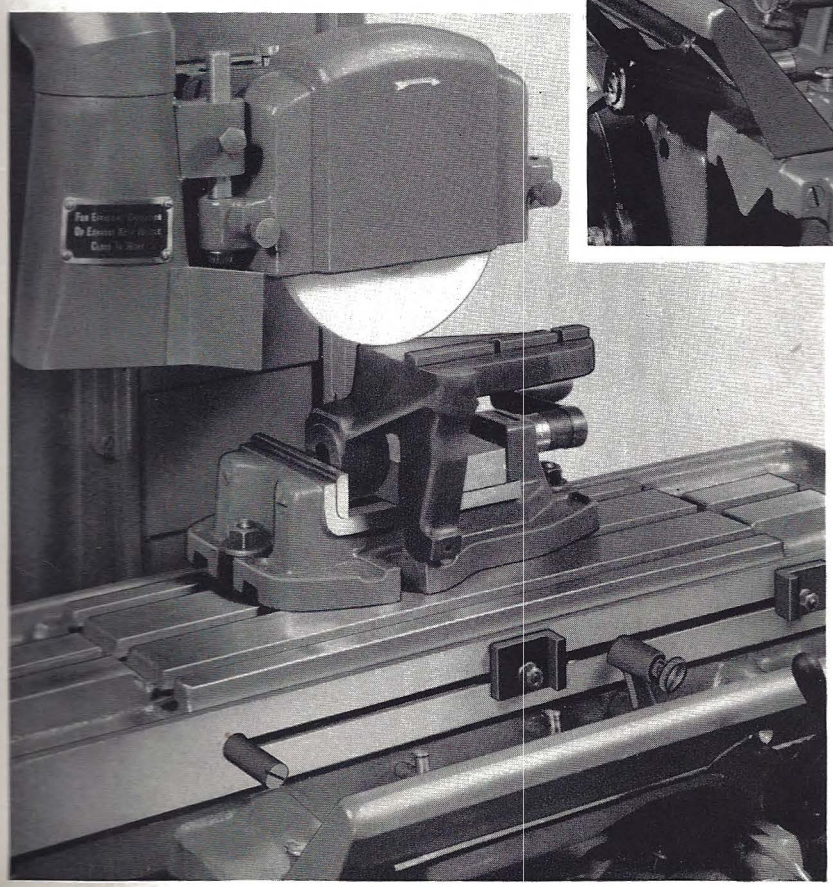


Fig. 10. Grinding the base of a bracket. On this single-piece toolroom job the surface to be ground is lined up horizontally by means of a height gage.

The table dogs are set for grinding the overall length of the piece. On the shorter portion (where the wheel is shown) the operator saves time by reversing the table by hand. For grinding the portion at the front of the integral key, the plunger of the dog-operated reversing lever is withdrawn to permit moving the work past the grinding wheel without disturbing the setting of the dogs.

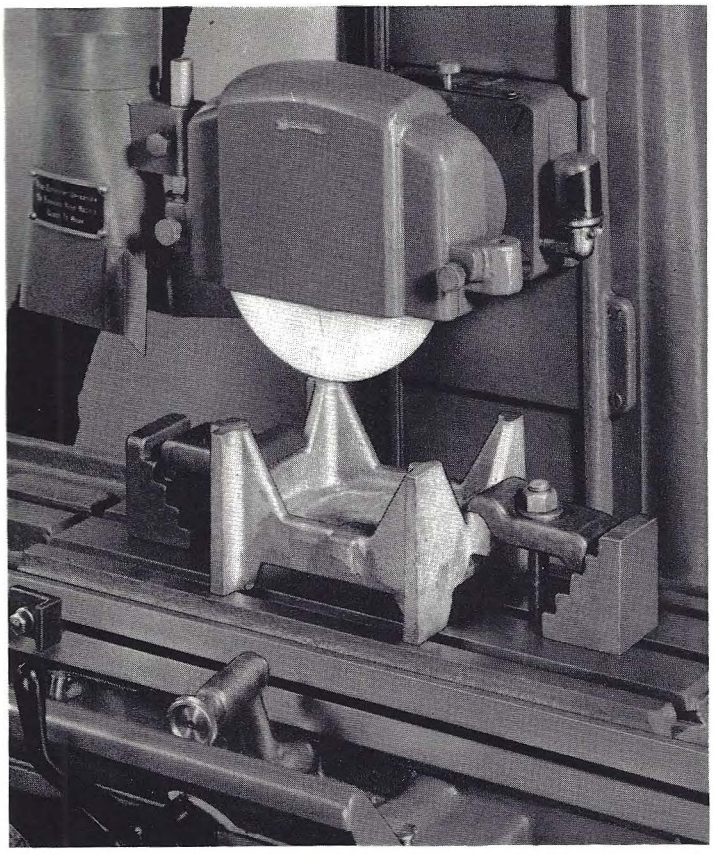


Fig. 11. Finishing four legs of a drill jig to uniform height. In grinding narrow, widely-separated surfaces such as this, time is saved by grinding one surface at a time, using hand feed as illustrated on page 6. The plunger of the dog-operated reversing lever is withdrawn to prevent bumping the lever with the table dogs. All four surfaces are ground each time before the wheel is lowered for the next cut.

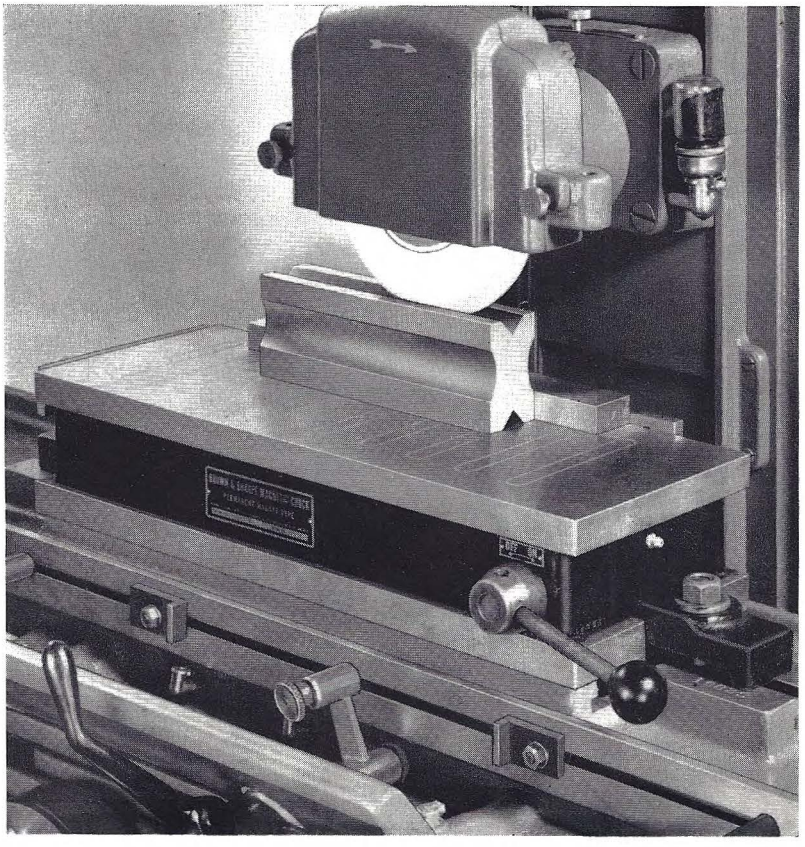


Fig. 12. A typical form grinding job — finish-grinding the V-groove of a V-block. Power table travel is used, with the cross feed drive disengaged. The wheel is formed to the required angle by means of the Radius and Angle Wheel Truing Attachment, and is fed downward an estimated .0001″ at each reversal. (Too heavy a feed will heat the work and cause inaccuracy due to warping.) After one side of the groove is finished, the piece is turned around and the other side is ground.

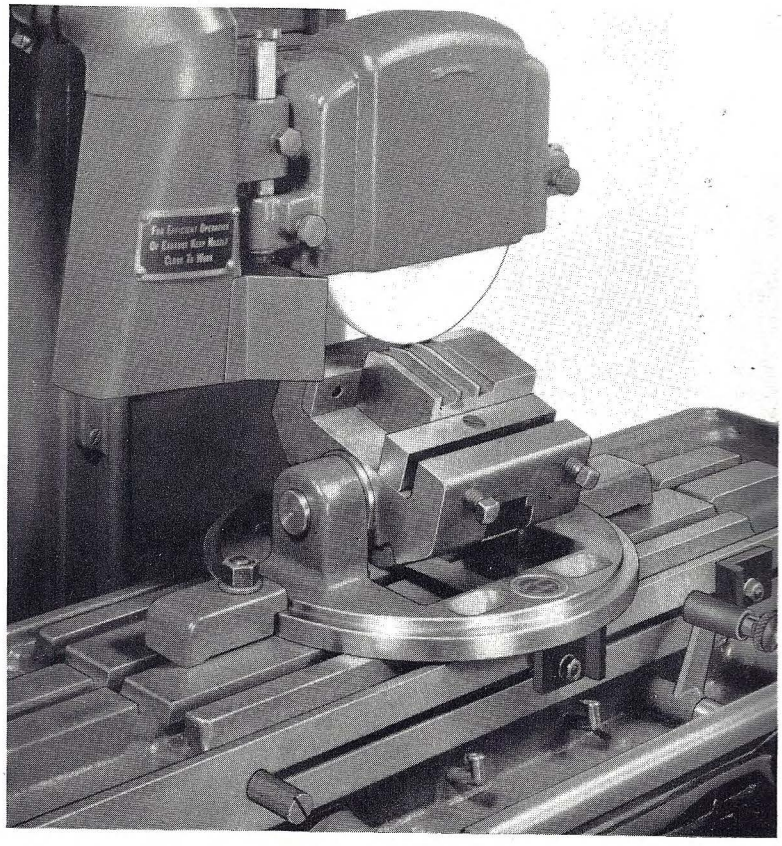


Fig. 13. Angular flat surfaces are ground as readily as parallel surfaces. The piece illustrated is held at the required angle by an Adjustable Swivel Vise, which is clamped to the table with the jaws set approximately in line with the T-slots.

As with all grinding jobs where coolant is not employed, use of an exhauster is recommended to protect the operator, the machine and neighboring machines from the dust and grit produced. The exhaust nozzle shown in these illustrations is part of the Exhaust Attachment described on page 17.

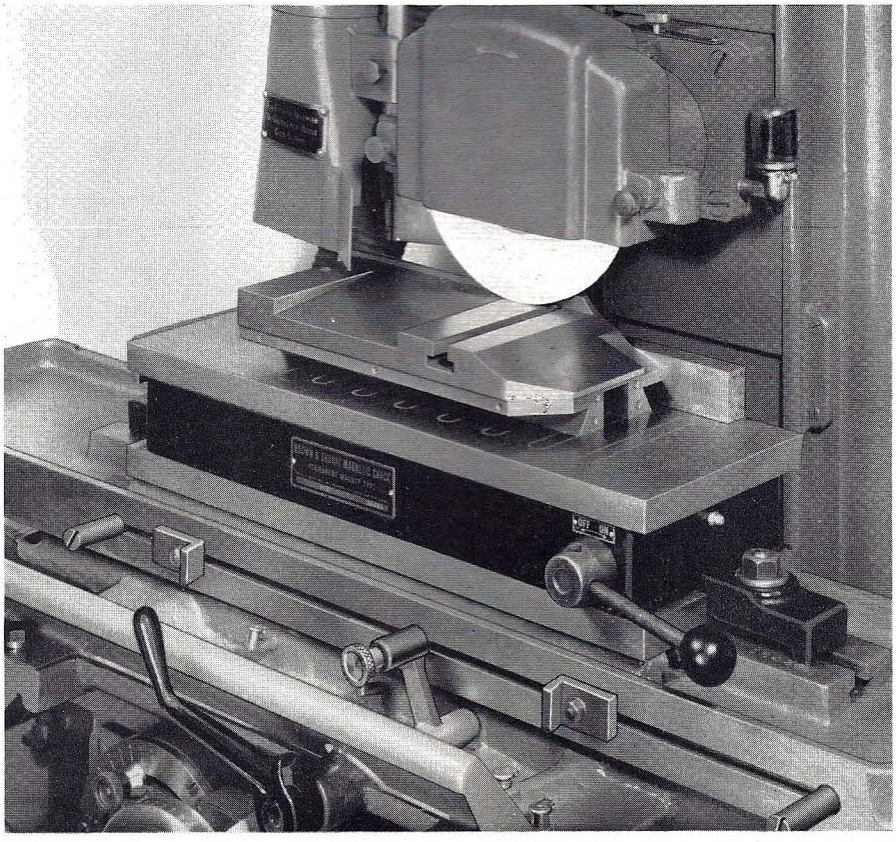


Fig. 14. Refinishing the top surface and shoulder of a screw machine cross slide. The work is mounted on a permanent-magnet-type magnetic chuck and is lined up by a parallel which bears against the rear stop plate of the chuck.

Since the shoulder is ground with the inner face of the wheel and the machine here used has a plain-bearing spindle, the knurled screw at the top of the spindle flange is tightened to clamp the thrust collar and prevent endwise movement of the spindle as explained on page 8.

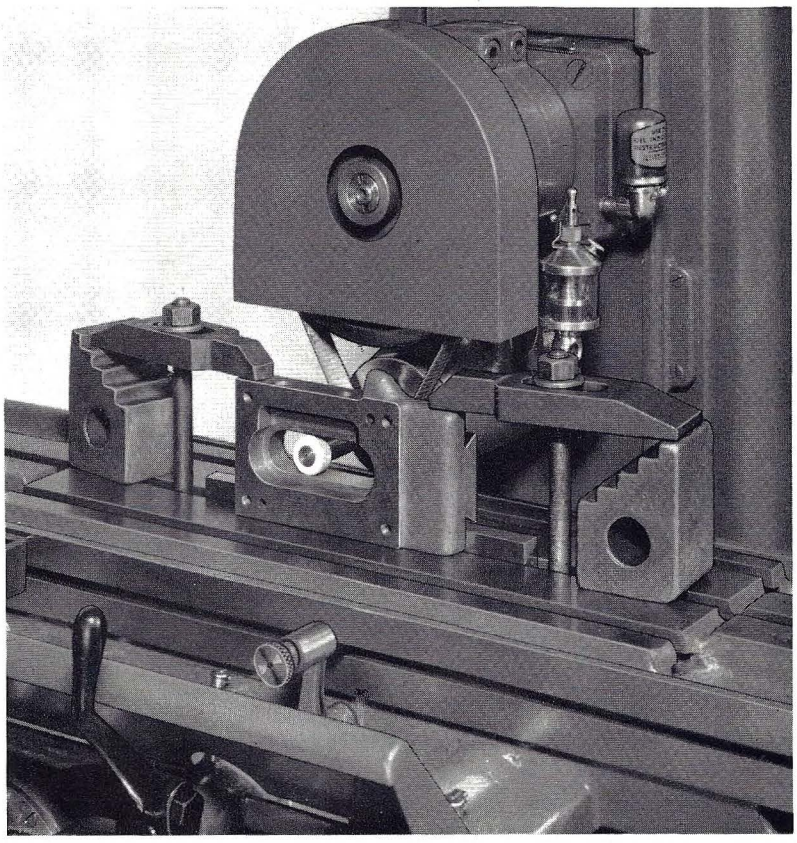


Fig. 15. This internal slot is readily ground by means of the High Speed Surface Grinding Attachment (described on page 20). The work-piece is strapped to the table and aligned by a parallel in the table T-slot. After finishing the bottom of the slot, the spindle head is raised and the upper surface is ground, thus assuring that the two surfaces will be exactly parallel. Hand feeds are used for this operation.

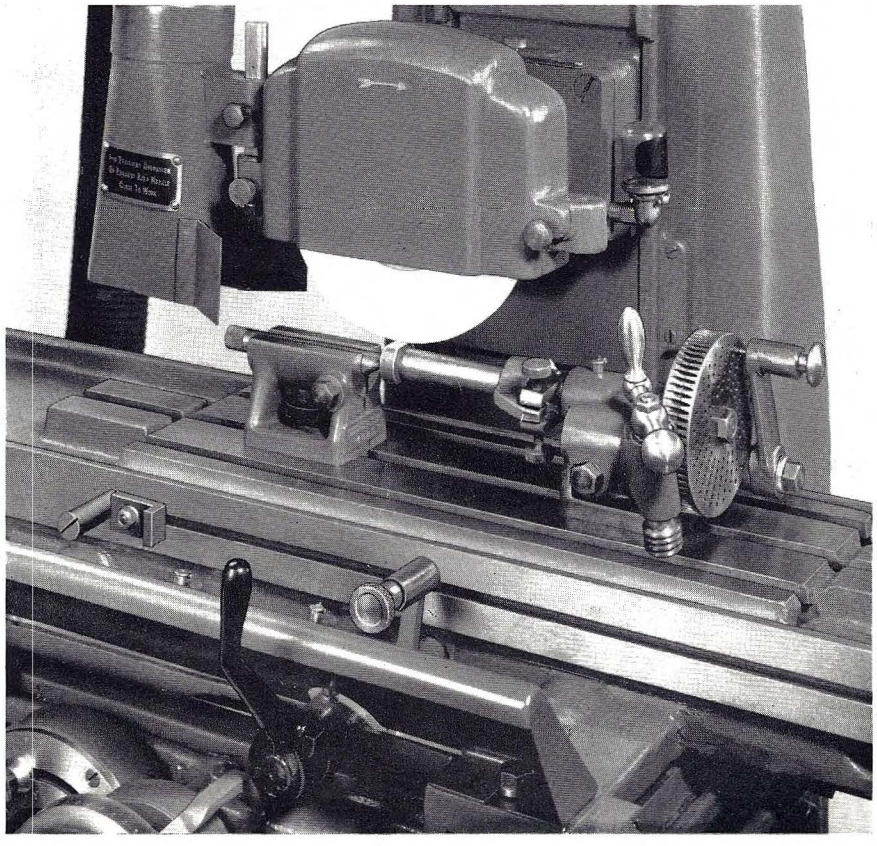


Fig. 16. The 4¾" Index Centers provide a convenient means of grinding two flats 180° apart. Numerous other angular spacings are likewise obtainable as outlined on page 20. The index worm is here disengaged and the index plate turned by hand.

Hand feed of the table is used in the set-up illustrated. If power feed is desired, the right-hand table dog should be set to reverse the table before the work driving dog touches the grinding wheel.

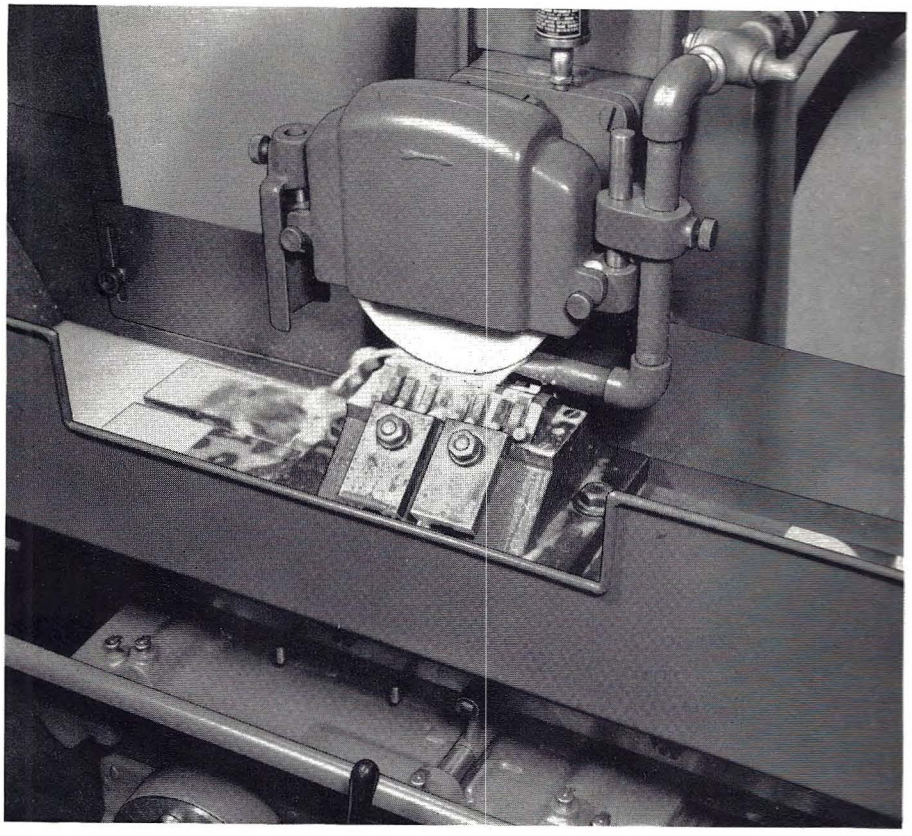


Fig. 17. A typical production set-up for grinding the ends of small pieces at an angle. The work is held in a fixture, and 16 pieces are ground at each loading. An ample flow of coolant provided by the Wet Grinding Attachment prevents heating of the work, thus permitting heavier cuts without loss of accuracy through heat distortion, and also takes care of the grit and dust produced.

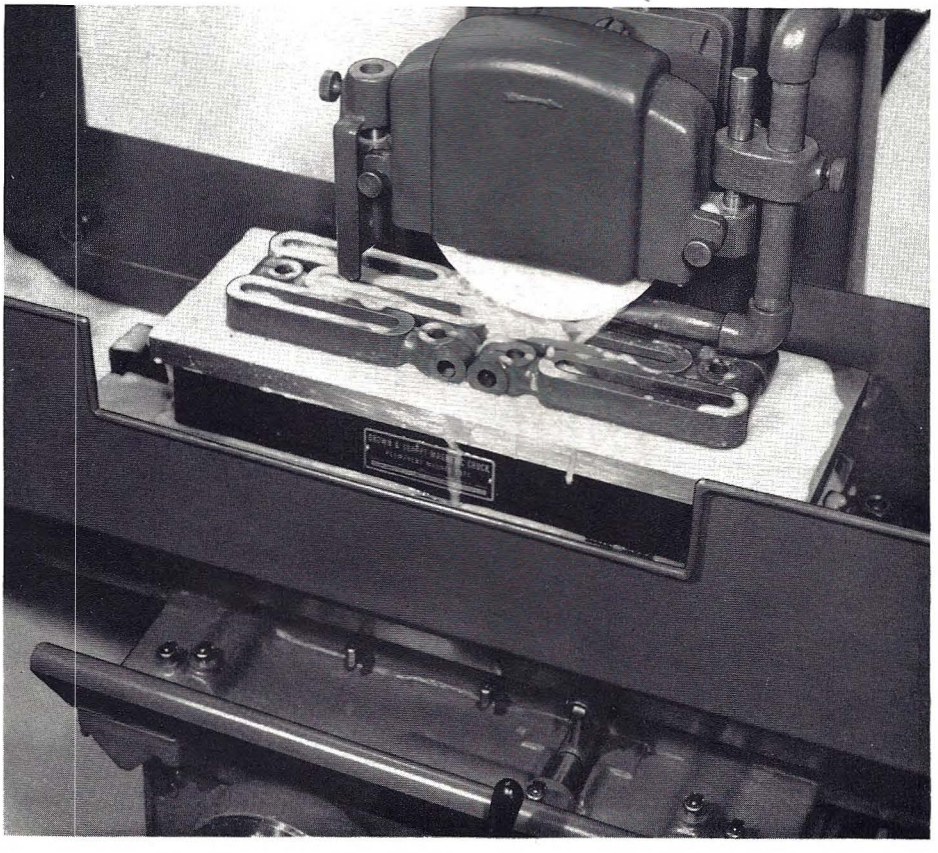


Fig. 18. Another representative production job — grinding the parallel faces of brackets. Six pieces are held on the permanent-magnet-type chuck at each loading, and the coolant supplied by the Wet Grinding Attachment allows relatively heavy cuts to be taken without distortion of the work due to heating.

In both of the operations shown on this page, a sheet steel splash guard can be slipped onto the front of the table tank if necessary. This guard is shown in position in Fig. 22, page 18.

CHAPTER III

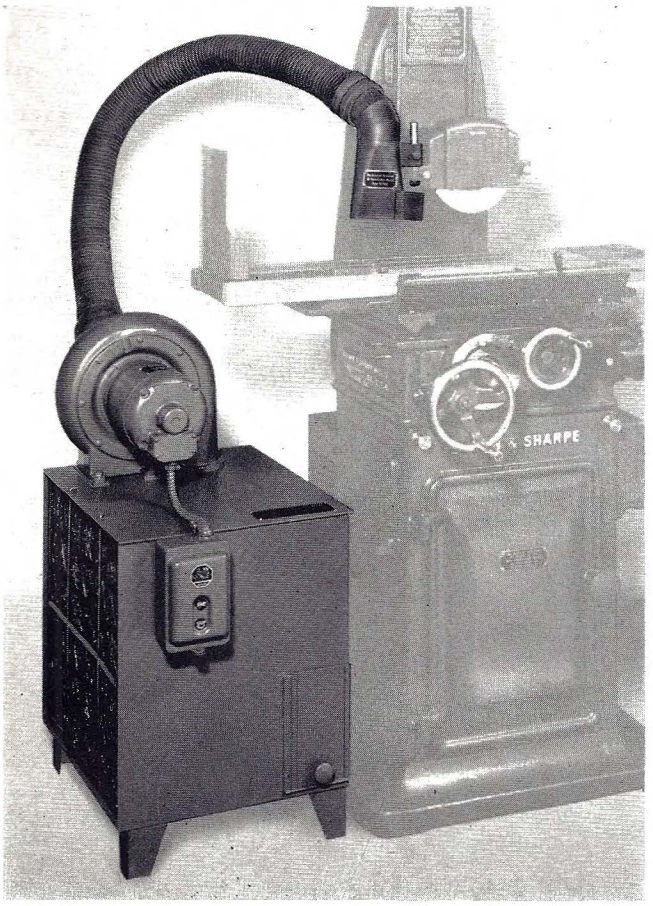
Additional Equipment (Furnished at Extra Cost)

This chapter describes and illustrates the various items of additional equipment available as extras and gives instructions on their set-up and use. This equipment includes an Exhaust Attachment, Exhaust Nozzle (for use with central plant exhaust system), Wet Grinding Attachment, Castered Base (for use with Wet Grinding and Exhaust Attachments), Magnetic Chucks, 4¾ Inch Index Centers, High Speed Surface Grinding Attachment, Adjustable Swivel Vise, and Radius and Angle Wheel Truing Attachment.

Exhaust Attachment

This Attachment removes grit and dust-laden air from the region of the grinding operation and separates out the foreign matter, leaving the air well-cleaned. It is readily moved from one machine to another, and is recommended for all dry grinding operations as a means of providing the necessary protection to the operator and machine. The Attachment is shown complete in Fig. 19 and is shown in use in pictures throughout this book.

Fig. 19. Exhaust Attachment.



The motor-driven fan on the separator tank draws the air at high speed through a flexible pipe from an adjustable exhaust nozzle attached to the wheel guard and blows it into a spiral separator, where the heavier particles are removed by centrifugal force. The air then passes slowly out through two viscous-coated renewable filter pads which remove the remaining finer particles. The separator chamber is emptied through the vertical sliding gate at the right front of the tank, while the filter pads are released for replacement by lifting out the two vertical rods which hold them in position.

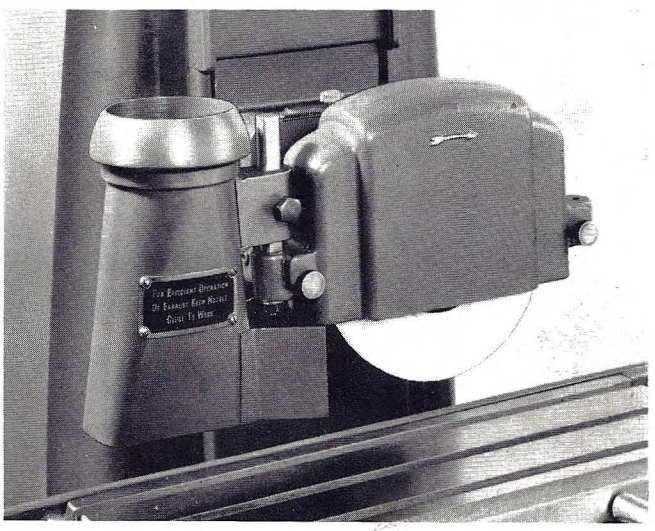
For most efficient dust removal, adjust the position of the exhaust nozzle on its supporting stud so as to keep the nozzle close to the work.

The ¼ h.p. fan motor is controlled by a starting switch having overload protection, and is designed to be connected directly to the power line. However, if the grinding machine is fitted with the receptacle used with the Wet Grinding Attachment, the Exhaust Attachment can be equipped with a plug and cable for plugging into the receptacle.

Exhaust Nozzle
for Use with Central Plant Exhaust System

The Exhaust Nozzle (Fig. 20) offers a convenient means for connecting the machine to a central exhaust system. A special stud is included for attaching the nozzle to the wheel guard of the machine and permits adjusting the position of the nozzle.

Fig. 20. Nozzle for connection to plant exhaust system.



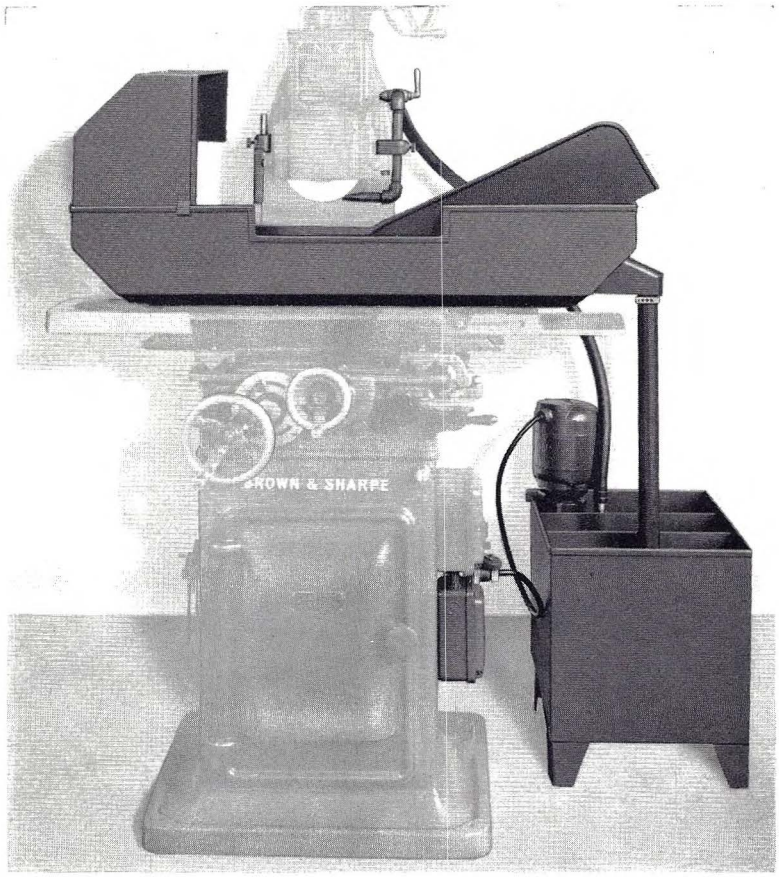


Fig. 21. Wet Grinding Attachment.

Fig. 22. Wet Grinding Attachment in use, showing adjustable splash guard on rear of work tank and removable splash guard on front.

Wet Grinding Attachment

As illustrated in Fig. 21, the Wet Grinding Attachment includes an 18-gallon baffled coolant tank, motor-driven centrifugal pump, flexible delivery pipe, valve, adjustable nozzle, adjustable splash guard (attached to the wheel guard), and a work tank which is mounted on the machine table and fitted with a hood and front and rear splash guards. Coolant is collected in the work tank and returns to the coolant tank through the piping shown.

Inside the work tank is a base plate provided with two screws having T-nuts for fastening to the middle T-slot of the machine table. The bottom of the work tank rests on three support blocks, one of which should be placed under each of the base plate screws and the other under the middle of the tank. The combined thickness of the base plate, tank bottom and support blocks reduces the vertical capacity of the machine by 1⅝".

To be sure of obtaining the highest accuracy in grinding work parallel, it is advisable to grind the top surface of the base plate each time the work tank unit is installed on the machine. Remove only the minimum amount of metal required to finish the entire top surface. Regrind occasionally if necessary to remove pits, burrs and scratches, as a smooth surface is essential for grinding work accurately parallel.

A start-stop switch for the pump and a plug-in receptacle are mounted on the right-hand side of the machine. The pump can be stopped independently, but can operate only when the machine motor is running. The disconnect plug provides for easy removal of the pump.

This Attachment is shown in use in Fig. 22. Since its primary purpose is to remove the heat of the grinding operation, it is recommended particularly for production grinding where relatively heavy cuts are taken.

Castered Base
for Use with Wet Grinding and Exhaust Attachments

The castered base or dolly (Fig. 23) provides a ready means of moving the coolant tank or separator tank to other machines or to a convenient

place for emptying and cleaning. It is sturdily constructed of heavy steel, is equipped with ball bearing casters and fits into the corners formed by the feet of the tank, raising the feet about ¼" off the floor to permit free movement.

Magnetic Chucks

The Brown & Sharpe Nos. 510 and 618 Rectangular Model Magnetic Chucks (Permanent Magnet Type) provide a quick, easy means of holding a variety of ferrous work for surface grinding. A 180° movement of the control lever (see Fig. 24) turns the chuck on or off; and since the chuck does not use electric current, it can be left turned on for as long as desired without heating. Auxiliary top plates are available to permit holding smaller work than can usually be held on a magnetic chuck.

For highest accuracy in grinding work parallel, the top surface of the chuck should be ground each time the chuck is mounted on the machine. Be sure that the chuck is turned on before doing this, and remove only the minimum amount of metal required to grind the entire top surface.

The chuck should not be subjected to excessive heat, shocks or blows, and the top should be kept free from pits and scratches. Regrind the top surface occasionally if necessary, as a smooth surface is essential for grinding work parallel.

Two removable stop plates are furnished with each chuck, one for the back and one for the left-hand end. These stop plates may be adjusted vertically to suit the work.

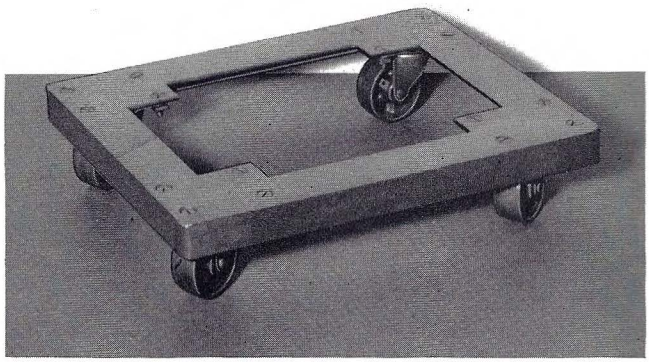


Fig. 23. Castered Base.

The No. 510 chuck is 3⅜" high and has a working surface 5⅝" x 10⅜", while the No. 618 chuck (illustrated below) is 3⅝" high and has a working surface 6⅜" x 18⅛". Brown & Sharpe Magnetic Chucks of the Permanent Magnet Type are for sale only in the United States of America and its Territories.

Electromagnetic chucks and controlling equipment together with a magnetic chuck generator, are also available. Information on application.

Generator is not available on machines fitted with motorized spindle.

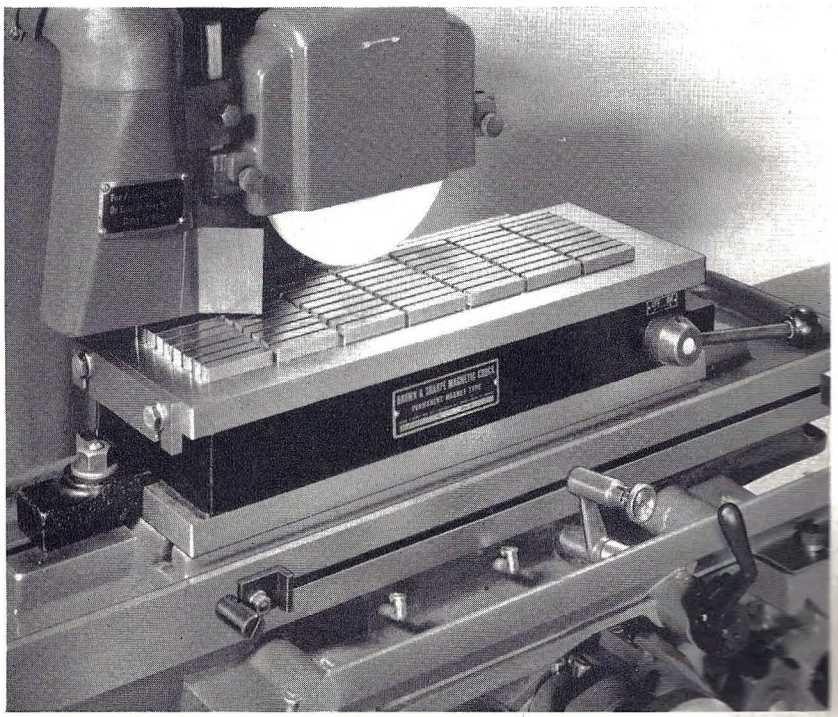


Fig. 24. Brown & Sharpe No. 618 Magnetic Chuck (Permanent Magnet Type) in use on a typical production job—precision-grinding 63 parts at each loading. Amount of holding power is controlled by lever shown.

Since chucks of this type have no electrical connections, they are readily moved from one machine to another.

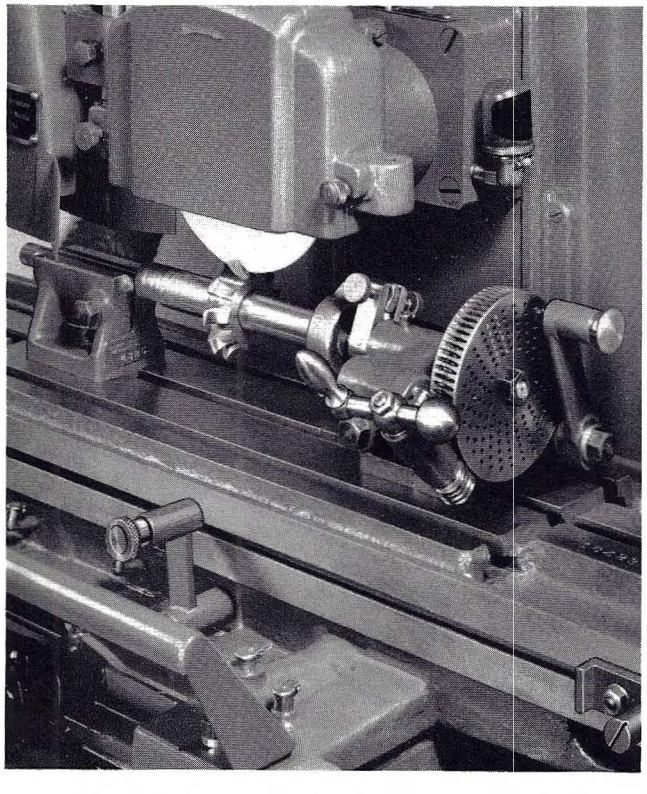
4¾ Inch Index Centers

These Index Centers (Fig. 25) permit accurate indexing of the more common circular divisions, facilitating the grinding of taps, reamers, formed cutters and similar work. The centers are clamped in position by T-bolts and are aligned by tongues which fit the table T-slots.

A spring-loaded locking pin on an adjustable arm, together with six rows of holes in the face of the combined index plate and worm wheel, provide for indexing all divisions from 2 to 14 and all even-numbered divisions from 18 to 28. The index plate can be turned by the worm, or the worm can be thrown out of mesh and the index plate turned by hand. To disengage the worm, loosen the adjacent clamp screw and swing the worm downward.

In using the Index Centers for sharpening formed cutters or similar work having radial tooth faces (see Fig. 25), first turn the cross feed handwheel to bring the centers in line with the face of the grinding wheel. Then, with the work mounted between centers, disengage the index pin and turn the worm to feed the face of a tooth into the grinding wheel, feeding the work a small amount and running the table back and forth by hand in successive steps until that tooth is properly sharpened. Next loosen the index pin arm, insert the pin in a hole in the proper circle and securely clamp the arm.

Fig. 25. 4¾ Inch Index Centers.



In sharpening the rest of the teeth where a considerable amount of stock is to be removed from each tooth face, feed the work to the grinding wheel by means of the worm to take the necessary number of successive cuts on each face until the index pin enters the proper hole. In case the grinding wheel requires dressing before all of the teeth are sharpened, readjust the position of the index centers relative to the grinding face of the wheel after dressing the wheel. Moving the carriage to bring the face of the last tooth ground into contact with the grinding wheel is often sufficient. After sharpening the remainder of the teeth a final adjustment of the carriage may be necessary for required accuracy, after which a light finishing cut all around will compensate for errors due to wheel wear.

The centers as illustrated in Fig. 25 swing work to 4¾″ diameter. Raising blocks which increase the swing to 8¼″ are available at extra cost.

High Speed Surface Grinding Attachment

Slots and other surfaces which do not permit the use of a wheel of large diameter can be ground with this Attachment. The Attachment spindle is mounted on super-precision ball bearings and is belt-driven from a pulley mounted on the spindle of the machine.

The Attachment body fits onto the machine spindle sleeve in place of the wheel guard as shown in Fig. 26 and can be used in practically any angular position around the machine spindle. With the Attachment spindle in the lowest position, the maximum vertical distance between center of Attachment spindle and top of machine table is 7″.

To install the Attachment, remove the grinding wheel and wheel guard from the machine and slip the Attachment body onto the spindle sleeve. Then put the belt on the Attachment spindle driving pulley, put the pulley inside the sheet metal belt guard and slip the guard and pulley into working position together. Fasten the pulley in position with the machine spindle nut, slip the belt onto the Attachment spindle and fasten the belt guard in position by tightening the clamp screw on the collar at the right rear of the guard. Finally, bring the Attachment spindle to the desired angular position around the machine spindle, turn the large knurled shoulder behind the belt guard to adjust the belt tension, and clamp both of these adjustments by tightening the rear hollow-head screw at the top of the Attachment body. Make sure that the other hollow-head screw is also tight before grinding.

The sight feed oiler should be kept vertical for all positions of the Attachment spindle. If the spindle is swung upward to the left of vertical move the oiler to the left side of the Attachment, where a

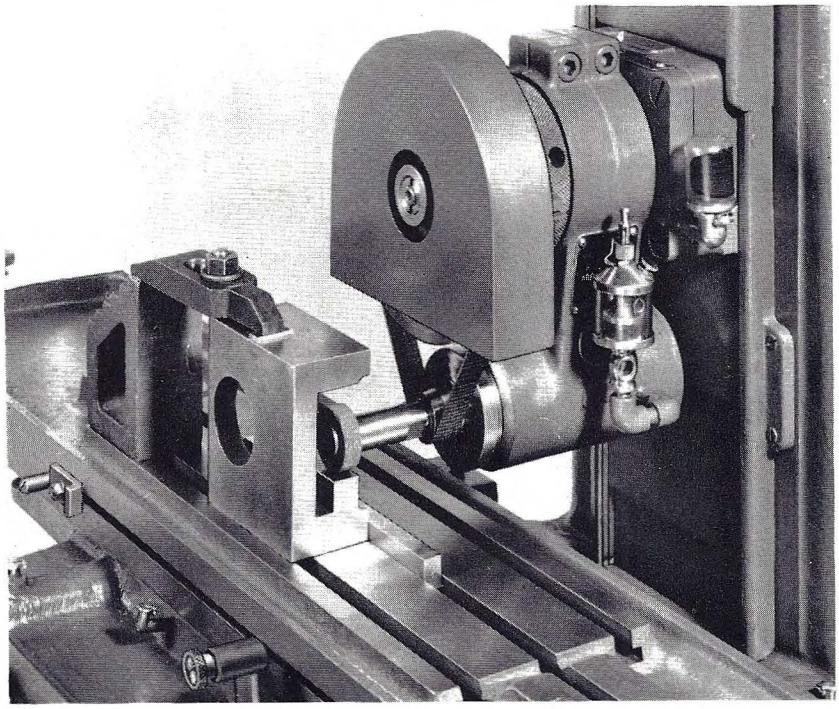


Fig. 26. High Speed Surface Grinding Attachment. Wheel arbors and grinding wheels are furnished at extra cost.

plugged tapped hole is provided. Use a high-quality spindle oil having a viscosity of 100 S.S.U. at 100° F., and adjust the oiler for a rate of feed of three drops per minute.

A variety of wheel arbors and grinding wheels are available at extra cost. The exacting limits and fine finish demanded of this equipment require extreme accuracy in the taper fit between spindle and wheel arbor; therefore we strongly recommend that all wheel arbors be furnished by us to assure the utmost in precision and finish.

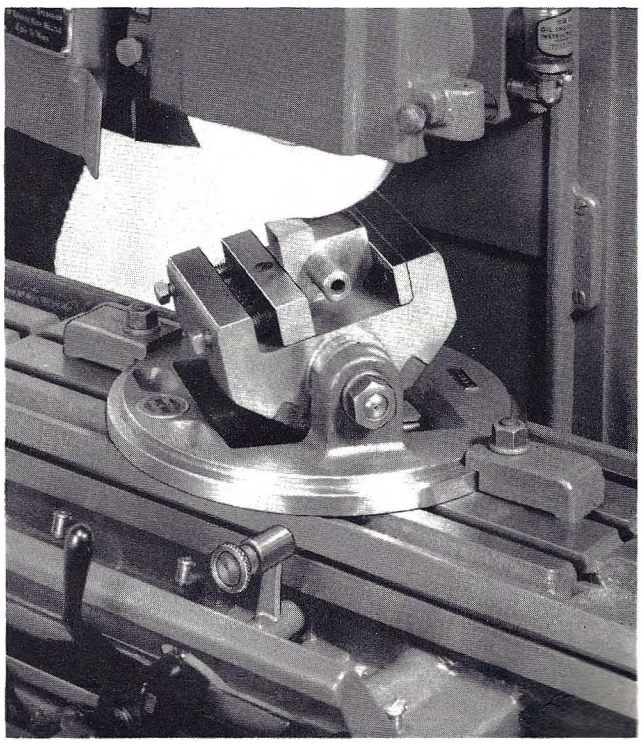
In changing wheels or arbors, a spring-loaded plunger in the front of the Attachment body above the spindle can be pushed in to hold the spindle from rotating. Make sure that the spindle hole and arbor shank are perfectly clean before inserting an arbor, and seat the arbor firmly in the spindle. Keep in mind that the arbors have a left-hand thread. Never put a cold arbor in a warm spindle; for when the arbor expands (or the spindle cools and contracts), the taper fit will be so tight that removal of the arbor will be difficult.

Adjustable Swivel Vise

As illustrated in Fig. 27, this vise can be clamped to the table with the jaws at any horizontal angle to the table T-slots. The jaws can also be tilted in a vertical plane to any angle up to 45° each side of horizontal. The latter setting is indicated by a scale graduated in degrees and is clamped by the nut at the right.

The hardened tool steel jaws are 5″ wide, 1″ deep and open 2¾″. The movable jaw is opened and closed by the two screws at the front. With the jaws horizontal, the distance from bottom of base to top of jaws is 4″.

Fig. 27. Adjustable Swivel Vise.



Radius and Angle Wheel Truing Attachment

This Attachment provides a ready means of forming wheels with accurate convex or concave outlines up to 1″ in radius and face angles up to 90° either side of zero, and permits combinations of radial and angular shapes to be developed.

The base of the Attachment carries a swivel platen upon which is mounted a slide which can be moved longitudinally by handwheel. A gib and adjusting screw provide means of compensating for wear in the slide. The base is keyed for accurate alignment; and an auxiliary base to facilitate using the Attachment on a magnetic chuck is furnished as regular equipment. (When a magnetic chuck is used in conjunction with the Wet Grinding Attachment, do not use the auxiliary base but conserve height by removing the tongues from the Attachment base and mounting the Attachment directly on the chuck.)

To form concave or convex outlines, clamp the diamond tool (diamond not furnished) in the upright parallel to the slide as shown in Fig. 28, locating the diamond point by means of the diamond tool setting gage (turned upward 180° from the position shown). Adjust the slide by handwheel to the desired radius as shown by the scale on the slide, setting the slide to the right of center to form a convex shape on the wheel and to the left of center to form a concave shape. Tighten the clamping screw on the back of the slide (not visible in illustrations) to lock the adjustment, and pass the diamond across the wheel by swiveling the Attachment on its base.

To true a wheel to an angle, swivel the slide to the desired setting as indicated in degrees by the scale on the base and tighten the clamp screw in the front of the base. Clamp the diamond tool in the upright at right angles to the slide (see Fig. 29) and pass the diamond across the wheel by running the slide back and forth by handwheel.

In either case, to obtain the desired shape adjust the height of the spindle head to bring the center of the spindle horizontal with the diamond point.

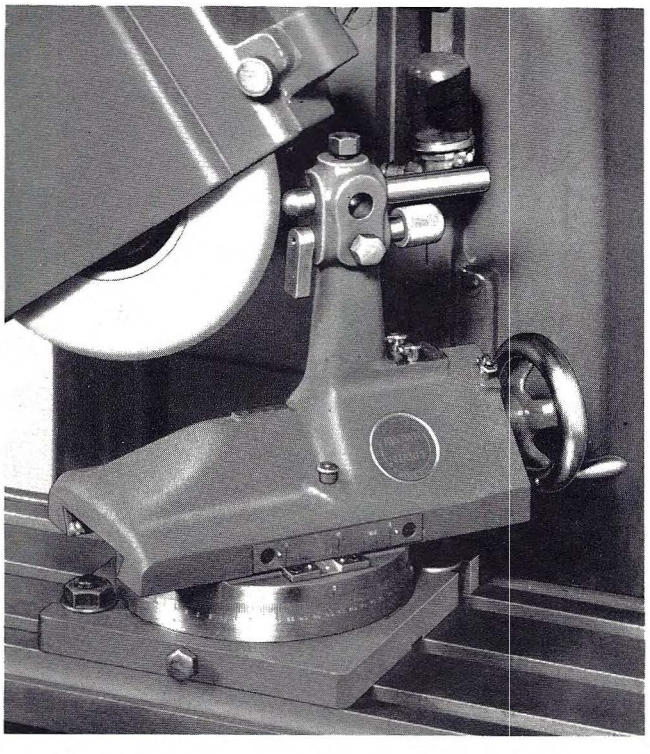


Fig. 28. Shaping a radial contour with the Radius and Angle Wheel Truing Attachment. The slide is clamped at the required radius, the diamond tool is set by the gage just below it and the slide is swiveled to form the wheel.

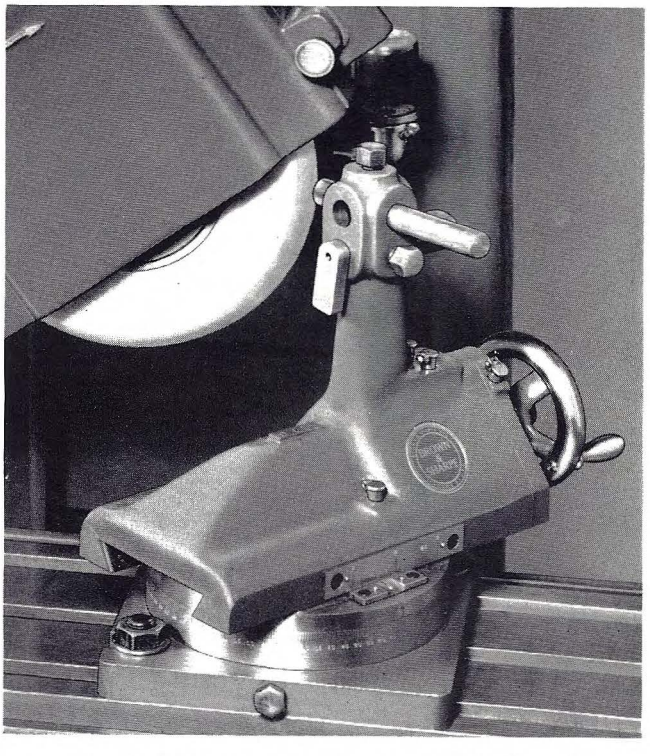


Fig. 29. Forming an angle. The swivel platen is clamped at the required angle and the slide is operated by the handwheel to true the wheel. In both cases the diamond is advanced by hand feed of the machine table.

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. 2 and No. 2B 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 these machines, locate the hoisting hook about six inches directly in front of the vertical adjustment screw guard. Pass one loop of rope across the front of the base under the two rope stanchions provided, then upward against the sides of the carriage near the front; and pass a second loop of rope under the large hook at the rear (between the two uprights) and up across the shoulders of the uprights. The No. 2 and No. 2B Machines weigh approximately 1435 lbs. and 1330 lbs. respectively when fitted with motor in base, and slightly less when fitted with motorized spindle.

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 30. CAUTION: To avoid damage, be sure to check direction of motor rotation as explained on page 30 before running the machine.

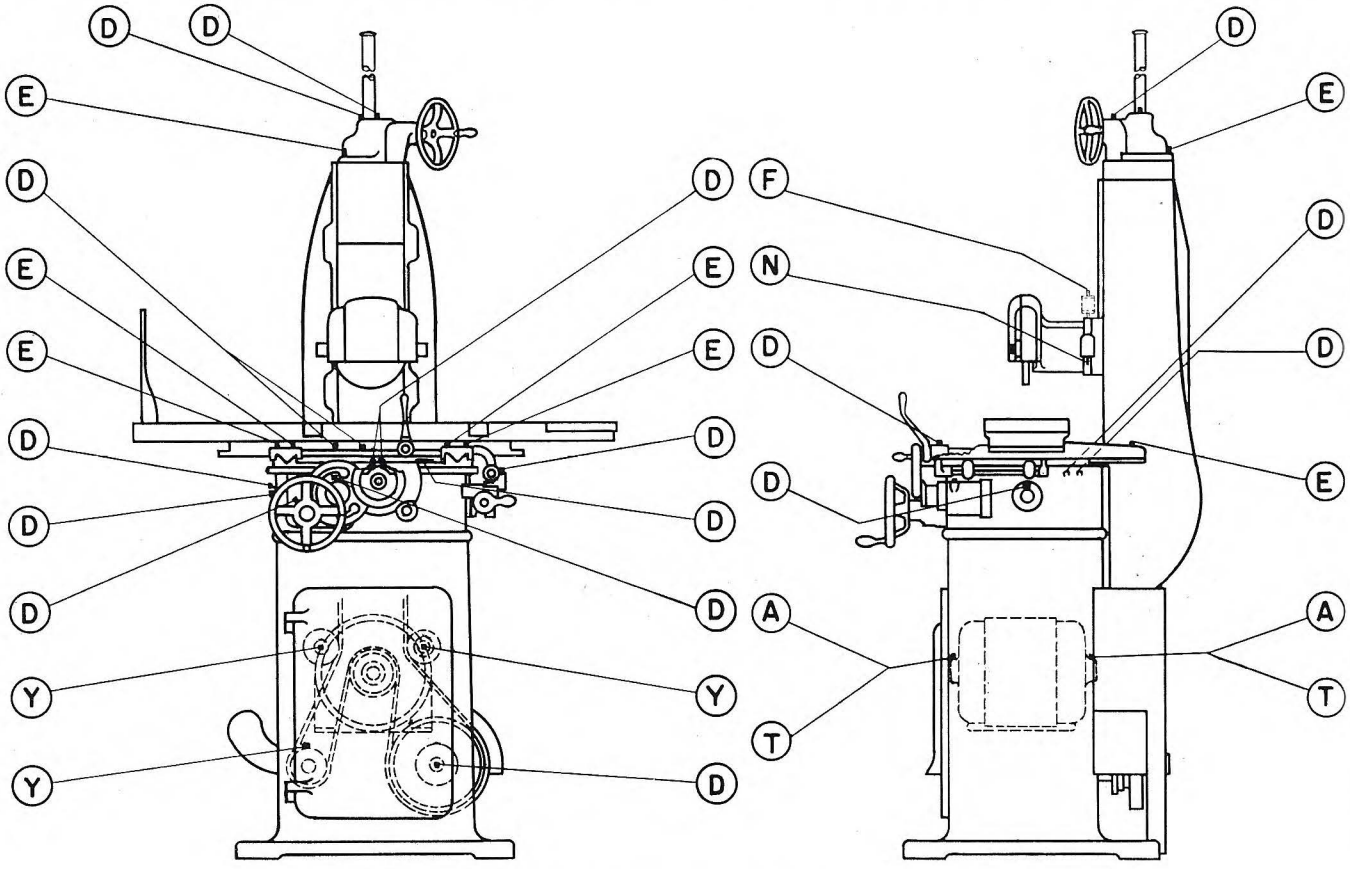


Fig. 30. Lubrication Diagram

A—Clean and grease annually (ball bearing motors). Use good grade ball bearing grease.

D—Oil daily with good grade machine oil of 300 S.S.U. at 100° F. Oil specified in "E" may be used at all "D" points if a limitation in the number of oils is desired.

E—Oil daily with a good grade, high lubricity, table way oil*—300 S.S.U. at 100° F.

F—Fill when necessary (antifriction-bearing spindle) with good grade spindle oil of 100 S.S.U. at 100° F.

N—Fill when necessary (plain-bearing spindle) with extra-light high-grade spindle oil of 32 S.S.U. at 100° F.

T—Inspect every three months (sleeve-bearing motors). Use good grade machine oil of 300 S.S.U. at 100° F.

Y—Grease yearly with good grade ball bearing grease.

* Gargoyle Vacuoline No. 1409 (Socony-Vacuum Oil Co., Inc.) or an equivalent table way oil

Lubrication

Instructions on oiling and greasing are given in the lubrication diagram (Fig. 30). Lubrication of the wheel spindle is covered in greater detail below and on page 28. Never start a new spindle without first filling the oil reservoir.

Wheel Spindle

These machines are regularly equipped with a plain-bearing spindle unit, though an antifriction-bearing spindle unit is supplied, when specified, at extra cost. The spindles are of removable-unit-type construction and are interchangeable.

Both ends of the spindle are tapered, to take the wheel sleeve and the driving pulley respectively. In removing a wheel sleeve or pulley be sure to *use the wheel sleeve puller* (furnished with the machine) to avoid damaging the spindle bearings by hammering.

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 (.00001″) 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 given below and in the following pages 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. Take off the grinding wheel, using the wheel sleeve puller. Unclamp the wheel guard and remove it from the spindle unit. Then take out the four clamping screws in the flange of the spindle unit. With a belt-driven spindle, remove the guard on the rear of the upright, pull the spindle unit forward an inch or so and lift the belt off the spindle pulley; then pull the spindle unit out of the head. When the spindle is driven by a direct-coupled motor, simply remove the screws in the flange and pull out the spindle unit.

Plain-Bearing Spindle Unit

The plain-bearing spindle is ground to extremely close limits of concentricity, straightness and finish, and has unusually small clearance between the tapered bearing surfaces and special bronze boxes. End play is taken up by compression springs as explained on page 8, and adjustment for wear can be made as described below.

Lubrication. The spindle is lubricated automatically from a reservoir supplied by a constant-level oiler (see Fig. 31, page 27).

Due to the unusually small clearance, the oil used in this spindle must be an *extra-light,* high-quality spindle oil having a viscosity of 32 S.S.U. at 100° F. Using a heavier lubricant such as ordinary spindle oil will cause excessive heating and will result in the spindle seizing.

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. An oil space of .00011″ has no room for grit and dirt.

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 ⅜″ (see Fig. 31).

Alternate Location of Oiler. The preferred position is on the right-hand side of the spindle unit, as shipped from our factory. However, if necessary, the oiler can be moved to the plugged pipe hole directly opposite on the left-hand side of the flange.

Disassembling and Repairing the Plain-Bearing Spindle Unit

Removing the Spindle. Remove the spindle unit from the machine as described at left, 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 screw that holds the driving pulley or coupling on the spindle (this screw has a *left-hand* thread). In removing the pulley use the wheel puller.

2. Remove the spindle rear box nut 0 (Fig. 31).

3. Take off the spindle bearing sleeve cover M and remove teated screw P.

4. Remove the screws in the front end of the unit; then pull off the spindle dust guard N unless the dowels are so tight as to make this difficult.

5. Tap the rear end of the spindle to free the thrust collar H, oil slinger Z and (if necessary) spindle dust guard N. 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 Q and should be .00011″.

With the spindle boxes properly scraped, the correct thickness of washer Q 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 Q 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 Q is well seated and set the indicator to read zero.

5. Remove the spindle, take off washer Q 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 Q, subtract the indicator reading from the measured thickness of the washer and add .005″. Bring the washer to the required thickness by grinding and lapping, working to the limits plus .00025″ minus .00000″.

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 Q. 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 .0005″ on a side, the space at the front washer would be increased by about $\frac{1}{32}$″ due to the small angle of taper of the boxes.

Disassemble the spindle as instructed above 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 Q to give the proper oil space as described above.

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 Q 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. 31.

The thrust collar H 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 H in position. The teated screw P 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 Q is at full normal thickness ($\frac{3}{16}$″ or more), locate thrust collar H so screw P will engage the hole nearest the rear end of the spindle. When washer Q is between $\frac{3}{16}$″ and $\frac{1}{8}$″

thick, put screw P in the middle hole; and when washer Q is $\frac{1}{8}$" thick or less, put screw P in the 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 M. Since this cover must be oil tight, lightly coat the horizontal clamping surfaces and fill grooves E in the sides of the cover 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 N.

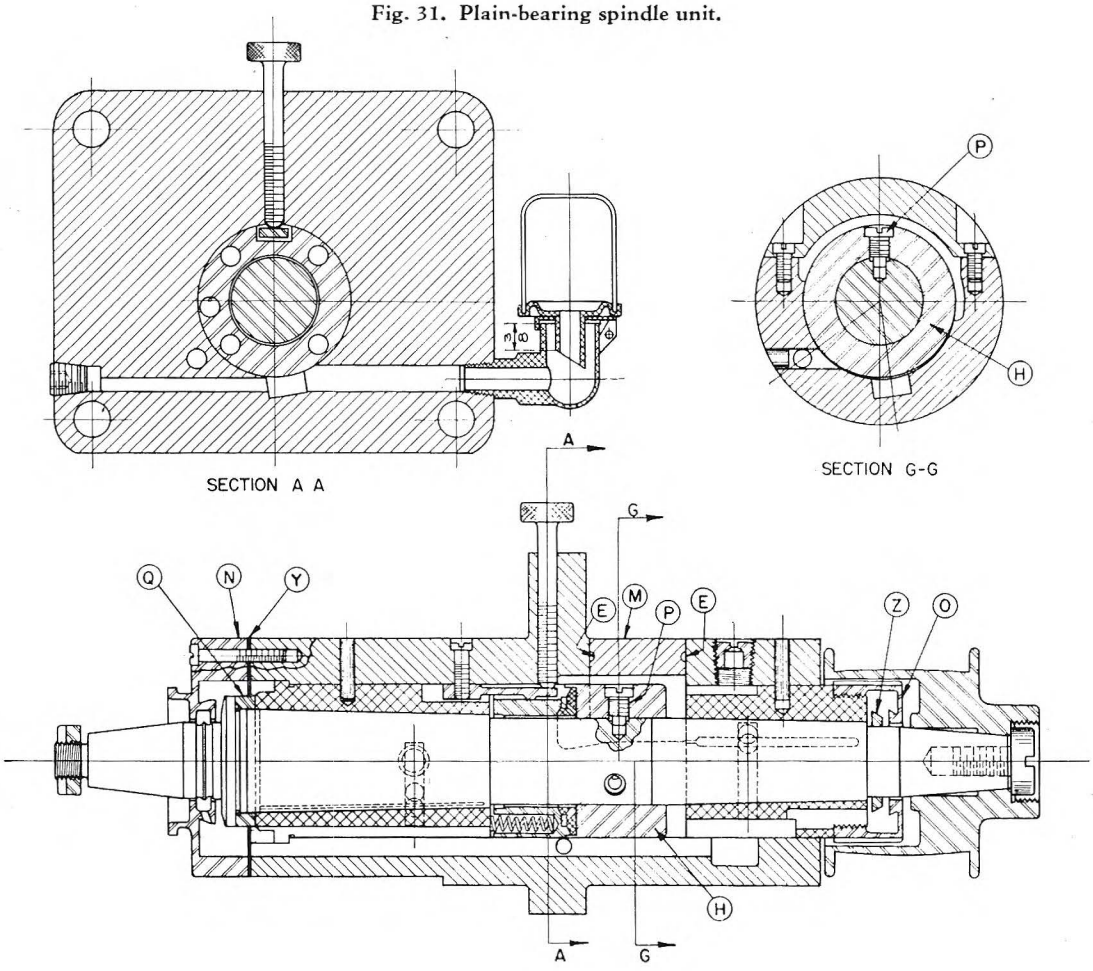
After the front box thrust washer Q has been reduced in thickness about $\frac{1}{16}$" in connection with rescraping the spindle, the spindle dust guard (which does not drop back with the spindle) may begin to interfere with the wheel sleeve. To prevent this, remove about $\frac{1}{16}$" from rear surface Y of the dust guard so as to bring the recess in the dust guard into proper relation with the grooves in the spindle as shown in Fig. 31. In doing this, be careful to keep surface Y 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 Z, locating it within $\frac{3}{32}$" of the end of the rear box to make sure that nut 0 will not come in contact with it.

6. Replace the spindle rear box nut 0 and the driving pulley or coupling, thus completing the spindle assembly.

Replacing Spindle Unit in Machine. Insert the spindle unit in the spindle head of the machine. With a belt-driven spindle, slip the driving belt over the pulley before pushing the spindle unit all the way in; and when the spindle is driven by a direct-coupled motor, rotate the spindle slightly while inserting the unit so that the pins in the coupling will line up with the holes in the rubber disk. Then tighten the four flange screws in rotation, using a wrench on the screwdriver to bring the flange up tight.

Fig. 31. Plain-bearing spindle unit.



Antifriction-Bearing Spindle Unit

This spindle unit uses preloaded roller bearings to take all radial loads and preloaded ball bearings to take end thrust.

A clean ball or roller bearing will run smoothly at high speeds for hundreds of hours, whereas a dirty bearing will vibrate, will wear rapidly and will be destroyed in a short time. Therefore, every precaution should be taken to keep this spindle clean; and if it is ever disassembled, the greatest care should be used in keeping all parts free of dirt and foreign matter.

Lubrication. All the spindle bearings dip into an oil reservoir. To fill the reservoir when first starting a new spindle, fill the oiler and then hold the control lever at the top of the oiler at a 45° angle while about half of the contents runs into the spindle. Then adjust the oiler for a rate of feed of one drop every two minutes.

Use a high-quality spindle oil having a viscosity of 100 S.S.U. at 100° F.

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.

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 23).

The grinding wheel may be out of balance. If so, it should be balanced or replaced (see page 9).

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 32 S.S.U. at 100° F. for the plain-bearing spindle, and a high-quality spindle oil of 100 S.S.U. at 100° F. for the anti-friction-bearing spindle.

May be due to insufficient oil. With the plain-bearing spindle, check the vertical position of the constant-level 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 (second column) 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 only job which may prove puzzling unless explained to some extent is that of removing the carriage, which is necessary in order to reach many of the parts; and this is readily done by following the steps outlined below. Incidentally, information on disassembling and reassembling much of the cross feed mechanism is included in the following material.

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

Removing Carriage of No. 2 Surface Grinding Machine

A preliminary study of Fig. 32 will aid in understanding the following instructions. Reference to the Repair Parts section will clarify any construction details that are not completely evident in Fig. 32.

1. Lift off the sliding table, and take the oil rollers and their springs out of the carriage ways.

2. Remove the lower left-hand vertical guide for the dust guards at the front of the upright (left-hand part 3829, page 32), and take off the sloping dust guard (part 704) on the front of the carriage.

3. Move the carriage to the rear and push back the horizontal sheet steel sliding covers under the carriage as far as they will go. This exposes a horizontal opening in the front of the bed top plate (see Fig. 32). Working through this opening, straighten the lug of the lock washer on the rack pinion shaft (at the right of the table handwheel shaft) and unscrew the nut so it will be loose on the shaft. (This shaft is shown on page 44 as part 707).

4. Take off the table handwheel.

5. Remove the bed front plate dial (768, page 44). This is the part which carries the two stops for setting the amount of power cross feed. The stops come off with the dial.

6. Disconnect the cross feed rack (751, page 46) from the friction feed disk (715, page 44) behind the dial by removing the screw which goes through the left-hand end of the rack; see Fig. 32. This screw is locked in place by a straight pin.

7. Pull out the rack pinion shaft and the assembly on the front end of the shaft as a unit. The rack pinion (163, page 44), the nut and lock washer, and the rack pinion shaft gear (713), which are carried by the shaft, will drop into the bed of the machine.

8. Remove the three screws from the ratchet wheel (large) lever plate. This plate is on the front of the ratchet wheel (large) lever just behind the cross feed handwheel (Fig. 32) and the screws are reached through the openings in the handwheel.

9. Take off the cross feed handwheel. Note that the nut on the cross feed screw is held by a lock washer, and that a hollow-head screw in the hub of the handwheel must be loosened before the handwheel can be pulled off. Wrenches for both nut and screw are furnished with the machine.

10. Pull off the ratchet wheel (large) lever. The ball thrust bearing will come off with it; see Fig. 32.

11. Remove the cast iron guard on which the cross feed handwheel index finger is mounted. Then pull off the ratchet wheel (large) lever sleeve, which is the next part on the cross feed screw.

12. Remove the two screws which hold the cross feed screw bushing (739, page 46) in place, and pull off the bushing. Then unscrew and remove the cross feed screw.

13. Pull the carriage to the front, lift and slide forward the sliding covers under the carriage and unscrew the cylindrical cross feed screw guard (3853, page 46) in the bottom of the carriage. Finally, lift off the carriage.

Reassembling. When putting the carriage back on the bed, make sure that the slot in the reversing lever fork (774, page 42) on the underside of the carriage fits over the reversing rod (777) so that the reverse levers will operate the reversing mechanism in the bed.

Replace the rack pinion shaft (and assembly on front end) before installing the cross feed screw and its parts. When installing the rack pinion shaft, take off the cover plate on the upper left side of the base and work through the opening to slip the rack pinion shaft gear (713, page 44), lock

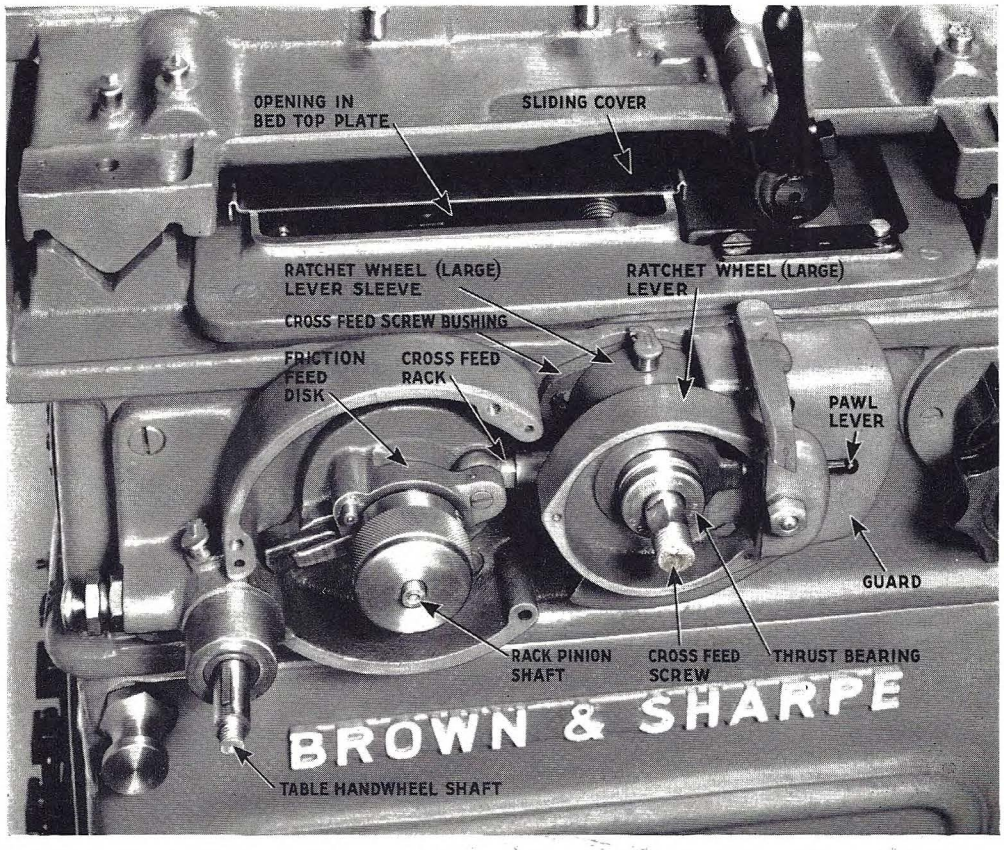


Fig. 32. No. 2 Machine with mechanism partly assembled, showing parts referred to in instructions on removing the carriage.

washer and nut onto the shaft in that order with the shaft pushed part way in. Then hold the rack pinion (163) in place in the carriage while inserting the shaft the rest of the way. In tightening the nut and bending the lock washer it is easiest to work through the opening in the bed top plate the same as when disassembling.

Next replace the cross feed screw, put on the inner thrust bearing and install the cross feed screw bushing. Put the cross feed rack in the ratchet wheel (large) lever sleeve, slip these parts into position and attach the cross feed rack to the friction feed disk as shown in Fig. 32. Then replace the guard on which the cross feed handwheel index finger is mounted.

Before putting on the ratchet wheel (large) lever, turn the mechanism on the rack pinion shaft so that it is on dead center as illustrated in Fig. 32 —that is, with the cross feed rack approximately horizontal and as far into the ratchet wheel (large) lever sleeve as it will go. Then put on the ratchet wheel (large) lever, taking care that the pawl lever is in neutral position and is horizontal as illustrated.

To complete the assembly, slip on the outer thrust bearing; replace the cross feed handwheel; fasten the ratchet wheel (large) lever plate in place; put on the bed front plate dial (first setting both stops for maximum amount of cross feed) ; and replace the table handwheel and the guards.

Removing Carriage of No. 2B Surface Grinding Machine (With Hand Feeds Only)

The parts referred to by number in the following instructions are shown on page 48 of the Repair Parts section.

1. Lift off the sliding table, and take the oil rollers and their springs out of the carriage ways.

2. Remove the nut on the front of the rack pinion shaft (part 3823) at the right of the table handwheel.

3. Take off the table handwheel.

4. Take off the cover plate on the upper left side of the base and hold the rack pinion shaft gear (713) with one hand while knocking the shaft free with the other, using a lead hammer. Push the shaft in to remove the gear; then pull the shaft out from the front.

5. Take off the cross feed handwheel, removing the nut on the cross feed screw and loosening the hollow-head screw in the hub of the handwheel. Then, in the interests of safety, take off the index finger.

6. Loosen the set screw in the bottom of the cross feed screw spacing collar (3824) just behind the handwheel and pull off the collar and ball thrust bearing.

7. Remove the cross feed screw bushing (739) ; then unscrew and remove the cross feed screw.

8. Pull the carriage to the front, lift and slide forward the sliding covers under the carriage and unscrew the cylindrical cross feed screw guard (3853) in the bottom of the carriage. Then lift off the carriage.

Electrical Controls

Connecting to Power Supply. The machine should be connected to the power line through a disconnect switch and should be properly grounded. The lines from the disconnect switch are connected directly to the magnetic starter on the right side of the machine.

Checking Motor Rotation. Before running a newly-connected machine, check the direction of motor rotation as follows:

Press the Start button, immediately press the Stop button and observe the direction of rotation of the wheel spindle. The spindle should rotate clockwise as seen from the front. If the direction of rotation is counterclockwise, reverse one phase of the power supply. (This is conveniently done by transposing two of the wires at the line disconnect switch.) Do not change the internal wiring of the machine; and do not under any circumstances allow the machine to run with the spindle rotating in the wrong direction.

PART II

REPAIR PARTS

for

No. 2 SURFACE GRINDING MACHINE

and

No. 2B SURFACE GRINDING MACHINE

WITH HAND FEEDS ONLY

REPLACEMENT parts are listed and illustrated in this section of the book. To facilitate the identification of parts as well as stripping and assembling, the parts are shown separated and are arranged so far as possible in the same relative position as in the machines.

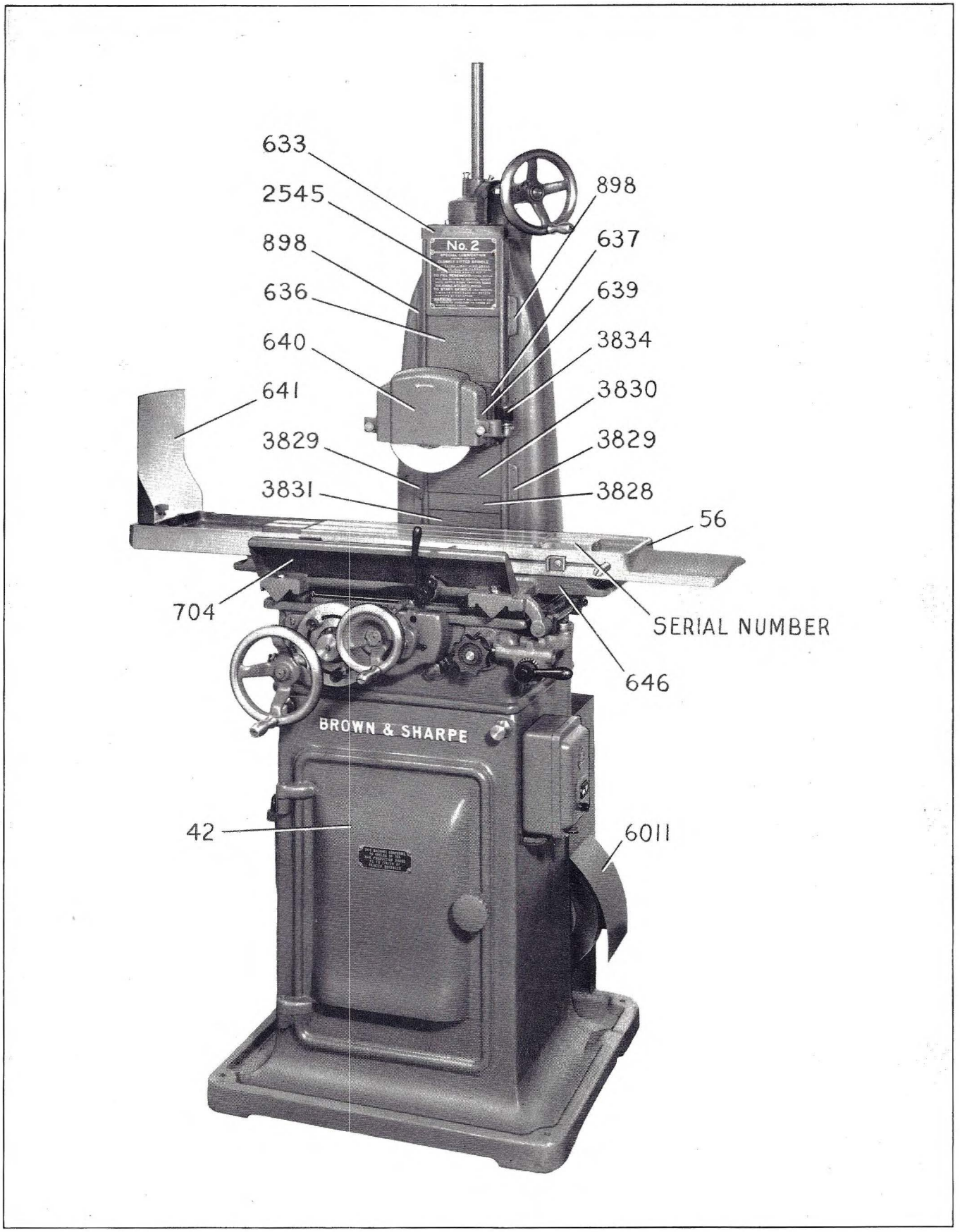
In some cases when a part is ordered, not only that part but one or more supplementary parts also may be sent. This is done when, from our experience, it is known to be advisable for a more satisfactory repair job.

When ordering repair parts it is essential that the size, style and serial number of the machine be stated in addition to the part number and name given in the following pages.

INDEX OF REPAIR PART GROUPS

IMPORTANT

Parts illustrated in this book are *finished* parts and are shown for identification purposes only. In some cases repair parts as furnished will require fitting and therefore may need to have holes drilled, shoulders squared or other machining in order to make them fit properly.



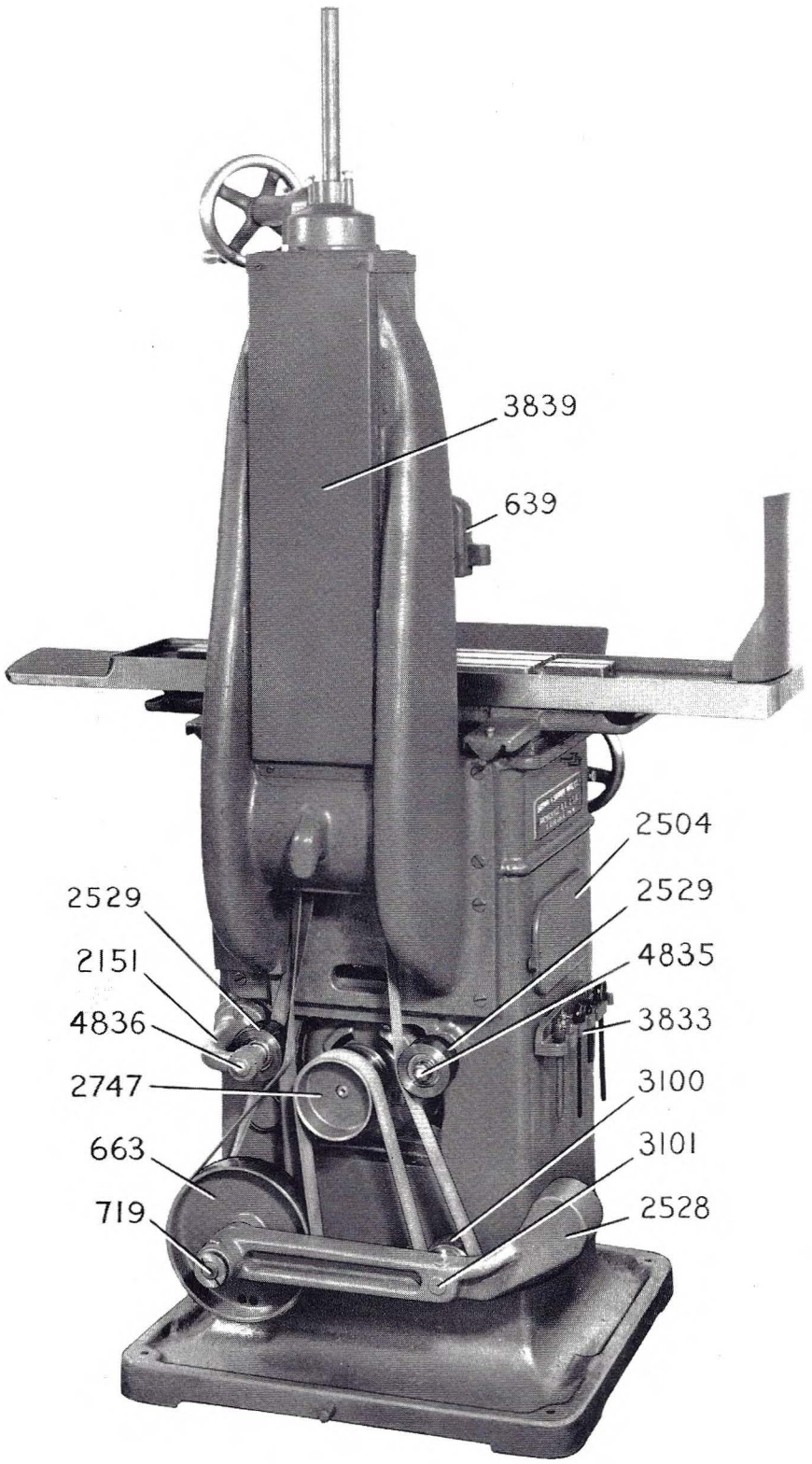
Front View
No. 2 Surface Grinding Machine

When ordering parts, state the size, style and serial number of the machine in addition to the part number and name.

Front View

No. 2 Surface Grinding Machine

42	Base Door
56	Sliding Table
633	Head Elevating Screw Upper Guard
636	Head Elevating Screw Lower Guard
637	Spindle Head
639	Wheel Guard
640	Wheel Guard Cover
641	Dust Deflector
646	Carriage
704	Carriage Dust Guard
898	Head Elevating Screw Guard Guide
2545	Spindle Lubrication Notice Plate
3828	Intermediate Dust Guard
3829	Dust Guard Guide
3830	Front Outer Dust Guard
3831	Front Inner Dust Guard
3834	Spindle Oiler
6011	Pulley and Belt Guard



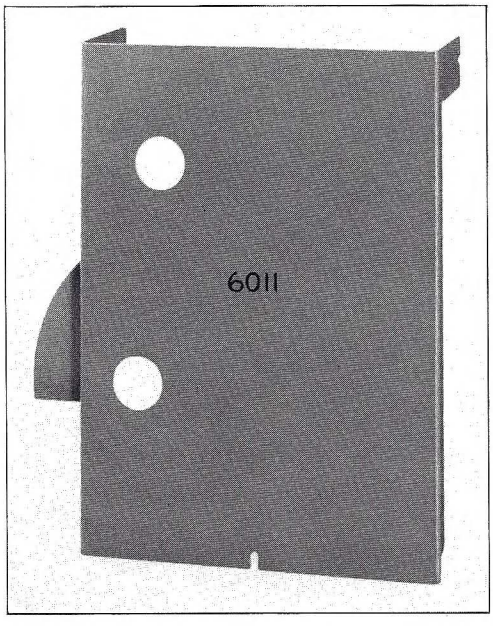
Rear View
No. 2 Surface Grinding Machine
(Guard Removed)

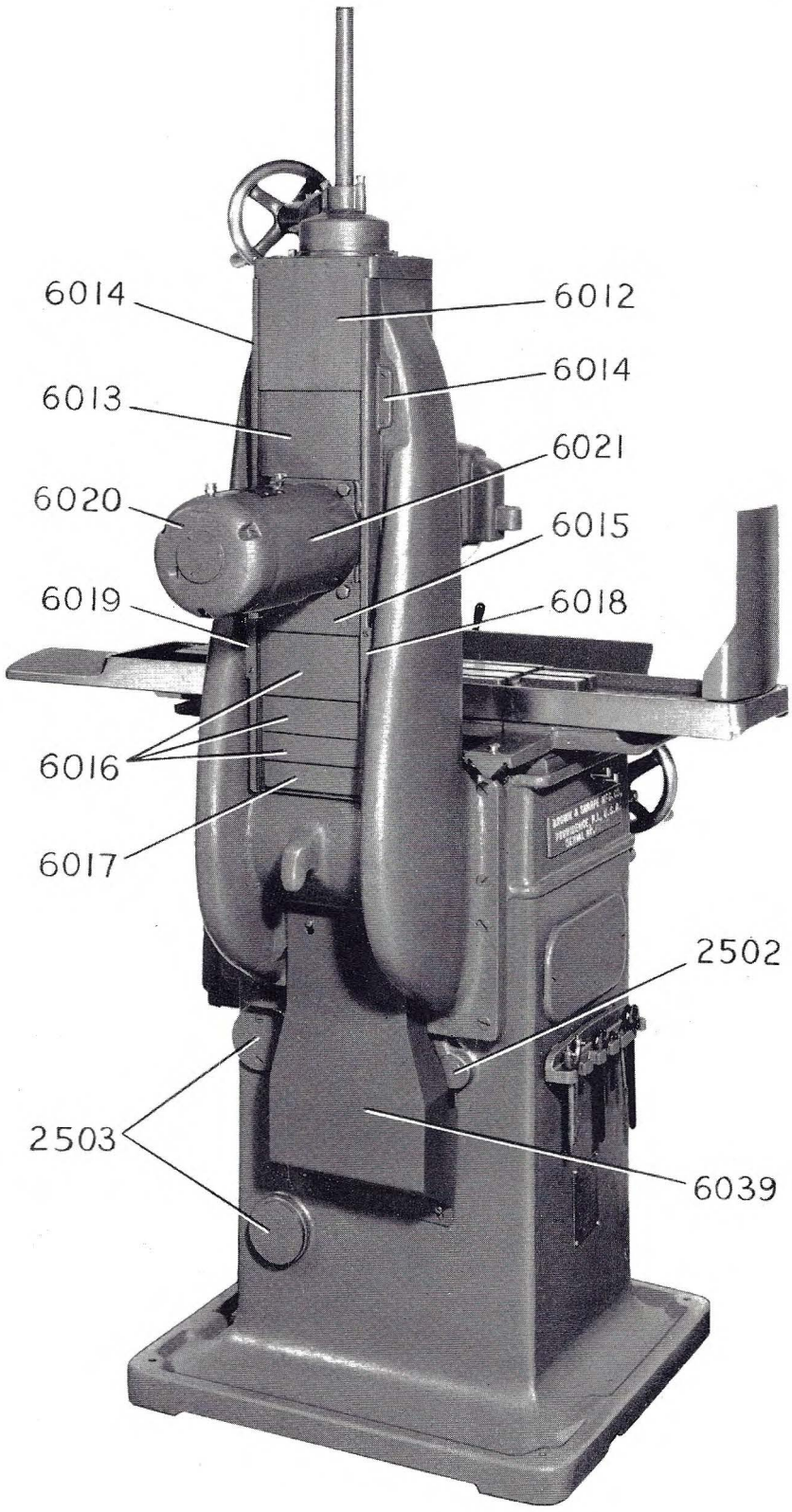
When ordering parts, state the size, style and serial number of the machine in addition to the part number and name.

Rear View

No. 2 Surface Grinding Machine
(Guard Removed)

639	Wheel Guard
663	Idler Pulley
719	Belt Tightener Frame Pivot Stud
2151	Idler Pulley Bracket
2504	Oil Compartment Cover
2528	Belt Tightener Frame
2529	Ball Bearing Idler Pulley
2747	Motor Pulley
3100	Belt Tightener Pulley
3101	Belt Tightener Pulley Stud
3833	Wrench Rack
3839	Head Elevating Screw Guard, Rear
4835	Ball Bearing Idler Pulley Stud, Left
4836	Ball Bearing Idler Pulley Stud, Right
6011	Pulley and Belt Guard





Rear View
No. 2 Surface Grinding Machine
Fitted with Motorized Spindle

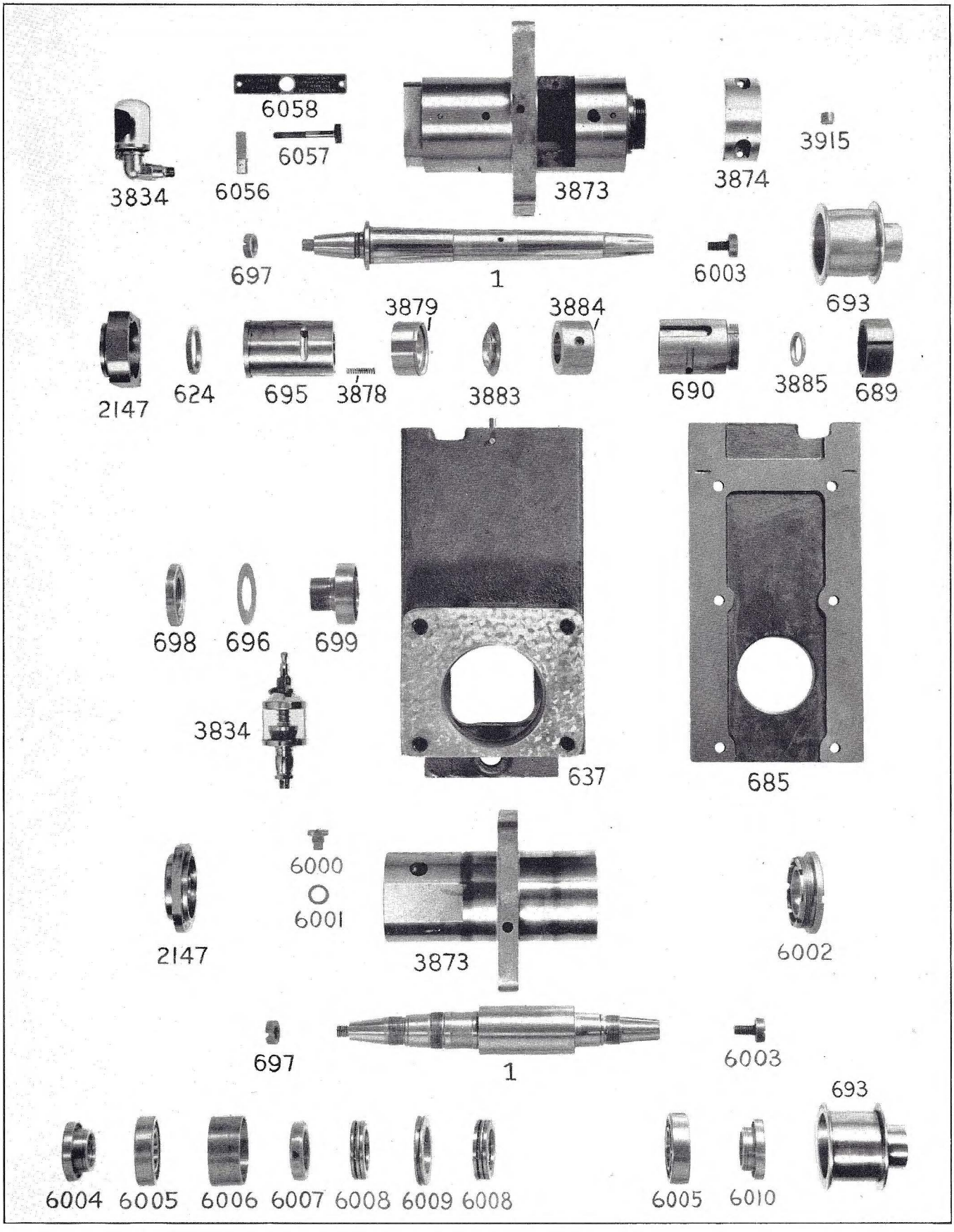
When ordering parts, state the size, style and serial number of the machine in addition to the part number and name.

Rear View

No. 2 Surface Grinding Machine
Fitted with Motorized Spindle

2502	Idler Pulley Stud Pad Cover
2503	Idler Pulley Bracket Pad Cover
6012	Elevating Screw Guard Rear, Upper
6013	Elevating Screw Guard Rear, Lower
6014	Elevating Screw Guard Guide, Upper
6015	Rear Outer Dust Guard
6016	Intermediate Dust Guard
6017	Rear Inner Dust Guard
6018	Dust Guard Guide Lower Rear, Right
6019	Dust Guard Guide Lower Rear, Left
6020	Spindle Motor End Shield
6021	Spindle Motor Housing
6039	Table Drive Belt Guard

For disassembled parts see pages 54 and 55.



Plain-Bearing and Antifriction-Bearing Wheel Spindle Units and Spindle Head

When ordering parts, state the size, style and serial number of the machine in addition to the part number and name.

Plain-Bearing and Antifriction-Bearing Wheel Spindle Units and Spindle Head

Plain-Bearing Unit

1	Wheel Spindle
624	Spindle Front Box Thrust Washer
689	Spindle Rear Box Nut
690	Spindle Rear Box
693	Spindle Pulley
695	Spindle Front Box
697	Spindle Nut
2147	Spindle Dust Guard
3834	Spindle Oiler
3873	Spindle Bearing Sleeve
3874	Spindle Bearing Sleeve Opening Cover
3878	Thrust Spring
3879	Thrust Spring Retainer
3883	Thrust Collar Washer
3884	Spindle Collar
3885	Spindle Oil Slinger
3915	Breather
6056	Thrust Spring Retaining Clamp
6057	Thrust Spring Retaining Clamp Screw
6058	Thrust Clamp Notice Plate

Antifriction-Bearing Unit

1	Wheel Spindle
693	Spindle Pulley
697	Spindle Nut
2147	Spindle Dust Guard
3834	Spindle Oiler
3873	Spindle Bearing Sleeve
6000	Adjusting Hole Screw
6001	Adjusting Hole Screw Gasket
6002	Roller Bearing Retainer Nut, Rear
6003	Spindle Pulley Locking Screw
6004	Roller Bearing Clamp Nut, Front
6005	Spindle Roller Bearing
6006	Roller Bearing Spacer
6007	Ball Bearing Retaining Nut
6008	Spindle Thrust Ball Bearing
6009	Ball Bearing Spacer
6010	Roller Bearing Clamp Nut, Rear

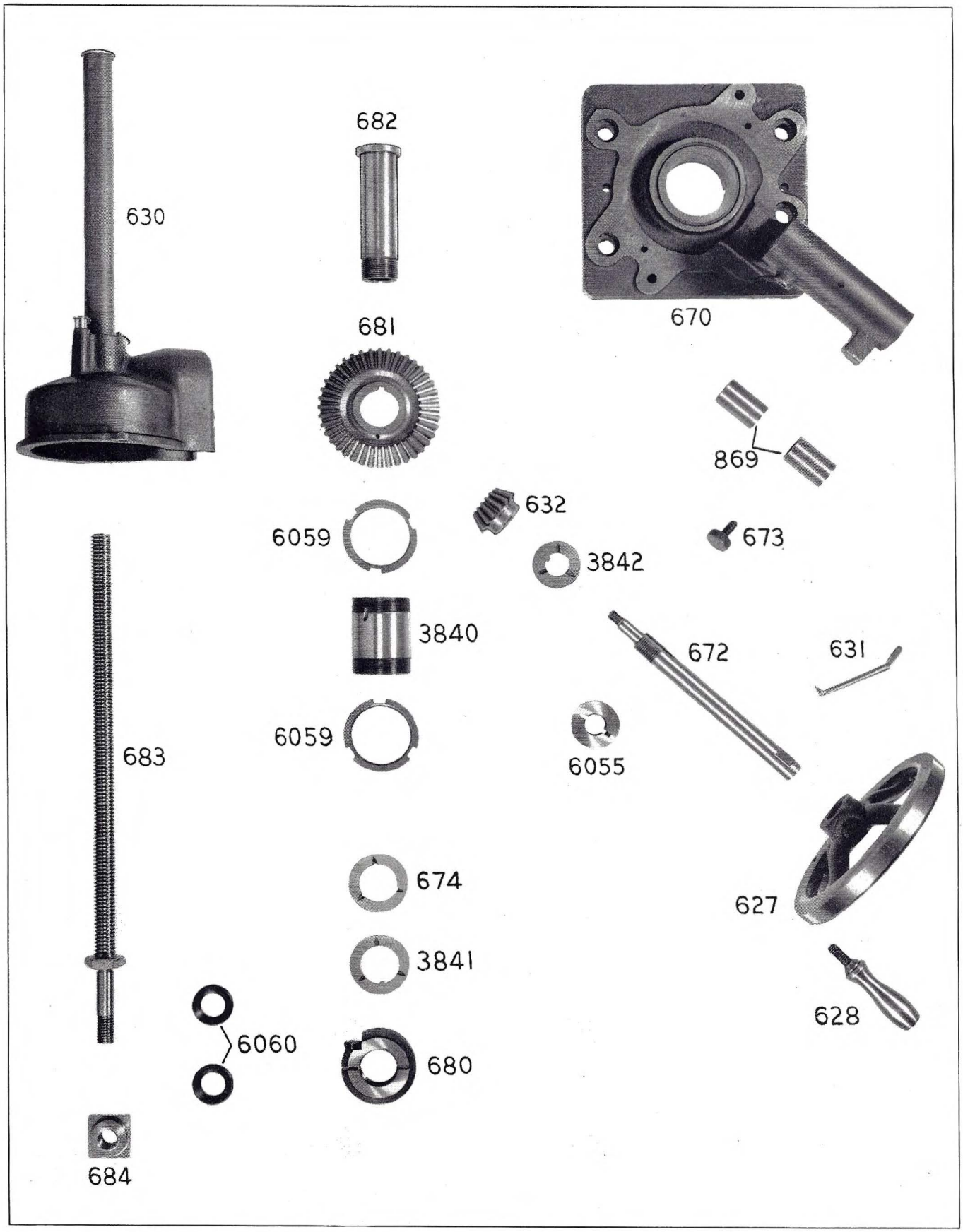
Belts
(Not illustrated)

*3213	Spindle Belt

Spindle Head and Wheel Sleeve Parts

637	Spindle Head
685	Spindle Head Gib Plate
696	Wheel Sleeve Washer
698	Wheel Sleeve Nut
699	Wheel Sleeve

* Smooth running, endless flat belt; 1½″ wide; for 60 cycle motor, inside circumference is 125″ when machine has 33 ft. per min. table speed and 130¾″ when machine has 17 ft. per min. table speed; for 50 cycle motor, inside circumference is 126¼″ when machine has 33 ft. per min. table speed and 137″ when machine has 17 ft. per min. table speed.



Spindle Head Elevating Parts

When ordering parts, state the size, style and serial number of the machine in addition to the part number and name.

Spindle Head Elevating Parts

627	Elevating Screw Handwheel
628	Elevating Screw Handwheel Handle
630	Head Elevating Screw Gear Guard
631	Elevating Screw Index Finger
632	Head Elevating Screw Pinion
670	Upright Top Plate
672	Head Elevating Shaft
673	Head Elevating Shaft Clamp Screw
674	Head Elevating Screw Gear Washer
680	Head Elevating Screw Gear Nut
681	Head Elevating Screw Gear
682	Head Elevating Nut
683	Head Elevating Screw
684	Elevating Screw Clamp Nut
869	Head Elevating Shaft Bushing
3840	Upright Top Plate Bushing
3841	Head Elevating Screw Thrust Washer
3842	Head Elevating Shaft Thrust Washer
6055	Head Elevating Shaft Nut
6059	Upright Top Plate Bushing Nut
6060	Head Elevating Shaft Countersunk Washer

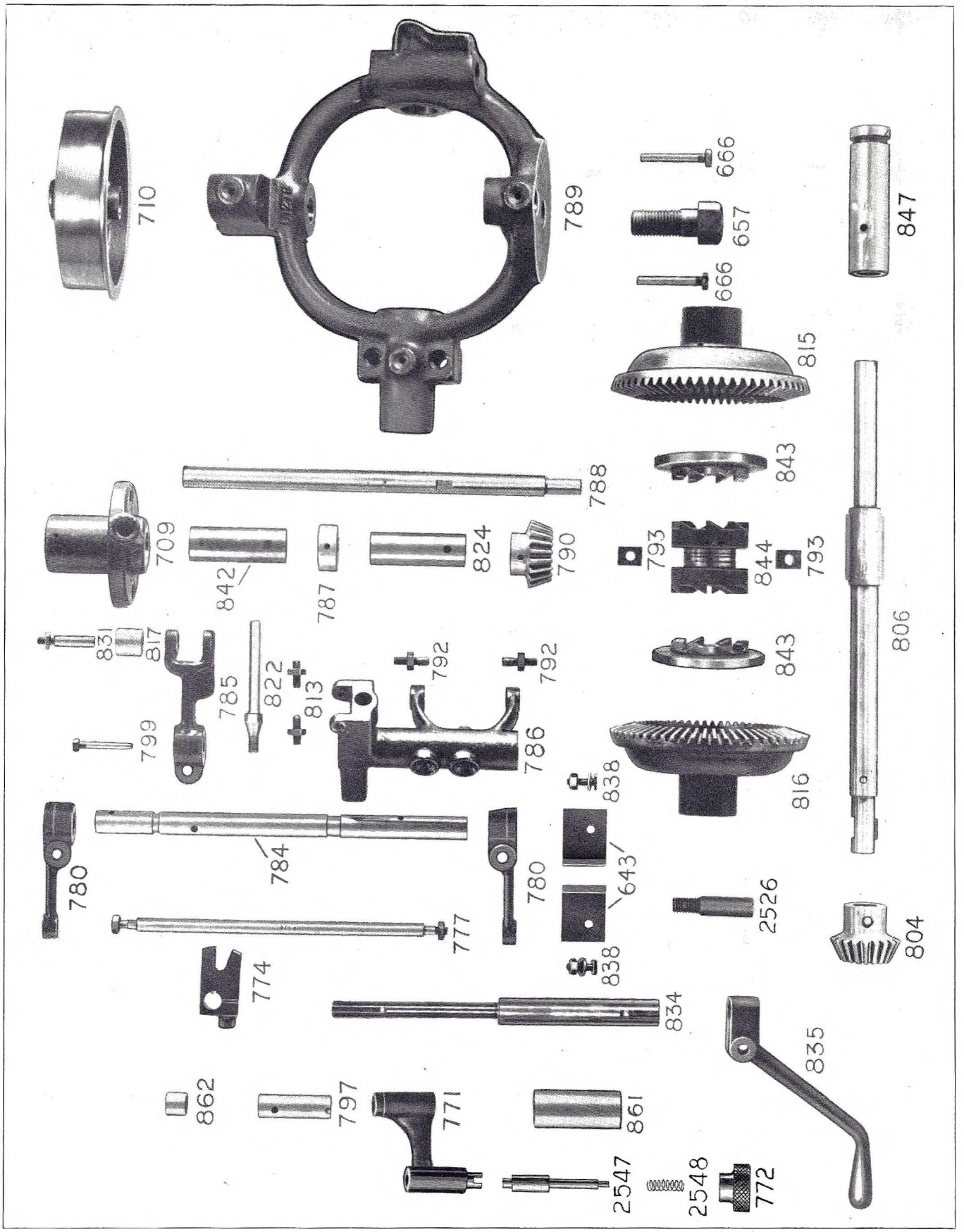


Table Reversing Mechanism
No. 2 Surface Grinding Machine

When ordering parts, state the size, style and serial number of the machine in addition to the part number and name.

Table Reversing Mechanism

No. 2 Surface Grinding Machine

643	Table Dog
657	Clutch Shaft Bracket Screw
666	Clutch Shaft Bracket Dowel Pin
709	Feed Shaft Bearing
710	Feed Pulley
771	Reversing Lever
772	Reversing Lever Knob
774	Reversing Lever Fork
777	Reversing Rod
780	Rocker Shaft Lever
784	Rocker Shaft
785	Plunger Roll Fork
786	Clutch Fork
787	Feed Shaft Collar
788	Feed Shaft
789	Clutch Shaft Bracket
790	Clutch Gear Driving Pinion
792	Clutch Block Screw
793	Clutch Block
797	Reversing Lever Stud Bushing, Middle
799	Plunger Roll Fork Dowel Pin
804	Clutch Shaft Pinion
806	Clutch Shaft
813	Clutch Fork Screw
815	Clutch Gear, Right
816	Clutch Gear, Left
817	Plunger Roll
822	Clutch Fork Extension
824	Clutch Shaft Bracket Bushing
831	Plunger Roll Stud
834	Reversing Lever Stud
835	Reversing Lever Handle
838	Table Dog Bolt
842	Feed Shaft Bushing
843	Clutch Face
844	Clutch
847	Clutch Gear Bushing
861	Reversing Lever Stud Bushing, Front
862	Reversing Lever Stud Bushing, Rear
2526	Table Dog Slot Screw
2547	Reversing Lever Plunger
2548	Reversing Lever Plunger Spring

Belts
(Not illustrated)

*3218	Table Feed Belt

* Smooth running, endless flat belt; 1″ wide; inside circumference 62″ when machine has 33 ft. per min. table speed and 59¾″ when machine has 17 ft. per min. table speed.

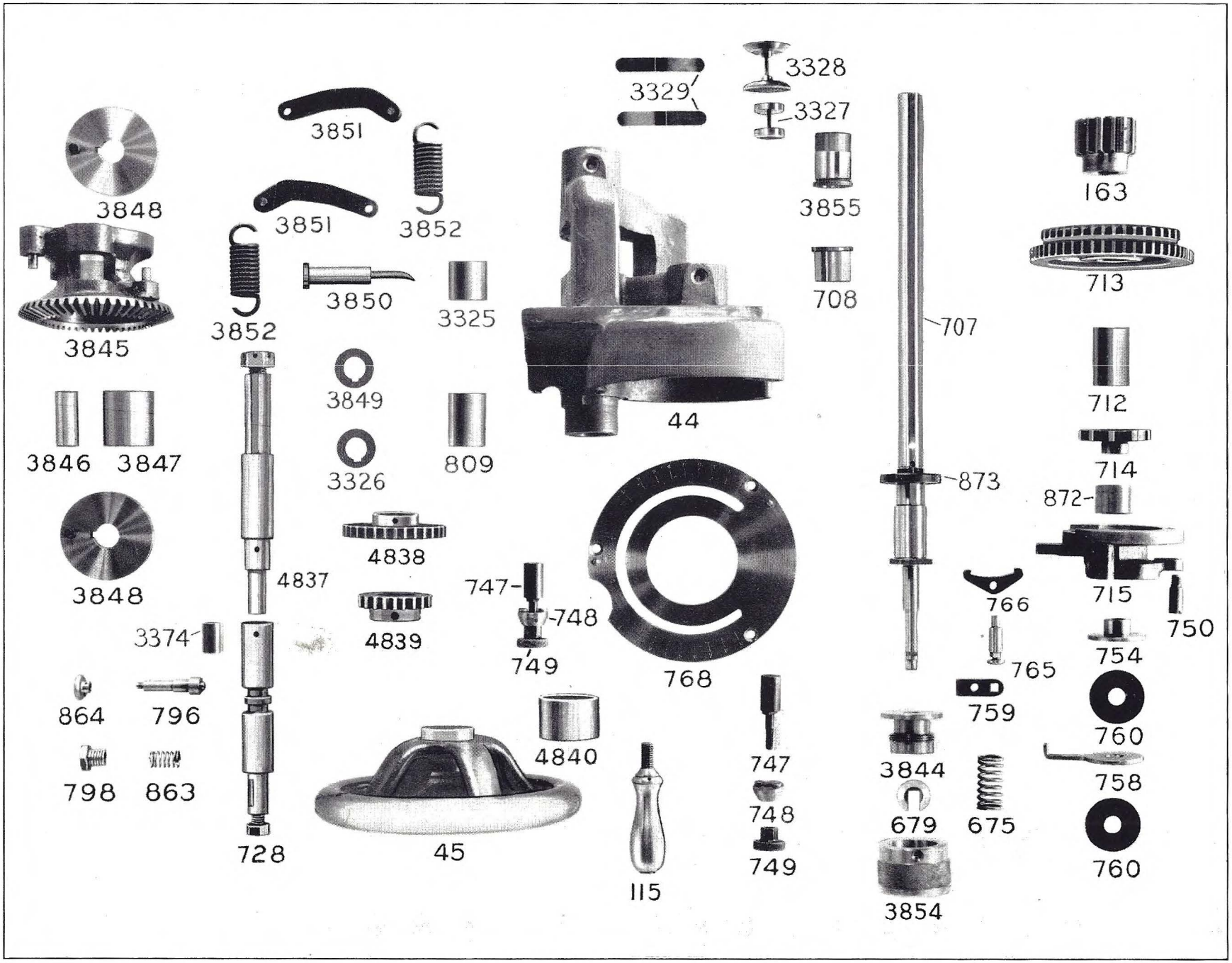


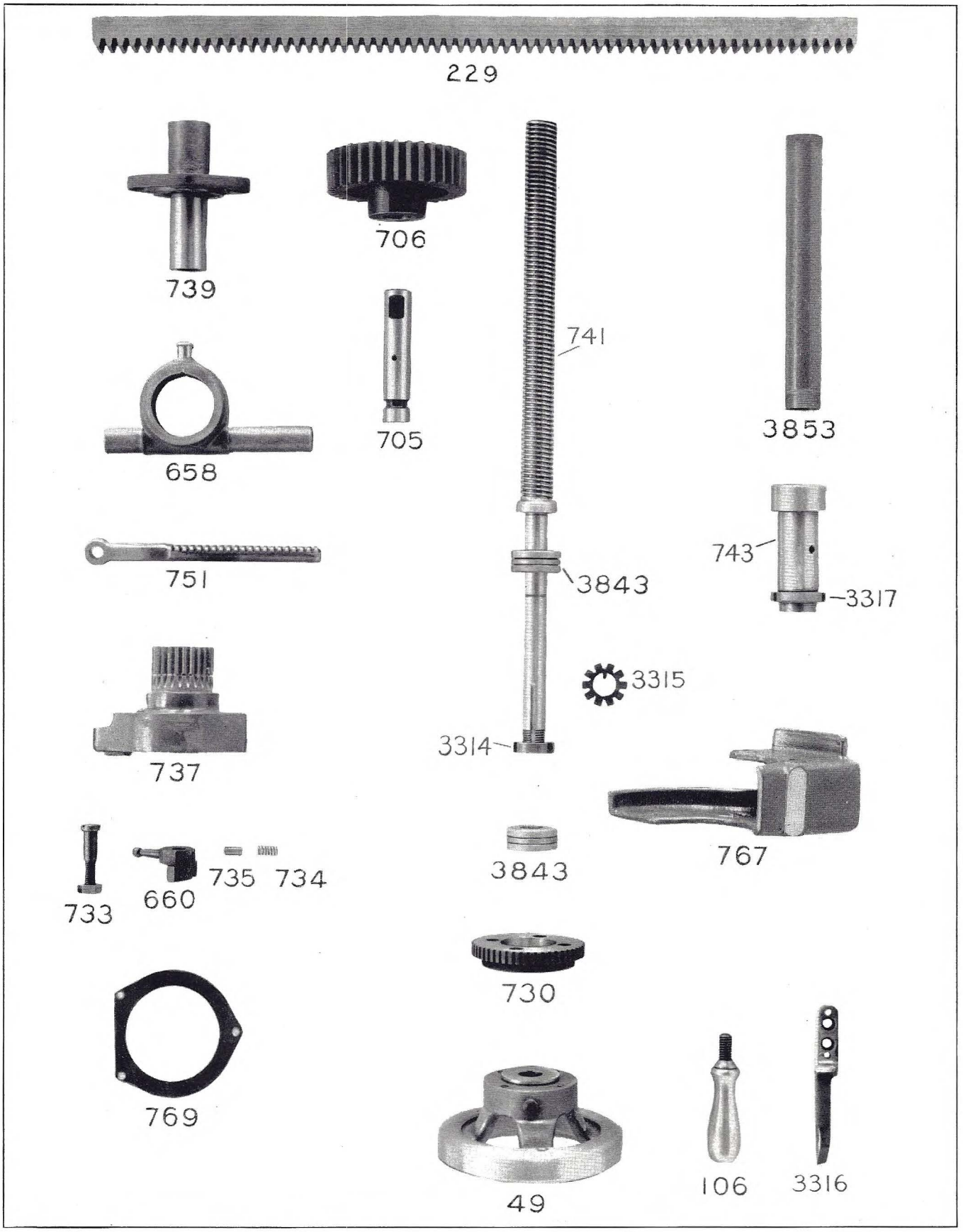
Table and Cross Feed Driving Mechanisms
No. 2 Surface Grinding Machine

When ordering parts, state the size, style and serial number of the machine in addition to the part number and name.

Table and Cross Feed Driving Mechanisms

No. 2 Surface Grinding Machine

44	Bed Front Plate
45	Table Handwheel
115	Table Handwheel Handle
163	Rack Pinion
675	Rack Pinion Shaft Spring
679	Spring Retaining Washer
707	Rack Pinion Shaft
708	Rack Pinion Shaft Bearing Bushing, Front
712	Rack Pinion Shaft Bushing
713	Rack Pinion Shaft Gear
714	Ratchet Wheel, Small
715	Friction Feed Disk
728	Table Handwheel Shaft
747	Friction Feed Disk Stop
748	Friction Feed Disk Stop Washer
749	Friction Feed Disk Stop Nut
750	Cross Feed Rack Fulcrum Screw
754	Friction Plate, Small
758	Ratchet Wheel (Small) Pawl Friction Lever
759	Ratchet Wheel (Small) Pawl Lever
760	Friction Feed Disk Washer
765	Ratchet Wheel (Small) Pawl Stud
766	Ratchet Wheel (Small) Pawl
768	Bed Front Plate Dial
796	Table Handwheel Shaft Plunger
798	Table Handwheel Shaft Plunger Bushing
809	Bed Front Plate Bushing, Front
863	Table Handwheel Shaft Plunger Spring
864	Table Handwheel Shaft Plunger Knob
872	Friction Feed Disk Bushing
873	Rack Pinion Shaft Nut
3325	Bed Front Plate Bushing, Rear
3326	Power Feed Shaft Washer
3327	Oil Roll Front, Complete
3328	Oil Roll Rear, Complete
3329	Oil Roll Spring
3374	Table Handwheel Shaft Bushing
3844	Friction Plate, Outer
3845	Shock Absorber Gear
3846	Shock Absorber Roller
3847	Shock Absorber Cam
3848	Shock Absorber End Plate
3849	Shock Absorber Washer
3850	Shock Absorber Oil Tube Bushing
3851	Shock Absorber Lever
3852	Shock Absorber Spring
3854	Friction Release Knob
3855	Rack Pinion Shaft Bearing Bushing, Rear
4837	Power Feed Shaft
4838	Power Feed Shaft Pinion
4839	Table Handwheel Shaft Pinion
4840	Table Handwheel Shaft Dust Guard



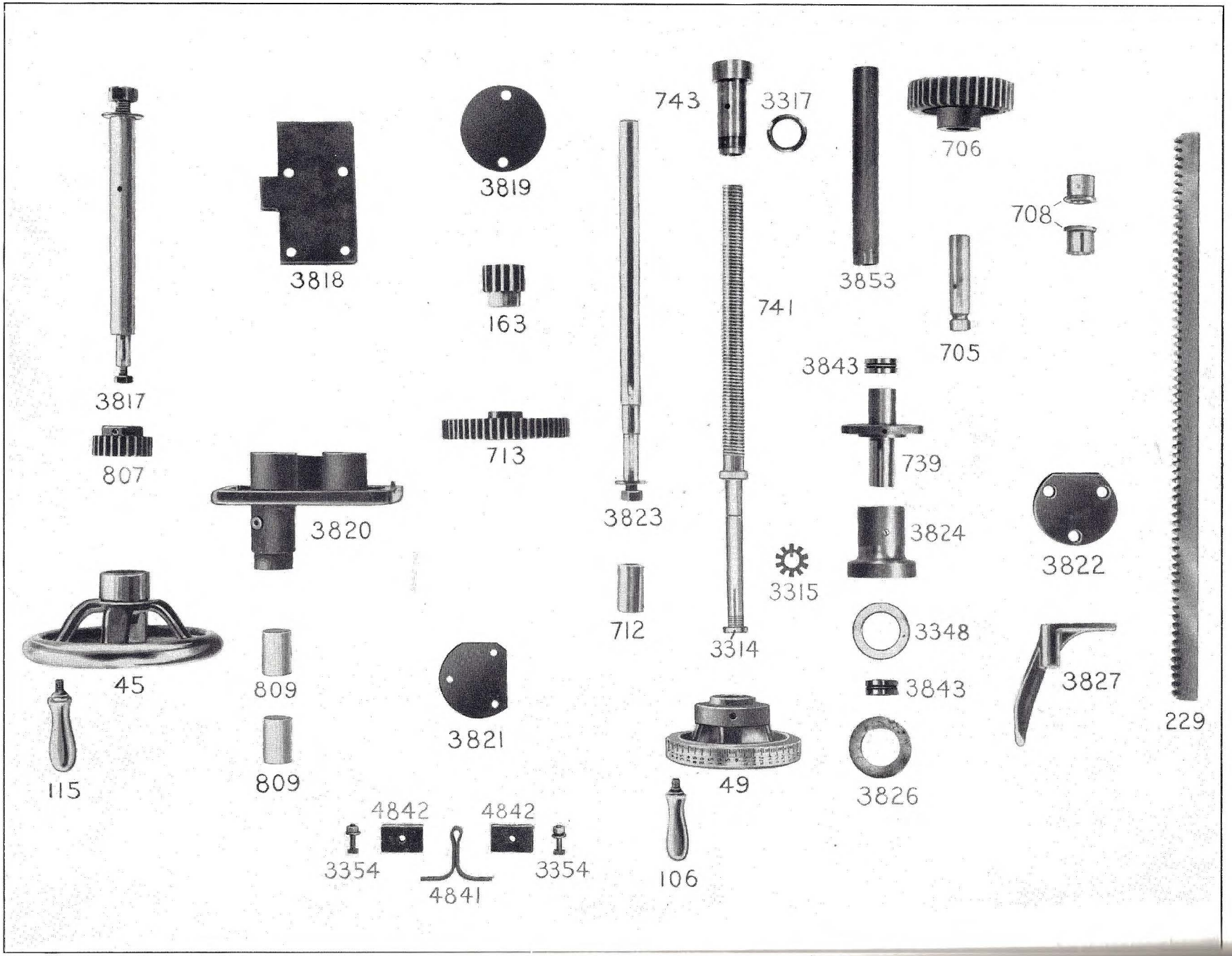
Cross Feed and Table Rack Parts
No. 2 Surface Grinding Machine

When ordering parts, state the size, style and serial number of the machine in addition to the part number and name.

Cross Feed and Table Rack Parts

No. 2 Surface Grinding Machine

49	Cross Feed Handwheel
106	Cross Feed Handwheel Handle
229	Table Rack
658	Ratchet Wheel (Large) Lever Sleeve
660	Ratchet Wheel (Large) Pawl
705	Rack Gear Stud
706	Intermediate Rack Gear
730	Ratchet Wheel, Large
733	Ratchet Wheel (Large) Pawl Stud
734	Ratchet Wheel (Large) Pawl Plunger Spring
735	Ratchet Wheel (Large) Pawl Plunger
737	Ratchet Wheel (Large) Lever
739	Cross Feed Screw Bushing
741	Cross Feed Screw
743	Cross Feed Nut
751	Cross Feed Rack
767	Ratchet Wheel (Large) Lever Sleeve Guard
769	Ratchet Wheel (Large) Lever Plate
3314	Cross Feed Screw Nut
3315	Cross Feed Screw Nut Lockwasher
3316	Cross Feed Handwheel Index Finger
3317	Cross Feed Nut Retaining Nut
3843	Cross Feed Screw Thrust Bearing
3853	Cross Feed Screw Guard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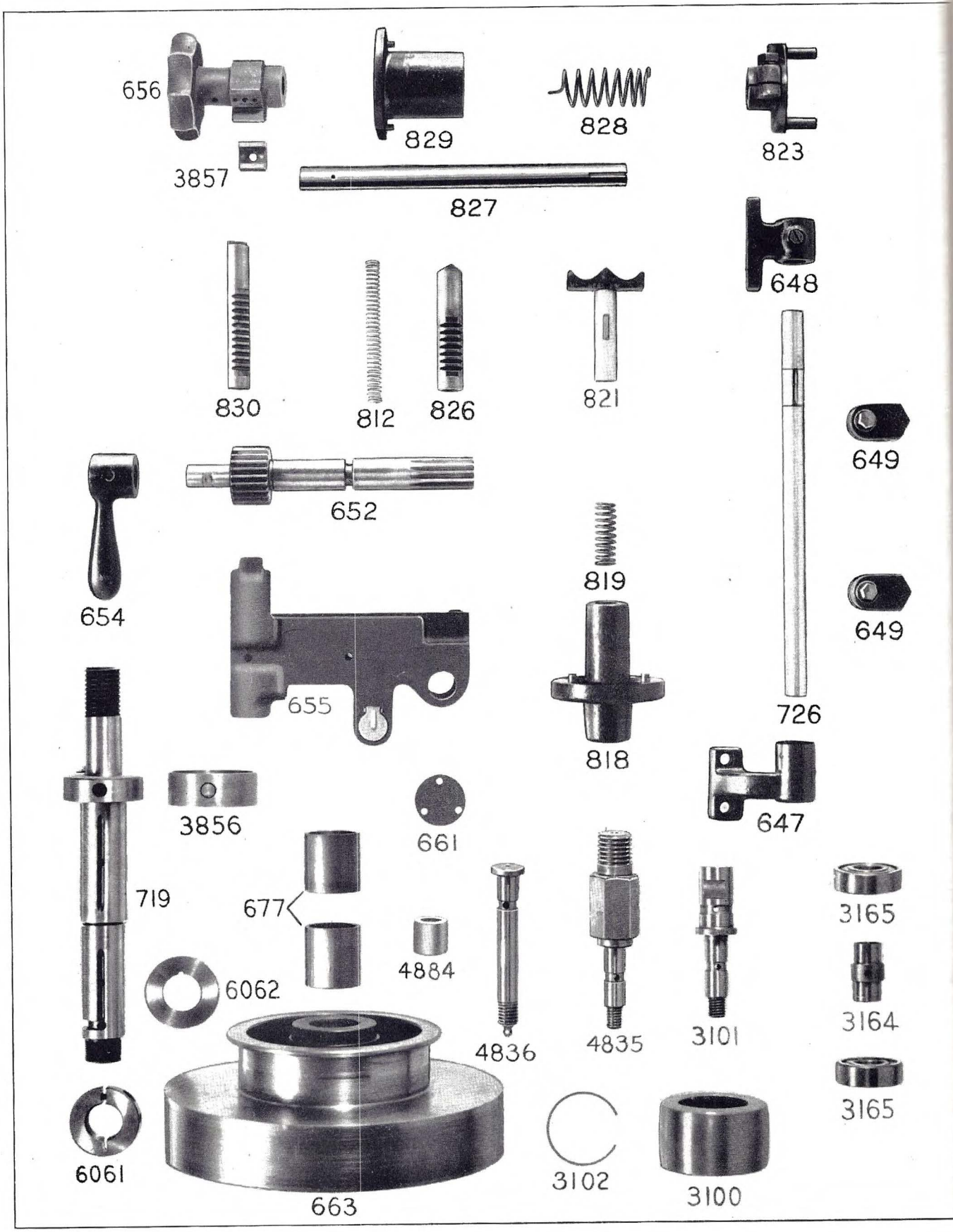
When ordering parts, state the size, style and serial number of the machine in addition to the part number and name.

Table Drive and Cross Feed Parts

No. 2B Surface Grinding Machine With Hand Feeds Only

45	Table Handwheel
49	Cross Feed Handwheel
106	Cross Feed Handwheel Handle
115	Table Handwheel Handle
163	Rack Pinion
229	Table Rack
705	Rack Gear Stud
706	Intermediate Rack Gear
708	Rack Pinion Shaft Bearing Bushing
712	Rack Pinion Shaft Bushing
713	Rack Pinion Shaft Gear
739	Cross Feed Screw Bushing
741	Cross Feed Screw
743	Cross Feed Nut
807	Table Handwheel Shaft Pinion
809	Table Handwheel Shaft Sleeve
3314	Cross Feed Screw Nut
3315	Cross Feed Screw Nut Lockwasher
3317	Cross Feed Nut Retaining Nut
3348	Spacing Collar Felt
3354	Table Stop Dog Bolt
3817	Table Handwheel Shaft
3818	Plunger Case Cover
3819	Feed Shaft Bearing Cover
3820	Bed Front Plate
3821	Bed Hole Cover, Front
3822	Bed Hole Cover, Side
3823	Rack Pinion Shaft
3824	Cross Feed Screw Spacing Collar
3826	Cross Feed Handwheel Collar
3827	Cross Feed Handwheel Index Finger
3843	Cross Feed Screw Thrust Bearing
3853	Cross Feed Screw Guard
4841	Table Stop
4842	Table Stop Dog

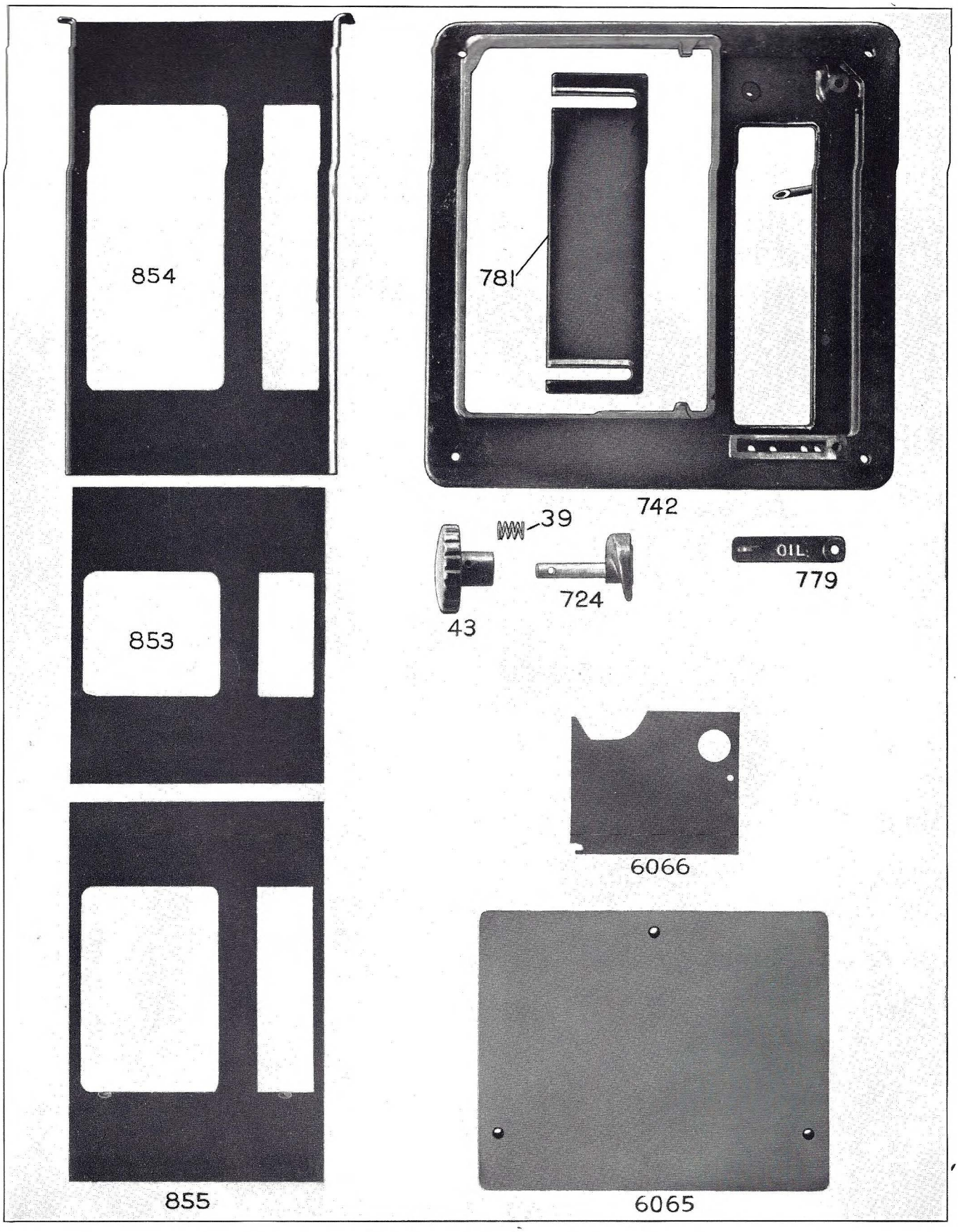


Stop Mechanism and Idler Pulley Parts

When ordering parts, state the size, style and serial number of the machine in addition to the part number and name.

Stop Mechanism and Idler Pulley Parts

647	Dog Rod Bracket, Front
648	Dog Rod Bracket, Rear
649	Feed Dog
652	Feed Trip Pinion
654	Feed Trip Lever
655	Plunger Case
656	Feed Stop Rod Knob
661	Plunger Case Washer
663	Idler Pulley
677	Idler Pulley Bushing
719	Belt Tightener Frame Pivot Stud
726	Feed Dog Rod
812	Feed Dog Plunger Spring
818	Spring Plunger Bushing
819	Spring Plunger Bushing Spring
821	Spring Plunger
823	Feed Stop Fork
826	Feed Dog Plunger
827	Feed Stop Rod
828	Stop Rod Knob Spring
829	Feed Stop Spring Case
830	Feed Trip Plunger
3100	Belt Tightener Pulley
3101	Belt Tightener Pulley Stud
3102	Belt Tightener Pulley Snap Rings
3164	Ball Bearing Spacing Sleeve
3165	Belt Tightener Pulley Ball Bearing
3856	Pivot Stud Spacer
3857	Feed Stop Rod Knob Insert
4835	Ball Bearing Idler Pulley Stud, Left
4836	Ball Bearing Idler Pulley Stud, Right
4884	Ball Bearing Idler Pulley Stud Sleeve
6061	Pivot Stud Nut
6062	Pivot Stud Washer

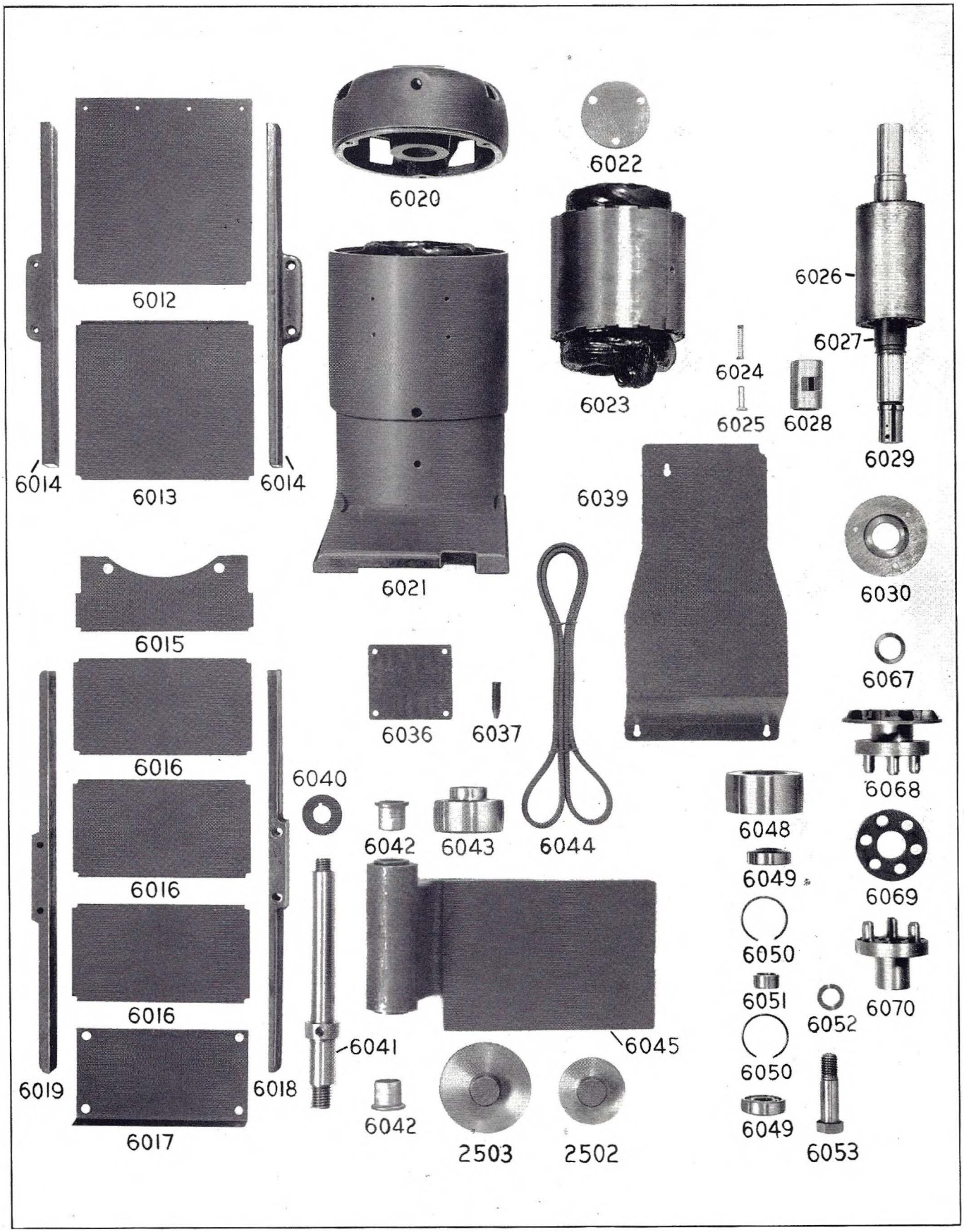


Bed Top Plate and Miscellaneous Parts

When ordering parts, state the size, style and serial number of the machine in addition to the part number and name.

Bed Top Plate and Miscellaneous Parts

39	Base Door Latch Spring
43	Base Door Knob
724	Base Door Latch
742	Bed Top Plate
779	Bed Top Plate Oil Cover
781	Bed Top Plate Cover
853	Bed Top Plate Sliding Cover, Small
854	Bed Top Plate Sliding Cover, Large
855	Bed Top Plate Sliding Cover, Medium
6065	Motor Bracket
6066	Bed Opening Cover Plate



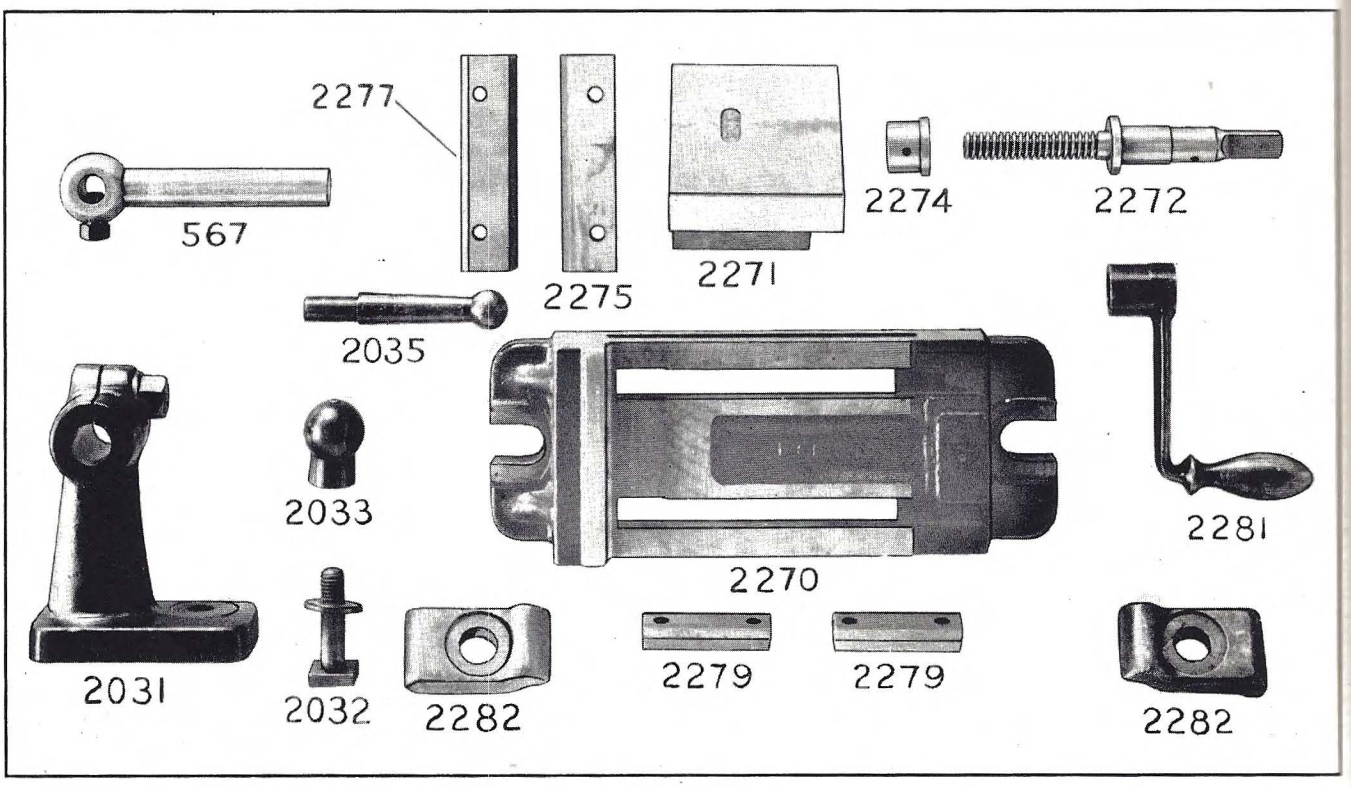
Spindle and Table Driving Parts for Machines Fitted with Motorized Spindle

When ordering parts, state the size, style and serial number of the machine in addition to the part number and name.

Spindle and Table Driving Parts for Machines Fitted with Motorized Spindle

2502	Idler Pulley Stud Pad Cover
2503	Idler Pulley Bracket Pad Cover
6012	Elevating Screw Guard Rear (Upper)
6013	Elevating Screw Guard Rear (Lower)
6014	Elevating Screw Guard Guide (Upper)
6015	Rear Outer Dust Guard
6016	Intermediate Dust Guard
6017	Rear Inner Dust Guard
6018	Dust Guard Guide Lower Rear (Right)
6019	Dust Guard Guide Lower Rear (Left)
6020	Spindle Motor End Shield
6021	Spindle Motor Housing
6022	Motor End Shield Cover
6023	Spindle Motor Stator
6024	Spindle Motor Oil Wick Spring
6025	Oil Wick Spring Plunger
6026	Spindle Motor Rotor
6027	Motor Shaft Sleeve
6028	Motor Shaft Bushing
6029	Motor Shaft
6030	Motor Housing Oil Seal Plate
6036	Spindle Head Wire Junction Cover
6037	Spindle Motor Stator Locking Screw
6039	Table Drive Belt Guard
6040	Motor Support Stud Washer
6041	Motor Support Stud
6042	Table Motor Support Bushing
6043	Table Motor Pulley (State Size)
*6044	Table Drive Belt
6045	Table Motor Support
6048	Table Feed Idler Pulley
6049	Idler Pulley Ball Bearing
6050	Idler Pulley Snap Ring
6051	Idler Pulley Ball Bearing Spacer
6052	Idler Pulley Bearing Spacer
6053	Idler Pulley Stud
6067	Coupling Washer
6068	Coupling Motor Plate
6069	Motor Flexible Coupling Disk
6070	Coupling Spindle Plate

* Smooth running, oil-resistant, endless flat belt; ¾″ wide; inside circumference 44⅛″ when machine has 33 ft. per min. table speed (60 cycle motor) or 17 ft. per min. table speed (60 or 50 cycle motor); inside circumference 45½″ when machine has 33 ft. per min. table speed (50 cycle motor).



When ordering parts, state the size, style and serial number of the machine in addition to the part number and name.

Wheel Truing Fixture and Vise Parts

567	Diamond Tool Holder
2031	Wheel Truing Fixture
2032	Wheel Truing Fixture Clamp Bolt
2033	Truing Fixture Clamp Bolt Nut
2035	Truing Fixture Clamp Bolt Nut Handle
2270	Vise Bed
2271	Vise Slide
2272	Vise Screw
2274	Vise Screw Collar
2275	Vise Jaw, Loose
2277	Vise Jaw, Fixed
2279	Vise Strap
2281	Vise Crank
2282	Vise Clamp