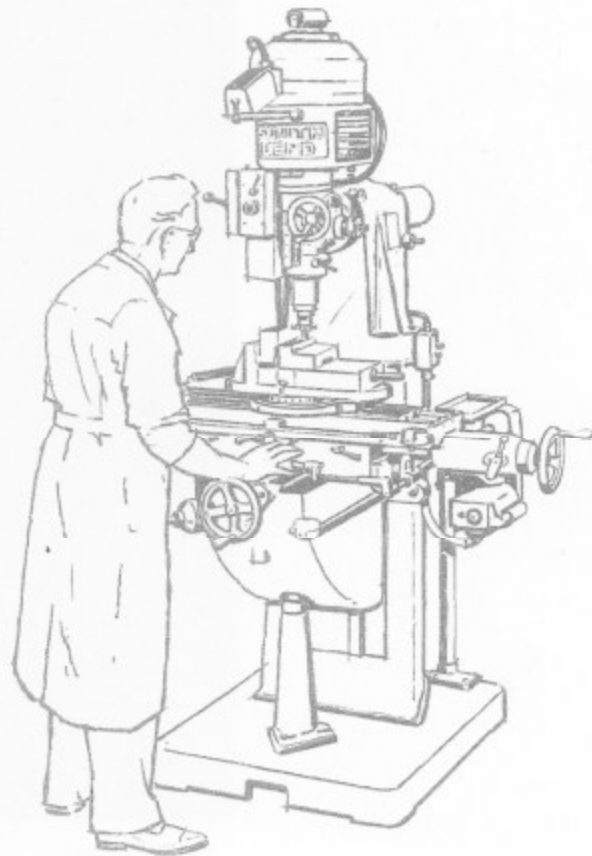


How to Install and Operate a
SOUTH BEND *Precision*
VERTICAL MILLING MACHINE





SPECIFICATIONS

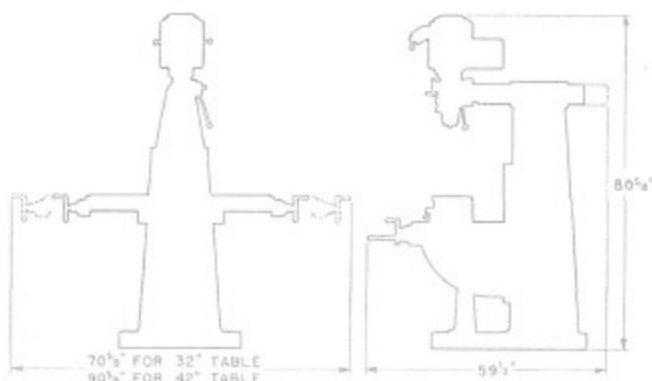
Table Lengths	32"-42"
Table Width	9"
Table Travel	20"-3"
Table Travel, cross	9 1/2"
Vertical Feed of Knee	18"
Spindle to Table	20"
Spindle to Column	20"
Ram Travel	15"
Ram Diameter	4 1/2"
Head Rotates	360°
Quill Diameter	3 1/4"
Quill Travel	4"
Collet Capacity	3/4"
Spindle Taper	#30MM
Spindle Speeds	

with 1 h.p., 1800 r.p.m. motor, 135-220-350-560-900-1450-2330-3750 r.p.m.;
with $\frac{3}{4}$ or 1 h.p., 1200 r.p.m. motor, 90-150-230-375-600-965-1550-2500 r.p.m.

In lieu of all warranties, products sold hereunder will be repaired or replaced at the purchase price will be refunded, at Seller's option, if return or rejection is made within six months in the case of mechanical presses and one year in the case of other products (i) if such products (other than components and other items purchased by seller from others, as to which Seller accords to Buyer the warranty it receives from its supplier) are defective because of faulty material or workmanship, or (ii) if such products are of Seller's design and prove to be unsuitable for the purpose for which they are ordinarily intended or used. Seller shall in no event be responsible for any consequential damages or for the cost of any work done without Seller's written approval on material furnished hereunder, and Seller expressly excludes all warranties, guarantees and representation, express or implied, including but not limited to warranties of merchantability, materials, workmanship, design and suitability for a purpose specified or intended.

South Bend Lathe, Inc. reserves the right, at its own discretion, without notice and without making similar changes in articles previously manufactured, to make changes in materials, design, finish, or specifications.

SOUTH BEND LATHE, Inc.
SOUTH BEND, INDIANA 46622



Technical drawing showing the front view of a mechanical assembly. Dimensions are provided in inches:

- Overall width: 28"
- Distance from left edge to centerline: 14" (28" / 2)
- Distance from centerline to mounting hole center: 1-5/8"
- Distance between mounting hole centers: 24-3/4"
- Distance from right edge to mounting hole center: 1-5/8"
- Overall height: 35-3/16"
- Distance from top edge to mounting hole center: 31-15/16"
- Distance from mounting hole center to bottom edge: 1-5/8"
- Mounting holes are specified as 3/4" - 10 TAPPED HOLES.

Fig. 3. Plan view showing locations of bolt holes for fastening milling machine base to floor.

How to Install and Operate a SOUTH BEND *Precision* VERTICAL MILLING MACHINE

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1. IMPORTANCE OF CORRECT INSTALLATION

The South Bend Vertical Milling Machine is a versatile tool capable of a wide variety of precision work. The most efficient production can be attained when it is properly located in the shop and properly installed. Good lighting and ample work space for the operator are essential. A substantial floor is needed to provide rigid support. Total net weight including accessories is approximately one ton.

2. UNPACK CAREFULLY

After moving the machine to the location where it is to be used, remove the crating with care to avoid damaging the machine. If the crate appears to be damaged when received, unpack in the presence of a claim adjuster and obtain a copy of his report on breakage or other damage. File your claim for damages with the carrier at once.

Check packing material thoroughly for small parts. Do not discard packing until you are sure nothing has been overlooked. Remove heavy grease on machined surfaces with a brush and kerosene. Wipe with a clean cloth and immediately coat all unpainted surfaces with oil to prevent rusting.

3. INSPECT MACHINE AND ACCESSORIES

Check all parts and accessories against the packing list to make sure nothing is missing. Equipment supplied with and included in the price of the milling machine is illustrated in Figs. 5 and 6. This should also be checked.

4. LEVEL MILLING MACHINE

When the milling machine has been placed in position, it should be leveled. Leveling is especially important if a coolant is to be used. Use a precision level, and level across the table slots as well as parallel with them.

Bolt holes in the base are threaded to permit use of leveling sleeves* if desired, but shims may be used. Metal shims are best. When the milling machine table is level and all four corners of the base bear weight uniformly (no rock), bolt securely to floor to prevent shifting.

*Leveling sleeves or shims are not supplied with milling machine.

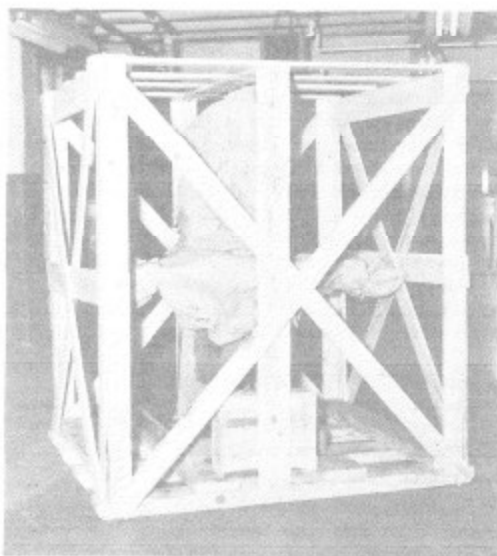


Fig. 4. Move machine to location, carefully remove crating, and clean off heavy grease.

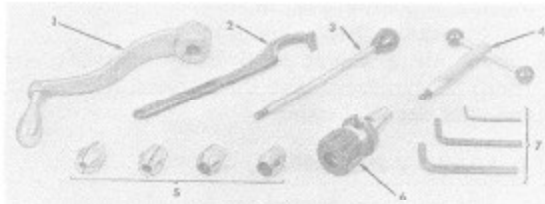
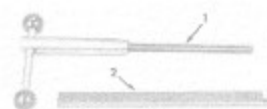


Fig. 5. Equipment supplied with hand feed milling machine.

1. Crank for elevating knee and positioning overarm.
2. Spanner wrench for collet chuck.
3. Quill feed lever.
4. T-wrench for operating worm gear adjustment for head angle.
5. Set of four collets, $\frac{3}{8}$ ", $\frac{1}{2}$ ", $\frac{5}{8}$ " and $\frac{3}{4}$ " capacities.
6. Collet chuck.
7. Set of three Allen wrenches, sizes $\frac{3}{16}$ ", $\frac{1}{8}$ " and $\frac{1}{4}$ ".

Fig. 6. Special wrenches for milling machine with power feed head.

1. Special extension T-wrench supplied in lieu of item 4, Fig. 5, for operating worm gear adjustment for head angle.
2. Special flat handle wrench for head lock Allen nuts.



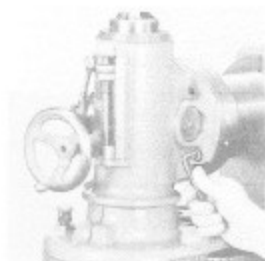


Fig. 7. Loosen head lock nuts with Allen wrench.

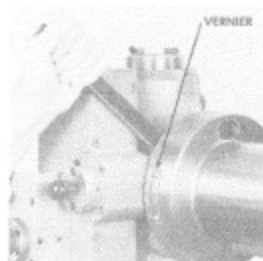


Fig. 8. Use special flat handle wrench if head has power feed.

5. ELEVATE HEAD

To save space and provide better packing, the milling machine head is inverted before crating for shipment. First loosen the head lock nuts with an Allen wrench, or with special flat handle wrench if head has power feed. See Figs. 7 and 8. Then use special T-handle wrench to turn worm gear adjustment for head angle as shown in Fig. 9. Revolve head to vertical position. As the head approaches a right angle with the column, it will be much easier to turn the worm gear adjustment if the weight of the head is supported by a helper as shown in Fig. 10. Square up head by aligning with vernier graduations (Fig. 8) on ram collar.

6. CHECK ELECTRICAL CURRENT

Before connecting with the electrical power line, make sure the power is of the proper voltage, phase and cycle for the motor and that the motor (if dual voltage) is connected for the proper voltage. Also see that all the switches on the milling machine are in the "off" position. All motor and control wiring should be done by a qualified electrician in accordance with the National Electric Code and local electrical codes.



Fig. 11. Milling Machine Motor.

7. ADJUST V-BELT DRIVE

The motor is hinged on one side and held in position by a binding lever on the other side as shown in Fig. 12. First loosen both binding levers,

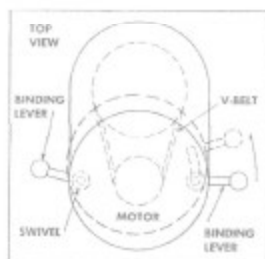


Fig. 12. Push motor back to loosen V-belt.

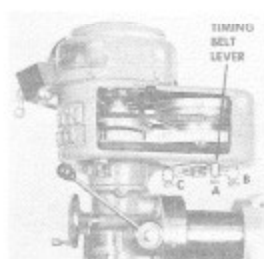


Fig. 13. To shift timing belt, place lever in position "C".



Fig. 9. Turn worm to move head to vertical position.



Fig. 10. Ease head past 90° position by lifting up.

then swivel motor to loosen or tighten the belt. In the extreme loose position the belt can be easily shifted from one step of the cone pulley to another to change spindle speeds.

8. ADJUST TIMING BELT DRIVE

Before adjusting the cogged timing belt, always loosen the motor binding levers (Fig. 12) because the timing belt adjustment will affect the tension on the V-belt.

The tension on the timing belt is controlled by the timing belt lever. See Fig. 13. This lever may be locked in two operating positions "A" and "B". It may also be pushed to position "C" for shifting the belt to change spindle speeds.

When the timing belt is in the lower position for slow spindle speeds, the timing belt lever should be placed in position "A". When this belt is in the upper position for high speeds, the lever should be in position "B".

After shifting the timing belt from one step of the spindle to the other, re-adjust the V-belt tension and tighten motor binding levers.

9. LUBRICATE BEFORE OPERATING

Before the milling machine is operated under power, it should be lubricated. The lubrication chart on the opposite page shows the locations of grease fittings, oil holes etc., and indicates the type of lubrication required. The importance of regular and thorough lubrication cannot be over-emphasized. With proper care, the smooth operation and precision performance of a new machine can be extended indefinitely. It is good practice to wipe the machine clean at the end of each day, and coat all machined surfaces with oil to prevent rusting.

10. OIL DRAIN FOR SPINDLE BEARINGS

When too much oil accumulates around the spindle bearings it may cause the spindle to run hot. To prevent this, a small oil drain hole is provided at the back of the quill, about an inch from the lower end. See illustration Fig. 15 on oiling chart.

The Allen head screw plug should be removed from this hole before oiling to permit any excess oil to drain off, and then replaced.

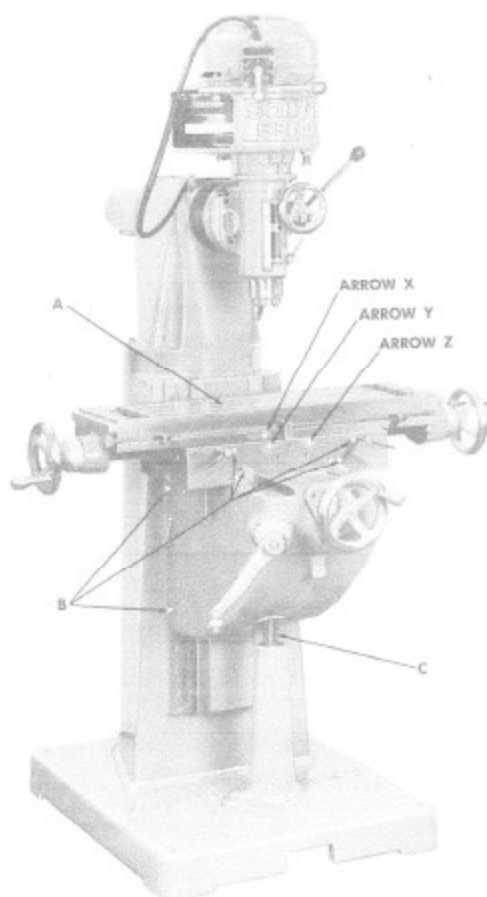


Fig. 14.

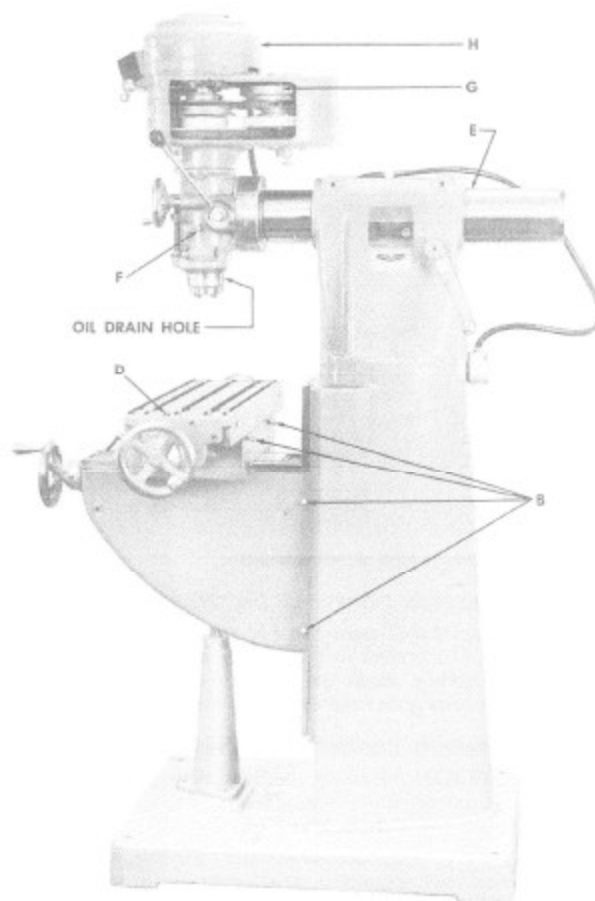


Fig. 15.

LUBRICATING CHART

KEY LETTER	LUBRICATION POINT	LUBRICATION RECOMMENDED	INSTRUCTIONS
A	Feed Screws and Feed Screw Nuts	CE1603 Machine Oil*	Remove set screw oil hole plug from table and align arrow "X" on table with arrow "Y" on saddle to oil table nut. Then align arrow "X" on table with arrow "Z" on saddle to oil saddle nut. Oil feed nuts and screws once a day.
B	Dovetails	No. 2 Soda Soap Grease or Petroleum Jelly	Ten Alemite grease fittings (covered with red Lubricaps) are provided for lubricating dovetails. Remove caps and grease with Alemite grease gun once a month, or oftener if needed. Don't overlook fittings for back dovetails on saddle.
C	Elevating Screw	CE1603 Machine Oil*	Oil thread once a day, or as needed.
D	Table Longitudinal Feed Bearing	CE1603 Machine Oil*	Oil bearing once a day, or as needed.
E	Overarm Mechanism	CE1603 Machine Oil*	Oil bearings once a day, or as needed.
F	Quill Bearings	CE1600** Machine Oil	Place quill in lowest (most extended) position and apply a few drops of oil once a day, or each eight hours in operation. See section 10, page 2.
G	Idler Pulley		Pre-lubricated sealed bearings need no attention.
H	Motor		Lubricate and clean according to motor manufacturer's instructions.
I	Power Quill Feed		See section 37, page 7.
J	Power Table Feed		See section 41, page 8.

*South Bend Lathe Lubricating Oil Cat. No. CE1603, Saybolt viscosity 240-500 seconds at 100° F.

**South Bend Lathe Lubricating Oil Cat. No. CE1600, Saybolt viscosity 100 seconds at 100° F.

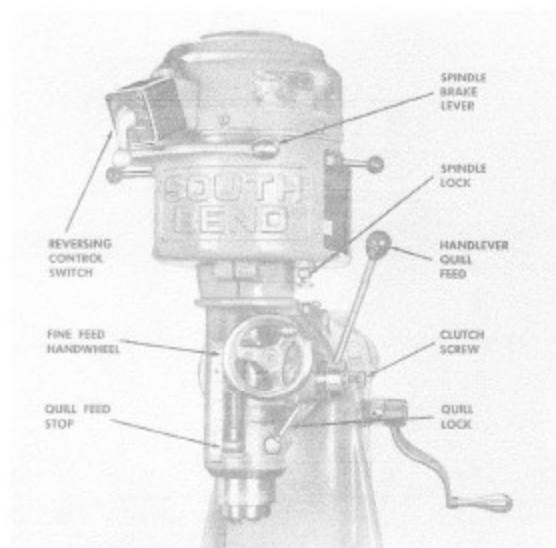


Fig. 16. Controls on head of milling machine.

11. OPERATING CONTROLS ON HEAD

The principal controls for the milling machine head are illustrated in Fig. 16. The operator should be thoroughly familiar with these controls and their functions before starting the machine.

12. REVERSING CONTROL SWITCH

CAUTION: Before starting the motor, make sure the spindle revolves freely. Turn spindle by pulling on the V-belt. See Fig. 17.

The reversing control switch (Fig. 16) has three positions: off, forward, and reverse. The forward position is used for right hand milling and drilling. Reverse is used for left hand milling.

It is not advisable to throw the control switch directly from forward to reverse without first allowing the spindle to come to a full stop.

When starting a single phase motor, hold the switch handle in the starting position until the motor comes up to full speed.

13. SPINDLE BRAKE LEVER

Push in on the spindle brake lever (Fig. 16) with reasonable pressure to stop the spindle quickly. When a heavy threaded cutter is revolving at high speed, brake slowly because centrifugal force may cause the cutter to unscrew if the spindle is stopped too suddenly.

14. SPINDLE LOCK

The spindle lock (Fig. 16) is used to prevent the spindle from turning when tightening or loosening the collet chuck or when threaded milling cutters are screwed onto or removed from an arbor mounted in the spindle. It is also used when mounting the 90° milling head and other tools.

CAUTION: Always make sure the spindle lock is disengaged before starting the motor. Never try to engage the lock while spindle is revolving.

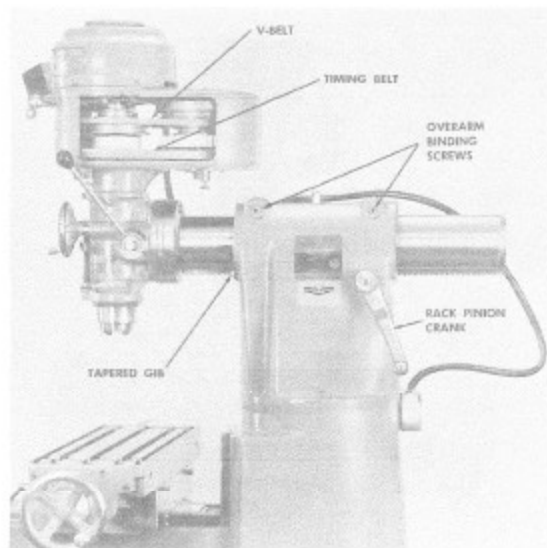


Fig. 17. Overarm adjustment for positioning head.

15. QUILL LOCK

Vertical adjustment of the quill is locked by tightening the quill lock clamp screw. See Fig. 16. This lock must be released before any vertical quill feed (hand or power operated) is employed.

16. QUILL FEED STOP

The quill feed stop (Fig. 16) is used for positioning the quill vertically, or as a depth gauge and stop for hand or power fed milling, drilling and boring operations. A graduated scale and micrometer collar permit accurate readings. Maximum vertical movement is 4 inches.

17. FINE FEED HANDWHEEL

The fine feed handwheel (Fig. 16) operates a worm drive for feeding the quill at a slow, steady rate. This is convenient for drilling and boring operations, and for adjusting the spindle accurately for depth of cut when milling. To engage the fine feed handwheel, the knurled clutch screw on the end of the quill feed shaft must be tightened and the hand-lever feed disengaged.

18. HANDLEVER QUILL FEED

The handlever operates a rack and pinion quill feed for positioning the spindle vertically, and for light milling and drilling operations. See Fig. 16. To engage the handlever feed, first unscrew the knurled clutch screw on the end of the feed shaft, then push the handlever in until pins in the face of the lever are fully engaged with the clutch. For better view of the quill stop, the fine feed handwheel may be removed when the handlever feed is used.

19. OVERARM ADJUSTMENT

Rack and pinion adjustment is provided for moving the overarm to position the milling head. The overarm binding screws (Fig. 17) must be

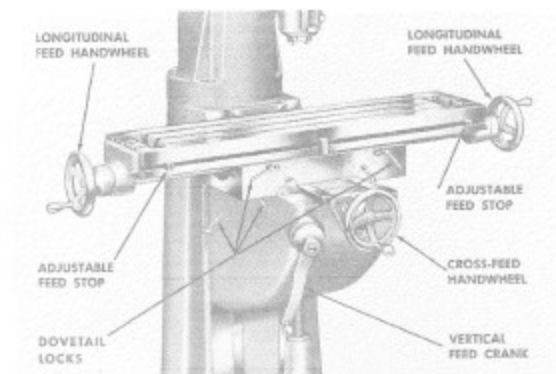


Fig. 18. Controls on table and knee of milling machine.

loosened before the overarm can be adjusted. These screws should always be tightened again after the head has been moved to the desired position.

A tapered gib (Fig. 17) bears against the side of the rack to hold the overarm in perfect alignment at all times. This gib should be adjusted so that it eliminates all play, but must not be so tight that it prevents free movement of the overarm.

20. CONTROLS FOR OPERATING TABLE

Important controls for the table, saddle and knee of the milling machine are shown in Fig. 18. The operator should become thoroughly familiar with all of these controls and their functions.

21. TABLE FEEDS

Movement of the table in the horizontal plane is controlled by the longitudinal and cross-feed handwheels. Vertical adjustment is controlled by the vertical feed screw which is operated by turning the vertical feed crank at the left of the cross-feed handwheel.

22. MICROMETER GRADUATED COLLARS

The longitudinal feed, cross-feed and vertical feed screws have graduated collars reading in thousandths of an inch for accurately positioning the table. A small lock screw on each graduated collar permits loosening the collar and adjusting the graduations to zero at any time. See Fig. 19.

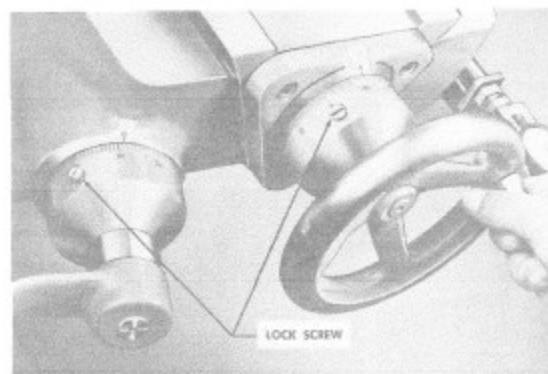


Fig. 19. Graduated collars on feed screws.

23. ADJUSTABLE FEED STOPS

Adjustable feed stops are attached to the front of the table. These stops may be used to limit the hand feed longitudinal travel of the table. See Fig. 18.

24. DOVETAIL SLIDE LOCKS

Lever type dovetail slide locks (Fig. 18) are provided for locking the knee to the column, the saddle to the knee, and the table to the saddle. These locks are used to prevent accidental movement and possible vibration.

When a cut is being taken, the dovetail slide used to feed the work should, of course, not be locked. However, all other dovetails should be securely locked. It is important to remember that the dovetail locks must be released before a locked dovetail slide can be used.

25. DOVETAIL GIB ADJUSTMENT

Tapered gibs are used for all three dovetails on the milling machine. These gibs should be adjusted so they are snug enough to eliminate looseness, but not so tight that they bind and prevent the dovetail slides from operating freely.

The longitudinal feed dovetail has two gibs, one in each end of the saddle at the front of the table. These are independently adjusted by turning the gib adjusting screws as shown in Fig. 20.



Fig. 20. Adjusting longitudinal feed gib.

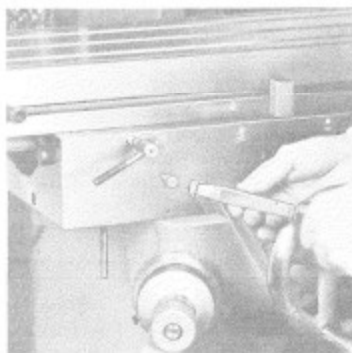


Fig. 21. Adjusting cross-feed gib.

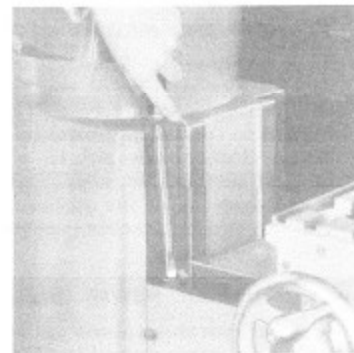


Fig. 22. Adjusting vertical slide gib.

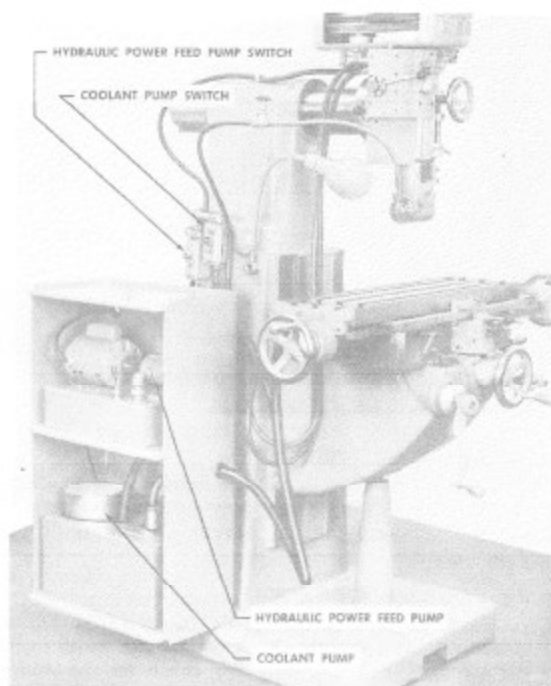


Fig. 23. Cabinet for milling machine, with side panel removed.

The cross-feed dovetail gib is located on the front left side of the knee as shown in Fig. 21. The brass chip scraper must be removed before this gib can be adjusted.

The vertical slide dovetail gib is on the left side of the knee as shown in Fig. 22. The brass chip scraper must be removed before adjustment can be made. This gib has two adjusting screws, one at the top and one at the bottom. It is tightened by unscrewing the lower screw and screwing in the upper screw.

26. CABINET FOR MILLING MACHINE

The steel cabinet shown in Fig. 23 is an accessory item for the milling machine. In this picture, the side panel has been removed to show the two compartments inside the cabinet for the coolant pump and the hydraulic power quill feed pump.

27. MOUNTING MILLING MACHINE CABINET

A heavy steel plate welded to the bottom of the cabinet has two holes for bolting the cabinet to the milling machine base. The top of the cabinet is held to the milling machine column with a short brace. Since both points of contact are rough casting surfaces, it may be necessary to use washers to shim under the cabinet, or between the brace and the milling machine column. The brace may be bent if necessary.

28. HYDRAULIC POWER QUILL FEED

The hydraulic power quill feed consists of the hydraulic pump assembly (Fig. 24) and the hydraulic feed mechanism (Fig. 25). With this equipment,

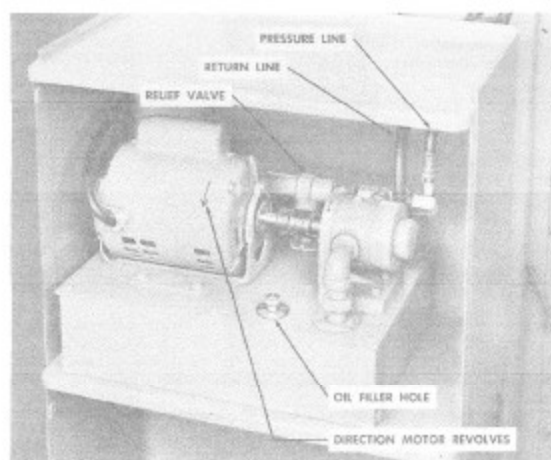


Fig. 24. Hydraulic pump for operating power quill feed.

infinitely variable power quill feeds ranging from 0 to 25" per minute are available.

29. HYDRAULIC PUMP

The hydraulic pump and reservoir are connected to the power feed mechanism with two high pressure tubes. The tube leading from the pump outlet must be connected to the upper threaded hole marked "IN" on the quill feed mechanism.

The motor for the hydraulic pump is wired to the starting switch which is mounted on the left side of the milling machine column. Make sure your electrical power is proper for the motor before making connections. The motor must turn counter-clockwise when you face the outer end of the motor shaft.

Fill the pump reservoir with $4\frac{1}{2}$ quarts of type DTE light hydraulic oil No. 503X9 with Saybolt Universal Viscosity of 150 seconds at 100° F. (South Bend Lathe Cat. No. MIL7054 or MIL7053). The oil in the reservoir should be maintained at a level between the two marks on the gauge rod attached to the oil filler hole cover.

30. HYDRAULIC PRESSURE RELIEF VALVE

An automatic by-pass relief valve (Fig. 24) limits the maximum hydraulic pressure produced by the pump to 300 lbs. per square inch. This permits the quill feed to stop automatically when maximum travel is reached. The quill feed positive depth stop may be set in any position and used to regulate the length of power quill feed. There is no danger of damaging the hydraulic power quill feed mechanism or the pump.

31. QUILL FEED CONTROL LEVER

The hydraulic quill feed control lever (Fig. 26) has three positions: "UP", "OFF", and "DOWN". Pushing the lever up raises the quill, pushing it down lowers the quill.

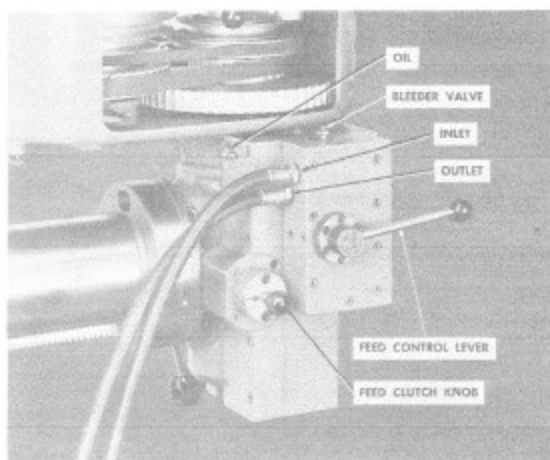


Fig. 25. Back view of power quill feed.

32. RAPID POWER QUILL FEED

The rapid power quill feed lever (Fig. 26) has two positions, "ON" and "OFF". The rapid feed is used for positioning the quill vertically, and for reaming operations. It is also used to return the quill quickly to the starting position after a vertical feed operation has been completed.

33. FINE FEED CONTROL

The fine feed control knob (Fig. 26) provides infinitely variable feeds ranging from 0 to 25" per minute. This control can be used only when the rapid feed lever is in the "OFF" position.

34. STARTING THE HYDRAULIC POWER FEED

CAUTION: Before using the hydraulic power quill feed, always make sure the handle lever feed and the handwheel fine feed are disconnected. The quill lock must also be released. See sections 15, 17, and 18, page 4.

When starting the power quill feed for the first time, it will be necessary to release air trapped in the feed mechanism. Air will also have to be released occasionally, when it accumulates in the feed mechanism and prevents the quill feed from operating smoothly. To release the air, proceed as follows:

- A. Start motor operating hydraulic power feed pump.
- B. Place rapid feed control lever at "ON" position. See Fig. 26.
- C. Move quill feed control lever to extreme "DOWN" position and allow quill to feed its entire length of travel, under power.
- D. Depress air bleeder valve, Fig. 25. Cover valve with cloth because depressing bleeder valve may result in a strong spray of oil from trapped air. Repeat depression of valve several times, if necessary.

35. TO ENGAGE POWER QUILL FEED

First move quill up with the hand feed lever as high as it will go, then disengage the hand feed

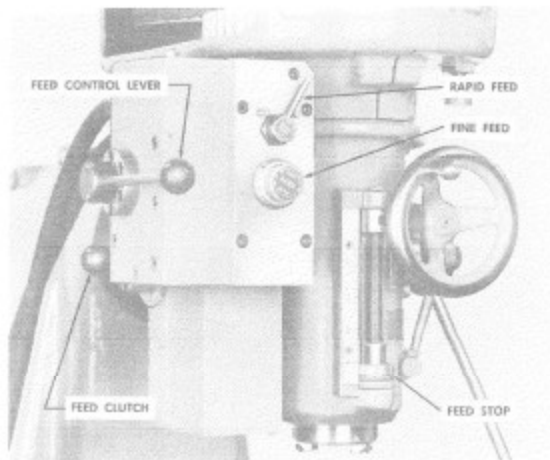


Fig. 26. Front view of power quill feed.

lever. Place rapid power feed control lever in "ON" position, push up on power quill feed lever and allow time for piston to reach top of cylinder, or until power feed sliding clutch knob (Fig. 25) stops turning.

Press in on the power feed sliding clutch knob with the left hand, and at the same time pull down on the power feed lever with the right hand until the clutch engages. Make sure the clutch engages at the top of the stroke, otherwise the full length of feed will not be available.

There is a witness mark on the clutch knob shaft and on the face of its housing. When these coincide, the power feed clutch can be engaged at the top of the stroke.

36. TO DISENGAGE POWER QUILL FEED

The hydraulic power quill feed is disengaged by pulling the power feed sliding clutch knob (Fig. 25) out. To free the clutch so the knob can be pulled out easily, push the power feed lever alternately up and down.

37. LUBRICATION OF POWER QUILL FEED

The motor which drives the hydraulic power feed mechanism should be lubricated according to the motor manufacturer's recommendations. An oil hole at the top of the power feed mechanism (Fig. 25) is provided for lubricating the rack. One or two drops of machine oil each day is sufficient.

38. POWER TABLE FEED

The mechanical power table feed consists of an independent motor drive and gear box (Fig. 27), and the power feed mechanism (Fig. 28). This equipment provides 30 feeds ranging from 1/4" to 15" per minute.

39. OPERATION OF GEARBOX

An index plate attached to the gearbox shows the arrangement of the gearbox levers for each of the 30 table feeds. These levers should be set in position before the gearbox drive motor is started.

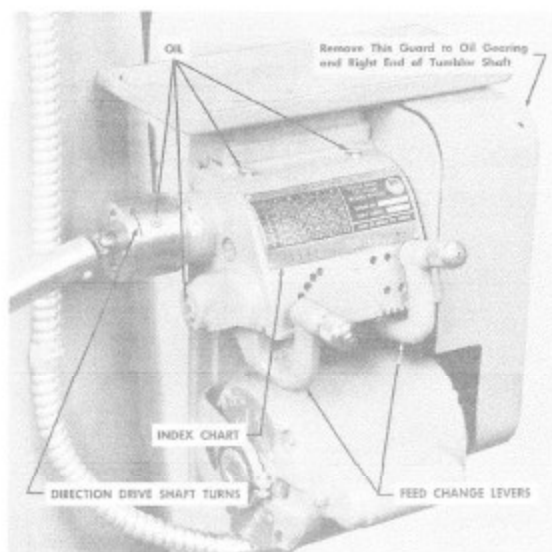


Fig. 27. Quick change gear box for power table feed.

The drive shaft between the gearbox and table should revolve counterclockwise. See Fig. 27.

40. OPERATION OF POWER TABLE FEEDS

Controls used to operate the power table feeds are shown in Fig. 28. Before engaging the power feed, make sure the table locks are released and the table slides freely. The direction of feed is determined by the feed control lever at the right end of the table. Push this lever to the left to feed table toward the left, and to the right to feed table toward the right.

To engage the power table feed, push the feed clutch lever to the left. To disengage the feed, push the feed trip lever down. When the automatic stop is tripped, the table must be backed away from the trip plunger manually before the feed clutch lever can be engaged again. This is a safety feature which prevents jamming the power feed mechanism.

The automatic feed trip stops attached to the side of the table may be set to stop the power table feed at any point. These stops will operate with the table feeding in either direction.

41. LUBRICATION OF POWER TABLE FEED

Locations of oil cups and grease fittings are shown in Figs. 27 and 28. The end gear guard must be removed to reach the oil hole in the right end of the tumbler shaft, and to oil the end gearing. Fill oil cups once a day, or each eight hours the power table feed is in use. Remove the feed clutch mechanism and grease clutch parts every six months.

42. COOLANT PUMP INSTALLATION

Coolant equipment for the milling machine consists of a motor driven coolant pump, reservoir, piping and hose as shown in Figs. 29 and 30. Make sure that your electrical power is correct for the

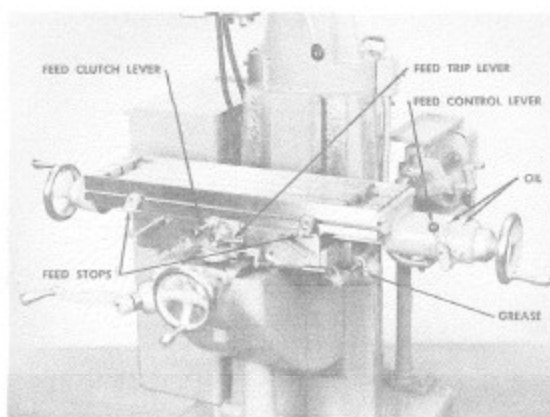


Fig. 28. Controls for power table feeds.

motor before making connections. Lubricate motor according to motor manufacturer's instructions.

If coolant equipment is not factory installed, drill and tap two holes in the milling machine column ($\frac{1}{2}$ "-13 thread) in locations shown in Fig. 29. Bolt the small brackets to the column to support the metal pipe.

Assemble the hoses for the pressure line and coolant return as shown in Fig. 30. Use a little soap or grease on the ends of the pipes, as they are a tight fit inside the hose.

The strainer provided for the lower end of the coolant return hose should be removed and chips emptied occasionally.

43. WORK LIGHT FOR MILLING MACHINE

Use of a shielded work light (Fig. 29) provides clear vision without eye strain. The light is bolted

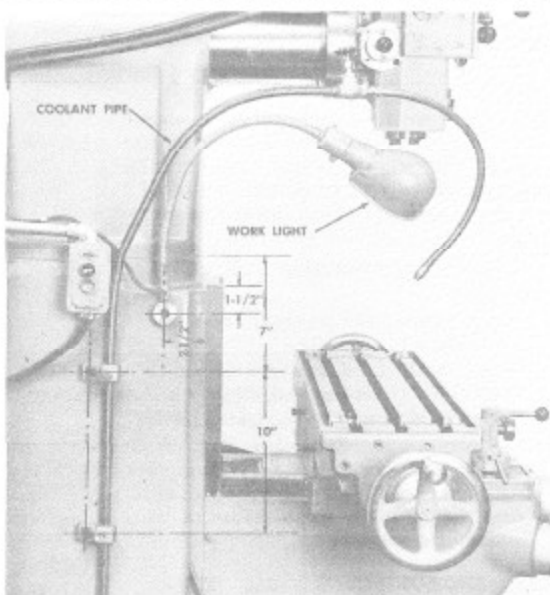


Fig. 29. Locations of holes for attaching coolant pipe and work light to milling machine column.

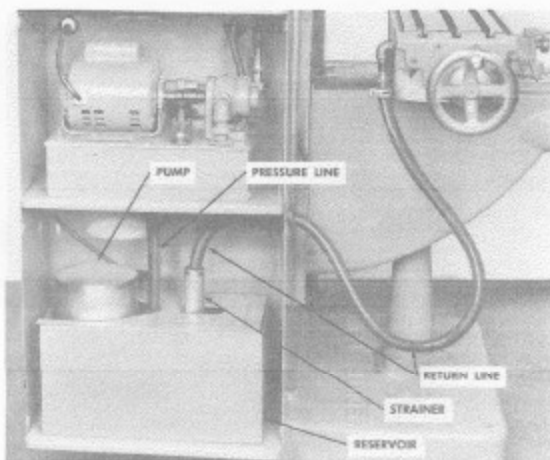


Fig. 30. Coolant pump installation.

to the side of the milling machine column. If work light is not factory installed, drill and tap one hole (5/16"-18 thread) on each side of the milling machine column in the location shown in Fig. 29. The light can then be clamped to either side.

44. MEASURING TRAYS FOR MILLING MACHINE

Measuring trays may be attached to the knee and table of the milling machine for positioning the table with extreme precision. See Fig. 31. A dial indicator is attached to the end of each tray as shown in Fig. 32. End measuring rods and inside micrometers are placed in the trays between the adjustable stops and the dial indicators. With this arrangement, it is possible to measure the cross and longitudinal movement of the table very accurately.

45. MOUNTING MEASURING TRAYS

The following procedure may be followed when mounting measuring trays on the milling machine:

- A. Remove the regular table stop from the center of the saddle and replace it with the adjustable stop rod holder as shown in Fig. 33. Align rod with table.
- B. Remove regular stops from T-slot side of table and replace them with long measuring tray. See Fig. 34. Use two spacers (1 1/2" long) to hold tray away from table.
- C. Attach adjustable stop rod holder to back of saddle as shown in Fig. 35.
- D. Attach short tray to side of knee, using threaded bushing assemblies to align both ends of tray with stop rod. See Fig. 35.
- E. Assemble dial indicators in housings, being careful to center indicator shaft in threaded hole. Use 1/4" x 3/4" fillister head screw and washer to hold indicator in housing. See illustration, Fig. 32.
- F. Screw spring plunger into bracket (Fig. 32).

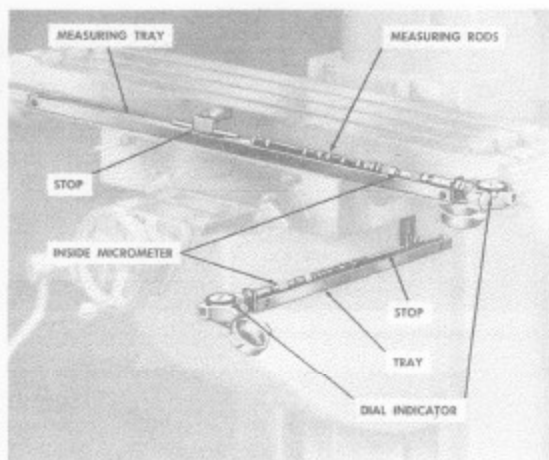


Fig. 31. Measuring trays on milling machine.

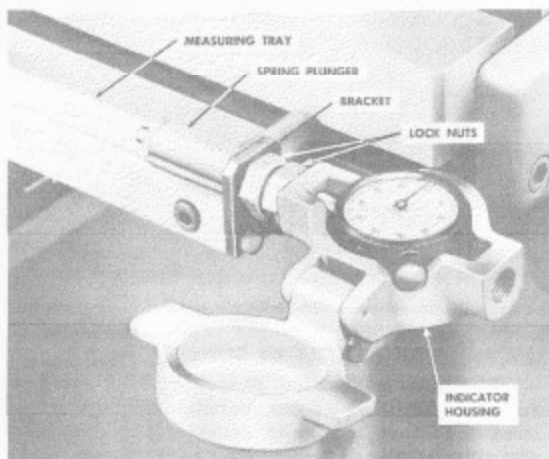


Fig. 32. Dial indicator assembly.

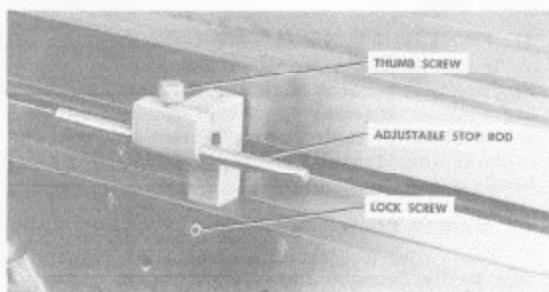


Fig. 33. Adjustable stop attached to front of saddle.

- G. Set dial indicator at zero. Screw spring plunger (with bracket and two lock nuts attached) into dial indicator housing until plunger touches end of indicator shaft and moves the needle about .005". Tighten locknut against indicator housing.
- H. Attach assembly to end of measuring tray, turn top of indicator up and tighten locknut against bracket to hold assembly securely.

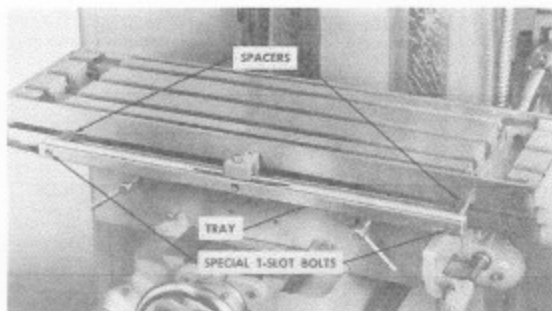


Fig. 34. Measuring tray attached to table.

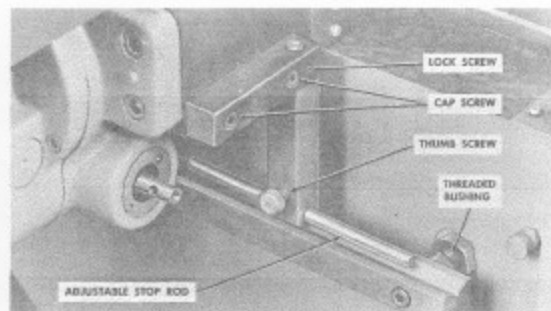


Fig. 35. Adjustable stop attached to back of saddle.

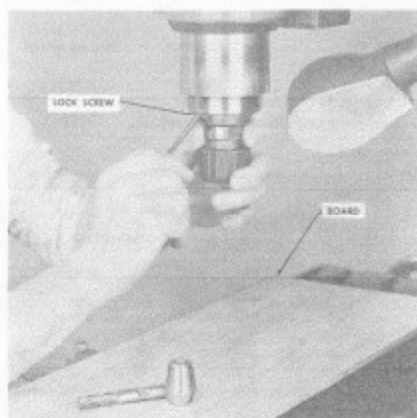


Fig. 36. Mounting collet holder in spindle.

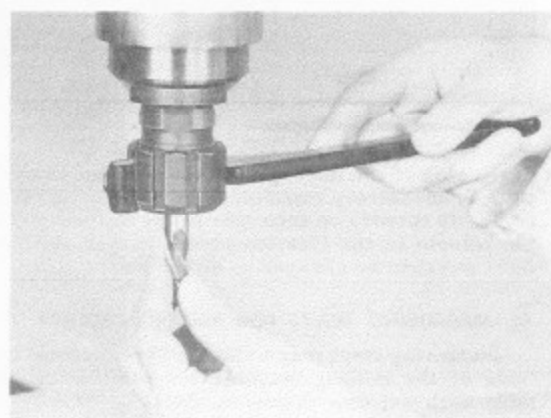


Fig. 37. Inserting end mill in collet.

46. MOUNTING TOOLS IN SPINDLE

The spindle has a No. 30 Milling Machine Taper to receive milling arbors, boring heads, collet holders and other tools and accessories. The face of the spindle also has four bolt holes tapped $\frac{3}{8}$ "-16 N.C. thread for attaching face milling cutters and other tools.

47. PROTECT MILLING MACHINE TABLE

It is a good plan to place a board over the milling machine table as shown in Fig. 36 when mounting tools or accessories in the spindle. The board will protect the table and tools from damage in case tools are accidentally dropped. It also provides a handy place to lay tools.

48. MASTER COLLET HOLDER

The collet holder is used to hold milling cutters, drills, reamers and other tools. The following procedure is recommended for mounting the collet holder (or any similar tool) in the spindle:

- Unscrew the two lock screws (Fig. 36) until they no longer project inside the spindle hole.
- Wipe taper hole inside spindle thoroughly with a clean cloth.

CAUTION: Never try to clean spindle taper while it is revolving.

- Wipe taper shank on collet holder clean and insert into spindle taper. Tighten the two

lock screws lightly at first, then screw them alternately, a little at a time, until they are tightened securely.

49. INSERTING TOOLS IN COLLET HOLDER

First lock the spindle to prevent it from revolving, using the spindle lock. See Fig. 16, page 4. Remove the threaded sleeve from the collet holder and insert a collet the size required to fit the tool shank. Replace threaded sleeve with collet, insert shank of tool and tighten sleeve with spanner wrench as shown in Fig. 37. Unlock spindle.

50. FLUSH MILLING ARBOR

The flush milling arbor shown in Figs. 38 and 39 is designed to hold standard size milling cutters and dovetail milling cutters from 3" to 6" in diameter with $\frac{1}{8}$ " to $\frac{3}{4}$ " face and having either a 1" or a $1\frac{1}{4}$ " diameter arbor hole. The cutter is held by a split expansion taper bushing and flush tightening screw. It is driven by a key. Spacing collars are used to accommodate various face widths.

51. MOUNTING CUTTERS ON ARBOR

It is important that milling cutters be correctly mounted on the flush milling arbor, otherwise the cutter may not run true, or may work loose. The following procedure is recommended:

- Mount taper shank of the flush milling arbor in milling machine spindle (see section 46).

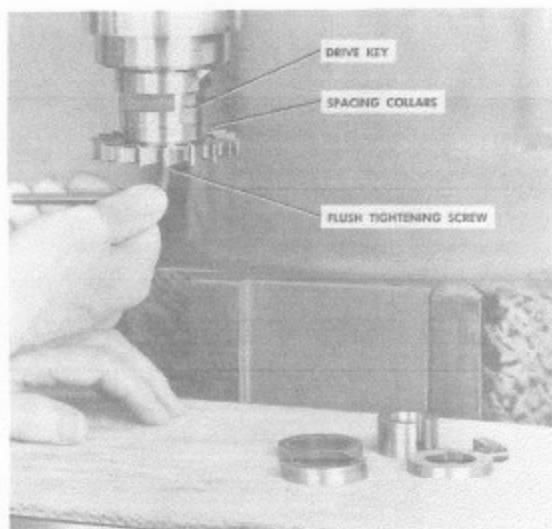


Fig. 38. Mounting milling cutter on flush milling arbor.

- B. Insert expansion bushing (with taper hole) and drive key in milling cutter, with rounded end of drive key up (see Fig. 38).
- C. If milling cutter is less than $\frac{3}{4}$ " face, add spacing collars to make up the difference between thickness of cutter and the total $\frac{3}{4}$ " thickness needed to bring lower side of cutter flush with (or slightly below) lower end of milling arbor.
- D. Push assembly on arbor and tighten flush tightening screw as shown in Fig. 38. This will draw the cutter up tight against the shoulder on the flush milling arbor.

CAUTION: Make sure all bushings, spacing collars, cutter hole and face, and all other parts are clean and free from dirt, chips and burrs. A very small chip or burr will prevent the cutter from running true, and may cause it to chatter.

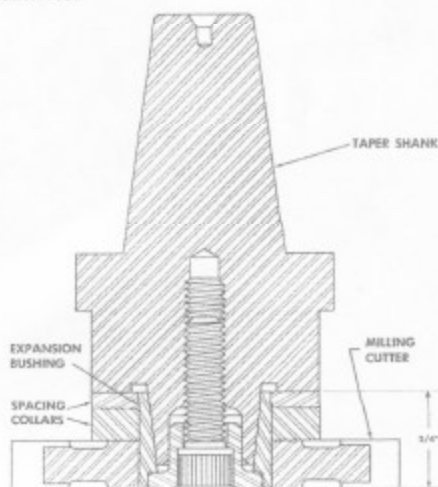


Fig. 39. Construction of flush milling arbor.

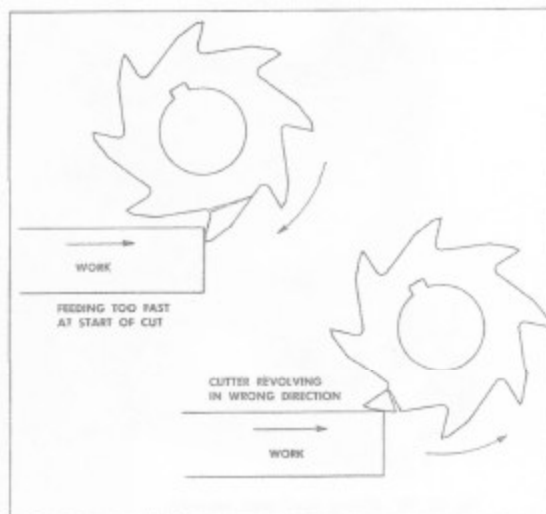


Fig. 40. Common causes of cutter breakage.

52. CARE PREVENTS CUTTER BREAKAGE

To avoid breaking cutters, be very careful when starting to take a cut. Make sure the spindle is revolving at the correct speed and in the correct direction. The work must be clamped securely to the milling machine table. Bring the work to the revolving cutter **SLOWLY**. The cutter will be broken if it suddenly strikes the work with a big "bite", or if the cutter is revolving backwards. It may also be broken if the work slips because it is not properly clamped to the table. Another cause of broken cutters is allowing them to become dull. Cutters should be kept sharp to avoid breakage as well as to turn out good work.

53. 90° MILLING HEAD

The 90° milling head is mounted on the end of the spindle to permit using cutting tools at 90° to the normal spindle position, as shown in Fig. 41. In this illustration, a fly cutter is being used to machine a metal pattern.

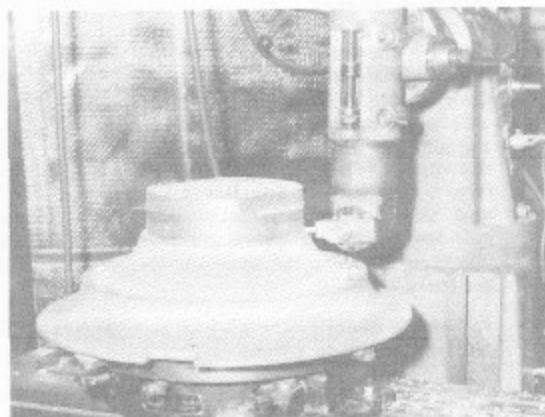


Fig. 41. Machining a radius with the 90° milling head.

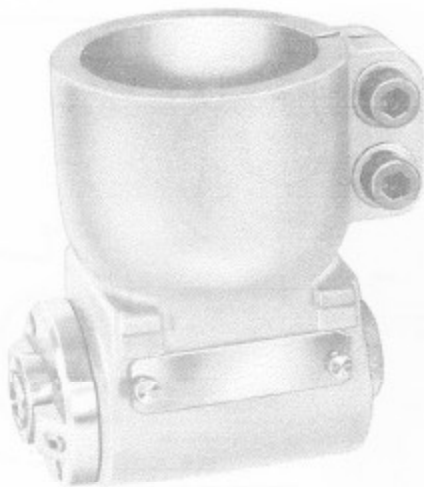


Fig. 42. 90° Milling Head main assembly.

The 90° milling head spindle has the same inside taper as the regular spindle, and will take the same tools and accessories. It is driven by the milling machine spindle through bevel gears and operates at the same speed as the milling machine spindle.

Equipment supplied with the 90° milling head consists of the 90° head main assembly, drive gear arbor, collet sleeve, collet draw bar, 1/2" collet and spanner wrench.

54. HOW TO MOUNT 90° MILLING HEAD ON SPINDLE

First remove any tool or arbor that may be in the milling machine taper, then proceed as follows:

- A. Insert drive gear arbor in milling machine spindle and tighten screws as shown in Fig. 42.
- B. Lower quill, then push the 90° milling head main assembly onto the quill as shown in Fig. 44. If the head casting fits too tightly, drive a small wedge into the saw slot to expand it a few thousandths.
- C. Remove the steel cover plate from one side of the 90° head casting. Turn the 90° head to the desired angle with the table. Insert the steel side plate as shown in Fig. 45, and use it as a gauge to adjust the 90° head vertically on the quill. When the gauge will just slip between the end of the bevel drive gear shaft and the outside diameter of the 90° head spindle, the bevel gears are properly meshed. Tighten binding screws to clamp 90° head securely on quill.
- D. Lubricate bevel gears with grease or heavy oil and replace side plates.
- E. Move quill up as far as it will go, and tighten the quill lock binding lever. The 90° milling head is now in position for normal use.

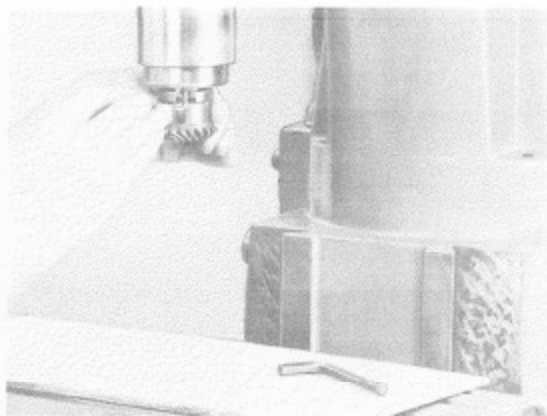


Fig. 43. Inserting drive gear arbor in spindle taper.

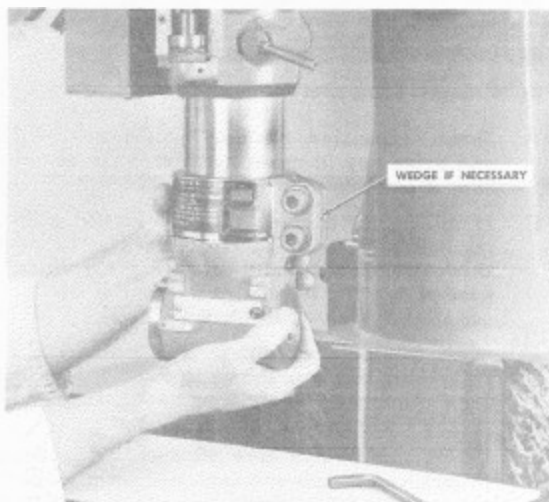


Fig. 44. Attaching 90° milling head to quill.

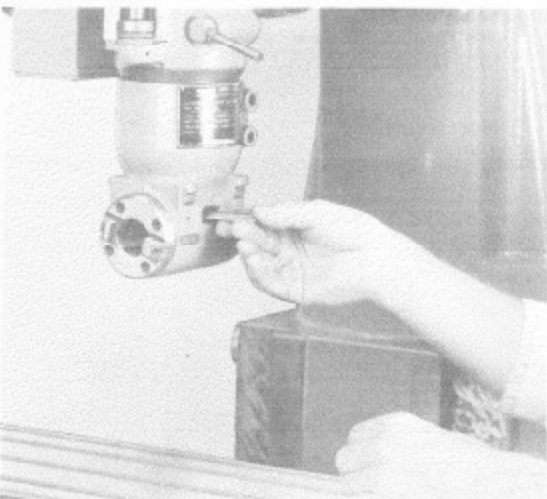
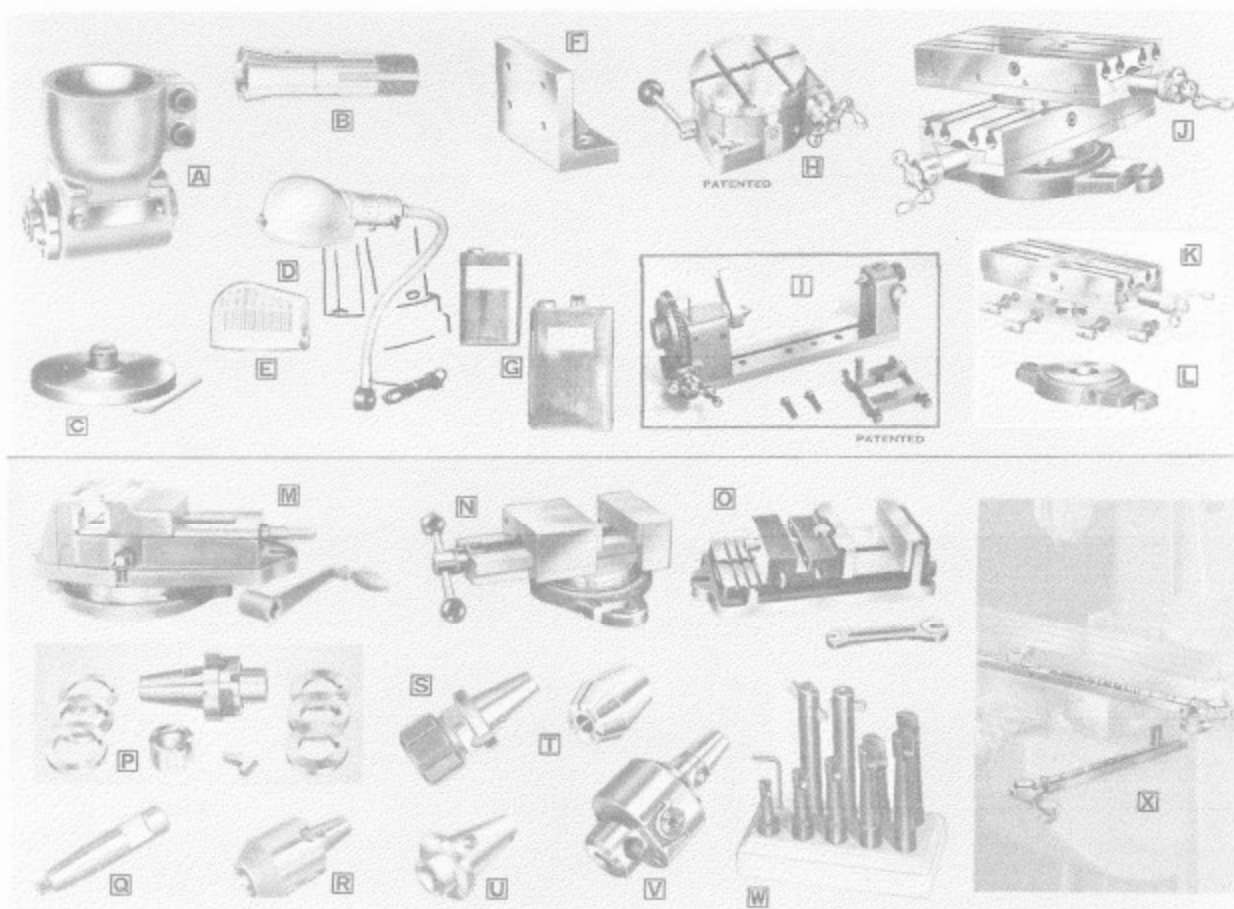


Fig. 45. Adjusting clearance for bevel drive gears.



ACCESSORIES FOR SOUTH BEND MILLING MACHINES

- | | |
|---------------------------------------------|----------------------------------------------|
| A 90° MILLING HEAD | M 6" SWIVEL VISE |
| B EXTRA COLLETS FOR 90° MILLING HEAD | N 4" SWIVEL VISE |
| C CHUCK ADAPTER STUD | O QUICK-ACTING VISE |
| D WORK LIGHT | P MILLING CUTTER ARBOR |
| E KOOL-SHIELD | Q THREADED ARBORS FOR ANGULAR CUTTERS |
| F ANGLE PLATE | R QUICK CHANGE TOOL HOLDERS |
| G HYDRAULIC OIL | S MASTER COLLET HOLDER |
| H ROTARY INDEXING TABLE | T EXTRA COLLETS |
| I INDEXING CENTERS | U MORSE TAPER SLEEVE |
| J UNIVERSAL TABLE COMPLETE | V OFFSET BORING HEAD |
| K SINGLE TABLE WITH ONE SWIVEL | W BORING TOOL SET |
| L BASE ONLY FOR SINGLE TABLE | X MEASURING TRAYS AND RODS |

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