

# HIGH SPEED PRECISION LATHE

MODEL: —1440 / 1460  
—1640 / 1660

## INSTRUCTION AND SPARE PARTS MANUAL

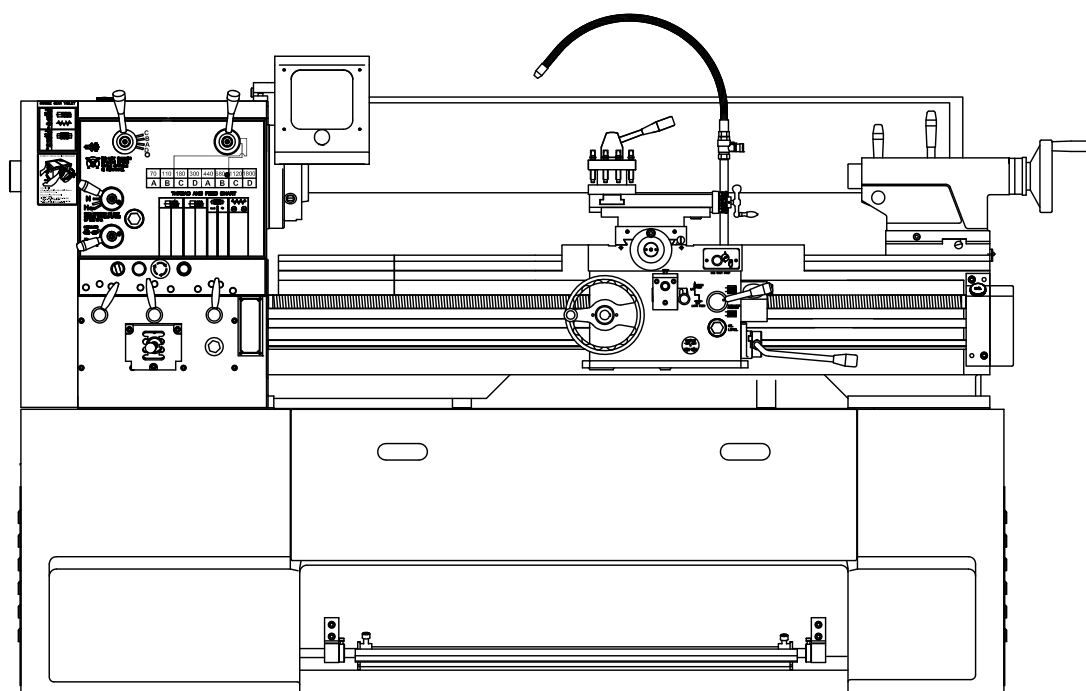


Photo shown model : 1440

# RML Series

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# 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

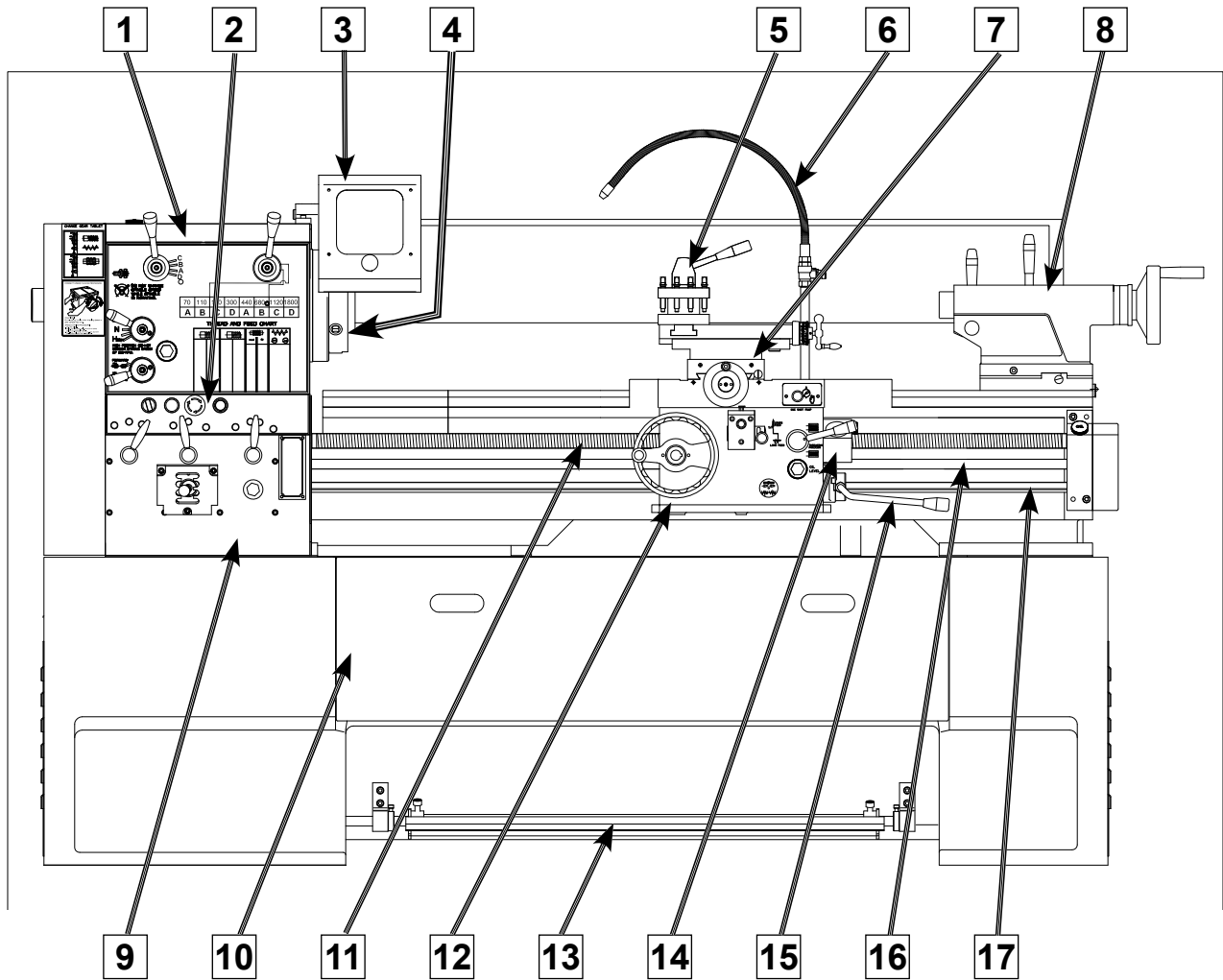


Figure 1. The RML-1440 Lathe.

- |                                  |                                     |
|----------------------------------|-------------------------------------|
| 1. Headstock                     | 10. Tailstock                       |
| 2. Control Panel                 | 11. Leadscrew                       |
| 3. Chuck Safety Guard            | 12. Apron                           |
| 4. D1-6 Camlock MT#6 Spindle     | 13. Brake Pedal                     |
| 5. Compound Rest & Tool Post     | 14. Thread Dial                     |
| 6. Cutting Fluid Tube and Nozzle | 15. Spindle Rotation ON / OFF Lever |
| 7. Cross Slide                   | 16. Feed Rod                        |
| 8. Tailstock                     | 17. Spindle ON / OFF Rod            |
| 9. Gearbox                       |                                     |

## Control Panel

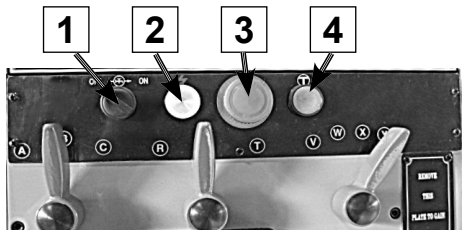


Figure 2. Control Panel.

1. **Cutting Fluid Pump Switch** : Turns cutting fluid delivery ON / OFF.
2. **Power Light** : Illuminates when lathe is receiving power.
3. **Emergency Stop Button** : Stops all machine functions. Twist clockwise to reset.
4. **Jog Button** : Turns the spindle motor ON while being pressed and held.

## Headstock Controls

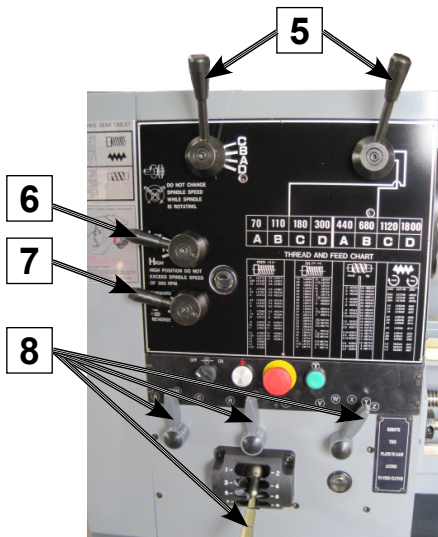


Figure 3. Headstock Controls.

5. **Spindle Range Lever** : Shifts the headstock into low or high range for spindle speeds between 70-300 RPM or 440-1800 RPM.
6. **Gearbox Range Lever** : This lever puts the gearbox in high or low range and has no effect on spindle RPM.
7. **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.

8. **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

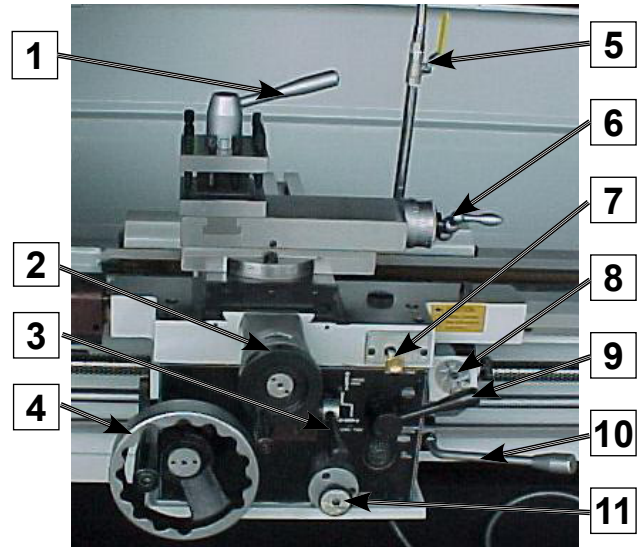


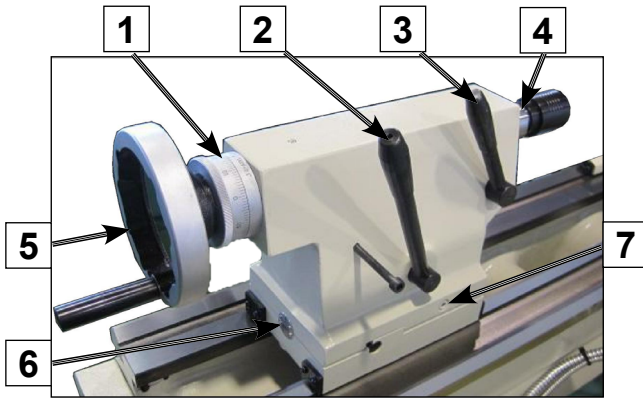
Figure 4. Carriage Controls.

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.

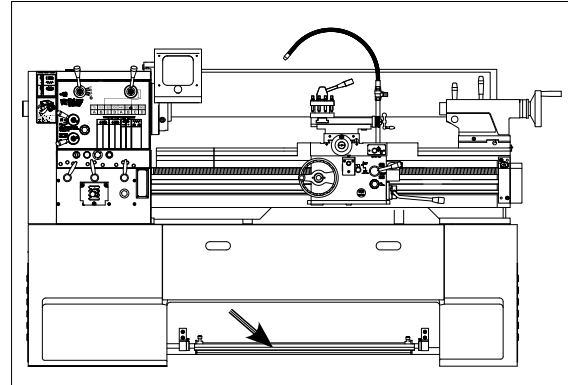
## Foot Brake

## Tailstock Controls



**Figure 5. 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).



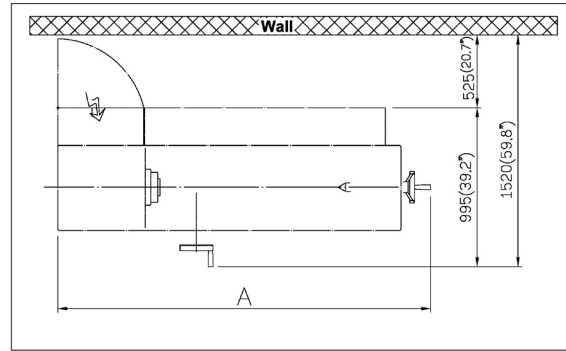
**Figure 6. Foot Brake.**

This lathe is equipped with a foot brake (Figure 6) 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° ~ 72°C(48.2° ~ 161.6°F); the relative humidity is outside the range of 20–95% (non-condensing); or the environment is subject to vibration, shocks, or bumps.



**Figure 7. Space required for full range of movement.**

Model	1440 / 1640	1460 / 1660
A	2300mm ( 90.6" )	2810mm ( 110.6" )

## 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

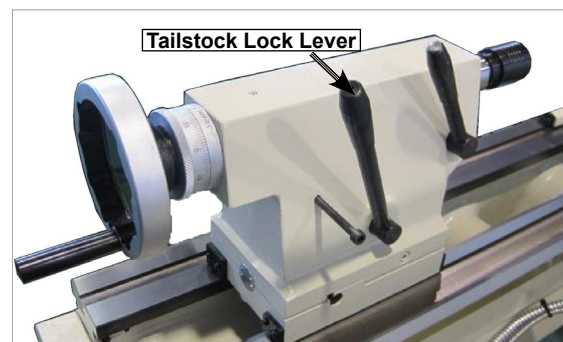
Consider the largest size of workpiece that will be processed through this machine and provide enough space around the machine for adequate operator material handling or the installation of auxiliary equipment. With permanent installations, leave enough space around the machine to open or remove doors/covers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

## 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.

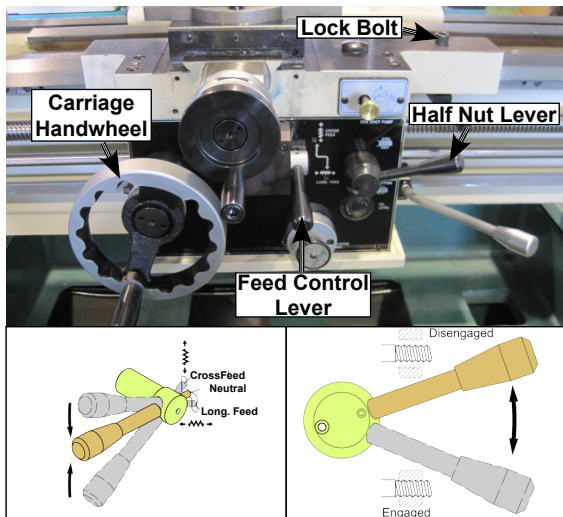
### To lift and move your lathe :

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 8), move the tailstock to the end of the bedway, then lock it in place.



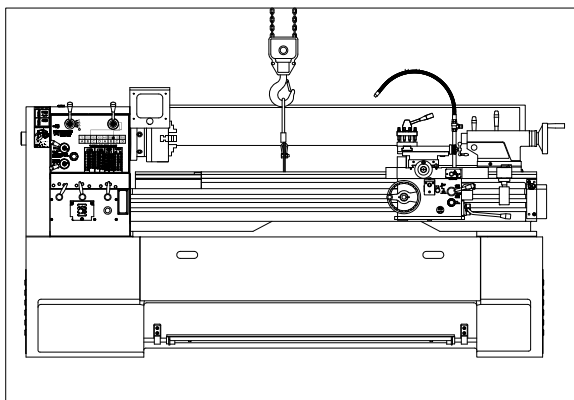
**Figure 8. Tailstock lock lever.**

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 9)



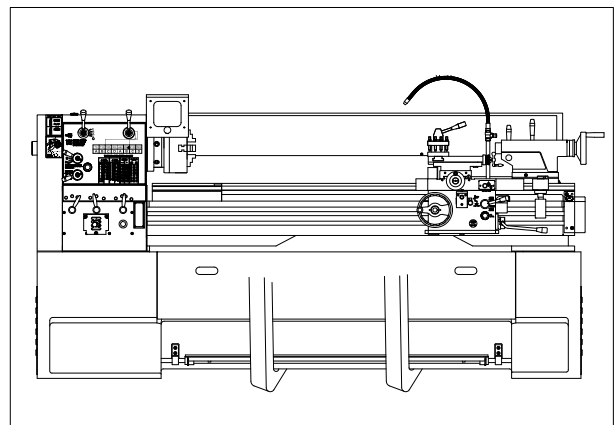
**Figure 9. Carriage controls set for moving the carriage.**

5. Locking the carriage lock bolt and tailstock lock lever.
6. **Lifting the machine with crane.**
  - 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.



**Figure 10. Lifting the machine with crane.**

7. **Moving the machine with a forklift.**
  - 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. 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 12. 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 unlevelled machine may slowly twist due to the dynamic loads placed on the machine during operation.

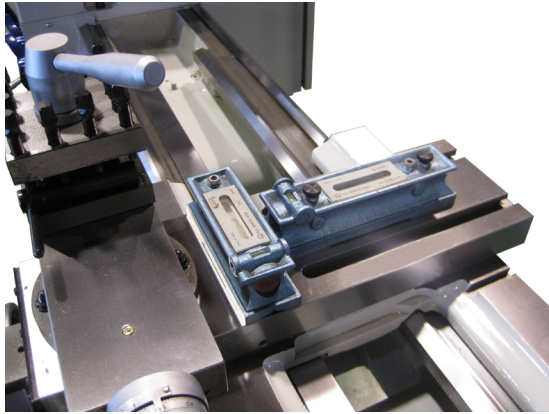


Figure 13. Example of a precision level.

## 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.(Figure 14)

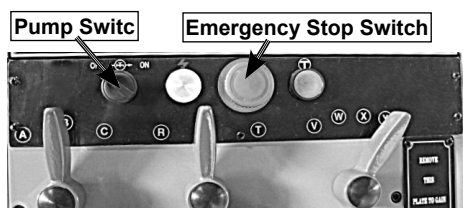


Figure 14. Control Panel.

5. Move the headstock range lever (Figure 15) to the left so the headstock is in low range (70-300 RPM).



Figure 15. Headstock range lever.

6. Move the Gearbox range lever to neutral as shown in Figure 16.



Figure 16. Gearbox range lever.

7. Move the feed direction forward / reverse lever to neutral as shown in Figure 17.



Figure 17. Feed forward / reverse lever.

8. 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 18.

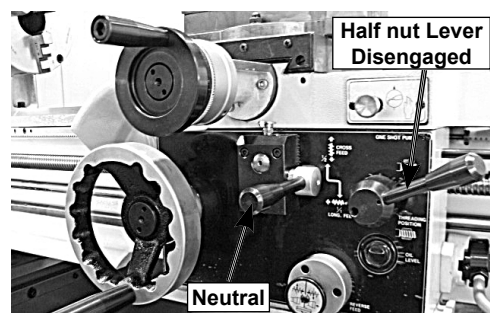
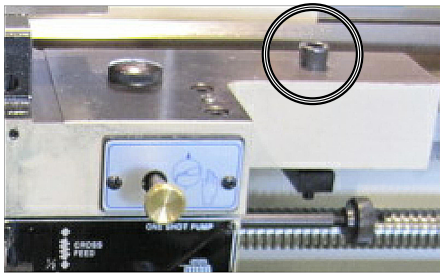


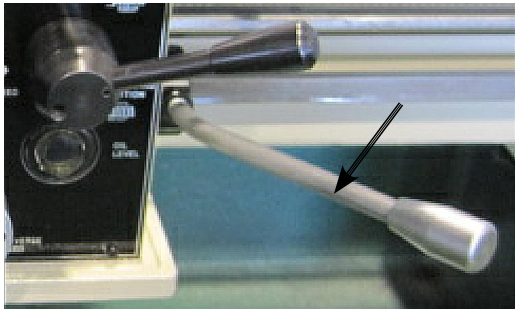
Figure 18. Apron disengaged.

- Using a 10mm hex wrench, loosen the carriage lock (Figure 19) so the carriage is free to slide.



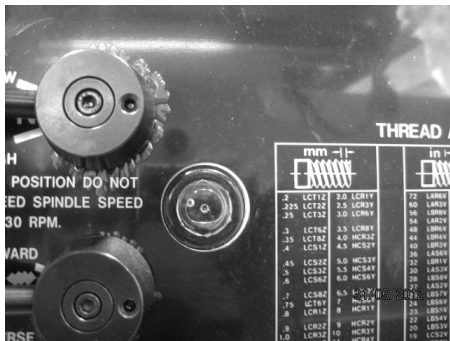
**Figure 19. Carriage lock.**

- Move the spindle ON / OFF lever to the OFF position as shown in Figure 20.



**Figure 20. Spindle ON / OFF lever.**

- 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 21). When oil flows out of the tube and against the sight glass, you can start the lathe.



**Figure 21. Oil pump sight glass.**

- Make sure that all bystanders are out of the way, tools are cleared away, and the chuck key is removed from the chuck.
- Move the spindle ON/OFF lever down and the chuck will rotate.
- Observe and listen for any abnormal noises or vibration. The lathe should run smoothly with little or no vibration or rubbing noises.
- Push the foot brake, and the lathe should come to a quick stop.

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

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

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

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

- 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.

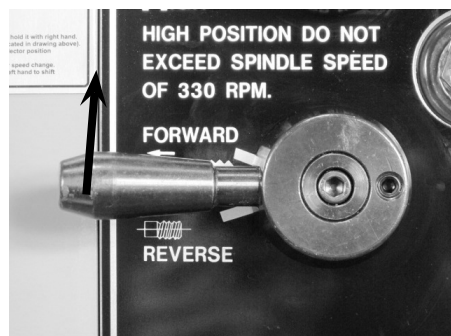
### To break-in the spindle :

- Complete the Test Run procedure.
- Move the gearbox range lever (Figure 22) to low range.



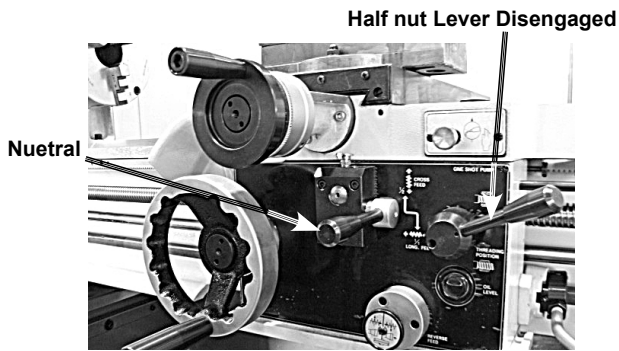
**Figure 22. Gearbox range lever.**

- Move the headstock range lever to low range.
- Move the feed direction forward / reverse lever (Figure 23) to FORWARD.



**Figure 23. Feed forward / reverse lever.**

5. Disengage the half nut and the power feed levers shown in Figure 24.



**Figure 24. Power feed and half nut levers disengaged.**

6. Turn the lathe ON, and let it run for ten minutes in each speed of 70, 110, 180, and 300 RPM, using the dial to adjust the speed.
7. After completing Step 7, stop the lathe and move the gearbox range lever to neutral, and move the headstock range lever to high.
8. Turn the lathe ON and let it run at for ten minutes in each speed of 440, 680, 1120, and 1800 RPM.
9. After completing Step 9, reduce the spindle speed to 440 RPM and let the lathe run for a final 15 minutes to allow the machine to cool and circulate the oil.
10. Shut the lathe down, replace the headstock and gearbox oil, and re-tension the V-belts.



# Section 3 : Operation

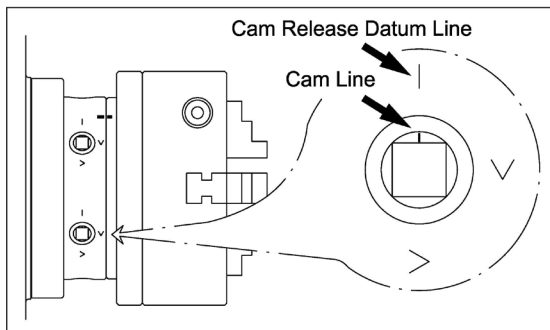
## Chuck

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.

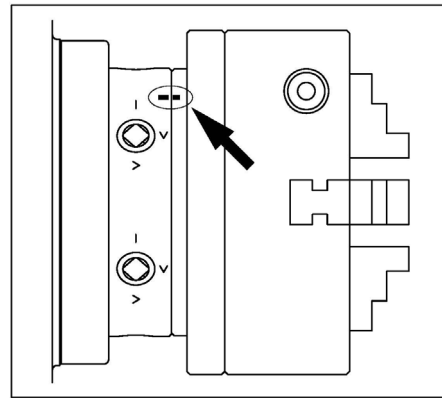
The chucks and faceplate have a D1-6 camlock mount. A chuck key is used to turn the locking cams (Figure 25) to secure / release the chuck / faceplate.



**Figure 25. Camlock loosened with the cam line aligned with the datum line.**

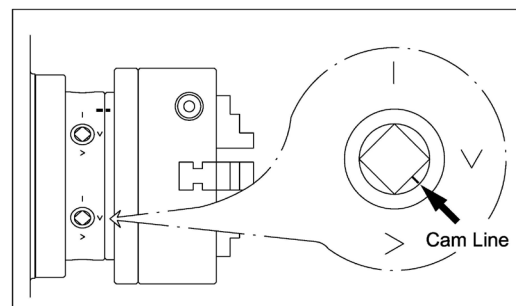
### To install a chuck :

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 26), and slide the chuck onto the spindle.



**Figure 26. Chuck timing marks aligned.**

7. Turn a camlock with the chuck key until the cam line falls between the "V" marks shown in Figure 27.



**Figure 27. 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 28.

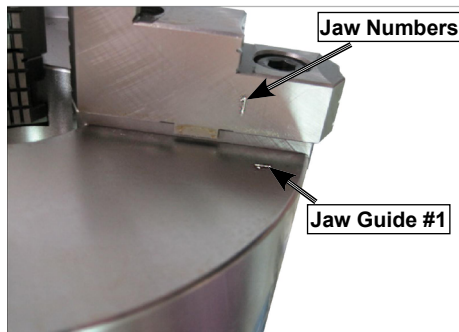


Figure 28. Jaw guides and jaw numbers.

### 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 29. Inserting jaw.

1. Pull on the jaw—now it should be locked into the jaw guide.
2. 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 30. Make sure the workpiece is mounted firmly on the chuck.

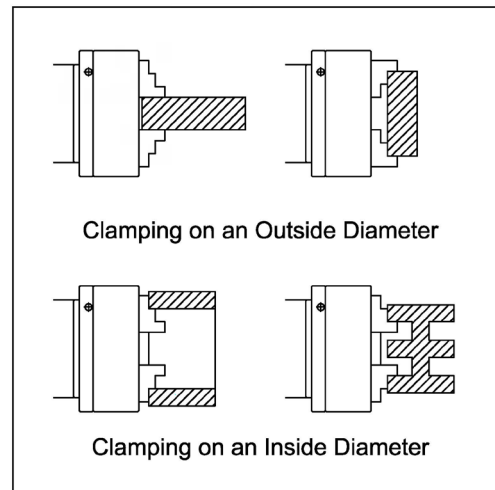


Figure 30. Examples of workpiece mounted in the 3-jaw chuck.

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.

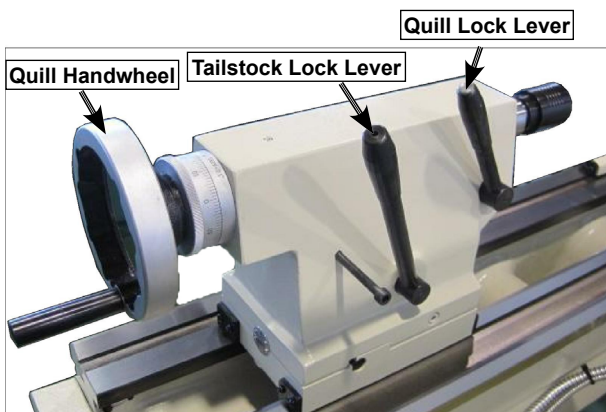


Figure 31. Tailstock and quill lock levers in locked position.

### 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 :

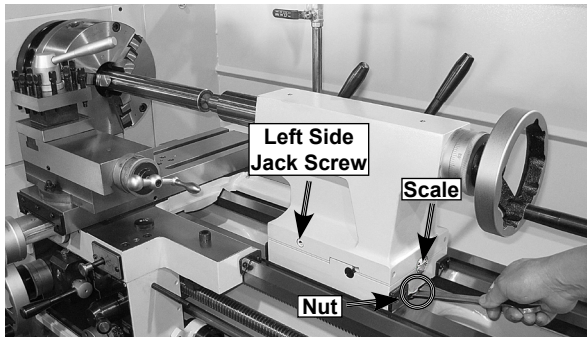
1. With the tailstock locked to the bed, release the quill lock lever.
2. Turn the quill feed handwheel clockwise to feed/move the quill towards the spindle, or turn counterclockwise to move the quill away from the spindle.
3. Push the quill lock lever forward to lock the quill in place.

### To install tooling in the tailstock :

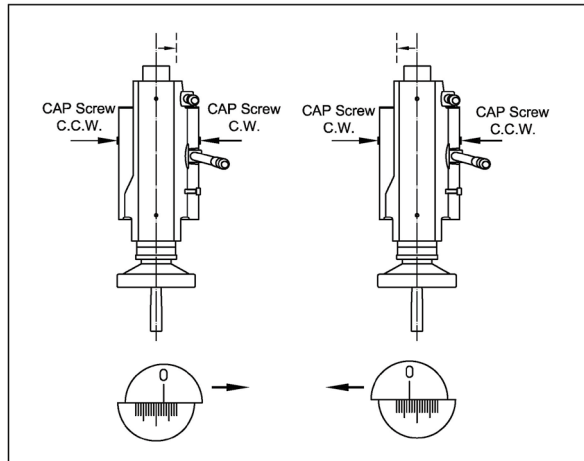
1. With the tailstock locked, unlock the quill lock lever.
2. Turn the quill handwheel CW to extend quill about 25mm out of the casting.
3. Insert a tapered drill arbor or a tapered drill bit into the quill until the taper is firmly seated and the tang is locked to the quill slot.
4. Turn the quill handwheel 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 32) indicates the offset you want. See Figure 33 for adjustment direction.
3. When the offset is achieved, snug the jack screws so the tailstock position is locked.



**Figure 32. Tailstock offset adjustments.**



**Figure 33. Jack screw adjustment versus 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

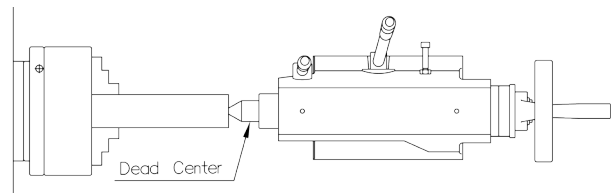
A live center has bearings that allow the center tip and the workpiece to rotate together, and can be installed in the spindle and the tailstock quill for higher speeds, but with a slight bit of accuracy loss.

#### 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.

#### 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 34. 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 35 to secure it in place.

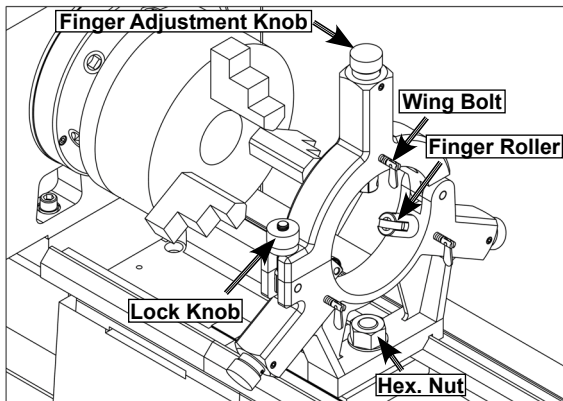


Figure 35. Steady rest components.

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 36.

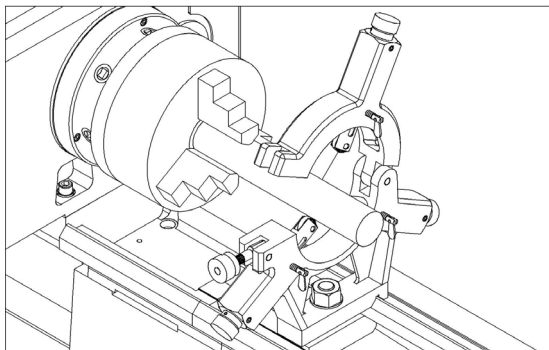


Figure 36. Workpiece mounted in the steady rest.

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 37). 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.

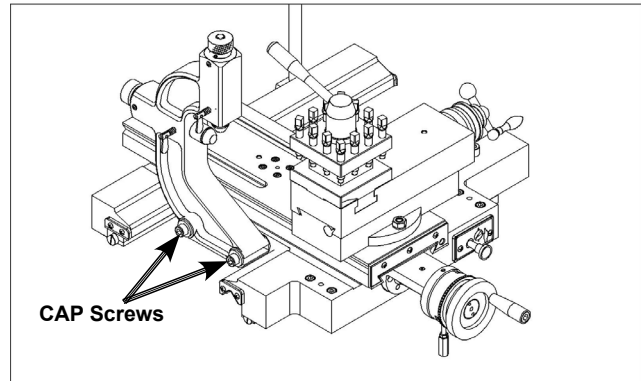


Figure 37. Follow rest attachment.

## 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 38).

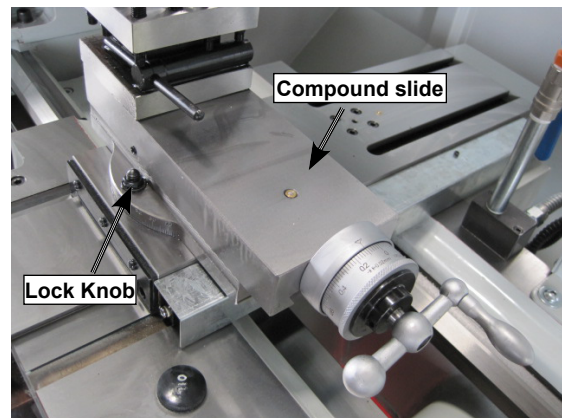


Figure 38. Compound slide set at an angle.

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 39.

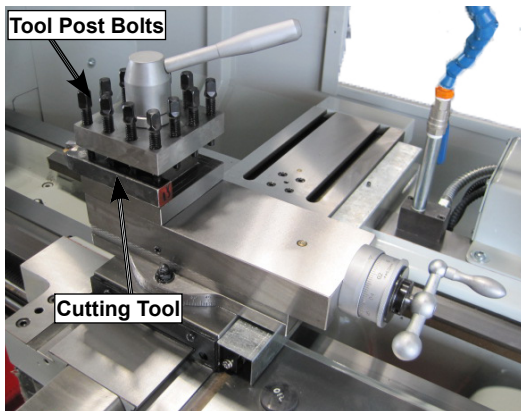


Figure 39. 4-way tool post.

## 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 40.

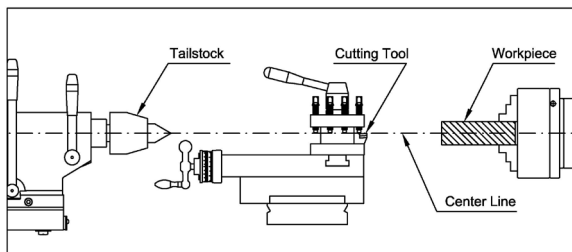


Figure 40. Cutting tool aligned with workpiece center.

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.

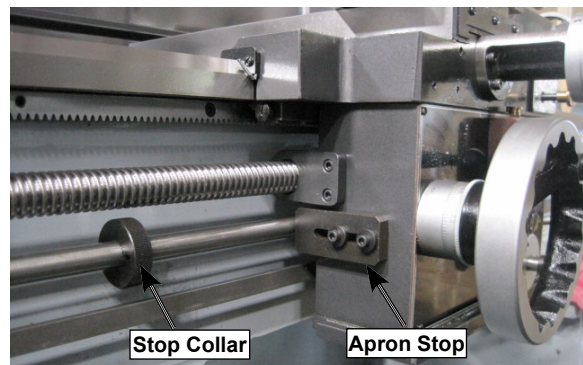


Figure 41. Apron stop and collar.

## Manual Feed

You can manually move the cutting tool around the lathe for facing or turning operations using the handwheels shown in Figure 42 and described below.

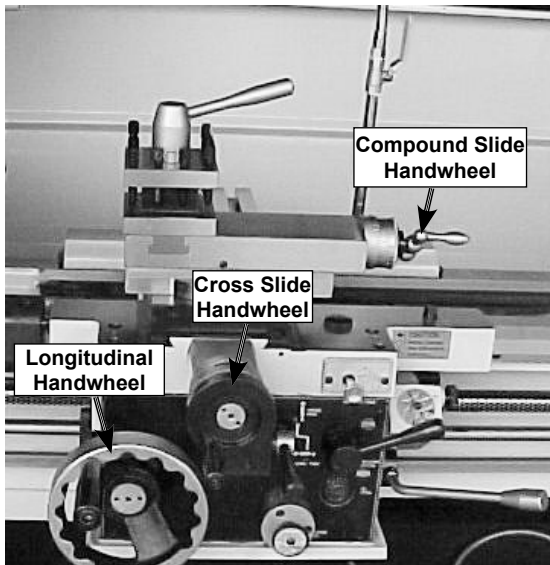


Figure 42. Carriage Controls.

### 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 :

$$\text{RPM} = \frac{CS \times 4}{D}$$

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 :

$$\text{RPM} = (40 \times 4) / 2 = 80$$

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 43 to determine the available spindle speed range closest to your calculated spindle speed.

SPEED				
Low	70	110	180	300
High	440	680	1120	1800
LEVER	A	B	C	D

Figure 43. Spindle speed range chart.

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

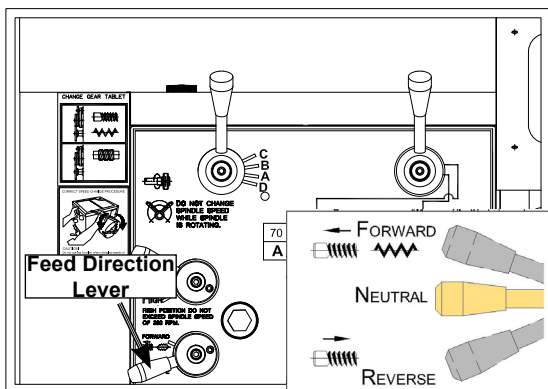


Figure 44. Feed Direction Lever.

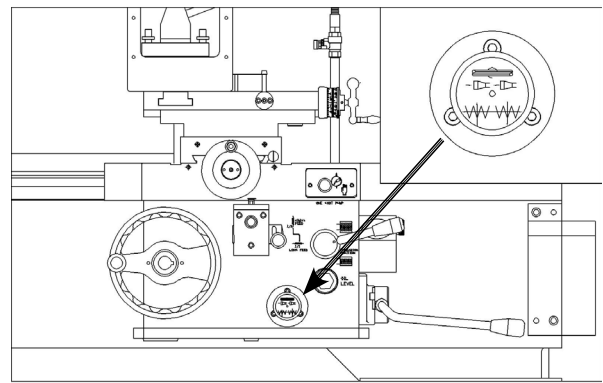


Figure 45. Quick change feed direction knob.

### To engage the power feed :

- Make sure the spindle is OFF and has come to a complete stop.
- Use the feed direction lever to select the direction that the feed rod will rotate.
- 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 46). 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.

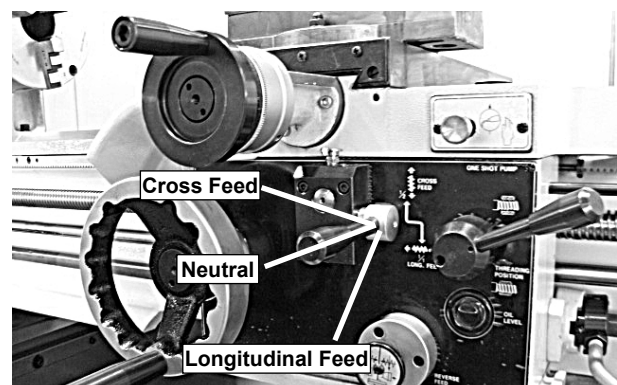


Figure 46. Feed control lever positions.

### To use the quick change feed direction knob :

- While the lathe is running, place the feed control lever in neutral.
- Push or pull the quick change feed direction knob to change the direction of the feed rod.
- 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 47 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)				
.2	LCT1Z	2.0	LCR1Y	72	LAR6V	12	LBT6V	.3	HCT6Z	44	HBR4V	.050	LCT1W	.002
.225	LCT2Z	2.5	LCR3Y	60	LAR3V	11½	LBT5V	.4	HCS1Z	40	HBR3V	.055	LCT2W	.0022
.25	LCT3Z	3.0	LCR6Y	56	LBR8V	11	LBT4V	.5	HCS3Z	36	HAS6V	.065	LCT4W	.003
.3	LCT6Z	3.5	LCR8Y	54	LAR2V	10	LBT3V	.6	HCS6Z	32	HBR1V	.085	LCT8W	.0033
.35	LCT8Z	4.0	HCR3Z	48	LBR6V	9	LBT2V	.7	HCS8Z	30	HAS3V	.10	LCS2W	.004
.4	LCS1Z	4.5	HCS2Y	44	LBR4V	8	LBT1V	.8	HCR1Z	28	HBS8V	.13	LCS4W	.005
.45	LCS2Z	5.0	HCS3Y	40	LBR3V	7½	HAS3V	.9	HCR2Z	26	HBS7V	.18	LCS8W	.007
.5	LCS3Z	5.5	HCS4Y	36	LAS6V	7	HBS8V	1.0	HCR3Z	24	HBS6V	.22	LCR2W	.009
.6	LCS6Z	6.0	HCS6Y	32	LBR1V	6	HBS6V	1.25	HCS3Y	22	HBS4V	.28	LCR4W	.011
.7	LCS8Z	6.5	HCS7Y	30	LAS3V	5	HBS3V	1.5	HCS6Y	20	HBS3V	.35	LCR8W	.014
.75	LCT6Y	7	HCS8Y	28	LBS8V	4½	HBS2V	1.75	HCS8Y	19	HCS2V	.44	LCS8X	.017
.8	LCR1Z	8	HCR1Y	27	LAS2V	4	HBS1V	2.0	HCR1Y	18	HBS2V	.55	LCR2X	.022
.9	LCR2Z	9	HCR2Y	26	LBS7V	3¾	HAT3V	2.25	HCR2Y	16	HBS1V	.68	LCR4X	.027
1.0	LCR3Z	10	HCR3Y	24	LBS6V	3	HBT6V	2.5	HCR3Y	16	HBS1V	.85	LCR8X	.033
1.1	LCR4Z	11	HCR4Y	23	LBS5V	2¾	HBT8V	2.75	HCR4Y	15	HAT3V	1.2	HCS2X	.047
1.2	LCR6Z	12	HCR6Y	22	LBS4V	2½	HBT8V	3.0	HCR6Y	14	HBT8V	1.4	HCS4X	.055
1.25	LCS3Y	13	HCR7Y	20	LBS3V	2¼	HBT4V	3.25	HCR7Y	13	HBT7V	1.7	HCS8X	.067
1.3	LCR7Z	14	HCR8Y	18	LBS2V	2	HBT3V	3.5	HCR8Y	12	HBT6V			
1.4	LCR8Z			16	LBS1V		HBT5V							
1.5	LCS6Y			15	LBT3V		HBT4V							
1.75	LCS8Y			14	LBT8V									
				13½	LAT2V		HBT3V							
				13	LBT7V		HBT2V							
							HBT1V							

Figure 47. 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 47 to Figure 48 show which gearbox levers must be moved to achieve an example feed rate.

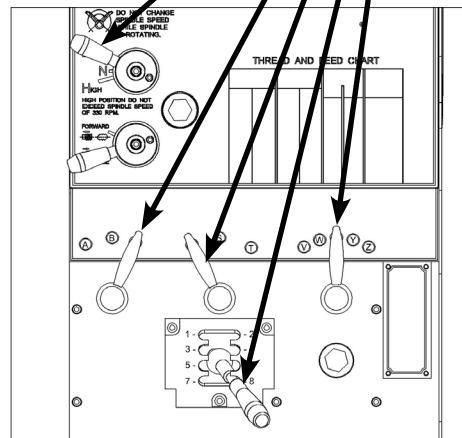


Figure 48. Thread and feed rate chart.

## 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 49. In the normal position, the 56T and 57T gears are meshed, which allows for inch threading and all general feed operations.

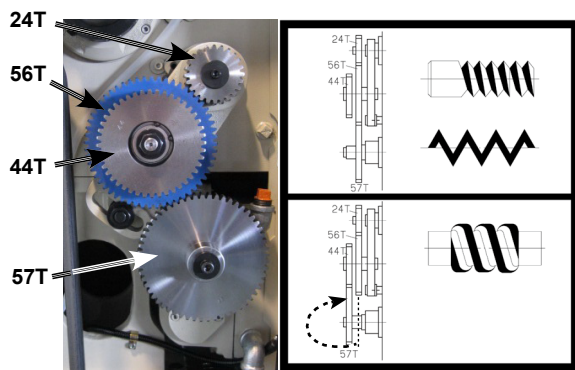


Figure 49. Normal end gear position.

### 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 50. In the normal position, the 55T and 64T gears are meshed, which allows for metric threading and all general feed operations.

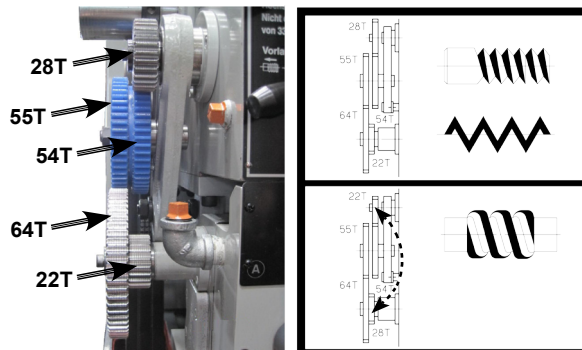


Figure 50. Normal end gear position.

### 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 51–52).

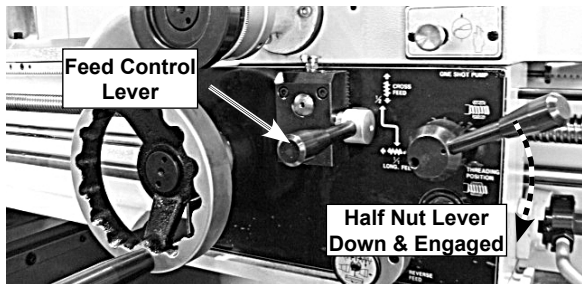


Figure 51. Carriage controls set up for threading.

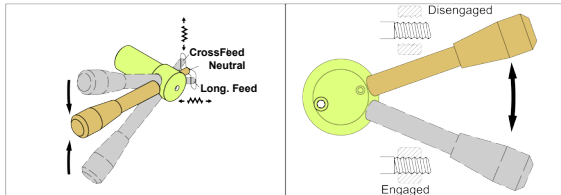


Figure 52. Feed control lever and half nut positions for threading.

## 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 53).

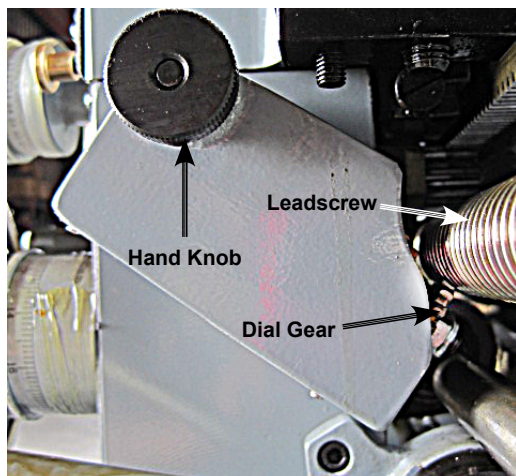


Figure 53. Thread dial engaged with the leadscrew.

## Using Thread Dial and Chart (Metric)

Find the length of each thread that you want to cut in the left column (see Figure 54), 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.

1.75, 3.5, 7, 14	14T	
4, 5, 9	18T	1, 3
5.5, 11	22T	
.25, .5, .75, 1		
1.5, 2, 3, 4	16T	1, 2
6, 8, 12		
1.25, 2.5, 5, 10	20T	3, 4

Figure 54. Thread dial chart (Metric).

1.75, 3.5, 7, 14	14T	
4.5, 9	18T	1, 3
5.5, 11	22T	

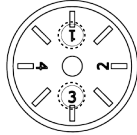


Figure 55. Thread dial chart of numbered position 1, 3.

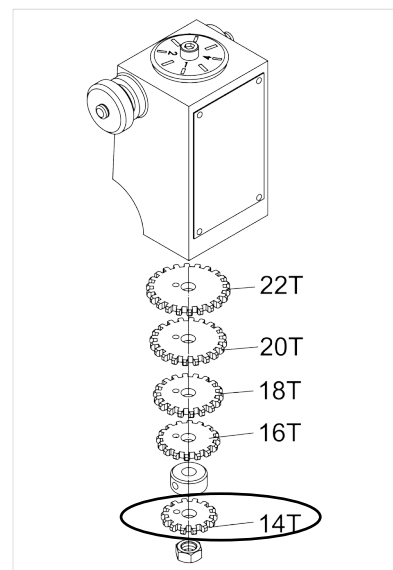


Figure 56. Example of thread dial - 14T.

### Length of each thread 1.75, 3.5, 7, 14

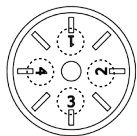
Select position 1, 3 on the thread dial and use the 14T gear on the bottom of thread dial for threading length of each thread 1.75, 3.5, 7, 14. (Figure 55 - 56)

**Length of each thread 4.5, 9**

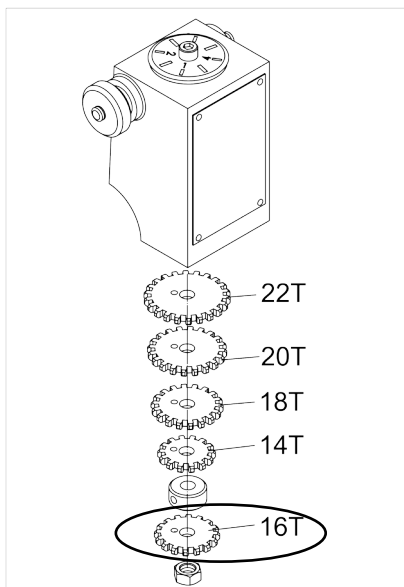
Select position 1, 3 on the thread dial and use the 18T gear on the bottom of thread dial for threading length of each thread 4.5, 9. (Figure 55 - 56)

**Length of each thread 5.5, 11**

Select position 1, 3 on the thread dial and use the 22T gear on the bottom of thread dial for threading length of each thread 5.5, 11. (Figure 55 - 56)

.25, .5, .75, 1	16T	1, 2	
1.5, 2, 3, 4		3, 4	
6, 8, 12	20T		
1.25, 2.5, 5, 10			

**Figure 57. Thread dial chart of numbered position 1, 2, 3, 4.**



**Figure 58. Example of thread dial - 16T.**

**Length of each thread 0.25 - 12 divisible by 0.25**

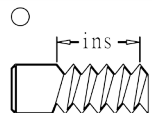

Select position 1, 2, 3 or 4 on the thread dial and use the 16T gear on the bottom of thread dial for threading length of each thread 0.25 - 12 divisible by 0.25. (Figure 57 - 58)

**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 bottom of thread dial for threading length of each thread 1.25, 2.5, 5, 10. (Figure 57 - 58)

**Using Thread Dial and Chart ( Inch )**


Find the TPI ( threads per inch ) that you want to cut in the left column (see Figure 59), 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.

	
4, 8, 12, 16, 20, 24, 28, 32, 36, 40, 44, 48, 56, 60, 72	ANY POSITION
2, 6, 10, 14, 18, 22, 26, 30, 54	NON NUMBERED POSITION
3, 5, 7, 9, 11, 13, 15, 19, 23, 27	NUMBERED POSITION 1, 2, 3, 4
2 <sup>1</sup> / <sub>2</sub> , 3 <sup>1</sup> / <sub>2</sub> , 4 <sup>1</sup> / <sub>2</sub> , 7 <sup>1</sup> / <sub>2</sub> , 11 <sup>1</sup> / <sub>2</sub> , 13 <sup>1</sup> / <sub>2</sub>	POSITION 1, 3 OR 2, 4
2 <sup>1</sup> / <sub>4</sub> , 2 <sup>3</sup> / <sub>4</sub> , 3 <sup>1</sup> / <sub>4</sub> , 3 <sup>3</sup> / <sub>4</sub>	POSITION 1 ONLY
<input type="radio"/> 2 <sup>7</sup> / <sub>8</sub> SAME METRIC THREADS CUTTING <input type="radio"/>	

**Figure 59. Thread dial chart (Inch).**

**TPI 4-72 Divisible By 4**


Use any line (position) on the thread dial, shown in Figure 60, or threading TPI divisible by 4.

TPI		
4, 8, 12, 16, 20, 24, 28, 32, 36, 40, 44, 48, 56, 60, 72	ANY POSITION	

**Figure 60. Any position is selected on the dial for hreading 4-72 TPI.**

**TPI 2-54 Not Divisible By 4**

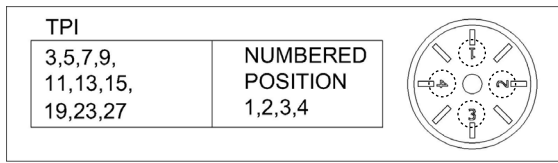
Use any of the non-numbered lines on the thread dial for threading the TPI shown in Figure 61.

TPI		
2, 6, 10, 14, 18, 22, 26, 30, 54	NON NUMBERED POSITION	

**Figure 61. Marks are selected on the dial for threading 2-54 TPI.**

### Odd Numbered TPI

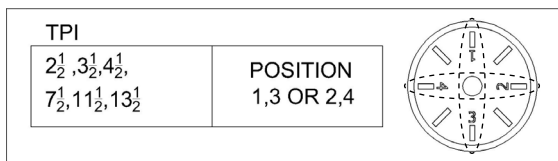
Use any of the numbered lines on the thread dial for threading the TPI shown in Figure 62.



**Figure 62. Numbers are selected on the dial for threading odd numbered TPI.**

### 1/2 Fractional TPI

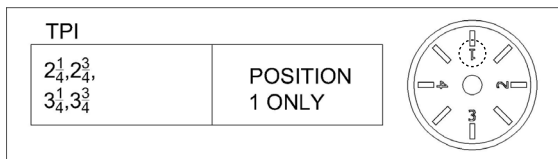
Use any opposing number pairs—2 or 4, or 1 or 3 on the thread dial for 1/2 fractional TPI (Figure 63). For example, to cut a 3 1/2 thread, select 1 on the dial, then start threading.



**Figure 63. Opposing number group are selected on dial for cutting 1/2 thread TPI.**

### Other Fractional TPI

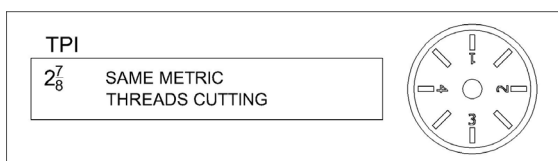
Use position 1 on the thread dial for cutting the TPI shown in Figure 64.



**Figure 64. Any number on dial is selected for other fractional TPI**

### 2 7/8 TPI

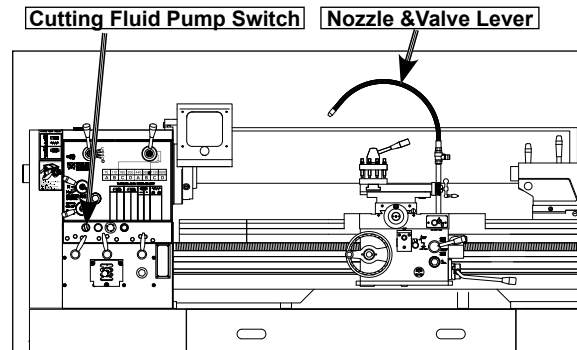
Use any numbered or non-numbered line on the thread dial to cut the TPI shown in Figure 65.



**Figure 65. Any number on the dial can be selected for 2 7/8 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 66. 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 28 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

#### Monitoring Oil Temperature

During operations, regularly monitor the oil temperature shown in the sight glass in Figure 67. 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.

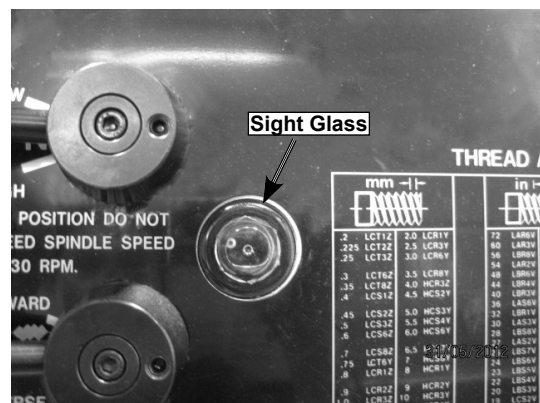


Figure 67. Location of the headstock oil sight glass.



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.

## Gearbox

### Checking & Adding Oil

The sight glass shown in Figure 68 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.

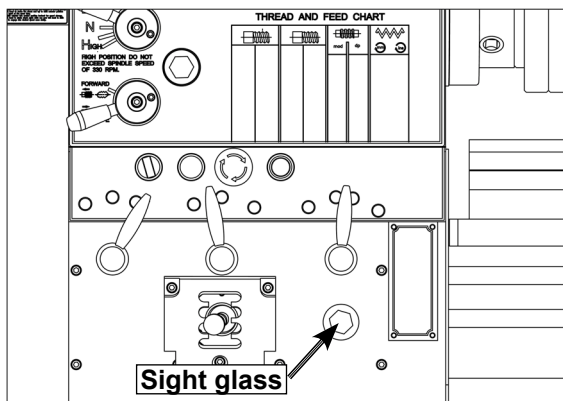


Figure 68. Gearbox sight glass location.

### 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 69 shows fill and drain plugs used when changing the gearbox oil.

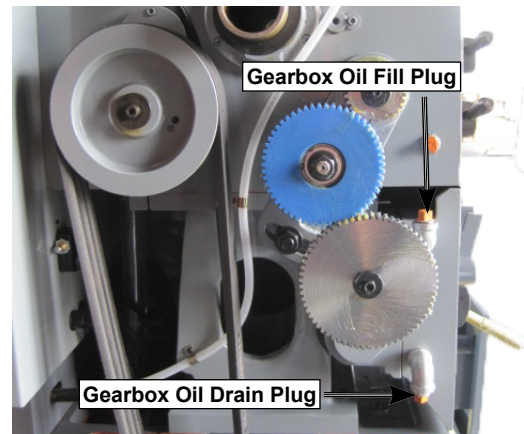


Figure 69. Location of gearbox fill and drain plugs.

## Apron

### Checking & Adding Oil

The sight glass shown in Figure 70 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.

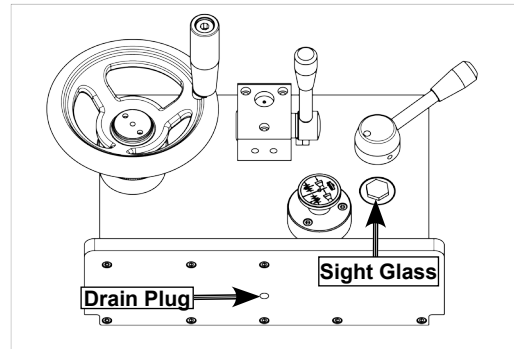


Figure 70. Location of apron drain plug & sight glass.

### 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 70 and the fill plug is shown in Figure 71.

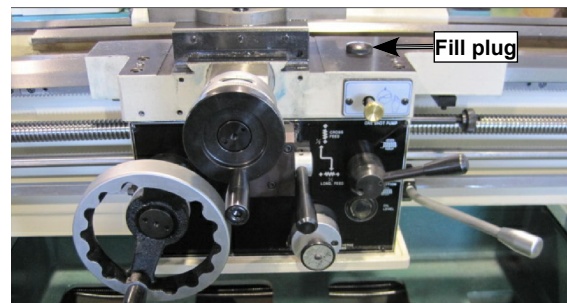


Figure 71. Location of fill plug for apron oil reservoir.

## Lead Screw & Feedrod Bearings

### Checking & Adding Oil

To check the oil level, remove the fill plug and look inside the reservoir (Figure 72). 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 72. Leadscrew lubrication.

## Lead Screw

Before lubricating the leadscrew (Figure 72), 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 73 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.

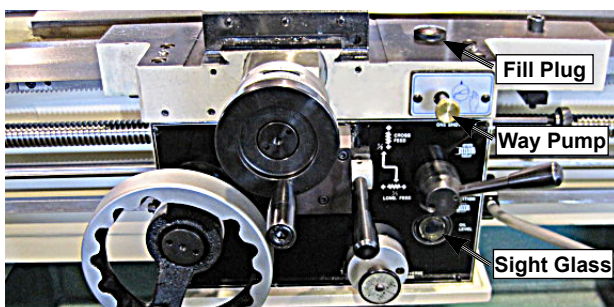


Figure 73. Location of way pump, fill plug, and sight glass on the apron.

## 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 74–75) 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.

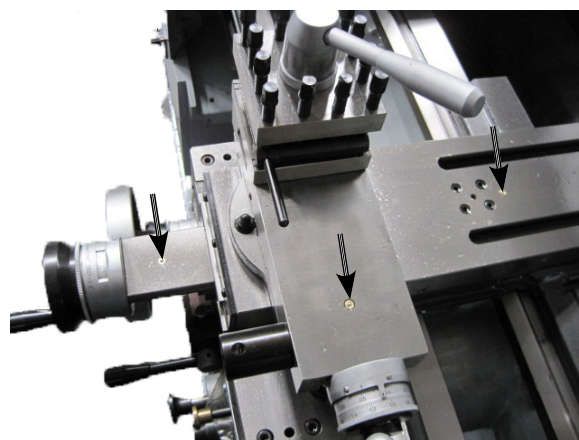


Figure 74. Ball oiler locations.

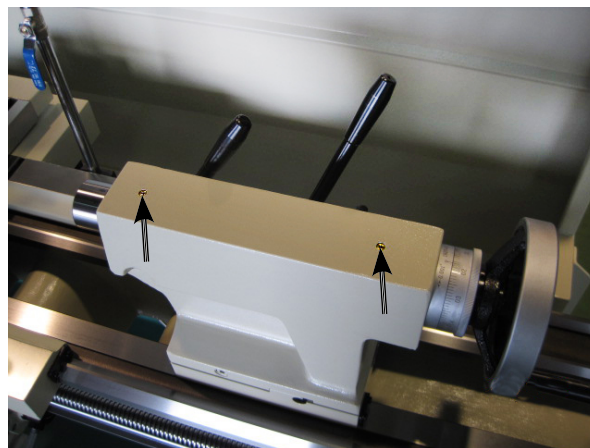


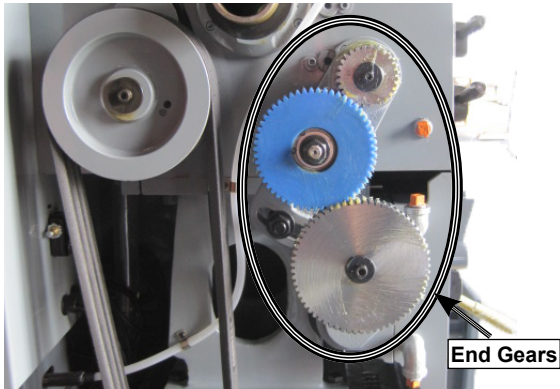
Figure 75. Tailstock ball oiler locations.

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.



## End Gearing

The end gears, shown in Figure 76, 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 77. 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 77.
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

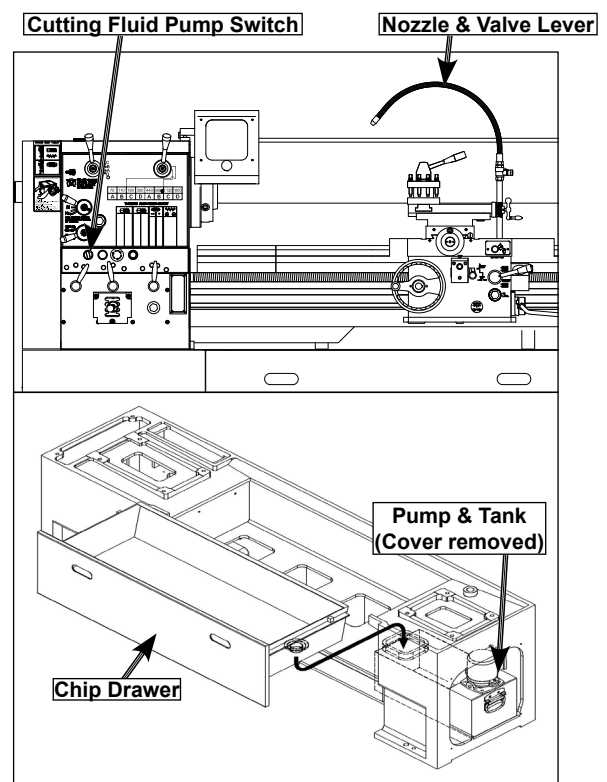
Once a year, remove all the end gears, clean them thoroughly, and apply a new coating of grease. Even if the headstock side cover has been kept in place throughout the year, it is still possible for dust from the V-belts to build-up in the grease, and the grease may also start to break down with extended 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 tank where it is picked up again by the pump. Figure 77 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 78. Cutting fluid system components and locations.**

## Hazards

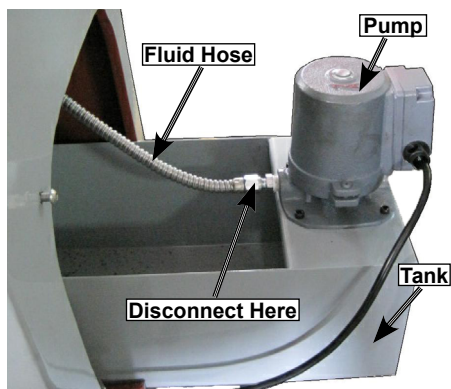
As some cutting fluid ages, dangerous microbes can proliferate and create a biological hazard.

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 79.



**Figure 79. 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 78 and slide the tank half way out of the base, as shown in Figure 79.

If necessary, disconnect the fluid hose from the pump, where shown in Figure 79.

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 80. 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.

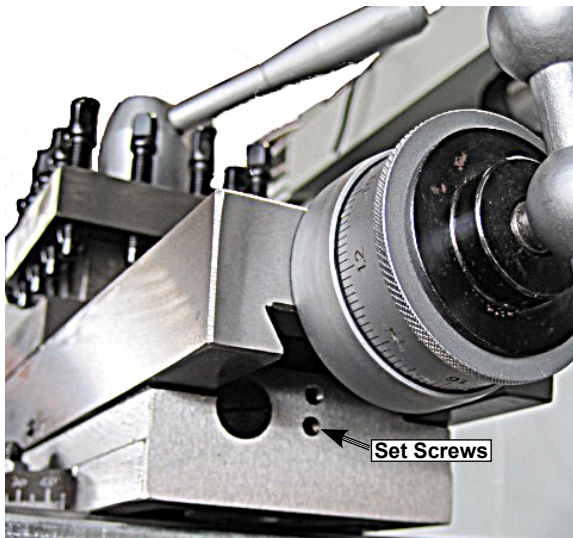


Figure 80. Compound slide backlash adjustment set screws.

### 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 81, 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.

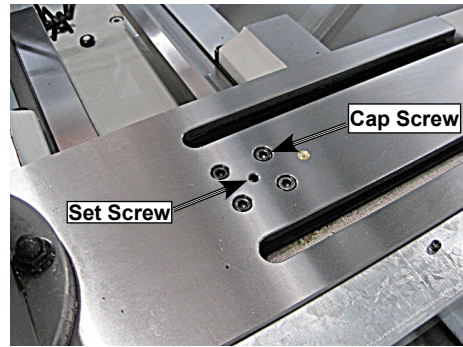


Figure 81. Compound slide backlash adjustment set screws.

## 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 82.



Figure 82. 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 83–86 show the location of the screws for each gib on this machine.



Figure 86. 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 87, clockwise about an 1/8 th of a turn.

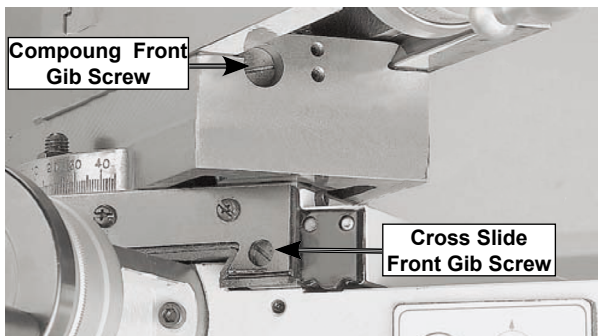


Figure 83. One of two cross slide and compound gib screws.



Figure 84. One of two rear saddle gib screws.

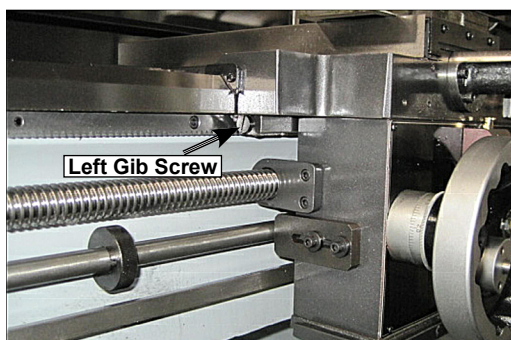


Figure 85. One of two front saddle gib screws.

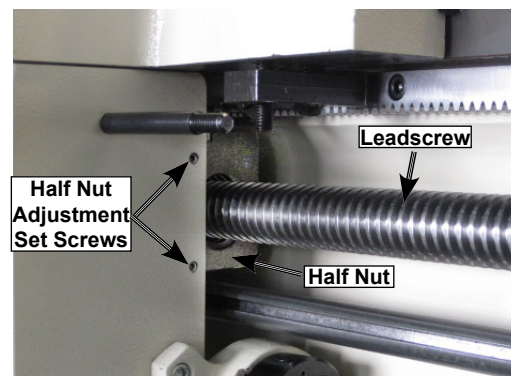


Figure 87. Half nut gib adjustment.

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 88.



Figure 88. Feed access covers removed.

3. Remove the clutch collar set screw, as shown in Figure 89.

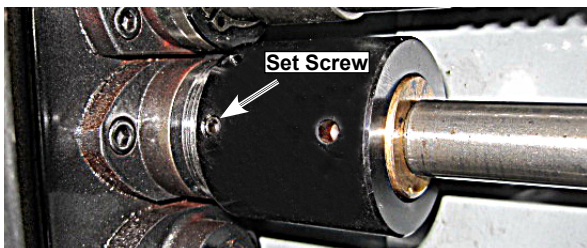


Figure 89. Removing set screw from clutch collar.

4. Insert the hex wrench into the collar adjustment hole shown in Figure 90, and use the wrench to rotate the clutch collar.

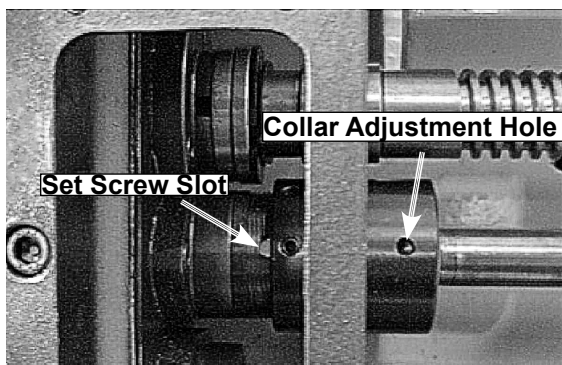


Figure 90. Feed clutch set screw alignment.

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 91.

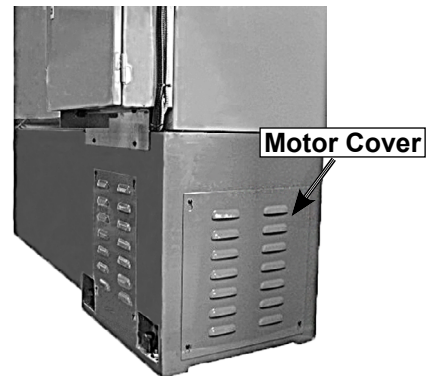


Figure 91. Location of motor cover.

3. Turn the hex nuts on the motor mount bolts shown in Figure 92 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.

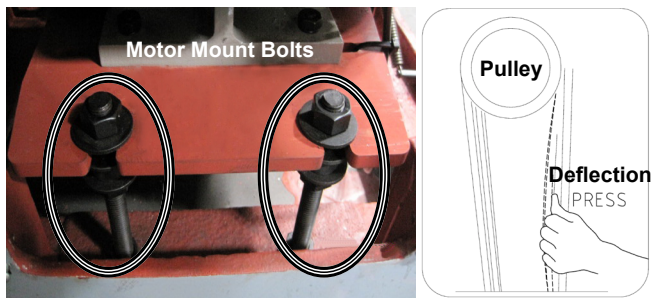


Figure 92. V-belt adjustment.

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 93.

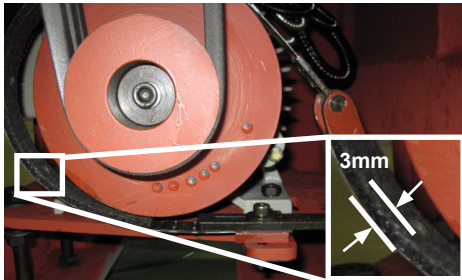


Figure 93. Minimum brake band lining thickness.

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.

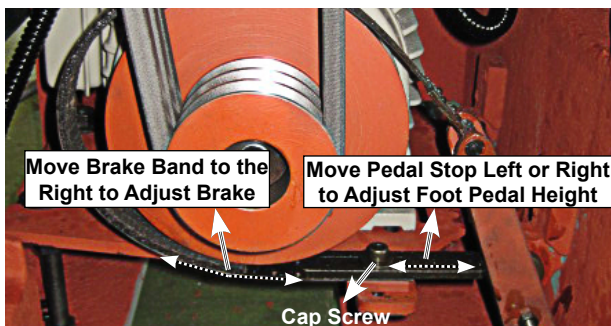


Figure 94. Brake linkage adjustments.

5. Remove pedal stop shown in Figure 95.
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 95) 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 95).

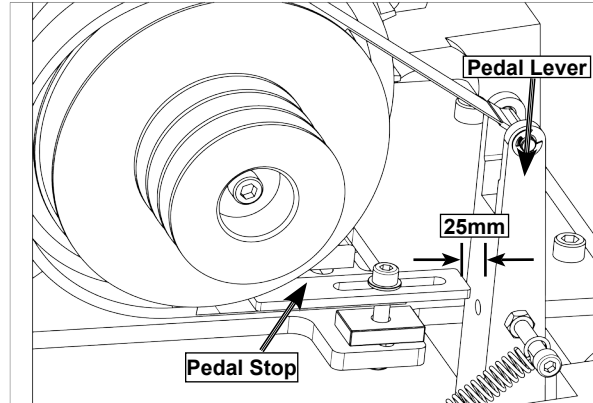


Figure 95. Pedal travel adjustment.

9. Tighten the cap screw on the pedal stop.
10. Locate the motor kill switch (shown in Figure 96) at the tailstock end of the lathe.

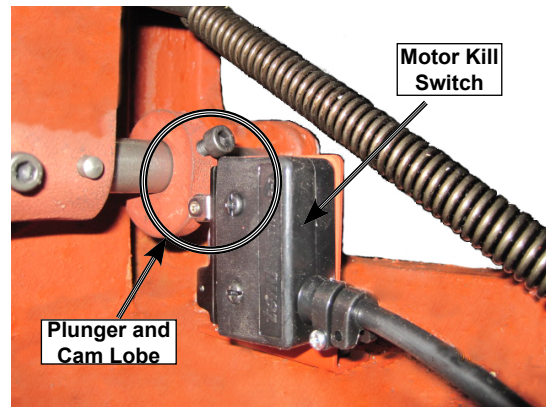


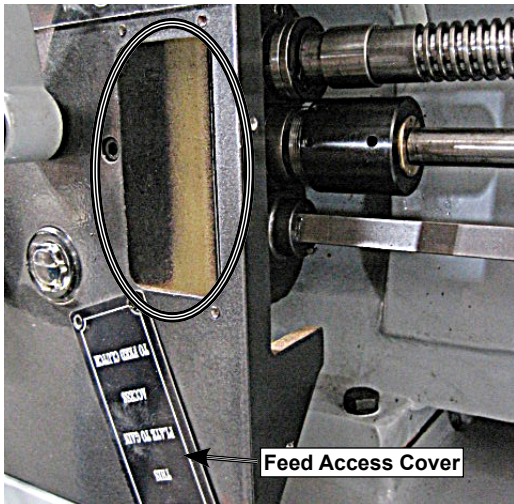
Figure 96. Motor kill switch.

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

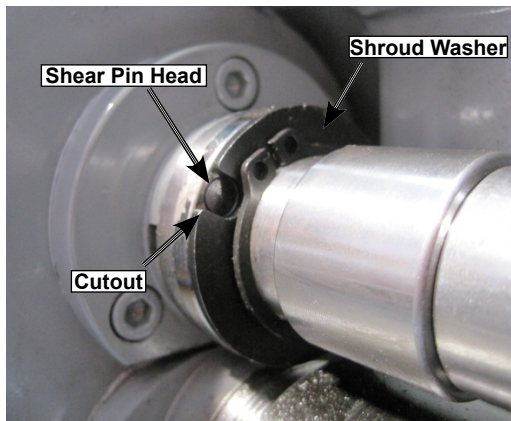
### To replace the shear pin :

1. Disconnect Lathe from POWER !
2. Remove the front and side feed access covers, as shown in Figure 97.



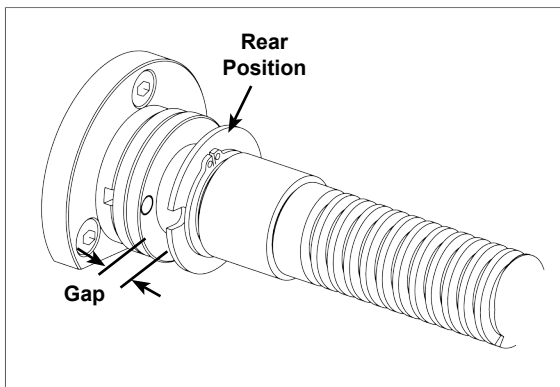
**Figure 97. Feed access covers removed.**

3. Rotate the shroud washer so the cutout lines up with the shear pin head, as shown in Figure 98.



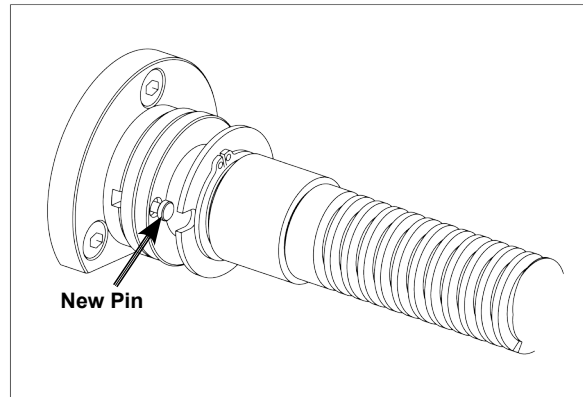
**Figure 98. Shroud washer / pin alignment.**

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.



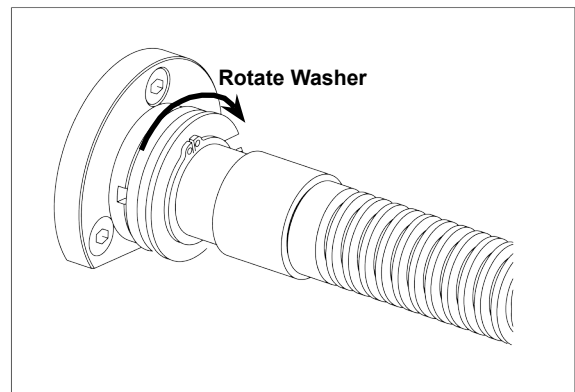
**Figure 99. Shear pin access.**

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 100.



**Figure 100. 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 101.



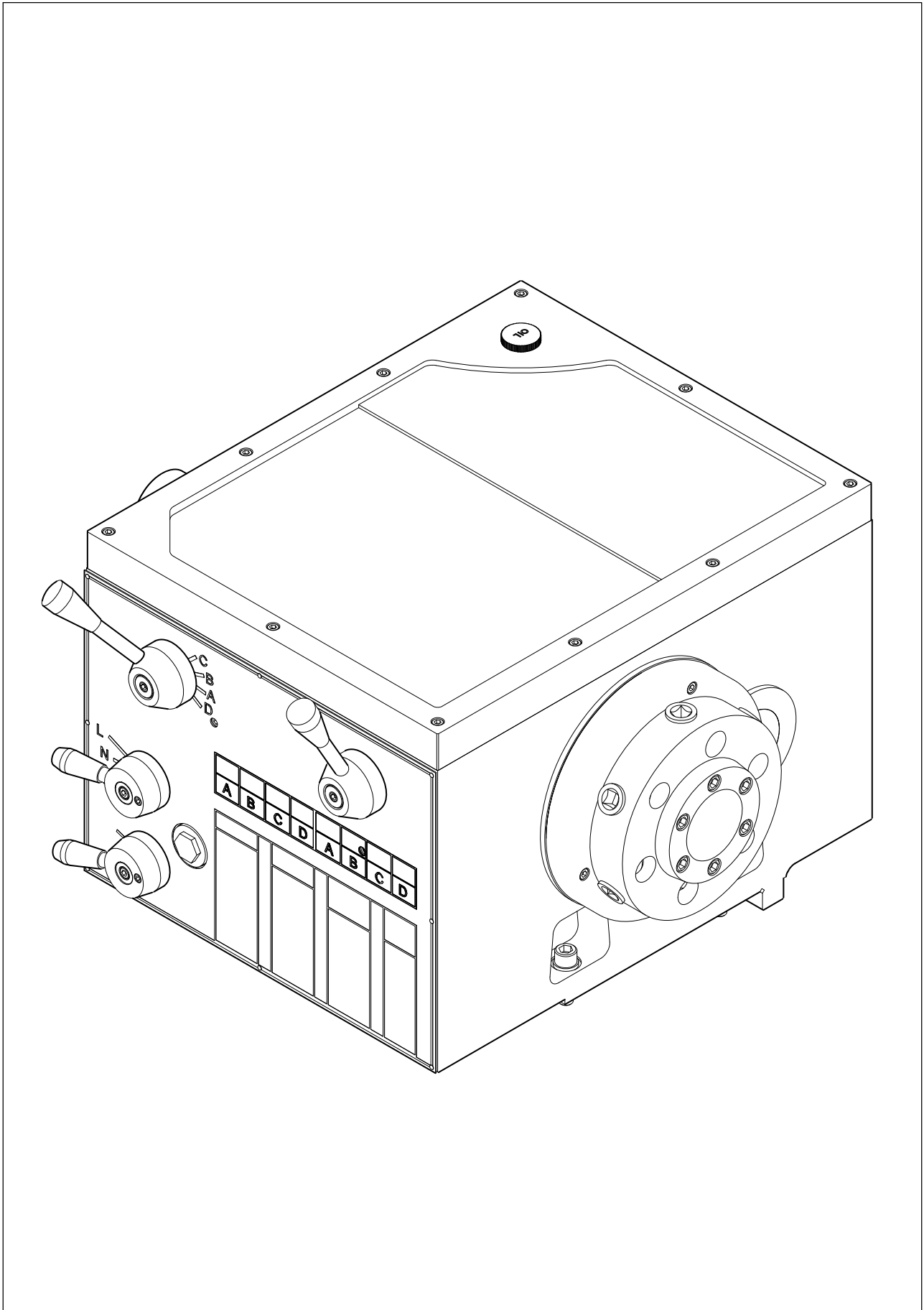
**Figure 101. Shroud washer positioning.**

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.

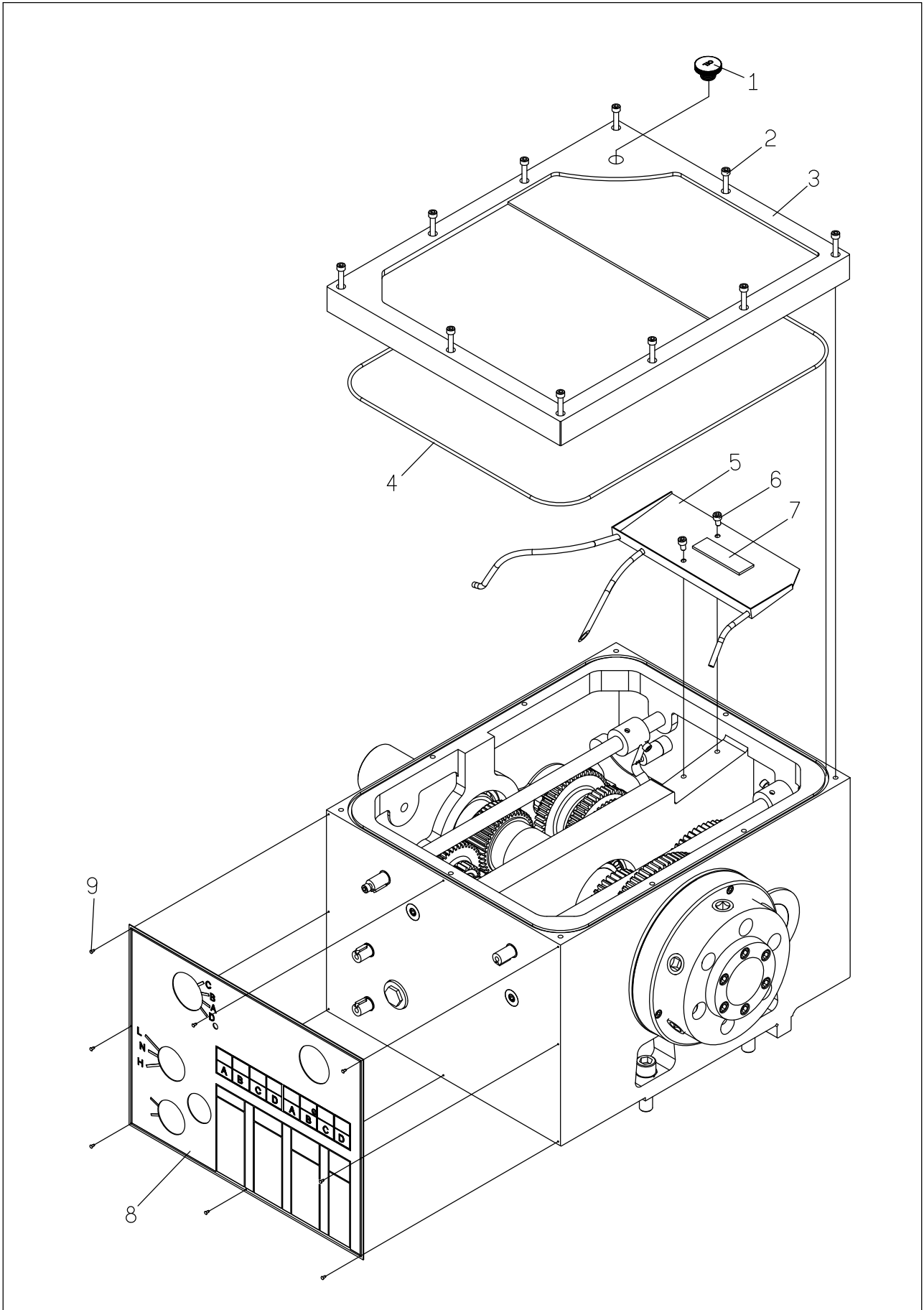


# Section 6 : Parts

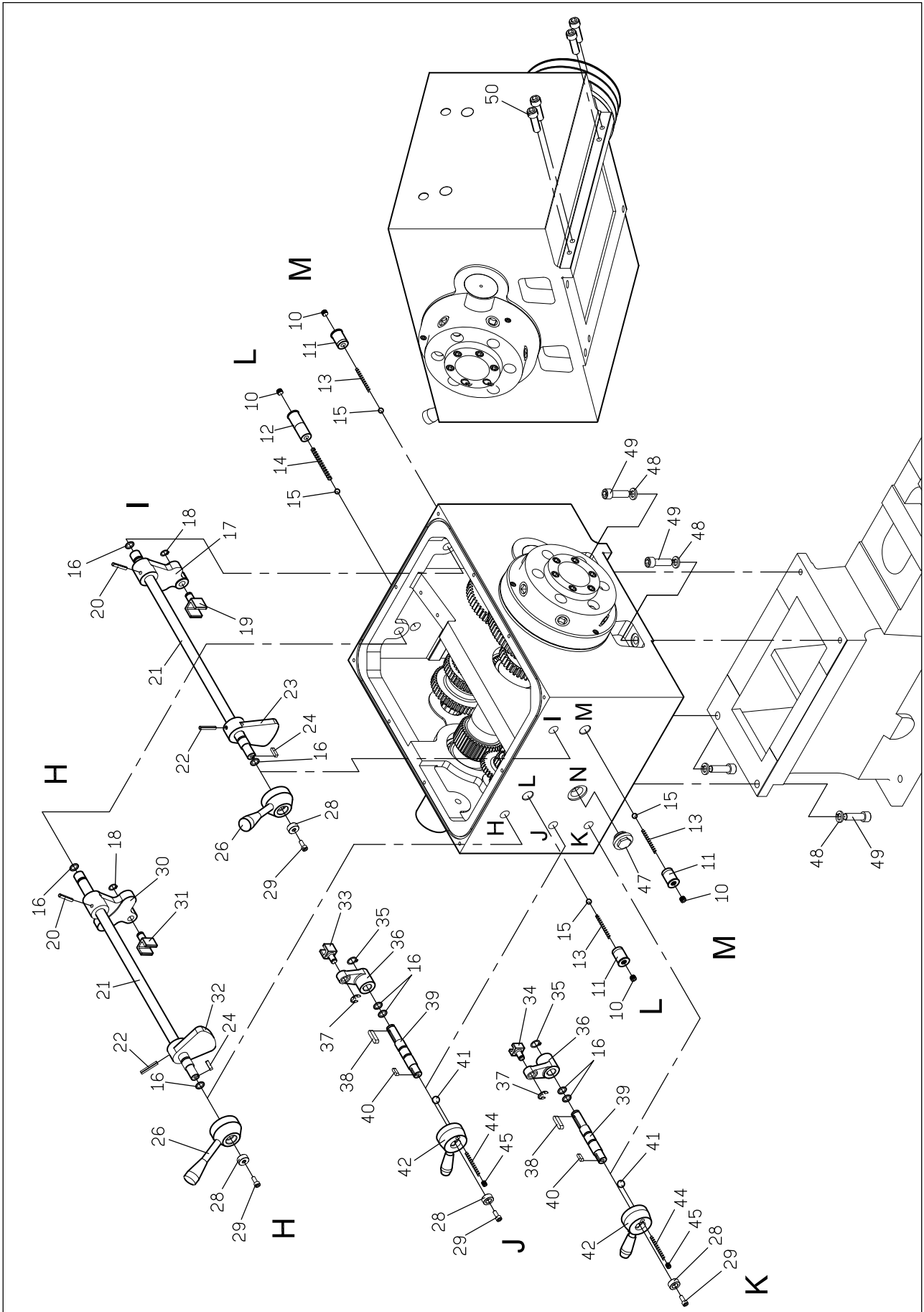
## Headstock



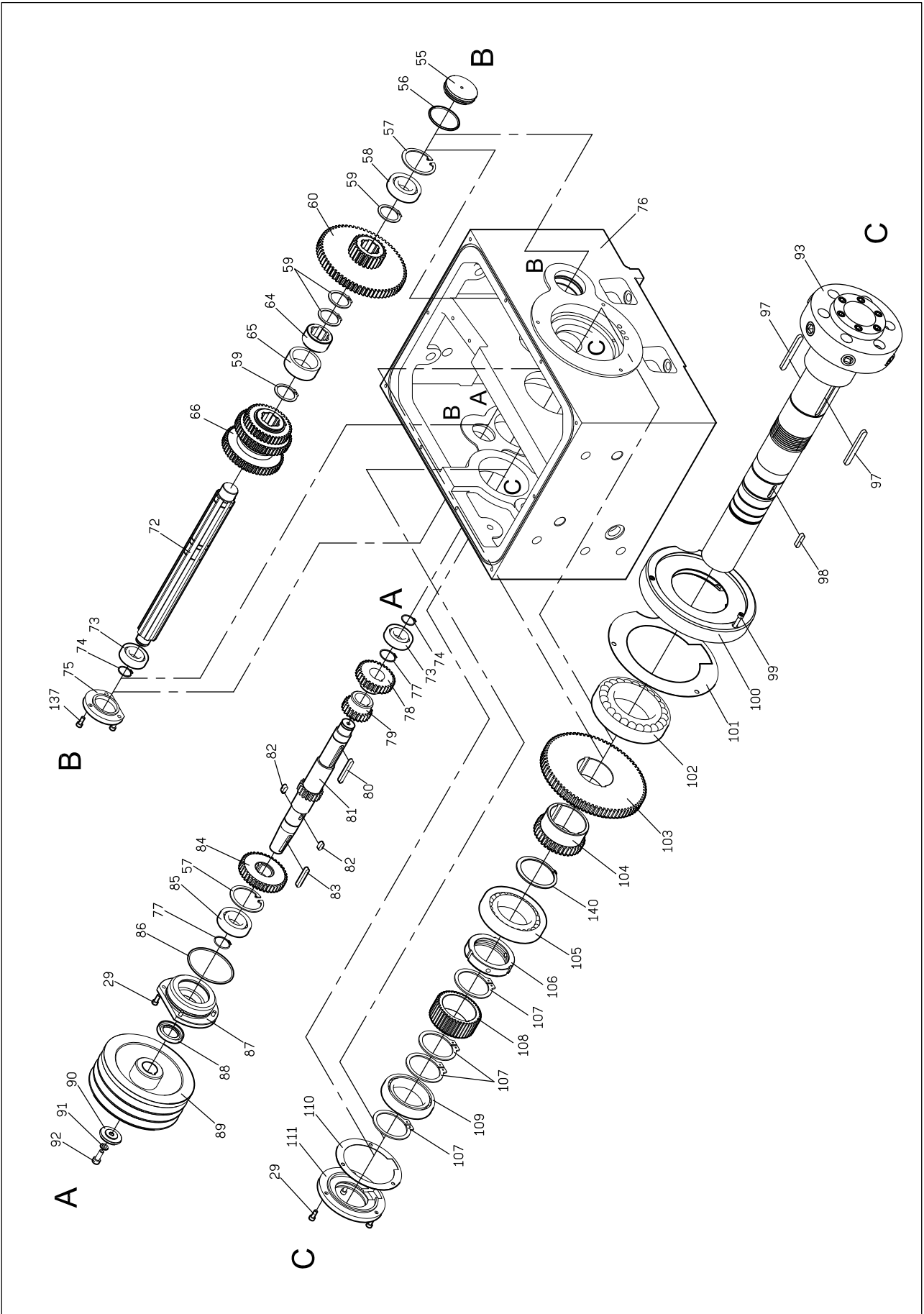
# Headstock



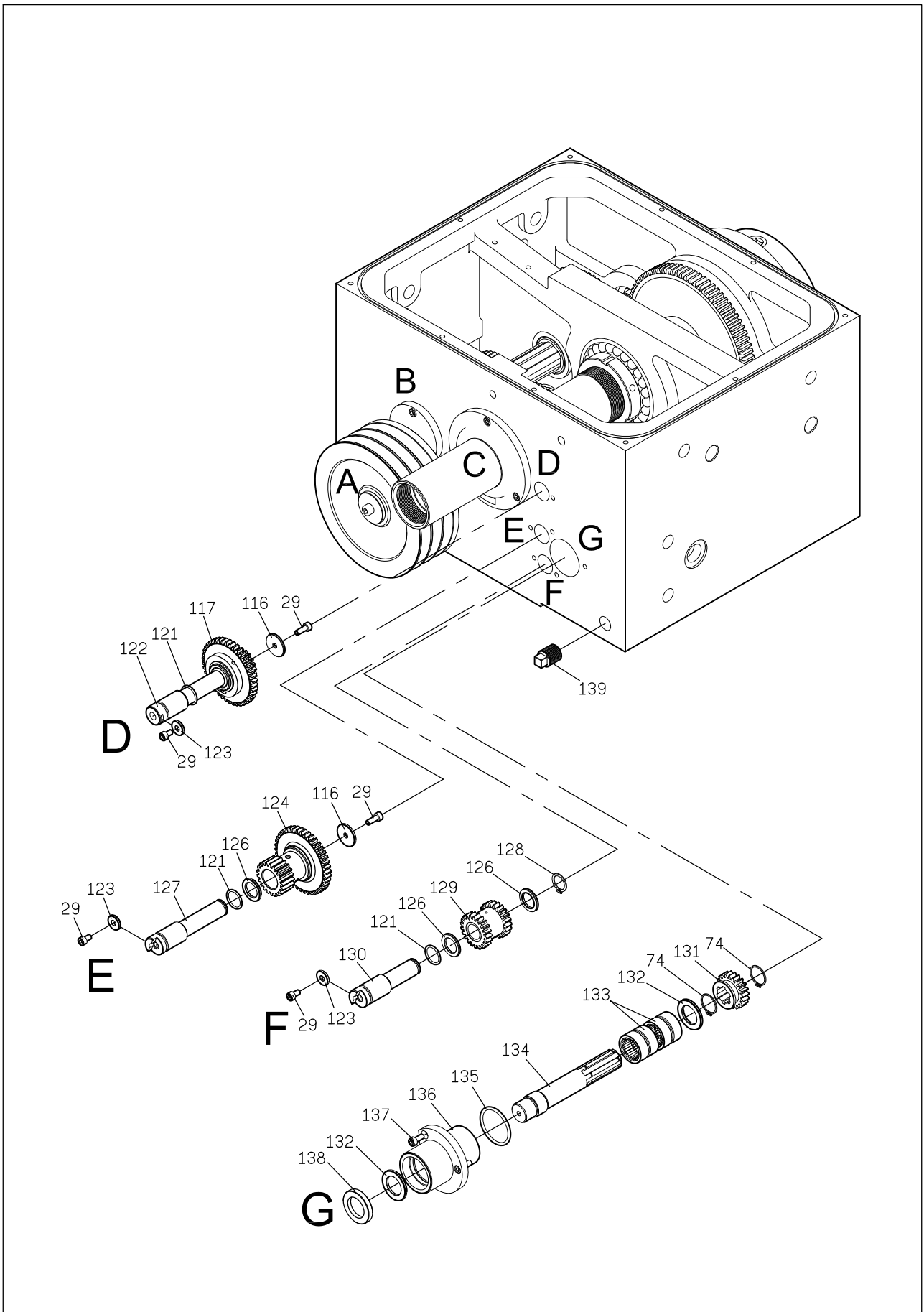
# Headstock



# Headstock



# Headstock



# Headstock

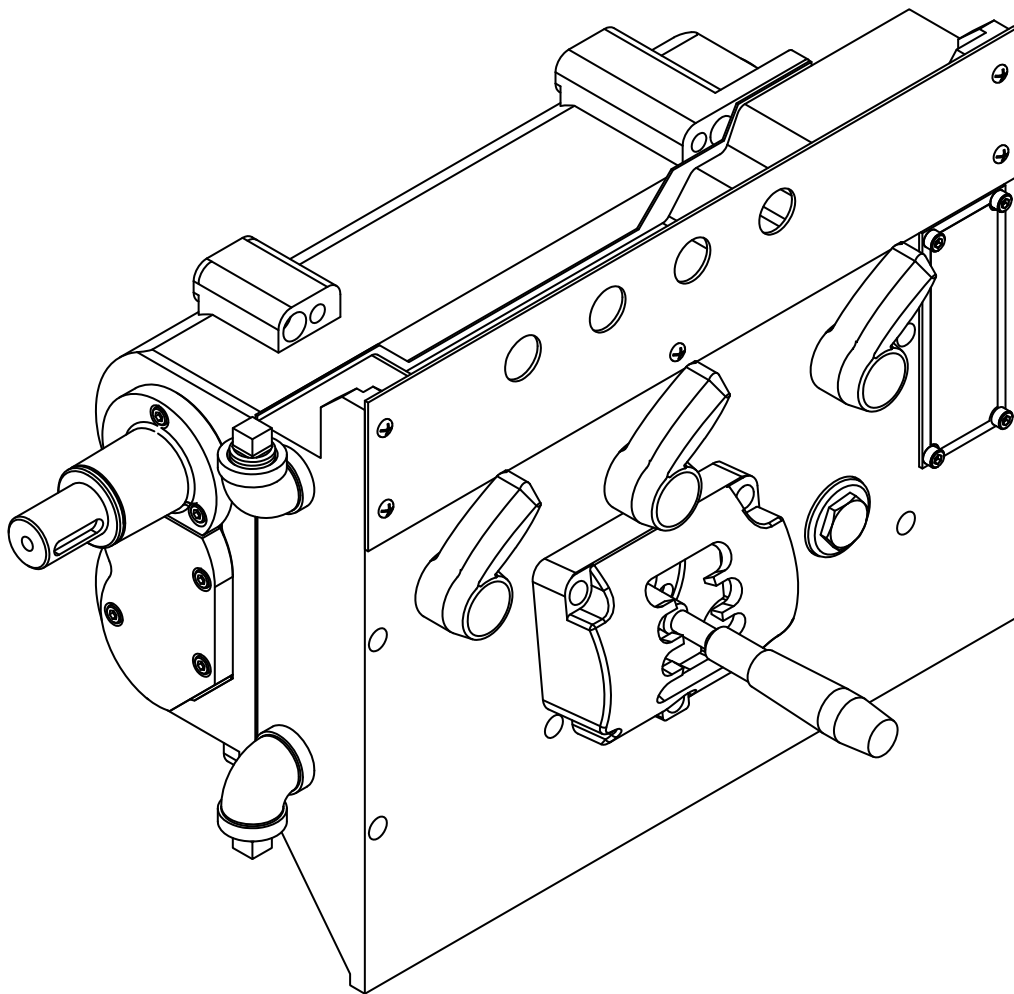
KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK	KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK	
1		Oil Cover	1	3/4"	44	20022	Spring	2	Ø6x27.5L	
2		Hex. socket head bolt	10	CAP 6x40	45		Set screw	2	M8x8L	
3	10057A	Headstock cover	1							
4		O ring	1	Ø4x1700	47		Oil sight	1	3/4"	
5	61053	Oil tank	1		48		Spring washer	4	M12	
6		Hex. socket head bolt	2	M6x10	49		Hex. socket head bolt	4	M12x45	
7		Magnetic iron plate	1		50		Hex. socket head bolt	4	M8x35	
8	61001	Name plate	1	Motor 4P						
	61001-5		1	Motor 4P/8P	55	10023	Plug	1		
9		Rivet	8	Ø2	56		O ring	1	G55	
10		Set screw	4	M10x10L	57		Clip	2	R62	
11	20026	Bush	3		58		Ball bearing	1	6206	
12	20029	Bush	1		59		Clip	4	S38	
13	20028	Spring	3	Ø8x37L	60	10019	Gear	1	24T	
14	ML-10084	Spring	1	Ø8x52.5L		10020	Key	2	10x6x20L	
15		Steel ball	4	Ø8.5			Gear	1	67T	
16		O ring	8	P14			Clip	1	S52	
17	20024A	Lever	1		64	10014	Collar	1		
18		Clip	2	S12	65	10110	Faceplate	1		
19	20030	Fork	1		66	10018A	Clip	1	S55	
20		Spring pin	2	Ø6x36			Gear	1	38T	
21	20014	Rod	2				10015A	Gear	1	46T
22		Spring pin	2	Ø6x40			10016A	Gear	1	50T
23	20015A	Lever	1				10017A	Gear	1	30T
24		Key	2	5x5x22L			Key	1	7x7x70	
26	20004	Spring pin	2	Ø3x24	72	10013A	Driving shaft	1		
	20003	Handle	2		73		Ball bearing	1	6205	
28	20027	Hub	2		74		Clip	3	S25	
28	20027	Washer	4		75	10022A	Cover	1		
29		Hex. socket head bolt	19	M6x16	76	14-10001	Headstock	1		
30	20023	Lever	1			16-10001				
31	20025	Fork	1		77		Clip	2	S30	
32	20010A	Lever	1		78	10027A	Gear	1	30T	
33	20044	Fork	1		79	10026A	Gear	1	22T	
34	20034	Fork	1		80		Key	1	7x7x55L	
35		Clip	2	S15	81	10025A	Gear shaft	1	18T	
36	20032	Lever	2		82		Key	2	7x7x16L	
37		Clip	2	E8	83		Key	1	7x7x45L	
38		Key	2	5x5x30L	84	10028A	Gear	1	38T	
39	20005	Shaft			85		Ball bearing	1	6206LU	
40		Key	2	5x5x17L	86		O ring	1	G85	
41		Steel ball	2	Ø1/4"	87	10024A	Flanged bearing	1		
42	20021	Hub	2		88		Oil seal	1	305008	
	20048	Handle	2		89	10031	Pulley	1		
		Spring pin	2	Ø3x24	90	10032	Washer	1		



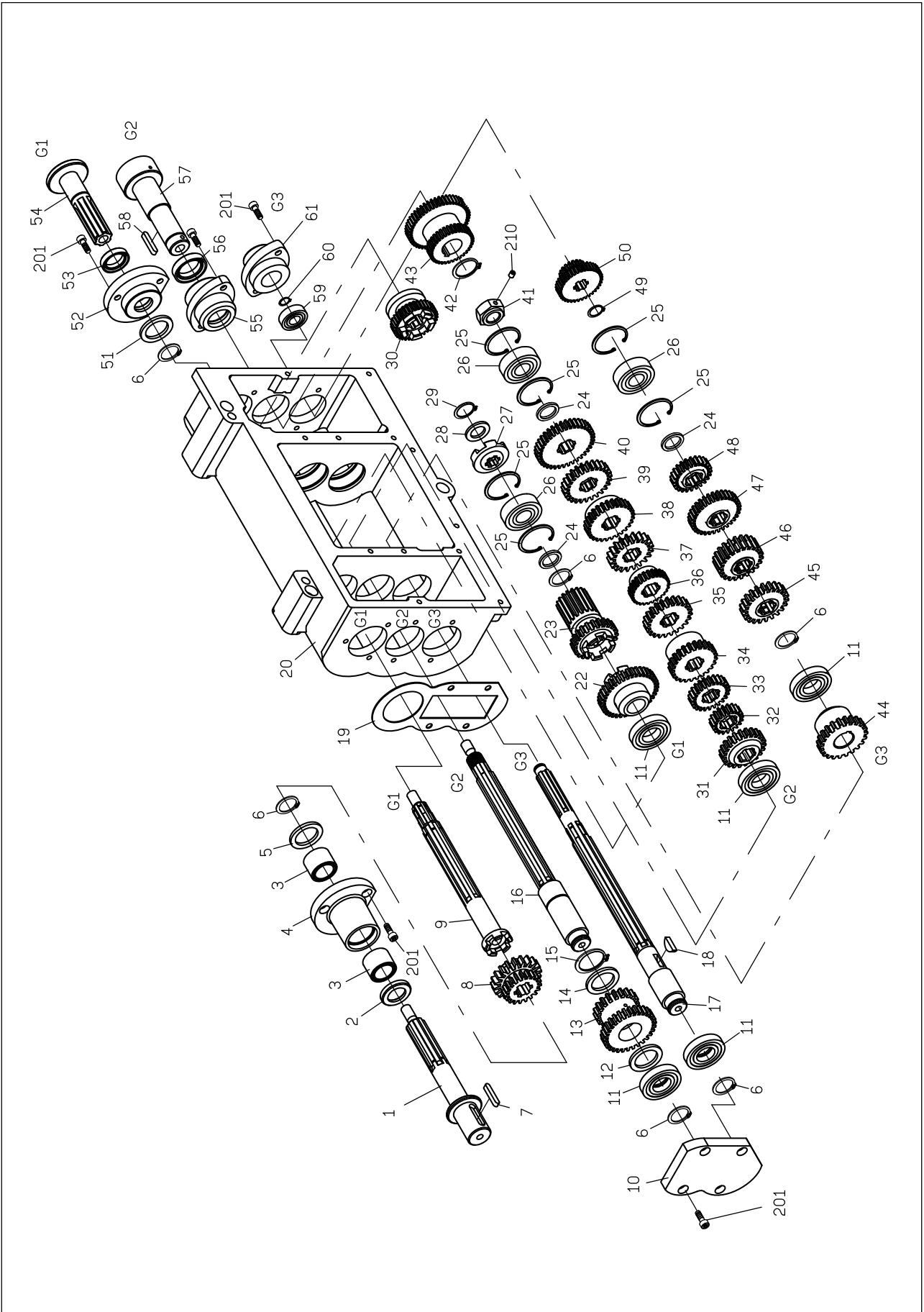
# Headstock

KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK	KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK
91		Spring washer	1	M8	131	10051	Gear	1	21T
92		Hex. socket head bolt	1	M8x25	132	10037	Washer	2	
93	10003	Bolt	6		133		Needle bearing	2	RNA-6904
	10003-D6	Spindle	1		134	10040	Shaft	1	
	10005	Cam spring	6		135		O ring	1	P44
	10004	Cams	6		136	10041	Flange bearing	1	
97		Key	2	10x6x85L	137		Hex. socket head bolt	3	M6x12
98		Key	1	7x7x30L	138		Oil seal	1	28x44x07
99		Hex. socket head bolt	3	M6x35	139		Square head plug	1	1/2"
100	10007-A6	Front bearing cover	1		140		Clip	1	S70
101	10007-P	Packing F	1						
102		Taper roller bearing	1	32019					
103	10008	Gear	1	79T					
104	10009	Gear	1	36T					
105		Taper roller bearing	1	30214A					
106		Nut	1	YSR70					
107		Clip	4	S65					
108	10010	Gear	1	42T					
109		Ball bearing	1	6013					
110	10012-P	Packing O	1						
111	10012	Outside cover	1						
116	10038	Washer	2						
117	13-10049	Gear	1	21T					
	13-10050	Gear	1	42T					
		Key	1	6x6x16					
		Clip	1	S35					
121		O ring	3	P21					
122	13-10034	Shaft	1						
123	13-10039	Washer	3						
124		Key	1	6x6x16					
		Clip	1	S35					
	13-10048	Gear	1	42T					
	13-10047	Gear	1	21T					
126	10036	Washer	3						
127	13-10035	Shaft	1						
128		Clip	2	S20					
129	10046	Gear	1	21T					
130	13-10033	Shaft	1						

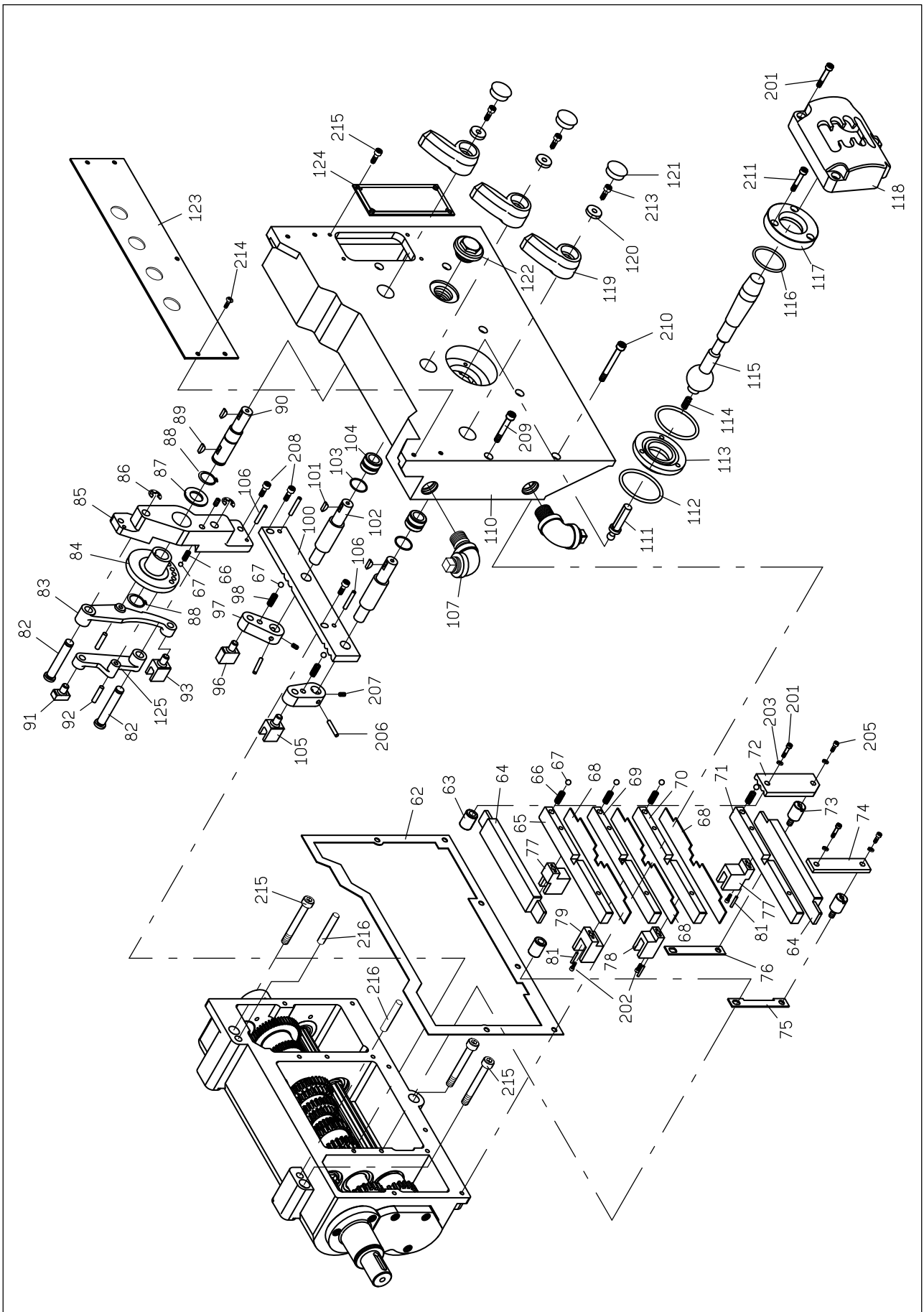
# Gearbox



# Gearbox



# Gearbox



# Gearbox

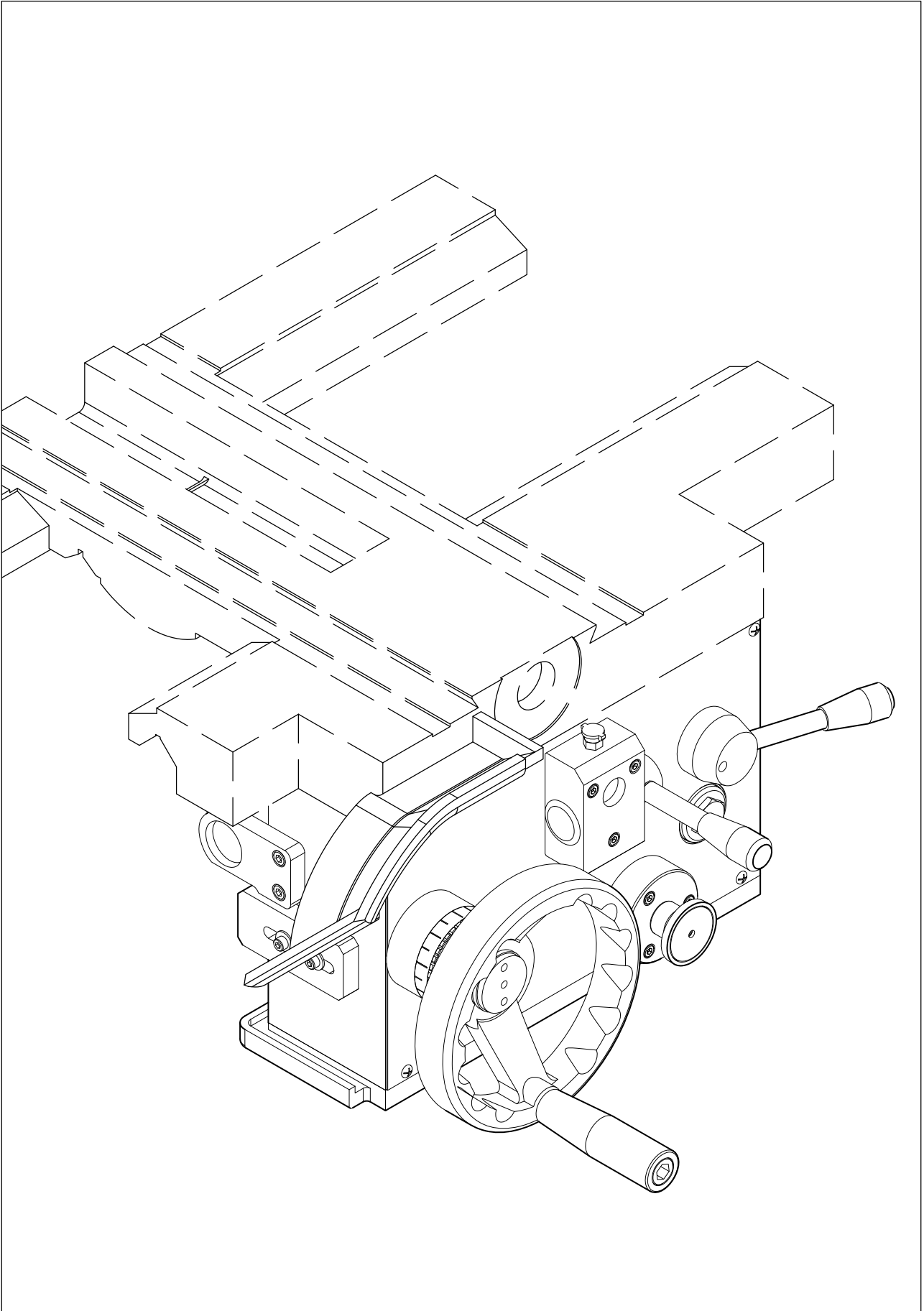
KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK	KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK
1	30003	Shaft	1		46	30039	Gear	1	22T
2		Oil seal	1	20x32x05	47	30040	Gear	1	33T
3		Bearing	2	TAF202820	48	30041	Gear	1	22T
4	30005	Flanged bearing	1		49		Clip	1	S17
5	30004	Washer	1		50	30042	Gear	1	20T/36T
6		Clip	6	S20	51	30016	Washer	1	
7		Key	1	7x7x30	52	30017	Flanged bearing	1	
8	30007	Gear	1	19T/20T	53		Oil seal	1	20x32x05
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	5x $\psi$ 19	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	$\phi$ 6.35x20
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	$\phi$ 3x16
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	4x $\phi$ 13
45	30038	Gear	1	22T	90	30057	Shaft	1	

# Gearbox

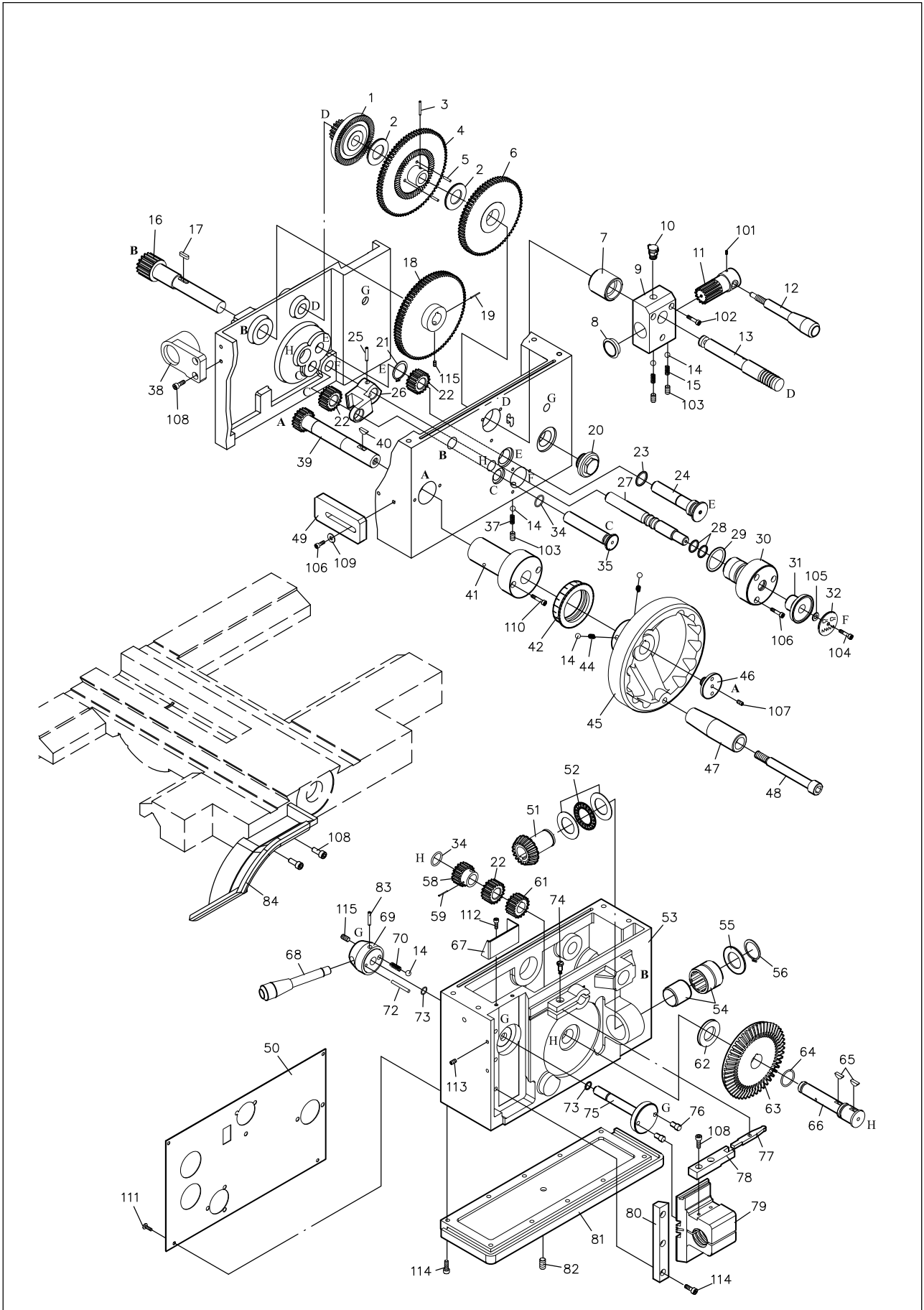
KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK	KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK
91	30047	Pad	1		201		Hex. socket head bolt	19	CAP 6x12
92	30062	Pin	2		202		Hex. socket head bolt	4	CAP 5x20
93	30063	Fork	1		203		Spring washer	4	M6
					205		Hex. socket head bolt	2	CAP 6x35
96	30046	Pad	1		206		Spring 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	61023	Switch plate	1						
124	30104	Plate	1						
125	30064	Arm	1						



# Apron



# Apron



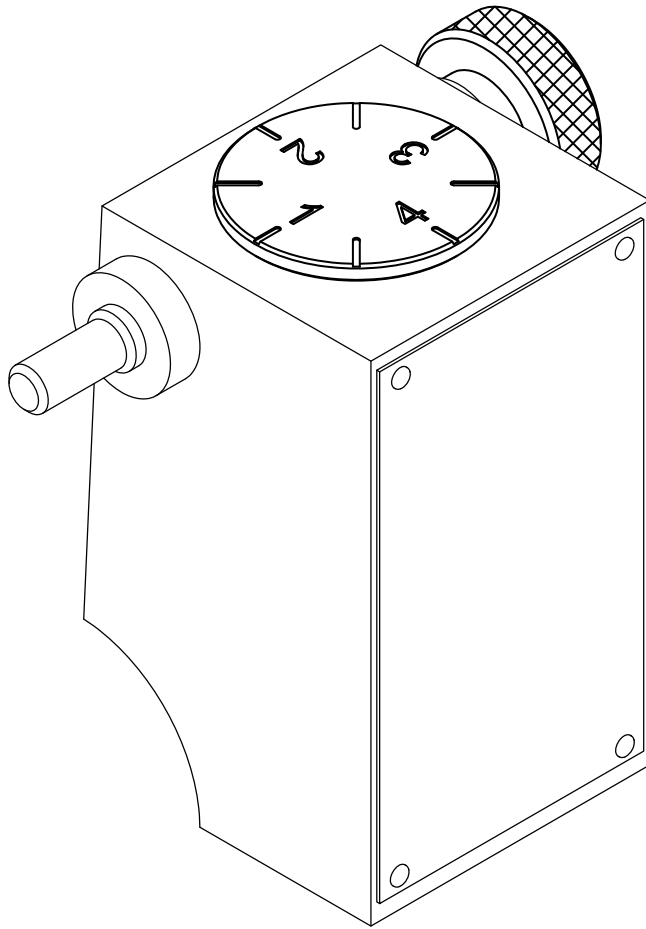
# Apron

KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK	KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK
1	40014	Gear	1	18T/60T	42	40005-M	Index ring	1	
2		Washer	2	AS3047		40005-I			
3		Spring pin	1	Ø4x22					
4	40015	Gear	1	81T/60T	44	40016	Spring	3	
5		Pin	3	Ø4x17	45	40007	Handle wheel	1	
6	40017	Gear	1	72T/60T	46	40011	Plug	1	
7	40060	Collar	1		47	40009	Handle	1	
8	40071	Plug	1		48	40008	Screw	1	
9	40023	Gear bracket	1		49	40078	Safety plate	1	
10		Oil cap	1		50	40077	Plate	1	
11	40019	Cam shaft	1		51	40034-N	Bevel gear	1	30T
12	40020	Handle	1		52		Thrust bearing	1	NTB/AS-2542
13	40018	Shaft	1		53	40001-L	Apron	1	
14		Steel ball	7	1/4"		40001-R			
15	13-30099	Spring	2	Ø6x13	54		Bearing	1	NK29/30
16	40013	Gear shaft	1	16T	55	40032	Washer	1	
17		Key	1	5x5x18	56		Clip	1	S25
18	40012-M	Gear	1	82T					
	40012-I			81T	58	40066	Gear	1	18T
19		Spring pin	1	Ø5x36	59		Spring pin	1	Ø5x22
20		Oil sight	1						
21		Clip	1	S16	61	40065	Gear	1	18T
22	40067	Gear	3	18T	62	40035	Washer	1	
23		O ring	2	P18	63	40033-N	Bevel gear	1	64T
24	40068	Shaft	1		64		O ring	1	P18
25		Spring pin	1	Ø4x24	65		Woodruff key	2	4xØ13
26	40063-L	Fork	1		66	40031-N	Shaft	1	
	40073-R				67	49001-L	Oil fence	1	
27	40062	Shaft	1		68	40037	Handle	1	
28		O ring	2	P16	69	40038	Hub	1	
29		O ring	1	P26	70		Spring	1	Ø6x27
30	40061	Shaft liner	1						
31	40076	Knob	1		72		Spring pin	1	Ø4x24
32	40025-L	Plate	1		73		O-ring	2	P9
	40024-R				75	40039	Cam shaft	1	
34		O ring	2	P12	76	40040	Pin	2	
35	40064	Shaft	1		77	40044	Lever	1	
					78	40042	Stopper	1	
37		Spring	1	Ø4x19	79	40041-M	Half nut	1	
38	40072	Bracket	1			40041-I			
39	40003	Gear shaft	1	18T	80	40043	Gid	1	
40		Woodruff key	1	19xØ5	81	40046	Base plate	1	
41	40004-M	Shaft liner	1		82		Plug	1	1/8"
	40004-I				83		Spring pin	1	Ø4x36
					84	13-40080	Handle wheel guard	1	

# 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					

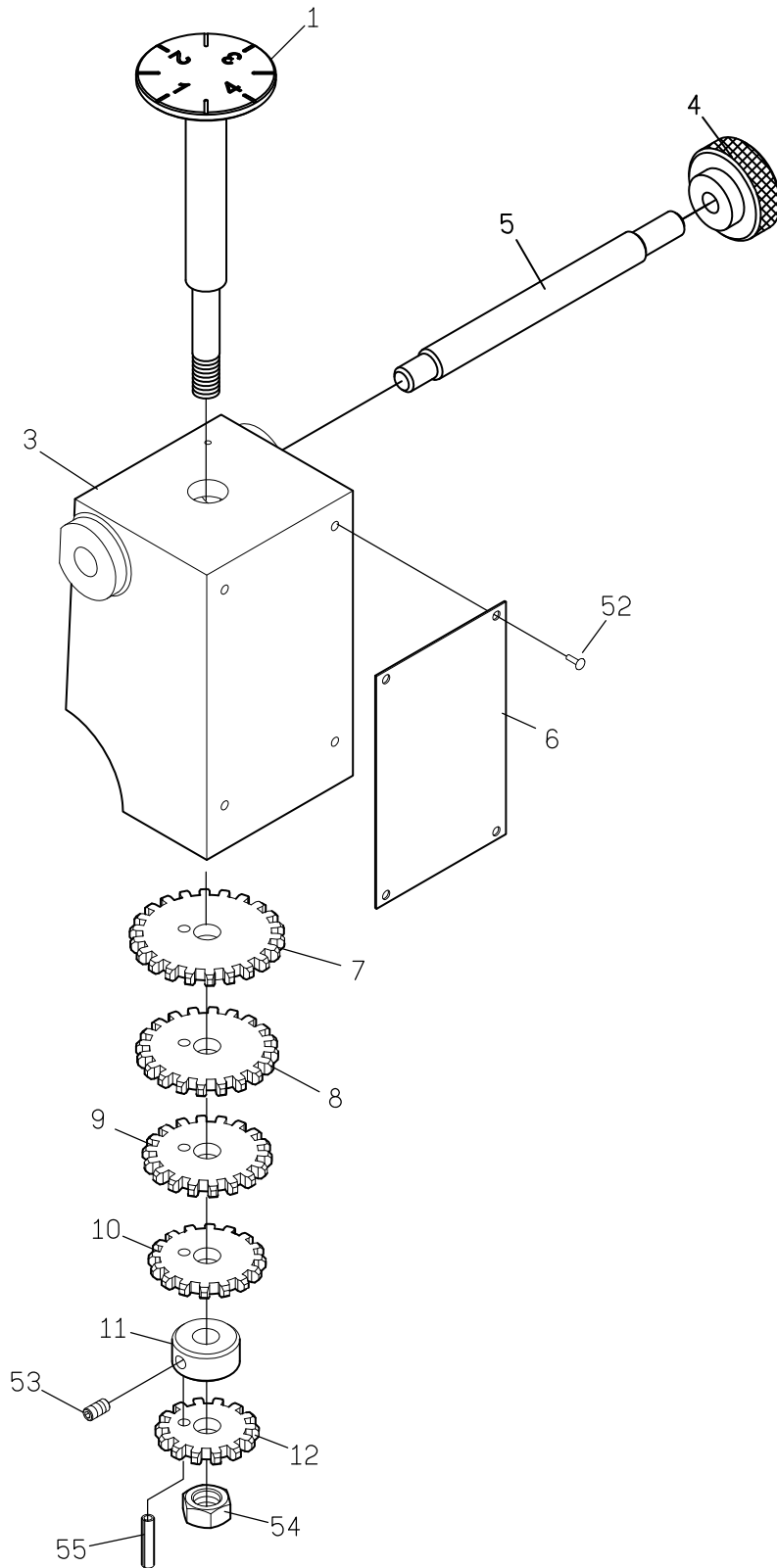
# Dail Indicator





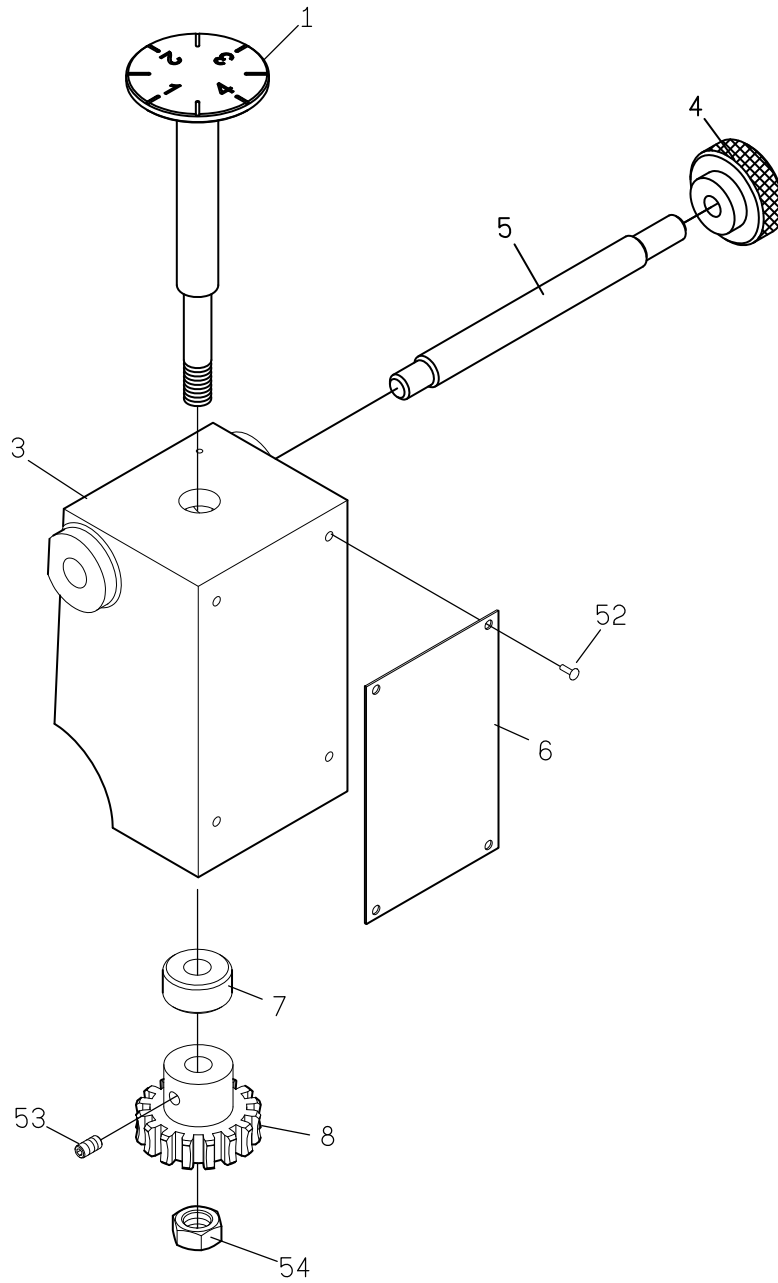
# Dial Indicator

**METRIC**



# Dial Indicator

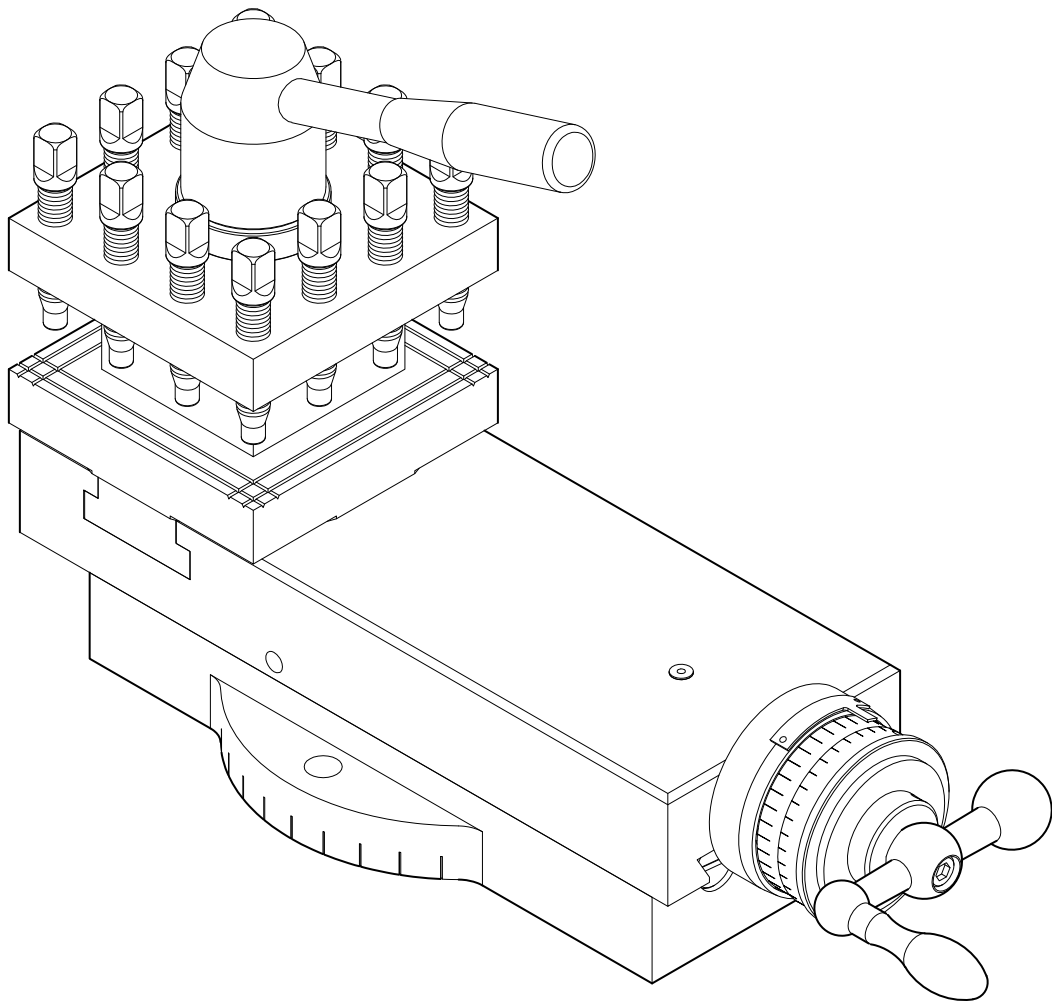
IMPERIAL



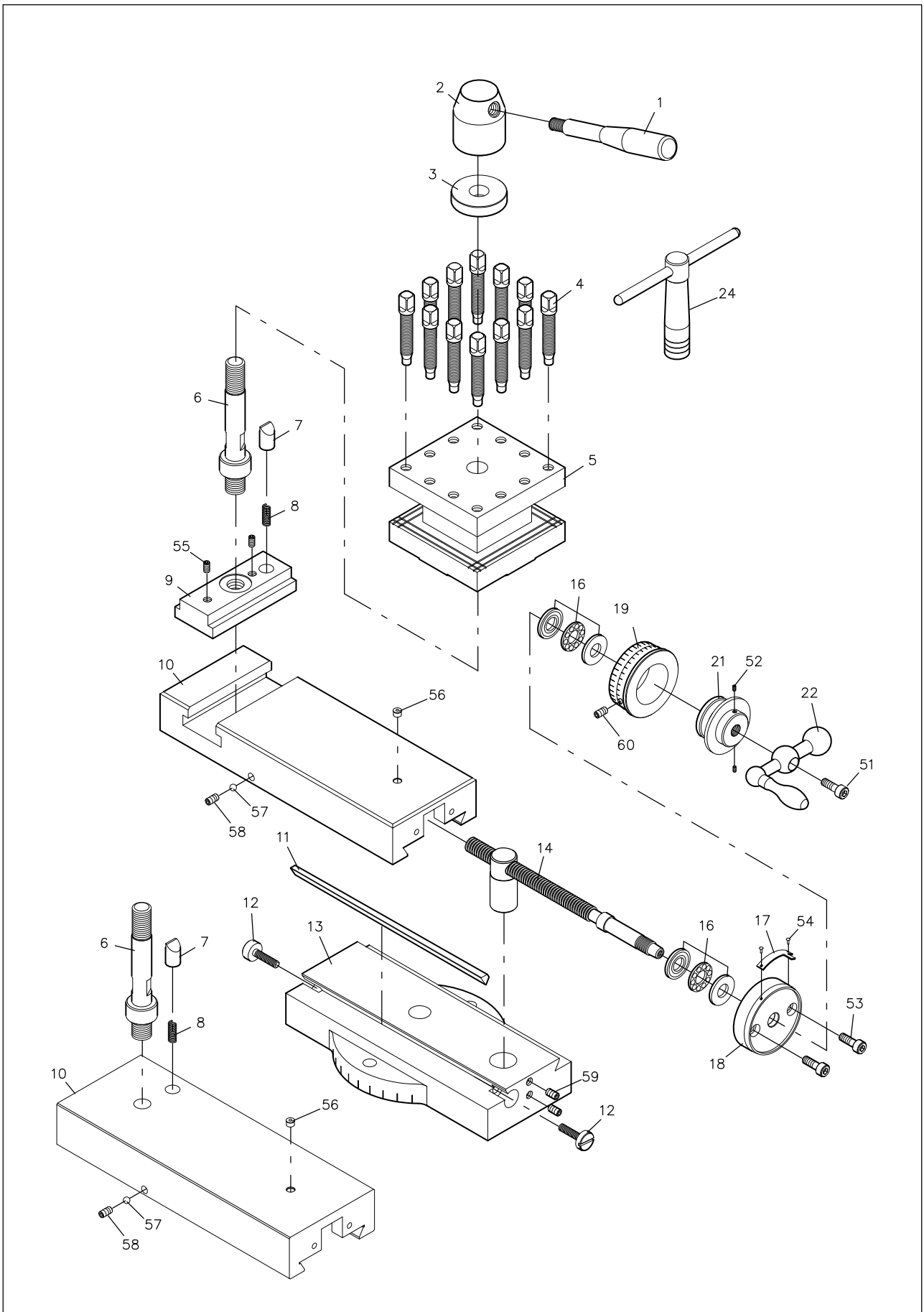
# Dail Indicator

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



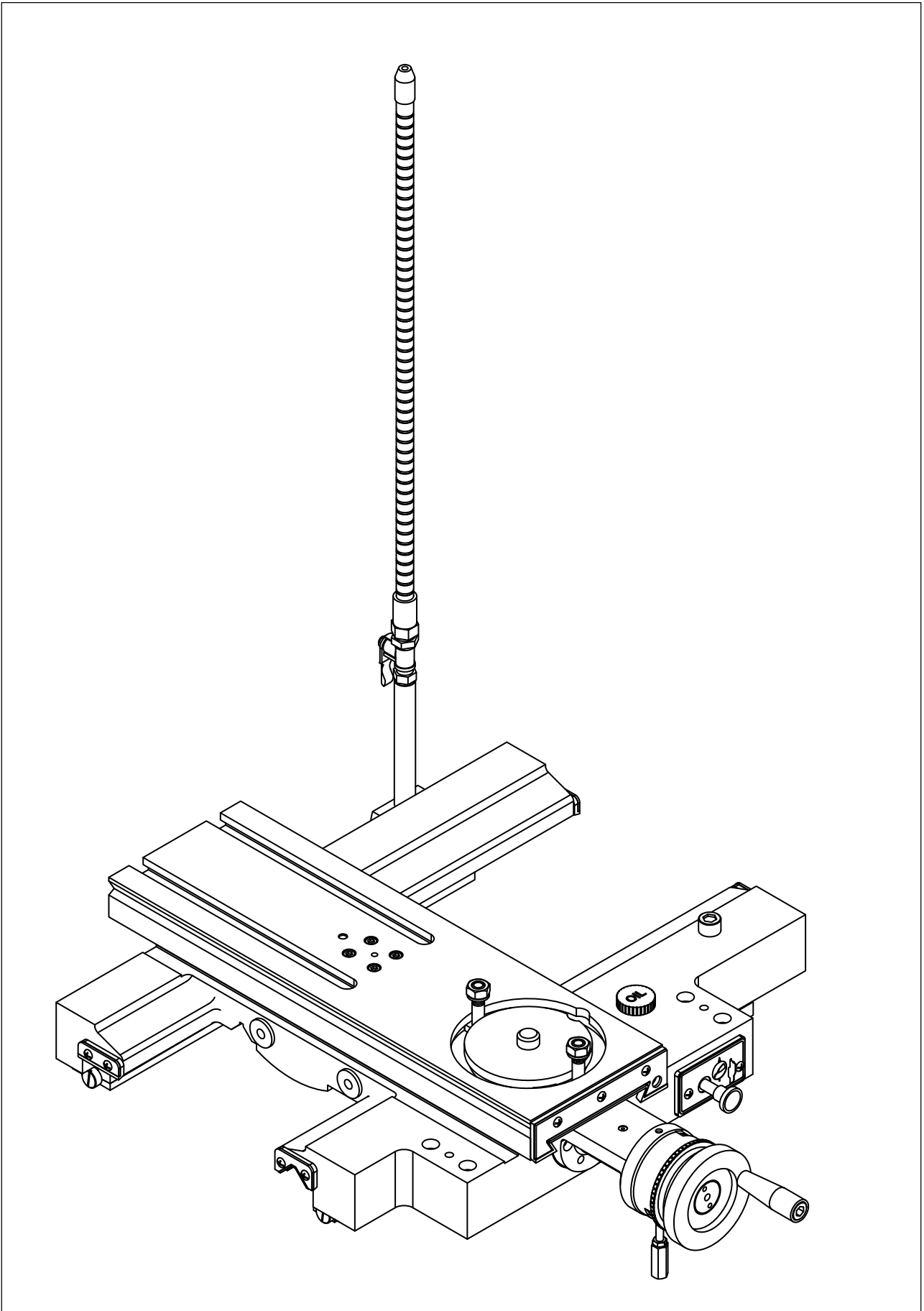
# Compound Rest & Tool Post



# Compound Rest & Tool Post

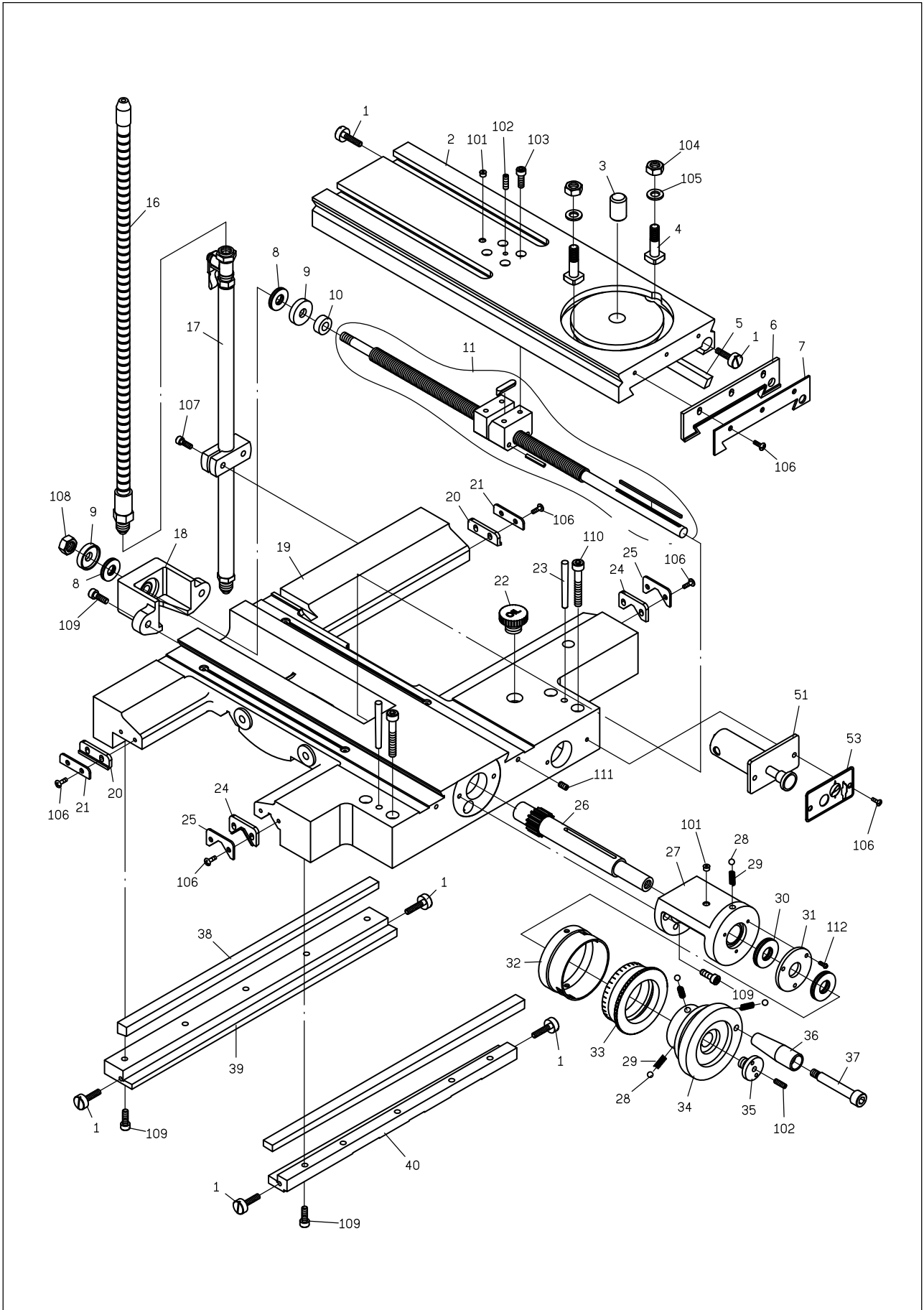
KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK	KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK
1	50067	Handle	1		51		Hex. Socket head bolt	1	CAP 6x10
2	50066	Turret nut	1		52		Set screw	2	SET 5x8
3	50065	Collar	1		53		Hex. Socket head bolt	2	CAP 6x20
4	50068	Bolt	12		54		Rivet	2	Ø2
5	50060	Turret body	1		55		Set screw	2	SET 8x16
6	50062	Turret shaft	1		56		Oil ball	1	1/4"
7	50064	Pin	1		57		Steel ball	1	1
8	50043	Spring	1		58		Set screw	1	SET 8x12
9	50061	T Nut	1		59		Set screw	2	SET 6x16
10	50006 50006-SP	Solid topslide	1		60		Set screw	1	SET 5x10
11	50056	Gib	1						
12	50054	Screw	1						
13	14-50004 16-50004	Swivel slide	1						
14	50038-M 50042-M 50038-I 50042-I	Nut Screw Nut Screw	1 1 1 1						
16		Trust bearing	2	51101					
17	50063	Curve pilot	1						
18	50041	Keep assy	1						
19	50044-M 50044-X	Dial Dual Dial	1						
21	50111	Bush	1						
22	50045	Handle wheel	1						
24	50108	T wrench	1						

# Saddles

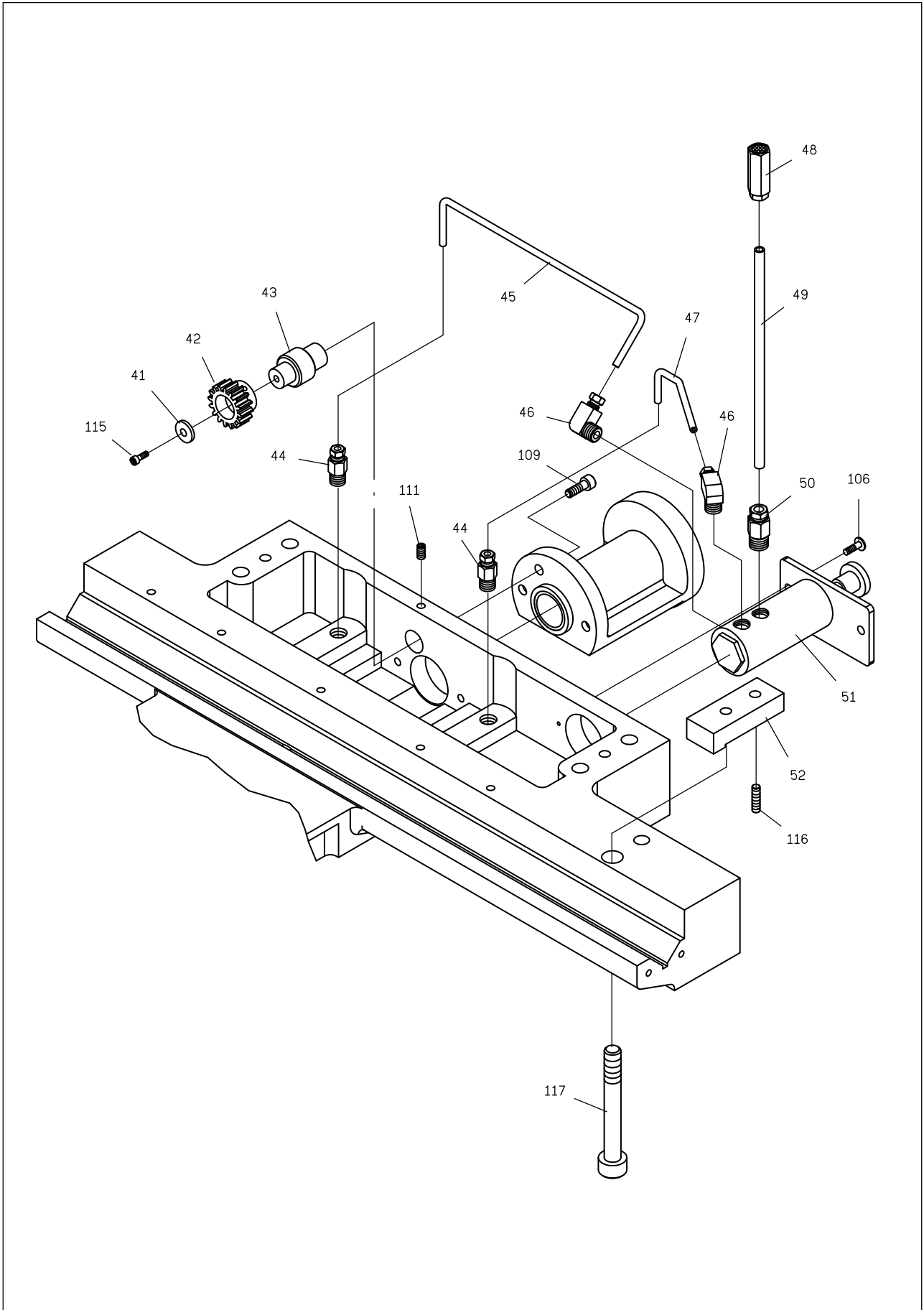




# Saddles



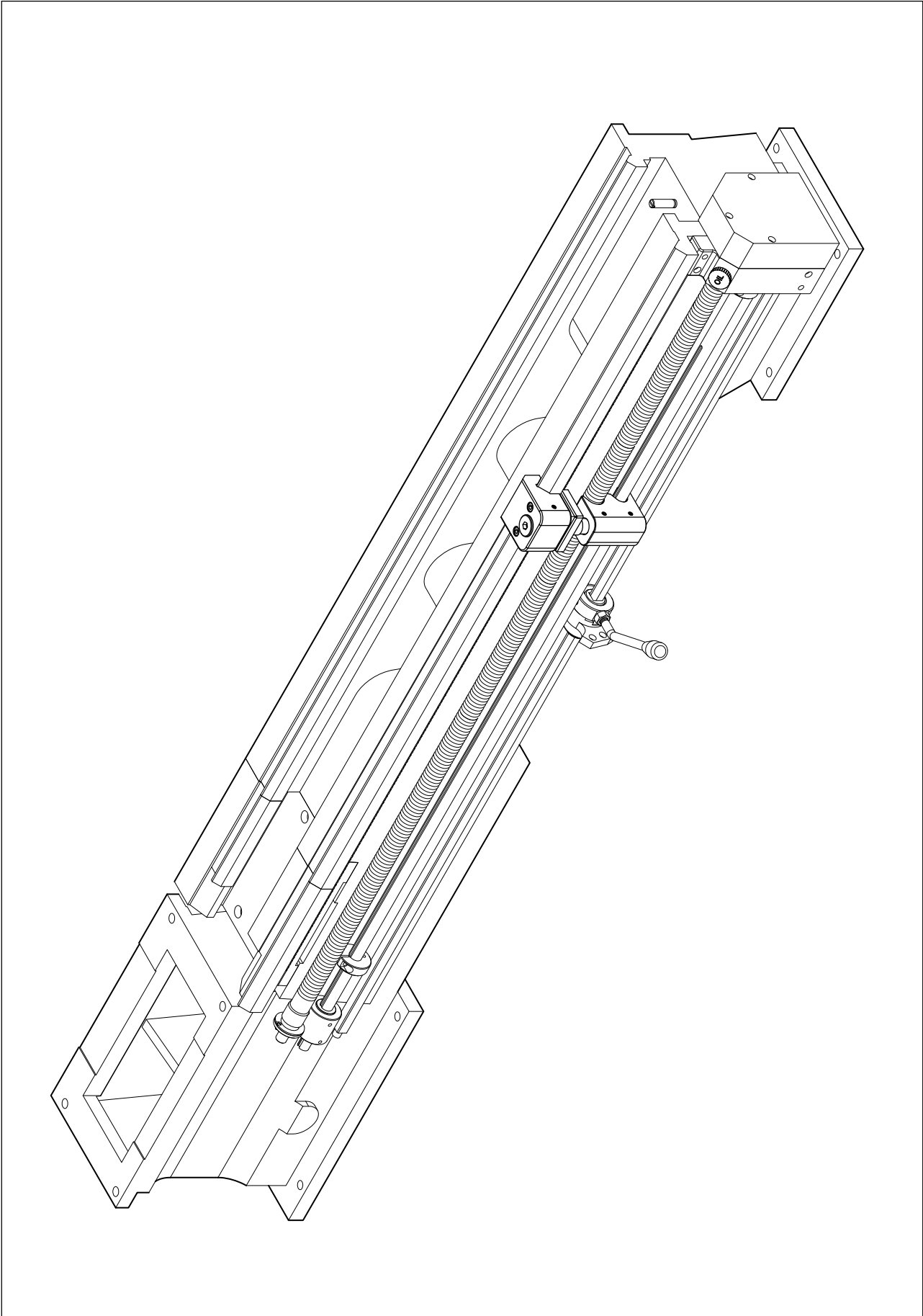
# Saddles



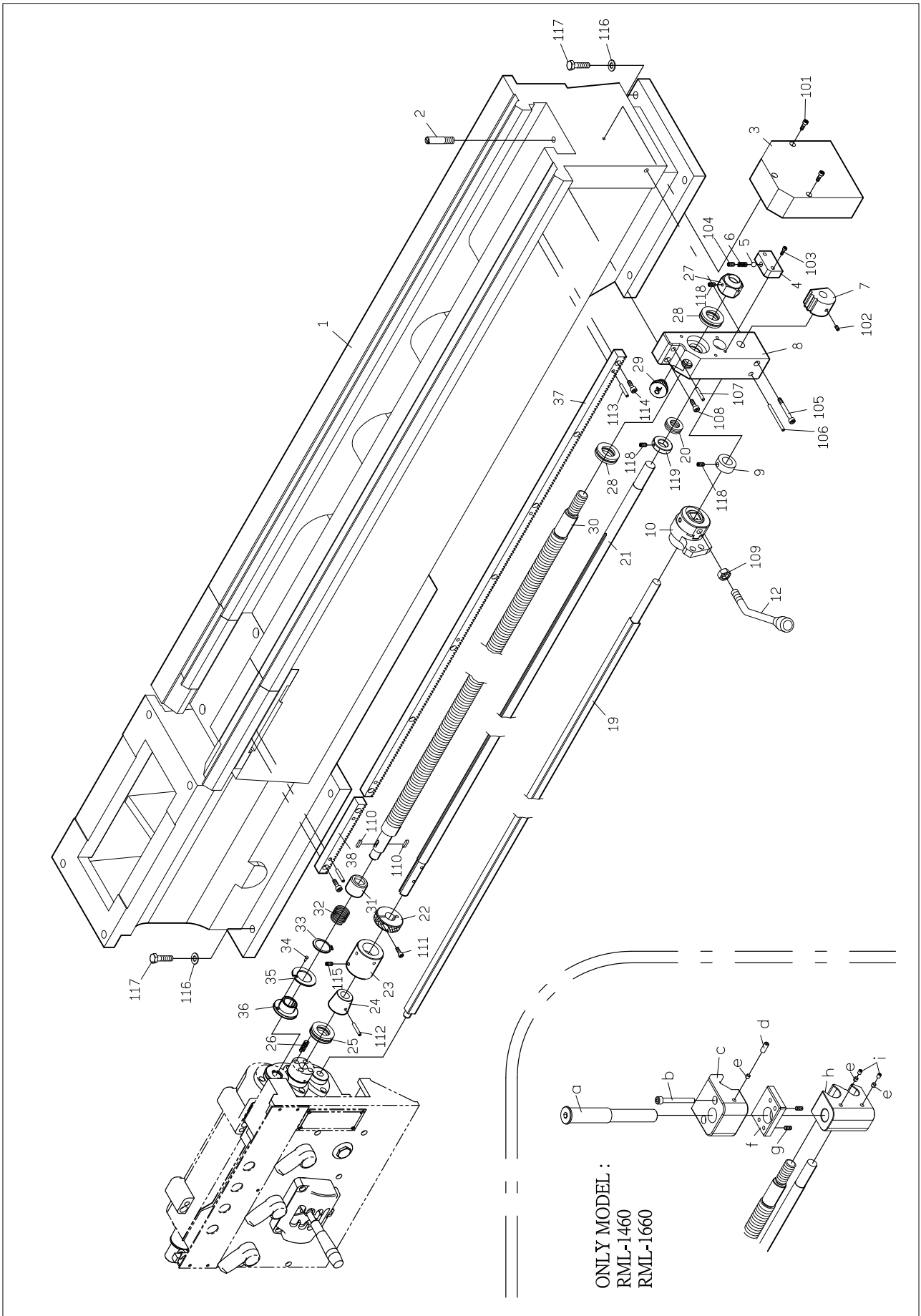
# Saddles

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					
	50030-I	Dual dial	1	200div/I , 254div/M					
34	50029	Hand wheel	1						
35	50033	Fix screw	1	M12xP1.75					
36	50035	Handle	1						

# Bed & Shafts



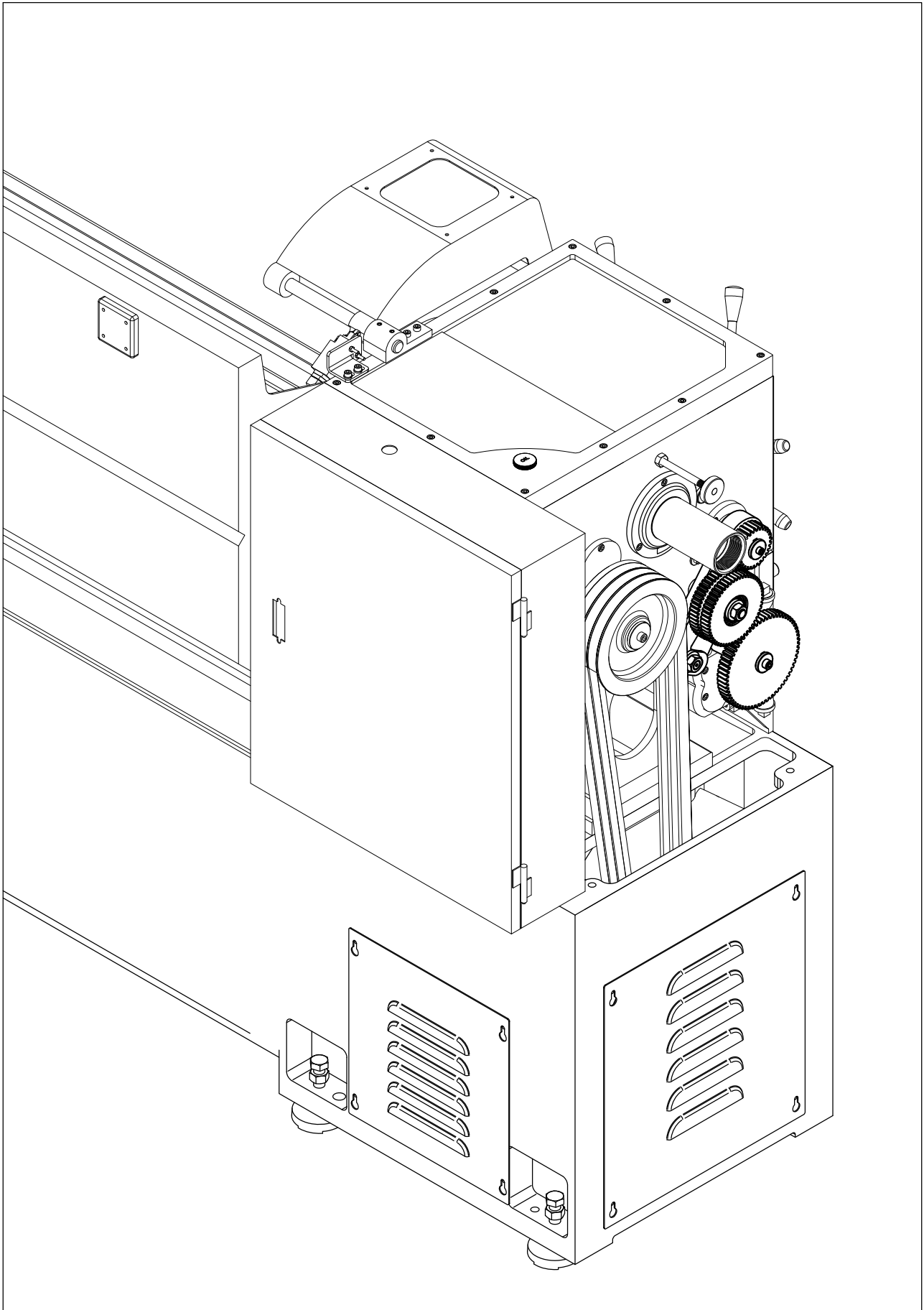
# Bed & Shafts



# Bed & Shafts

KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK	KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK
1	63001-40	Bed	1		38	13-63024-GL	Gap Rack	1	14DP
	63001-60					14-63024-60G			14DP
2	63038	Bolt	1		101		Hex. socket head bolt	3	CAP 6x55
3	63027	Cover	1		102		Set screw	1	SET 6x16
4	63028	Fixed block	1		103		Hex. socket head bolt	2	CAP 6x25
5		Steel ball	1	5/16"	104		Set screw	1	SET 10x10
6	18-40015	Spring	1		105		Hex. socket head bolt	1	CAP 8x70
7	63029	Switch flanged	1		106		Taper pin	1	#7x3 1/4"L
8	63026	Bracket	1		107		Taper pin	1	#7x2"L
9	63043	Collar	1		108		Hex. socket head bolt	1	CAP 8x35
10	63020	Lever assy	1		109		Nut	2	M12
	63021	Pin	2		110		Key	2	5x5x15
	63015	Third rod bracket	1		111		Hex. socket head bolt	1	CAP 6x20
	63019	Sleeve	1		112		Taper pin	1	#4x30L
	63018	Spring	1		113		Spring pin	6	Ø6x25L
	63017	Spring cover	1		114		Hex. socket head bolt	9	CAP 6x20
			Snap ring	1	S32	115		Set screw	1
12	63022	Handle	1		116		Washer	8	M12
	63030	Knob	1		117		Hexagon head bolt	8	M12x45
19	63014A-40	Third rod shaft	1		118		Set screw	3	SET 6x8
	63014A-60				119	60035	Collar	1	
20		Thrust bearing	1	NTB/AS2 1831					
21	63011A-40	Feed rod	1						
	63011A-60				a	63048-60	Shaft	1	
22	63012	Stopper	1		b		Hex. socket head bolt	2	CAP 8x30
23	63016	Clutch collar	1		c	63046-60	Chunk	1	
24	63013	Bush	1		d		Set screw	1	SET 8x20
25		Thrust bearing	1	51203	e	63050-60	Pin	3	
26	63042	Spring	4		f	63049-60	Chunk	1	
27	63025	Nut	1		g		Set screw	2	SET 8x16
28		Thrust bearing	2	51105	h	63047-60	Bracket	1	
29		Oil cover	1		i		Set screw	2	SET 8x8
30	63005A-40M	Leadscrew	1						
	63005A-40I								
	63005A-60M								
	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						
37	13-63023-40	Rack	1	14DP					
	14-63023-60		2	14DP					

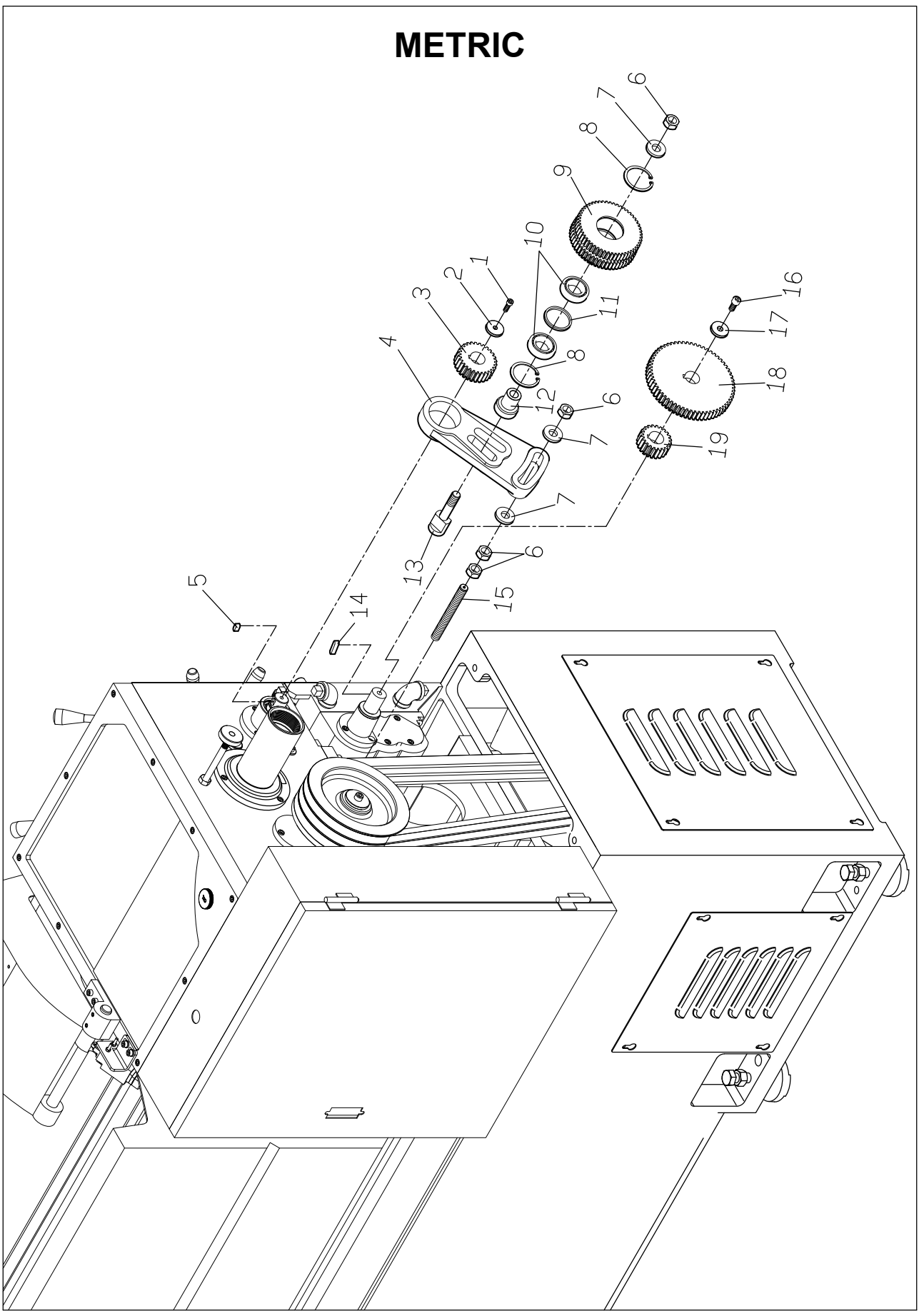
# End Gear





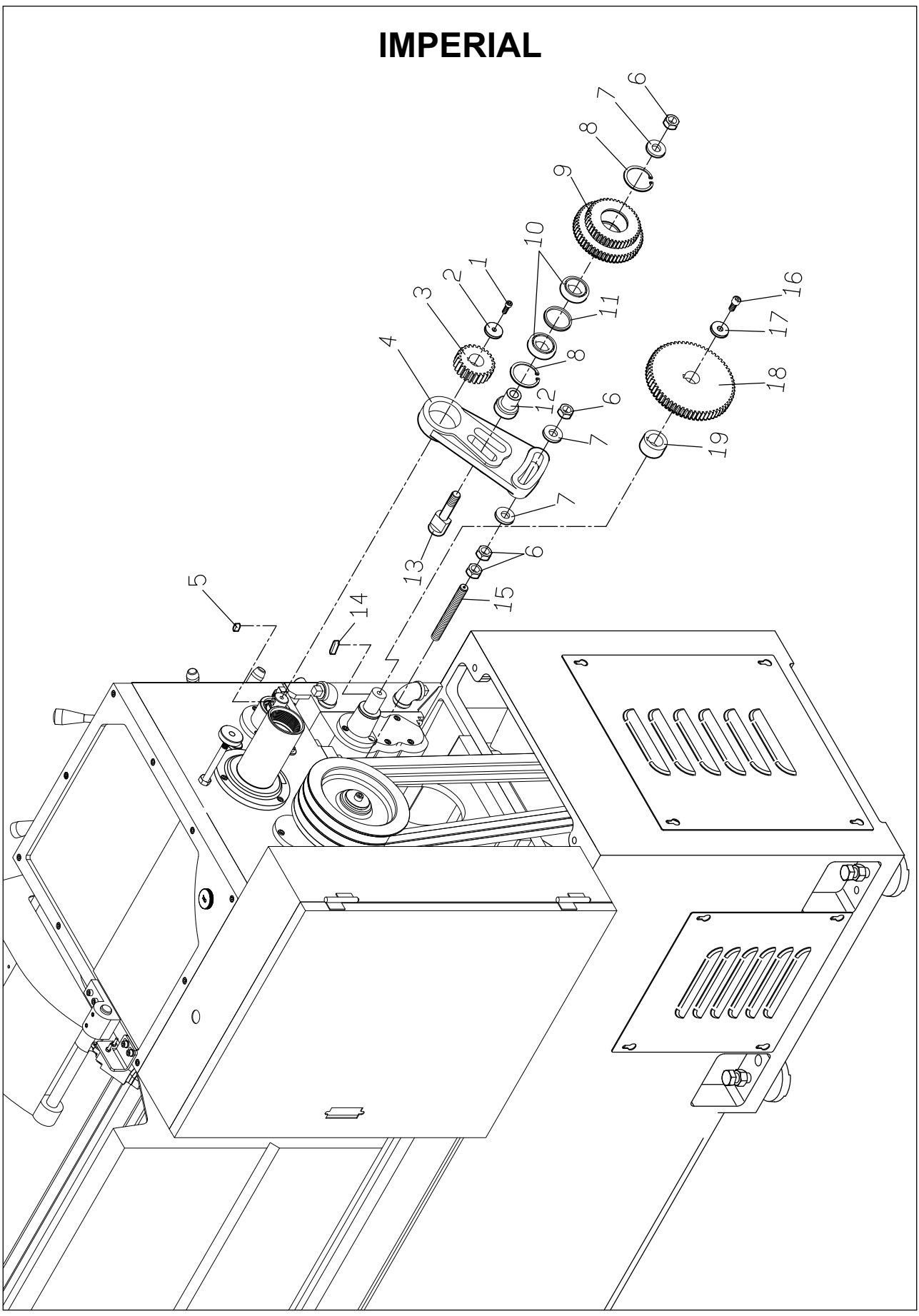
# End Gear - 14"

METRIC



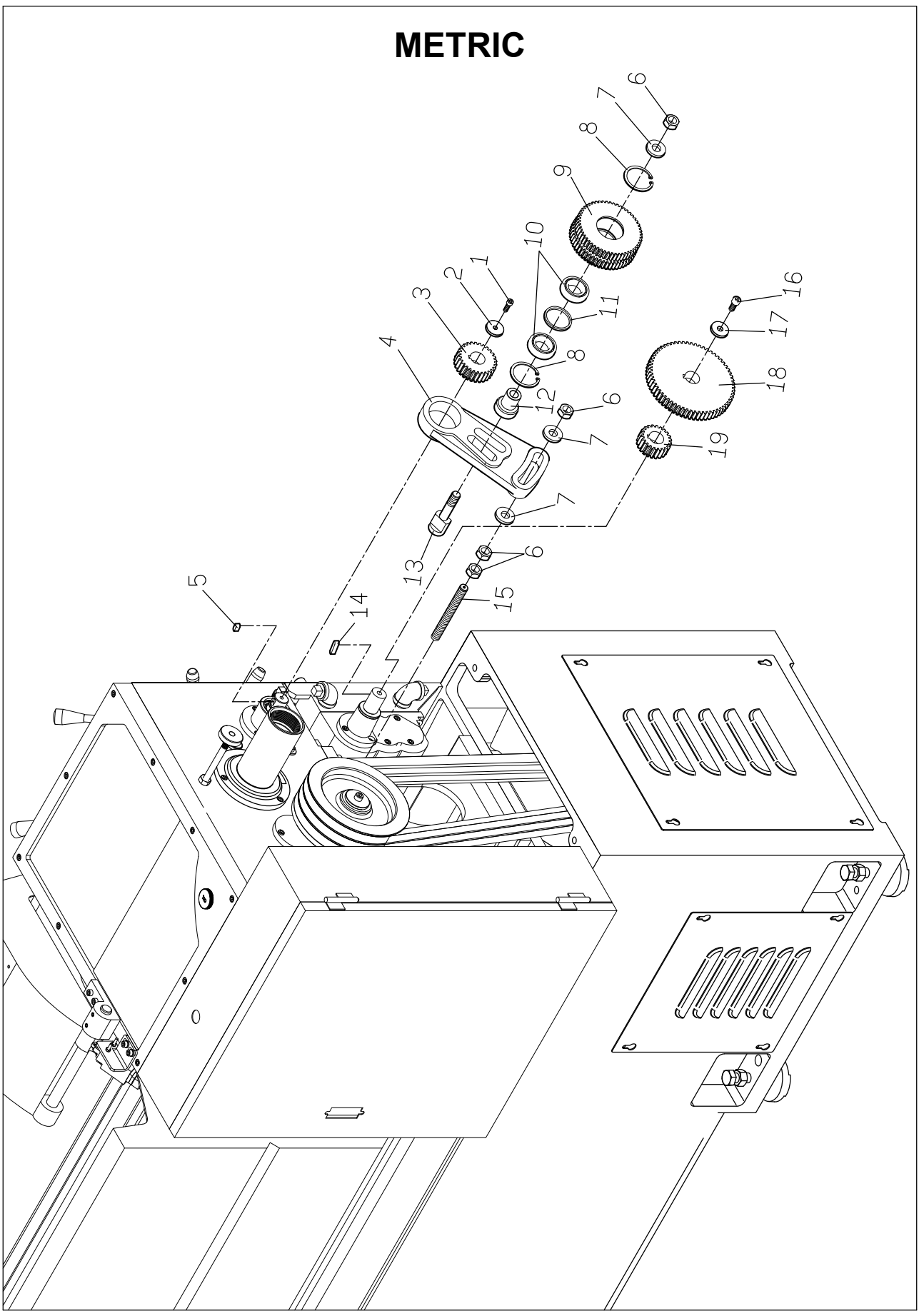
# End Gear - 14"

## IMPERIAL



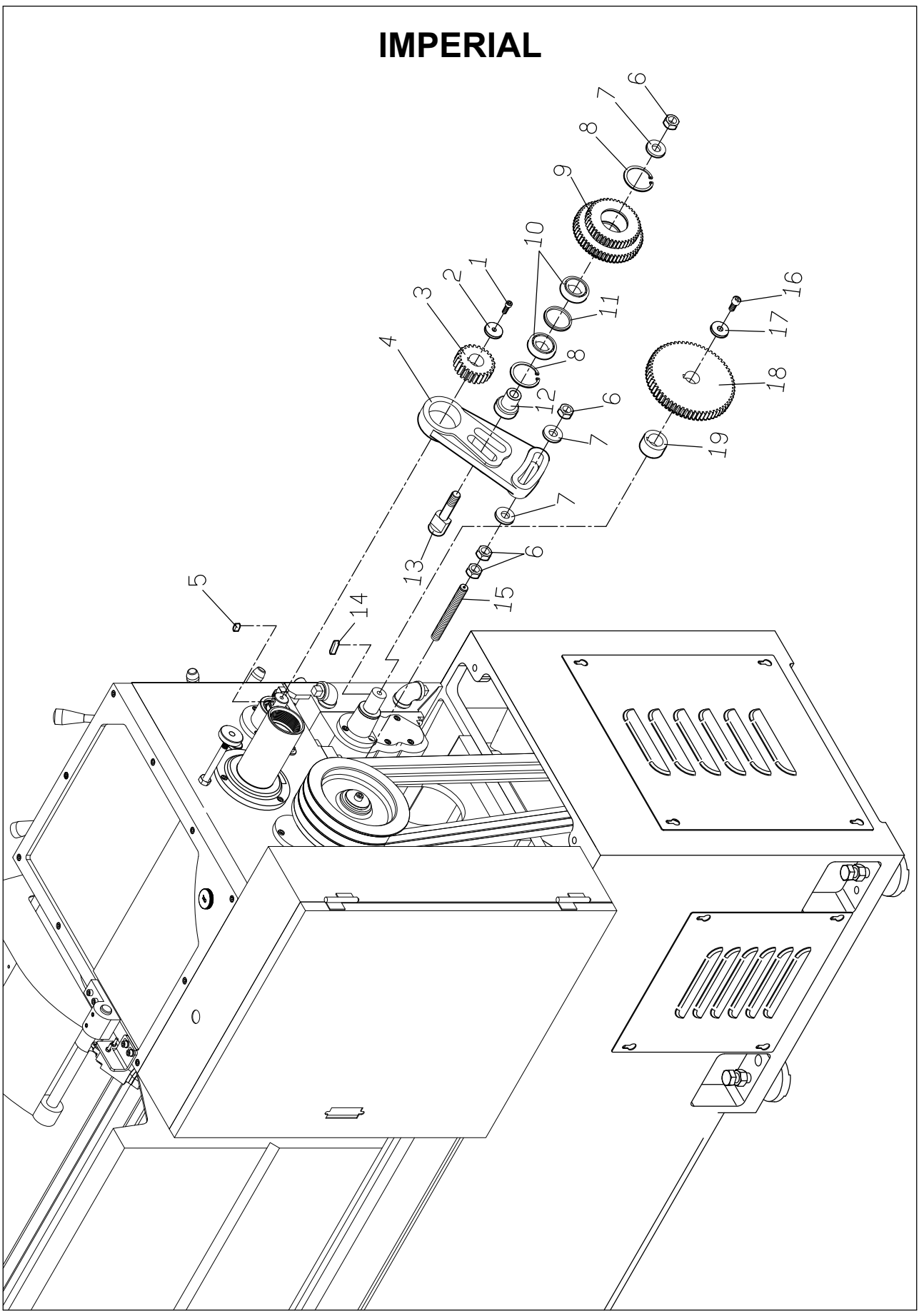
# End Gear - 16"

METRIC



# End Gear - 16"

## IMPERIAL



# End Gear

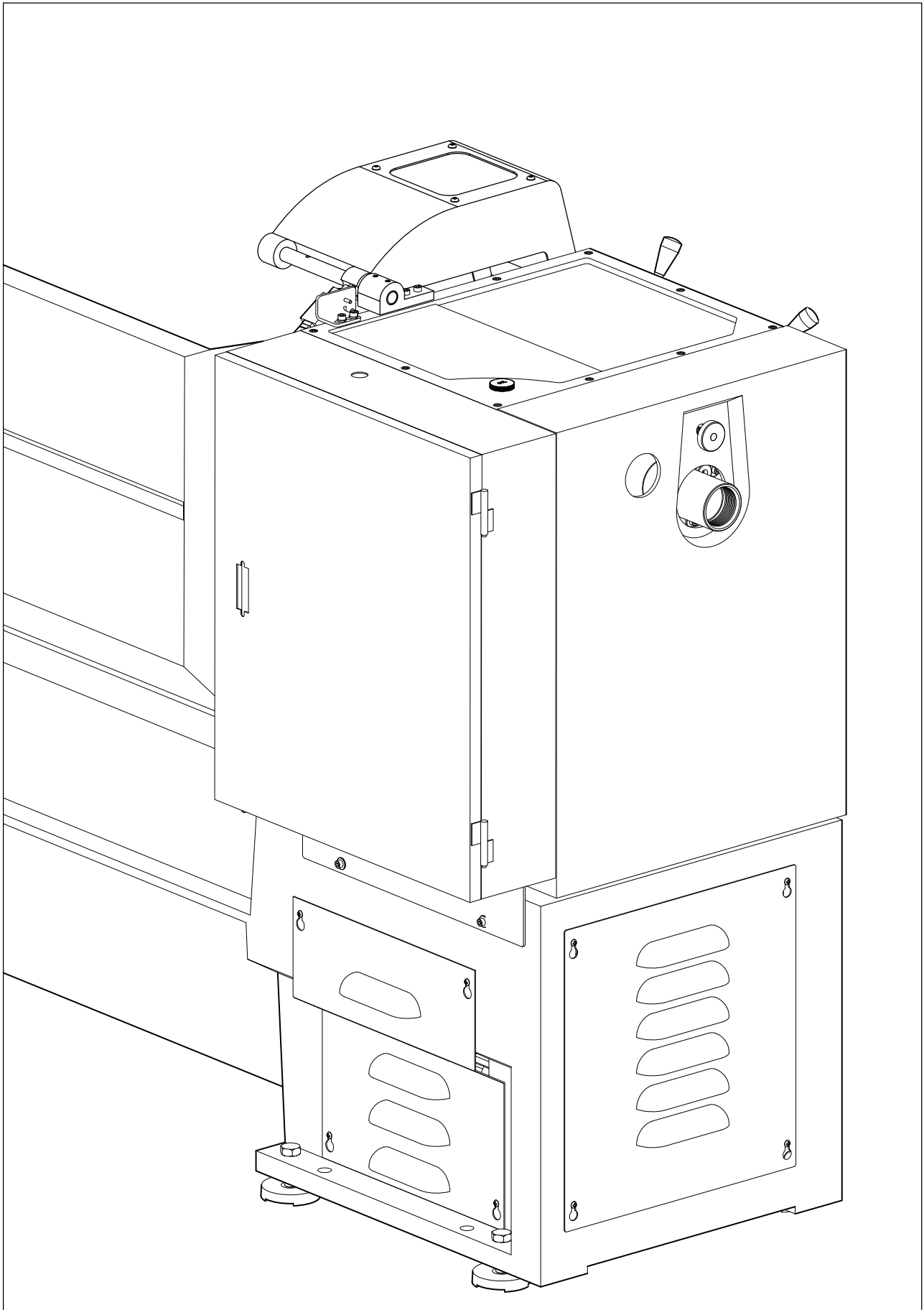
END GEAR--METRIC RML-14					END GEAR--IMPERIAL RML-14				
KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK	KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK
1		Hex. socket head bolt	1	CAP 6x20	1		Hex. socket head bolt	1	CAP 6x20
2	60022	Washer	1		2	60022	Washer	1	
3	13-60001-M	Gear	1	28T	3	13-60001-I	Gear	1	24T
4	60017	Swing frame	1		4	60017	Swing frame	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		Hex. socket head bolt	1	CAP 8x20	16		Hex. socket 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	13-60005-M	Gear	1	22T	19	60016	Collar	1	

# End Gear

END GEAR--METRIC RML-16					END GEAR--IMPERIAL RML-16				
KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK	KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK
1		Hex. socket head bolt	1	CAP 6x20	1		Hex. socket head bolt	1	CAP 6x20
2	60022	Washer	1		2	60022	Washer	1	
3	16-60001-M	Gear	1	28T	3	16-60001-I	Gear	1	24T
4	16-60017	Swing frame	1		4	16-60017	Swing frame	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		Hex. socket head bolt	1	CAP 8x20	16		Hex. socket 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	16-60005-M	Gear	1	22T	19	60016	Collar	1	

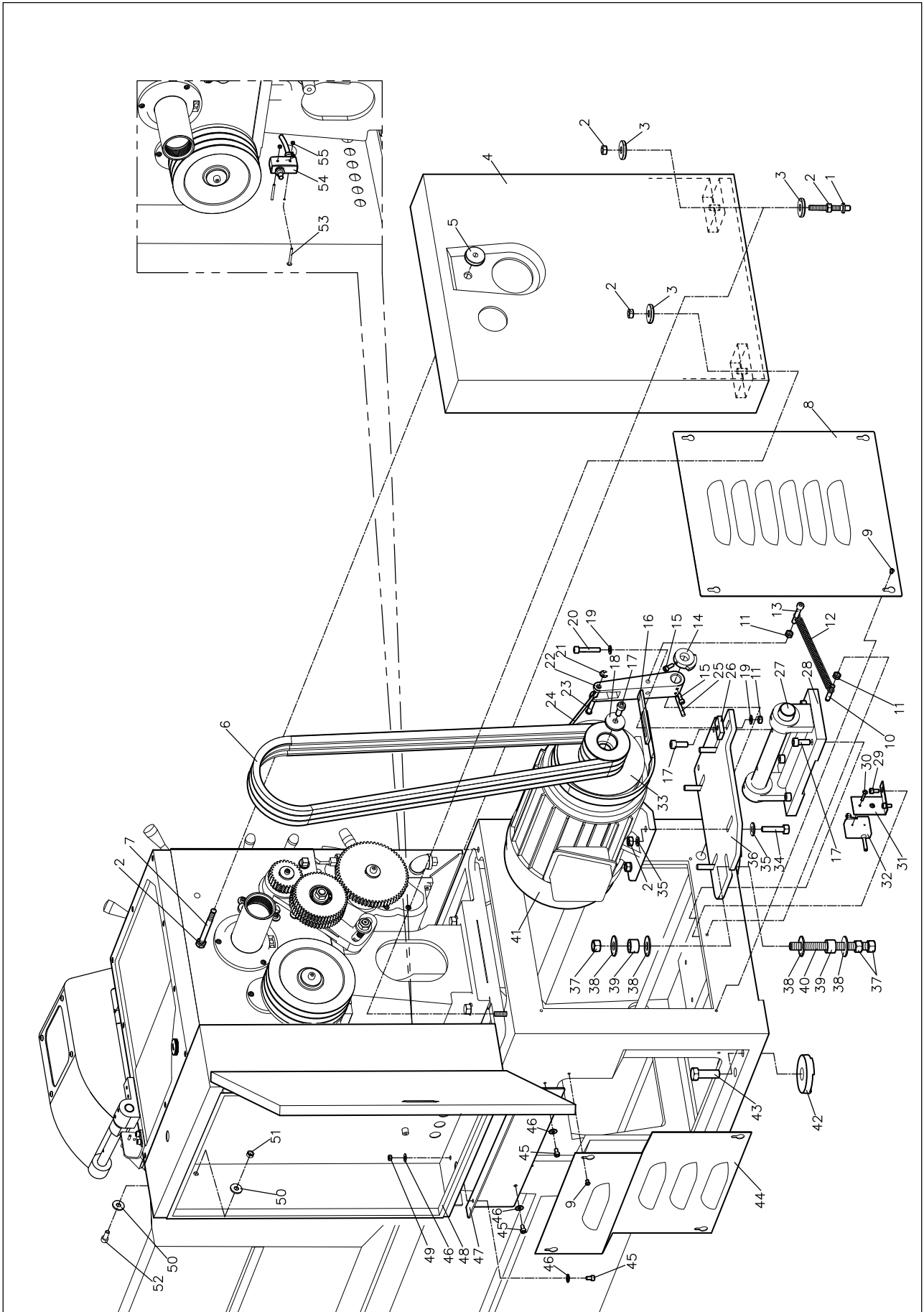
# Main Motor

THE CHIP TRAY IN THE MIDDLE



# Main Motor

THE CHIP TRAY IN THE MIDDLE





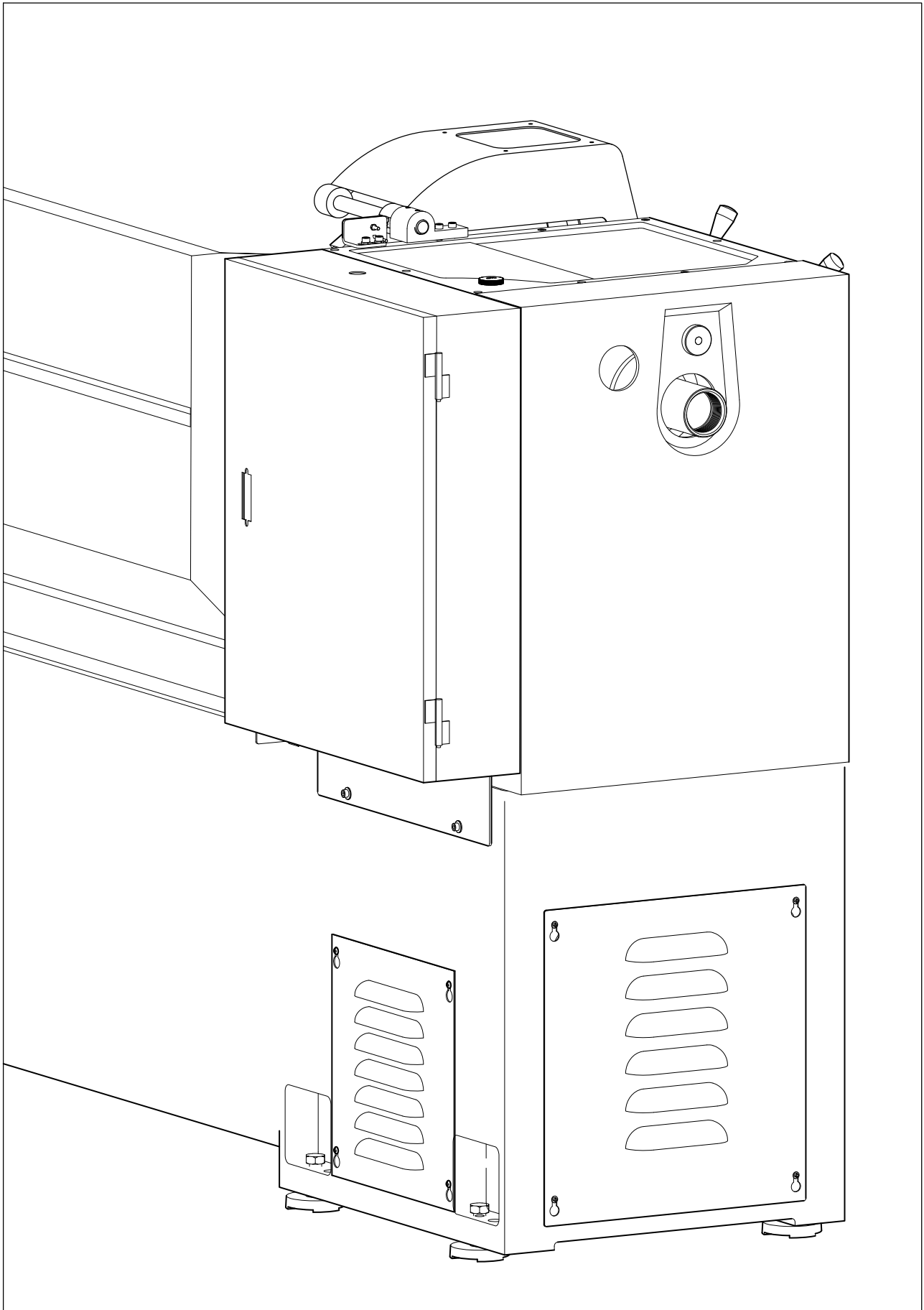
# Main Motor

## 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	60058	Pin	2		45		Hex. socket head bolt	4	CAP 6x10
2		Nut	9	M10	46		Washer	6	Ø6xØ16
3		Washer	4	M10	47	61075	Cover	1	
4	14-61004	Cover	1		48	61024A	Cover	1	
	16-61004					61025A	Electrical box	1	
5	60056	Nut	1		49		Nut	2	M6
6		V belt	3	B69	50		Washer	2	M8
7	60055	Bolt	1		51		Nut	1	M8
8	61017	Cover	1		52		Hex. socket head bolt	1	CAP 8x20
9		Dome cross screw	8	M6x10	53		Dome cross screw	2	M4x40
10	60053	Bolt	1		54		Limit switch	1	Tm1307
11		Nut	3	M8xP1.25	55		Nut	2	M4
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	1	CAP 10x25					
18	60044	Washer							
19		Washer	1	M10					
20		Hex. socket head bolt	1	CAP 8x45					
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							
27	60036	Shaft	1						
28	60061	Support	1						
29		Hex. socket head bolt	2	CAP 6x12					
30		Dome cross screw	2	M4x30					
31	61028A	Bracket	1						
32		Limit switch	1	Tm-1704					
33	10043A56	Motor pully	1						
34		Hex. socket head bolt	4	CAP 10x45					
35		Washer	8	M10					
36	61045RM5	Plate	1						
37		Nut	3	M16xP2.0					
38		Washer	4	Ø16.5xØ40					
39	600048	Rubber ring	2						
40	60031	Screw	1	M16x170					
41		Motor	1	5 HP					
42	63043	Block	6						
43		Hexagon head bolt	6	M16x50					
44	61018	Plate	1						

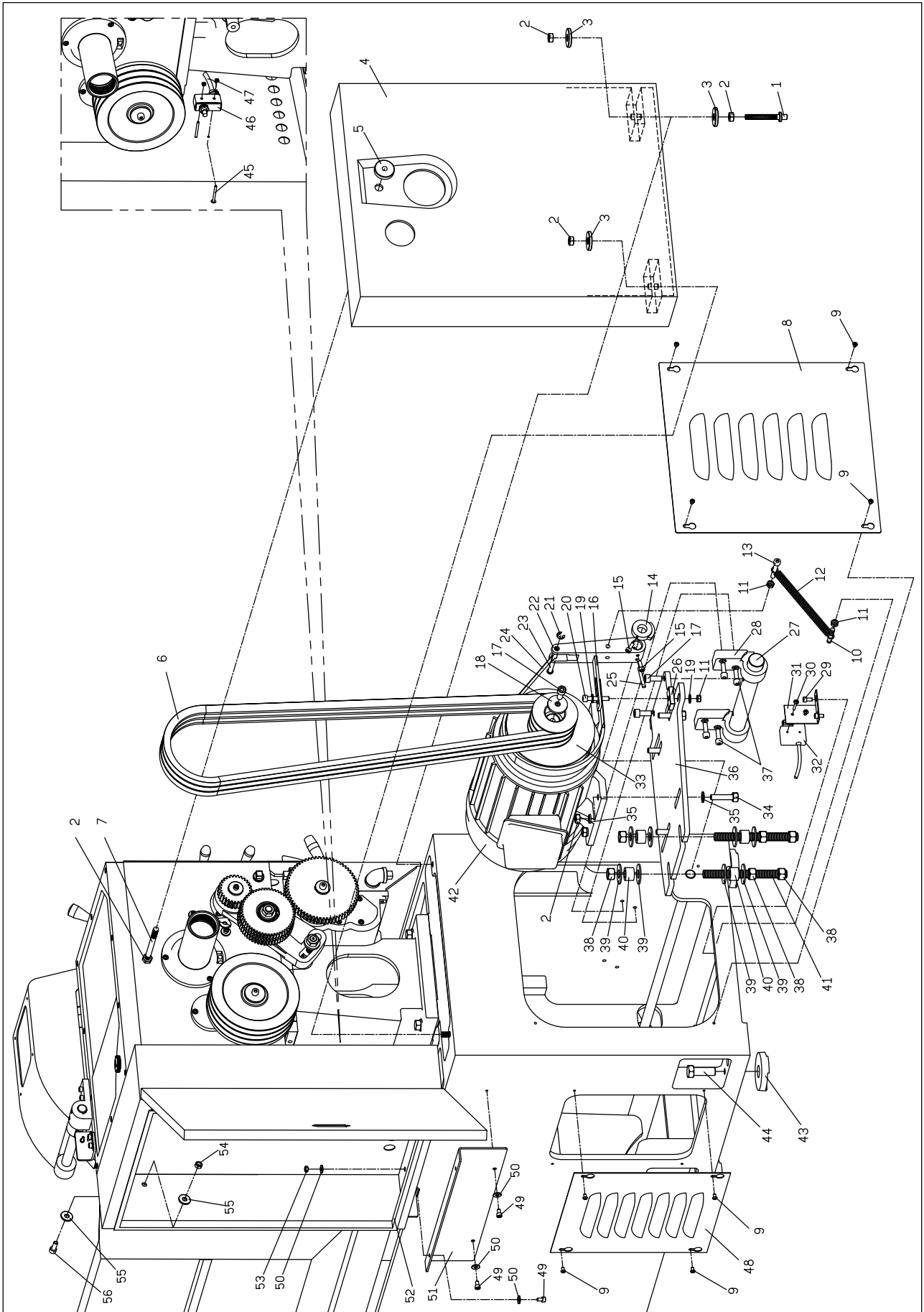
# Main Motor

FRONT MOVEABLE CHIP TRAY OPTIONAL



# Main Motor

FRONT MOVEABLE CHIP TRAY OPTIONAL

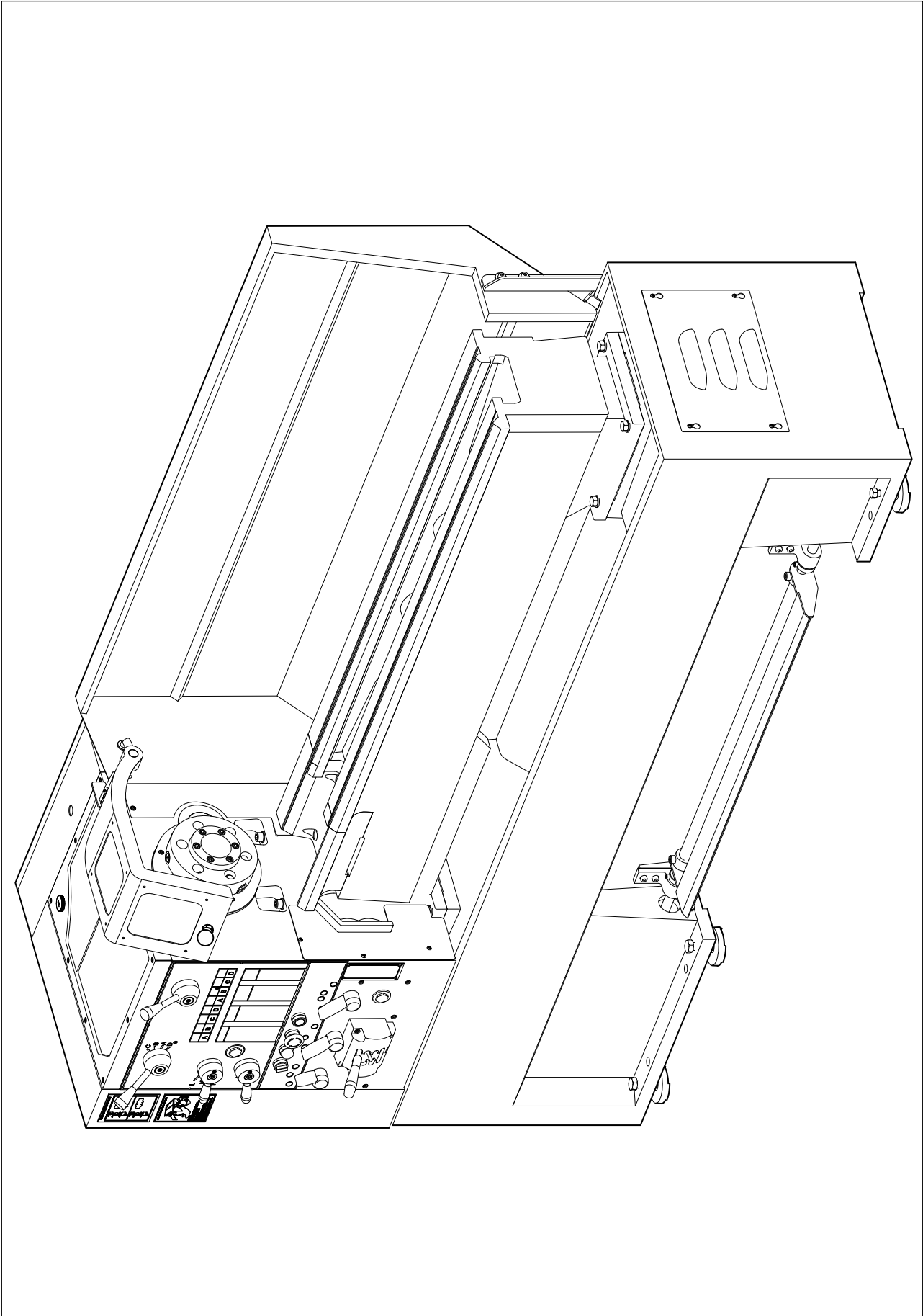


# Main Motor

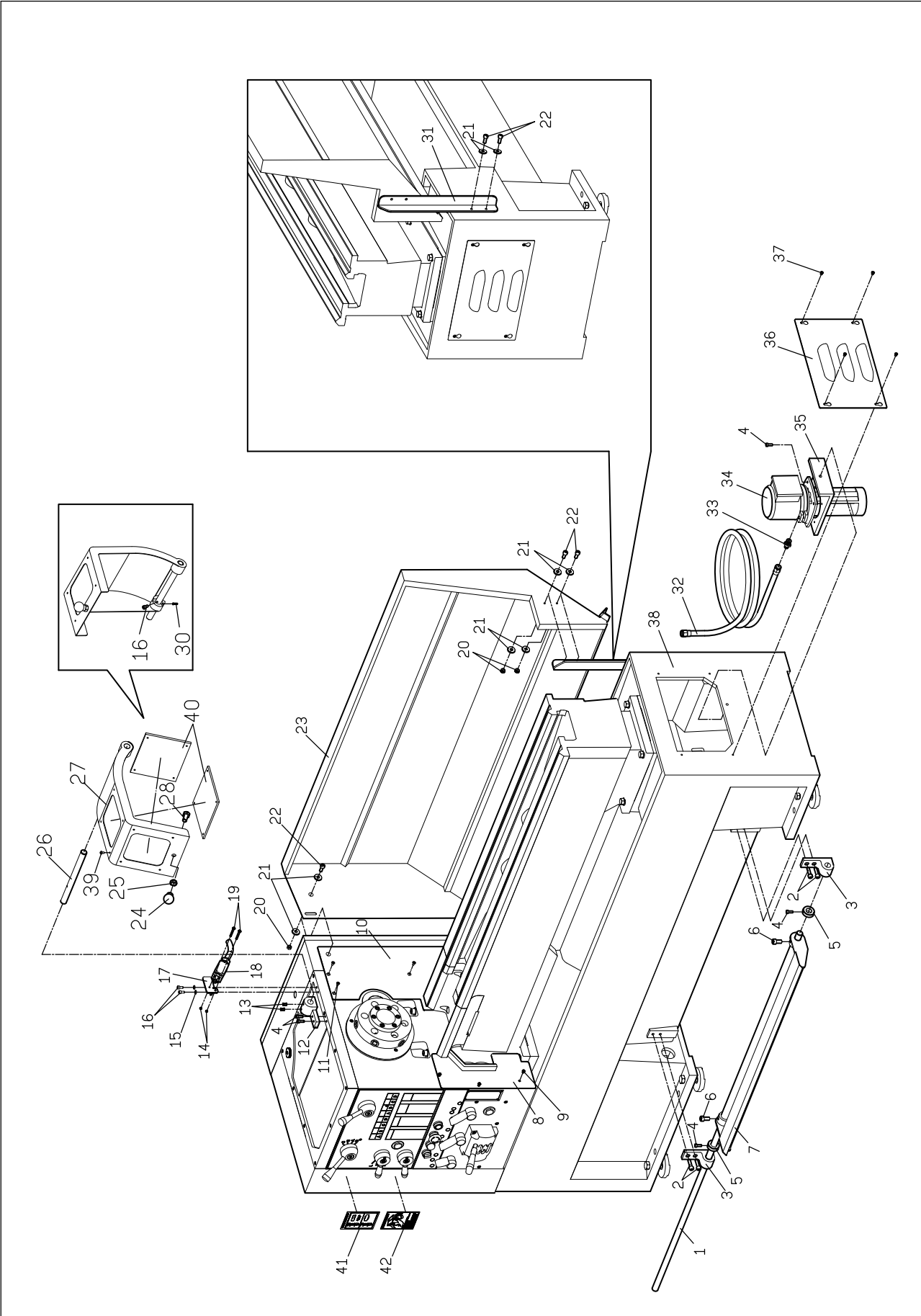
## FRONT MOVEABLE CHIP TRAY OPTIONAL

KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK	KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK
1	60058	Pin	2		45		Dome cross screw	2	M4x40
2		Nut	9	M10	46		Limit switch	1	Tm1307
3		Washer	4	M10	47		Nut	2	M4
4	14-61004	Cover	1		48	64018	Cover	1	
	16-61004				49		Hex. socket head bolt	4	CAP 6x10
5	60056	Nut	1		50		Washer	6	Ø6xØ16
6		V belt	3	B69	51	61075	Cover	1	
7	60055	Bolt	1		52	61024A	Cover	1	
8	61017	Cover	1			61025A	Electrical box	1	
9		Dome cross screw	8	M6x10	53		Nut	2	M6
10	60053	Bolt	1		54		Nut	1	M8
11		Nut	3	M8	55		Washer	2	M8
12	60046	Spring	1		56		Hex. socket head bolt	1	CAP 8x20
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	1	CAP 10x25					
18	60044	Washer	1						
19		Washer	2	M8					
20		Hex. socket head bolt	1	CAP 8x45					
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	60036	Shaft	1						
28	TML-60061	Support	1						
29		Hex. socket head bolt	2	CAP 6x12					
30		Dome cross screw	2	M4x30					
31	61028A	Bracket	1						
32		Limit switch	1	Tm-1704					
33	10043A56	Motor pully	1						
34		Hex. socket head bolt	4	CAP 10x45					
35		Washer	8	M10					
36	61045TM7	Plate	1						
37		Hex. socket head bolt	4	M8x25L					
38		Nut	6	M16xP2.0					
39		Washer	8	Ø16.5xØ40					
40	600048	Rubber ring	4						
41	60031	Screw	2	M16x170					
42		Motor	1	5 HP					
43	63043	Block	4						
44		Hexagon head bolt	4	M16x50					

# Cabinet & Panel



# Cabinet & Panel

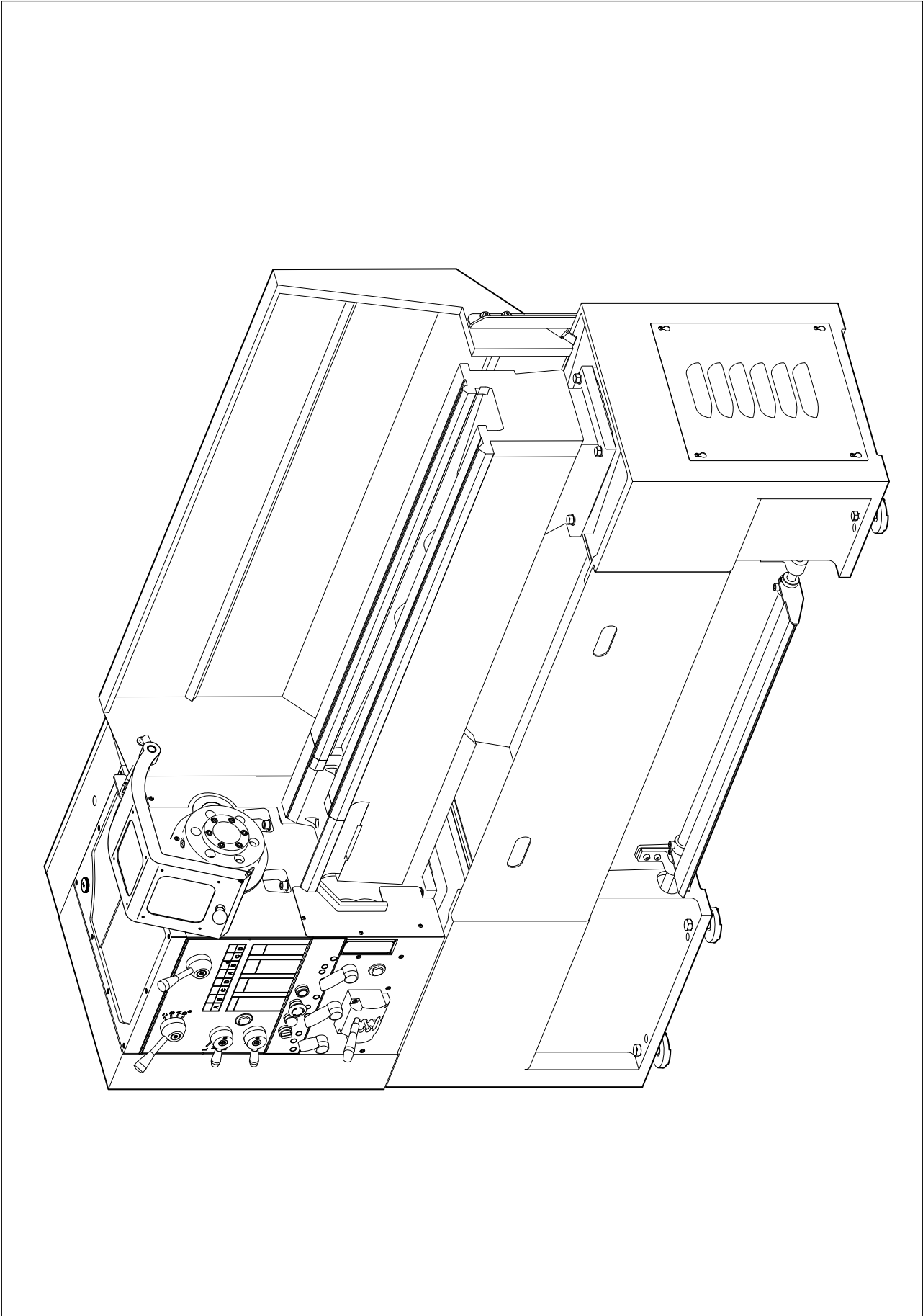




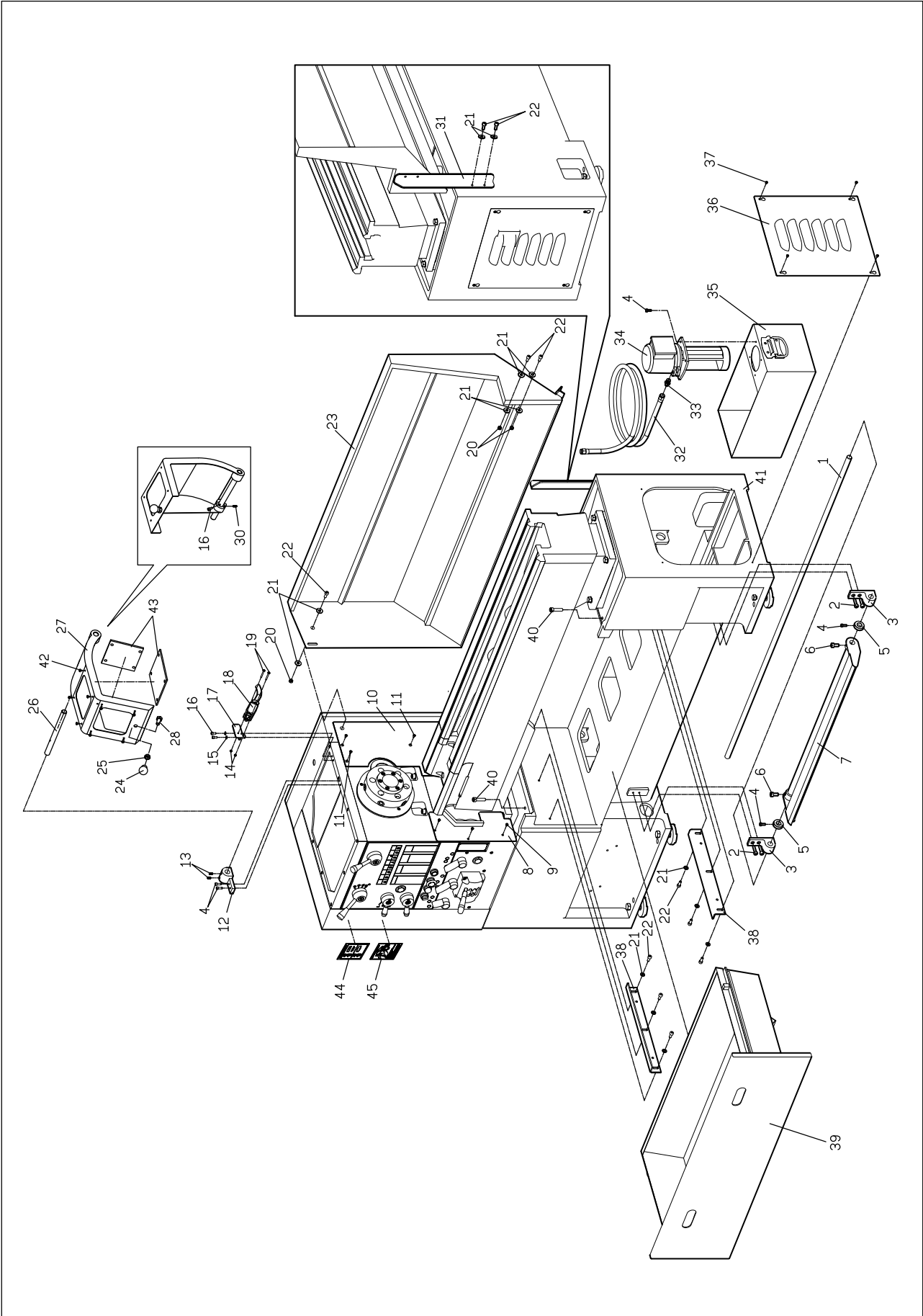
# Cabinet & Panel

KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK	KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK
1	60032A-40	Shaft	1		41	13-61037	Plate	1	
	60032A-60				42	13-61024	Plate	1	
2		Hex. socket head bolt	4	CAP 8x25					
3	60029	Pedal bracket	2						
4		Hex. socket head bolt	6	CAP 6x16					
5	13-60039	Collar	2						
6		Hex. socket head bolt	2	CAP 10x20					
7	61043-40	Saddle	1						
	61043-60								
8	61016	Guard	1						
9		Dome cross screw	7	M5x8					
10	14-61020	Plate	1						
	16-61020								
11		Flat hexagon screw	3	M5x8					
12	10058	Small bracket	1						
13		Set screw	2	SET 8x12					
14		Nut	2	M4					
15		Spring washer	2	M6					
16		Hex. socket head bolt	3	CAP 6x12					
17	61056	Bracket	1						
18		Limit switch	1	Tz9212					
19		Dome cross screw	2	M4x40					
20		Nut	3	M8					
21		Washer	8	M8					
22		Hex. socket head bolt	5	CAP 8x20					
23	61010-40	Splash guard	1						
	61010-60								
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					
30		Set screw	1	SET 5x16					
31	61079	Angle steel	1						
32		Coolant conduit - 40	1	CT801x3/8"x74"					
		Coolant conduit - 60		CT801x3/8"x80"					
33		Nipple	1	3/8"PTx3/8"PH					
34		Coolant pump	1	MC6180					
35	63061	Pump base	1						
36	61019	Cover	1						
37		Dome cross screw	4	M6x10					
38	63003-40	Bed	1						
	63003-60								
39		Dome hexagon screw	8	M6x12					
40		Plate	2	PC					

# Cabinet & Panel



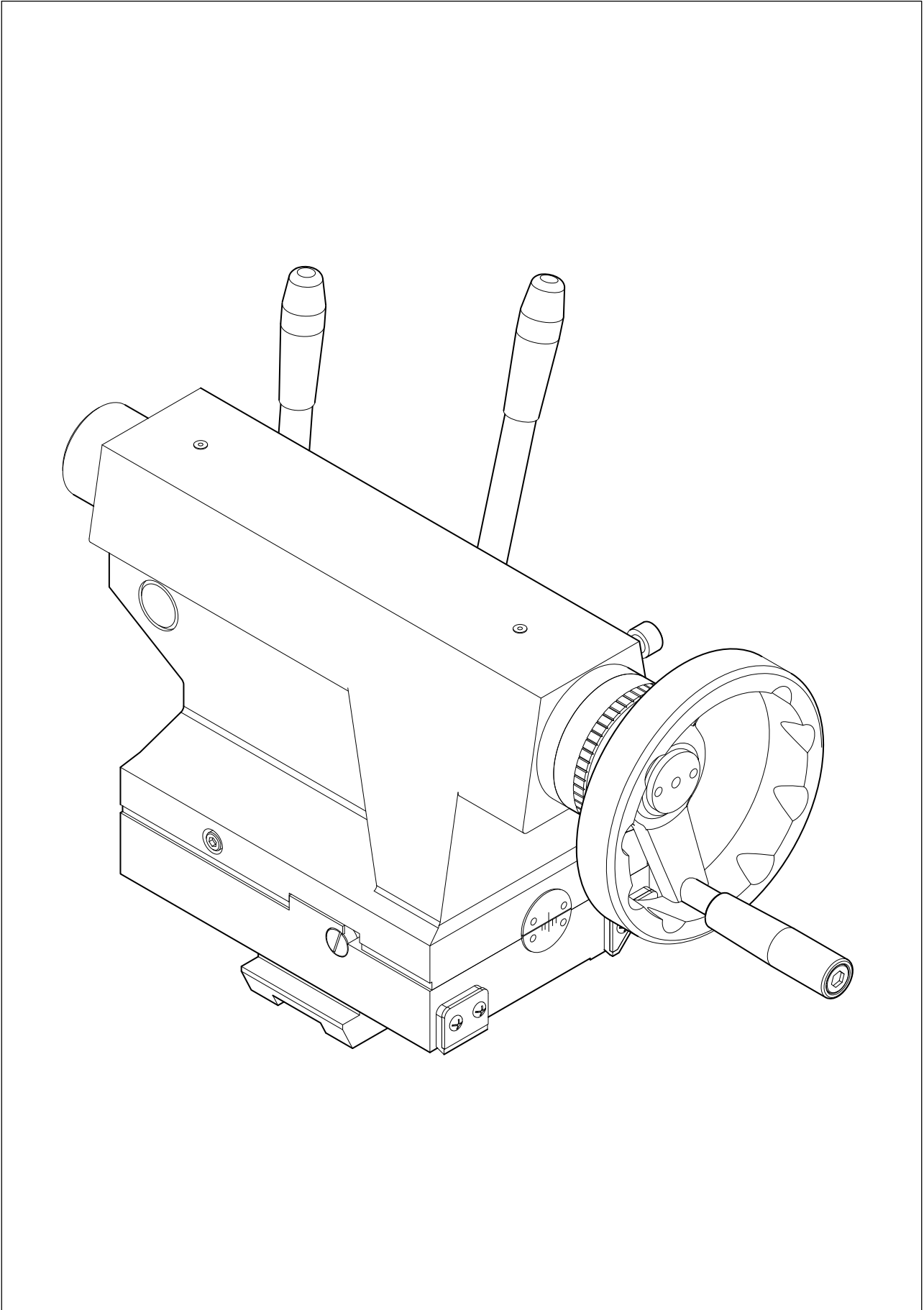
# Cabinet & Panel



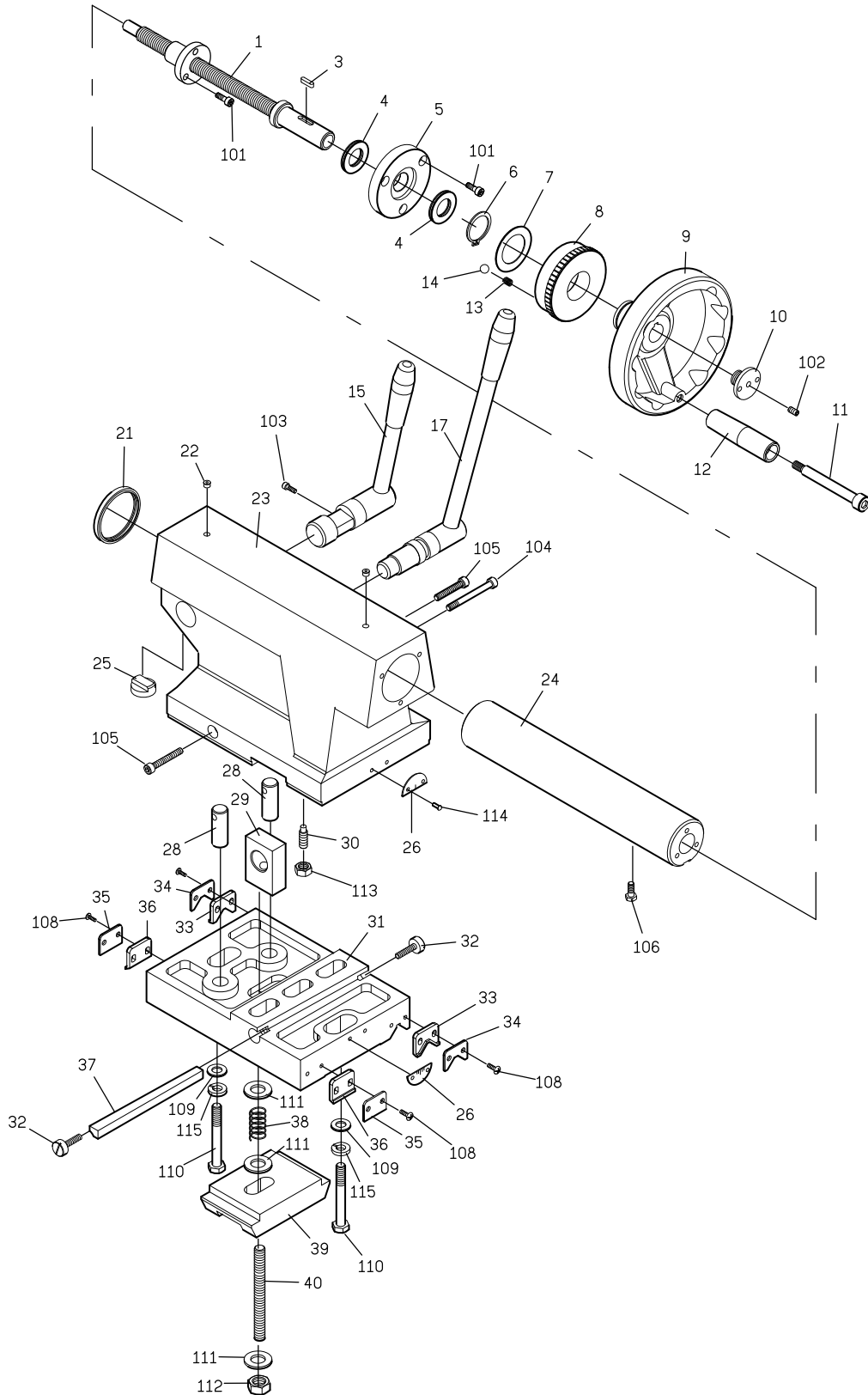
# Cabinet & Panel

KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK	KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK
1	60032A-40	Shaft	1		41	63003-40	Bed	1	
	60032A-60					63003-60			
2		Hex. socket head bolt	4	CAP 8x25	42		Dome hexagon screw	8	M6x12
3	60029	Pedal bracket	2		43		Plate	2	PC
4		Hex. socket head bolt	6	CAP 6x16	44	13-61037	Plate	1	
5	13-60039	Collar	2		45	13-61024	Plate	1	
6		Hex. socket head bolt	2	CAP 10x20					
7	61043-40	Saddle	1						
	61043-60								
8	61016	Guard	1						
9		Dome cross screw	3	M5x8					
10	14-61020	Plate	1						
	16-61020								
11		Flat hexagon screw	3	M5x8					
12	10058	Small bracket	1						
13		Set screw	2	SET 8x12					
14		Nut	2	M4					
15		Spring washer	2	M6					
16		Hex. socket head bolt	3	CAP 6x12					
17	61056	Bracket	1						
18		Limit	1	Tz9212					
19		Dome cross screw	2	M4x40					
20		Nut	3	M8					
21		Washer	14	M8					
22		Hex. socket head bolt	11	CAP 8x20					
23	61010-40	Splash guard	1						
	61010-60								
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					
30		Set screw	1	SET 5x16					
31	61079	Angle steel	1						
32		Coolant conduit - 40	1	CT801x3/8"x74"					
		Coolant conduit - 60		CT801x3/8"x80"					
33		Nipple	1	3/8"PTx3/8"PH					
34		Coolant pump	1	MC6180					
35	15-61010	Coolant tank	1						
36	61017	Cover	1						
37		Dome cross screw	4	M6x10					
38	61009PB6	Angle steel	2						
39	61009B4	Chip tray	1						
	61009B6								
40		Hex. socket head bolt	2	CAP 10x45					

# Tailstock



# Tailstock

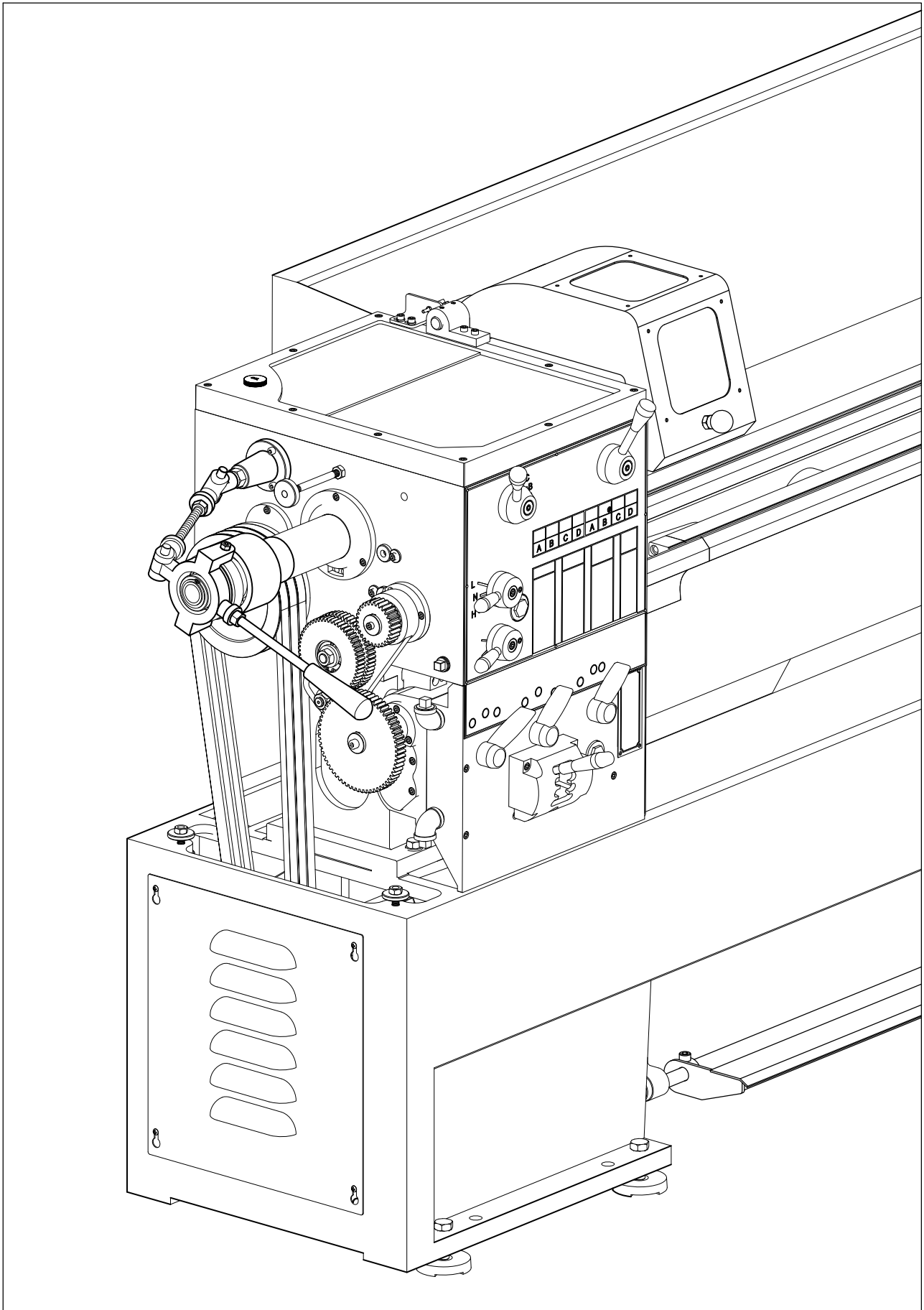


# Tailstock

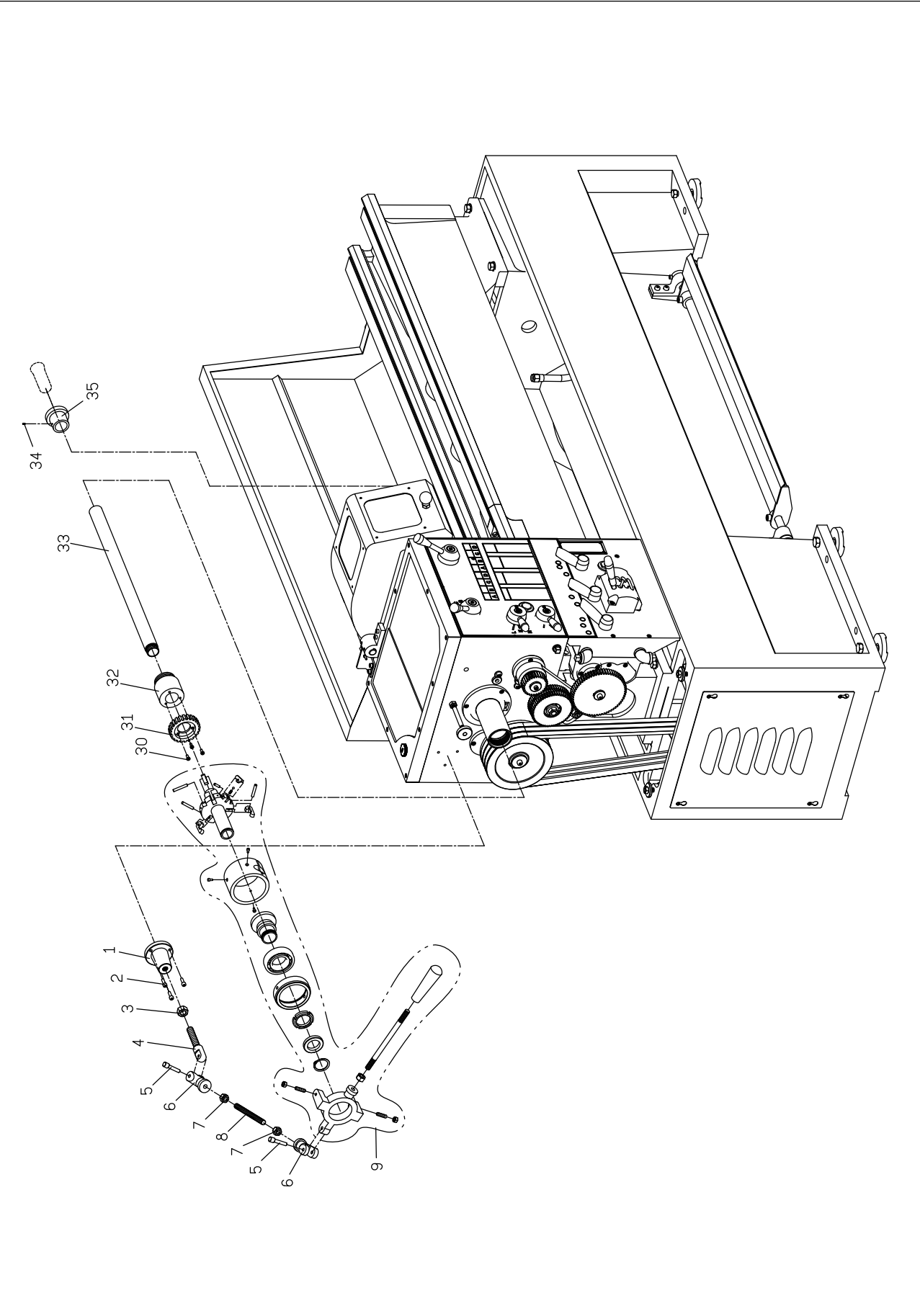
KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK	KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK
1	70004-M	Lead screw	1		37	70018	Gib C	1	
	70005-M	Nut	1		38		Spring	1	Ø25x45
	70004-I	Lead screw	1		39	70020	Clamp block	1	Ø25x45
	70005-I	Nut	1		40	60018	Stud	1	M14x135
3		Key	1	5x5x20					
4		Thrust bearing	2	MTB/AS2-2035					
5	70007-M	Flange	1		101		Hex. socket head bolt	6	CAP 6x16
	70007-I				102		Set screw	1	SET 6x25
6		Snap ring	1	S32	103		Hex. socket head bolt	1	CAP 6x12
7	70006	Washer	1		104		Hex. socket head bolt	1	CAP 8x70
8	70008-M	Index ring	1	125 dividing	105		Hex. socket head bolt	2	CAP 8x60
	70008-I			100 dividing	106		Hex. socket head bolt	1	CAP 6x8
9	70009	Handwheel	1						
10	70010	Fixed screw	1		108		Dome cross screw	8	M5x12
11	70011	Bolt	1	M8x90	109	70095	Washer	2	M10
12	70012	Handle	1		110		Hexagon head bolt	2	M10x55
13	40016	Spring	3	Ø6.2x16	111		Washer	4	M14
14		Steel ball	3	1/4"	112		Hexagon nut	1	M14
15	70022	Clamp lever L	1		113		Hexagon nut	1	M8
	70013	Cam shaft L	1		114		Rivet	4	Ø2
					115		Spring washer	2	M10
17	70021	Clamp lever R	1						
	70017	Cam shaft R	1						
19		Spring pin	2	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	M8x25					
31	70002	Base	1						
32	50054	Gib screw	2	M6xØ16					
33	70024	Wiper V	2						
34	70025	Plate V	2						
35	70027	Plate F	2						
36	70026	Wiper F	2						



## 5C Collet Closer Attachment



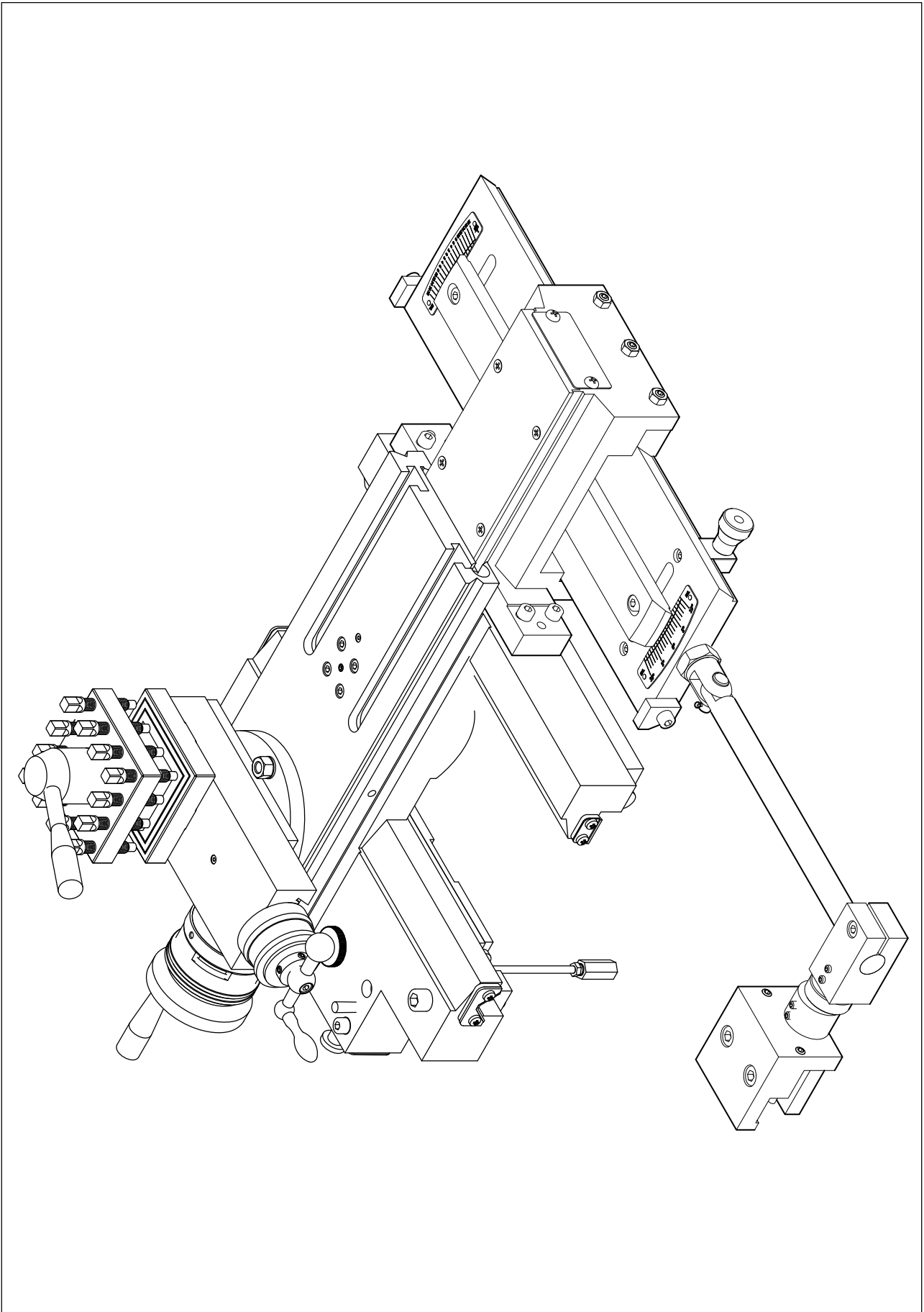
# 5C Collet Closer Attachment



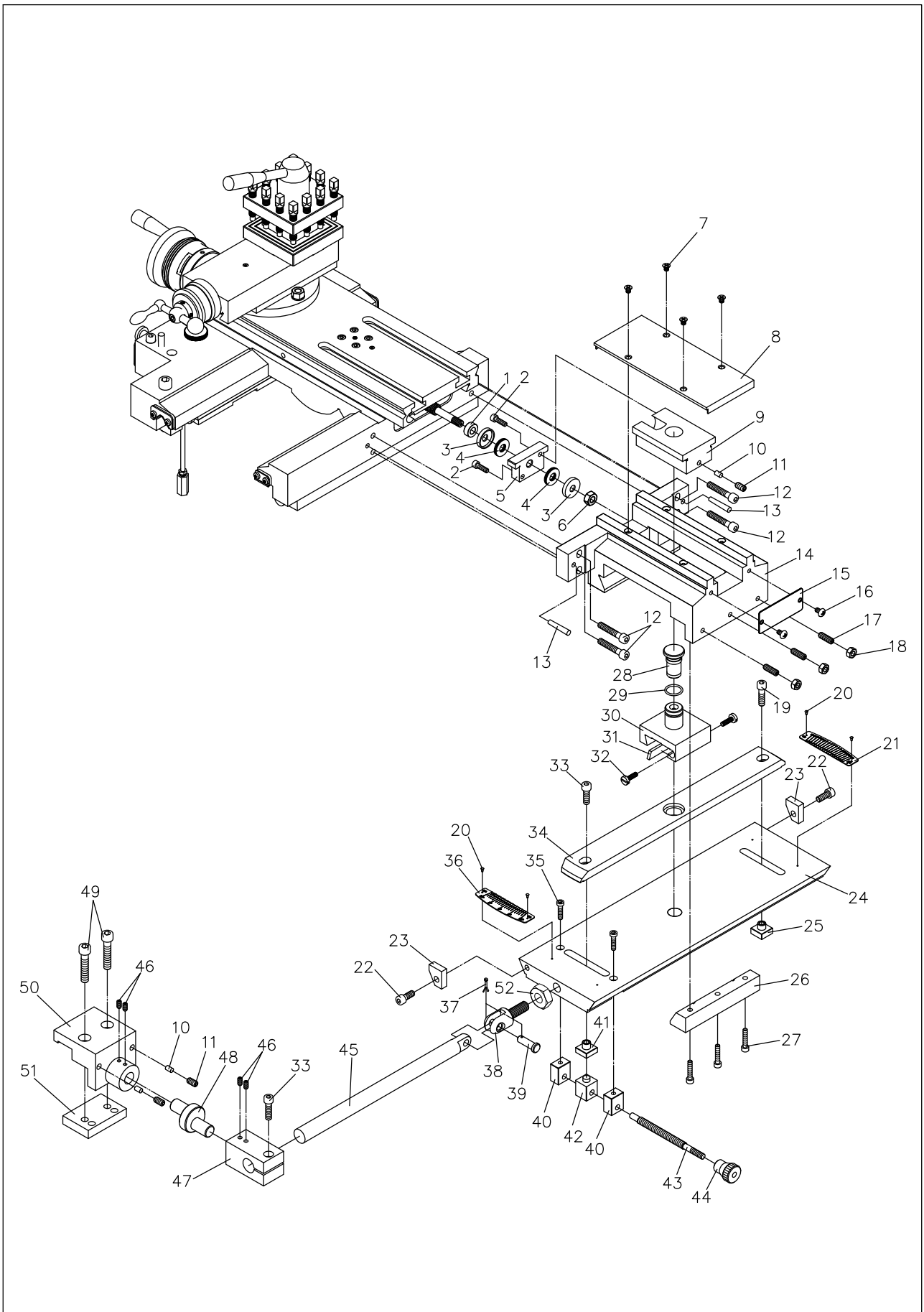
## 5C Collet Closer Attachment

KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK	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					
9	90044	Handle Casting	1	SET 8x30 M8 1/2"-12UNC S34 Ø52.4xØ34.4x9 6208 CAP 4x8 Ø6x40 Ø5 Ø5x18					
	00ST30M8	Set screw	2						
		Nut	2						
		Nut	1						
	90045	Handle Rod	1						
	90046	Handle	1						
		Clip	1						
		Washer	1						
	90042	Nut	1						
	90038	Bearing and Retainer	1						
		Ball bearing	1						
	90037	Cam	1						
		Hex. socket head bolt	3						
	90043	Collar	1						
	90029	Tube	1						
	90031	Finger	3						
	90032	Pivot Pin	3						
90035	Knob	1							
	Steel ball	1							
90033	Spring	1							
	Pin	1							
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



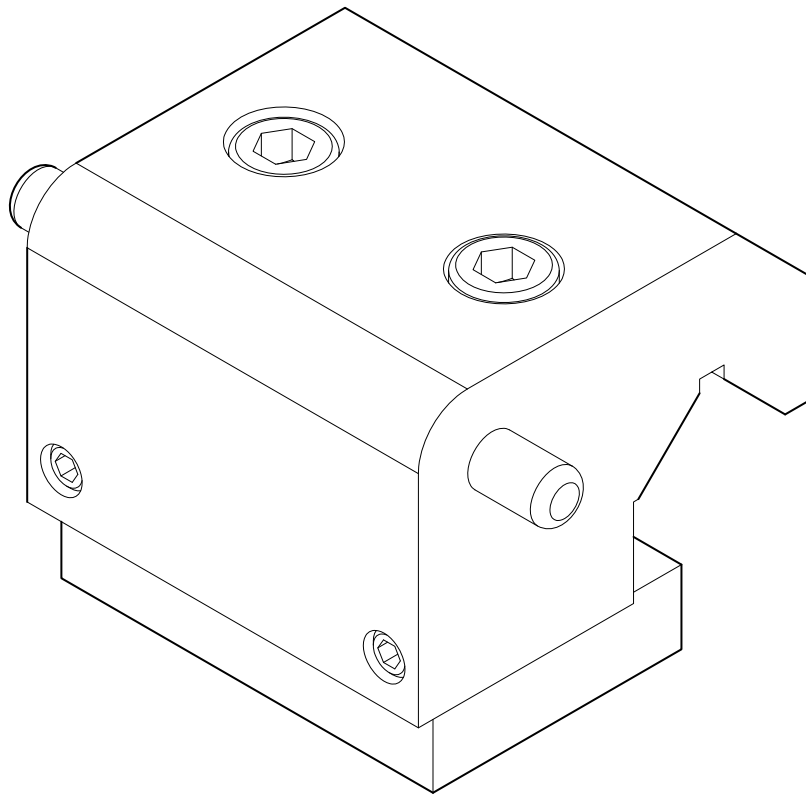
# Taper Attachment



# Taper Attachment

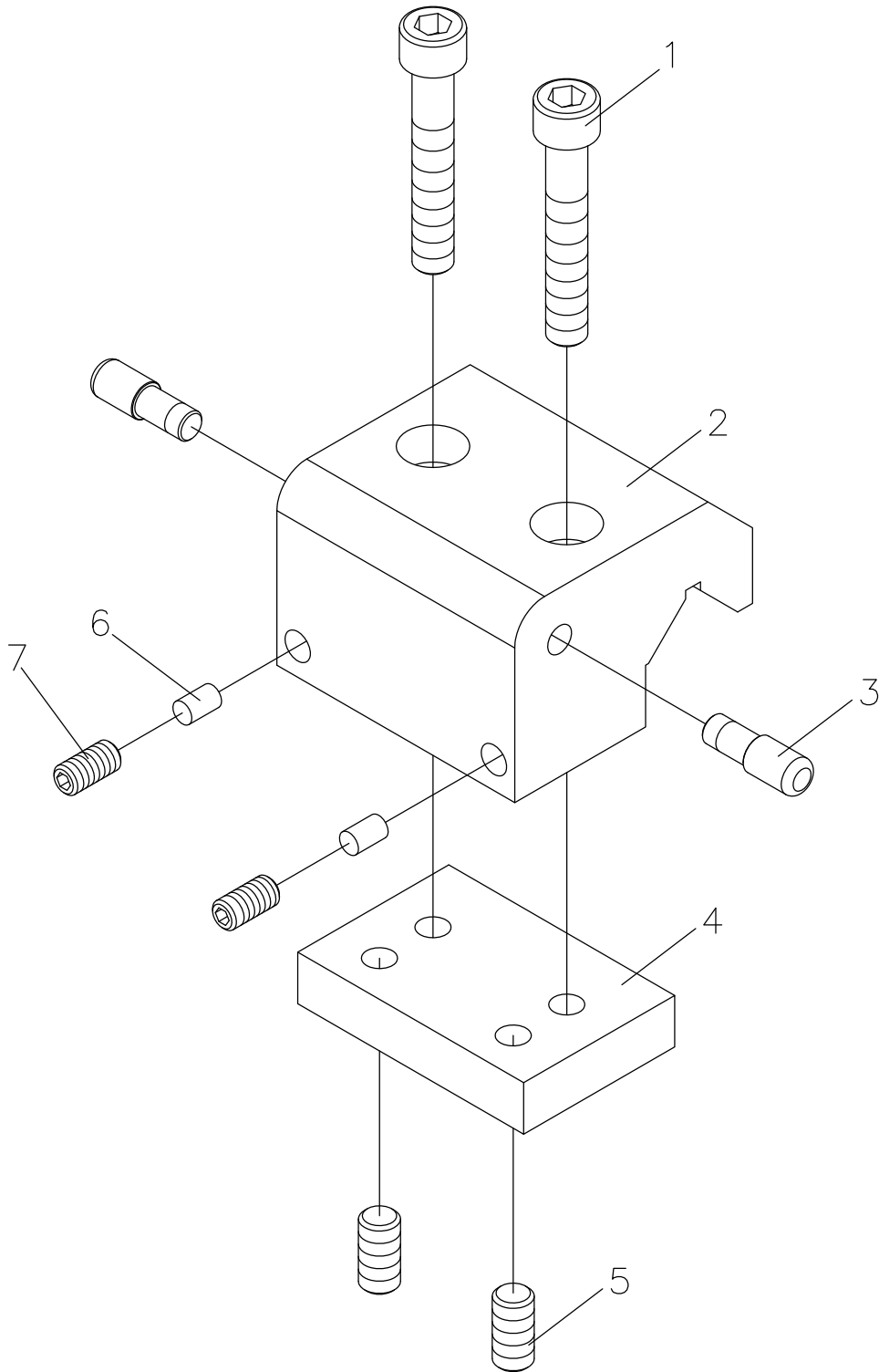
KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK	KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK
1	50017	Collar	1		46		Set screw	4	SET 6x12
2		Hex. socket head bolt	2	CAP 6x20	47	18-80021	Bracket	1	
3	50026	Cap collar	2		48	18-80020	Eccentric pin	1	
4		Thrust bearing	2	NTB/AS2 1226	49		Hex. socket head bolt	2	CAP 10x50
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



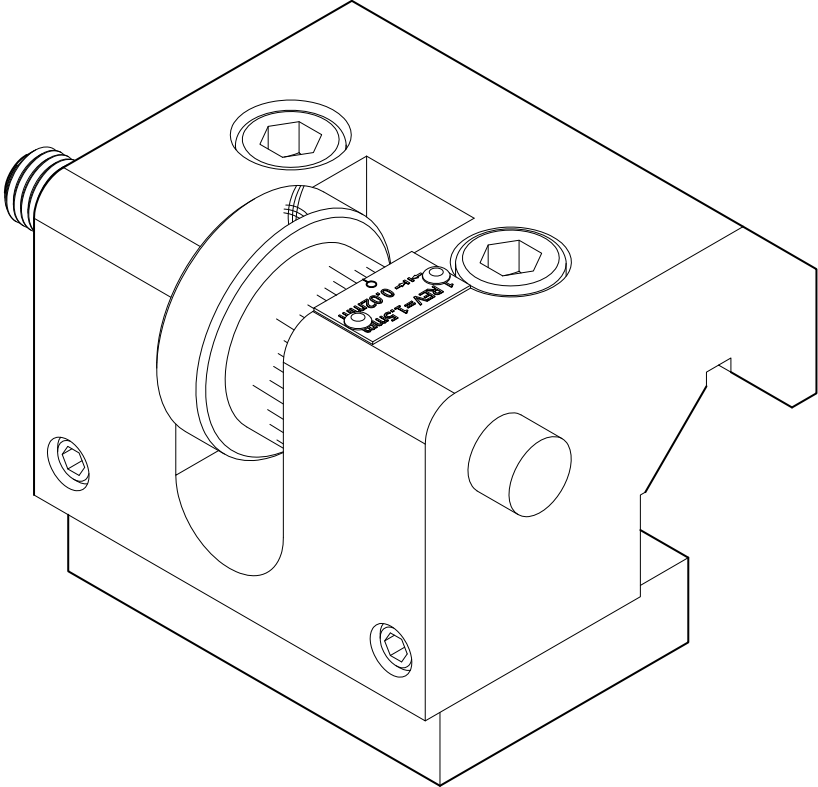


# Bed Stop

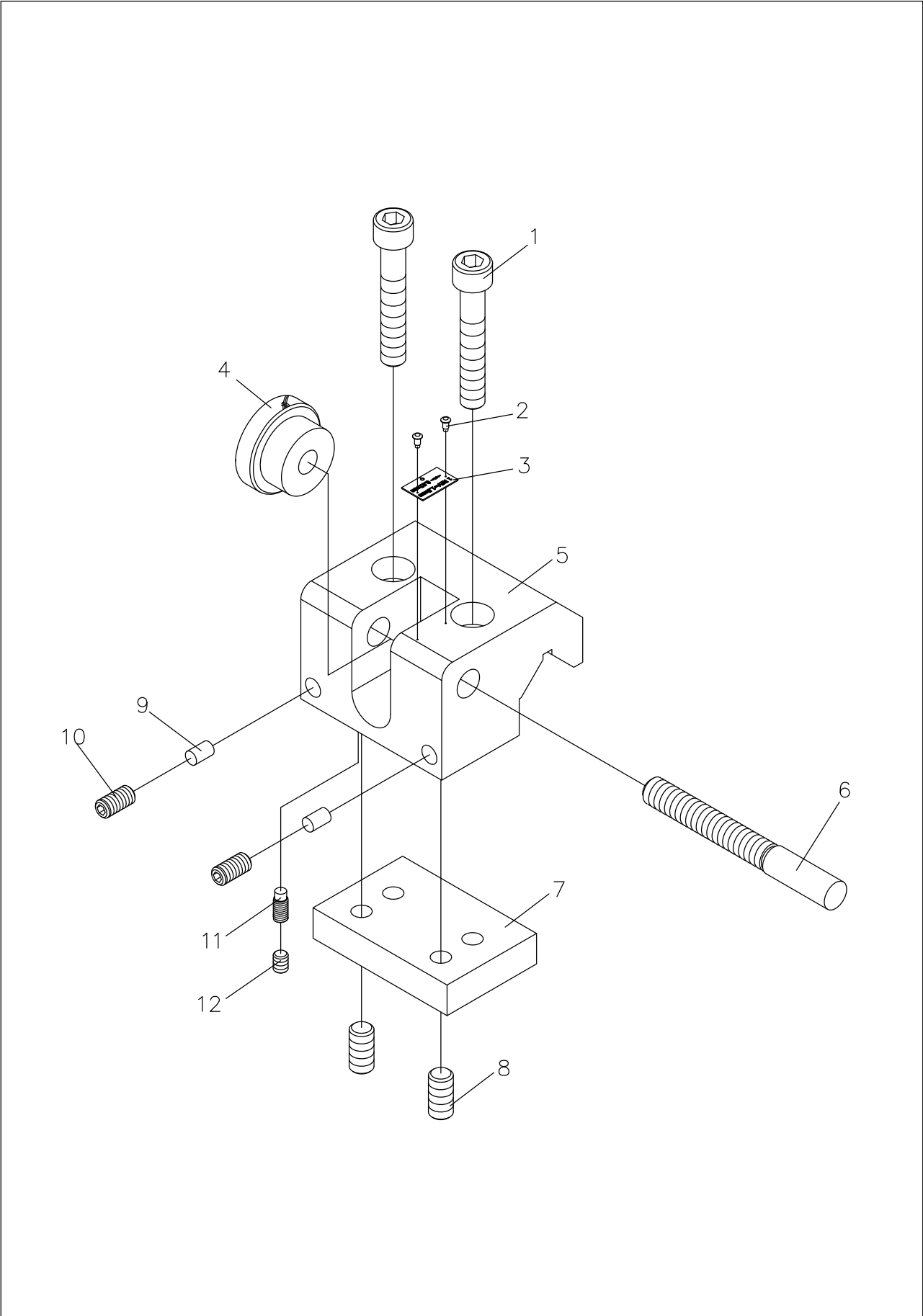




# Bed Stop - Micrometer



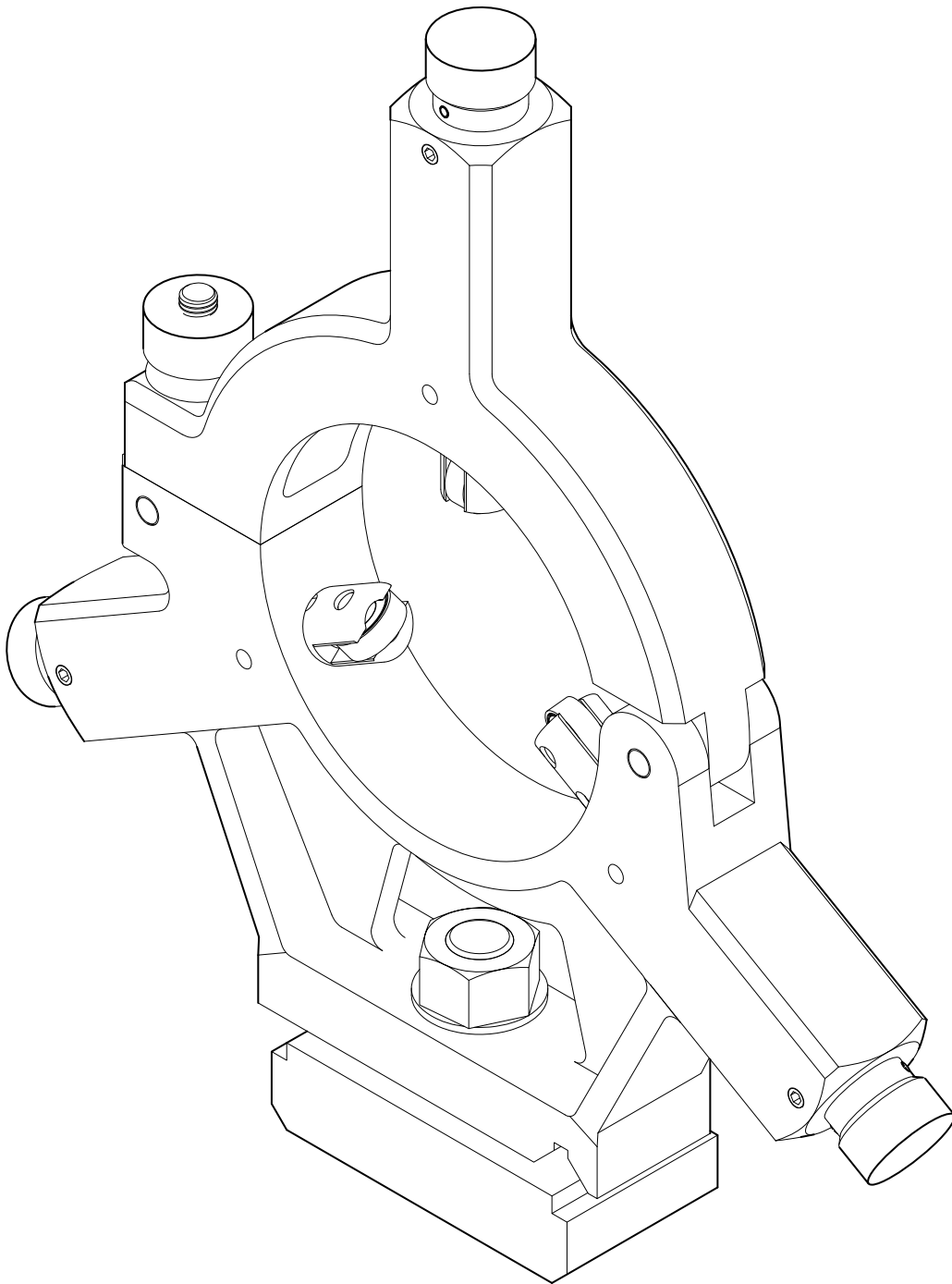
# Bed Stop - Micrometer



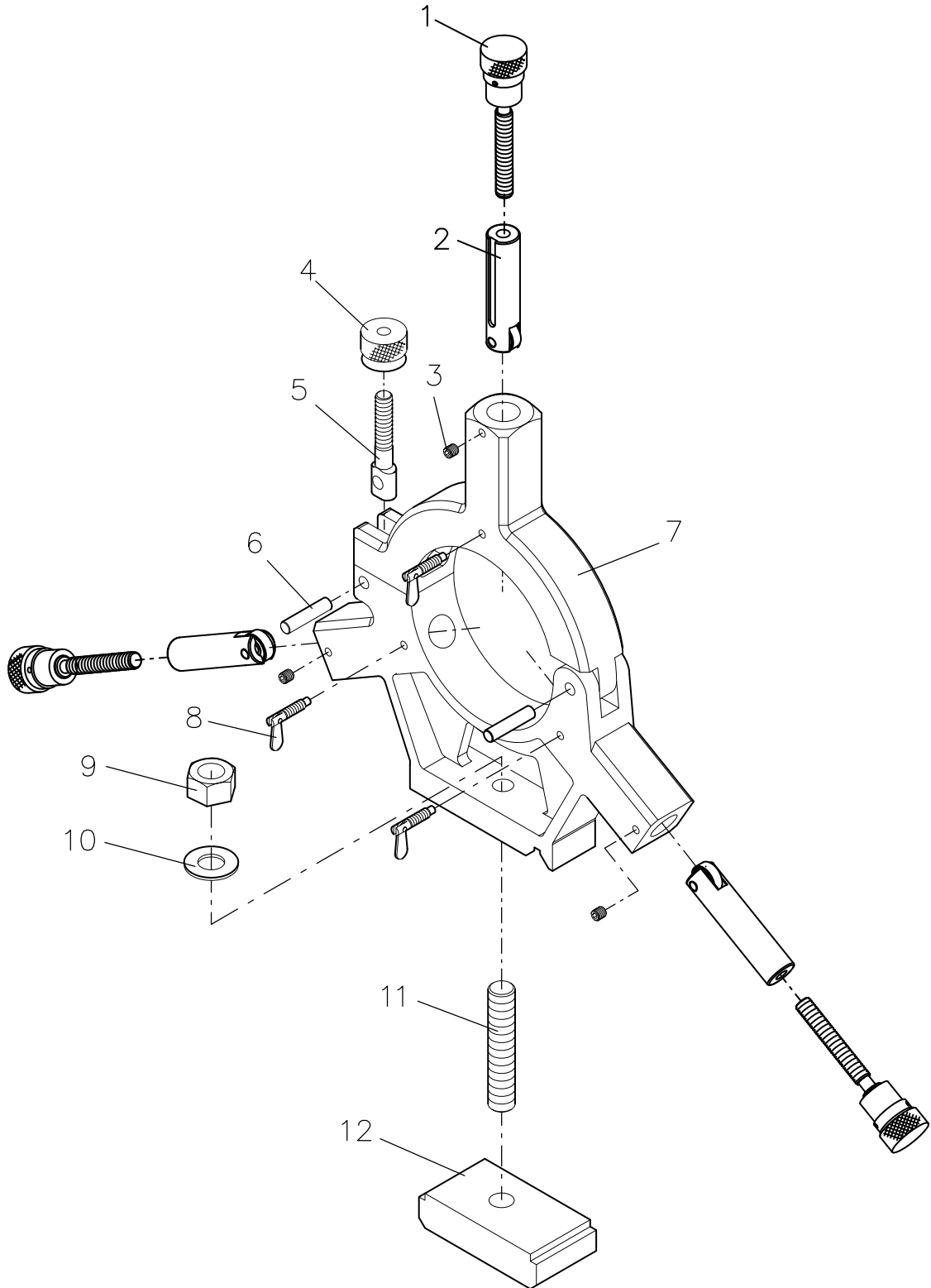
## Bed Stop - Micrometer

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

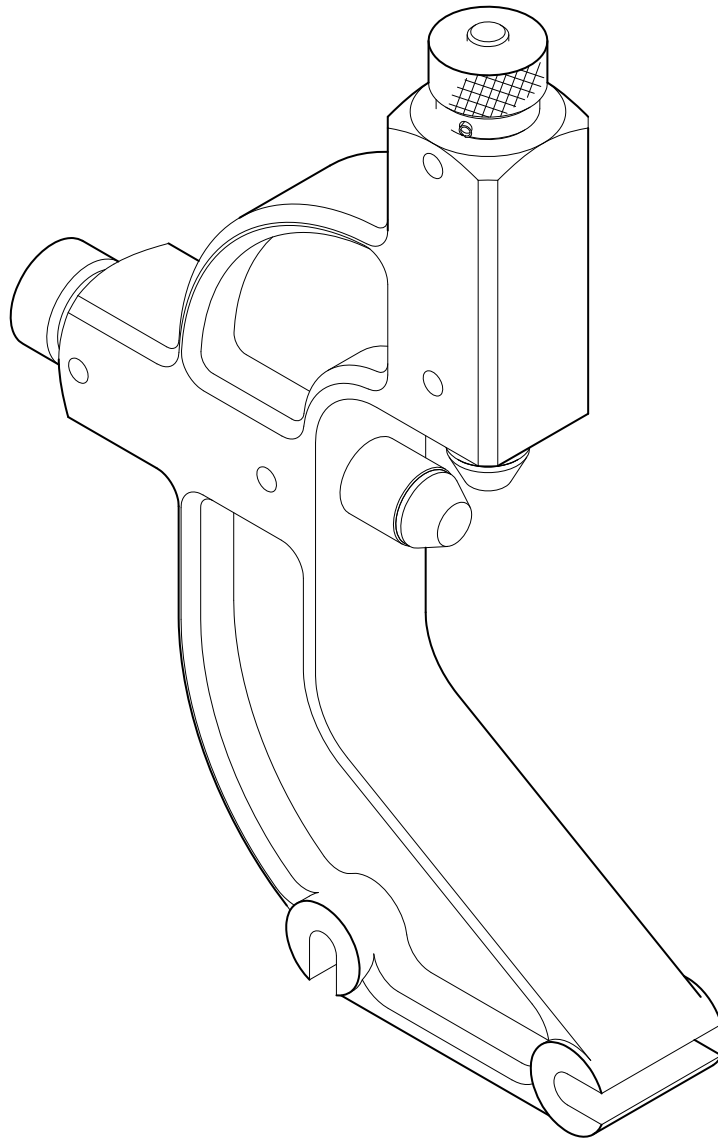


# Steady Rest

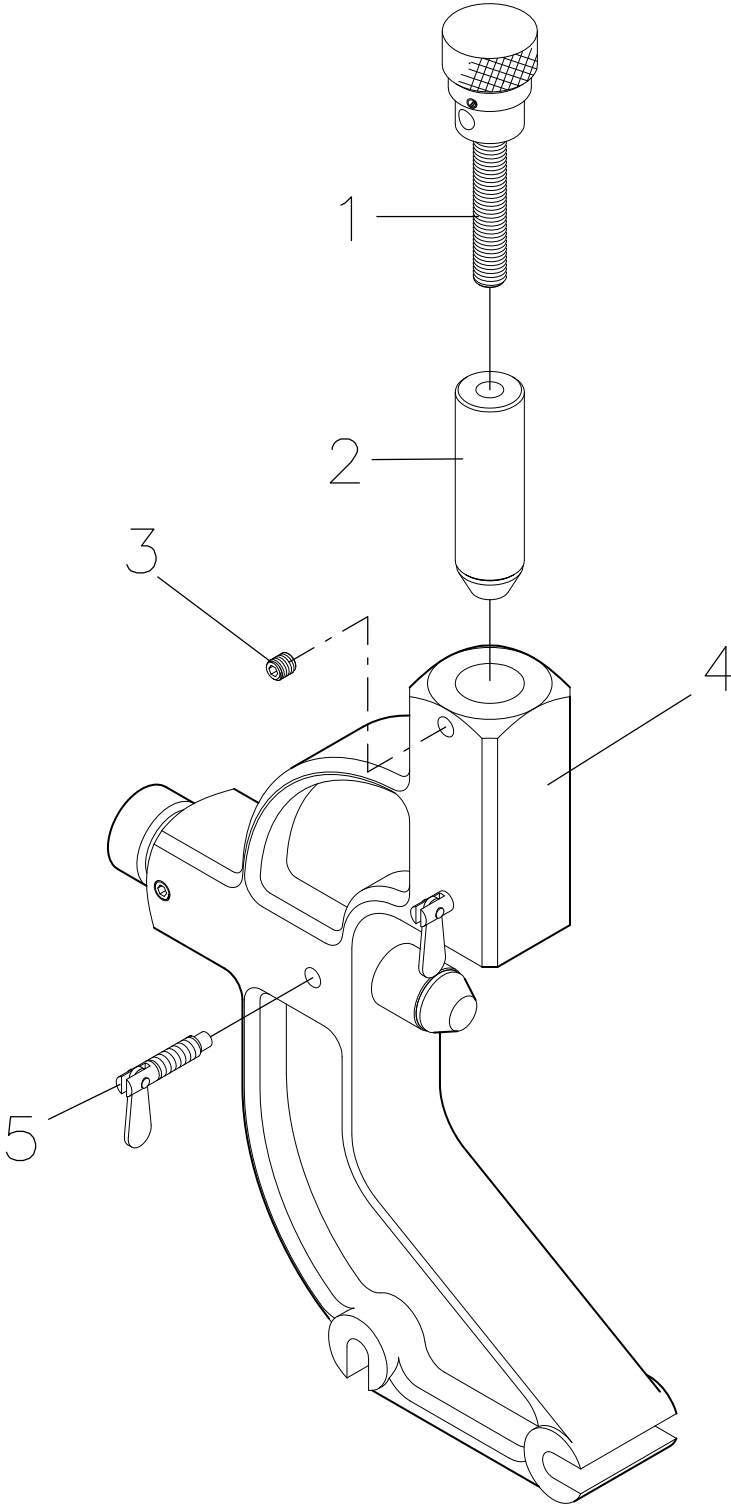
KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK	KEY NO.	PARTS NO.	PARTS NAME	Q'TY	REMARK
1	70038	Adjusting knob	3	Ø4x40					
		Spring pin	3						
	70062	Collar	3						
	70035	Screw	3						
2	70037	Finger	3	Ø8x23 627					
		Pin	3						
		Ball bearing	3						
3		Set screw	3	SET 8x8					
4	70064	Knob nut	1						
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



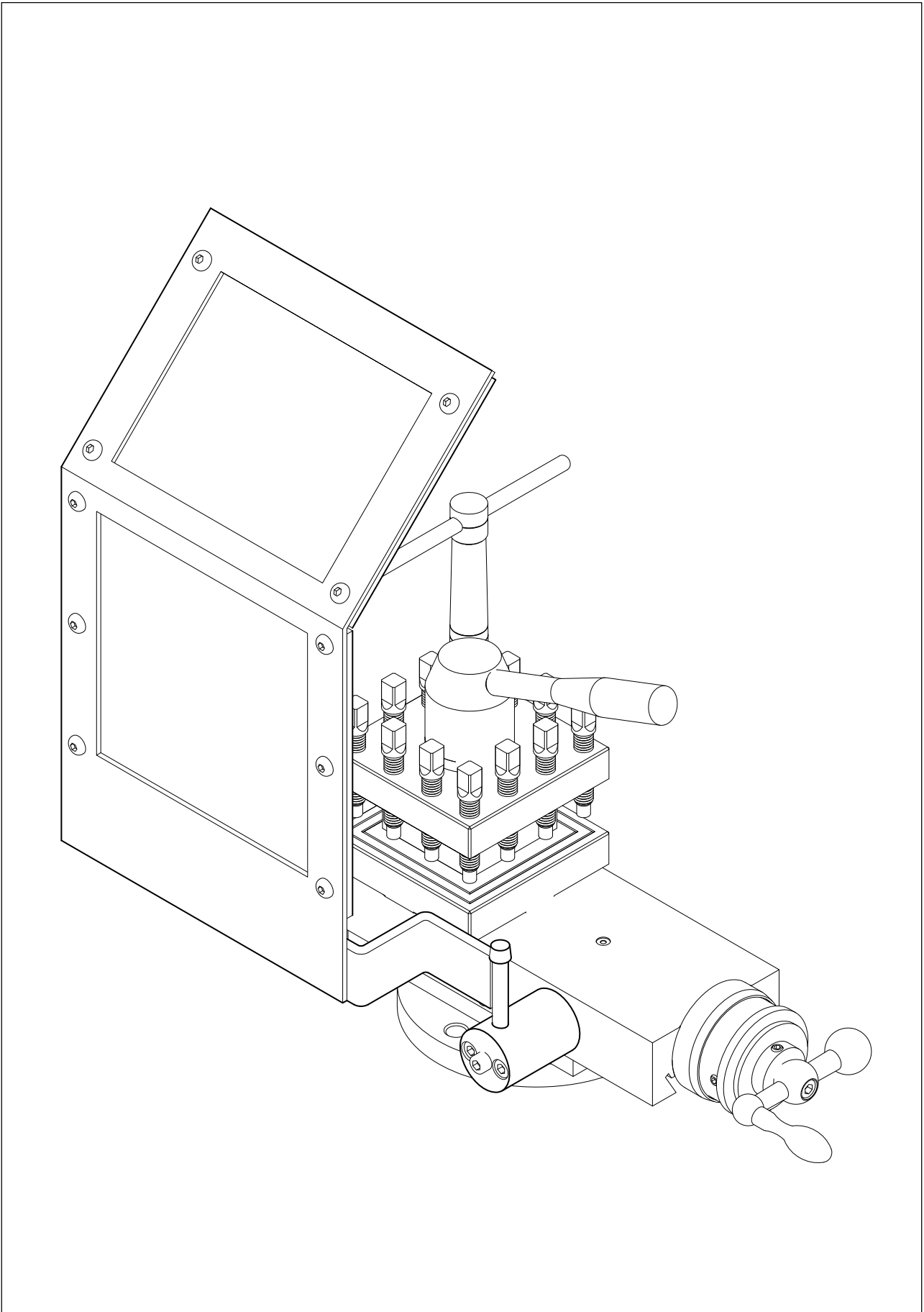
# Follow Rest



# 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	Ø4x40					
		Spring pin	3						
	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

