HIGH SPEED PRECISION LATHE

MODEL: —1440V / 1460V
—1640V / 1660V

INSTRUCTION
AND
SPARE PARTS MANUAL

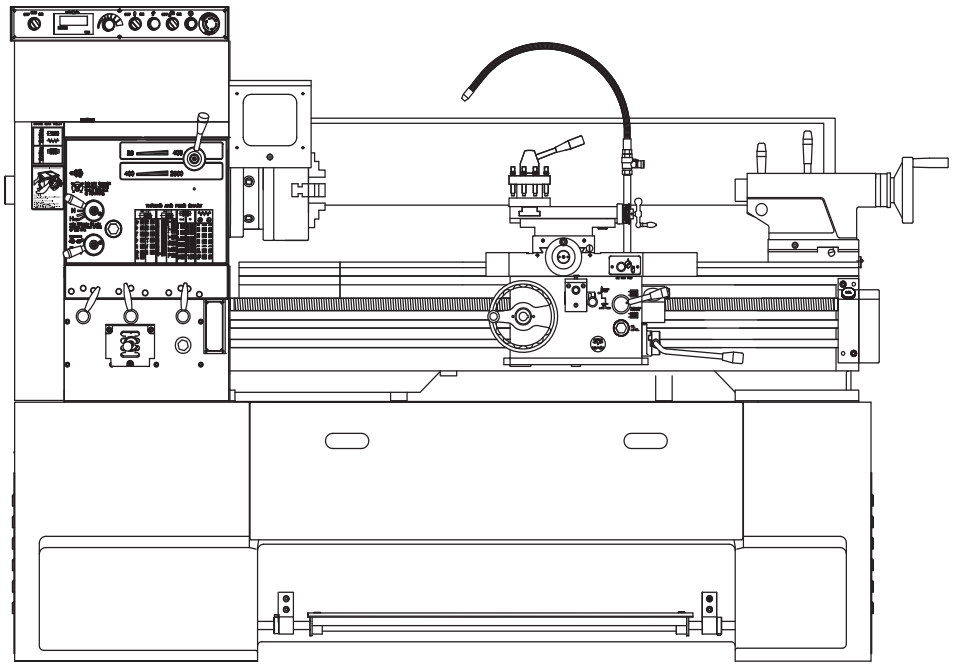


Photo shown model : 1440V

RML-V Series

Table of Contents

Safety Instructions

ATTENTION

It is essential to read this operation manual and understand the program instructions and maintenance instructions before operating the machine.

This operation manual should be attached to the machine at all time where it is readily available to the operator for reference.

1. **Owner's Manual :** All machinery and machining equipment presents serious injury hazards to untrained users. To reduce the risk of injury, anyone who uses this item must read and understand this entire manual before starting.

2. **Safe Environment :** Operating electrically powered equipment in a wet environment may result in electrocution; operating near highly flammable materials may result in a fire or explosion. Only operate this item in a dry location that is free from flammable materials.

3. **Trained / Supervised Operators Only :** Untrained users can seriously injure themselves. Only allow trained and properly supervised personnel to operate this item. Make sure safe operation instructions are clearly understood. If electrically powered, use padlocks and master switches, and remove start switch keys to prevent unauthorized use or accidental starting.

4. **Work Area :** Clutter and dark shadows increase the risks of accidental injury. Only operate this item in a clean, non-glaring, and well-lighted work area.

5. **Personal Protective Equipment :** Operating or servicing this item may expose the user to flying debris, dust, smoke, dangerous chemicals, or loud noises. These hazards can result in eye injury, blindness, long-term respiratory damage, poisoning, cancer, reproductive harm or hearing loss. Reduce your risks from these hazards by wearing approved eye protection, respirator, gloves, or hearing protection.

6. **Guards / Covers :** Accidental contact with moving parts during operation may cause severe entanglement, impact, cutting, or crushing injuries. Reduce this risk by keeping any included guards/covers/doors installed, fully functional, and positioned for maximum protection.

7. **Entanglement :** Loose clothing, gloves, neckties, jewelry or long hair may get caught in moving parts, causing entanglement, amputation, crushing, or strangulation. Reduce this risk by removing / securing these items so they cannot contact moving parts.

8. **Mental Alertness :** Operating this item with reduced mental alertness increases the risk of accidental injury. Do not let a temporary influence or distraction lead to a permanent disability! Never operate when under the influence of drugs/ alcohol, when tired, or otherwise distracted.

9. **Electrical Connection :** With electrically powered equipment, improper connections to the power source may result in electrocution or fire. Always adhere to all electrical requirements and applicable codes when connecting to the power source. Have all work inspected by a qualified electrician to minimize risk.

10. **Disconnect Power :** Adjusting or servicing electrically powered equipment while it is connected to the power source greatly increases the risk of injury from accidental startup. Always disconnect power before any service or adjustments, including changing blades or other tooling.

11. **Secure Workpiece / Tooling :** Loose workpieces, cutting tools, or rotating spindles can become dangerous projectiles if not secured or if they hit another object during operation. Reduce the risk of this hazard by verifying that all fastening devices are properly secured and items attached to spindles have enough clearance to safely rotate.

Lathe Safety

1. **Clearing Chips :** Metal chips can easily cut bare skin—even through a piece of cloth. Avoid clearing chips by hand or with a rag. Use a brush or vacuum to clear metal chips.

2. **Chuck Key Safety :** A chuck key left in the chuck can become a deadly projectile when the spindle is started. Always remove the chuck key after using it. Develop a habit of not taking your hand off of a chuck key unless it is away from the machine.

3. **Tool Selection :** Cutting with an incorrect or dull tool increases the risk of accidental injury because extra force is required for the operation, which increases risk of breaking or dislodging components, which can cause small shards of metal to become dangerous projectiles. Always select the right cutter for the job and make sure it is sharp. A correct, sharp tool decreases strain and provides a better finish.

4. **Securing Workpiece :** An improperly secured workpiece can fly off of the lathe spindle with deadly force, which can result in a severe impact injury. Make sure the workpiece is properly secured in the chuck or faceplate before starting the lathe.

5. **Large Chucks :** Large chucks are very heavy and difficult to grasp, which can lead to crushed fingers or hands if mishandled. Get assistance when installing or removing large chucks to reduce this risk. Protect your hands and the precision-ground ways by using a chuck cradle or piece of plywood over the ways of the lathe when servicing chucks.

6. **Safe Clearances :** Workpieces that crash into other components on the lathe may throw dangerous projectiles in all directions, leading to impact injury and damaged equipment. Before starting the spindle, make sure the workpiece has adequate clearance by hand-rotating it through its entire range of motion. Also, check the tool and tool post clearance, chuck clearance, and saddle clearance.

7. **Speed Rates :** Operating the lathe at the wrong speed can cause nearby parts to break or the workpiece to come loose, which will result in dangerous projectiles that could cause severe impact injury. Large workpieces must be turned at slow speeds. Always use the appropriate feed and speed rates.

8. **Stopping Spindle by Hand :** Stopping the spindle by putting your hand on the workpiece or chuck creates an extreme risk of entanglement, impact, crushing, friction, or cutting hazards. Never attempt to slow or stop the lathe spindle with your hand. Allow the spindle to come to a stop on its own or use the brake (if equipped).

9. **Crashes :** Driving the cutting tool or other lathe components into the chuck may cause an explosion of metal fragments, which can result in severe impact injuries and major damage to the lathe. Reduce this risk by releasing automatic feeds after use, not leaving lathe unattended, and checking clearances before starting the lathe. Make sure no part of the tool, tool holder, compound slide, cross slide, or carriage will contact the chuck during operation.

10. **Long Stock Safety :** Long stock can whip violently if not properly supported, causing serious impact injury and damage to the lathe. Reduce this risk by supporting any stock that extends from the chuck/headstock more than three times its own diameter. Always turn long stock at slow speeds.

11. **Coolant Safety :** Contaminated cutting fluid is a very poisonous biohazard that can cause personal injury from skin contact alone. Incorrectly positioned cutting fluid nozzles can splash on the operator or the floor, resulting in an exposure or slipping hazard. To decrease your risk, change cutting fluid regularly and position the cutting fluid nozzle where it will not splash or end up on the floor.

Section 1 : Controls & Components

Identification

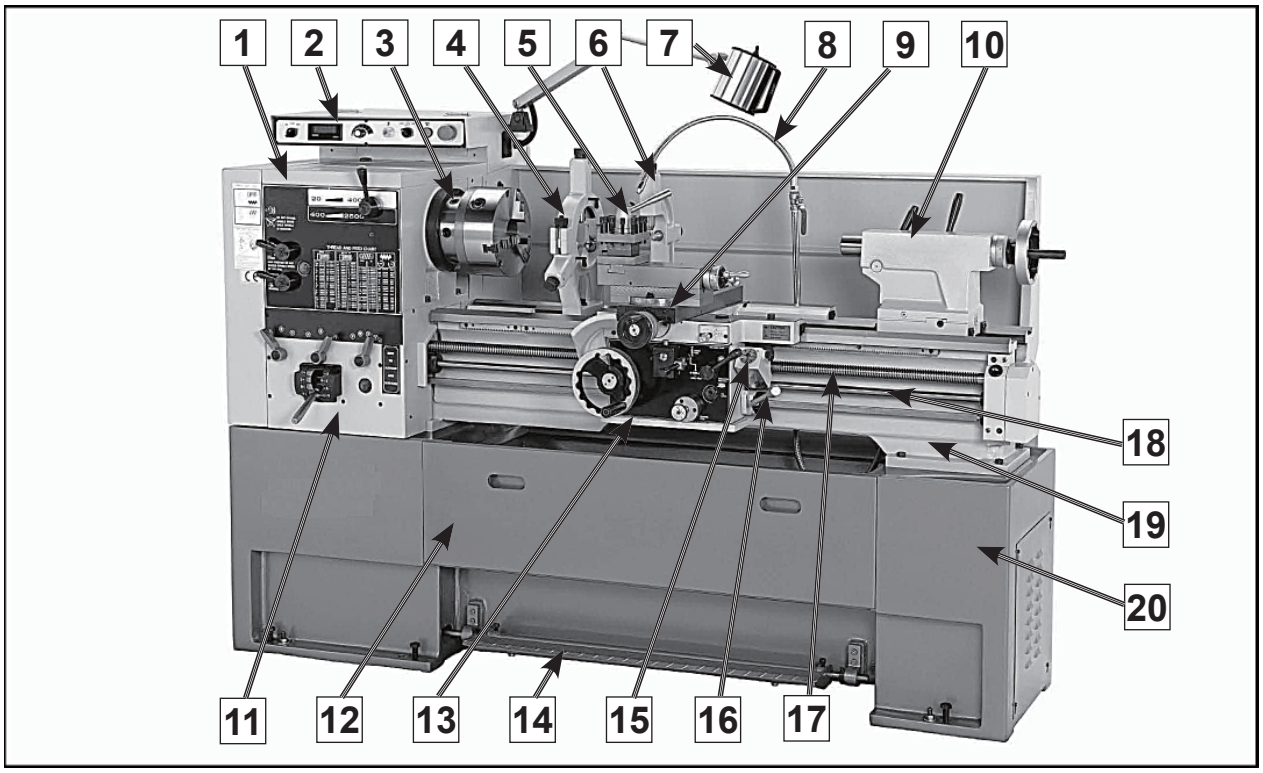


Figure 1. The RML-1440 EVS Lathe.

1. Headstock
2. Control Panel
3. D1-6 Camlock MT#6 Spindle
4. Steady Rest
5. 4-Position Tool Holder
6. Follow Rest
7. Work Lamp
8. Universal Cutting Fluid Tube and Nozzle
9. Cross Slide
10. Tailstock
11. Gearbox
12. Removable Chip Drawer
13. Apron
14. Brake Pedal
15. Thread Dial
16. Spindle Rotation ON / OFF Lever
17. Leadscrew
18. Feed shaft
19. Bed
20. Base

Control Panel

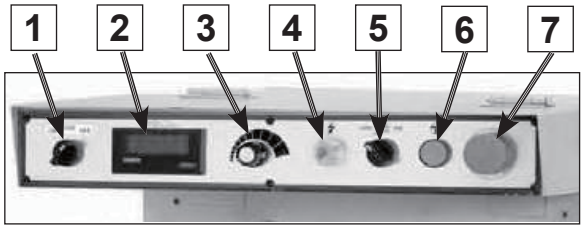


Figure 2. Control Panel.

1. **CSS ON / OFF Switch :** Turns the constant surface speed feature ON or OFF.

2. **Tachometer Display :** Indicates what RPM the spindle is currently rotating at.

3. **Spindle Speed Dial :** Changes the spindle speed to user-defined levels.

4. **Power Light :** Illuminates when lathe is receiving power.

5. **Cutting Fluid Pump Switch :** Turns cutting fluid delivery ON / OFF.

6. **Jog Button :** Turns the spindle motor ON while being pressed and held.

7. **Emergency Stop Button :** Stops all machine functions. Twist clockwise to reset.

8. **Main Power Switch (Optional) :** Located at the rear of the lathe on the electrical box cover, this switch turns power ON / OFF to the lathe so lathe operations can begin.

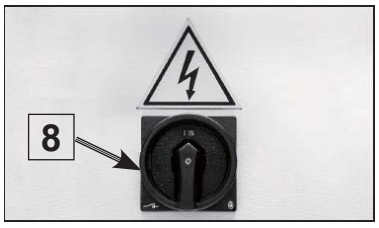


Figure 3. Main Power Switch.

Headstock Controls

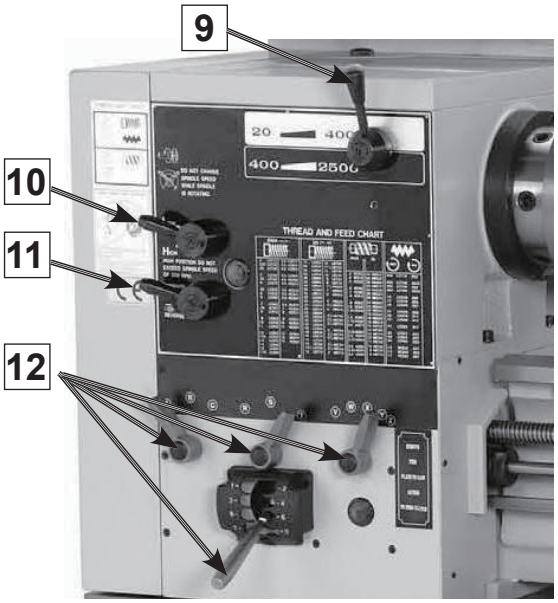


Figure 4. Headstock Controls.

9. **Spindle Range Lever :** Shifts the headstock into low or high range for spindle speeds between 20-400 RPM or 400-2500 RPM.

10. **Gearbox Range Lever :** This lever puts the gearbox in high or low range and has no effect on spindle RPM.

11. **Feed Direction Lever :** This lever changes the direction that the gearbox is turning at, and as a result the leadscrew and feed rod change direction.

12. **Gearbox Levers :** Moves the gearbox gears into particular ratios, which then turn the leadscrew and feed rod for threading and power feed operations.

Carriage Controls

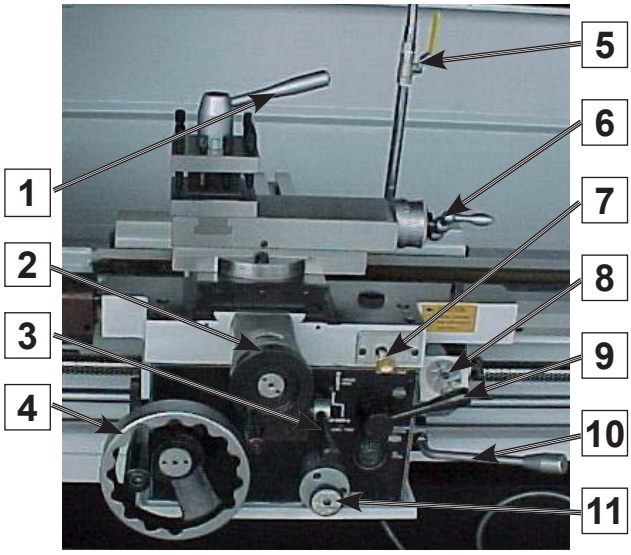


Figure 5. Carriage Controls.

1. **4-Way Tool Post Lever :** Used for locking the rotary tool post in four possible detents.
2. **Cross Slide Handwheel :** Positions the cross slide in or out.
3. **Feed Control Lever :** Engages and disengages the cross feed and longitudinal feed gearing.
4. **Longitudinal Carriage Handwheel :** Allows for manual movement of the carriage from left to right along the bed.
5. **Cutting Fluid Flow Control Lever :** Used to vary the flow of cutting fluid out of the nozzle.
6. **Compound Hand Crank :** Used to position the compound along the compound slide.
7. **Manual Carriage Oil Pump :** Draws oil from the apron case and lubricates the carriage and ways through various oil ports.
8. **Thread Dial :** Indicates when to engage the half nut during threading operations.
9. **Halfnut Lever :** Engages and disengages the apron with the leadscrew for threading operations.
10. **Spindle ON / OFF Lever :** Used to start and stop the lathe during normal operation.
11. **Feed Direction Lever :** This lever changes the direction that the gearbox is turning at, and as a result the leadscrew and feed rod change direction.

Tailstock Controls

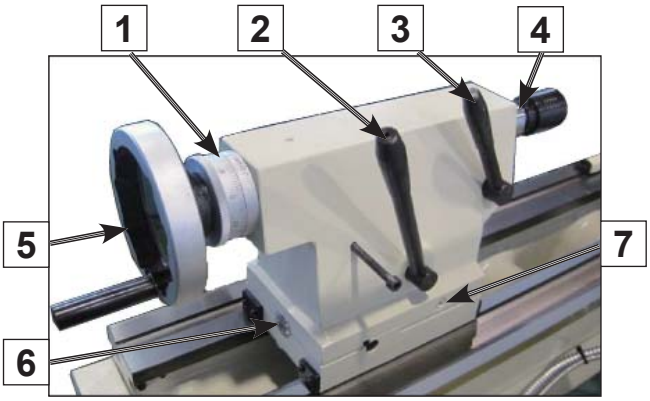


Figure 6. Tailstock Controls.

1. **Graduated scale :** Indicates quill movement in increments of 0.001" or 0.02mm.
2. **Tailstock Lock Lever :** Secures the tailstock in place along the bedway.
3. **Quill Lock Lever :** Locks the quill in position.
4. **Quill :** Moves toward and away from the spindle and holds centers and tooling.
5. **Quill Handwheel :** Moves the quill toward or away from the spindle.
6. **Offset Scale :** Indicates the distance of tailstock offset from the spindle center line.
7. **Tailstock Offset Screw :** Adjusts and secures the tailstock offset (1 of 2).

Foot Brake

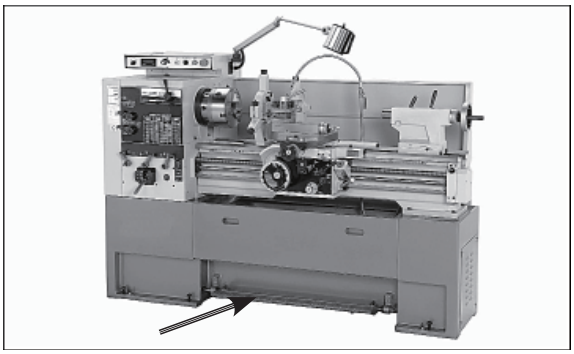


Figure 7. Foot Brake.

This lathe is equipped with a foot brake (Figure 7) to quickly stop the spindle. Pushing the foot brake while the spindle is ON cuts power to the motor and stops the spindle. Once stopped, the spindle lever MUST be returned to the neutral position before the spindle can be restarted.

Section 2 : Setup

Physical Environment

The physical environment where your machine is operated is important for safe operation and longevity of parts. For best results, operate this machine in a dry environment that is free from excessive moisture, hazardous or flammable chemicals, airborne abrasives, or extreme conditions. Extreme conditions for this type of machinery are generally those where the ambient temperature is outside the range of 9° ~ 72ºC(48.2° ~ 161.6ºF); the relative humidity is outside the range of 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 access to a means of disconnecting the power source or engaging a lockout / tagout device.

Lighting

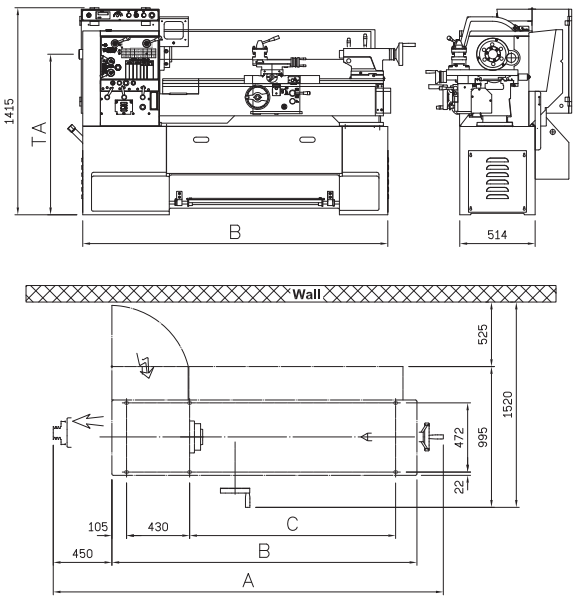
Lighting around the machine must be adequate enough that operations can be performed safely. Shadows, glare, or strobe effects that may distract or impede the operator must be eliminated.

Weight Load

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 workpiece 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.



Model	A	B	C	TA
1440 / 1640	2720	2080	1405	1095 / 1120
1460 / 1660	3228	2588	1913	1095 / 1120

UNIT : mm

Figure 8. Space required for full range of movement.

Lifting & Moving

This lathe is an extremely heavy machine. Serious personal injury or death may occur if safe lifting and moving methods are not followed. Get assistance from a professional rigger if you are unsure about your abilities or maximum load ratings of your lifting equipment.

To lift and move your lathe :

1. Prepare the permanent location for the lathe.

2. Remove the shipping crate top and sides, then remove the small components from the shipping pallet.

3. To balance the lifting load, loosen the tailstock lock lever (Figure 9), move the tailstock to the end of the bedway, then lock it in place.

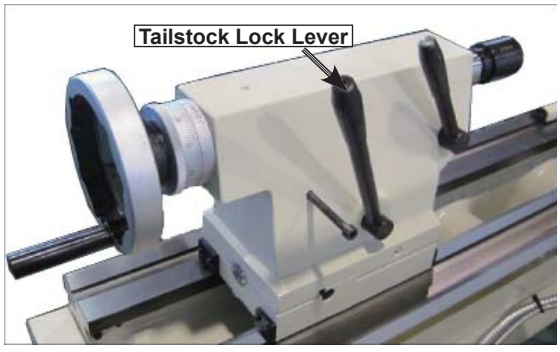


Figure 9. Tailstock lock lever.

4. To further balance the load, loosen the carriage lock bolt, disengage the half nut lever, put the feed control lever in neutral, then use the carriage handwheel to move the carriage next to the tailstock. (Figure 10)

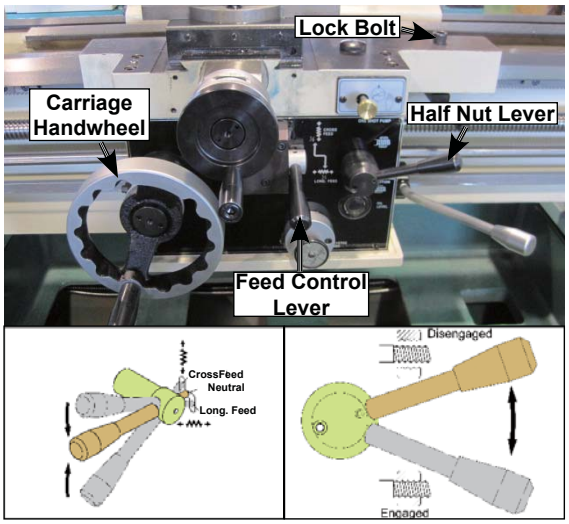


Figure 10. Carriage controls set for moving the carriage.

5. Locking the carriage lock bolt and tailstock lock lever.

6. Lifting the machine with crane. (Figure 11)

a. Make sure that minimum crane capacity is more than 2 tons for security.

b. Only an authorized crane operator should use the lift machine.

c. Crane work should be cooperatively done by two persons, that is, an operator and a watchman, not to damage projecting on the machine perimeter.

d. To put in the jig with wire set inserting to bed way.

e. Make sure that two hexagon nuts is fixed.

f. Keep the machine's center of gravity at the center of the crane.

7. Moving the machine with a forklift. (Figure 12)

a. Make sure that the minimum forklift capacity is more than 2 tons for security.

b. Forklift work should be cooperatively done by two persons, that is an operator and watchman, not to damage projecting on the machine perimeter.

c. To put the fork, use the fork inserting the plinth mid-lift.

d. Keep the machine's balance of gravity at the center of the forks.

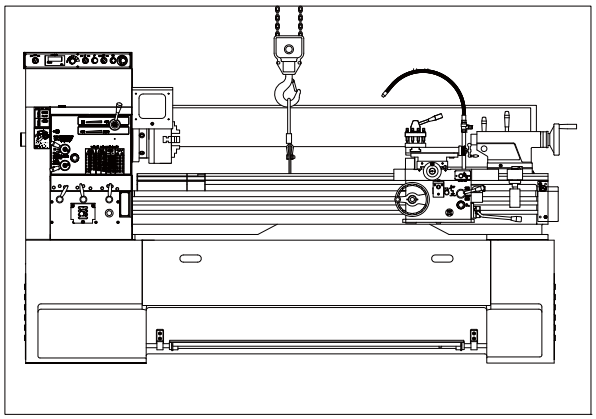


Figure 11. Lifting the machine with crane.

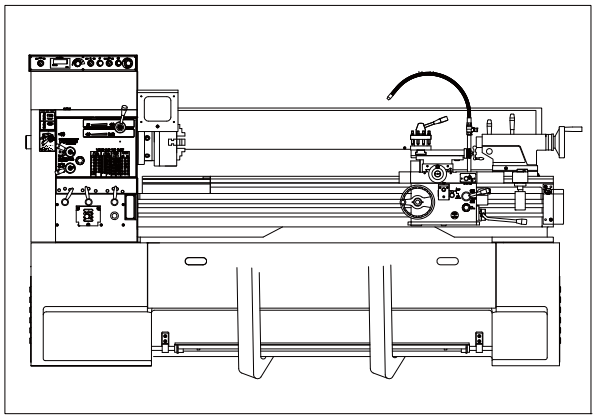


Figure 12. Moving the machine with a forklift.

Leveling

This lathe must be placed on the included leveling studs and cast-iron feet. Complete support at each of the six leveling stud locations is mandatory. The bed cannot be twisted or bent, and the ways must be perfectly level with the floor. If a misalignment condition arises, adjust the leveling studs, or shim the cast iron feet where they touch the floor until the bed and ways are in alignment.

Figure 13. Leveling pads and screws.

To level the machine, use a precision level to make sure the bedways are level from side-to-side and from front-to-back.

Leveling machinery helps precision components, such as bedways, remain straight and flat during the lifespan of the machine. Components on an unleveled machine may slowly twist due to the dynamic loads placed on the machine during operation.

Figure 14. Example of a precision level.

Test Run

After all preparation steps have been completed, the machine and its safety features must be tested to ensure correct operation. If you discover a problem with the operation of the machine or its safety components, shut the machine down, disconnect it from power, and do not operate it further until you have resolved the problem.

To test run the lathe:

1. Disconnect the lathe from POWER !

2. Make sure that the headstock oil tank, gearbox, apron, and lead screw reservoir oil levels are full.

3. Make sure that the chuck and jaws are secure.

4. Turn the pump switch to the OFF position, fill the cutting fluid reservoir, and point the fluid nozzle into the chip pan.

5. Turn the CSS ON / OFF switch to ON, turn the spindle speed dial (Figure 15) to its minimum speed, and make sure the cross slide is backed out to avoid possibility of a high-speed start.

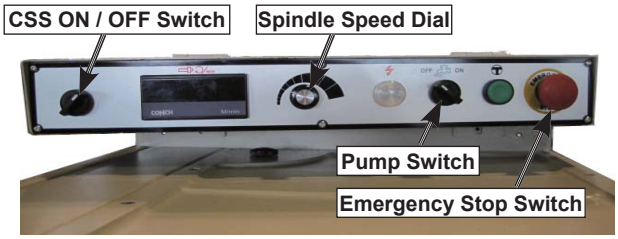


Figure 15. Control panel.

6. Move the headstock range lever (Figure 16) to the left so the headstock is in low range (20-400 RPM).

Figure 16. Headstock range lever.

7. Move the Gearbox range lever to neutral as shown in Figure 17.

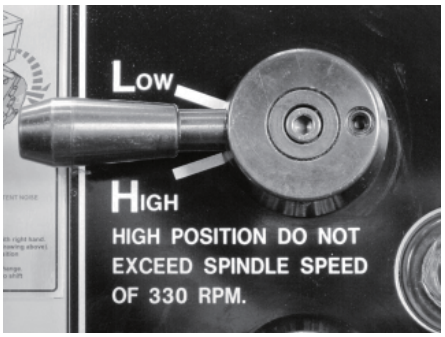


Figure 17. Gearbox range lever.

8. Move the feed direction forward / reverse lever to neutral as shown in Figure 18.

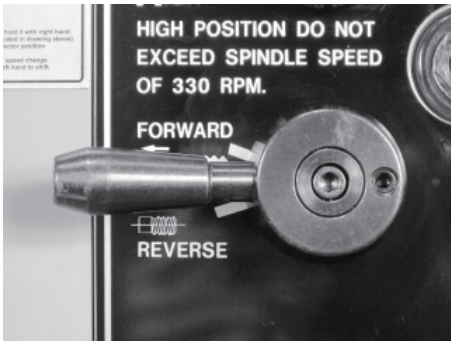


Figure 18. Feed forward / reverse lever.

9. Disengage the half nut lever, put the feed control lever in neutral, and make sure the carriage lock bolt is loose as shown in Figure 19.

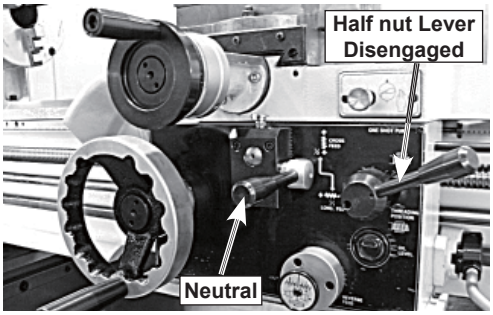


Figure 19. Apron disengaged.

10. Using a 10mm hex wrench, loosen the carriage lock (Figure 20) so the carriage is free to slide.

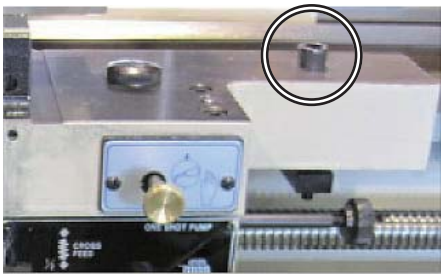


Figure 20. Carriage lock.

11. Move the spindle ON / OFF lever to the OFF position as shown in Figure 21.

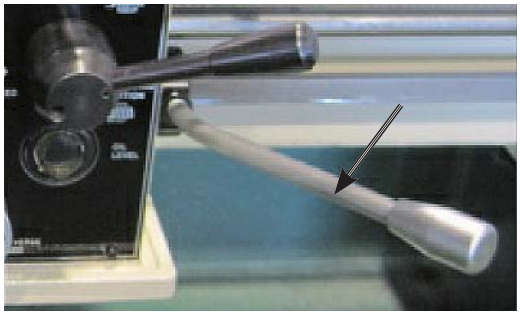


Figure 21. Spindle ON / OFF lever.

12. Connect the lathe to power, and at the rear of the headstock, turn the master power switch to the ON position (Figure 22).

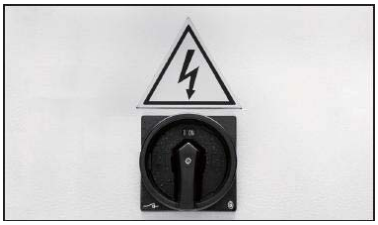


Figure 22. Main Power Switch in ON position.

13. Rotate the red EMERGENCY stop switch knob clockwise until it pops out and the pump will turn on. Observe the oil pump tube sight glass (Figure 23). When oil flows out of the tube and against the sight glass, you can start the lathe.

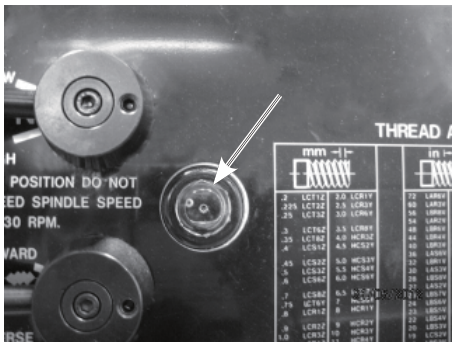


Figure 23. Oil pump sight glass.

14. Make sure that all bystanders are out of the way, tools are cleared away, and the chuck key is removed from the chuck.

15. Move the spindle ON/OFF lever down and the chuck will rotate.

16. Observe and listen for any abnormal noises or vibration. The lathe should run smoothly with little or no vibration or rubbing noises.

17. Push the foot brake, and the lathe should come to a quick stop.

18. Open the lathe headstock side cover approximately 25mm so the door safety limit switch opens and disables the lathe from starting

19. Attempt to start the lathe. Should the lathe start, the safety limit switch is faulty and needs replacement.

20. Close the door and start the lathe again, and push the EMERGENCY STOP switch and the lathe should stop.

21. Turn the cutting fluid pump on, and fluid should flow from the nozzle.

22. The test run is now finished. Shut the lathe down and begin the Spindle Break-In procedure.

Spindle Break-in

It is essential to closely follow the proper break-in procedures to ensure trouble-free performance. Complete this process once you have familiarized yourself with all instructions in this manual and completed the test run.

To break-in the spindle :

1. Complete the Test Run procedure.

2. Turn the CSS ON / OFF dial to OFF and the spindle speed dial to the minimum speed.

3. Move the gearbox range lever (Figure 24) to low range.

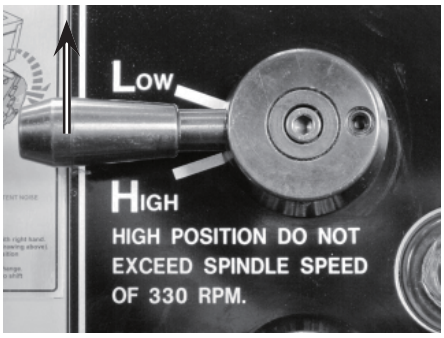


Figure 24. Gearbox range laver.

4. Move the headstock range lever to low range.

5. Move the feed direction forward / reverse lever (Figure 25) to FORWARD.

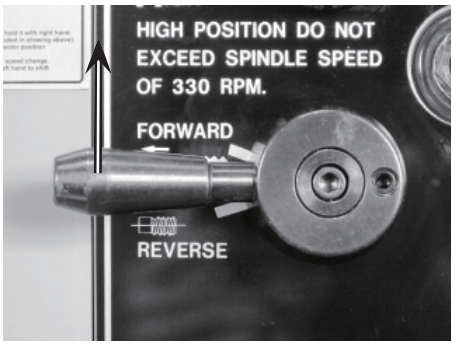


Figure 25. Feed forward / reverse laver.

6. Disengage the half nut and the power feed levers shown in Figure 26.

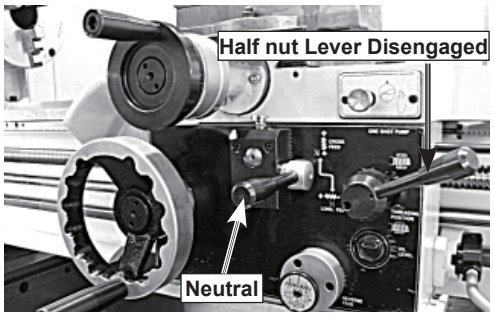


Figure 26. Power feed and half nut levers disengaged.

7. Turn the lathe ON, and let it run for ten minutes in each speed of 20, 200, and 400 RPM, using the dial to adjust the speed.

8. After completing Step 7, stop the lathe and move the gearbox range lever to neutral, and move the headstock range lever to high.

9. Turn the lathe ON and let it run at for ten minutes in each speed of 400, 1000, and 2500 RPM.

10. After completing Step 9, reduce the spindle speed to 400 RPM and let the lathe run for a final 15 minutes to allow the machine to cool and circulate the oil.

11. Shut the lathe down, replace the headstock and gearbox oil, and re-tension the V-belts.

Section 3 : Operation

CSS System

This lathe is equipped with a CSS (Constant Surface Speed) system (Figure 27) that gives consistent finishes between surfaces with different diameters.

Figure 27. CSS System.

If the CSS switch is in the ON position, the spindle speed automatically changes with the position of the cross slide. For example, during facing operations, as the tool bit moves toward the center of the workpiece, the spindle speed increases to maintain a constant surface speed during cutting as diameter decreases.

As a result of this automatic spindle speed control, surface finishes are consistent, tooling lasts longer, and fewer workpieces will be lost from mistakes.

Another benefit derived from the CSS feature is that from reduced machine shutdown and less lever shifting cycles, shorter machining time will be achieved which can mean increased productivity.

Note: When the CSS switch is in the ON position, the spindle RPM can be adjusted with the spindle speed dial.

When the CSS switch is in the OFF position, the cross slide position has no effect on spindle speed. The spindle speed is only adjusted with the spindle speed dial.

Chuck

This lathe is shipped with the 3-jaw chuck installed. This is a scroll-type chuck, meaning that all three jaws move in unison when adjusted.

The optional 4-jaw chuck features independent jaws, which are used for square or unevenly-shaped stock.

If neither chuck can hold your workpiece, the cast-iron faceplate has slots for T-bolts that hold standard or custom clamping hardware. With the correct clamping hardware, this faceplate will hold non-cylindrical parts such as castings.

The chucks and faceplate have a D1-6 camlock mount. A chuck key is used to turn the locking cams (Figure 28) to secure / release the chuck / faceplate.

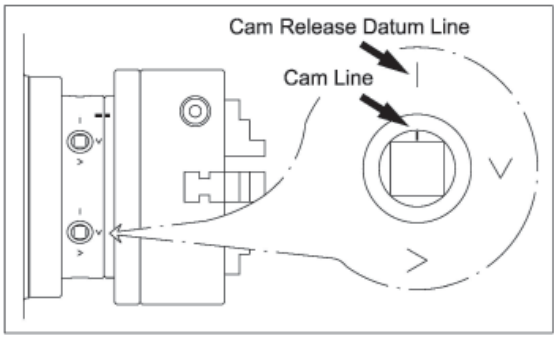


Figure 28. Camlock loosened with the cam line aligned with the datum line.

To install a chuck :

1. Disconnect lathe from POWER !
2. Place a piece of plywood across the lathe ways and position it just under the chuck.
3. Place the chuck on the cradle.
4. Make sure the chuck taper and spindle taper mating surfaces are perfectly clean.
5. Inspect and make sure that all camlock studs are undamaged, are clean and lightly oiled, and that the camlock stud cap screws are in place and snug.
6. If equipped, align the chuck-to-spindle timing marks (Figure 29), and slide the chuck onto the spindle.

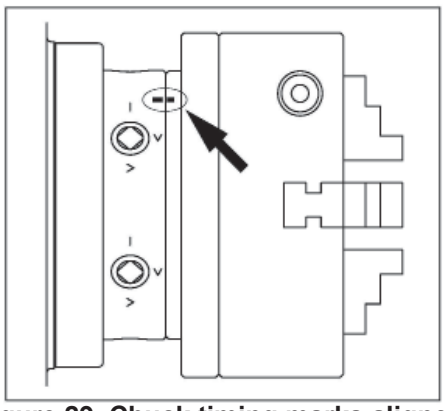


Figure 29. Chuck timing marks aligned.

7. Turn a camlock with the chuck key until the cam line falls between the "V" marks shown in Figure 30.

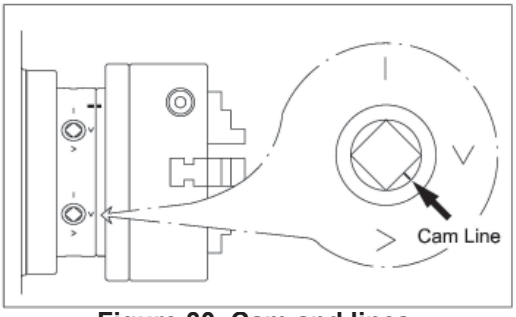


Figure 30. Cam and lines.

8. Lock the other cams in a crisscross or star pattern so the chuck is drawn up evenly on all sides without any chance of misalignment.

9. Remove the chuck key.

To remove a chuck :

1. Disconnect lathe from POWER !

2. Place a piece of plywood across the lathe ways to protect the ways, or use a support cradle and position it just under the chuck.
3. Turn a cam with the chuck key until the cam line aligns with the cam release datum line.

4. Unlock the other cams in the same manner. Make sure to support the chuck as you align the last cam.

5. Remove the chuck key.

Installing and Adjusting Camlock Stud

When fitting a chuck or faceplate with camlock studs, or when mounting a new chuck or faceplate, it may be necessary to install or adjust the camlock studs.

In order to properly install or adjust one or more camlock studs, you must remove a stud locking cap screw, then thread the camlock stud in or out until the line on the side of the stud is flush with the top of the chuck casting.

3-Jaw Chuck

The 3-jaw scroll-type chuck included with this lathe features hardened steel jaws that center the workpiece. When the operator opens or closes the jaws with the chuck key, the jaws move in unison.

There are two sets of jaws included with the 3-jaw chuck ─ inside and outside jaws. Use the correct jaws for the size and configuration of the workpiece to hold it firmly and securely on the chuck.

Numbered from 1-3, the jaws must be used in the matching numbered jaw guides, as shown in Figure 31.

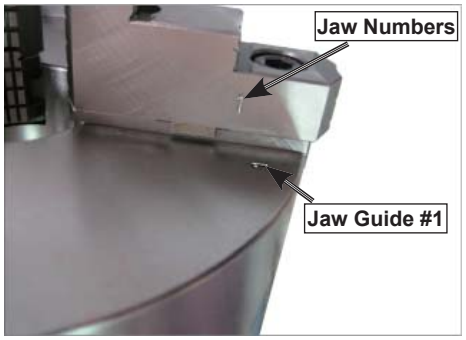


Figure 31. Jaw guides and jaw numbers.

To change the jaw :

1. Disconnect Lathe from POWER !

2. Place a piece of wood over the ways to protect them from potential damage.

3. Insert the chuck key and turn it counterclockwise to back the jaws out and remove them.
4. Clean the jaw mating surfaces and apply a thin film of white lithium grease to the mating surfaces.

5. Set the previously mounted jaws aside in a safe place free of moisture and abrasives.

6. Rotate the chuck key clockwise until you see the tip of the scroll gear lead thread just begin to Insert jaw #1 into jaw guide #1 and hold the jaw against the scroll gear lead thread.

7. Rotate the chuck key clockwise one turn to engage the tip of the scroll gear lead thread into the jaw.

Figure 32. Inserting jaw.

8. Pull on the jaw—now it should be locked into the jaw guide.

9. Repeat the Steps 6–8 on the remaining jaws.

To mount a workpiece in the 3-jaw chuck :

1. Disconnect Lathe from POWER !

2. Place a chuck cradle or plywood on the bedway below the chuck to protect it.

3. Use the chuck key to move the jaws and mount the workpiece to the chuck, similar to one of the methods shown in Figure 33. Make sure the workpiece is mounted firmly on the chuck.

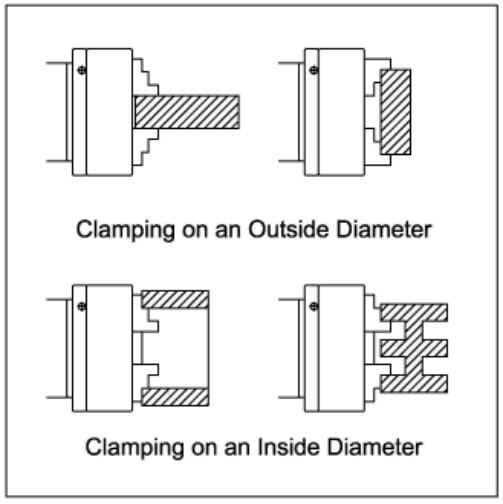


Figure 33. Examples of workpiece mounted in the 3-jaw chuck.

4. Rotate the chuck by hand to make sure the workpiece makes even contact with all three jaws and is centered.

4-Jaw Chuck

The 4-jaw chuck features independently adjustable hardened steel jaws to hold non-cylindrical or off-center workpieces. Each jaw can be removed from the chuck body and reversed for a wide range of work holding versatility.

To mount a workpiece on the 4-jaw chuck :

1. Disconnect Lathe from POWER !

2. Place a chuck cradle or plywood on the bedway below the chuck to protect it.

3. Use the chuck key to open each jaw so the workpiece will lay flat against the chuck face or jaw steps.

4. With help from another person or a supporting device, mount the workpiece centered on the chuck, then turn each jaw until it makes contact with the workpiece.

5. Tighten each jaw in small increments. After you have adjusted the first jaw, continue tightening in an opposing sequence.

6. After the workpiece is held in place by the jaws, turn the chuck by hand and pay attention to the workpiece alignment.

Tailstock

The tailstock on your lathe can be used to support workpieces with the use of a live or dead center.

It can also be used to drill or bore holes in the center of a part or cut shallow tapers by using the offset adjustment.

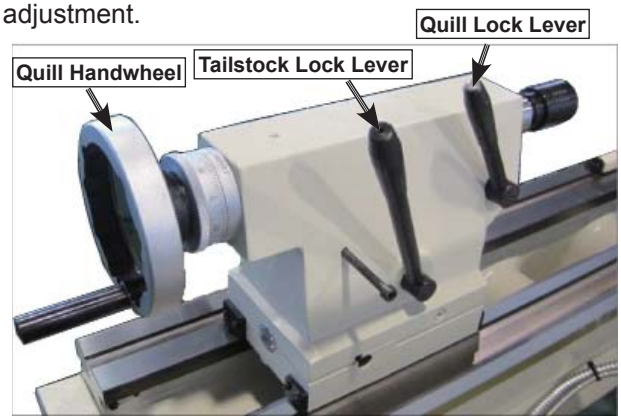


Figure 34. Tailstock and quill lock levers in locked position.

To move the tailstock :

1. Pull back on the lock lever.

2. Slide the tailstock to the desired position.

3. Push the tailstock lock lever forward to lock the tailstock to the lathe bed.

To use the tailstock quill :

1. With the tailstock locked to the bed, release the quill lock lever.

2. Turn the quill feed handwheel clockwise to feed/move the quill towards the spindle, or turn counterclockwise to move the quill away from the spindle.

3. Push the quill lock lever forward to lock the quill in place.

To install tooling in the tailstock :

1. With the tailstock locked, unlock the quill lock lever.

2. Turn the quill handwheel CW to extend quill about 25mm out of the casting.

3. Insert a tapered drill arbor or a tapered drill bit into the quill until the taper is firmly seated and the tang is locked to the quill slot.

4. Turn the quill handwheel CW to feed the drill bit into the rotating workpiece.

5. To remove the tooling from the tailstock, turn the quill handwheel CCW until the tooling is pushed out of the taper.

To offset the tailstock :

1. Lock the tailstock in position.

2. Loosen two nuts of bottom, adjust the left and right jack screws until the scale (Figure 35) indicates the offset you want. See Figure 36 for adjustment direction.

3. When the offset is achieved, snug the jack screws so the tailstock position is locked.

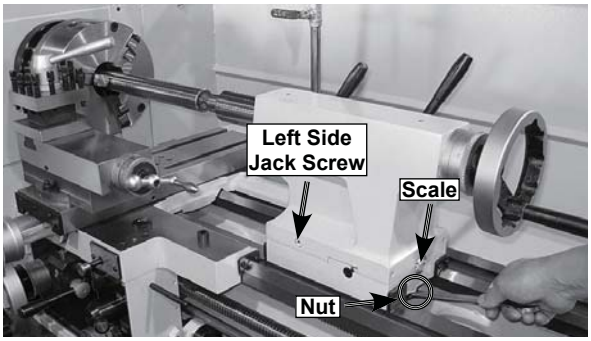


Figure 35. Tailstock offset adjustments.

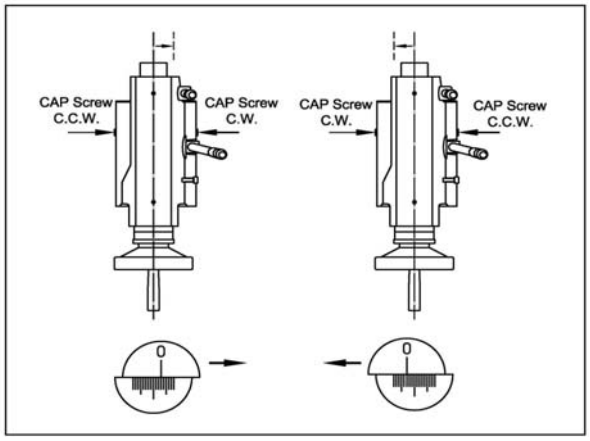


Figure 36. Jack screw adjustment verses tailstock movement.

Centers

Dead Centers

The dead center achieves more accurate results than a live center, but it requires low spindle speeds and a small amount of oil to reduce friction heat that may damage the workpiece.

Use the HSS dead center in the spindle, where the workpiece does not rotate on the tip and does not generate friction.

Use the carbide-tipped dead center in the tailstock where the workpiece will rotate against it and generate friction. The carbide-tipped dead center can better withstand the effects of friction; however, the tip of the center must be lubricated to avoid premature wear and maximize smooth operation. Also, using low spindle speeds will also reduce the heat and wear from friction.

Live Centers

A live center has bearings that allow the center tip and the workpiece to rotate together, and can be installed in the spindle and the tailstock quill for higher speeds, but with a slight bit of accuracy loss.

Mounting Dead Center in Spindle

1. Disconnect Lathe from POWER !

2. Thoroughly clean and dry the tapered mating surfaces of the spindle bore, tapered sleeve, and the center.

3. Insert the center into the sleeve, then insert the sleeve into the spindle bore through the chuck or faceplate.

Removing Center from Spindle

To remove the sleeve and center from the spindle, insert a piece of round bar stock or similar tool through the outboard end (on the left side of the headstock), then tap the sleeve loose.

Mounting Center in Tailstock

Either a dead center or live center can be mounted in the tailstock. Mounting instructions are the same for both.

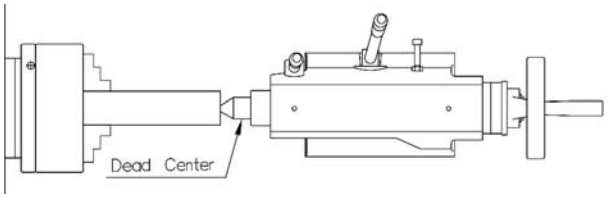


Figure 37. Example of using a dead center installed in the tailstock.

To mount a center in the tailstock :

1. Disconnect Lathe from POWER !

2. Thoroughly clean and dry the tapered mating surfaces of the tailstock quill bore and the carbide-tipped dead center.

3. Use the tailstock quill handwheel to feed the quill out from the casting about 25mm.

4. Insert the center into the tailstock quill.

5. Seat the center firmly into the quill during workpiece installation by rotating the quill handwheel clockwise to apply pressure.

Removing Center from Tailstock

To remove the center from the quill, hold onto it with a rag in one hand, then rotate the tailstock handwheel counterclockwise to draw the quill back into the casting until the center released.

Steady Rest

The steady rest supports long shafts and can be mounted anywhere along the length of the bed.

To install and use the steady rest :

1. Disconnect Lathe from POWER !

2. Thoroughly clean the machined base of the steady rest, then place it on the lathe bedways so the triangular notch fits over the bedway prism.

3. Position the steady rest where required to properly support the workpiece, then tighten the hex nut shown in Figure 38 to secure it in place.

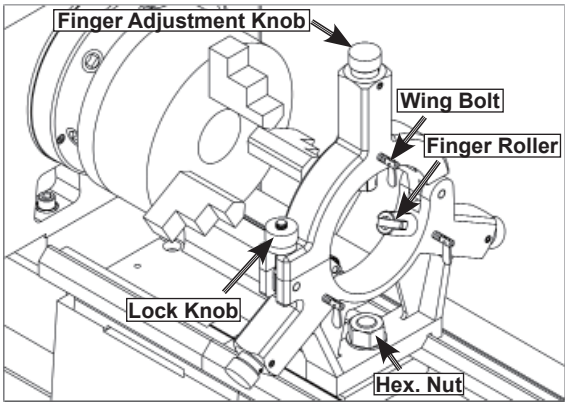


Figure 38. Steady rest components.

4. Loosen the lock knob and open the steady rest so the workpiece can rest on the bottom two finger rollers, as shown in Figure 39.

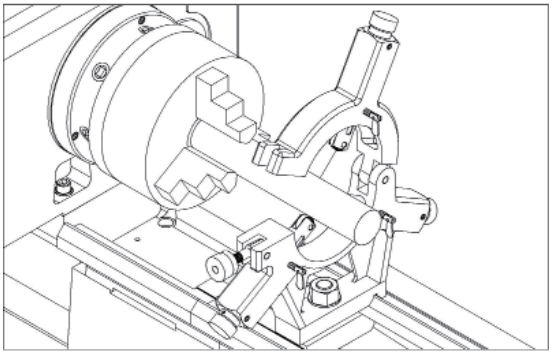


Figure 39. Workpiece mounted in the steady rest.

5. Close the steady rest so that the workpiece is inside the finger rollers, then tighten the lock knob.

6. Loosen the three wing bolts so the finger roller positions can be adjusted.

7. Use the finger adjustment knobs to just touch the finger rollers against the workpiece without causing workpiece deflection.

8. Tighten the three wing bolts.

Follow Rest

The follow rest mounts to the saddle with two cap screws (Figure 40). It is used on long, slender parts to prevent workpiece flexing from the pressure of the cutting tool during operation.

Adjust the sliding finger rollers on the follow rest in the same manner as those on the steady rest.

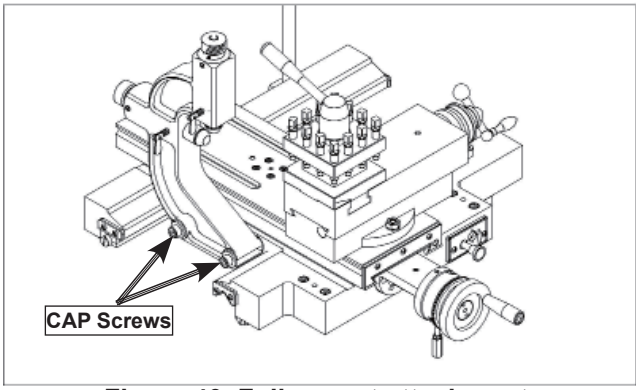


Figure 40. Follow rest attachment.

Compound Slide

The compound slide handwheel has an indirect-read graduated scale. This means that the distance shown on the scale represents the actual distance the tool moves, which of course, will remove twice as much material from the diameter of the workpiece. The base of the compound slide has another graduated scale used for setting the tool to a specific angle.

To set the compound slide at a certain angle :

1. Loosen the two hex nuts at the base of the compound slide (1 of 2 shown in Figure 41).

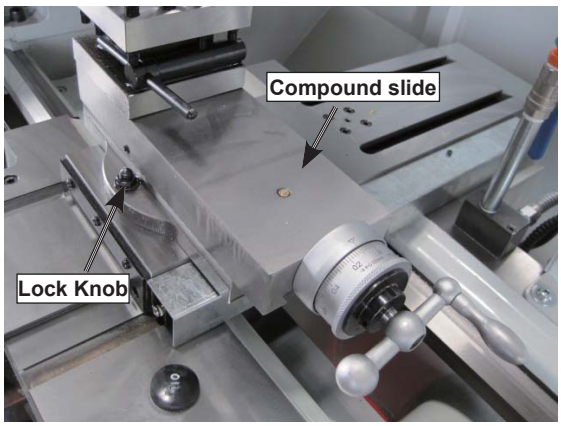


Figure 41. Compound slide set at an angle.

2. Rotate the compound to the desired angle, as indicated by the scale at the base, then retighten the two hex nuts.

4-Way Tool Post

The four-way tool post is mounted on top of the compound slide, and allows a maximum of four tools to be loaded simultaneously.
The four-way tool post allows for quick indexing to different tools. This is accomplished by loosening the top handle, rotating the tool post to the desired position, then re-tightening the handle to lock the tool into position.

To load the tool :

1. Choose the desired cutting tool.

2. Loosen the tool post bolts so that the cutting tool can fit underneath them.

3. Firmly secure the cutting tool with at least two tool post bolts, as shown in Figure 42.

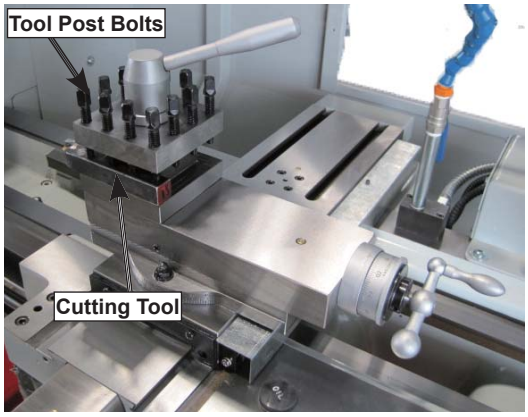


Figure 42. 4-way tool post.

Aligning Cutting Tool with Tailstock Center

For most operations, the cutting tool tip should be aligned with the spindle center line, as illustrated in Figure 43.

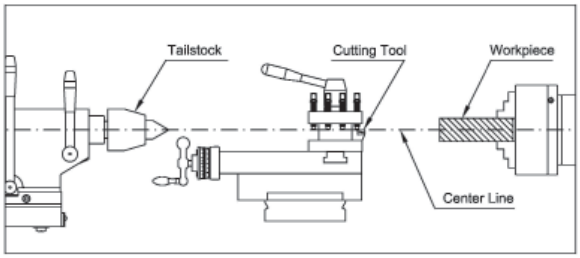


Figure 43. Cutting tool aligned with workpiece center.

There are a number of ways to check and align the cutting tool to the spindle center line. Below are two common methods :

- Align the tip of the cutting tool with a center installed in the tailstock. For this to work, the tailstock must be aligned to the spindle center line.

- Make a facing cut on a piece of round bar stock. If the tool is above/below the spindle center line, a nub will be left in the center of the workpiece. Adjust the height of the workpiece, then repeat the facing cut to check the adjustment. Repeat as necessary until the center of the workpiece is smoothly faced.

To align the cutting tool with the tailstock center :

1. Mount the cutting tool in the tool post, then turn the tool post so the tooling faces the tailstock.

2. Install a center in the tailstock, and position the center tip near the tip of the cutting tool.

3. Lock the tailstock and quill in place.

4. Adjust the height of the cutting tool with a steel shim, so the tip just touches the end of the tailstock center.

Apron Stop

Use the adjustable apron stop collar to set the location where the carriage will be disengaged by the feedrod friction clutch.

When the adjustable apron stop contacts the stop collar during a longitudinal feeding operation, the clutch disengages the feedrod from the apron and the carriage movement stops.

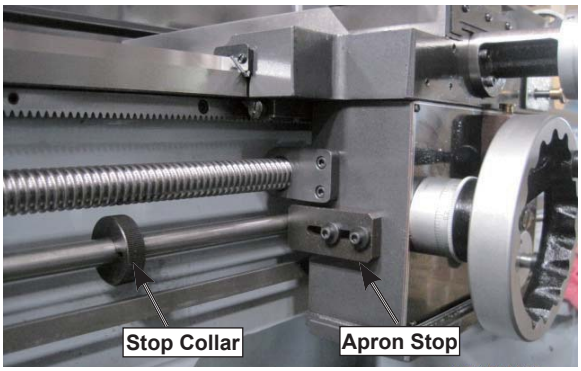


Figure 44. Apron stop and collar.

Manual Feed

You can manually move the cutting tool around the lathe for facing or turning operations using the handwheels shown in Figure 45 and described below.

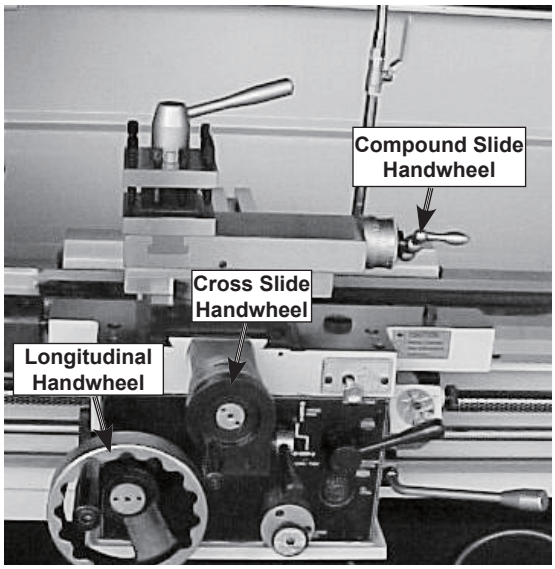


Figure 45. Carriage Controls.

Longitudinal Handwheel

The longitudinal handwheel moves the carriage left or right along the bed. Use this control when setting up the machine for facing or turning.

Cross Slide Handwheel

The cross slide handwheel moves the top slide toward and away from the work. Turning the dial clockwise moves the slide toward the workpiece. Adjust the graduated scale by holding the handwheel with one hand and turning the dial with the other.

Compound Slide Handwheel

The compound slide handwheel controls the position of the cutting tool relative to the workpiece. The compound is adjustable for any angle within its range. The combo inch/metric graduated scale is engraved into a rotatable barrel. Angle adjustment is secured by cap screws on the base of the compound.

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.

2. Configure the lathe controls to produce the required spindle speed.

Determining Spindle Speed

Many variables affect the optimum spindle speed to use for any given operations, but the two most important are the recommended cutting speed for the workpiece material and the diameter of the workpiece, as noted in the formula :

$$RPM = \frac{CSx4}{D}$$

RPM = Spindle speed, revolution per minute.
CS = Cutting speed in surface feet per minute (SFM)
D = Diameter of workpiece

EXAMPLE :
If the cutting speed is 40 for a certain alloy steel and the workpiece is 2 inches in diameter, find the rpm as follows :
RPM = = 80
After calculating the RPM, use the nearest or next lower speed on the lathe and set the spindle speed.

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. All of these sources will help you take into account all the applicable variables in order to determine the best spindle speed for the operation.

Setting Spindle Speed

1. Make sure the spindle is turned OFF and it has come to a complete stop.

2. Use the chart in Figure 46 to determine the available spindle speed range closest to your calculated spindle speed.

SPEEDS	
LEVER	RPM
LOW	20 – 400
HIGH	400 - 2500

Figure 46. Spindle speed range chart.

3. Adjust the spindle speed range lever to the range that covers your calculated spindle speed.

4. Turn the spindle ON and slowly turn the variable speed dial to carefully adjust the spindle speed to your calculated spindle speed.

Power Feed

On this machine, both the carriage and cross slide have power feed capability. The rate that these components move (feed rate) is controlled by how the levers are configured on the gearbox.

Feed rate and spindle speed must be considered together. The sources you use to determine the optimum spindle speed for an operation will also provide the optimal feed rate to use with that spindle speed.

Often, the experienced machinist will use the feeds and speeds given in their reference charts or web calculators as a starting point, then make minor adjustments to the feed rate (and sometimes spindle speed) to achieve the best results.

The carriage can alternately be driven by the leadscrew for threading operations. However, this section covers using the power feed option for the carriage and cross slide components for non-threading operations.

Power Feed Controls

The feed direction lever controls direction of the carriage. The quick change feed direction knob reverses the feed direction of the carriage while the lathe is running.

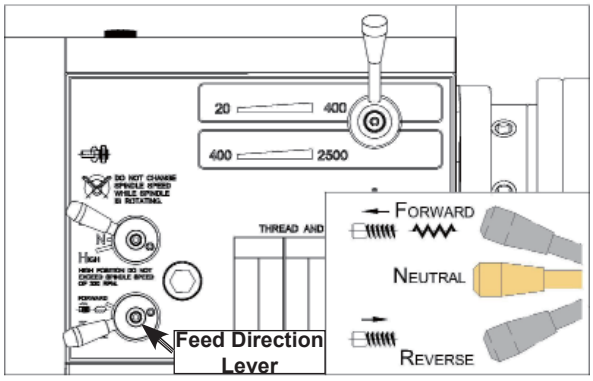


Figure 47. Feed Direction Lever.

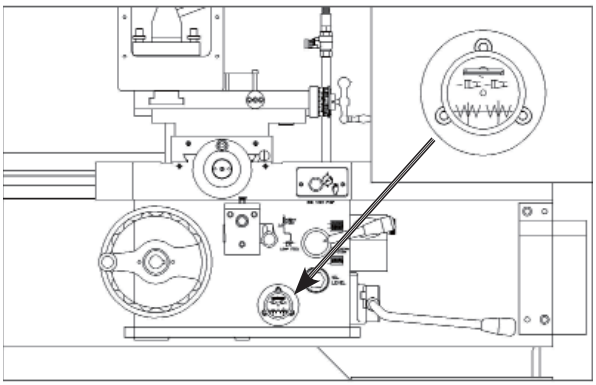


Figure 48. Quick change feed direction knob.

To engage the power feed :

1. Make sure the spindle is OFF and has come to a complete stop.

2. Use the feed direction lever to select the direction that the feed rod will rotate.

3. Use the feed control lever on the front of the apron to engage power feed for either the carriage or the cross slide (see Figure 49). To engage the carriage, push the lever to the left and down. To engage the cross slide, push the lever to the right and up.

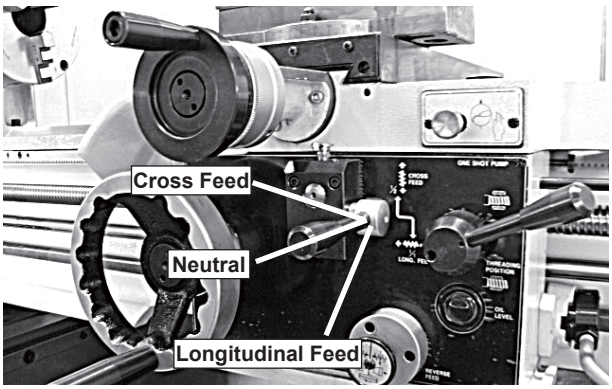


Figure 49. Feed control lever positions.

To use the quick change feed direction knob :

1. While the lathe is running, place the feed control lever in neutral.

2. Push or pull the quick change feed direction knob to change the direction of the feed rod.

3. Re-engage the feed direction lever. The feed rod rotation will now be reversed, causing the engaged carriage or cross slide to move in the opposite direction.

Thread & Feed Rate Chart

Figure 50 shows the configurations of gearbox levers that are required to set the available feed rates. This same chart can also be found on the machine.

METRIC THREADING				INCH THREADING				MODULAR OR DIAMETRAL				TURNING FEED RATE (DIST./REVOLUTION)		
mm				in.				mod		dp		mm		ins
.2	LCT1Z	2.0	LCR1Y	72	LAR6V	12	LBT6V							
.225	LCT2Z	2.5	LCR3Y	60	LAR3V	11½	LBT5V	.3	HCT6Z	44	HBR4V	.050	LCT1W	.002
.25	LCT3Z	3.0	LCR6Y	56	LBR8V	11	LBT4V	.4	HCS1Z	40	HBR3V			
				54	LAR2V	10	LBT3V	.5	HCS3Z	36	HAS6V	.055	LCT2W	.0022
.3	LCT6Z	3.5	LCR8Y	48	LBR6V	9	LBT2V			32	HBR1V	.065	LCT4W	.003
.35	LCT8Z	4.0	HCR3Z	44	LBR4V	8	LBT1V			30	HAS3V	.085	LCT8W	.0033
.4	LCS1Z	4.5	HCS2Y	40	LBR3V	7½	HAS3V	.6	HCS6Z	28	HBS8V			
				36	LAS6V	7	HBS8V	.7	HCS8Z	26	HBS7V	.10	LCS2W	.004
.45	LCS2Z	5.0	HCS3Y	32	LBR1V	6	HBS6V	.8	HCR1Z			.13	LCS4W	.005
.5	LCS3Z	5.5	HCS4Y	30	LAS3V					24	HBS6V	.18	LCS8W	.007
.6	LCS6Z	6.0	HCS6Y	28	LBS8V	5	HBS3V	.9	HCR2Z	22	HBS4V			
				27	LAS2V	4½	HBS2V	1.0	HCR3Z	20	HBS3V	.22	LCR2W	.009
.7	LCS8Z	6.5	HCS7Y	26	LBS7V	4	HBS1V	1.25	HCS3Y	19	HCS2V	.28	LCR4W	.011
.75	LCT6Y	7	HCS8Y	24	LBS6V					18	HBS2V	.35	LCR8W	.014
.8	LCR1Z	8	HCR1Y	23	LBS5V	3¾	HAT3V	1.5	HCS6Y	16	HBS1V			
				22	LBS4V	3½	HBT8V	1.75	HCS8Y	15	HAT3V	.44	LCS8X	.017
.9	LCR2Z	9	HCR2Y	20	LBS3V	3¼	HBT7V	2.0	HCR1Y	14	HBT8V			
1.0	LCR3Z	10	HCR3Y	19	LCS2V					13	HBT7V	.55	LCR2X	.022
1.1	LCR4Z	11	HCR4Y	18	LBS2V	3	HBT6V	2.25	HCR2Y	12	HBT6V	.68	LCR4X	.027
				16	LBS1V	2⅞	HBT5V	2.5	HCR3Y	11	HBT4V	.85	LCR8X	.033
1.2	LCR6Z	12	HCR6Y	15	LBT3V	2¾	HBT4V	2.75	HCR4Y					
1.25	LCS3Y	13	HCR7Y	14	LBT8V					10	HBT3V	1.2	HCS2X	.047
1.3	LCR7Z	14	HCR8Y	13½	LAT2V	2½	HBT3V	3.0	HCR6Y	9	HBT2V	1.4	HCS4X	.055
1.4	LCR8Z			13	LBT7V	2¼	HBT2V	3.25	HCR7Y	8	HBT1V	1.7	HCS8X	.067
1.5	LCS6Y					2	HBT1V	3.5	HCR8Y					
1.75	LCS8Y													

Figure 50. Thread and feed rate chart.

Positioning Gearbox Levers

To cut a particular thread or establish a particular feed rate, you may need to first swap the gearbox drive gear, depending on where it is currently set.

Once you have confirmed that the end gear is set up properly, you can then move the gearbox levers to the required positions. The arrows going from Figure 50 to Figure 51 show which gearbox levers must be moved to achieve an example feed rate.

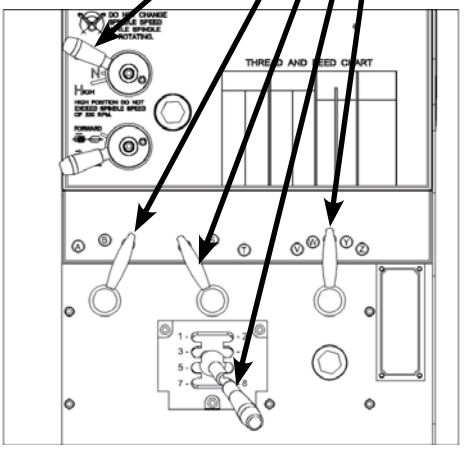


Figure 51. Thread and feed rate chart.

End Gear Setup

The gearbox drive gear on this lathe can be configured for the normal position or the alternate position, depending upon the type of operation to be performed. The lathe is shipped with the end gears in the normal position. Gears must be thoroughly cleaned and re-coated in grease before installing, and the backlash must be maintained at 0.127mm (0.005") for correct meshing.

Normal Position (Inch)
The 24T end gear is installed in the top position, the 44T/56T end gears in the middle position, and the 57T end gear in the bottom position, as shown in Figure 52. In the normal position, the 56T and 57T gears are meshed, which allows for inch threading and all general feed operations.

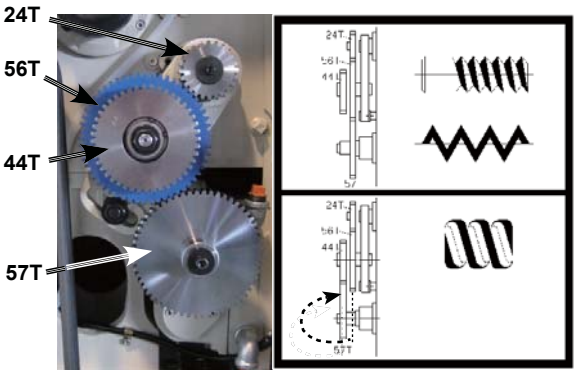


Figure 52. Normal end gear position.

Alternate Position (Inch)
When the 44- and 57-tooth end gears are meshed, you can perform modular and diametral pitch turning.

Configuring the End Gears
1. Disconnect Lathe from POWER !

2. Move the gearbox range lever to "Low" so that the gears will not rotate in the following steps, then open the lathe headstock side cover.

3. **To change the position of the 57T gear :**
   a. Remove the cap screw and flat washer that secures the gear, then remove the gear.

   b. Clean away debris and grime from the gear and apply a light coat of machine oil.

   c. Swap the position of the gear, then align it with the key and insert it on the gear shaft.

   d. Re-install the flat washer and cap screw.

4. Close and secure the headstock side cover.

Normal Position (Metric)
The 28T end gear is installed in the top position, the 55T/54T end gears in the middle position, and the 64T/22T end gear in the bottom position, as shown in Figure 53. In the normal position, the 55T and 64T gears are meshed, which allows for metric threading and all general feed operations.

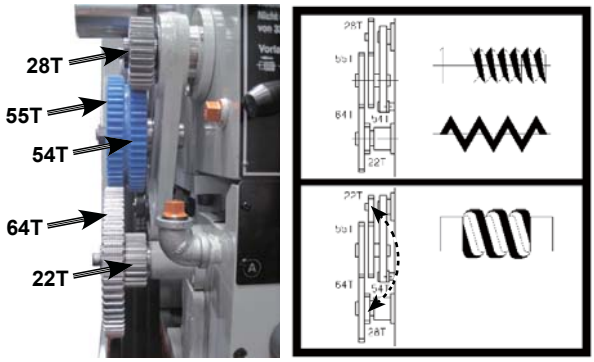


Figure 53. Normal end gear position.

Alternate Position (Metric)
When the 28- and 22-tooth end gears are exchanged, you can perform modular and diametral pitch turning.

Configuring the End Gears
1. Disconnect Lathe from POWER !

2. Move the gearbox range lever to "Low" so that the gears will not rotate in the following steps, then open the lathe headstock side cover.

3. To change the position of the 22T/28T gear :

   a. Remove the cap screw and flat washer that secures the gear, then remove the gear.

   b. Clean away debris and grime from the gear and apply a light coat of machine oil.

   c. Swap the position of the gear, then align it with the key and insert it on the gear shaft.

   d. Re-install the flat washer and cap screw.

4. Close and secure the headstock side cover.

Threading Controls

If you are unfamiliar with threading procedures on a lathe, we strongly recommend that you read books, review industry trade magazines, or get formal training before beginning any threading projects.

Power Feed Lever

The feed control lever must be in the neutral (horizontal) position for threading operations or the half nut will not engage with the leadscrew (see Figures 54–55).

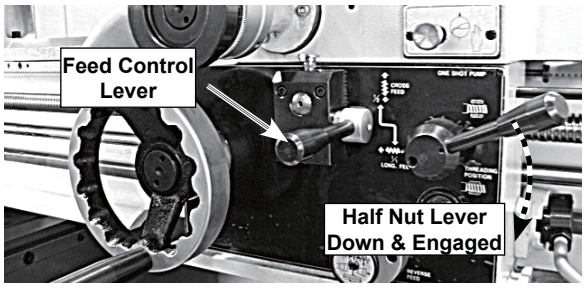


Figure 54. Carriage controls set up for threading.

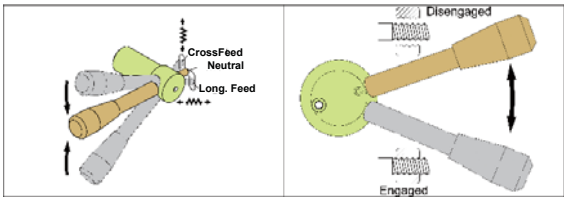


Figure 55. Feed control lever and half nut positions for threading.

Half Nut Lever

The half nut lever engages the carriage with the leadscrew which moves the cutting tool along the length of the workpiece.

Thread Dial & Chart Overview

The numbers on the thread dial are used with the thread dial chart to show when to engage the half nut during inch threading. The thread dial gear must be engaged with the leadscrew for this to work. Loosen the knurled hand knob on the thread dial, pivot the dial gear into mesh with the leadscrew, then tighten the hand knob, (see Figure 56).

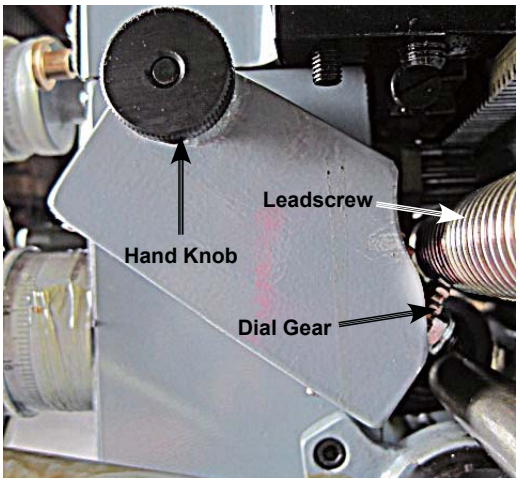


Figure 56. Thread dial engaged with the leadscrew.

Using Thread Dial and Chart (Metric)

Find the length of each thread that you want to cut in the left column (see Figure 57), then reference the dial number to the right of it. The dial numbers indicate when to engage the half nut for a specific thread pitch. The thread dial chart can also be found on the front of the thread dial housing.

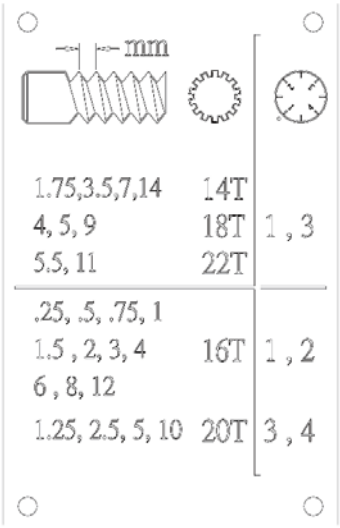


Figure 57. Thread dial chart (Metric).

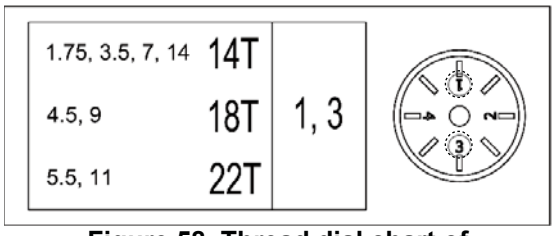


Figure 58. Thread dial chart of numbered position 1, 3.

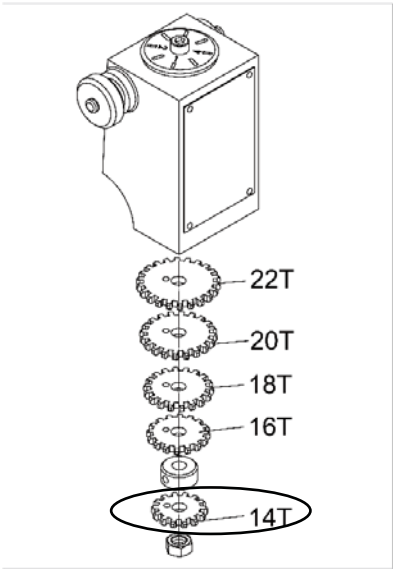


Figure 59. Example of thread dial - 14T.

Length of each thread 1.75, 3.5, 7, 14
Select position 1, 3 on the thread dial and use the 14T gear on the buttom of thread dial for threading length of each thread 1.75, 3.5, 7, 14. (Figure 58 - 59)

Length of each thread 4.5, 9
Select position 1, 3 on the thread dial and use the 18T gear on the buttom of thread dial for threading length of each thread 4.5, 9. (Figure 58 - 59)

Length of each thread 5.5, 11
Select position 1, 3 on the thread dial and use the 22T gear on the buttom of thread dial for threading length of each thread 5.5, 11. (Figure 58 - 59)

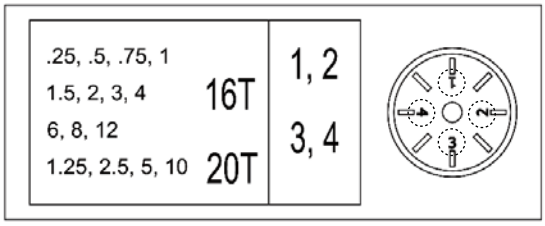


Figure 60. Thread dial chart of numbered position 1, 2, 3, 4.

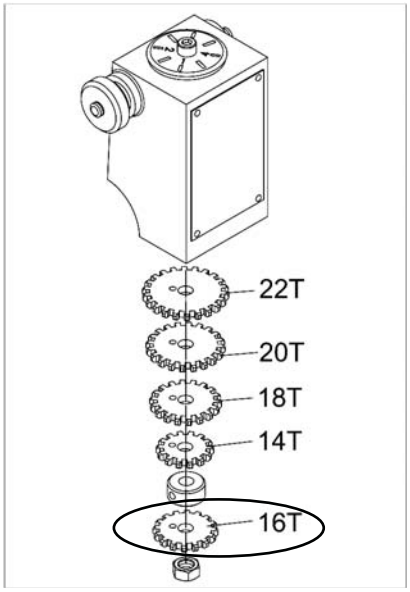


Figure 61. Example of thread dial - 16T.

Length of each thread 0.25 - 12 divisible by 0.25
Select position 1, 2, 3 or 4 on the thread dial and use the 16T gear on the buttom of thread dial for threading length of each thread 0.25 - 12 divisible by 0.25. (Figure 60 - 61)

Length of each thread 1.25, 2.5, 5, 10
Select position 1, 2, 3 or 4 on the thread dial and use the 20T gear on the buttom of thread dial for threading length of each thread 1.25, 2.5, 5, 10. (Figure 60 - 61)

Using Thread Dial and Chart (Inch)

Find the TPI (threads per inch) that you want to cut in the left column (see Figure 62), then reference the dial number to the right of it. The dial numbers indicate when to engage the half nut for a specific thread pitch. The thread dial chart can also be found on the front of the thread dial housing.

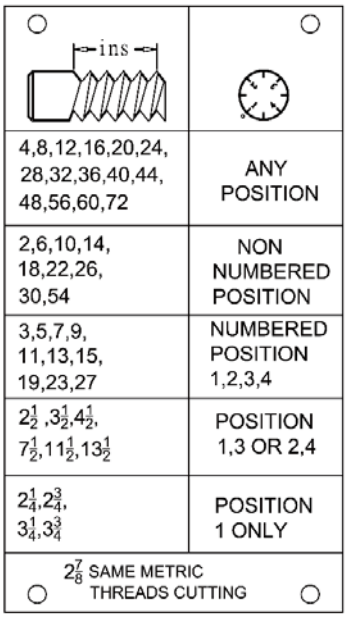


Figure 62. Thread dial chart (Inch).

TPI 4-72 Divisible By 4
Use any line (position) on the thread dial, shown in Figure 63, or threading TPI divisible by 4.

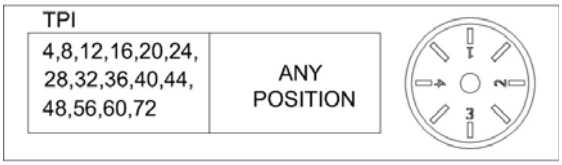


Figure 63. Any position is selected on the dial for hreading 4-72 TPI.

TPI 2-54 Not Divisible By 4
Use any of the non-numbered lines on the thread dial for threading the TPI shown in Figure 64.

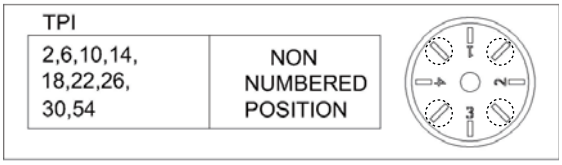


Figure 64. Marks are selected on the dial for threading 2-54 TPI.

Odd Numbered TPI
Use any of the numbered lines on the thread dial for threading the TPI shown in Figure 65.

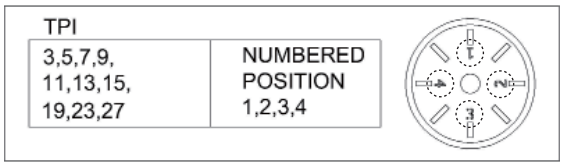


Figure 65. Numbers are selected on the dial for threading odd numbered TPI.

1⁄2 Fractional TPI
Use any opposing number pairs—2 or 4, or 1 or 3 on the thread dial for 1⁄2 fractional TPI (Figure 66). For example, to cut a 3 1⁄2 thread, select 1 on the dial, then start threading.

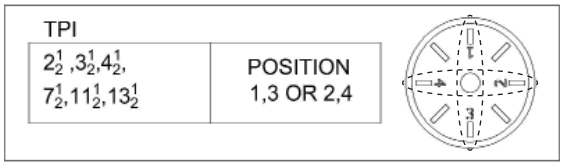


Figure 66. Opposing number group are selected on dial for cutting 1⁄2 thread TPI.

Other Fractional TPI
Use position 1 on the thread dial for cutting the TPI shown in Figure 67.

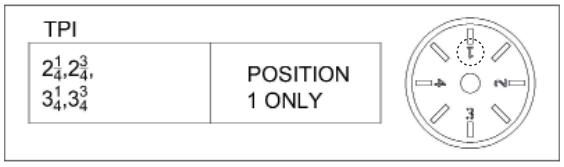


Figure 67. Any number on dial is selected for other fractional TPI

2⅞ TPI
Use any numbered or non-numbered line on the thread dial to cut the TPI shown in Figure 68

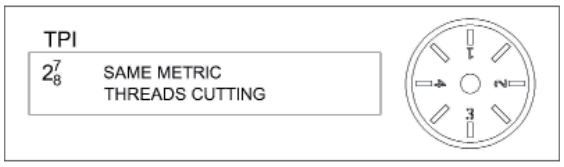


Figure 68. Any number on the dial can be selected for 2⅞ TPI.

Cutting Fluid System

The cutting fluid system delivers cutting fluid through a positionable nozzle and is controlled by the control panel cutting fluid pump switch and the valve lever near the base of the nozzle hose.

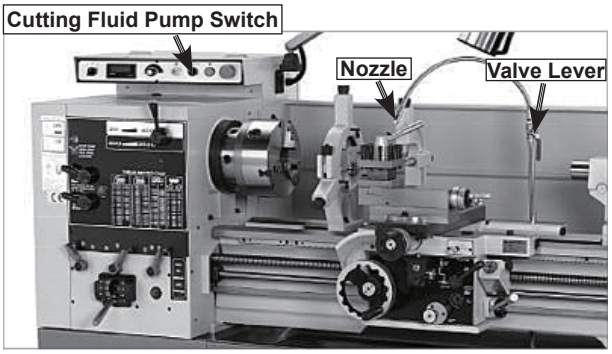


Figure 69. Coolant system controls and components.

Always use high quality cutting fluid in your coolant system and follow the manufacturer's instructions for diluting.

Refer to Cutting Fluid System on Page 30 for detailed instructions on how to add or change cutting fluid. Check the cutting fluid regularly and promptly change it when it becomes overly dirty or rancid.

To use the cutting fluid system on your lathe :
1. Make sure the tank is properly serviced and filled with cutting fluid, and that you wear the necessary personal protection equipment.

2. Position the cutting fluid nozzle for your operation.

3. Use the control panel cutting fluid pump switch to turn the coolant pump ON.

4. Adjust the flow of cutting fluid by using the valve lever near the base of the nozzle hose.

Section 4 : Maintenance

Schedule

Each operator of this machine is responsible for ensuring proper care of the equipment. We strongly recommend all operators make a habit of following the daily maintenance procedures.

For optimum performance from this machine, this maintenance schedule must be strictly followed.

Ongoing
To maintain a low risk of injury and proper machine operation, if you ever observe any of the items below, shut the machine down immediately and fix the problem before continuing operations :

- Loose mounting bolts or fasteners.
- Worn, frayed, cracked, or damaged wires.
- Guards removed.
- Limit/kill switches bypassed.
- Emergency stop button not working correctly or not requiring you to reset it before starting the machine again.
- A reduction in braking speed or efficiency.
- Headstock oil not flowing against sight glass.
- Cutting fluid not flowing out.
- Any other unsafe condition.

Daily, Before Operations

- Check / add gearbox oil.
- Check / add apron oil.
- Check cutting fluid level.
- Lubricate the ways.
- Put oil in the ball oilers.
- Check / add leadscrew & feedrod bearing oil.
- Clean / lubricate the leadscrew.
- Turn spindle speed dial all the way down.
- Move the power feed lever on the apron to neutral (to prevent crashes upon startup).
- Ensure carriage lock bolt is loose.

Daily, During Operations

- Verify headstock oil flows when power is turned ON.
- Verify electrical box cooling fan is operating.
- Verify headstock oil temperature is under 138°C (280° F).

Daily, After Operations

- Vacuum/clean all chips and swarf from bed, slides, and chip drawer.
- Wipe down all unpainted or machined surfaces with an oiled rag.
- Depress emergency stop button and shut OFF the main power switch (to prevent accidental startup).

Monthly

- Drain and clean the cutting fluid tank, then add new cutting fluid.
- Remove electrical box air filter and clean with compressed air or a vacuum.

Annually (or Semi-Annually with Hard Use)

- Drain and clean the headstock oil reservoir, then add new oil.
- Change the apron oil.
- Change the gearbox oil.

Cleaning

Regular cleaning is one of the most important steps in taking good care of this lathe. Each operator is responsible for cleaning the machine immediately after using it or at the end of the day. We recommend that the cleaning routine be planned into the workflow schedule, so that adequate time is set aside to do the job right.

Typically, the easiest way to clean swarf from the bed ways and chip drawer is to use a wet/dry shop vacuum that is dedicated for this purpose only. The small chips leftover after vacuuming can be wiped up with a slightly oiled rag. Avoid using compressed air to blow off chips, as it may drive them deeper into moving surfaces and could cause sharp chips to fly into your face or hands.

All visible swarf should be removed from the lathe during cleaning. Remember, personal neatness gives you personality.

Lubrication

Headstock

This headstock lubrication system is the most important lubrication system on the machine. It consists of an electric oil pump, a low oil pressure kill switch, a holding tank, oil lines, and a distribution manifold. The headstock has a series of oil lines that direct oil to key locations, such as the spindle bearings and headstock gearing, to ensure that they always remain well lubricated.

The oil pump automatically turns ON and begins oiling the headstock components when the main power switch is turned ON and the emergency stop button is reset. The oil is pumped before the spindle is started to protect the spindle bearings against potential damage from dry starts.

Checking & Adding Oil
The sight glass on the side of the headstock oil tank, shown in Figure 70, has a dual function of showing the oil level and temperature. When checking the oil level, read the sight glass as you would a dipstick on a car—the bottom line represents the minimum and the top line represents the maximum.

Figure 70. Headstock oil tank & components.

When the oil level approaches the minimum line, add enough oil to bring it up to the maximum line (about 16 liters).

Monitoring Oil Temperature

During operations, regularly monitor the oil temperature shown in the sight glass in Figure 71. The temperature of the headstock oil must remain under 138°C (280° F). or the oil will start to overheat and break down, causing it to lose its lubrication properties.

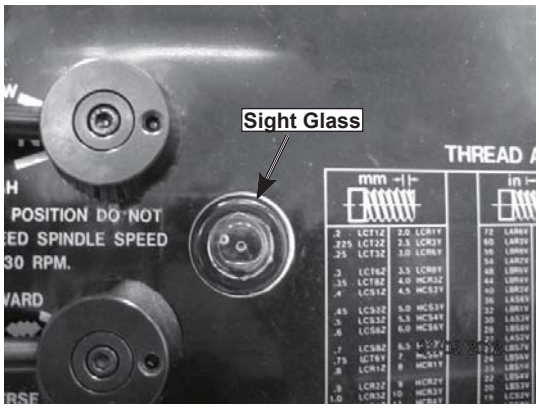


Figure 71. Location of the headstock oil sight glass.

Under normal conditions, the oil should not reach 138°C (280° F).; however, if it does, shut down the machine and allow the oil to cool. Investigate why the oil is getting so hot. Possibilities may be poor ventilation, excessive work loads, poor oil quality, oil that is losing lubricity due to long term use, or extreme work site temperatures.

If possible, correct the conditions causing the oil to get hot. If the oil is old or you suspect it is of poor quality, change it. If the work loads or working environment are extreme, reduce the duty cycle of the lathe to allow the oil to cool down when it gets hot.

If the oil temperature ever exceeds 138°C (280°F)., change it as soon as possible to make sure the spindle bearings have high quality lubrication.

Verifying Oil Pump Operation

If the oil pump ever stops working, the spindle bearings and headstock gears will stop being lubricated, which can quickly result in major damage. Therefore, it is critical to regularly monitor the oil flow while operating the lathe.

Cleaning Pump System & Changing Oil

The headstock oil pump system must be cleaned and the oil changed after the break-in period and then annually (or every six months with hard service or extreme working conditions).

To clean the oil pump system :

1. Disconnect Lathe from POWER !

2. Remove the cap from the fill spout shown in Figure 72.

Figure 72. Headstock oil tank component locations.

3. Place at least a 3-gallon drain pan under the tank and remove the drain plug to empty the oil into the pan.

4. Clean away any dust, debris, metal shavings, or grime from the access cover.

5. Using a 4mm hex wrench, remove the four access cover cap screws, then use the cap screw in the center as a handle and lift off the access cover.

6. Put on splash-proof safety glasses, rubber gloves, and a respirator rated for fumes.

7. Using mineral spirits and rags, wipe down the inside of the tank to clean it. Make sure to soak up any excess mineral spirits with a dry rag, so it does not stay in the tank.

8. After the tank is completely cleaned out, unthread the screen from the bottom of the pump suction pipe, and remove the screen from the tank.

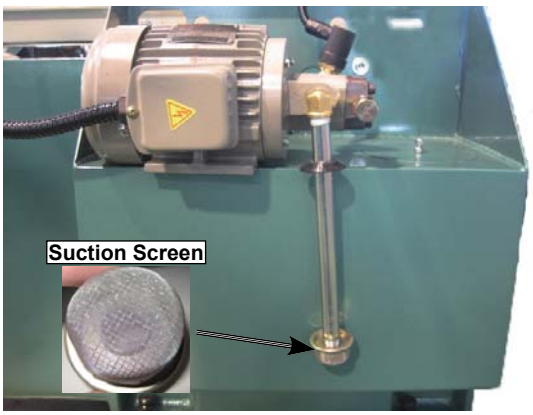


Figure 73. Suction screen removal.

9. Clean the suction screen thoroughly with mineral spirits and compressed air.

10. Reinstall the suction screen.

11. Reinstall the drain plug.

12. Refill the tank with oil.

13. Replace the fill spout plug.

Gearbox

Checking & Adding Oil

The sight glass shown in Figure 74 shows the oil level in the gearbox. At the maximum level, the oil fills approximately 3⁄4 of the sight glass. At the minimum level, the oil only fills 1⁄4 of the sight glass.

Check the oil level daily. When the oil approaches the minimum level, add enough oil to bring it up to the maximum level.

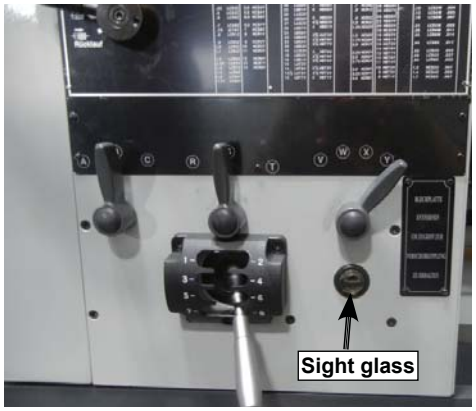


Figure 74. Gearbox sight glass location.

Changing Oil

The gearbox oil must be changed after the break-in period and then annually (or every six months with hard service or extreme working conditions). Figure 75 shows fill and drain plugs used when changing the gearbox oil.

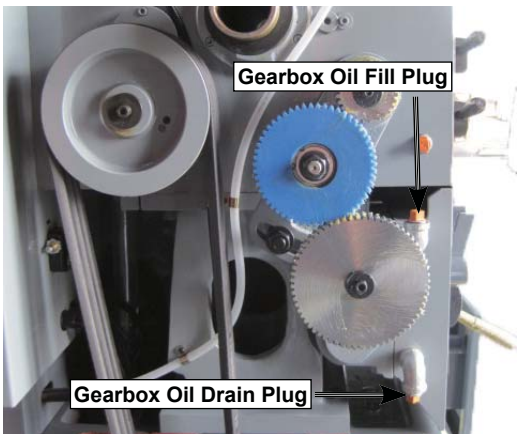


Figure 75. Location of gearbox fill and drain plugs.

Apron

Checking & Adding Oil

The sight glass shown in Figure 76 shows the oil level in the apron. At the maximum level, the oil fills approximately 3⁄4 of the sight glass. At the minimum level, the oil only fills 1⁄4 of the sight glass.

Check the oil level daily. When the oil approaches the minimum level, add enough oil to bring it up to the maximum level. This oil is also used by the way pump to lubricate the ways and slides.

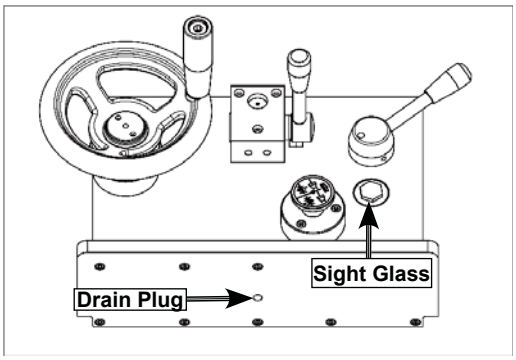


Figure 76. Location of apron drain plug & sight glass.

Changing Oil

The oil in the apron reservoir must be changed after the break-in period and then annually (or every six months with hard service or extreme working conditions). The drain plug is shown in Figure 76 and the fill plug is shown in Figure 77.

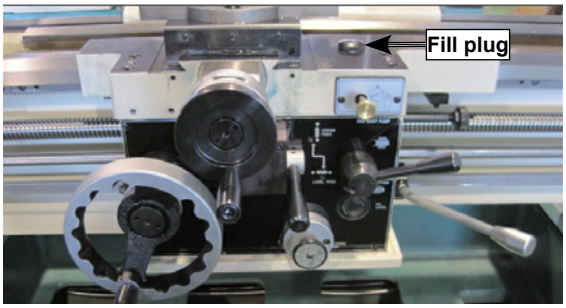


Figure 77. Location of fill plug for apron oil reservoir.

Lead Screw & Feedrod Bearings

Checking & Adding Oil

To check the oil level, remove the fill plug and look inside the reservoir (Figure 78). The oil level must remain full to keep the leadscrew bearing adequately lubricated. Pour oil in the reservoir until it is as full as possible without overflowing.

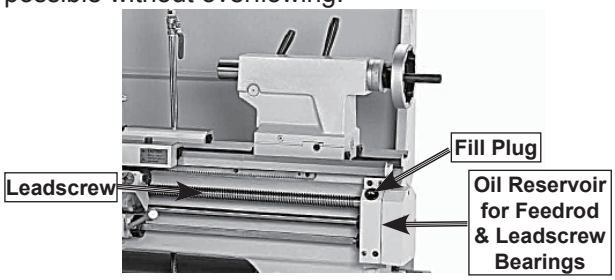


Figure 78. Leadscrew lubrication.

Lead Screw

Before lubricating the leadscrew (Figure 78), clean it first with mineral spirits. A paint brush works well to help clean out the threads. Make sure to move the carriage out of the way, so you can clean the entire length of the leadscrew.

Apply oil along the length of the leadscrew. Use a paint brush to make sure the oil is evenly applied and down in the threads.

Ways & Slides

The way pump shown in Figure 79 lubricates the saddle and cross slide way guides with the oil from the apron reservoir.

To use the way pump to lubricate the ways, pull the pump knob out for two or three seconds and then push it in. The pump draws oil from the apron reservoir and then forces it through drilled passages to the way guides.

Repeat this process and move the carriage left/ right and the cross slide forward/backward to distribute oil along the way guides.

Lubricate the guides once before and once after operating the lathe. If the lathe is in a moist or dirty environment, increase the lubrication interval and make sure to keep the oil level full.

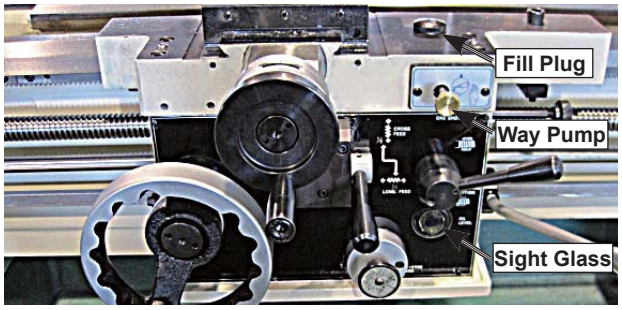


Figure 79. Location of way pump, fill plug, and sight glass on the apron.

Unpainted & Machined Surfaces

Besides the ways and leadscrew, all other unpainted and machined surfaces should be wiped down daily to keep them rust-free and in top condition. This includes the top of the saddle, the cross slide, compound slide, tool post, chuck, feedrod, and any other surface you can find that could be vulnerable to rust if left unprotected (this especially includes any parts that may be exposed to water soluble cutting fluids). Typically with these parts, a thin film of oil is all that is necessary for protection.

Ball Oilers

This lathe has five ball oiler locations (see Figures 80 - 81) that should be oiled on a daily basis. In order to properly squirt oil into the ball oiler mechanisms, you will need an oil can or gun.

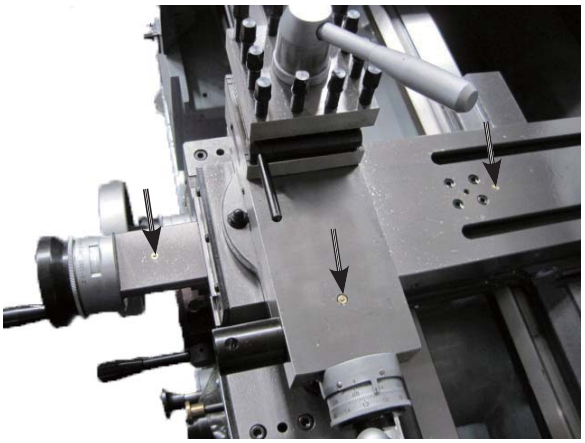


Figure 80. Ball oiler locations.

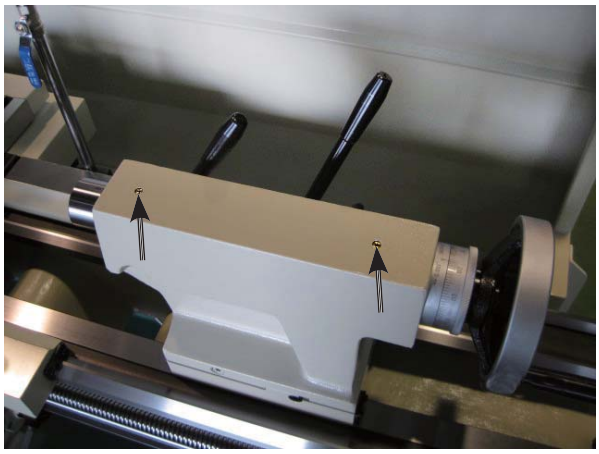


Figure 81. Tailstock ball oiler locations.

To lubricate the ball oilers, clean the outside surface to remove any dust or grime, push the ball with the tip of the oil can nozzle, and squirt a small amount inside. If the lathe is in a moist or dirty environment, increase the oiling interval.

Cleaning Electrical Box Filter

The door of the electrical box contains an air filter (Figure 82) to prevent dust from entering the box as the cooling fan pulls in cool air to reduce heat.

The air filter should be cleaned on a monthly basis to ensure proper air circulation in the electrical box. A clogged air filter will not allow the cooling fan to do its job, which could result in a decreased lifespan of the electrical components.

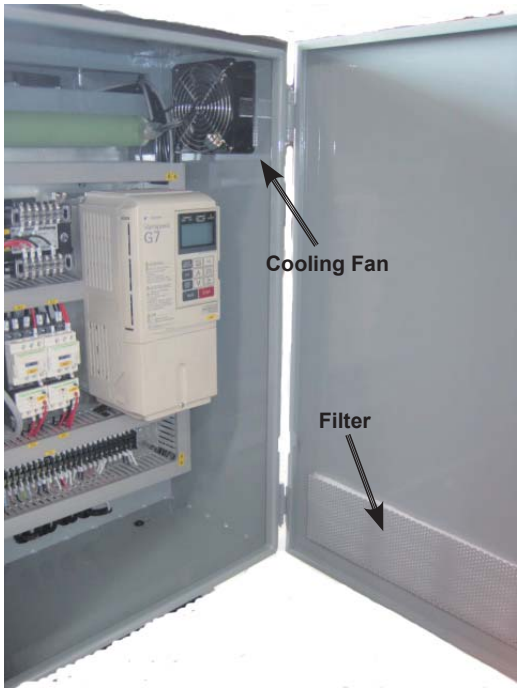


Figure 82. Electrical box cooling fan and filter.

To clean the filter :

1. Disconnect Lathe from POWER !

2. Put on a dust mask or respirator to reduce your risk of inhaling fine dust.

3. Open the electrical box door, and remove electrical box air filter.

4. Use compressed air to blow dust out of the filter. Make sure to blow the dust from the clean side (the side facing inward) of the filter so you do not drive dust farther into the filter.

5. Re-install filter and close electrical box door.

End Gearing

The end gears, shown in Figure 83, should always have a thin coat of heavy grease to reduce the minimize/prevent corrosion, noise, and wear. Care must be taken to avoid over-greasing because excess grease may be flung onto the V-belts, which will reduce optimal power transmission from the motor.

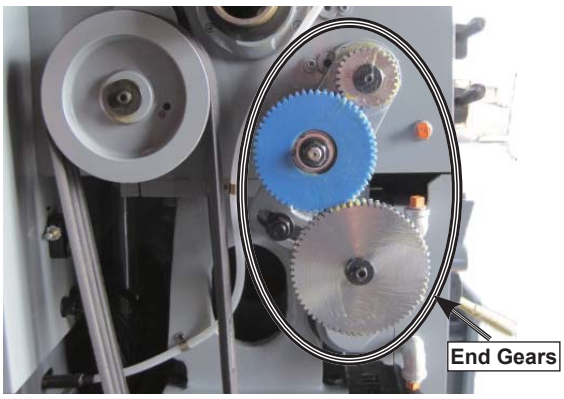


Figure 83. Location of end gears that require grease.

Handling & Care

Make sure to clean and lubricate any gears you install or swap. Unless you are very careful during handling and storage, the coating of grease on the gears will easily pickup dirt or debris, which can then spread to the other gears and increase the rate of wear.

Make sure to the cover remains installed whenever possible to keep the gears free of dust or debris from the outside environment.

Lubricating

1. Disconnect Lathe from POWER !

2. Remove the headstock side cover and all the end gears shown in Figure 83.

3. Clean the end gears thoroughly in mineral oil to remove all the old grease. Use a small brush if necessary to clean between the teeth.

4. Clean the shafts from which the end gears were removed, and wipe up any old grease splatters in the vicinity and on the inside of the headstock cover.

5. With clean hands, apply a thin layer of grease on both sides of the gears. Make sure to get grease between the gear teeth, but not so much that it fills the voids between the teeth.

6. Install the end gears and mesh them together with an approximate backlash of 0.127mm. Once the gears are meshed together, apply a small dab of grease in the crux of where the gears mesh together—this grease will spread around when the gears start moving and re-coat any areas scraped off during installation.

Annual Maintenance

Once a year, remove all the end gears, clean them thoroughly, and apply a new coating of grease. Even if the headstock side cover has been kept in place throughout the year, it is still possible for dust from the V-belts to build-up in the grease, and the grease may also start to break down with extended or heavy use.

Cutting Fluid System

The cutting fluid system consists of a fluid tank, pump, and flexible nozzle. The pump pulls fluid from the tank and sends it to the valve, which controls the flow of cutting fluid to the work area. When the valve is opened or closed, the fluid comes out of the nozzle and drains through the chip drawer and into the catch tray and then into the tank where it is picked up again by the pump. Figure 84 shows many of these components and their locations.

Although most swarf from machining operations falls into the chip tray and stays there, some small chips drain into the tank. The pump uses a screen to prevent it from picking up the small swarf that ends up in the tank.

Since the swarf is spread throughout the coolant system, cleaning the system on a regular basis is a requirement to maintain the life of the pump.

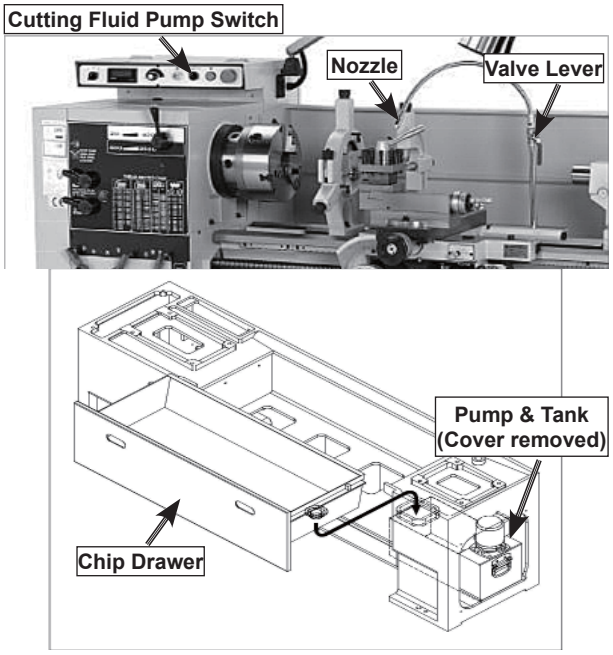


Figure 84. Cutting fluid system components and locations.

Hazards

As some cutting fluid ages, dangerous microbes can proliferate and create a biological hazard.
The risk of exposure to this hazard can be greatly reduced by replacing the old cutting fluid on a monthly basis, as indicated in the maintenance schedule.
The important thing to keep in mind when working with the cutting fluid is to minimize exposure to your skin, eyes, and respiratory system by wearing the proper PPE (personal protective equipment), such as splash-resistant safety glasses, long-sleeve gloves, protective clothing, and a NIOSH approved respirator.

Adding Fluid

1. Disconnect Lathe from POWER !

2. Remove the vented cover and slide the tank out, as shown in Figure 85.

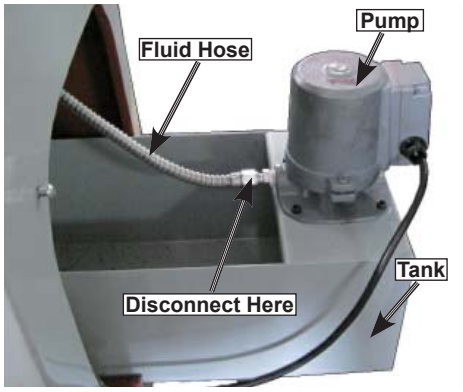


Figure 85. Cutting fluid pump and tank.

3. Pour cutting fluid in the tank until it is nearly full.

4. Slide the tank back into the base and replace the vented cover.

Changing Cutting Fluid

When you replace the old cutting fluid, take the time to thoroughly clean out the chip drawer, catch tray, and chip tray while you are at it. The entire job only takes about a 1⁄2 hour when you are prepared with the proper materials and tools.

To change the cutting fluid :

1. Position the coolant nozzle over the splash guard, so it is pointing behind the lathe. If you have the optional hose, connect it to the end of the coolant nozzle now.

2. Place the 5-gallon bucket behind the lathe and underneath the coolant nozzle. If you have the optional hose, place the hose in the bucket. Otherwise, you may need to hold the bucket up to the coolant nozzle to prevent coolant from splashing outside of the bucket.

3. Turn cutting fluid the pump ON (or have another person turn it ON if you are holding the bucket), and pump the old cutting fluid out of the tank. Turn the pump OFF immediately after fluid stops flowing.

4. Disconnect Lathe from POWER !

5. Remove the vented cover shown in Figure 84 and slide the tank half way out of the base, as shown in Figure 85.

If necessary, disconnect the fluid hose from the pump, where shown in Figure 85.

6. Pour out the old cutting fluid into your 5-gallon bucket and close the lid.

7. Flush the tank with hot soapy water, making sure the intake screen at the bottom of the pump intake pipe (inside the tank) is clean, and wipe up any remaining fluid residue.

8. Slide the tank partially into the base and reconnect the fluid hose.

9. Refill the tank with new cutting fluid, then slide the tank completely into the base.

10. Connect Lathe to power.

11. Open the valve on the cutting fluid nozzle.

12. Turn the cutting fluid pump ON to verify that fluid cycles properly, then turn it OFF.

Machine Storage

If the machine is not properly prepared for storage, it may develop rust or corrosion. If decommissioning this machine, use the steps in this section to ensure that it remains in good condition for later use.

To prepare your machine for short-term storage (up to a year) :

1. Pump out the old cutting fluid, and flush the lines and tank.

2. Disconnect Lathe from POWER !

3. Thoroughly clean all unpainted, bare metal surfaces, then apply a liberal coat of way oil.

4. Lubricate the machine as outlined in the lubrication section.

5. Cover and place the machine in a dry area that is out of direct sunlight and away from hazardous fumes, paint, solvents, or gas. Fumes and sunlight can bleach or discolor paint and make plastic guards cloudy.

6. Once or twice a month, depending on the ambient humidity levels in the storage environment, wipe down the machine as outlined in Step 3.

7. Every few months, start the machine and run all gear-driven components for a few minutes. This will keep the bearings, bushings, gears, and shafts well lubricated and protected from corrosion, especially during the winter months.

To prepare your machine for long-term storage (a year or more) :

1. If the machine has oil-lubricated gearboxes, bring the machine to operating temperature and drain and refill the all gearboxes with fresh oil.

2. Pump out the old cutting fluid, and flush the lines and tank.

3. Disconnect Lathe from POWER !

4. Thoroughly clean all unpainted, bare metal surfaces, then apply a liberal coat of way oil, a heavy grease, or rust preventative. Take care to ensure these surfaces are completely covered but that the rust preventative or grease is kept off of painted surfaces.

5. Lubricate the machine as outlined in the lubrication section.

6. Loosen or remove machine belts so they do not become stretched during the storage period. Be sure to also affix a maintenance note on the machine as a reminder that the belts have been loosened or removed.

7. Place a few moisture absorbing desiccant packs inside of the electrical box.

8. Cover and place the machine in a dry area that is out of direct sunlight and away from hazardous fumes, paint, solvents, or gas. Fumes and sunlight can bleach or discolor paint and make plastic guards cloudy.

Section 5 : Service

Backlash Adjustment

Compound Leadscrew

Backlash is adjusted by tightening the set screws shown in Figure 86. When these screws are adjusted against the leadscrew nut, they offset part of the half nut to remove play between the nut and leadscrew.

If you end up adjusting the half nut too tight, loosen the set screws, tap the compound a few times with a rubber or wooden mallet, and turn the handle slowly back and forth until it moves freely.

To readjust the backlash, rock the handle back and forth, and tighten the screws slowly until the backlash is at approximately 0.025mm as indicated on the handwheel dial.

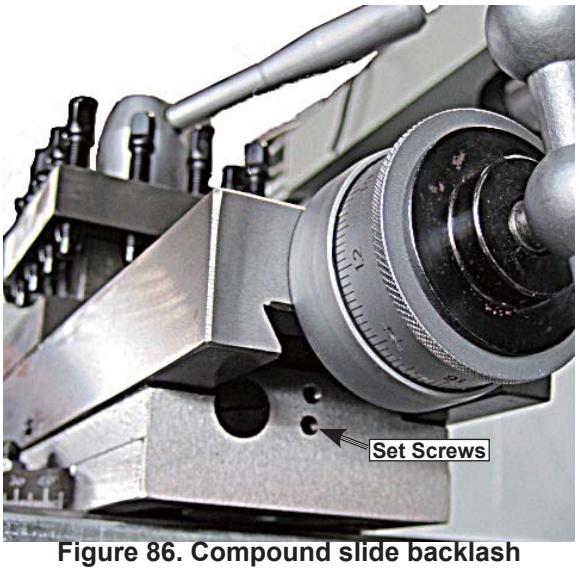


Figure 86. Compound slide backlash adjustment set screws.

Cross Slide Leadscrew

Backlash can be felt by turning the cross slide handwheel in one direction, then turning the handwheel the other direction, then noticing the amount the handwheel moves while the cross slide does not. When the cross slide begins to move, the backlash has been taken up.

Backlash is adjusted by loosening all four cap screws shown in Figure 87, and then tightening the center set screw, which pushes down on a wedge and forces the half nut apart, taking up lash in the half nut and leadscrew. If you end up adjusting the half nut too tight, loosen the set screw, tap the cross slide a few times with a rubber or wooden mallet, and turn the handle slowly back-and-forth, until the handle turns freely.

To re-adjust the backlash, rock the handle back and forth and tighten the set screw slowly until the backlash is at approximately 0.025mm as indicated on the handwheel dial.

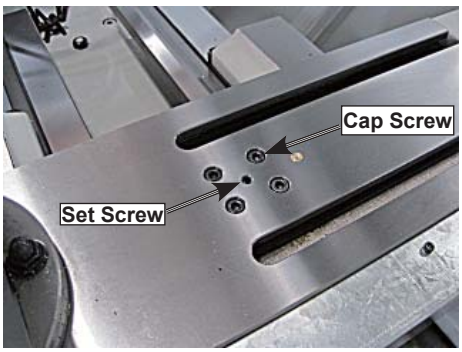


Figure 87. Compound slide backlash adjustment set screws.

Leadscrew End Play Adjustment

After a long period of time, you may find that the leadscrew develops a small amount of end play. This lathe is designed so that leadscrew end play can be easily removed with adjustment.

To remove leadscrew end play :

1. Disconnect Lathe from POWER !

2. Remove the three cap screws and end cover.

3. Loosen both retaining nut set screws shown in Figure 88.

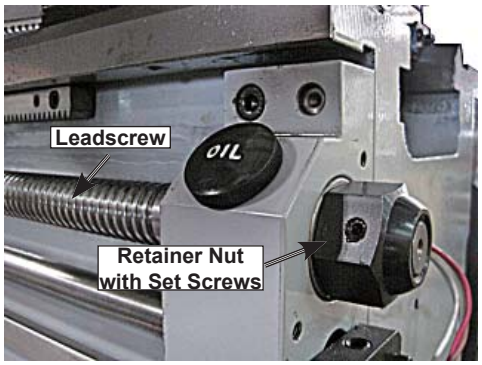


Figure 88. Leadscrew end play adjustment.

4. Engage the half nut lever.

5. Rotate the carriage feed handwheel back and forth slightly and tighten the retaining nut at the same until the end play is removed.

6. Tighten both set screws and reinstall the cover.

Gib Adjustment

The goal of adjusting the cross slide, tailstock, saddle, and compound gib screws is to remove sloppiness in the ways without over-adjusting them to the point where the slides become stiff and difficult to move.

In general, loose gibs cause poor finishes and tool chatter; however, over-tightened gibs cause premature wear on the slide, leadscrew, and half nut, and are difficult to operate.

The gibs have a tapered shape and are held in position by screws at opposing ends of the slide. When the opposing screws are turned in the opposite directions from each other, the taper fills the void between the sliding components.

The gib adjustment process usually requires some trial-and-error. Typically, you make a slight adjustment to the gib screw, then check the feel of the adjustment by turning the handwheel.
You then repeat this process as necessary until you find the best balance between loose and stiff movement. Most machinists find that the ideal gib adjustment is where a small amount of drag or resistance is present yet the handwheels are still easy to move.

Figures 89–92 show the location of the screws for each gib on this machine.

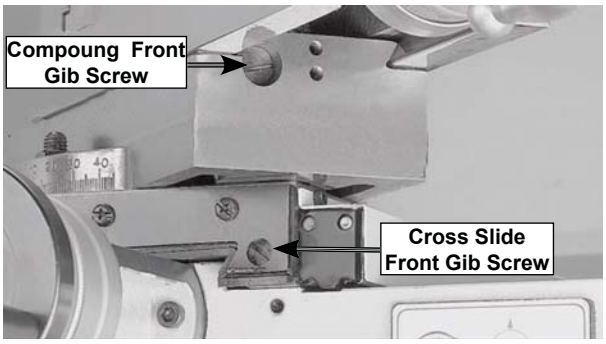


Figure 89. One of two cross slide and ompound gib screws.

Figure 90. One of two rear saddle gib screws.

Figure 91. One of two front saddle gib screws.

Figure 92. One of two tailstock gib screws.

Half Nut Adjustment

The half nut mechanism can be tightened if it becomes loose from wear. The pressure exerted by the half nut is controlled by a gib similar to the one in the saddle. The half nut gib is adjusted with two set screws.

To adjust the half nut :

1. Open the half nut.

2. Remove the thread dial.

3. Turn the two half-nut adjustment set screws, shown in Figure 93, clockwise about an 1⁄8th of a turn.

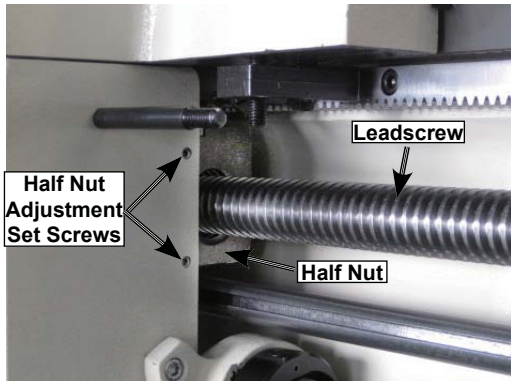


Figure 93. Half nut gib adjustment.

4. Open/close the half nut several times and notice how it feels (you may need to move the carriage handwheel slightly to get the half nut to close).

The half nut is correctly adjusted when it has a slight drag while opening and closing.

5. The movement should not be too stiff or too sloppy.

6. Repeat Steps 3–4, if necessary, until you are satisfied with the half nut adjustment. (If the half nut becomes too stiff, turn the set screws counterclockwise to loosen it.

7. Re-install the thread dial.

Feedrod Clutch Adjustment

This lathe has an adjustable feed clutch that helps protect the drivetrain from overload.

The feed clutch release point is adjusted at the factory. However, it can be easily adjusted depending on operator requirements.

To adjust the clutch release point :

1. Disconnect Lathe from POWER !

2. Remove the front and side feed access covers, as shown in Figure 94.

Figure 94. Feed access covers removed.

3. Remove the clutch collar set screw, as shown in Figure 95.

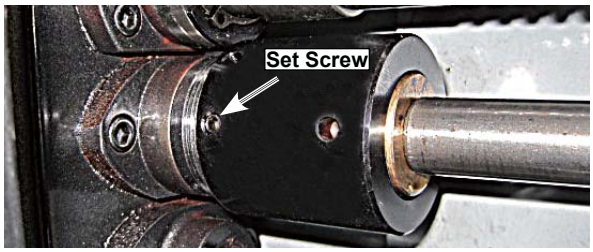


Figure 95. Removing set screw from clutch collar.

4. Insert the hex wrench into the collar adjustment hole shown in Figure 96, and use the wrench to rotate the clutch collar.

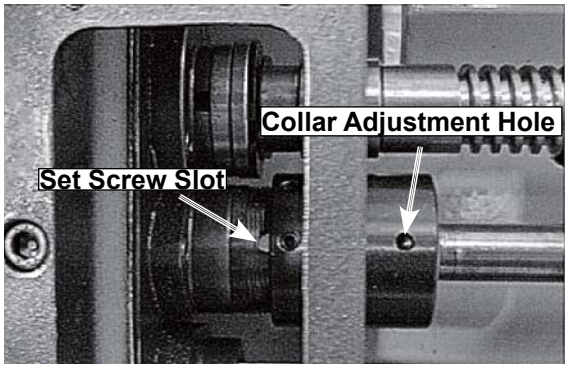


Figure 96. Feed clutch set screw alignment.

5. Line up the set screw hole in the clutch collar with the closest set screw slot that is cut into the feedrod.

6. Install and tighten the set screw so it is fully seated in the slot.

7. Reinstall both access covers.

V-Belts

V-belts stretch and wear with use, so they should be checked on a monthly basis to ensure optimal power transmission. Replace all the V-belts if any of them show signs of glazing, fraying, or cracking.

To adjust or replace the V-belts on the lathe :

1. Disconnect Lathe from POWER !

2. Remove the cover shown in Figure 97.

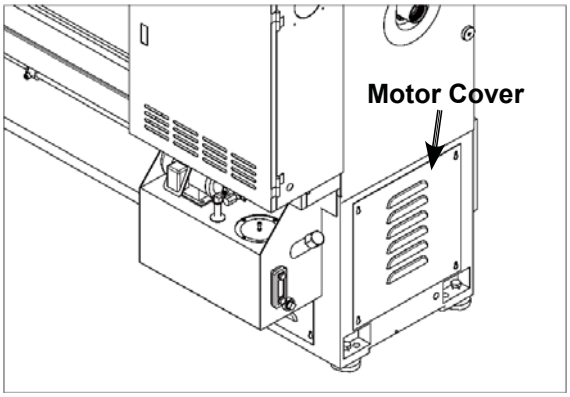


Figure 97. Location of motor cover.

3. Turn the hex nuts on the motor mount bolts shown in Figure 98 to move the motor mount plate up or down and adjust the V-belt tension. When correctly tensioned, each belt should have about 19mm deflection when pressed firmly.

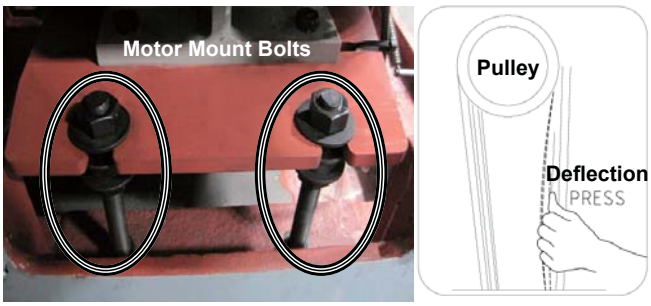


Figure 98. V-belt adjustment.

4. Firmly tighten the hex nuts (loosened in the previous step) against the motor mount plate to prevent it from moving out of adjustment during operation, then reinstall the motor cover.

Brake & Switch

As the brake lining wears, the foot pedal develops more travel. If the brake band is not adjusted to compensate for normal wear, the limit switch will still turn the lathe off, but the spindle will not stop as quickly. It is especially important that the brake is kept properly adjusted so you can quickly stop the spindle in an emergency.

To adjust the brake and brake switch :

1. Disconnect Lathe from POWER !

2. Put on a respirator and eye protection to protect yourself from hazardous brake dust.

3. Remove the motor cover.

4. Measure the remaining brake band lining at the thinnest point, which is usually at the 8 o'clock position, as shown in Figure 99.

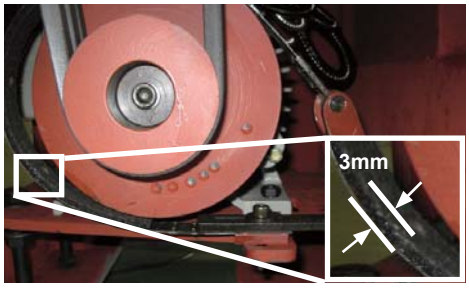


Figure 99. Minimum brake band lining thickness.

When the brake band is new, the lining is approximately 6mm thick. If the lining thickness wears to 3mm or less, the brake band must be replaced; otherwise, the rivets that secure the lining to the band will soon grind into the brake hub. If the hub becomes damaged, it must be replaced, which will substantially increase the cost of repair, compared to just replacing the brake band.

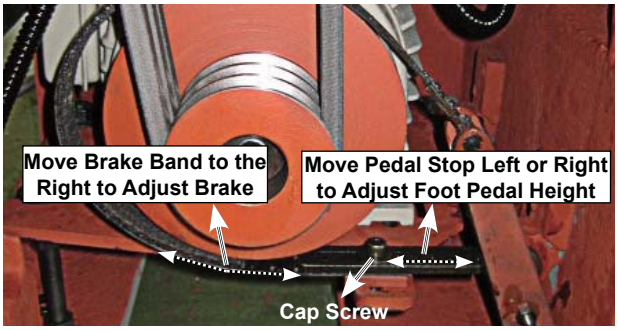


Figure 100. Brake linkage adjustments.

5. Remove pedal stop shown in Figure 101.

6. Move the brake band to the right one hole, and reinstall the pedal stop, tightening it until it is just snug.

7. Firmly push the pedal lever (Figure 101) to the right until it stops and the brake band is fully clamped around the brake hub.

8. Tap the pedal stop into position so there is approximately a 25mm gap between the pedal lever and the stop (see Figure 101).

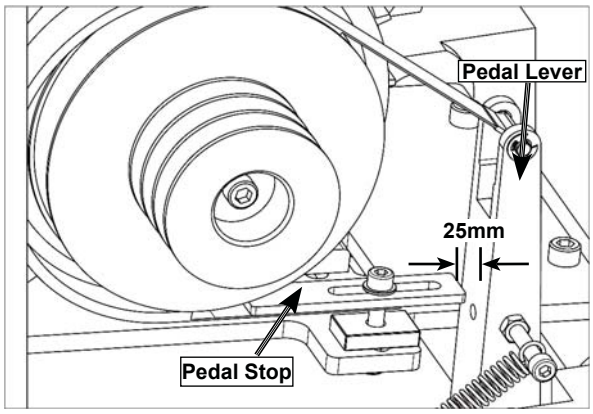


Figure 101. Pedal travel adjustment.

9. Tighten the cap screw on the pedal stop.

10. Locate the motor kill switch (shown in Figure 102) at the tailstock end of the lathe.

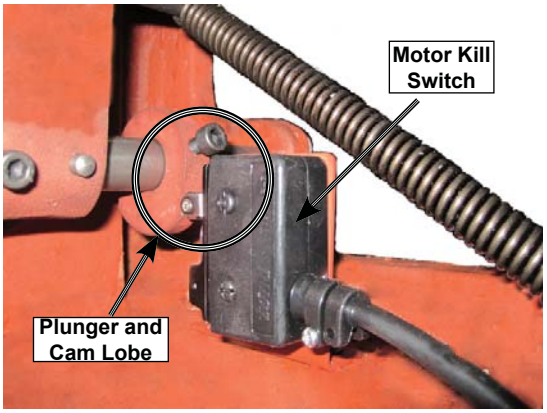


Figure 102. Motor kill switch.

11. Push the pedal lever down to verify that the cam lobe pushes the kill switch plunger in.

12. When pushed in, you should hear the switch click.

13. Reinstall the cover, test the brake operation.

Leadscrew Shear Pin Replacement

To replace the shear pin :

1. Disconnect Lathe from POWER !

2. Remove the front and side feed access covers, as shown in Figure 103.

Figure 103. Feed access covers removed.

3. Rotate the shroud washer so the cutout lines up with the shear pin head, as shown in Figure 104.

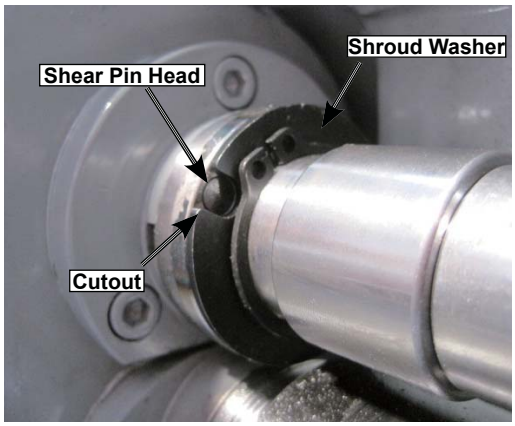


Figure 104. Shroud washer / pin alignment.

4. Put on safety glasses.

5. Remove the retaining ring from its groove and place it in the rear-most position away from the shroud washer.

6. Move the shroud washer away from the shear pin (to the rear position), so there is enough of a gap to remove the shear pin.

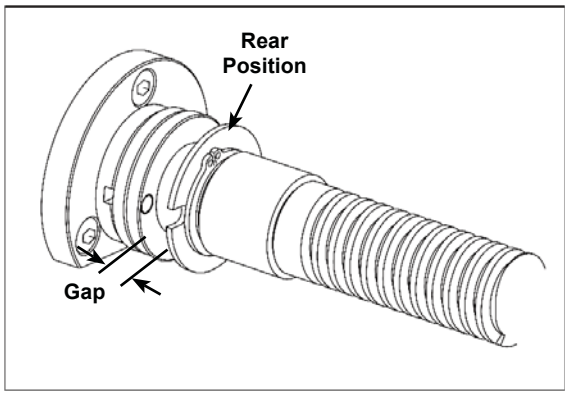


Figure 105. Shear pin access.

7. Use the magnet to remove the shear pin head, then rotate the lathe spindle to line up the inner and outer bores. Next, use the magnet to remove the other half of the broken shear pin when it becomes visible.

8. Insert a blow gun tip into the shear pin hole, blow out the hole with compressed air, and put a drop of oil in the hole.

9. Insert the new shear pin into the bore, as shown in Figure 106.

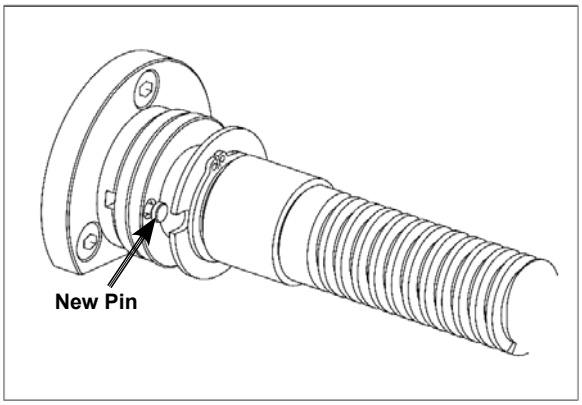


Figure 106. New shear pin installed in bore.

10. With the pin completely seated in the bore and the head flush with the leadscrew shoulder, slide the shroud washer against the shoulder, then rotate the washer 180° until it covers the head of the shear pin, as shown in Figure 107.

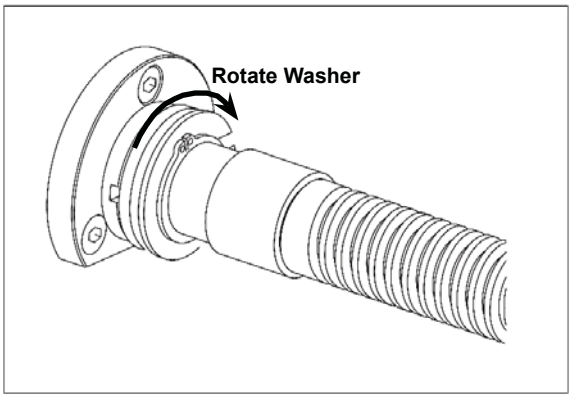


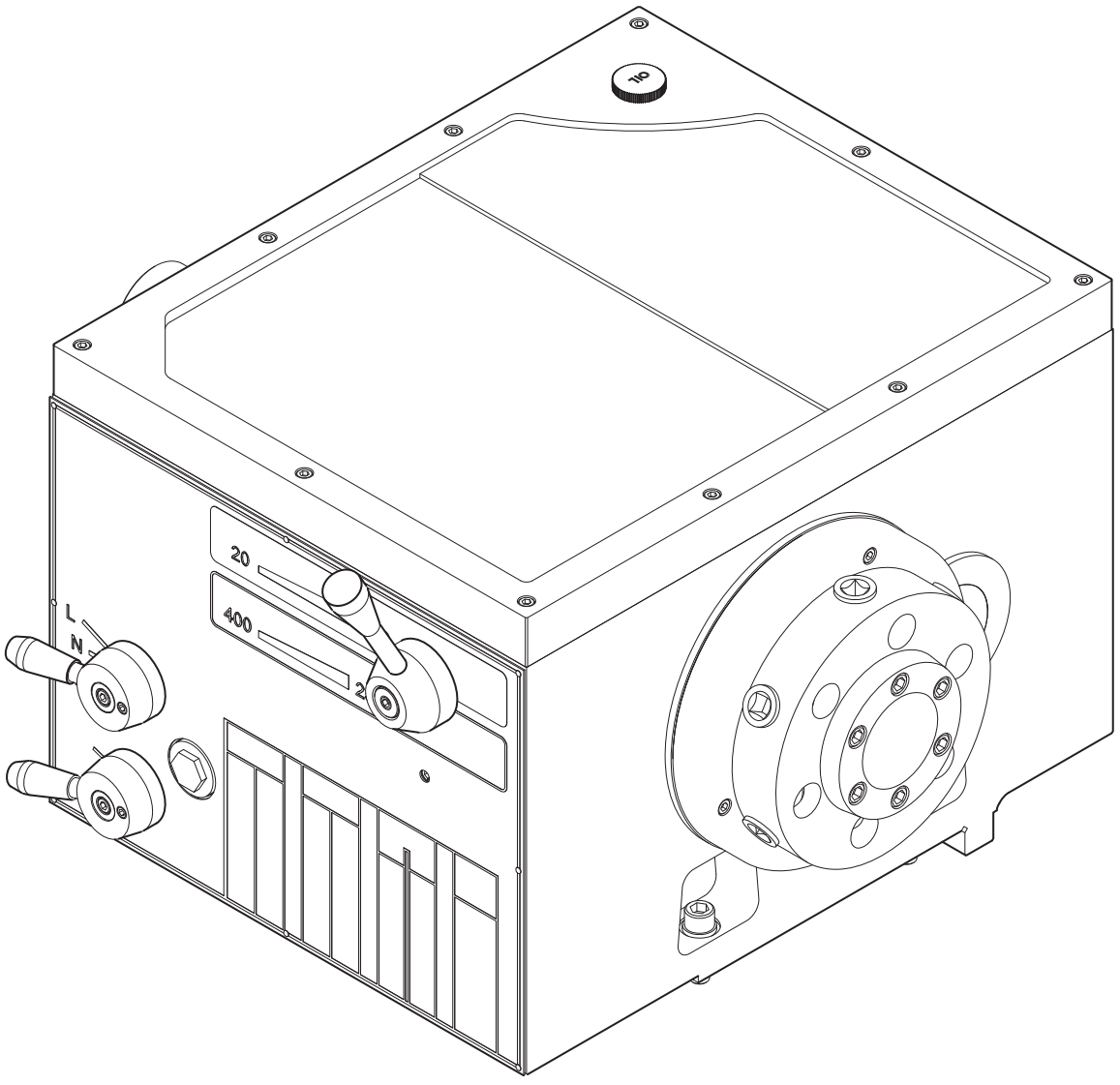
Figure 107. Shroud washer positioning.

11. Using retaining ring pliers, return the retaining ring to its groove, and position the retaining ring ears over the shear pin head, to prevent the shear pin from falling out—if the shroud washer rotates into alignment with the pin access groove lines.

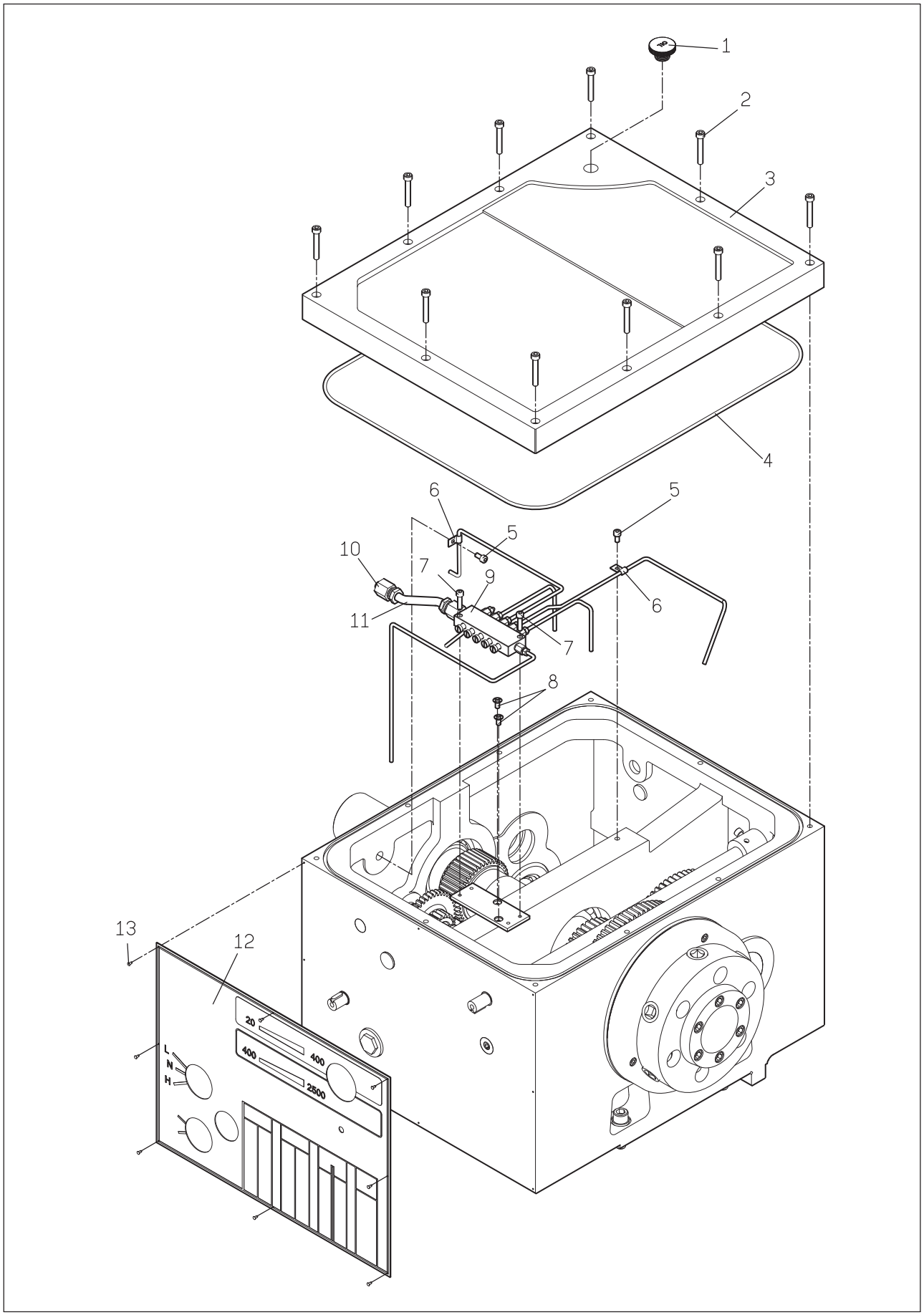
12. Reinstall the access covers.

Section 6 : Parts

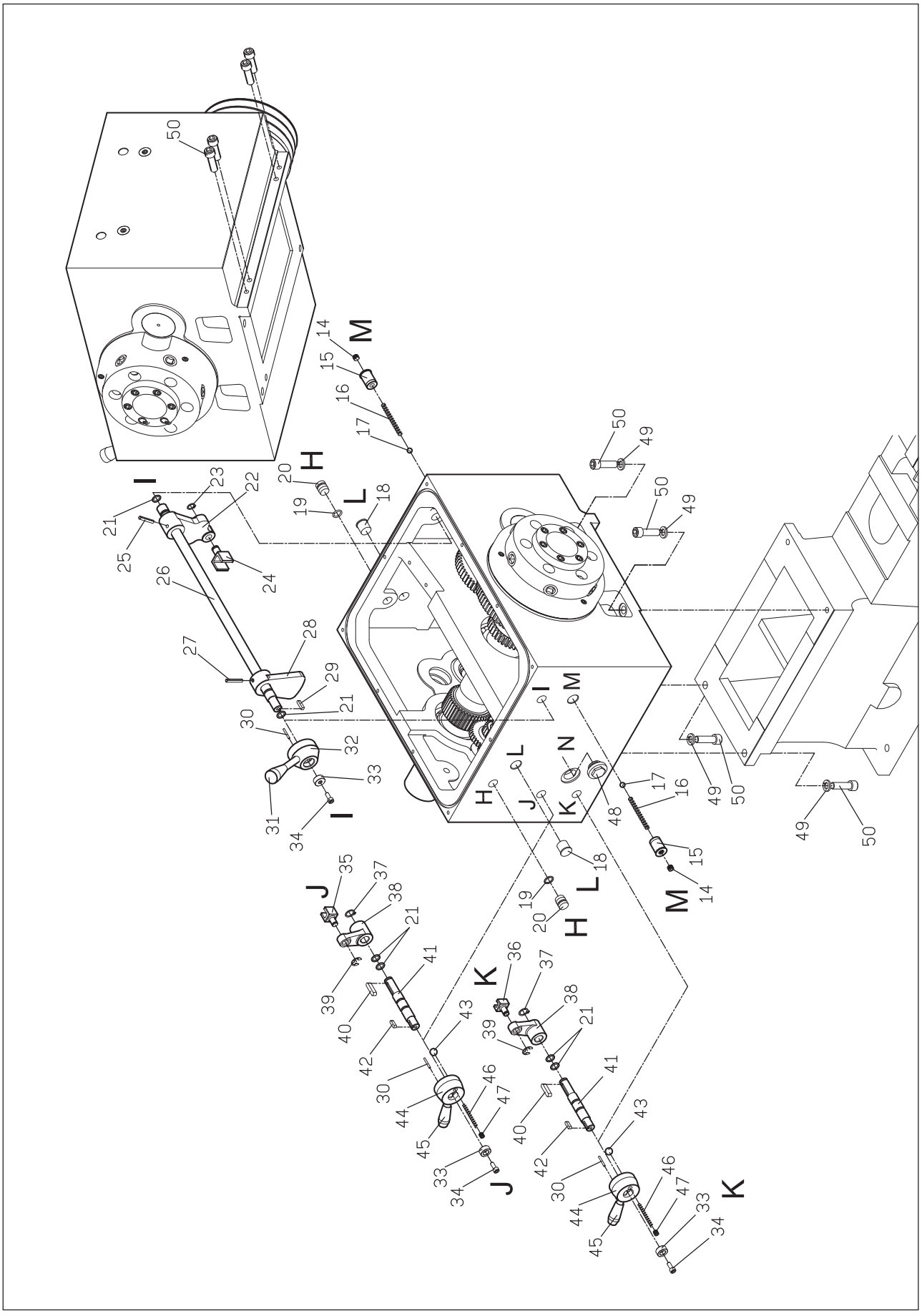
Headstock



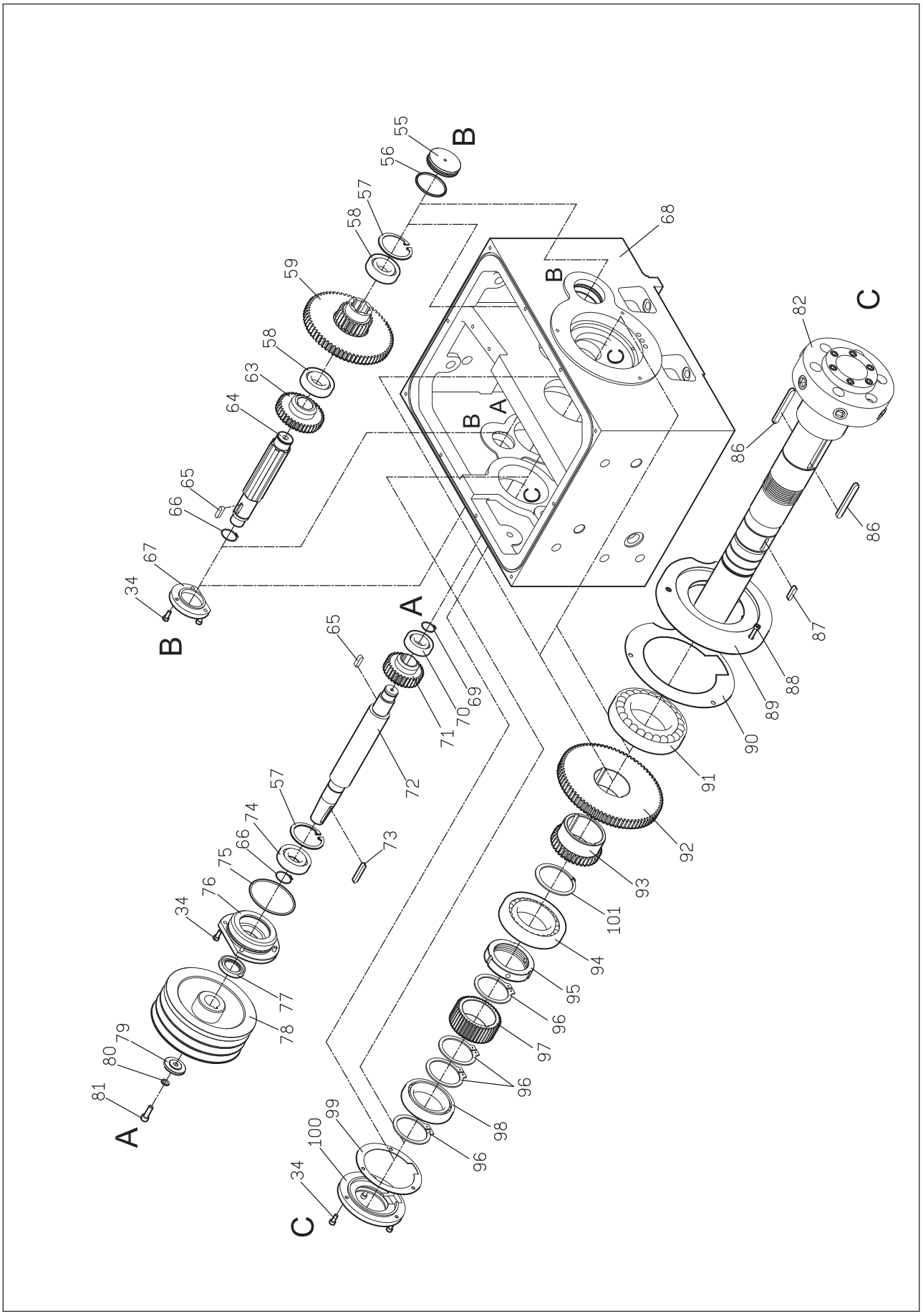
Headstock



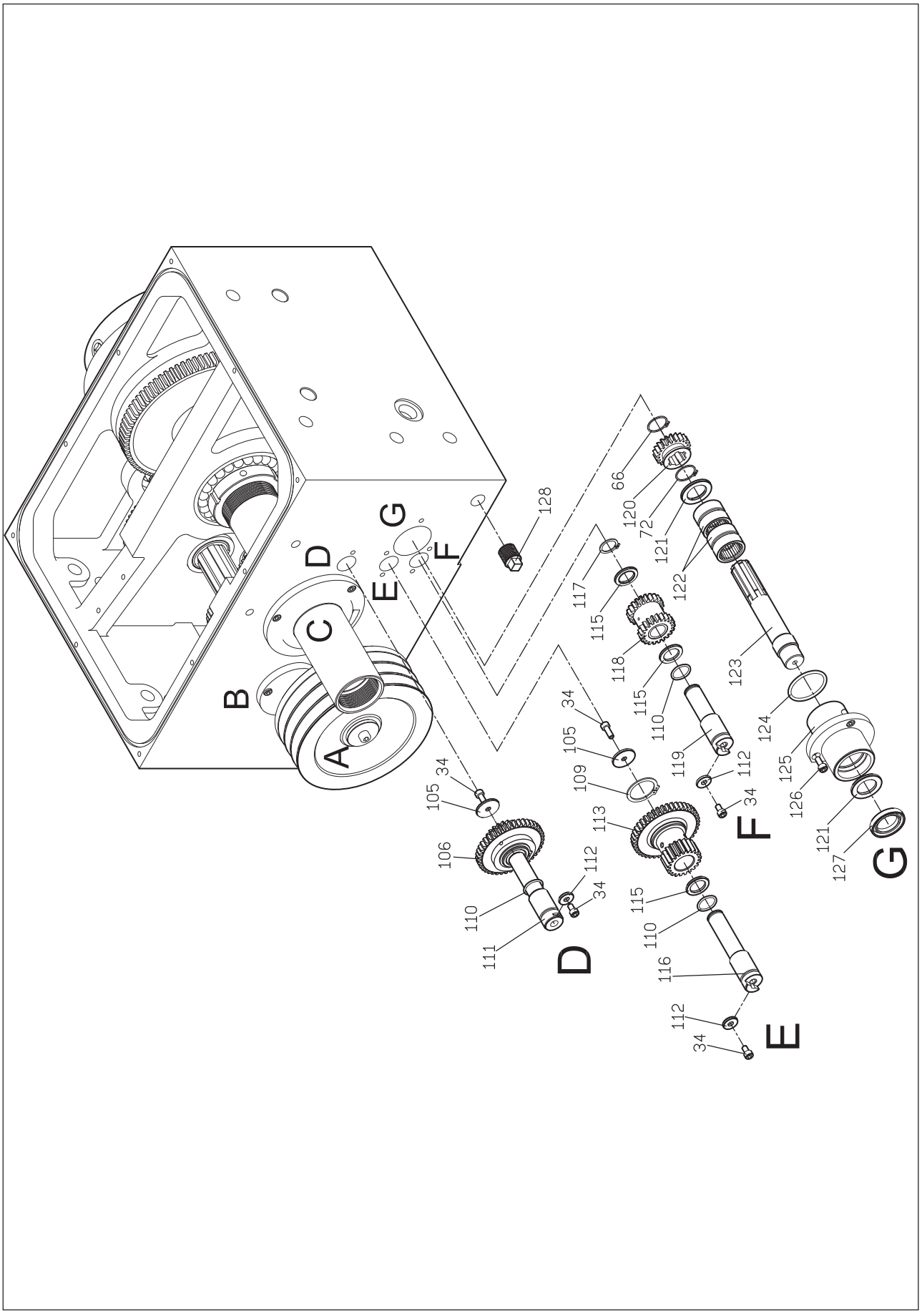
Headstock



Headstock


A
B
C
34
55
56
57
58
59
63
64
65
66
67
68
69
70
71
72
73
74
75
76
77
78
79
80
81
82
86
87
88
89
90
91
92
93
94
95
96
97
98
99
100
101

Headstock


A
B
C
D
E
F
G
128
66
120
72
121
122
123
124
125
126
127
117
115
118
115
110
119
112
34
105
109
113
106
112
34
110
111
115
110
116
112
34

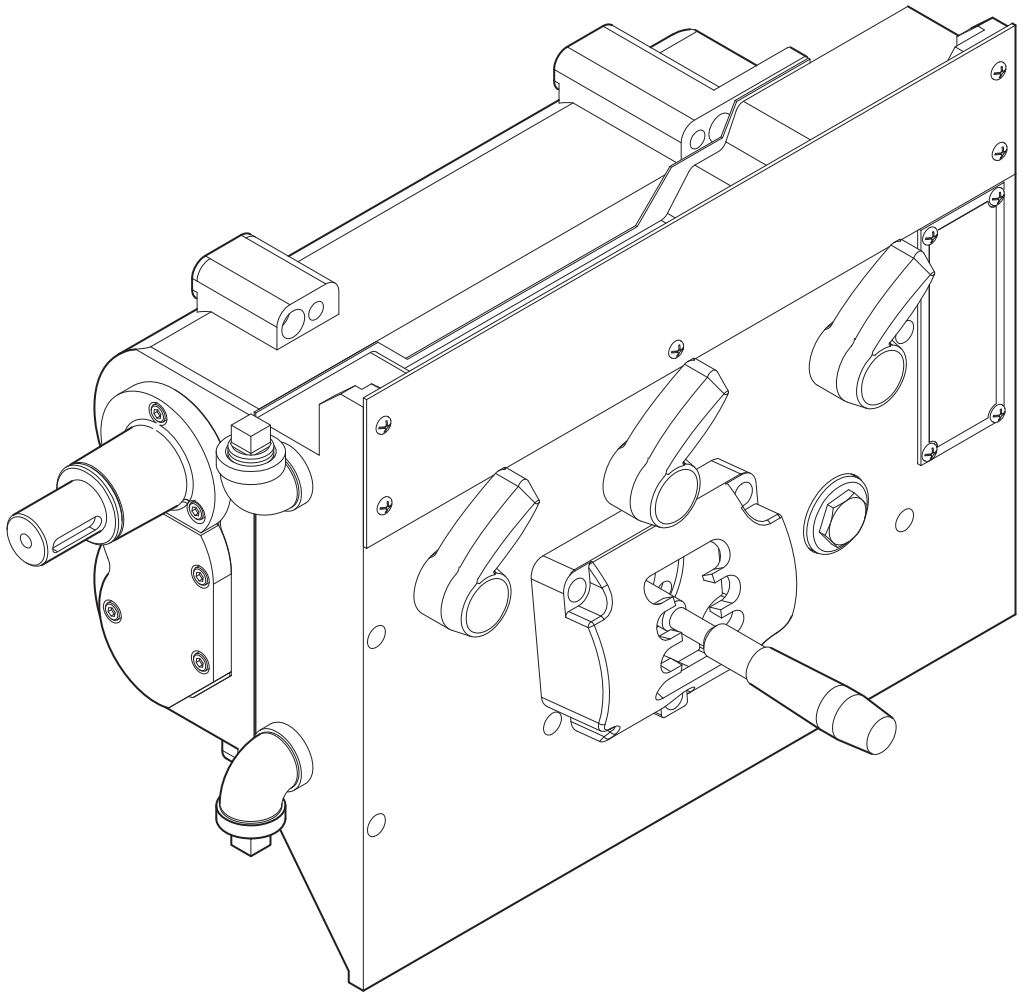
Headstock

KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK	KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK
1		Oil Cover	1	3/4"	46	20022	Spring	2	
2		Hex. socket head bolt	10	M6x40	47		Set screw	2	M8x8L
3	10057A	Head stock cover	1		48		Oil sight	1	3/4"
4		O ring	1	Ø4x1700	49		Spring washer	6	M12
5		Hex. socket head bolt	2	M5x10	50		Hex. socket head bolt	6	M12x40
6		Piple clip	2	Ø4					
7		Hex. socket head bolt	2	M5x20					
8		Flat cross screw	2	M5x8	55	13-10023	Piug	1	
9		Oil distributor	1	A-5S	56		O ring	1	G55
10		Quarter joint	1	Ø10	57		Clip	2	R62
11		Nylon tube	1	Ø10	58		Ball bearing	2	6206
12	61001-V	Name plate	1		59	CNL-10019	Gear	1	24T
13		Rivet	8	Ø2			Key	2	10x8x25L
14		Set screw	2	M10x10L		CNL-10020	Gear	1	67T
15	20026	Bush	2				Clip	1	S52
16	20028	Spring	2	Ø8x37L	63	10018-V	Gear	1	38T
17		Steel ball	2	Ø8.5	64	10022-V	Driving shaft	1	
18	20098	Plug	2	Ø20	65		Key	1	7x7x25L
19		O ring	2	P14	66		Clip	3	S30
20	20014V14	Plug	2	Ø18	67	10022A	Cover	1	
21		O ring	6	P16	68	10001V14	Head stock	1	
22	20024A	Lever	1			10001V16			
23		Clip	1	S12	69		Clip	1	S25
24	20030	Fork	1		70		Ball bearing	1	6205
25		Spring pin	1	Ø6x36	71	10027-V	Gear	1	30T
26	20014	Rod	1		72	10025-V	Input haft	1	
27		Spring pin	1	Ø6x40	73		Key	1	7x7x45L
28	20015A	Lever	1		74		Ball bearing	1	6206LU
29		Key	1	5x5x22L	75		O ring	1	G85
30		Spring pin	3	Ø3x24	76	10024A	Flanged bearing	1	
31	20004	Handle	1		77		Oil seal	1	305008
32	20003	Hub	1		78	10031	Pully	1	
33	20027	Washer	3		79	10032	Washer	1	
34		Hex. socket head bolt	19	M6x16	80		Spring washer	1	M8
35	20044	Fork	1		81		Hex. socket head bolt	1	M8x25
36	20034	Fork	1		82	10003	Bolt	6	
37		Clip	2	S15		10003-D6	Spindle	1	
38	20032	Lever	2			10005	Cam spring	6	
39		Clip	2	E8		10004	Cams	6	
40		Key	2	5x5x30L	86		Key	2	10x6x85L
41	20005	Shaft	2		87		Key	1	7x7x30L
42		Key	2	5x5x17L	88		Hex. socket head bolt	3	M6x35
43		Steel ball	2	Ø1/4"	89	10007-A6	Front bearing cover	1	
44	20021	Hub	2		90	10007-P		1	
45	20048	Handle	2		91		Taper roller bearing	1	32019

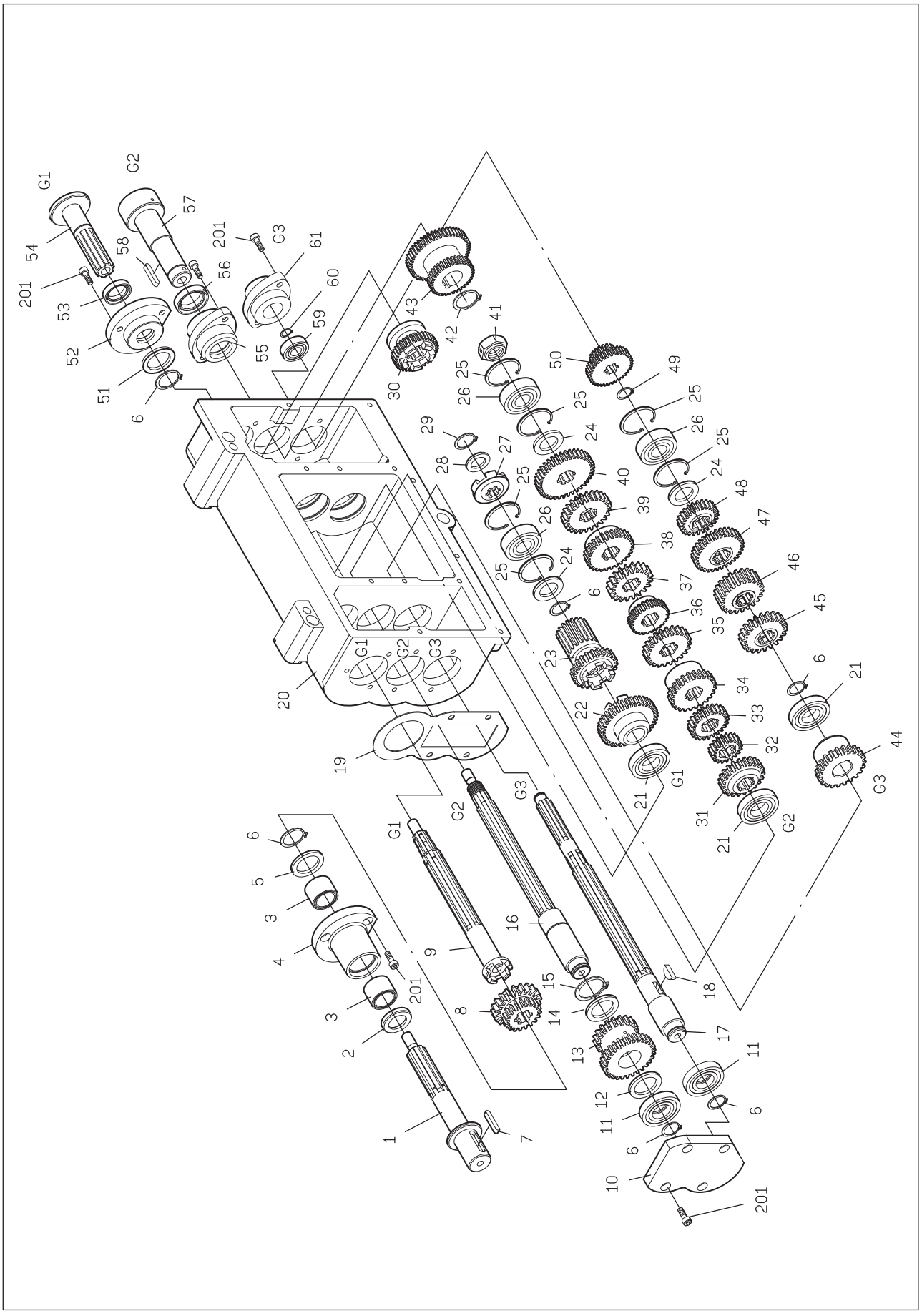
Headstock

KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK	KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK
92	17-10008	Gear	1	79T					
93	17-10009	Gear	1	36T					
94		Taper roller bearing	1	30214A					
95		Nut	1	YSRM70x2					
96		Clip	4	S65					
97	10010	Gear	1	42T					
98		Ball bearing	1	6013					
99	10012-P	Packing O	1						
100	10012	Outside cover	1						
101		Clip	1	S70					
105	10038	Washer	2						
106	13-10049	Gear	1	21T					
	13-10050	Gear	1	42T					
		Key	1	6x6x15L					
		Clip	1	S35					
110		O ring	3	P21					
111	10034	Shaft	1						
112	13-10039	Washer	3						
113		Key	1	6x6x15L					
		Clip	1	S35					
	13-10048	Gear	1	42T					
	13-10047	Gear	1	21T					
115	10036	Washer	3						
116	10035	Shaft	1						
117		Clip	2	S20					
118	10046	Gear	1	21T					
119	10033	Shaft	1						
120	10051	Gear	1	21T					
121	10037	Washer	2						
122		Needle bearing	2	RNA-6904					
123	10040	Shaft	1						
124		O ring	1	P44					
125	10041	Flange bearing	1						
126		Hex. socket head bolt	3	M6x12					
127		Oil seal	1	28x44x07					
128		Square head plug	1	1/2"					

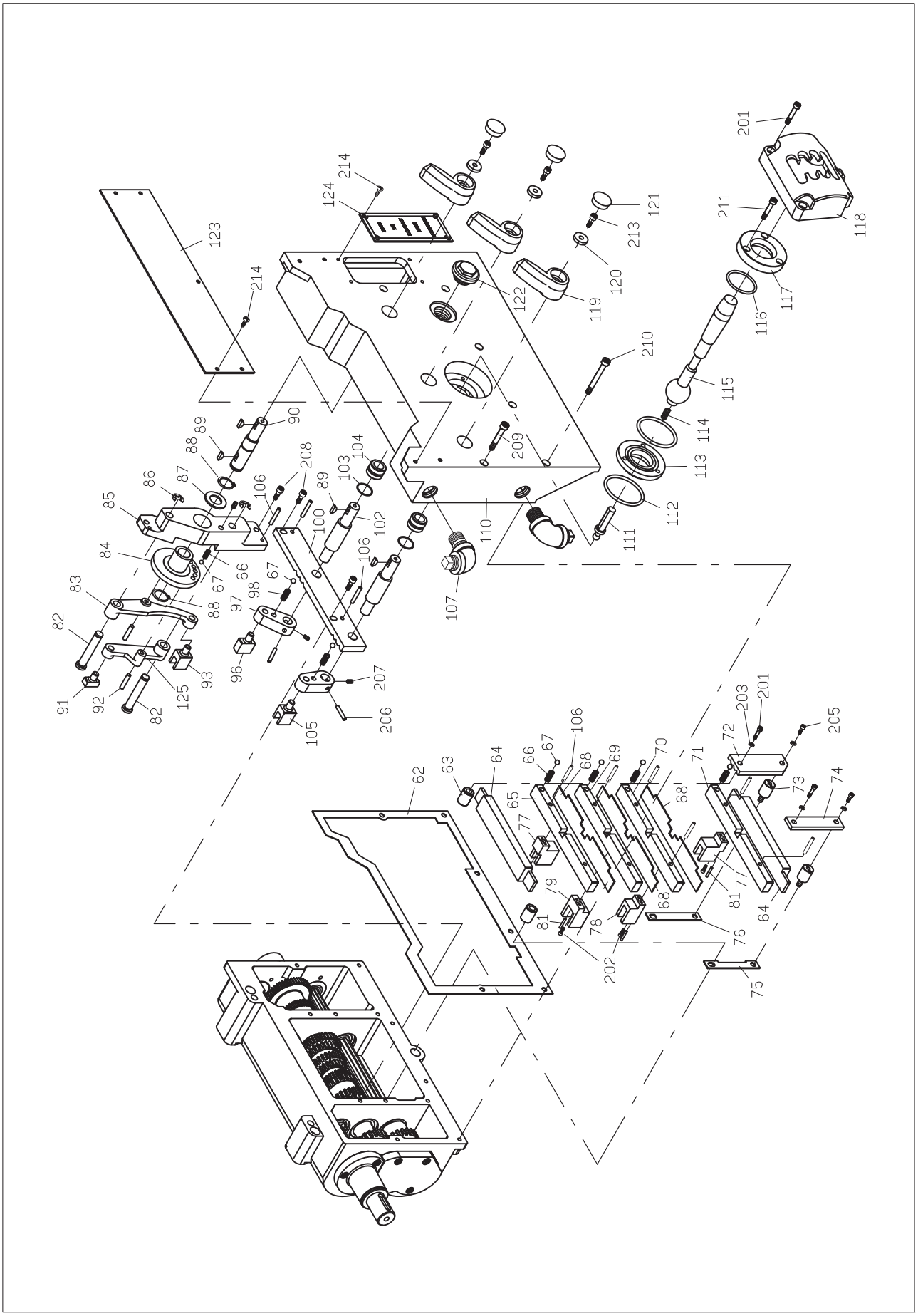
Gearbox



Gearbox


G1
G2
G3
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
201

Gearbox


201
214
124
123
214
211
213
121
118
120
122
119
117
116
210
115
114
113
112
111
110
107
90
89
88
87
86
85
84
83
82
91
92
82
125
93
208
104
103
106
89
100
102
106
67
66
98
97
88
67
96
207
206
105
209
62
63
64
65
66
67
106
68
69
70
71
72
203
201
205
73
74
68
77
79
81
78
202
76
75
64
77
81
68

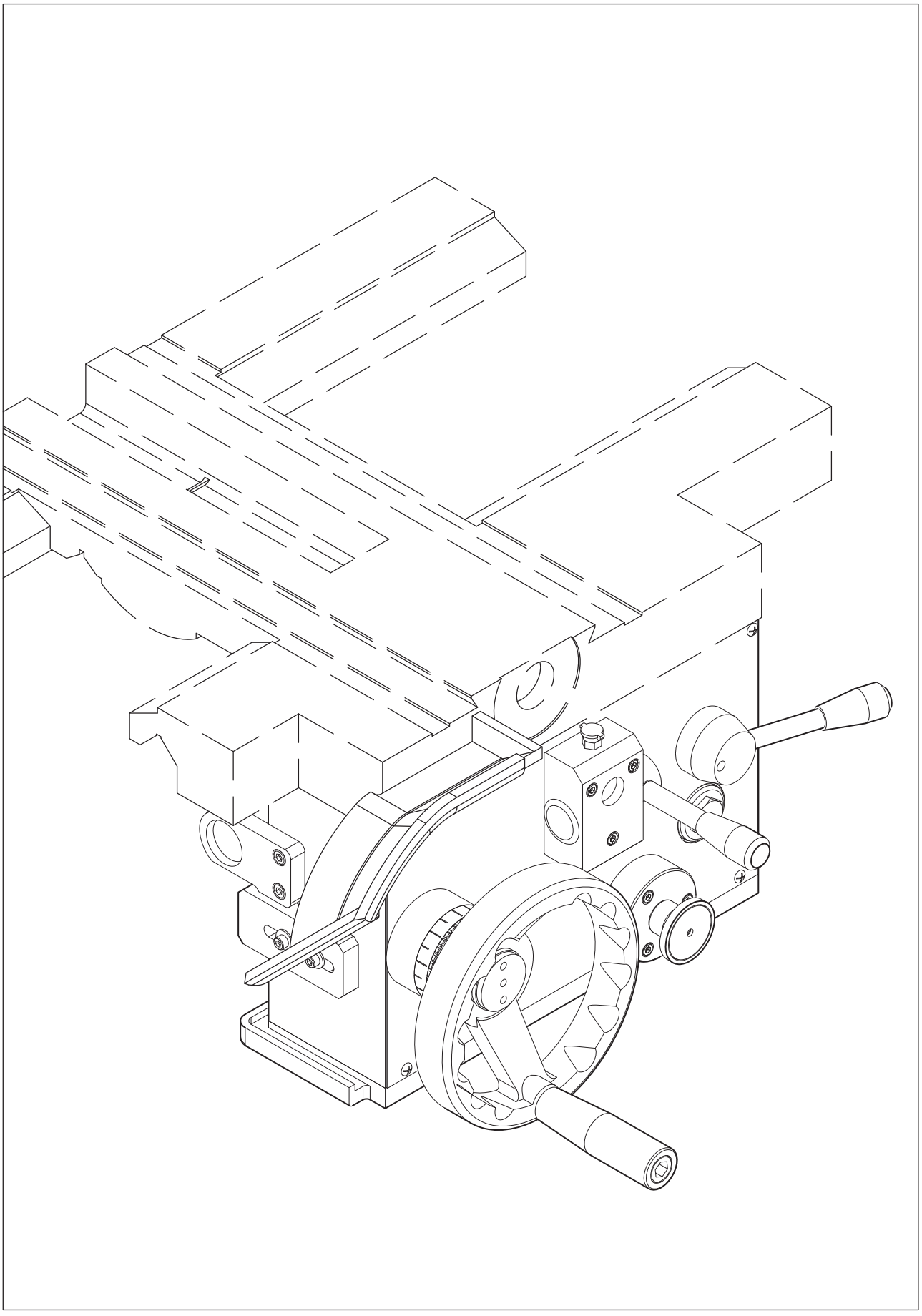
Gearbox

KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK	KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK
1	30003	Shaft	1		46	30039	Gear	1	22T
2		Oil seal	1	TC 203205	47	30040	Gear	1	33T
3		Bearing	2	TAF202820	48	30041	Gear	1	22T
4	30005	Flanged bearing	1		49		Clip	1	S17
5	30004	Washer	1		50	30042	Gear	1	20T/36T
6		Clip	6	S20	51	30016	Washer	1	
7		Key	1	7x7x30	52	30017	Flanged bearing	1	
8	30007	Gear	1	19T/20T	53		Oil seal	1	TC 203205
9	30008	Shaft	1		54	30014	Shaft	1	
10	30018	Cover	1		55	30035	Flanged bearing	1	
11		Bearing	5	16004	56		Oil seal	1	24x35x08
12	30006	Washer	1		57	30033	Shaft	1	
13	30020	Gear	1	19T/30T	58		Key	1	5x5x35
14	30021	Washer	1		59		Bearing	1	6001
15		Clip	1	S25	60		Clip	1	S12
16	30019	Shaft	1		61	30043	Flanged bearing	1	
17	30036	Shaft	1		62	30002-P	Seal	1	
18		Woodruff key	1	5xψ19	63	30084	Partition nut	2	
19	30018-P	Oil seal	1		64	30077	Upper plate	2	
20	30001	Gearbox body	1		65	30082	Fort support	1	
21		Bearing	3	16004	66	30070	Spring	5	Ø6.35x20
22	30009	Gear	1	38T	67		Steel ball	7	1/4"
23	30010	Gear	1	23T/19T	68	30079	Partition	3	
24	30011	Washer	3		69	30080	Fort support	1	
25		Clip	6	R40	70	30078	Fort support	1	
26		Bearing	3	6203	71	30081	Fort support	1	
27	30012	Clutch	1		72	30087	Reverse-stop	1	
28	30013	Washer	1		73	30085	Spacer	2	
29		Clip	1	S16	74	30086	Shoulder plate	1	
30	30015	Gear	1	35T	75	30100	Fixed plate A	1	
31	30022	Gear	1	22T	76	30083	Fixed plate B	1	
32	30023	Gear	1	19T	77	30053	Fork	2	
33	30024	Gear	1	20T	78	30055	Fork	1	
34	30025	Gear	1	24T	79	30054	Fork	1	
35	30026	Gear	1	23T					
36	30027	Gear	1	27T	81		Spring pin	8	Ø3x16
37	30028	Gear	1	24T	82	30061	Shaft	2	
38	30029	Gear	1	28T	83	30065	Arm	1	
39	30030	Gear	1	26T	84	30060	Cam	1	
40	30031	Gear	1	38T	85	30059	Support seat	1	
41	30032	Nut	1		86		Clip	2	E9
42		Clip	1	S22	87	30058	Washer	1	
43	30034	Gear	1	36T/50T	88		Clip	2	S17
44	30037	Gear	1	22T	89		Woodruff key	4	4xØ13
45	30038	Gear	1	22T	90	30057	Shaft	1	

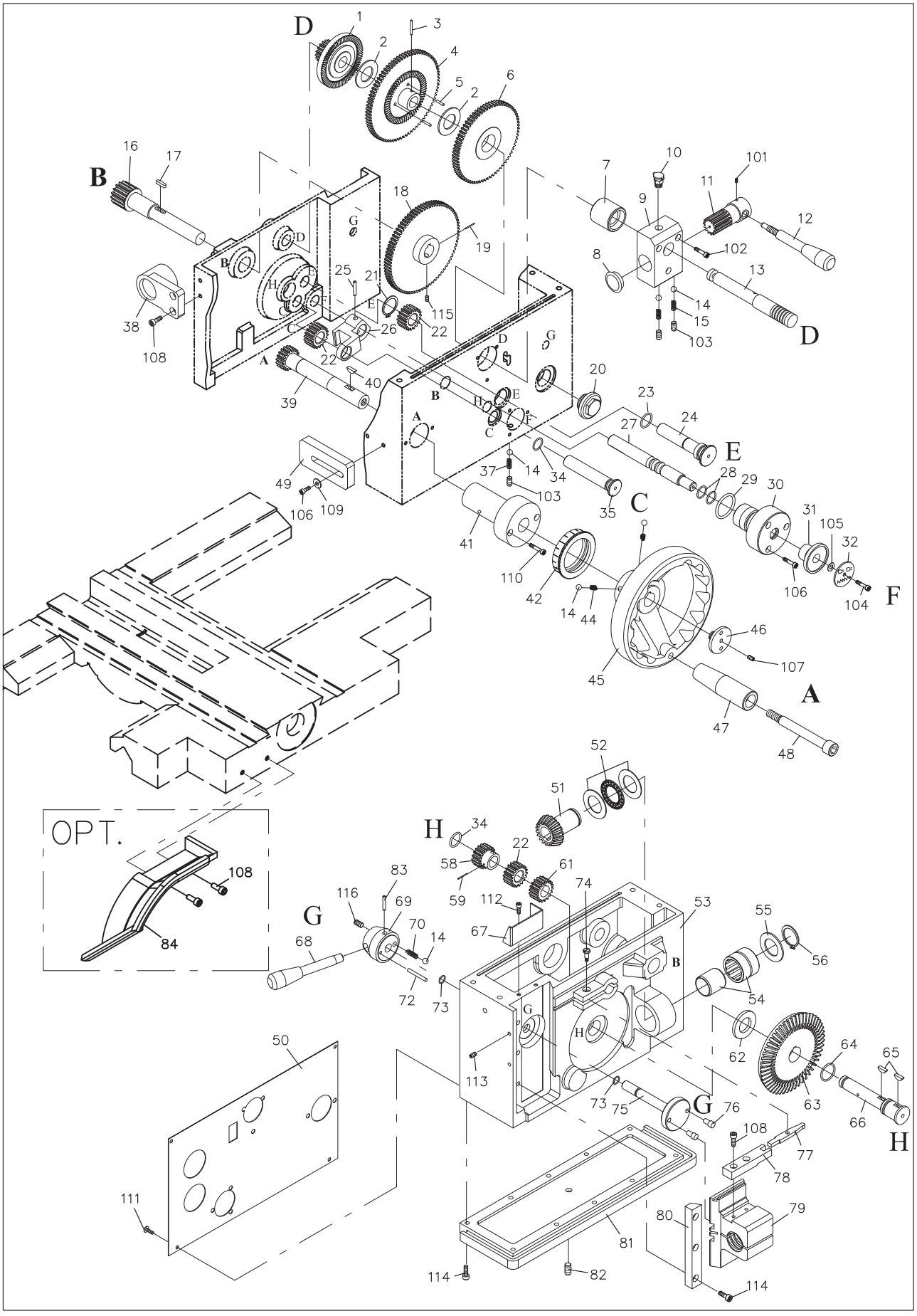
Gearbox

KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK	KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK
91	30047	Pad	1		201		Hex. socket head bolt	19	CAP 6x12
92	30062	Pin	2		202		Hex. socket head bolt	4	CAP 5x20
93	30063	Fork	1		203		Spring washer	4	M6
					205		Hex. socket head bolt	2	CAP 6x35
96	30046	Pad	1		206		Spring pin	2	Ø4x24
97	30048	Lever	1		207		Set screw	2	SET 6x8
98	30099	Spring	2	Ø6x13	208		Hex. socket head bolt	4	CAP 6x20
					209		Hex. socket head bolt	6	CAP 6x70
100	30052	Selector bar	1		210		Set screw	1	SET 5x6
101		Spring pin	2	Ø4x24	211		Hex. socket head bolt	3	CAP 5x25
102	30050	Shaft	2						
103		O ring	2	P18	213		Hex. socket head bolt	3	CAP 5x12
104	30051	Bush	2		214		Dome cross screw	9	M4x6
105	30045	Fork	1		215		Hex. socket head bolt	3	CAP 8x65
106		Spring pin	4	Ø5x16	216		Taper pin	2	#7x3 1/4"
107		Square head plug	2	1/2"					
		Elbow	2	1/2"					
		Nipple	2	1/2"x1"					
110	30002	Gearbox cover	1						
111	30088	Selector lever	1						
112		O ring	2	G40					
113	30066	Selector lever support	1						
114	30069	Spring	1						
115	30068	Selector lever	1						
116		O ring	1	G30					
117	30067	Selector lever cover	1						
118	30076	Specifying base	1						
119	30071	Handle	3						
120	30072	Washer	3						
121	30073	Plug	3						
122		Oil sight	1						
123	30103-V	Plate	1						
124	30104	Plate	1						
125	30064	Arm	1						

Apron



Apron



Apron

APRON(L.H) ASSEMBLY

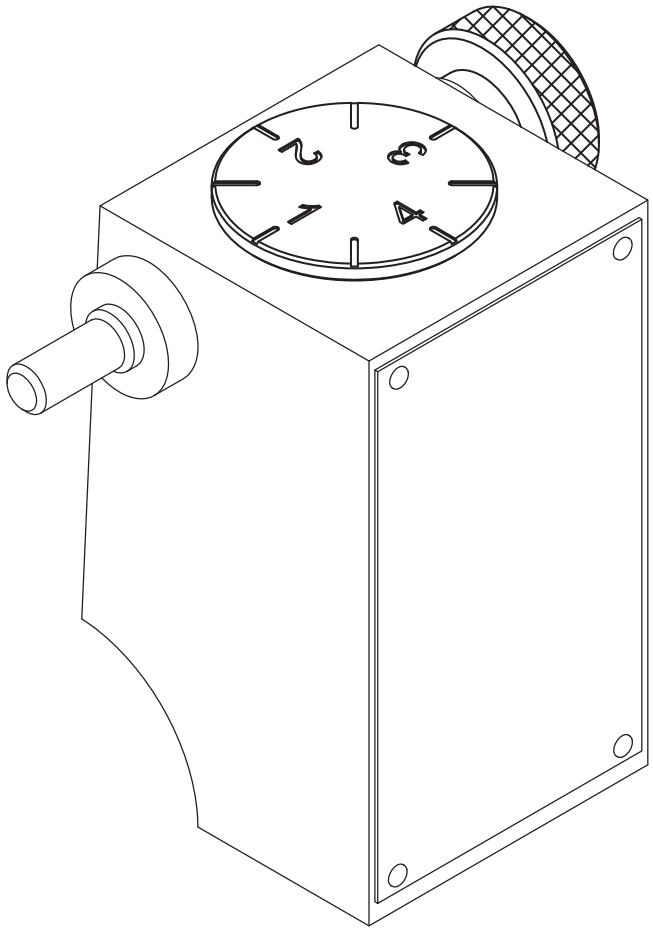
KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK
1	40014	Gear	1	18T/60T
2		Washer	2	AS3047
3		Spring pin	1	Ø4x22
4	40015	Gear	1	81T/60T
5		Pin	3	Ø4x17
6	40017	Gear	1	72T/60T
7	40060	Collar	1	
8	40071	Plug	1	
9	40023	Gear bracket	1	
10		Oil cap	1	
11	40019	Cam shaft	1	
12	40020	Handle	1	
13	40018	Shaft	1	
14		Steel ball	7	1/4"
15	13-30099	Spring	2	Ø6x13
16	40013	Gear shaft	1	16T
17		Key	1	5x5x16
18	40012-M	Gear	1	82T
	40012-I			81T
19		Spring pin	1	Ø5x36
20		Oil sight	1	
21		Clip	1	S16
22	40067	Gear	3	18T
23		O ring	2	P18
24	40068	Shaft	1	
25		Spring pin	1	Ø4x24
26	40063-L	Fork	1	
	40073-R			
27	40062	Shaft	1	
28		O ring	2	P16
29		O ring	1	P26
30	40061	Shaft liner	1	
31	40076	Knob	1	
32	40025-L	Plate	1	
	40024-R			
34		O ring	2	P12
35	40064	Shaft	1	
37		Spring	1	Ø4x19
38	40072	Bracket	1	
39	40003	Gear shaft	1	18T
40		Woodruff key	1	19xØ5
41	40004-M	Shaft liner	1	
	40004-I			

KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK
42	40005-M	Index ring	1	
	40005-I			
44	40006	Spring	3	
45	40007	Handle wheel	1	
46	40011	Plug	1	
47	40009	Handle	1	
48	40008	Screw	1	
49	40078	Safety plate	1	
50	61039-L	Plate	1	
	61040-R			
51	40034	Bevel gear	1	23T
52		Thrust bearing	1	NTB/AS-2542
53	40001-L	Apron	1	
	40001-R			
54		Bearing	1	NK29/30
55	40032	Washer	1	
56		Clip	1	S25
58	40066	Gear	1	18T
59		Spring pin	1	Ø5x22
61	40065	Gear	1	18T
62	40035	Washer	1	
63	40033	Bevel gear	1	64T
64		O ring	1	P18
65		Woodruff key	2	4xØ13
66	40031	Shaft	1	
67	49001-L	Oil fence	1	
68	40037	Handle	1	
69	40038	Hub	1	
70		Spring	1	Ø6x27
72		Spring pin	1	Ø4x24
73		O-ring	2	P9
75	40039	Cam shaft	1	
76	40040	Pin	2	
77	40044	Lever	1	
78	40042	Stopper	1	
79	40041-M	Half nut	1	
	40041-I			
80	40043	Gid	1	
81	40046	Base plate	1	
82		Plug	1	1/8"
83		Spring pin	1	Ø4x36
84	13-40080	Handle wheel guard	1	OPT.

Apron

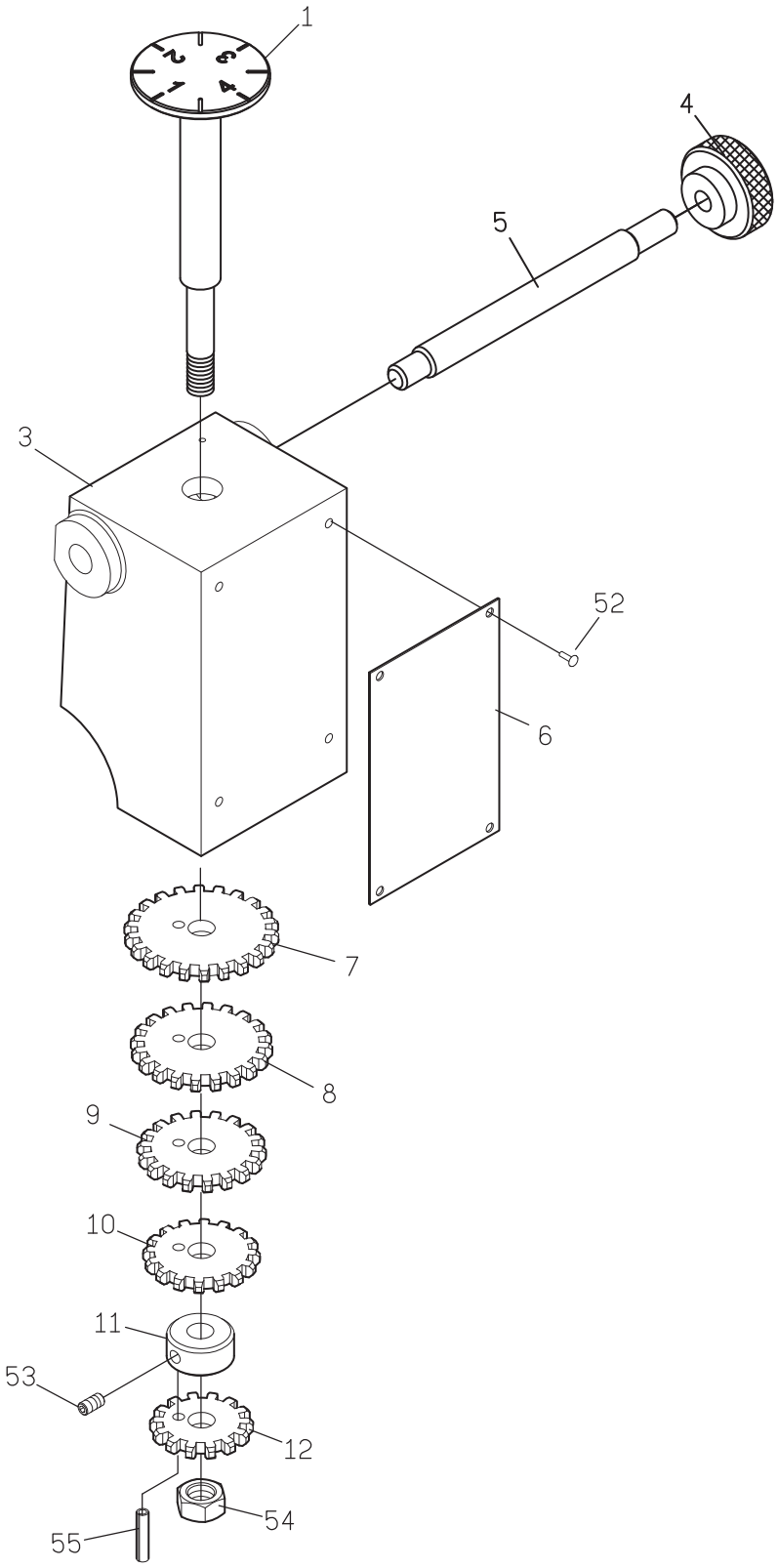
KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK	KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK
101		Set screw	1	SET 5x6					
102		Hex. socket head bolt	3	CAP 5x35					
103		Set screw	4	SET 8x8					
104		Dome hexagon screw	1	M5x12					
105		Washer	1	M6					
106		Hex. socket head bolt	5	CAP 6x25					
107		Set screw	1	SET 6x25					
108		Hex. socket head bolt	6	CAP 6x16					
109	40077	Washer	2						
110		Hex. socket head bolt	2	CAP 5x25					
111		Dome cross screw	4	M4x6					
112		Hex. socket head bolt	2	CAP 5x8					
113		Set screw	2	SET 6x6					
114		Hex. socket head bolt	13	CAP 5x16					
115		Set screw	1	SET 6x8					
116		Set screw	1	SET 8x16					

Dail Indicator



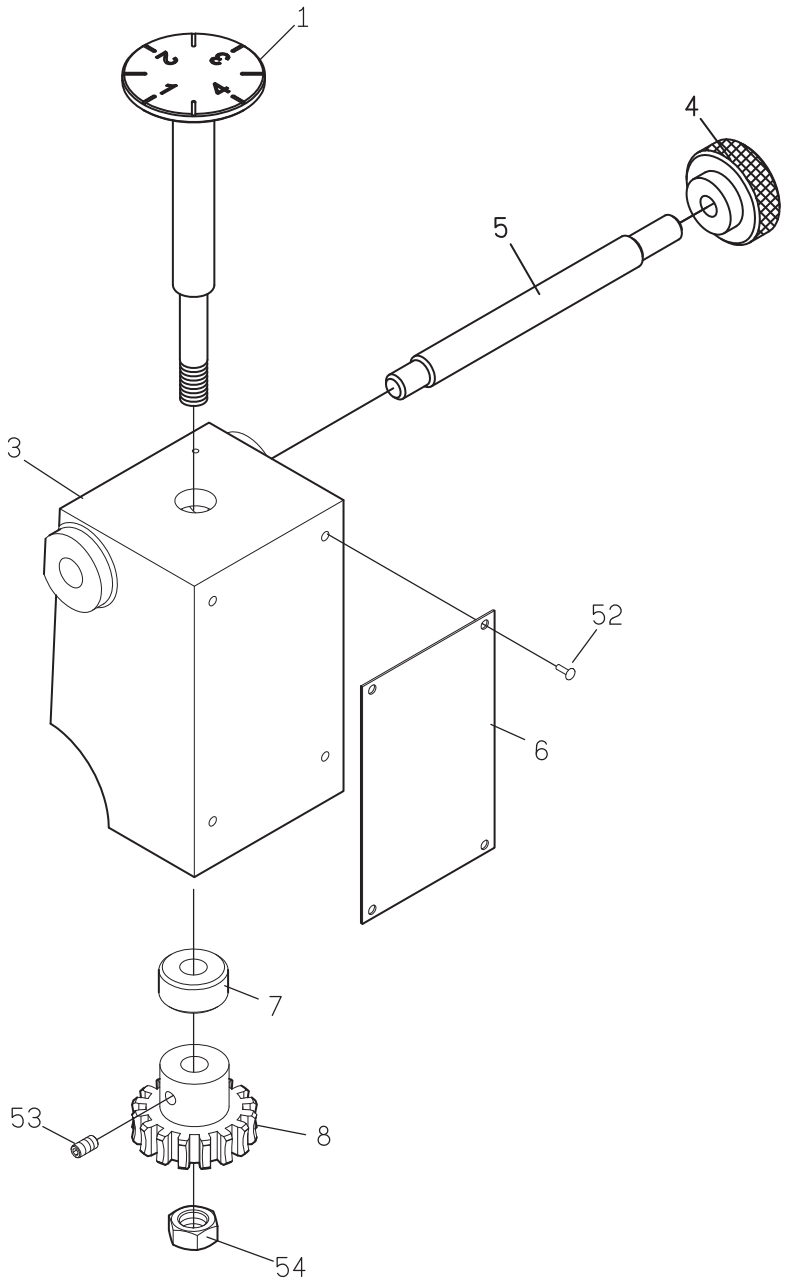
Dail Indicator

METRIC



Dail Indicator

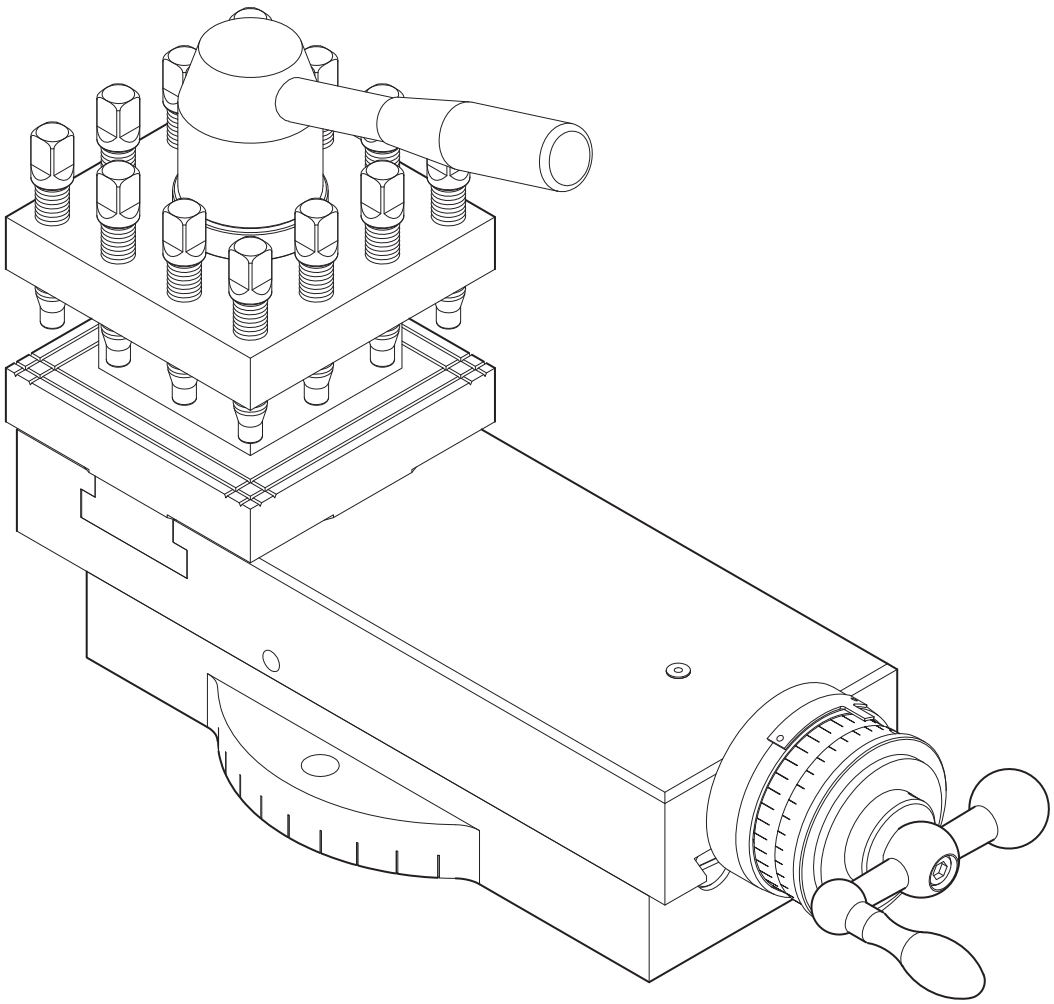
IMPERIAL



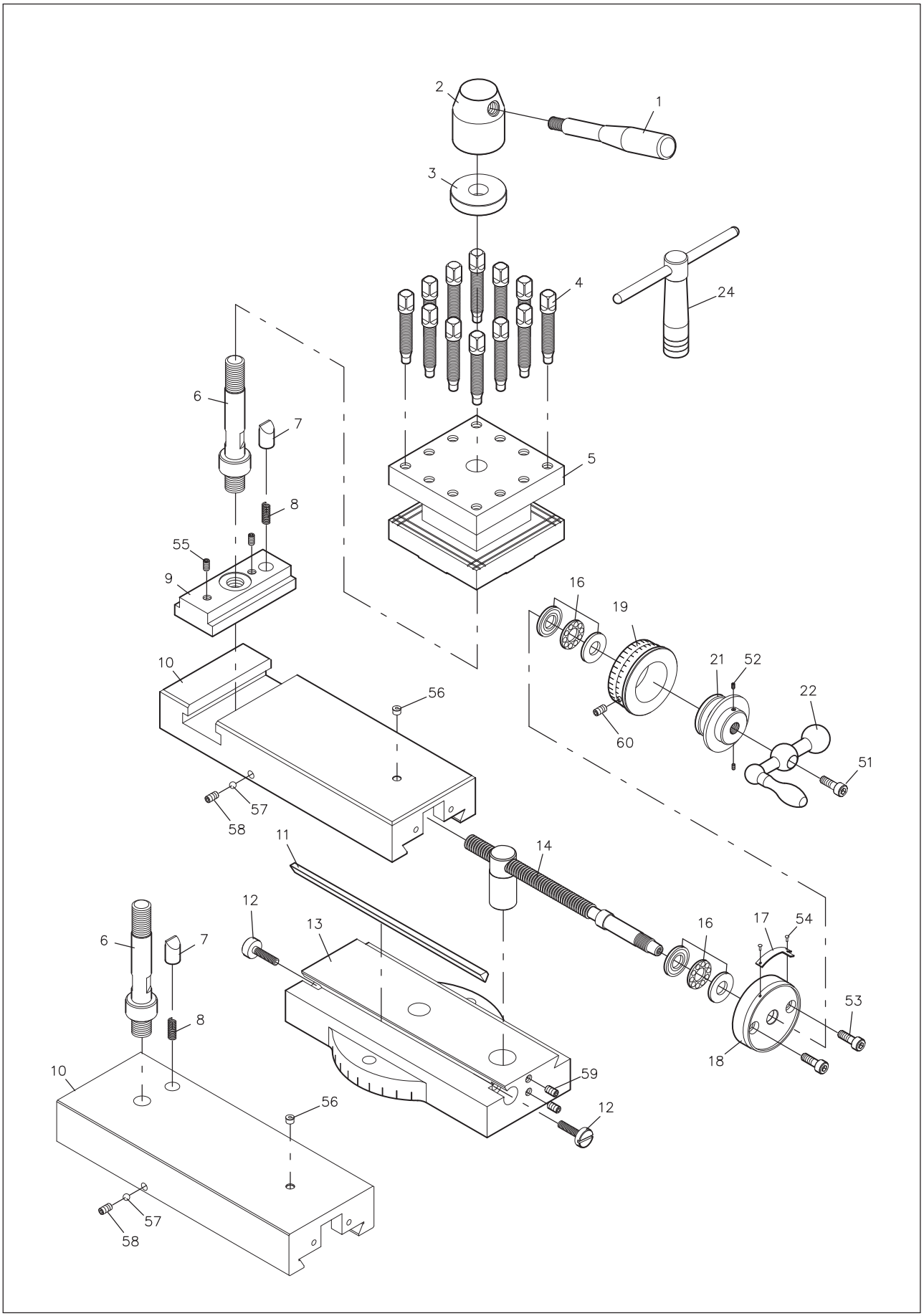
Dail Indicator

METRIC(LEADSCREW PITCH 6)					IMPERIAL(LEADSCREW 4 T.P.I.)				
KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK	KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK
1	40048	Gear pivot	1		1	40048	Gear pivot	1	
3	40092	Body	1		3	40092	Body	1	
4	40053	Nut	1		4	40053	Nut	1	
5	40094	Stud	1		5	40094	Stud	1	
6	40074-M	Threading plate	1		6	40074-I	Threading plate	1	
7	40058	Gear	1	22T	7	40050	Spacer	1	
8	40057	Gear	1	20T	8	40059	Dial gear	1	16T
9	40056	Gear	1	18T					
10	40055	Gear	1	16T					
11	40051	Spacer	1						
12	40054	Gear	1	14T					
52		Rivet	4	Ø2	52		Rivet	4	
53		Set screw	1	M6x6L	53		Set screw	1	M6x6L
54		Nylon Jam Nut	1	M8	54		Nylon Jam Nut	1	M8
55		Spring pin	1	Ø3x10L					

Compound Rest & Tool Post



Compound Rest & Tool Post



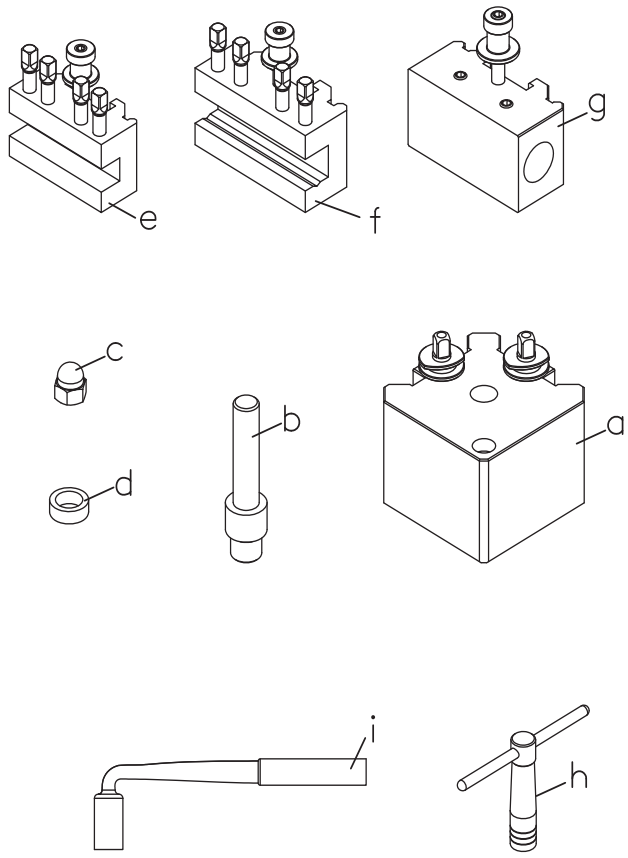
Compound Rest & Tool Post

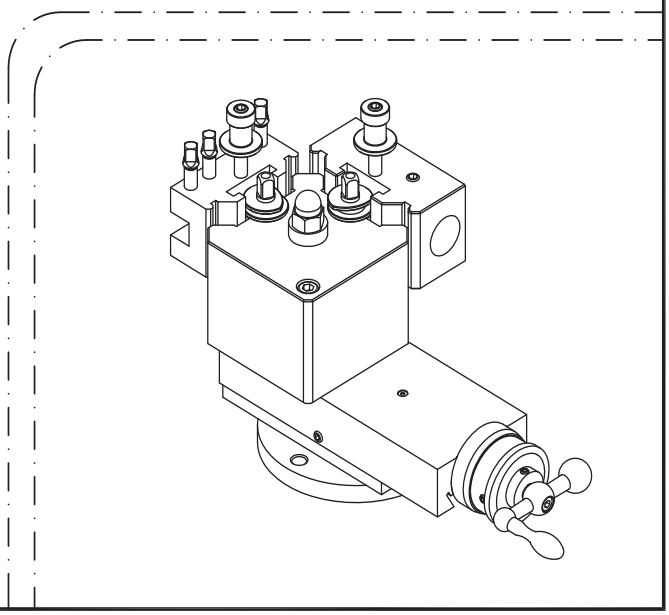
KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK
1	50067	Handle	1	
2	50066	Turret nut	1	
3	50065	Collar	1	
4	50068	Bolt	12	
5	50060	Turret body	1	
6	50062	Turret shaft	1	
7	50064	Pin	1	
8	50043	Spring	1	
9	50061	T Nut	1	
10	50006	Solid topslide	1	
	50006-SP			
11	50056	Gib	1	
12	50054	Screw	1	
13	14-50004	Swivel slide	1	
	16-50004			
14	50038-M	Nut	1	
	50042-M	Screw	1	
	50038-I	Nut	1	
	50042-I	Screwt	1	
16		Trust bearing	2	51101
17	50063	Curve pilot	1	
18	50041	Keep assy	1	
19	50044-M	Dial	1	
	50044-X	Dual Dial		
21	50111	Bush	1	
22	50045	Handle wheel	1	
24	50108	T wrench	1	

KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK
51		Hex. Socket head bolt	1	CAP 6x10
52		Set screw	2	SET 5x8
53		Hex. Socket head bolt	2	CAP 6x20
54		Rivet	2	Ø2
55		Set screw	2	SET 8x16
56		Oil ball	1	1/4"
57		Steel ball	1	1
58		Set screw	1	SET 8x12
59		Set screw	2	SET 6x16
60		Set screw	1	SET 5x10

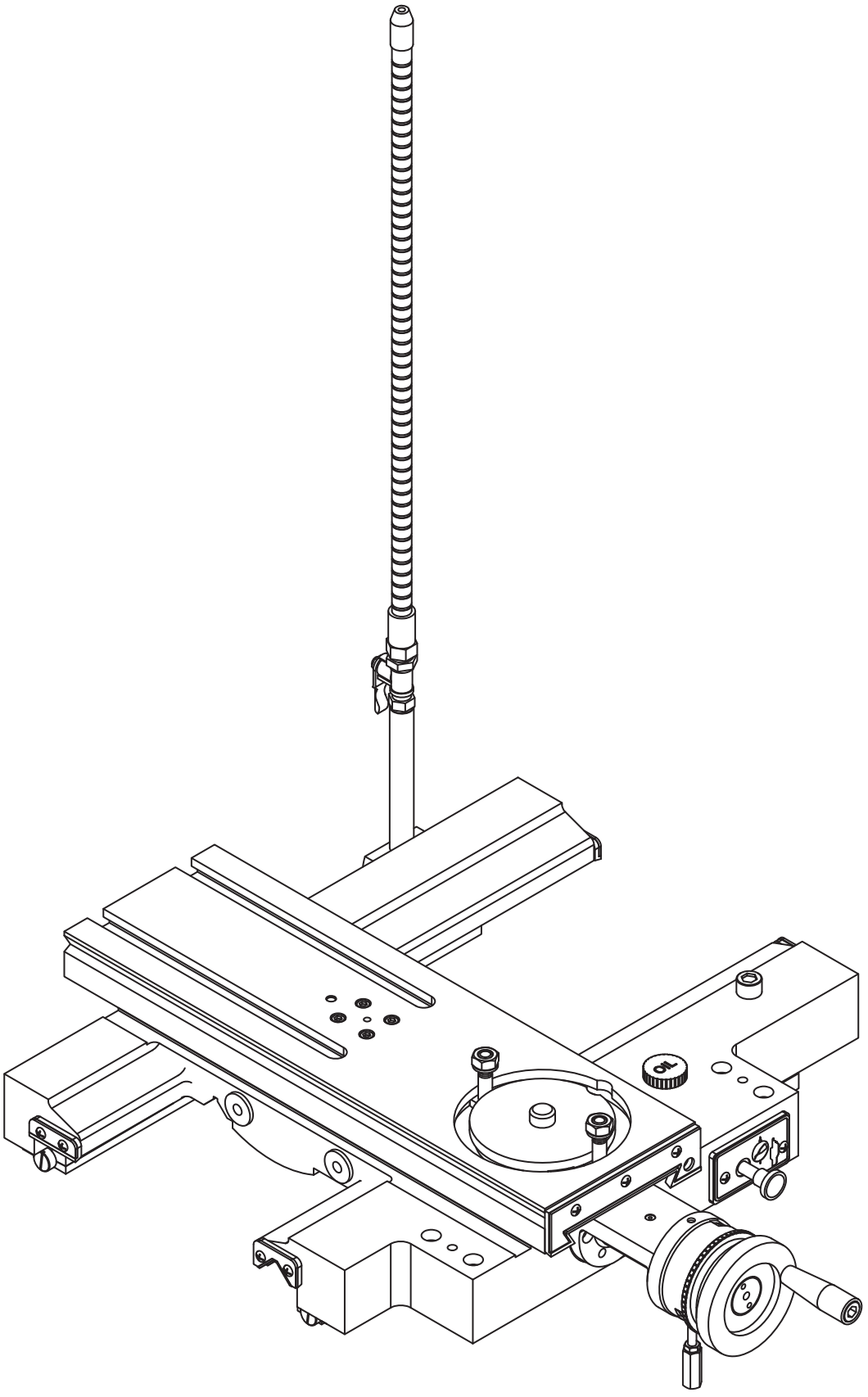
QUICKCHANGE TOOL POST SET (OPTIONAL)

KEY NO.	PARTS NAME QTY	
a	TURRET BODY (SPECIFICATION-100)	1
b	TURRET SHAFT	1
c	HEXAGON CAP NUT	1
d	WASHER	1
e	STANDARD TOOLHOLDER	1
f	VEE TOOLHOLDER	1
g	PLAIN BORE TOOLHOLDER	1
h	T WRENCH	1
i	L WRENCH	1

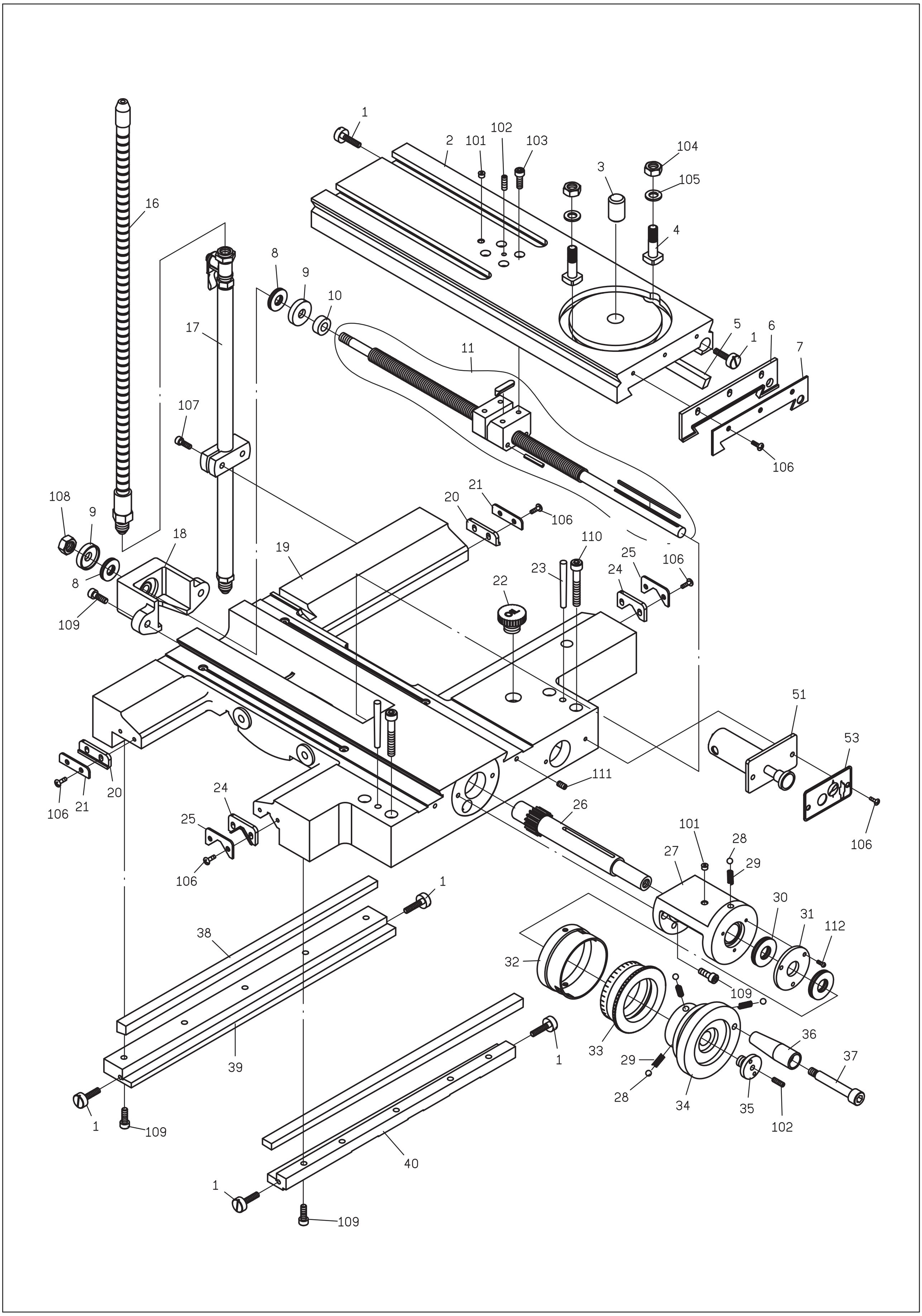




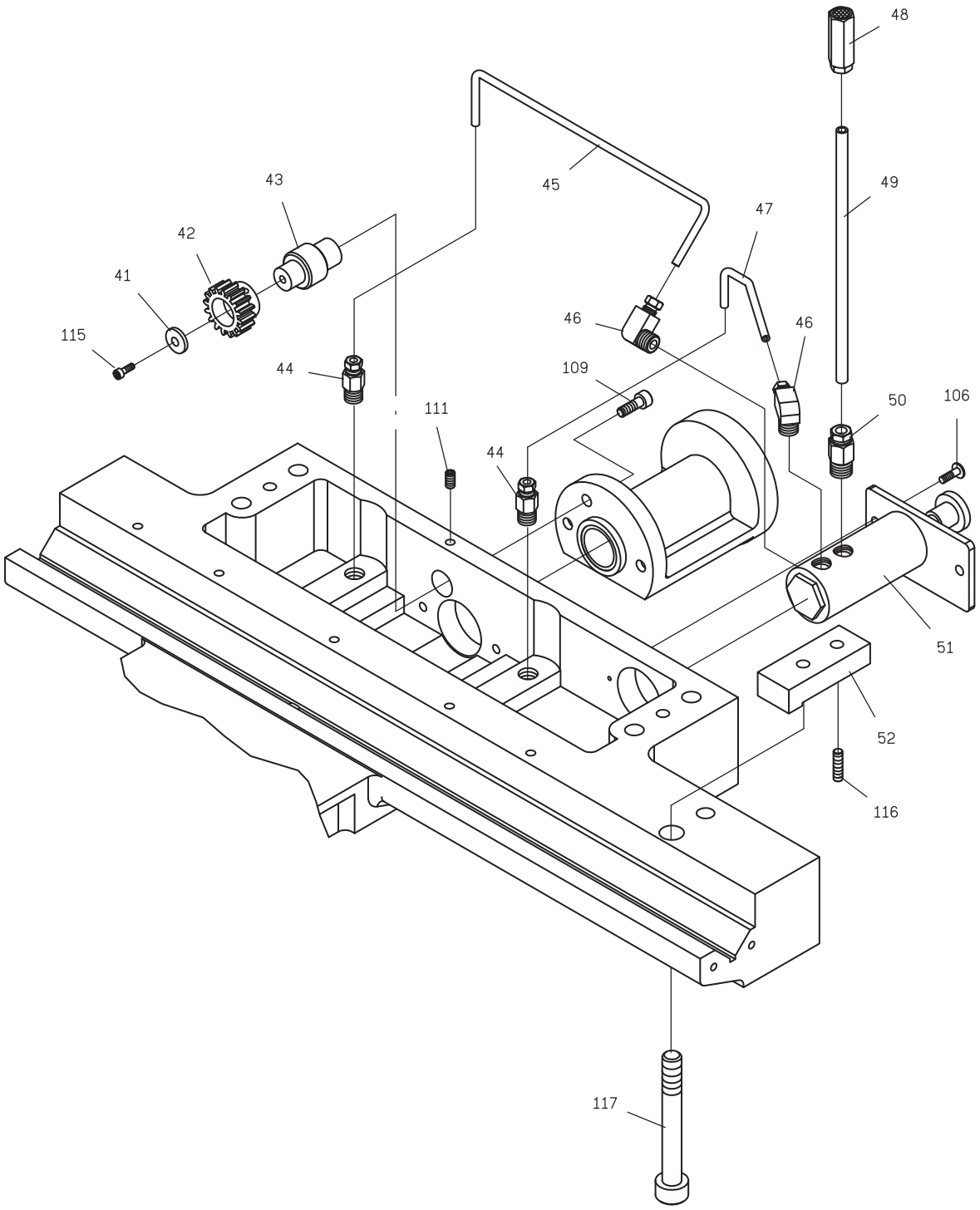
Saddles



Saddles


1
2
101
102
103
104
105
3
4
16
8
9
10
17
5
1
6
7
11
107
106
108
9
21
20
106
18
19
110
25
106
8
23
24
22
109
51
53
111
106
24
20
21
106
25
26
101
28
106
27
29
1
30
31
112
38
32
109
33
29
36
37
39
1
1
28
34
35
102
109
40
1
109

Saddles

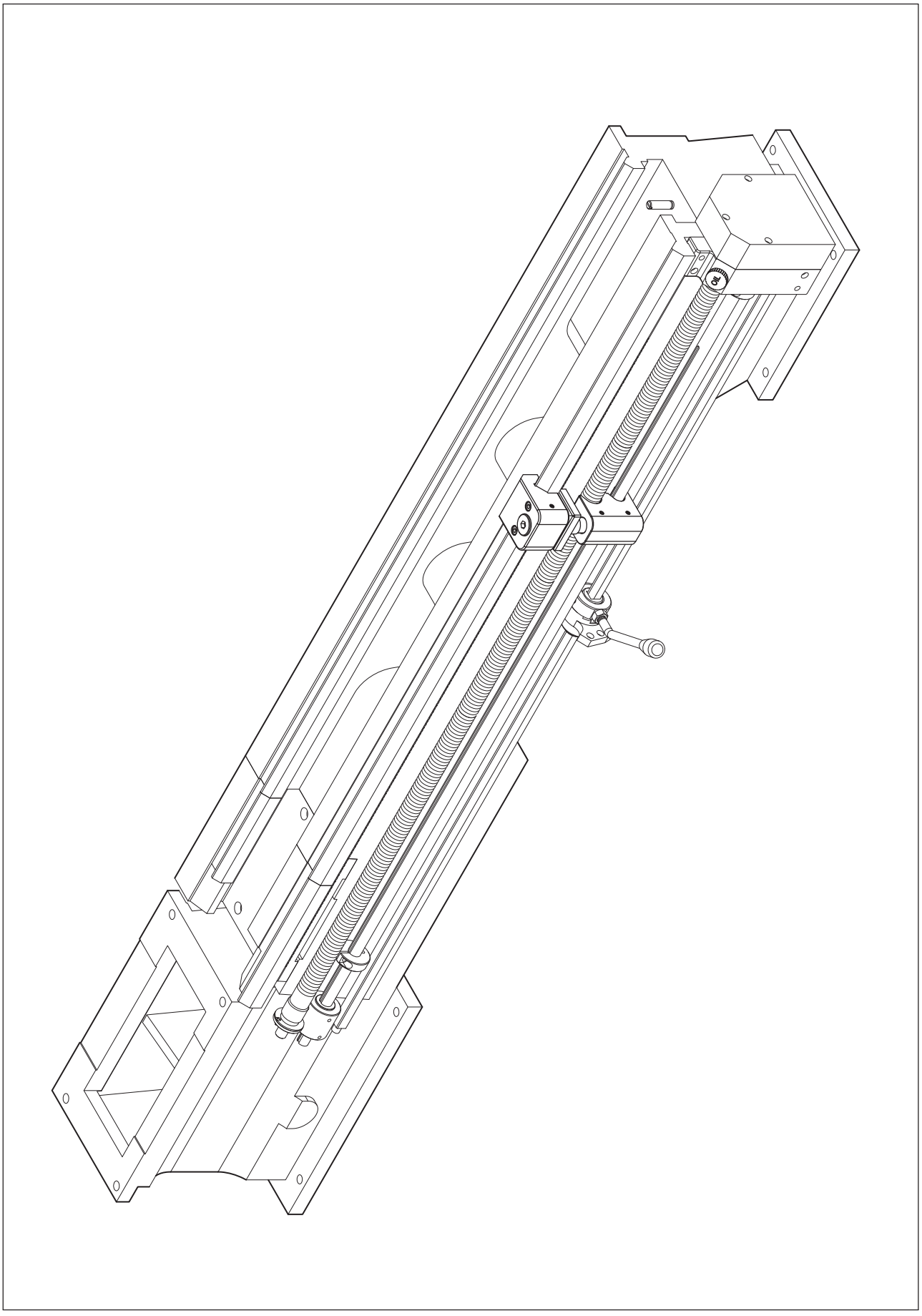


Saddles

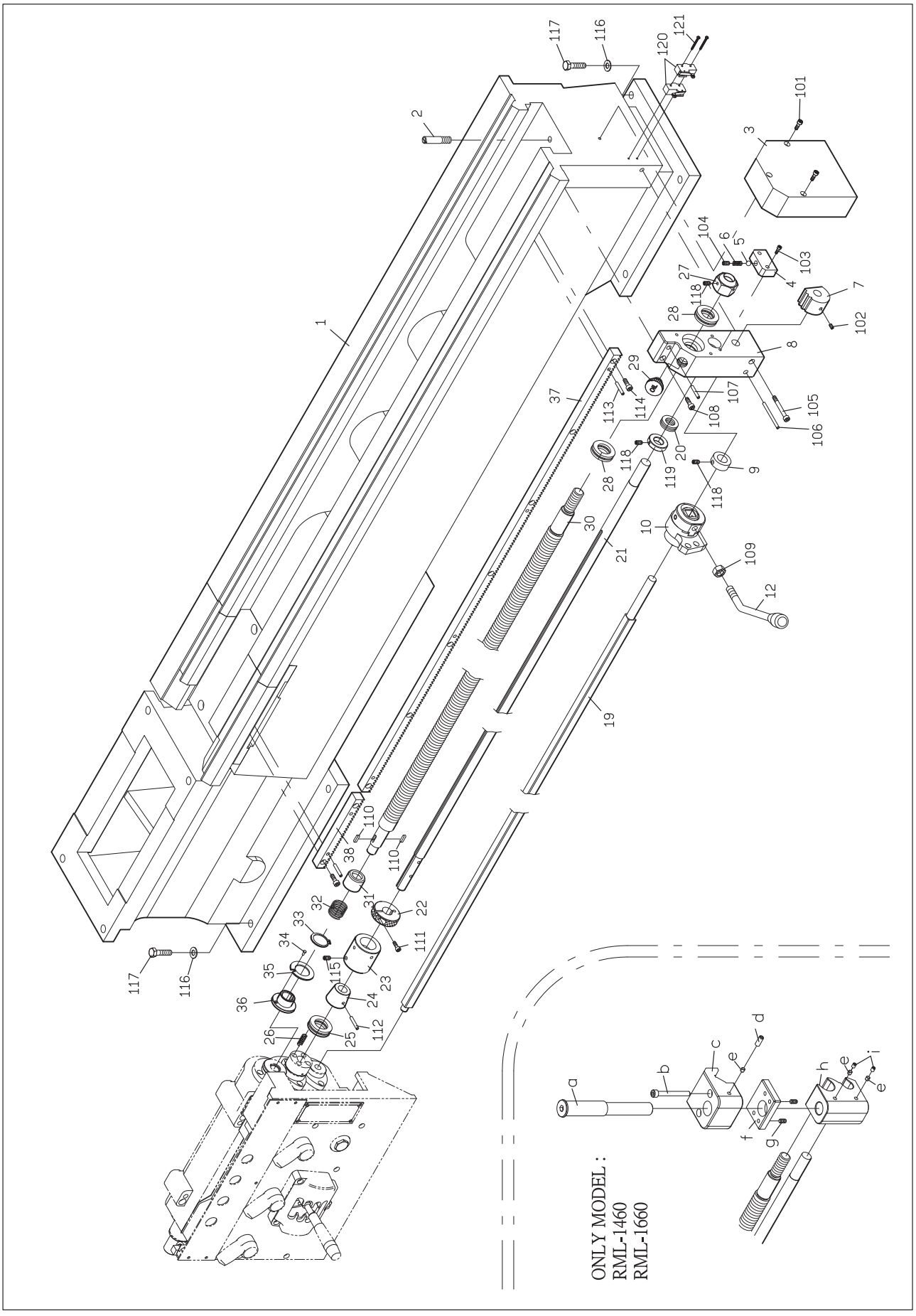
KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK	KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK
1	50054	Adjust screw	6		37	50034	Bolt	1	
2	50003	Cross slide	1		38	50053	Gib-Z	2	
3	50036	Pivot	1	Ø18x28	39	50052	Front anti-floater	1	
4	50037	T bolt	2		40	50055	Rear anti-floater	1	
5	50023	Gib-X	1		41	50013	Washer	1	Ø6.5xØ15x3
6	50070	Wiper-X	1		42	50011	Gear	1	16T
7	50069	Plate -X	1		43	50012	Short shaft	1	
8		Trust bearing	2	NTB/AS2 1226	44		Straight adapter	2	PT1/8xØ4
9	50026	Cap collar	2		45		AL. tube	1	Ø4x260
10	50017	Washer	1		46		Elbow adapter	2	PT1/8xØ4
11	50021	Wedge	1	7x7x30	47		AL. tube	1	Ø4x120
	50019-M	Nut	1		48		Oil filter	1	Ø6
	50016-M	Screw	1		49		AL. tube	1	Ø6x160
		Key	1	3x3x100	50		Straight adapter	2	PT1/8xØ6
		Spring pin	2	Ø5x40	51		Lubricator assy.	1	
	50021	Wedge	1	7x7x30	52	50058	Clamp plate	1	
	50019-I	Nut	1		53	50077	Plate	1	
	50016-I	Screw	1						
		Key	1	3x3x100					
		Spring pin	2	Ø5x40					
					101		Oil ball	2	1/4"
16		Spraying pipe	1	PT3/8 x 24"	102		Set screw	2	SET 6x30
17		Valve & junction assy.	1	PT3/8	103		Hex. socket head bolt	4	CAP 6x30
18	50018	Rear bracket	1		104		Nut	2	M10
19	50001	Saddle	1		105		Washer	2	M10
20	50050	Wiper F	2		106		Dome cross screw	13	M5x12
21	50051	Plate F	2		107		Hex. socket head bolt	2	CAP 6x25
22		Oil cover	1	NF 3/4"	108		Nut	1	M10
23		Taper Pin	2	#6x2 3/4"L	109		Hex. socket head bolt	15	CAP 6x20
24	50048	Wiper V	2		110		Hex. socket head bolt	4	CAP 8x60
25	50049	Plate V	2		111		Set screw	3	SEY 6x8
26	50014	Pinion	1	160DP 16T	112		Hex. socket head bolt	3	CAP 4x10
27	50015	Front bracket	1						
28		Steel ball	4	1/4"					
29	50032	Spring	4	Ø6x15 L	115		Hex. socket head bolt	1	CAP 5x16
30		Trust bearing	2	NTB/AS2 1730	116		Set screw	1	SET 8x35
31	50030	Washer	1	Ø18xØ52x4	117		Hex. socket head bolt	1	CAP 12x75
32	50027-M	Dial ring	1						
	50027-I	Dial ring	1						
33	50031-M	Dial	1	250dividing					
	50031-X	Dual dial	1	200div/I , 254div/M					
34	50029	Hand wheel	1						
35	50033	Fix screw	1	M12xP1.75					
36	50035	Handle	1						

106.06.03

Bed & Shafts



Bed & Shafts

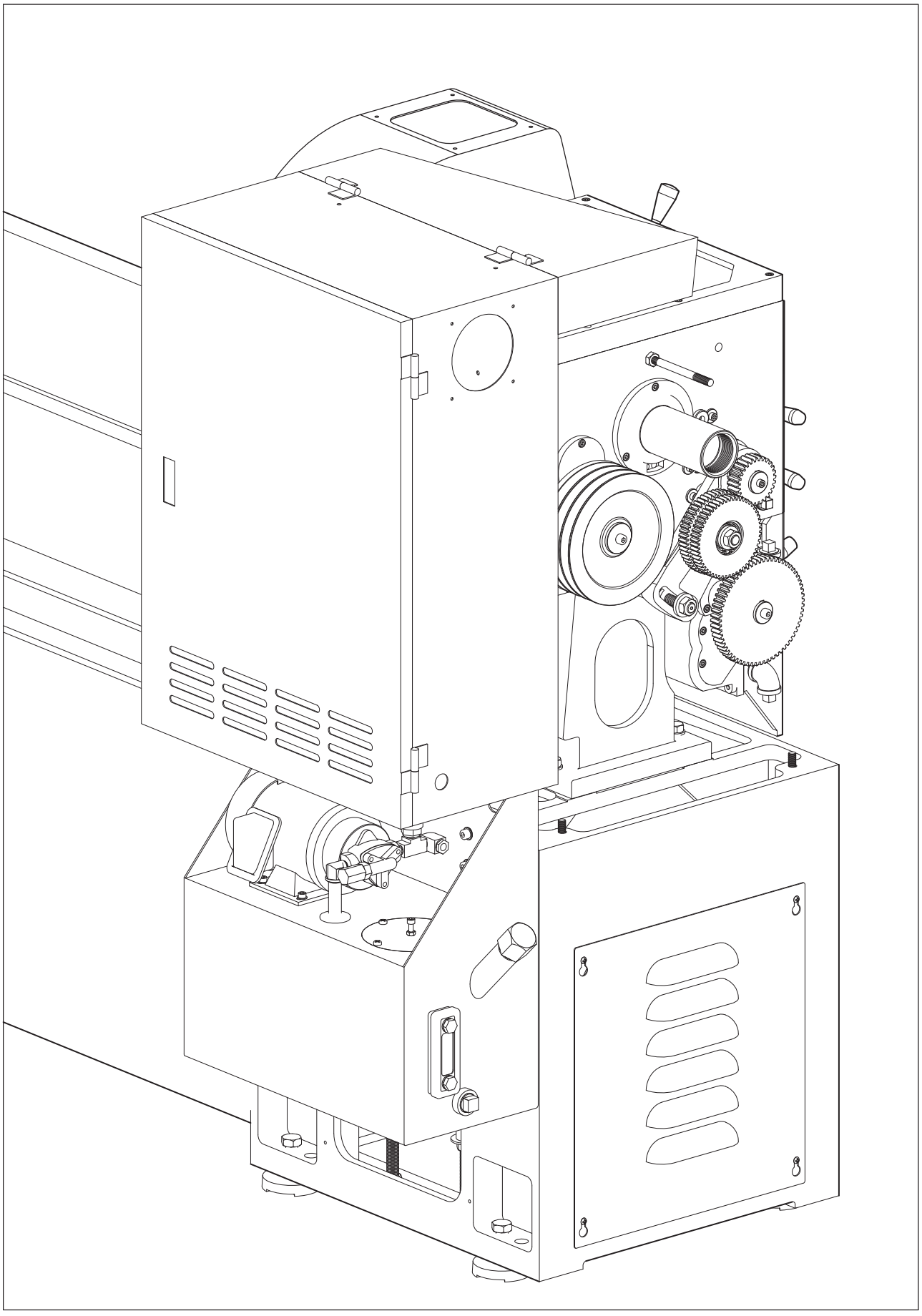


Bed & Shafts

KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK
1	63001-40	Bed	1	
	63001-60			
2	63038	Bolt	1	
3	63027	Cover	1	
4	63028	Fixed block	1	
5		Steel ball	1	5/16"
6	18-40015	Spring	1	
7	63029	Switch flanged	1	
8	63026	Bracket	1	
9	63043	Collar	1	
10	63020	Lever assy	1	
	63021	Pin	2	
	63015	Third rod bracket	1	
	63019	Sleeve	1	
	63018	Spring	1	
	63017	Spring cover	1	
		Snap ring	1	S32
12	63022	Handle	1	
	63030	Knob	1	
19	63014A-40	Third rod shaft	1	
	63014A-60			
20		Thrust bearing	1	NTB/AS2 1831
21	63011A-40	Feed rod	1	
	63011A-60			
22	63012	Stopper	1	
23	63016	Clutch collar	1	
24	63013	Bush	1	
25		Thrust bearing	1	51203
26	63042	Spring	4	
27	63025	Nut	1	
28		Thrust bearing	2	51105
29		Oil cover	1	
30	63005A-40M	Leadscrew	1	
	63005A-60M			
	63005A-40I			
	63005A-60I			
31	63006	Spring cover	1	
32	63007	Spring	1	Ø27x55
33		Snap ring	1	S30
34	63010	Shear pin	1	
35	63008	Shroud washer	1	
36	63009	Collar	1	

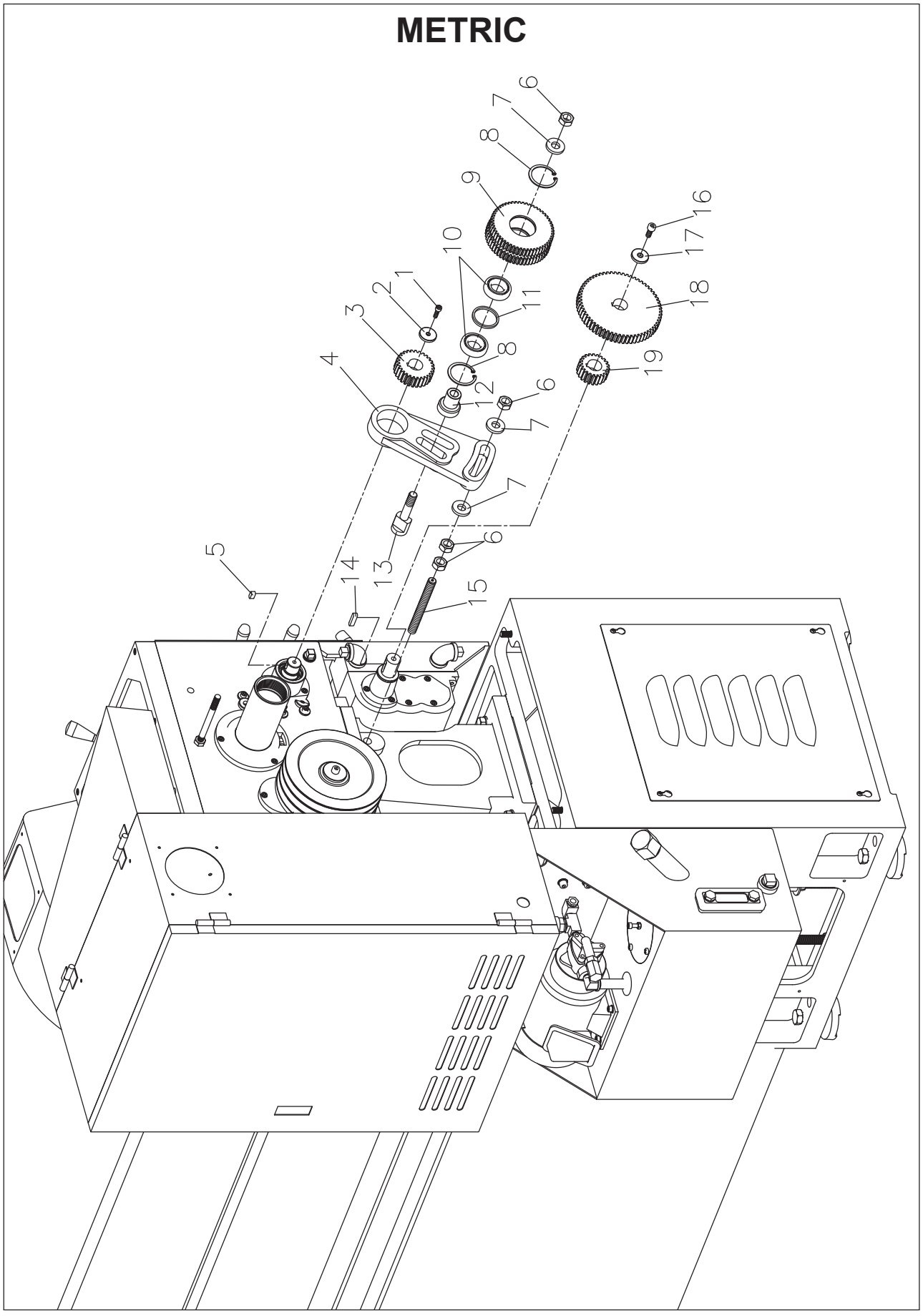
KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK
37	13-63023-40	Rack	1	
	14-63023-60		2	
38	13-63024-GL	Gap Rack	1	
	14-63024-60G			
101		Hex. socket head bolt	3	CAP 6x55
102		Set screw	1	SET 6x16
103		Hex. socket head bolt	2	CAP 6x25
104		Set screw	1	SET 10x10
105		Hex. socket head bolt	1	CAP 8x70
106		Taper pin	1	#7x3 1/4"L
107		Taper pin	1	#7x2"L
108		Hex. socket head bolt	1	CAP 8x35
109		Nut	2	M12
110		Key	2	5x5x15
111		Hex. socket head bolt	1	CAP 6x20
112		Taper pin	1	#4x30L
113		Spring pin	6	Ø6x25L
114		Hex. socket head bolt	9	CAP 6x20
115		Set screw	1	SET 6x6
116		Washer	8	M12
117		Hexagon head bolt	8	M12x45
118		Set screw	3	SET 6x8
119	60035	Collar	1	
120		Limit switch	2	TM1704
121		Dome cross screw	2	M4x40
a	63048-60	Shaft	1	
b		Hex. socket head bolt	2	CAP 8x30
c	63046-60	Chunk	1	
d		Set screw	1	SET 8x20
e	63050-60	Pin	3	
f	63049-60	Chunk	1	
g		Set screw	2	SET 8x16
h	63047-60	Bracket	1	
i		Set screw	2	SET 8x8

End Gear



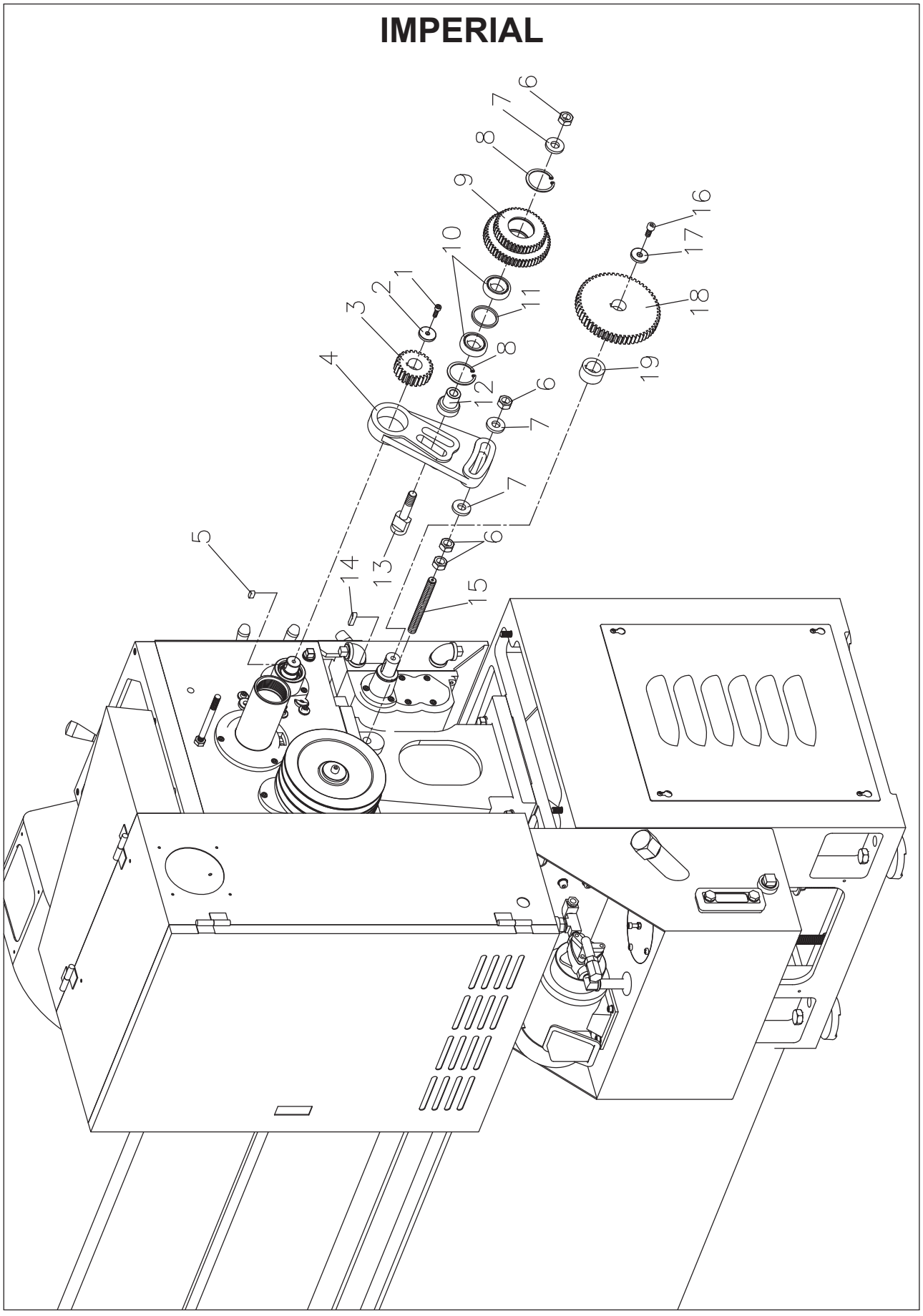
End Gear - 14"

METRIC



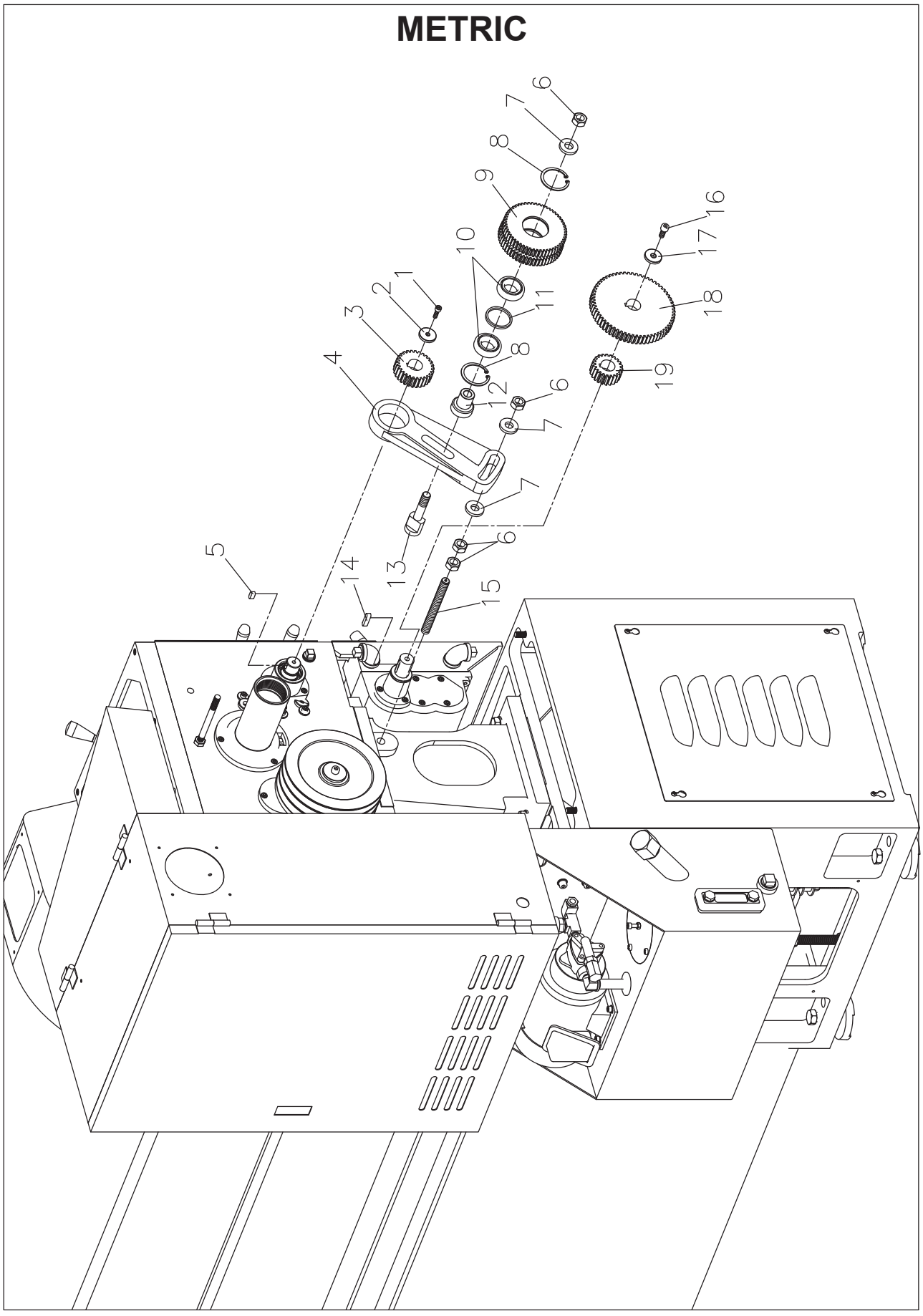
End Gear - 14"

IMPERIAL



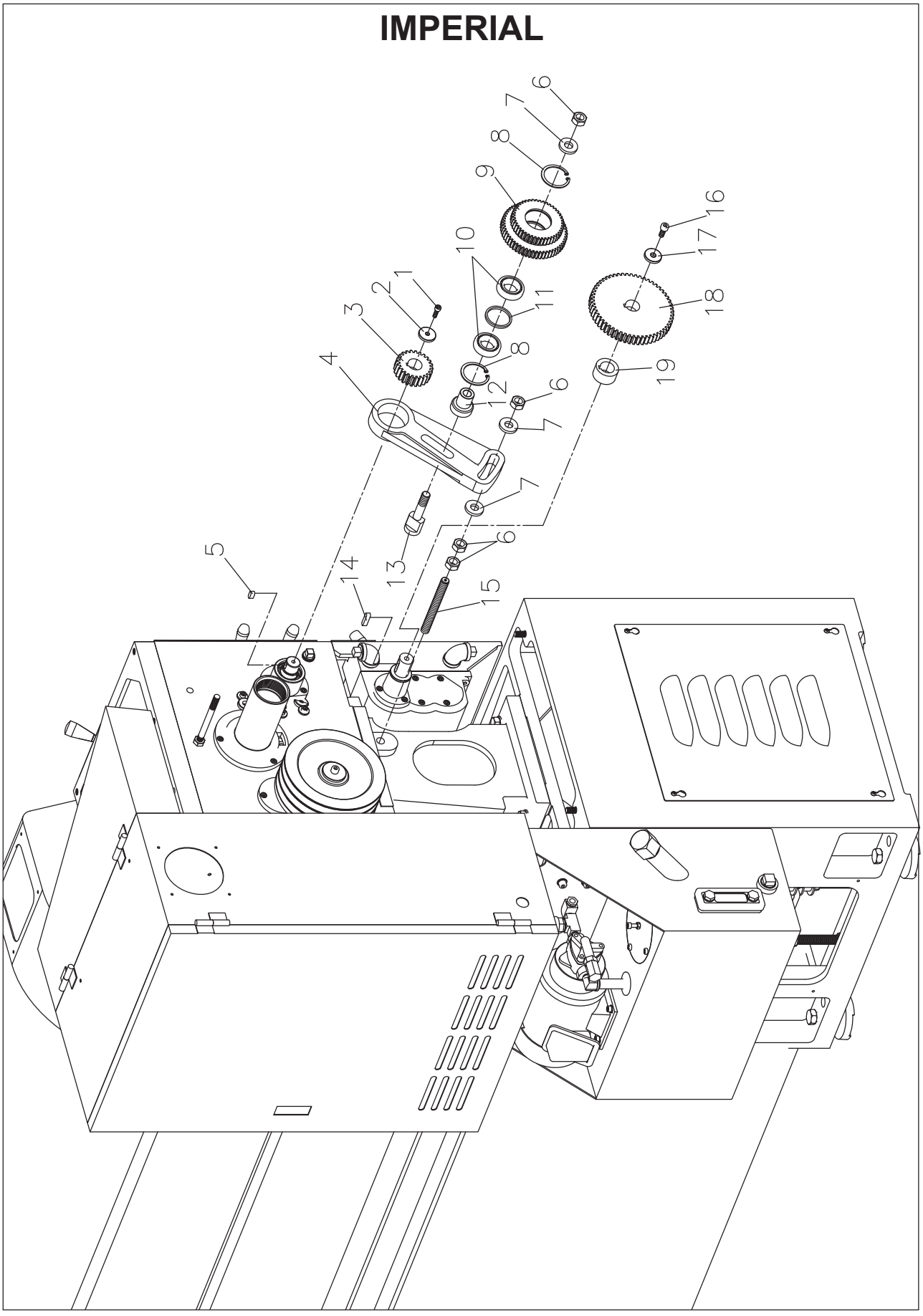
End Gear - 16"

METRIC



End Gear - 16"

IMPERIAL



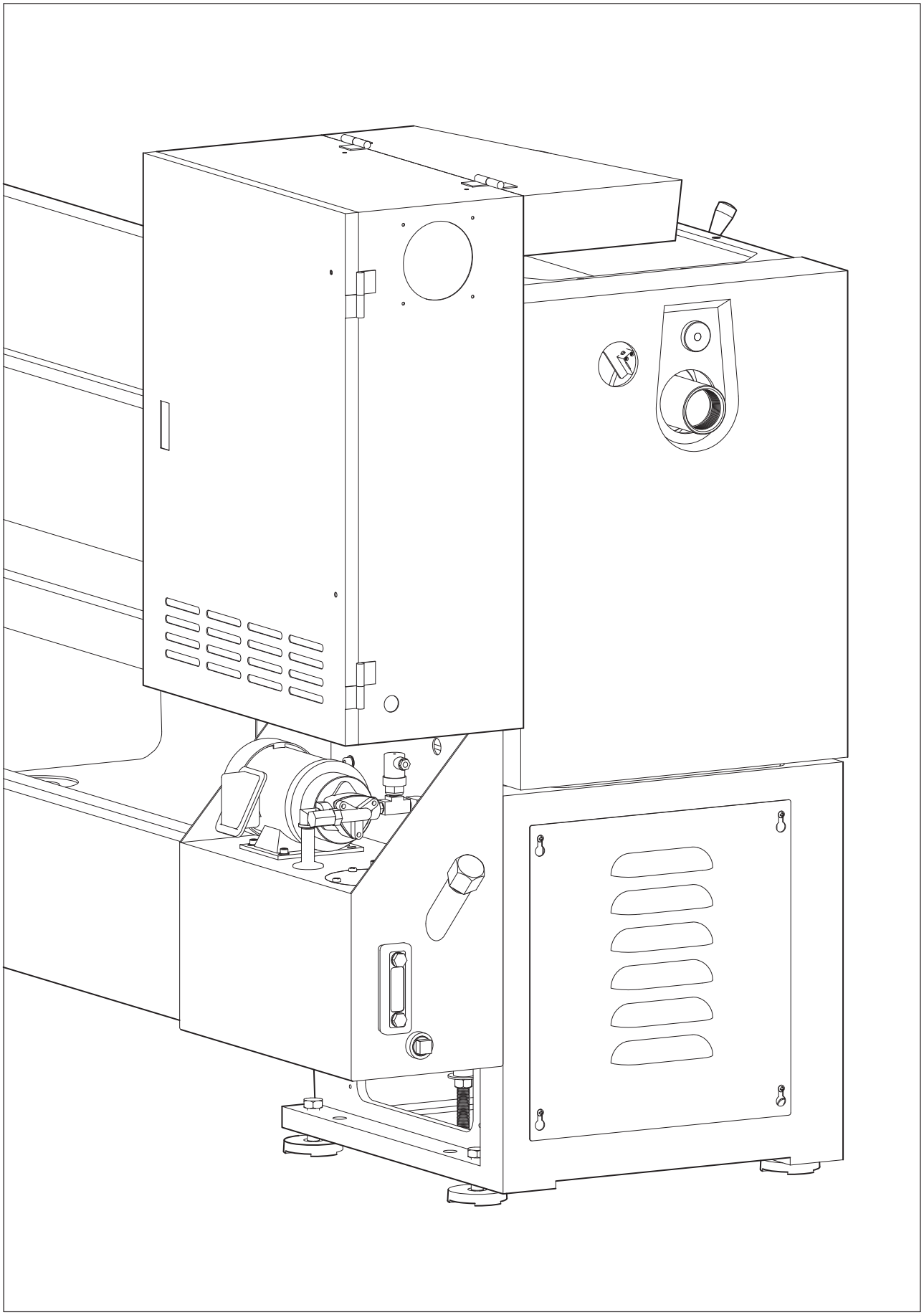
End Gear

METRIC RML-14					IMPERIAL RML-14				
KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK	KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK
1		Hexagon head bolt	1	CAP 6x20	1		Hexagon head bolt	1	CAP 6x20
2	60022	Washer	1		2	60022	Washer	1	
3	13-60001-M	Gear	1	28T	3	13-60007-I	Gear	1	24T
4	14-60017	Swing frane	1		4	14-60017	Swing frane	1	
5		Key	2	7x7x15	5		Key	2	7x7x15
6		Nut	2	M14	6		Nut	2	M14
7	60023	Washer	3		7	60023	Washer	3	
8		Clip	2	R47	8		Clip	2	R47
9	13-60002-M	Gear	1	54T/55T	9	13-60008-I	Gear	1	44T/56T
10		Ball bearing	2	6005	10		Ball bearing	2	6005
11	60020	Washer	1		11	60020	Washer	1	
12	60013	Shaft collar	1		12	60013	Shaft collar	1	
13	60015	Gear shaft	1		13	60015	Gear shaft	1	
14		Key	1	7x7x30	14		Key	1	7x7x30
15	60018	Stud	1		15	60018	Stud	1	
16		Hexagon head bolt	1	CAP 8x20	16		Hexagon head bolt	1	CAP 8x20
17	60021	Washer	1		17	60021	Washer	1	
18	13-60004-M	Gear	1	64T	18	13-60010-I	Gear	1	57T
19	13-6005-M	Gear	1	22T	19	60016	Collar	1	1

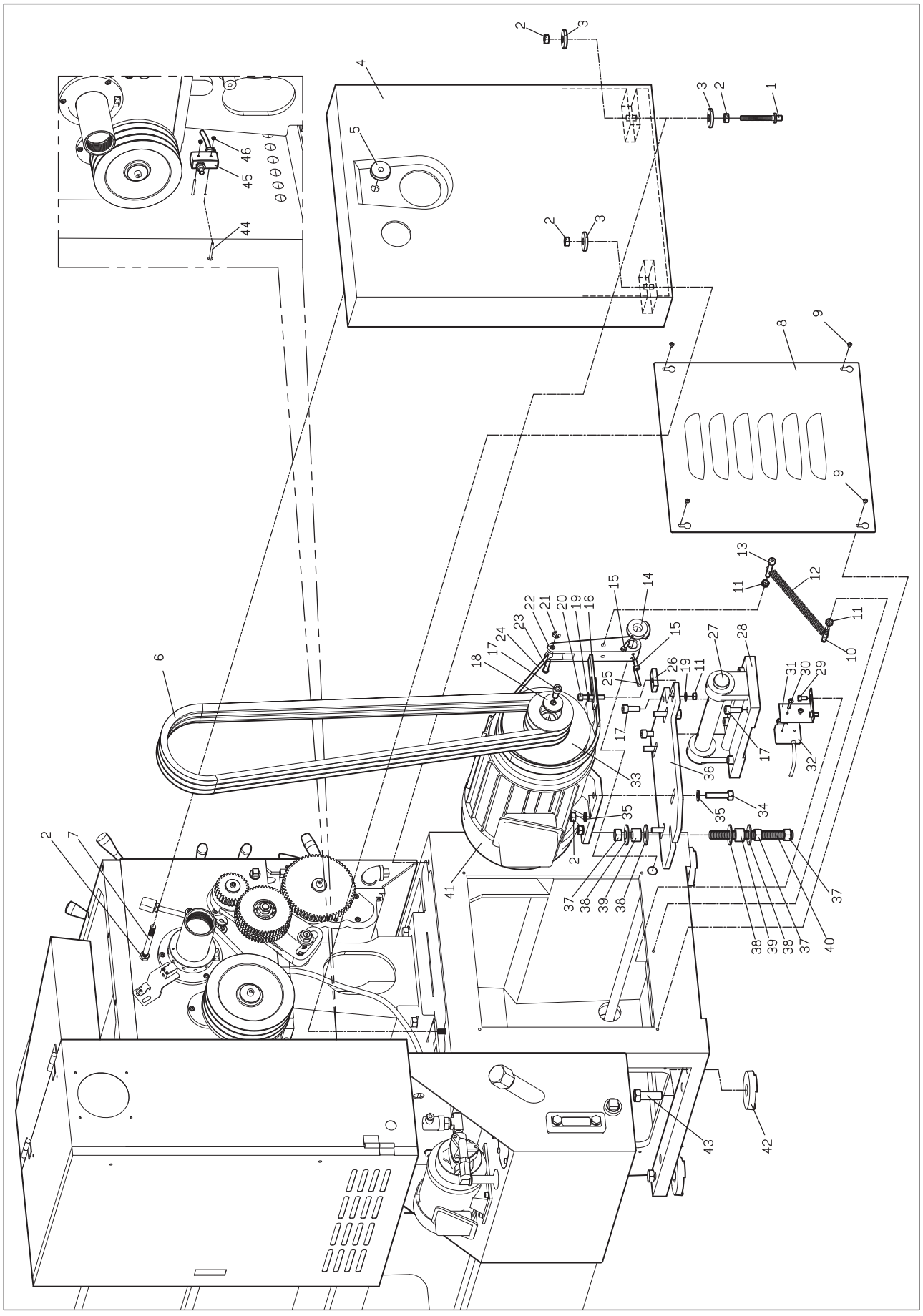
End Gear

METRIC RML-16					IMPERIAL RML-16				
KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK	KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK
1		Hexagon head bolt	1	CAP 6x20	1		Hexagon head bolt	1	CAP 6x20
2	60022	Washer	1		2	60022	Washer	1	
3	16-60001-M	Gear	1	28T	3	16-60007-I	Gear	1	24T
4	16-60017	Swing frane	1		4	16-60017	Swing frane	1	
5		Key	2	7x7x15	5		Key	2	7x7x15
6		Nut	2	M14	6		Nut	2	M14
7	60023	Washer	3		7	60023	Washer	3	
8		Clip	2	R47	8		Clip	2	R47
9	16-60002-M	Gear	1	54T/55T	9	16-60008-I	Gear	1	44T/56T
10		Ball bearing	2	6005	10		Ball bearing	2	6005
11	60020	Washer	1		11	60020	Washer	1	
12	60013	Shaft collar	1		12	60013	Shaft collar	1	
13	60015	Gear shaft	1		13	60015	Gear shaft	1	
14		Key	1	7x7x30	14		Key	1	7x7x30
15	60018	Stud	1		15	60018	Stud	1	
16		Hexagon head bolt	1	CAP 8x20	16		Hexagon head bolt	1	CAP 8x20
17	60021	Washer	1		17	60021	Washer	1	
18	16-60004-M	Gear	1	64T	18	16-60010-I	Gear	1	57T
19	16-6005-M	Gear	1	22T	19	60016	Collar	1	1

Main Motor



Main Motor

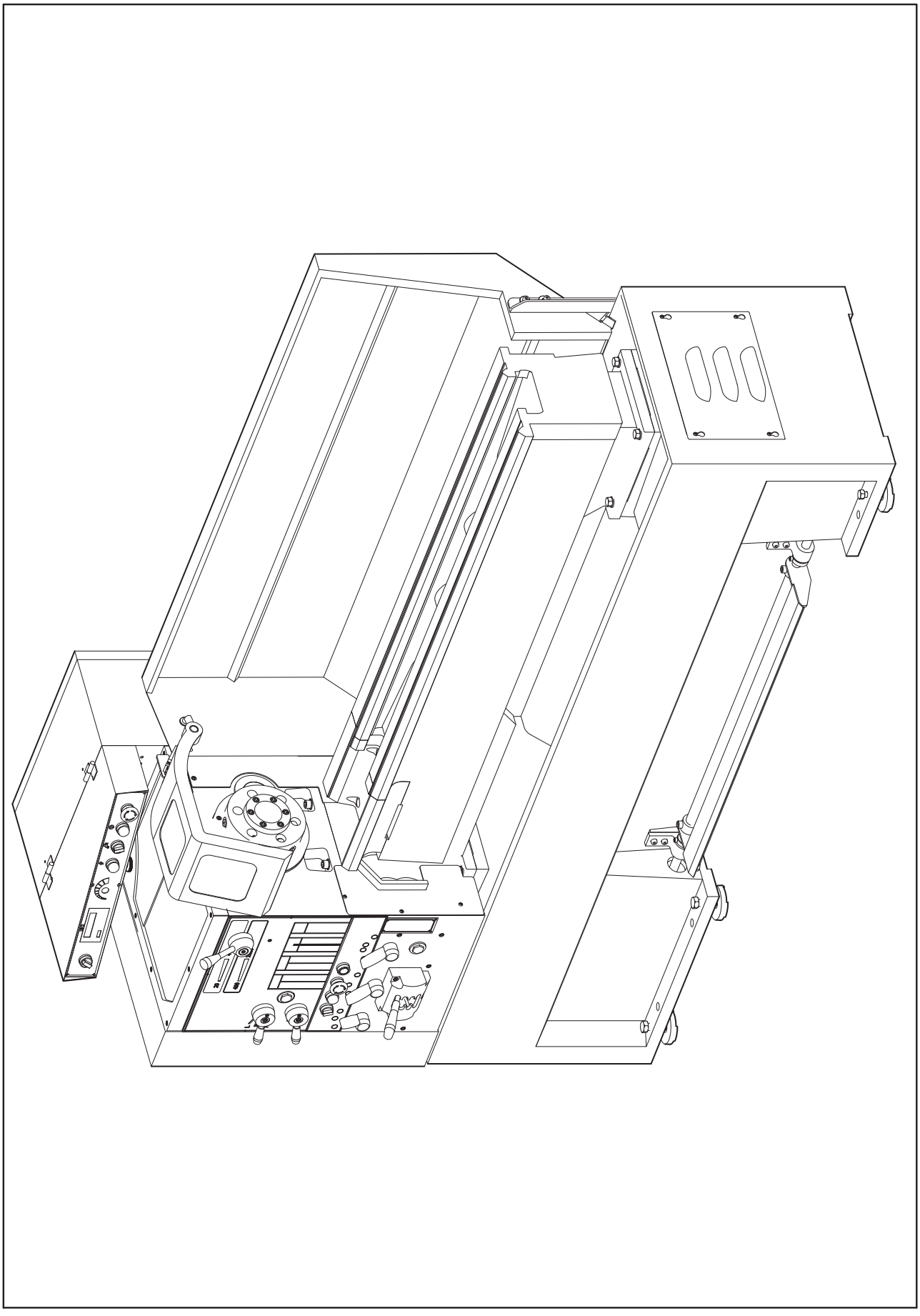


Main Motor

KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK	KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK
1	60058	Pin	2		45		Limit switch	1	Tm1307
2		Nut	9	M10xP1.5	46		Nut	2	M4xP0.7
3		Washer	4	M10					
4	14-61004 16-61004	Cover	1						
5	60056	Nut	1						
6		V belt	3	B69					
7	60055	Bolt	1						
8	61017	Cover	1						
9		Dome cross screw	4	M6x10L					
10	60053	Bolt	1						
11		Nut	3	M8xP1.25					
12	60046	Spring	1						
13		Hex. socket head bolt	1	CAP 8x55					
14	13-60033	Cam	1						
15		Hex. socket head bolt	2	CAP 6x16					
16	60061	Fixed plate	1						
17		Hex. socket head bolt	7	CAP 10x25					
18	60044	Washer	1						
19		Washer	2	M8					
20		Hex. socket head bolt	1	M8x45L					
21		Clip	1	E8					
22	60047	Lever	1						
23	60028	Pin	1						
24	60019	Brake belt	1						
25		Taper pin	1	#4x1 3/4"L					
26	61045RM5	Platform	1						
27	60043	Shaft	1						
28	17-60061	Support	1						
29		Hex. socket head bolt	2	CAP 6x12					
30		Dome cross screw	2	M4x30L					
31	63028	Bracket	1						
32		Limit switch	1	Tm-1704					
33	10043A56	Motor pully	1						
34		Hex. socket head bolt	4	M10x45L					
35		Washer	8	M10					
36	61045RM5	Plate	1						
37		Nut	3	M16xP2.0					
38		Washer	4	Ø16.5xØ40					
39	60048	Rubber ring	2						
40	60031	Screw	1						
41		Motor	1	5hp					
42	63043	Block	6						
43		Hexagon head bolt	6	CAP 16x50					
44		Dome cross screw	2	M4x40L					

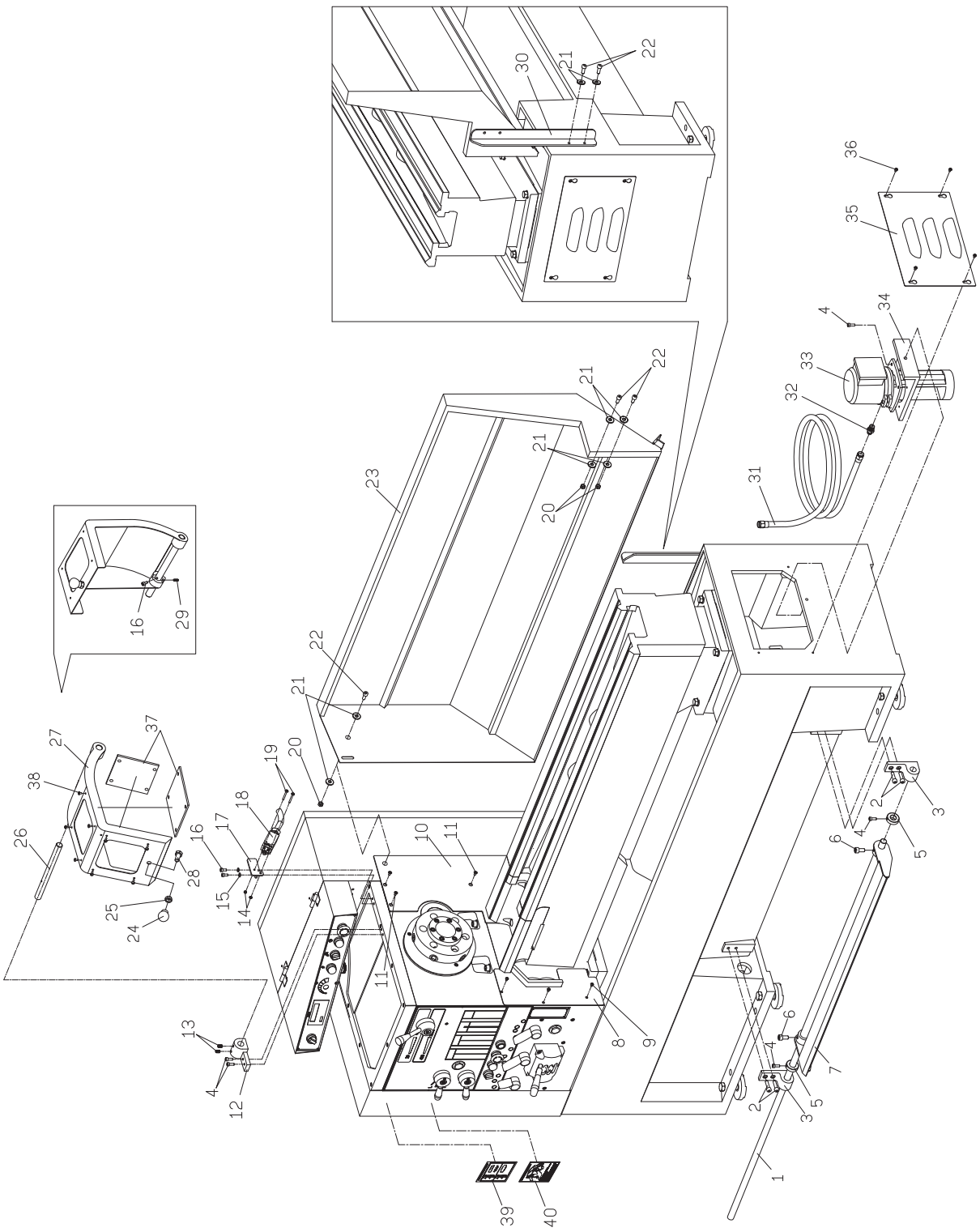
Cabinet & Panel

THE CHIP TRAY IN THE MIDDLE



Cabinet & Panel

THE CHIP TRAY IN THE MIDDLE



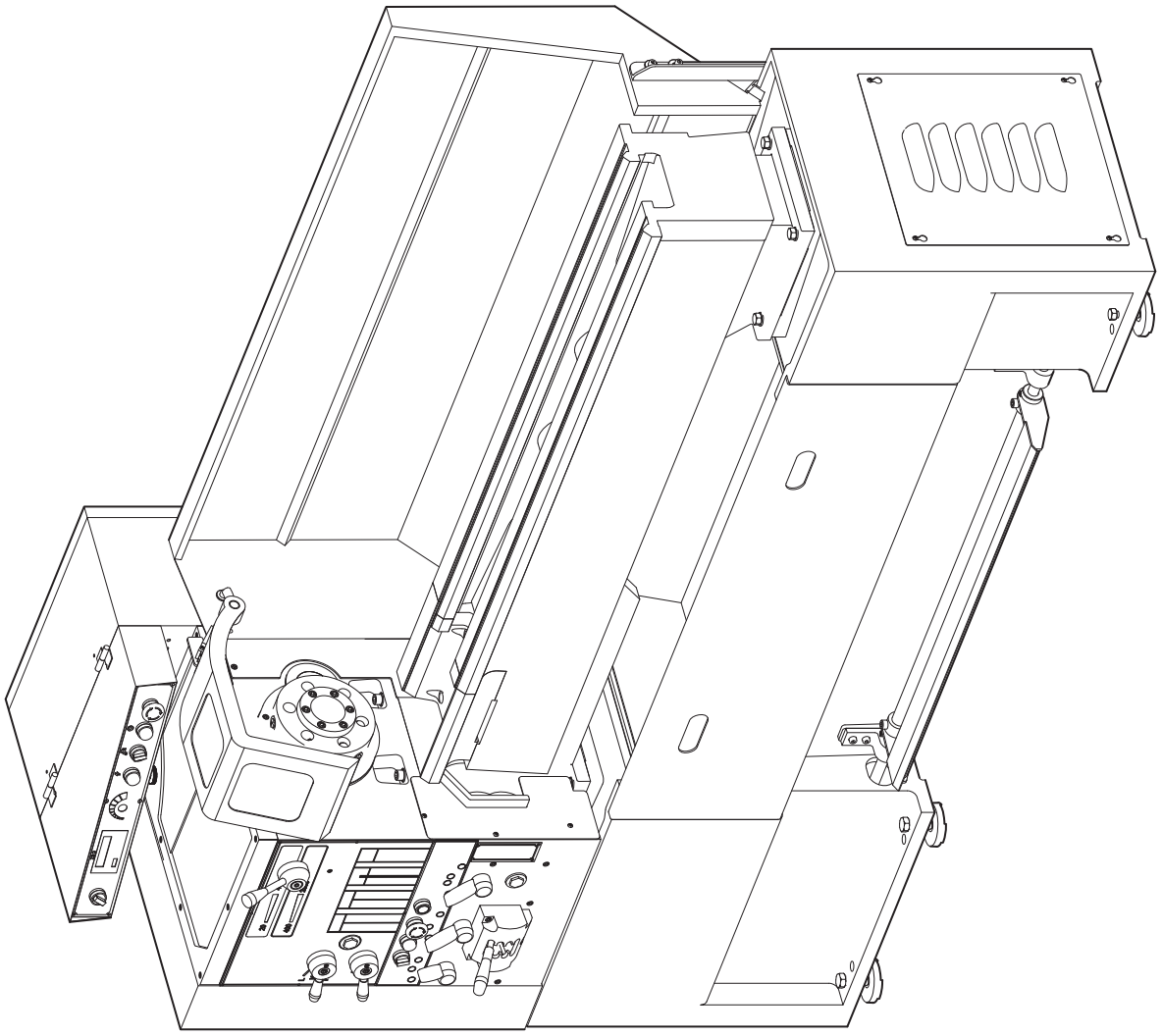
Cabinet & Panel

THE CHIP TRAY IN THE MIDDLE

KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK	KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK
1	60032A	Shsft	1		42		Work lamp	1	136
2		Hex. socket head bolt	4	CAP 8x25	43		Dome hexagon screw	4	M6x12
3	60029	Pedal bracket	2		44		Nut	4	M6
4		Hex. socket head bolt	12	CAP 6x16					
5	13-60039	Collar	2						
6		Hex. socket head bolt	2	CAP10x20					
7	61043-40	Saddle	1						
	61043-60								
8	61016	Guard	1						
9		Dome cross screw	7	M5x8					
10	61228	Plate	1						
11		Flat hexagon screw	2	M5x8					
12	10058	Small bracket	1						
13		Set screw	2	SET 8x12					
14		Nut	2	M4xP0.7					
15		Spring washer	2	M6					
16		Hex. socket head bolt	3	CAP 6x12					
17	15-61056	Bracket	1						
18		Limit switch	1	Tz9212					
19		Dome cross screw	2	M4x40					
20									
21		Washer	11	M8					
22		Hex. Socket head bolt	11	CAP 8x20					
23	61210-LA4	Splash guard	1						
	61210-LA6								
24		Knob	1						
25		Nut	1	M12					
26	13-10102	Piovt	1						
27	15-65053-B	Chuck safety guard	1						
28		Hex. socket head bolt	1	CAP 12x20					
29		Set screw	1	M5x16					
30	NL-61229	Bracket	1						
31		Coolant conduit - 40	1	CT801x3/8"x74"					
		Coolant conduit - 60		CT801x3/8"x80"					
32		Nipple	1	3/8"PTx3/8"PH					
33		Coolant pump	1	MC6180					
34	63061	Pump base	1						
35	61019	Cover	1						
36		Dome cross screw	4	M6x10					
37		Plate	2						
38		Dome Hex. Screw	8	M6x12					
39	13-61037	Nameplate	1						
40	13-61024	Nameplate	1						
41		Washer	4	M6					

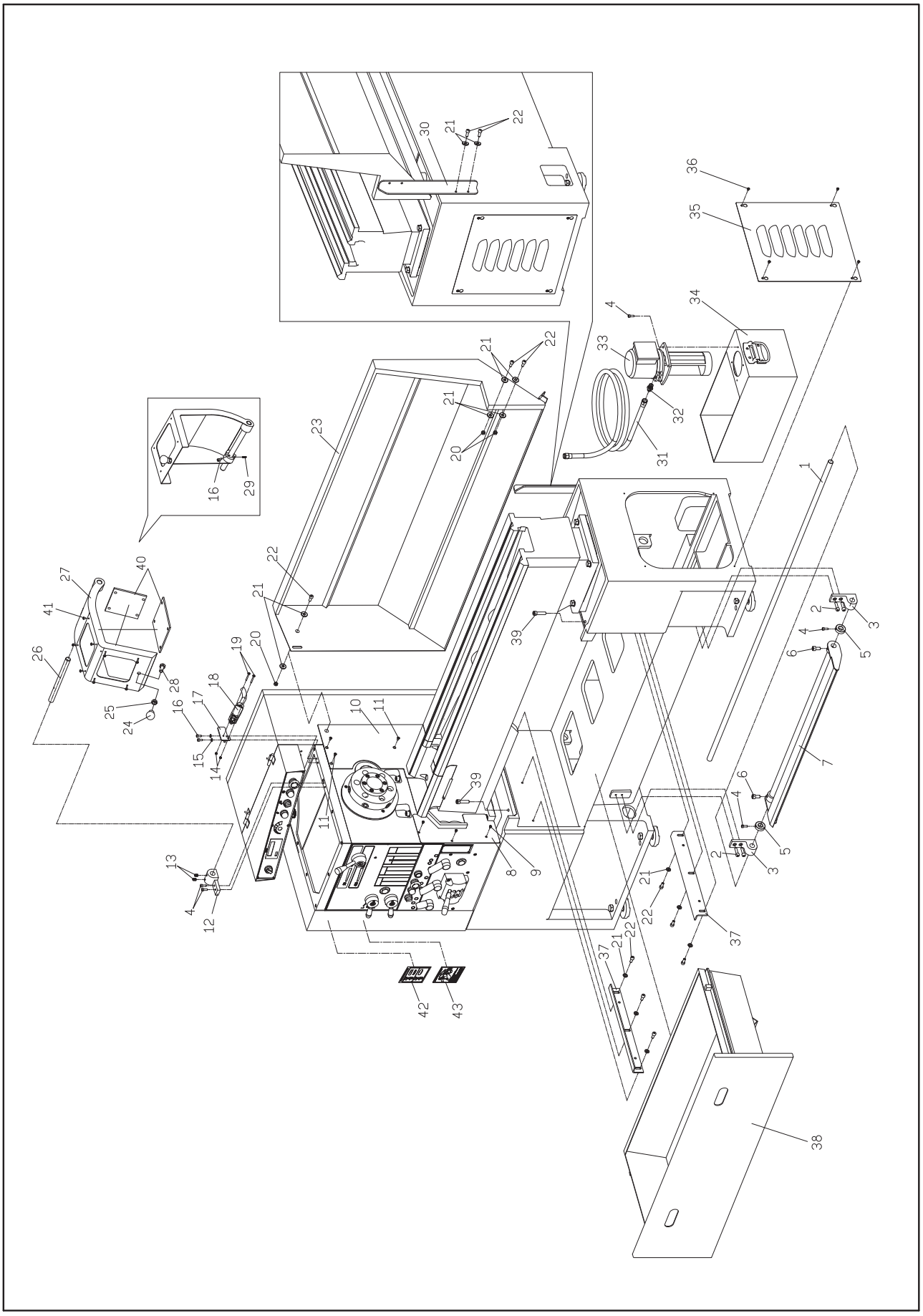
Cabinet & Panel

FRONT MOVEABLE CHIP TRAY OPTIONAL



Cabinet & Panel

FRONT MOVEABLE CHIP TRAY OPTIONAL

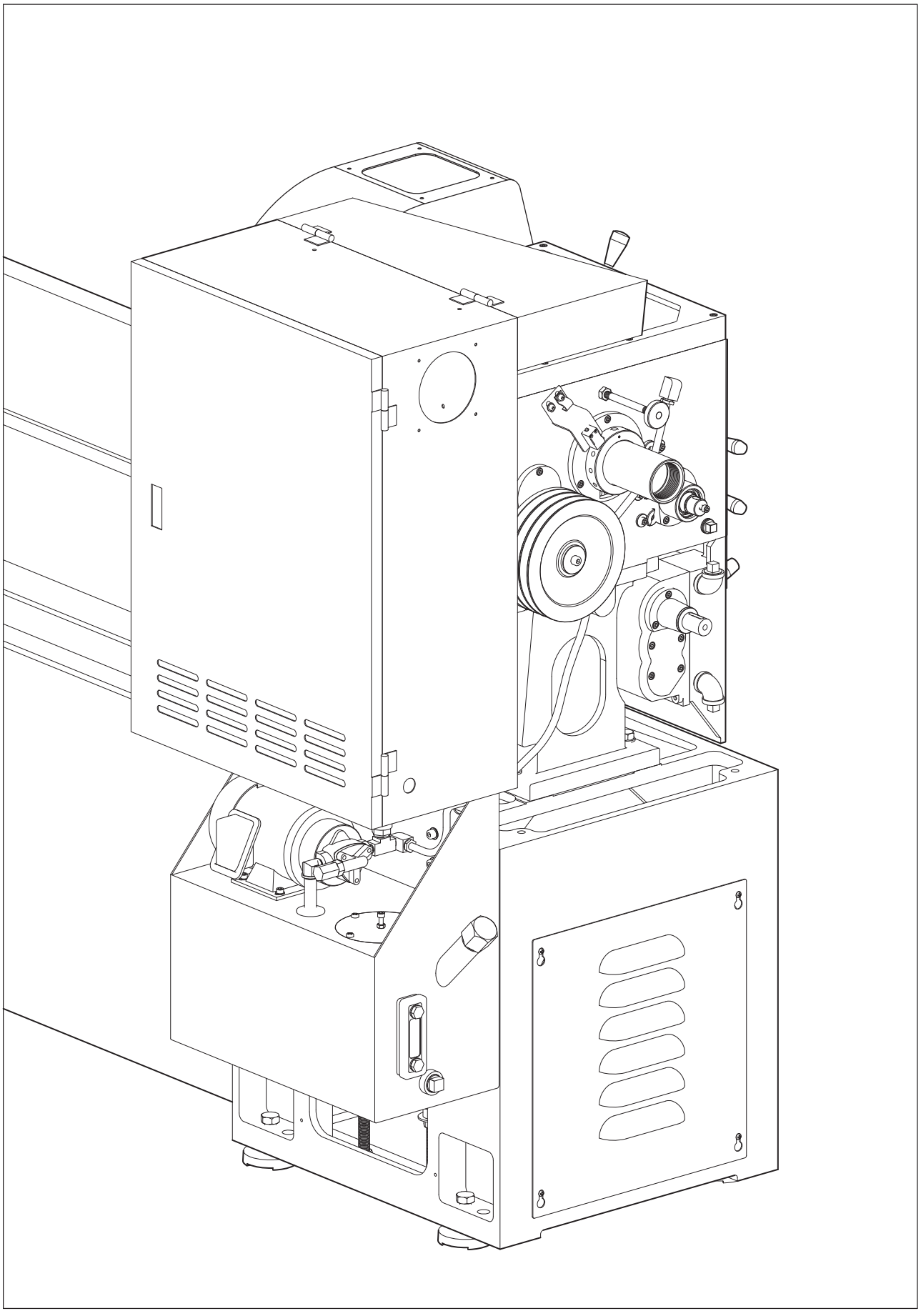


Cabinet & Panel

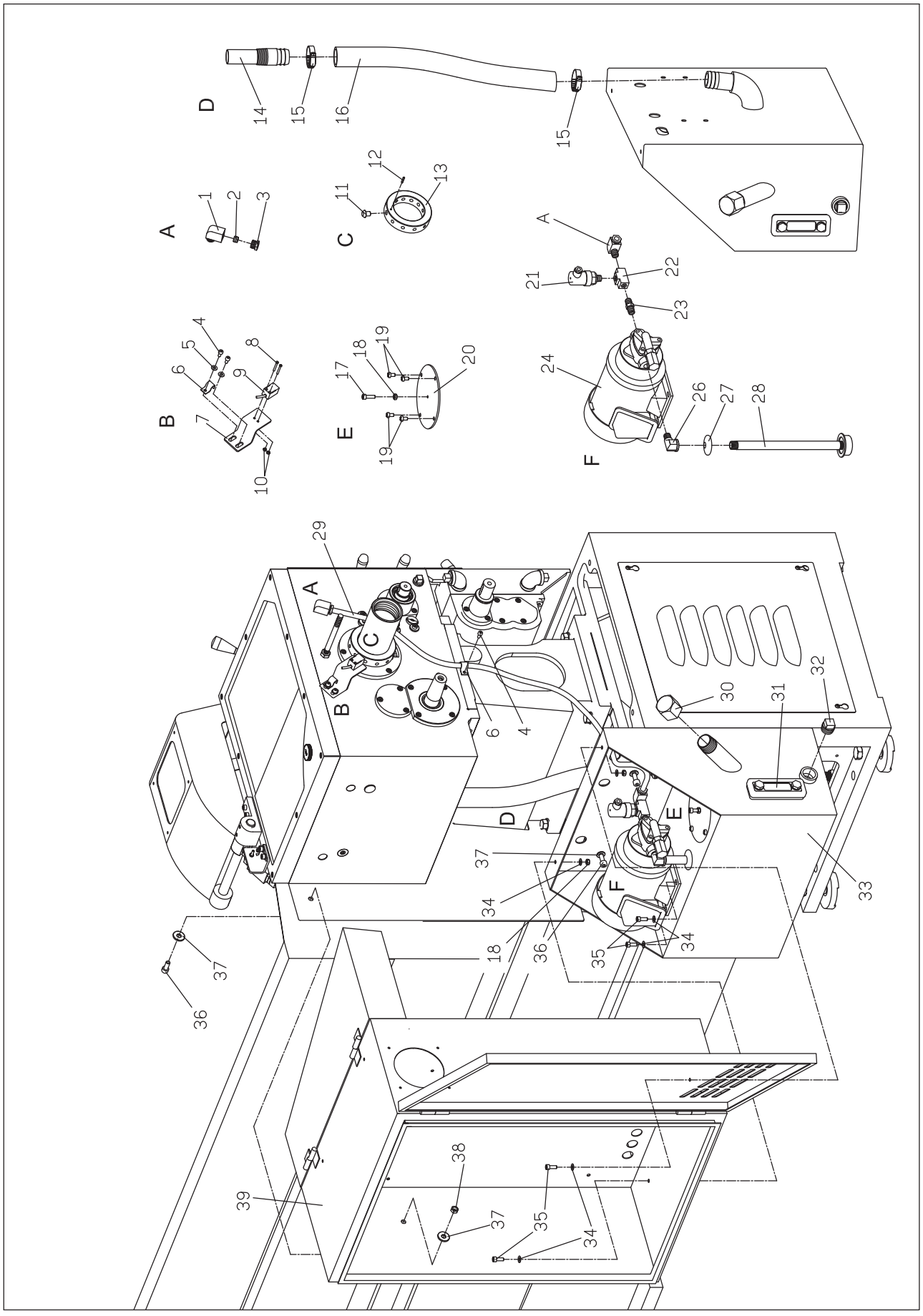
FRONT MOVEABLE CHIP TRAY OPTIONAL

KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK	KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK
1	60032A	Shsft	1		42	13-61037	Nameplate	1	
2		Hex. socket head bolt	4	CAP 8x25	43	13-61024	Nameplate	1	
3	60029	Pedal bracket	2		44		Washer	4	M6
4		Hex. socket head bolt	12	CAP 6x16	45		Work lamp	1	136
5	13-60039	Collar	2		46		Dome hexagon screw	4	M6x12
6		Hex. socket head bolt	2	CAP 10x20	47		Nut	4	M6
7	61043-40	Saddle	1						
	61043-60								
8	61016	Guard	1						
9		Dome cross screw	3	M5x8					
10	61228	Plate	1						
11		Flat hexagon screw	2	M5x8					
12	10058	Small bracket	1						
13		Set screw	2	SET 8x12					
14		Nut	2	M4xP0.7					
15		Spring washer	2	M6					
16		Hex. socket head bolt	3	CAP 6x12					
17	15-61056	Bracket	1						
18		Limit	1	Tz9212					
19		Dome cross screw	2	M4x40					
20									
21		Washer	11	M8					
22		Hex. Socket head bolt	11	CAP 8x20					
23	61210-LA4	Splash guard	1						
	61210-LA6								
24		Knob	1						
25		Nut	1	M12xP1.75					
26	13-10102	Piovt	1						
27	15-65053-B	Chuck safety guard	1						
28		Hex. socket head bolt	1	M12x20					
29		Set screw	1	M5x16					
30	NL-61229	Bracket	1						
31		Coolant conduit - 40	1	CT801x3/8"x74"					
		Coolant conduit - 60		CT801x3/8"x80"					
32		Nipple	1	3/8"PTx3/8"PH					
33		Coolant pump	1	MC6180					
34	61010-15	Coolant tank	1						
35	61017	Cover	1						
36		Dome cross screw	4	M6x10					
37	61009PB6	Angle steel	2						
38	61009B4	Chip tray	1						
39		Hex. socket head bolt	2	M10x45					
40		Plate	2						
41		Dome Hex. Screw	8	M6x12					

Cabinet & Panel - Oil delivered



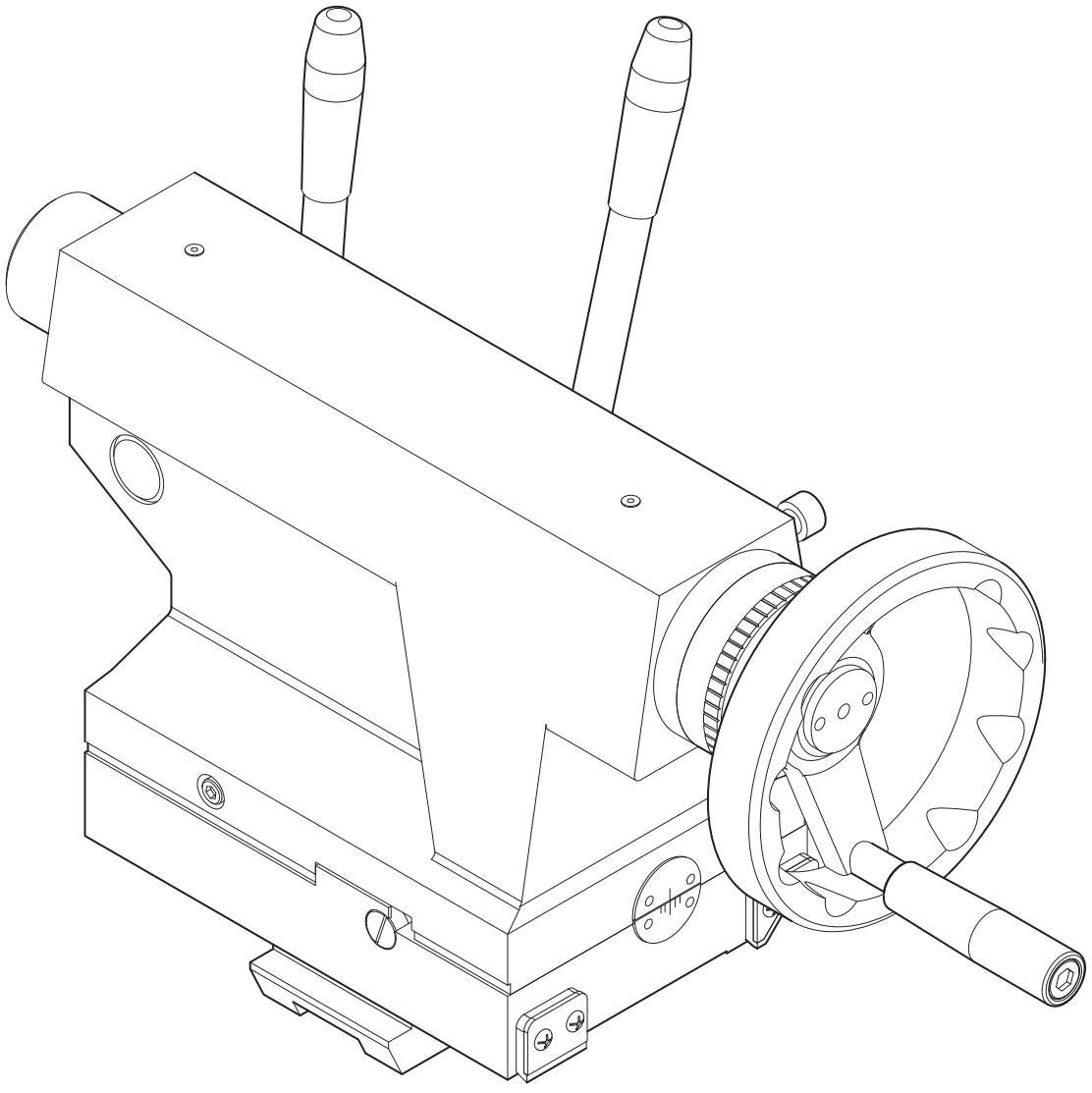
Cabinet & Panel - Oil delivered



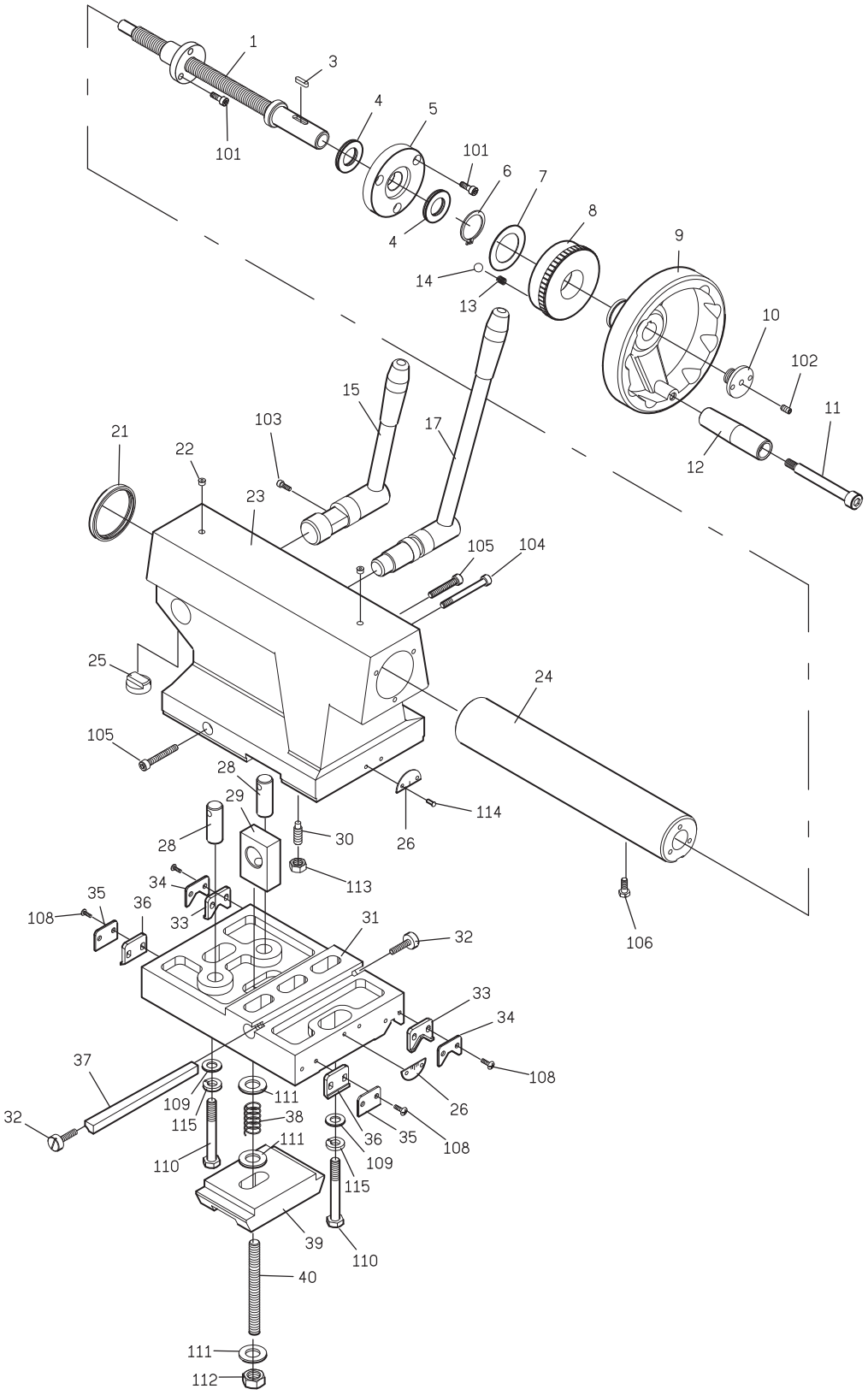
Cabinet & Panel - Oil delivered

KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK	KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK
1		Quarter joint	2	3/8xM16					
2		Thimble	2	PB10					
3		Thimble nut	2	PA10					
4		Hex. socket head bolt	3	CAP 5x10					
5		Washer	2	M5					
6		Pipe clip	2	Ø10					
7	61059	Bracket E	1						
8		Dome cross screw	2	M3x25L					
9		Encoder	1	FQP2-1604N-3U2					
10		Hexagon nut	2	M3					
11	18-10077-V	Minor tip	1						
12		Spring pin	1	Ø3x15L					
13	10021-V	Balance ring	1						
14	12001	Hexagon bushing	1						
15		Hose clamp	2	1 1/2					
16		Net hose	1	1 1/4x430L					
17		Hex. socket head bolt	1	CAP 6x20					
18		Hexagon nut	3	M6					
19		Hex. socket head bolt	4	CAP 6x10					
20	61018P01	Round cover	1						
21		Pressure switch	1						
22		T-joint	1	PT1/4"					
23		Hexagon bushing	1	PT1/4"xPT1/4"					
24		Lubrication pump	1	AM5					
		Direct drive motor	1	1/4HP					
26		Quarter joint	1	PT1/4"xPT1/4"					
27		Rubber ring	1						
28		Nipple	1	PT3/8"X245L					
29		Nylon tube	1	Ø10x100L					
30		Plug nut	1	PT1"					
31		Oil sight	1						
32		Square heard plug	1	PT3/4"					
33	61018V14	Oil tant	1						
34		Washer	8	M6					
35		Hex. socket head bolt	6	CAP 6x16					
36		Hex. socket head bolt	5	CAP 8x20					
37		Washer	6	M8					
38		Hexagon nut	1	M8					
39	61024-V	Electrical box	1						

Tailstock



Tailstock

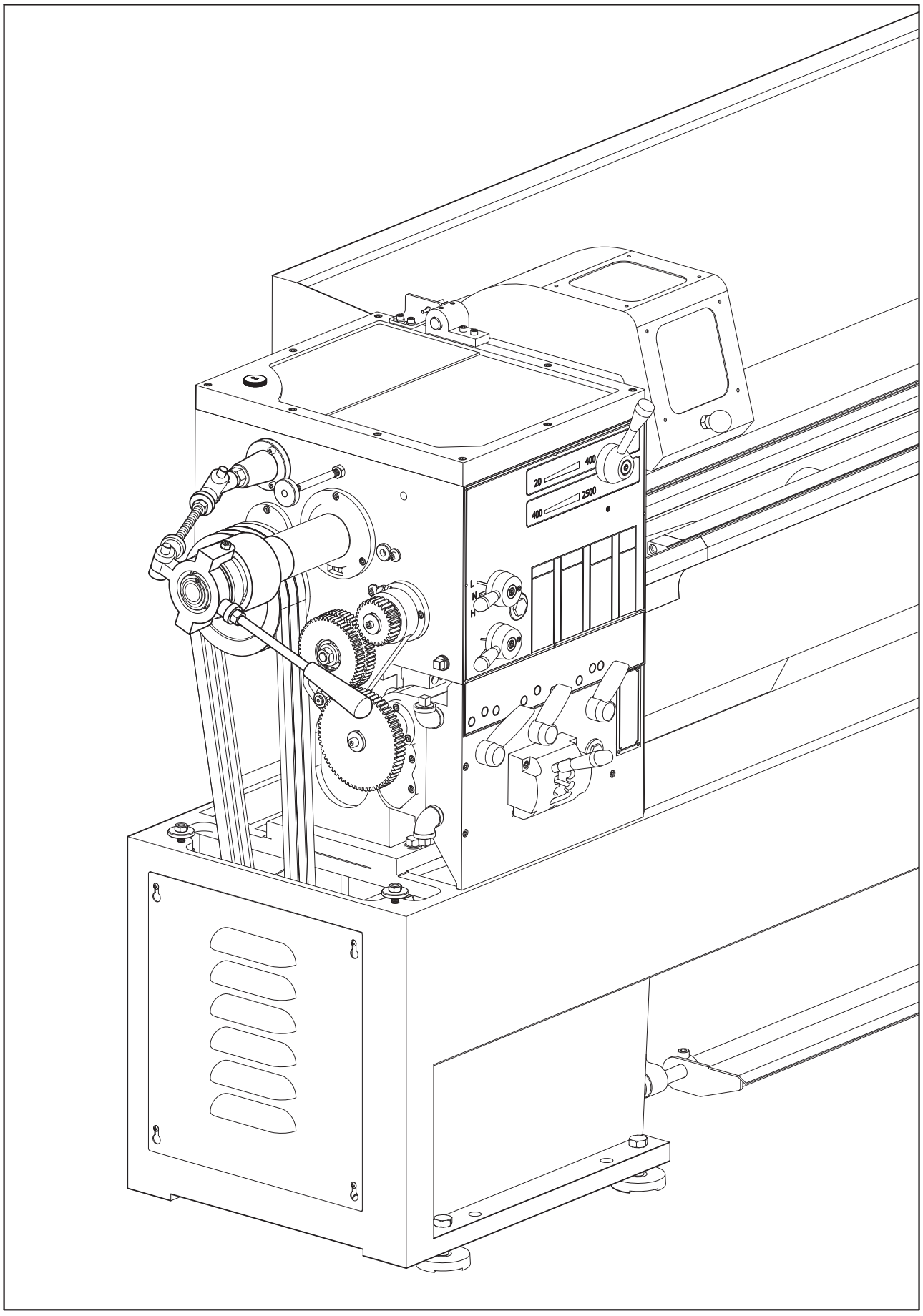

1
3
4
5
101
101
6
7
8
9
4
14
13
10
102
11
12
15
103
17
21
22
23
105
104
25
24
105
28
29
114
26
28
30
113
34
35
108
36
33
31
32
106
33
34
108
37
26
32
109
115
111
38
36
35
108
111
110
109
115
39
110
40
111
112

Tailstock

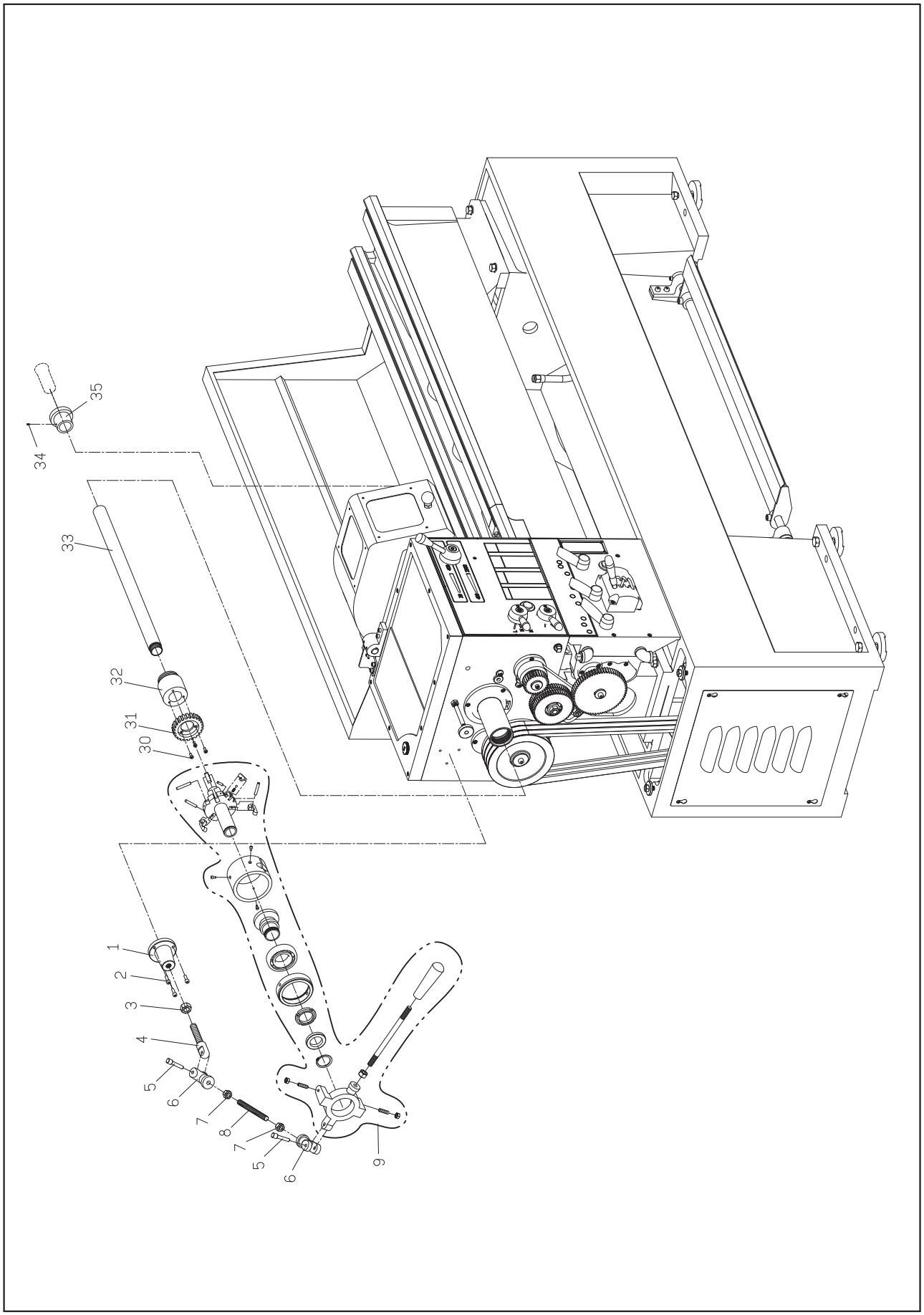
TAILSTOCK ASSMEBLY

KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK
1	70004-M	Lead screw	1	
	70005-M	Nut	1	
	70004-I	Lead screw	1	
	70005-I	Nut	1	
3		Key	1	5x5x20L
4		Thrust bearing	2	MTB/AS2-2035
5	70007-M	Flange	1	
	70007-I			
6		Snap ring	1	S32
7	70006	Washer	1	
8	70008-M	Index ring	1	100 dividing
	70008-I			125 dividing
9	70009	Handwheel	1	
10	70010	Fixed screw	1	
11	70011	Bolt	1	M8x90L
12	70012	Handle	1	
13	40016	Spring	3	Ø6.2x16
14		Steel ball	3	1/4"
15	70022	Clamp lever L	1	
	70013	Cam shaft L	1	
		Spring pin	1	Ø4x24
17	70021	Clamp lever R	1	
	70017	Cam shaft R	1	
		Spring pin	1	Ø4x24
21		Oil seal	1	DH53
22		Oil ball	2	1/4"
23	14-70001	Tail stock	1	
	16-70001			
24	70003	Quill	1	
25	70014	Guide key	1	
26	70032-U	Marked plate U	1	
	70032-D	Marked plate D	1	
28	70015	Pin nut	2	
29	70016	Pivot block	1	
30		Set screw	1	14-M8x25
				16-M8x50
31	70002	Base	1	
32	50054	Gib screw	2	
33	70024	Wiper V	2	
34	70025	Plate V	2	
35	18-70029	Plate F	2	
36	18-70027	Wiper F	2	
37	70018	Gib C	1	
38	ML-70102	Spring	1	Ø25x122L
39	70020	Clamp block	1	Ø25x45
40	14-60018	Stud	1	M14x110L
	16-60018			M14x135L
101		Hex. socket head bolt	6	CAP 6x16
102		Set screw	1	M6x25
103		Hex. socket head bolt	1	CAP 6x12
104		Hex. socket head bolt	1	CAP 8x70
105		Hex. socket head bolt	2	CAP 8x60
106		Hex. socket head bolt	1	CAP 6x8
108		Dome cross screw	8	M5x12
109	70095	Washer	4	
110		Hexagon head bolt	2	M10x55
111		Washer	4	M14
112		Hexagon nut	1	M14
113		Hexagon nut	1	M8
114		Rivet	4	Ø2
115		Spring washer	2	M10

5C Collet Closer Attachment



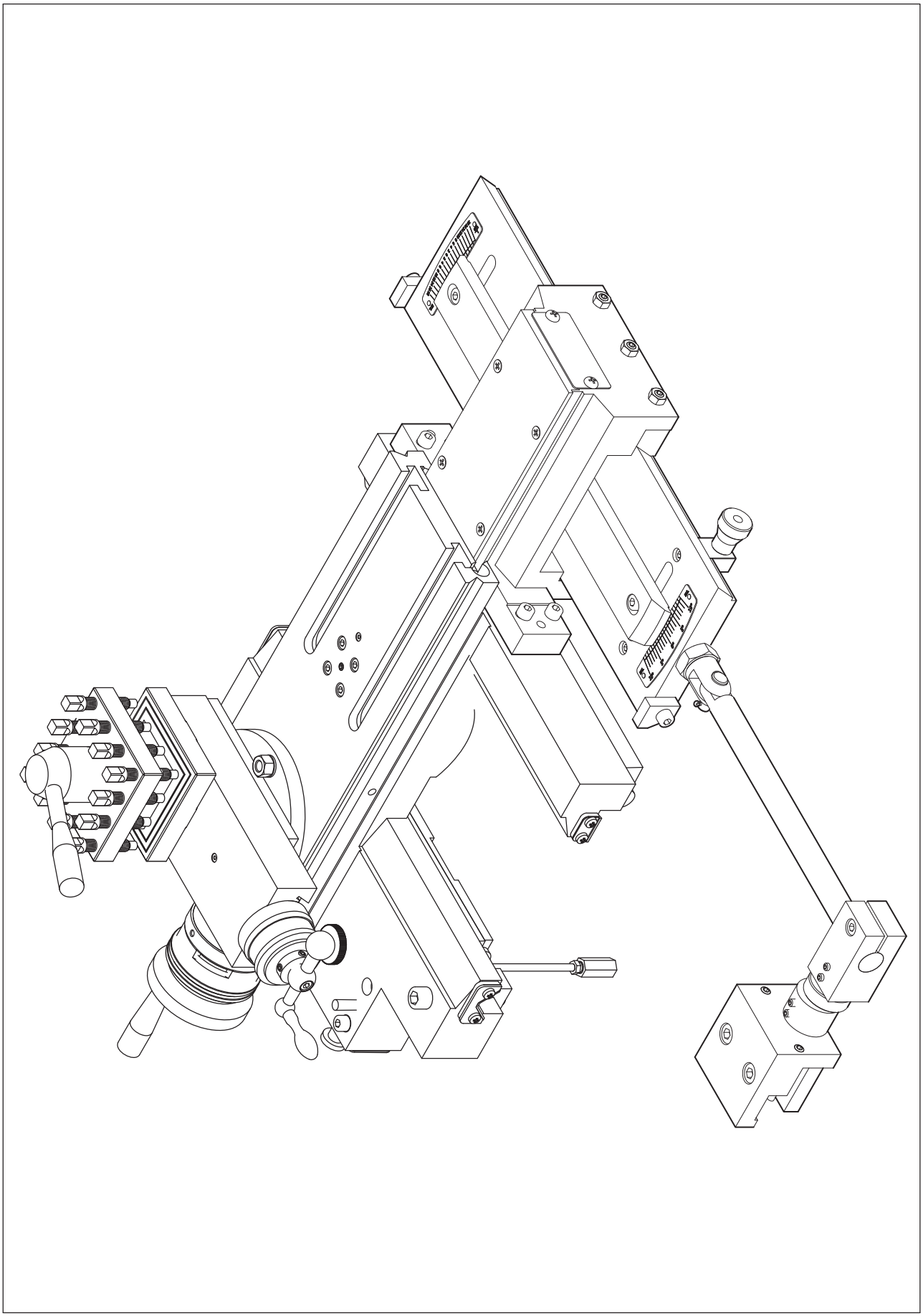
5C Collet Closer Attachment



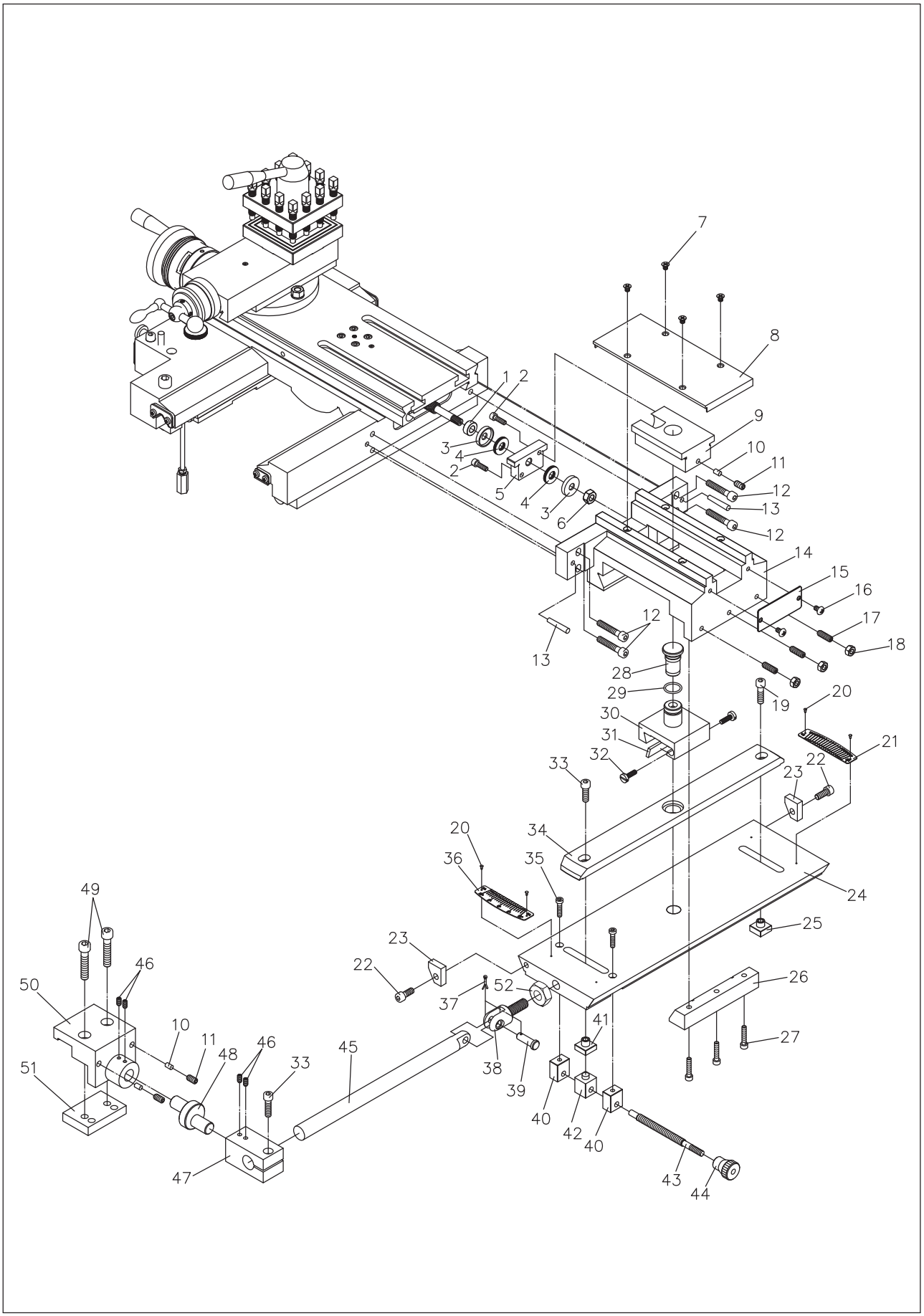
5C Collet Closer Attachment

KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK
1		Hex. socket head bolt	3	M6x25
2	90048	Bracket	1	
3		Nut	1	M16
4	90049	Bolt	1	
5	90055	Bolt	1	
6	90047	Connector Casting	1	
7		Nut	2	W1/2"
8	90050	Screw	1	W1/2x155mm
	90044	Handle Casting	1	
	00ST30M8	Set screw	2	SET 8x30
		Nut	2	M8
		Nut	1	1/2"-12UNC
	90045	Handle Rod	1	
	90046	Handle	1	
		Clip	1	S34
		Washer	1	Ø52.4xØ34.4x9
	90042	Nut	1	
	90038	Bearing and Retainer	1	
9		Ball bearing	1	6208
	90037	Cam	1	
		Hex. socket head bolt	3	CAP 4x8
	90043	Collar	1	
	90029	Tube	1	
	90031	Finger	3	
	90032	Pivot Pin	3	Ø6x40
	90035	Knob	1	
		Steel ball	1	Ø5
	90033	Spring	1	
		Pin	1	Ø5x18
30		Hex. socket head bolt	3	M5x12
31	90025	Index Ring	1	
32	90023	Hub	1	
33	90028	Tube	1	
34	90027	Pin	1	
35	90026	Bush	1	

Taper Attachment



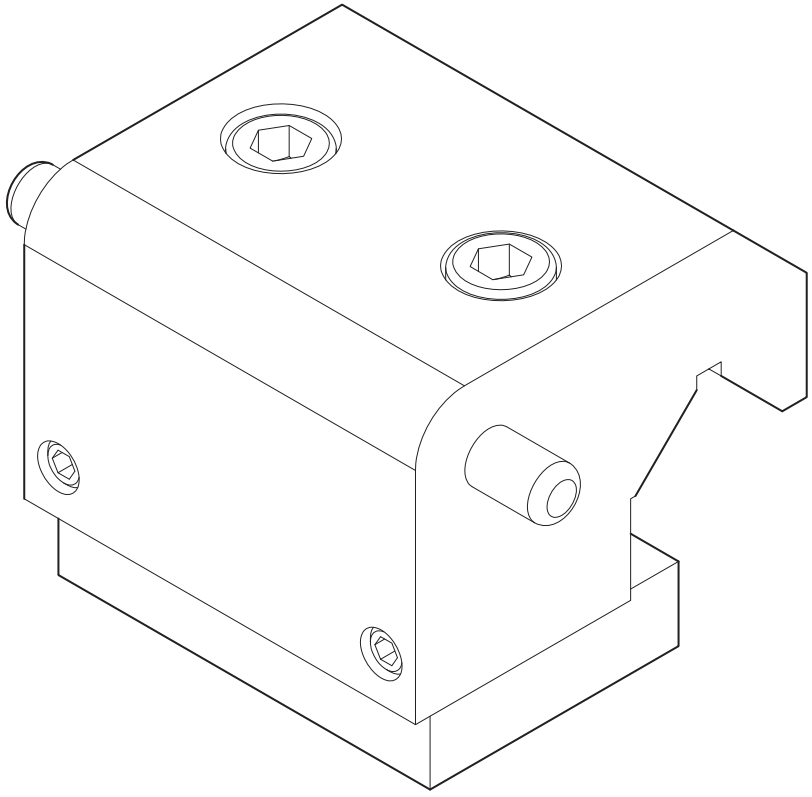
Taper Attachment



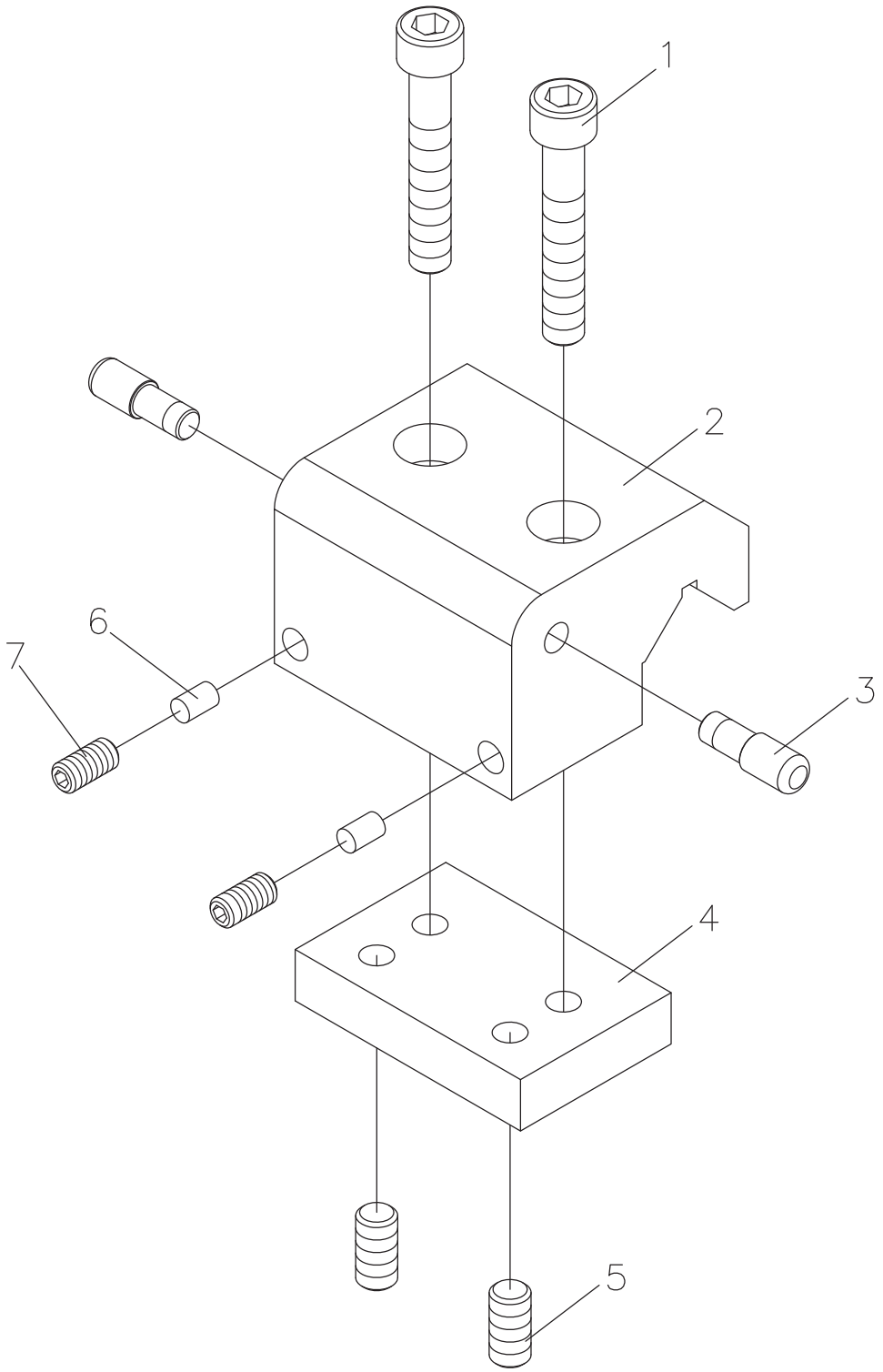
Taper Attachment

KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK	KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK
1	50017	Collar	1		46		Set screw	4	SET 6x12
2		Hex. socket head bolt	2	CAP 6x20	47	18-80021	Bracket	1	
3	50026	Cap collar	2		48	18-80020	Eccentric pin	1	
4		Thrust bearing	2	NTB/AS2 1226	49		Hex. socket head bolt	2	CAP 10x50
5	80005	Yoke Plate	1		50	80027	Bracket	1	
6		Nut	1	M10	51	18-80023	Hub	1	
7		Flat hexagon screw	4	M6x8	52		Nut	1	M14
8	80002	Cover plate	1						
9	80004	Yoke	1						
10	18-70083	Copper pin	3						
11		Set screw	3	SET 8x16					
12		Hex. socket head bolt	4	CAP 8x45					
13		Taper pin	2	#6x1 1/2"L					
14	15-80001	Main bracket	1						
15	18-80003	Plate	1						
16		Done cross screw	2	M6x10					
17		Set screw	3	SET 8x25					
18		Hexagon nut	3	M8					
19		Hex. socket head bolt	2	CAP 8x30					
20		Rivet	4	Ø2					
21	15-80025	Name plate	1						
22		Hex. socket head bolt	2	CAP 8x20					
23	18-80033	Stop	2						
24	15-80010	Plate	1						
25	18-80017	Nut	1						
26	15-80012	Gib	1						
27		Hex. socket head bolt	3	CAP 6x30					
28	18-80011	Slide pivot pin	1						
29		O ring	1	P21					
30	18-80006	Side block	1						
31	80008	Gib	1						
32	80007	Screw	1						
33		Hex. socket head bolt	2	CAP 8x25					
34	15-80009	Swive slide	1						
35		Hex. socket head bolt	2	CAP 6x25					
36	15-80024	Name plate	1						
37		Split pin	1	Ø2.5x16					
38	18-80031	Bolt	1						
39	18-80030	Pin	1						
40	18-80019	Block	2						
41	18-80016	Nut	1						
42	18-80018	Block	1						
43	18-80015	Screw	1						
44	18-80014	Knob	1						
45	18-80028	Bolt	1						

Bed Stop



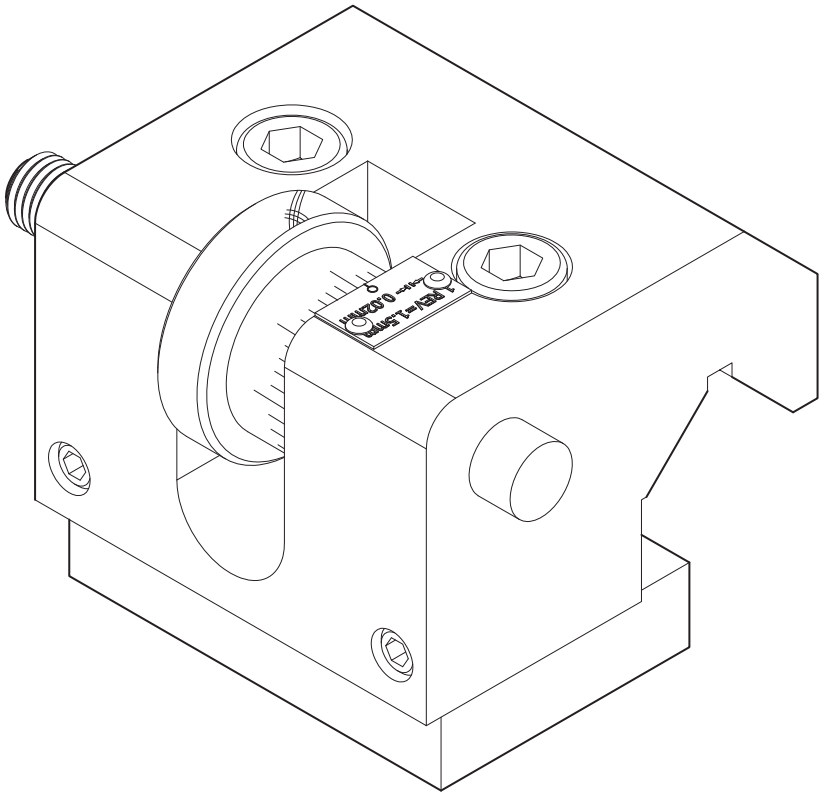
Bed Stop



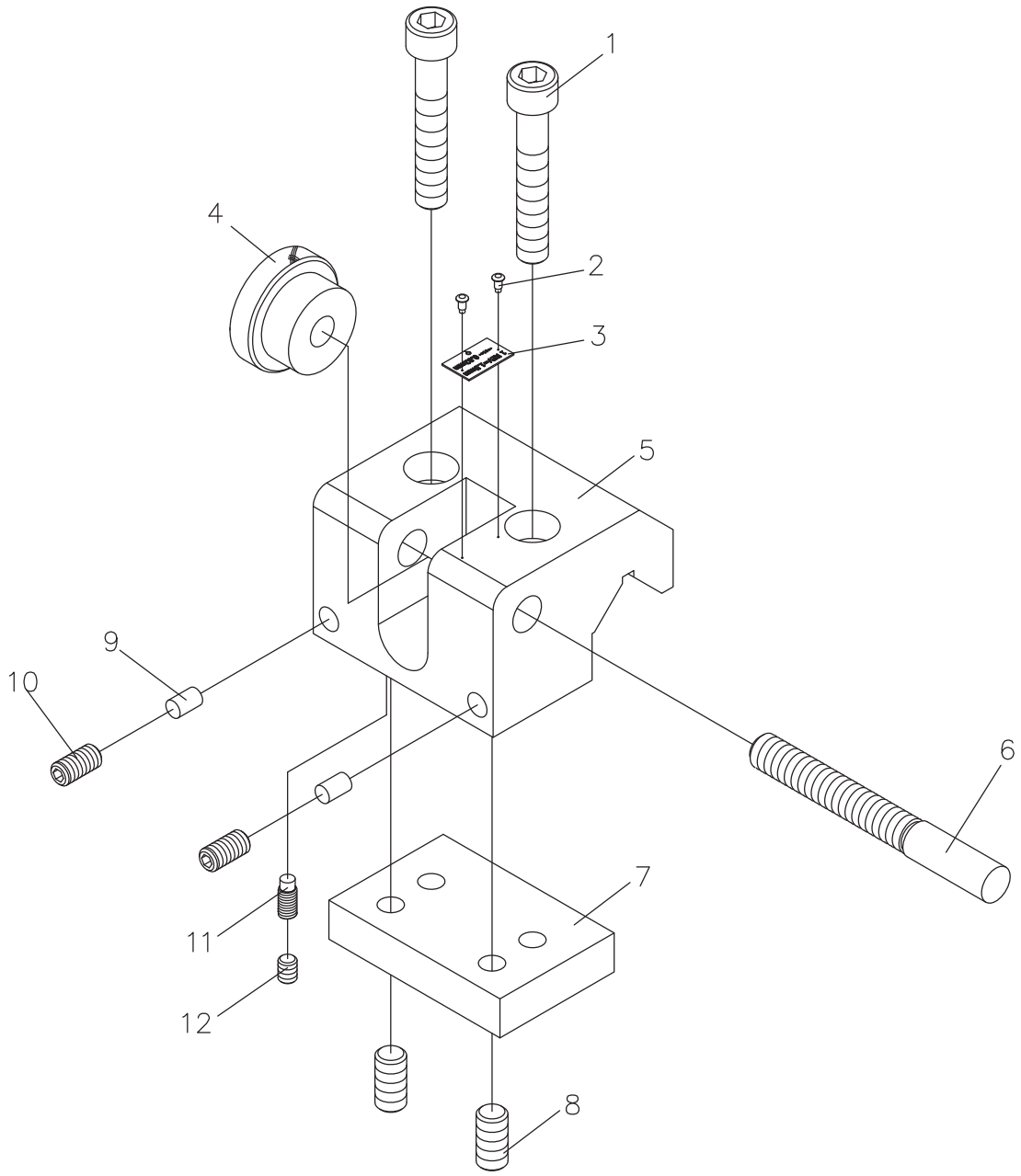
Bed Stop

KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK	KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK
1		Hex. socket head bolt	2	M10x60					
2	70085-13	Body	1						
3	18-70084	Pad	2						
4	18-70059	Clamp plate	1						
5		Set screw	2	M10x20					
6	18-70083	Copper pin	2						
7		Set SCREW	2	M8x16					

Bed Stop - Micrometer



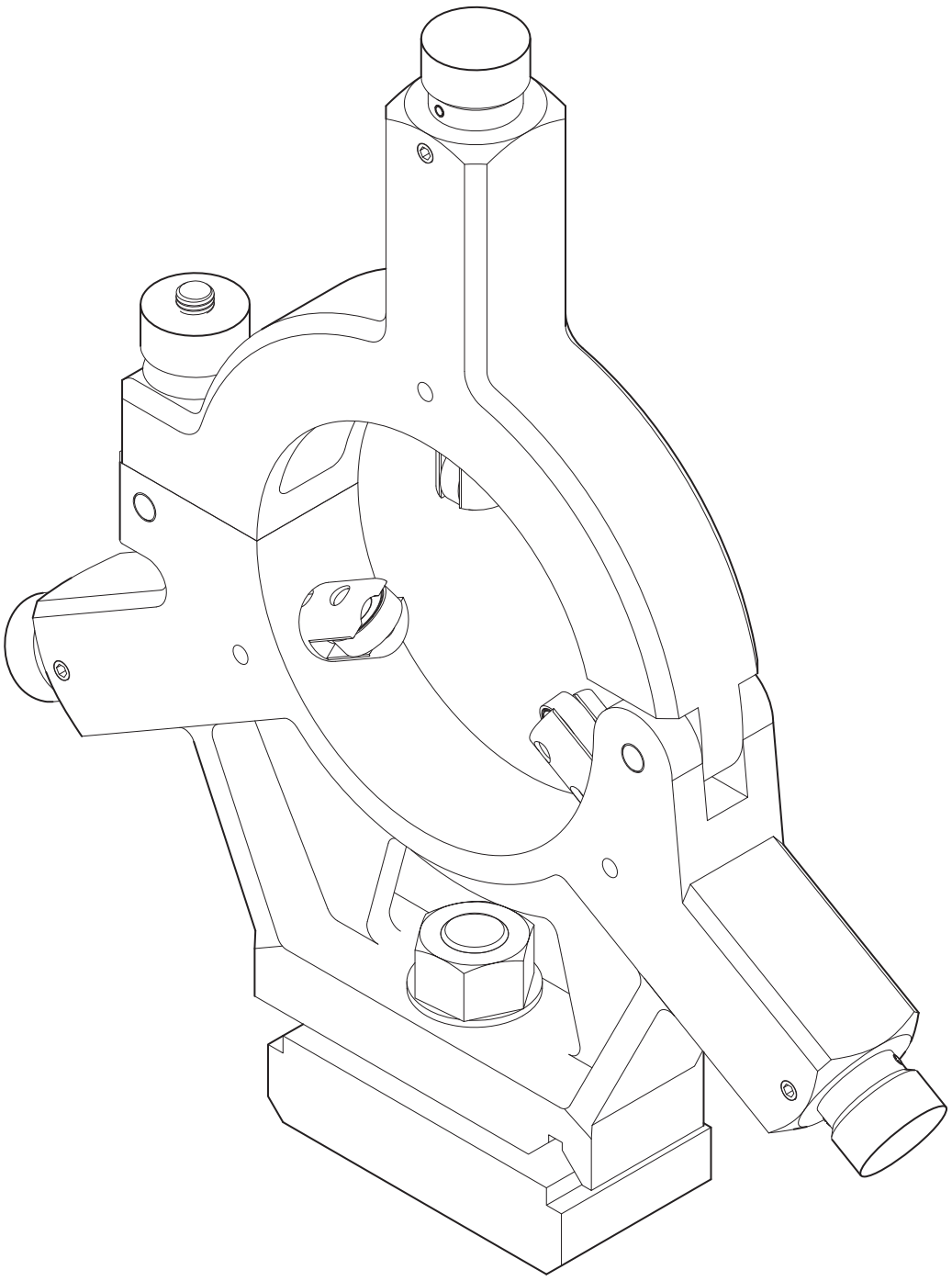
Bed Stop - Micrometer



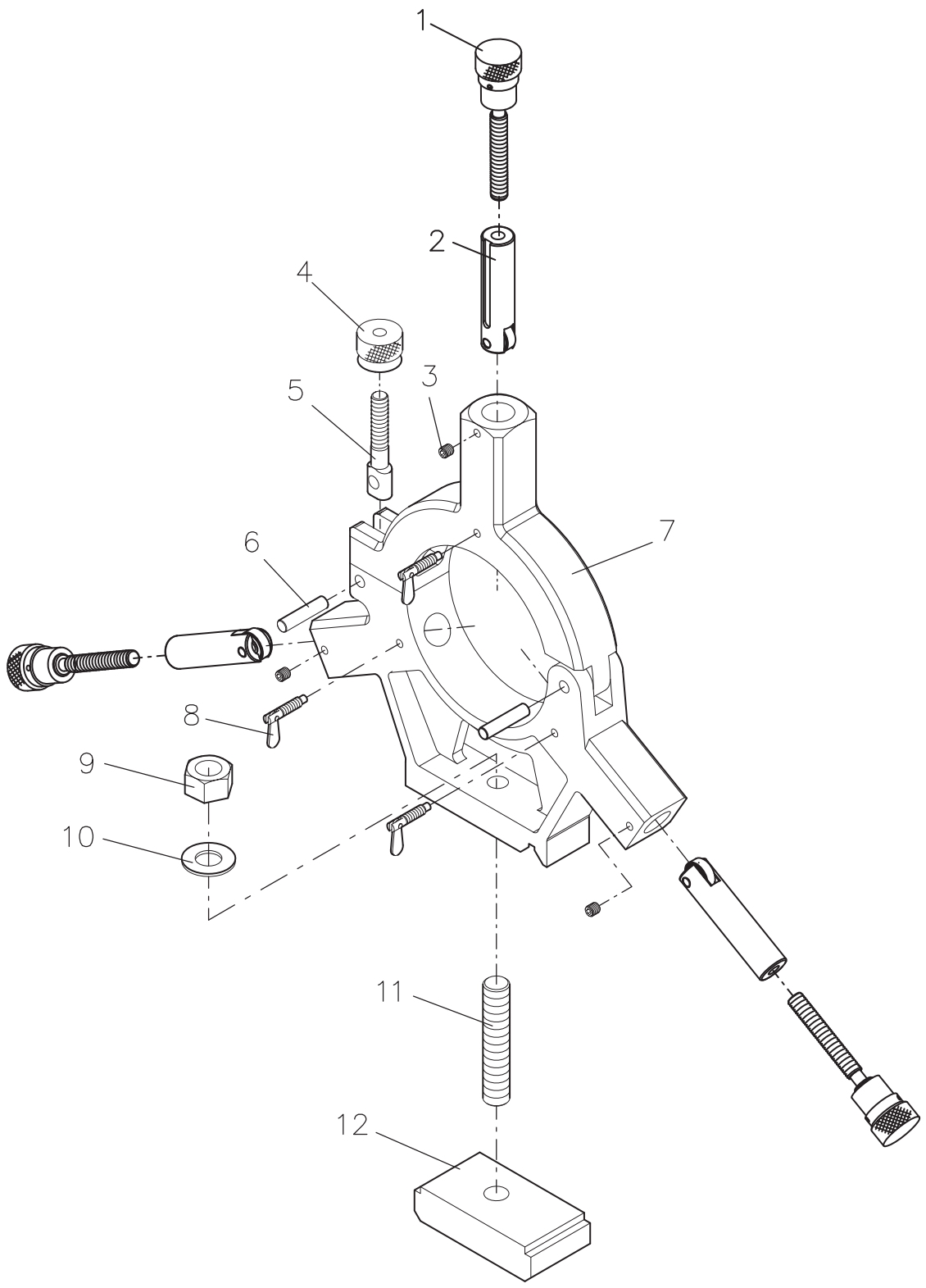
Bed Stop - Micrometer

KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK	KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK
1		Hex. socket head bolt	2	CAP 10x60					
2		Rivet	2	Ø2					
3	18-70060-M	Name plate	1						
	18-70060-I								
4	18-70057-M	Micro dial	1						
	18-70057-I								
5	70048-13	Body	1						
6	18-70056-M	Rod	1						
	18-70056-I								
7	18-70059	Clamp plate	1						
8		Set screw	2	SET 10x20					
9	18-70083	Copper pin	2						
10		Set screw	2	SET 8x16					
11		Set screw	1	M8x12					
12		Set screw	1	SET 8x12					

Steady Rest



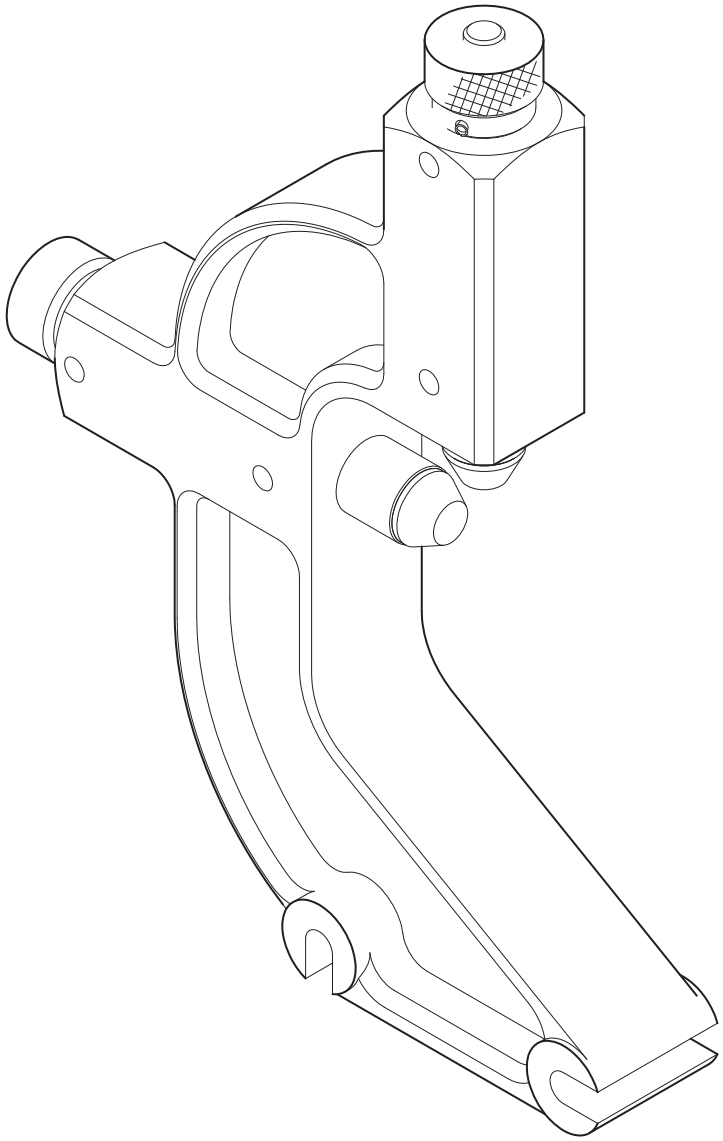
Steady Rest



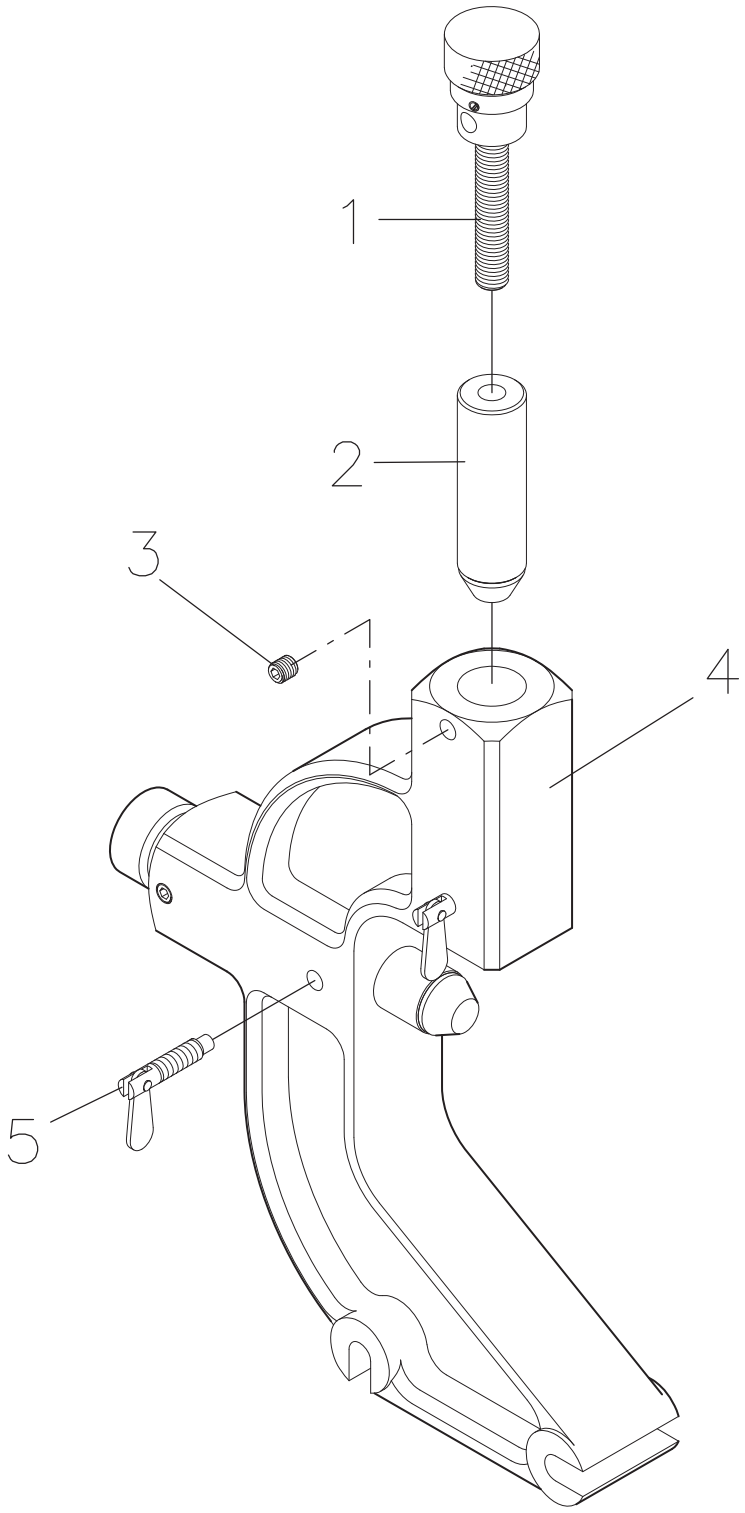
Steady Rest

KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK
1	70038	Adjusting knob	3	
		Spring pin	3	Ø4x40
	70062	Collar	3	
	70035	Screw	3	
2	70037	Finger	3	
		Pin	3	Ø8x23
		Ball bearing	3	627
3		Set screw	3	SET 8x8
4	70064	Knob nut	1	
5	70033	Clamp screw	1	
6	70032	Hinge pin	2	
7	70029	Top casting	1	
	14-70030	Base casting	1	
	70029	Top casting	1	
	16-70030	Base casting	1	
8	70063	Single wing bolt	3	
9		Nut	1	M12
10		Spring washer	1	M12
11		Hexagon head bolt	1	M12x75
12	70039	Clamp plate	1	

Follow Rest



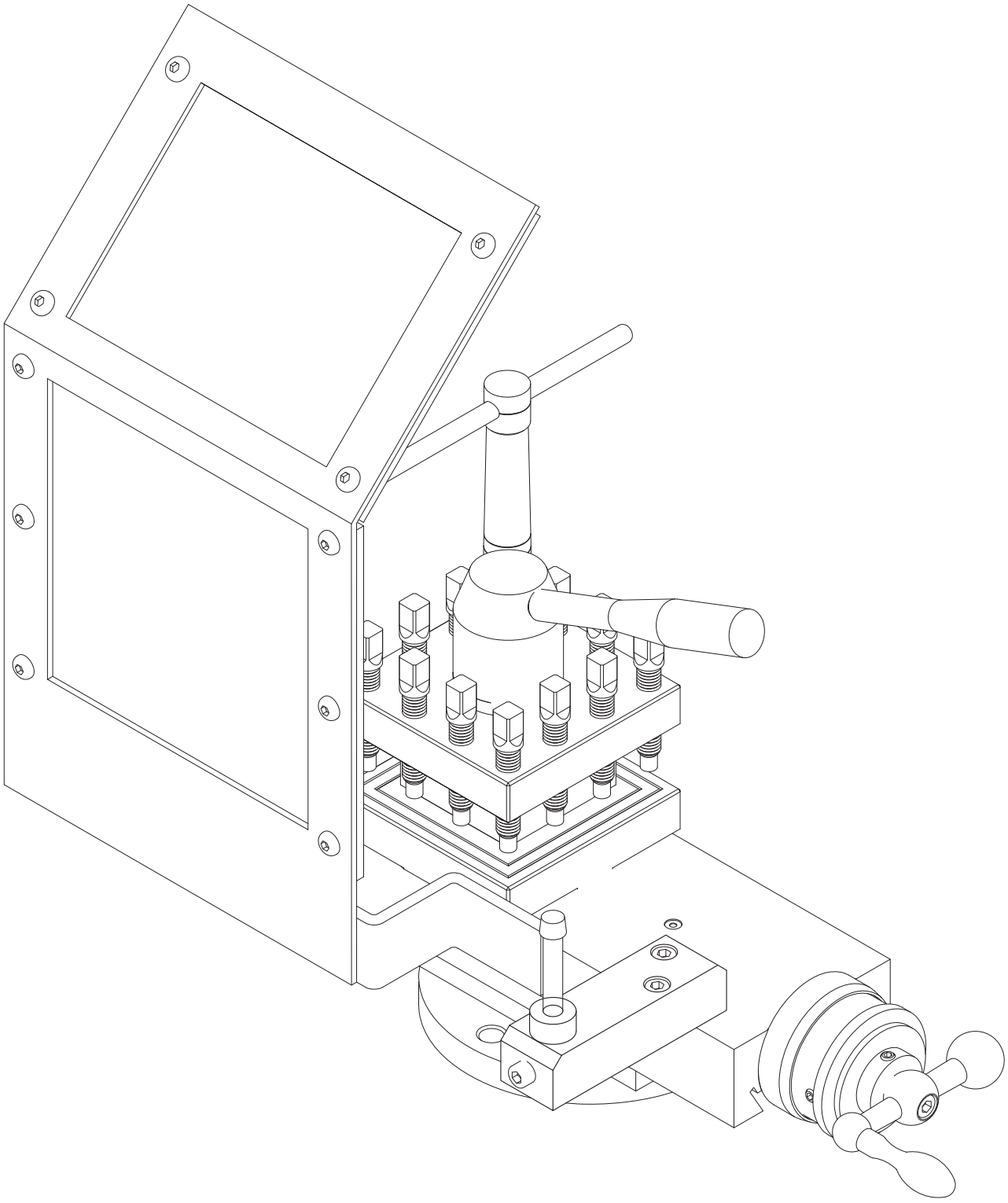
Follow Rest



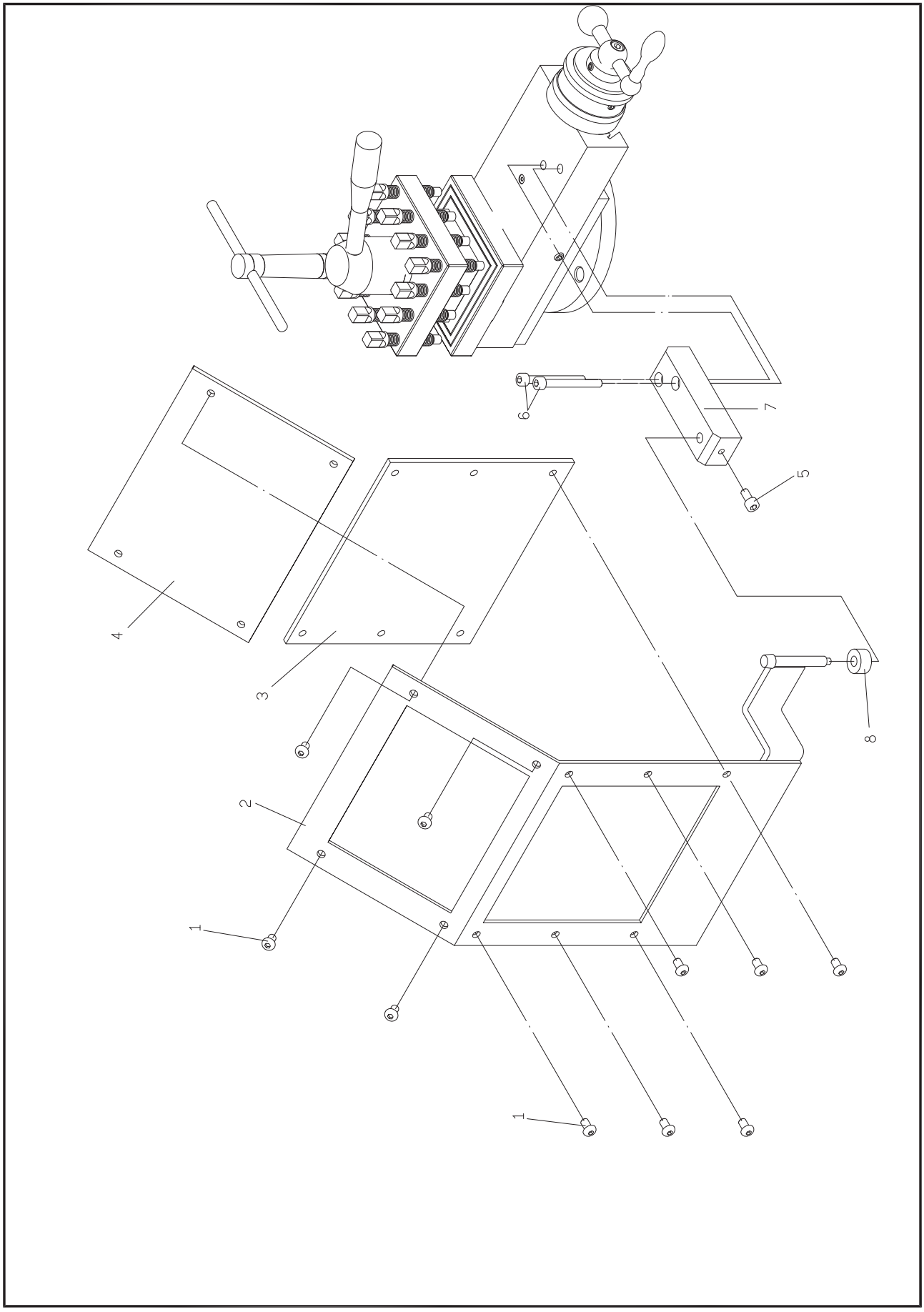
Follow Rest

KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK	KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK
1	70038	Adjusting screw	2						
		Spring pin	3	Ø4x40					
	70062	Collar	3						
	70045	Screw	2						
2	70044	Finger	2						
	70047	Bracket	2						
3		Set screw	2	SET 8x8					
4	14-70041	Casting	1						
	16-70041								
5	70063	Single wing bolt	2						

Tool Post Safety Guard



Tool Post Safety Guard



Tool Post Safety Guard

CHIP COVER

KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK	KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK
1		Dome hexagon screw	10	M6x10L					
2	18-68001	Chip frame	1						
3	18-68004	Plate - down	1	199x175xt4.5					
4	18-68003	Plate - up	1	199x144xt4.5					
5		Hex. socket head bolt	1	M6x12L					
6		Hex. socket head bolt	2	M6x25L					
7	18-68002		1						