MINI-LATHE ML-360

&

MILLING ATTACHMENT MA-360

2

Instruction Manual
Accessories List
&
Parts List

For Your Own Safety Read Instruction
Manual Before Operating Tool

SAKAI SPECIAL CAMERA MFG. CO., LTD.

SAFETY RULES FOR POWER TOOLS

1. **KEEP GUARDS IN PLACE** and in working order.
2. **REMOVE ADJUSTING KEYS AND WRENCHS.** Form the habit of checking to see that keys and adjusting wrenches are removed from the tool before turning it on.
3. **KEEP WORK AREA CLEAN.** Cluttered areas and benches invite accidents.
4. **DON'T USE IN DANGEROUS ENVIRONMENT.** Don't use power tools in damp or wet locations, or expose them to rain. Keep work area well lighted.
5. **KEEP CHILDREN AWAY.** All visitors should be kept safe distance from work area.
6. **MAKE WORKSHOP KID PROOF** with padlocks, master switches, or by removing starter keys.
7. **DON'T FORCE TOOL.** It will do the job better and safer at the rate for which it was designed.
8. **USE RIGHT TOOL.** Don't force tool or attachment to do a job for which it was not designed.
9. **USE PROPER EXTENSION CORD.** Make sure your extension cord is in good condition. When using an extension cord, be sure to use one heavy enough to carry the current your product will draw. An undersized cord will cause a drop in line voltage resulting in loss of power and overheating. Table 1 shows the correct size to use depending on cord length and nameplate ampere rating. If in doubt, use the next heavier gage. The smaller the gage number, the heavier the cord.
10. **WEAR PROPER APPAREL.** Do not wear loose clothing, gloves, neckties, rings, bracelets or other jewelry which may get caught in moving parts. Nonslip footwear is recommended. Wear protective hair covering to contain long hair.
11. **ALWAYS USE SAFETY GLASSES.** Also use face or dust mask if cutting operation is dusty. Everyday eyeglasses only have impact resistant lenses, they are NOT safety glasses.
12. **SECURE WORK.** Use clamps or a vise to hold work when practical. It's safer than using your hand and it frees both hands to operate tool.
13. **DON'T OVERREACH.** Keep proper footing and balance at all times.
14. **MAINTAIN TOOLS WITH CARE.** Keep tools sharp and clean for best and safest performance. Follow instruction for lubricating and changing accessories.
15. **DISCONNECT TOOLS** before servicing; when changing accessories, such as blades, bits, cutters, and the like.
16. **REDUCE THE RISK OF UNINTENTIONAL STARTING.** Make sure switch is in off position before plugging in.
17. **USE RECOMMENDED ACCESSORIES.** Consult the owner's manual for recommended accessories. The use of improper accessories may cause risk of injury to persons.
18. **NEVER STAND ON TOOL.** Serious injury could occur if the tool is tipped or if the cutting tool is unintentionally contacted.
19. **CHECK DAMAGED PARTS.** Before further use of the tool, a guard or other part that is damaged should be carefully checked to determine that it will operate properly and perform its intended function - check for alignment of moving parts, binding of moving parts, breakage of parts, mounting, and any other conditions that may affect its operation. A guard or other part that is damaged should be properly repaired or replaced.

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

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

Table 1

Ampere Rating		Volts	Total length of cord in feet			
		120V	25ft.	50ft.	100ft.	150ft.
		240V	50ft.	100ft.	200ft.	300tt.
More Than	Not More Than	AWG				
0	6		18	16	16	14
6	10		18	16	14	12
10	12		16	16	14	12
12	16		14	12	Not Recommended	

GROUNDING INSTRUCTION

In the event of a malfunction or breakdown, grounding provides a path of least resistance for electric current to reduce the risk of electric shock. This tool is equipped with an electric cord having an equipment-grounding connector and a grounding plug. The plug must be plugged into a matching outlet that is properly installed and grounded in accordance with all local codes and ordinances.

Do not modify the plug provided - if it will not fit the outlet, have the proper outlet installed by a qualified electrician.

Improper connection of the equipment-grounding conductor can result in a risk of electric shock. The conductor with insulation having an outer surface that is green with or without yellow stripes is the equipment-grounding conductor. If repair or replacement of the electric cord or plug is necessary, do not connect the equipment-grounding conductor to a live terminal.

Check with a qualified electrician or service personnel if the grounding instructions are not completely understood, or if in doubt as to whether the tool is properly grounded.

Use only 3-wire extension cords that have 3-prong grounding plugs and 3-pole receptacles that accept the tool's plug.

Repair or replace damaged or worn cord immediately.

CAUTION !

Read all operating instructions and safety rules carefully before attempting any machining operations.

INSTRUCTION MANUAL

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Milling Attachment MA-360

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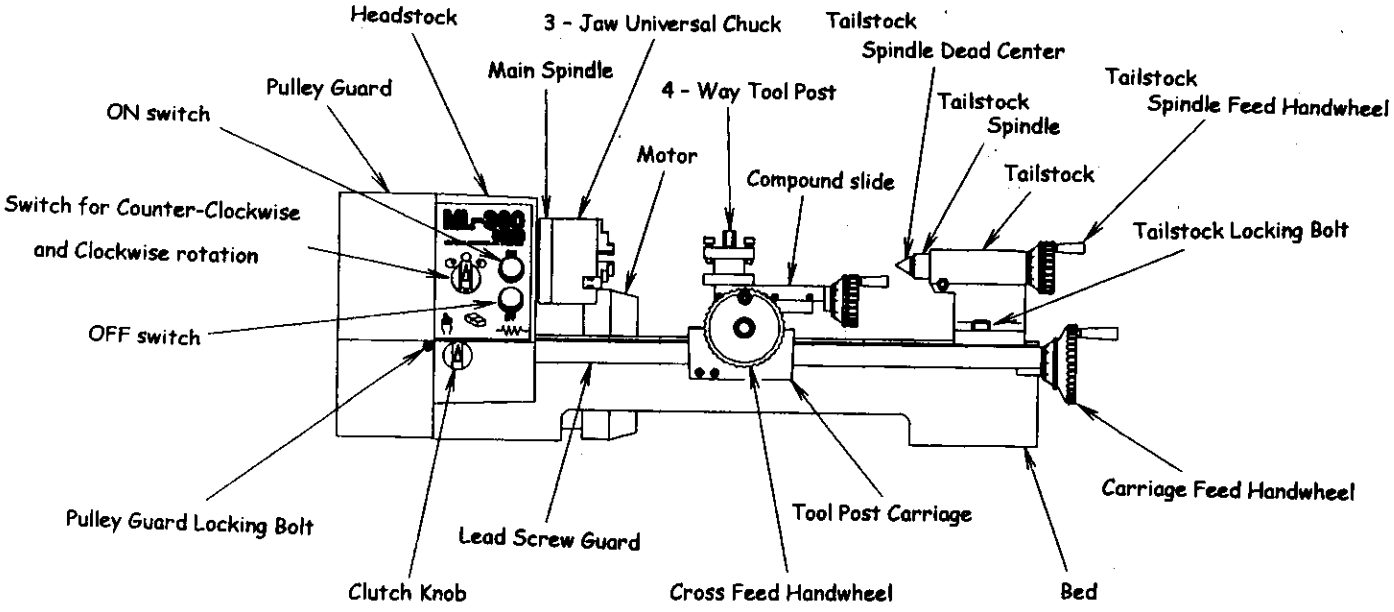
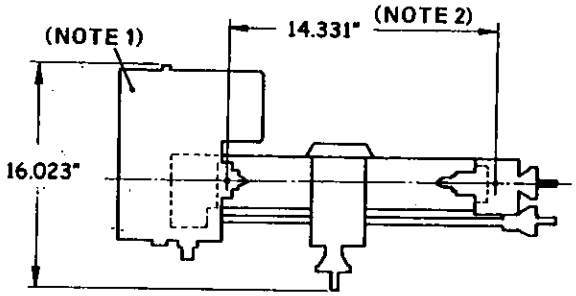
The Mini Lathe -360 is a top-quality machine developed with highly sophisticated machining techniques based on our experience as a leading manufacturer of professional large format cameras.

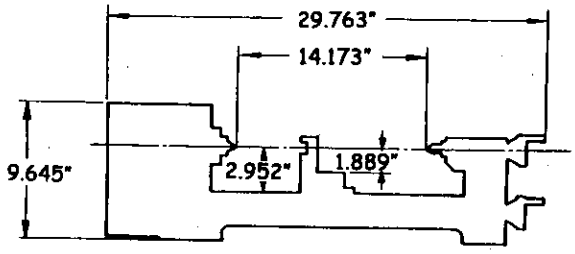
While compact in size, the ML-360 maintains excellent rigidity and durability, as well as outstanding performance and accuracy. With a large range of accessories to choose from, the ML-360 is ideal for a variety of machining operations.

MINI-LATHE ML-360 ILLUSTRATION & SPECIFICATIONS



Swing over bed	6" ϕ	
Distance between centers	14.173"	
Swing over Carriage	3.779" ϕ	
Center height	3"	
Main spindle through hole	5/8" ϕ	
Main spindle speed	60Hz	260, 520, 845, 970, 1845, 2860 rpm
	Slow speed attachment - 80 / 170 rpm	
Main spindle taper	MT#2	
Tailstock spindle travel	1.771"	
Tailstock spindle diameter	0.944" ϕ	
Tailstock spindle taper	MT#2 (short type 40L)	
Carriage cross travel	3.346"	
Carriage longitudinal travel	Whole range between centers	
Reversible condenser motor, single phase	Input 470W Output 300W 3180 rpm (60Hz)	
Dimensions	29.763"L x 14.842"W x 9.645"H	
Weight	66LBS (30kg) without accessories	



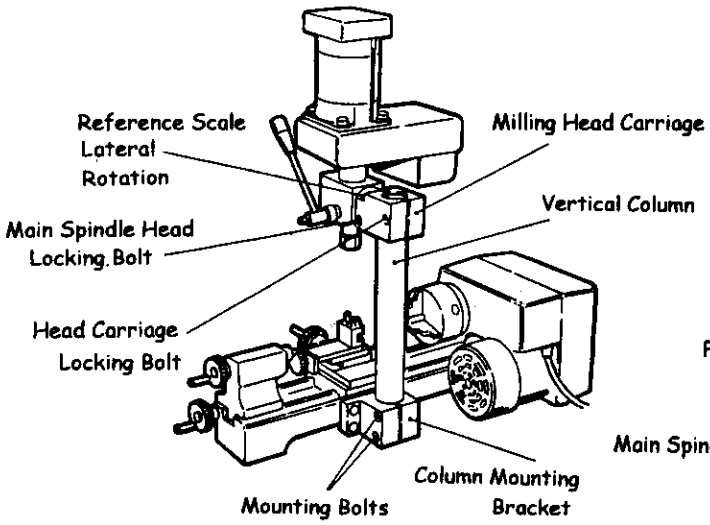


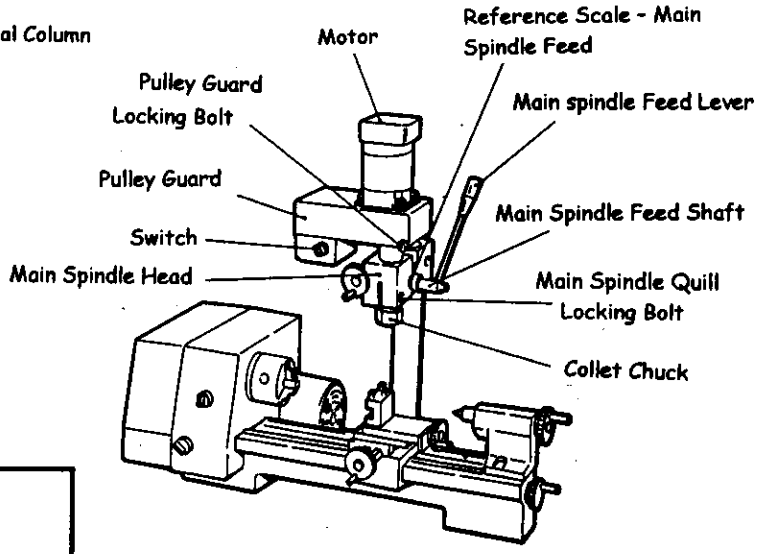
NOTE 1: When moving the ML-360, never carry it by the pulley guard. Remove the pulley guard first, then lift the machine while supporting it beneath the bed.

NOTE 2: Only operate the ML-360 on a flat surface. (Use 2 M8-clamping bolts at 14.331" pitch to bolt it down).

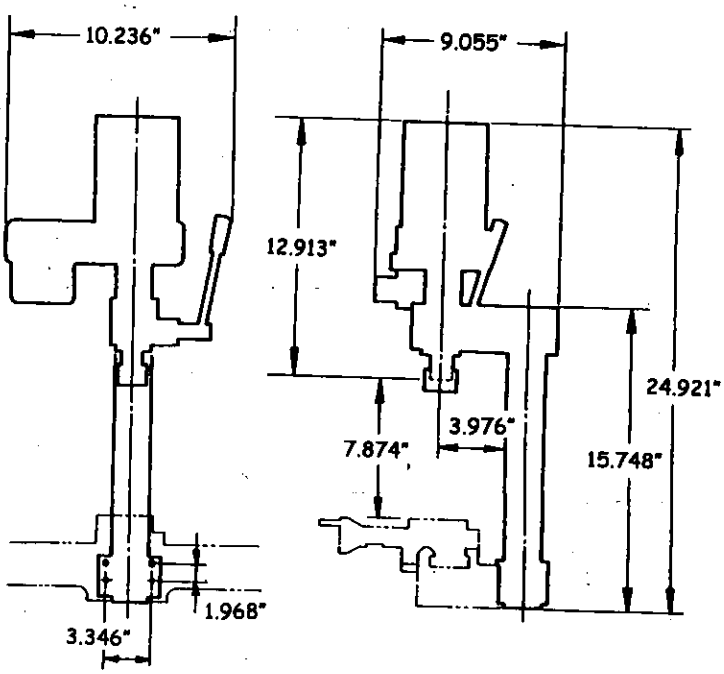
MILLING ATTACHMENT MA-360

ILLUSTRATION & SPECIFICATIONS





Distance between main spindle and column	3.996"	
Distance between main spindle nose and tool post	6.654"	
Main spindle taper	8°	
Main spindle quill travel	1.181"	
Chucking capacity	0.393" ϕ	
Main spindle nose thread	M24 x 1.5	
Main spindle head swing	360°	
Main spindle speed	60Hz	240 490 740 1120 2210 rpm
Condenser motor, single phase	Input 240W (0.32HP) Output 120W (0.16HP) 3000 rpm (60Hz)	
Dimensions	10.236"L x 9.055"W x 15.748"H	
Weight	29LBS (13kg)	



[1] << Mechanism and Operation >>

1. Starting and Stopping the Main Spindle

1) Only use the correct voltage as indicated on the rating plate on the top of the headstock (Fig 1).

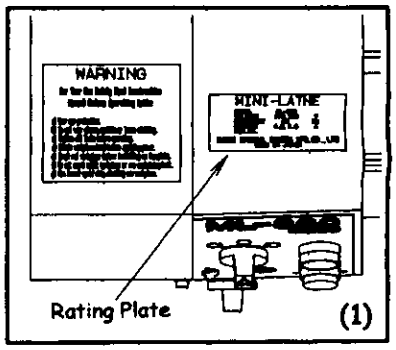
2) Turn the power on by turning the key to the right (Fig 2-1). (The key can not be pulled out when it is the on position.)

3) Turn the rotation direction knob to the desired position (forward or reverse).

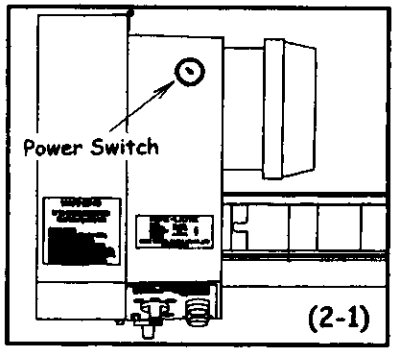
4) Press the ON button to begin operation (Fig 2-2).

5) When changing the direction of rotation, check first that the machine has completely stopped moving. Turn the direction knob to the desired direction and press the ON button to restart the lathe.

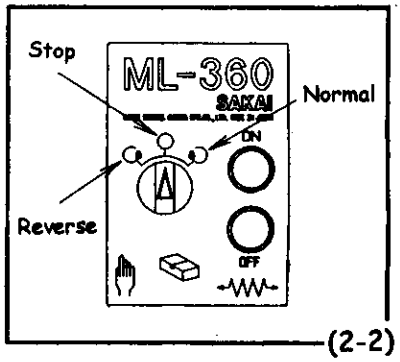
6) Before leaving the machine unattended, press the OFF button and make sure the machine has completely stopped moving. Turn the power off by turning the key to the left. This key must NOT be left inserted in the machine. It is important that the key is kept on the machine user or out of reach of unauthorized users (such as children) when the machine is not in use. Please avoid use by any unauthorized users. (Use utmost caution in the storage of this key.) Finally, be sure to unplug the machine before leaving it unattended.



(1)



(2-1)



(2-2)

2. Main Spindle Speed

(1) Adjusting the Speed

The ML-360 is capable of 6 spindle speeds (Fig. 3-1).
Position A is for high speeds and position B is for low speeds.

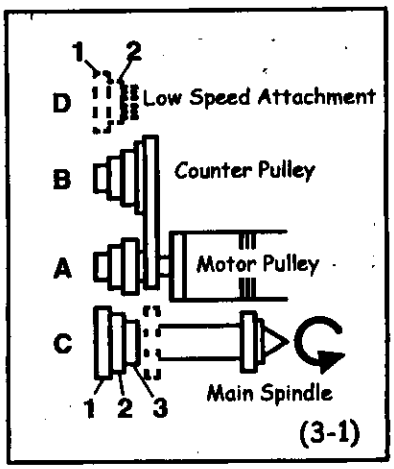
To reposition the belt (K-21), stop the main spindle and open the pulley guard. Loosen bolt (1) which is to the right of the counter pulley (b) so that the tension pulley (2) can be manually adjusted between positions A and B (Fig. 3-2).

Then place tension pulley (2) in a position between A & B, and set the belt from the main spindle pulley (c) to the motor pulley for the speed desired.

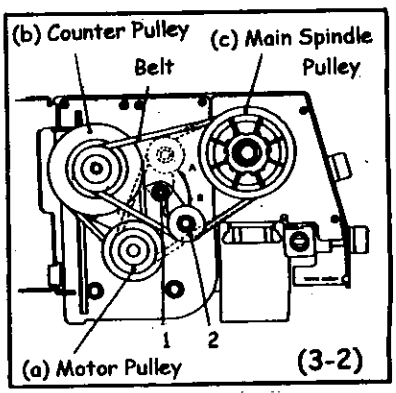
*For high speeds, the bolt runs from main spindle pulley (c) to motor pulley (a); for low speeds, the bolt runs from main spindle pulley (c) to counter pulley (b).

Diagram 3-2 shows the setting for low speed (B) usage. When the belt is set on the 2 pulleys, tighten bolt (1). Then move the tension pulley (2) to position A if using high speeds, or to position B if using low speeds. Make sure there is proper tension in the belt before tightening the bolt (1).

** NOTE: Be careful not to place too much tension on the belt



(3-1)



(3-2)

(2) Selecting the Proper Main Spindle Speed

The main spindle speed is determined by the workpiece material and diameter. Nonferrous metals, such as aluminum or brass, are machined at higher speeds than ferrous metals, such as steel or cast iron. Smaller diameters require higher speeds. If the motor should stall, or the belt come loose during operation, turn the machine off immediately. Move the tool away from the workpiece before resuming machining with a more shallow cut.

(3) Workpiece and Main Spindle rpm

Main Spindle rpm is determined by the cutting speed of the tool point. This is calculated by how many inches per minute the tool cuts into the workpiece.

Main spindle rpm $N = 36\ V / \pi D$

π : pi = 3.14 V : cutting speed (in/min.)

D : diameter of workpiece (in) N : Main spindle rpm

For Example: For an aluminum alloy material with a diameter of 3/4in (cutting speed 55yd/min.), the main spindle rpm is calculated as follows:

$$N = \frac{36 \times 55}{3.14 \times 3/4} = 1980 / 2.355 \fallingdotseq 840 \text{ (rpm)}$$

Spindle Speeds

Number of revolution per minute.

	A	B
C-1	970	260
C-2	1845	520
C-3	2860	845
D-1		80
D-2		170

(4-1)

Reference Figures are given in Table 4-2.

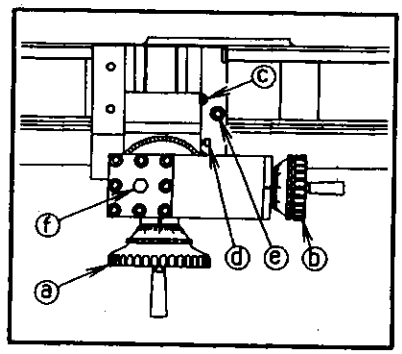
Main spindle rpm to the diameter of workpiece

Material	Cutting speed Yd/min (V)	Workpiece diameter (D), in			
		3/16	3/8	3/4	1 - 3/16
Aluminum alloy	55	2860 rpm	1845 rpm	845 rpm	520 rpm
Brass, Copper	55	2860 rpm	1845 rpm	845 rpm	520 rpm
Free cutting steel	22	970 rpm	520 rpm	260 rpm	260 rpm

(4-2)

3. Carriage

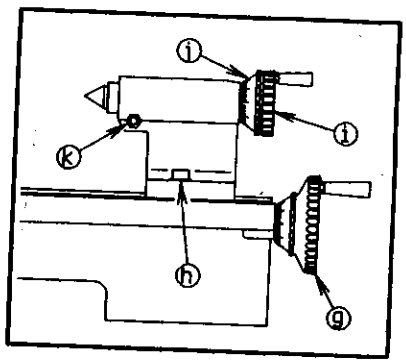
Handwheel (g) feeds the carriage longitudinally. Handwheel (a) feeds the cross slide across the bed. Screw (c) is used to adjust the tightness of the cross slide gib strip. Bolt (d) locks the cross slide, and bolt (e) locks the carriage to the lathe bed (Fig 5, 6).



(5)

4. Tailstock

To slide the tailstock along the lathe bed ways longitudinally, loosen bolt (h). Feed the tailstock spindle with handwheel (i), and lock the tailstock spindle by tightening bolt (k).



(6)

A dead center, live center, or drill chuck can be fitted to the tailstock spindle. Before fitting these accessories, it is essential that the tapered arbor of the accessory and the internal taper in the tailstock spindle are absolutely clean and free of grease.

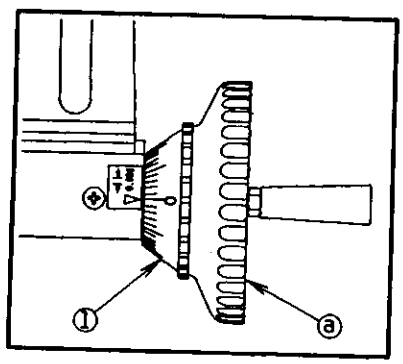
Feed the tailstock spindle forward by rotating the tailstock spindle feed handwheel (i), Firmly push in the accessory. The accessory is automatically ejected when the spindle is retracted to its fullest extent.

The spindle and handwheel calibration (j) is a useful reference for drilling and similar operations in the lathe (Fig 6).

5. Handwheel Calibration

Each handwheels has a calibrated cone (l) which can be re-set zero as a reference.

After taking a roughing cut, determine the remaining depth of cut required to finish the workpiece. Set the calibrated cone (l) to the zero position while holding the handwheel (a) so it does not move (Fig 7). This makes it easy to keep track of how much has been removed from the workpiece and how much more needs to be cut.



(7)

One revolution of the handwheel is equivalent to .050 in. feed. The short graduations are each .001 in. and the long graduations each represent .005 in.

[2] << Holding the Workpiece >>

There are several ways of holding the workpiece, depending upon its shape and size. As a general rule, the workpiece is held with a chuck. Longer pieces can be held between main spindle and tailstock spindle centers. Irregular shapes can be secured to the face plate. For extreme accuracy or repetitive cutting of small parts, the collet chuck is recommended.

(8)

1. Holding With a Chuck

The following types of chucks are available for your ML-360.

- 3-jaw Universal Chuck

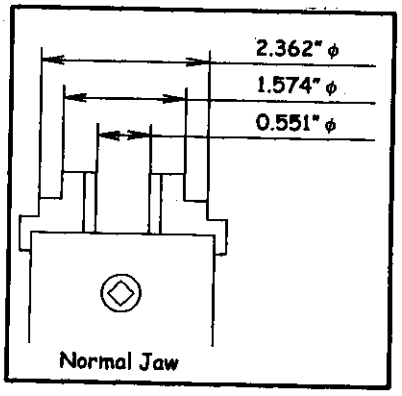
-4-jaw Independent Chuck

-Collet Chuck

(1) 3-jaw Universal Chuck (No.3501)

The jaws of the 3-jaw universal chuck are opend and closed by turning the chuck key (Photo 8). The jaws move simultaneously and center the workpiece automatically as they close. Please refer to Figures 9 and 10 for the recommended dimensions of round or hexagonal workpiece to be held in the 3-jaw chuck.

*In the interest of safety, the recommended chuck capacity should not be exceeded.

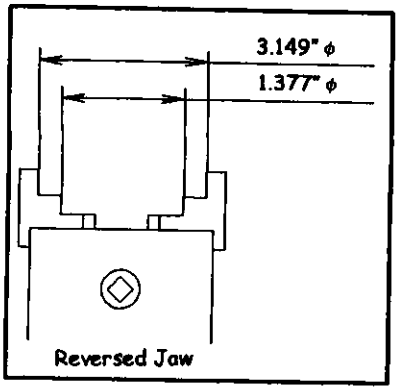


(9)

A. Fitting the Jaws

a) Normal Jaw Fitting

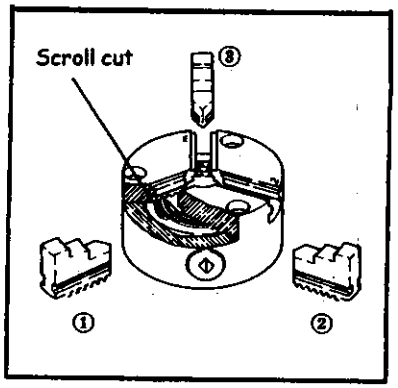
Turning the chuck key clockwise will cause the scroll in the chuck to rotate counterclockwise. With the jaws removed, turn the key until the end of the scroll thread appears in jaw slot No.1. Then turn back slightly and insert jaw 1 so that the jaw comes in contact with the scroll. Turn the key farther clockwise to engage jaw 1 with the scroll thread. Next, the end of the scroll thread will appear in jaw slot No.2. Follow the same procedures to fit jaws 2 and 3. It is important to insert the jaws in order from 1 to 3, so as to make the jaws meet evenly at the center.



(10)

b) Reversed Jaw Fitting

With all jaws removed from the chuck, follow the same procedure as normal jaw fitting to fit the set of reversed jaws in order from 1 to 3 (Fig. 11).



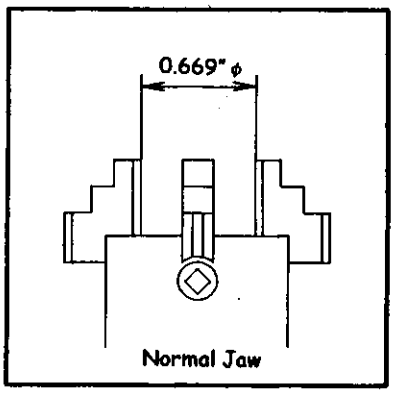
(11)

(2) 4-Jaw Independent Chuck (No.3502)

The 4-Jaw independent chuck is used to grip round, square, rectangular, or irregularly shaped workpieces. Recommended maximum workpiece dimensions are given in Figures 12 and 13. In the interest of safety, these dimensions should not be exceeded. Each of the 4 jaws is operated independently. Therefore, the jaws do not automatically center the workpiece.

A. Jaw Reversing

Remove the jaws with the chuck key provided, and refit the reversed jaws onto the chuck. There is no specific order in which the reversed jaws must be attached.



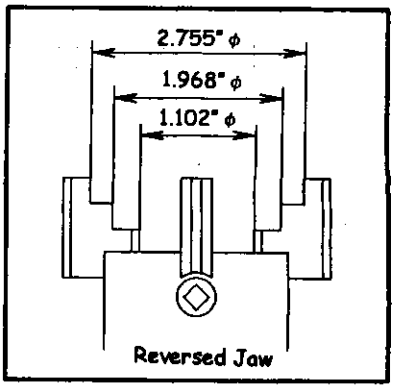
(12)

B. Centering the Workpiece

To hold the workpiece with the 4-Jaw independent chuck, the 4 jaws must each be brought into position and tightened evenly. A surface gauge or cutting tool fitted to the tool post is convenient reference for this procedure.

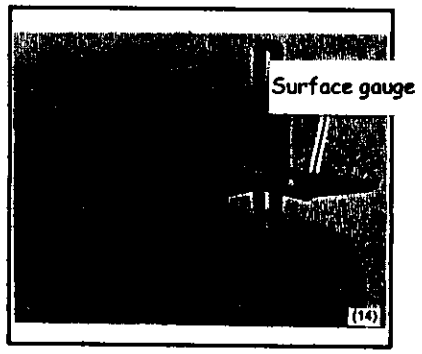
a) Centering

1) Open the jaws with the chuck key and hold the workpiece in approximately the correct position. Adjust two opposite jaws to grip the work lightly.



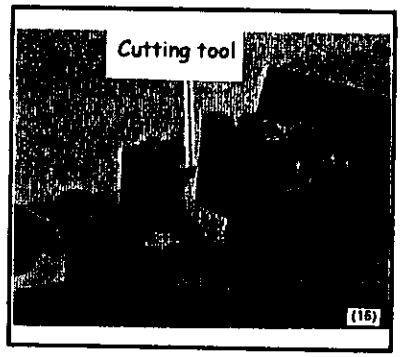
(13)

2) Close the other 2 jaws alternately to grip the workpiece as uniformly as possible.



3) For final centering, set a surface gauge (Photo 14) or cutting tool tip (Photo 15) close to a reference mark on the face of the workpiece.

4)Rotate the check and workpiece by hand to check the reference mark. When the final position is determined, tighten the jaws evenly.



(3) Fitting and Removing the Chuck

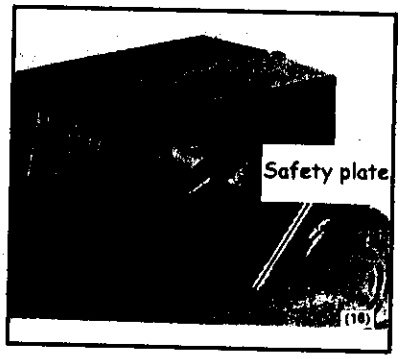
A. Fitting the Chuck

1) Clean the end of the main spindle and back of the chuck thoroughly.

2) Place the chuck on the end of the main spindle with the shoulder on the main spindle seated evenly in the undercut on the back of the chuck.

3) Insert the socket head bolts and tighten them evenly to secure the chuck (Photo 16).

4) When fitting the 4-jaw independent chuck, tighten the four bolts evenly in diagonal order.

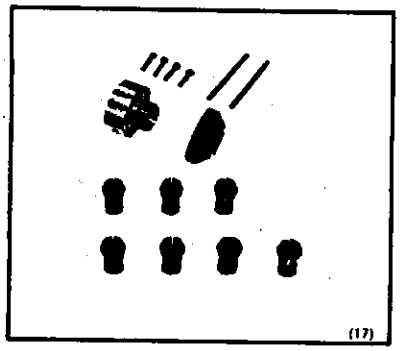


B. Removing the Chuck

To remove the chuck, reverse the "fitting" procedure. Place a safety plate of plywood or some soft material on the lathe bed to protect it in case the chuck is accidentally dropped(Photo 16).

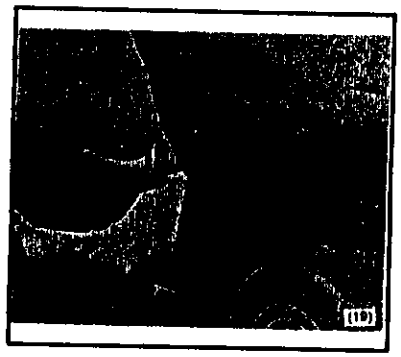
(4) Collet Chuck (No.3509)

A collet is used to grip small diameter workpiece with great accuracy. The Collet sets (No.35310) includes standard round collet sizes: 1/8, 3/16, 1/4, 5/16, 3/8, and 1/2". It also includes a blank collet which you may finish to any required size (Photo 17).



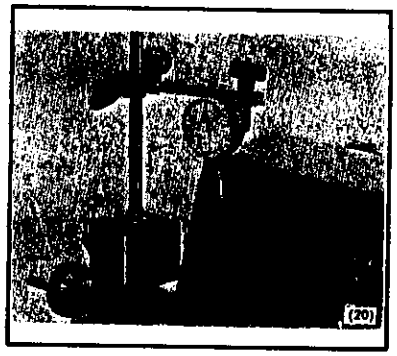
A. Fitting the Collet Chuck

The collet chuck is fitted to the end of the main spindle and consists of a collet holder, a collet nut, and interchangeable collets. A dial gauge, or indicator, is required for centering the collet chuck.



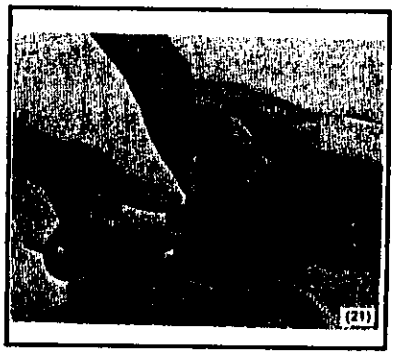
a) Fitting the Collet Chuck

1) Fit the collet holder to the end of the main spindle by lightly screwing in the Allen socket head bolts (Photo 19).



2) Use the dial gauge on the outside of the collet holder to center it. When the collet holder is properly centered, tighten the socket head bolts firmly (Photo 20).

3) Insert the required collet into the collet holder (Photo 21).



4) Screw in the collet nut just enough to prevent the collet from rattling around (Photo 22).

Do not tighten the collet chuck without a workpiece in it, as this will cause the collet to be distorted.

B. Holding the Workpiece

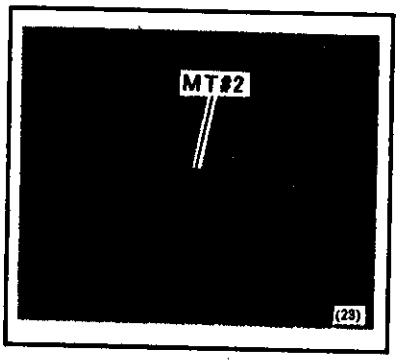
Insert the workpiece into the collet. Insert one of the 2 locking bars into the hole in the collet holder, and the other bar in the hole in the collet nut. Turn the bar in the holder counter clockwise and the bar in the nut clockwise to tighten.

2. Holding with Centers

When machining a long workpiece, it is best to mount it between centers in the main spindle and tailstock spindle. The tips of the center have a 60° conical shape.

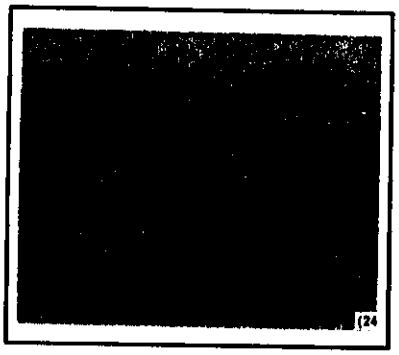
(1) Tailstock Spindle Dead Center (No.3505)

The dead center fits into the internal taper of the tailstock spindle. When the workpiece is rotating, it is important to keep the tip of the center and the center hole of the workpiece lubricated constantly to avoid overheating due to friction (Photo 23).



(2) Main Spindle Dead Center (No.3505)

Dead center No. 3505 also fits the internal taper of the main spindle. When the dead center is used in the main spindle, it dose not have to be lubricated, because it rotates whit the workpiece.



(3) Live Center (No.3507)

The live center fits into the internal taper of the tailstock spindle. The tip of the live center rotates with the workpiece on two ball bearings. This eliminates friction between the workpiece and the center and makes lubrication unnecessary (Photo 24).

(4) Fitting the Centers

It is important to keep the external tapers of the centers and the internal tapers of the spindles clean and free of grease. Wipe all contacting surfaces to clear them of chips, dirt, and lubricants.

A. Fitting a Tail Spindle Center

Single center machining is the process of machining a workpiece which is held between the chuck on the main spindle and a live or dead center on the tailstock spindle. The end of the workpiece that is held by a center must be center drilled.

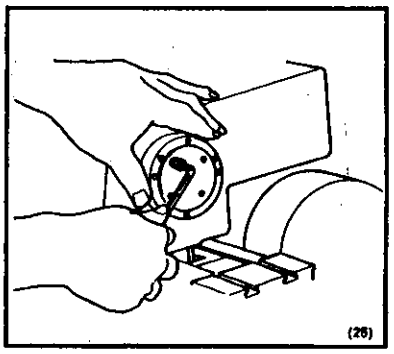
B. Fitting Two Centers

Machining between two centers is the process of machining when the workpiece is mounted between one center on the main spindle and another on the tailstock spindle. For this process, the workpiece must have been center drilled on both ends.

a) Fitting the Centers

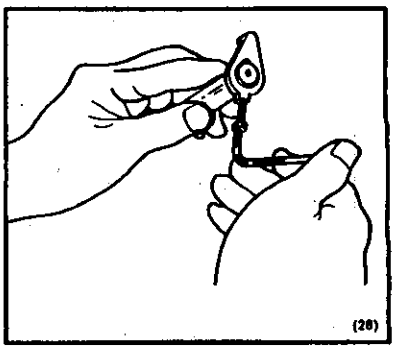
1) Clean the internal taper of the main and tailstock spindles thoroughly.

2) Fit the dead center into the main spindle. Fit the rotation stopper bolt (Fig. 25).

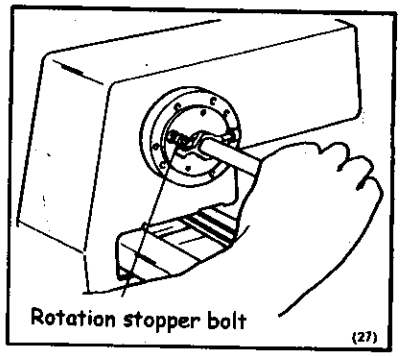


3) Fit the dead/live center to the tailstock spindle, ensuring that both surfaces are clean.

4) Mount the lathe dog (No. 3404) on the workpiece (Fig. 26).

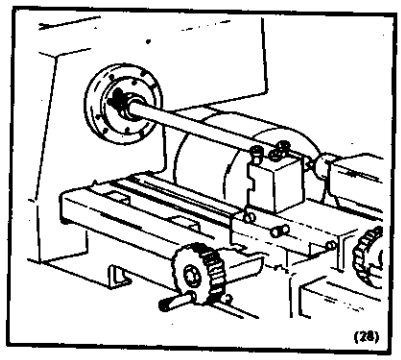


5) Place the end of the workpiece (with lathe dog attached) against the main spindle dead center (Fig. 27).



6) Support the other end of the workpiece with the tailstock spindle center. Be sure that there is no backlash (Fig. 28).

* The dead center is recommended for more precise cutting. However, the dead center must be well lubricated so that the center hole is not damaged.



b) Removing the Centers

Refer to 'Tailstock' on page 5 regarding the automatic ejection of the accessory from the tailstock spindle. The live center and the dead center are both removed in the same manner.

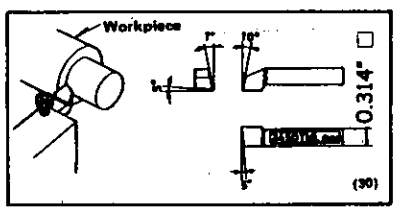
To remove the dead center from the main spindle, insert a soft metal bar (1/2 in. dia. or smaller) into the main spindle from outer end. Gently tap out the center.

Always hold one hand open under the center when removing it, so that it does not fall onto the bed (Photo 29).

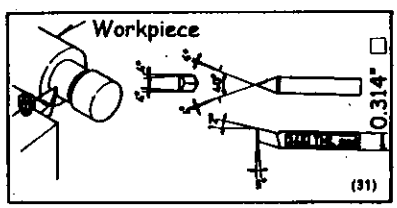
[3] <<Cutting Tools>>

1. Types of Cutting Tools

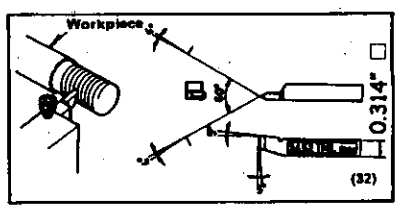
There are 8 types of cutting tools specially designed for your Mini Lathe. These tools are ready-ground for immediate use. From time to time, it may become necessary to regrind the tool to sharpen it, or to reshape it for a certain type of work. Tools can be ground using a high quality bench grinder fitted with the correct grinding wheel (Refer to Regrinding Figs. 30~34)
Sakai cutting tools are all made from High Speed Tool Steel.



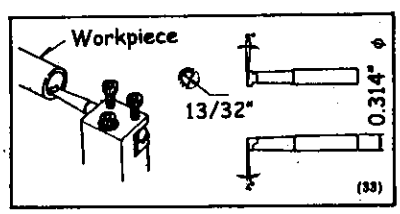
1) Right-hand finishing tool (No. 3450)
For cylindrical turning and facing cuts. The tool moves from the right (tailstock) end to the left (headstock) end of the workpiece for turning (Fig. 30) or across the end of the workpiece for facing.



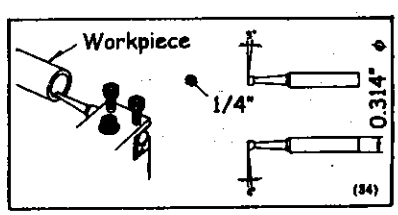
2) Roughing tool (No. 3451)
For cylindrical and step turning. The tool moves either from right to left or vice versa (Fig. 31)



3) External threading tool (No.3452)
For cutting external threads (Fig. 32)



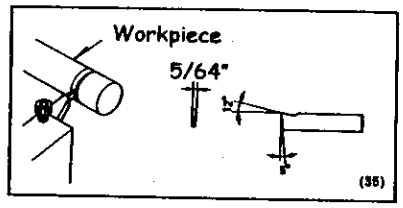
4) Boring Bar - 10 mmø (No.3053)
For boring holes that are 13/32 in. dia. or larger (Fig. 33).

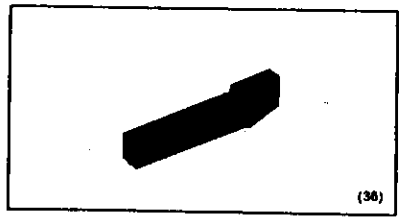


5) Boring Bar - 6 mmø (No. 3054)
For boring holes that are 1/4 in. dia. or larger (Fig. 33).
When boring with either No. 3053 or No. 3054 boring tool, the hole must be started with a drill or by some other means. The boring bars are used to enlarge existing holes.

6) Cut Off Tool (No.3055)

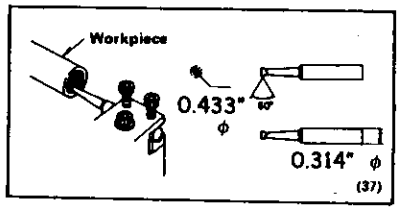
This tool is used for cutting off a part of the workpiece or for cutting grooves in a workpiece. It can also be ground for a particular application, e.g., cutting an external thread. The tool is used with the cut off tool holder (No. 3416). Three pieces are included in each set (Fig. 35).





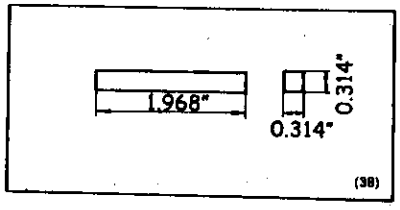
7) Cut Off Tool Holder (No.3416)

The flat tool holder is used to hold the cut off tool (No.3055) (Photo 36).



8) Internal threading tool (No.3056)

This tool is used for cutting internal threads (Fig. 37)



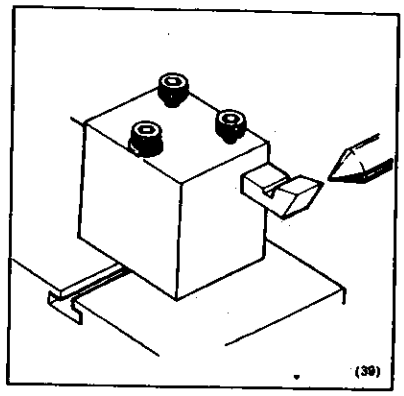
9) Unground tool (No.3060)

A square bit which can be ground to suit your specific needs (Fig. 38).

(1) Fitting the Cutting Tools to the Tool Post

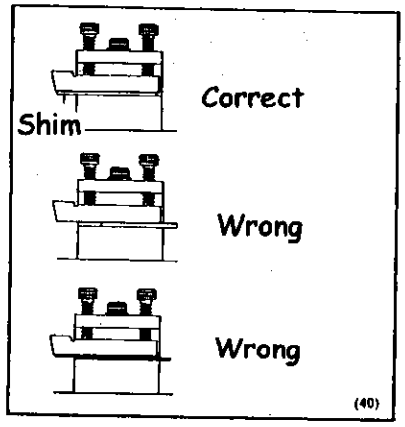
The cutting tool must be securely mounted in the tool post. It must be free of movement or vibration to perform accurate machining. Note the following points:

1) The overhang of the tool from the tool post surface must not exceed 1.5 times the thickness of the tool shank. Tools having excessive overhang may cause an inaccurate cut, or damage may result to the tool.



2) The point of the cutting tool must be aligned with the center height or axis of the lathe. Align the tip of the tool with the tip of the dead center fitted in the main or tailstock spindle (Fig. 39).

To attain the best tool position, it may be necessary to raise the tool by inserting a shim under the tool shank. The shim should have the same dimensions as the tool shank (Fig. 40).

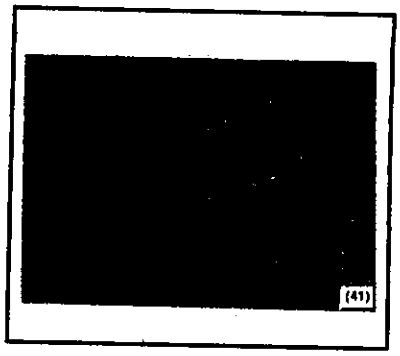


3) To secure the tool, tighten the two clamping bolts with the Allen wrench. The bolts should be tightened alternately and evenly.

*The tool may shift down slightly when tightening the bolt. Please take this into consideration when adjusting the shim.

4) Round cutting tools should be fitted to the round tool adaptor (No.3459) (Photo 41).

Fit the adaptor to the tool post with the round shank of the tool in the 'V' shape of the adaptor.



[4] << Machining >>

Generally, machining is the process of rotating the workpiece, applying the tool to it, and adjusting the feed to remove metal from the workpiece. However, there are many different ways of machining, depending upon the desired end product.

* Be careful not to touch the chuck, workpiece, or other rotating parts while the lathe is running.

1. Cylindrical Turning

This is the most basic method of machining, and involves cutting the outside of the workpiece.

1) Mount the workpiece in a chuck, on the face plate, or between lathe centers.

2) Fit the right-hand finishing tool or roughing tool in the tool post.

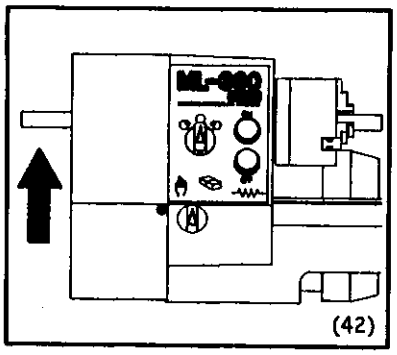
3) Select the required spindle speed which is determined by the type of metal and the diameter of the workpiece. Open the pulley cover, and position the belts according to the speed required.

4) Advance the cross slide to set the required depth of cut, and start the main spindle.

* First, make a roughing cut leaving about .008 ~ .012 in. oversize. Check the dimensions of the workpiece to determine the remaining cut. Resume machining while occasionally checking the dimensions until the desired size has been attained.

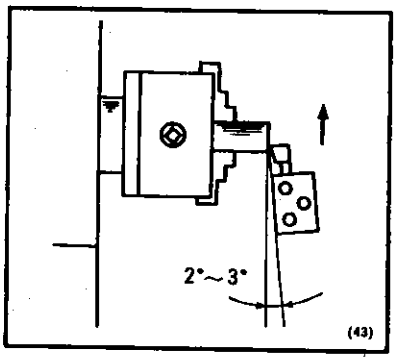
* Generally, the right-hand finishing tool (No.3450) is used for finishing cuts and the roughing tool (No.3451) for preliminary cuts.

* When machining a long workpiece, it is very dangerous to work with the unmachined end protruding from the headstock main spindle (Note arrow in Fig. 42). Cut the workpiece to a shorter length to avoid excessive protrusion.


(42)

2. Facing Cuts

This is the process of machining the surface of the workpiece that is at a right angle to the main spindle.



(43)

1) Fit the right-hand finishing tool (No.3450) to the tool post, aligning it with the center height. Tighten the tool post after checking the tool angle against the workpiece (Fig. 43).
2) Move the tool into cutting position by adjusting the carriage longitudinally on the lathe bed.
3) Turn on the motor and commence cutting from the outer edge to the center of the workpiece by advancing the cross slide.

3. Step Turning

Decide the depth of the step and then follow the procedures for cylindrical turning (Photo 44).

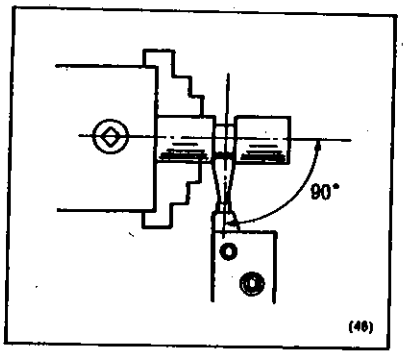

(44)

1) Fit the right-handed finishing tool (No.3450) to the tool post.
2) Feed the carriage so that the cutting tool point comes in contact with the outer edge of the workpiece. Set the calibrated cone of each handwheel to zero (for setting procedure refer to 'Handwheel Calibration', page 5).

* Repeat cylindrical and counterface cutting alternately until the workpiece is cut to the required dimensions. When a deep cut is required, it will be necessary to repeat the operation several times.

4. Cut Off

This is the process of cut off a part of the workpiece by feeding the cutting tool at a right angle to the center line of the main spindle. The Cut Off Tool (No.3055) is fitted to the tool post with the cut off tool holder (No.3416) (Fig.45).



(1) The Cut Off Procedure

1) The cut off should be made as close as possible to the chuck. If the cut-off position is too far from the chuck, chatter may result and damage the tool or the workpiece.

2) Align the point of the cut off tool with the center height of the lathe. Set it at an exact right angle to the center line of the main spindle (Fig. 45).

3) Select a lower speed than for cylindrical turning. Adjust the belt positions accordingly.

4) Feed the tool to the cut off position.

5) Turn on the motor and carefully feed the tool into the workpiece.

* Decrease the feed rate at the center of the workpiece, especially as you near the cut off point. This is the most crucial part of the cut off process.

* Use plenty of lubricant oil in order to protect the cutting tool from damage.

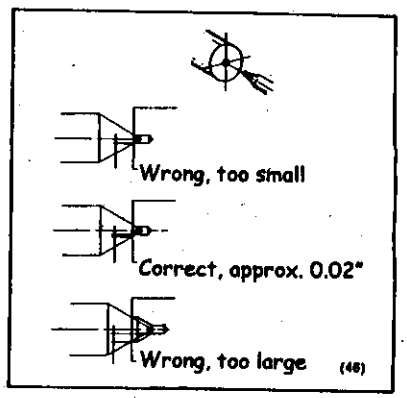
5. Center Drilling and Centering

Centering is a very important technique for accurate machining. Center drilling the location of any hole makes it easier to drill the hole more precisely.

The maximum permissible overhang of the workpiece from the chuck (3-jaw, 4-jaw, or collet) is generally three times the diameter of the workpiece. Longer workpieces must be supported by a center in the tailstock spindle.

(1) Center

The center hole is extremely important, as it becomes the base of other machining processes. Therefore, the utmost care is required in machining the most exact and accurate center hole (Fig. 46). Center drills (No.3071) are available in sizes of 1.0, 1.5, and 2.0 mm diameter at the tip.



A. The Centering Procedure

1) Mount the workpiece in the 3-jaw, 4-jaw, or collet chuck.

2) Remove the dead center from the tailstock spindle. Insert the tapered part of the drill chuck (No. 3508) into the tapered hole of the tailstock spindle.

3) Fit the appropriate center drill in the drill chuck, and tighten the chuck with the chuck key.

4) Loosen the tailstock locking bolt. Move the tailstock close to the workpiece and lock it in position.

5) Set the appropriate main spindle speed.

6) Turn the motor on and feed the drill with the tailstock spindle feed handwheel.

* The center drill tip is especially susceptible to damage. It must be fed in slowly using plenty of cutting oil.

6. Boring


(47)

Boring is the process of enlarging a hole made by a drill or other means to a specific size (Photo 47).

* In the case that the workpiece does not already have a hole in it, one must be made by drilling.

(1) The Boring Procedure

1) Mount the workpiece in the chuck.

2) Fit the boring tool to the tool post using the adaptor (No. 3459). Align the point of the boring tool with the center height of the lathe.

3) Select the main spindle speed, and adjust the belts.

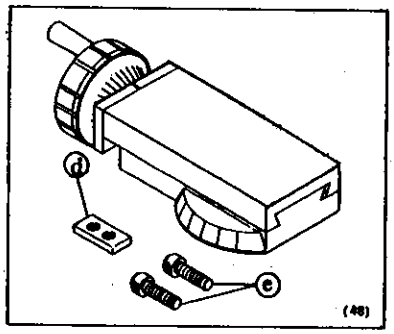
4) Turn the motor on and feed the tool.

* Due to the length of the boring tool, it may chatter unless the correct (slow) feed rate is used.

* Be sure to keep the workpiece free of chips and use plenty of cutting oil for better boring.

[5] <<Machining with Accessories>>

A wide range of accessories are available for the ML-360. The following is an introduction to the use of the accessories.



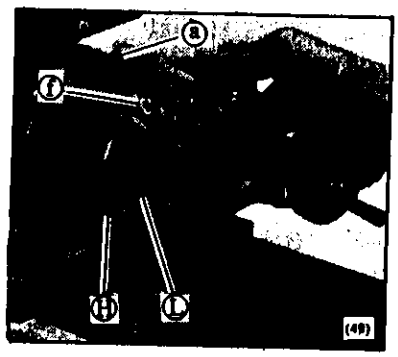
1. Compound Slide (No.35317)

Any taper is possible with the use of this attachment (Photo 48).

(1) Fitting the Compound Slide

1) Turn the handwheel of the compound slide counter clockwise to expose the eccentric bush.

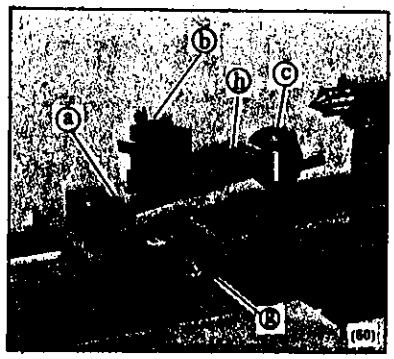
2) Insert part (f) of the compound slide (a) into the hole (H) in the cross slide (Fig 48, Photos 49).



3) Insert the nut (d) into the T-slot on the cross slide, fit the Allen head bolts (e) through the eccentric bush in the attachment, and tighten lightly with the Allen wrench (5 mm.).

4) The compound slide body (a) has a scale graduated in 5° increments to a maximum of 45° on either side. Align the required angle with the reference mark (L) on the cross slide and tighten firmly.

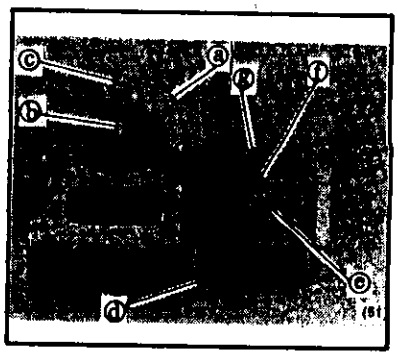
5) Fit the tool to be used on the tool post (b).



* For adjusting the height of the tool, refer to 'Fitting Cutting Tools to the Tool Post', page 14.

* The tool is fed with the cross feed handwheel (g), and a taper is cut by turning the feed handwheel (c) on the compound slide (Photo 50).

* If the top slide (h) is moved too far to the right (Photo 50), the feed gear may separate from the base (a). To avoid this danger, stay within the 2.04" maximum feed limit for the compound slide.

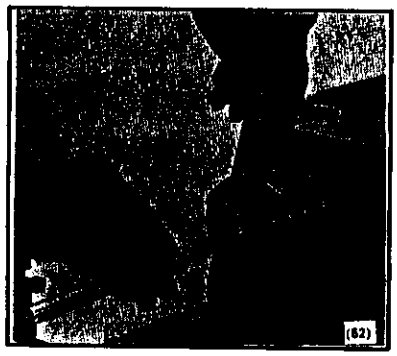


2. Steady Rest (No.3520)

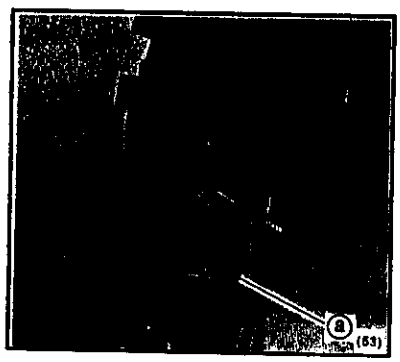
The steady rest is recommended for supporting long, thin workpieces in all cutting operations (Photo 51).

(1) Fitting the Steady Rest

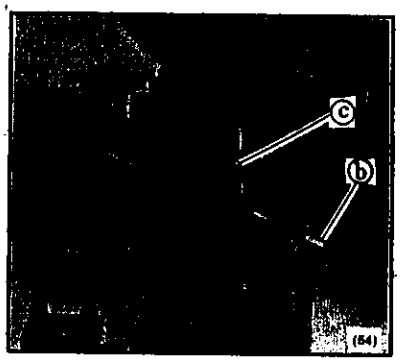
1) Hold one end of the workpiece gently with the chuck (Photo 52).



2) Slide the steady rest (a) over the workpiece and place it as close as possible to the machining area. Attach the steady rest to the lathe bed with the bolt (e), washer (f), nut (g) and nut plate (d) (Photo 51, 53).
For turning between centers, position the rest near the center of the workpiece.



3) Loosen the slide bar clamp bolts (c) and adjust the workpiece. While slowly turning the chuck by hand, adjust the steady rest bars (b) so that they hold the workpiece firmly. Clamp the 3 bolts (c) to secure the bars in postition (Photo 54).
* When working with a centered workpiece, it is best to set the workpiece in the tail spindle before adjusting the 3 bars (b) on the steady rest.



4) When the workpiece is aligned correctly, clamp the chuck firmly.
* When tightening the chuck, be sure that there is a very small space between the steady rest bars and the workpiece, so that the workpiece can be turned easily by hand. Too much space will cause inaccurate machining and may damage the tool or workpiece. Conversely, if the bars are too tight, the workpiece may be scored, or it may overload the lathe motor.

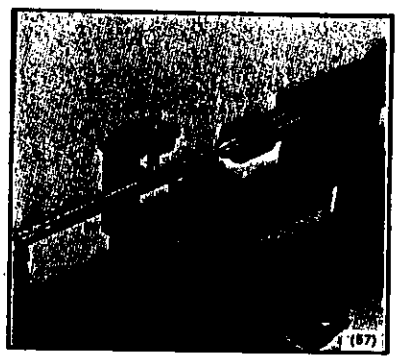
5) Lubricate the contact surface between the workpiece and the steady rest bars well before starting the main spindle (Photo 55).

* If the surface of the workpiece is not perfectly round or smooth, turn a smooth, round surface first, and then fit the bars of the steady rest on that surface.

* The maximum diameter to be held with the steady rest is 1.950 in.

3. Traveling Rest (No.3521)

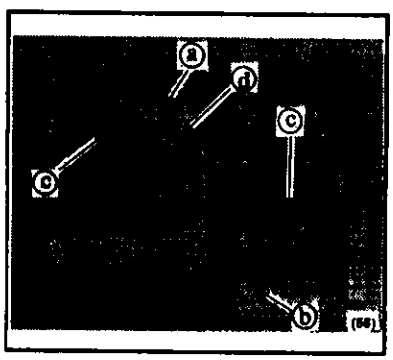
The traveling rest is used for supporting long or thin workpieces and is attached to the carriage.



(1) Fitting the Traveling Rest

1) Mount the traveling rest (a) on to the carriage with the washers (b) and Allen head bolts (c) (Photos 56, 57).

2) Hold the workpiece with the chuck and a center or between two centers.



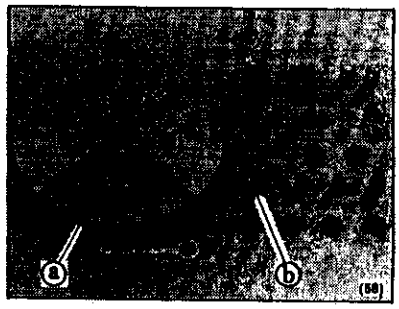
3) Loosen the clamp bolts (d) and close the bars (e) around the workpiece lightly. While turning the chuck by hand, adjust the space between the workpiece and the bars. Finally, tighten the bolts to secure the bars.

4) For smooth cutting, lubricate the contact surface between the workpiece and bars before starting the main spindle.

* Refer to 'Steady Rest' page 19 for further information.

* Maximum diameter to be held with the traveling rest is 1.950 in.

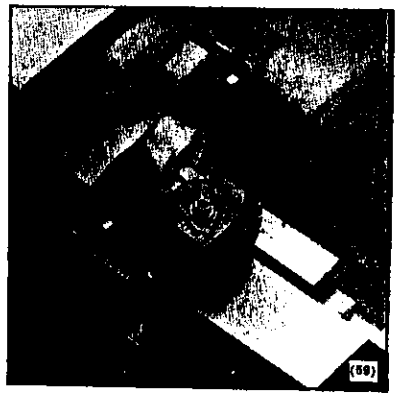
4. T Slot Face Plate 5.9 in. dia. (No.3523)



The T-slot face plate is used for lathe and milling work with large and irregularly shaped workpieces. The fixture set (No. 3443) comes with the face plate (Photo 58).

(1) Fitting the Face Plate

1) Fit the T-slot face plate (a) to the nose of the main spindle with the Allen head bolts (b).



2) Clamp the workpiece on the face plate using the fixture set (Photo 59).

* It is important to use a counter-balancing weight when fitting irregularly shaped workpieces. Without the proper balance, the workpiece may fly off, or the lathe may vibrate intensely, posing a serious danger.

* In order to confirm the balance, start the spindle at its lowest speed.

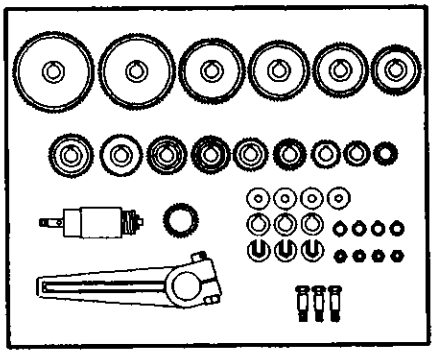
3) For milling processing, the T-slot face plate is fitted on the Index head (No. 3535) or Circular dividing table (No. 3565) with the Allen head bolts (Photo 60). It is also possible to attach the T-slot face plate to the milling table (No. 3534) or the cross slide, using the 2 Allen head bolts.

* Its large diameter (5.9 in) also makes it convenient as a circular table.

5. Automatic Feed / Thread Cutting Attachment (No. 3511)

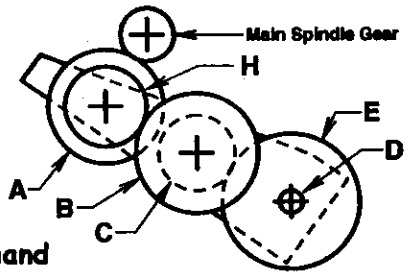
This accessory allows the longitudinal feed to be operated automatically. By changing the gears, it is possible to attain feed rates of 0.0025 or 0.005 in. per revolution of the main spindle. It is also possible to cut 31 different unified thread pitches ranging from 10 to 80 threads per inch (Fig. 61, Table 62).

* The automatic feed allows even, accurate, and precise machining. It also helps to preserve the tool life.

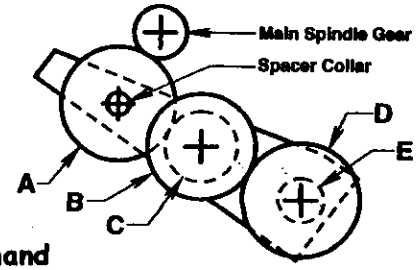


(61)

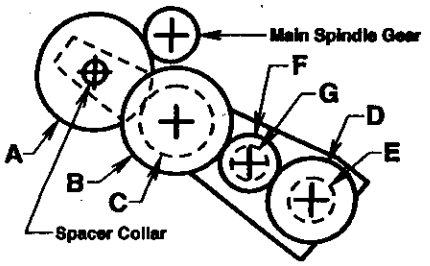
Automatic feed



Right hand



Left hand



Automatic feed

Feed per revolution	Gear		
	H / A	B / C	D / E
0.0025 in	20 / 60	70 / 25	- / 75
0.005 in	40 / 60	70 / 25	- / 75

Thread cutting

Threads per inch	Gear			
	A	B / C	D / E	F / G
10	55	40 / 20	30 / -	25 / -
11	55	40 / 30	22 / -	35 / -
12	55	50 / 20	45 / -	25 / -
13	55	60 / 45	26 / -	25 / -
14	55	50 / 35	30 / -	25 / -
15	55	40 / 20	45 / -	25 / -
16	45	50 / 30	40 / -	20 / -
17	55	60 / 34	45 / -	20 / -
18	55	50 / 30	45 / -	25 / -
19	55	60 / 45	38 / -	20 / -
20	55	40 / 20	60 / -	20 / -
22	60	30 / 22	45 / -	20 / -
24	45	50 / 30	60 / -	20 / -
26	50	40 / 26	60 / -	20 / -
28	55	50 / 35	60 / -	20 / -
30	55	- / 40	- / 45	20 / -
32	55	50 / 40	60 / -	20 / -
34	55	40 / 34	60 / -	20 / -
36	55	50 / 45	60 / -	20 / -
38	55	40 / 38	60 / -	20 / -
40	55	30 / 40	45 / -	35 / -
44R	45	50 / 60	55 / -	
44L	45	- / 20	55 / -	50 / 60
48	55	25 / 40	45 / -	20 / -
52	55	20 / 26	60 / -	25 / -
56	55	25 / 35	60 / -	40 / -
60	55	35 / 45	70 / -	20 / -
64	55	25 / 40	60 / -	20 / -
68	55	20 / 34	60 / -	25 / -
72R	55	25 / 45	60 / -	
72L	55	- / 20	60 / -	25 / 45
76R	55	20 / 38	60 / -	
76L	55	- / 25	60 / -	20 / 38
80R	55	25 / 40	75 / -	
80L	55	- / 20	75 / -	25 / 40

(62)

For the section marked -, use the collar instead of gear.

(1) Fitting the Feed/Thread Attachment

The No. 3511 set includes the automatic feed unit and the thread cutting unit. Each unit is fitted in the same manner.

*(Complete the belt adjustment for main spindle speed before beginning this fitting procedure.)

1) Switch the clutch control to manual.

2) Open the pulley guard. Using the gear bracket 360 (b), fit the gear shaft assembly (a) firmly to the lead screw hole located on the left hand side of the bed (Fig. 63).

3) Loosely attach the bolt (c), key socket (d), washer (e), and nut (f) to the gear bracket 360 (b). Then mount the bracket on the gear shaft assembly (a) and lightly clamp it in place with the Allen head bolt (h) (Fig. 63, 64).

4) Select the feed rate or pitch (refer to Table 62) and prepare the main spindle gear, and idler gear A~H.

5) Slide the main spindle gear (W) on the end of the spindle until it touches the step on the left end of the main spindle. Secure the gear by tightening the setscrew with the Allen key, making sure that the screw fits into the D-shaped cut (Fig. 65).

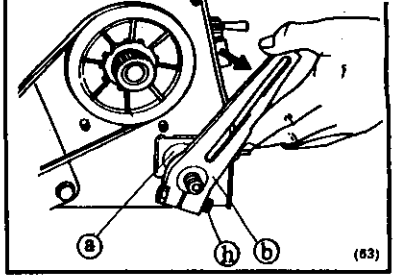
6) Attach the lead screw gear D or E to the key socket on the left side of the gear shaft assembly (a) with the spacer collar , washer (e), and hexagon nut (i) (Fig. 66).

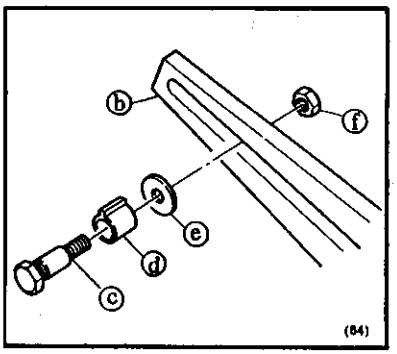
7) The order of assembly of the idler gear A, B/C, and F/G is especially important. Be sure to check Table 62 before assembling. Loosen the gear shaft bolt (c) and attach the lead screw gear D or E, adjusting for backlash. Tighten the gear shaft bolt and fit the gear stopper (j).

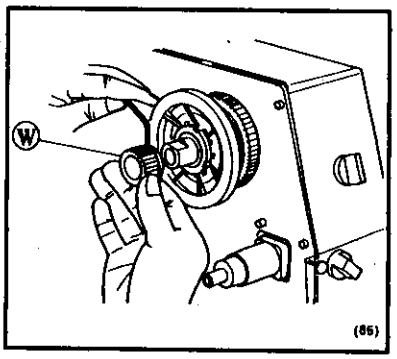
8) Engage A with B/C, and B/C with F/G referring to Figure 67.

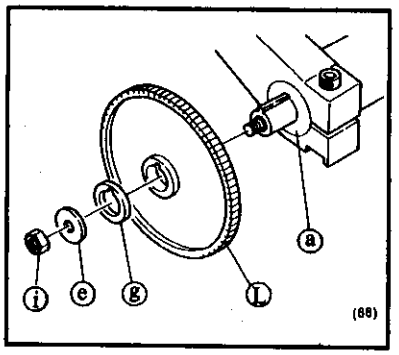
9) Rotate the gear bracket 360 (b) using the gear shaft assembly (a) as the fulcrum, so that the main spindle gear and idler gear A mesh with proper clearance. Use a strip of paper between the gears to test the mesh of the gear teeth. Tighten the Allen head bolt (h) using the Allen key (Fig. 68).

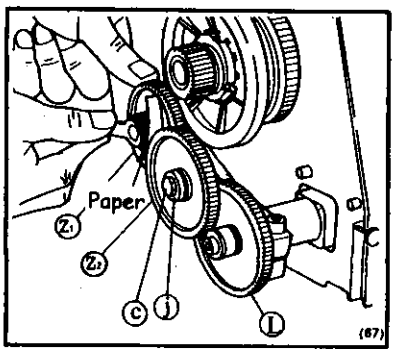
10) Close the pulley guard.

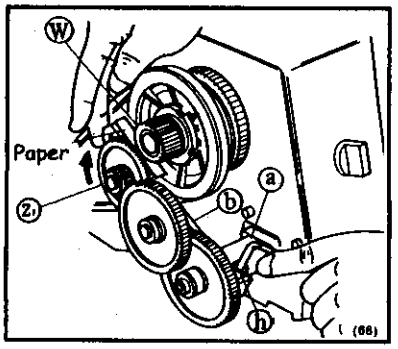












(2) Operating the Feed/Thread Attachment

Turn on the main spindle and switch the clutch control to automatic. The carriage will move automatically.

To disengage the automatic feed, switch the clutch control to manual. This releases the clutch, stopping the carriage movement.

* When the clutch control is in the automatic position, the carriage feed handwheel cannot be operated by hand. When using the automatic feed, pay attention to the location of the carriage (tool post) so that it does not hit and damage other parts of the machine.

* With normal rotation of the main spindle, the carriage travels from right to left.

With reverse rotation of the main spindle, the carriage travels from left to right.

Note: The clutch knob on the headstock can only be turned to the automatic feed position while the main spindle is running.

(3) Thread Cutting

1) Hold the workpiece with the chuck.

2) Set the main spindle speed to the lowest rpm, or to a slow speed with the Slow Speed Attachment (No. 3519).

3) Fit the external threading tool to the tool post. Start the main spindle and feed the carriage manually until the tool comes in contact with the outside of the workpiece. At this point, set the cross feed dial to zero and move the cutting tool away from the surface.

4) Set the first cutting depth with the cross feed handwheel and switch the clutch control to automatic.

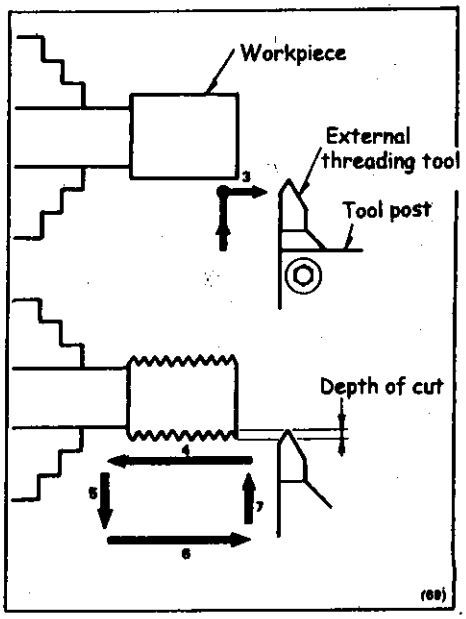
5) Upon completion of the first threading cut, move the cutting tool away from the workpiece and stop the main spindle.

* Do not release the clutch until the threading operation is complete.

6) Reverse the main spindle rotation to return the carriage to the starting point, and stop the main spindle.

7) Return the cutting tool to the starting point, set the depth of cut for the second pass, and commence the second pass.

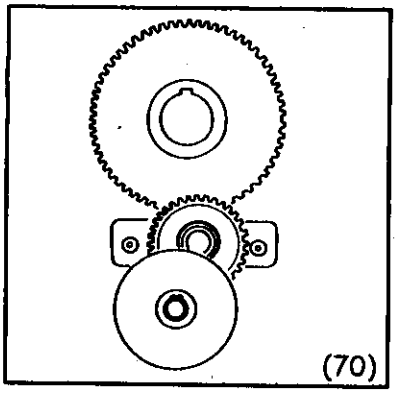
8) Repeat steps 5) to 7) until the thread has been cut to the required depth (Fig. 69).



Do not try to cut the thread to full depth all at once. Take several passes, deepening the thread by .002 to .005 in. on each succeeding pass of the tool.

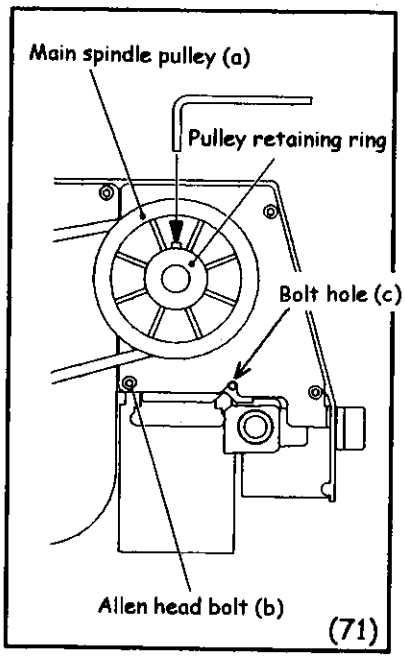
6. Slow Speed Attachment (No. 3519)

With this attachment, the main spindle speed can be reduced to 80 rpm or to 170 rpm (Fig.70).


(70)

(1) Fitting the Slow Speed Attachment

* When using the automatic feed/thread cutting attachment and the slow speed attachment at the same time, fit the slow speed attachment first.

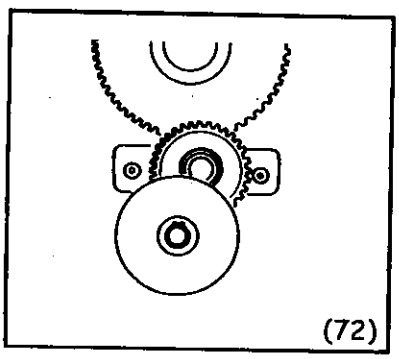


(71)

1) Open the pulley guard and remove the V-belt (K-21) from the main spindle pulley (a).

2) Use the Allen key to remove the Allen head bolt (b) from the plate below main spindle (Fig. 71).

3) Loosen the setscrew in the pulley retaining ring and remove it from the main spindle. Then remove the main spindle pulley. Slide the slow speed gear 100 onto the main spindle and secure it with the pulley retaining ring (Fig. 71).

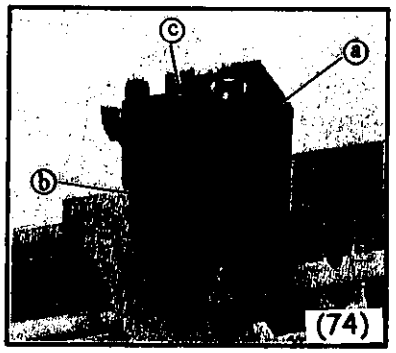

(72)

4) Mount the attachment with the two Allen head bolts supplied. Screw the Allen head bolts into bolt hole (c) and bolt hole (b) so that the gear of the attachment meshes with the slow speed gear 100 (Fig. 72).

5)Set the belt (K-20) on the attachment pulley and counter pulley. Next, pass it over the tension pulley, raising the pulley to create tension in the belt. Tighten the tension bolt.

7. Quick-change Tool Holder (No. 3581)

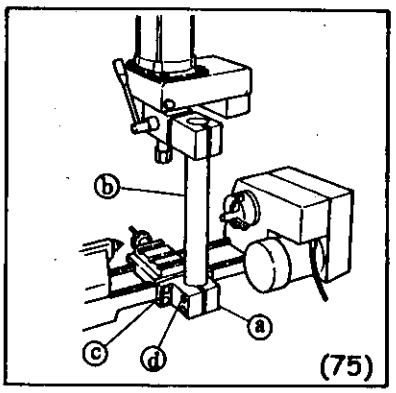
The quick-change tool holder (a) is mounted on the cross slide, and allows quick tool change with the detachable cartridge (b). The height of the cutting tool is easily adjusted with the adjusting screw (c) (Photo 74).



* Align the tip of the tool with the center height or axis of the lathe. Positioning the tools in the cartridges in advance allows for speedy machining. (Holder comes with two cartridges.)

8. Milling Attachment MA-360 (No. 35330)

For complex milling operations, the milling attachment is recommended. It is easily installed on the machined boss on the back of the lathe bed.

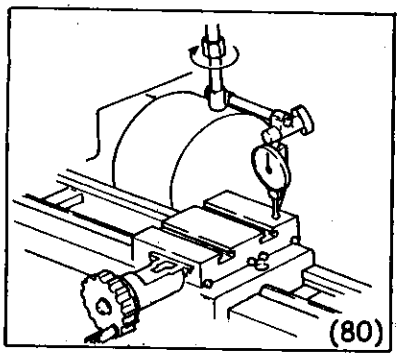


(1) Fitting the Milling Attachment MA-360

Attach the mounting bracket (a) to the machined boss on the back of the lathe bed with the Allen head bolts (c). Insert the column (b) in the mounting bracket (a) and tighten the two Allen head bolts (d) to secure the unit (Fig. 75).

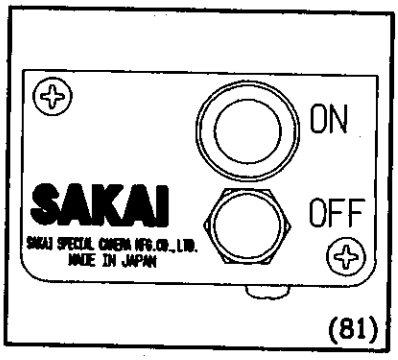
By following the above procedure, the unit should end up at a right angle to the surface of the cross slide table. However, for greater accuracy, use the dial indicator before tightening the mounting bracket (Fig. 80).

Mount the dial indicator on a rod gripped in a collet in the nose of the milling attachment. Rotate the spindle of the milling attachment by hand to take indicator readings from the top of the table.


(80)

(2) Starting/Stopping the Main Spindle

1) The electric current supply must comply with the specifications indicated on the rating plate on the front of the pulley guard.
2) To start, push the switch to ON. To stop, push the switch to OFF (Fig 81).

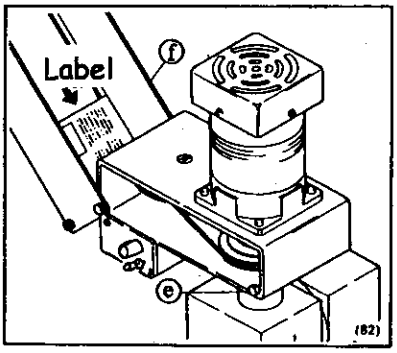


(81)

(3) Selecting the Main Spindle Speed

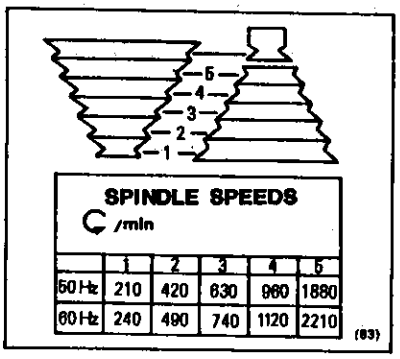
Loosen the two pulley cover screws (e) and open the pulley guard (f) to find the speed chart inside (Fig. 82).

There is one pulley cover screw at the front and another at the back of the unit.



(82)

* Belt positions and main spindle speeds are shown in Fig. 83.

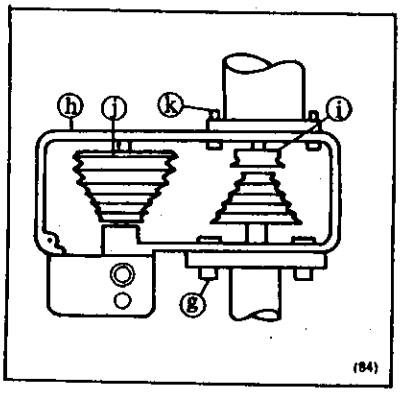


	1	2	3	4	5
50 Hz	210	420	630	960	1880
60 Hz	240	490	740	1120	2210

(83)

* Always turn the machine off before changing the main spindle speed.

Loosen the hex. bolts (g), to shift the position of the motor bracket (h). Slide the bracket to the right to decrease belt tension. Set the belt at the appropriate position, slide the motor bracket back to the left to apply tension to the belt, and tighten the hex. bolts (g). Belt tension between the main spindle pulley (i) and the counter pulley (j) is adjusted with the Allen head bolts (k) (Fig. 84).



(84)

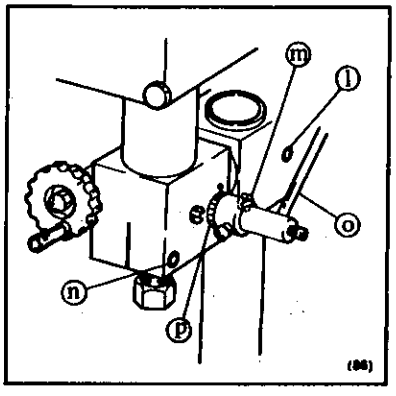
Recommended main spindle speeds in relation to cutting tool diameters are indicated in Table 85. Cutting conditions depend upon the type and material of the cutting tool and the workpiece, etc. For further information, refer to the lathe turning conditions on Page 4.

Main spindle rpm to tool diameter			
Tool diameter	Material		
	Free cutting steel	Aluminum	Plastic
~ 5/32 in	1120 rpm	2210 rpm	2210 rpm
5/32 ~ 3/8	740 rpm	1120 rpm	1120 rpm
3/8 ~ 13/16	490 rpm	740 rpm	740 rpm
13/16 ~ 1-3/16	240 rpm	240 rpm	240 rpm
1-3/16 ~ 1-9/16	240 rpm	240 rpm	240 rpm

(85)

(4) Operating Each Component

1) The bolt (l) is to secure the vertical position and lateral angle of the milling head carriage.
2) The bolt (m) is to secure the angle of the lateral rotation of the spindle head. While the head is normally used in the vertical position, it is possible to drill at an angle or to mill a chamfer, etc., by loosening the bolt and inclining the head.
3) The bolt (n) is to lock the main spindle quill at any position.
4) Vertical travel of the main spindle quill is operated with the feed lever (o). The reference scale (p) indicates the depth of feed. A built-in stroke control mechanism is adjustable to keeps the cutting depth fixed (Fig. 86).

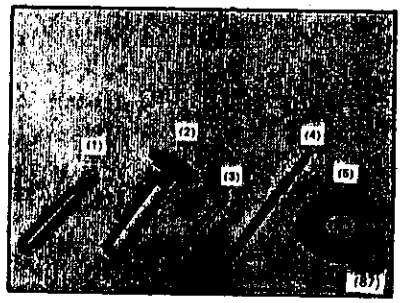


(86)

* When loosening bolts (l) and (m), support the unit with one hand to prevent it from falling.

(5) Cutting Tools

The following are the basic tools available for milling/drilling operations.



1) End mill - for surface machining, grooving, etc.

2) Key Seat Cutter - for machining key seats and slots

3) Center Drill - for centering

4) Twist Drill - for drilling operations

5) Metal Saw - for metal slitting and cutting-off (Photo 87)

There are also the T-slot cutter, side cutter, gear cutter, and fly cutter.

(6) Fitting the Cutting Tools

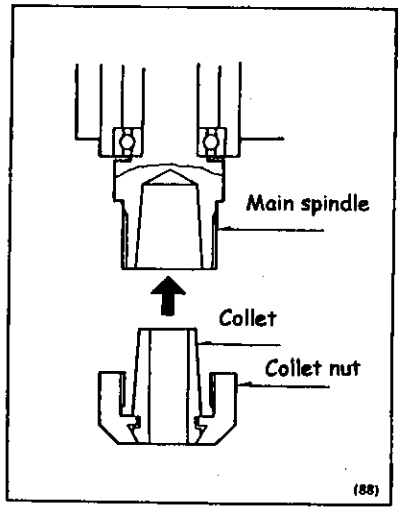
Milling operations differ from lathe operations in that the cutting tool, rather than the workpiece, is rotated. This milling attachment can be used with the following types of tool holders and tools :

1) Milling Collet (No. 35332)

2) Drill Chuck (No. 35333)

1) Cutter Arbor (No. 34341)

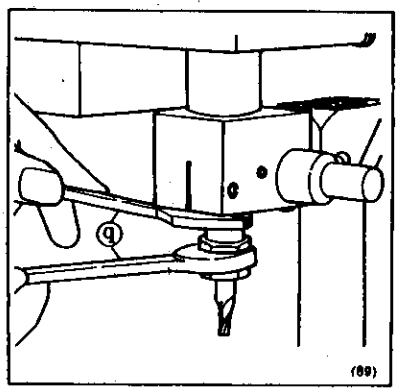
2)Fly Cutter (No.34345)



A. Milling Collet

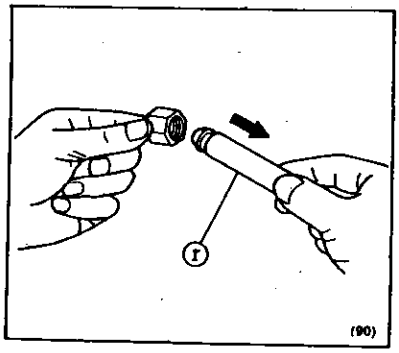
1) The end of the main spindle of the attachment has an 8° collet taper. The standard collet sizes are 1/4, 3/8, and 1/2"-dia. The collet is inserted into the collet nut and lightly screwed into the main spindle (Fig. 88). The groove in the collet engages the ring inside the collet nut.

2) Fit the cutting tool into the collet and tighten by using one spanner (q) to hold the main spindle edge and the other spanner to tighten the collet nut (Fig. 89).



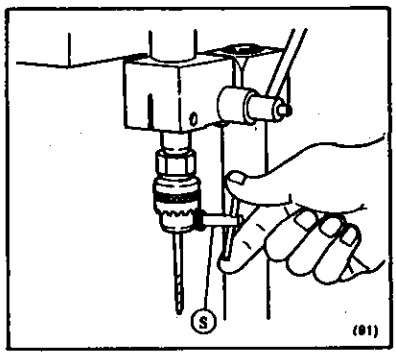
* Do not tighten the collet nut without setting a cutting tool in it first, as it may distort the collet.

3) To remove the collet from the collet nut, push the collet removing tool (r) into the collet nut. This action compresses the collet so that it can be pulled out with the tool (Fig. 90).



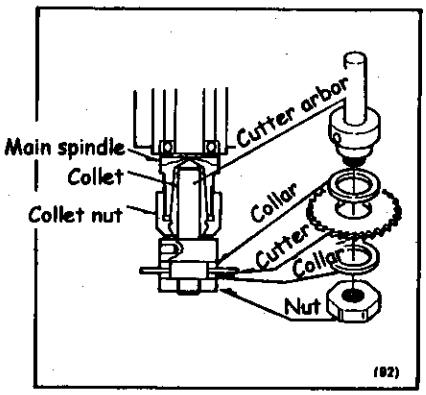
B. Drill Chuck

The drill chuck for milling (No. 35333) has a straight, round shank of 1/2 in. dia. Insert the drill chuck shank into the 1/2 in. collet and tighten with the spanner. Fit the drill to the drill chuck and tighten the chuck with the chuck handle (s) (Fig. 91)



C. Cutter Arbor

1) The cutter arbor (No. 34341) makes it possible to use a metal saw or side cutter. It has a 3/8 in. dia. shank and should be used with the 3/8 in. collet.
2) Attach the cutting tool to the arbor with the collars and nut. Insert the locking bar into the hole of the cutter arbor, and tighten the nut with the spanner (Fig. 92).

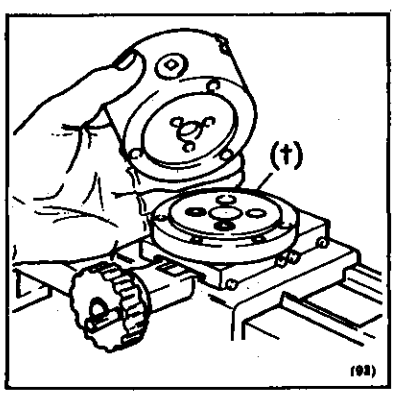


* When mounting the cutter arbor, make sure that the direction of the cutter teeth coincides with the direction of rotation of the main spindle and the cutter arbor.

(7) Holding the Workpiece

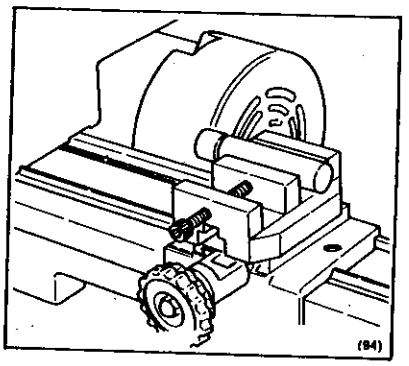
A. With a chuck

The workpiece may be held in a 3-jaw, 4-jaw, or collet chuck. Chucks can be fitted to the chuck mounting adaptor (No. 3503) (t) on the cross slide for convenience (Fig. 93).



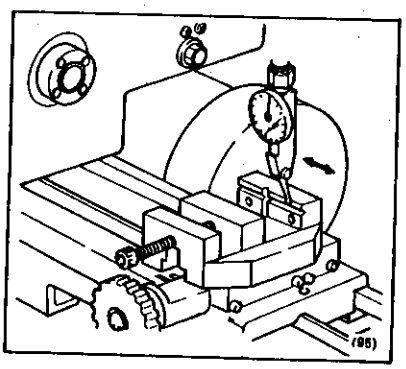
B. With a Milling Vise

The workpiece can also be held with the milling vise (No. 3542), which can be fitted directly onto the cross slide (Fig. 94).


(94)

a) Fitting the Vise

1) Fit the vise on the cross slide or on the milling table (No. 3534). Loosely clamp the vise with the square nuts and Allen head bolts, allowing for adjustments.

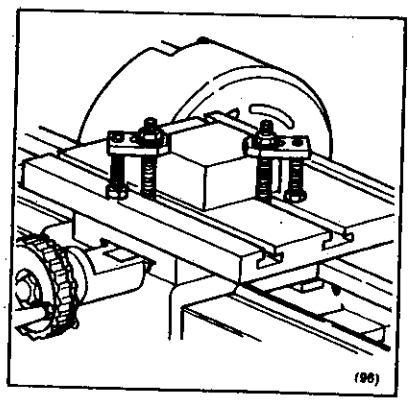

(95)

2) Fit the dial gauge or indicator on the main spindle so that the measuring point touches the fixed jaw of the vise (Fig. 95).

3) Feed the carriage back and forth and adjust its position until you attain a zero reading on the dial gauge all the way across.

4) When the vise is in a parallel position, tighten the clamp bolts firmly.

* After tightening, re-check with the dial gauge to ensure that the vise has not moved.


(96)

C. Clamps

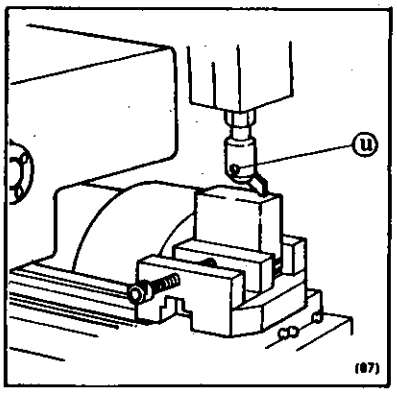
Attach the milling table (No. 3534) to the cross slide. Fit the Fixtures (No. 3443) using the milling table T-slots, and hold the workpiece with them (Fig. 96).

(8) Machining

1) Surface Milling

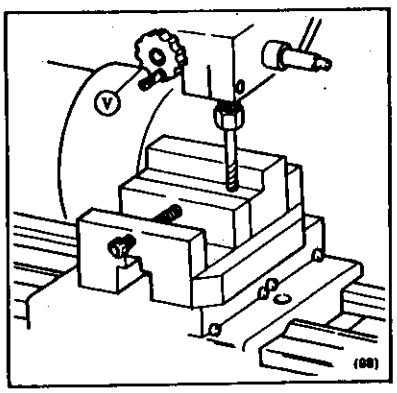
The end mill is generally used in several steps for surface milling. The fly cutter (No.34345) is useful on broad surfaces or when a fine finish is required. The cutting diameter can be controlled by adjusting the cutting tool which is held at a 45° angle in the body of the fly cutter. To secure the cutting tool, tighten bolt (u) firmly (Fig. 97).

*Use cutting oil on the workpiece toget a good finish and to preserve the life of the cutting tool.



2) Slotting

The end mill is also used for slotting. In order to get a more precise cut, use the fine feed attachment (No. 35331). Refer to page 35 for details (Fig. 98).

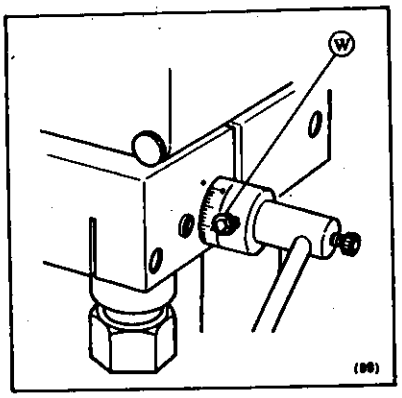


3) Drilling

Use the drill chuck (No. 35333) for drilling operations.

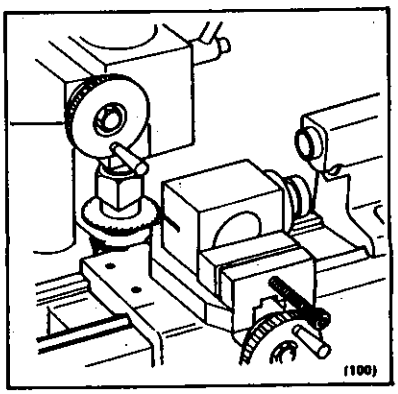
* The reference scale is calibrated in increments of .050 in. To drill a blind hole, set the scale to the desired depth and lock the bolt (w). The cut will begin at the point at which the tool is set and end when it has reached the depth indicated by the reference scale. The scale will read 0 at the stopping point (Fig. 99).

* When depth adjustment is not required, set the scale to any position except 0 ~ 1.



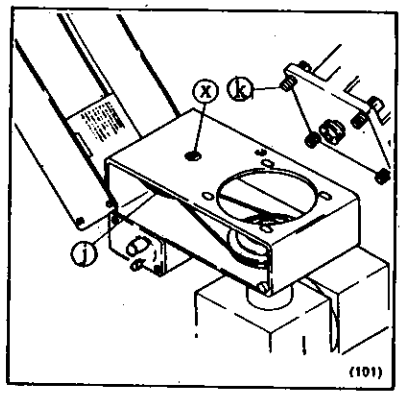
4) Metal Slitting

Fig. 100 illustrates the method of slitting a workpiece. The spindle speed should be set at the lowest rpm to accommodate for the large diameter of the cutting tool. Pay close attention to the cutting depth, direction, and feed rate, as great friction is generated during this operation. Use cutting fluid on the workpiece.



* Changing the Belt

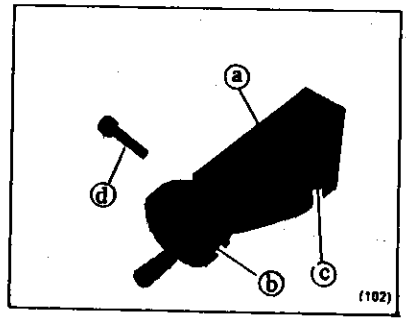
After a long period of use, the belt will wear from friction and may snap or tear. To replace the belt, loosen the motor bolts (k) with the allen key and remove the motor. Next loosen the idler shaft (x) and pull it out. The counter pulley will come free, allowing the belt to be removed and replaced. For instructions on fitting the belt, refer to page 28 and follow the steps in reverse (Fig. 101).



(101)

9. Fine Feed Attachment (No. 35331)

Fitted to the milling attachment, this accessory allows fine feeding of the main spindle. The handwheel has a scale which is calibrated in increments of .001 in. One full revolution of the handwheel equals .050 in. (Photo 102).



(102)

(1) Fitting the Fine Feed Attachment

1) The clutch shaft (c) of the fine feed attachment is fitted through the main spindle feed shaft hole (H) on the left hand side of the main spindle head (Fig. 103).

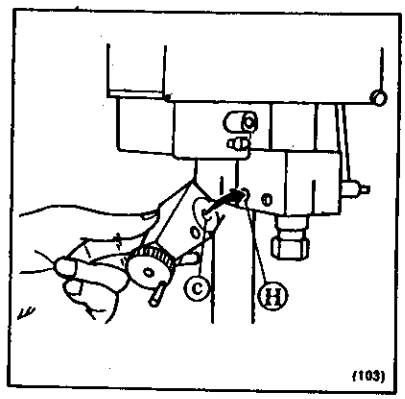
* Pull out the clutch shaft completely before inserting it into the main spindle feed shaft hole.

2) Secure the fine feed attachment (a) to the main spindle head with the allen head bolt (d).

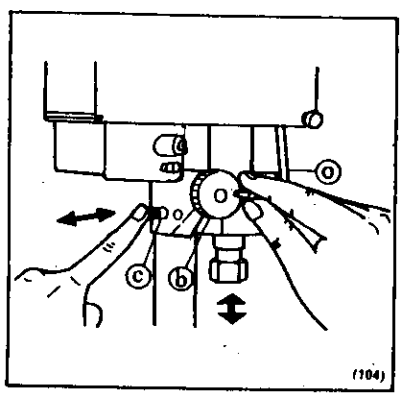
* Make sure the handwheel (b) turns easily. If there is any resistance, loosen the bolt and retighten so that the handwheel rotates freely.

3) To switch to fine feed, turn the handwheel (b) while pushing in the clutch shaft (c) until you hear a click and the clutch shaft snaps in (Fig. 104). The fine feed can now be controlled with the handwheel (b).

4) To release the fine feed, pull out the clutch shaft (c). The movement of the main spindle quill can now be controlled with the lever (o).

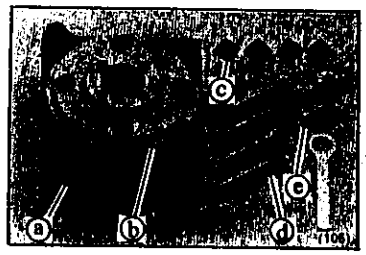


(103)



(104)

10. Index Head (No. 3535)



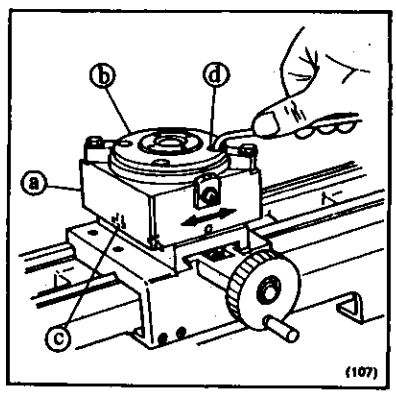
The index head is used for dividing operations (Photo 105).
The 48-slot dividing plate is supplied with the index head, and the 30, 36, and 40-slot dividing plates are available as accessories. The divisions listed in Table 106 can be made using these plates.

Plates	Division														
30	2	3		5	6			10		15					30
36	2	3	4		6		9		12			18			36
40	2		4	5		8		10					20		40
48	2	3	4		6	8			12		16			24	48

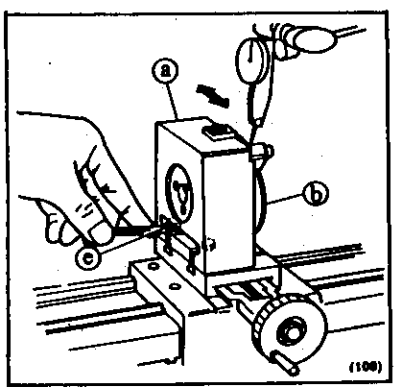
(106)

(1) Fitting the Index Head

The index head can be mounted directly on the cross slide or on the milling table (No. 3534).



1) Horizontal positioning
Align the 4 holes of the basic unit (a) with those of the main spindle (b). Insert the T-slot nuts (c) into the T-slots of the cross slide or milling table, and tighten with the allen head bolts (d) (Fig. 107).

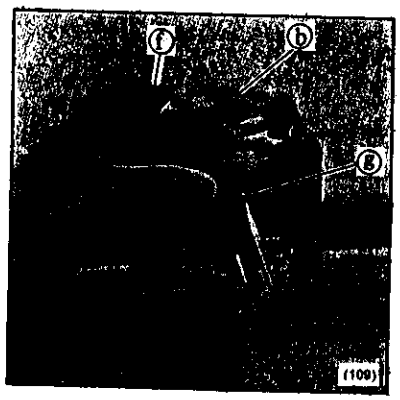


2) Vertical positioning
Secure the basic unit (a) by inserting the T-slot nuts (c) and hex. bolts (e) through the 2 holes on the side of the basic unit.

With the dial gauge, check to see that the surface of the main spindle (b) is vertical and in a parallel position (Fig. 108).

(2) Operating the Index Head

1) The index head can be used with the 3-jaw, 4-jaw, and collet chucks, and the T-slot face plate. Refer to pages 8, 9, and 22 for the fitting procedures.

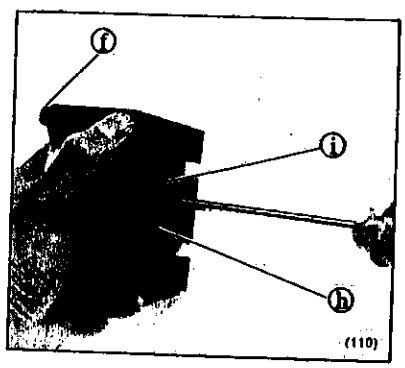


2) For the dividing operation, loosen the main spindle locking bolts (f) and rotate the chuck by hand. A click can be felt at each division. Confirm the required dividing position with the reference scale (in 5° increments) on the outside of the main spindle (b), and tighten the 2 main spindle locking bolts (Photo 109).

* During machining operations, make sure that the main spindle locking bolts (f) are always tightened firmly.

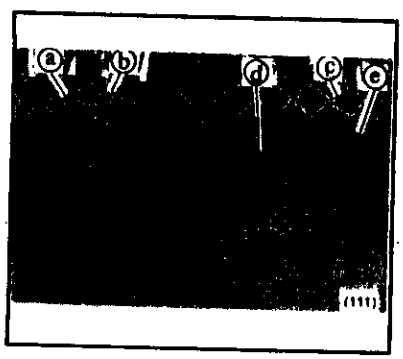
* The index plate (g) can be set to record the starting position of the dividing operation.

A. Changing Dividing Plates



Secure the main spindle by tightening the main spindle locking bolts (f). Then loosen the 3 plate locking screws (h) to change the dividing plate (i) (Photo 110).

12. Circular Dividing Table (No. 3565)



The circular dividing table, with 1:40 worm gear allows most divisions between 1/2 and 1/100 of a circle to be made. This attachment is useful for making gears, ratchets, dividing plates, and similar items. It can also be used as a rotary table for cutting circular arcs and cams (Photo 111).

The following 4 dividing plates are supplied with the circular dividing table.

(42 & 27 holes), (40 & 33 holes), (39 & 34 holes), (38 & 36 holes)

Possible divisions using the above plates are shown in Table 112.

No. of Division	Division Angle	No. of Revolution	NO. of Holes to Add							
			27	33	34	36	38	39	40	42
2	180°	20								
	175°	19	12							
	170°	18	24							
	160°	17	21							
	150°	16	18							
	140°	15	15							
	130°	14	12							
	125°	13	24							
3	120°	13	9	11		12		13		14
	110°	12	6							
	100°	11	3							
4	90°	10								
	80°	8	24							
	75°	8	9	11		12		13		14
5	72°	8								
	70°	7	21							
	65°	7	6							
6	60°	6	18	22		24		26		28
	55°	6	3							
7		5								30
	50°	5	15							
8	45°	5								
9	40°	4	12			16				
10	36°	4								
11		3		21						
12	30°	3	9	11		12		13		14
13		3						3		
14		2								36
	25°	2	21							
15	24°	2	18	22		24		26		28

No. of Division	Division Angle	No. of Revolution	NO. of Holes to Add							
			27	33	34	36	38	39	40	42
16		2			17	18	19		28	21
17		2			12					
18	20°	2	6			8				
19		2					4			
20	18°	2								
	16°	1	21							
21		1								30
22		1		27						
24	15°	1	18	22		24		26		28
25		1							24	
26		1						21		
27		1	13							
28		1								10
30	12°	1	9	11		12		13		14
32		1				9			10	
33		1		7						
34		1			6					
35		1								6
36	10°	1	3			4				
38		1					2			
39		1						1		
40	9°	1								
42										40
44					30					
45	8°		24			32				
48						30				35
50									32	
	7°		21			28				
52								30		
54			20							

No. of Division	Division Angle	No. of Revolution	NO. of Holes to Add							
			27	33	34	36	38	39	40	42
55				24						
56										30
60	6°		18							
64									25	
65								24		
66				20						
68					20					
70										24
72	5°		15			20				
76							20			
78								20		
80					17	18	19		20	21
84										20
85					16					
88				15						
90	4°		12			16				
95							16			
96						15				
100									16	
120	3°		9	11		12		13		14
180	2°		6			8				
200									8	
210						6				7
270			4							
300	1°		3							
	40'		2							
	30'					2				
	20'		1							

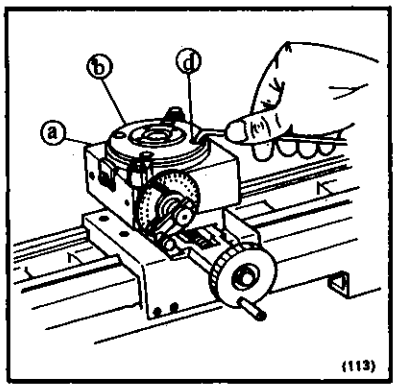
(112)

(1) Fitting the Dividing Table

The circular dividing table can be mounted directly on the cross slide or on the milling table (No. 3534).

1) Horizontal positioning

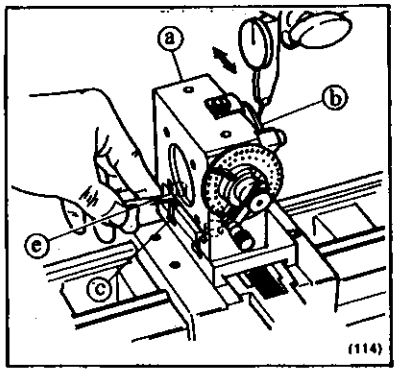
Align the holes of the table (a) with those of the main spindle (b). With the square nuts and allen head bolts (d), secure the table to the T-slots of the cross slide or milling table (Fig. 113).



2) Vertical positioning

Attach by fitting the square nuts (c) and bolts (e) into the 2 slots on the side of the basic unit (a).

* Use the dial gauge to make sure that the surface of the main spindle (b) is vertical and in a parallel position (Fig. 114)



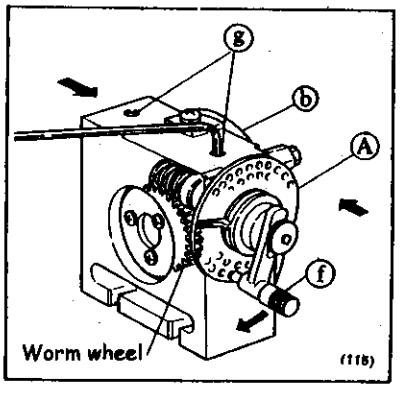
(2) Operating the Dividing Table

1) The circular dividing table can be used with the 3-jaw, 4- jaw, and collet chucks, and the T-slot face plate. Refer to pages 8, 9, and 22 for fitting procedures.

2) Determine the most convenient position for the crank (f) (i.e. decide on which side you want to attach the crank). Loosen the screws (g) and set the worm shaft assembly (A) to the side you prefer.

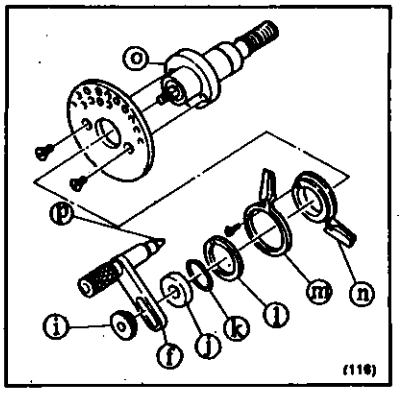
*It is important to adjust the backlash of the main spindle worm wheel before tightening the worm shaft assembly with screws (g).

* Backlash adjustment is an indispensable part of operating the circular dividing table. The way the worm meshes with the worm wheel is changed by a single turn of the worm shaft assembly (a). With two fingers, turn the worm shaft assembly until the wheel and assembly mesh lightly. Then secure it in position with the screw (g) (Fig. 115).



3) Select the appropriate dividing plate for the required division (refer to Table 112) and fit as follows.

Remove the thumb nut (i) and in order, pull out the crank (f), spacer A (j), wave washer (k), spacer B (l), sector B (m), and sector A (n). Remove the 2 flat head screws that hold the dividing plate to the worm shaft shoulder and change the dividing plate. Adjust the space between the stems of the 2 sectors (explained on Page 40) and re-attach the fittings in the reverse order to which they were removed (Fig. 116).



3) Next we will prepare for the actual dividing operation. The example given below illustrates how to obtain 15 divisions.

● With crank revolution n and division N, and the worm gear rate at 1/40, the relationship between n and N can be expressed as :

$$n = 40/N \quad \ldots\ldots\ldots\ldots\ldots \quad (1)$$

Using formula (1), if the division is 15, the crank revolution becomes :

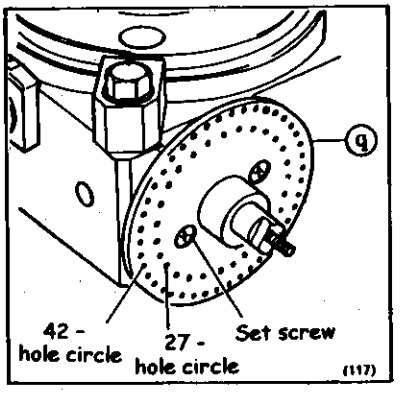
$$n = 40/15 = 2\ \&\ 10/15 \quad \ldots\ldots(2)$$

This means that the required crank feed is 2 revolutions and 10 holes of a 15-hole dividing plate. However, since there is not a 15-hole plate, the number (2 & 10/15) must be recalculated to correspond with the dividing plates available. The following are the possible substitutions:

2 & 10/15 = (2 & 2/3) = 2 & 18/27 (2 revolutions + 18 holes of a 27-hole plate)

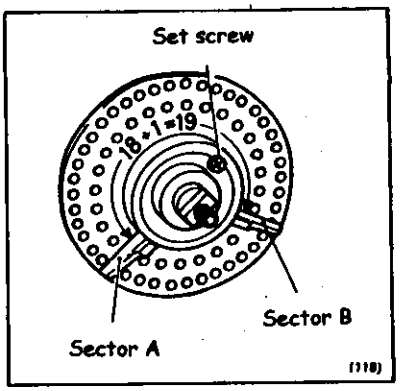
2 & 10/15 = 2 & 22/33 (2 revolutions + 22 holes of a 33-hole plate)

2 & 10/15 = 2 & 24/36 etc...



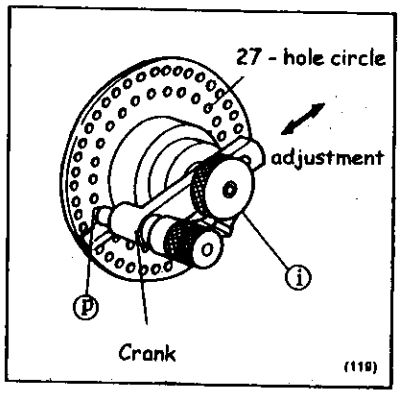
● Refer to section 3 above to fit the 42 & 27 hole plate to the main spindle of the dividing table (Fig. 117).

Loosen the screw on Sector A and position the sectors so that 19 (18+ 1) holes appear between the stems of Sector A and Sector B. Then tighten the screw (Fig. 118).



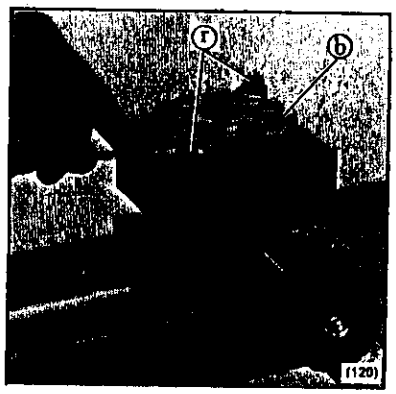
* Don't forget that you must always add an extra hole to the required number. In this example, the required number is 18; the clamp pin at the tip of the crank must be placed in hole number 19 in order for the crank to move 18 spaces.

* Set the space between Sectors A and B before re-attaching spacer B, the wavy washer, spacer A, the crank, the crank screw, etc.



● Finally, set the clamp pin (p) so that it fits into one of the holes of the 27-hole plate, and tighten the clamp screw (i) firmly.

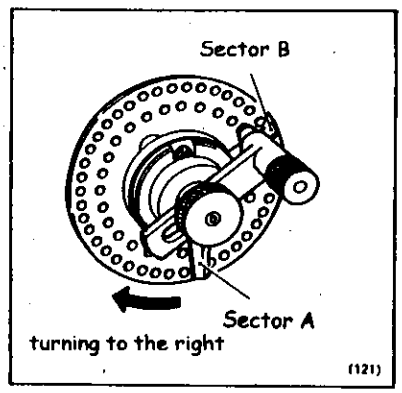
This completes the preparation for the dividing operation (Fig. 119).



5) Before beginning the dividing operation, loosen the rotation stopper bolts (r) on the circular dividing table (Photo 120).

● Pull the crank out while rotating it, and fit the crank pin into any hole between the stems of Sector A and Sector B. Turn the unit of Sectors A and B to the right, and stop when the stem of Sector A touches the crank pin.

● This becomes the starting position. While pulling out, turn the crank 2 revolutions to the right and stop at the starting hole. Feed the crank pin 18 holes (from the above calculation) to the right until the pin comes in contact with the stem of Sector B. Tighten the 2 rotation stopper bolts and begin cutting. To prepare for another dividing operation, loosen the rotation stopper bolts and turn the unit of Sectors A and B to the right until the stem of Sector A touches the crank pin. Then repeat the whole procedure (Fig. 121).



● When feeding in the opposite direction, pay attention to the backlash between the worm shaft and the worm wheel. Feed to the left past the necessary point, and then turn back to the right to fit the crank pin in the necessary hole.

[6] << Safety and Maintenance >>

1. Safety

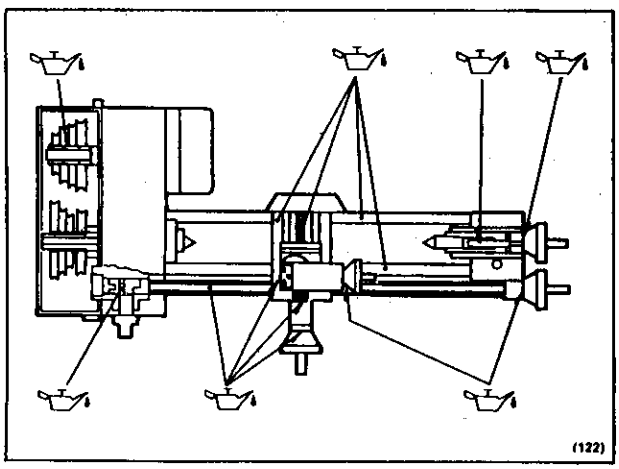
Although the ML-360 is small in size, it is very powerful and should be handled with the same caution required with a full-sized lathe. Note the following points on personal safety:

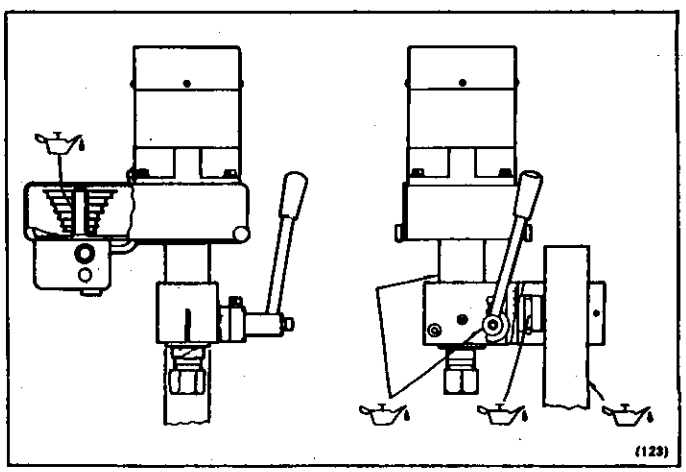
* Never operate the lathe while wearing gloves.
* Wear the proper workclothes for machining operations - loose and long sleeves pose a serious danger.
* Avoid removing metal chips and dust with your bare hands - a brush or rag is recommended.
* Use goggles or other protective eye wear at all times.

2. Maintenance

After machining with the ML-360 and its accessories, all surfaces should be brushed free of metal chips and dust, and then cleaned well with an oiled cloth. . Pulleys and belts should be wiped free of oil and dust with a dry cloth. Fig. 122 and 123 illustrate the parts on which a thin coating of oil should be left to prevent corrosion.

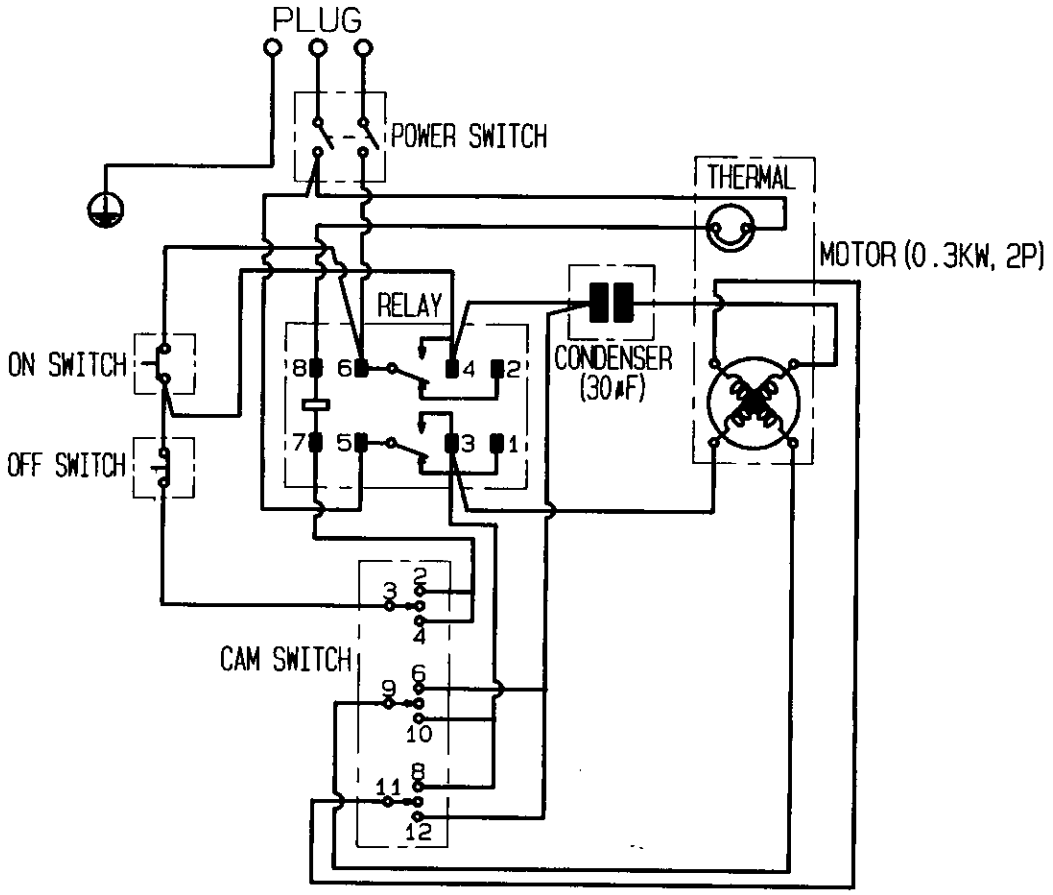
* It is recommended that you keep the original packing cartons for storage and shipping. The cartons have been especially designed for easy handling and protection of the equipment.


(122)

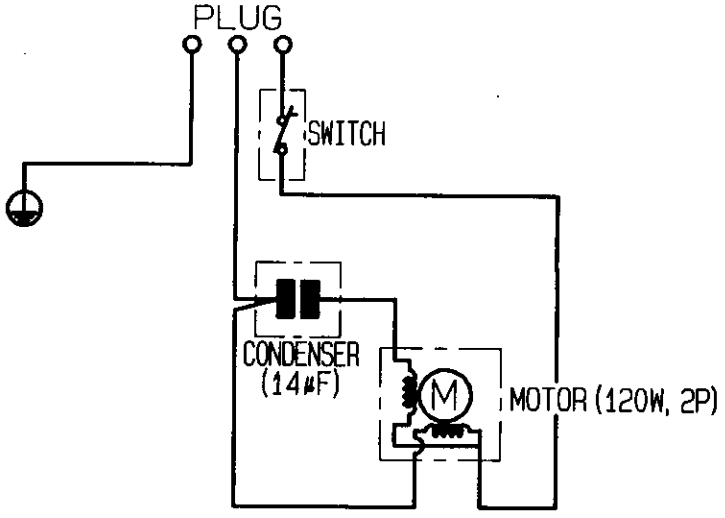

(123)

[7] << Electric Wiring >>

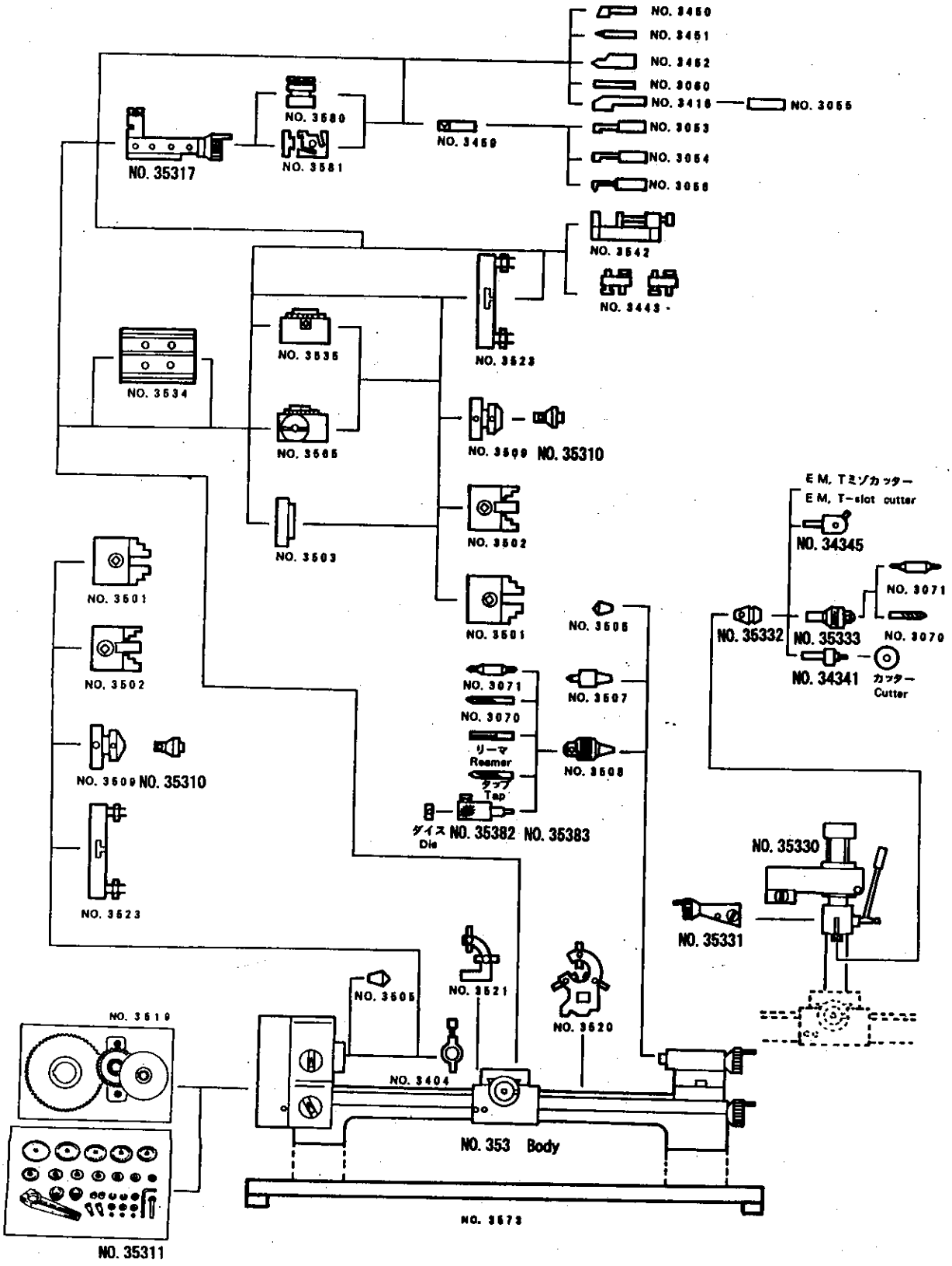
MINI - LATHE ML - 360



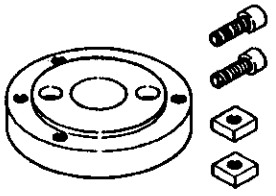
MILLING ATTACHMENT MA - 360

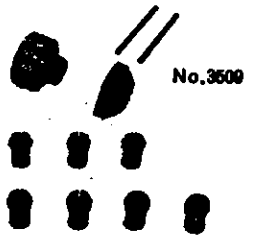
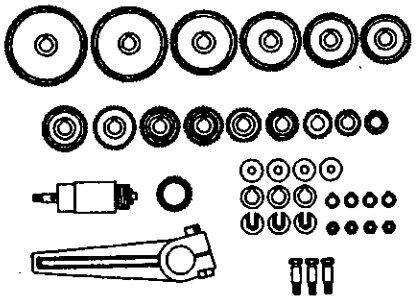
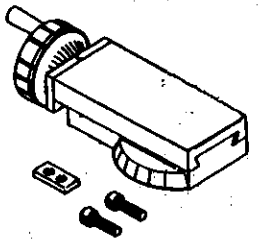
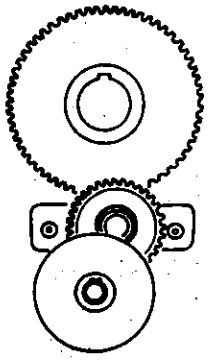


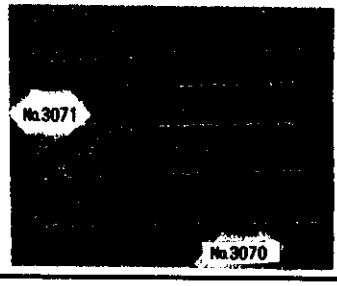
[8] << SYSTEM >>


NO. 3450
NO. 3451
NO. 3452
NO. 3060
NO. 3418
NO. 3055
NO. 3053
NO. 3054
NO. 3056
NO. 3459
NO. 3680
NO. 3581
NO. 35317
NO. 3542
NO. 3443
NO. 3523
NO. 3535
NO. 3534
NO. 3565
NO. 3509
NO. 35310
NO. 3503
NO. 3502
NO. 3501
NO. 3505
NO. 3071
NO. 3070
NO. 3507
リーマ Reamer
タップ Tap
NO. 3508
ダイス Die
NO. 35382
NO. 35383
NO. 3509
NO. 35310
NO. 3523
E M, Tミゾカッター
E M, T-slot cutter
NO. 34345
NO. 3071
NO. 35332
NO. 35333
NO. 3070
NO. 34341
カッター Cutter
NO. 35330
NO. 35331
NO. 3521
NO. 3505
NO. 3520
NO. 3404
NO. 353 Body
NO. 3573
NO. 3519
NO. 35311

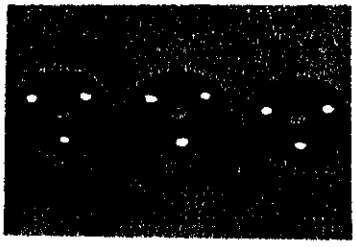
[9] << ACCESSORIES >>

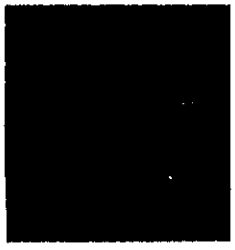
Part Number	Nomenclature	Description	
3501	3-Jaw Universal Chuck	Self-centering chuck with hardened jaws. Designed to grip workpieces up to 0.551" ϕ. Reversed jaws can grip up to 3.149" ϕ.	
3502	4-Jaw Independent Chuck	Hardened and individually adjustable jaws can grip workpieces up to 0.669" ϕ. Reversed jaws can grip up to 2.755" ϕ.	
3503	Chuck Mounting Adaptor	An adaptor for mounting the chucks, collet holder, and T-slot face plate.	
3404	Lathe Dog - 15mm ϕ	Used in double-center machining. Clamps and drives workpieces up to 0.590" ϕ.	
3505	Dead Center	Dead center can be used on both main spindle and tail spindle. Nose 60°, shank MT#2.	
3507	Live Center	Built in ball-bearings prevent friction, allowing full control when machining with centers.	
3508	Drill Chuck	Can hold drills with shanks up to 0.393" ϕ. Comes with arbor MT#2.	

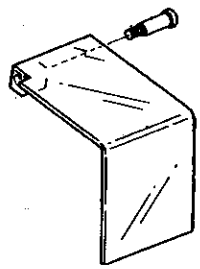
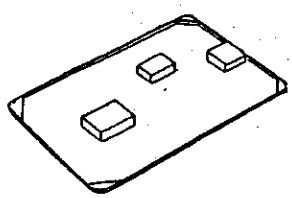
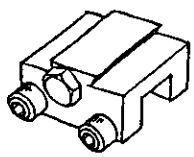
Part Number	Nomenclature	Description	
3509	Collet Holder	Used with the collet #35310.	
35310	Collets	A set including collet sizes 1/8, 3/16, 1/4, 5/16, 3/8, 1/2" and blank. Used with the collet chuck.	
35311	Automatic Feed/Thread Cutting Attachment	Used for automatic longitudinal feed, including 0.0025 and 0.005. By changing gears, 31 different unified thread pitches can be cut (Pitch rang from 80 to 10 thread per inch).	
35317	Compound Slide	Used for cutting tapers. Turning scales graduated up to 45° on both sides, tool post travels up to 2.047 in.	
3519	Slow Speed Attachment	Used to lower the main spindle speed to 80·170rpm. Effectice when threading or machining large diameters.	

Part Number	Nomenclature	Description	
3520	Steady Rest	Used to support the workpiece when a center can not be used. Largest holding diameter is 1.950" ϕ.	
3521	Travelling Rest	Used to support thin or long workpieces. Maximum machining diameter is 1.950" ϕ.	
3523	T-slot Face Plate - 150 ϕ	Useful when processing irregularly-shaped workpieces or workpieces too large for a chuck, and for milling. Comes with the Fixture (No. 3443).	
3459	Round Tool Adaptor	To hold round cutting tools, such as Nos. 3053, 3054, and 3056 to tool post.	
3416	Cut Off Tool Holder	For holding the Cut Off Tool, No. 3055.	
3055	Cut Off Tool	Used for cutting- off and grooving. Can be ground for cutting external threads. Used with the Cut Off Tool Holder, No.3416.	
3070	Drill	A set of 1.5, 2.0, 2.5, 3.0, 3.3, 3.5, 4.0, 4.2, 4.5, 5.0, 5.5, 6.0, and 6.5mm ϕ drills	
3071	Center Drill	Set of 1.0, 1.5, and 2.0mm ϕ drills.	

Part Number	Nomenclature	Description	
3450	Right-hand Finishing Tool	For cylindrical and counterface turning. Moves from right to left.	
3451	Roughing Tool	For cylindrical and step turning. Moves from right to left.	
3452	External Threading Tool	For threading external screws.	
3053	Boring Bar - 10mm ϕ	For boring over 3/8" ϕ. Can also be ground to be used for grooving.	
3054	Boring Bar - 6mm ϕ	For boring over 1/4" ϕ.	
3056	Internal Threading Tool	For cutting internal threads.	
3060	Unground Tool	A square bit, ready to be ground for your specific needs.	
35330	Milling Attachment	Useful for various milling applications. Main spindle head can be swiveled 360 ° horizontally and vertically.	

Part Number	Nomenclature	Description	
35331	Fine Feed Attachment	Used on the Milling attachment (No. 35330), to allow fine feed controlled with the handwheel. Minimum graduation of 0.001in.	
35332	Milling Collet	Collet for the milling attachment. A set of 3 collets, 1/4, 3/8, & 1/2" ϕ. * Standard Accessory.	
35333	Drill Chuck - 10mm ϕ	Used with the No. 35330 milling attachment. Can hold workpieces up to 0.393" ϕ and is useful with drilling operations.	
3534	Milling Table	Used mounted on the carriage. Holds workpieces fixed with the Fixture on the three T-slots.	
3535	Index Head with Dividing Plate of 48 Divisions	For 2, 3, 4, 6, 8, 12, 16, 24, & 48 divisions. Used with chucks 3501 and 3502, collet chuck 3509, and face plate 3523.	
3536	Dividing Plate 30	For 2, 3, 5, 6, 10, 15, & 30 divisions.	
3537	Dividing Plate 36	For 2, 3, 4, 6, 9, 12, 18, & 36 divisions.	
3538	Dividing Plate 40	For 2, 4, 5, 8, 10, 20, and 40 divisions.	

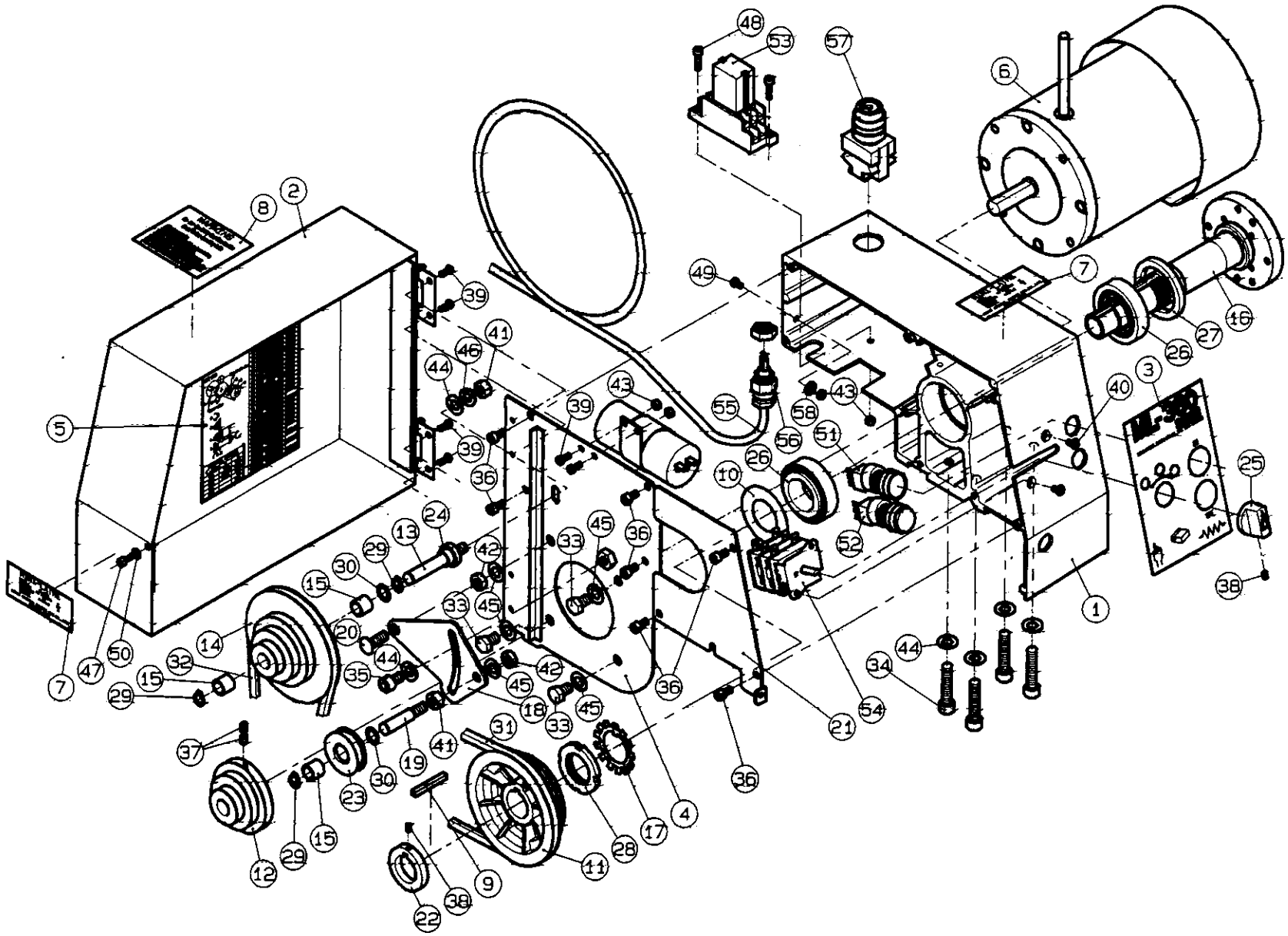
Part Number	Nomenclature	Description	
34341	Cutter Arbor	Tool for holding the metal saw, etc. Holds cutters up to 5/8" ϕ.	
3542	Milling Vise	Mounted directly on to the carriage or through the milling table. Useful for holding round and square workpieces. Mouthpiece: 2.362" wide, 0.787" high, 1.811" open.	
3443	Clamps	Used to fix the workpiece on to a surface with T-slots, such as the milling table, T-slot face plate 5.9" ϕ,.	
34345	Fly Cutter	Mounted to the milling attachment for surface machining and boring. 3/8" ϕ shank, fitted to collet. Comes with cutting bit.	
3565	Circular Dividing Table	with 1:40 worm gear, allow most divisions between 1/2 and 1/100.	

Part Number	Nomenclature	Description	
3580	4-Way Tool Post	Holds four cutting tools, for more efficient machining.	
3581	Quick-change Tool Holder	The base of the Holder remains fixed, and the cartridge on which the tool is set can be detached for quick machining.	
35382	Tailstock Die Holder-13/16"	Used with the Die for cutting external threads. The guide shank is held with the drill chuck.	
35383	Tailstock Die Holder-1"		
3584	Chuck Guard	A cover for the 3-jaw and 4-jaw chucks.	
3573	Precision Mounting Base	Mounts the lathe accurately and stabilizes it. Also serves to collect chips and oil. Size : 25.590" x 16.929" x 0.787".	
3585	Detachable Tool Cartridge	Extra cartridge for the quick change tool holder.	

MINI-LATHE ML-360

Headstock

No.	Part Number	Nomenclature	Quantity
1	353-0001	Head Stock 360	1
2	353-0017	Pulley Guard	1
3	353-0019	Name Plate	1
4	353-0046	Motor Mounting Plate	1
5	353-0048	Table (Main Spindle Speed)	1
6	353-0052	Motor	1
7	353-0090	Rating Plate	1
8	353-0091	Warning Plate	1
9	35-D0003	Main Spindle Key	1
10	35-D0005	Bearing Cover	1
11	35-C0007	Main Spindle Pulley	1
12	35-D0010	Pulley	1
13	35-D0013	Counter Pulley Shaft	1
14	35-C0014	Counter Pulley	1
15	35-D0018	Bush, 101412	3
16	35-B0038	Main Spindle 2	1
17	35-D0039	Tooth Washer AW06X	1
18	35-D0040	Tension Plate	1
19	35-D0042	Tension Pulley Shaft	1
20	35-D0043	Tension Plate Pivot	1
21	35-C0045	Bulkhead 2	1
22	35-D0047	Retaining Ring	1
23	35-D0058	Tension Pulley 2	1
24	35-D0063	Counter Pulley Collar	1
25	35-D0016	Knob ϕ 28	1
26		Taper Roller Bearing, HR32006 XJ-4	2
27		Oil seal VB,	1
28		Retaining Nut, AN06, M	1
29		C-shaped Snap Ring, STW-10	3
30		Washer, STW-FT, ϕ 10 x 0.5	2
31		V. Belt, K-21, Motor/Main Spindle	1
32		V. Belt, K-16, Motor/Counter Pulley	1
33		Hex. Head Bolt, M8 x 12	3
34		Allen Head Bolt, M8 x 40	4
35		Allen Head Bolt, M8 x 12	1
36		Allen Head Bolt, M5 x 10	7
37		Set Screw, M6 x 8, Hollow End	2
38		Set Screw, M4 x 6, Hollow End	2
39		Machine Screw, Pan Head, Phillips, M4 x 10	6
40		Machine Screw, Flat End, Phillips, M4 x 8	2
41		Hex. Nut, M8, Cl. 1	2
42		Hex. Nut, M8, Cl.3	2
43		Hex. Nut, M4, Cl. 1	5
44		Washer, ϕ 8 x ϕ 17 x 1.6t	6
45		Washer, ϕ 8 x ϕ 16.5 x 0.8t,	5
46		Spring Washer, ϕ 8, No.2	1
47		Allen Head Bolt, M4 x 10	1
48		Allen Head Bolt, M4 x 16	2
49		Hex. Head Bolt, Phillips, M4 x 10	1
50		Washer, ϕ 4 x ϕ 9 x 0.8t,	1
51		ON Switch	1
52		OFF Switch	1
53		Relay	1
54		Switch for Counter-Clockwise and Clockwise Rotation	1
55		Power Cable without Plug	1
56		Cable Lock	1
57		Power Switch	1
58		Spring Washer, ϕ 4, No.2	1

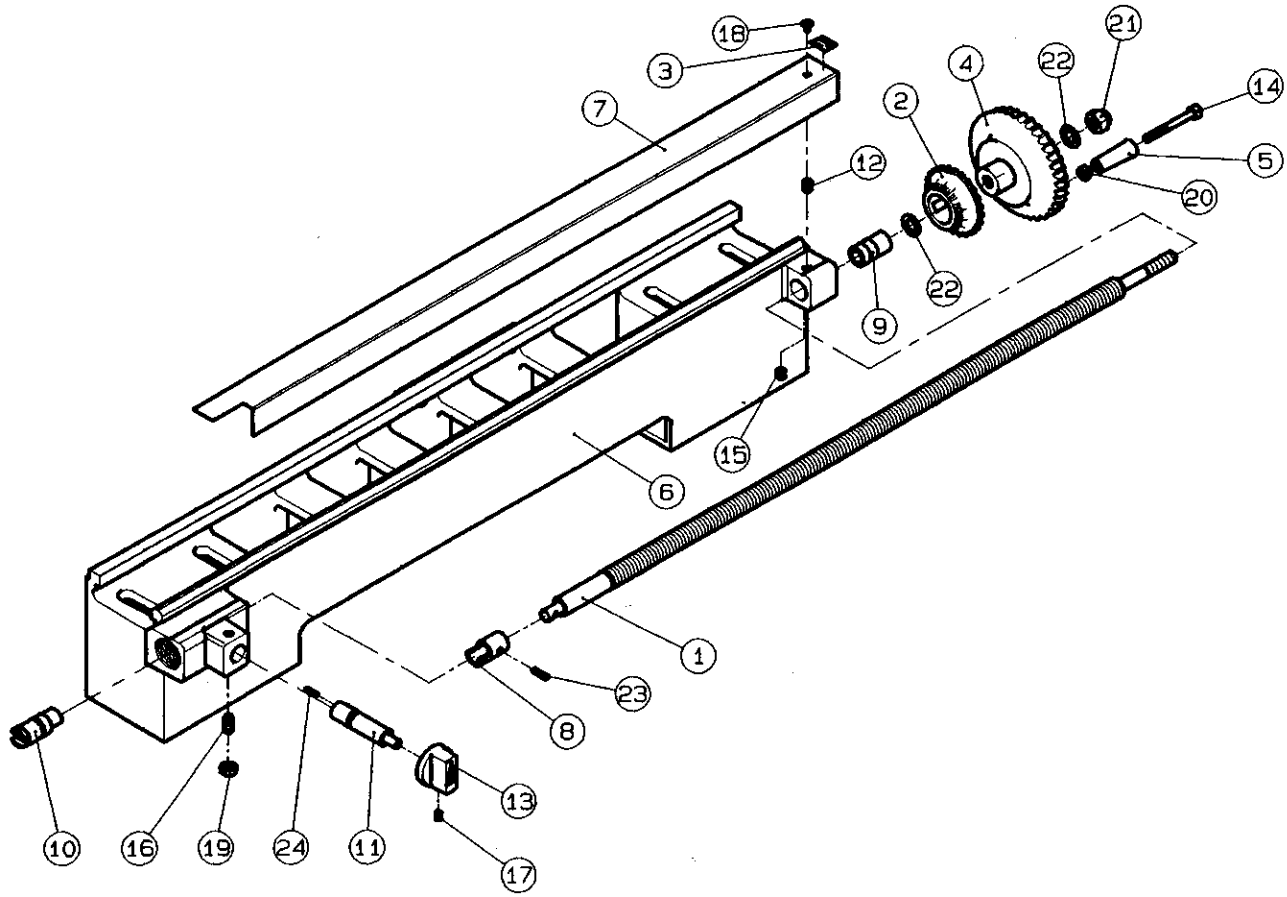


Bed

No.	Part Number	Nomenclature	Quantity
1	353-0102	Lead Screw 360	1
2	353-0109	Calibrated Cone 51	1
3	353-0113	Lead Screw Counter Mark	1
4	353-0120	Handwheel 80	1
5	353-0121	Handle Knob 36	1
6	35-A0101	Bed 360	1
7	35-C0103	Lead Screw Cover	1
8	35-D0104	Clutch 360 - Lead Screw	1
9	35-D0105	Plain Bearing 360 (Lead Screw 360)	1
10	35-D0106	Clutch	1
11	35-D0107	Clutch Shaft 360	1
12	35-D0112	Threaded Collar	1
13	35-D0016	Knob ϕ 28	1
14		Allen Head Bolt, M5 x 45 (S=16)	1
15		Set Screw, M6 x 6, Hollow End	1
16		Set Screw, M6 x 12, Flat End	1
17		Set Screw, M4 x 6, Hollow End	1
18		Machine Screw, Philips, M3 x 6	1
19		Hex. Nut, M6, Cl. 3	1
20		Hex. Nut, M5, Cl. 2	1
21		Cap Nut, M8, Type 3	1
22		Washer, ϕ 8 x ϕ 15.5 x 0.5t	2
23		Roll Pin, ϕ 3 x 12	1
24		Grooved Pin, ϕ 2 x 10, Type D	1

Tailstock

No.	Part Number	Nomenclature	Quantity
1	353-0302	Tailstock Spindle 24	1
2	353-0303	Tailstock Spindle Feed Lead Screw 360	1
3	353-0310	Handwheel 52	1
4	353-0311	Handle Knob 27	1
5	35-B0301	Tailstock 360	1
6	35-D0304	Plain Bearing 360 (Tailstock Spindle Feed Lead Screw 360)	1
7	35-D0305	Tailstock Fastening Square Nut	1
8	353-0109	Calibrated Cone 51	1
9	35-D0210	Threaded Collar	1
10		Allen Head Bolt, M8 x 30	1
11		Allen Head Bolt, M6 x 22	1
12		Allen Head Bolt, M4 x 35 (S=14)	1
13		Set Screw, M6 x 10, Hollow End	1
14		Hex. Nut, M6, Cl. 1	1
15		Hex. Nut, M4, Cl. 2	1
16		Cap Nut, M8, Type 3	1
17		Washer, ϕ 8 x ϕ 15.5 x 0.5t	3
18		Grooved Pin, ϕ 4 x 8, Type B	1
19	3505	Dead Center 360	1
20	3507	Live Center 360	1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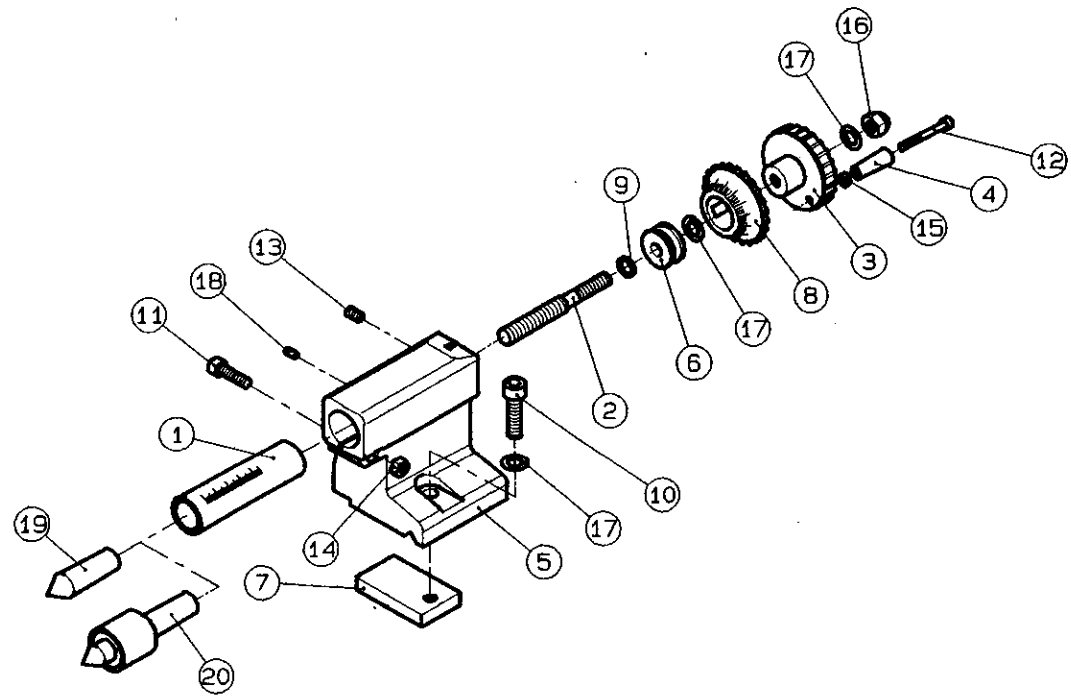
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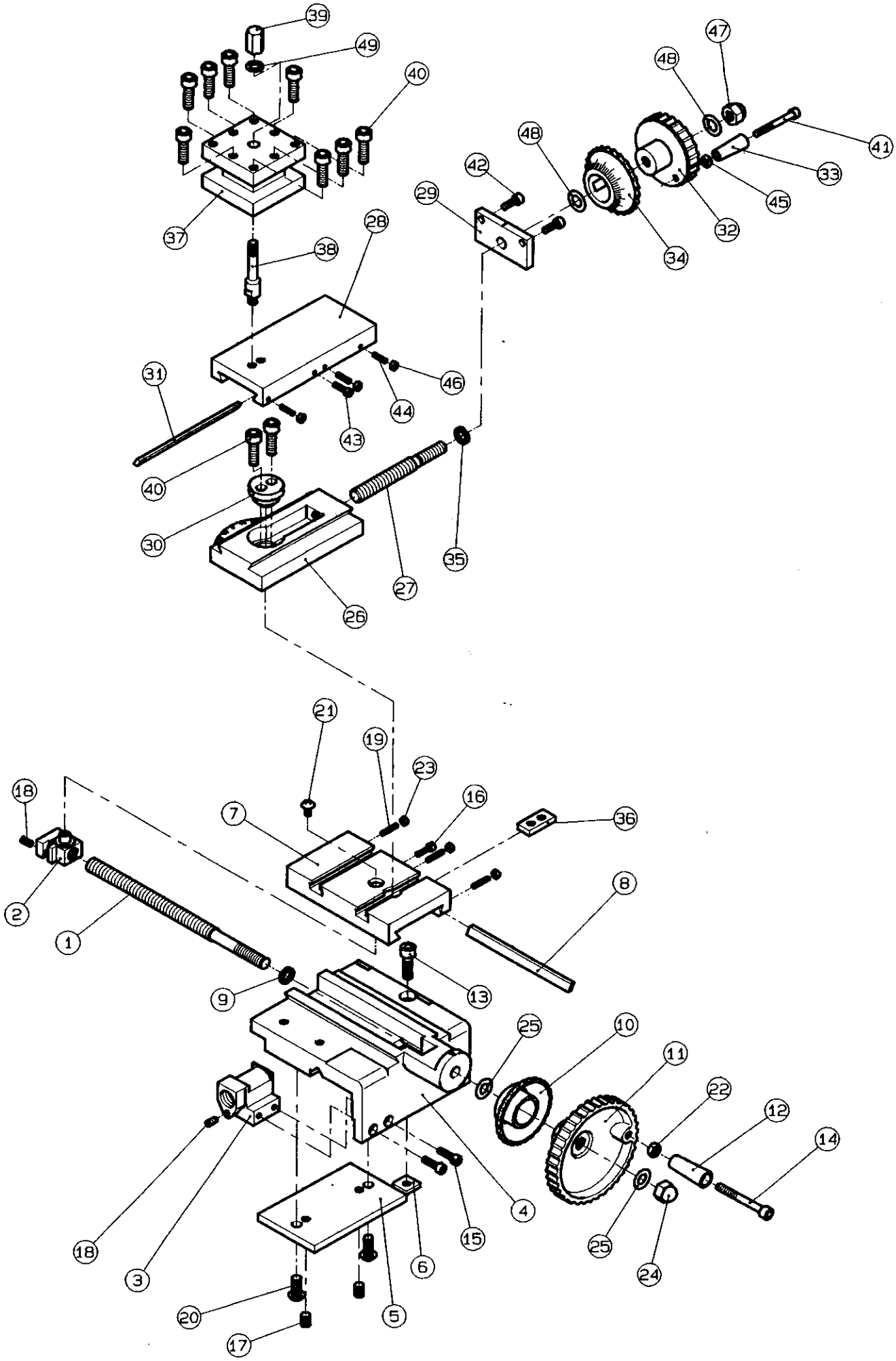
Taper Turning Attachment & Tool Post Carriage

No.	Part Number	Nomenclature	Quantity
1	353-0206	Cross Feed Lead Screw 360	1
2	353-0207	Special Nut 360 (Cross Feed Lead Screw 360)	1
3	353-0208	Special Nut (Lead Screw 360)	1
4	35-B0201	Tool Post Carriage 360	1
5	35-D0202	Tool Post Carriage Back Plate 360	1
6	34-D0203	Carriage Fastening Square Nut	1
7	35-C0203	Cross Feed Table 360	1
8	35-D0204	Shim	1
9	35-D0210	Threaded Collar	1
10	353-0109	Calibrated Cone 51	1
11	353-0120	Handwheel 80	1
12	353-0121	Handle Knob 36	1
13		Allen Head Bolt, M6 x 20	1
14		Allen Head Bolt, M5 x 45 (S=16)	1
15		Allen Head Bolt, M4 x 12	2
16		Allen Head Bolt, M3 x 12	1
17		Set Screw, M6 x 6, Hollow End	2
18		Set Screw, M4 x 8, Hollow End	2
19		Set Screw, M3 x 15, Hollow End	3
20		Allen Head Button Bolt, M6 x 14	2
21		Machine Screw, Phillips, M4 x 8	1
22		Hex. Nut, M5, Cl. 2	1
23		Hex. Nut, M3. Cl. 1	3
24		Cap Nut, M8, Type 3	1
25		Washer, ϕ 8 x ϕ 15.5 x 0.5t	2
26	35317-0001	Swivel Base 360	1
27	35317-0007	Lead Screw	1
28	3517-C0002	Taper Feed Table	1
29	3517-D0004	Retainer Plate	1
30	3517-D0005	Eccentric Bush	1
31	35-D0204	Shim	1
32	353-0310	Handwheel 52	1
33	353-0311	Handle Knob 25	1
34	353-0109	Calibrated Cone 51	1
35	35-D0210	Threaded Collar	1
36	3517-D0008	Square Nut II	1
37	3580-C0001	4 - Way Tool Post	1
38	3580-D0002	Pivot	1
39	3580-D0005	Fastening Nut	1
40		Allen Head Bolt, M6 x 20	10
41		Allen Head Bolt, M4 x 35 (S=14)	1
42		Allen Head Bolt, M4 x 12	2
43		Allen Head Bolt, M3 x 12	1
44		Set Screw, M3 x 12, Hollow End	3
45		Hex. Nut, M4, Cl. 2	1
46		Hex. Nut, M3, Cl. 1	3
47		Cap Nut, M8, Type 3	1
48		Washer, ϕ 8 x ϕ 15.5 x 0.5t	2
49		Washer, ϕ 6 x ϕ 11.5 x 0.8t	1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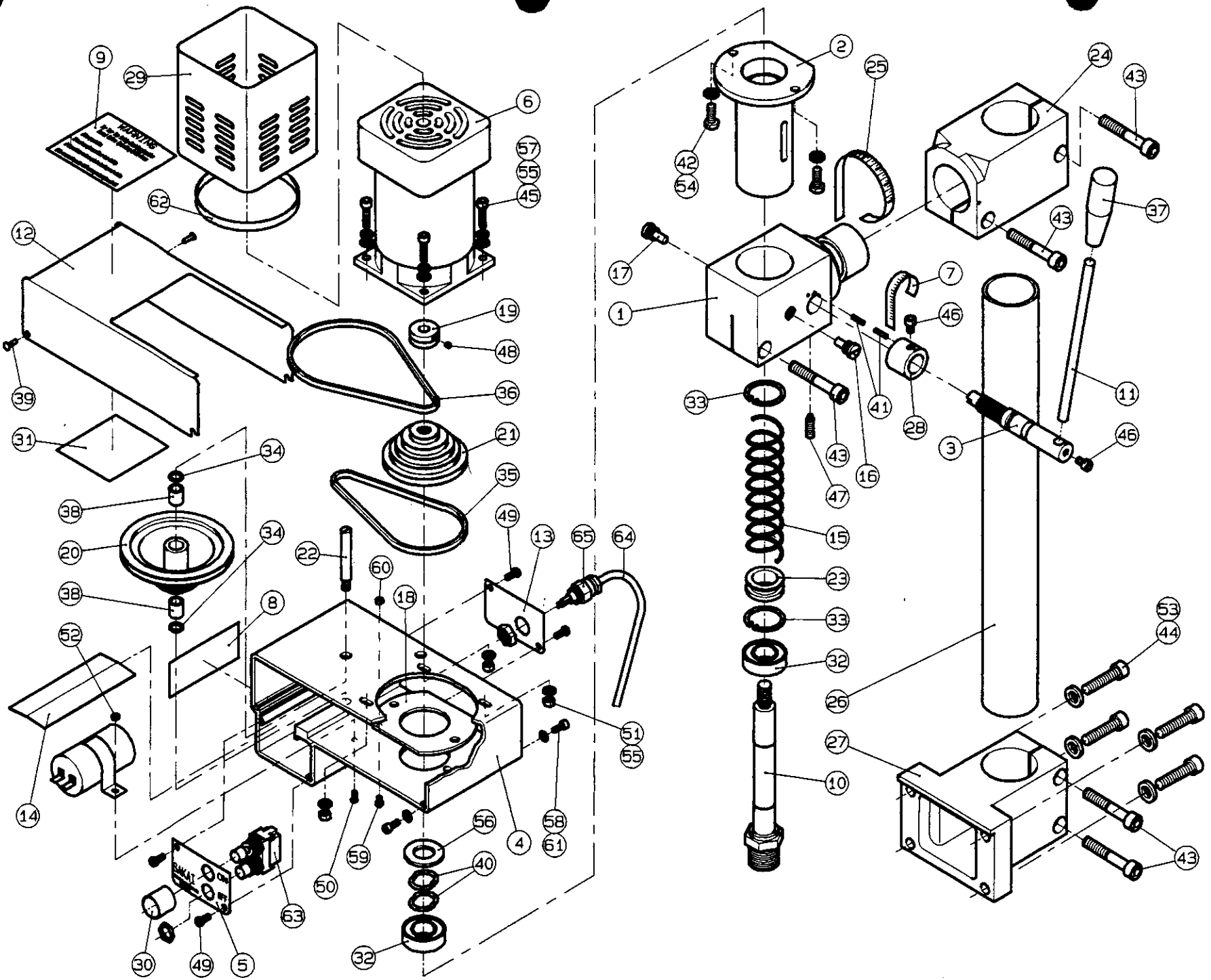
No.	Part Number	Nomenclature	Quantity
1	35330-0001	Main Spindle Head	1
2	35330-0002	Main Spindle Quill 45	1
3	35330-0004	Pinion Shaft 360MA (Main Spindle Feed)	1
4	35330-0006	Motor Bracket 360MA	1
5	35330-0008	Switch Plate 360MA	1
6	35330-0052	Motor	1
7	35330-0080	Reference Scale (Main Spindle Feed)	1
8	35330-0090	Rating Plate	1
9	35330-0091	Warning Plate	1
10	3530-C0003	Main Spindle 360MA	1
11	3530-D0005	Lever (Main Spindle Feed)	1
12	3530-B0007	Pulley Guard 360MA	1
13	3530-D0009	Back Plate 360MA	1
14	3530-D0010	Partition 360MA	1
15	3530-D0011	Coiled Spring 360MA (Main Spindle Quill)	1
16	3530-D0012	Guide Screw RH	1
17	3530-D0013	Guide Screw LH	1
18	3530-D0014	Plate Nut (Main Spindle Quill)	1
19	3530-D0015	Motor Pulley 360MA	1
20	3530-C0016	Counter Pulley 360MA	1
21	3530-C0017	Main Spindle Pulley 360MA	1
22	3530-D0018	Shaft 360MA (Counter Pulley)	1
23	3530-D0019	Spring Collar (Main Spindle Quill)	1
24	3530-B0020	Carriage 360MA (Milling Head)	1
25	3530-C0021	Reference Scale 360MA (Lateral Swing)	1
26	3530-C0022	Vertical Column 360MA	1
27	3530-B0023	Column Mounting Block 360MA	1
28	3430-D0005	Stop Ring 26	1
29	34-0028	Motor Guard	1
30	35330-0092	Switch Guard	1
31	3530-C0024	Table 360MA (Main Spindle Speed)	1
32		Ball Bearing, 6003ZZ	2
33		C-shaped Snap Ring, Inner Use, RTW-30	2
34		Washer, STW-FT, ϕ 8 x 0.5	2
35		Primary Power Transmit Belt, 5M - 325	1
36		Secondary Power Transmit Belt, 5M - 375	1
37		Rubber Cap	1
38		Bush, ϕ 8 x ϕ 12 x 12L	2
39		Rivet, Round Head, Grooved, M3 x 10	2
40		Wave Washer, ϕ 17	2
41		Roll Pin, ϕ 3 x 12	2
42		Hex. Head Bolt, M6 x 15	2
43		Allen Head Bolt, M8 x 50	5
44		Allen Head Bolt, M8 x 35	4
45		Allen Head Bolt, M5 x 20	4
46		Allen Head Bolt, M5 x 8	2
47		Set Screw, M6 x 20, Flat End	1
48		Set Screw, M4 x 4, Hollow End	1
49		Self Tapping Screw, M4 x 10	4
50		Machine Screw, Phillips, M3 x 12,	1
51		Hex. Nut, M5, Cl. 1	4
52		Hex. Nut, M3, Cl. 1	1
53		Washer, ϕ 8 x ϕ 17 x 1.6t	4
54		Washer, ϕ 6 x ϕ 11.5 x 1.6t	2
55		Washer, ϕ 5 x ϕ 10 x 1t	8
56		Washer, ϕ 17x ϕ 32 x 2.6t	1
57		Spring Washer, ϕ 5, No. 2	4
58		Allen Head Bolt, M4 x 10	2
59		Hex. Head Bolt, Phillips, M4 x 10	1
60		Hex. Nut, M4, Cl. 1	1
61		Washer, ϕ 4 x ϕ 9 x 0.8t	2
62		Rubber #270	1
63		Switch	1
64		Power Cable without Plug	1
65		Cable Lock	1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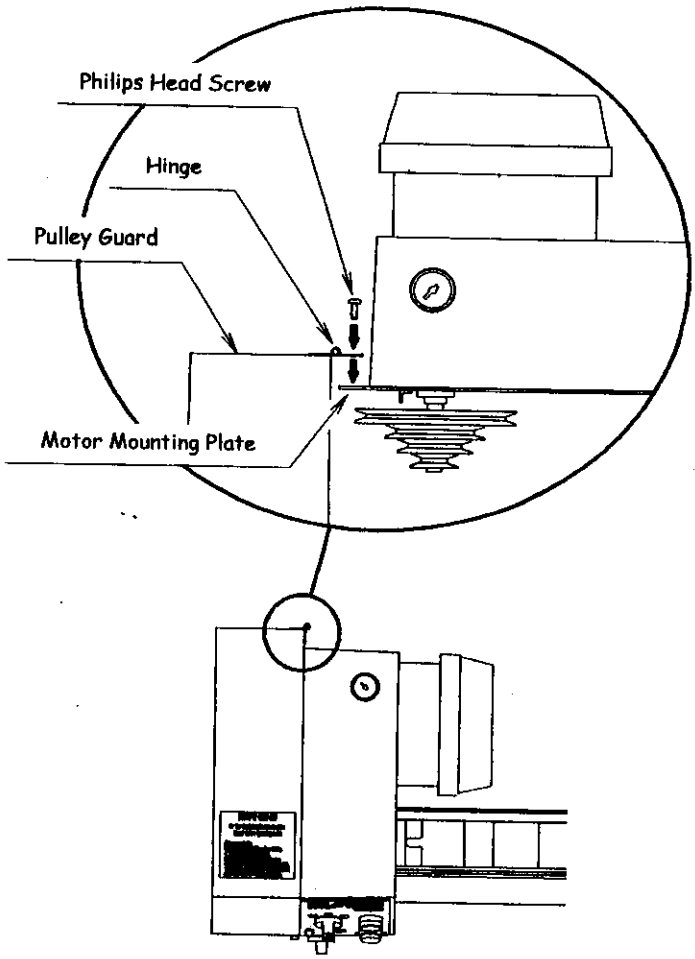
[1] Installing Pulley Guard:

1. The hinges on the pulley guard are attached to the motor mounting plate by means of four Philips head screws.
2. Position the pulley guard so that the holes in the hinges are in line with the threaded holes in the motor mounting plate.
3. Use a Philips screwdriver to tighten the four screws to secure the hinges and the cover.
4. Check the alignment of the cover to be sure that it clears the top edge of the motor mounting plate.
5. When the pulley guard closes freely, screw in the socket head capscrew from the front to secure the pulley guard in the closed position.
6. Safety note: The pulley guard must always be closed and properly secured when running the ML-360 Mini Lathe to ensure that personal injury does not occur to the operator because of the belts, pulleys, and gears in the Lathe operating mechanism.



[2] Mounting the Handle Knob on the Longitudinal Handwheel:

1. The knob B is attached to the handwheel by means of a socket head cap screw which passes through the knob and is screwed into the tapped hole in the handwheel.
2. Screw the nut on the socket head screw between the handle knob and the handwheel.
3. After screwing the socket head screw into the handwheel, adjust the nut and tighten it with the 8 mm. wrench to allow 0.5 mm. (approximately 1/64") clearance between the nut and the handle knob.