Operation, Maintenance and Repair Parts of the No. 0 Omniversal Milling Machine

For Machines Beginning Serial No. 198

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 No. 0 Omniversal Milling Machine.

The book explains in detail each set-up adjustment and operating control of the machine and its standard equipment. Representative operations are illustrated and described. A description is given of the various items of additional equipment available, together with instructions on the set-up and operation of this equipment. A chapter on maintenance covers the slinging and installation of the machine, lubrication, mechanical adjustments and electrical maintenance. Finally there is a repair parts section, with the parts of the machine laid out in correct relation to each other to facilitate identification and reassembly.

Such subjects as the selection of feeds and speeds, types of cutters and other phases of general milling practice have not been included, since this book is intended primarily to cover the Brown & Sharpe Omniversal Milling Machine in detail rather than milling in general. Those interested in a discussion of the elements of milling practice will find much valuable information in our "Practical Treatise on Milling and Milling Machines", a copy of which is shipped with each machine.

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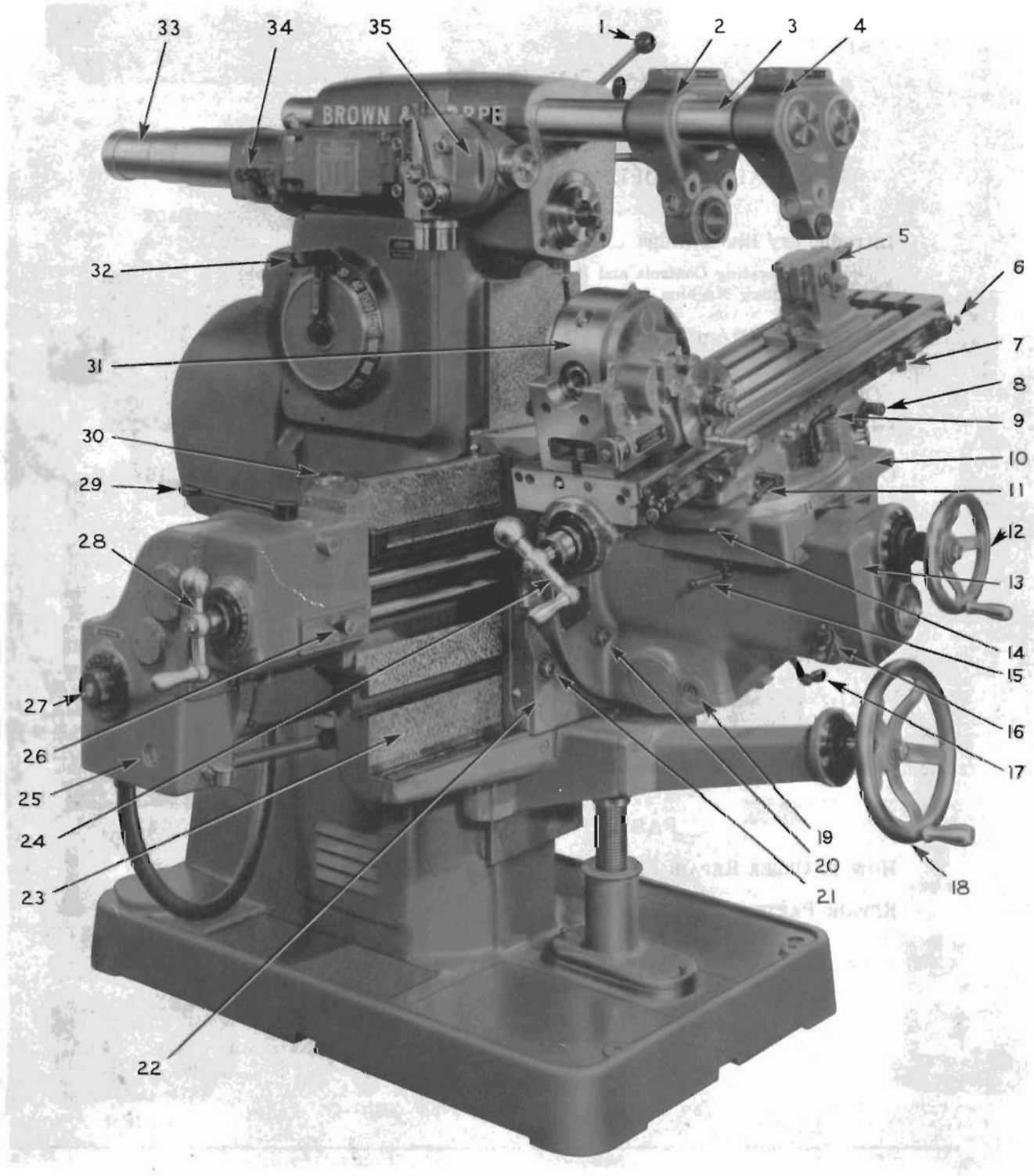

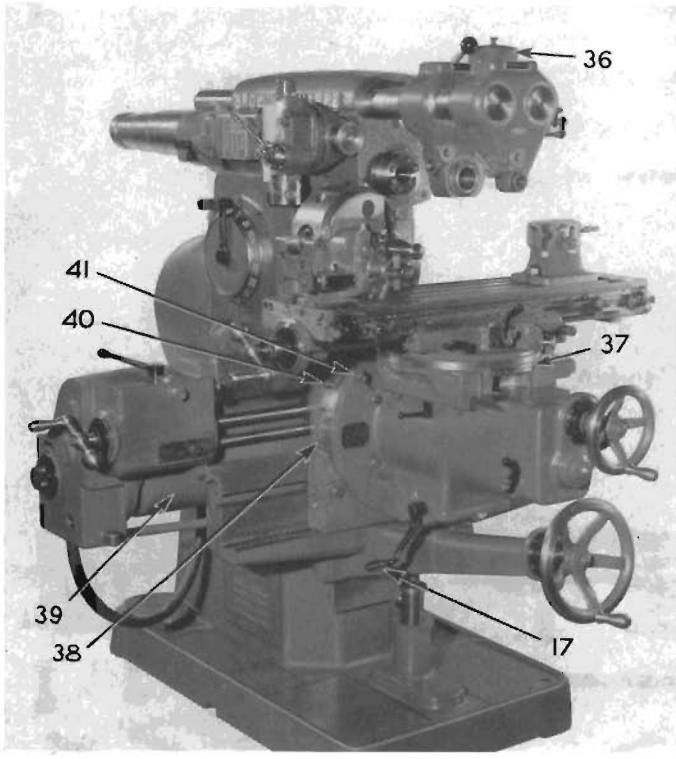

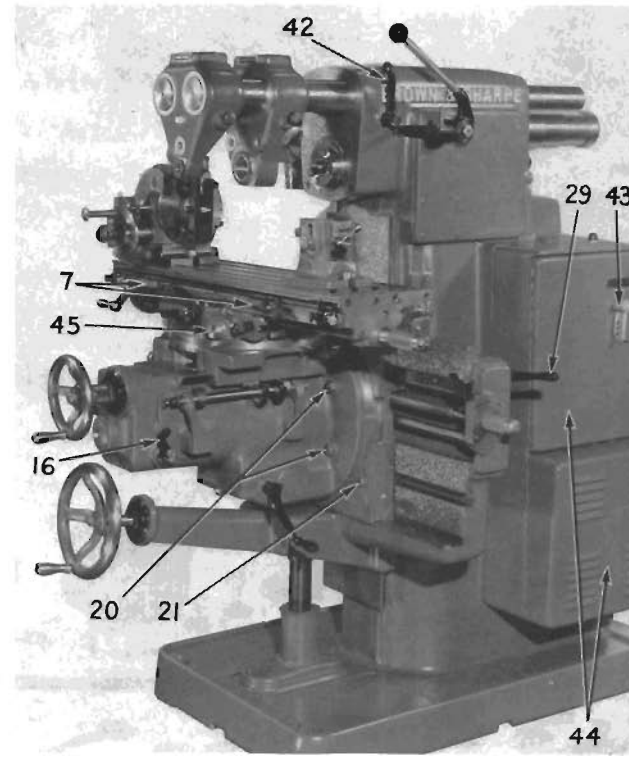

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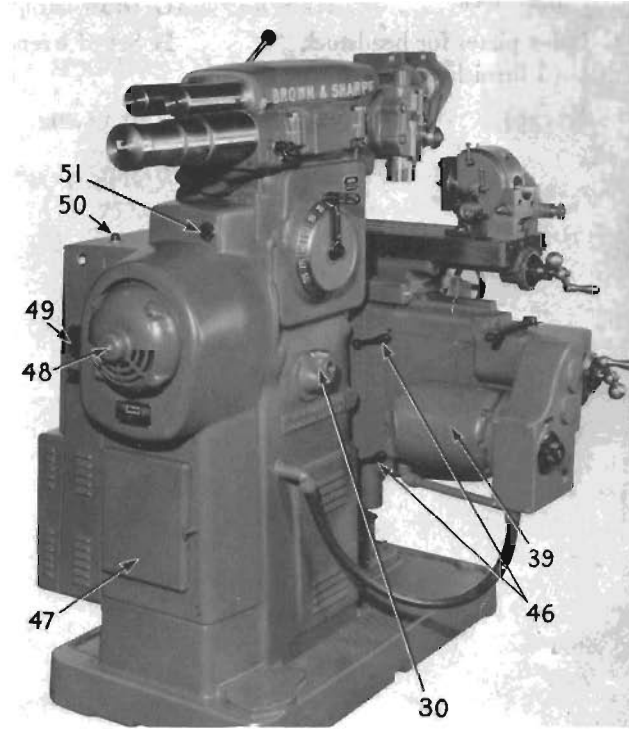
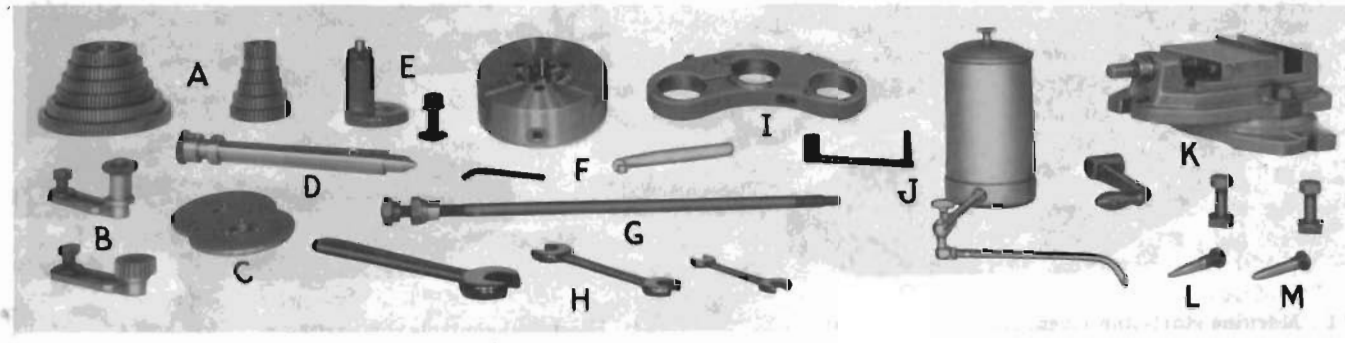




STANDARD EQUIPMENT

A Change gears for headstock

B Intermediate gear plate, and reverse gear and plate for headstock

C Index plates for headstock (3 furnished)

D Differential indexing center

E Center rest

F 7″ 3-jawed self-centering chuck

G Draw-in bolt

H Set of wrenches

I Arm bracket

J Coolant drip can and support

K No. 22S swivel vise

L Knee locking pin

M Knee slide aligning pin

CHAPTER I

Set-Up Adjustments and Operating Controls

This chapter explains in detail the purpose and use of each of the controls and adjustments used in setting-up and operating the Omniversal Milling Machine and its standard equipment.

A general familiarity with this machine will be gained by a study of the introductory material on the pages immediately preceding.

Machine Start-Stop Lever

This lever is located on the upper right side of the machine (Fig. 1) and operates the main start-stop switch in the right-hand side of the column. Pushing the lever upward a few degrees starts both spindle rotation and table feed drive. When released, the lever assumes a slightly lower position; and pulling the lever downward from this running or intermediate position stops both spindle and table.

On the downward movement, the lever first operates the Stop switch and then applies a brake on the spindle motor for rapid and positive stopping of the cutter. This braking action can also be used to keep the spindle from turning while setting-up or replacing cutters.

The start-stop lever is friction-mounted (without a key) on a tapered bushing on the end of its shaft and can be quickly adjusted to the position most convenient for the operator. To do this, loosen the retaining nut a couple of turns, pull down on the lever to free it on the taper, position the lever as desired and tighten the nut, using a normal pull on the wrench.

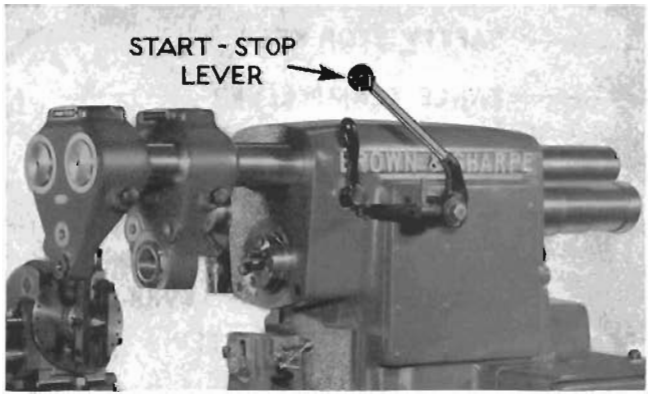


Fig. 1 (above). Machine start-stop lever.

Spindle

Drive. The spindle is gear-driven from a constant-speed motor on the rear of the machine. The various spindle speeds are obtained through sliding gears in the column controlled by the speed selector lever. A section drawing showing part of the driving mechanism is shown on page 25.

Selecting Rate of Speed. Eighteen rates of spindle speed are provided on this machine — 40 to 1530 R.P.M. (with 60-cycle motor) in either direction.

To change the speed, rotate the speed selector lever on the left side of the machine (Fig. 2). The lever can be rotated in either direction and each complete turn gives a change in speed, the rate engaged being shown in revolutions per minute on the large rotating dial. Always stop the machine before changing speed.

The spindle jog button is at the rear of the machine as shown on page 5, adjacent to the speed selector lever. If occasional difficulty should be encountered in changing speed, a touch of the jog button will remedy the situation.

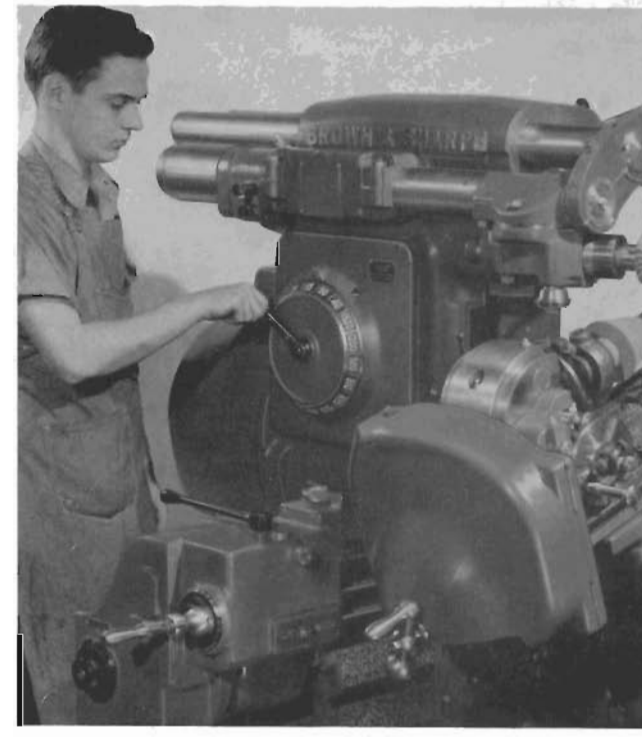


Fig. 2 (right). Speed selector lever. Dial and triangular marker show rate of speed engaged.

Reversing the Spindle. The direction of spindle rotation is governed by a reversing switch at the rear of the electrical controls compartment, the setting for right-hand and left-hand cutter rotation being shown on an adjacent plate. With the switch at Off position, only the spindle motor is disconnected. Stop the machine before operating the reversing switch.

Table and Knee

The table of the Omniversal has horizontal angular adjustment similar to that of a universal milling machine, and in addition swivelling the knee on the knee slide gives angular adjustment in a vertical plane at right angles to the machine spindle.

Horizontal feed of the entire knee assembly along the knee slide rail is provided.

Feeds of the table, knee slide, and saddle can be used individually or in conjunction, the combined longitudinal feeds providing extra-fast feed rates up to 30″ per minute and cutting capacity up to 34″ in length.

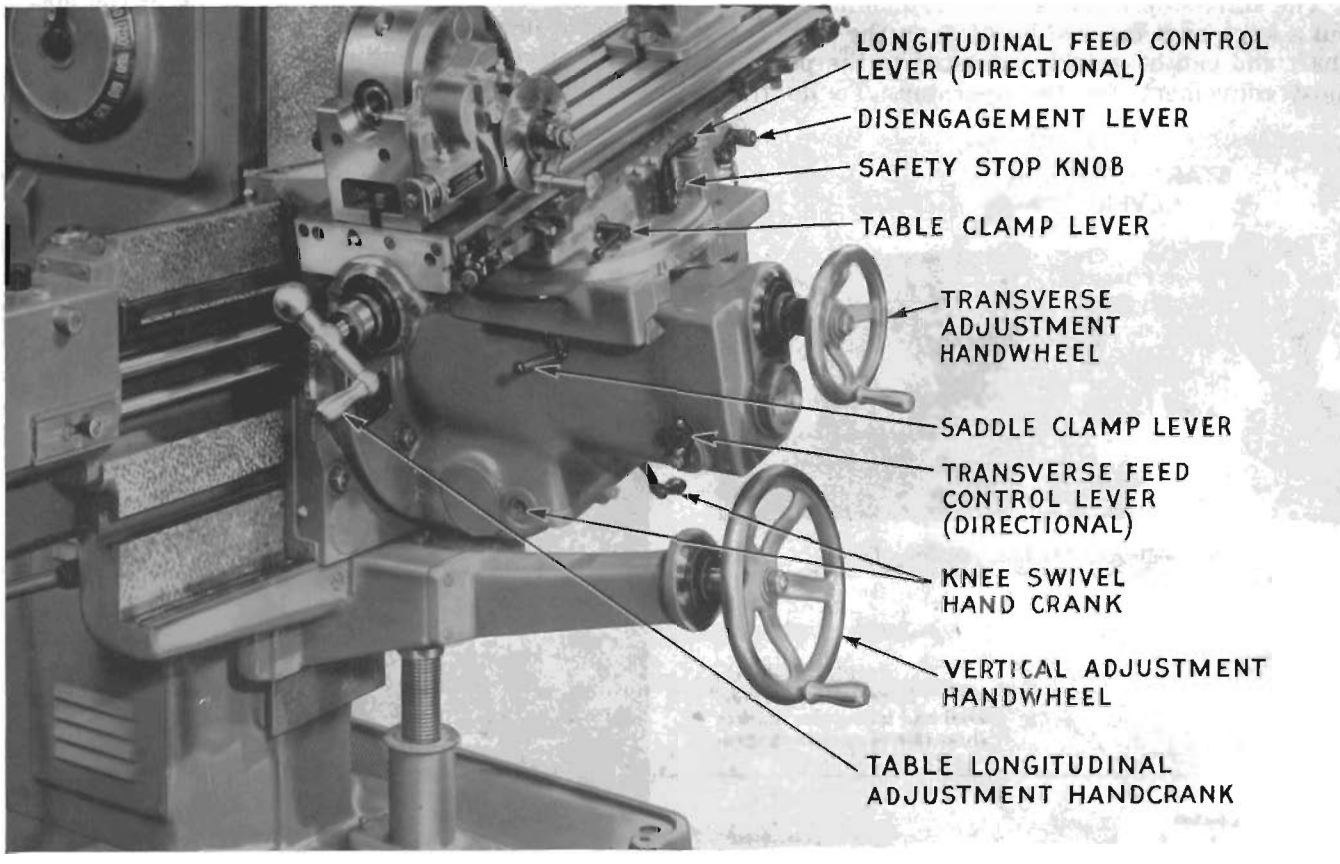
Drive. A variable-speed, electronically-controlled motor, mounted on the feed case at the left-rear of the knee slide rail, provides power, independent of the spindle drive, for all feed movements. The machine starting lever starts or stops both feed and spindle motors. Feed changes are made by turning the knob and integral dial on the left end of the feed case.

Hand Adjustments. Adjustable dials reading to .001″ facilitate settings when making longitudinal, transverse and vertical adjustments. To set a dial, turn the adjacent knurled clamp nut counterclockwise to release the dial; turn the adjustment crank or handwheel in the direction of intended movement until the normal backlash is taken up; then turn the dial to the desired setting and tighten the clamp nut.

When using the left-of-table operating position, turning the table and knee slide longitudinal adjustment cranks clockwise moves the table and knee slide respectively, to the right. With the cranks at the right-of-table operating position, clockwise rotation causes movement to the left.

Turning the transverse adjustment handwheel clockwise moves the clamp bed, saddle and table toward the rear. The handwheel is engaged by pulling out the sleeve on the handwheel hub. Disengagement is automatic when power feed is engaged.

Fig. 3. Controls and adjustments at front of machine.



Turning the vertical adjustment handwheel clockwise raises the knee unit and table.

Angular settings of the table are indicated on a circular scale at the bottom of the saddle. This scale is graduated to 50° each side of zero and a vernier gives readings to 2′.

The knee swivel has a scale reading to 60° each side of zero with a vernier on each side of the knee permitting readings to 2′. Two taper pins provided permit locating and locking the knee with the table horizontal and the knee slide central (with the knee slide feed locked out).

Adjustment Clamps. Clamps for longitudinal and transverse adjustments are shown in Fig. 3. To clamp the table, pull the table clamp lever upward; to clamp the saddle, pull the saddle clamp lever forward; and to clamp the knee slide rail, push the clamp levers (on the back of the rail) downward.

A mechanical interlock prevents tightening the table clamp while longitudinal table feed is engaged, and prevents engaging longitudinal table feed while the table is clamped.

The angular adjustment of the table is clamped by three T-bolts in a circular slot. These bolts are located at the lower front of the saddle and under each end.

The angular adjustment of the knee is made by means of the handcrank from either the right or left side, and four clamp bolts hold it securely in position.

Longitudinal adjustment of the knee slide is clamped by a bolt on the lower part of the slide at both sides of the knee swivel.

The above clamps should be tightened before starting a cut.

Selecting Rate of Feed. An infinite number of power feed rates are provided—½″ to 15″ per minute. To change the feed rate, turn the rotating knob and dial on the left end of the feed case, the rate engaged being shown in inches per minute. Feeds can be changed with the table motor running, although this should not be done with longitudinal or transverse feed engaged.

Fig. 4. Feed case.

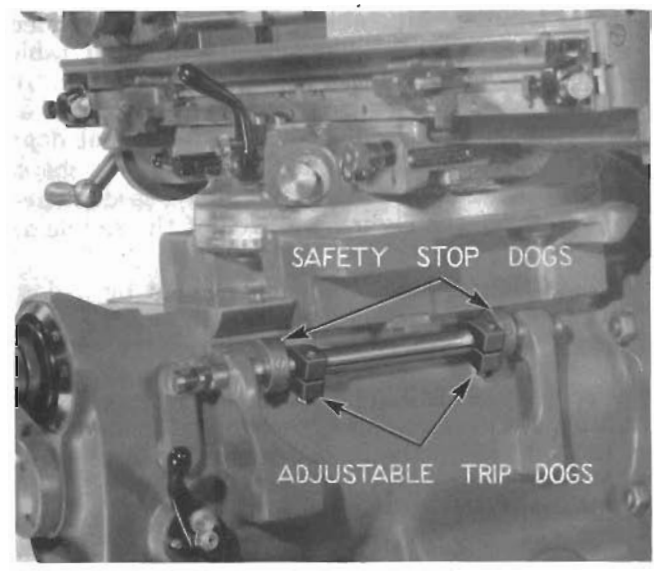


Fig. 5. Transverse feed dogs.

Feeds less than ½″ per minute cannot be accurately read from the dial but are available for flytool and similar operations—eliminating the need of a feed reducing attachment.

Feeds of table, knee slide and saddle can be used both individually and in conjunction.

Feed Control Levers. Longitudinal table, longitudinal knee slide and transverse feeds are each engaged by a single lever. All feed control levers are directional, so that to engage feed in a given direction the operator simply moves the proper lever in the desired direction of feed. For example, to engage left-hand feed of the table, throw the longitudinal feed control lever to the left; to engage right-hand feed of the knee slide, push the knee slide feed control lever to the right and so on. These levers are identified in Figs. 3 or 4.

Both longitudinal feed of knee slide and transverse feed of table have dual controls on opposite sides of machine.

The longitudinal and transverse feed control levers are provided with a safety stop which can be used to prevent engagement of feed in either direction, as selected. This device consists of a finger on the back of the lever which can be turned by a knurled knob at the front so as to come in contact with either of two pins, preventing the lever from being thrown to engage feed in the direction in which the finger is pointing. The finger is turned upward to permit engaging feed in both directions.

Trip Dogs. Adjustable trip dogs are provided for table and knee slide longitudinal and table transverse power movements in each direction. In addition, safety stops are provided at both ends of each path of travel. The table longitudinal dogs are on the front of the table, the knee slide dogs on the knee slide rail, while the transverse dogs are located under the right hand side of the saddle as shown in Fig. 5.

When the feed has been disengaged by a dog, power movement in the opposite direction can be engaged by the respective feed control lever.

Taper Spiral Milling. To perform taper spiral milling, it is necessary to synchronize the rotation of the work with the movement of the knee slide. The control knob for "Regular" or "Taper Spiral Milling" on the front of the feed case, Fig. 4, is set for Taper Spiral Milling. This synchronizes the rotation of the upper shaft A, which imparts longitudinal feed to the knee slide, with rotation of the lower shaft B which through the table mechanism rotates the Universal Spiral Index Centers headstock. Shaft B normally drives the longitudinal and transverse table feeds, and for taper spiral milling, it is necessary to disengage the table feed by means of the table feed disengagement lever at the right of the saddle, Figs. 3 and 5. After the knee slide feed lever is engaged, the table feed lever should be used to give proper direction or rotation of table screw, which determines whether the work shall have a left-hand or a right-hand spiral.

Omniversal Milling Head

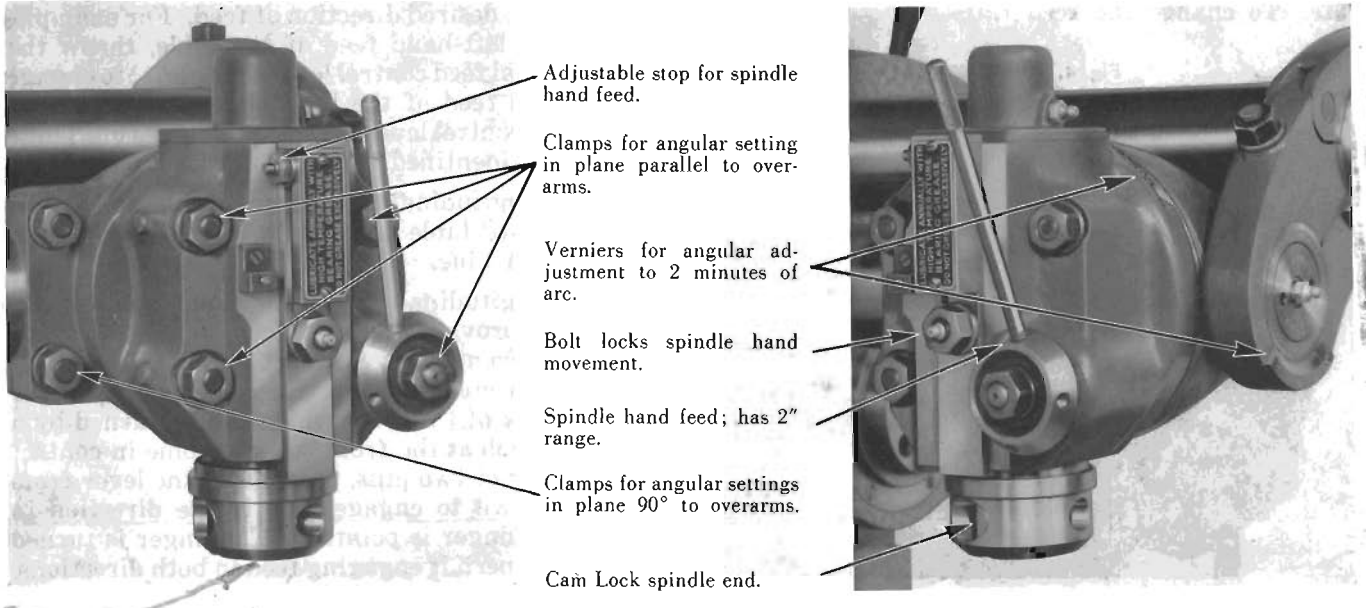
This auxiliary spindle, Fig. 6, for boring, reaming and other light machining operations is gear

Fig. 6. Omniversal Milling Head in left-of-column position.

driven from the machine spindle at twice the spindle speed. It may be used either in its normal position at the left side of the column, or in either overarm hole. When desired, cutters can be used simultaneously in both the milling head spindle and machine spindle.

The driving gear on the rear of the machine spindle drives the quill gear on the Omniversal head driving shaft through a gear containing an automatic overload release. The quill gear is mounted in a sleeve which permits longitudinal adjustment of the head. The gear case housing and collapsible guard, Fig. 8, at the rear may be rotated about the machine spindle to bring the drive to the quill gear for any of the three sleeve positions. When only the machine spindle is to be used, the Omniversal head drive may be disengaged by the lever at the rear. Two clamp bolts securely fasten the sleeve in the normal position, and the overarm

Fig. 7. Omniversal Milling Head.



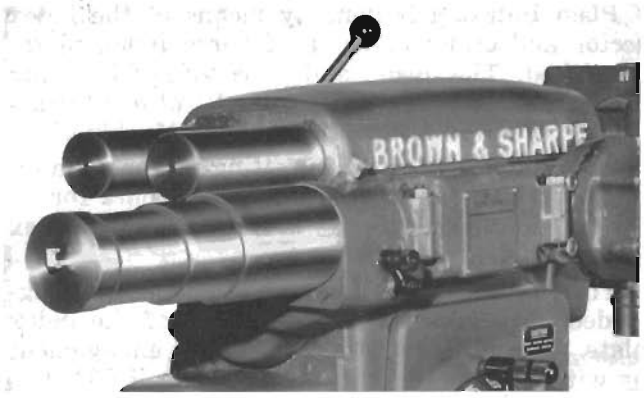


Fig. 8. Drive to Omniversal Milling Head.

clamps hold it in place when used in an overarm hole.

In addition to the choice of the three sleeve positions, the head may be adjusted transversely (i.e., parallel to the overarms) throughout a range of 13⅜" when used in the left-of-column position, and 5¾" when used in either overarm position. The head has universal angular adjustment, for the spindle can be set at any angle in planes both parallel and at right angles to the overarms, by verniers reading to two minutes of the arc. The spindle itself has a 2" axial hand feed, and may be clamped in position anywhere along this path of travel.

The Omniversal Milling Head is useful in numerous types of work; and the Brown & Sharpe Cam Lock spindle construction, which enables the quick interchange of tools, is a valuable feature where two or more kinds of operations, such as milling, boring or reaming, are to be done consecutively on a given job.

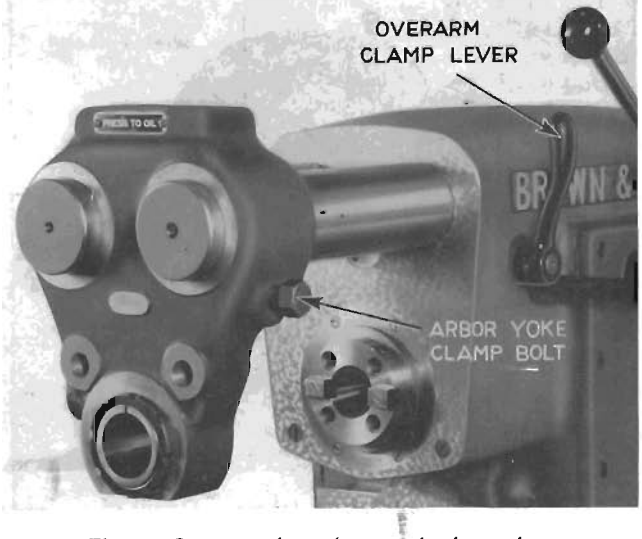


Fig. 9. Overarm clamp lever and arbor yoke. (Inner arbor yoke illustrated.)

The 2" hand feed of the spindle is of value in many instances, making it possible to feed the cutter axially into the work for boring or reaming, regardless of the angular setting. An adjustable positive stop permits duplication of feed. This axial spindle movement is also of convenience in setting-up.

Clamping bolts assure maintenance of adjustment in both horizontal and vertical planes.

The outer end of the Omniversal Head is supported in the arm bracket which also has the verniers for accurate angular adjustment.

Arbor Support

For maximum rigidity, the cutter should be mounted as close as possible to the spindle nose. The added clearance for work and fixtures provided by the extended spindle face permits the cutter to be located several inches closer to the spindle nose than is possible on other machines, and the set-up man or operator should not fail to take advantage of this feature.

Overarms. The two solid steel cylindrical overarms are clamped evenly at both front and rear of the column by a small forward movement of the overarm clamp lever (illustrated in Fig. 9). When the clamp is released, the overarms can be moved in or out of the column.

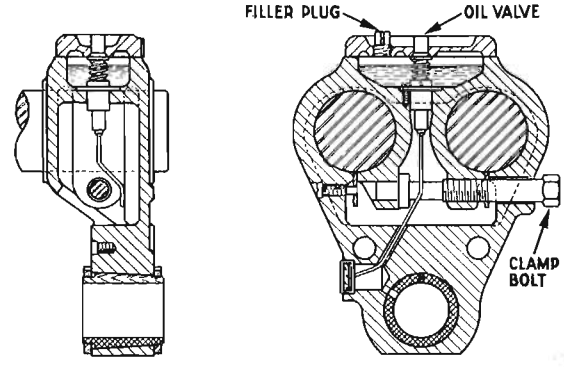


Fig. 10. Sections through arbor yoke show valve and reservoir for oiling adjustable arbor bushing, and illustrate method of securing equalized clamping to overarms.

Arbor Yokes. Two arbor yokes are furnished —one inner yoke and one outer. The inner yoke takes arbor sleeves 1⅞" diameter, and the outer yoke supports the outer end of arbors having a $^{23}/_{32}$"-diameter pilot.

Each of the arbor yokes is clamped evenly to both overarms by a single clamp bolt at the right-hand side of the yoke (Figs. 9 and 10).

Each yoke has an adjustable bronze bushing for supporting the arbor. To tighten the bushing, first loosen the rear nut; then take up on the front nut until the bushing is adjusted properly and tighten the rear nut.

Each arbor bushing is lubricated from an oil reservoir at the top of the yoke by means of a manually-operated spring-closed push valve (Fig. 10). Pushing the plunger all the way down and immediately releasing it will deliver a drop of oil to the bushing. The sight gage in the left side of the yoke enables the operator to see the amount of oil released. The reservoir is filled by removing a plug at the top.

In putting an arbor yoke on the overarms, it is easiest to start with one of the arms projecting several inches ahead of the other. Clamp the overarms and wring the yoke onto the projecting arm; then slide it along and onto the second overarm.

When changing cutters it is often convenient to bring one of the overarms forward so that the arbor yoke will remain on that arm after being pulled free of the other overarm and arbor; then the yoke can be swung upward on its arm and pushed back to rest on the top of the other overarm while changing the cutter equipment.

Draw-In Bolt

The draw-in bolt furnished is of standardized design. With the bolt in the spindle hole, the front end is threaded into the arbor or adapter by means of the hexagonal knob on the rear end; then the arbor is drawn into the spindle nose by turning the nut up against back end of the spindle.

Universal Spiral Index Centers

The Universal Spiral Index Centers and equipment illustrated in Fig. 13 (next page) are furnished as standard equipment. They can be used in any position of the table or knee. These centers swing work to 10" diameter and take 17¾" length.

Plain Indexing is done by means of the index sector and crank and one of three index plates furnished. The theory and procedure of indexing are covered in detail in Chapter VI of our "Practical Treatise on Milling and Milling Machines".

The adjustments used in setting-up for plain indexing are shown in Fig. 11. Set-up data for all available divisions to 382 are listed in the index table furnished.

The handle of the index crank includes a spring-loaded pin which fits into the holes of the index plate. The pin can be locked out of engagement by withdrawing the knob and turning it 90°.

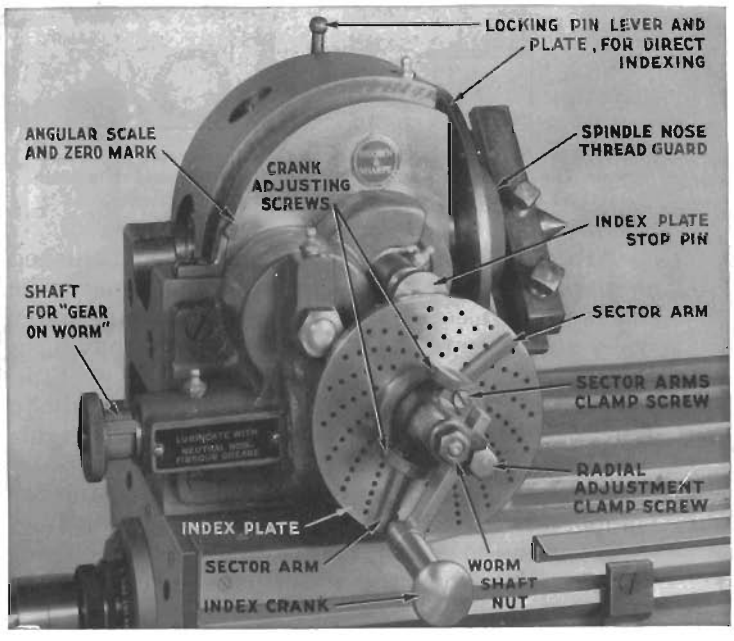
To change the index plate, remove the worm shaft nut; slip off the index crank assembly, sector spring and sector arms; and remove the three screws holding the index plate in position.

For plain indexing, the stop pin behind the upper part of the index plate must be inserted in one of the holes of the plate. Turn the knurled body counterclockwise to allow the pin to come forward to engage the index plate.

To set the sector arms to the graduation listed in the index table, loosen the sector arms clamp screw, adjust the arms and tighten the screw.

To adjust the index crank radially for the specified circle of holes, loosen the radial adjustment clamp screw, insert the index pin in one of the holes in the required circle and tighten the screw.

To bring the index pin to the nearest hole in the plate without disturbing the setting of the work, turn the index crank relative to the worm by means of the two knurled crank adjusting screws on the hub assembly. Turn both screws, loosening one and tightening the other, until the pin enters a hole; then tighten both screws.



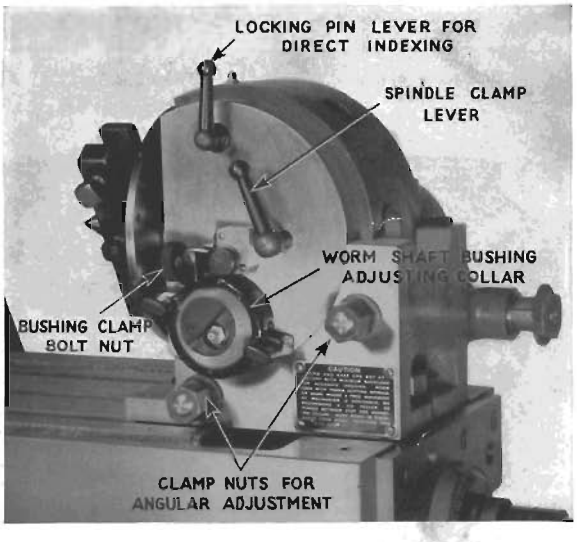


Fig. 11 (left) and Fig. 12 (above). Details of the Universal Spiral Index Centers headstock.

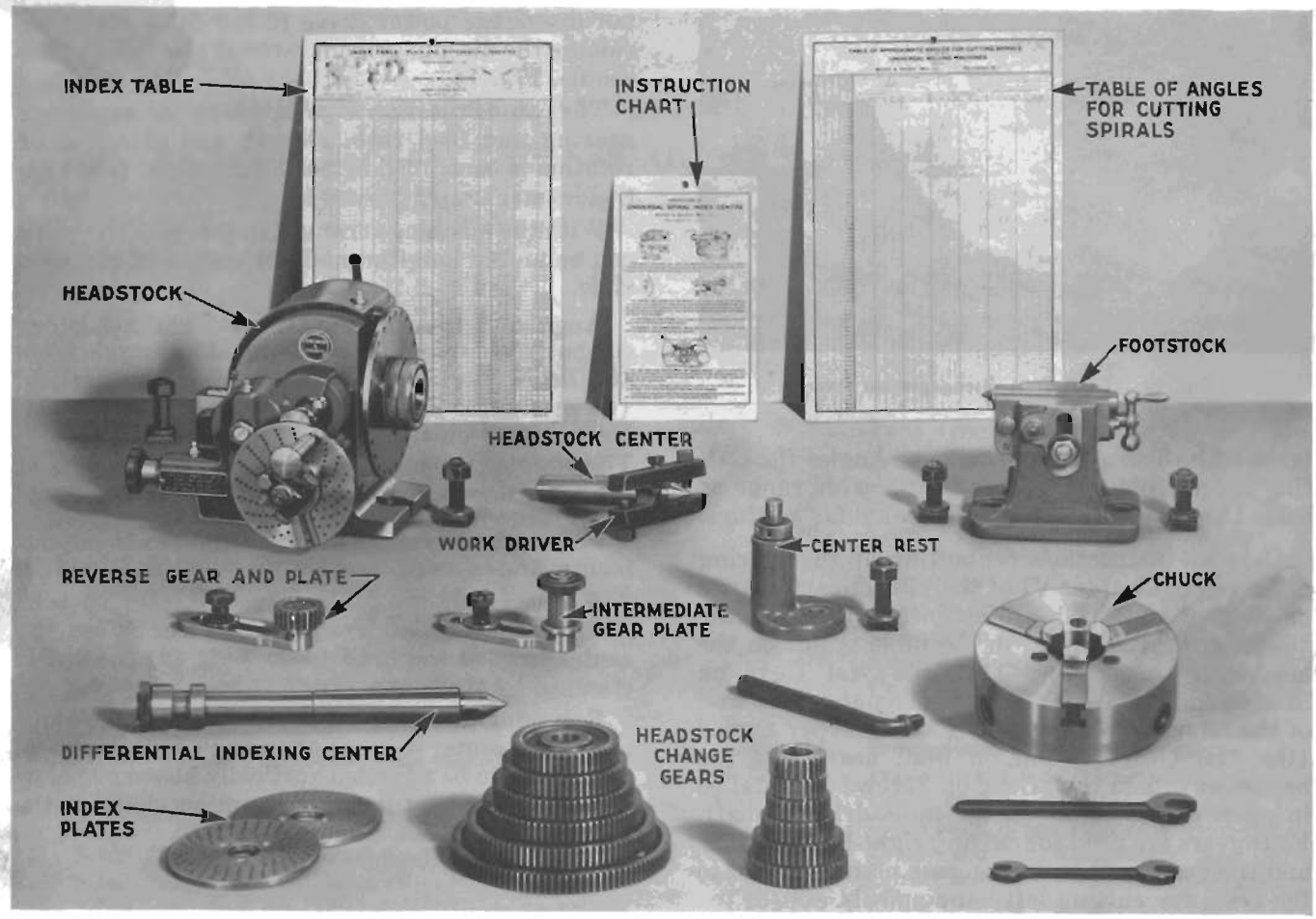


Fig. 13. Universal Spiral Index Centers and equipment.

Differential Indexing is used to obtain those divisions which are not obtainable by plain indexing. Set-up data for differential indexing are listed in the index table, and a diagram at the top of the table indicates how to arrange the gearing.

Use of eight additional change gears, furnished as extras, permits indexing all divisions to 1008; and set-up data for all divisions from 383 to 1008 inclusive are listed in a table in our "Practical Treatise on Milling and Milling Machines". Note that many of the divisions within this range are obtained either by plain indexing or by differential indexing using the gears regularly furnished.

For differential indexing, the index plate stop pin must be disengaged to permit the index plate to rotate. To lock the pin out of engagement, push the knurled body inward and turn it clockwise.

Direct Indexing of 2, 3, 4, 6, 8, 12 and 24 divisions is accomplished by means of the 24-hole plate on the spindle nose and the lever-operated locking pin at the top of the headstock. To allow the spindle to be turned by hand, the headstock worm is disengaged as follows:

First disengage the index plate stop pin. Then referring to Fig. 12, loosen the bushing clamp bolt nut and swing the bolt out of the slot. This allows the worm shaft bushing adjusting collar to be turned in a counterclockwise direction about one-quarter revolution. When the worm shaft bushing adjusting collar brings up against the stop block, the worm is completely disengaged.

To engage the worm, the reverse procedure is followed until the positive stop is reached, then securely tighten the bushing clamp bolt nut. To avoid damage to the worm and wheel, always make sure that the worm is either fully engaged or completely disengaged.

Cutting Spirals. The change gears furnished permit cutting spirals of all common leads from 2.500″ to 149.31″ when geared to the headstock worm; and leads 1/40 of all leads within this range are obtainable by gearing directly to the headstock spindle, using the differential indexing center in the spindle. (This latter method of gearing bypasses the regular indexing mechanism and requires that the spindle be parallel to the machine

Fig. 14. Table feed disengagement lever.

table.) The Table of Approximate Angles for Cutting Spirals lists the gearing for a wide range of leads together with the required angular settings.

Detailed instructions for setting-up the gearing are given in Chapter VI of the "Practical Treatise on Milling and Milling Machines". In brief, the "Gear on Worm" listed in the table is put on the headstock shaft (Fig. 11); the "1st Gear on Stud" and "2nd Gear on Stud" are put on the stud of the intermediate gear plate in the order named (the "1st Gear" is put on first, nearest to the headstock); and the "Gear on Screw" is installed in place of the collar on the table driving shaft. Four gears are used for cutting right-hand spirals, and the gear on the reverse gear plate is added to the train for cutting left-hand spirals.

Disengaging Table Feed. Where rotation of the table screw is desired without feed of the table, the table feed disengagement lever, Fig. 14, at the right of the saddle can be thrown to disconnect the table nut clutch. In order to line up the clutch teeth, set line on clutch to the pointer at the end of the saddle before lifting lever to disconnect position.

If it is desired to synchronize the movement of the knee slide with rotation of the table screw, the control knob on the front of the feed case should be set to "Taper Spiral Milling".

Before starting to drive the headstock, make sure that the locking pin at the lower front of the index plate is locked out of engagement. Also see that the direct-indexing plunger is withdrawn; that the spindle clamp is released; that the worm is engaged; and that the index crank pin is inserted in one of the holes of the index plate.

Using Headstock for Rotary Milling. Within certain obvious limitations the headstock of the Universal Spiral Index Centers can be used like a Rotary Attachment for milling segments of circles or circular slots. To drive the spindle by power for work of this sort, arrange the headstock gearing the same as for cutting a spiral (see previous page) but disengage power drive to the table screw by raising the disengagement lever at the right of the saddle, Fig. 14.

The rate of rotation is governed by the headstock gearing and feed rate selected, and direction of rotation is controlled by the longitudinal feed control lever.

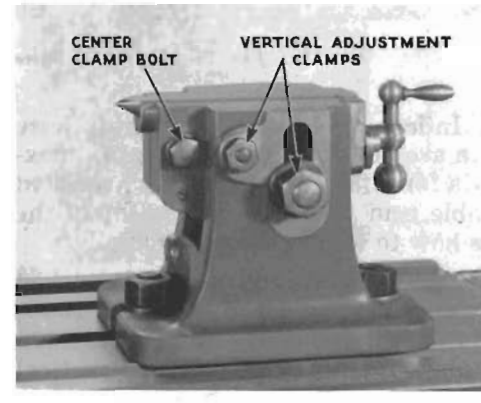
With the machine arranged in this way the work can be moved longitudinally by means of the knee slide.

Angular Setting of Headstock. The headstock can be driven with the spindle set at any angle from 10° below horizontal to 5° beyond the vertical (these figures are with the table horizontal). Graduations on the side of the head read to ½°. The angular setting is clamped by the two nuts at the rear, shown in Fig. 12.

Footstock Adjustments. The footstock adjustments and clamps are shown and identified in Fig. 15.

Turning the ball crank clockwise moves the center toward the headstock. This adjustment is clamped by the center clamp bolt.

Releasing the two vertical adjustment clamps allows the center to be set at an angle in the vertical plane, and to be adjusted vertically above or below center height by turning the pinion shaft at the rear.



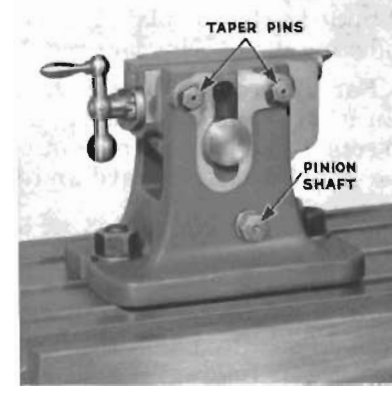


Fig. 15. Footstock.

Above—Front view.

Right—Rear view.

Before making either angular or vertical adjustment, remove the two taper pins at the rear; a twist with a wrench will free them. These pins should be used in relocating the center horizontal and at center height.

Make certain that both the vertical adjustment clamps and the center clamp bolt are tight before starting to take a cut.

Center Rest. The adjustable center rest (Fig. 16) is included with the Universal Spiral Index Centers and is used to give additional support to long or slender work held between centers. To adjust this unit, turn the knurled nut at the top to bring the non-rotating inner part to the desired height. To clamp the adjustment, tighten the set screw in the adjusting nut.

Fig. 16.
Adjustable center rest.

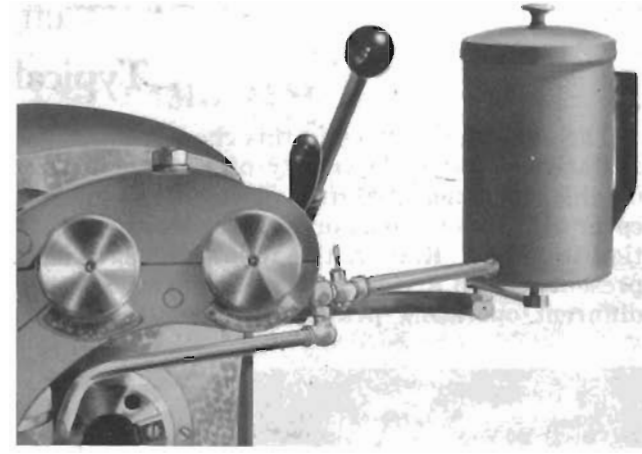


Fig. 17. Coolant Drip Can.

Coolant Drip Can

The drip can provides a handy and easily controlled method of furnishing coolant in the limited quantity needed for most work on this machine. It is supported on an adjustable bracket as shown in Fig. 17.

CHAPTER II

Typical Operations

The operations shown in this chapter are representative of the wide variety of work performed on this machine. No attempt has been made to cover all types of jobs, or to describe each operation in detail. Rather, the following material is presented with a view to demonstrating as many different operating principles as possible in the space available in a book of this nature.

Note that in many instances the work shown could be performed on another type machine, but this would require the use of special fixtures or attachments, or the necessity of relocating the work in the holding device.

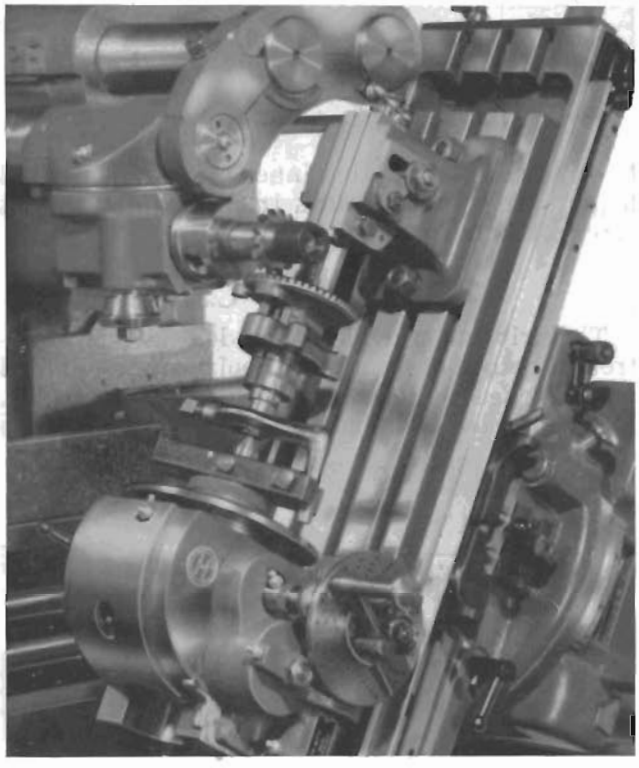


Fig. 18 (left). Milling teeth in bevel gear blank rigidly supported between centers. The work is mounted parallel to the table, and the table is set at zero and clamped, thus bringing the work in a plane parallel to the path of knee slide travel. The knee is then set to the desired cutting angle and fed horizontally to cut the teeth.

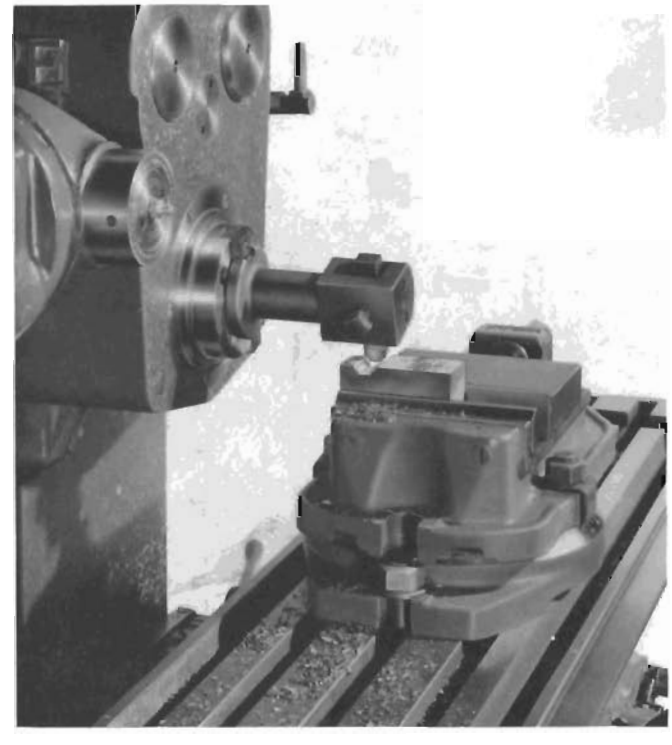


Fig. 19 (right). Using a fly tool to cut a form; a job frequently found necessary in the toolroom. The low feeds available with this machine are especially advantageous when it is desired to use a fly tool.

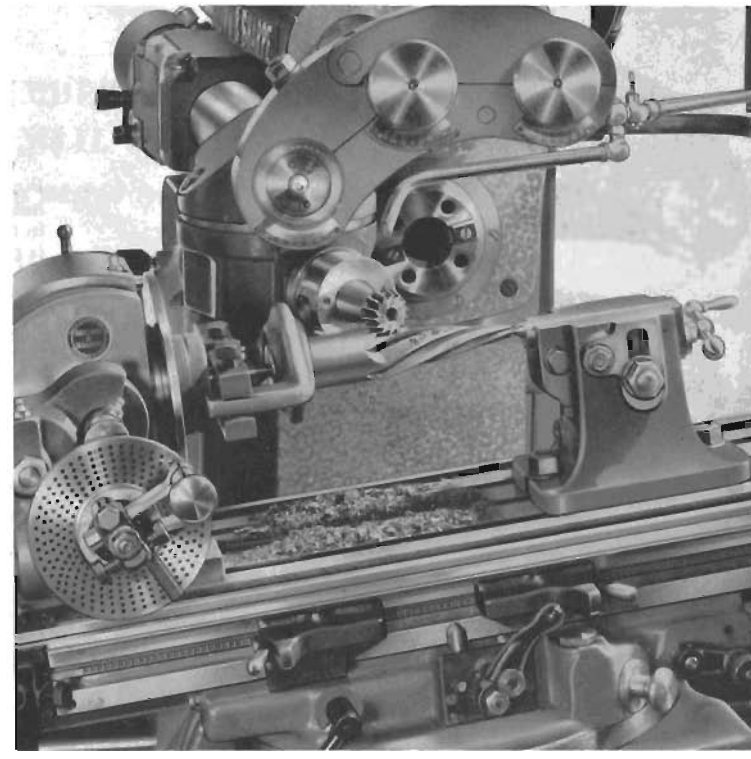


Fig. 20 (right). Cutting a spiral taper reamer. The work is mounted on centers parallel with the table, and the table is set parallel to the knee slide rail. The milling head spindle is set, in a horizontal plane, to cut the desired spiral; and the knee is swiveled to the proper angle to secure lands of uniform width throughout the length of the work. Table feed is disengaged; the taper spiral milling control is set to synchronize the rotation of the knee slide and table feed screws; and the work is rotated by power from the table feed screw in synchronism with the feed of the knee slide.

Fig. 21 (below). Drilling two rows of evenly-spaced bushing holes in inserted-tooth cutter blank (coolant drip can is used to supply necessary coolant). The knee is swiveled to the cutter tooth angle; and after indexing and drilling one row of holes, the knee is moved horizontally to locate the other row. This method assures the holes being parallel and at the desired angle.

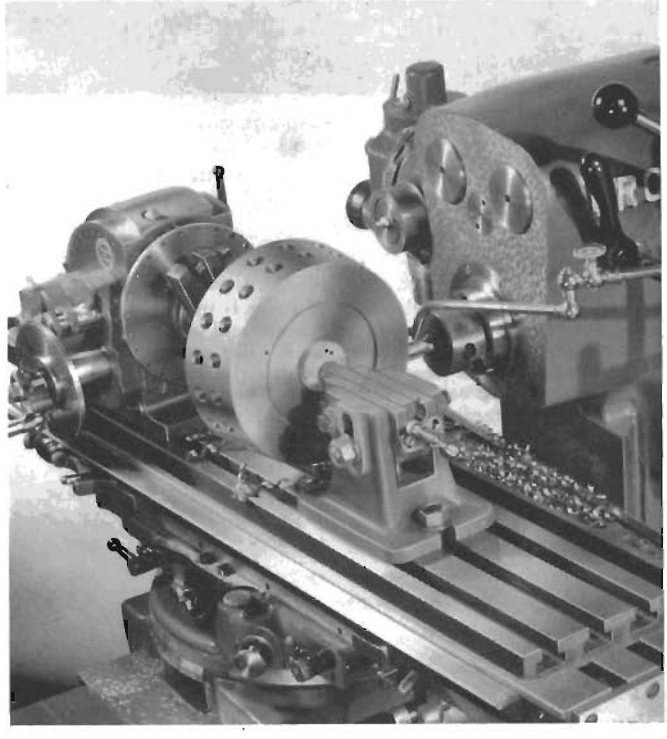
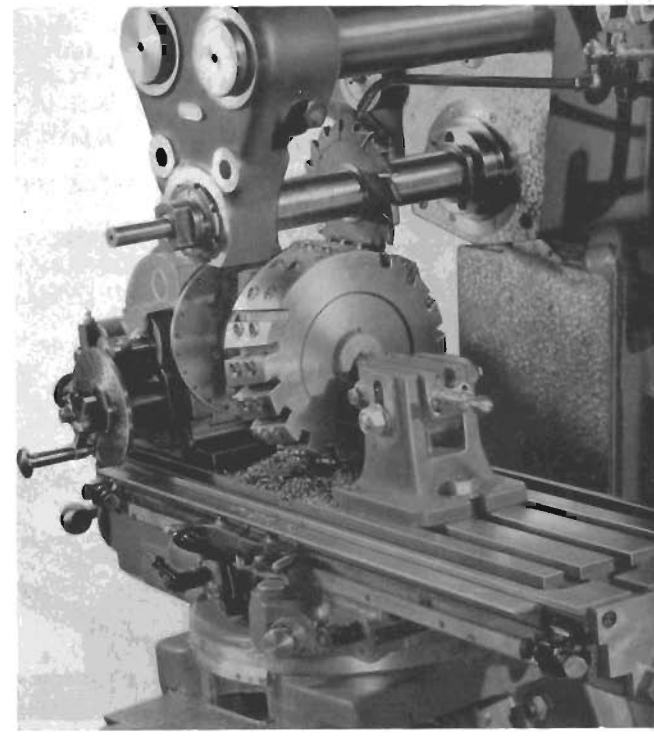


Fig. 22 (below). Milling slots in inserted-tooth cutter body. The work is mounted on an arbor and held securely between the centers of the universal spiral index centers. The table is set to 12° to give angle of this amount between sides of slot and axis. Knee is set to give 5° angle between bottom of slot and axis. Horizontal feed of the knee is used, with table clamped.



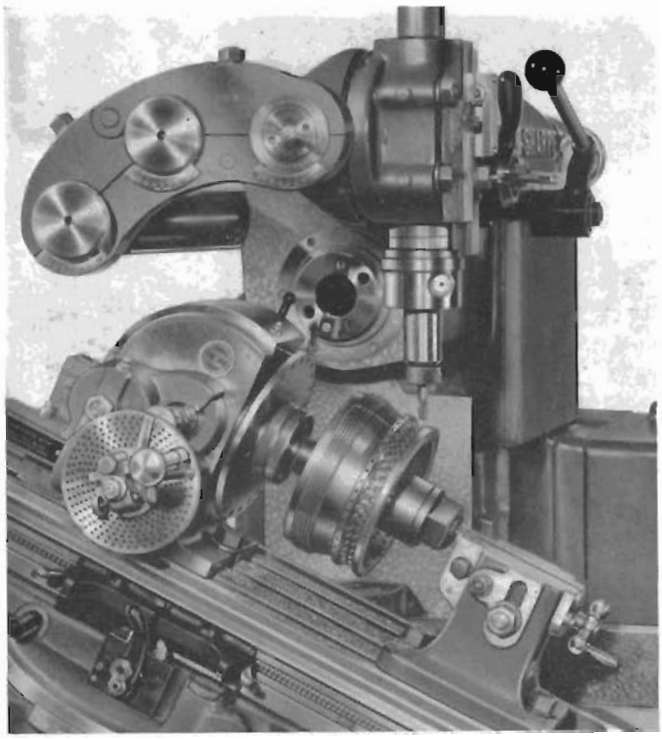


Fig. 23 (left). Milling evenly spaced angular holes. The Omniversal Milling Head is located in the right-hand overarm hole, and the overarm is placed in the milling head bracket on the left side of the machine. Hand feed of the spindle is used with stop set to give accurate depth.

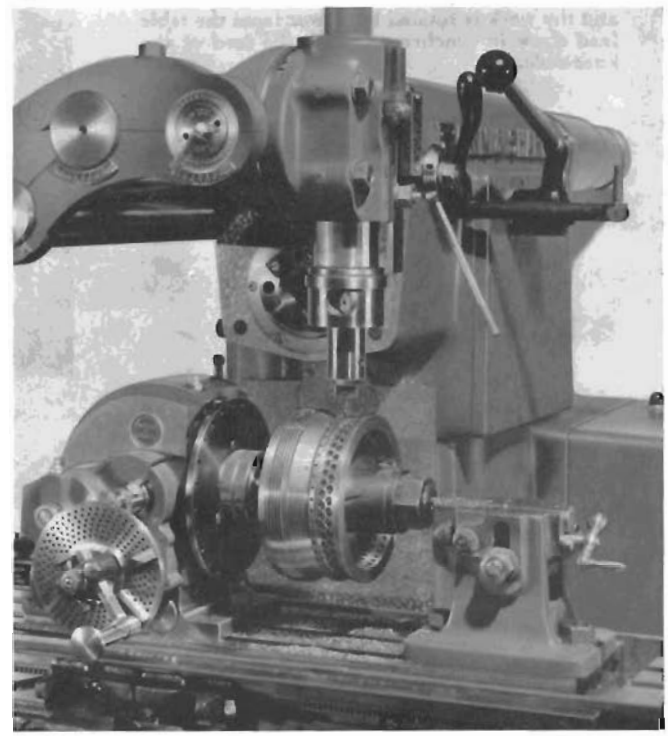


Fig. 24 (right). The knee is swiveled to the horizontal position and, without changing the location of the work on the table, another series of holes is drilled with a minimum of time required for set-up.

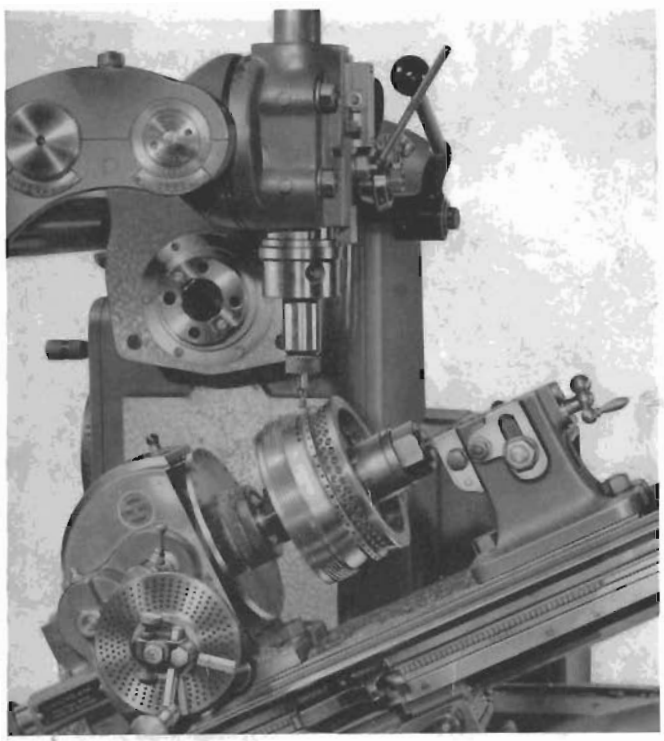
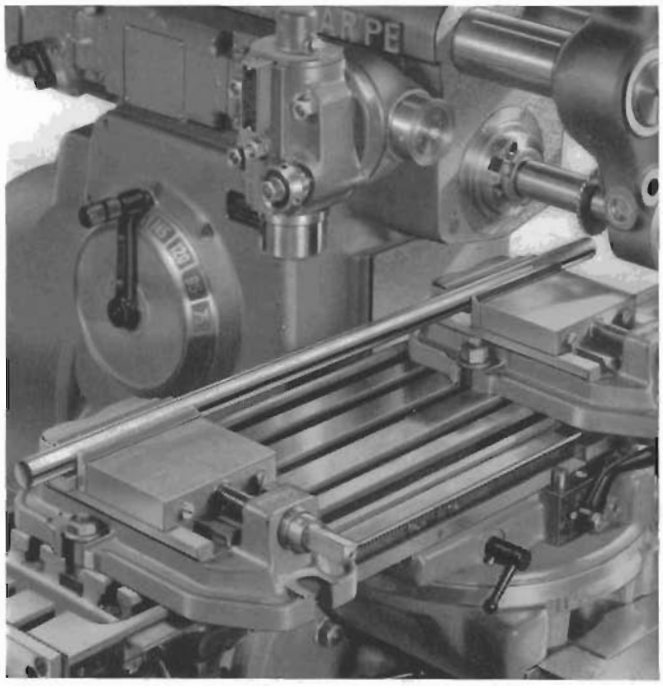


Fig. 25 (left). A third series of holes is milled by swiveling the knee counterclockwise and using the hand feed of the milling head. The swivel adjustment of the knee permits drilling of holes at any angle up to 60° either side of zero. Frequently the Omniversal Milling Head is used; the universal adjustment permits milling holes at practically any angle.



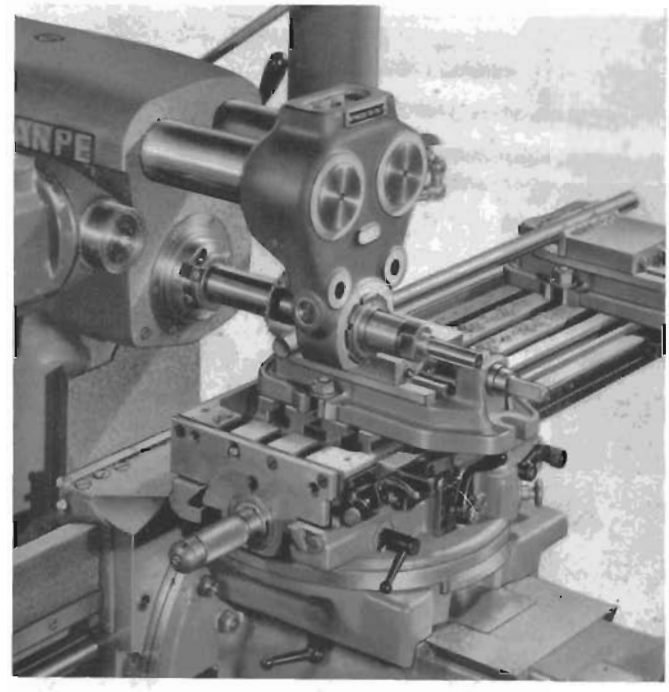
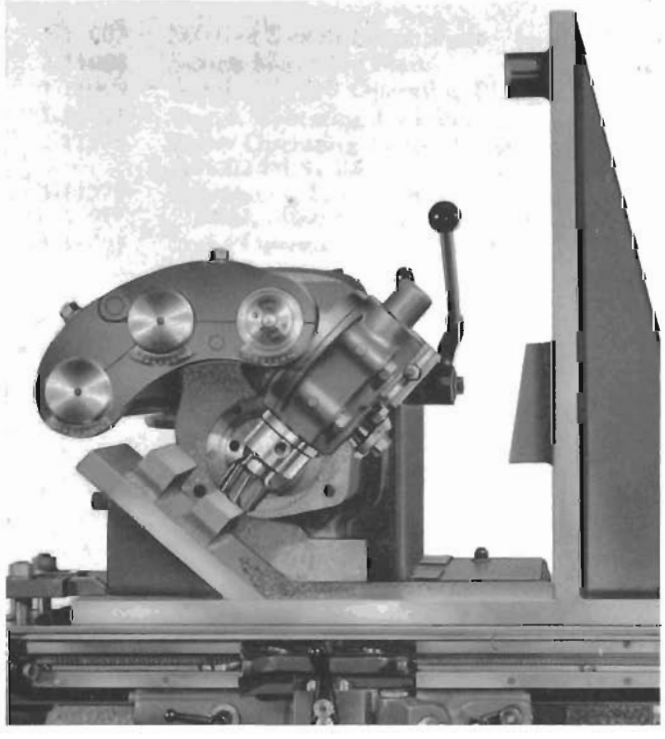
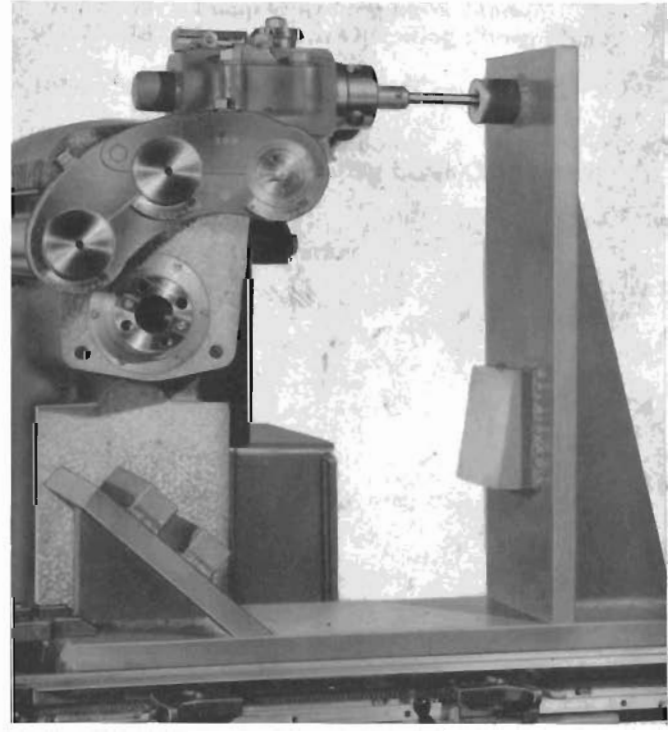


Fig. 26 (above). Milling keyway in shaft 34" long. Cuts to 17" in length may be made by feeding either the knee slide or the table. Cuts up to 34" in length are made by feeding both knee slide and table, either consecutively or jointly.

Fig. 27 (below). Boring a hole and milling angular surfaces in same vertical plane without repositioning work on table. Omniversal Milling Head is used in right-hand overarm hole and is clamped in proper angular position. Longitudinal table feed is used when boring hole and transverse feed is used when milling angular surfaces. Note wide vertical range obtainable. Center of hole is 20¾" above working surface of table. Holes with centers up to 24½" above top of table can be bored in this manner.





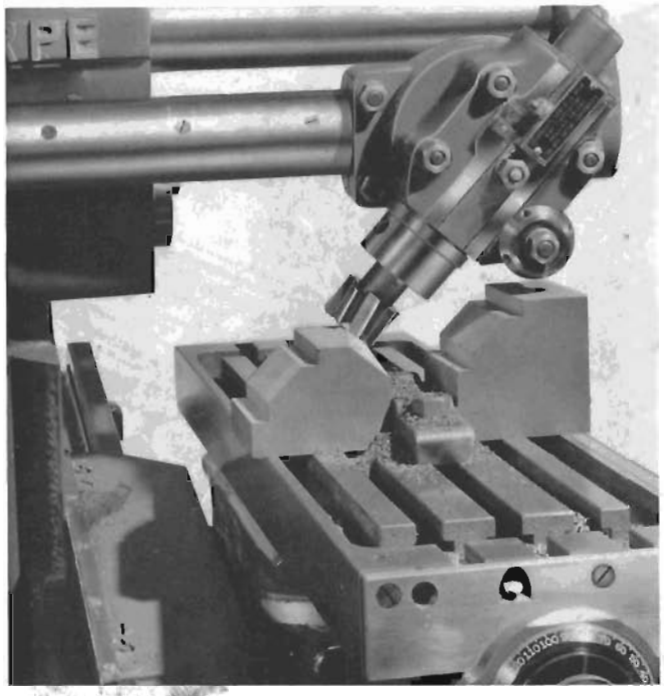


Fig. 28 (above). Milling a compound angle. The milling head spindle is set at 41° 18′ and the knee at 8° 38′ to give the desired angularity. With the table clamped, horizontal feed of the knee slide is used in making the cut. The milling head spindle may be set either ahead or back of vertical, and the knee swiveled in either direction.

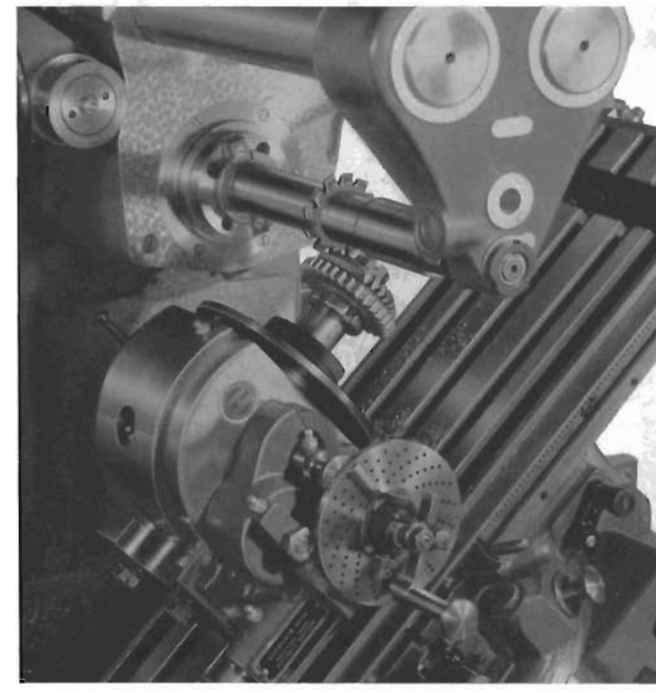


Fig. 29 (above). Cutting combination spur and bevel gear. The spur teeth are cut first, using longitudinal table feed, either with the table horizontal or with the knee swiveled. Then, without relocating the work, the table is clamped, and, with the knee set at the pitch angle, the bevel teeth are cut using horizontal knee slide feed.

CHAPTER III

Additional Equipment (Furnished at Extra Cost)

This chapter describes and illustrates the items of additional equipment available as extras, and gives data and instructions needed for set-up and operation.

No. 0 Slotting Attachment

The Slotting Attachment offers a convenient means of handling a wide variety of toolroom and

Fig. 30. No. 0 Slotting Attachment.

small-lot work such as cutting keyways, forming special tools and dies and making templates.

The slide is operated by a crank of adjustable radius which is driven from the machine spindle by a pair of gears in 1:1 ratio. To set the length of stroke, bring the slide to the top of its path of movement, loosen the crank adjustment nut (a socket wrench is furnished), move the slide to bring the zero mark to the desired length of stroke as shown on the adjacent scale, and tighten the nut. Any length of stroke from zero to 3″ may be selected; and the tool slide can be set at any angle to 90° either side of zero.

The slotting tool is held in position by a clamp bolt at the front, and a stop that swings over the top of the tool shank makes it impossible for the tool to be pushed through.

No. 0A Change Gear Guard for Drive to Universal Spiral Index Centers

Completely enclosing the headstock gearing, this guard is designed particularly for use where the lead of the spiral being cut is such as to cause the gears to rotate with dangerous rapidity. The guard allows the standard set of change gears to be used; and the hinged construction provides full freedom in changing gears. A keyed shaft extension and handcrank are furnished for making longitudinal adjustments of the table with guard closed.

The guard is made of aluminum alloy for ease of handling, and is quickly placed in position or removed from the machine, being held in place simply by two screws which attach it to the table. At some positions of the table, knee and kneeslide, use of this guard slightly decreases the length of table travel and clockwise swing of the table.

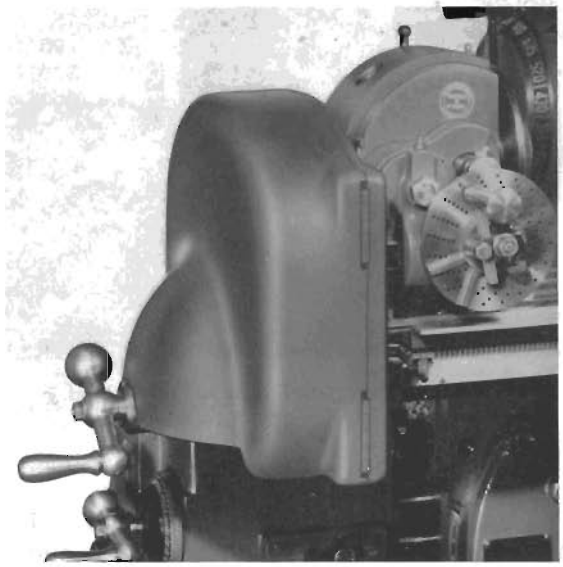


Fig. 31. No. 0A Change Gear Guard.

Rotary Attachment
10″ Hand Feed

Used in conjunction with the Omniversal Milling Head, the Rotary Attachment makes possible a variety of rotary milling operations such as milling segments of circles and circular slots. Furthermore, it affords a convenient means of indexing, and is useful in die sinking, making templates, and

in a wide variety of slotted work when used with the Slotting Attachment.

The attachment is rotated by a worm and wheel operated by a handwheel at the front, and for setting-up, the worm can be disengaged and the table turned by hand. When engaged, the worm and wheel serve as a lock to prevent unwanted table rotation, while rigid clamping of the table is provided by a lever near the front.

The circumference of the Attachment table is graduated to half-degrees, and an adjustable index finger permits readings to be taken from the nearest graduation at all settings. The index finger is adjusted by loosening its clamp screw and pushing the finger sideways. An adjustable dial behind the handwheel provides for making fine adjustments of the table.

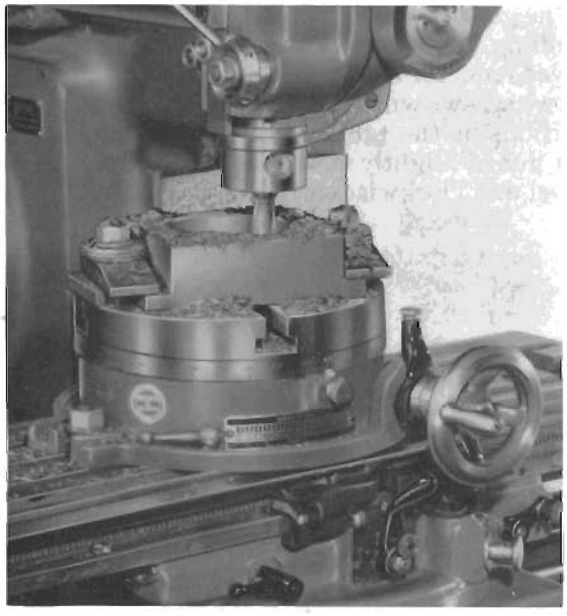


Fig. 32. Rotary Attachment 10″ Hand Feed.

Index Centers

The extensive line of Brown & Sharpe Index Centers covers a wide range of work from complex toolroom operations to high-production three-spindle indexing. With the exception of the No. 2½ Triple Index Centers, all of this equipment has the following similar features of design and operation:

In setting-up, two knurled thumbscrews on the index crank hub assembly provide for bringing the pin to the nearest hole in the index plate without disturbing the setting of the work. Both screws should be tightened before indexing.

The index sector is graduated to permit setting-up without counting the number of holes required. Simply set the sector arms to the graduation listed in the index table furnished. The setting is clamped by a screw in the face of the sector.

The worm can be locked out of engagement to allow the headstock spindle to be turned by hand; and a spindle clamp is provided. Positive stops indicate when the worm is completely disengaged and properly engaged.

The front end of the headstock spindle is threaded to accommodate a chuck or face plate. When not in use, the threads should be protected by the knurled guard nut provided.

Illustrated specifications describing the various Index Centers in detail will be furnished on request.

Universal Index Centers. These centers are similar to the Universal *Spiral* Index Centers, except that the *Universal* Index Centers have no provision for gear drive. Sizes available swing work to 6″ and 10″ diameter.

Plain Index Centers. These centers (Fig. 33) are exceptionally rigid in construction. As the worm wheel is accurately cut and of large diameter, the possibility of error in indexing is considerably lessened. They are frequently used on jig work where accurate indexing is imperative.

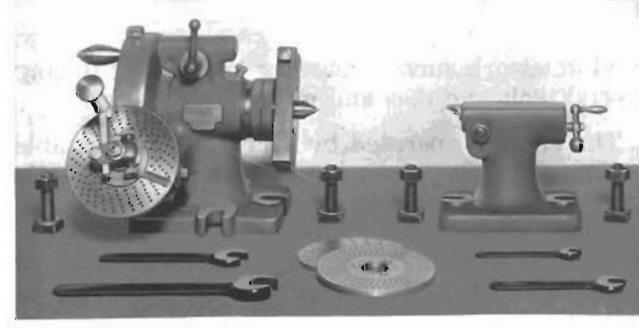


Fig. 33. 10″ Plain Index Centers.

CHAPTER IV

Maintenance

Installing or Relocating the Machine

In lifting or moving the machine, pass the hoisting rope under the two overarms next to the column at both front and rear. It will be approximately in balance when the hoisting hook is located over a point slightly behind the knee-supporting face of the column, and adjustment for balance can be made by moving the saddle in or out. The Omniversal machine weighs approximately 3600 pounds.

Fig. 34. Proper method of rigging machine with rope sling.

The machine should be located on a level and rigid floor which is free from heavy vibration. 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 of the base 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 25. CAUTION: To avoid damage, be sure to check the direction of motor rotation as explained on page 25 before starting to use the machine.

Lubrication

All driving mechanisms throughout the column and feed case and bearing surfaces on knee slide rail are oiled automatically from two reservoirs as described below. These reservoirs are drained before the machine is shipped from our factory; therefore, be sure to fill both reservoirs before starting a newly-delivered machine.

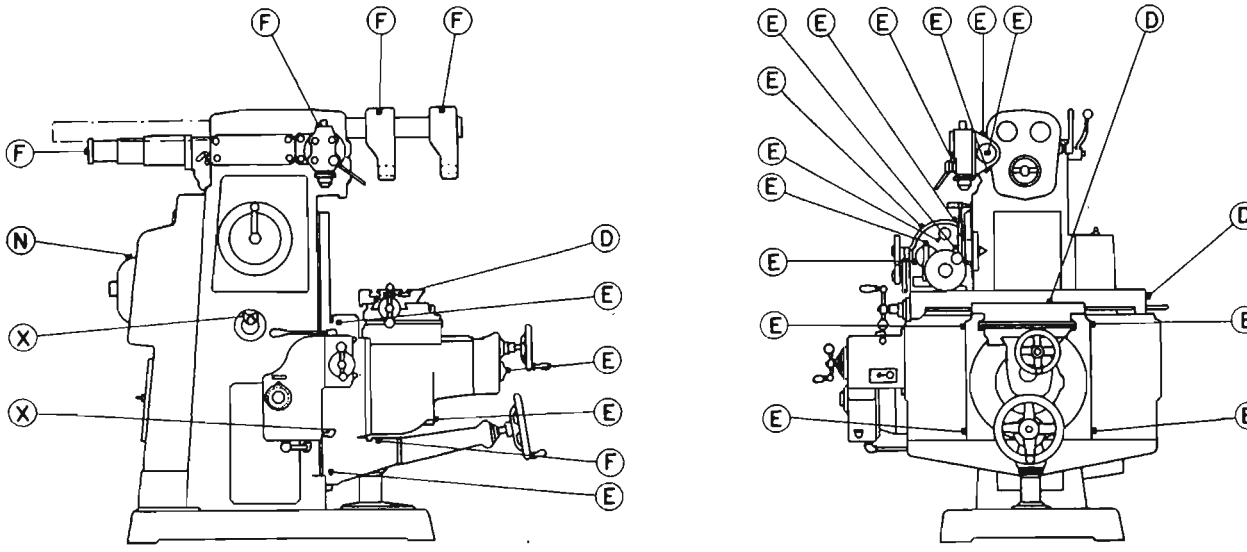


Fig. 35. Lubrication Diagram.

D—Oil daily with good grade machine oil of 300 S.S.U. at 100°F.

E—Fill when necessary with neutral non-fibrous grease.

F—Fill when necessary. Use good grade machine oil of 300 S.S.U. at 100°F.

N—Permanently-sealed bearings.

X—Keep filled to gage (Automatic lubrication) with good grade machine oil of 300 S.S.U. at 100°F.

A hand-operated plunger pump at the front of the saddle provides lubrication for the table driving mechanism and table ways, from an adjacent reservoir.

The fact that automatic oiling is provided should by no means lead the operator or maintenance man to forget the matter of lubrication. Check the level of the oil reservoirs weekly and refill as necessary (Fig. 35). Also, look at the oil sight indicators occasionally during operation to make sure that the oiling systems are functioning.

Note further that self-closing oilers in the Omniversal milling head driving shaft bracket and collapsible guard at the rear of the machine, as well as at the top of the knee elevating screw, require oiling every few days.

Use a good grade of mineral oil having a viscosity of 300 S.S.U. at 100°F, or S.A.E. 20 throughout.

The gears and bearings within the column are oiled by a plunger pump immersed in a reservoir in the column. The pump runs continuously whenever the spindle motor is running. The filler for the reservoir is on the side of the machine and has a sight gage and indicator.

The pump and strainer unit is located in the left side of the column as illustrated in Fig. 36. To remove this unit take out the three screws, tap the edges of the projecting casting to loosen it and pull it out. Before doing this, empty the oil reservoir by removing the adjacent drain plug.

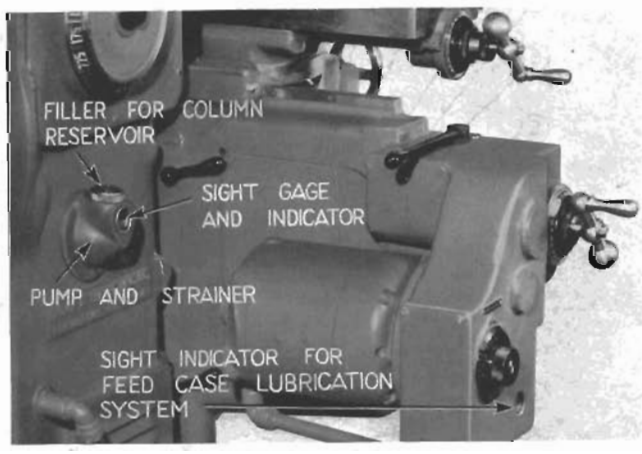


Fig. 36. Oil gages, etc., for automatic lubrication systems.

All Feed Case Mechanisms and the bearing surfaces on the knee slide rail as well are oiled by a plunger pump immersed in a reservoir in the bottom of the feed case. This pump runs continuously whenever the table motor is running.

All Table Driving Mechanisms and the table ways are oiled from a reservoir in the right of the saddle by a hand-operated pump (Fig. 37) adjacent to it. The knob should be pulled out and released about twice a day to assure adequate lubrication. When the machine has been idle for long periods, it is advisable to actuate the knob a few times. This will insure oiling the internal units and table ways.

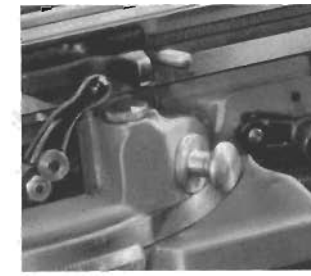


Fig. 37. Hand-operated pump.

The Knee and Knee Slide are grease-lubricated through six fittings—four on the knee slide, and two on the front of the knee. Four fittings are also placed on the Omniversal Milling Head itself and one on the intermediate driving gear stud at the back of the machine. Grease with a good grade of non-fibrous high-temperature bearing grease.

Arbor yokes are oiled manually by means of the push valve at the top of each yoke as described on page 11.

Motors regularly furnished have grease-sealed ball bearings of the "sealed for life" type. Instructions for regreasing (after several years of service) are given on a tag fastened to each motor.

Mechanical Adjustments

The adjustments described here are those which would be puzzling or difficult to make unless explained to some extent. Other more commonplace adjustments which may require occasional attention—for example, taking up the table and saddle gibs—are well understood by the competent maintenance mechanic and are not covered in this book.

Section drawing (Fig. 38) will be of assistance in diagnosing and curing any troubles in the spindle driving mechanism, and the illustrations in the Repair Parts section will be found of considerable help in disassembling and reassembling all parts of the machine.

To avoid excessive or rapid wear, make adjustments when their need first becomes apparent. It is difficult to produce good work on a machine in need of adjustment.

Spindle Bearings

To adjust the center spindle bearing, first remove the stand opening cover and plug (Fig. 39). Turn the speed selector lever until the spindle driving gears slide into a neutral position to permit free rotation of the spindle. Unloosen set-screw in edge and adjust nut A. After play is removed retighten set-screw.

To adjust bearings on shaft B, Fig. 38, remove stand cover on rear of machine. This cover is held on by six screws, two of these being under the hinged cover at the top. Straighten lockwasher C and tighten nuts D. After adjustment is made, lock by bending cleat of washer.

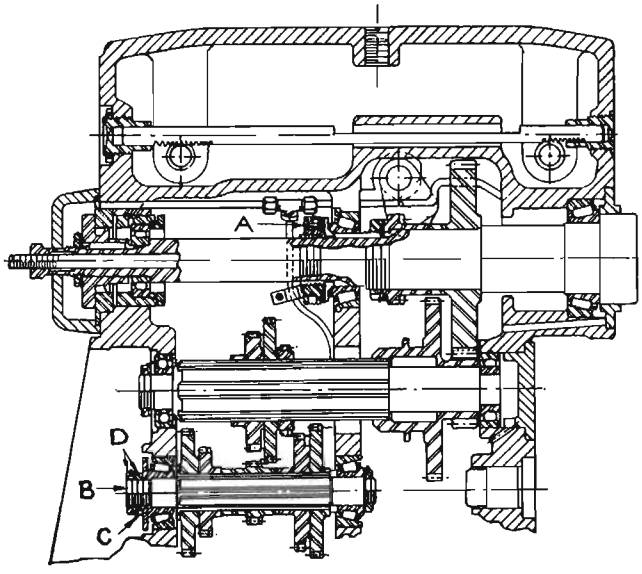


Fig. 38. Developed section through spindle drive.

The other bearings throughout the machine should seldom if ever require adjustment.

Electrical Controls

Connecting to Power Supply. The machine should be connected to the power line through the disconnect switch and should be properly grounded. The power wires are led into the machine through a hole in the electrical control compartment Fig. 40).

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

Note the direction of rotation of the spindle. With the switch at the rear of the electrical controls compartment set for *right-hand cutter* rotation, the spindle should rotate counter-clockwise as seen from in front of machine. If the direction is opposite to the above, reverse one phase of the power supply to correct the rotation of the spindle motor. (This is conveniently done by transposing two of the wires at the line disconnect switch.) Do not under any circumstances change the internal wiring of the machine.

Start-Stop Switch Unit. The machine start-stop switch assembly is located in a covered compartment in the right-hand side of the column (Fig. 40). The mechanical adjustments are for assembly purposes only and should not be tampered with.

Transformer. The transformer (Fig. 40) provides a control circuit voltage of 110 volts on 60-cycle power supply, and is protected by a manually-reset overload relay which is reset by pushing the red button at the top. The transformer has sufficient extra capacity to supply power for a 100-watt light.

Magnetic Switches and Overload Relays. These units, illustrated and identified in Fig. 40 are mounted on a panel behind a hinged cover in a compartment at the right side of the machine column.

Trouble-Shooting. Overload of any circuit stops the entire machine. In case of repeated stopping due to overload, determine which circuit is causing the trouble.

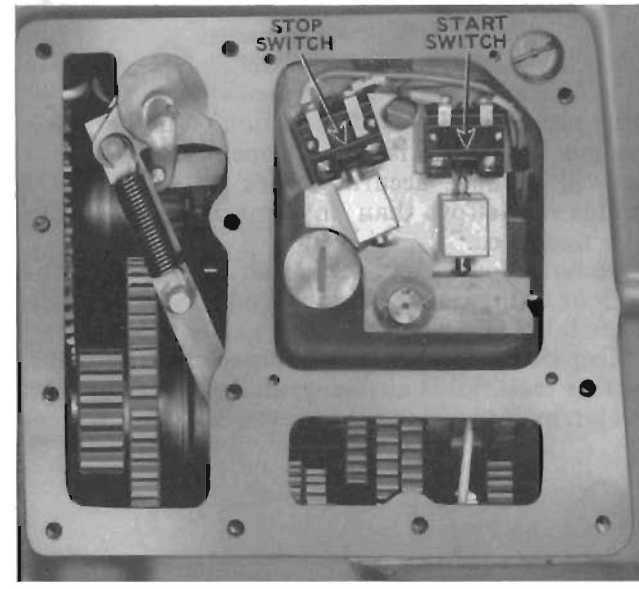


Fig. 39. Start-stop switch unit and operating mechanism.

The elementary and wiring diagrams sent with the machine will aid in tracing of the trouble. If it becomes necessary to disconnect any wires, be careful to replace them properly according to the wiring diagram sent with the machine and the numbers on the terminals.

Cleaning the Contacts. The electrical equipment should be inspected about twice a year. At this time, or in trouble-shooting, the contacts of the manually-operated and magnetic switches may be cleaned with a rag if necessary. Never use sandpaper or emery for this purpose, since particles might adhere to the surface of the contacts and give serious trouble during operation. If an instance should occur where cleaning with a rag is not sufficient, use a very fine file. Note that the black substance on the contacts does no harm, and that removing this deposit will merely shorten the life of the contacts.

Caution. To prevent the possibility of the table motor running for long periods unnoticed, do not leave the machine with the spindle reversing switch in the Off position.

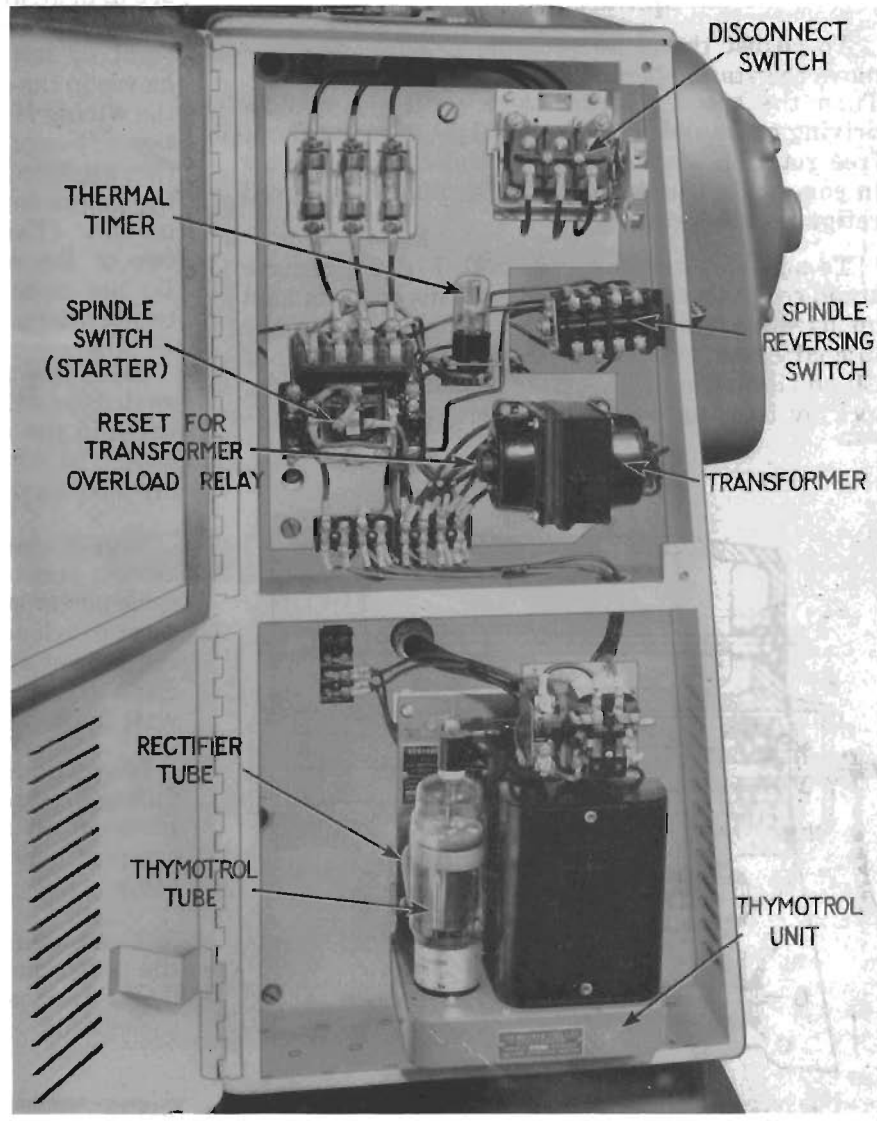


Fig. 40. Electrical controls in compartment on right-hand side of column.

Suggestions to the Operator

Much maintenance work can be avoided by keeping the machine clean and in good condition. Furthermore, on a machine which is given proper care the operator will produce accurate work with much less trouble and effort than on a machine which has been neglected.

Do not allow chips to pile too high around the work or fixture, or to clog the T-slots and channels of the table.

Keep the bearing surfaces free of chips and dirt; for this material is abrasive, and particles of such foreign matter which get between bearing surfaces will quickly score or wear the bearings and will also make the machine hard to manipulate.

The use of compressed air for cleaning work and fixtures is not recommended, since the force of the blast and the resultant air currents will very likely carry dirt to parts of the machine which it otherwise could never reach—parts which cannot be protected by guards. If compressed air is used at all, be careful not to blow chips and dirt into the machine or into other machines nearby. In general, it is much better to clean with a brush.