OPERATOR'S MANUAL

SUPER MAJOR

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⚠WARNING

WEARING PROPER APPAREL. Do not wear clothing, apparel or jewelry that can become entangled in moving parts. Always tie back or cover long hair. Wear non-slip footwear to avoid accidental slips, which could cause loss of work-piece control.

HAZARDOUS DUST. Dust created while using machinery may cause cancer, birth defects, or long-term respiratory damage. Be aware of dust hazards associated with each workpiece material, and always wear an approved respirator to reduce your risk.

HEARING PROTECTION. Always wear hearing protection when operating or observing loud machinery. Extended exposure to this noise without hearing protection can cause permanent hearing loss.

REMOVE ADJUSTING TOOLS. Tools left on machinery can become dangerous projectiles upon startup. Never leave chuck keys, wrenches, or any other tools on machine. Always verify removal before starting!

USE CORRECT TOOL FOR THE JOB. Only use this tool for its intended purpose—do not force it or an attachment to do a job for which it was not designed. Never make unapproved modifications—modifying tool or using it differently than intended may result in malfunction or mechanical failure that can lead to personal injury or death!

AWKWARD POSITIONS. Keep proper footing and balance at all times when operating machine. Do not overreach! Avoid awkward hand positions that make workpiece control difficult or increase the risk of accidental injury.

CHILDREN & BYSTANDERS. Keep children and bystanders at a safe distance from the work area. stop using machine if they become a distraction.

GUARDS & COVERS. Guards and covers reduce accidental contact with moving parts or flying debris. Make sure they are properly installed, undamaged, and working correctly.

FORCING MACHINERY. Do not force machine. it will do the job safer and better at the rate for which it was designed.

NEVER STAND ON MACHINE. Serious injury may occur if machine is tipped or if the cutting tool is unintentionally contacted.

STABLE MACHINE. Unexpected movement during operation greatly increases risk of injury or loss of control. Before starting, verify machine is stable and mobile base (if used) is locked.

USE RECOMMENDED ACCESSORIES. Consult this owner's manual or the manufacturer for recommended accessories. Using improper accessories will increase the risk of serious injury.

UNATTENDED OPERATION. To reduce the risk of accidental injury, turn machine ***OFF*** and ensure all moving parts completely stop before walking away. Never leave machine running while unattended.

MAINTAIN WITH CARE. Follow all maintenance instructions and lubrication schedules to keep machine in good working condition. A machine that is improperly maintained could malfunction, leading to serious personal injury or death.

CHECK DAMAGED PARTS. Regularly inspect machine for any condition that may affect safe operation. Immediately repair or replace damaged or misadjusted parts before operating machine.

MAINTAIN POWER CORDS. When disconnecting cord-connected machines from power, grab and pull the plug—not the cord. Pulling the cord may damage the wires inside. Do not handle cord/plug with wet hands. Avoid cord damage by keeping it away from heated surfaces, high traffic areas, harsh chemicals, and wet/damp locations.

EXPERIENCING DIFFICULTIES. If at any time you experience difficulties performing the intended operation, stop using the machine!

⚠WARNING

Additional Safety for Mill/Drills

UNDERSTANDING CONTROLS. Make sure you understand the use and operation of all controls before starting the mill/drill.

SAFETY ACCESSORIES. To reduce the risk of injury from flying chips, always use a face shield in addition to safety glasses when using the mill/drill.

CLEAN-UP. Metal chips can cut your hands. Do not clear chips by hand or compressed air that can force the chips farther into the machine. Use a brush or vacuum, and never clear chips while the spindle is turning.

SECURING TOOLING. Objects that are thrown by the spinning action of the mill/drill can be deadly missiles. Always firmly secure the cutting tool before starting the machine. Always remove the chuck key, drawbar wrench, and any tools immediately after use.

CUTTING TOOL INSPECTION. Inspect cutting tools for sharpness, chips, or cracks before each use. Replace dull, chipped, or cracked cutting tools immediately. Handle cutting tools with care. Leading edges are very sharp and can cause lacerations.

STOPPING SPINDLE. Serious injury may occur if you try to stop the moving spindle by hand. Do not stop the spindle using your hand or any other object. Allow the spindle to stop on its own.

WORK HOLDING. A workpiece that moves unexpectedly during operation can be ejected from the machine, causing personal injury or property damage. Before starting the machine, be certain the workpiece is properly clamped to the table. NEVER hold the workpiece by hand during operation.

MACHINE CARE AND MAINTENANCE. Never operate the mill/drill with damaged or worn parts that can break apart during operation. Maintain your mill/drill in proper working condition. Perform routine inspections and maintenance promptly. Put tools away after use.

MAINTENANCE/ADJUSTMENTS. To avoid possible electrocution or physical injury, make sure the mill is turned ***OFF***, disconnected from power, and all moving parts have come to a complete stop before changing cutting tools or starting any inspection, adjustment or maintenance procedure.

SPINDLE SPEEDS. For safe and good results, select the spindle speed that is correct for the type of work and material. Allow the spindle to reach full speed before beginning a cut.

POWER DISRUPTION. In the event of a local power outage during operation, turn spindle switch ***OFF*** to avoid a possible sudden start up once power is restored.

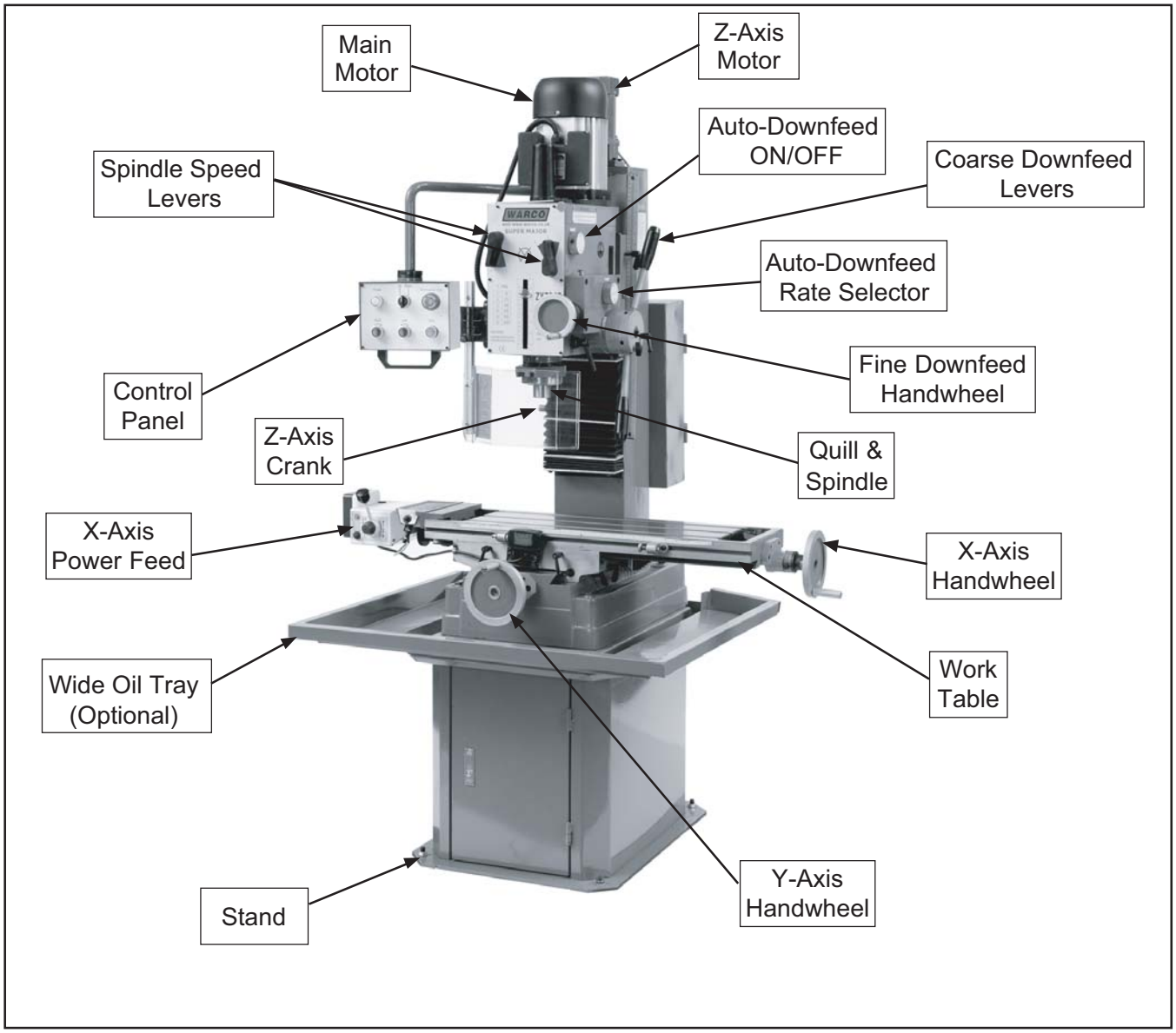
⚠WARNING

Like all machinery there is potential danger when operating this machine. Accidents are frequently caused by lack of familiarity or failure to pay attention. Use this machine with respect and caution to decrease the risk of operator injury. If normal safety precautions are overlooked or ignored, serious personal injury may occur.

⚠CAUTION

No list of safety guidelines can be complete. Every shop environment is different. Always consider safety first, as it applies to your individual working conditions. Use this and other machinery with caution and respect. Failure to do so could result in serious personal injury, damage to equipment, or poor work results.

Identification



SPECIFICATION

Max drilling capacity	30mm
Max end milling capacity	20mm
Max face milling capacity	75mm
Spindle taper	R8
Spindle stroke	125mm
Head tilt left and right	90º - 0º - 90º
Number of spindle speeds	6
Range of spindle speed	75 - 1600 rpm
Table size	800x240mm
Number of T-slots	3
T-slot size	14mm
Longitudinal table travel	550mm
Cross table travel	190mm
Vertical head travel	350mm
Max. distance spindle to column	250mm
Max. distance spindle to table	450mm
Main motor	1.5KW/240V/1PH
Elevation motor	90W/240V/1PH
Weight (machine+stand)	450kg
Shipping Dimesion of stand	680x600x800mm
Shipping Dimesion of machine	900x880x1400mm

NOTICE

The specifications in this manual are given as general information and are not binding. We reserves the right to effect, at any time and without prior notice, changes or alterations to parts, fitting and accessory equipment deemed necessary for any reason whatsoever.

POWER SUPPLY

Availability

Before installing the machine, consider the availability and proximity of the required power supply circuit. If an existing circuit does not meet the requirements for this machine, a new circuit must be installed. To minimize the risk of electrocution, fire, or equipment damage, installation work and electrical wiring must be done by an electrican or qualified service personnel in accordance with all applicable codes and standards.

⚠WARNING

Electrocution, fire, or equipment damage may occur if machine is not correctly grounded and connected to the power supply.

Full-Load Current Rating

The full-load current rating is the amperage a machine draws at 100% of the rated output power. On machines with multiple motors, this is the amperage drawn by the largest motor or sum of all motors and electrical devices that might operate at one time during normal operations.

Full-Load Current Rating at 240V..... 13 Amps

The full-load current is not the maximum amount of amps that the machine will draw. If the machine is overloaded, it will draw additional amps beyond the full-load rating.

If the machine is overloaded for a sufficient length of time, damage, overheating, or fire may result—especially if connected to an undersized circuit. To reduce the risk of these hazards, avoid overloading the machine during operation and make sure it is connected to a power supply circuit that meets the requirements in the following section.

Circuit Requirements for 240V

This machine is prewired to operate on a 240V power supply circuit that has a verified ground and meets the following requirements:

Nominal Voltage	**240V**
Cycle	**50 Hz**
Phase	**1 Phase**
Power Supply Circuit	**13 Amps**

A power supply circuit includes all electrical equipment between the breaker box or fuse panel in the building and the machine. The power sup-ply circuit used for this machine must be sized to safely handle the full-load current drawn from the machine for an extended period of time. (If this machine is connected to a circuit protected by fuses, use a time delay fuse marked D.)

⚠CAUTION

For your own safety and protection of property, consult an electrician if you are unsure about wiring practices or electrical codes in your area.

Note: *The circuit requirements listed in this manual apply to a dedicated circuit—where only one machine will be running at a time. If this machine will be connected to a shared circuit where multiple machines will be running at the same time, consult a qualified electrician to ensure that the circuit is properly sized for safe operation.*

Cleanup

the unpainted surfaces of your machine are coated with a heavy-duty rust preventative that prevents corrosion during shipment and storage. this rust preventative works extremely well, but it will take a little time to clean.

Be patient and do a thorough job cleaning your machine. the time you spend doing this now will give you a better appreciation for the proper care of your machine's unpainted surfaces.

there are many ways to remove this rust preventative, but the following steps work well in a wide variety of situations. Always follow the manufacturer's instructions with any cleaning product you use and make sure you work in a well-ventilated area to minimize exposure to toxic fumes.

before cleaning, gather the following:

- disposable rags
- Cleaner/degreaser (Wd•40 works well)
- safety glasses & disposable gloves
- plastic paint scraper (optional)

basic steps for removing rust preventative:

1. put on safety glasses.

2. Coat the rust preventative with a liberal amount of cleaner/degreaser, then let it soak for 5–10 minutes.

3. Wipe off the surfaces. if your cleaner/degreaser is effective, the rust preventative will wipe off easily. if you have a plastic paint scraper, scrape off as much as you can first, then wipe off the rest with the rag.

4. repeat **Steps 2–3** as necessary until clean, then coat all unpainted surfaces with a quality metal protectant to prevent rust.

⚠WARNING

Gasoline and petroleum products have low flash points and can explode or cause fire if used to clean machinery. Avoid using these products to clean machinery.

⚠CAUTION

Many cleaning solvents are toxic if inhaled. Only work in a well-ventilated area.

NOTICE

Avoid chlorine-based solvents, such as acetone or brake parts cleaner, that may damage painted surfaces.

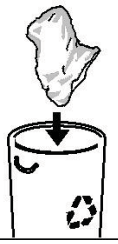
SETUP

Unpacking

Your machine was carefully packaged for safe transportation. Remove the packaging materials from around your machine and inspect it.

Save the containers and all packing materials for possible inspection by the carrier or its agent. *Otherwise, filing a freight claim can be difficult.*

When you are completely satisfied with the condition of your shipment, inventory the contents.



⚠WARNING

SUFFOCATION HAZARD!
Keep children and pets away from plastic bags or packing materials shipped with this machine. Discard immediately.

Needed for Setup

The following are needed to complete the setup process, but are not included with your machine.

Description	Qty
• Additional People	2
• Safety Glasses	1sets/Person
• Cleaner/Degreaser	As Needed
• Disposable Shop Rags	As Needed
• Forklift (rated for at least 3 Ton.)	1
• Solid Steel Rod 25mm Dia. x 1050mm L	2
• Slotted Screwdriver	1

Inventory

The following is a list of items shipped with your machine. Before beginning setup, lay these items out and inventory them.

If any nonproprietary parts are missing (e.g. a nut or a washer), we will gladly replace them; or for the sake of expediency, replacements can be obtained at your local hardware store.

Small Item Inventory (Figure 2):		Qty
A.	Handwheel Handles w/Screws	2
B.	T-Bolts M12-1.75 x 55 w/Washers & Nuts	2
C.	Bottle for Oil	1
D.	Toolbox	1
E.	Open-End Wrenches 17/19, 22/24mm	1 Ea
F.	Hex Wrench Set 2.5, 3, 4, 5, 10mm	1 Ea
G.	Drift Key	1
H.	Drill Chuck B16, 1–13mm w/Chuck Key	1
I.	Spindle Sleeve R-8–MT#3	1
J.	Drill Chuck Arbor R-8–B16	1
K.	Spindle Sleeve MT#3–MT#2	1

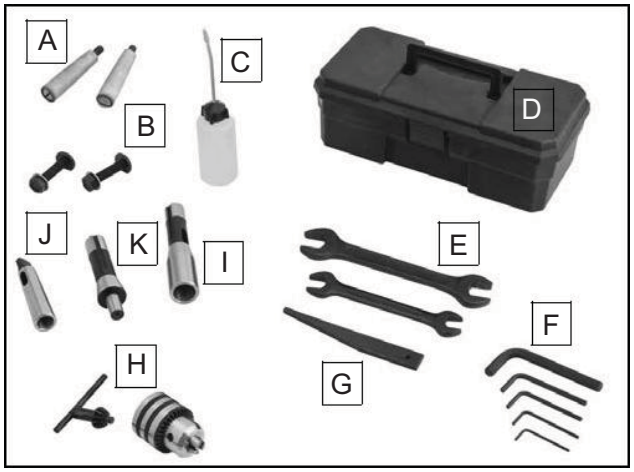


Figure 2. Small item inventor

Site Considerations

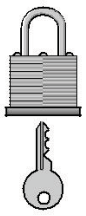
Weight Load

refer to the **Machine Data Sheet** for the weight of your machine. Make sure that the surface upon which the machine is placed will bear the weight of the machine, additional equipment that may be installed on the machine, and the heaviest work-piece that will be used. Additionally, consider the weight of the operator and any dynamic loading that may occur when operating the machine.

Space Allocation

Consider the largest size of workpiece that will be processed through this machine and provide enough space around the machine for adequate operator material handling or the installation of auxiliary equipment. With permanent installations, leave enough space around the machine to open or remove doors/covers as required by the maintenance and service described in this manual.

See below for required space allocation.



⚠CAUTION

children or untrained people may be seriously injured by this machine. Only install in an access restricted location.

Physical Environment

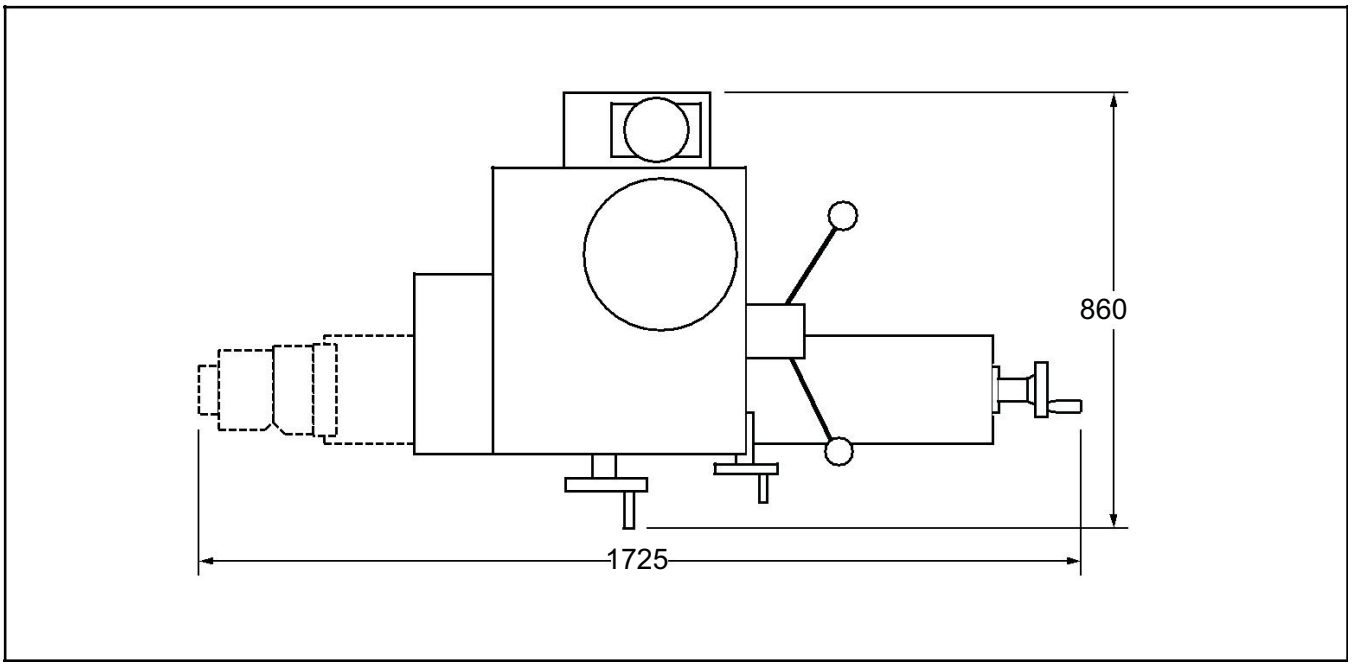
the physical environment where the machine is operated is important for safe operation and longevity of machine components. For best results, operate this machine in a dry environment that is free from excessive moisture, hazardous chemicals, airborne abrasives, or extreme conditions. Extreme conditions for this type of machinery are generally those where the ambient temperature range exceeds 41°–104°F; the relative humidity range exceeds 20% –95% (non-condensing); or the environment is subject to vibration, shocks, or bumps.

Electrical Installation

place this machine near an existing power source. Make sure all power cords are protected from traffic, material handling, moisture, chemicals, or other hazards. Make sure to leave enough space around machine to disconnect power supply or apply a lockout/tagout device, if required.

Lighting

Lighting around the machine must be adequate enough that operations can be performed safely. shadows, glare, or strobe effects that may distract or impede the operator must be eliminated.



Anchoring to Floor

Anchoring machinery to the floor prevents tipping or shifting and reduces vibration that may occur during operation, resulting in a machine that runs slightly quieter and feels more solid.

if the machine will be installed in a commercial or workplace setting, or if it is permanently connected (hardwired) to the power supply, local codes may require that it be anchored to the floor.

if not required by any local codes, fastening the machine to the floor is an optional step. if you choose not to do this with your machine, we recommend placing it on machine mounts, as these provide an easy method for leveling and they have vibration-absorbing pads.

Anchoring to Concrete Floors

Lag shield anchors with lag screws (see below) are a popular way to anchor machinery to a concrete floor, because the anchors sit flush with the floor surface, making it easy to unbolt and move the machine later, if needed. however, anytime local codes apply, you Must follow the anchoring methodology specified by the code.

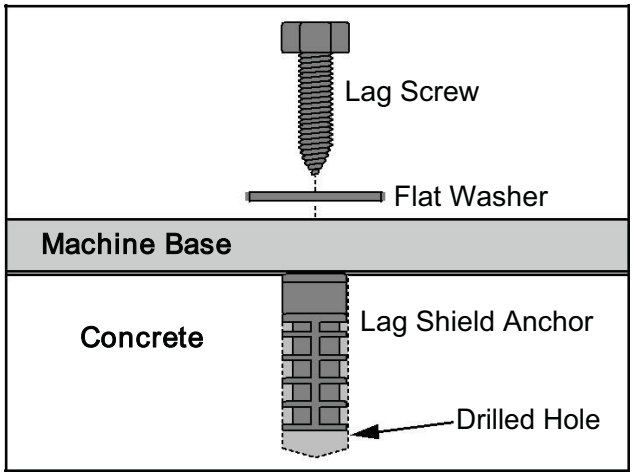


Figure 3. Popular method for anchoring machinery to a concrete floor.

Assembly

Except for the handwheel handles, the mill/drill was fully assembled at the factory.

Use a slotted screwdriver to attach the handwheel handles, as shown in **Figure 4**.

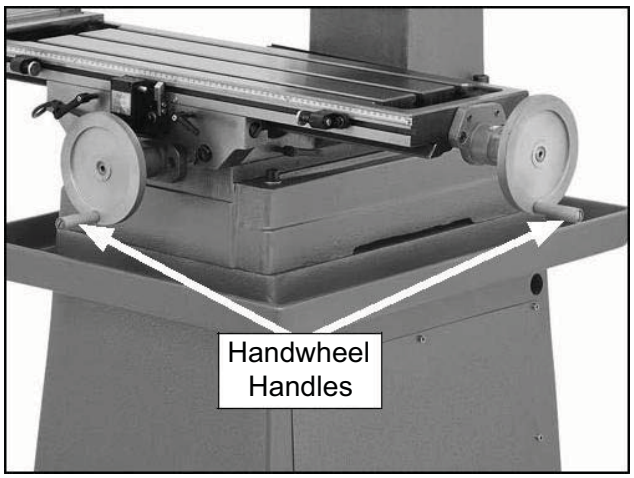


Figure 4. Handwheel handles attached.

Joining Drill Chuck & Arbor

An arbor is included for the drill chuck that comes with thi s m achine. The fol lowing pr ocedure describes how to install the arbor in the chuck.

After the ar bor is installed in the drill chuck, it is very di fficult to s eparate the as sembly. If you would like to use a different chuck in the future, we recommend obtaining a new arbor.

Important: *DO N OT i nstall t he dr ill c huck and arbor assembly into the spindle until AFTER the test run.*

To join the drill chuck and arbor:

1. Use acetone or lacquer thinner to clean drill chuck and arbor mating surfaces, especially the bore.

2. Retract chuck jaws completely into chuck.

3. Insert small end of arbor into chuck.

4. Hold as sembly by the ar bor and t ap c huck onto a block of wood with medium force, as illustrated in **Figure 5**.

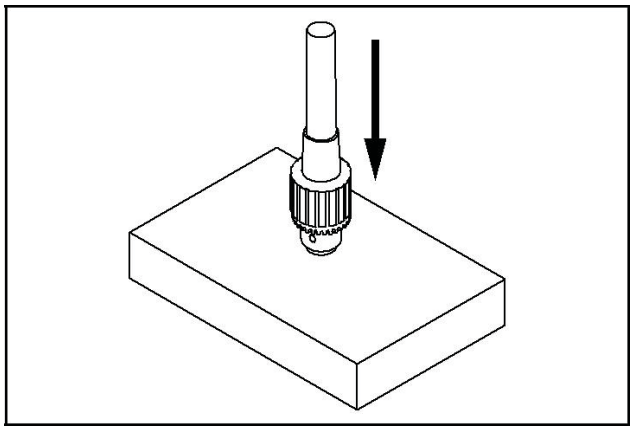


Figure 5. Tapping drill chuck/arbor on block of wood.

5. Attempt to separate drill chuck and arbor by hand—-if they separate, repeat **Steps 3–4**.

Lubricating Mill/Drill

The heads tock o il r eservoir m ust be pr operly filled with oil before the m ill/drill can be oper ated for the first time.

Damage c aused by r unning the m ill/drill w ithout the pr oper amount of oi l in the r eservoir will n ot be covered under warranty.

Test Run

The purpose of the test run is to verify that the machine functions properly and is ready for regular operation.

Before beginning this procedure, make sure: (1) you understand the safety instructions at the beginning of this manual, (2) the machine is set up properly, and (3) all tools and objects used during setup are cleared away from the machine.

IMPORTANT: If the machine or its components do not function as described, or if the machine has unusual noises or vibrations, immediately turn it *OFF* and disconnect power.

For your convenience, a **Troubleshooting** table is provided on the manual.

To test run the machine:

1. Push Emergency Stop button (see **Figure 6**).

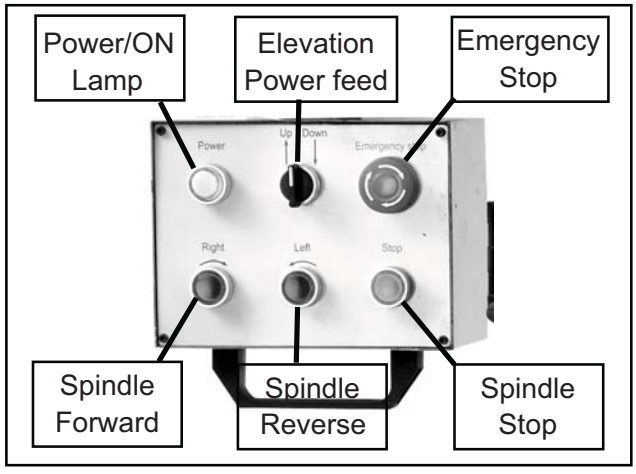


Figure 6. Control panel.

2. Rotate Elevation Power Feed switch to OFF.

3. Connect machine to power source by inserting power cord plug into matching receptacle.

4. Twist Emergency Stop button clockwise until it pops out—this resets the switch so the machine can be started (see **Figure 7**).

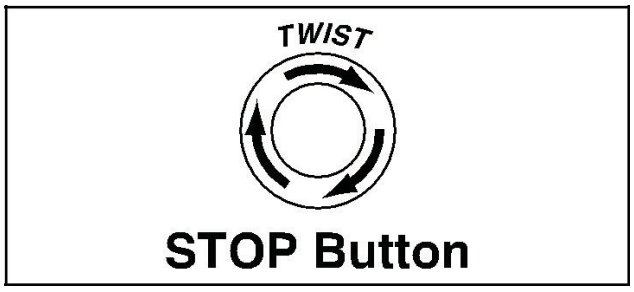


Figure 7. Resetting the switch.

5. Push the Power Lamp/ON button to enable power to the motor—the lamp should light.

6. Push Spindle Forward button to start machine. A correctly operating machine runs smoothly with little or no vibration or rubbing noises.

7. Press Emergency Stop button to stop machine.

8. WITHOUT resetting Emergency Stop button, press Spindle Forward button—the machine should not start.

   —If the machine *does* start (with the Emergency Stop button pushed in), immediately disconnect machine from power.

   the Emergency Stop button safety feature is not working correctly. This safety feature must work properly before proceeding with regular operations.

9. Reset Emergency Stop button and use Elevation Power Feed switch to raise and lower headstock.

The Test Run is complete. Before beginning any regular operations, perform the **Spindle Break-** procedure on the next page.

Spindle Break-In

Before placing operation loads on the spindle, complete this break-in procedure to fully distribute lubrication throughout the bearings and ensure trouble-free performance.

> ***NOTICE***
>
> **Failure to complete the spindle break-in process may lead to premature failure of the bearings—this will not be covered under warranty.**

To perform the spindle break-in procedure:

1. Make sure the spindle is completely stopped, then set spindle speed to 75 RPM

> ***NOTICE***
>
> **Do not leave the mill/drill unattended during the Spindle Break-In procedure. If your attention is needed elsewhere during this procedure, stop the mill/drill and restart the procedure later from the beginning.**

2. Run machine for a minimum of 10 minutes.

3. Repeat **Step 2** for each spindle speed, working to progressively higher speeds.

Note: *If the machine is new, we recommend changing the headstock oil while it is still warm and any particles from the manufacturing process are still in suspension.*

The spindle break-in is now complete!

Inspections & Adjustments

The following list of adjustments were performed at the factory before the machine was shipped:

- Gib Adjustments.....
- Leadscrew Backlash Adjustments.....
- Return Spring Tension.....

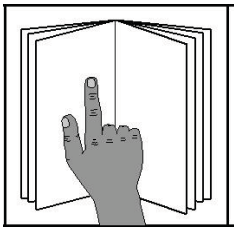
Be aware that machine components can shift during the shipping process. Pay careful attention to these adjustments during operation of the machine. If you find that the adjustments are not set according to the procedures in this manual or your personal preferences, re-adjust them.

OPERATIONS

Operation Overview

The purpose of this overview is to provide the novice machine operator with a basic understanding of how the machine is used during operation, so the machine controls/components discussed later in this manual are easier to understand.

Due to the generic nature of this overview, it is **not** intended to be an instructional guide. To learn more about specific operations, read this entire manual and seek additional training from expe-rienced machine operators, and do additional research outside of this manual by reading "how-to" books, trade magazines, or websites.

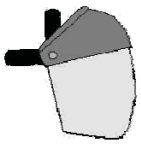


⚠WARNING

To reduce your risk of serious injury, read this entire manual BEFORE using machine.

⚠WARNING

To reduce risk of eye or face injury from flying chips, always wear approved safety glasses and a face shield when operating this machine.



NOTICE

If you are not experienced with this type of machine, WE STRONGLY RECOMMEND that you seek additional training outside of this manual. Read books/magazines or get formal training before beginning any projects. Regardless of the content in this section, Wel will not be held liable for accidents caused by lack of training.

To complete a typical operation, the operator does the following:

1. Examines workpiece to make sure it is suitable for cutting.
2. Puts on protective gear.
3. Securely clamps workpiece to table.
4. With machine disconnected from power, installs correct cutting tool.
5. Adjusts headstock height above table.
6. Without the machine running, checks range of table or spindle movement to make sure setup is safe and correct for operation.
7. Selects correct spindle speed.
8. Connects machine to power and turns it ***ON***.
9. Uses downfeed controls or table controls to perform cutting operation.
10. Turns machine ***OFF*** and waits for spindle to completely stop before removing workpiece.

Control Panel

Refer to **Figure 8** and the following descriptions to become familiar with the control panel functions.

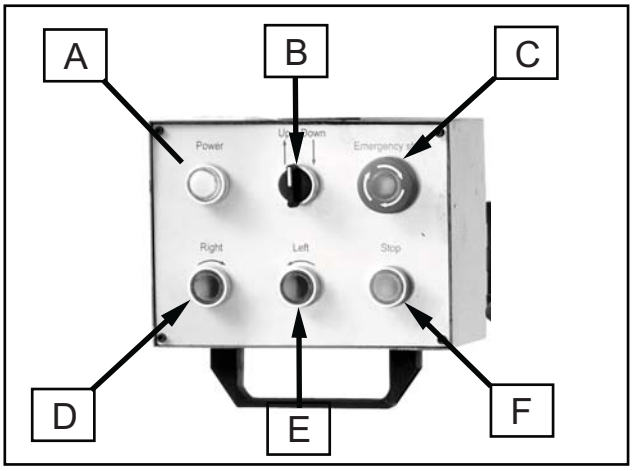


Figure 8. Control panel components

A. Power/ON Lamp Button: Lights when machine is connected to power. Push this button to enable power to the motor.

B. Elevation (Z-Axis) Power Feed Switch: Controls headstock elevation.

C. Emergency Stop Button: Cuts power to spindle and Z-axis motors. This button does NOT disconnect machine from power.

D. Spindle Forward Button: Starts clockwise spindle rotation.

E. Spindle Reverse Button: Starts counter-clockwise spindle rotation.

F. Spindle Stop Button: Stops spindle motor.

Downfeed Controls

Downfeed Controls

Use **Figure 9** and the descriptions below to identify the downfeed controls that are referred to in the following procedures.

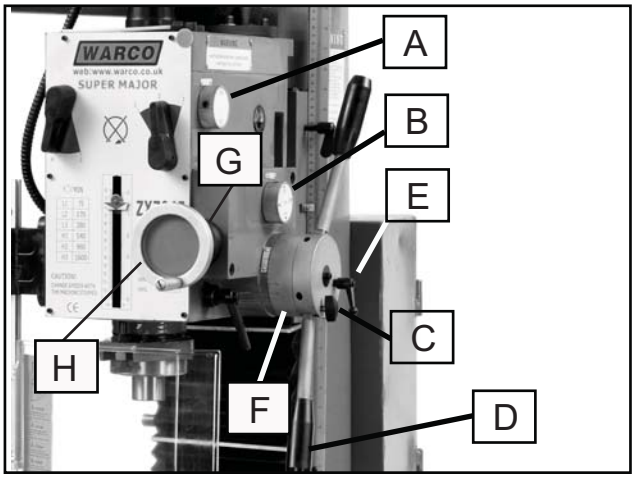


Figure 9. Identification of downfeed controls.

A. Auto-Downfeed ON/OFF Knob

B. Auto-Downfeed Rate Selector Knob

C. Coarse Handle Lock-Down Thumb Screw

D. Coarse Downfeed Handle

E. Depth Graduated Dial Lock Handle

F. Depth Graduated Dial

G. Fine Downfeed Graduated Dial

H. Fine Downfeed Handwheel

Coarse Downfeed

Use the coarse downfeed handles to control spindle travel in rapid, large amounts for milling/drilling.

To use coarse downfeed:

1. Make sure spindle is completely stopped.
2. Loosen depth graduated dial lock handle (E).
3. Rotate depth graduated dial (F) to limit downfeed depth, then retighten lock handle.
4. Rotate auto-downfeed ON/OFF knob (**A**) and auto-downfeed rate selector knob (**B**) counterclockwise to OFF positions.
5. Push coarse downfeed handles (D) *toward* headstock and tighten coarse handle lock-down thumb screw (C) to hold them in place.
6. Rotate mode selection switch on control panel to Drilling/Milling position.
7. Start spindle rotation and use coarse downfeed handles to control spindle travel.

Fine Downfeed

Use the fine downfeed handwheel to control spindle travel in slow, small amounts for milling/drilling.

To use fine downfeed:

1. Make sure spindle is completely stopped.
2. Loosen depth graduated dial lock handle (E).
3. Loosen coarse handle lock-down thumb screw (C) and pull coarse downfeed handles (D) *away* from headstock.
4. Rotate auto-downfeed ON/OFF knob (**A**) and auto-downfeed rate selector knob (**B**) coun-terclockwise to OFF positions.
5. Rotate depth graduated dial (F) to limit downfeed depth, then retighten lock handle.

6. Rotate mode selection switch on control panel to Drilling/Milling position.

7. Start spindle rotation and use fine downfeed handwheel (H) to control spindle travel.

   Note: *Use the fine downfeed graduated dial (G) and the attached thumb screw to measure the relative amount of spindle travel.*

Auto-Downfeed

The auto-downfeed feature uses headstock gears to control powered downfeed in rates of 0.10, 0.18, and 0.26 mm per spindle revolution.

To use auto-downfeed:

1. Make sure spindle is completely stopped.

2. Loosen depth graduated dial lock handle (E). This will disengage depth graduated dial from the operation.

3. Rotate auto-downfeed ON/OFF knob (A) to ON position.

4. Rotate auto-downfeed rate selector knob (B) clockwise to desired downfeed rate.

5. Loosen coarse handle lock-down thumb screw (C) and pull coarse downfeed handles (D) *away* from headstock.

6. Rotate mode selection switch on control panel to Drilling/Milling position.

NOTICE

When using auto- downfeed, the spindle will not automatically stop or reverse when it reaches the bottom depth of travel. To avoid machine damage, manually stop spindle rotation before this happens.

7. Start spindle forward rotation to engage the auto-downfeed.

8. When desired depth of spindle travel is reached, stop spindle travel.

9. Push coarse downfeed handles *toward* headstock and use them to return spindle to top.

Depth Digital Display

The depth digital display on the headstock displays the relative spindle depth.

Use **Figure 9.1**and the following descriptions to gain an understanding of the display controls.

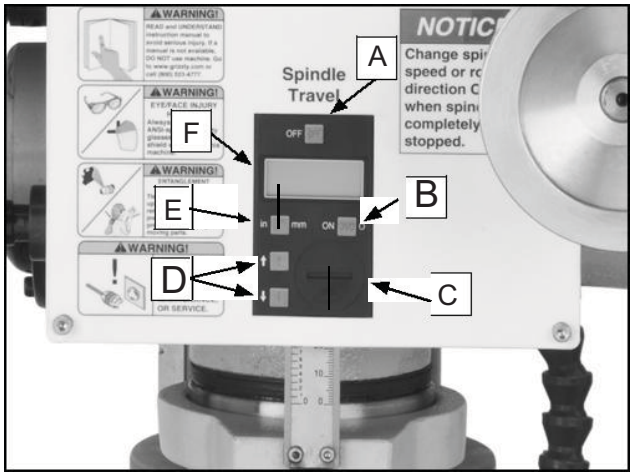


Figure 9.1 Depth digital display controls.

A. OFF Button

B. ON/0 Button: Turns display ***ON***. When the display is ON, zeros the display.

C. Battery Compartment: Holds the CR2032 3V lithium cell battery that powers the unit.

D. Up/Down Buttons: Adjusts the display reading when pressed.

E. In/mm Button: Alternates the display between inch and millimeter measurements.

F. LED Digital Display

Headstock Movement

The headstock travels up and down the column, and tilts 90° left and right relative to the table.

Raising/Lowering Headstock

Loosen the lock handles shown in **Figure 10**, then use the Elevation (Z-Axis) Switch (see **Figure 11**) on the control panel to raise/lower the headstock.

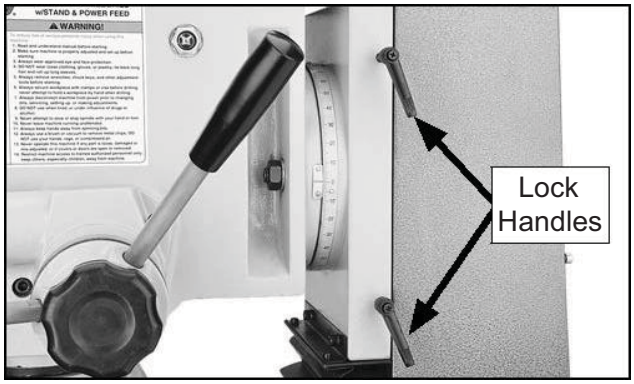


Figure 10. Lock handles for headstock elevation.

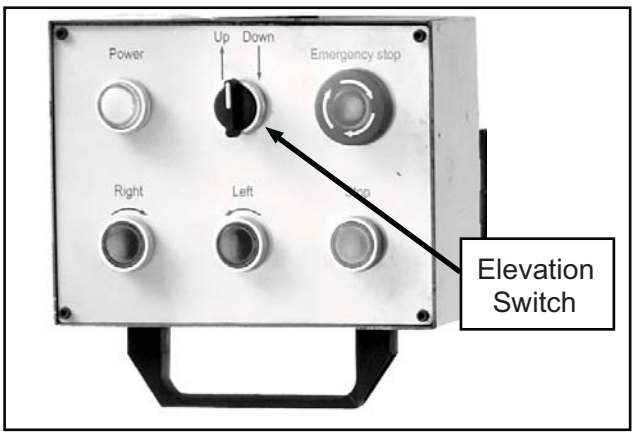


Figure 11. Elevation switch that controls motorized head travel.

⚠CAUTION

The Z- axis crank will rotate rapidly and may cause impact injuries if left attached during powered Z-axis operation. Always remove Z-axis crank before using the switch on the control panel.

The limit stops shown in **Figure 12** stop headstock travel when contacted by the limit block.

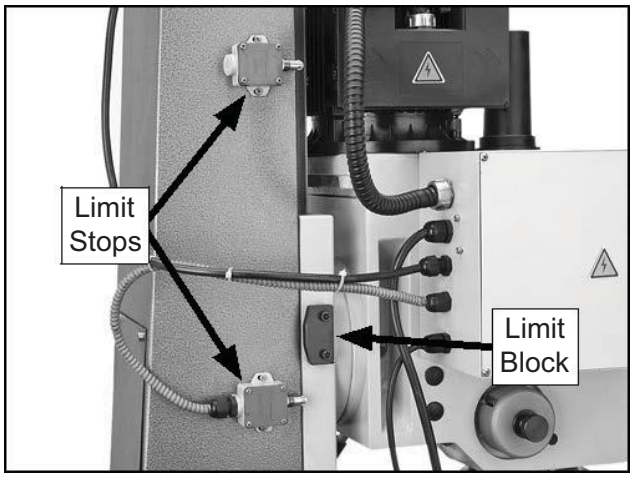


Figure 12. Z-axis limit controls.

The headstock can also be raised/lowered by hand using the crank shown in **Figure 13**.

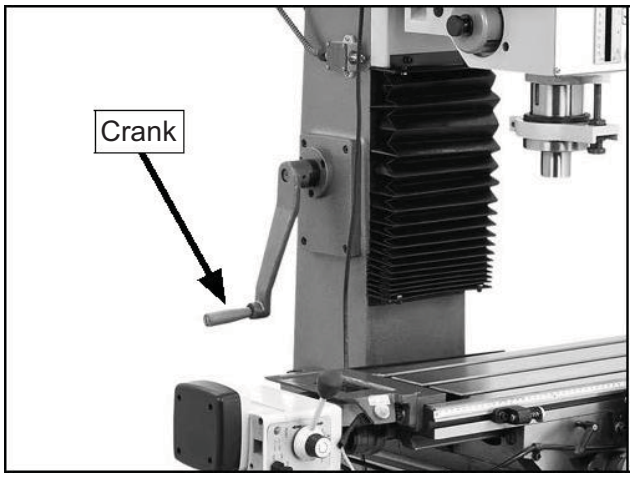


Figure 13. Z-axis crank.

Note: *Lock the headstock in place by re-tightening the lock handles before beginning operation to avoid unexpected headstock movement.*

Tilting Headstock

1. Use a 22mm wrench to loosen the three locking hex nuts (see **Figures 14–15**), then tilt headstock to desired angle on tilt scale.

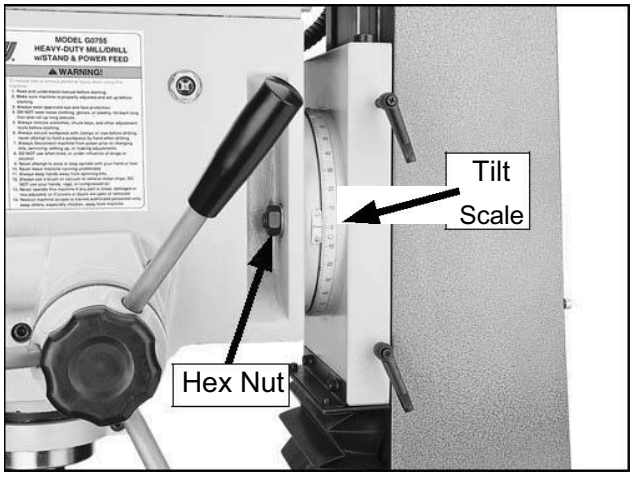


Figure 14. Tilt locking hex nut (one on each side of head).

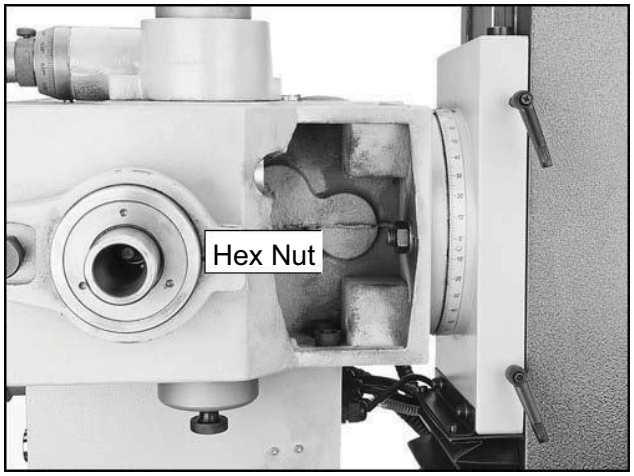


Figure 15. Hex nut underneath head.

2. Lock headstock in place by re-tightening the three hex nuts.

NOTICE

When tilting the head back to 90°, you will need to tram the spindle with the table to ensure that it is set perfectly.

Table Travel

The table travels in two directions, as illustrated in **Figure 16**. These movements are controlled by handwheels and the X-axis power feed. When using the power feed, travel is limited by the position of the limit stops along the front of the table.

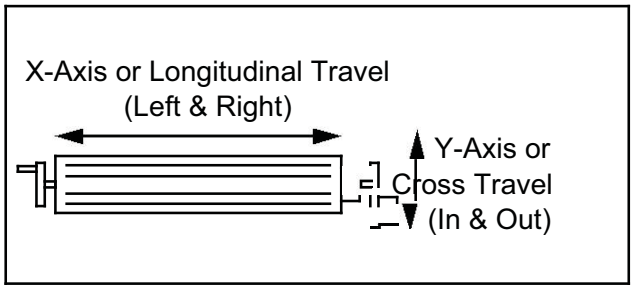


Figure 16. The directions of table movement.

Graduated Dials

The handwheels have graduated scales that are used to determine table movement in 0.001" or 0.05mm increments. One full revolution of the handwheel equals 0.100" or 3mm of table movement.

Loosen the locking thumb screw shown in **Figure 17**, adjust the graduated dial to "zero" it for a relative starting point, then re-tighten the thumb screw.

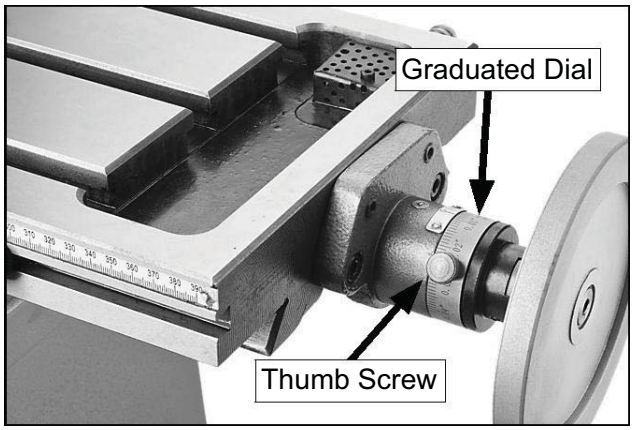


Figure 17. Graduated dial and locking thumb screw.

X- & Y-Axis Handwheels

Use **Figure 18** and the following descriptions to become familiar with the X- and Y-axis manual table movement.

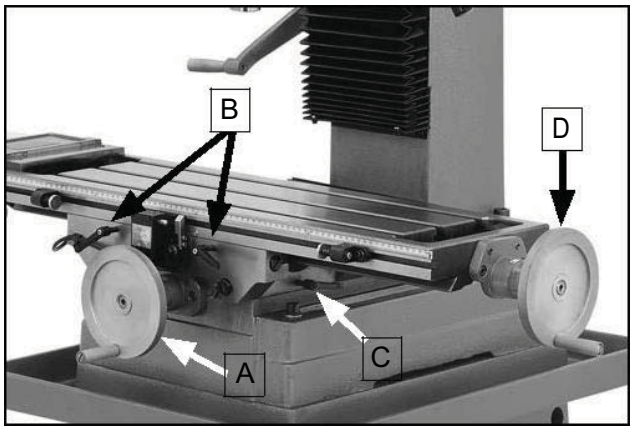


Figure 18. Table locks and limit stops.

A. **Y-Axis Handwheel:** Moves table back and forth.

B. **X-Axis Table Locks:** Increase rigidity of table when X-axis movement is not required for operation.

C. **Y-Axis Table Lock:** Increase rigidity of table when Y-axis movement is not required for operation.

D. **X-Axis Handwheel:** Moves table side to side.

X-Axis Power Feed

Use **Figures 19–20** and the following descriptions to become familiar with the power feed controls.

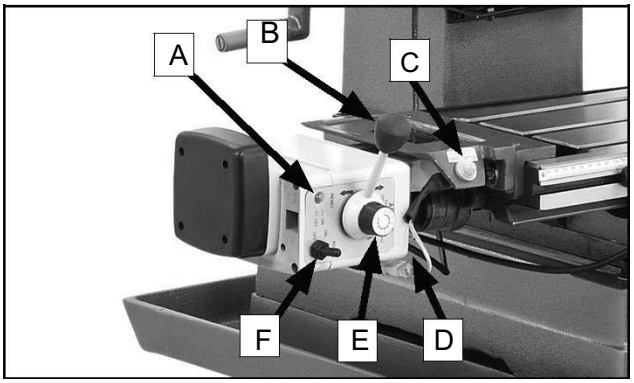


Figure 19. X-axis power feed controls.

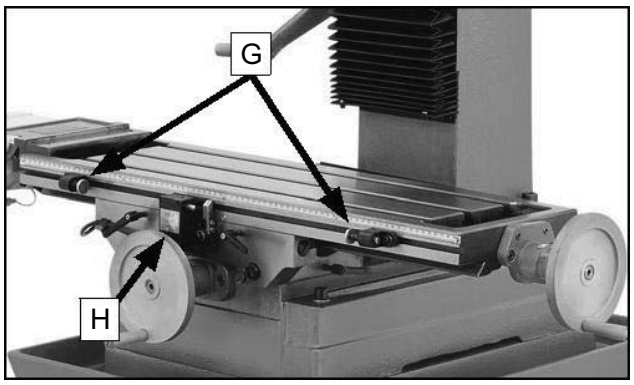


Figure 20. Limit switch and limit stops.

A. **ON/OFF Light:** Lights when unit is turned *ON*.

B. **Direction Lever:** Controls direction of powered table travel.

C. **Rapid Switch:** When held down, moves table rapidly in chosen direction.

D. **Power Light:** Lights when unit is connected to power.

E. **Speed Dial:** Controls rate of power feed.

F. **ON/OFF Switch**

G. **X-Axis Limit Stops:** Adjustable along front of table to restrict X-axis table movement, particularly when using the power feed.

H. **Limit Switch:** Stops power fed when contacted by a limit stop.

Installing/Removing Tooling

The mill is includes the following spindle tools (see **Figure 21**):

A. **1-16mm/B16 Drill Chuck:** Use with drill bits.

B. **R-8–MT#3 Spindle Sleeve**: Use with MT#3 tooling with or without a tang. Has a drift key slot for tool removal.

C. **MT#3–B16 Taper Shank:** Use with the MT#3-B16 taper shank for B16 drill chuck. Has a drift key slot for tool removal.

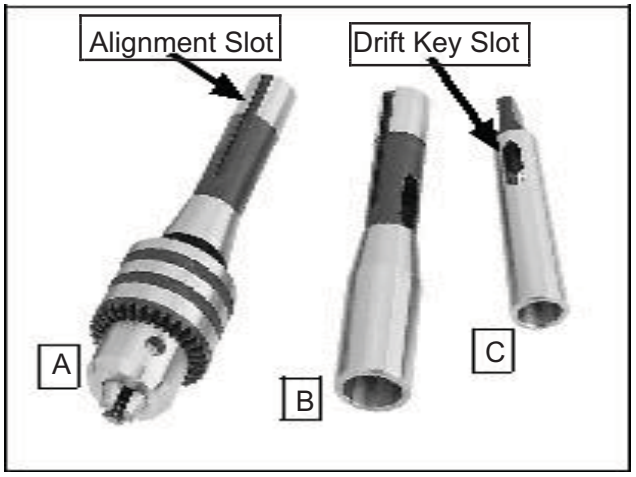


Figure 21. Drill chuck and arbors

⚠CAUTION

Cutting tools are sharp and can easily cause laceration injuries. Always protect your hands with leather gloves or shop rags when handling cutting tools.

Installing Tool Holder

Tool Needed **Qty**

Wrench 19mm 1

To install tool holder:

1. DISCONNECT MACHINE FROM POWER!

2. Remove drawbar cap as shown in **Figure 22**.

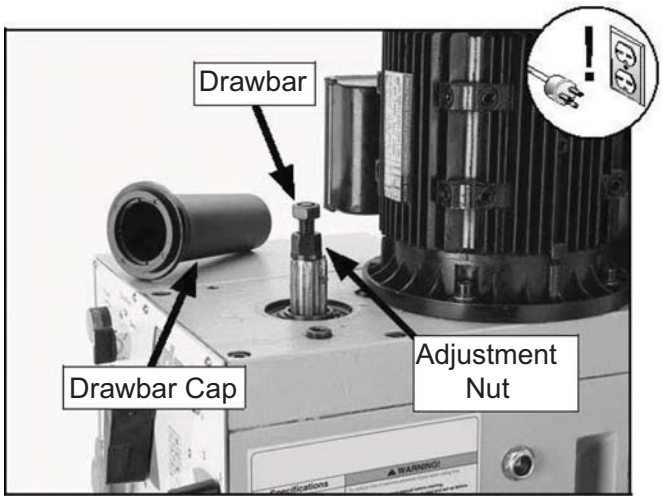


Figure 22. Drawbar components.

3. Align tool holder alignment slot (see **Figure 21**) with pin inside spindle, then insert tool holder into spindle until it contacts drawbar.

   Note: *Drawbar height inside spindle can be changed by rotating the adjustment nut (see **Figure 22**).*

4. Working from the top, hand-thread drawbar into tool holder until snug, then use a 19mm wrench to tighten it.

   Note: *DO NOT over tighten drawbar. Over tightening makes tool holder removal difficult and could damage arbor and drawbar threads.*

5. Re-install drawbar cap.

Removing Tool Holder

Tools Needed	Qty
Wrench 19mm	1
Brass or Dead Blow Hammer.	1

To remove tool holder:

1. DISCONNECT MACHINE FROM POWER!

2. Remove drawbar cap, and only unthread drawbar from tool holder one full rotation.

   Note: *Do not fully unthread tool holder from drawbar, or drawbar and tool holder threads could be damaged during the next step.*

3. Tap top of drawbar with hammer to unseat taper.

4. Hold onto tool holder with one hand and fully unthread drawbar with the other hand.

Spindle Speed

Using the correct spindle speed is important for safe and satisfactory results, as well as maximizing tool life.

To set the spindle speed for your operation, you will need to: 1) Determine the best spindle speed for the cutting task, and 2) configure the spindle speed levers to produce the required spindle speed.

Determining Spindle Speed

Many variables affect the optimum spindle speed to use for any given operation, but the two most important are the recommended cutting speed for the workpiece material and the diameter of the cutting tool, as noted in the formula shown in **Figure 23**.

$$\frac{{}^{*}\text{Recommended Cutting Speed (FPM)} \times 12}{\text{Tool Dia. (in inches)} \times 3.14} = \text{Spindle Speed (RPM)}$$

*Double if using carbide cutting tool

Figure 23. Spindle speed formula for mill/drills.

Cutting speed, typically defined in feet per minute (FPM), is the speed at which the edge of a tool moves across the material surface.

A recommended cutting speed is an ideal speed for cutting a type of material in order to produce the desired finish and optimize tool life.

The books **Machinery's Handbook** or **Machine Shop Practice**, and some internet sites, provide excellent recommendations for which cutting speeds to use when calculating the spindle speed. These sources also provide a wealth of additional information about the variables that affect cutting speed and they are a good educational resource.

Also, there are a large number of easy-to-use spindle speed calculators that can be found on the internet. These sources will help you take into account the applicable variables in order to determine the best spindle speed for the operation.

Setting Spindle Speed

The chart below explains how to position the spindle range and speed levers to set the desired spindle speed.

Spindle Speed	Range Lever	Speed Lever
75 RPM	L	1
170 RPM	L	2
280 RPM	L	3
540 RPM	H	1
960 RPM	H	2
1600 RPM	H	3

NOTICE

Changes spindle speed only when the spindle is completely stopped. Otherwise machine damage could occur.

With the spindle completely stopped, position the spindle range and speed levers (see **Figure 24**) to set the spindle speed.

Note: *If the levers will not move to the desired position, rotate the spindle by hand while applying pressure on the lever. When the gear teeth align, the lever will move into place.*

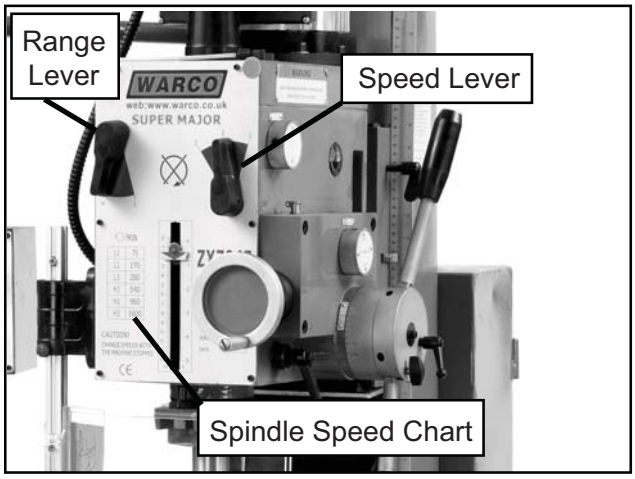
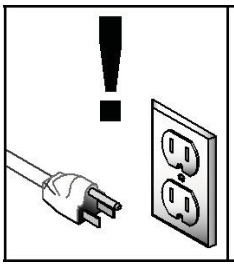


Figure 24. Spindle speed controls.

MAINTENANCE



⚠WARNING
To reduce risk of shock or accidental startup, always disconnect machine from power before adjustments, maintenance, or service.

Schedule

For optimum performance from your machine, follow this maintenance schedule and refer to any specific instructions given in this section.

Daily Check:
- Loose mounting bolts.
- Damaged tooling.
- Worn or damaged wires.
- Clean debris and built up grime off of machine.
- Any other unsafe condition.

Every 8 Hours of Operation:
- Check/add headstock oil
- Lubricate ball oilers
- Lubricate table/column ways and quill

•

Every 40 Hours of Operation:
- Lubricate table leadscrews.

Every 90 Days of Operation:
- Lubricate quill rack and pinion.
- Lubricate Z-axis leadscrew.

Annually:
- Change headstock oil.

Cleaning and Protecting

Metal chips left on the machine will invite oxidation and a gummy residue build-up around the moving parts. Use a brush and shop vacuum to remove chips and debris from the working surfaces of the mill/drill. Never blow off the mill/drill with compressed air, as this will force metal chips deep into the mechanisms and may cause injury to yourself or bystanders.

Remove any rust build-up from unpainted cast iron surfaces of your mill/drill and treat with a non-staining lubricant after cleaning.

Keep unpainted cast iron surfaces rust-free with regular applications of way oil

Lubrication

An essential part of lubrication is cleaning the components before lubricating them.

This step is critical because grime and chips build up on lubricated components, which makes them hard to move. Simply adding more lubricant will not result in smooth moving parts.

Clean all exterior components in this section with mineral spirits, shop rags, and brushes before lubricating.

DISCONNECT MACHINE FROM POWER BEFORE PERFORMING LUBRICATION.

NOTICE

Follow reasonable lubrication practices as outlined in this manual. Failure to do so could lead to premature failure of your machine and will void the warranty.

Headstock Reservoir

Check/Add Frequency..... 8 Hrs. of Operation
Change Frequency..... Annually

The headstock has the proper amount of oil when the sight glass is halfway full (see **Figure 25**).

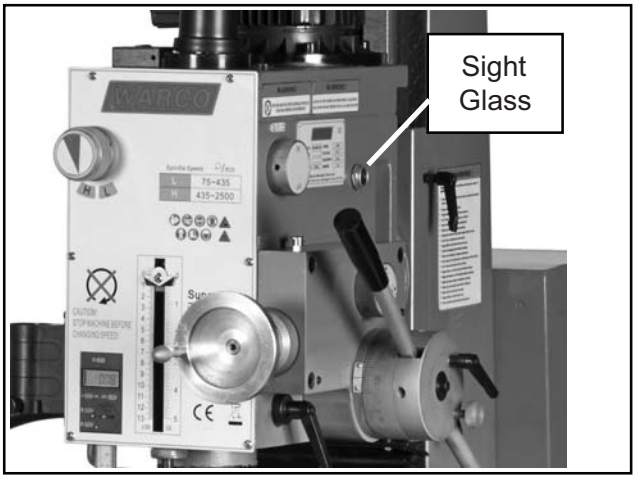


Figure 25. Headstock sight glass.

Tool Needed	Qty
Hex Wrench 8mm..	1

To change the headstock oil:

1. Run the spindle at 540rpm approximately 10 minutes to warm the oil.

2. DISCONNECT MACHINE FROM POWER!

3. Remove the fill plug (see **Figure 26**).

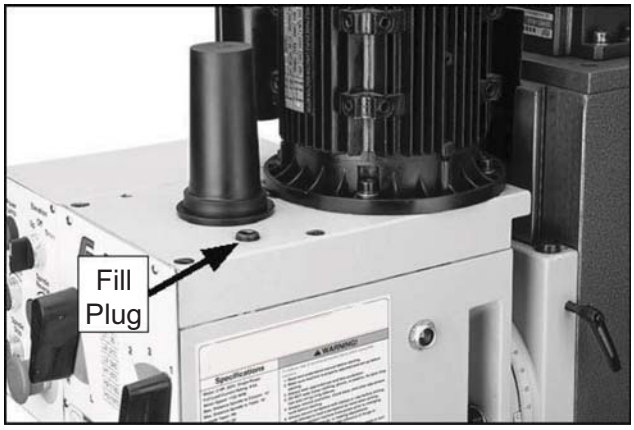


Figure 26. Headstock oil fill plug.

4. Place a larger drain pan on the table under the headstock.

5. Remove the drain plug (see **Figure 27**) from underneath the headstock. Allow the oil to completely drain into the pan.

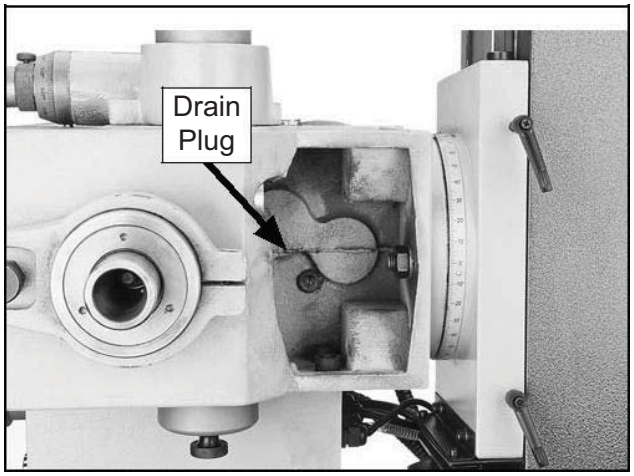


Figure 27. Headstock drain plug (headstock tilted 90° for clarity).

NOTICE

Follow federal, state, and local requirements for proper disposal of used oil.

6. Replace the drain plug.

7. Add oil until the sight glass is halfway full, then replace the fill plug.

8. Clean up any spilled oil to prevent slipping hazards.

Ball Oilers

Lubrication Frequency..... 8 Hrs. of Operation

Proper lubrication of ball oilers (shown in **Figures 27–28**) is done with a pump-type oil can that has a plastic or rubberized cone tip. We do not recommend using metal needle or lance tips, as they can push the ball too far into the oiler, break the spring seat, and lodge the ball in the oil galley.

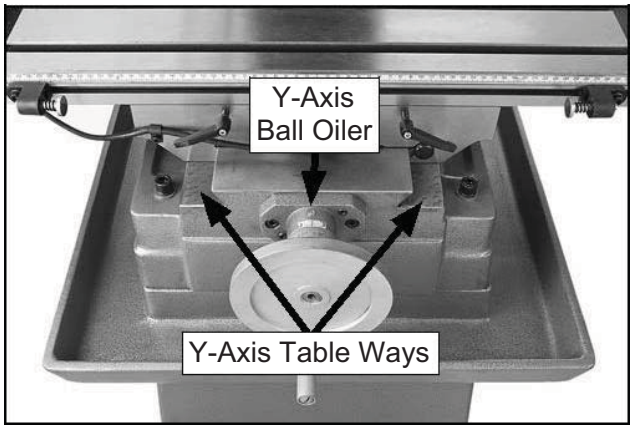


Figure 27. Y-axis ball oiler and ways.

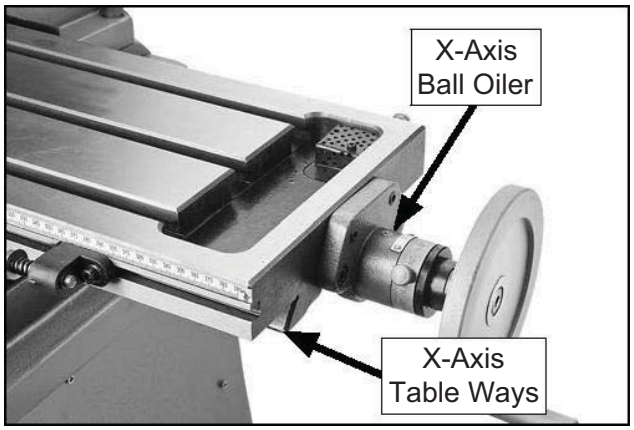


Figure 28. X-axis ball oiler and ways.

Push the tip of the oil can nozzle against the ball oiler to create a hydraulic seal, then pump the oil can once or twice. if you see sludge and contami-nants coming out of the lubrication area, continue pumping the oil can until the oil runs clear. When finished, wipe away the excess oil.

Table/Column Ways & Quill

Oil Amount..... Thin Coat
Lubrication Frequency..... 8 Hrs. of Operation

Refer to **Figures 27–30** to identify each component to lubricate.

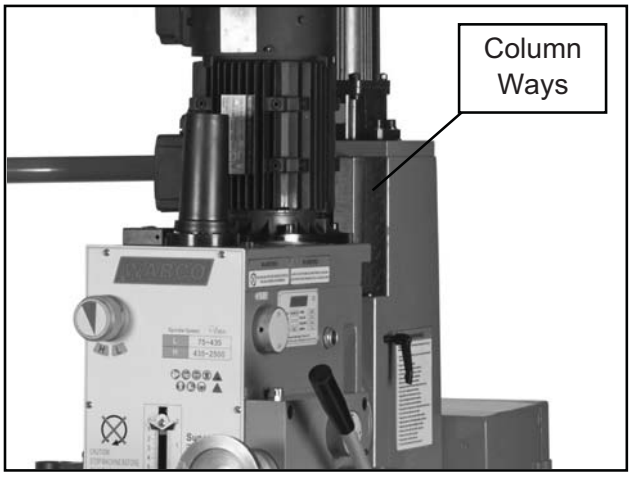


Figure 29. Column ways.

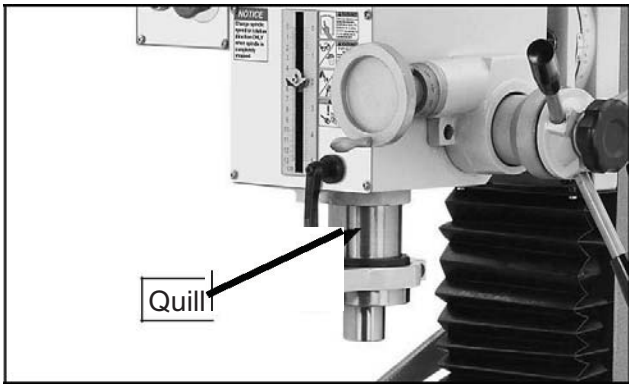


Figure 30. Outside surface of the quill.

Use the component controls to access the entire length of the surfaces, then clean them with mineral spirits and shop rags.

When dry, apply a thin coat of oil to the surfaces. Move each component through the entire path of travel several times to distribute the lubricant.

Table Leadscrews

Oil Type..... Grease
Oil Amount..... Thin Coat
Lubrication Frequency..... 40 Hrs. of Operation

Move the table as necessary to access the entire length of the X-axis and Y-axis leadscrews (see **Figures 31–32**), then use mineral spirits, shop rags, and a brush to clean them.

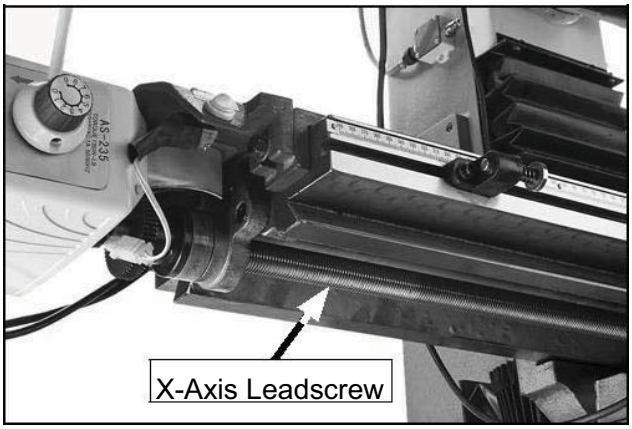


Figure 31. X-axis leadscrew.

Note: *Use a 4mm hex wrench to remove the way cover from the column and access the Y-axis leadscrew.*

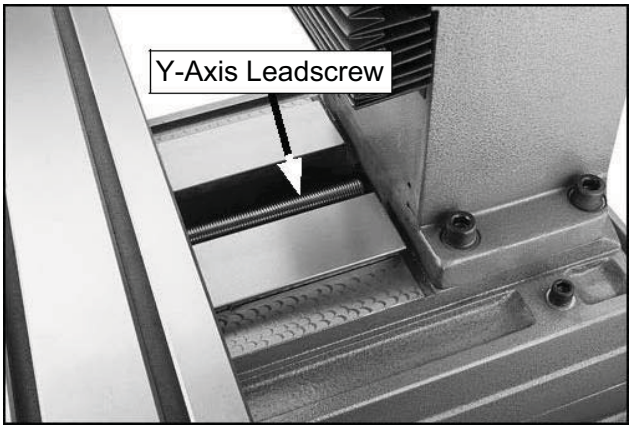


Figure 32. Y-axis leadscrew.

Use a clean brush to apply a thin coat of oil to the leadscrew threads, then move the table through the X- and Y-axis paths to distribute the oil.

Replace the way cover before connecting the machine to power.

Quill Rack & Pinion

Oil Type..... Grease
Oil Amount..... Thin Coat
Lubrication Frequency..... 90 Days of Operation

Move the quill up and down to gain full access to the rack and pinion (see **Figure 33**), then clean the teeth with mineral spirits, shop rags, and a brush.

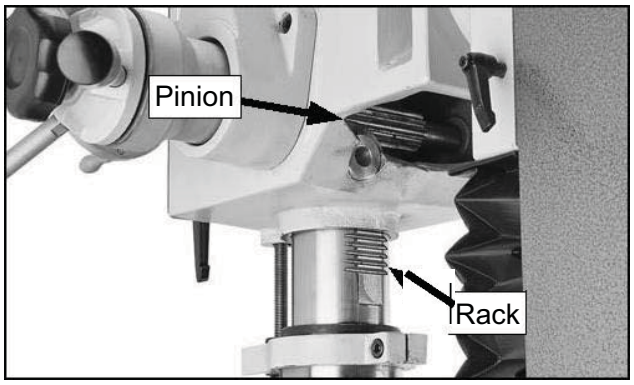


Figure 33. Quill rack and pinion.

Use a brush to apply a thin coat of grease to the teeth, then raise/lower the quill several times to distribute the grease.

Note: *Re-apply oil to the smooth outside surface of the quill that was removed during the cleaning process.*

Z-Axis Leadscrew

Oil Type..... Grease
Oil Amount..... Thin Coat
Lubrication Frequency..... 90 Days of Operation

Using a 5mm hex wrench, remove the rear column cover to access the Z-axis leadscrew and worm gear (see **Figure 34**).

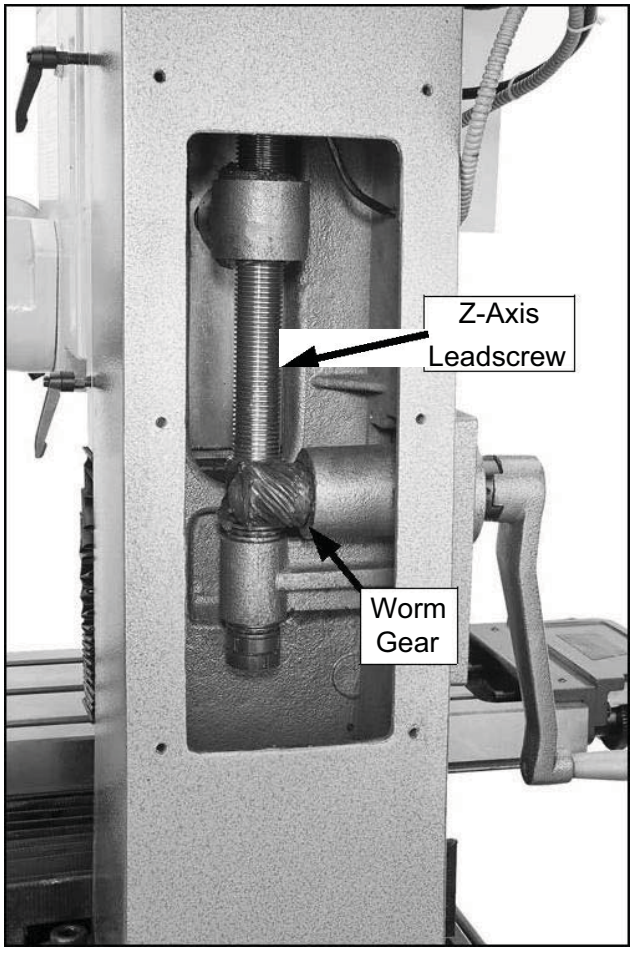


Figure 34. Z-axis leadscrew and worm gear exposed.

Use mineral spirits, shop rags, and a brush to clean away the old grease from the leadscrew threads and the worm gear teeth.

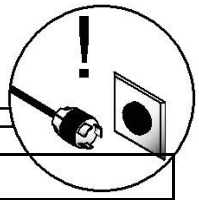
Use a brush to apply a thin coat of grease to the threads and teeth, then raise/lower the headstock several times to distribute the grease.

Note: *Replace the rear column cover before re-connecting the machine to power.*

SERVICE

Review the troubleshooting and procedures in this section if a problem develops with your machine.

Troubleshooting



Symptom	Possible Cause	Possible Solution
Machine does not start.	1. Emergency stop button depressed.	1. Twist emergency stop button clockwise until it pops out to reset it.
	2. Plug at fault or wired incorrectly.	2. Ensure plug is not damaged and is wired correctly.
	3. Incorrect power supply voltage.	3. Ensure power supply voltage matches circuit requirements.
	4. Wall fuse/circuit breaker is blown/tripped.	4. Ensure circuit size is correct and a short does not exist. Reset breaker or replace fuse.
	5. Wiring is open/has high resistance.	5. Check for broken wires or disconnected/corroded connections; repair/replace as necessary.
	6. Motor wired incorrectly.	6. Ensure motor wiring is correct.
	7. Control panel buttons at fault.	7. Ensure each button is wired correctly; replace if at fault.
	8. Motor or motor components are at fault.	8. Test/repair/replace.
Machine stalls or is overloaded.	1. Feed rate/cutting speed too fast.	1. Decrease feed rate/cutting speed.
	2. Wrong cutter type.	2. Use the correct cutter for the task.
	3. Machine is undersized for the task or tooling is incorrect for the task.	3. Use smaller or sharper tooling; reduce feed rate or spindle speed; use cutting fluid if possible.
	4. Motor has overheated.	4. Clean off motor, let cool, and reduce workload.
	5. Motor wired incorrectly.	5. Ensure motor wiring is correct.
	6. Motor bearings are at fault.	6. Test by rotating shaft; rotational grinding/loose shaft requires bearing replacement.
	7. Motor or motor components are at fault.	7. Test/repair/replace motor.
Machine has vibration or noisy operation.	1. Motor or machine component is loose.	1. Inspect/replace stripped or damaged bolts/nuts, and re-tighten with thread locking fluid.
	2. Workpiece not secure.	2. Properly clamp workpiece on table or in vise.
	3. Excessive depth of cut.	3. Decrease depth of cut.
	4. Cutter/tooling is loose.	4. Make sure tooling is properly secured.
	5. Cutter is dull or at fault.	5. Replace/resharpen cutter.
	6. Bit is chattering.	6. Replace/sharpen bit; index bit to workpiece; use appropriate feed rate and cutting RPM.
	7. Machine is incorrectly anchored to floor or sits unevenly.	7. Tighten/replace anchor bolts; relocate/shim machine.
	8. Motor fan is rubbing on fan cover.	8. Replace dented fan cover or damaged fan.
	9. Motor bearings are at fault.	9. Test by rotating shaft; rotational grinding/loose shaft requires bearing replacement.

Symptom	Possible Cause	Possible Solution
Tool loose in spindle.	1. Tool is not fully drawn up into spindle taper. 2. Debris on tool or in spindle taper. 3. Taking too big of a cut.	1. Tighten draw bar. 2. Clean collet and spindle taper. 3. Lessen depth of cut and allow chips to clear.
Breaking tools or cutters.	1. Spindle speed/feed rate is too fast. 2. Cutting tool too small. 3. Cutting tool getting too hot. 4. Taking too big of a cut. 5. Spindle extended too far down.	1. Set spindle speed correctly or use slower feed rate. 2. Use larger cutting tool and slower feed rate. 3. Use coolant fluid or oil for appropriate application. 4. Decrease depth of cut. 5. Fully retract spindle and lower headstock. This increases rigidity.
Workpiece vibrates or chatters during operation.	1. Table locks not tight. 2. Workpiece not secure. 3. Spindle speed/feed rate is too fast. 4. Spindle extended too far down.	1. Tighten down table locks. 2. Properly clamp workpiece on table or in vise. 3. Set spindle speed correctly or use a slower feed rate. 4. Fully retract spindle and lower headstock. This increases rigidity.
Table is hard to move.	1. Table locks are tightened down. 2. Chips have loaded up on ways. 3. Ways are dry and need lubrication. 4. Table limit stops are interfering. 5. Gibs are too tight.	1. Make sure table locks are fully released. 2. Frequently clean away chips that load up during operations. 3. Lubricate ways. 4. Check to make sure that all table limit stops are not in the way. 5. Adjust gibs.
Bad surface finish.	1. Spindle speed/feed rate is too fast. 2. Using a dull or incorrect cutting tool. 3. Wrong rotation of cutting tool. 4. Workpiece not secure. 5. Spindle extended too far down.	1. Set spindle speed correctly or use a slower feed rate. 2. Sharpen cutting tool or select one that better suits the operation. 3. Check for proper cutting rotation for cutting tool. 4. Properly clamp workpiece on table or in vise. 5. Fully retract spindle and lower headstock. This increases rigidity.
Cutting results not square.	1. Table and spindle are not at 90° to each other.	1. Tram the spindle.

Adjusting Gibs

Gibs are tapered lengths of metal that are sandwiched between two moving surfaces. Gibs control the gap between these surfaces and how they slide past one another. Correctly adjusting the gibs is critical to producing good results.

Correctly positioning gibs is a matter of trial and error and patience. Tight gibs make table movement more accurate but stiff. Loose gibs make table movement sloppy but easier to do. The goal of gib adjustment is to remove unnecessary sloppiness without causing the ways to bind.

Many experienced machinists adjust the gibs just to the point where they can feel a slight drag in table movement.

Screws on each end of the gib allow gib adjustment to increase or decrease the friction between the sliding surfaces.

DISCONNECT MACHINE FROM POWER BEFORE ADJUSTING THE GiBS!

Make sure all table locks are loose. Then, loosen one gib adjustment screw (see **Figure 35**) and tighten the opposing screw the same amount to move the gib, while at the same time rotating the handwheel to move the table until you feel a slight drag in that path of movement.

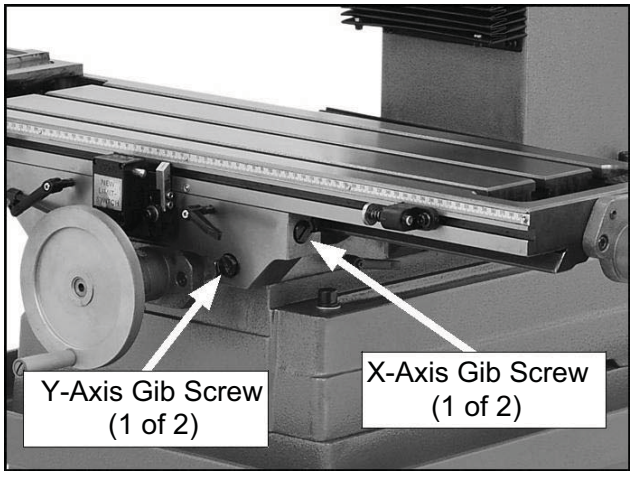


Figure 35. Location of table gib screws.

Adjusting Leadscrew Backlash

Leadscrew backlash is the amount of freeplay movement in the leadscrew (when the leadscrew moves but the table does not) after changing the direction of rotation.

Leadscrews must have a certain amount of backlash to rotate easily, but over time, it increases with wear. Generally, 0.075–0.15mm leadscrew backlash is acceptable to ensure smooth movement and reduce the risk of premature thread wear.

The X- and Y-axis leadscrew backlash is adjusted using a long 4mm hex wrench to tighten/loosen the cap screw on the leadscrew nut. This adjusts the force the leadscrew nut exerts on the leadscrew threads.

The X-axis leadscrew nut shown in **Figure 36** is accessed from underneath the left side of the table.

The Y-axis leadscrew nut is similar and is accessed from inside the cabinet underneath the machine base.

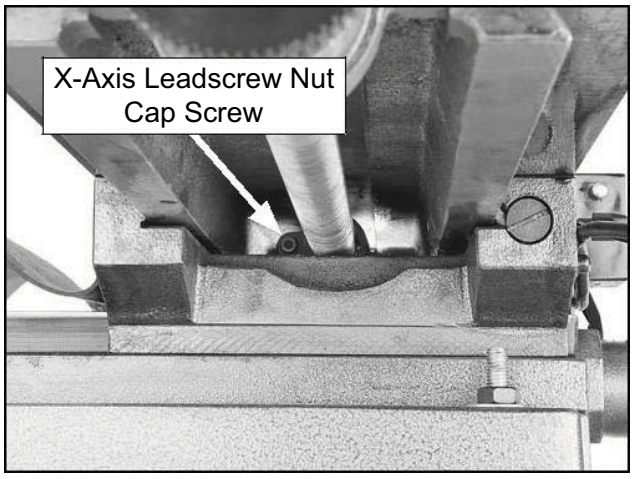


Figure 36. Location of X-axis leadscrew nut for adjusting backlash.

Tramming Spindle

When your operation requires that the spindle axis be precisely perpendicular to the table, you must tr am the s pindle w ith the t able. S imply adjusting the headstock tilt to the 90° mark on the tilt scale will not be pr ecise enough for highly accurate results.

This procedure involves mounting a dial indicator to the quill or spindle, rotating it around the table, and adjusting the head position so that the spindle axis is 90° to the table X-axis, as illustrated in **Figure 37**.

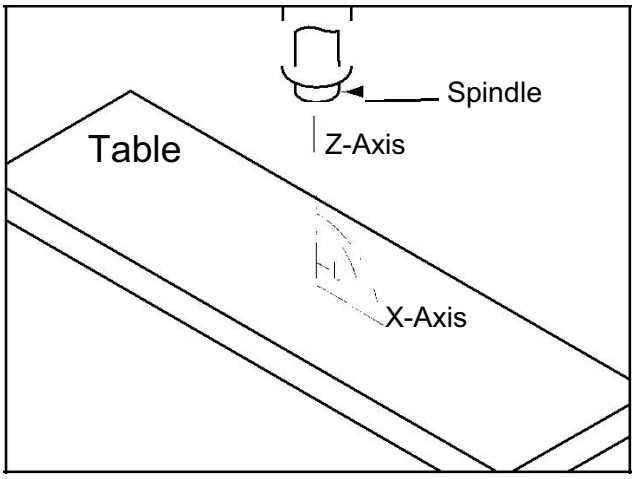


Figure 37. Spindle centerline properly trammed to the table.

Note: *Keep in mind that the top surface of your workpiece will not l ikely be ex actly par allel with the table top. Depending on your operation, you may choose to tram the spindle to the top surface of the w orkpiece after it i s m ounted i nstead o f tram-ming to the table.*

Tools Needed **Qty**
Dial Indicator (with at least 0.01mm resolution) 1
Indicator Holder (mounted on quill/spindle)..... 1
Precision Parallel Block (1-2-3 Blocks). 1

Note: *A precision-ground plate can be substituted for the par allel bl ock. The farther the indicator point can be placed from the spindle axis, the more ac curate th e al ignment measurements will be.*

To tram the spindle with the table:

1. DISCONNECT MACHINE FROM POWER!

2. Prepare machine by performing the following tasks:

   —Stone table to r emove all nicks and burrs, then c lean off al l debr is. V erify tabl e i s clean by running your hand over the top of it.

   —Position table for the operation you intend to perform after tramming—preferably cen-tered with saddle.

   —Tighten a ny tabl e l ocks that s hould be tight during intended milling operation.

3. Place parallel block underneath spindle.

4. Install indicator holder i nto spindle or onto quill, then mount indicator onto i t so that the point is as parallel to the block as pos-sible (see the illustration i n **Figure 38** for an example).

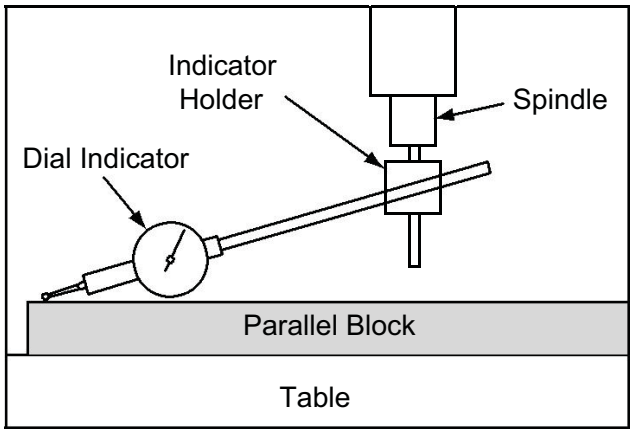


Figure 38. Dial indicator mounted.

5. Place the parallel block directly under spindle and indicator across length of table, as illus-trated in **Figure 39**.

   Note: *If you must re-position quill to accommodate the above step, then review tasks in **Step 2** to make sure mill is properly prepared for tramming.*

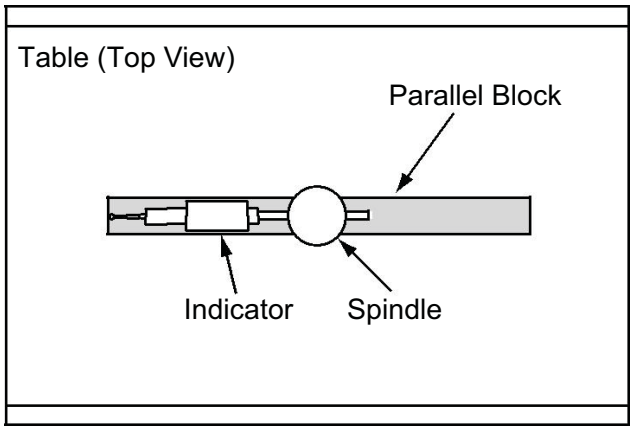


Figure 39. Setup for the X-axis adjustment.

   Note: *Generally, the goal is to get the difference of the indicator readings between ends of the parallel bar down to 0.0 1. However, the acceptable variance will depend on the requirements for your operation.*

6. Rotate spindle by hand so that the indicator point rests on one end of parallel block, as illustrated in **Figure 39**, then zero dial.

7. Rotate spindle so that the indicator point rests in the same manner on other end of block, then read dial.

   —If indicator dial still reads zero or is within the acceptable variance, continue on with **Step 8**.

   —if indicator dial has moved from zero beyond the acceptable variance, you will need to compensate for that amount by tilting head left or right. Repeat **Steps 6–7** until you are satisfied with spindle axis alignment along table X-axis.

   Tip: *Keep one of the tilting hex nuts snug so that the head does not move loosely while you adjust it in small amounts.*

8. Re-tighten tilting hex nuts.

Replacing Power Feed Carbon Brushes

The X-axis power feed motor has a carbon brush-es that will wear with normal use. There is one on the top of the power feed (see **Figure 40**) and one on the bottom.

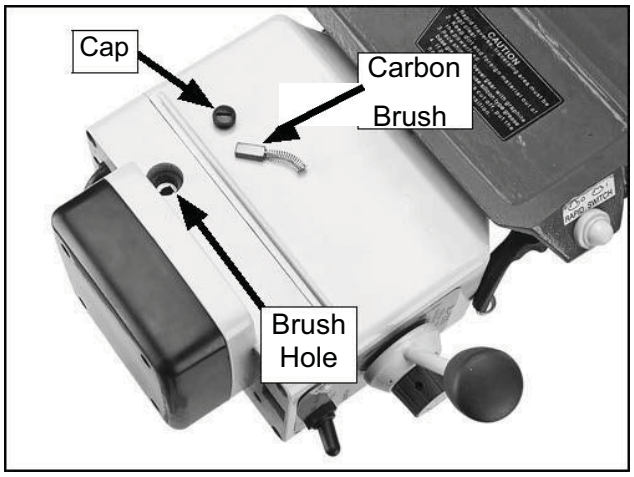


Figure 40. Carbon brush removed from power feed.

If, over time, the power feed starts to seem sluggish or will not operate, check the carbon brushes. If they are less than 4.75mm in length, replace them with new ones.

Note: *For proper performance, replace both carbon brushes at the same time.*

Use a flat screwdriver to unthread (turn counter-clockwise) the cap covering the carbon brush, replace the brush assembly, then secure it with the cap.

Tightening Return Spring Tension

The return spring moves the spindle back up when the coarse downfeed handles are released. The tension of this spring was adjusted at the factory, but it may need to be tightened during the life of the mill/drill.

Important: *Do not perform this procedure unless it is absolutely necessary.*

During this procedure, you will loosen the spring cover thumb screw (See **Figure 41**) just enough to pull the cover back to clear the roll pin, then rotate the cover counterclockwise to fit the roll pin in the next slot.

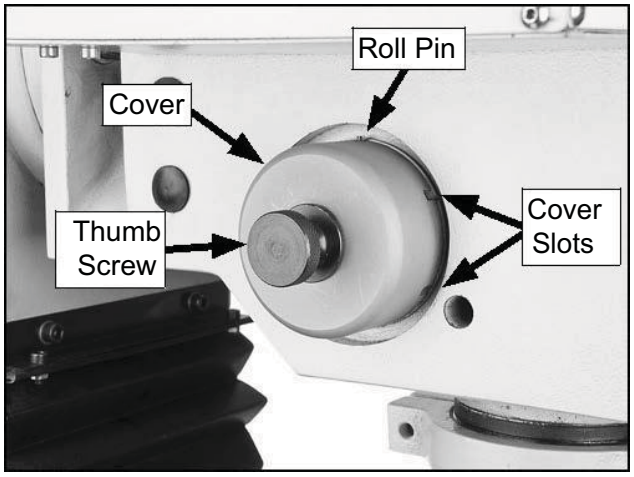
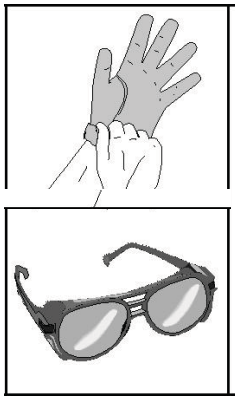


Figure 41. Return spring components.



⚠WARNING

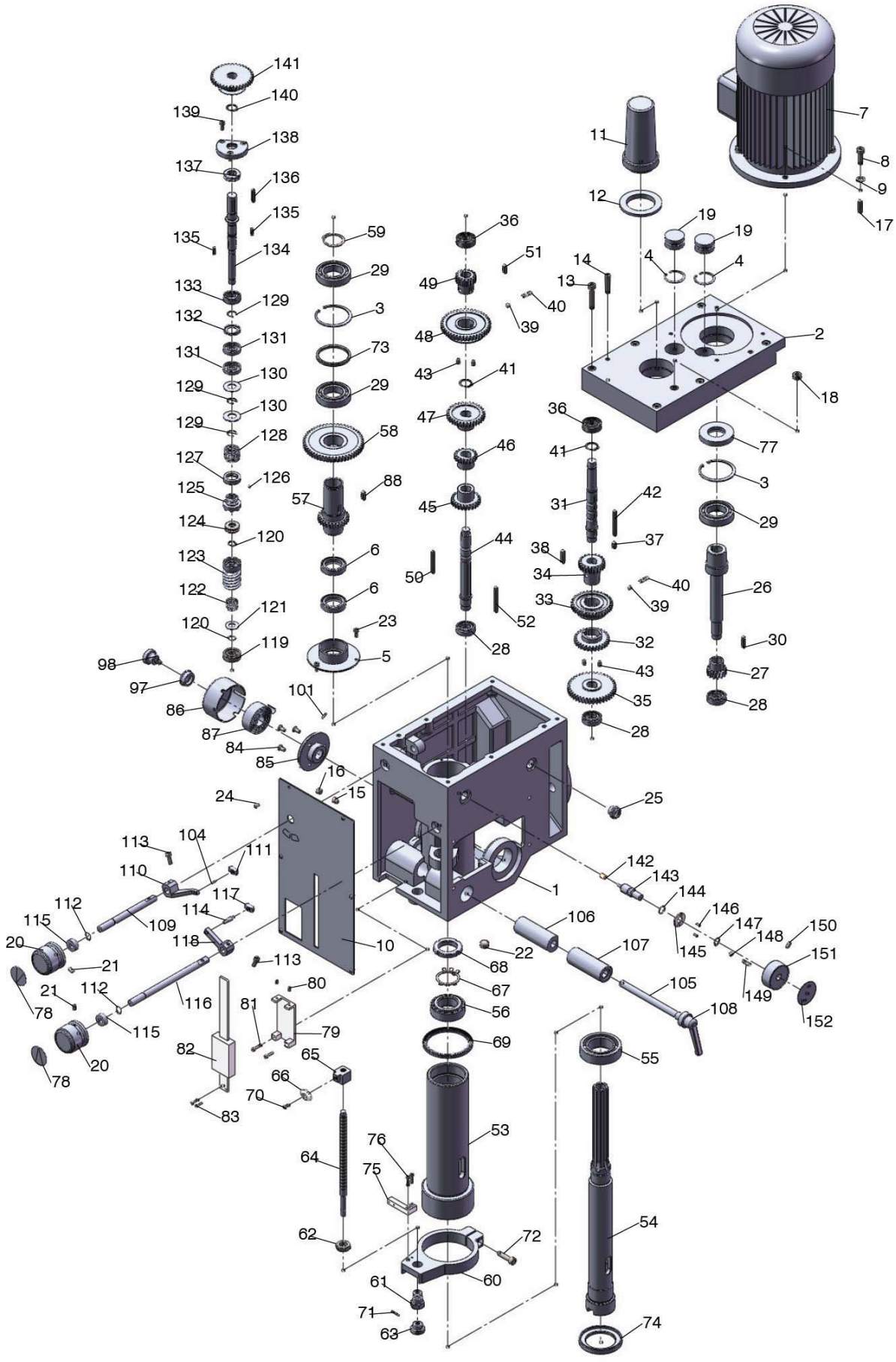
If the return spring should come loose from the spring cap and rapidly unwind, laceration or impact injuries could occur. Always wear heavy leather gloves and safety glasses when adjusting the return spring tension.

To adjust the return spring tension:

1. DISCONNECT MACHINE FROM POWER!
2. Wipe off any oil on spring cover so it does not slip when you hold it during adjustments.
3. Mark slot on cover that engages the roll pin at the top—this is the factory setting.
4. Put on heavy leather gloves to protect your hands from lacerations if spring uncoils during next step.

   Note: *Keep a good grip on spring cover during next step. Letting go of cover when roll pin is not engaged will cause spring to rapidly uncoil.*
5. While holding spring cover against side of headstock so the spring will not unwind, loosen thumb screw approximately 1/4.
6. Pull cover out to disengage it with roll pin, then rotate it counterclockwise to engage roll pin in the next slot in cover.
7. Re-tighten thumb screw to secure setting.

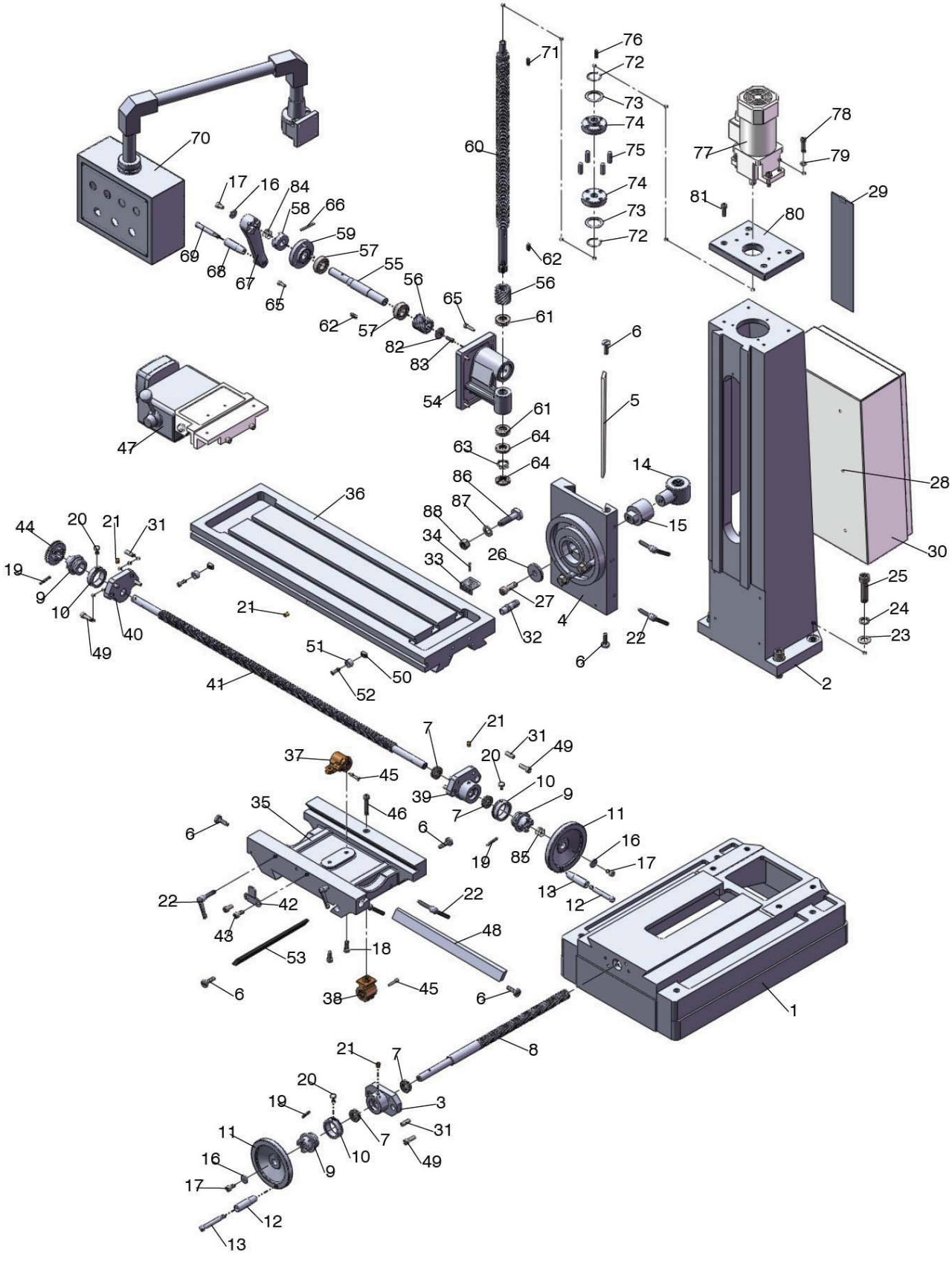
HEAD ASSEMBLY



No	Qty.	Code	Name	No	Qty.	Code	Name
1	1	20010B	Head body	37	1	6x14	Key
2	1	20011B	Head body cover	38	1	6x28	Key
3	2	62	Retaining ring	39	2	8	Ball
4	2	35	Retaining ring	40	2		Spring
5	1	20018B	Airtight base	41	2	18	Retaining ring
6	2	FB45x35x10	Airtight ring	42	1	5x50	Key
7	1		Motor	43	4	M6x8	Screw
8	4	M8x25	Screw	44	1	20107B	III shaft
9	4	8	Washer	45	1	20109-B	Gear
10	1	20201	Plate	46	1	20110-2-B	Gear
11	1	20304-1B	Arbor bolt cover	47	1	20112-B	Gear
12	1	20304-2B	Arbor bolt cover base	48	1	20113-B	Gear
13	6	M8x45	Screw	49	1	20115-B	Gear
14	2	8x40	Pin	50	1	5x50	Key
15	1	M10x10	Screw	51	1	6x18	Key
16	1	M10x8	Screw	52	1	6x75	Key
17	1	8x28	Key	53	1	20019	Spindle sleeve
18	1	ZG3/8	Bolt	54	1	20104B	Spindle
19	2	20020B	Cap	55	1	33009-P5	Bearing
20	2	20307B	Speed lever	56	1	33007-P5	Bearing
21	2	M6X12	Screw	57	1	20114-B	Splined sleeve
22	1	ZG3/8	Oil plug	58	1	20116-B	Gear
23	3	M5x10	Screw	59	1	35	Retaining ring
24	6	M4x8	Screw	60	1	20012	Feed base
25	1	M18x1.5	Oil pointer	61	1	20128	Support base
26	1	20105B	I shaft	62	1	20129	Nut
27	1	20105-1-B	Gear	63	1	20130	Knob
28	3	6003-P5	Bearing	64	1	20131	Graduated rod
29	3	6007-P5	Bearing	65	1	20021	Fixed bolt
30	1	5x25	Key	66	1	20132	Scale board
31	1	20106B	II shaft	67	1	35	Lock washer
32	1	20108-B	Gear	68	1	M35x1.5	Lock nut
33	1	20110-1-B	Gear	69	1	20308	Rubber washer
34	1	20111-B	Gear	70	1	M4x8	Screw
35	1	20106-1-B	Gear	71	1	3x18	Split pin
36	2	6202-P5	Bearing	72	1	M8x30	Bolt

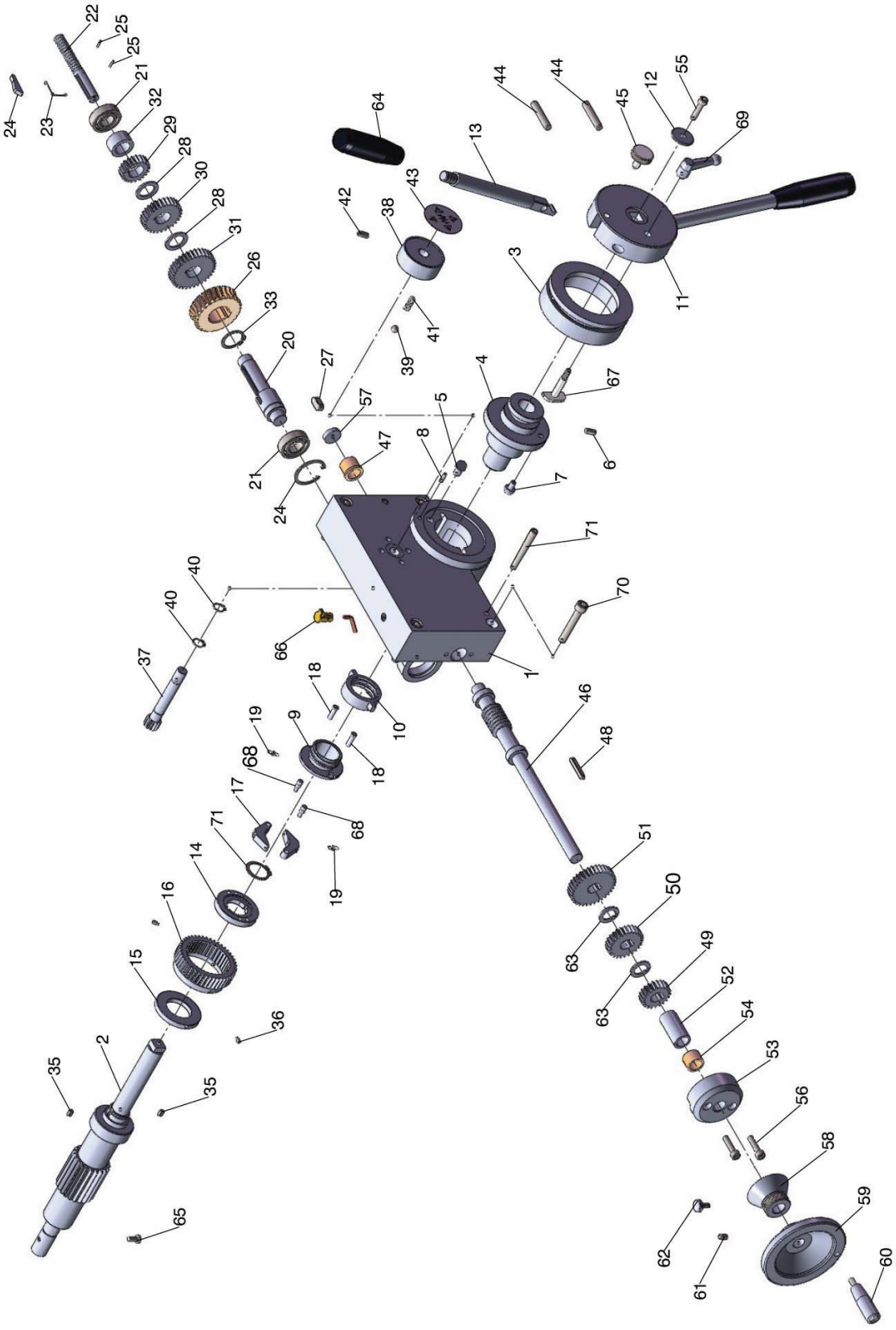
No	Qty.	Code	Name	No	Qty.	Code	Name
73	1	20024B	Separating ring	119	1	6201	Bearing
74	1	20133B	Oil tight cover	120	2	12	Retaining ring
75	1	20010C3	Connecting rod	121	1	12	Washer
76	2	M4X12	Screw	122	1	20209	Spring
77	1	FB62X35X10	Oil seal	123	1	20207A	Worm shaft
78	2	20307C2	Plate	124	1	51101	Bearing
79	1	20010C2	Stents	125	1	20208B	Clutch base
80	2	M4X10	Screw	126	1	M4x5	Screw
81	2	M4X16	Screw	127	1	M22x1.5	Locked out
82	1		Digital display	128	1	20205B	Spring
83	2	X3X10	Screw	129	3	15	Retaining ring
84	3	M6X12	Screw	130	2	20108A	Washer
85	1	20118	Spring base	131	2	FB15x32x7	oil seal
86	1	20123	Spring cap	132	1	20103A	Fixed sleeve
87	1	20122	Spring plate	133	1	6002	bearing
88	1	6X18	key	134	1	20213A	I shaft
97	1	203063	Washer	135	2	4x16	key
98	1	203066	Bolt	136	1	5x30	key
100				137	1	51103	bearing
101	2	3x12	Pin	138	1	20104A	flange
104	1	3x12	Pin	139	3	M5x16	screw
105	1	20124B	Fxed bolt	140	1	17	retaining ring
106	1	20203B	Fixed tight block	141	1	20212A	gear
107	1	20202B	Fixed tight block	142	1	20109A	quil
108	1		Adjust handle	143	1	20214A	lever shaft
109	1	20125B	Llever shaft	144	1	12x2.4	O-airtight
110	1	2022-1B	Lever	145	1	20250	flange cover
111	1	20204-2B	Lever bracket	146	2	M3x8	screw
112	2	12	Retaining ring	147	1	12	retaining ring
113	2	M6x16	Screw	148	1	8	steel ball
114	1	20204-3B	Lever rod	149	1		spring
115	2	12x22x8	Oil seal	150	1	M6x18	screw
116	1	20216B	Long lever shaft	151	1	20201	speed lever
117	1	20204-1B	Lever bracket	152	1	20303	label
118	1	20022-2B	Lever				

TABLE & COLUMN ASSEMBLY



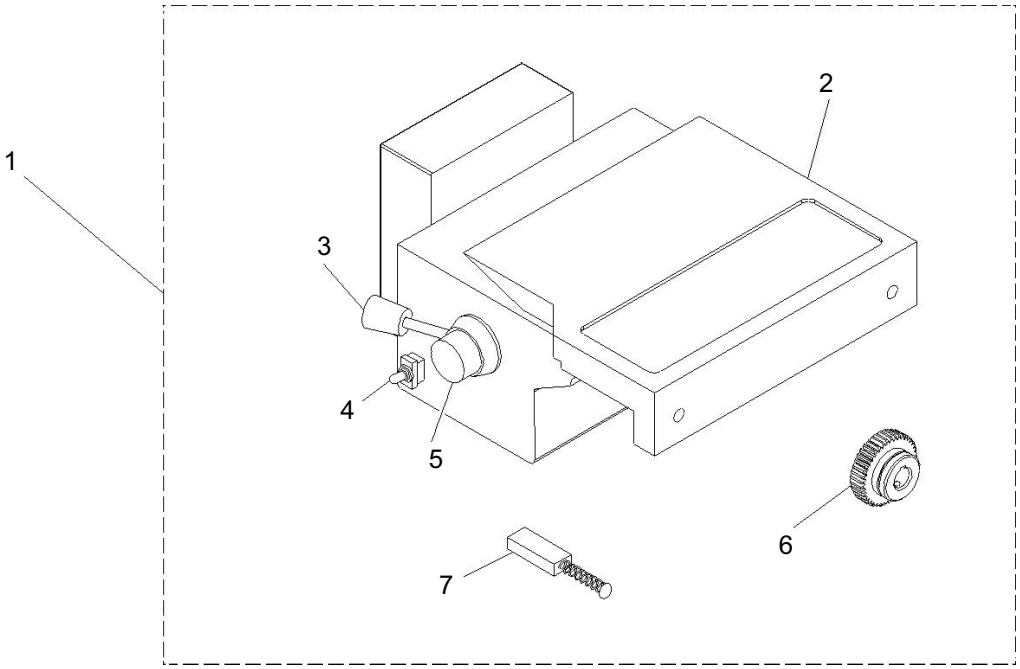
No	Qty.	Code	Name	No	Qty.	Code	Name
1	1	10010	base	45	2	M5X20	screw
2	1	10013	column	46	1	M8X45	screw
3	1	10021	square flange	47	2	135LBS	Power feed
4	1	10016	raise and lower base	48	1	10022	gib strip
5	1	10025	gib strip	49	6	M8X25	screw
6	6	10106	screw	50	2	10108	movable fixed block
7	4	51103	bearing	51	2	10109	fixed block support
8	1	10104	table screw	52	2	M6X16	screw
9	3	10102	dial clutch	53	1	10023	gib strip
10	3	10111	graduated plate	54	1	10017	raise and lower base
11	2	10301	wheel	55	1	10113	shaft
12	2	20305-1B	turn handle	56	2	20109	gear
13	2	20305-2B	screw	57	2	6004	bearing
14	1	10024	nut	58	1	450209	dial clutch
15	1	10117	nut bracket	59	1	10015	flange
16	3	6	washer	60	1	10016	raise and lower screw
17	3	M6X16	screw	61	2	51104	bearing
18	2	M8X25	screw	62	2	6 X 20	key
19	3	5X35	pin	63	1	20	lock washer
20	3	10107	screw	64	2	M20X1.5	lock nut
21	4	8	oil cup	65	7	M6 X 25	screw
22	6	M8	fixed handle	66	1	5 X 40	pin
23	4	16	washer	67	1	10018	heaf handle
24	4	16	washer	68	1	10018.1	turn handle
25	4	M16X60	bolt	69	1	10018.2	Screw M10
26	1	10120	washer	70	1		Electrical box
27	1	M12X35	screw	71	1	5X22	key
28	6	M6x12	screw	72	2	30	retaining ring
29	1	10124	protecting cover	73	2	10152	washer
30	1	10119	Electrical box	74	2	10150	
31	6	8X30	pin	75	4	10151	
32	1		Pipe joint	76	1	5X25	key
33	1		Filter screen	77	1	Motor	90W220V60Hz1ph
34	2	M3X25	table nut	78	4	M8X25	screw
35	1	10011	center base	79	4	8	washer
36	1	10012	table	80	1	10014	motor mount
37	1	10202	table nut	81	4	M8 X 25	screw
38	1	10203	table base nut	82	1	8	washer
39	1	10020	right flange	83	1	M8 X 25	screw
40	1	10019	left flange	84	1	450209.2	Spring
41	1	10103	table screw	85	1	10102.2	Spring
42	1	10105	fixed block	86	3	M14x55	T-screw
43	2	M8x16	screw	87	3	14	washer
44	1		Gear	88	3	M14	nut

AUTO SPINDLE FEED ASSEMBLY



No	Code	Qty.	Name	No	Code	Qty.	Name
1	20102	1	Feed box	38	20201	1	Speed lever
2	20234	1	Pinion shaft	39		1	Steel ball 8
3	20243	1	Spindle stroke dial	40		2	Retainer ring 12
4	20242	1	Clutch bushing set	41		1	Spring
5	20241	1	Backing pin	42		1	Screw M6 X 20
6		1	Pin 6 X 12	43	20303	1	Plate
7	20247	1	Ball head pin	44	20206	2	pin
8		2	Pin 4 X 10	45	20204	1	Limited screw
9	20239	1	Square thread set	46	20233	1	Worm shaft
10	20240	1	Square thread nut	47	20306	1	Bush
11	20244	1	Handle body	48		1	Key
12	20245	1	Washer	49	20228	1	Gear
13	20203	2	Handle	50	20229	1	Gear
14	20237	1	Clutch key base set	51	20230	1	Gear
15	20236-2	1	Bush	52	20106	1	Bush
16	20236-1	1	Worm gear	53	20227	1	Worm cover
17	20231	2	Clutch screw set	54	20305	1	Bush
18	20235	2	Screw	55		2	Screw M6 X 12
19	20232	2	Sping	56		2	Screw M6 X 25
20	20223	1	II shaft	57	20107	1	Plate
21		2	Bearing 6003	58	20226	1	Mirco feed dial
22	20215	1	Change gear lever set	59	20105	1	Hand wheel
23	20220	1	Spring	60		1	Hand
24	20222	1	Pull key	61		1	Screw M5 X 8
25		2	Pin 2 X10	62		1	Locked screw M5 X 12
26	20304	1	Worm gear	63	20307	1	Bushing
27		1	Key 8 X 16	64	20301	2	Knob
28	20217	2	Bushing	65		1	Screw M5 X 12
29	20218	1	Gear	66		1	Oil cup
30	20219	1	Gear	67	20246	1	Screw
31	20221	1	Gear	68	20308	2	Pin
32	20216	1	Bushing bracket	69		1	Locked handle
33		2	Retainer ring 24	70		4	Screw M8 X 50
34		1	Retainer ring 35	71		2	Taper pin 6X 60
35		2	Key 4 X 8	72			
36		3	Screw M4 X 12	73			
37	20202	1	Gear	74			

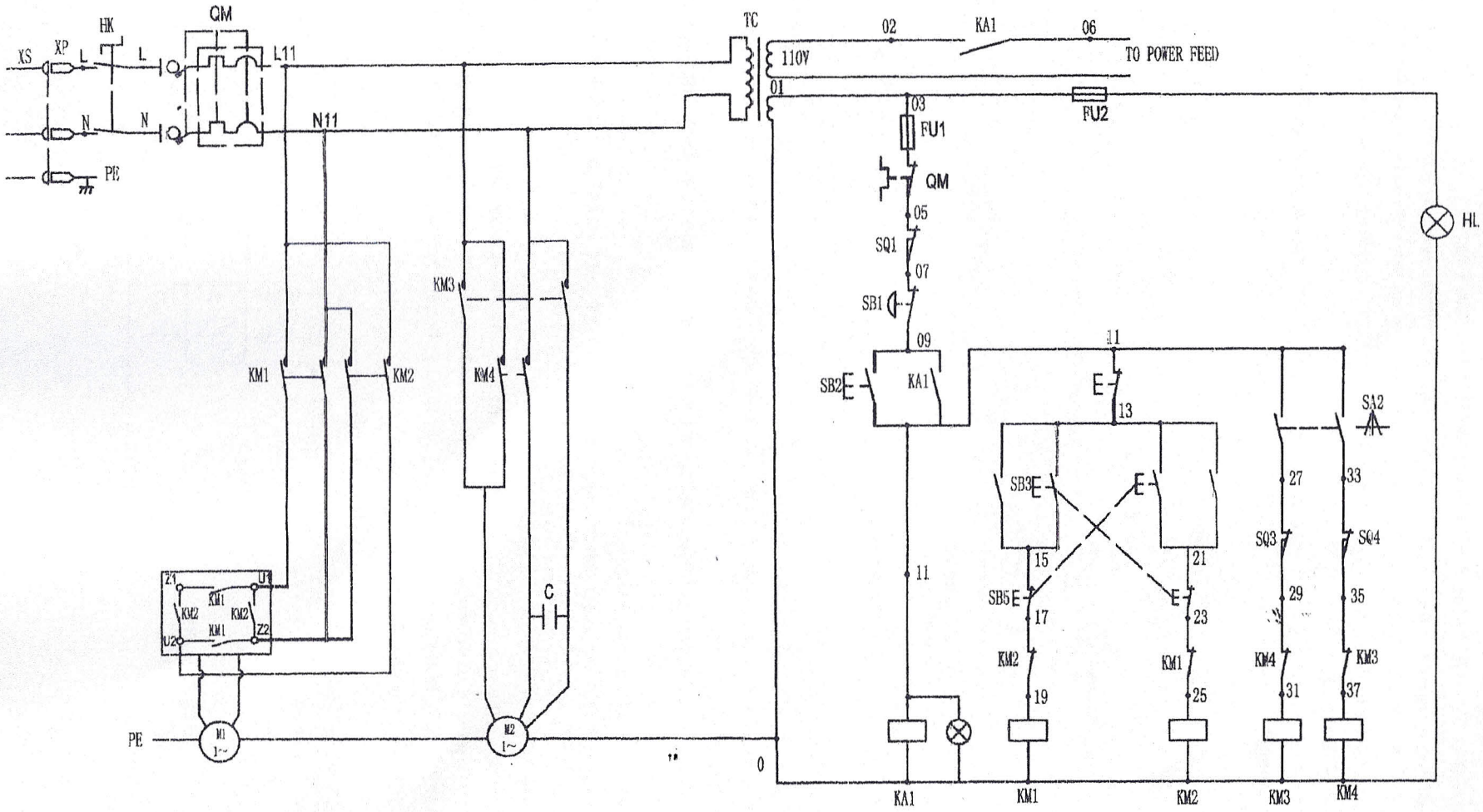
Power Feed



No.	Code	Name
1	301	POWER FEED ASSY ALIGN AS-235
2	302	MOUNTING BRACKET 2-PC
3	303	CONTROL HANDLE
4	304	SPEED CONTROL KNOB

No.	Code	Name
5	305	ON/OFF SWITCH
6	306	LEADSCREW DRIVE GEAR
7	307	POWER FEED MOTOR CARBON BRUSH

S/MAJOR.


XS
XP
HK
QM
L
L
L11
N
N
N11
PE
TC
110V
02
KA1
06
TO POWER FEED
01
03
FU1
FU2
QM
05
SQ1
07
SB1
09
SB2
KA1
11
HL
KM1
KM2
KM3
KM4
C
SB3
SB5
13
15
17
19
21
23
25
27
29
31
33
35
37
SQ3
SQ4
SA2
M1
1~
M2
1~
PE
0
KA1
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