Operation Manual

Turret Milling Machine

Model:4VS/4HS/4S

Table of Contents

Familiarize yourself with the following safety notices used in this manual:

⚠CAUTION This means that if precautions are not heeded, it may result in minor injury and/or possible machine damage.

⚠WARNING This means that if precautions are not heeded, it may result in serious injury or possibly even death.

- - SAVE THESE INSTRUCTIONS - -

Warnings

1. Some dust created by power sanding, sawing, grinding, drilling and other construction activities contain chemicals known to cause cancer, birth defects or other reproductive harm. Some examples of these chemicals are:

- Lead from lead based paint.
- Crystalline silica from bricks, cement and other masonry products.
- Arsenic and chromium from chemically treated lumber.

Your risk of exposure varies, depending on how often you do this type of work. To reduce your exposure to these chemicals, work in a well-ventilated area and work with approved safety equipment, such as face or dust masks that are specifically designed to filter out microscopic particles.

2. Permanently connected tools:
This tool should be connected to a grounded metal permanent wiring system; or to a system having an equipment-grounding conductor.

3. For your own safety read instruction manual before operating drill press

(a).Wear eye protection.

(b).Do not wear gloves ,necktie, or loose clothing.

(c).Clamp workpiece or brace against column to prevent rotation.

(d).Use recommended speed for drill press accessory and workpiece material.

FOR ALL TOOLS AS APPLICABLE

1. KEEP GUARDS IN PLACE and in working order.

2. REMOVE ADJUSTING KEYS AND WRENCHES. Form habit of checking to see that keys and adjusting wrenches are removed from tool before turning it on.

3. KEEP WORK AREA CLEAN. Cluttered areas and benches invite accidents.

4. DON'T USE IN DANGEROUS ENVIRONMENT. Don't use power tools in damp or wet locations, or expose them to rain. Keep work area well lighted.

5. KEEP CHILDREN AWAY. All visitors should be kept safe distance from work area.

6. MAKE WORKSHOP KID PROOF with padlocks, master switches, or by removing starter keys.

7. DON'T FORCE TOOL It will do the job better and safer at the rate for which it was designed.

8. USE RIGHT TOOL Don't force tool or attachment to do a job for which it was not designed.

9. WEAR PROPER APPAREL Do not wear loose clothing, gloves, neckties, rings, bracelets, or other jewelry which may get caught in moving parts. Nonslip footwear is recommended. Wear protective hair covering to contain long hair.

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10. ALWAYS USE SAFETY GLASSES. Also use face or dust mask if cutting operation is dusty. Everyday eyeglasses only have impact resistant lenses, they are NOT safety glasses.

11. SECURE WORK. Use clamps or a vise to hold work when practical. It's safer than using your hand and it frees both hands to operate tool.

12. DON'T OVERREACH. Keep proper footing and balance at all times.

13. MAINTAIN TOOLS WITH CARE. Keep tools sharp and clean for best and safest performance. Follow instructions for lubricating and changing accessories.

14. DISCONNECT TOOLS before servicing; when changing accessories, such as blades, bits, cutters, and the like.

15. REDUCE THE RISK OF UNINTENTIONAL STARTING. Make sure switch is in off position before plugging in.

16. USE RECOMMENDED ACCESSORIES. Consult the owner's manual for recommended accessories. The use of improper accessories may cause risk of injury to persons.

17. NEVER STAND ON TOOL. Serious injury could occur if the tool is tipped or if the cutting tool is unintentionally contacted.

18. CHECK DAMAGED PARTS. Before further use of the tool, a guard or other part that is damaged should be carefully checked to determine that it will operate properly and perform its intended function - check for alignment of moving parts, binding of moving parts, breakage of parts, mounting, and any other conditions that may affect its operation.
A guard or other part that is damaged should be properly repaired or replaced.

19. DIRECTION OF FEED. Feed work into a blade or cutter against the direction of rotation of the blade or cutter only.

20. NEVER LEAVE TOOL RUNNING UNATTENDED. TURN POWER OFF. Don't leave tool until it comes to a complete stop.

Introduction

This manual covering the safe operation and maintenance procedures for a Model MDM/4HS/4VS/4S Turret Mill. This manual contains instructions on installation, safety precautions, general operating procedures, maintenance instructions and parts breakdown. This machine has been designed and constructed to provide years of trouble free operation if used in accordance to instructions set forth in this manual.

Specifications

Model Number:	4VS/4S/4HS
Spindle Taper	R-8 or NT30
Diameter of Quill (in.)	3-3/8 or 4-1/8
Number of Spindle Speeds	Variable(4VS only)
Number of Spindle Speeds	16/8(4S/4HS only)
Range of Spindle Speeds (RPM)	60 – 4,200
Power Down Feed per Revolutions of Spindle (in.)	0.0015 - 0.0030 - 0.006
Number of Power Feeds	3
Spindle Travel (in.)	5
Collet Capacity	1/8" – 7/8"
Head Movement (L to R)	90 degrees
Head Tilt (F & B)	45 degrees
Overarm Travel (in.)	21
Max Distance Spindle to Table (in.)	19
Min Distance Spindle to Column (in.)	6
Max Distance Spindle to Column (in.)	26
Max Longitudinal Table Travel (in.)	35
Max Cross Table Travel (in.)	12
Max Knee Table Travel (in.)	16
Size of Table	10" x 50
Maximum Weight of Workpiece (lbs.)	700
Number of T-slots	3
T-Slot Size (in.)	5/8
T-Slot Centers (in.)	2-1/2
Motor	3HPor 5HP 3Ph
Overall Dimensions (in./W x D x H)	95 x 68.5 x 80

The above specifications were current at the time this manual was published, but because of our policy of continuous improvement, our reserves the right to change specifications at any time and without prior notice, without incurring obligations.

Unpacking

1. Finish removing the sides of the crate. Leave the mill bolted to the skid until it is ready to move to its final location.
2. Clean all rust protected surfaces with kerosene or a light solvent. Do not use gasoline, paint thinner, or lacquer thinner. These will damage painted surfaces.
3. Cover all machined surfaces with a film of light machine tool oil to inhibit rust.

Contents of the Shipping Container

1 Mill
1 Flat Way Cover (rear)
1 Accordion Way Cover (front)
1 Tool Box:
1 Operator's Manual

⚠WARNING **Read and understand the entire contents of this manual before attempting set-up or operation! Failure to comply may cause serious injury.**

Set-up and Installation

Preparing the Milling Machine for Service

1. Remove any crating which may be covering the machine on the pallet.
2. Remove from the pallet the toolbox and rubber splashguard that are typically shipped separate from the machine. You will find a machine wrench, fine and coarse feed handles, and other tools inside the toolbox.
3. Check the tightness of the lifting ring on the ram to be certain it is tight.
4. Check the tightness of the lock handles on the ram to be certain the ram is locked tight.
5. Remove the nuts and/or bolts, which secure the machine to the pallet.
6. Center an overhead crane or other suitable overhead lifting device and sling arrangement over the lifting ring.

   Note: This machine weighs over 2400 pounds! Be certain the lifting arrangement is new or in excellent condition and has a safety factor that will account for age, difficulties in lifting, etc. When lifting using the ring, the machine will tip forward. If you wish, you can minimize this tipping by rigging a support sling over the front of the machine. Be careful when doing this, to prevent the sling from damaging any components on the front of the machine.
7. Lift the machine off the pallet no higher than necessary to clear the hold-down hardware, then pull the pallet out of the way. Do NOT get hands or feet underneath the machine when removing the pallet!
8. Put the machine base over the hold-down system where the machine will be spotted.

   Note: The accompanying diagrams show you the maximum dimensions of the machines with the table, ram, etc., fully extended in all possible directions. When spotting the machine be certain to leave room not only for the machine itself, but also for operator clearance and clearance for workers servicing the machine, and any unusual sizes of workpieces that might extend off the machine's table.
9. When the machine is over its anchors, level the machine using shims under the corners needing them. The machinist's level used for leveling should be placed on the table. The table is the reference surface for both side-to-side and fore-and-aft leveling. Be certain you get it level in BOTH directions.
10. When the machine is level, secure the base to the anchor system, securely.
11. Loosen the four hex head nuts (about 1/4 turn each, just enough to allow rotation of the head).
12. While assisting the worm mechanism by putting upward pressure on the motor by hand, use the wrench supplied with the machine to turn the worm nut and raise the head to upright position.
13. Tighten the headbolts slightly — not torqued — just snug.
14. Using mineral spirits or other non-flammable cleaning solvent, clean all of the rust proofing from where it may have been applied. This is important. Moving the table or any other components before removing the rust proofing will only put rust proofing where you don't want it.

    Some of the following steps may have already been performed on the machine. If so, ignore the instructions related to these steps. Otherwise, perform them in the order listed.
15. Install the table end and cross-feed cranks on their respective shafts using the nuts on the shafts to secure the cranks.
16. Remove any rust proofing from the drawbar and its washer, and put the drawbar with washer installed into the spindle center through the top of the machine.
17. Slide the fine feed handwheel over the handwheel hub and push it back until its rollpin engages the hole in the hub and the wheel is flush with the hub surface.
18. Put the coarse feed lever on the feed shaft and tap it lightly until its rollpin engages a hole in the hub and it is flush against the hub surface.
19. Unwrap and clean the knee crank and install it on its shaft.

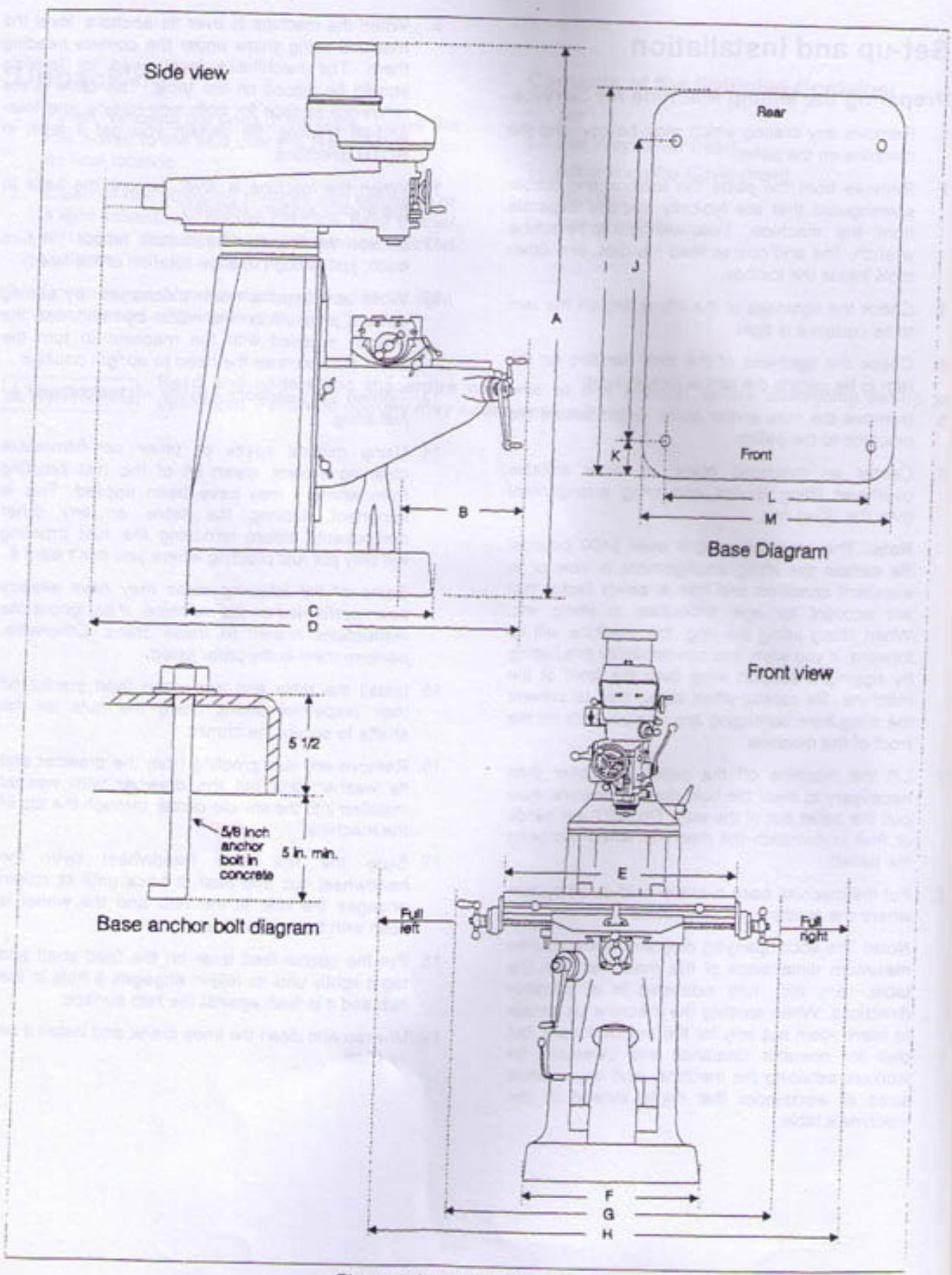


Figure 1: Installation Diagram

Removal of Mill Head Block

Before shipment, the mill head is rotated to the side to lower the machine center of gravity. A wooden block is placed between the mill head and the worktable to support the head. The block is removed by raising the mill head. Before attempting to raise the mill head, refer to Mill Head – Left/Right Adjustment in the Setup section for procedures to safely raise and setup the mill head.

Optional Coolant Pump Installation

⚠WARNING Disconnect electrical power to the machine when installing the coolant pump.

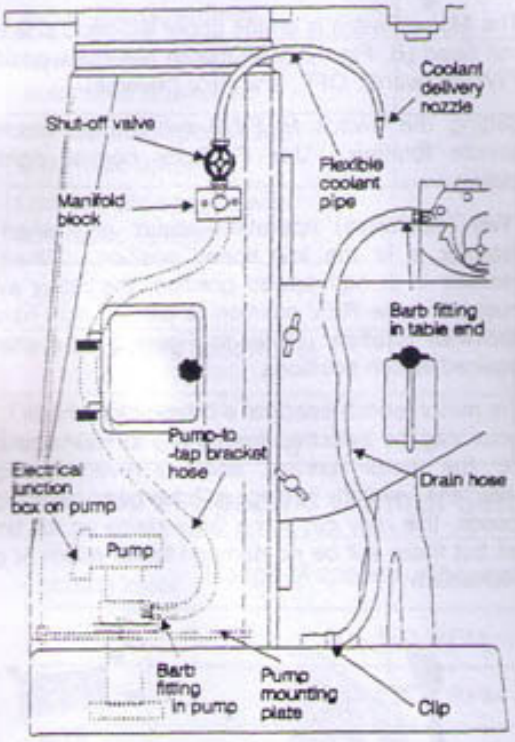


Figure 2

Install coolant pump as follows:

1. Remove cover plate from machine base.
2. Attach mounting plate to machine base using socket head cap screws.
3. Install a barb fitting in front of pump.
4. Install longest hose on pump barb fitting and secure with hose clamp.
5. Open the side door on the base and set the pump in position. Position barb fitting toward the front of the machine.
6. Secure the pump with socket head cap screws. Put hose through hole at top of machine base.
7. Install barb fitting in the manifold.
8. Install the nipple and valve on the manifold.
9. Install a clamp over the free end of the hose. Install the hose on the barb fitting in the manifold. Tighten the hose clamp.
10. Position manifold on machine with the valve handle outward. Secure manifold to machine using socket head cap screws.
11. Install the flex pipe and nozzle on coolant valve.
12. Remove two pipe plugs at the end of the worktable. Install two barb fittings in the worktable.
13. Install two hoses on barb fitting on worktable. Secure hoses with clamps.
14. Slide hose clips on hose from motor (refer to Figure 2 for location).

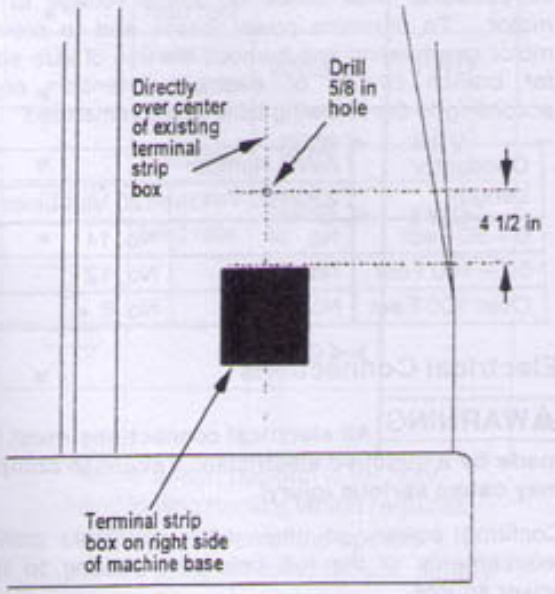


Figure 3

15. Mark location of holes for mounting hose clips. Drill and tap for 10-24 screws at each clip.
16. Secure hose clips to machine using screws and washers.
17. Drill a 5/8-inch diameter hole for the pump cable in the machine base (refer to Figure 3).
18. Install the pump switch on the base near the cable access hole.

⚠CAUTION Electrical connections must meet local electrical code requirements. Connections should be made by a qualified electrician. Failure to adhere to these requirements could result in damage to the coolant pump.

19. Remove junction box cover on pump and connect electrical cable. (Refer to the **Wiring Data** section for electrical connection requirements.)
20. Fill the sump with coolant and check operation of the coolant pump.

Electrical

General Electrical Cautions

This machine should be grounded in accordance with the National Electrical Code and local codes and ordinances. This work should be done by a qualified electrician. The machine should be grounded to protect the user from electrical shock.

Wire Sizes

Caution: for circuits, which are far away from the electrical service box, the wire size must be increased in order to deliver ample voltage to the motor. To minimize power losses and to prevent motor overheating and burnout, the use of wire sizes for branch circuits or electrical extension cords according to the following table is recommended:

Conductor Length	AWG Number	
	230/460 Volt	120 Volt Lines
0 – 50 Feet	No. 14	No. 14
50 – 100 Feet	No. 14	No. 12
Over 100 Feet	No. 12	No. 8

Electrical Connections

⚠WARNING All electrical connections must be made by a qualified electrician! Failure to comply may cause serious injury!

Confirm power at the site matches power requirements of the mill before connecting to the power source.

Before hooking up to the power source, make sure that the switch is in the off position.

The mill must be properly grounded.

Check for proper spindle rotation **in the high-speed range**. The spindle should rotate clockwise when viewed from the top of the machine. If the spindle rotates counter-clockwise, switch two of the three power leads.

Operating Instructions

Operating Controls

The lubrication system is a manually operated, one-shot system requiring operator intervention. The operator must lower the one-shot lever to lubricate the machine ways and ballscrews. The one-shot lubrication system reservoir is located on the left side of the machine.

The position of the milling machine mill head can be set up to accommodate the work piece being machined. The mill head can be set up for angles to the left or right and for fore and aft angles. The mill head can also be rotated on its turret. The ram can be moved back and forth to reach work piece locations at the fore and aft extremes of worktable travel. Refer to the **Adjustments** section.

Motor Switch

The *Motor Switch* is on the upper left-hand side of the mill head (B, Fig 4). The switch has three positions: FWD (forward), OFF, and REV (reverse).

Setting the switch to FWD will provide clockwise spindle rotation. Use FWD for normal, right-had tooling

FWD (clockwise) operation occurs only when the gearbox is in the low speed position. When the gearbox is in high-speed position, the motor switch must be in the REV position to provide right-hand or clockwise rotation. Refer to Figure 5 for a chart of required switch positions.

The motor switch controls a three-phase motor. The motor can be switched from FWD to REV and back with the motor running, and will reverse direction when the switch setting is changed. At higher speeds, this may put some large stains on the timing belt but there will be no damage to the motor or gear mechanism.

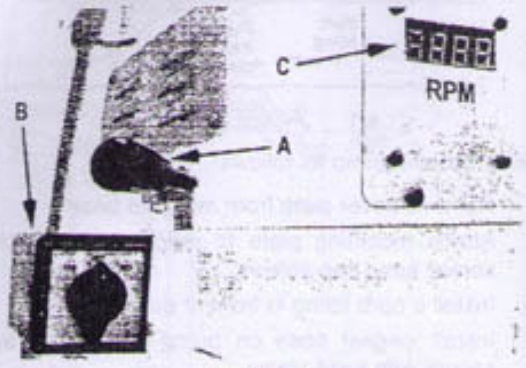


Figure 4

Control Positions for Milling and Drilling Operations

Control / Action	High/low lever	Quill feed lever	Feed trip cam lever	Quill feed select lever	Feed direction control	Motor switch*
High spindle speeds						REV
Low spindle speeds						FWD
High spindle speeds with automatic downfeed				Select feed rate		REV
Low spindle speeds with automatic downfeed				Select feed rate		FWD
High spindle speeds with automatic upfeed				Select feed rate		REV
Low spindle speeds with automatic upfeed				Select feed rate		FWD
Lever feed						
Fine feed using handwheel						
Free-turning spindle for positioning or working with tooling						

Speeds at Specific Control Settings

Hi/low speed control lever	Range of speeds using control wheel
	60 - 500 RPM
	500 - 4,200 RPM

Figure 5

* Motor switch position is for right-hand tooling (tooling which requires clockwise rotation of the spindle.) If you are using left-hand tooling, simply change the motor switch to the opposite setting.

Variable Speed Control

ACAUTION **Change speed only when spindle is turning.**

The vari-speed handwheel is used to control the spindle speed. The handwheel is located on the right side of the mill head. The speeds for high and low speed ranges are displayed on the panel on the front of the mill head (B, Fig. 6).

All speed changes must be made with the motor is running. Attempting speed changes with the motor running can result in damage to the drive mechanism.

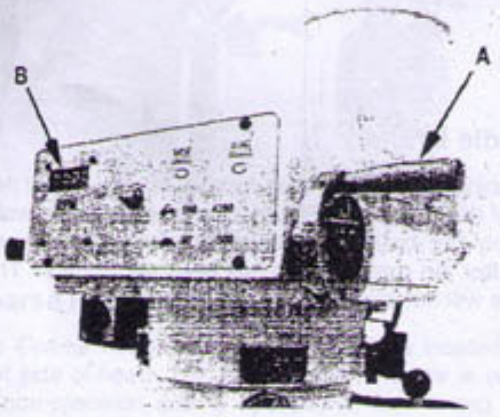


Figure 6

Step Speed Control

Hi Speed: move the handle (Fig 6-1 , A,)on front of top of head ,keep the handle B (Fig 6-2 B) on in position, rotate the spindle nose by handle until the gears match with the clutch, change the handle B on out position(Fig 6-2,B)

Low-Speed: move the handle A leave from top of head, then move the handle B on IN position

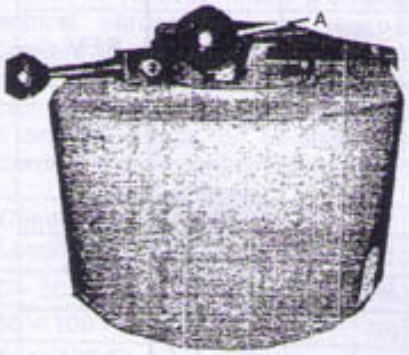


Figure 6-1

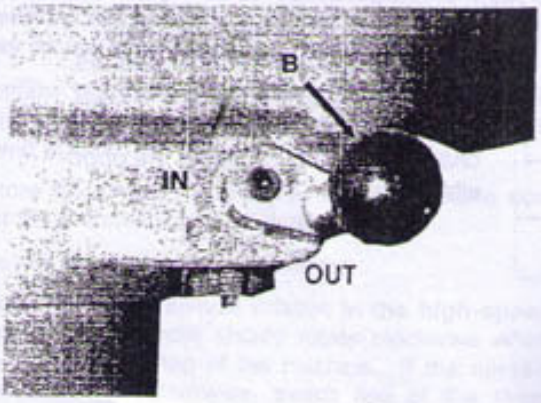


Figure 6-2

Spindle Brake

The spindle brake lever is located on the upper left side of the mill head (Figure 7). Pull lever downward to apply the brake. The spindle brake lever is used only after the motor switch has been set to OFF. The spindle will not stop with the motor running.

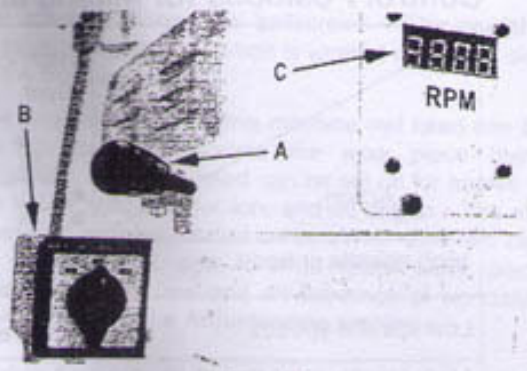


Figure 7

High-Neutral-Low Shift Lever

The mill head can be driven directly (High Speed) or through the back gear (Low Speed) in the mill head. The selection is made by changing the position of the shift lever.

The *shift lever* is located at the lower right side of the mill head (Figure 8). The lever position closest to the operator is the *High* setting. The lever position away from the operator is the *Low* setting. The middle position is the *Neutral* setting.

⚠CAUTION **Do not shift the High-Low Gear Lever while the motor is running. Rotate the spindle by hand to facilitate changing lever positions.**

Figure 8

Quill Feed Lever

⚠CAUTION **Do not use power feed at speeds above 27000 R.P.M.**

⚠CAUTION **It is recommended to disengage the power feed worm gear whenever the power feed is not required. This avoids unnecessary wear on the worm gear.**

⚠CAUTION **Do not move the Quill Feed Lever unless the motor is at a complete stop. When changing the lever position, do it gently. If the gear does not engage, jog the motor and allow is to stop before attempting to change.**

The quill feed lever is located on the right side of the mill head (Figure 9). It is used to engage and disengage the quill power feed mechanism.

The quill feed is engaged by pulling out the knob and rotating the handle to a new locked position. When engaged, the power feed mechanism will drive the spindle upward or downward. The power feed mechanism will not drive the spindle when the handle is in the disengage position.

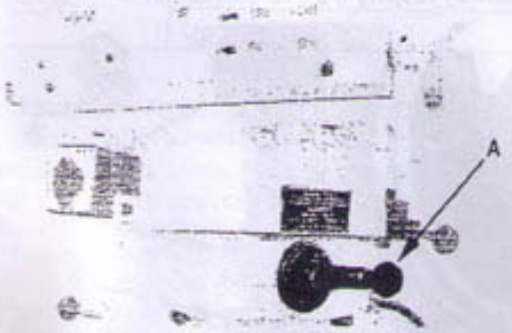


Figure 9

Feed Rate Lever

The *Feed Rate Lever* (Figure 10) is used to set the per-revolution rate of the power feed mechanism. Three feed rates are available: 0.0015-inch, 0.003-inch, and 0.006-inch per revolution. The positions are shown on an indicator plate under the feed rate lever.

The rate is selected by pulling out the knob on the feed rate lever and moving the handle to the detent of the desired feed rate.

Note: The knob is spring loaded – pull out to rotate to new position.

Unlike other controls on the machine, the lever shifts into engagement more easily with the motor running, and the quill feed lever engaged.

Figure 10

Feed Trip Cam Lever

The *Feed Trip Cam Lever* (A, Fig. 11) is located on the left side of the head behind the *Manual Fine Feed Handwheel* (B, Fig. 11). It engages the overload clutch on pinion shaft when positioned to the left.

The *Feed Trip Cam Lever* stays engaged until *Quill Stop* (C, Fig. 14) comes in contact with *Micrometer Adjusting Nut*, forcing it to drop out automatically, or until it is released manually by engaging the lever to the right.

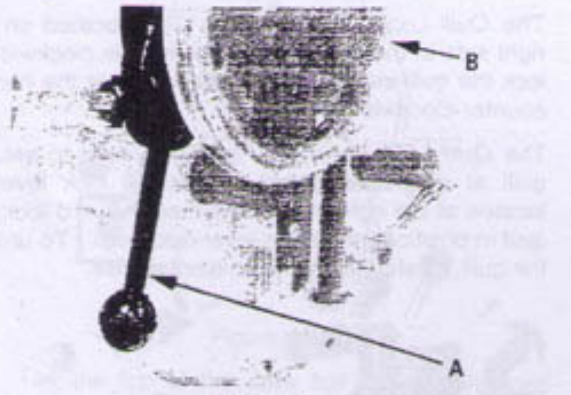


Figure 11

Feed Direction Control

The *Feed Direction Control* (B. Fig. 12) determines whether the power feed will move up, down, or not move at all. The position of the knob depends upon the direction of spindle rotation (see the *Motor Switch* section). The position of the control may be changed with the system stopped or running. If the control does not engage easily, move the fine feed handle (A. Fig. 12) back and forth to aid engagement.

If the spindle is rotating clockwise, *in* is downfeed; *out* is upfeed. If the spindle rotation is counterclockwise, *out* is downfeed; *in* is upfeed. Neutral position is between the *in* and *out* position.

⚠CAUTION **It is recommended that the Feed Direction Knob be left in the neutral position when not in use.**

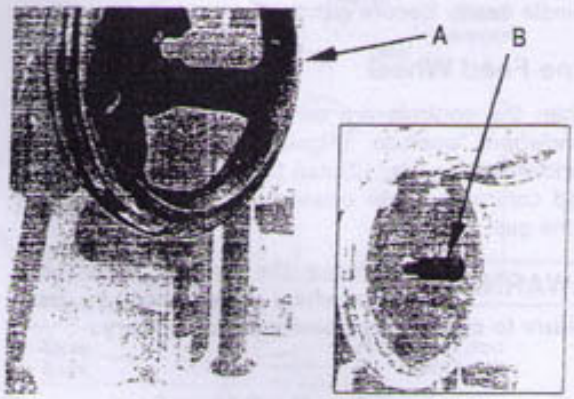


Figure 12

Coarse Feed Handle

The *Coarse Feed Handle* (A, Fig. 13) is located on right side of head. The *Coarse Feed Handle* is used for non-precision drilling operations, for moving the quill to a specific depth, and to move the quill stop

knob of the reverse feed lever to allow power feed engagement.

Quill Lock Lever

The *Quill Lock Lever* (B, Fig. 13) is located on the right side of the head. Rotate the handle clockwise to lock the quill in a desired position. Rotate the handle counter-clockwise to release.

The *Quill Lock Lever* (B, Fig. 13) is used to set the quill at a specific height. The quill lock lever is located at the right front of the machine. To lock the quill in position, rotate the lever clockwise. To unlock the quill, rotate the lever counterclockwise.

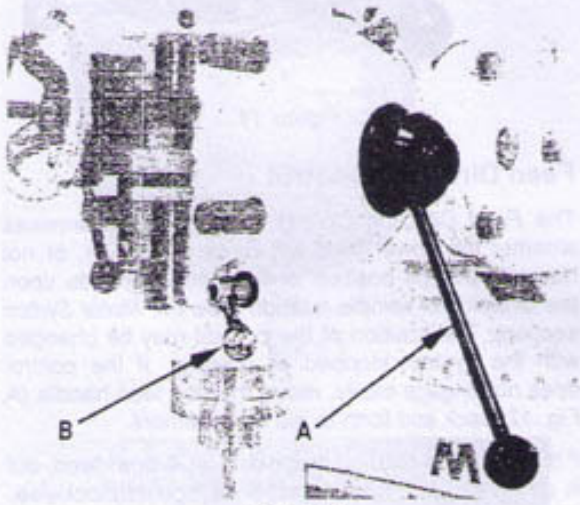


Figure 13

Micrometer Adjusting Nut

The *Micrometer Adjusting Nut* (A, Fig. 14) is located on the front of the head. Use for setting specific spindle depth. Secure with the *lock nut* (B, Fig. 14).

Fine Feed Wheel

When the controls are set for the *Fine feed using handwheel* position (Figure 5), the *Fine Feed Handwheel* (A, Fig. 12) can be used for manual fine feed control in either upward or downward direction of the quill.

⚠WARNING **Remove the Manual Fine Feed Handwheel when not in use. Failure to comply may cause serious injury.**

Depth Scale and Stop

Referring to Figure 14:

The *Depth Scale and Stop* is used in drilling operations to set the depth of the drilled hole. The depth scale is located on the front of the mill head. The scale consists of a *Micrometer Adjusting Nut* (A), *Lock Nut* (B), *Quill Stop* (C), *Quill Stop Screw* (D), and *Scale* (E).

The *Micrometer Adjusting Nut* is set to the desired dimension and locked in place using the Lock Nut. The quill stop provides a positive stop for quill travel.

The graduations on the micrometer nut are in 0.001-inch increments. Adjustment of quill travel is made by rotating the micrometer nut.

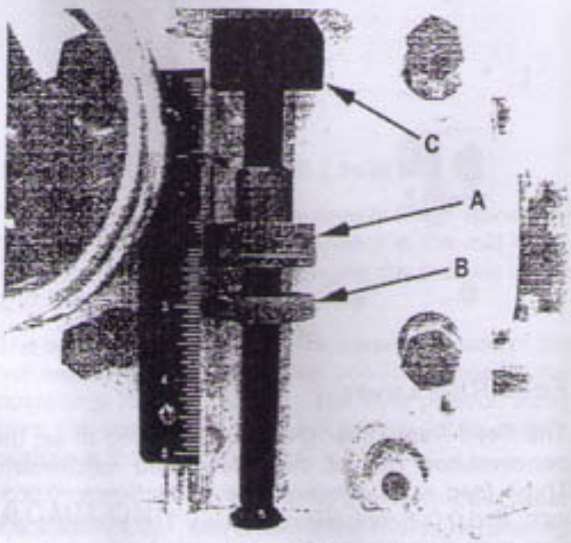


Figure 14

Power Feed Operation

The *Feed Trip Adjustment* sets the point at which the quill will reset during *Power Feed*.

Referring to Figure 16:

⚠WARNING **Be sure that the Manual Fine Feed Handwheel is removed. Failure to comply may cause serious injury.**

1. Loosen the Locknut (J).
2. With the *Quill Feed Handle* (K), advance the quill to the point where the feed should stop.
3. Engage *the Feed Trip Cam Lever* (D) by pulling away from head assembly.
4. Adjust *Micrometer Adjusting Nut* (I) against *Quill Stop* (H).
5. Continue turning the *Micrometer Adjusting Nut* (I) until the *Feed Trip Cam Lever* (D) trips.
6. Tighten the *Locknut* (J).
7. Ensure *Quill Lock* (L) is off by rotating counter-clockwise.
8. Turn the spindle on (A):
   FWD rotates the spindle counterclockwise.
   REV rotates the spindle clockwise.
9. Select feed rate with the *Variable Speed Control Handwheel* (F).
10. Set the *Feed Rate Lever* (B) to the feed rate required for the tooling and material required.

11. Place the *Power Feed Engagement Crank* (G) in the *Engaged* position.
12. Select feed direction by setting the *Feed Direction Knob* (C) position per the table:

Spindle Dir	Feed Dir	Knob Pos
CW	Down	In
	Up	Out
CCW	Down	Out
	Up	In

Figure 15

13. Engage the *Feed Trip Cam Lever* (D) by pulling away from head assembly.

Note: Due to variables in tool diameter, coatings, coolant, and materials, no specific spindle speed nor fed rate recommendations are provided. Use general shop manuals that have data applicable to the milling and drilling operations being performed. Or, contact the supplier of the tooling, coolant, and material for specific recommendations.

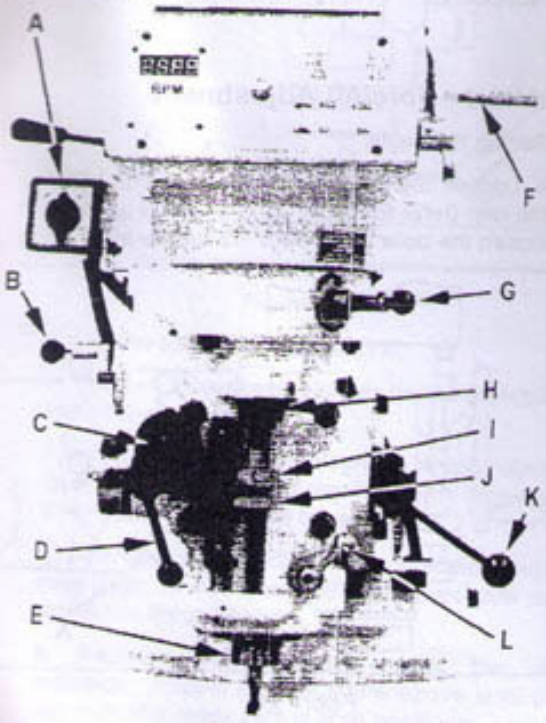


Figure 16

Draw Bar Operation - Changing Tooling

1. Using the wrench provided with the machine, loosen the draw bar two or three turns (turn counterclockwise) using the draw bar hex (Figure 17).

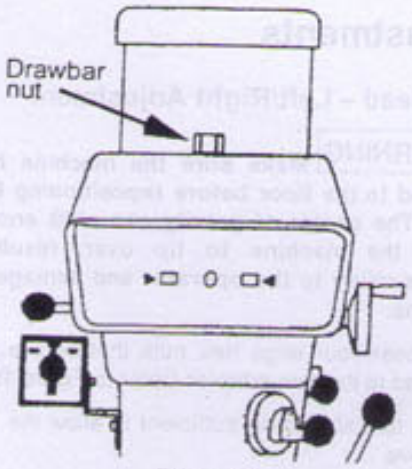
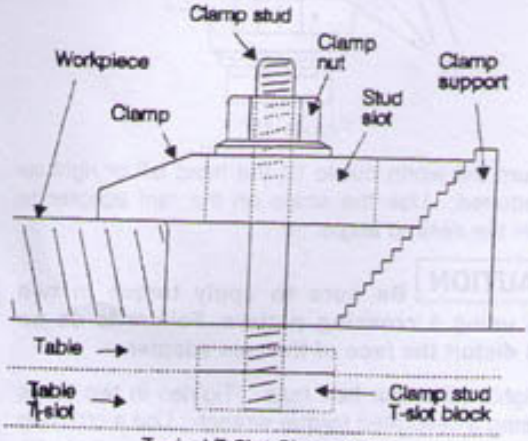


Figure 17

2. Tap the top of the draw bar with a soft-faced hammer to loosen the collet from the taper.
3. Remove the tool from the collet.
4. Insert the tool you are going to use into the collet.
5. Tighten the draw bar firmly using the wrench provided with the machine. Turn the draw bar .The tool is now ready for use.

Clamping Work Piece to the Table

1. The worktable has 5/8-inch T-slots for clamping the work piece to the table.
2. Set motor switch to STOP position.
3. Place the work piece on the table.
4. Clamp the work piece using the T-slot clamps, studs, and step blocks as required (Figure 18).



Typical T-Slot Clamp Setup

Figure 18

Adjustments

Mill Head – Left/Right Adjustment

⚠WARNING Make sure the machine base is secured to the floor before repositioning the mill head. The center of gravity can shift enough to cause the machine to tip over, resulting in serious injury to the operator and damage to the machine.

1. Loosen four large hex nuts that secure the mill head to the ram adapter (refer to Figure 19).

   1/4 turn should be sufficient to allow the head to move.

NOTE: For angles greater than 10 degrees, use your free hand to support the mill head, taking some weight off the brass worm gears. Doing so will greatly lengthen the life of the worm gears.

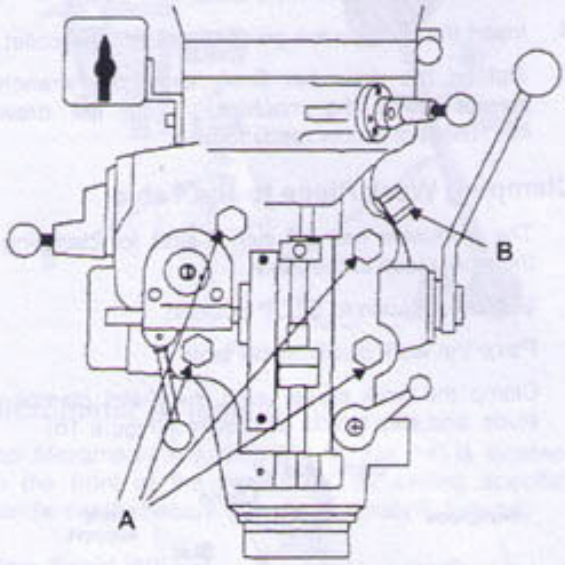


Figure 19

2. Turn the worm nut to tilt the head left or right as required. Use the scale on the ram adapter to set the desired angle.

⚠CAUTION Be sure to apply torque in two steps using a crossing pattern. Failure to do so could distort the face of the ram adapter.

3. Tighten the four hex nuts. Tighten in two steps using a calibrated torque wrench. Use a crossing pattern to tighten the nuts. Tighten initially to 25 foot-pounds.
4. Before applying final torque, check to make sure the mill head is perpendicular to the worktable.
5. Set up a dial indicator in a collet and secure using the draw bar (refer to Figure 21).
6. Put the spindle drive in neutral.
7. Set the dial indicator plunger on the worktable. Zero the indicator.
8. 8Rotate the spindle 180 degrees (when rotating, raise the dial indicator plunger by hand to prevent it from dropping into the table T-slots).
9. Read the dial indicator. The indicator should read zero. If not, loosen the four hex nuts and reposition the mill head.
10. Recheck perpendicularity using the dial indicate. Repeat the procedure above until the dial indicator reads zero in both positions.

⚠CAUTION Be sure to apply torque in two steps using a crossing pattern. Failure to do so could distort the face of the ram adapter.

11. Tighten the four hex nuts. Tighten in two steps using a calibrated torque wrench. Use a crossing pattern to tighten the nuts. Tighten initially to 25 foot-pounds, then tighten to a final torque of 50 foot-pounds.

Mill Head – Fore/Aft Adjustment

1. Setting the angle:

   a. Loosen the three ram adapter clamp bolts on the ram (refer to Figure 20). There is no need to loosen the bolts more than 1/2 turn to allow tilting.

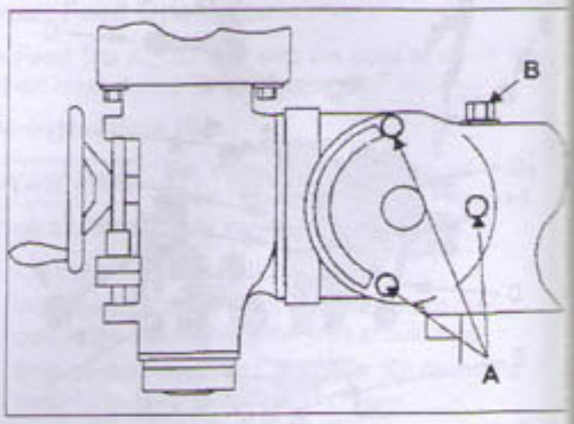


Figure 20

   b. Support the mill head with your free hand. Press upward on the spindle when changing the angle.

   c. Turn the ram adapter worm nut to tilt the head forward and backward. Use the scale on the ram adapter to set the desired angle.

2. Returning to upright position:

a. When returning the mill head to its full upright position, be sure to support the head by upward on the spindle as you turn the worm nut.

b. Check to make sure the mill head is perpendicular to the worktable.

c. Set up a dial indicator in a collet and secure using the draw bar (refer to Figure 21).

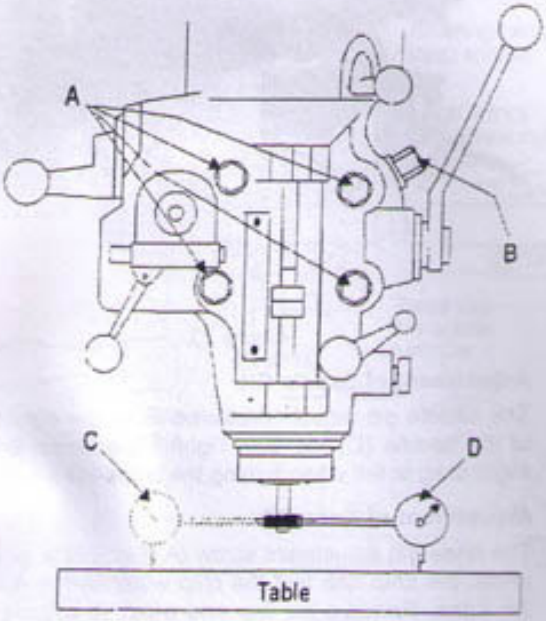


Figure 21

d. Put the spindle drive in neutral.

e. Set the dial indicator plunger on the worktable. Zero the indicator.

f. Rotate the spindle 180 degrees (when rotating, raise the dial indicator plunger by hand to prevent it from dropping into the table T-slots).

g. Read the dial indicator. The indicator should read zero. If not, loosen the four hex nuts and reposition the mill head.

h. Recheck perpendicularity using the dial indicator. Repeat the procedure above until the dial indicator reads zero in both positions.

i. When the indicator reads zero, tighten the ram adapter clamp bolts.

Positioning the Ram

Positioning the Ram Fore and Aft

1. Loosen the two bolts (A, Fig. 22) that lock the ram to its ways.

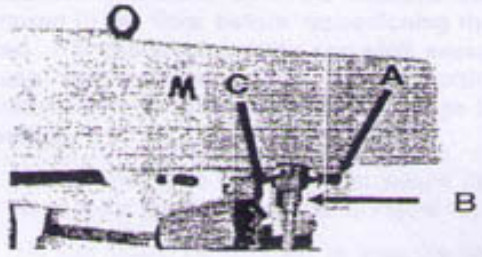


Figure 22

2. Using a 14mm wrench, turn the bolt (B, Fig. 22) to move the arm on its ways.
3. When the desired position is reached, lock the bolts (A, Fig. 22) securely.

Positioning the Ram on its Turret

⚠WARNING Make sure the machine base is secured to the floor before repositioning the ram. The center of gravity can shift enough to cause the machine to tip over, resulting in serious injury to the operator and damage to the machine.

1. Loosen four turret lock bolts (C, Fig. 22) that clamp the ram to the top of the base. 1/2 turn should be sufficient to allow the ram to move.

Note: Use gentle hand pressure to avoid rapid movement.

2. Turn the ram until the spindle is in the desired position.
3. Tighten the four ram lock bolts (C. Fig. 22).

Gib Adjustment

The table, saddle and knee are equipped with adjustable gibs. The gibs may require adjustment if unusual vibration is noted when the locking mechanisms are off, or if you experience unusual vibration when spindle speed, tooth pitch or depth of cut do not account for the vibration.

Adjustment of Table Gib

The table gib adjustment screw (B, Fig. 23) is on the left-hand side, underneath the table. Tighten the screw until a slight drag is felt when turning the table crank.

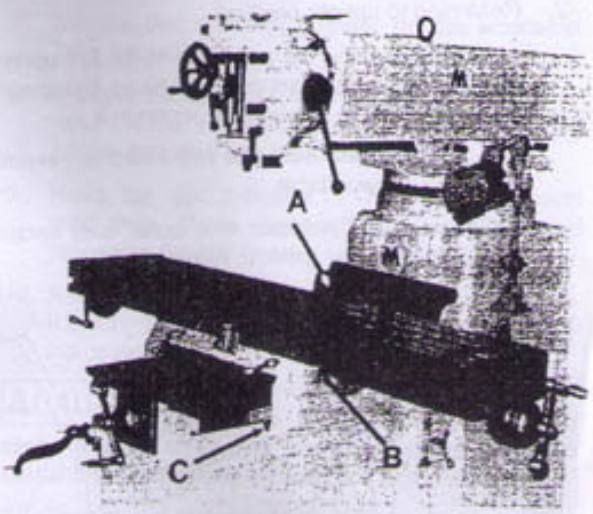


Figure 23

Adjustment of Saddle Gib

The saddle gib adjustment screw is on the right front of the saddle (C, Fig. 23). Tighten the screw until a slight drag is felt when turning the cross-feed crank.

Adjustment of Knee Gib

The knee gib adjustment screw (A, Fig. 23) is located under the chip flap and the chip wiper at the rear of the knee. Remove the flap and wiper to expose the gib adjustment screw. Tighten the screw until a slight drag is felt when turning the knee crank.

6. Set up a dial indicator to check longitudinal backlash. Gently move the hand wheel back and forth while watching the dial indicator. The backlash should be between 0.003 inch and 0.005 inch.

If necessary, repeat the steps above to set backlash.

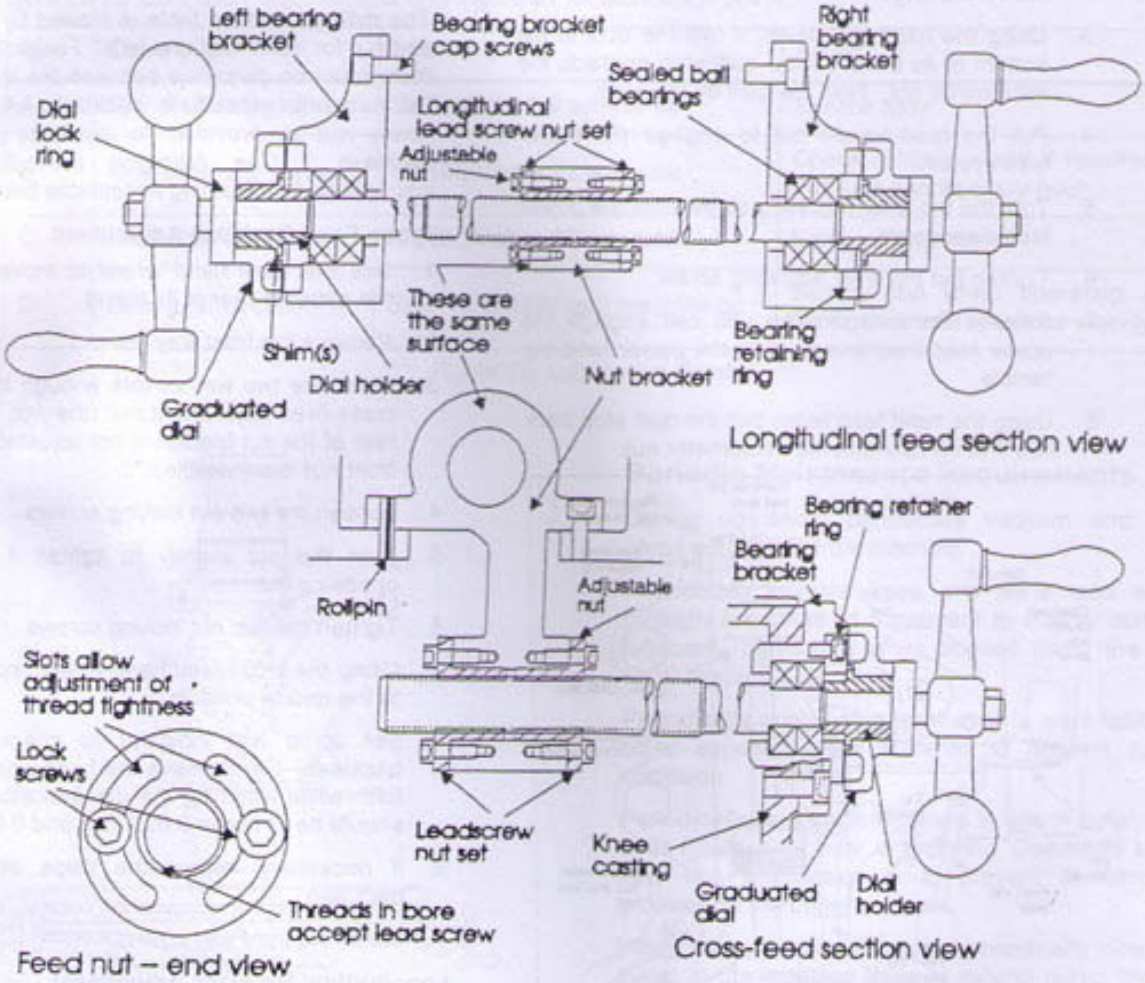


Table Lead Screw Components

Figure 25

Power Feed Trip Lever Mechanism

Refer to Figure 24.

The power feed trip lever mechanism will need to be adjusted if worn or whenever any trip lever mechanism components are replaced.

1. Loosen the trip lever adjusting screw lock nut.
2. Loosen the adjusting screw until it is loose in the lever and no longer contacts the bottom of the feed trip plunger.
3. Using the hand feed lever, move the quill to the bottom of its travel so the quill stop contacts the micrometer nut. Hold the quill on the stop.
4. Pull the feed handle out to engage the power feed system.
5. Turn the trip lever adjusting screw until the power feed disengages.
6. Tighten the trip lever adjusting screw.
7. Release the quill stop so you can engage the power feed mechanism using the power feed trip handle.
8. Using the hand feed lever, pull the quill stop back into firm contact with the micrometer nut.

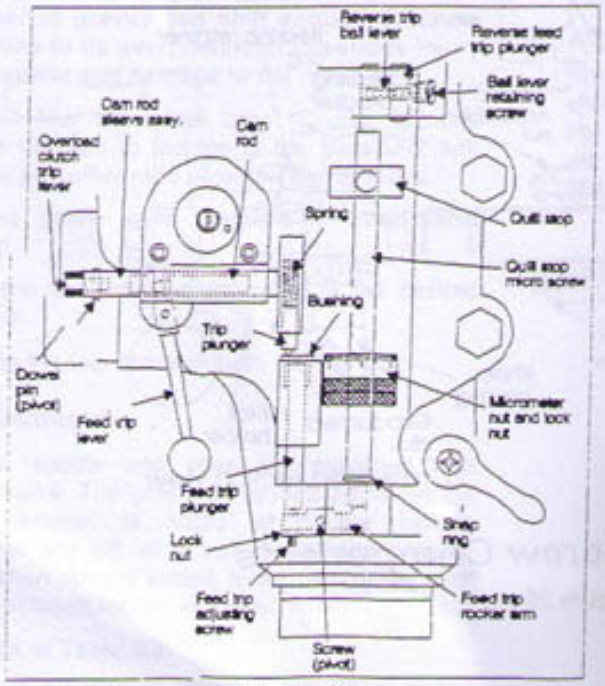


Figure 24

Note: The power feed should disengage when the quill stop pushes on the micrometer nut. If it does not disengage, repeat the adjustment steps above.

9. Engage the power feed and move the quill stop to the top of its travel. Make sure that the reverse trip mechanism also disengages the power feed. If not, readjust the mechanism until positive disengagement occurs when the quill is at the top of its stroke.
10. Check for correct operation using the coarse feed lever. If operating correctly, start the drive motor and engage the power feed mechanism. Verify that the power feed lever correctly engages and disengages when driven by the drive motor.

Table Lead Screw Backlash Adjustment

Refer to Figure 25.

The milling machine table is moved by a lead screw and nut for each machine axis. For proper operation there must be clearance between the lead screw and the nut, which results in backlash. A second lead screw nut is provided to eliminate most of the backlash. The following procedures provide instructions for obtaining acceptable backlash.

Cross Feed Backlash Adjustment

1. Use the table hand wheel to move the table to the extreme rear of its travel.
2. Remove the front way cover.
3. Open the two way covers enough to expose the cross-feed adjustment nut (the nut is toward the rear of the nut bracket is not adjustable – only the front nut is adjustable).
4. Loosen the two nut locking screws.
5. Turn the nut slightly to tighten it against the opposing nut.
6. Tighten the two nut locking screws.
7. Using the cross-feed hand wheel, move the table to the middle position.
8. Set up a dial indicator to check cross-feed backlash. Gently move the hand wheel back and forth while watching the dial indicator. Backlash should be between 0.003 inch and 0.005 inch.
9. If necessary, repeat the steps above to set backlash.
10. Install the front way cover.

Longitudinal Backlash Adjustment

Refer to Figure 25.

1. Only one of the longitudinal lead screw nuts can be adjusted. The other nut is fixed. The left hand nut is typically adjustable. The can be determined by looking at the nut from the underside of the table.
2. Loosen the two nut locking screws.
3. Turn the nut slightly to tighten it against the opposing nut.
4. Tighten the two nut locking screws.
5. Using the longitudinal hand wheel, move the table to the middle position.

Maintenance

⚠WARNING Before any intervention on the machine, disconnect it from the electrical supply by pulling out the plug or switching off the main switch! Failure to comply may cause serious injury.

Lubrication

The milling machine is equipped with a "one-shot" lubrication system. The system lubricates the lead screws and ways. Grease cups on the mill head provide lubrication for the spindle bearings and back gear mechanism. Refer to Figure 26 for lubrication requirements and Figure 27 for lubrication points.

Key	Description	Lubricant	Action
A	Spindle bearing oil cup	SAE 10 or 10W spindle oil	Service daily
B	One-shot lube system	MOBIL Vectra #2 way lube	Check oil daily – add if required. Pull lube handle every hour.
C	Knee lead screw	MOBIL Vectra #2 way lube	Service fitting weekly
D	Back gear oil cup	SAE 10 or 10W light machine oil	Service cup when operating in back gear mode – service weekly

Figure 26: Lubrication Points

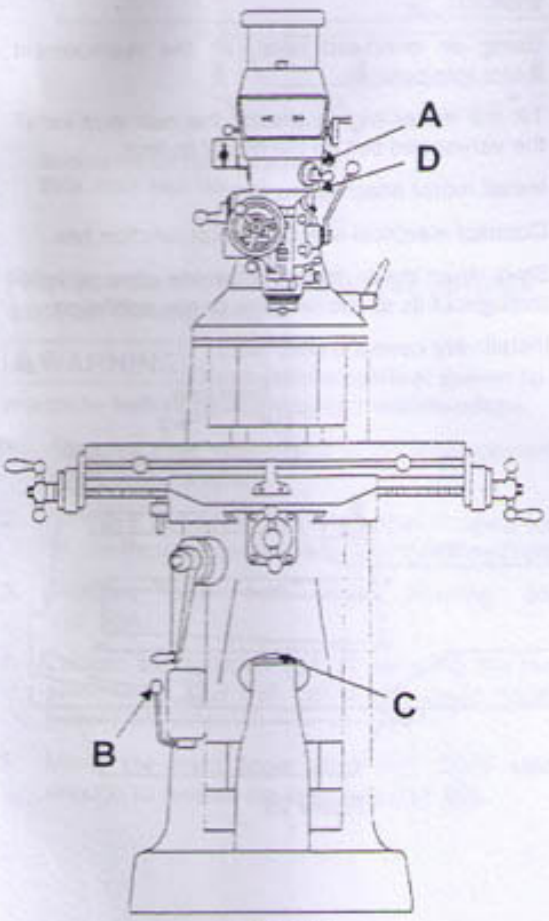


Figure 27

Periodic Maintenance Requirements

During operation, periodically vacuum and brush chips and debris from machine.

Periodically operate knee and table lead screws through full range of movement to evenly distribute lubricant (particularly when applied using the "one-shot" system.

Periodically apply light machine oil to work table and other exposed metal surfaces to prevent rust or corrosion.

Periodically remove vent panels to check pulleys and belts for unusual wear or grooving. Operators should vary speed occasionally to prevent formation of grooves on the pulley surfaces.

When using the coolant pump, periodically clean the sump in the machine base to extend pump life and promote efficient cutting. Change coolant regularly at intervals recommended by the coolant supplier.

Replacement of Drive Motor

Refer to Figure 28 and *Head Assembly* in the *Parts* section.

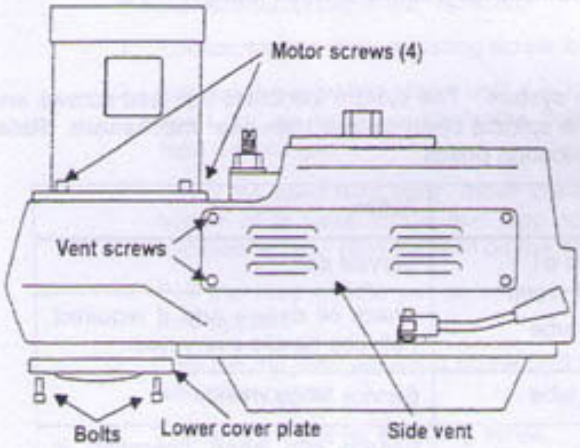


Figure 28

1. Operate spindle at its highest speed.

⚠WARNING Disconnect electrical power to the machine before performing any maintenance.

2. Disconnect electrical power. Remove junction box cover and disconnect wiring. Tag wires to identify leads for reinstallation.
3. Remove vent covers on both sides of head to provide access to the vari-speed belt and pulleys.
4. Remove the cover plate under the motor pulley (at the rear of the cover) by removing three cap screws.
5. Remove four motor attaching screws.
6. Connect a lifting sling to support and lift the motor during removal. Ease the motor up and forward on the housing.
7. Tilt the motor slightly toward the rear to slacken the vari-speed belt. Remove the vari-speed belt from the motor pulley.
8. Remove the belt; lift the motor clear of the housing.

⚠WARNING Do not attempt to remove the screw from the end of the motor shaft without use of a hydraulic press. Failure to comply may cause serious injury.

The screw retains the underlying spring stop washer, which is under spring tension. Serious injury can result if the spring tension is not gradually released using the hydraulic press.

9. Support the drive motor in a hydraulic press. Move the hydraulic ram into contact with the spring stop washer (ref. 9). Remove the screw (ref. 107) from the end of the motor shaft.
10. Slowly release pressure on hydraulic ram until the spring (ref. 8) is fully extended.
11. Remove the lengthening shaft (ref. 106), spring stop washer (ref. 9), spring (ref. 8) and outermost pulley (ref. 5) from the motor shaft.
12. Loosen set screw (ref. 3) on innermost pulley (ref. 2). Remove the pulley (ref. 2) and drive key (ref. 7) from the motor shaft.
13. Install drive key (ref. 7) and pulley (ref. 2) on shaft of replacement motor. Tighten set screw (ref. 3) on pulleys.
14. Support the drive motor in a hydraulic press. Place the outermost pulley (ref. 2) on the motor shaft.
15. Install the spring (ref. 8), spring stop washer (ref. 9), and lengthening shaft (ref. 106) on the motor shaft.
16. Move the hydraulic ram into contact with the spring stop washer (ref. 9). Compress the spring (ref. 8) and install the lengthening shaft (ref. 106) on the motor shaft. Install and tighten the attaching screw (ref. 107) in the end of the motor shaft.
17. Using an overhead hoist, lift the replacement motor into position.
18. Tilt the motor slightly toward the rear and install the vari-speed belt on the motor pulleys.
19. Install motor attaching screws.
20. Connect electrical wiring to motor junction box.
21. Start the drive motor. Operate the spindle throughout its speed range to check operation.
22. Install vent covers on mill head.

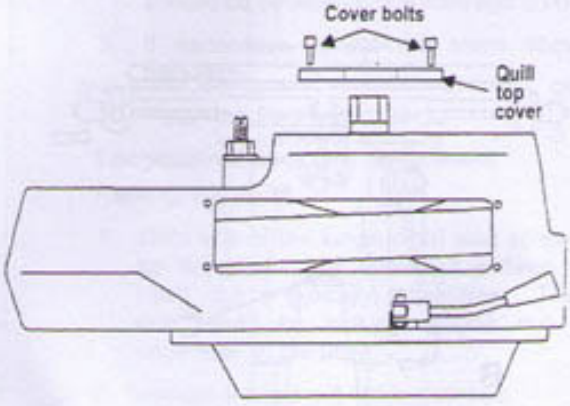


Figure 29

Replacement of Vari-Speed Belt

Refer to Figure 30 and *Head Assembly* in the *Parts* section.

⚠WARNING Disconnect electrical power to the machine before performing any maintenance.

1. Remove drive motor (refer to the *Replacement of Drive Motor* section).
2. Remove *Quill Top Cover* (Figure 29).
3. Remove the top housing.
4. Remove the vari-speed belt (ref. 4).
5. Install the vari-speed belt (ref. 4) on the driven hub (ref. 44).
6. Install drive motor (refer to the *Replacement of Drive Motor* section).

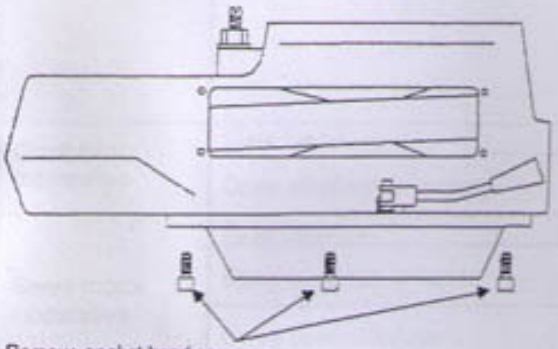


Figure 30

Replacement of Brake Shoes, Springs and/or Timing Belt

⚠WARNING Disconnect electrical power to the machine before performing any maintenance.

1. Remove drive motor (refer to the *Replacement of Drive Motor* section).
2. Remove vari-speed belt and upper housing (refer to the *Replacement of Vari-Speed Belt* section).
3. Remove bolts from lower housing cover (ref. 50A).
4. Loosen the setscrew (ref. 3) securing the brake pivot finger stud (ref. 58) in the lower housing cover (ref. 50A).
5. Move the pivot finger stud (ref. 50A) inward enough to remove the snap ring (ref. 60).

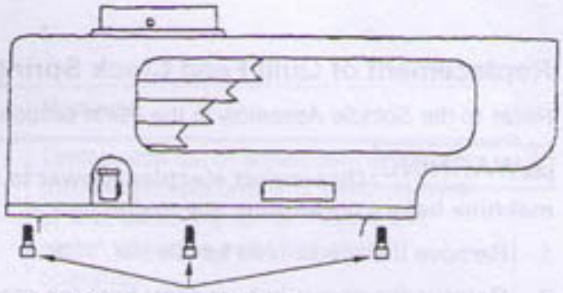


Figure 31

6. Pull the pivot finger stud (ref. 58) out of the lower housing cover (ref. 50A) and the brake fingers (ref. 59).
7. Before removing, note the orientation of the pivot fingers (ref. 59) for correct positioning for reassembly. Remove the pivot fingers.

If replacing the brake components only, skip Steps 8 and 9 and go to Step 10.

To replace the timing belt:

8. Remove lower housing cover and pulley.
9. Replace belt.

To replace the brake components:

10. Using a soft-faced mallet, tap upward to separate the lower housing cover (ref. 50A) and the brake assembly (ref. 47) from the bearing (ref. 43).
11. Remove the brake shoes (ref. 47) and springs (ref. 49). Install the replacement brake shoes and springs.

For all:

12. Position the pivot fingers (ref. 59) as noted during removal. Install the pivot finger stud (ref. 58) through the lower housing cover (ref. 50A) and into the pivot fingers (ref. 59). Install the snap ring (ref. 60) on the pivot finger stud.
13. Tighten the setscrew (ref. 3) to secure the pivot finger stud (ref. 58).
14. Install the brake assembly (ref. 47) on the lower housing cover (ref. 50A).
15. Secure the lower housing cover (ref. 50A) with four screws.
16. Install timing belt and upper housing.
17. Install vari-speed belt (refer to the *Replacement of Vari-Speed Belt* section).
18. Install drive motor (refer to the *Replacement of Drive Motor* section).

Replacement of Quill Feed Clock Spring

Refer to the *Spindle Assembly* in the *Parts* section.

⚠WARNING Disconnect electrical power to the machine before performing any maintenance.

1. Remove the coarse feed handle (ref. 138).
2. Remove the screw, hub, and key from the coarse feed shaft (ref. 141, 132, and 147).
3. Remove six screws (Ref. 1) and allow the spring (ref. 122) to slowly unwind.
4. Remove feed handle hub sleeve (ref. 130).
5. Lift the end of the spring (ref. 122) from the pin (ref. 152) on the pinion shaft (ref. 154).
6. Remove the spring (ref. 122) from the spring cover (ref. 130).
7. Install the replacement spring (ref. 122) in the spring cover (ref 130).
8. Install end of spring (ref. 122) over the pin (ref. 168) on pinion shaft (ref. 154).
9. Install pin (ref. 152) in feed handle hub sleeve (ref. 130) on other end of spring (ref. 122).
10. Turn the spring cover (ref. 130) to wind the spring (ref. 122). Turn the spring cover (ref. 130) until the desired tension is achieved. Hold the spring cover (ref. 130) in position and secure with six screws (ref. 1).
11. Install the key, hub, and screw (ref. 147, 132, and 141) onto the feed shaft (ref. 154).

Troubleshooting

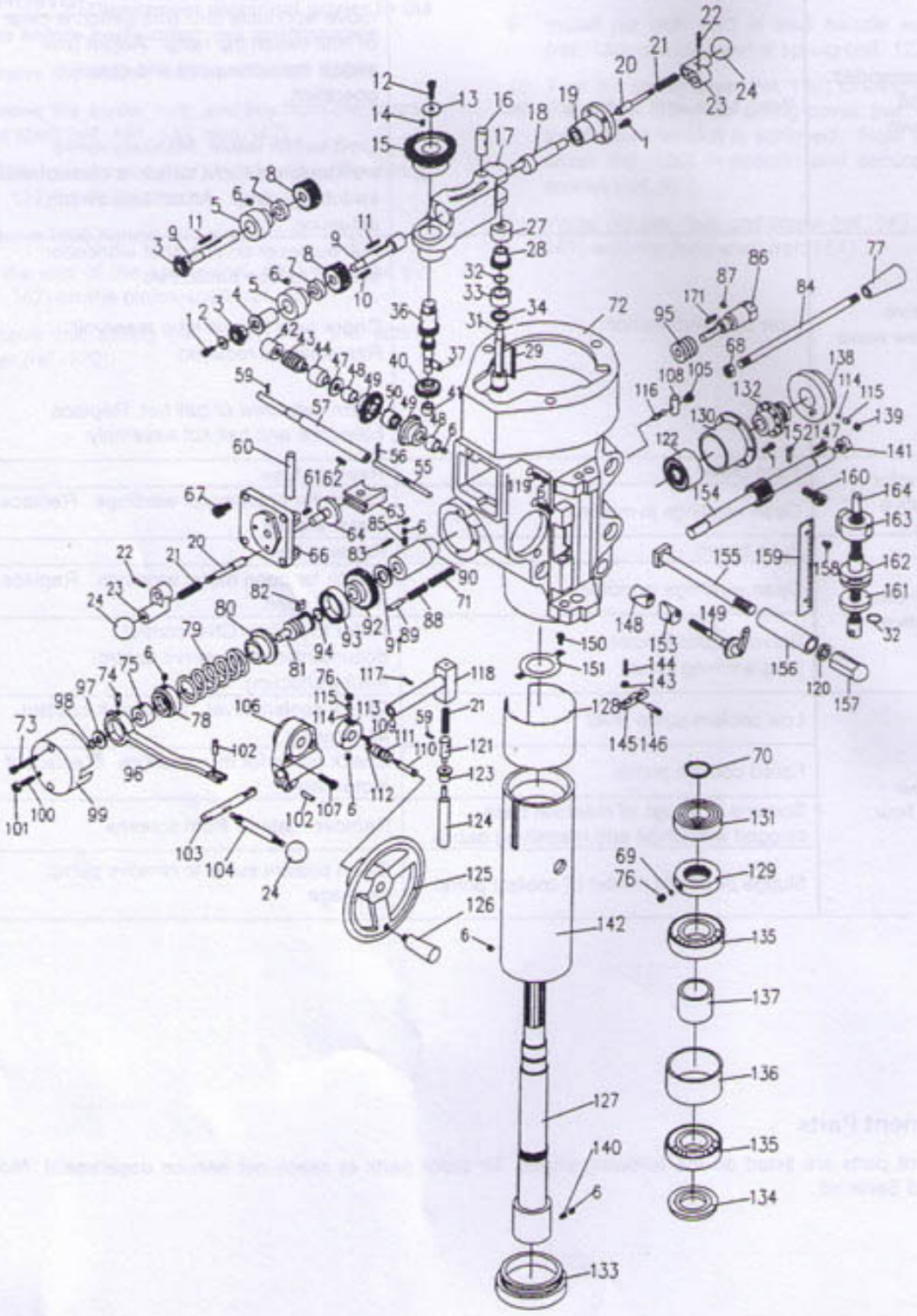
Trouble	Probable Cause	Remedy
Uncommanded machine shutdown	Work table limit switch actuated.	Limit switch out of adjustment. Manually move worktable until limit switch is clear of limit switch trip ramp. Adjust limit switch actuation point and check operation. Limit switch failure. Manually move worktable until limit switch is clear of limit switch trip ramp. Adjust limit switch actuation.
Excessive ballscrew noise	Low or no lubrication.	Pull out lever on one-shot lubrication system to lube ballscrews. Check lube level in lube reservoir. Replenish as required. Worn ballscrew or ball nut. Replace ballscrew and ball nut assembly.
Drive motor inoperative	Fuse blown.	Replace fuse.
	Open windings in motor	Check for open motor windings. Replace motor if open
Servo motor inoperative	Fuse blown.	Replace fuse
	Open windings in motor.	Check for open motor windings. Replace motor if open.
	Servo control failure/ programming error.	Refer to Anilam CNC control documentation for servo control troubleshooting
No or low coolant flow.	Low coolant sump level.	Check coolant level. Replenish coolant as required.
	Failed coolant pump.	Check pump for motor failure. Replace if motor failed.
	Screens in trough of machine base clogged with chips and machining debris.	Remove material from screens.
	Sludge or debris in inlet of coolant pump.	Clean coolant sump to remove pump blockage.

Parts

Replacement Parts

Replacement parts are listed on the following pages. To order parts or reach our service department, Model Number and Serial no.

Head Assembly



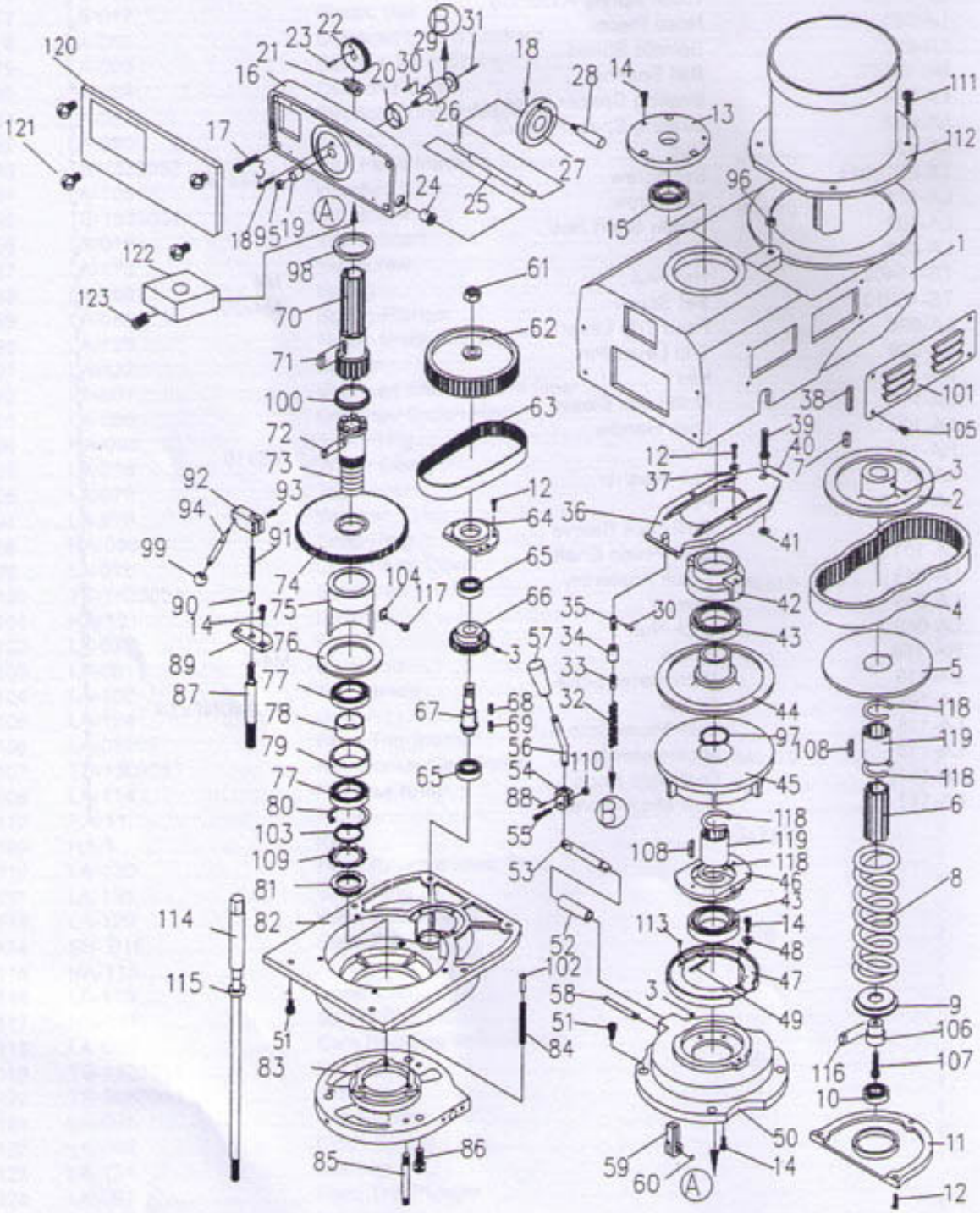
Head Parts List

Index No.	Part No.	Description	Size	Qty.
1	TS-1533042	Screw	M5x10	6
2	HA-002	Bevel Pinion Washer		1
3	LA-166A	Feed Gear		1
4	LA-161	Shaft Sleeve		1
5	LA-162	Worm Cradle Bushing		1
6	TS-1523011	Set Screw	M6x6	9
7	LA-163	Worm Gear Spacer		1
8	LA-164	Feed Drive Worm Gear		1
9	LA-165	Worm Gear Shaft		1
10	HA-010	Worm Shaft Key	3x3x8	1
11	KEY3320	Key	3x3x20	1
12	HA-012	Hex Socket Cap Screw	M6X16	1
13	WASM082302	Washer	ø6	1
14	HA-014	Cluster Gear Key	3x3x8.5	1
15	LA-154	Feed Reverse Bevel Gear		1
16	LA-167	Feed Engage Pin		1
17	LA-166	Worm Gear Cradle		1
18	LA-066	Cam Rod		1
19	LA-002	Shift Sleeve		1
20	LA-004	Plunger		2
21	LA-005	Spring		3
22	HA-022	Spring Pin	3x22	2
23	LA-033	Cam Rod		2
24	LA-006	Plastic Ball		3
27	LA-147	Upper Bushing		1
28	LA-144	Cluster Gear Assembly		1
29	HA-029	Cluster Gear Key	3x3x45	1
31	LA-143	Cluster Gear Shaft		1
32	HA-032	Snap Ring		2
33	LA-142	Bevel Gear Bushing		1
34	LA-141	Thrust Spacer		1
36	LA-156	Feed Drive Gear		1
37	KEY3310	Key	3x3x10	1
40	LA-157	Feed Drive Gear		1
41	HA-041	Needle Bearing		1
42	LA-168	Bushing		1
43	LA-139	Worm		1
44	LA-138	Feed Worm Shaft Bushing		1
47	LA-137	Bevel Gear Thrust Spacer		1
48	LA-134	Bushing		2
49	LA-135	Feed Reverse Bevel Gear		2
50	LA-136	Feed Reverse Clutch		1
55	LA-132	Reverse Clutch Rod		1
56	HA-056	Spring Pin	3x20	1
57	LA-133	Feed Worm Shaft		1
59	HA-059	Spring Pin	3x12	2
60	LA-150	Feed Shift Rod		1
61	TS-1522031	Set Screw	M5x10	1
62	HA-062	Key	3x3x15	1
63	LA-149	Feed Gear Shift Fork		1
64	LA-151	Cluster Gear Shift Crank		1
66	LA-148	Cluster Gear Cover		1
67	TS-1504011	Hex Socket Cap Screw	M8x10	4
68	TS-1524011	Set Screw	M8x8	1
69	HB1291	Lock Washer		1
70	RINS30	Snap Ring		1

Index No.	Part No.	Description	Size	Qty.
71	HA-193	Spring	10x20	1
72	LA-016	Quill Housing		1
73	TS-1502081	Hex Socket Cap Screw	M5x35	2
74	LA-081	Clutch Ring Pin		2
75	LA-080	Clutch Ring		1
76	TS-1524011	Set Screw	M8x8	2
77	LB-017	Plastic Ball		1
78	LA-082	Overload Clutch Lockout		1
79	LA-083	Safety Clutch Spring		1
80	LA-084	Overload Clutch		1
81	LA-085	Overload Clutch Sleeve		1
82	LA-090	Key		1
83	TS-1532052	Pan Head Machine Screw	M4x16	3
84	LA-105	Handle		1
85	TS-1523031	Set Screw	M6x10	2
86	LA-019	Worm Shaft		1
87	LA-173	Set Screw		1
88	LA-169	Spring		1
89	LA-089	Spring Plunger		1
90	LA-123	Pinion Shaft Bushing		1
91	LA-122	Spacer		1
92	LA-087	Overload Clutch Worm Gear		1
93	LA-086	Overload Clutch Ring		1
94	HA-094	Snap Ring		1
95	LA-018	Worm Gear		1
96	LA-079	Trip Lever		1
97	LA-078	Washer		1
98	HA-098	Snap Ring		1
99	LA-076	Clutch Arm Cover		1
100	TS-1523051	Set Screw	M6x10	1
101	HA-101	Locknut		1
102	LA-077	Pin		3
103	LA-091	Cam Rod		1
104	LA-100	Trip Handle		1
105	LA-124	Screw		1
106	LA-09209	Feed Trip Bracket		1
107	TS-1503051	Hex Socket Cap Screw	M6x20	2
108	LA-114	Reverse Knob		1
112	HA-11	Plunger		1
109	HA-1	Key	3x3x10	1
110	LA-130	Feed Reverse Knob Stud		1
111	LA-131	Snap Ring		1
113	LA-129	Hand wheel Clutch		1
114	SB-3/16	Steel Ball	3/16	2
115	HA-115	Spring		2
116	LA-113	Lever		1
117	HA-117	Spring Pin		1
118	LA-093	Cam Rod Sleeve Assembly		1
119	TS-1523011	Set Screw	M6x6	2
120	TS-0680061	Washer	1/2	4
121	LA-095	Trip Plunger		1
122	LA-102	Clock Spring		1
123	LA-121	Bushing		1
124	LA-097	Feed Trip Plunger		1
125	LA-126	Hand wheel		1
126	LA-125	Handle		1

Index No.	Part No.	Description	Size	Qty.
127	LA-050A	Spindle		1
128	LA-060	Quill Skirt		1
129	LA-048	Lock Nut		1
130	LA-103	Spring Cover		1
131	BB-6206ZZ	Ball Bearing		1
132	LA-104	Hub Sleeve		1
	LA-102/3	Clock Spring Assembly		1
133	LA-051	Nose Piece		1
134	LA-052	Spindle Shield		1
135	BB-7207C	Ball Bearing		2
136	LA-054	Bearing Spacer (large)		1
137	LA-053	Bearing Spacer (small)		1
138	LA-106	Hub		1
139	TS-0270021	Set Screw	5/16x1/4	1
140	LA-172	Set Screw		1
141	LA-107	Pinion Shaft Hub		1
142	LA-058	Quill		1
143	TS-154021	Hex Nut	M4	1
144	TS-1521071	Set Screw	M4x20	1
145	LA-098	Feed Trip Lever		1
146	LA-099	Trip Lever Pin		1
147	HA-171	Key		2
148	LA-111	Quill Lock Sleeve		1
149	LA-109	Lock Handle		1
150	HA-150	Screw	M5x10	2
151	LA-057	Felt Washer		1
152	LA-101A	Pin		1
153	LA-110	Quill Lock Sleeve		1
154	LA-101	Quill Pinion Shaft		1
155	LA-043	T-Bolt Assembly		4
156	LA-046	Spacer		4
157	LA-040	Lock Nut		4
158	HA-158	Screw	M4x5	2
159	LA-118	Micrometer Scale		1
160	LA-165A	Screw	3/8-24UNFx3/4	1
161	LA-115	Quill Micro-Stop Nut		1
162	LA-116	Micrometer Nut		1
163	LA-117E	Quill Stop Knob		1
164	LA-112	Quill Micro-Screw		1

VS Upper Head Assembly



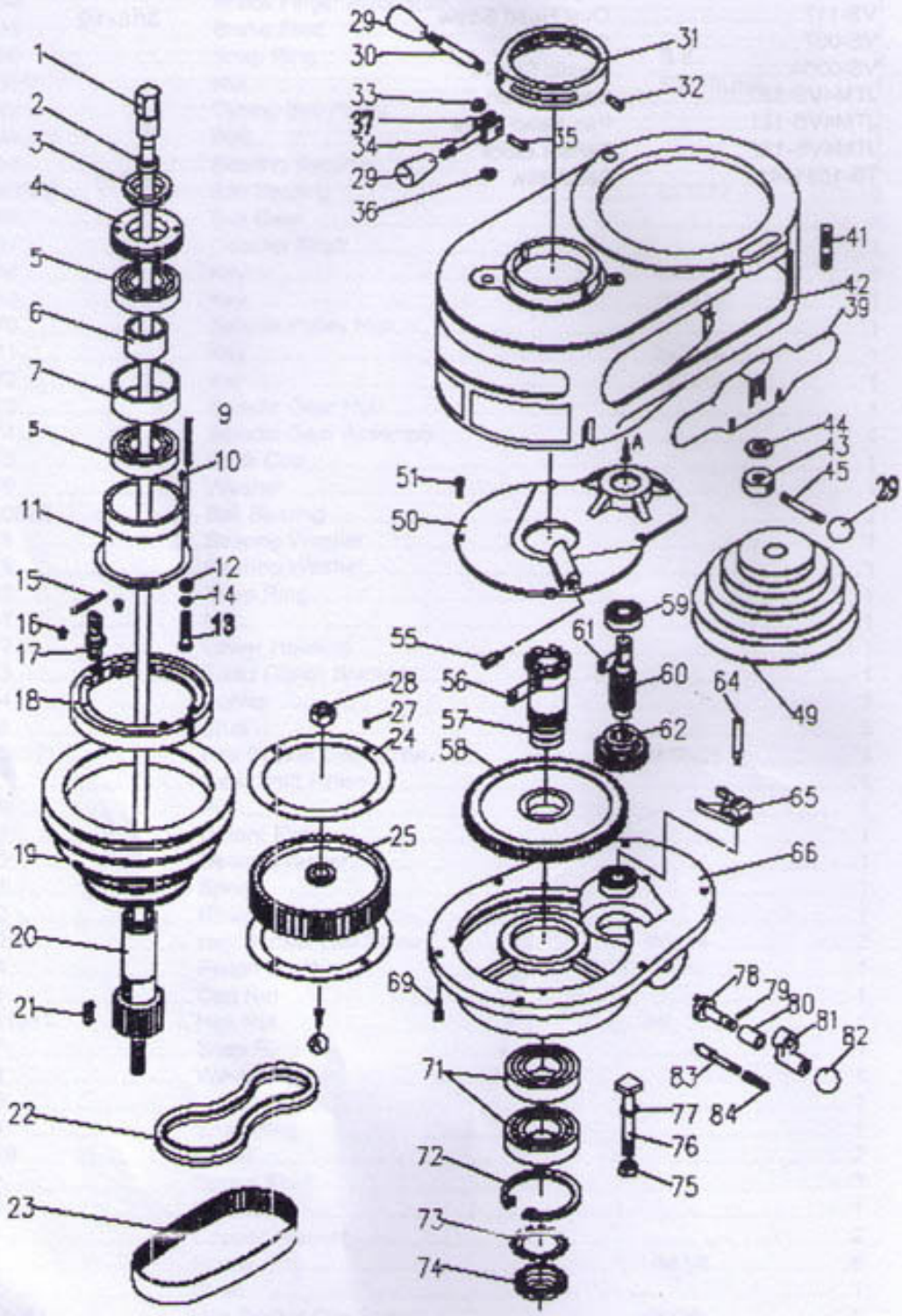
VS Upper Head Parts List

Index No.	Part No.	Description	Size	Qty.
1	VS-001	Upper Housing		1
2	VS-002	Motor Pulley		1
	VS-044A	Motor Pulley Bushing (not shown)		1
3	TS-1523011	Set Screw	M6x6	4
4	VS-004	Belt		1
5	VS-005	Motor Pulley Disk		1
6	VS-006	Motor Pulley Shaft		1
7	KEY7725	Key	7x7x25	1
8	VS-008	Motor Pulley Spring		1
9	VS-009	Spring Stop Washer		1
10	BB-6206ZZ	Ball Bearing	6206ZZ	1
11	VS-011A	Motor Pulley Cover		1
12	TS-1502051	Hex Socket Cap Screw	M5x20	8
13	VS-013	Cover		1
14	TS-1503041	Hex Socket Cap Screw	M6x16	10
15	BB-6007ZZ	Ball Bearing	6007ZZ	1
16	VS-016	Dial Cover		1
17	TS-1503071	Hex Socket Cap Screw	M6x30	4
18	TS-1523041	Set Screw	M6x16	2
19	VS-019	Bushing		1
20	VS-020	Bushing		1
21	VS-021	Worm		1
22	VS-022	Worm Gear		1
23	VS-023	Spring Pin	5x10	2
24	VS-024	Bushing		2
25	VS-025	Dial Control Shaft		1
26	VS-026	Spring Pin	3x12	1
27	VS-027	Dial Wheel		1
28	VS-028	Wheel Handle		1
29	VS-029	Shaft		1
30	VS-030	Spring Pin	4x16	2
31	VS-031	Spring Pin	3x25	1
32	VS-032	Speed Change Chain		1
33	VS-033	Adjustment Stud		1
34	VS-034	Sleeve Nut		1
35	VS-035	Adjustment Stud		1
36	VS-036	Tilter		1
37	VS-037	Bushing		2
38	KEY6645	Key	6x6x45	1
39	VS-039	Regulating Screw		1
40	VS-040	Spring Pin	3/32x3/4	1
41	VS-041	Washer		1
42	VS-042	Support		1
43	BB-6010VV	Ball Bearing		2
44	VS-044N	Driven Pulley Assembly		1
45	VS-045N	Steady Pulley		1
46	VS-046	Bearing Cover		1
47	VS-047	Brake Lining		1
48	VS-048	Lock Screw		1
49	VS-049	Brake Spring		2
50	VS-050	Lower Housing Cover		1
51	TS-1504031	Hex Socket Cap Screw	M8x20	4
52	VS-052	Brake Shaft Sleeve		1
53	VS-053	Brake Lock Shaft		1
54	VS-054	Brake Lock Block		1

Index No.	Part No.	Description	Size	Qty.
55	TS-1503061	Hex Socket Cap Screw	M6x25	1
56	VS-056	Brake Lock Handle		1
57	VS-057	Plastic Ball		2
58	VS-058	Brake Finger Pivot Stud		1
59	VS-059	Brake Stud		2
60	VS-060	Snap Ring	S-8	2
61	TS-0561072	Nut	5/8-18UNF	1
62	VS-062	Timing Belt Pulley		1
63	VB225L100	Belt		1
64	VS-064	Bearing Retainer		1
65	BB-6203ZZ	Ball Bearing	6203ZZ	2
66	VS-066	Bull Gear		1
67	VS-067	Counter Shaft		1
68	VS-068	Key	5X5X15	1
69	VS-069	Key	5x5x18	1
70	VS-070	Spindle Pulley Hub		1
71	VS-071	Key	8x7x24	1
72	VS-072	Key	8x7x12	1
73	VS-073	Spindle Gear Hub		1
74	VS-074	Spindle Gear Assembly		1
75	VS-075	Rack Cup		1
76	VS-076	Washer		1
77	BB-6908ZZ	Ball Bearing		2
78	VS-078	Bearing Washer		1
79	VS-079	Bearing Washer		1
80	VS-080	Snap Ring		1
81	VS-081	Nut		1
82	VS-082	Lower Housing		1
83	VS-083	Fixed Clutch Bracket		1
84	VS-084	Spring		3
85	VS-085	Stud		3
86	TS-1506021	Hex Socket Cap Screw	M12x25	3
87	VS-087	Gear Shift Pinion		1
88	VS-088	Pin		1
89	VS-089	Detent Plate		1
90	VS-090	Detent Washer		1
91	VS-091	Spring		1
92	VS-092	Pinion Block		1
93	TS-1503011	Hex Socket Cap Screw	M5x14	2
94	VS-094	Pinion Crank		1
95	VS-095	Cap Nut		1
96	TS-0561031	Hex Nut	3/8	1
97	VS-097	Snap Ring		1
98	VS-098	Wave Washer		1
99	VS-099	Plastic Ball		1
100	VS-100	Snap Ring		1
101	VS-101B	Cover		2
102	VS-102	Spring Shaft		3
103	VS-103	Washer		1
104	VS-104	Copper Washer		2
105	VS-105	Screw	1/4x3/8	8
106	VS-107	Shaft		1
107	TS-1504061	Hex Socket Cap Screw	M8x30	1
108	VS-120	Key	6x4x32	2
109	VS-109	Lock Washer		1
110	TS-1540041	Hex Nut	M6	1
111	TS-0209051	Hex Socket Cap Screw	3/8x1	4

Index No.	Part No.	Description	Size	Qty.
112	4VS-112	Motor		1
113	VS-113	Oval Head Screw	1/8x1/4	4
114	JTM1-001VS	Draw Bar	#30/NT40	1
115	JTM4VS-A002B	Draw Bar Washer		1
116	VS-116	Key		1
117	VS-117	Oval Head Screw	3/16x1/2	1
118	VS-007	Snap Ring		4
119	VS-005A	Plastic Sleeve		2
120	JTM4VS-120	Speed Chart		1
121	JTM4VS-121	Pan Head screw	M4	4
122	JTM4VS-122	Sensor Block		1
123	TS-1521041	Set Screw	M4X10	1

4S Upper Head Assembly

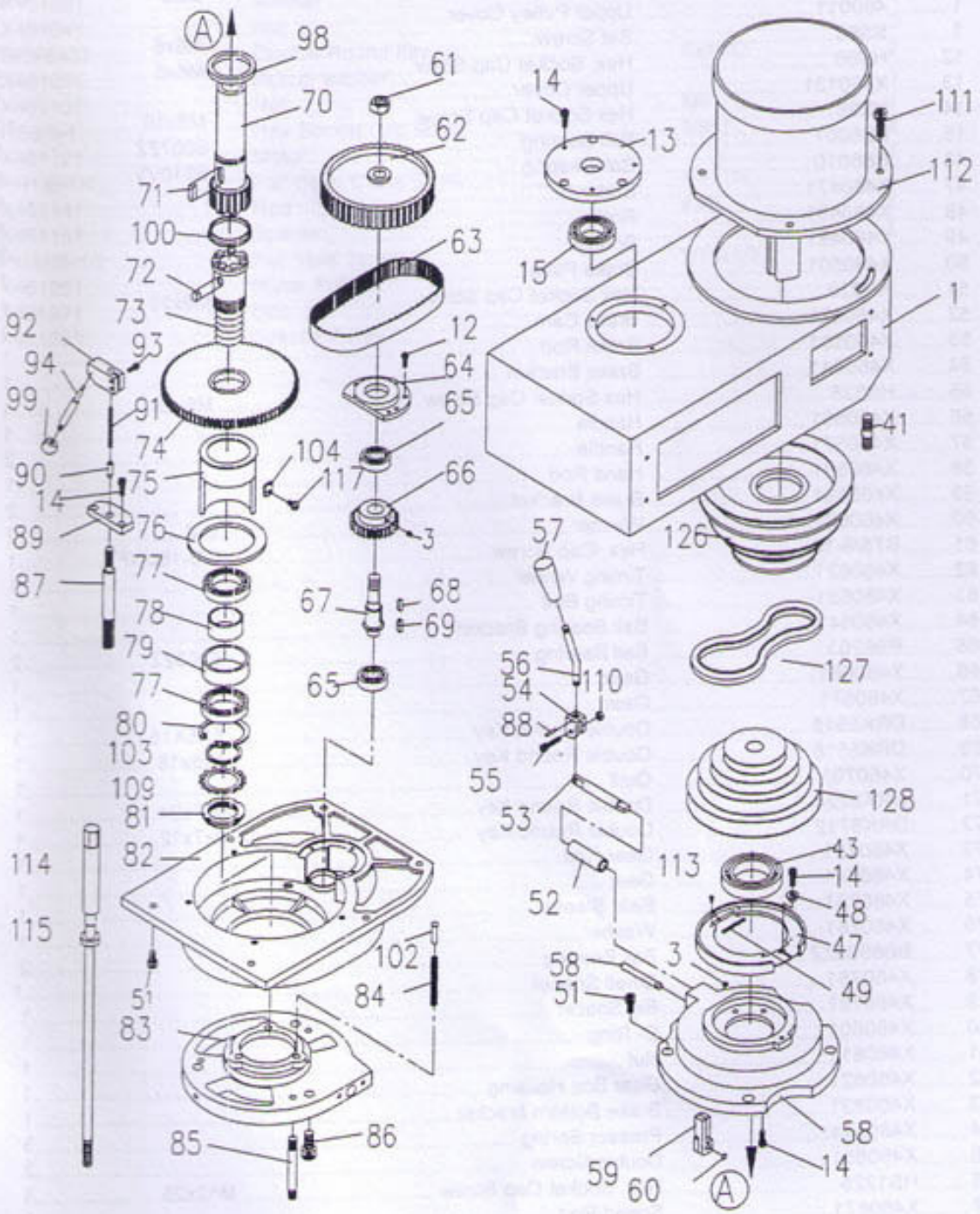


4S Upper Head Parts List

Index No.	Part No.	Description	Size	Q'ty
1	LA-072	Draw Bar	R8 (W7/16-20UNF)	1
2	JTM4VS-A002B	Draw Bar Washer		1
3	LA-071	Upper Bearing Lock Nut		1
4	LA-070	Bearing Sleeve Lock Nut		1
5	BB-6207ZZ	Ball Bearing		1
6	LA-068	Upper Bearing Spacer (small)		1
7	LA-069	Upper Bearing Spacer (large)		1
9	LA-169	Compression Spring		1
10	TS-1520041	Set Screw	M3x10	2
11	LA-066	Spindle Pulley Bearing Sleeve		1
12	TS-0571021	Hex Jam Nut	5/16	1
13	TS-0720081	Lock Washer	5/16	1
14	LA-034	Brake Ring Screw		1
15	LA-036	Spring		2
16	BUTW1814	Screw	W1/8x1/4	1
17	LA-037	Brake Lock Stud		1
18	LA-035	Brake Assembly		1
19	LA-065	Spindle Pulley		1
20	LA-064	Spindle Pulley Hub		1
21	JTM1-021	Key	8x7x24	1
22	VB-A33	V-belt	A-33	1
23	VB225L100	Timing Belt	2252x100	1
24	LA-027	Timing Belt Flange		1
25	LA-026	Timing Belt Pulley		1
27	JTM1-C27	Flat Head Screw	W1/8x1/4	1
28	TS-0571072	Hex Jam Nut	5/8-18UNF	1
29	LA-006	Plastic Ball	W3/8	2
30	LA-074	Spindle Clutch Lever		1
31	LA-073	Cam Ring		1
32	JTM1-032	Cam Ring Pin		1
33	JTM1-C33	E-Ring	E-5.5	1
34	LA-039	Brake Lock Handle		1
35	LA-038	Brake Lock Pin		1
36	TS-0680061	Washer	W1/2	1
37	JTM1-037	Spindle Speed Plate		1
39	JTM1-039	Belt Guard Assembly		2
41	LA-012	Motor Mount Studs		2
42	LA-015	Belt Housing		1
43	LA-007	Motor Lock Nut		1
44	LA-008	Washer		1
45	LA-009	Motor Lock Nut Handle		1
49	LA-011	Motor Pulley		1
50	LA-013	Gear Housing Cover		1
51	JTM1-C51	Hex Socket Cap Screw	M5x14	1
55	JTM1-055	Oil Cup		1
56	JTM1-C56	Key	8x7x15	1
57	LA-062	Spindle Gear Hub		1
58	LA-061	Spindle Bull Gear Assembly		1
59	BB-6203ZZ	Ball Bearing	6203ZZ	2
60	LA-026	Shaft		1
61	JTM1-061	Key	5x5x15	1
62	LA-025	Gear		1
64	LA-032	Dowel Pin		1
65	LA-031	Back Gear Shifter Fork		1
66	LA-014	Gear Housing		1

Index No.	Part No.	Description	Size	Q'ty
69	TS-1503041	Hex Socket Cap Screw	M6x16	1
71	BB-6208Z	Ball Bearing	6208Z	2
72	JTM1-C72	Snap Ring	R-80	1
73	JTM1-C73	Lock Washer		1
74	LA-059	Bearing Lock Nut		1
75	JTM1-C75	Hardened Nut	W7/16	1
76	LA-045	T-Bolt		1
77	JTM1-C77	Bolt Washer	W7/16	1
78	LA-001	Shift Crank		1
79	JTM-C79	Spring Pin	Ø3x20	1
80	LA-044	Back Gear Shift Bushing		1
81	LA-003	Shaft Crank Handle		1
82	LA-006	Plastic Ball		2
83	LA-004	Gearshift Plunger		1
84	LA-005	Compression Spring		1

4HS Upper Head assembly

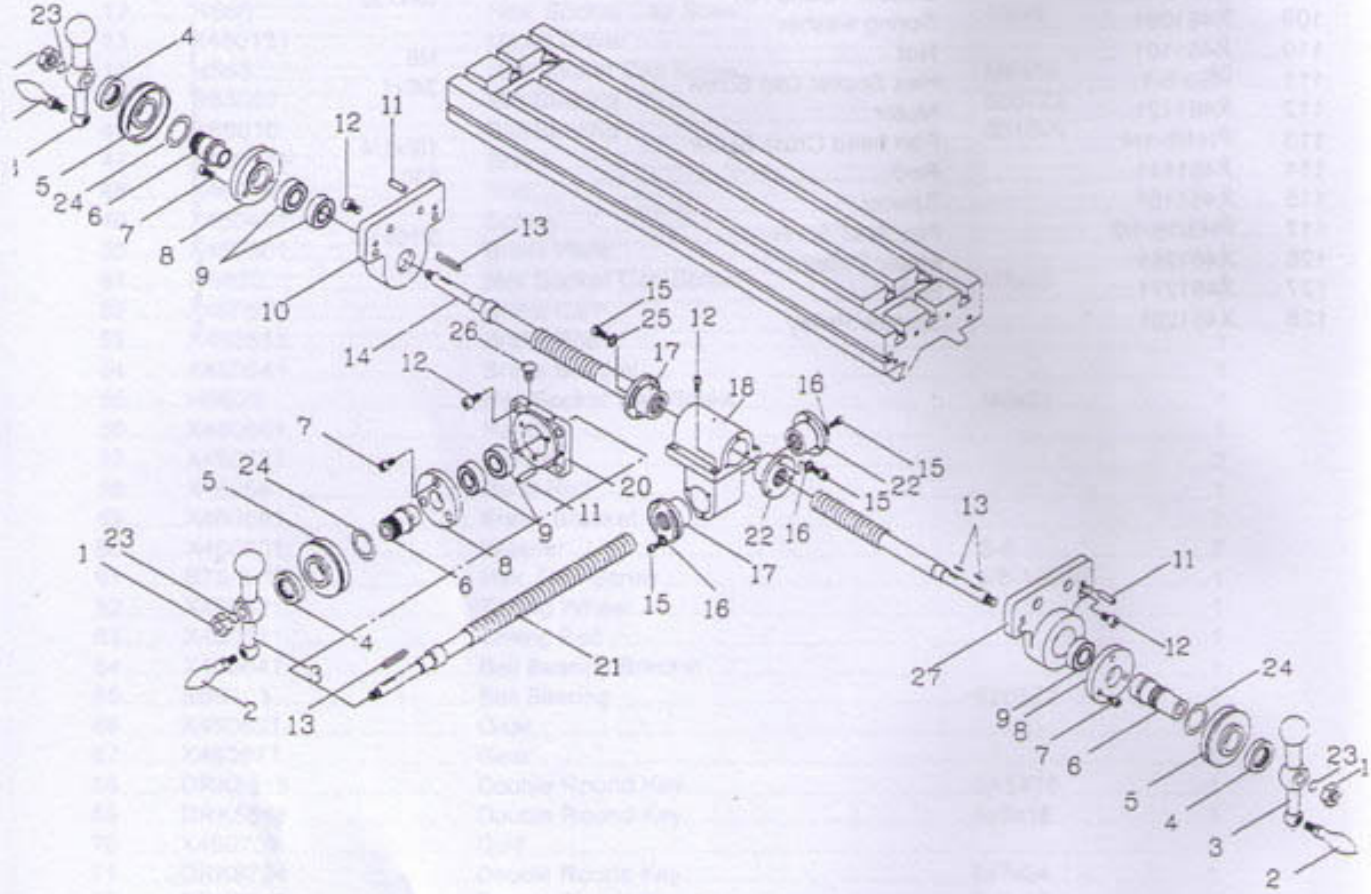


4HS Upper Head Parts List

Index No.	Part No.	Description	Size	Qty.
1	460011	Upper Pulley Cover		1
3	SS66	Set Screw	M6x6	4
12	HS66	Hex. Socket Cap Scew	M6x6	4
13	X460131	Upper Cover		1
14	HS66	Hex Socket Cap Screw	M6x16	10
15	BB6007	Ball Bearing	6007ZZ	1
43	BB6010	Ball Bearing	6010VV	1
47	X460471	Brake		1
48	X460481	Rod		1
49	X460491	Spring		2
50	X460501	Brake Plate		1
51	HS820	Hex Socket Cap Screw	M8x20	4
52	X460521	Brake Cam		1
53	X460531	Brake Rod		1
54	X460541	Brake Bracket		1
55	HS625	Hex Socket Cap Screw	M6x25	1
56	X460561	Handle		1
57	X460571	Handle		2
58	X460581	Hand Rod		1
59	X460591	Brake Bracket		2
60	X460601	Washer	S-8	2
61	BT5/8-18	Hex. Cap Screw	5/8-18UNF	1
62	X460621	Timing Wheel		1
63	X460631	Timing Belt		1
64	X460641	Ball Bearing Bracket		1
65	BB6203	Ball Bearing	6203ZZ	2
66	X460661	Gear		1
67	X460671	Gear		1
68	DRK5515	Double Round Key	5X5X15	1
69	DRK5518	Double Round Key	5x5x18	1
70	X460701	Quill		1
71	DRK8724	Double Round Key	8x7x24	1
72	DRK8712	Double Round Key	8x7x12	1
73	X460731	Gear Rod		1
74	X460741	Gear		1
75	X460751	Bear Sleeve		1
76	X460761	Washer		1
77	BB6908ZZ	Ball Bearing		2
78	X460781	Small Spacer		1
79	X460791	Big Spacer		1
80	X460801	C- Ring		1
81	X460811	Nut		1
82	X460821	Gear Box Housing		1
83	X460831	Brake Bottom bracket		1
84	X460841	Pressur Spring		3
85	X460851	Double Screw		3
86	HS1225	Hex. Socket Cap Screw	M12x25	3
87	X460871	Speed Rod		1
88	X460881	Pin		1
89A	X460891	Connect Plate		1
90	X460901	Hi/Low Sleeve		1
91	X460911	Spring		1
92	X460921	Connect Bracket		1
93	HS514	Hex. Socket Cap Screw	M5x14	2
94	X460941	Handle		1

Index No.	Part No.	Description	Size	Qty.
99	X460991	Ball Handle		1
100	X461001	Timing Wheel Sleeve		1
102	X461021	Spring Rod		3
103	X461031	washer		1
104	X461041	Nut		2
108	DRK6432	Double Round Key	6x4x32	2
109	X461091	Spring washer		1
110	X461101	Nut	M6	1
111	HS3/8-1	Hex Socket Cap Screw	3/8x1	4
112	X461121	Motor		1
113	PH1/8-1/4	Pan head Cross Screw	1/8x1/4	4
114	X461141	Rod	#30	1
115	X461151	Spacer		1
117	PH3/16-1/2	Pan Head Screw	3/16x1/2	1
126	X461261	Motor Pulley		1
127	X461271	Belt		1
128	X461281	Spindle Pulley		1

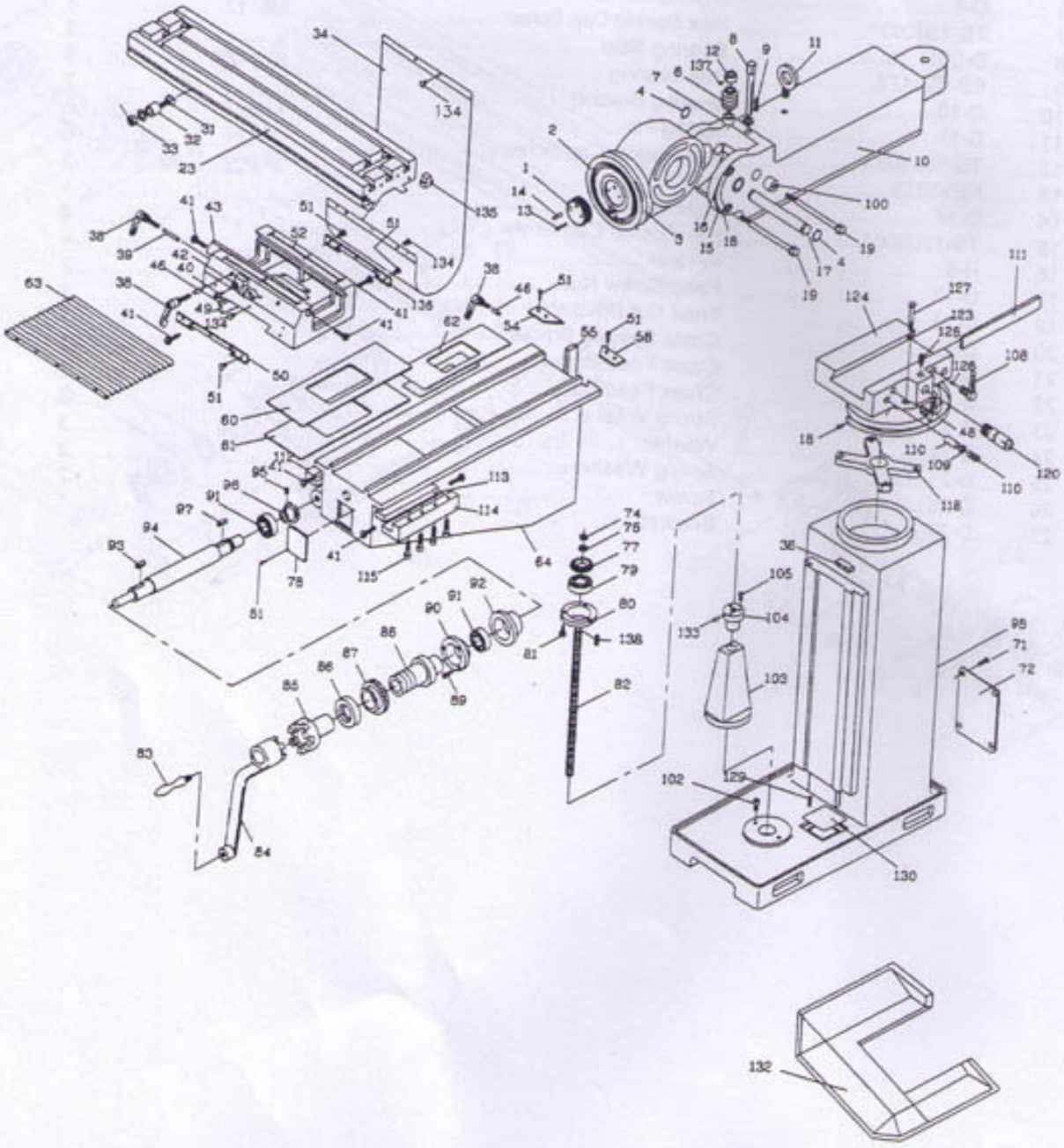
Lead Screw Assembly



Lead Screw Parts List

Index No.	Part No.	Description	Size	Qty.
1	D-1	Nut	1/2"-20NF	3
2	D-2	Handle		3
3	D-3	Ball Crank		3
4	D-4	Dial Lock Nut		3
5	D-5	Dial		3
6	D-6	Dial Holder		3
7	TS-1503031	Hex Socket Cap Screw	M6*12	9
8	D-90	Bearing Stop		3
9	BB-6204ZZ	Ball Bearing	6204ZZ	5
10	D-10	Bearing Bracket		2
11	D-11	Spring Pin	5*25	6
12	TS-1505031	Hex Socket Cap Screw		16
13	KEY3325	Key	3*3*25	3
14	D-14	Leadscrew		1
15	TS-1503061	Hex Socket Cap Screw		8
16	H-9	Washer		4
17	D-17	Feed Screw Nut		2
18	D-18	Feed Nut Bracket		1
20	D-20	Cross Bearing Bracket		1
21	D-21	Cross Feed Screw		1
22	D-22	Cross Feed Nut		2
23	D-23	Spring Washer	1/2"	3
24	D-24	Washer		3
25	D-25	Spring Washer		2
26	D-26	Screw		2
27	D-27	Bracket		1

Base Assembly

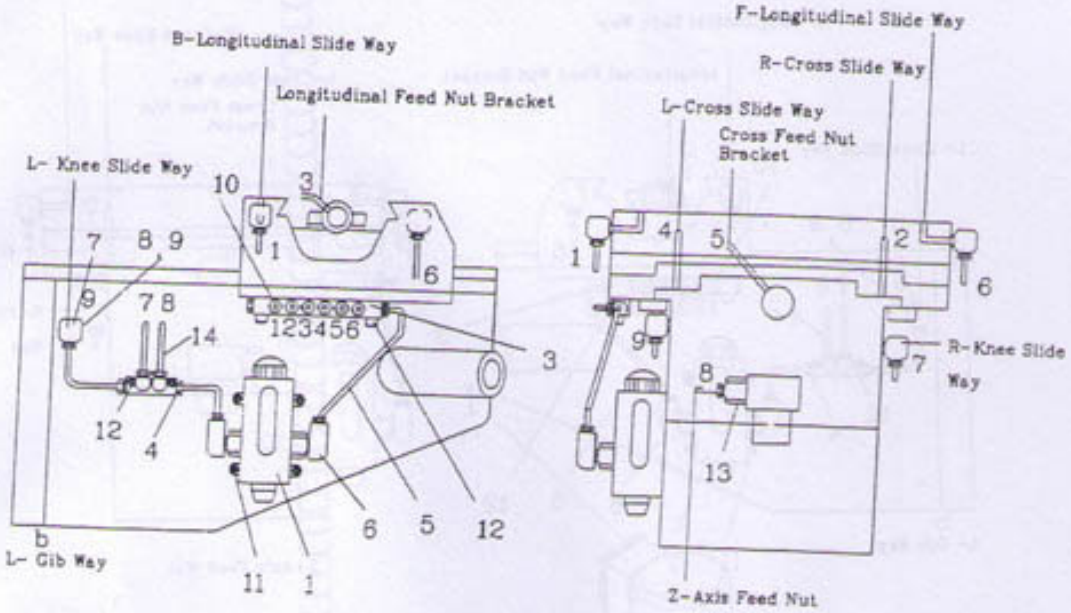


Base Assembly

Index No.	Part No.	Description	Size	Qty.
1	1050C-1	Worm Washer		1
2	1050C-2	Ram Adapter		1
3	1050C-3	Adapter Scale		1
4	1050C-4	Lock Nut		1
6	1050C-6	Worm Gear		1
7	1050C-12	Collar		1
8	1050C-8	Worm Shaft		1
9	KEY5550	Key	5*5*50	1
10	1050C-10	Ram		1
11	1050C-11	Hook	M20	1
12	C-7-1	Washer		1
13	TS-1504061	Hex Socket Cap Screw	M8*30	2
14	1050C-14	Spring Pin		1
15	1050C-15	Angle Plate		1
16	1050C-16	Rivet		10
17	1050C-17	Adapter Pivot Stud		1
18	C-18	Washer		3
19	C-19	Locking Bolt		3
23	C-23	Table		1
31	C-31E	T-Bolt	M10	2
32	C-32	Table Stop Piece		2
33	C-33E	Hex Nut	M10	2
34	C-34	Chip Guard		1
36	C-36E	Pan Head Screw	M6X12	4
38	C-38A	Saddle Lock Bolt	M12	5
39	C-39	Saddle Lock Plunger		1
40	C-40	Hex Socket Cap Screw		2
41	C-41E	Adjusting Screw	M8X35L	10
42	C-42	Table Stop Bracket		1
43	C-43	Gib		1
46	C-46	Table Lock Plunger		4
49	C-49	Saddle Knee Gib		1
50	C-50-1	Wiper		2
51	C-51	Pan Head Screw	M5	18
52	C-52	Sadle		1
54	C-54	Knee Wiper Felt		1
55	C-55	Knee Column Gib		1
58	C-58	Knee Wiper Felt		1
60	C-60	Chip Guards		1
61	C-61	Chip Guards		1
62	C-62	Chip Guards		1
63	C-63	Chip Guards		1
64	C-64	Knee		1
71	C-71E	Pan Head Screw	M6X12	8
72	C-72	Cover		1
73	C-23-1	Washer		1
74	C-74	Nut	1/2"-20NF	1
75	KEY5525	Key	5*5*25	1
76	C-76	Washer		1
77	C-77	Bevel Gear		1
78	C-78	Front Cover		1
79	3305	Ball Bearing	3305	1
80	C-80	Bearing Stop		1
81	TS-1503051	Hex Socket Cap Screw	M6X20	3
82	C-82	Leadscrew	Metric	1

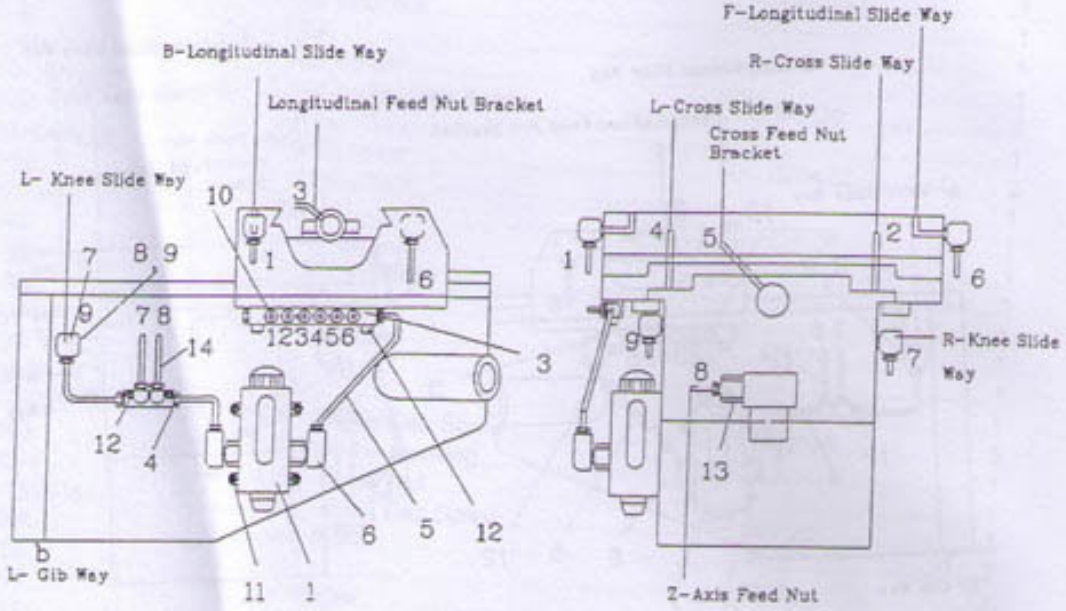
Index No.	Part No.	Description	Size	Qty.
83	C-53	Handle		1
84	C-54	Elevating Crank		1
85	C-85	Gear Shear Clutch		1
86	C-86	Dial Lock Nut		1
87	C-87	Dial		1
88	C-88	Dial Holder		1
89	TS-1503051	Hex Socket Cap Screw	M6*20	3
90	C-90	Bearing Stop		1
91	BB-6204ZZ	Ball Bearing	6204ZZ	2
92	C-92	Bearing Stop		1
93	KEY3318	Key	3*3*18	1
94	C-94	Shaft		1
95	C-95	Grub Set Screw		1
96	C-96	Bevel Gear		1
97	KEY4418	Key	4*4*18	1
98	C-98	Column		1
100	C-19-1	Collar		1
102	TS-1505051	Hex Socket Cap Screw	M10*35	3
103	C-103	Lead Screw Housing		1
104	C-82-1	Lead Screw Nut		1
105	TS-1503051	Hex Socket Cap Screw	M6*20	3
108	C-38A	Lock Bolt	M12	2
109	C-109	Nut	M10	2
110	C-110	Set Screw		2
111	C-111	Gib		1
112	C-112	Gib Holder(l)		1
113	C-113	Gib		1
114	C-114	Gib Holder(R)		1
115	TS-1505051	Hex Socket Cap Screw	M10*35	8
118	C-118	Spider		1
120	C-120	Ram Pinion	16T	1
123	C-123	Spring Wsher		4
124	C-124	Turret		1
126	C-126	Ram Lock Plunger		2
127	C-127	Locking Bolt	M12X185L	4
128	C-128	Ram Pinion Set Screw	M8	1
129	C-129	River	M5X12	2
130	C-130	Strainer		1
131	JM-1050	Stripe Decal(not shown)		1
132	C-132	Chip Pan		1
133	JTM1050VSE-133	Oil Plug		1
134	JTM1050VSE-134	Pan head screw		6
135	JTM1050VSE-135	T-Nut Rubber		6
136	JTM1050VSE-136	Wiper		1
137	JTM1050VSE-137	Set Screw	M6X6	1
138	JTM1050VSE-138	Key	5X5X25	1

One Shot Lubrication System



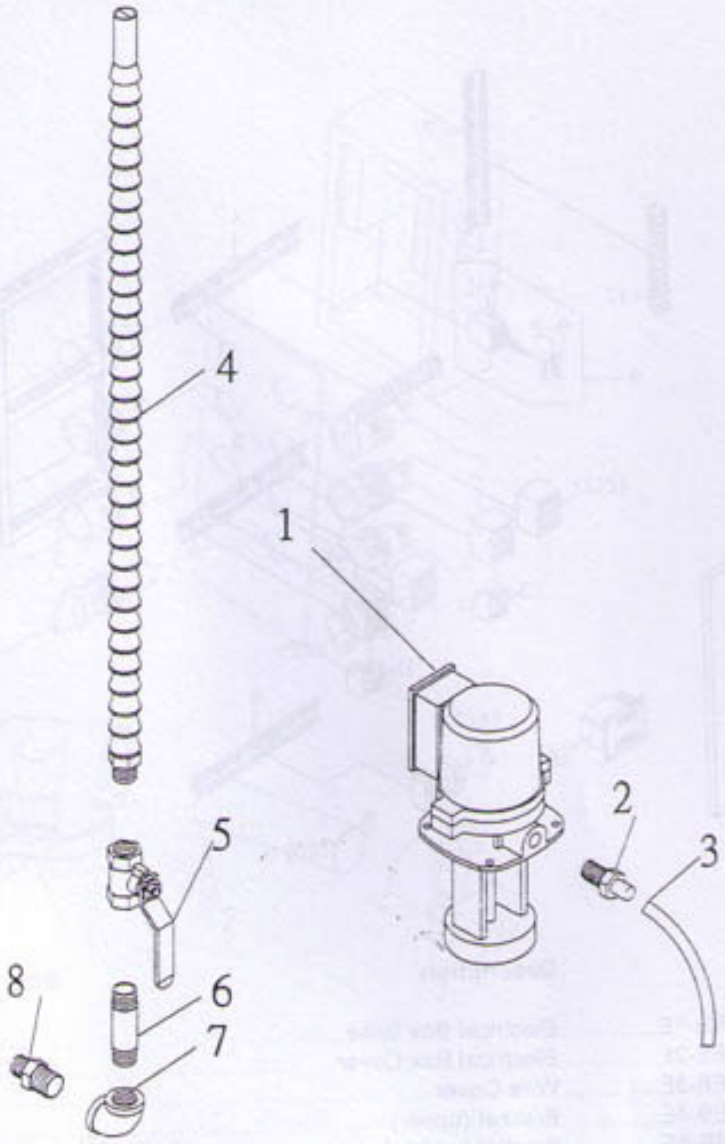
Index No.	Part No.	Description	Size	Qty
1	CLA-8	Hand Oiler		1
2	ALMP-04	Aluminum Pipe	13.5	1
3	A-8	Oil Regulating Distributor		1
4	A-4	Oil Regulating Distributor		1
5	A-5	Flexible Steel Tube	4x550	1
6	PH-4011	Elbow Joint		2
7	PA-401	Elbow Joint		6
8	PA-4	Thimble Nut		20
9	PB-4	Thimble		20
10	PG-004	Union		1
11	JTM4VS-BUTW1458	Screw	M6 x14	4
12	TS-1502061	Hex Socket Cap Screw	M5×25	4
13	PD-401	Straight Joint		1
14	A-14	Nylon Piece	4x700	1

One Shot Lubrication System



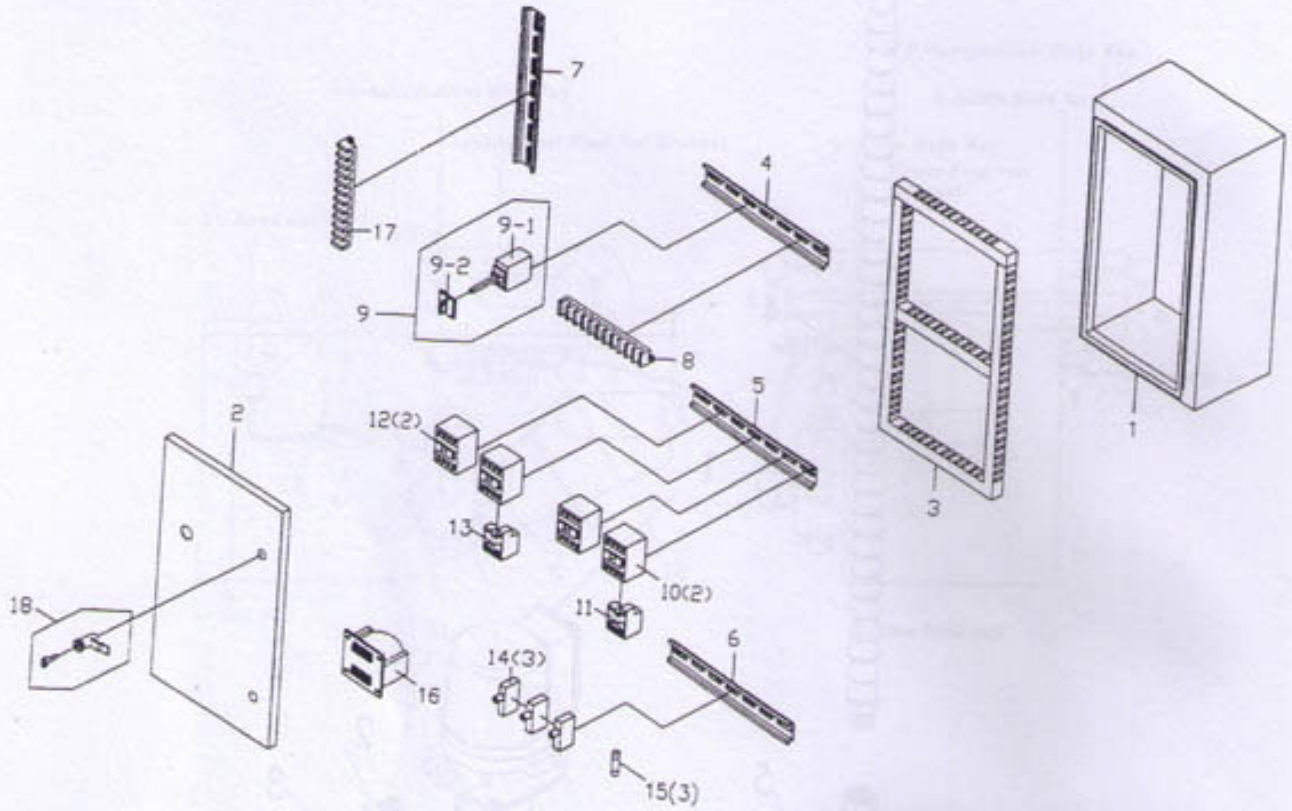
Index No.	Part No.	Description	Size	Qty
1	CLA-8	Hand Oiler		1
2	ALMP-04	Aluminum Pipe	13.5	1
3	A-8	Oil Regulating Distributor		1
4	A-4	Oil Regulating Distributor		1
5	A-5	Flexible Steel Tube	4x550	1
6	PH-4011	Elbow Joint		2
7	PA-401	Elbow Joint		6
8	PA-4	Thimble Nut		20
9	PB-4	Thimble		20
10	PG-004	Union		1
11	JTM4VS-BUTW1458	Screw	M6 x14	4
12	TS-1502061	Hex Socket Cap Screw	M5×25	4
13	PD-401	Straight Joint		1
14	A-14	Nylon Piece	4x700	1

Coolant Pump Assembly



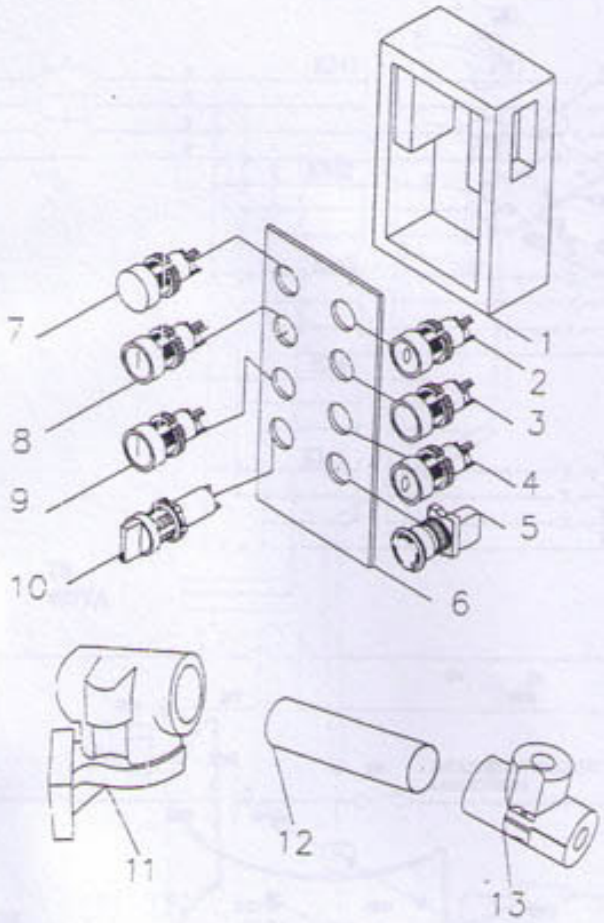
Index No.	Part No.	Description	Size	Qty.
1	JVM836VSD-P01E	Coolant pump		1
2	JVM836VSD-CP-4	Connect Elbow		1
3	JVM836VSD-CP-5	Hose		1
4	JVM836VSD-CP-6	Nozzle		1
5	JVM836VSD-CP-7	Valve		1
6	JVM836VSD-CP-8	Extend Elbow		1
7	JVM836VSD-CP-9	90° Joint		1
8	JVM836VSD-CP-10	Connect Elbow		1

Electrical Box Assembly



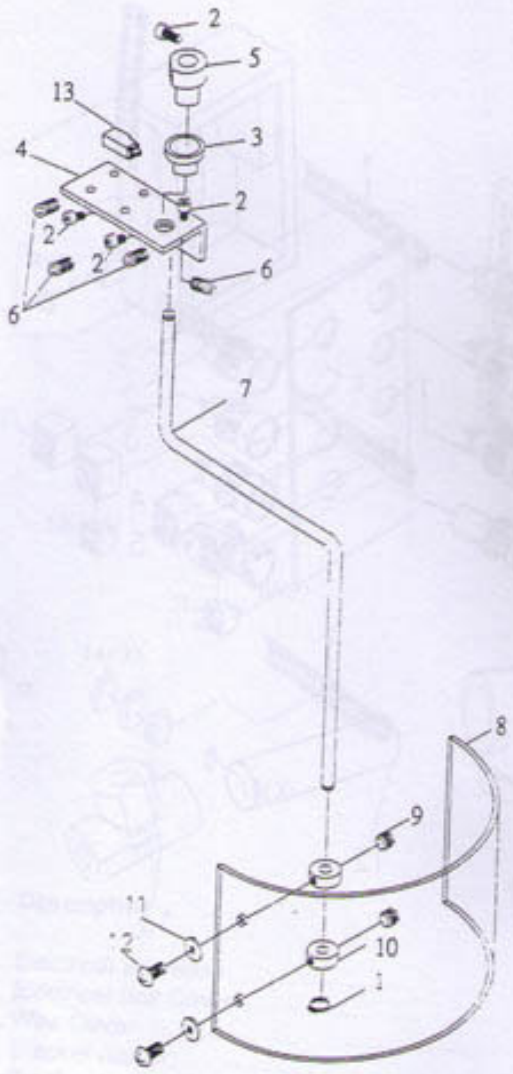
Index No.	Part No.	Description	Size	Qty.
1	JTM4VSE-EB-1E	Electrical Box Base		1
2	JTM4VSE-EB-2E	Electrical Box Cover		1
3	JTM4VSE-EB-3E	Wire Cover		1
4	JTM4VSE-EB-4E	Bracket (upper)		1
5	JTM4VSE-EB-5E	Bracket (middle)		1
6	JTM4VSE-EB-6E	Bracket (lower)		1
7	JTM4VSE-EB-7E	Bracket (right)		1
8	JTM4VSE-EB-8E	Terminal		1
9	JTM4VSE-EB-9E	Door Switch Assembly		1
9-1	JTM4VSE-EB-9-1E	Door Switch		1
9-2	JTM4VSE-EB-9-2E	Door Switch Knob		1
10	JTM4VSE-EB-10E	Contactor (Motor)		1
11	JTM4VSE-EB-11E	Overload (Motor)		2
12	JTM4VSE-EB-12E	Contactor (Pump)		1
13	JTM4VSE-EB-13E	Overload (Pump)		2
14	JTM4VSE-EB-14E	Fuse Bracket		1
15	JTM4VSE-EB-15E	Fuse		3
16	JTM4VSE-EB-16E	Transformer	2A	3
17	JTM4VSE-EB-1AE	Terminal		1
18	JTM4VSE-EB-18E	Lock w/ Key		1
				2

Operation Panel Assembly



Index No.	Part No.	Description	Size	Qty.
1	JTM4VSE-OP-1E	Operation Box		1
2	JTM4VSE-OP-2E	Spindle Stop Switch		1
3	JTM4VSE-OP-3E	Reverse Switch		1
4	JTM4VSE-OP-4E	Power Feed Stop Switch		1
5	JTM4VSE-OP-5E	Emerge Stop Switch		1
6	JTM4VSE-OP-6E	Panel		1
7	JTM4VSE-OP-7E	Power Light		1
8	JTM4VSE-OP-8E	Forward Switch		1
9	JTM4VSE-OP-9E	Power Feed Start Switch		1
10	JTM4VSE-OP-10E	Coolant Pump Switch		1
11	JTM4VSE-OP-11E	Bracket		1
12	JTM4VSE-OP-12E	Support Rod		1
13	JTM4VSE-OP-13E	Bracket		1

Swing Away Safety Shield Assembly



Index No.	Part No.	Description	Size	Q'ty
2	JVM836VSD-SG-02	Hex Socket Cap Screw	M8	4
3	JVM836VSD-SG-03E	Adjusting Bracket		1
4	JVM836VSD-SG-04E	Support Bracket		1
5	JVM836VSD-SG-05E	Turning Bracket		1
6	JVM836VSD-SG-06	Set Screw	M8	4
7	JVM836VSD-SG-07	Turning Rod		1
8	JVM836VSD-SG-08	Clear Plastic Cover		1
9	JVM836VSD-SG-09	Set Screw	5/16"	2
10	JVM836VSD-SG-10	Collar		2
11	JVM836VSD-SG-11	Flat Washer	ø25xt3mm	2
12	JVM836VSD-SG-12	Cross Round Screw	5/16"	2
13	JVM836VSD-SG-13	Limit Switch		1

Electrical Drawing