



OPERATION MANUAL

VS-1

Turret Milling Machine



Operation and Maintenance Manual

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1 Safety

Read this manual before you operate the machine. It explains how to install, operate and maintain the VS-1 turret mill safely and correctly.

■ WARNING

Read this manual fully before you operate this machine, and make sure you understand its contents.

1.1 Regulations and standards

Operate this machine in accordance with the Health and Safety at Work Act and all other applicable regulations.

Further safety precautions are given in the American National Standards Institute standard Safety Requirements for the Construction, Care, and Use of Drilling, Milling, and Boring Machines (ANSI BLL 8-1974).

To help users design point-of-operation safeguarding for their own applications, the Occupational Safety and Health Administration publishes the booklet Concepts and Techniques of Machine Safeguarding (O.S.H.A. Publication Number 1910 212).

1.2 General precautions

These precautions supplement the operating technique and safety instructions given by the MACH engineer or dealer when the machine is installed.

The machine is designed so that every section is safe to use. Used improperly, however, it can cause a serious accident. Always follow these basic precautions:

- Safeguarding at the point of operation can only be designed and built once the parameters of the particular operation are known. Refer to ANSI BLL 8-1974.
- Only a trained operator who is familiar with the machine may operate it. Train any operator who is not familiar with the machine before they use it.
- Never touch, or bring any object close to, a rotating or moving part.

1.3 Safety labels

The following safety labels are fitted to the machine. Obey them at all times.



Figure 1-1: Safety label: Do not operate without eye protection

**DO NOT OPERATE
WITHOUT GUARDS**

Figure 1-2: Safety label: Do not operate without guards

CAUTION
**KEEP HANDS OUT
OF MACHINE**

Figure 1-3: Safety label: Caution, keep hands out of machine

CAUTION
**DISCONNECT
POWER BEFORE
SERVICING**

Figure 1-4: Safety label: Caution, disconnect power before servicing

2 Specifications

The VS-1 turret mill is supplied with one of two milling heads:

- Variable-speed head (1 1/2 VS-T): infinitely variable spindle speed.
- Step-pulley head (1 1/2 VA-T): belt-driven spindle speeds selected on stepped pulleys.

Section 2.1 gives the basic-machine data that goes with the variable-speed head. Section 2.2 gives the data that goes with the step-pulley head. Where the figures differ, use the data for your head type, and confirm any critical value with MACH before you rely on it.

2.1 Basic machine: variable-speed head

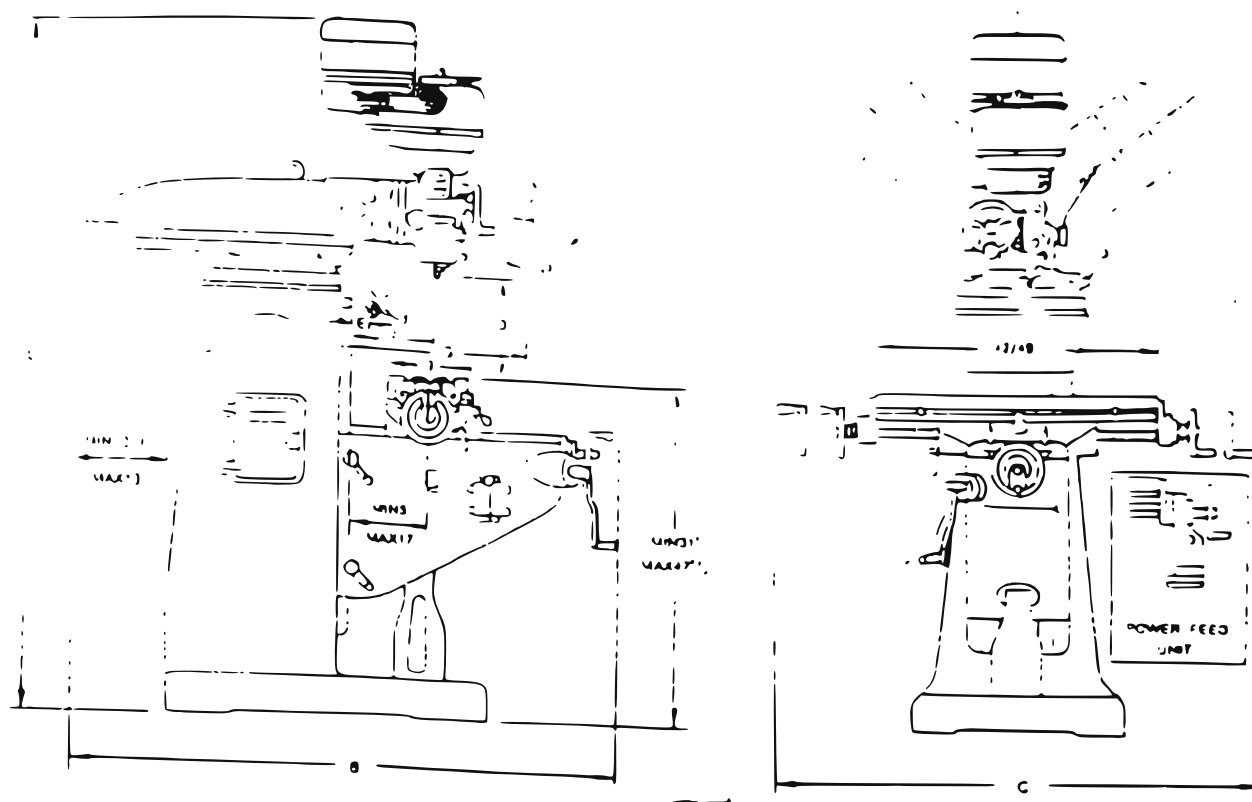


Figure 2-1: Machine outline, side and front elevations (B = overall depth, C = overall width)

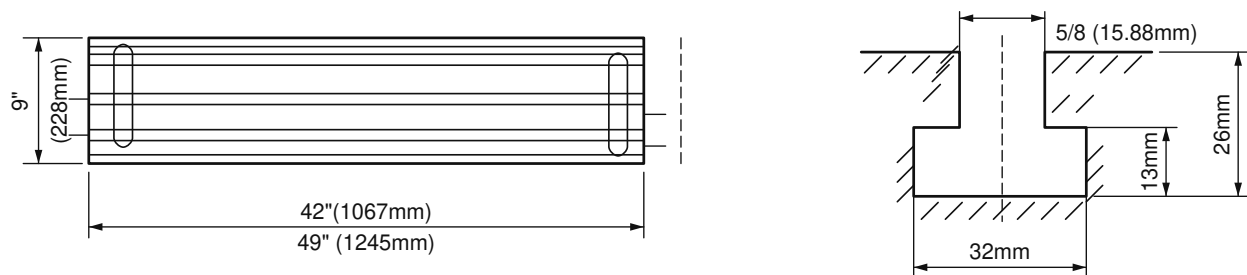


Figure 2-2: Table and T-slot dimensions

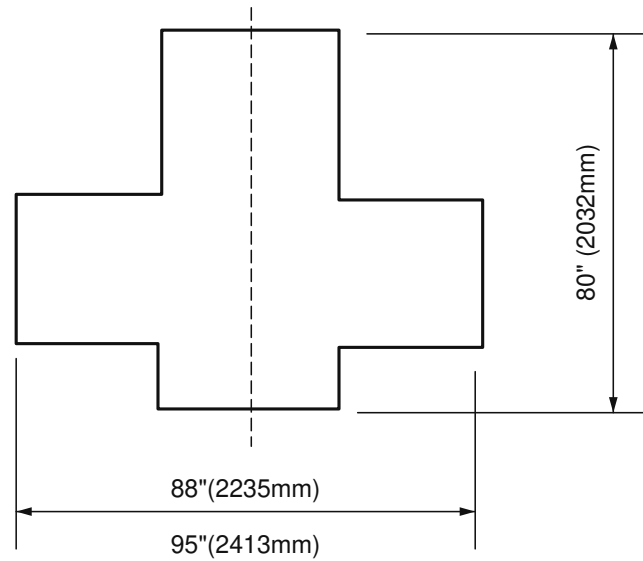


Figure 2-3: Floor area occupied

Table 2-1: Basic machine specification, variable-speed head

Item	in	mm
Table length	48	1219
Longitudinal traverse (manual)	31	787
Longitudinal traverse (power feed)	31	787
Cross traverse	12	304
Vertical traverse	14 1/4"	361
Number of T-slots	3	
T-slot width and centres	5/8" at 2 1/2"	15.88 at 63.5
Ram movement	12	305
Spindle speeds	Infinitely variable	
Spindle speed range	60–4200rpm	
Quill feeds per revolution of spindle	.0015 / .003 / .006	.038 / .076 / .152
Motor (hp)	2	
Overall height	85	2159
Overall depth	64	1625
Overall width	95 / 95	2413 / 2413
Table to spindle gauge line (min–max)	0–18 1/4"	0–463
Head 45° inward (min–max)	0–11 1/4	0–285
Head 90° (min–max)	6 5/8"–20 3/4"	168–527
Head 45° outward (min–max)	14–26	355–660
Floor area occupied	Not stated	Not stated
Case space occupied	Not stated	Not stated
Net weight	2094lb / 2227lb	950kg / 1010kg
Gross weight	2976lb / 3005lb	1350kg / 1363kg

NOTE Where two values are printed in one cell, the original specification sheet does not state which machine each applies to. They are thought to relate to the 42" and 49" table options.

2.2 Basic machine: step-pulley head

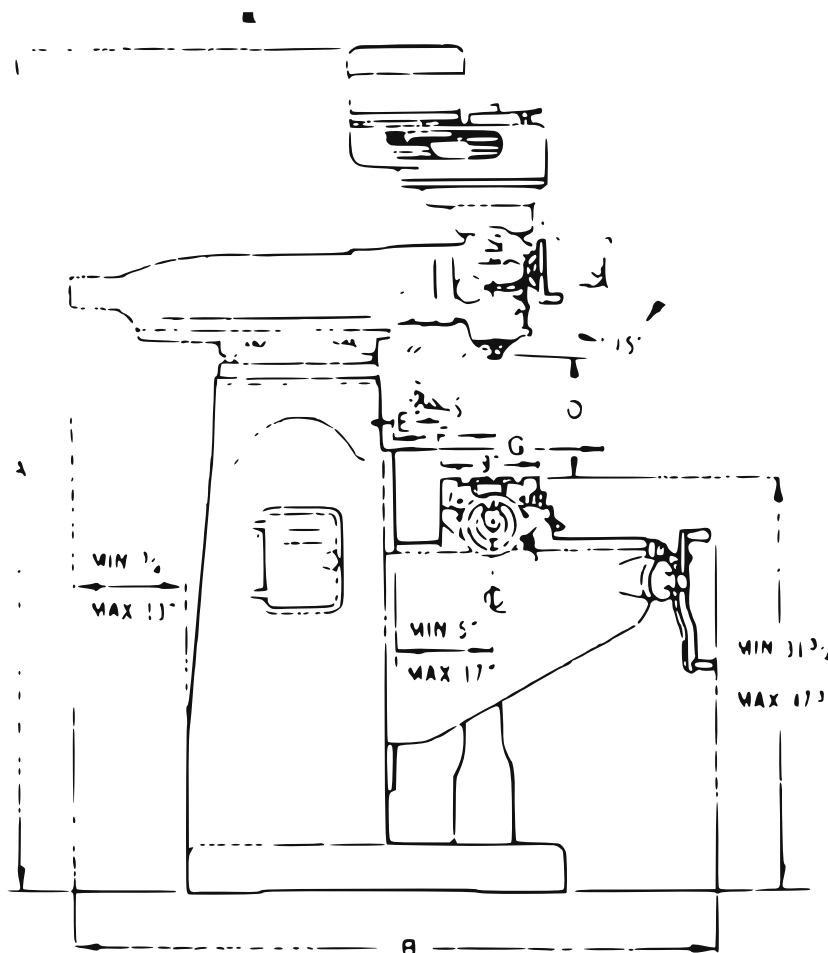


Figure 2-4: Machine side elevation with dimension letters A to G (see Table 2-2)

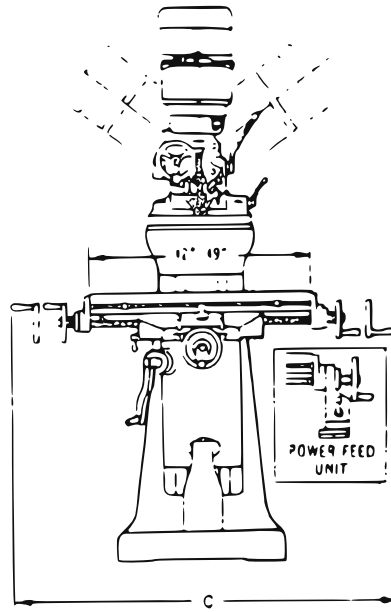


Figure 2-5: Machine front elevation (C = overall width, including power feed unit)

Table 2-2: Basic machine specification, step-pulley head (letters refer to Figures 2-4 and 2-5)

Item	Limit	in	mm
Table length		48	1219
Longitudinal travel (X)		31	787
Longitudinal travel (with power feed unit)		31	787
Cross travel (Y)		12	305
Vertical travel of knee (Z)		14 1/4"	361
A. Overall height		85	2159
B. Overall depth		64	1625
C. Overall width		95	2413
D. Spindle nose to table	min	0	0
	max	18 1/4"	463
E. Head 45° inward	min	0	0
	max	11 1/4	285
F. Head 90°	min	6 7/8"	168
	max	20 3/4"	527
G. Head 45°	min	14	355
	max	26	660
Net weight		2108lb	1016kg

Spindle speeds (60Hz)	80, 135, 210, 325, 660, 1115, 1750, 2720rpm
Spindle taper	R8 or NST 30
Power feed per spindle revolution	.0017", .0032", .0053" (.04, .08, .13mm)
Quill travel	5" (127mm)
Motor	3HR

Table length options	42" (1067mm) or 49" (1245mm)
Net weight	2108lb, 2240lb (956kg, 1016kg), for the 42" and 49" tables respectively
Special accessories	Coolant system; power longitudinal feed

NOTE MACH reserves the right to modify and improve its products.

2.3 Head specification: variable-speed head

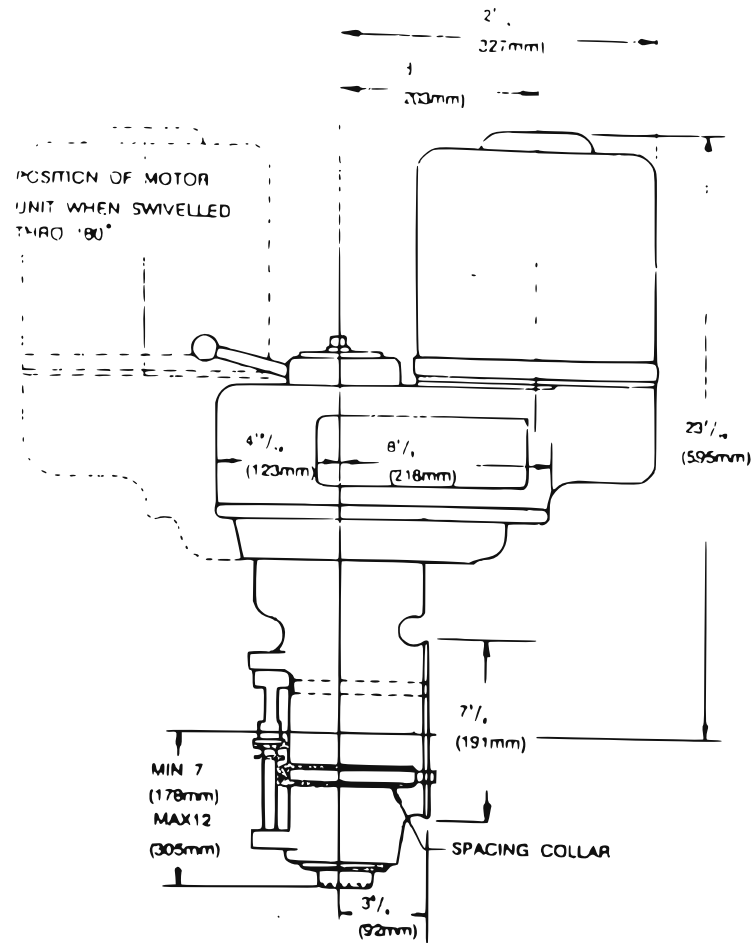


Figure 2-6: Variable-speed head, side elevation

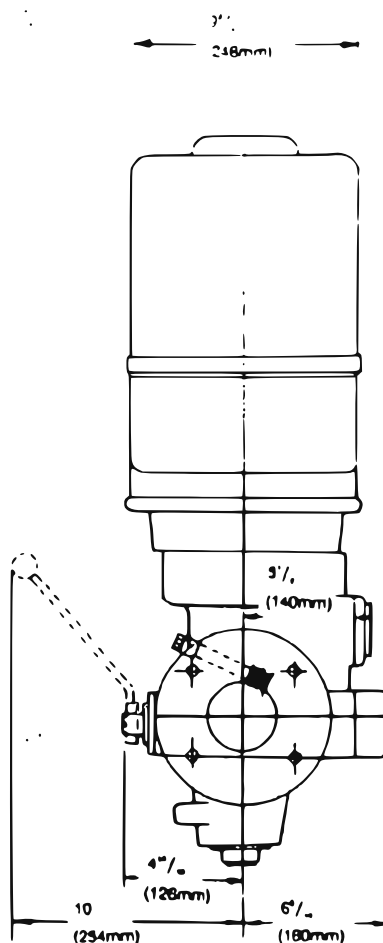


Figure 2-7: Variable-speed head, front elevation

Spindle speeds (60 cycles)	60–4200rpm, infinitely variable
Power feed per spindle revolution	.0015" / .003" / .006" (.038 / .076 / .152mm)
Spindle taper	R8
Quill travel	5" (127mm)
Collet capacity	1/8" to 3/4" (3mm–19mm)
Motor	2hp
Weight	183lb (83kg)

3 Installation

3.1 Handling

The machine weighs approximately 2200lb (997kg). Lift it by one of the two methods below.

3.1.1 Method 1: eye bolt

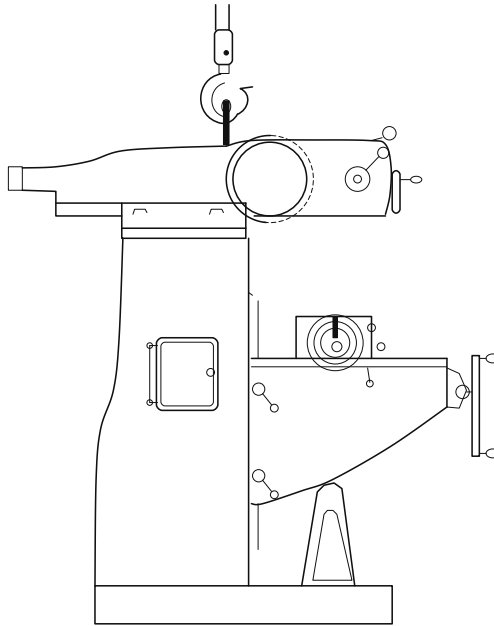


Figure 3-1: Lifting method 1, eye bolt in the ram

- 1 Screw a 5/8"-11NC eye bolt into the tapped hole.
- 2 Make sure the eye bolt is fully secured before you lift.

■ WARNING

Do not lift the machine until the eye bolt is fully secured.

NOTE It is advisable to swivel the head before lifting the machine.

3.1.2 Method 2: rope sling

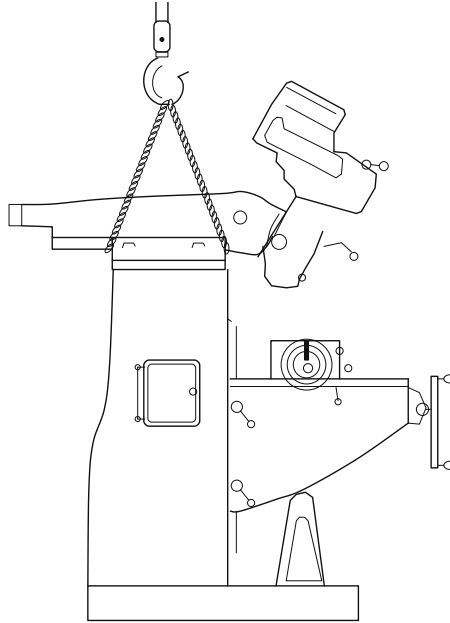


Figure 3-2: Lifting method 2, rope sling

- 1 Use a rope sling as illustrated.
- 2 Insert pads of soft cloth between the rope and any machined edges.

NOTE It is advisable to tilt the head before lifting the machine.

3.2 Cleaning

- 1 Remove the rust preventative before you move any slideway.
- 2 Soften the coating with paraffin applied with a clean brush, then remove it with clean rags.
- 3 Oil or grease all lubrication points (see Chapter 6).

3.3 Floor plan

Figure 3-3 gives the machine footprint and anchor-bolt positions. Dimension A is the overall width with the table at full travel; Table 3-1 gives its value for each table size.

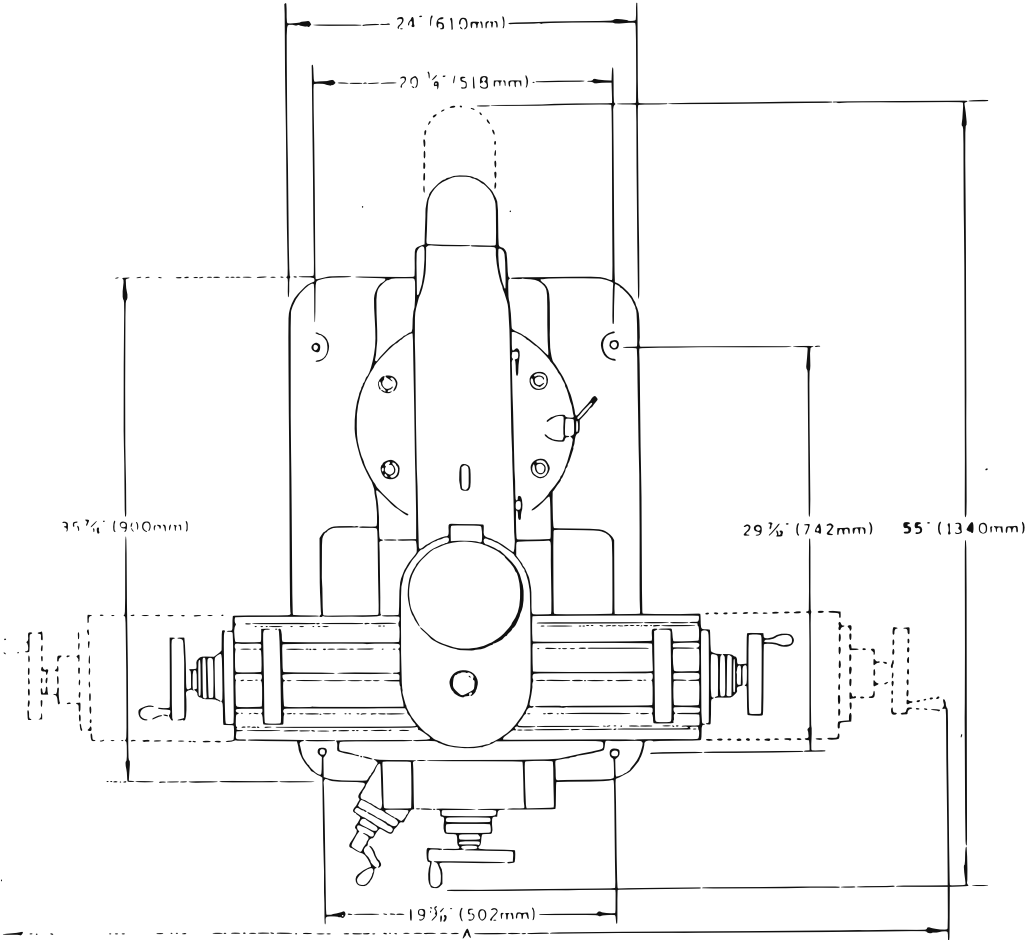


Figure 3-3: Floor plan

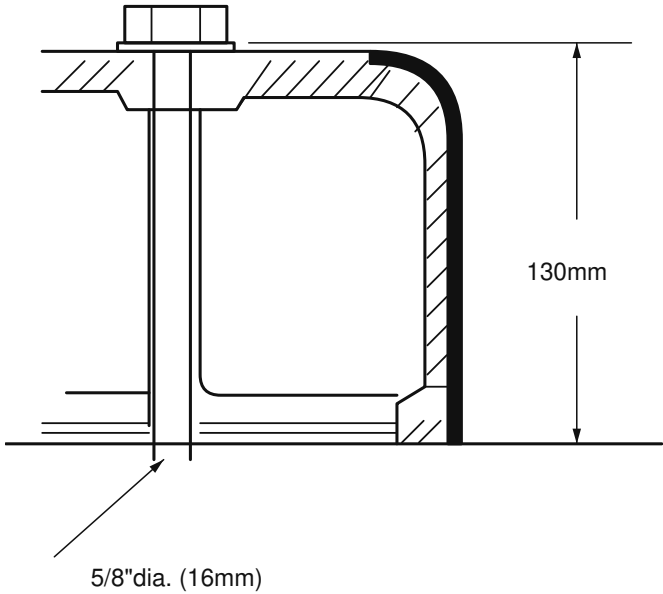


Figure 3-4: Anchor bolt through the base flange

Table 3-1: Dimension A

Table size	Plain machine
42"	95" (2413mm)
49"	107" (2718mm)

3.4 Foundation

Ideally, bolt the machine to a concrete foundation. Otherwise, stand it on a solid, level floor or on anti-vibration pads so that it cannot rock.

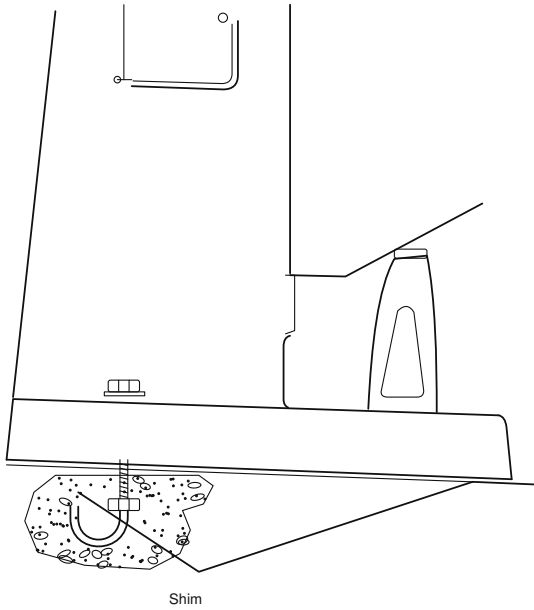


Figure 3-5: Base on the foundation, showing anchor bolt and shim

Build the foundation to the plan and section in Figures 3-6 to 3-8. Table 3-2 gives the dimensions.

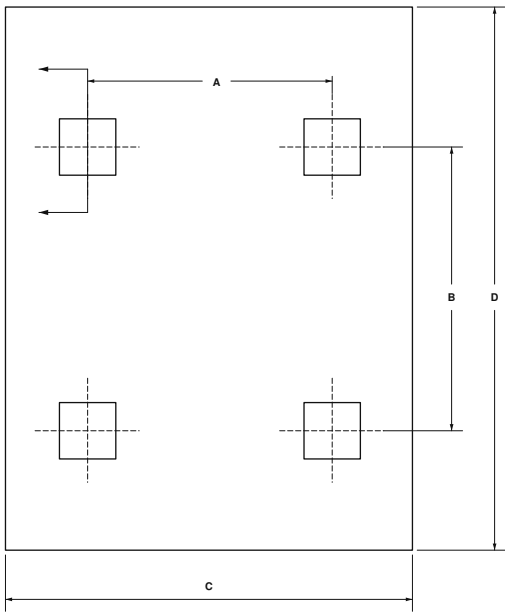


Figure 3-6: Foundation plan

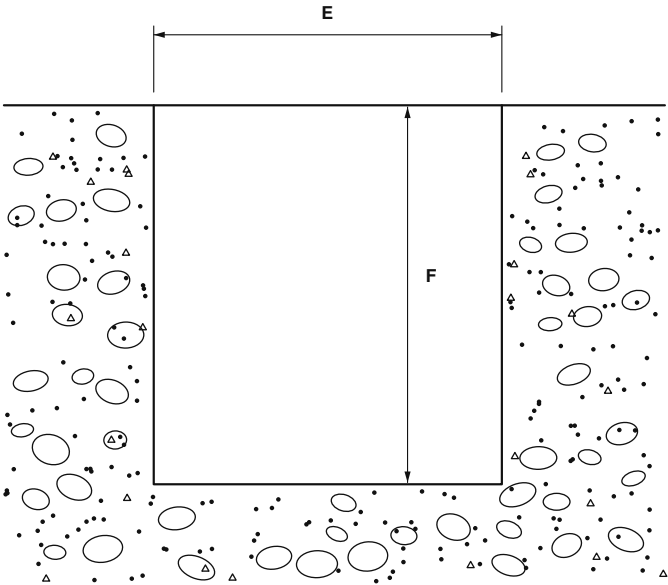


Figure 3-7: Foundation structure, anchor pocket

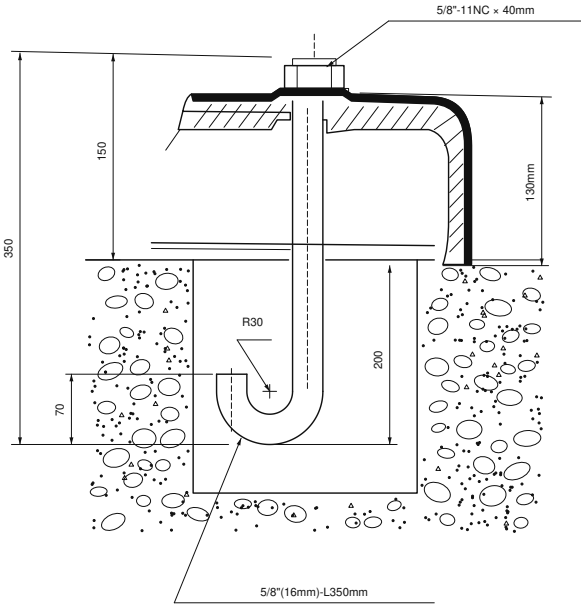


Figure 3-8: Foundation structure, anchor bolt detail

Table 3-2: Foundation dimensions (letters refer to Figures 3-6 and 3-7)

Dimension	Size
A	518mm (20 3/8")
B	742mm (24 7/32")
C	1020mm (40 5/32")
D	1242mm (48 7/8")
E	200mm (7 7/6")
F	250mm (9 27/32")

3.5 Power supply

- 1 Check the motor voltages against the supply.
- 2 Connect the supply in compliance with local safety regulations.

■ WARNING

The head switch has NO overload protection when a control panel is not fitted.

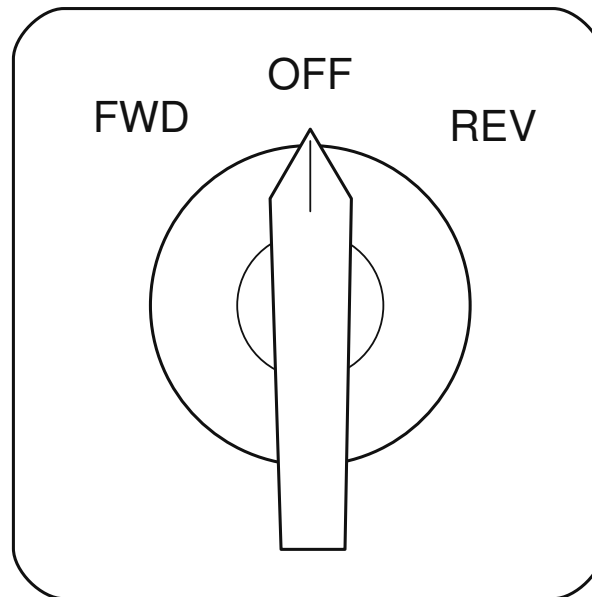


Figure 3-9: Head switch (FWD / OFF / REV)

3.6 Levelling

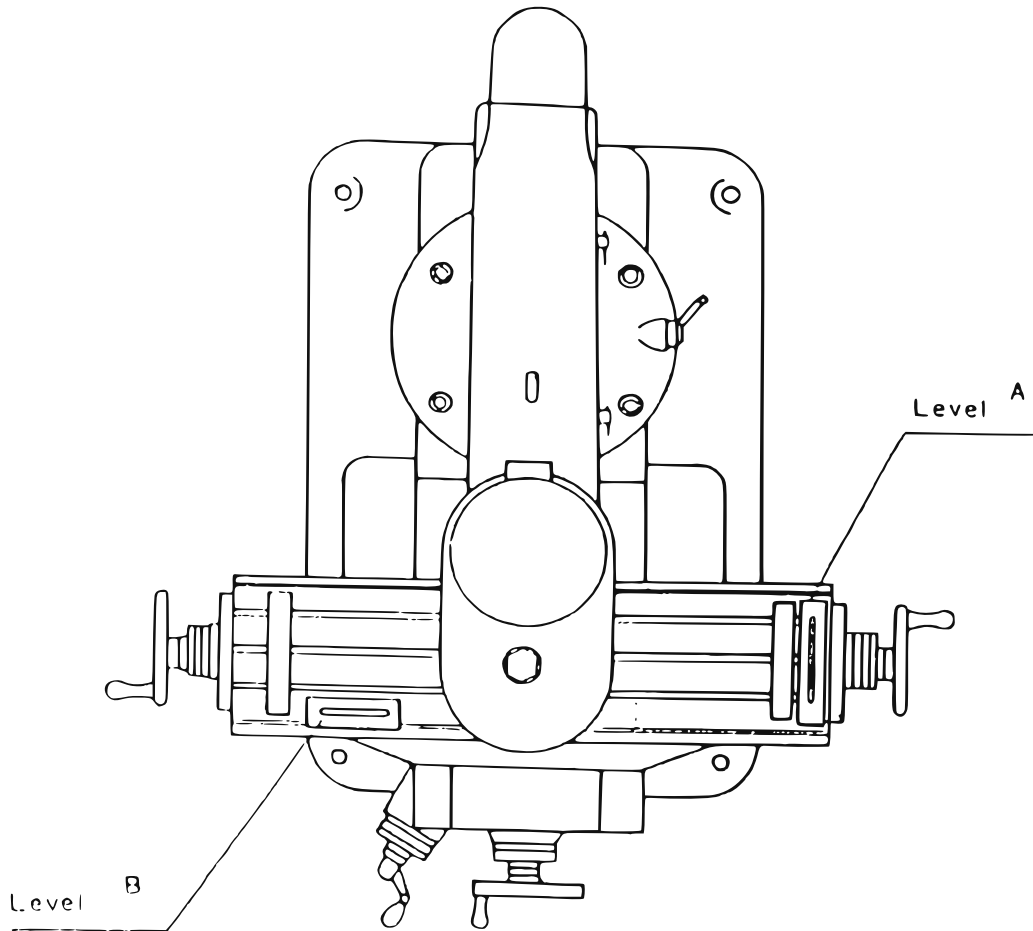


Figure 3-10: Level positions on the table

- 1 Place the levels on the table as shown in Figure 3-10.
- 2 Check levels A and B. The allowance is approximately 0.06mm/m.
- 3 Fit pads under the base if necessary, then tighten the anchor bolts.

3.7 Setting the head square to the table

There are two methods of setting the milling head square to the table:

- Method I: mount a large 90° set square on the table and align the aligning faces with the square.
- Method II: mount a dial indicator in the spindle nose and sweep it through a 4 1/2" (114mm) radius.

NOTE Set each axis separately, and lock it before you set the next.

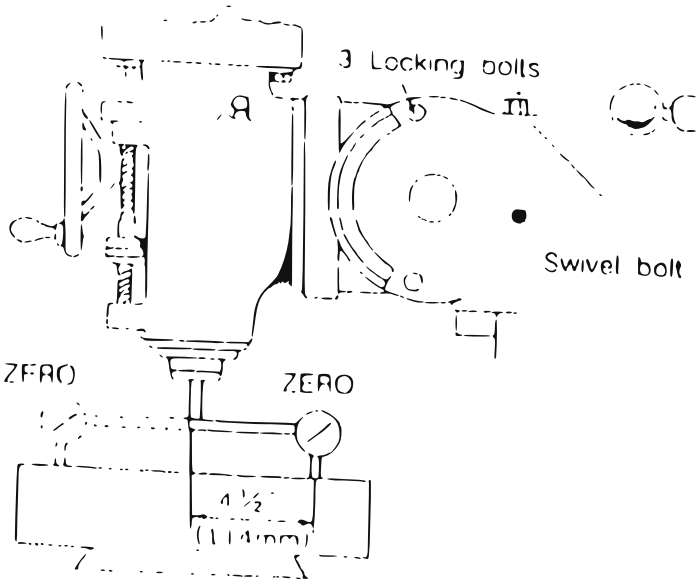


Figure 3-11: Setting the nodding axis (side view)

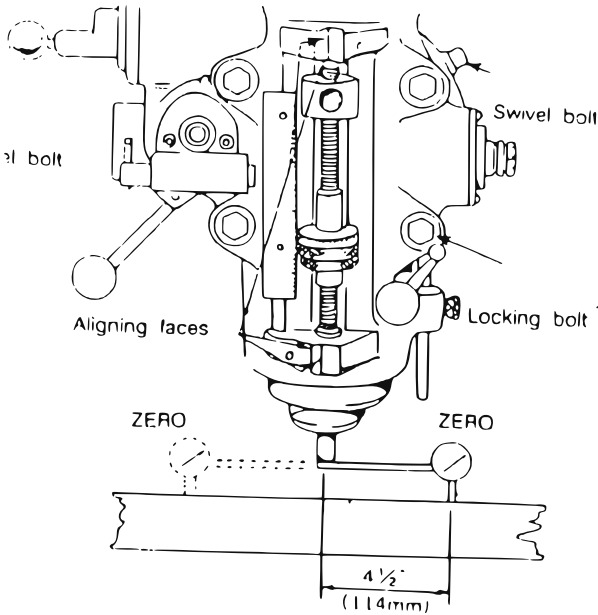


Figure 3-12: Setting the tilt axis (front view)

4 Controls

This chapter identifies the controls of the machine and the head. Machines differ in detail according to the head fitted and whether a table power feed unit is fitted, so use the figures that match your machine.

4.1 Machine controls: step-pulley head with table power feed

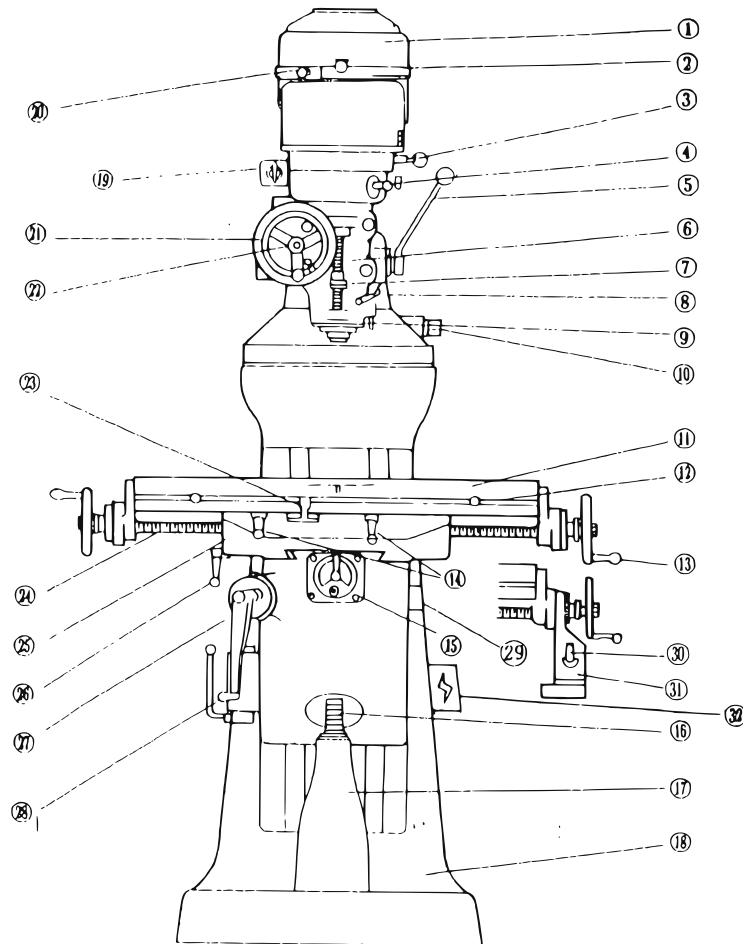


Figure 4-1: Machine controls, step-pulley head with table power feed unit

4.2 Machine controls: variable-speed head

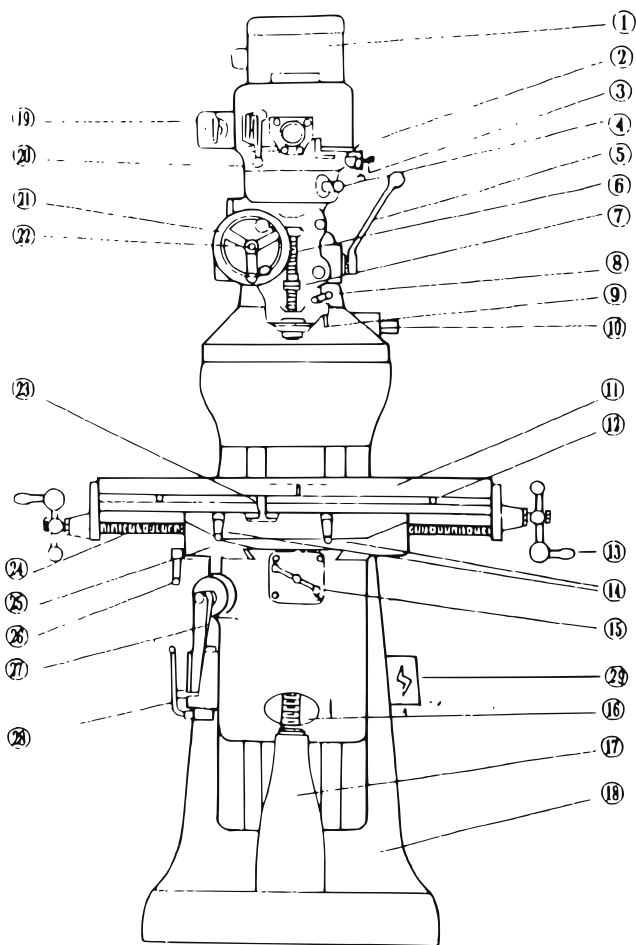


Figure 4-2: Machine controls, variable-speed head (no table power feed unit)

4.3 Head controls: step-pulley head

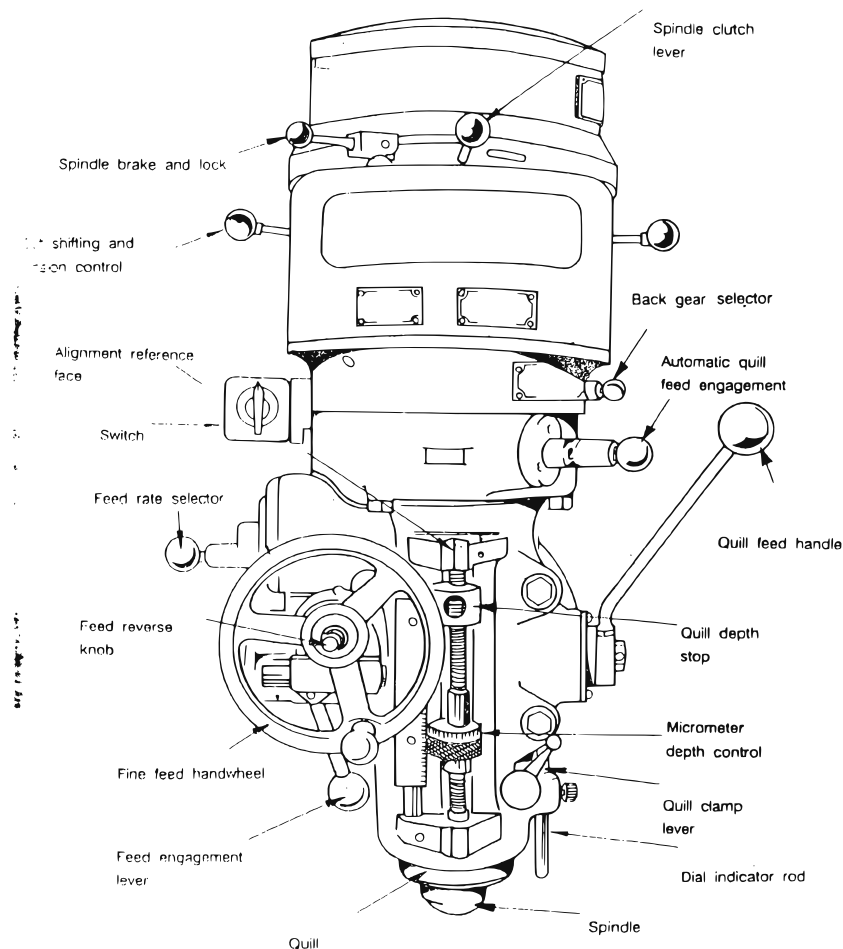


Figure 4-3: Head controls, step-pulley head

4.4 Head controls: variable-speed head (1 1/2 VS-T)

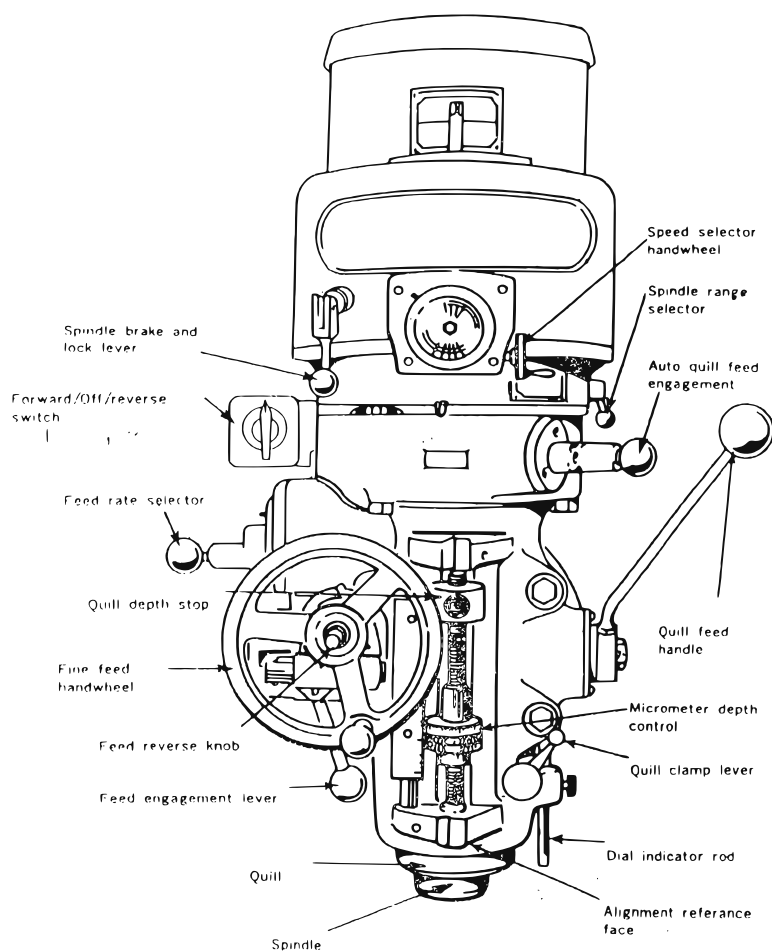


Figure 4-4: Head controls, 1 1/2 VS-T variable-speed head

5 Operation

5.1 Starting and stopping

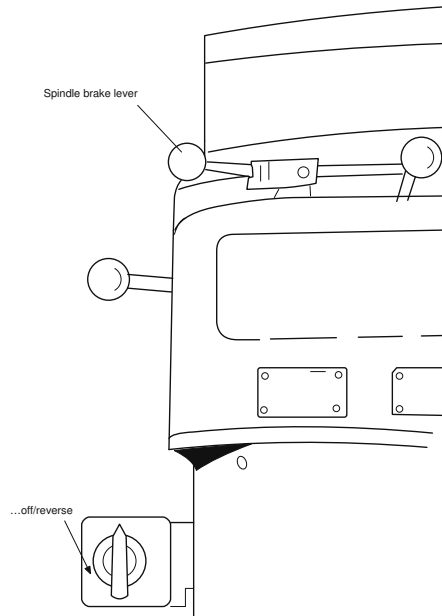


Figure 5-1: Spindle brake lever and switch, 1 1/2 VA-T step-pulley head

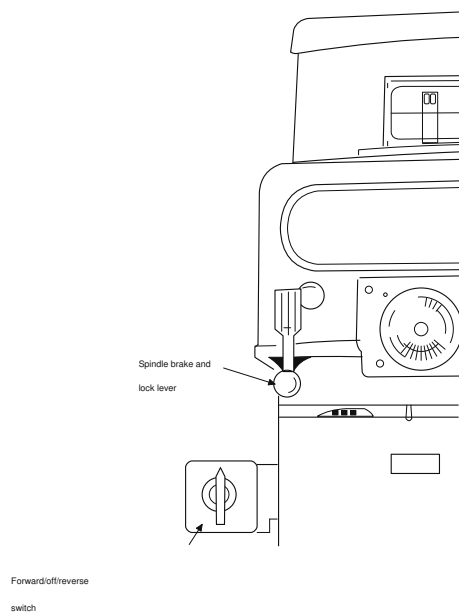


Figure 5-2: Spindle brake and lock lever and switch, 1 1/2 VS-T variable-speed head

5.1.1 Starting

- 1 Connect the power.
- 2 Turn the switch to the required position (Forward or Reverse).

5.1.2 Stopping

- 1 Stop the feed.
- 2 Turn the switch to OFF.
- 3 Turn the spindle brake lever to BRAKE until the spindle stops.

5.2 Clamping the slides

5.2.1 Saddle to knee

Use moderate pressure only. Excess pressure distorts the slide and makes the table stiff to wind.

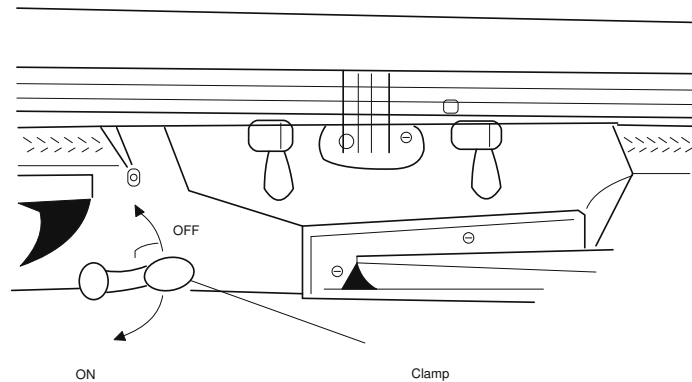


Figure 5-3: Saddle-to-knee clamp

5.2.2 Table to saddle

Use moderate pressure only.

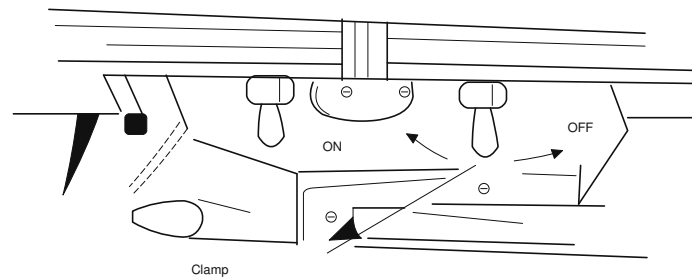


Figure 5-4: Table-to-saddle clamp

5.2.3 Knee to column

Use moderate pressure only.

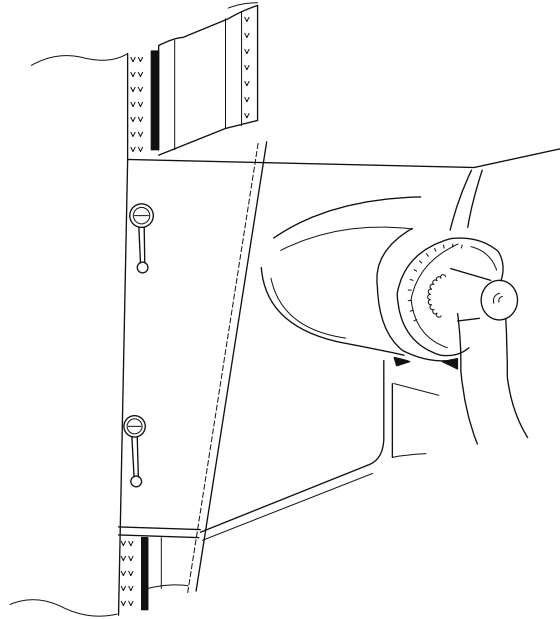


Figure 5-5: Knee-to-column clamps

5.3 Swivelling the turret

- 1 Unlock the four turret bolts with a spanner.
- 2 Index the turret to the required setting.
- 3 Lock the four bolts.

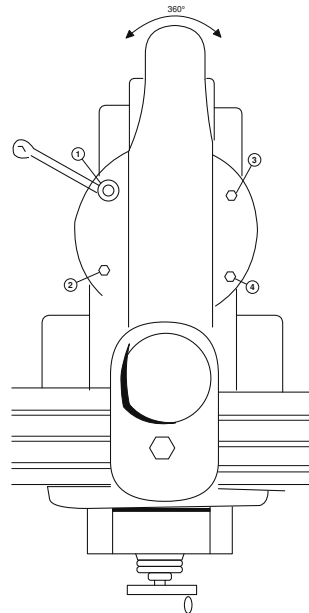


Figure 5-6: Turret bolts (plan view)

5.4 Moving the ram

- 1 Loosen the two lock levers.
- 2 Turn the handle to move the ram to the required position.
- 3 Tighten the lock levers, rear lever first.

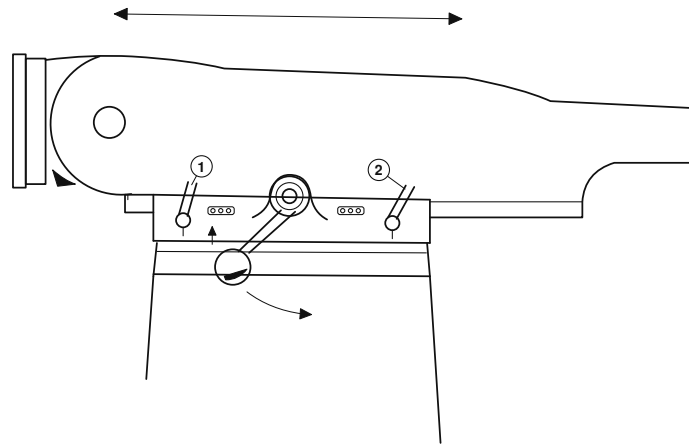


Figure 5-7: Ram lock levers and adjustment handle

5.5 Swivelling the belt housing

- 1 Slacken the three locking nuts A. Keep enough tension on them to stop binding.
- 2 Swivel the belt housing to the required angle.
- 3 Tighten the three locking nuts. Before final tightening, run the spindle to give correct spline alignment.

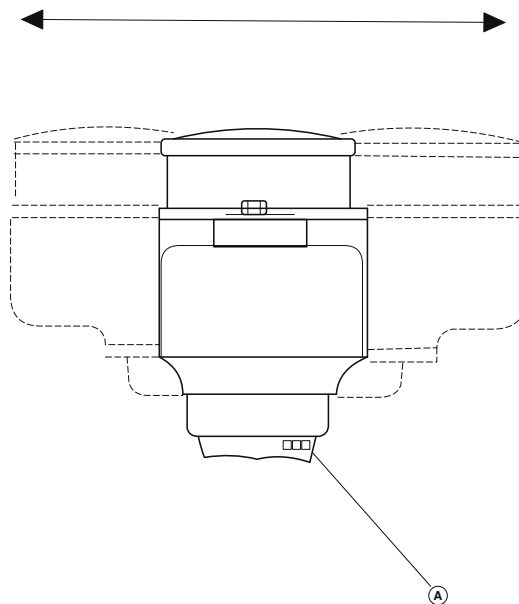


Figure 5-8: Swivelling the belt housing

NOTE Tightening locking nuts A unequally can cause incorrect spline alignment. The quill feed then becomes unevenly stiff, which can be felt through the sensitive feed handle.

5.6 Spindle brake

Swing the spindle brake lever from Off to Brake in either direction to stop the spindle (see 5.1.2).

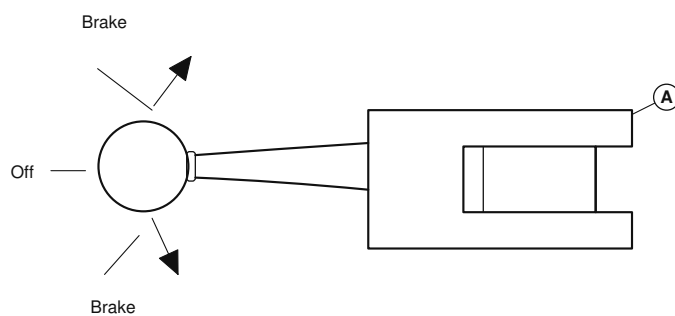


Figure 5-9: Spindle brake lever positions

5.7 Quill sensitive hand feed

- 1 Place the handle on the boss.
- 2 Select the most suitable position.
- 3 Push the handle home until the locating pin engages.

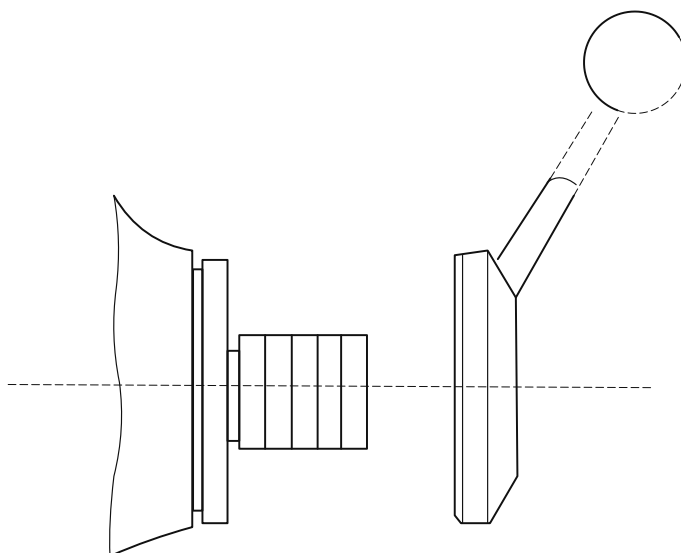


Figure 5-10: Quill feed handle on the boss

5.8 Quill feed

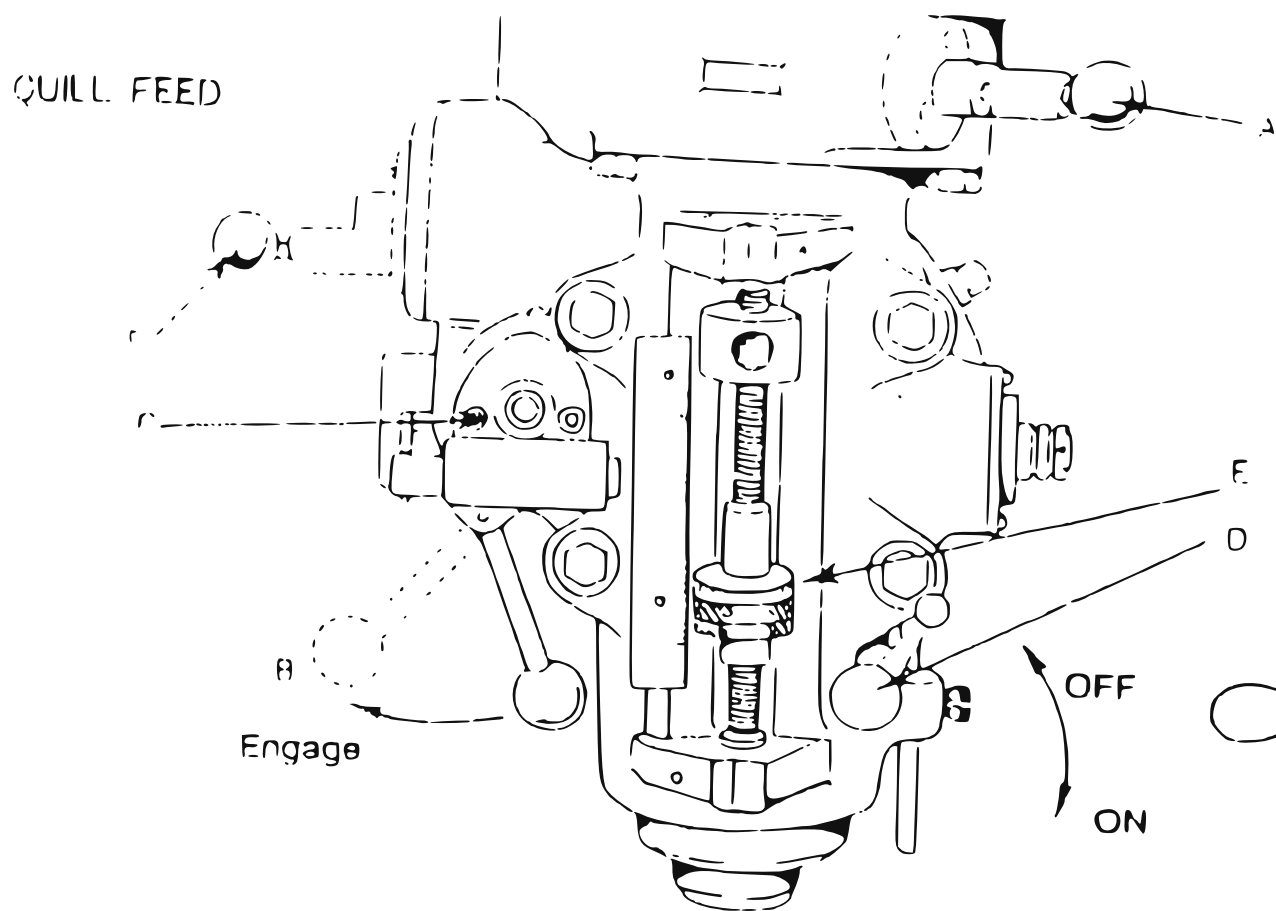


Figure 5-11: Quill feed controls

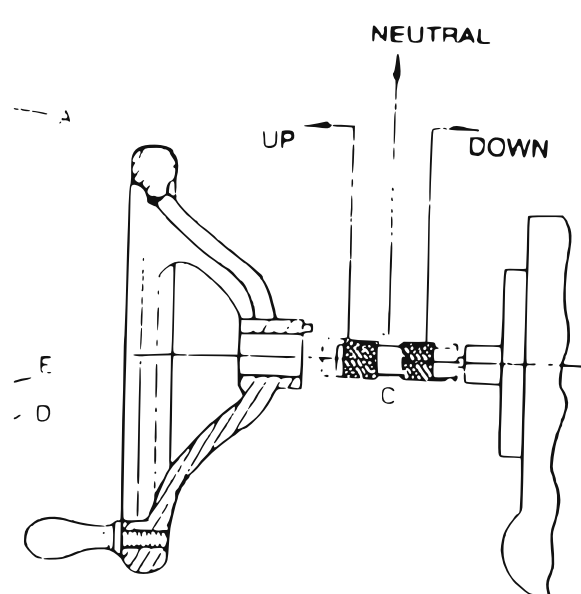


Figure 5-12: Feed reverse knob C positions

5.8.1 Fine hand feed

- 1 Disengage the auto quill feed A.

- 2 Set the feed reverse knob C to the mid (neutral) position.
- 3 Engage the feed trip lever B.
- 4 The quill is now under handwheel control.

5.8.2 Automatic feed

NOTE Maximum load: 3/8" (9.5mm) diameter drill in steel.

■ CAUTION

Do not engage the auto quill feed A above 3000rpm.

- 1 Make sure the quill lock D is off.
- 2 Set the micrometer dial E to the required depth.
- 3 Engage the auto quill feed A (with the motor stopped).
- 4 Select the feed rate F.
- 5 Select the feed direction C.
- 6 Engage the feed trip lever B.
- 7 The quill is now under automatic feed.

5.9 Spindle speeds: step-pulley head

■ CAUTION

Stop the motor before you change speed.

5.9.1 Changing speed within a range

- 1 Isolate the machine (turn the power off).
- 2 Slacken the two motor lock levers A.
- 3 Slide the motor forward.
- 4 Position the belt on the appropriate pulleys.
- 5 Slide the motor to the rear to tension the V-belt.
- 6 Tighten the two motor lock levers.

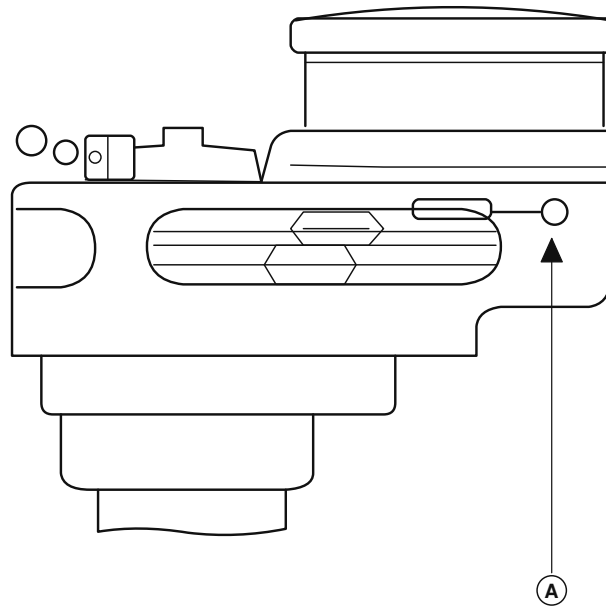


Figure 5-13: Step-pulley belt housing and motor lock lever

5.10 Spindle speeds: variable-speed head

■ CAUTION

Change speed only while the spindle is running. Do not change speed while the spindle is stopped.

NOTE Run the variable-speed unit from low speed to high speed twice in every five-day working week. This clears dirt and dust, drawn in through the belt system and out through the fan, from the shaft and keyway, and keeps speed changing smooth.

5.10.1 Changing speed within a range

- 1 Start the spindle.
- 2 Turn handwheel A to select the required speed. Change speed only while the spindle is running.

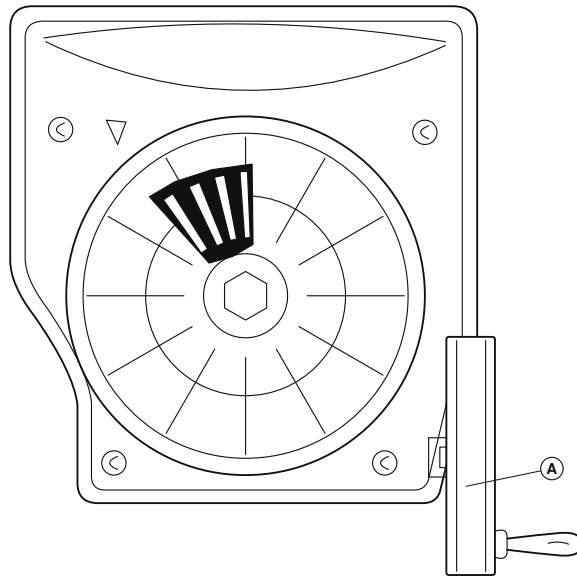


Figure 5-14: Speed selector handwheel A. Do not change speed while the spindle is stopped.

5.11 Changing spindle range (direct and back gear drive)

■ WARNING

Do not change range while the spindle is running.

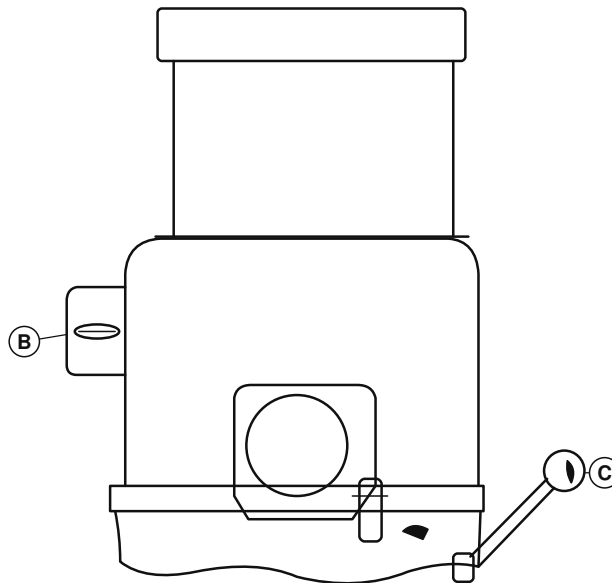


Figure 5-15: Range switch B and range lever C

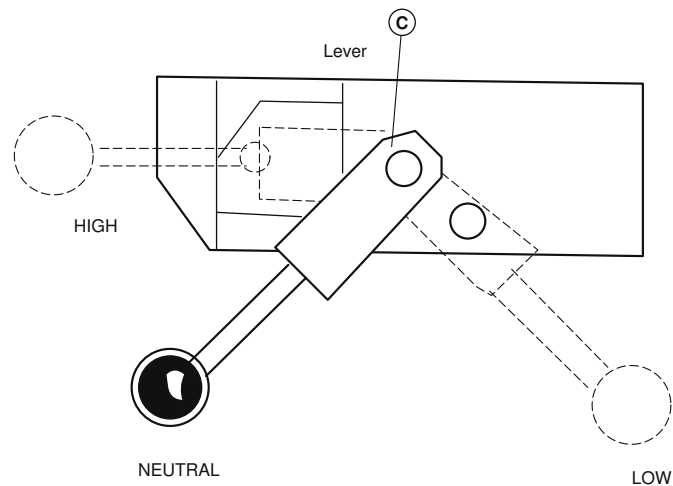


Figure 5-16: Range lever C positions (HIGH / NEUTRAL / LOW)

5.11.1 From direct drive to back gear drive

- 1 Turn switch B to OFF.
- 2 Move lever C through neutral to LOW. This reverses the spindle rotation.
- 3 Turn switch B to LOW.

5.11.2 From back gear drive to direct drive

- 1 Turn switch B to OFF.
- 2 Move lever C through neutral to HIGH.
- 3 Rotate the spindle by hand until you feel the clutches engage.
- 4 Turn switch B to HIGH.

6 Lubrication

Lubricate the machine at the intervals shown in this chapter, using the lubricants listed. Before operation each day, oil every lubrication point (see 7.1).

6.1 Head lubrication: step-pulley head

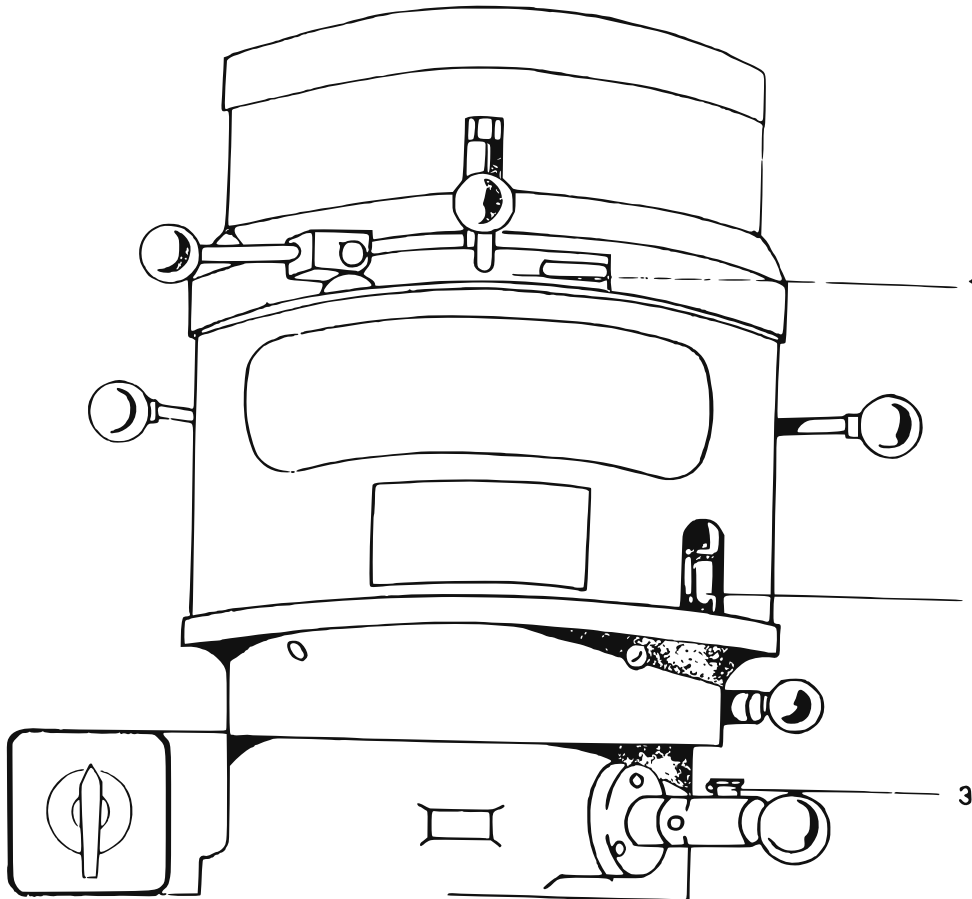


Figure 6-1: Head lubrication points, step-pulley head

NOTE Point 2 (spindle bearing/quill feed) is the unnumbered lubrication point between points 1 and 3 in Figure 6-1, on the right-hand side of the head housing.

Table 6-1: Head lubrication, step-pulley head

Frequency	Lubricate	Lubricant	Quantity	At
Twice weekly	Pulley cam	Vactra Heavy-Medium S.A.E. 10 or 10W Light	5 drops	1
Twice weekly	Spindle bearing/quill feed	Vactra Heavy-Medium S.A.E. 10 or 10W Light	Top up	2
Twice weekly	Quill bearings	Vactra Heavy-Medium S.A.E. 10 or 10W Light	Top up	3

■ CAUTION

Failure to lubricate the quill bearings at point 3 can result in tight quills and partial seizure of the quill in its housing.

6.2 Head lubrication: variable-speed head

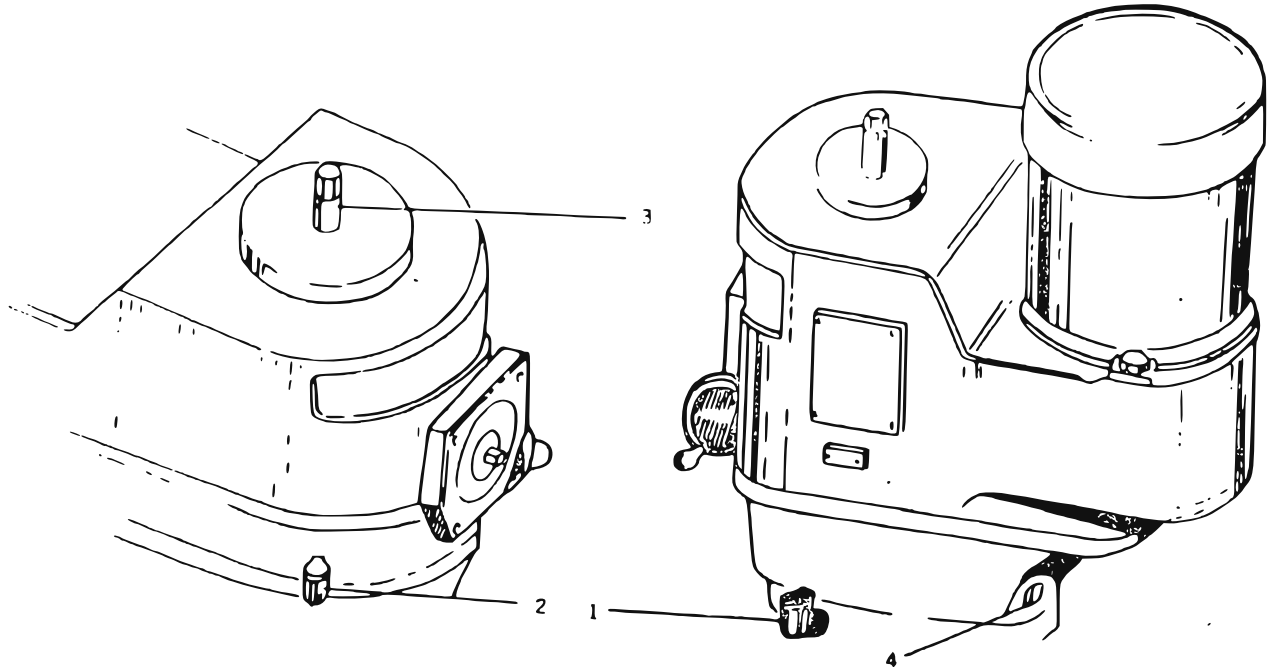


Figure 6-2: Head lubrication points, variable-speed head

Table 6-2: Head lubrication, variable-speed head

Frequency	Lubricate	Lubricant	Quantity	Att
Twice daily	Quill bearings	Vactra Heavy-Medium S.A.E. 10 or 10W Light	5 drops	1
Twice daily (when feed is in use)	Spindle down feed	Vactra Heavy-Medium S.A.E. 10 or 10W Light	Top up	2
Twice weekly	Drawbar splines (move quill down 2")	Vactra Heavy-Medium S.A.E. 10 or 10W Light	Top up	3

■ CAUTION

Failure to lubricate the quill bearings at point 1 can result in tight quills and partial seizure of the quill in its housing.

6.3 Back gear

Table 6-3: Back gear lubrication

Frequency	Lubricate	Lubricant	Quantity	Note
Every 2 months (of normal use)	Back gear	Grease	Equivalent of 1 teaspoonful	Before greasing, put the gear lever back to LO and keep the spindle stationary.

6.4 Machine lubrication

The lead screw and slideways are oiled by the centralised lubrication pump on the knee. Operate the pump daily, and check the reservoir oil level weekly. Oil the elevating screw with an oil gun.

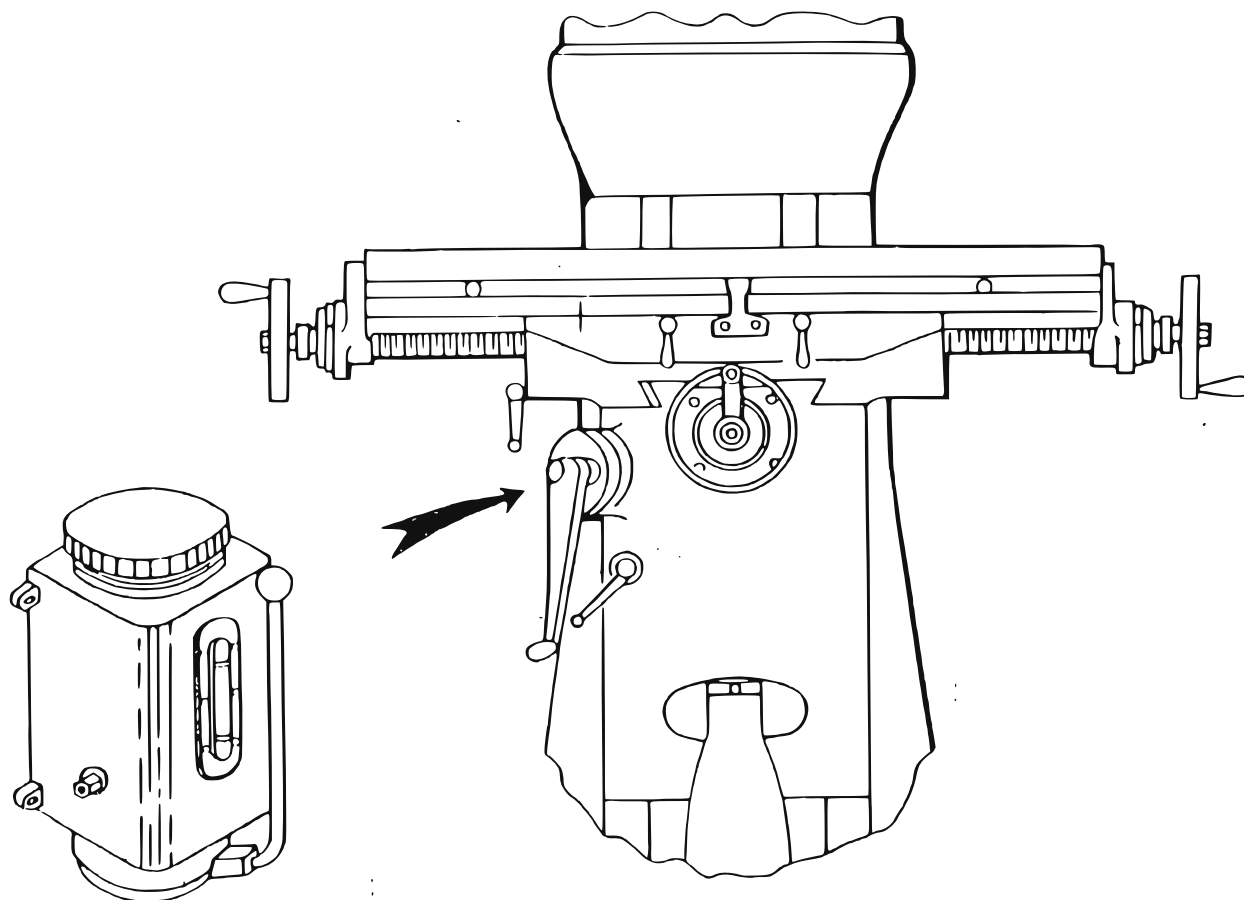


Figure 6-3: Centralised lubrication pump

Table 6-4: Machine lubrication

Frequency	Lubricate	Lubricant	Quantity
Daily (centralised lubrication pump)	Lead screw	Shell Carnea Oil 41, Mobil X 2, Socony Gargoyle Vactra No.2	One pump
Daily (centralised lubrication pump)	Saddle-table ways	"Sunoco" Waylube #80, Mobil X 2	One pump
Daily (centralised lubrication pump)	Saddle-knee ways	"Sunoco" Waylube #80, Mobil X 2	One pump
Daily (centralised lubrication pump)	Knee-column ways	"Sunoco" Waylube #80, Mobil X 2	One pump
Twice weekly	Elevating screw	Shell Carnea Oil 41, Socony Gargoyle Vactra No.2	5 shots (oil gun)

NOTE Check the centralised lubrication pump reservoir level weekly.

6.5 Lubrication system

The plunger pump (11) feeds the oil distributor (12), which supplies the outlets listed below. A second branch from the pump feeds the elevating guideways.

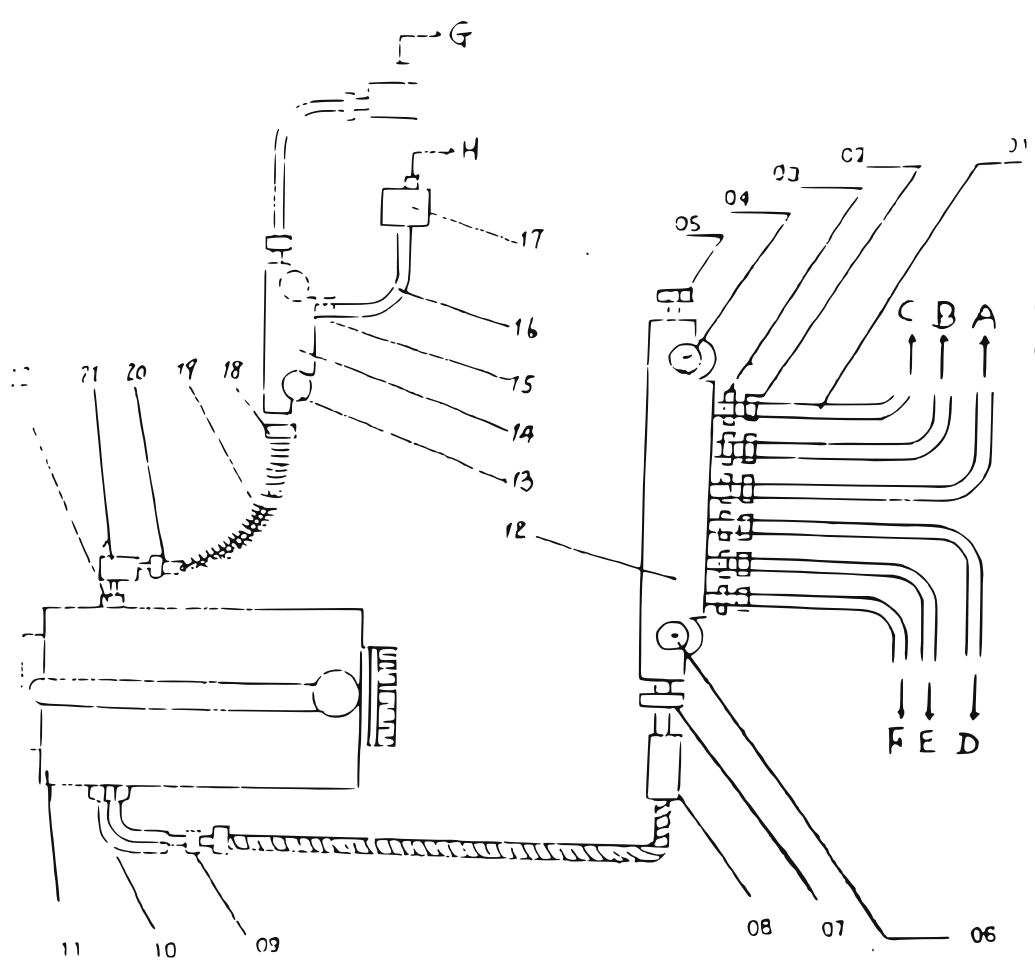


Figure 6-4: Lubrication system piping

- (A) To table and saddle rear guideway.
- (B) To table screw.
- (C) To cross screw.
- (D) To knee and saddle left guideway.
- (E) To knee and saddle right guideway.
- (F) To table and saddle front guideway.
- (G) To elevating left guideway.
- (H) To elevating right guideway.
- (I) To saddle left guideway.

Table 6-5: Lubrication system parts (numbers refer to Figure 6-4)

Item	Part name	Qty
01	Aluminium pipe (φ4)	6
02	Pipe lock nut (PA-4)	12

Item	Part name	Qty
03	Pipe joint (PB-4)	12
04	Socket hd. bolt	12
05	Plug (PG-1)	1
06	Socket hd. bolt	1
07	Pipe lock nut (PA-4), pipe joint (PB-4)	1
08	Flexible hose ($\phi 4 \times 200\text{mm}$)	1
09	Pipe lock nut	2
10	L-type universal connector	1
11	Plunger pump (LT-8)	1
12	Oil distributor	1
13	Socket hd. bolt	2
14	Socket hd. bolt	2
15	Pipe lock nut (PA-4), pipe joint (PB-4)	2
16	Aluminium pipe ($\phi 4$)	2
17	L-type joint	2
18	Pipe lock nut (PA-4), pipe joint (PB-4)	2
19	Flexible hose ($\phi 4$)	1
20	Pipe lock nut (PA-4), pipe joint (PB-4)	1
21	L-type joint	1
22	Check valve	1

7 Maintenance

7.1 Preventive maintenance

To preserve the accuracy and life of the machine, carry out the checks in Table 7-1.

Table 7-1: Preventive maintenance schedule

Frequency	Item
Daily	1. Oil each lubrication point before operation.
Daily	2. Check the oil level in the lubricator and fill if necessary.
Daily	3. After operation, release the clamps, then clean and lubricate the table.
Monthly	1. Check all gibs and adjust if necessary.
Monthly	2. Check the backlash between all screws and nuts, and adjust if necessary.
Quarterly	1. Check and adjust the machine accuracy.

NOTE The accuracy inspection chart referred to in the original manual is not included in this edition.

7.2 Before you start

■ WARNING

For your safety, isolate the machine electrically before you attempt any maintenance.

For efficient working, read the relevant section of this manual before you start.

When you order replacement parts, quote:

- The machine serial number, found above the door on the left-hand side of the column.
- The head serial number, found on the front of the belt housing.
- Item number.
- Part number.
- Quantity.
- Description.

7.3 Belt replacement: step-pulley head

- 1 Isolate the machine electrically.
- 2 Remove the drawbar.
- 3 Remove the motor.
- 4 Lower the quill to its full extent.
- 5 Remove the 6 screws A.
- 6 Remove belt housing B. Tap it to withdraw it from the dowels.

7 Change the belts.

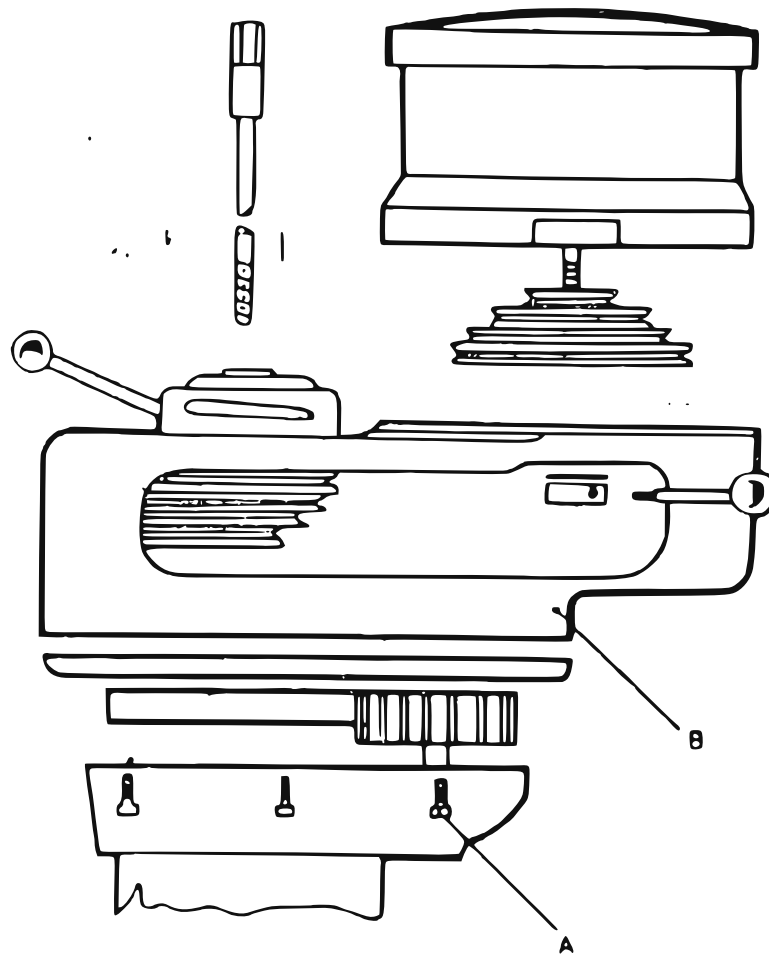


Figure 7-1: Belt replacement, step-pulley head

7.4 Brake shoe replacement: step-pulley head

First carry out steps 1 to 6 of 7.3.

- 1 Remove the 4 screws A.
- 2 Remove the 2 screws B.
- 3 Push bearing hub C clear of the housing.
- 4 Remove the 3 screws D.
- 5 Replace the shoe.
- 6 Make sure screws D are fully tightened and locked with washers and nuts.

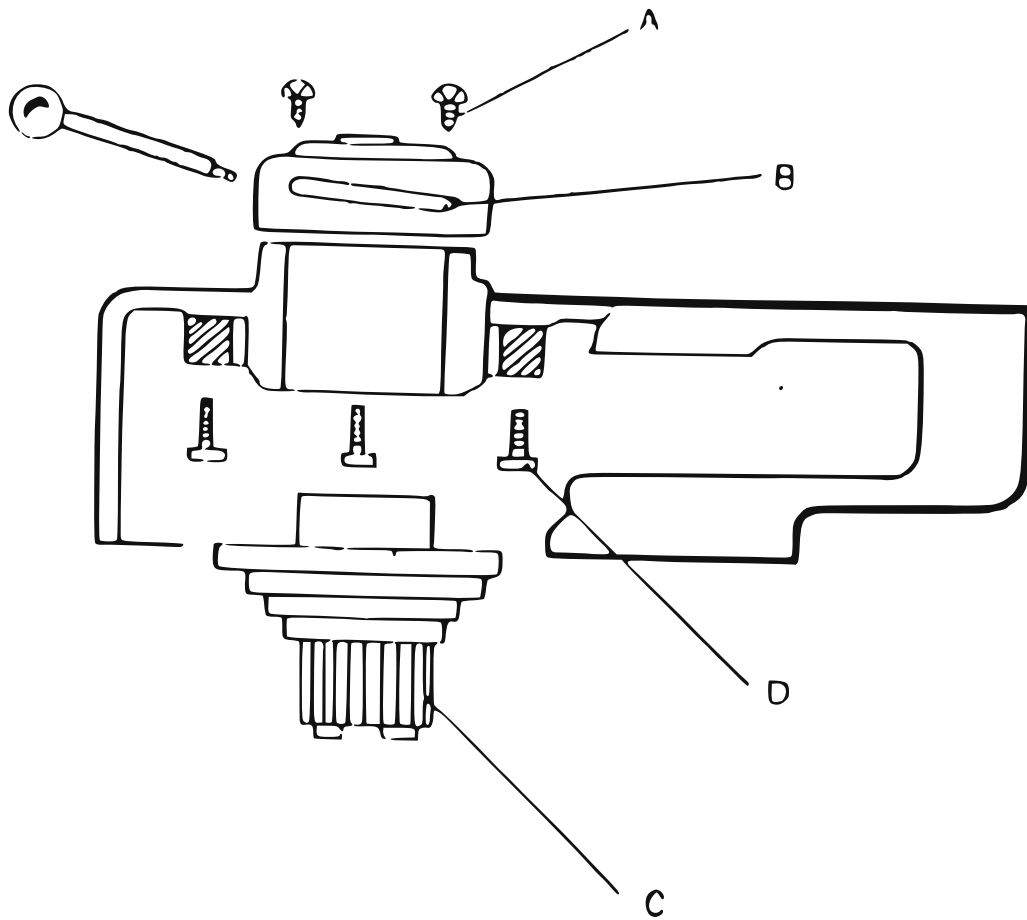


Figure 7-2: Brake shoe replacement, step-pulley head

7.5 Motor removal: variable-speed head

- 1 Rotate and adjust the head to the lowest speed.
- 2 Isolate the machine electrically.
- 3 Remove the 3 screws A and cover B.
- 4 Use two of the screws A to compress spring C.
- 5 Rotate the speed changer to the highest speed.
- 6 Remove the reversing switch from the belt housing.
- 7 Remove the two locking nuts D.
- 8 Lift the motor and rest the case on stud E.
- 9 Ease the belt over the lower drive disc and remove the motor.

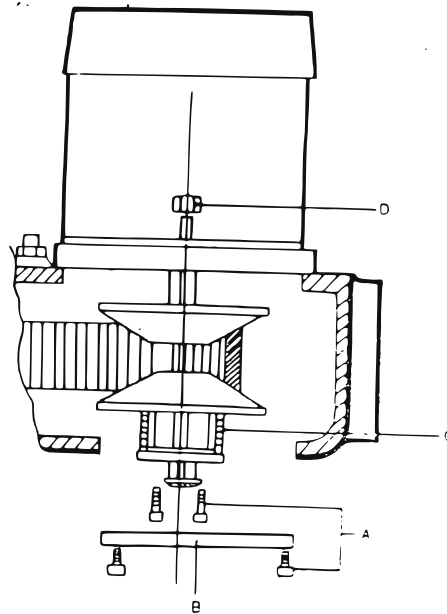


Figure 7-3: Motor removal, section through motor and belt housing

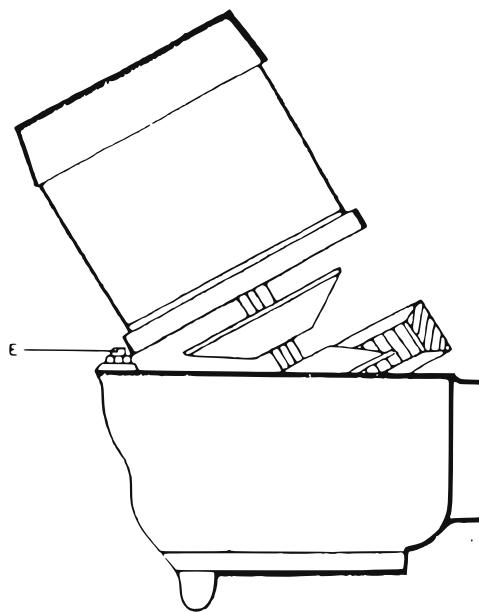


Figure 7-4: Motor resting on stud E

7.6 Timing belt replacement: variable-speed head

- 1 Remove the motor (see 7.5).
- 2 Lower the quill to its full extent.
- 3 Remove the two lower cap screws from the speed changer housing.
- 4 Remove the four cap screws B.
- 5 Remove top assembly C. Tap it to clear the dowels.
- 6 Replace the belt.

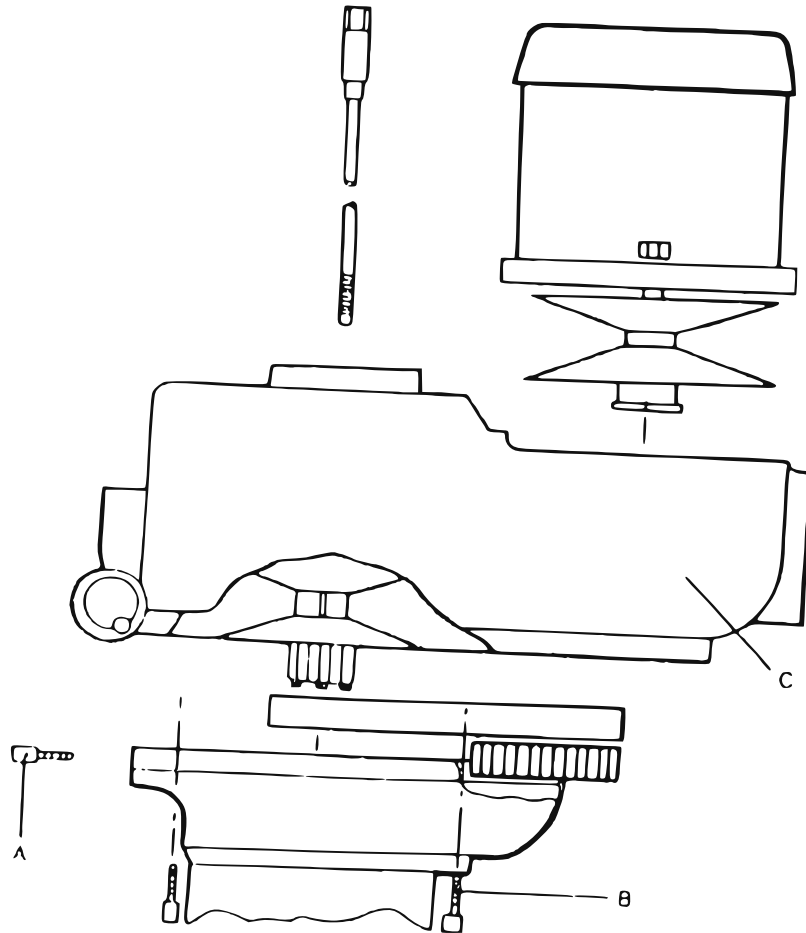


Figure 7-5: Timing belt replacement, variable-speed head

7.7 Drive belt replacement: variable-speed head

- 1 Remove the motor (see 7.5).
- 2 Remove the three screws A. Insert them into the adjacent tapped holes and withdraw bearing housing B.
- 3 Remove the two screws and the bushes C.
- 4 Remove the four screws D and the one screw E.
- 5 Remove the four screws securing speed changer F.
- 6 Remove top housing G. Tap it to clear the dowels.
- 7 Replace the belt.

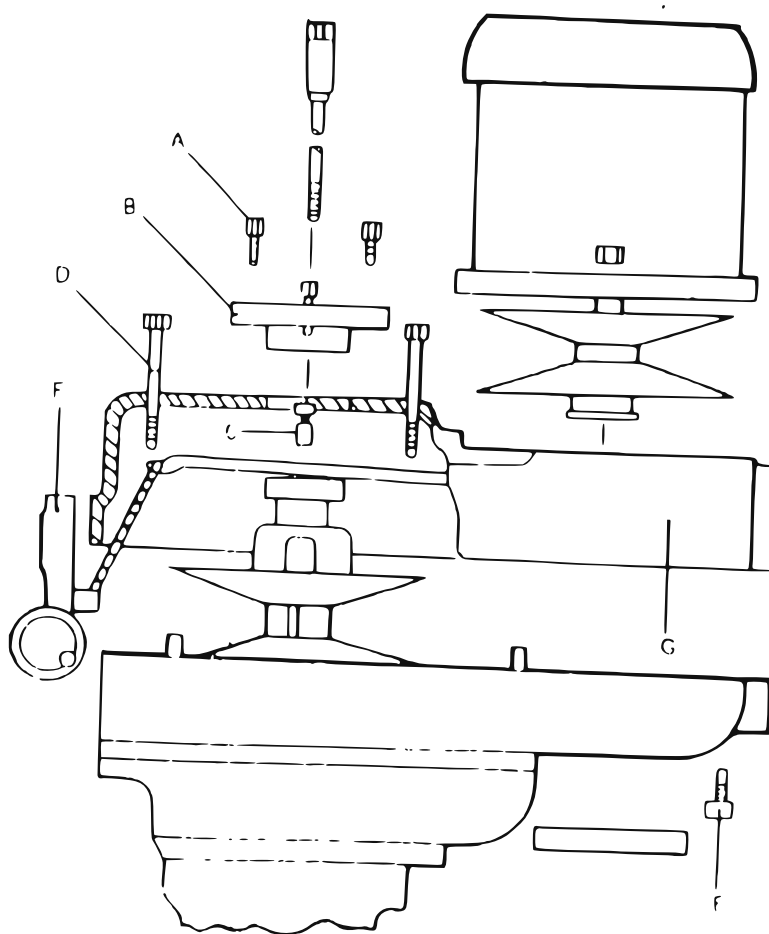


Figure 7-6: Drive belt replacement, variable-speed head

7.8 Brake shoe replacement: variable-speed head

- 1 Remove the top section.
- 2 Remove the two screws A.
- 3 Remove clutch hub assembly B and D.
- 4 Replace brake shoes C.

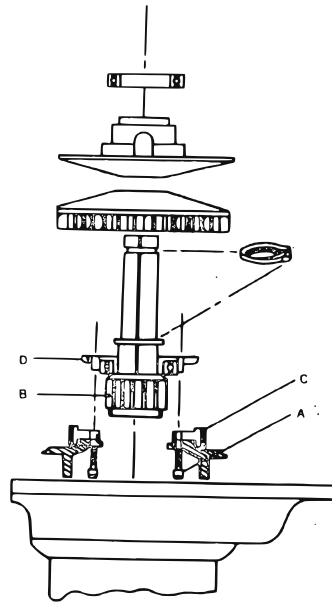


Figure 7-7: Brake shoe replacement, variable-speed head

7.9 Quill removal

- 1 Isolate the machine electrically.
- 2 Remove the motor.
- 3 Remove the drawbar.
- 4 Fully extend the quill.
- 5 Remove the 3 nuts A.
- 6 Remove the top section completely.
- 7 Remove the 2 screws B from the top of the quill.
- 8 Remove clock spring housing C. To replace the spring, see 7.10.
- 9 Remove screw D and the ball reverse lever E.
- 10 Remove circlip F, screw G and arm H.
- 11 Thread shaft J out through the micro nuts and remove it.
- 12 Remove screw K and stop L.
- 13 Remove the quill.
- 14 Clean all areas, oil liberally and reassemble.
- 15 Check that the feed trip linkage operates correctly (see 7.11).

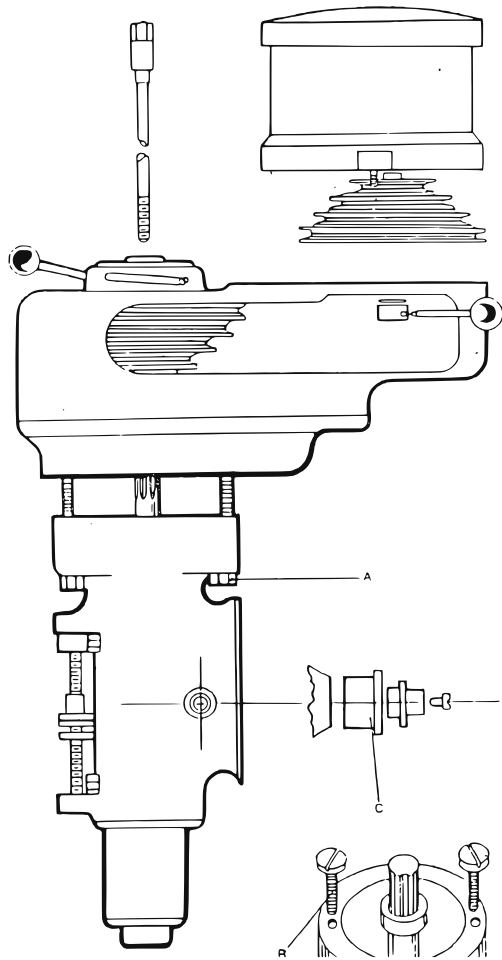


Figure 7-8: Quill removal, head top section and clock spring housing

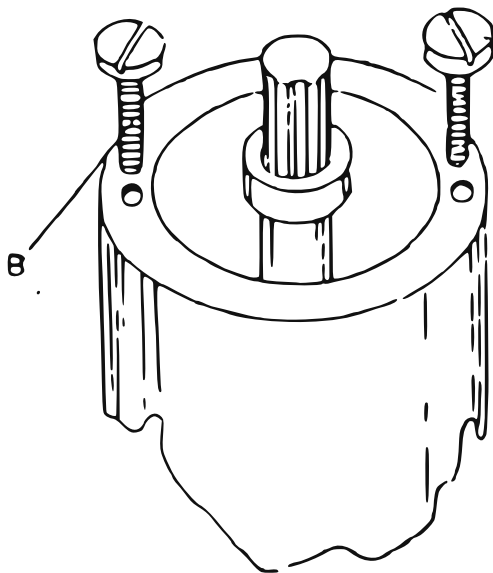


Figure 7-9: Screws B at the top of the quill

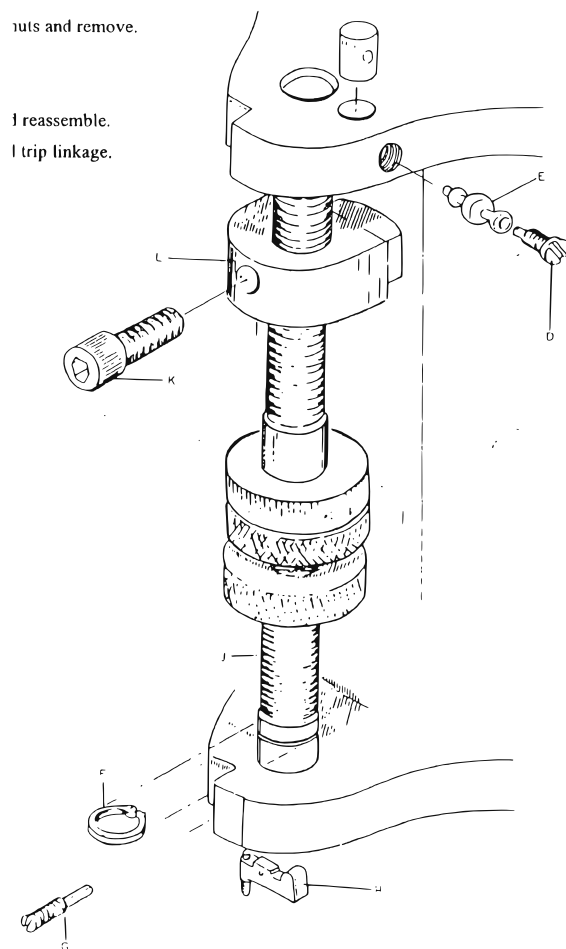


Figure 7-10: Quill depth stop and micro nut assembly

7.10 Quill balance spring replacement

- 1 With the quill at the top of its travel, apply the quill lock.
- 2 Remove screw A, hub B and key C.
- 3 Remove screws D, allowing the housing to rotate slowly and release the spring tension.
- 4 Lift the end of the spring from the peg on the pinion shaft.
- 5 Rotate housing E anticlockwise from the head casting.
- 6 Remove the spring from the housing and replace it.
- 7 Refit the spring to the main housing casting, turning the housing clockwise until the spring locates on the peg in the pinion shaft.

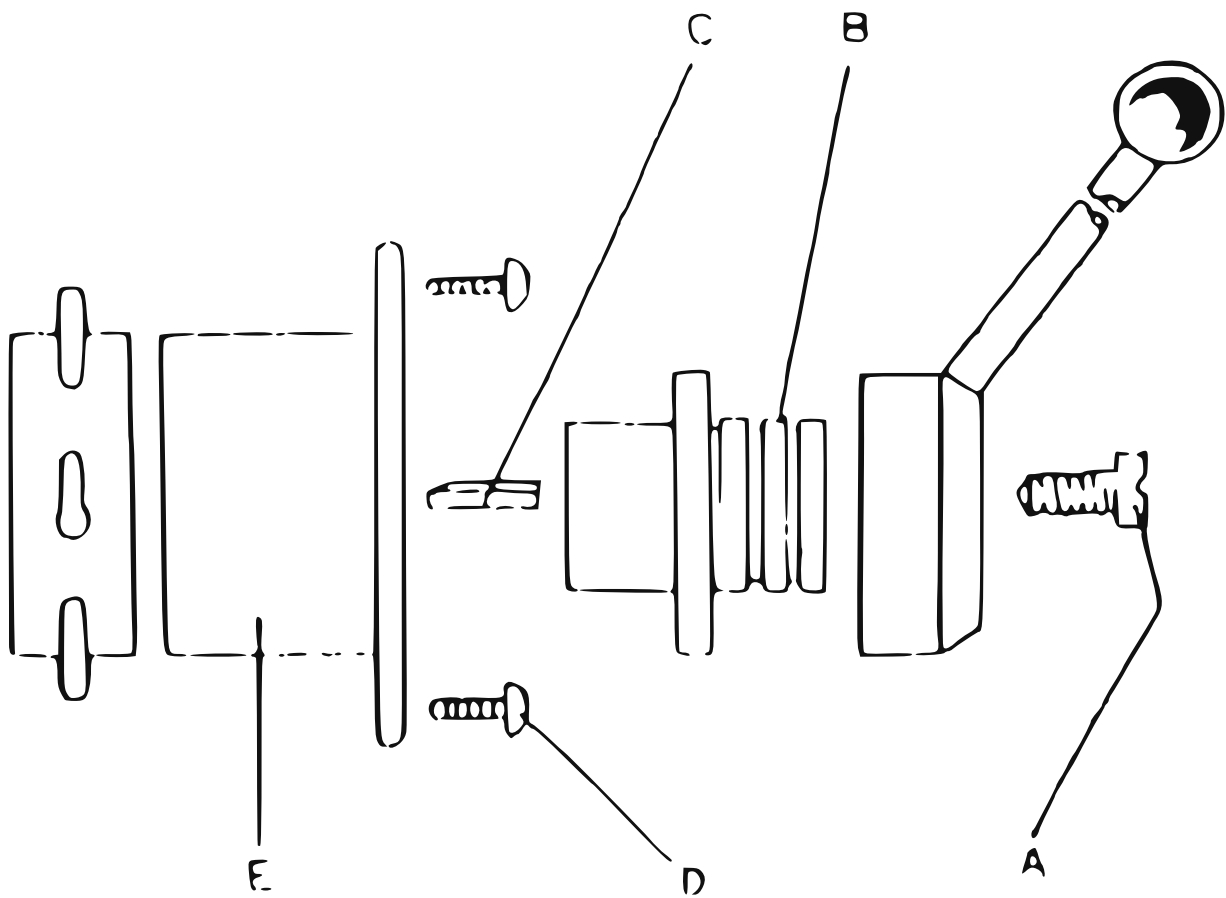


Figure 7-11: Quill balance spring assembly

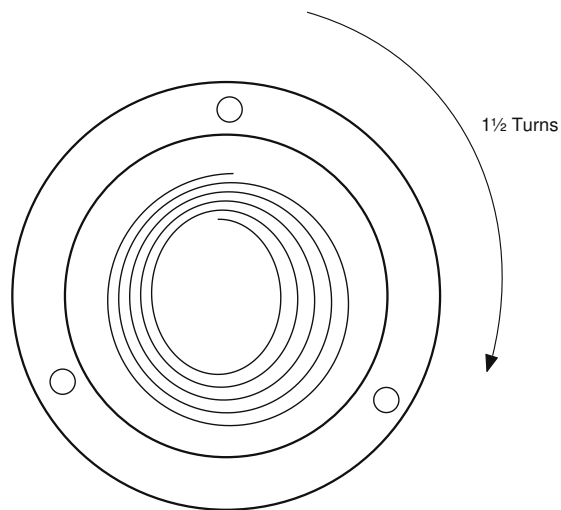


Figure 7-12: Spring housing, 1 1/2 turns

NOTE Figure 7-12 shows the spring housing turned 1 1/2 turns.

7.11 Feed trip adjustment

- 1 Release locknut A.
- 2 Engage trip handle C.
- 3 Adjust the micro nuts against quill stop B.
- 4 Slowly turn adjusting screw D until lever C trips.
- 5 At this point, secure locknut A.
- 6 Check that a smart trip action is obtained.

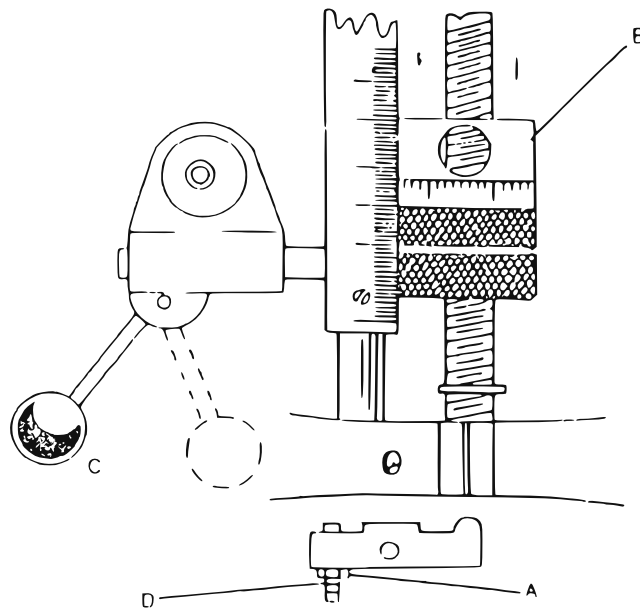


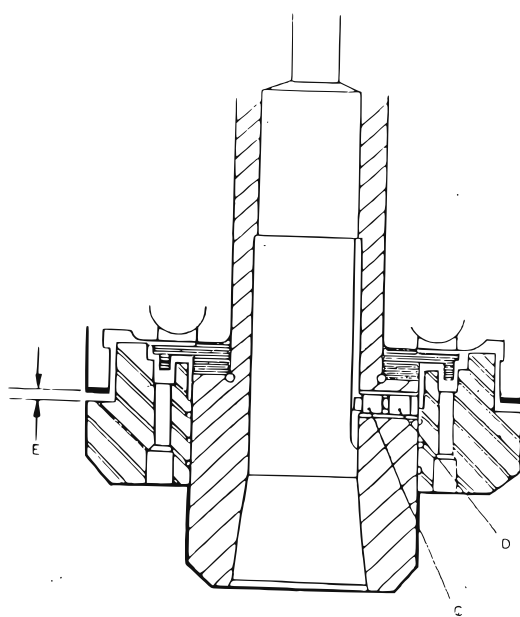
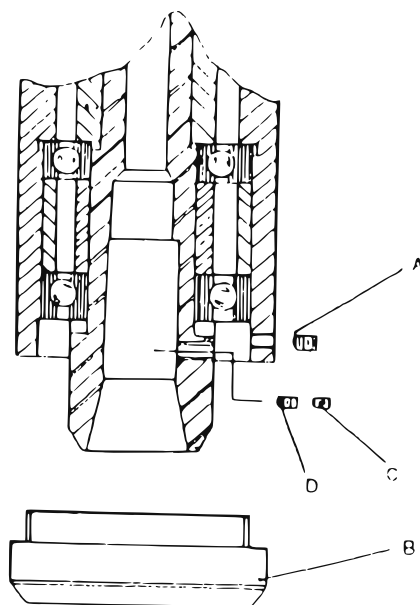
Figure 7-13: Feed trip adjustment

7.12 Collet aligning screw replacement (R8 spindle taper)

■ CAUTION

When you refit set screw A (step 8), do not overtighten it. Overtightening causes distortion.

- 1 Mark a reference line across the quill and nose cap B with a felt pen.
- 2 Remove set screw A.
- 3 Remove nose cap B.
- 4 Remove lock screw C and aligning screw D.
- 5 Refit D. Insert an R8 collet and check that the dog on the end of the screw does not touch the bottom of the guide slot.
- 6 Refit lock screw C.
- 7 Refit nose cap B. Check that the felt-pen marks are correctly aligned.
- 8 Refit set screw A. Do not overtighten.
- 9 Check gap E ($0.003'' = .08\text{mm}$).



7.13 Cross screw backlash adjustment

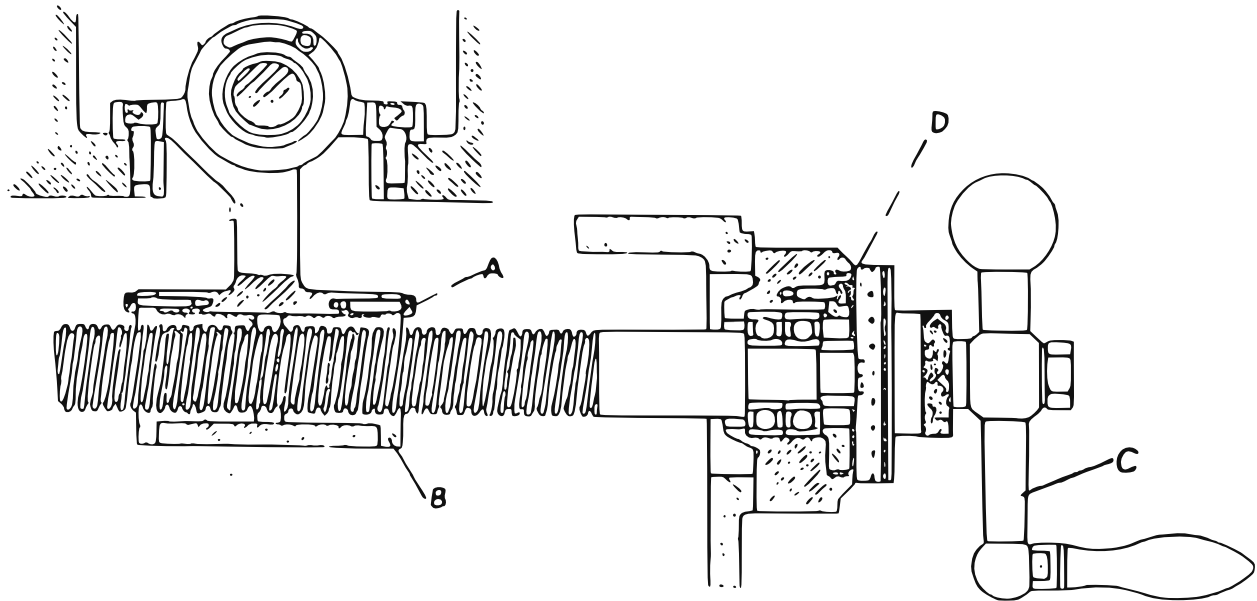


Figure 7-16: Cross screw backlash adjustment

- 1 Crank the saddle to the mid position.
- 2 Withdraw the 4 screws D.
- 3 Pull the saddle forward to expose screws A and B.
- 4 Back off screw A by 1/2 a turn.
- 5 While slowly turning handle C, tighten screw B until 0.004" or 0.005" is obtained.
- 6 Lock screw A onto B.
- 7 Crank the saddle to the front of the knee and refit the 4 screws D.

7.14 Table screw backlash adjustment

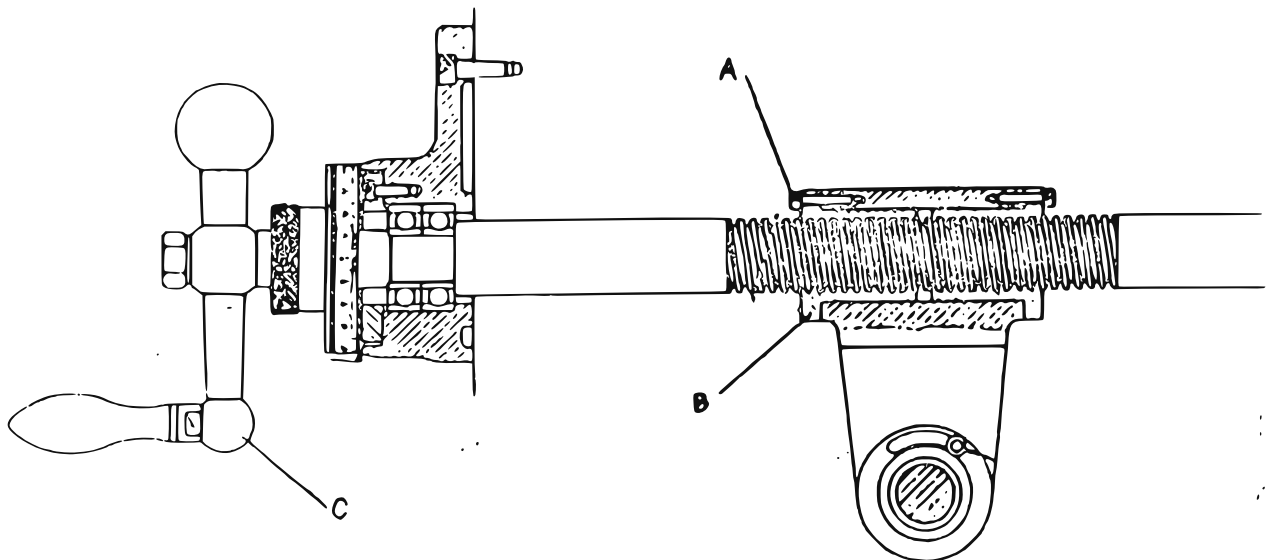


Figure 7-17: Table screw backlash adjustment

- 1 Crank the table to the left.
- 2 Back off screw A by 1/2 a turn.
- 3 While slowly turning handle C, tighten screw B until 0.004" or 0.005" is obtained.
- 4 Lock screw A onto B.

7.15 Gib strip adjustment

7.15.1 Table to saddle ways

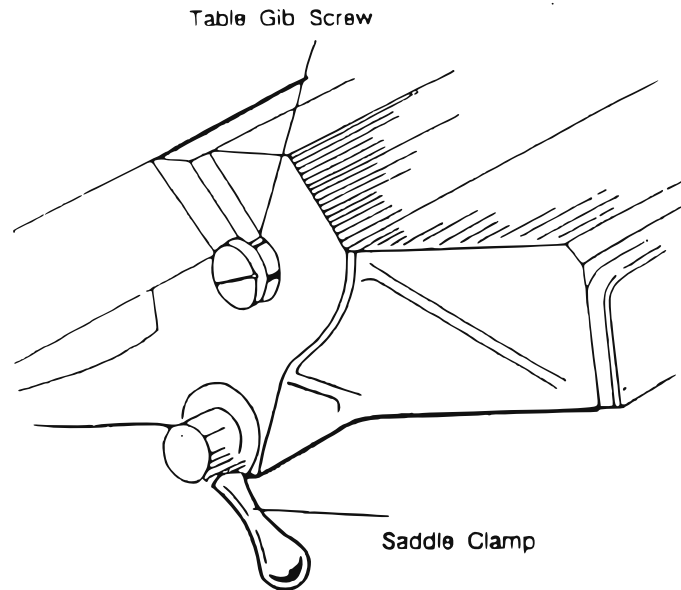


Figure 7-18: Table gib screw

- 1 Remove all dirt from the area.
- 2 Turn the table gib screw clockwise while moving the table until a slight drag is felt.

7.15.2 Saddle to knee ways

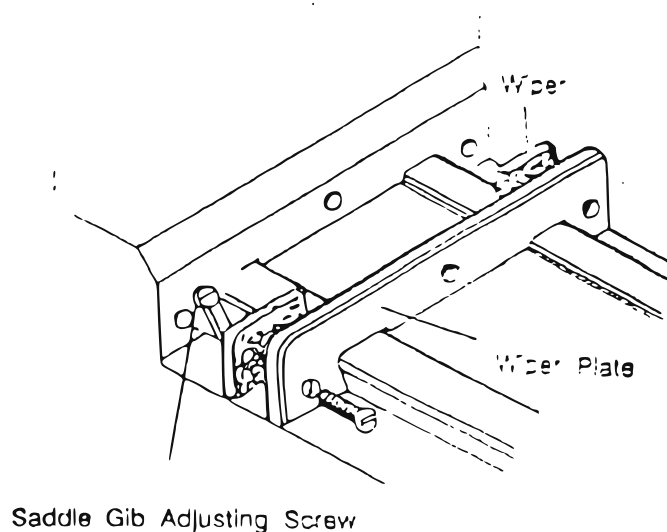


Figure 7-19: Saddle gib adjusting screw and wiper

- 1 Remove all dirt from the area.
- 2 Remove the chip wiper guards and wiper.
- 3 Turn the gib adjusting screw clockwise while moving the saddle until a slight drag is felt.
- 4 Refit the chip wiper plate and wiper.

7.15.3 Knee to column ways

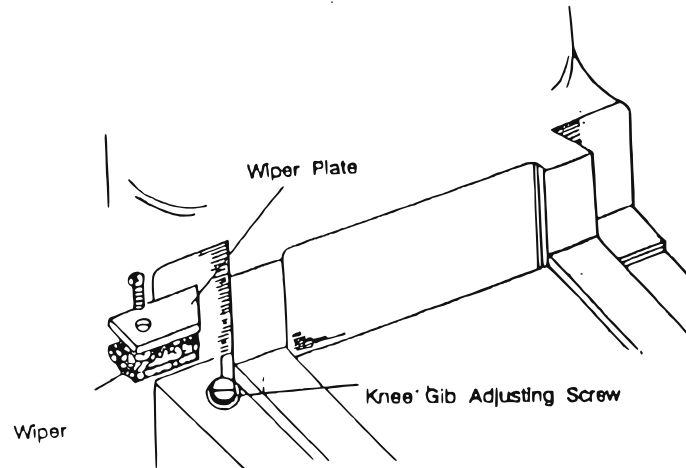


Figure 7-20: Knee gib adjusting screw and wiper

- 1 Remove all dirt from the area.
- 2 Remove the chip wiper plate.
- 3 Remove the wiper.
- 4 Turn the gib adjusting screw clockwise while moving the knee until a slight drag is felt.
- 5 Refit the wiper plate and wiper.

8 Troubleshooting

Table 8-1 lists typical operating faults, with their possible causes and remedies.

Table 8-1: Troubleshooting

Trouble	Possible causes	Remedy
Spindle feed abnormal	Quill clamp lever not released	Release the clamp lever
Spindle brake not working	Brake shoe worn out	Replace
Spindle does not rotate	1. Poor contact at the switch. 2. Drive belt too slack. 3. Motor faulty.	1. Check the switch. 2. Adjust or replace. 3. Repair or renew.
Incorrect rotation	Switch knob set to the wrong position	Change to the correct position
Table vertical, cross or longitudinal feed not smooth	1. Gib strip too tight. 2. Incorrect backlash between nut and screws. 3. Lubricant not reaching the lubrication points.	1. Release. 2. Adjust. 3. Check lubrication.
Vibration when machining	1. Machine unstable. 2. Unsuitable cutting conditions.	1. Reclamp. 2. Select the proper cutting speed for the material and cutter.

9 Electrical

■ WARNING

Disconnect the power before servicing.

9.1 Circuit diagram

Figure 9-1 shows the motor circuits. The standard circuit feeds a two-speed (2P/4P) motor through main contactor M and overload OL. The single-speed arrangement feeds the motor through switch CS. The control circuit uses stop and start push buttons, contactor coil M with a hold-in contact M, and overload contact OL.

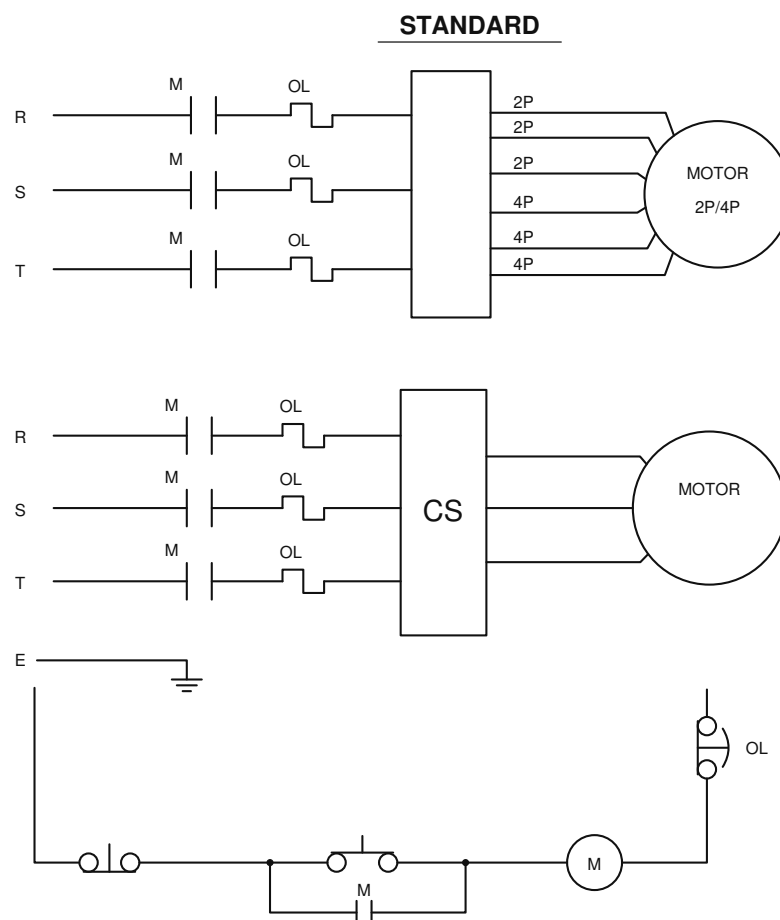


Figure 9-1: Electrical circuit diagram

NOTE No wire numbers, terminal numbers, voltages or ratings are shown on this diagram. Confirm the actual wiring of your machine before you carry out any electrical work.



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