

TECHNICAL MANUAL

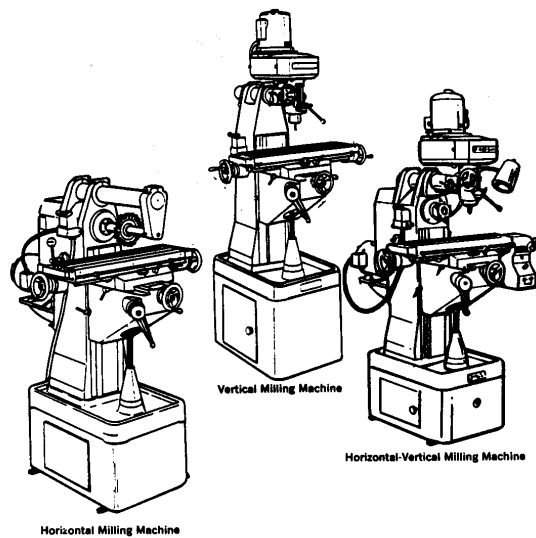
**OPERATOR'S, ORGANIZATIONAL, DIRECT SUPPORT
AND GENERAL SUPPORT MAINTENANCE
MANUAL INCLUDING REPAIR PARTS LIST**

FOR

**MILLING MACHINE
MODELS 21-122-W/49-697 & 52-020
(NSN 3417-00-494-9573)
(ROCKWELL INTERNATIONAL CORP.)**

HEADQUARTERS, DEPARTMENT OF THE ARMY

OCTOBER 1981



WARNING

- 1. IF YOU ARE NOT** thoroughly familiar with the operation of Milling Machines, obtain advice from your supervisor, instructor or other authorized person.
- 2. MAKE SURE** wiring codes and recommended electrical connections are followed and that machine is properly grounded.
- 3. HAVE** the power off when making any adjustment.
- 4. REMOVE** tie, rings, watch and other jewelry and roll up sleeves.
- 5. ALWAYS** wear safety glasses or a face shield.
- 6. BE SURE** work is properly clamped in place before making a cut.
- 7. BEFORE STARTING** a cut , set the proper feed, speed and depth of cut. Failure to follow this rule can break a cutter, bend an arbor, throw a work piece out of the machine, or cause some other dangerous condition.
- 8. YOU** will have a broken cutter, etc. If you start cutting with the feed set for rapid traverse.
- 9. KEEP** machine clean and free of chips. Shut off power and wait for machine to stop before removing chips. Do not clean machine with a rag or a brush while machine is running.
- 10. MAKE SURE** cutters are sharp. Handle them with care to avoid cutting yourself.
- 11. BE SURE** cutter is turning in the right direction. A broken cutter, etc. can occur if cutter is turning backwards.
- 12. GUARDS** should be used at all times.
- 13. IF A COOLANT** is used, wash your hands and arms thoroughly to prevent danger of dermatitis or infection from the coolant.

This manual contains copyright material

Technical Manual
No. 9-3417-211-14&P



HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, DC, 27 October 1981

**OPERATOR'S, ORGANIZATIONAL, DIRECT SUPPORT
AND GENERAL SUPPORT MAINTENANCE MANUAL
INCLUDING REPAIR PARTS LIST
FOR
MILLING MACHINE
MODELS 21-122 W/49-697 & 52-020
NSN 3417-00-494-9573**

REPORTING OF ERRORS

You can help improve this manual. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2, located in the back of this manual direct to: Commander, US Army Armament Materiel Readiness Command, ATTN: DRSAR-MAS, Rock Island, IL 61299.

A reply will be furnished directly to you.

NOTE

This manual is published for the purpose of identifying an authorized commercial manual for the use of the personnel to whom this equipment is issued.

Manufactured by: Rockwell International Corp.
131 Park Street, NE
Vienna, Virginia 22180

Procured under Contract No. DAAA09-77-C-6003

This technical manual is an authentication of the manufacturers' commercial literature and does not conform with the format and content specified in AR 310-3, Military Publications. This technical manual does, however, contain available information that is essential to the operation and maintenance of the equipment.

**INSTRUCTIONS FOR REQUISITIONING PARTS
NOT IDENTIFIED BY NSN**

When requisitioning parts not identified by National Stock Number, it is mandatory that the following information be furnished the supply officer.

- 1 - Manufacturer's Federal Supply Code Number - 80318
- 2 - Manufacturer's Part Number exactly as listed herein.
- 3 - Nomenclature exactly as listed herein, including dimensions, if necessary.
- 4 - Manufacturer's Model Number - Model 21-122 W/49-697 & 52-020
- 5 - Manufacturer's Serial Number (End Item)
- 6 - Any other information such as Type, Frame Number, and Electrical Characteristics, if applicable.
- 7 - If DD Form 1348 is used, fill in all blocks except 4, 5, 6, and Remarks field in accordance with AR 725-50.

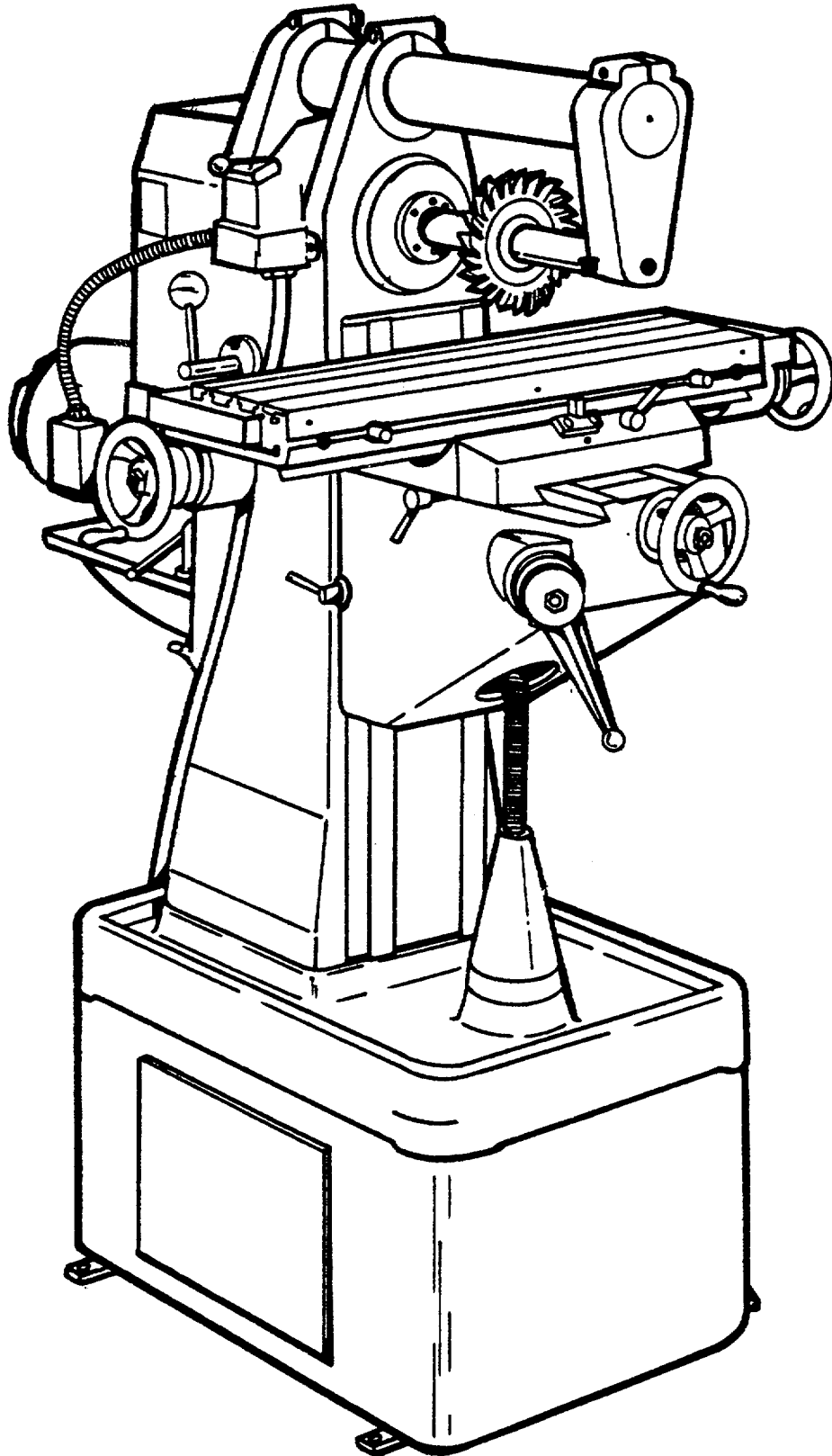
Complete Form as Follows:

- (a) In blocks 4, 5, 6, list manufacturer's Federal Supply Code Number — 80318 followed by a colon and manufacturer's Part Number for the repair part.
- (b) Complete Remarks field as follows:
Noun: (nomenclature of repair part)
For: NSN: 3417-00-494-9573
Manufacturer: Rockwell International Corp.

Model: 21-122 W/49-697 & 52-020
Serial: (of end item)

Any other pertinent information such as Frame Number, Type, Dimensions, etc.

HORIZONTAL
MILLING MACHINE



CATALOG LISTING

No. 21-120 Milling Machine on cabinet. less electricals. Hand Screw Feed Table Model. 900 lbs.

VARIABLE RATE TABLE FEED

No. 21-820 Variable Rate Power Table Feed for 115 V. single phase, 60 hertz, with 8-toot grounding type cord and plug. Available factory mounted and wired on all Mills. Instructions for field mounting are included. Fits in place of right table hand wheel, but left table hand wheel still can be used. No. 21-838 Table Travel Limit Switch Kit is recommended. 28 lbs.

No. 21-816 VERTICAL HEAD complete, for use on Horizontal Milling Machine. Includes head with ram, spindle and quill, spindle brake and lock, feed parts. guards for pulleys and V belt, pulleys, V belt, motor mounting plate, draw bolt for collets. worm and gear tilting mechanism, tilt scale and instructions for field mounting. Less electricals. 132 lbs.

NOTE: For Motors and Controls for No. 21-816 Vertical Head, See Page on Horizontal-Vertical Milling Machine.

HORIZONTAL MILLING MACHINE

MOTORS AND CONTROLS FACTORY MOUNTED AND WIRED (NEMA 145T)

MOTOR	MOTOR CONTROL	HERTZ AND MOTOR RPM	MOTOR VOLTAGE	SHIP WT. LBS.	CATALOG NUMBER	CAT. NO. 200 V
Single Phase 1 1/2 Horsepower	LVC CONTROL-24 V Push Button Reversing Station Magnetic Starter, Transformer and Overload Protection	60-1725	115/230	70	49-697	
Three Phase, 1 1/2 Horsepower	LVC CONTROL-24 V Push Button Reversing Station, Magnetic Starter, Transformer and 3-Leg Overload Protection	60-1725	230/460	64	†49-774	†52-193

NOTE: Three phase electricals will be supplied wired for 230 V, unless 460 V is specified. Single phase electricals will be supplied wired for 230 V only, cannot be supplied wired for 115 V. Power cord and plug supplied for single phase only. †Where

MACHINE DATA

TABLE

Working Surface61/2 x 24" (165 x 609.6 mm)
 No. of T-Slots.....3 Size of T-Slots7/16" (11.1 mm)
 Spacing of T-Slots (Center to Center)2" (50.8 mm)
 Height from Floor (Lowest Position)33" (838.2 mm)
 Micrometer Collars 2 3/8" (60.3 mm) Dia.;
 Graduated to .001" (.0254 mm)
 Travel for each revolution of hand wheel..... 200" (5.08 mm)

RANGE

Table Longitudinal Travel
 With Hand Screw Feed16" (406.4 mm)
 With Variable Rate Power Feed15 1/2" (393.7 mm)
 Table Cross Travel.....6 3/4" (171.45 mm)
 Table Vertical Travel16 1/2" (419.1 mm)
 Table to I. of Spindle0 to 15" (0 to 381 mm)
 Cutter Dia. (Maximum with Overarm)8" (203.2 mm)
 Spindle Nose to Arbor Support (Max.)12 3/4" (323.85 mm)
 Maximum Arbor Length (Shoulder to Nut)11" (279.4 mm)
 Bottom of Overarm Bracket to C_L to Spindle1" (25.4 mm)

POWER TABLE FEED RATES (Inches/mm Per Minute)

Infinitely Variable from0 to 22" (0 to 558.8 mm)
 Jog or Rapid Approach......30" (762 mm)

SADDLE WIDTH12" (204.8 mm)

DOVE-TAILS

Size..... 3/4" (19.05 mm) Kind of Gib Tapered

MACHINE DATA FOR 21-816 VERTICAL HEAD ACCESSORY

RANGE

Spindle Nose to Table0 to 17" (0 to 431.8 mm)
 Spindle C_L to Column V ways 3 3/4" to 12 1/2" (95.3 to 317.5 mm)

SPINDLE

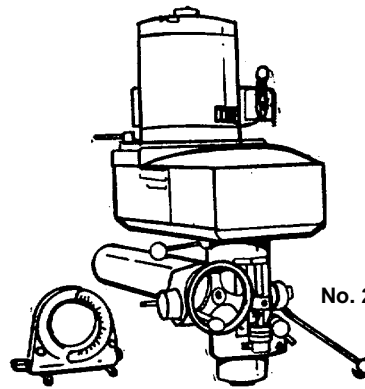
Spindle Taper R8 Hole Through Spindle7/16" (11.11 mm)
 Number of Bearings5 Number of Splines 6

SPEEDS

With 1725 rpm motor..... 370, 706, 1170, 2440, 4420 and 6300 rpm
 With 1140 rpm motor 245, 470, 780, 1620, 2940 and 4200 rpm

STANDARD EQUIPMENT

Basic Milling Machine includes storage type cabinet with door, guards for V belts and pulleys, draw bolt threaded 1/2" --13, overarm support for Style A arbors, V belts (2), motor pulley (3/4" bore), two 1 1/16" open end wrenches, and oil for spindle bearings. Without arbors and electricals.



No. 21-816 VERTICAL HEAD

electrical controls must comply with ANSI B-11 Series Machine Tool Standards, NFPA 79 Standard or JIC Standards, the No. 49-001 Electrical Kit must be ordered in addition to the Catalog Number of the designated Electrical Package.

SPINDLE

Taper NMTB #30 Hole 21/32" (16.67 mm)
 Precision Timken Roller Bearings (Oil Bath Lubricated) 2

OVERARM ARBOR SUPPORT BRACKET

..... Takes Style A Arbors with 23/32"18.26 mm) Pilot

DRIVE

Motor to Ball Bearing Countershaft 8M Belt
 Countershaft to Spindle..... 8M Belt
 Back Gears (Alloy Steel, Heat Treated) Oil Bath Lubricated

SPEEDS (With 1725 rpm Motor)

Gear Drive 60, 135, 240, 300 and 385 rpm
 Direct Drive 375, 845, 1500, 1875 and 2400 rpm

MOTORS

Accommodates Frame Sizes Delta #8 1/2 and NEMA #182
 Horsepower Recommended 1 1/2

OVERALL DIMENSIONS

Height 57 1/2" (1460.5 mm)
 Width (Table in center position) 37 3/4" (958.85 mm)
 Front to Rear (Motor mounted) 51" (1295.4 mm)

CABINET BASE DIMENSIONS

Width ... 17 1/2" (444.5 mm) Front to Rear 261/2" (673.1 mm)

SHIPPING WEIGHT WITH ELECTRICALS

(Approx.)..... 975 lbs. (442.3 kg)

QUILL (Hard Chrome Plated)

Diameter 3" (76.2 mm)
 Stroke 2 1/2" (63.5 mm)
 Feed Choice of Rapid or Fine Feed

MOTORS

NEMA C Face Frame (Special)..... .56
 Horsepower Recommended 3/4
 Speeds Recommended (RPM) 1725 or 1140
 Special Shaft Length (from Face of Flange) 4 3/32" (103.98 mm)

INSTALLATION UNPACKING

Milling Machine is shipped completely assembled and mounted to a heavy wooden skid which should remain in place until the mill is moved to its permanent shop location.

SELECTING FLOOR SPACE

Vibration transmitted through inadequately constructed floors by adjacent machinery or other sources can impair the accuracy of your mill. Therefore, it is of utmost importance that the mill be mounted to a solid, level foundation, preferably concrete.

Unless substantially constructed, a wood floor should be braced against sagging and transmission of vibration. Refer to fig. 2, for floor plan dimensions for your Horizontal Milling Machine.

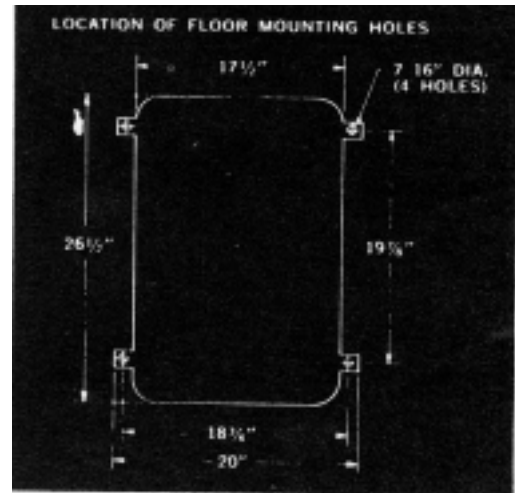


Fig. 2.

WARNINGS

Have the power off when making any adjustments.

Remove tie, rings, watch and other Jewelry and roll up sleeves.

Always wear safety glasses or a face shield.

CLEANING THE MILL

The ways and all other machined and unpainted surfaces of the mill are protected with a coating of rust preventive. This coating may be removed with a soft cloth moistened with kerosene (do not use acetone, gasoline, or lacquer thinner for this purpose.) After cleaning, lubricate all exposed ways and unpainted surfaces with a light film of good machine oil.

Then, move each unit to the opposite limit stop and similarly clean and lubricate the exposed ways. Loosen the two clamping screws to unlock the overarm, and move it forward and backward its full length in order to clean and lubricate.

LEVELING THE MILL

Proper leveling is an important factor to consider when setting up the machine. The floor should be as smooth as possible, and tapered wedges should be inserted in any openings so that the base receives as much foundation as possible. Four bolt pads are provided for securing the machine to the floor after leveling. (See Fig. 3).

A sensitive graduated tube spirit level, reading to 10 seconds per graduation (0.0005" per foot) and provided with screw adjustment is required. This level should be mounted on the table, both longitudinally and transversely. A carpenter's level or a machinist's combination square level is not good enough. Place shims under the four bolt pads of the cabinet until the table is level in all directions. Securely tighten the four lag screws or bolts and recheck leveling.

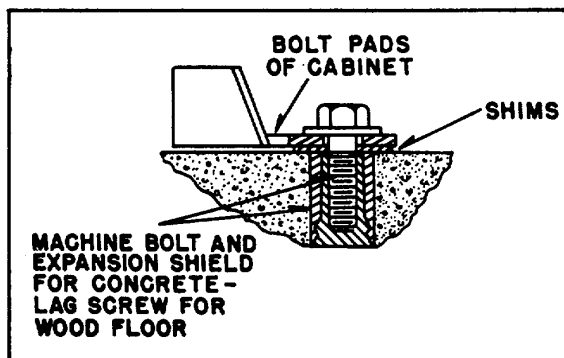


Fig. 3.

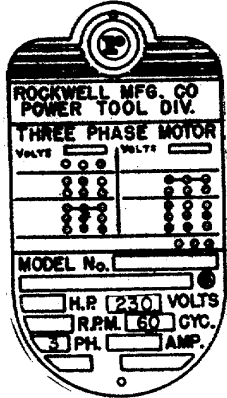
ELECTRICAL RECOMMENDATIONS

A constant speed 1 HP, or 1-1/2 HP, 1725 rpm motor is recommended. The motor pulley supplied with the mill is designed to fit a motor shaft 3/4" in diameter, a motor pulley is also available to fit a motor shaft 7/8" in diameter. The motor mounting dimensions of the mill will accommodate 8-1/2 and NEMA 182 Frame Motors.

Wiring diagrams are included with the Switch Kits made available for use for your mill.

WARNING

Make sure wiring codes and recommended electrical connections are followed and the machine is properly grounded.

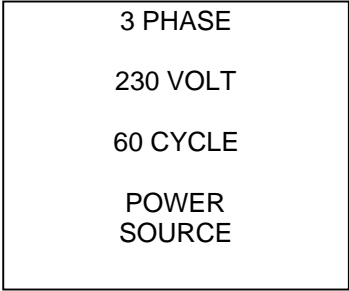


Nameplate on motor.

Make sure electrical characteristics are the same.



To connect to power source use heavy enough wire.



Your power source.

H.P.	1 Phase	3 Phase
1 & 1-1/2	#12	
1 & 1-1/2		#14

Fig. 4.

OPERATION AND CONTROLS

The following is an explanation of the operating controls of the Horizontal Milling Machine. An experienced operator knows that there is always some difference between the location and type of control between different models, even though the purpose of the controls is similar between one mill and other. The novice should study these explanations carefully before turning on the power, to avoid damage to the mill or injury to himself.

CAUTION: Before turning on power, be sure machine has sufficient oil for the roller bearings of the spindle. See item 4A on Page 13.

All operators will profit by a knowledge of how the controls operate and how they are to be set for standard milling operations.

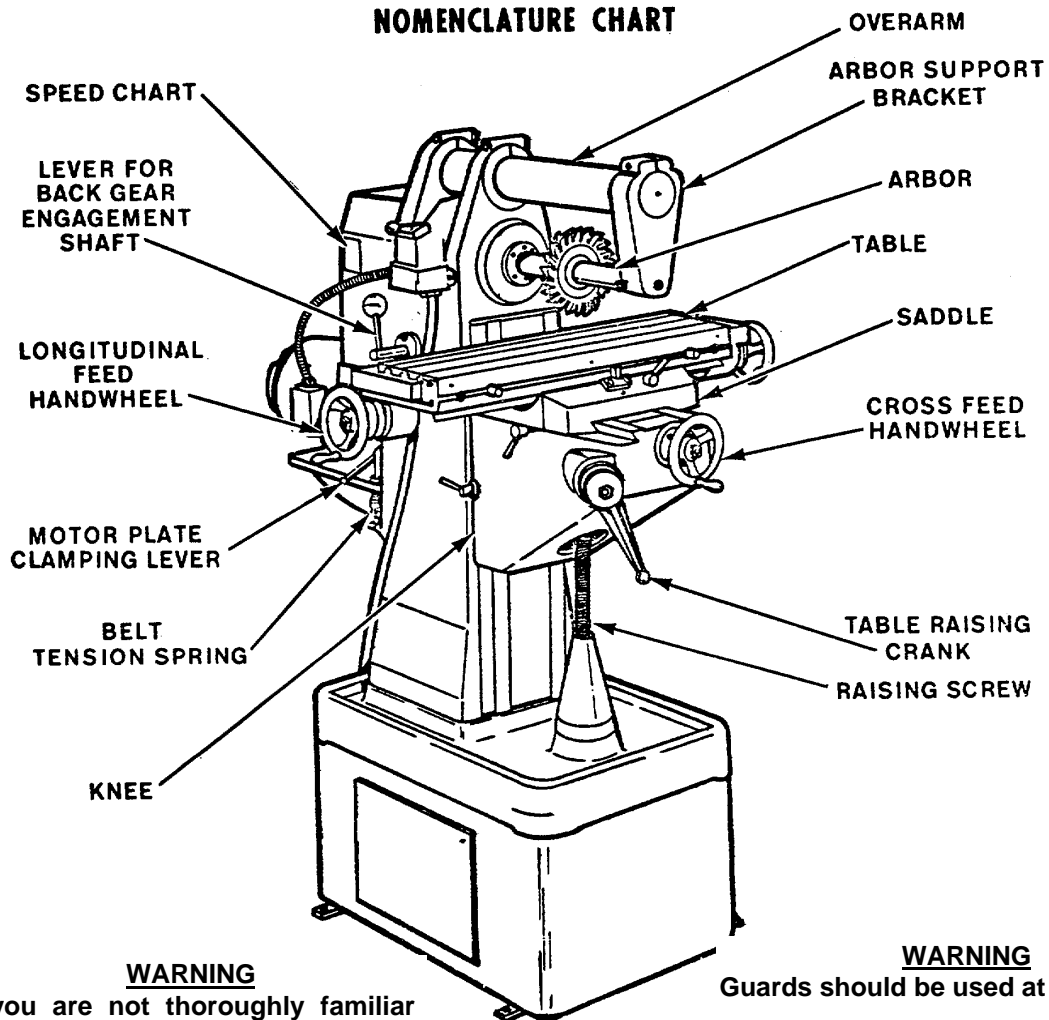


Fig. 5.

DRIVE CONTROLS

Direct Drive Control Dog Clutch The motor should be stopped and the belt guard removed before using this control. The Direct Drive Control Dog Clutch must be engaged for direct drive and disengaged before the back gears are engaged by means of the Back Gear Engagement Shaft.

The Direct Drive Control Dog Clutch should be engaged only when the back gears are disengaged.

To engage the clutch for direct drive, push the Direct Drive Control Dog Clutch toward the spindle pulley and engage the clutch. To do this it will usually be necessary to rotate the spindle pulley by hand to find the position where the dogs will drop into their slots. See Fig. 6.

To disengage the Direct Drive Control Dog Clutch, pull the clutch away from the spindle pulley until the clutch dogs are disengaged.

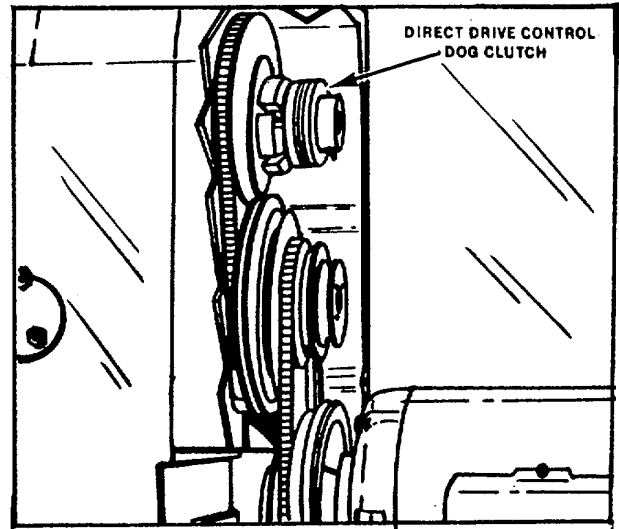


Fig. 6.

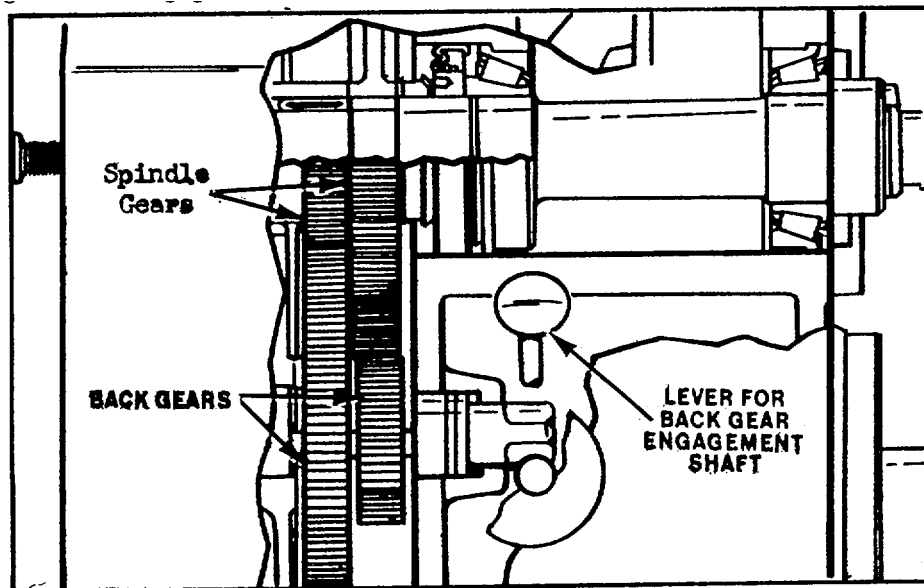


Fig. 7.

Back Gear Engagement Shaft -The motor should be stopped and the direct drive control dog clutch disengaged before using this control. The shaft works through an eccentric, to either raise the back gears into engagement with the spindle gears or drop them down out of engagement, See Fig. 7. The lever on the hub of the shaft must be rotated until it points up before shifting. Then after shifting it must be rotated to point down, before the motor is turned on, to be sure the gears will stay engaged or disengaged during operation. Push the shaft all the way in for direct drive and loose spindle, or pull it way out against the stop for back gear drive. If the shaft does not snap way out against the stop the gears will not be in full engagement. Occasionally, it is necessary to rotate the spindle by hand to find the engagement position of the gears.

SPINDLE SPEEDS

WARNINGS

Be sure work is properly clamped in place before making a cut.

Before starting a cut, set the proper feed, speed and depth of cut. Failure to follow this rule can break a cutter, bend an arbor, throw a work piece out of the machine, or cause some other dangerous condition.

Ten speeds between 60 and 2400 rpm are available with your Horizontal Milling Machine. The spindle speeds in back gear drive are 60 to 385 rpm. The spindle speeds in direct drive are 375 to 2400 rpm., as shown in Fig. 8. These speeds are obtained with a 1725 rpm motor.

WARNINGS

You will have a broken cutter, etc. if you start cutting with the feed set for rapid traverse.

Keep machine clean and free of chips. Shut off power and wait for machine to stop before removing chips. Do not clean machine with a rag or a brush while machine is running.

Make sure cutters are sharp. Handle them with care to avoid cutting yourself.

Be sure cutter is turning in the right direction. A broken cutter can occur if cutter is turning backwards.

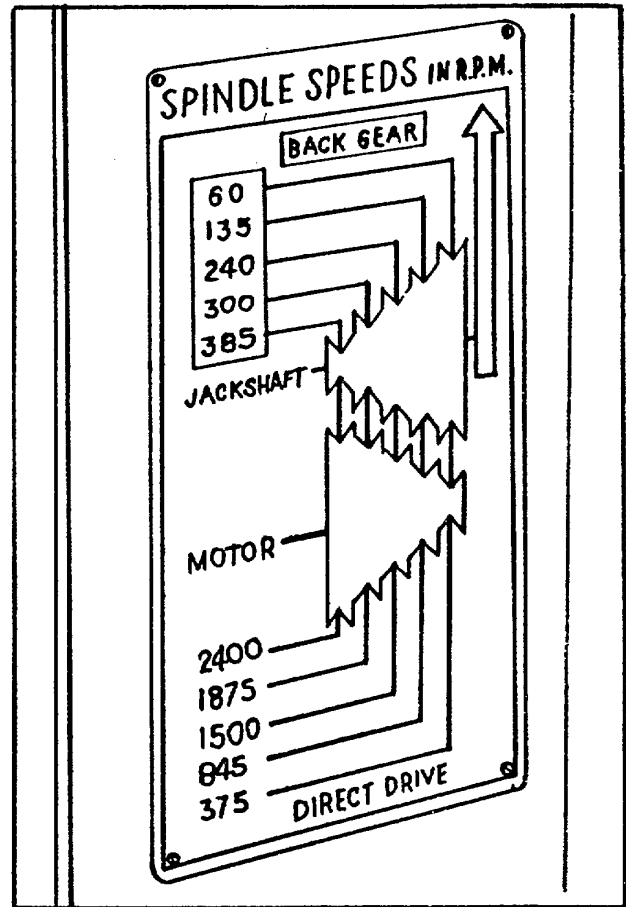


Fig. 8.

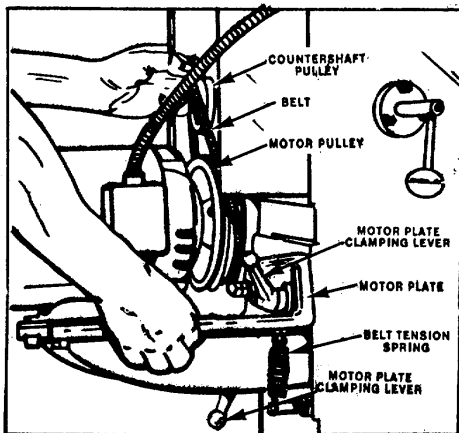


Fig. 9.

To change spindle speeds, loosen both motor plate clamping levers and swivel the motor plate up toward the spindle to release belt tension, as shown in Fig. 9, and lock the upper motor plate clamping lever. Move the belt to the desired steps on the countershaft pulley and the motor pulley, loosen the upper motor plate clamping lever, let the belt tension spring supply the correct belt tension and lock the motor plate clamping levers. The correct tension on the belt is 5/16" deflection-with 5 pounds thumb pressure in center of span.

TABLE CONTROLS

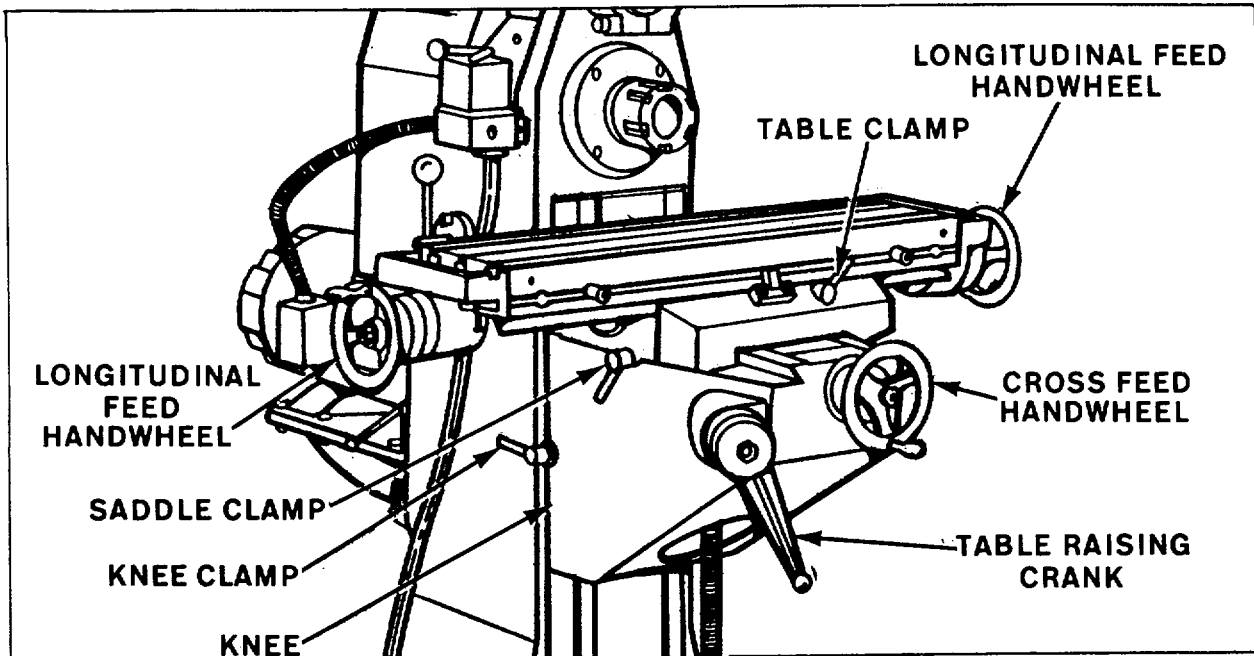


Fig. 10.

To locate the work in a definite relation to the cutter, it is necessary to move the table either longitudinally, transversely, or vertically. Each of these movements is controlled by a handle or handwheel which can be reached easily from the front of the machine.

Lengthwise or longitudinal movement of the table is accomplished by turning either one of the **LONGITUDINAL FEED HANDWHEELS**. These handwheels are connected to the table feed screw which is mounted in the table and extends from end to end.

When the handle is turned, the screw rotates in a compound feed nut in the saddle and moves the table lengthwise.

Crosswise or transverse movement of the table is accomplished by turning the **Cross Feed Handwheel** which is mounted on the end of the cross feed screw. Clockwise rotation of the **Cross Feed Handwheel** moves the table toward the column, while counterclockwise rotation moves the table away from the column.

Vertical movement of the table is obtained by rotating the **TABLE RAISING CRANK** clockwise to raise and counterclockwise to lower the table. One complete rotation of the crank moves the table up or down $1/10"$. To avoid the possibility of the table changing its height setting during a cut, always approach the final height setting by raising the table with its full weight on the elevating mechanism parts, instead of coming down to the desired setting.

CLAMPS are provided for locking the table, knee, and saddle in position when these parts are not used to feed the work to the cutter. The **CLAMPS** for these units should be loosened before feeding. Considerably more effort will be required to move the parts when the **CLAMPS** are tight and the bearing surfaces are very likely to become scored.

The **KNEE CLAMP** should be loosened before the **KNEE** is raised or lowered. The **SADDLE CLAMP** should be loose when the table is moved in or out.

The **TABLE CLAMP** should be loose before the table is moved lengthwise. Clamps on all members not being used to feed the work should be tightened when cuts are in progress.

A micrometer collar is mounted on each screw used to move the table in its three directions: lengthwise, crosswise, and vertically. The outer circumference of the collars is evenly divided into graduations which measure the movements of the table in thousandths of an inch.

The graduated collar provides micrometer adjustment for setting or feeding the work in relation to the milling cutter.

When the collar is clamped to the feed screw, it becomes an integral part of the feed screw. Thus when the feed screw is turned to move the table, the distance is measured on the collar.

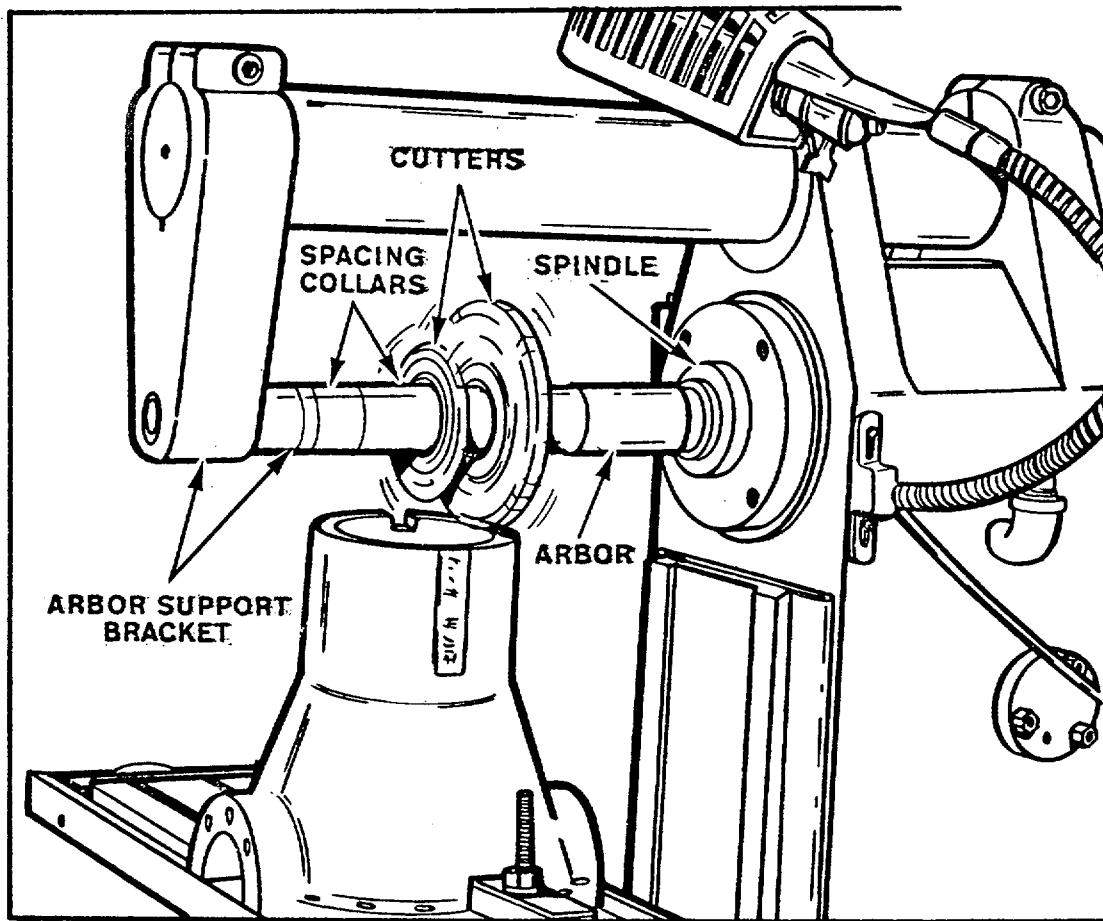


Fig. 11.

TYPE OF ARBORS USED

The Horizontal Mill accommodates Style A arbors with a 23/32" Pilot. The arbor is supported at one end by the spindle, which has a NMTB #30 Taper, and at the other end by the overarm arbor support bracket. (See Fig. 11).

By using Cat. #21-834 Overarm Arbor Support Bracket, a Style B Arbor with a running bushing 1 7/8" O.D. may be used with the Horizontal Mill. The Cat. # 21-834 Overarm Arbor Support Bracket may also be used with the Style A Arbor as an intermediate support for extra rigidity.

The NMTB #30 Spindle Taper on your mill will accommodate Style C Arbors used for end milling operations. When Style C Arbors are used, the overarm arbor support bracket is not used and should be rotated 180 degrees, so that it is pointing straight up, and locked in place.

MOUNTING STYLE A ARBORS

To mount Style A Arbors, proceed as follows:

1. Wipe clean the hole in the spindle and the taper shank of the arbor.
2. Insert the arbor into the spindle nose. Insert the drawbolt into the rear of the spindle and screw securely into the arbor. **IMPORTANT:** Before inserting the drawbolt into the spindle, remove any accumulations of chips or dirt. Tighten the drawbolt lock nut securely.
3. Place spacing collars, key, and cutter on the arbor at the desired position. **IMPORTANT:** The key must fully engage the keyway in the cutter.
4. Assemble the arbor nut to the end of the arbor and tighten finger tight. Locate and clamp securely the overarm arbor support, and then tighten the arbor nut securely.

SERVICE ADJUSTMENTS ADJUSTING BELT TENSION

To increase tension on the motor to countershaft belt (A) Fig. 12, the motor must be shifted down. This may be done as follows:

1. Loosen the motor plate clamping levers (B) and (F) Fig. 12.
2. Let the belt tension spring (C) Fig. 12 supply the correct tension on the belt or push down the motor mounting plate (D) until the correct tension is obtained, and lock the motor plate clamping levers. The correct tension for the belt from the motor to the countershaft is $5/64$ " deflection with five pounds thumb pressure in center of span.

To increase tension on the countershaft to spindle belt, proceed as follows:

1. Remove the belt guard and the motor to countershaft belt (A) Fig. 12.

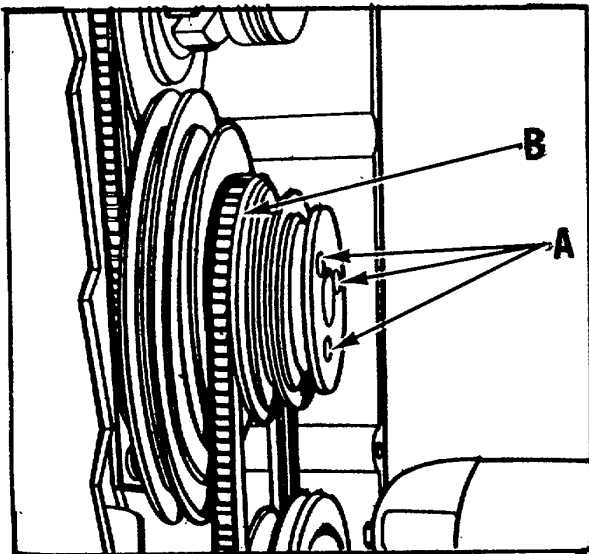


Fig. 13.

4. Loosen the four cap screws (A) Fig. 14, that hold the countershaft bracket to the mill.

5. With a heavy screwdriver or other suitable tool placed between the one step countershaft pulley (B) Fig. 14, and the spindle pulley (C), pry the pulleys apart until correct tension is obtained on the countershaft to spindle belt, and tighten the four screws (A). **CAUTION: Care must be taken that the grooves of the counter-shaft pulley and the spindle pulley are not damaged during this operation. The correct tension for the countershaft to spindle belt is $5/64$ " deflection with five pounds thumb pressure in center of span.**

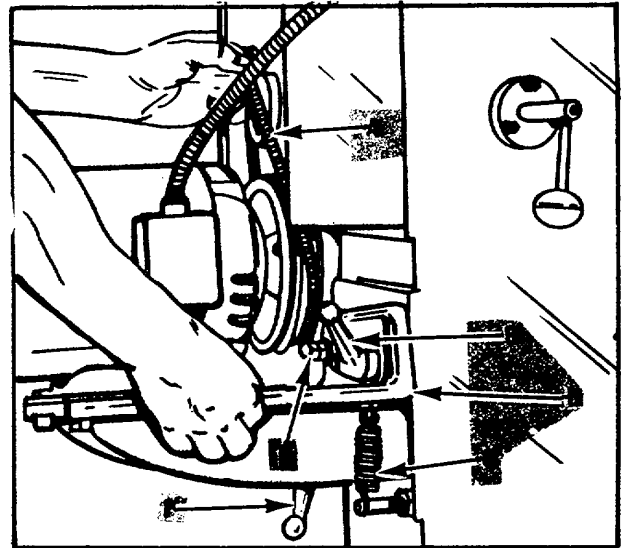


Fig. 12.

2. Disconnect the belt tension spring (C) Fig. 12. Remove nut (E) and two hand levers (B) and (F) that hold the motor mounting plate (D) Fig. 12, to the frame, and remove the motor mounting plate, motor, and motor pulley as a unit.

3. Remove the three screws (A) Fig. 13, located on the face of the countershaft pulley, and remove the five step countershaft pulley (B).

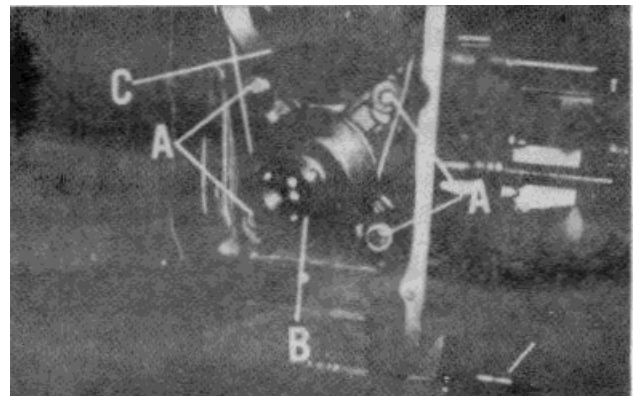


Fig. 14.

ADJUSTING BELT TENSIONING SPRING

The belt tensioning spring (A) Fig. 15, is adjusted at the factory to supply correct belt tension (5/64" deflection with five pounds thumb pressure in center of span) for the motor to countershaft belt. If the belt tensioning spring ever needs to be adjusted to increase or decrease tension of the belt, proceed as follows:

1. Loosen the motor plate clamping levers (B) Fig. 15.
2. To increase tension, loosen nut (D) Fig. 15, and tighten nut (C) until correct tension is obtained.
3. To decrease tension, loosen nut (C) Fig. 15, until correct tension is obtained and tighten nut (D).

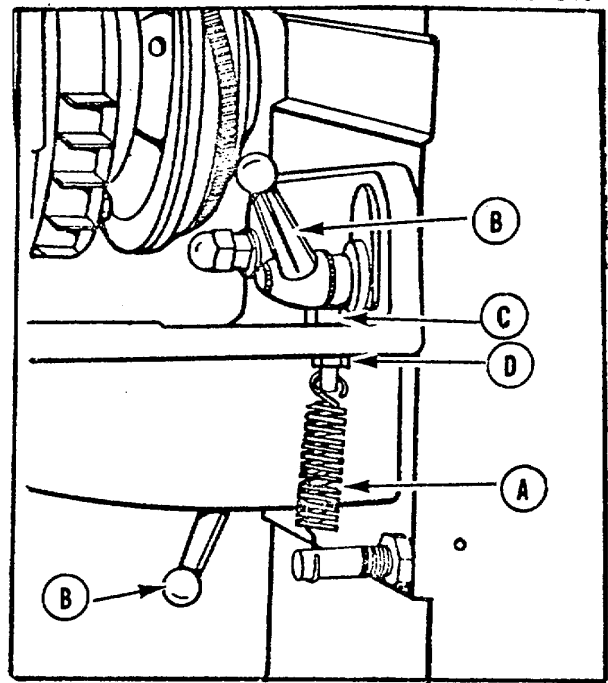


Fig. 15.

ADJUSTING BACKLASH BETWEEN BACK GEARS AND SPINDLE GEARS

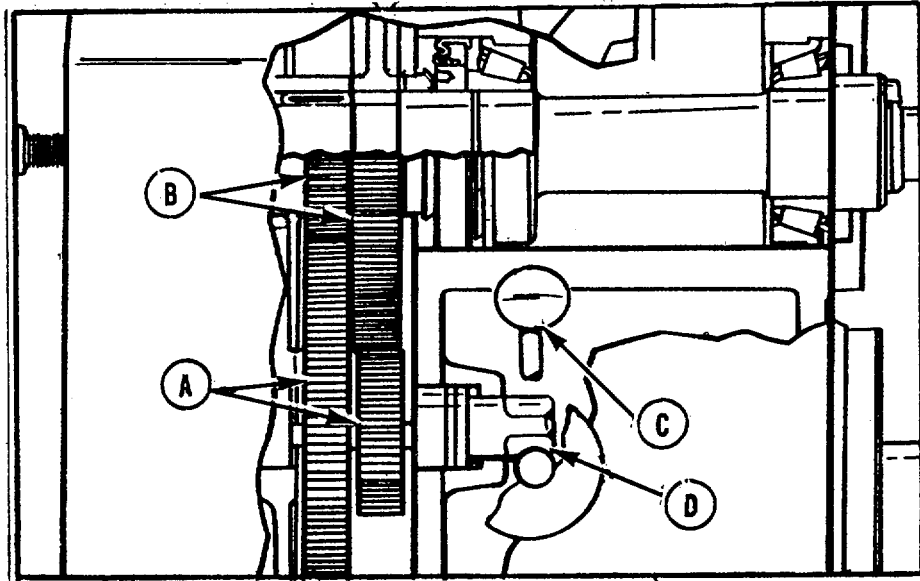


Fig. 16.

Proper backlash is accomplished when the back gears (A) Fig. 16, and the spindle gears (E) are engaged and the back gear eccentric shaft (D) is near the high point of its eccentric e.g., when the back gear engagement shaft (C) is pulled out against the stop, the back gears and the spindle gears should be properly engaged.

If it is ever necessary to adjust the backlash, proceed as follows:

To increase backlash:

1. Engage the back gears and spindle gears by pulling the back gear engagement shaft (E) Fig. 17, out against the stop and rotating the shaft so the lever points down.
2. Loosen three set screws (B) Fig. 17, and tighten the three jam nuts and the three acorn nuts (A) until correct backlash is obtained. Then tighten the three set screws (B) so that they bottom on flange (F).

To decrease backlash:

1. Engage the back gears and spindle gears by pulling the back gear engagement shaft (E) Fig. 17, out against the stop and rotating the shaft so the lever points down.
2. Loosen the three acorn nuts and three jam nuts (A) Fig. 17. Tighten the three set screws (B) until correct backlash is obtained. Then tighten the jam nuts and acorn nuts (A) Fig. 17.

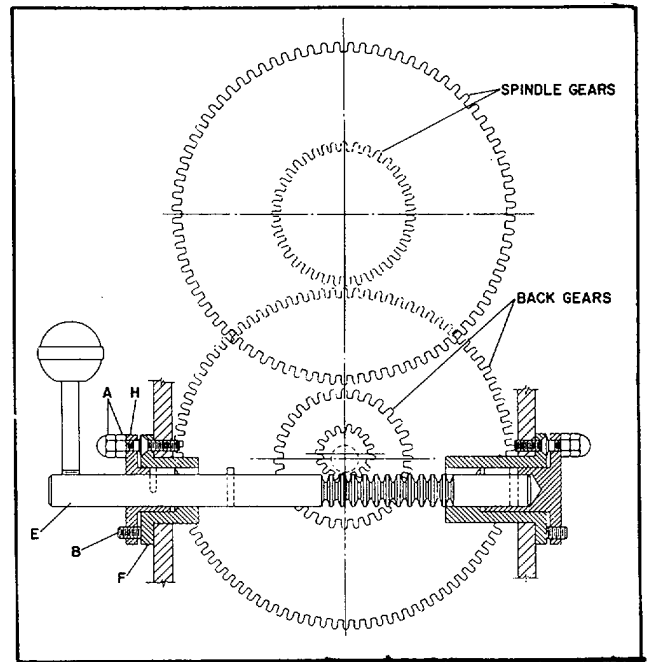


Fig. 17.

GIB ADJUSTMENT FOR TABLE, SADDLE, AND KNEE

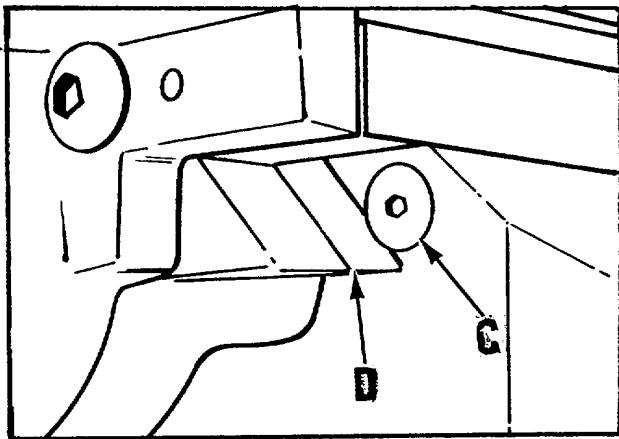


Fig. 18.

A gib is provided to take up all the play between the mating dove-tail ways of the table and saddle, the saddle and knee, and the knee and column.

If the table, saddle, or knee move too freely or bind, it is necessary to readjust the gib.

1. To tighten the gib, loosen the screw (A) on the small end of the tapered gib (B) Fig. 19. Turn in on screw (C) Fig. 18 on the large end of the tapered gib (D), until a

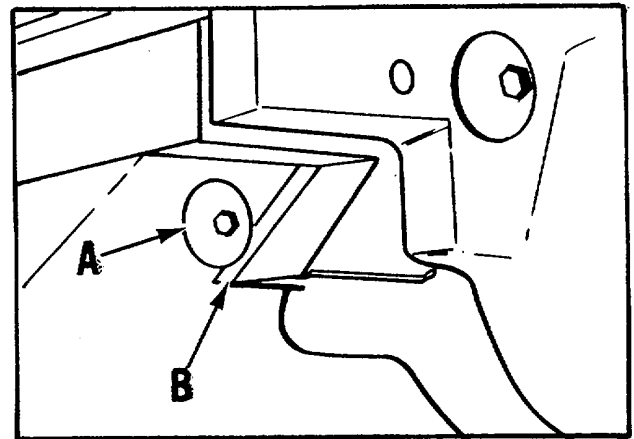


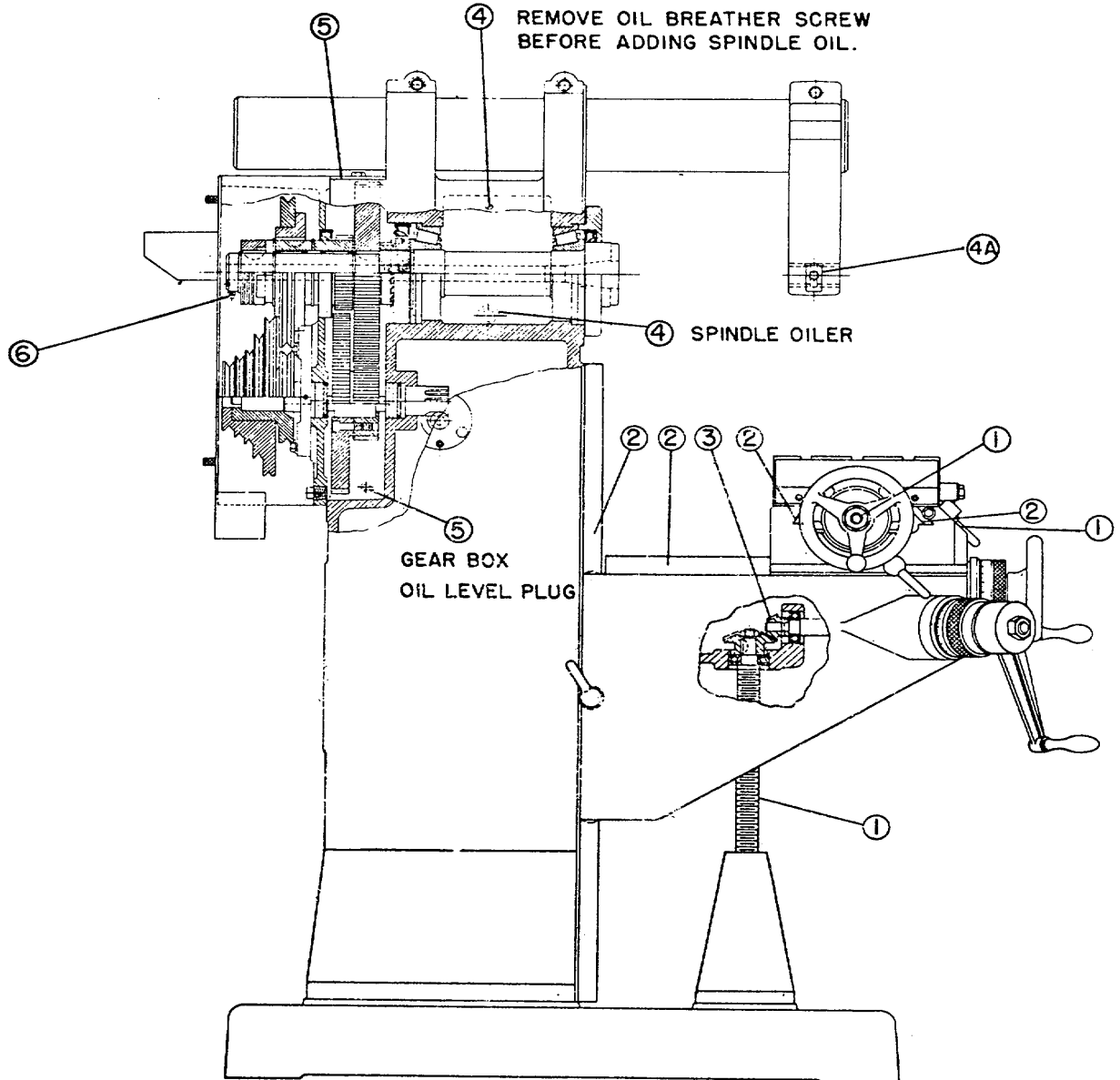
Fig. 19.

good, snug, sliding fit is obtained. When this is done, tighten screw (A) Fig. 19, recheck and make minor adjustments if necessary.

3. To loosen the gib, loosen the screw (C) on the large end of the tapered gib (D) Fig. 18. Turn in on screw (A) on the small end of tapered gib (B) Fig. 19, until a good, snug, sliding fit is obtained. When this is done, tighten screw (C) Fig. 18, recheck and make minor adjustment if necessary.

LUBRICATION

- (1) WITH S.A.E.-10 OIL DAILY.
- (2) WITH MARFAK #0 WEEKLY.
- (3) CROSS SLIDE TOWARD COLUMN UNTIL LOWER SHIELD BEGINS TO MOVE. SLIDE UPPER SHIELD BACK TO UNCOVER LEAD SCREW AND) BEVEL GEARS. GREASE BEVEL GEARS WITH MARFAK #0 GREASE WEEKLY.
- (4) FILL TO LEVEL OF SPINDLE OILER WITH HIGH GRADE SPINDLE OIL, CAT. No. 24-812, HAVING VISCOSITY OF 58-60 SAYBOLDT AT 100° F.
- (4A) WITH CAT. No. 24-812 SPINDLE OIL UNTIL OIL IS VISIBLE IN FILLER.
- (5) TO OIL LEVEL PLUG (APPROX. 7 FL OZ.) WITH EP-140 GEAR GREASE.
- (6) STARFAK # 2 PRESSURE GUN GREASE OR EQUIVALENT WEEKLY.



MAINTENANCE AND REPAIRS
REPLACING BELTS, PULLEYS, GEARS, SPINDLE BEARINGS, SPINDLE, AND RELATED PARTS

1. Remove the belt guard and the motor to countershaft belt (A) Fig. 20.
2. Disconnect the belt tension spring. Remove the motor plate clamping lever (B) and the nut (C) Fig. 20. Also remove the clamping lever located underneath the motor plate (D). Then remove the motor mounting plate, motor, and motor pulley as a unit.
3. Remove the three screws (E) Fig. 20, located on the face of the five step countershaft pulley (F), and remove the five step countershaft pulley(F).

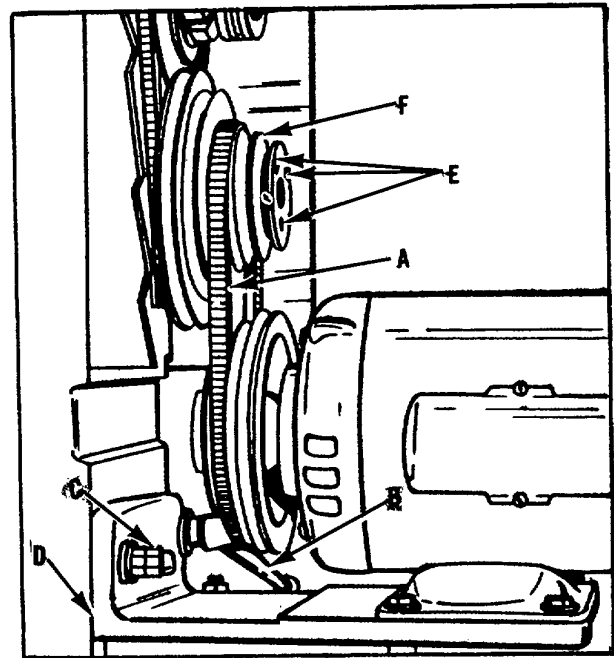


Fig. 20.

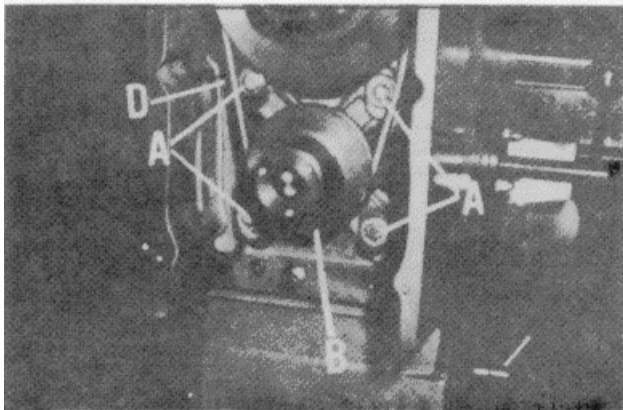


Fig. 21.

4. Remove the four cap screws (A) Fig. 21, that hold the countershaft bracket to the mill, and remove the countershaft to spindle belt (D). Remove the one step countershaft pulley (B) Fig. 21, and the countershaft bracket as a unit.

5. Remove the oil breather plate (A) Fig. 22 located on top of the gearbox and the oil drain plug (B) Fig. 22, and drain the oil from the gear box.
6. Remove the grease fitting (C) Fig. 22, located on the end of the spindle, and remove the snap ring (D).
7. Remove set screw, spring, and ball, (E) Fig. 22 Then remove the clutch half (F) and key (G).

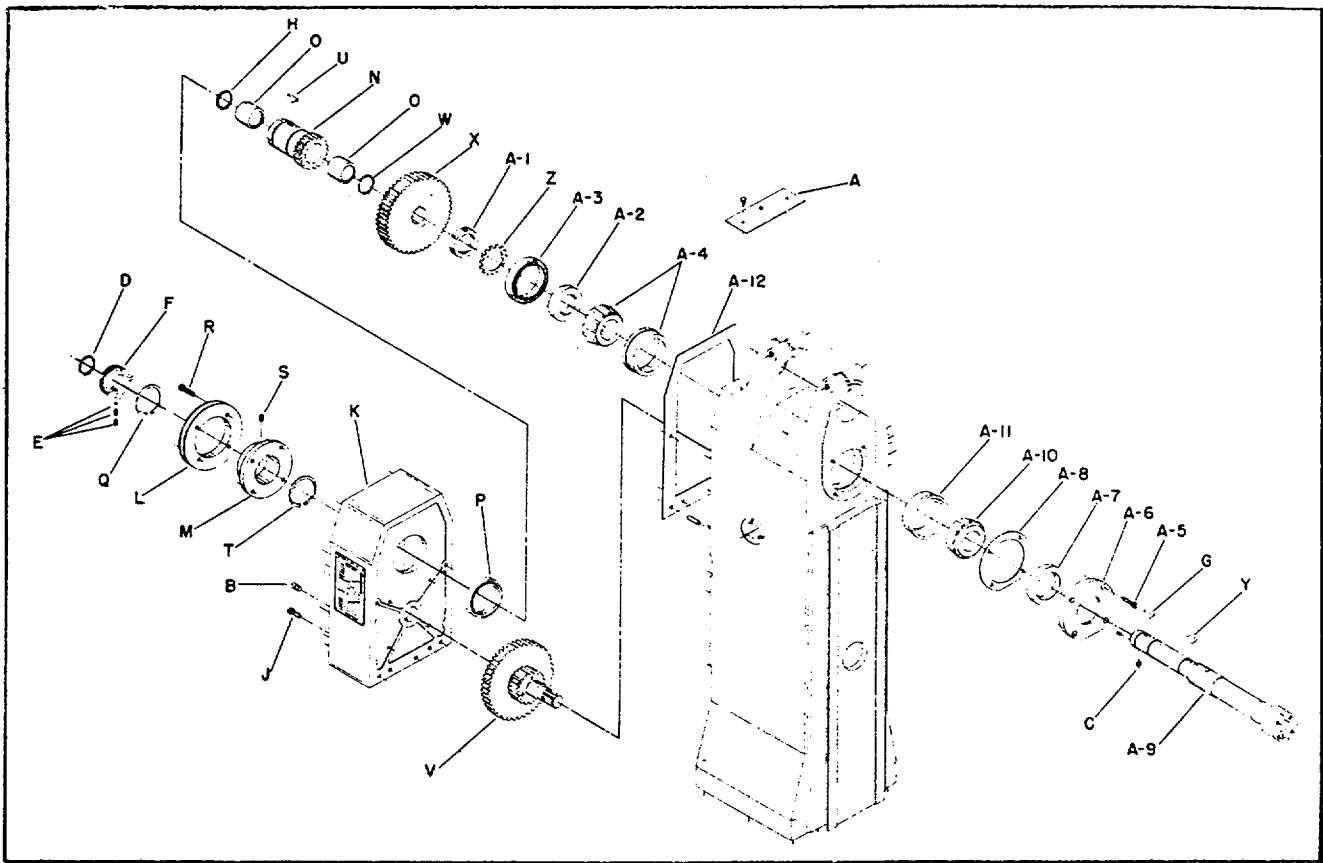


Fig. 22.

8. Remove snap ring (H) Fig. 22, and remove four cover plate screws (J).

9. Remove gear box cover plate (K) Fig. 22. Spindle pulley (L), snap ring (Q), plate (M), clutch half (N), two needle bearings (O), and oil seal (P) will come off with the cover plate. If any of these parts are to be replaced, remove snap ring (Q), four screws (R), pulley (L), set screw (S), plate (M); and snap ring (T). Then remove key (U), and slide clutch half (N) out of the gear box cover plate (K). When reassembling these parts, we recommend that the oil seal (P) be replaced and the clutch half (N) placed on the spindle before gear box cover plate (K). Then wrap the clutch half (N) with cellophane tape so that when the cover plate (K) is placed on the frame the oil seal (P) is not damaged.

10. Remove jackshaft gear cluster (V) Fig. 22.

11. Remove snap ring (W), bull gear (X), and key (Y) Fig. 22.

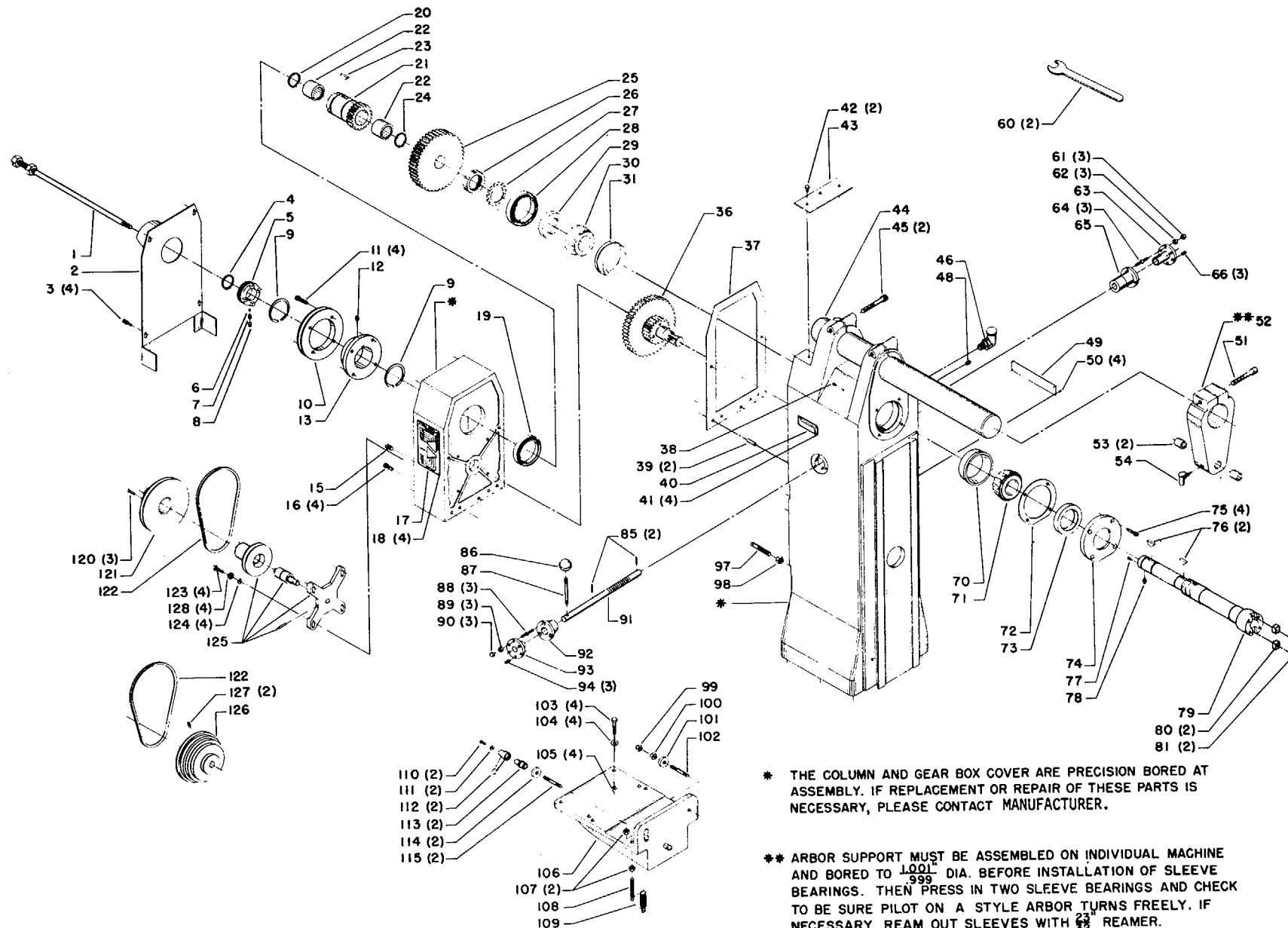
16. Reassemble in the reverse order. When reassembling the oil seals should be replaced and care should be taken not to damage them. When reassembling the cover plate (K), make sure there is a sufficient amount of permatex around the gasket (A-12) to prevent oil leaking from the gear box.

12. Unlock bearing lockwasher (Z) and back off bearing locknut (A-i) Fig. 22. Using a spanner wrench remove bearing adjusting nut (A-2). When replacing bearing adjusting nut (A-2) tighten the nut with a spanner wrench until it takes a torque of 15 inch pound to turn spindle.

13. Remove oil seal (A-3) Fig. 22. The rear tapered bearing assembly (A-4) can then be removed from the spindle.

14. Remove four screws (A-5), retainer (A-6), oil seal (A-7), and gasket (A-8) Fig. 22.

15. Then remove the spindle (A-9) Fig. 22. It may be necessary to use a soft hammer or a block of wood to drive the spindle out through the front of the machine. The tapered bearing cone (A-10) will probably come off with the spindle and the bearing cup (A-11) can then be removed from the machine

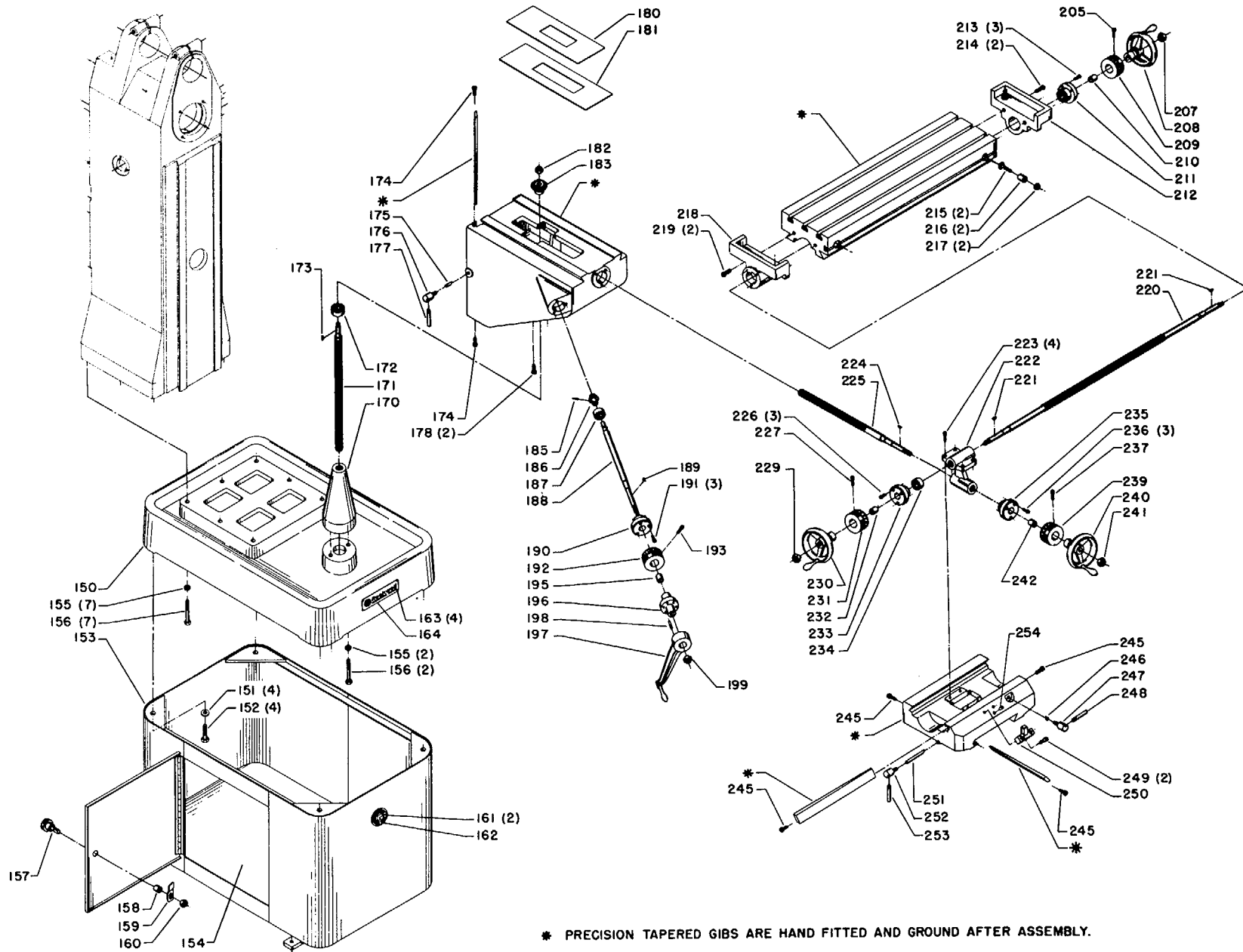


* THE COLUMN AND GEAR BOX COVER ARE PRECISION BORED AT ASSEMBLY. IF REPLACEMENT OR REPAIR OF THESE PARTS IS NECESSARY, PLEASE CONTACT MANUFACTURER.

** ARBOR SUPPORT MUST BE ASSEMBLED ON INDIVIDUAL MACHINE AND BORED TO $\frac{1.001}{.999}$ DIA. BEFORE INSTALLATION OF SLEEVE BEARINGS. THEN PRESS IN TWO SLEEVE BEARINGS AND CHECK TO BE SURE PILOT ON A STYLE ARBOR TURNS FREELY. IF NECESSARY, REAM OUT SLEEVES WITH $\frac{3}{32}$ REAMER.

Replacement Parts

Ref. No.	Part No.	Description	Ref. No.	Part No.	Description
1	450-02-412-0001	Draw Bolt	70	921-02:102-0957	Cup Bearing
2	450-02-354-0001	Pulley and Belt Guard	71	921-02-202-0956	Cone Bearing
3	450-02-112-0003	#10-32 Knurled Thumb Screw	72	450-02-116-0002	Gasket
4	904-15-011-7118	Snap Ring - Ext.	73	908-00-000-5268	Oil Seal
5	450-02-028-0001	Direct Drive Control Dog Clutch	74	450-02-379-0001	Retainer
6	SP-29	3/16" Dia. Steel Ball	75	SP-750	5/16-18 x 1 Soc. Hd. Cap Scr.
7	NCS-263	Spring	76	927-01-100-2610	1/4 x 7/8 Hi-Pro Key
8	901-04-141-9152	1/4-20 x 5/16 Soc. Set Screw	77	901-04-081-3631	#10-32 x 1/8 Headless Set Scr.
9	904-15-012-0285	Snap Ring - Ext.	78	907-01-050-5241	Oil Fitting
10	926-01-042-0616	Spindle Pulley	79	450-02-085-0002	Spindle
11	SP-3309	1/4-20 x 5/8 Soc. Hd. Cap Scr.	80	450-02-088-0001	Stop
12	901-04-150-6202	5/16-18 x 3/8 Soc. Set Scr.	81	SP-755	1/4-20 x 3/4 Soc. Hd. Cap Scr.
13	450-02-001-0002	Adapter for Spindle Pulley	85	SP-2733	5/32 x 7/8 Roll Pin
15	906-01-010-3492	3/8" Oil Drain Plug	86	NJ-247	Hand Knob
16	SP-757	5/16-18 x 3/4 Soc. Hd. Cap Scr.	87	450-02-108-0001	Hand Lever for Back Gear Engage
17	960-04-012-1408	Speed Chart			Shaft
18	SP-2250	#4 x 3/16 Drive Screw	88	450-02-112-0002	1/4-20 Spec. Adj. Screw
19	908-00-000-5268	Oil Seal	89	SP-1034	1/4-20 Hex. Nut
20	904-15-011-7118	Snap Ring - Ext.	90	902-09-010-5928	1/4-20 Acorn Nut
21	450-02-351-0002	Clutch Half and Gear (30 Teeth) Including:	91	450-02-106-0001	Back Gear Engagement Shaft
22	920-24-062-0959	Needle Bearing	92	450-02-001-0001	Adapter
23	927-01-100-2610	1/4 x 7/8 Hi-Pro Key	93	450-02-105-0005	Sleeve
24	904-15-011-7118	Snap Ring - Ext.	94	901-04-150-1155	5/16-18 x 1/2 Soc. Set Screw
25	450-02-051-0004	Bull Gear (75 Teeth)	97	450-02-108-0003	1/2-13 x 2 1/2 Spec. Stud
26	902-07-010-7182	Bearing Lock Nut	98	SP-1266	1/2-13 Hex. Nut
27	904-04-010-7183	Bearing Lockwasher	99	FJ-318	3/8-16 Acorn Nut
28	908-00-000-5269	Oil Seal	100	SP-1026	3/8-16 Hex. Nut
29	450-02-079-0001	Bearing Adj. Nut	101	BS-257	29/64 x 1 1/4 x 7/32 Washer
30	921-02-202-0956	Cone Bearing	102	J-11	3/8-16 x 2 1/4 Stud
31	921-02-102-0957	Cup Bearing	103	SP-617	3/8-16 x 1 1/2 Hex. Hd. Cap Scr.
36	450-02-351-0001	Gear Cluster	104	SP-1606	7/16 x 1 x 5/64 Washer
37	450-02-116-0003	Gasket	105	SP-1026	3/8-16 Hex. Nut
38	901-02-010-7718	#10-32 x 5/16 Oil Breather Scr.	106	450-02-314-0001	Motor Plate
39	SP-6722	3/8 x 1 Roll Pin	107	SP-5433	3/8-16 Hex. Nut
40	414-02-037-5003	Instruction Plate	108	450-02-108-0002	Stud for Belt Tension Spring
41	SP-2252	#2 x 3/16 Drive Screw	109	928-02-251-8892	Belt Tension Spring
42	SP-601	1/4-20 x 3/8 Hex. Hd. Cap Scr.	110	SP-509	1/4-20 x 1/2 Rd. Hd. Mach. Scr.
43	450-02-331-0004	Oil Breather Plate	111	SP-1603	1/4 x 9/16 x 3/64 Washer
44	450-02-089-0001	Overarm	112	SR-217	Motor Plate Clamping Lever
45	901-03-010-0794	1/2-13 x 2 3/4 Soc. Hd. Cap Scr.	113	HJ-9	Serrated Nut
46	907-01-200-5245	Oil Filler Plug	114	BS-257	29/64 x 1 1/4 x 7/32 Washer
48	906-01-010-8868	1/8" Oil Level Plug	115	J-11	3/8-16 x 2 1/4 Stud
49	960-02-012-0050	Nameplate	120	901-03-030-8013	1/4-20 x 3/4 Flat Hd. Soc. Cap Scr.
50	SP-2250	#4 x 3/16 Drive Screw	121	926-06-042-0618	Five Step Countershaft Pulley
51	901-03-010-0794	1/2-13 x 2 3/4 Soc. Hd. Cap Scr.	122	Cat. #49-084	V Belt
52	450-02-389-0001	Arbor Support Bracket	123	SP-608	5/16-18 x 7/8 Hex. Hd. Cap Scr.
53	450-02-105-0001	Bearing Sleeve	124	SP-1614	5/16 Flat Washer
54	907-01-200-5242	Oiler	125	450-02-314-0003	Single Step Countershaft Pulley W/Bracket and Bearing
60	MH-3100	1 1/16 Open End Wrench	126	Cat. #41-844	Five Step Motor Pulley, 3/4 Bore, Including:
61	902-09-010-5928	1/4-20 Acorn Nut			
62	SP-1034	1/4-20 Hex. Nut	127	SP-206	5/16-18 x 5/16 Soc. Set Screw
63	450-02-105-0004	Sleeve	126	Cat. #41-845	Five Step Motor Pulley, 7/8 Bore, Including:
64	450-02-112-0002	1/4-20 Spec. Adj. Screw			
65	450-02-105-0002	Sleeve	127	SP-206	5/16-18 x 5/16 Soc. Set Screw
66	901-04-150-1155	5/16-18 x 1/2 Soc. Set Scr.	128	SP-1703	5/16 Lockwasher
			*	Cat. #24-812	Spindle Oil
			*	Not Shown	



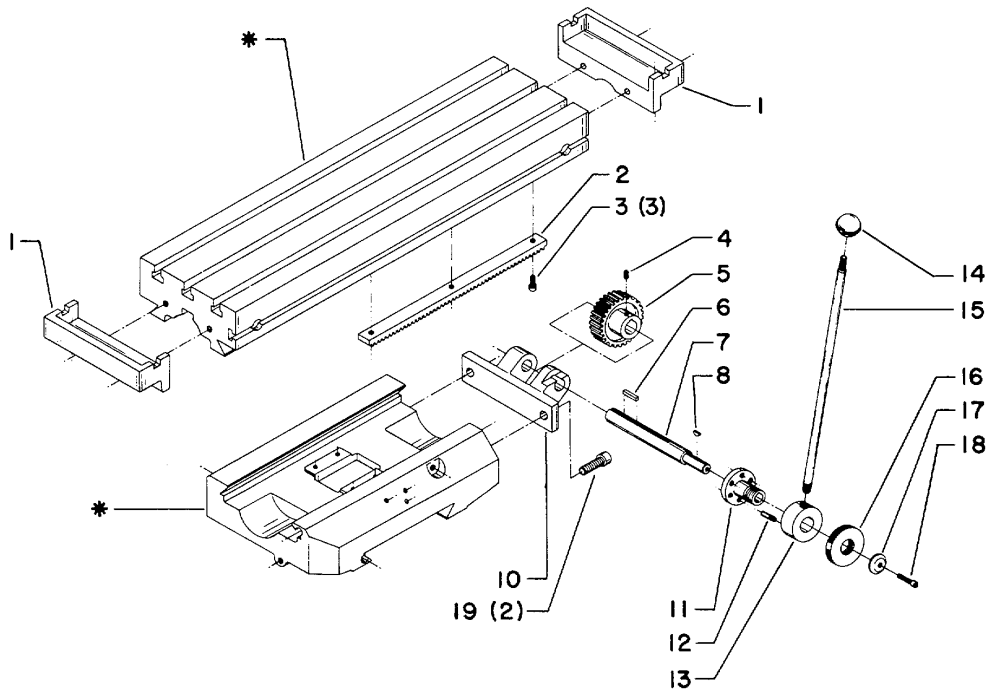
Replacement Parts

Ref. No.	Part No.	Description	Ref. No.	Part No.	Description
150	450-01-305-0005	Base	207	* 902-01-010-9115	1/2-20 Hex. Nut
151	DDL-174	29/64 x 1 x 1/8 Washer	208	* 930-01-991-9029	Longitudinal Feed Handwheel
152	SP-3080	7/16-14 x 1 1/2 Hex Hd Cap Scr.	209	* 450-01-337-0001	Micrometer Collar(200)
153	450-02-318-0001	Cabinet	210	* 450-01-104-5001	Bearing Spacer
154	450-01-415-0001	Shelf	211	* 450-01-379-5001	Bearing Holder W/Bearing
155	SP-1704	3/8 Lockwasher	212	* 450-01-314-0001	End Bracket
156	901-01-061-9849	3/8-16 x 2 1/2 Hex. Hd. Cap Scr.	213	* SP-715	1/4-20 x 1/2 Fil. Hd. Screw
157	931-02-121-6392	Latch Knob	214	901-03-040-8086	3/8-16 x 7/8 Button Hd. Soc. Cap Scr.
158	450-01-104-5002	Latch Sleeve	215	SP-2365	5/16-18 x 1 1/4 Sq. Hd. Bolt
159	450-01-068-5002	Latch	216	450-01-088-5002	Table Stop Barrel
160	SP-1227	1/2 -20 Hex Jam Nut	217	902-01-040-1030	5/16-18 Hex. Nut
161	SP-2252	#2 x 3/16 Drive Screw	218	* 450-01-314-0001	End Bracket
162	960-02-012-0028	Nameplate	219	901-03-040-8086	3/8-16 x 7/8 Button Hd. Soc. Cap Scr.
163	SP-2250	#4 x 3/16 Drive Screw	220	* 450-01-112-5003	Table Screw
164	960-02-012-1401	Nameplate	221	* SP-2607	#404 Woodruff Key
170	450-01-305-0006	Elevating Screw Housing	222	450-01-012-5002	Feed Nut Body
171	450-01-112-5002	Elevating Screw	223	SP-755	1/4-20 x 3/4 Soc. Hd. Cap Scr.
172	920-05-011-6621	Bearing	224	SP-2607	#404 Woodruff Key
173	SP-2607	#404 Woodruff Key	225	450-01-112-5001	Cross Feed Screw
174	901-03-042-0801	5/16-18 x 7/8 Button Hd. Soc. Cap Scr.	226	* SP-715	1/4-20 x 1/2 Fil. Hd. Screw
175	450-01-074-0002	Thread Seat	227	* SP-755	1/4-20 x 3/4 Soc. Hd. Cap Screw
176	450-01-068-5001	Knee Clamp	229	* 902-01-010-9115	1/2-20 Hex. Nut
177	450-01-108-5002	Handle for Knee Clamp	230	* 930-01-991-9029	Longitudinal Feed Handwheel
178	901-03-040-8086	3/8-16 x 7/8 Button Hd. Soc., Cap Scr.	231	* 450-01-337-0001	Micrometer Collar (200)
180	450-01-084-5001	Shield	232	* 450-01-104-5001	Bearing Spacer
181	450-01-084-5002	Shield	233	* 450-01-079-5002	Bearing Holder
182	902-01-010-9114	7/16-20 Hex Nut	234	* 920-04-010-7273	Bearing
183	450-01-051-5003	Bevel Gear	235	450-01-379-5001	Bearing Holder W/Bearing
185	SP-2704	1/8 x 3/4 Roll Pin	236	SP-715	1/4-20 x 1/2 Fil. Hd.Screw
186	450-01-051-5004	Bevel Gear	237	SP-755	1/4-20 x 3/4 Soc. Hd. Cap Screw
187	920-04-010-7273	Bearing	239	450-01-337-0001	Micrometer Collar (200)
188	450-01-106-5004	Shaft for Table Raising Crank	240	930-01-991-9029	Cross Feed Handwheel
189	SP-2607	#404 Woodruff Key	241	902-01-010-9115	1/2-20 Hex. Nut
190	450-01-379-5001	Bearing Holder W/Bearing	242	450-01-104-5001	Bearing Spacer
191	SP-715	1/4-20 x 1/2 Fil. Hd. Screw	245	901-03-042-0801	5/16-18 x 7/8 Button Hd. Soc. Cap Scr.
192	450-01-337-0002	Micrometer Collar (100)	246	450-01-074-0001	Thread Seat
193	SP-755	1/4-20 x 3/4 Soc. Hd. Cap Screw	247	450-01-068-5001	Table Clamp
195	450-01-104-5001	Bearing Spacer	248	450-01-108-5002	Handle for Table Clamp
196	450-01-105-5001	Gear Shaft Clutch Sleeve	249	SP-762	5/16-18 x 5/8 Soc. Hd Cap Scr.
197	450-01-333-5001	Table Raising Crank, Including:	250	450-01-388-0002	Table Stop
198	HBS-731	1/4 x 13/16 Knurled Pin	251	450-01-074-0003	Thread Seat
199	902-01-010-9115	1/2-20 Hex. Nut	252	450-01-068-5001	Saddle Clamp
205	SP-755	1/4-20 x 3/4 Soc. Hd. Cap Screw	253	450-01-108-5002	Handle for Saddle Clamp
254	907-01-010-5234	5/16" Oiler			

*These parts are used with the Hand Screw Feed Table Model only.

Parts not marked with an asterick are used on both Hand Lever and Hand Screw Machines.

HAND LEVER FEED TABLE MODEL



* PRECISION TAPERED GIBS ARE HAND FITTED AND GROUND AFTER ASSEMBLY. IF REPLACEMENT OR REPAIR OF THESE PARTS IS NECESSARY, PLEASE CONTACT MANUFACTURER.

Replacement Parts

Ref No.	Part No.	Description
1	450-02-014-0005	End Bracket
2	450-02-051-0009	Rack
3	SP-229	1/4-20 x 1/2 Soc. Hd. Cap Screw
*	450-02-314-0002	Bracket Assembly, consisting of:
4	SP-1185	1/4-20 x 5/16 Soc. Set Screw
5	450-02-051-0008	Gear
6	SP-2655	3/16 x 3/16 x 7/8 Key
7	450-02-106-0005	Shaft
8	SP-2607	1/8 x 1/2 Woodruff Key
10	450-02-014-0004	Bracket
11	450-02-107-0001	Hub
12	HBS-731	Knurled Pin
13	450-02-107-0002	Hub
14	NJ-247	Handle Ball
15	450-02-106-0004	Rod
16	450-02-033-0003	Retainer
17	450-02-033-0002	Retainer
18	SP-3345	1/4-20 x 1 Soc. Hd. Cap Screw
19	SP-753	1/2 - 13 x 1 1/4 Soc. Hd. Cap Screw
*	Not Shown Assembled	

**ELECTRICAL WIRING DIAGRAMS
FOR
HORIZONTAL MILLING MACHINES**

The wiring diagram shown on page 22 applies to all Horizontal Mills wired for Cat. No. 49-695 Reversing Manual Drum Switch Control for 230 Volt Single Phase Motors.

The wiring diagram shown on page 23 applies to all Horizontal Mills wired for Cat. No. 49-696 Reversing Manual Drum Switch Control with Overload Switch for 230 Volt Single Phase Motors.

The wiring diagram shown on page 24 applies to all Horizontal Mills wired for Cat. No. 49-697 Reversing Drum Switch and Magnetic Starter with Full Voltage Control for 230 Volt Single Phase Motors.

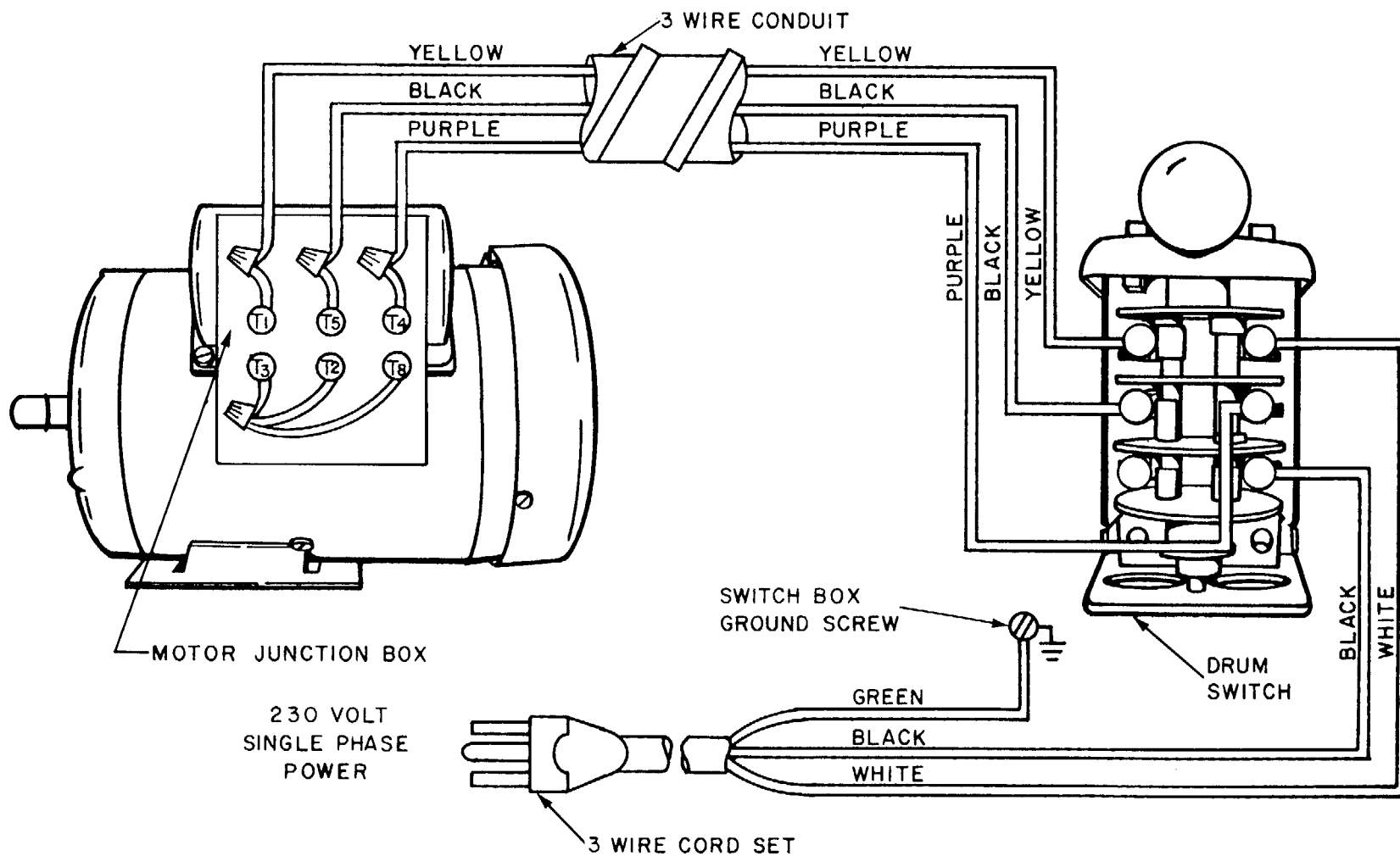
The wiring diagram shown on page 25 applies to all Horizontal Mills wired for Cat. No. 49-772 Reversing Manual Drum Switch Control with Overload Switch for Three Phase Motors.

The wiring diagram shown on page 26 applies to all Horizontal Mills wired for Cat. No. 49-773 Reversing Drum Switch and Magnetic Starter with Full Voltage Control for Three Phase Motors.

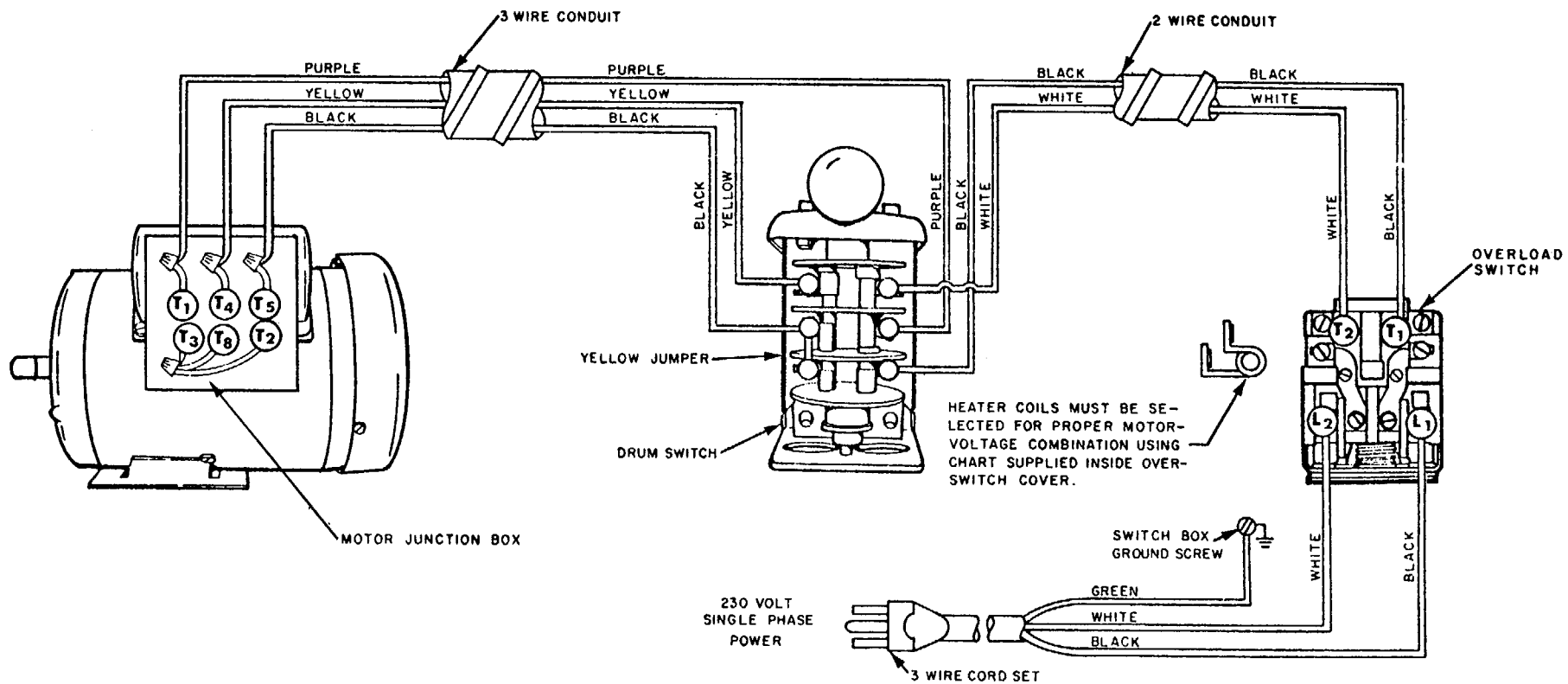
The wiring diagram shown on page 27 applies to all Horizontal Mills wired for Cat. No. 49-774 Reversing Drum Switch and Magnetic Starter with Low Voltage Control for Three Phase Motors.

REVERSING MANUAL DRUM SWITCH CONTROL

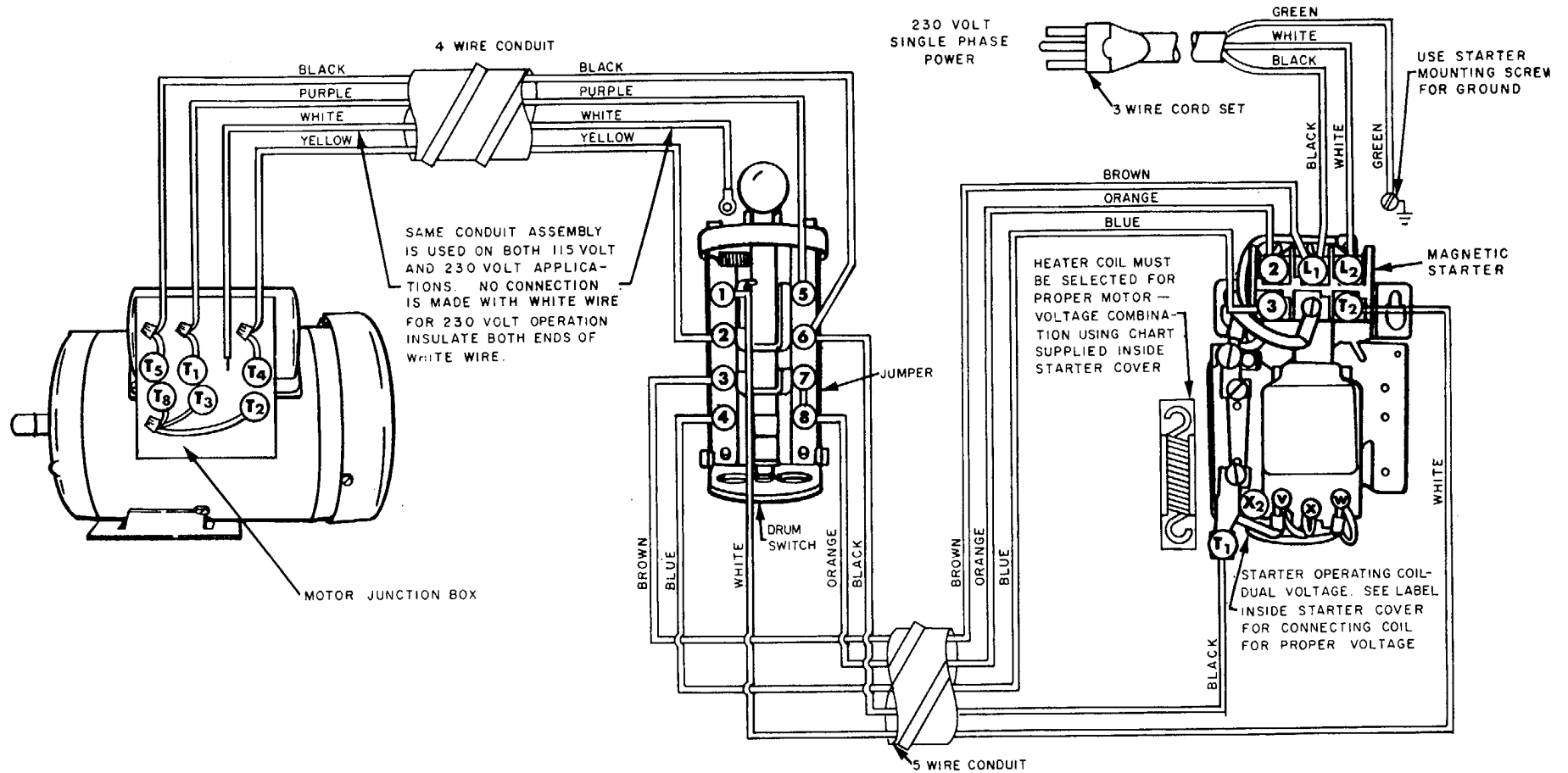
FOR 230 VOLT SINGLE PHASE MOTORS



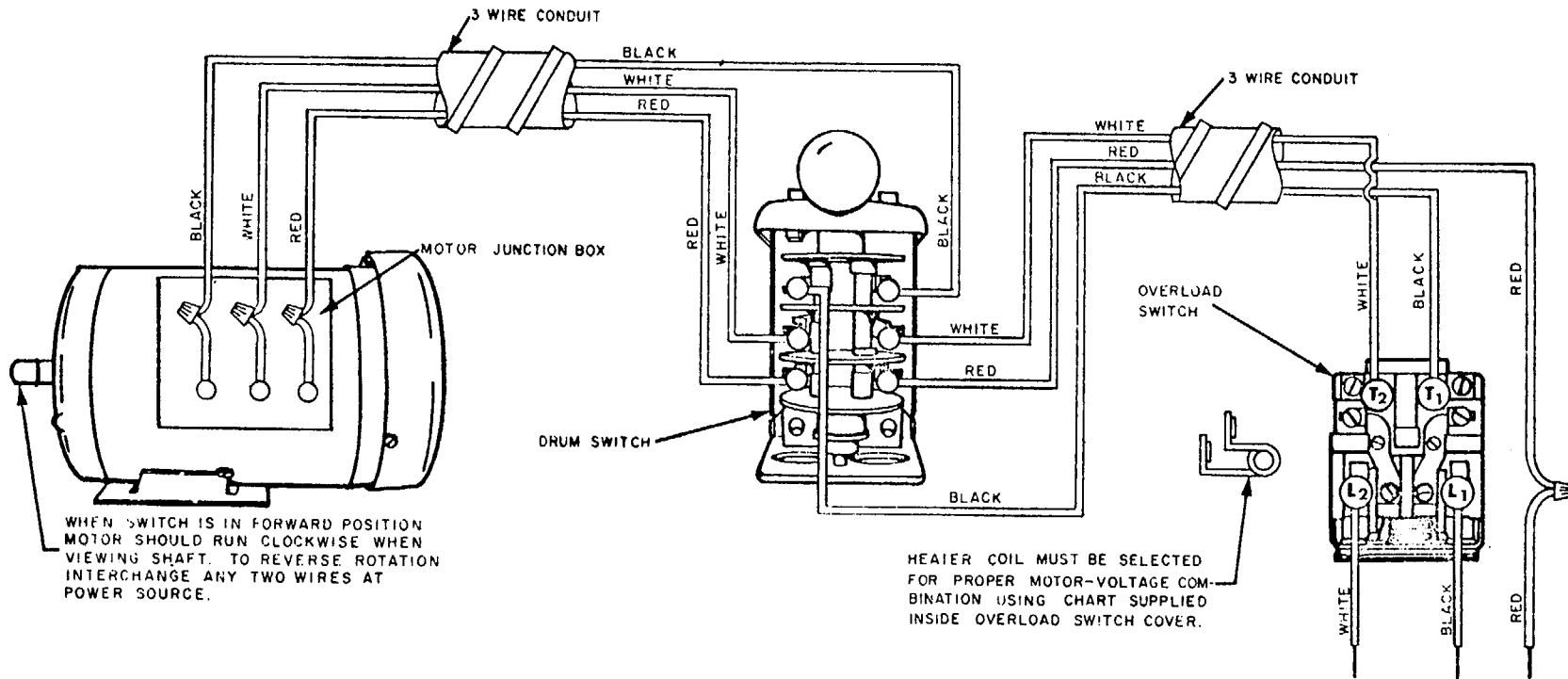
**REVERSING MANUAL DRUM SWITCH CONTROL
WITH OVERLOAD SWITCH
FOR 230 VOLT SINGLE PHASE MOTORS**



**REVERSING DRUM SWITCH AND MAGNETIC STARTER
WITH FULL VOLTAGE CONTROL
FOR 230 VOLT SINGLE PHASE MOTORS**



**REVERSING MANUAL DRUM SWITCH CONTROL
WITH OVERLOAD
FOR THREE PHASE MOTORS**



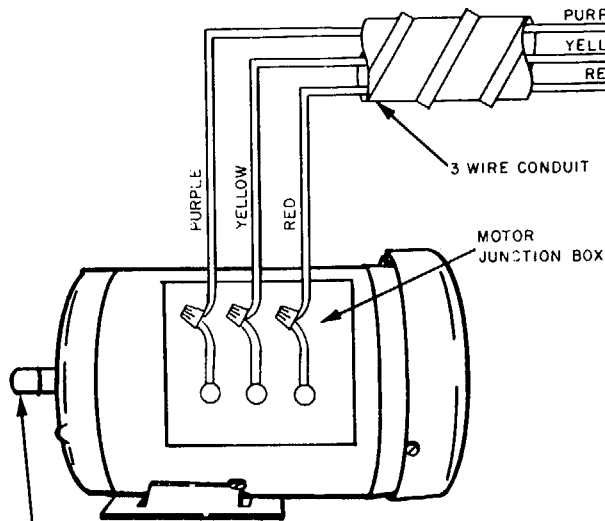
WHEN SWITCH IS IN FORWARD POSITION MOTOR SHOULD RUN CLOCKWISE WHEN VIEWING SHAFT. TO REVERSE ROTATION INTERCHANGE ANY TWO WIRES AT POWER SOURCE.

HEATER COIL MUST BE SELECTED FOR PROPER MOTOR-VOLTAGE COMBINATION USING CHART SUPPLIED INSIDE OVERLOAD SWITCH COVER.

IMPORTANT: THIS DIAGRAM SHOWS THREE MOTOR LEADS. SOME MOTORS HAVE MORE THAN THREE LEADS. MAKE SURE MOTOR LEADS ARE CONNECTED FOR CORRECT VOLTAGE ACCORDING TO MOTOR NAMEPLATE.

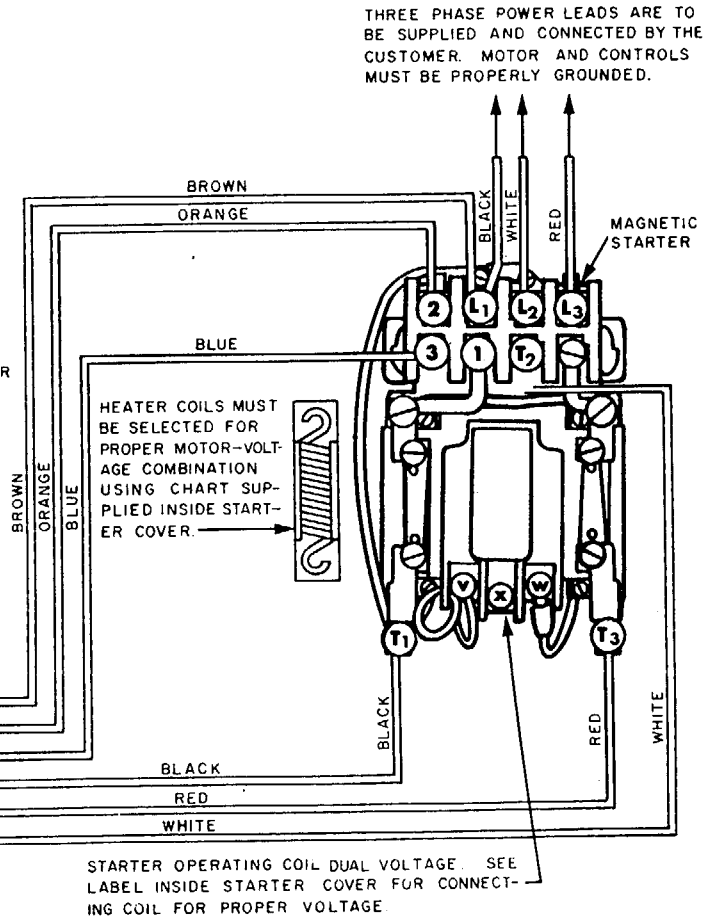
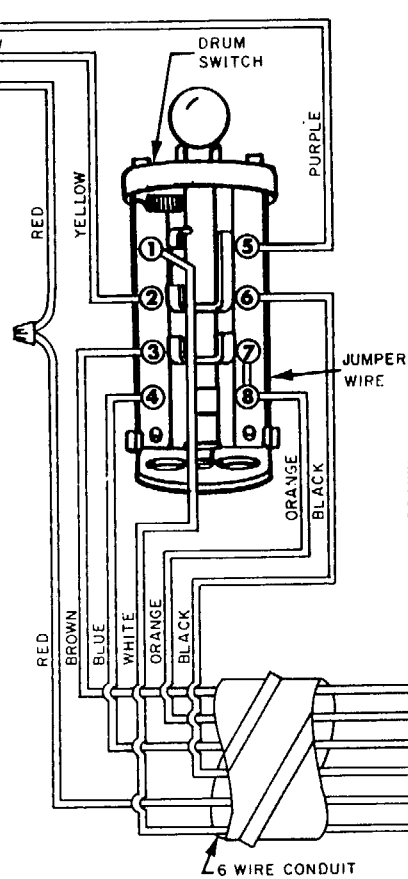
THREE PHASE POWER LEADS ARE TO BE SUPPLIED AND CONNECTED BY THE CUSTOMER. MOTOR AND CONTROLS MUST BE PROPERLY GROUNDING.

**REVERSING DRUM SWITCH AND MAGNETIC STARTER
WITH FULL VOLTAGE
FOR THREE PHASE MOTORS**



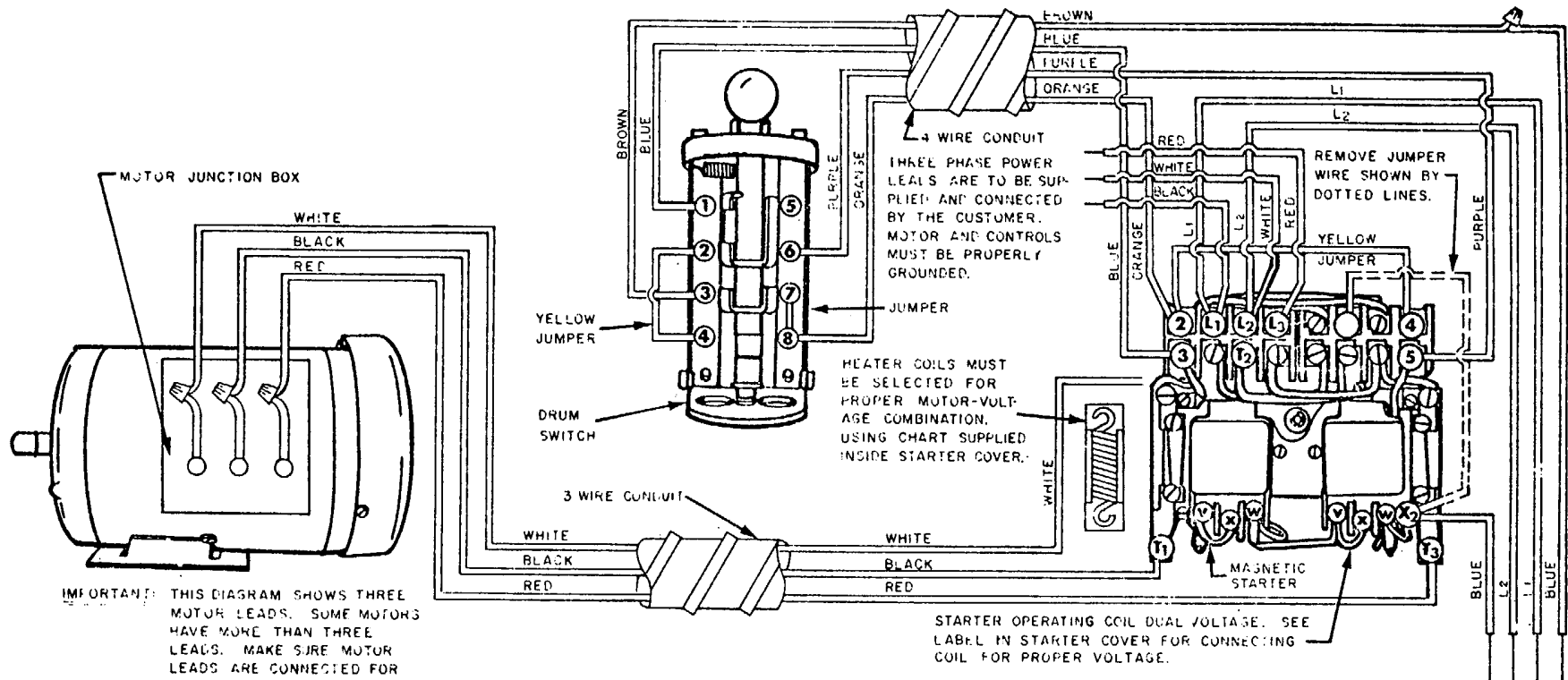
WHEN SWITCH IS IN FORWARD POSITION MOTOR SHOULD RUN CLOCKWISE WHEN VIEWING SHAFT. TO REVERSE ROTATION INTERCHANGE ANY TWO WIRES AT POWER SOURCE.

IMPORTANT: THIS DIAGRAM SHOWS THREE MOTOR LEADS. SOME MOTORS HAVE MORE THAN THREE LEADS. MAKE SURE MOTOR LEADS ARE CONNECTED FOR CORRECT VOLTAGE ACCORDING TO MOTOR NAMEPLATE.



THREE PHASE POWER LEADS ARE TO BE SUPPLIED AND CONNECTED BY THE CUSTOMER. MOTOR AND CONTROLS MUST BE PROPERLY GROUNDED.

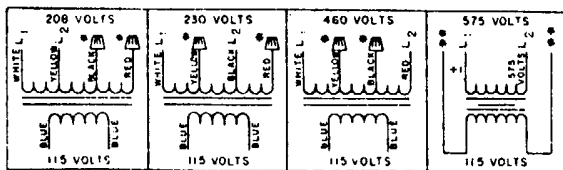
**REVERSING DRUM SWITCH AND MAGNETIC STARTER
WITH LOW VOLTAGE CONTROL
FOR THREE PHASE MOTORS**



IMPORTANT: THIS DIAGRAM SHOWS THREE MOTOR LEADS. SOME MOTORS HAVE MORE THAN THREE LEADS. MAKE SURE MOTOR LEADS ARE CONNECTED FOR CORRECT VOLTAGE ACCORDING TO MOTOR NAMEPLATE

STARTER OPERATING COIL DUAL VOLTAGE. SEE LABEL IN STARTER COVER FOR CONNECTING COIL FOR PROPER VOLTAGE.

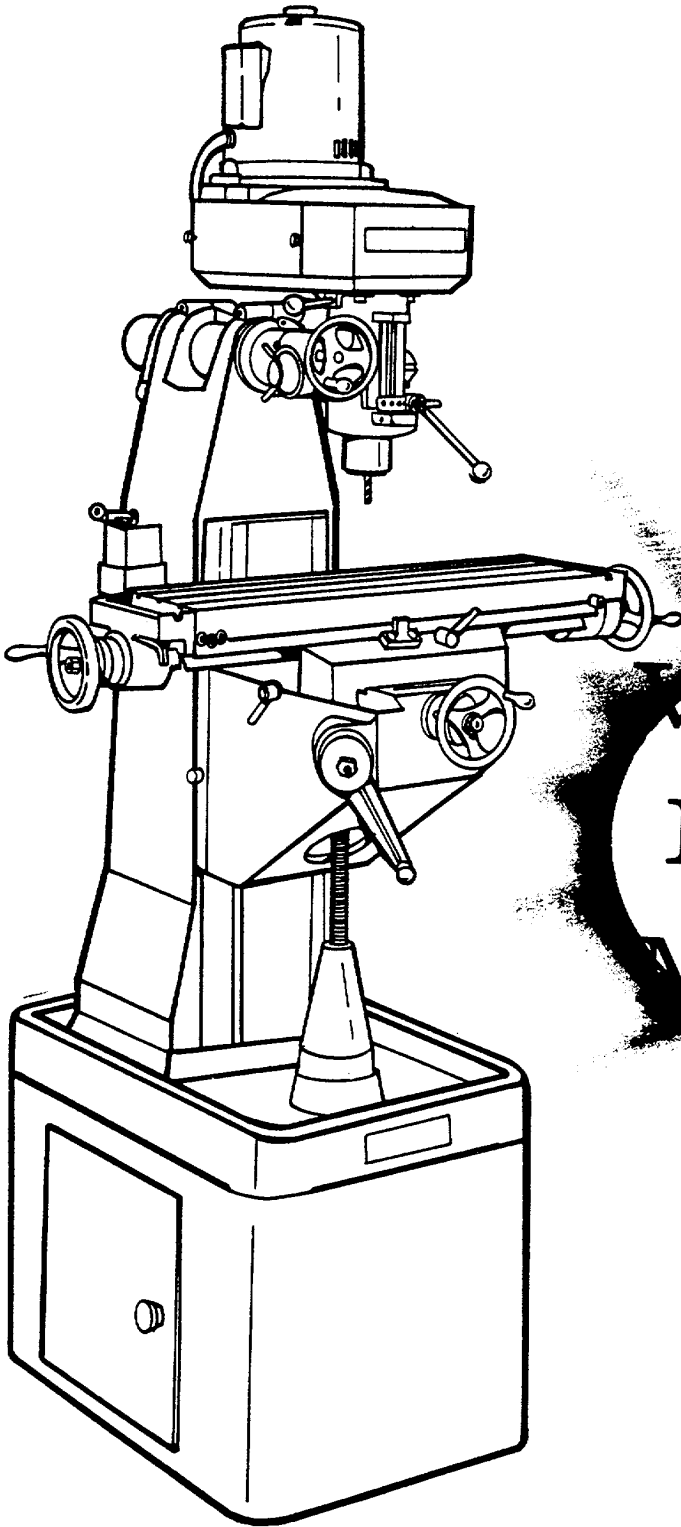
LEADS GO TO TRANSFORMER. SEE CONNECTION DIAGRAMS AT LEFT FOR DETAILS.



- INSULATE AND SECURE THESE LEADS
- THESE LEADS ARE TO REPLACE THE BLUE TRANSFORMER LEADS SHOWN, AND ARE TO BE CONNECTED AT THE SAME TWO LOCATIONS



TYPICAL TRANSFORMER FOR CONNECTIONS SEE PANELS AT LEFT



VERTICAL
MILLING
MACHINE

VERTICAL MILLING MACHINE

CATALOG LISTING

No. 21-100 Milling Machine on cabinet, with V belt and motor pulley (3/4" bore), less electricals. Hand Screw Feed Table Model. 750 lbs.

VARIABLE RATE TABLE FEED

No. 21-820 Variable Rate Power Table Feed for 115 V, single phase,

60 hertz, with 8-foot grounding type cord and plug. Available factory mounted and wired on Vertical Mills. Instructions for field mounting are included. Fits in place of right table hand wheel, but left table hand wheel can still be used. No. 21-838 Table Travel Limit Switch Kit is recommended. 28 lbs.

MOTORS AND CONTROLS FACTORY MOUNTED AND WIRED

(Vertical Milling Head Uses Special C Flange Motor

Order From Chart Below.)

MOTOR	MOTOR CONTROL	HERTZ AND MOTOR RPM	MOTOR VOLTAGE	SHIP. WT. LBS.	CATALOG NUMBER	CAT. NO. 200 V
Single Phase, 1/2 Horsepower	Full Voltage Drum Reversing Switch	60-1140	115/230	40	49-473	
	LVC CONTROL—24 V Push Button Reversing Station, Magnetic Starter, Transformer and Overload Protection	60-1140	115/230	46	49-475	
Single Phase, 3/4 Horsepower	Full Voltage Drum Reversing Switch	60-1725	115/230	36	49-476	
	LVC CONTROL—24 V Push Button Reversing Station, Magnetic Starter, Transformer and Overload Protection	60-1725	115/230	42	49-477	
Three Phase, 1/2 Horsepower	LVC CONTROL—24 V Push Button Reversing Station, Magnetic Starter, Transformer and 3-Leg Overload Protection	60-1140	230/460	60	†49-679	†52-184
Three Phase, 3/4 Horsepower	LVC CONTROL—24 V Push Button Reversing Station, Magnetic Starter, Transformer and 3-Leg Overload Protection	60-1725	230/460	60	†49-680	†52-187

NOTE: Single phase electricals will be supplied wired for 115 V, unless 230 V is specified. Three phase electricals will be supplied wired for 230 V, unless 460 V is specified. Power cord and plug supplied for single phase only. †Where electrical controls must comply with

ANSI B-11 Series Machine Tool Standards, NFPA 79 Standard or JIC Standards, the No. 49-001 Electrical Kit must be ordered in addition to the Catalog Number of the designated Electrical Package.

MACHINE DATA

TABLE

Working Surface 6 1/2" x 24" (165.1 mm)
 No. of T-Slots 3 (76.2 mm)
 Size of T-Slots 7/16" (11.11 mm)
 Spacing of T-Slots (Center to Center) 2" (50.8 mm)
 Height from Floor (Lowest Position) 35" (889 mm)

RANGE

Table Longitudinal Travel 16" (406.4 mm)
 Table Cross Travel 6 3/4" (171.45 mm)
 Table Vertical Travel 16 1/2" (419.1 mm)
 Spindle Nose to Table 0 to 16 1/2" (0 to 419.1 mm)
 Spindle Q to Column V ways 2 5/8" to 11 1/4" (66.67 to 285.75 mm)

SPINDLE

Spindle Taper R8
 Hole Through Spindle 7/16" (11.11 mm)
 Number of Bearings 5
 Number of Splines 6

SPEEDS

With 1725 RPM Motor 370, 700, 1170, 2440, 4420 and 6300 rpm
 With 1140 RPM Motor 245, 470, 780, 1620, 2940 and 4200 rpm

QUILL

Diameter 3" (76.2 mm)
 Stroke 2 1/2" (63.5 mm)
 Feed Choice of Rapid or Fine Feed

SADDLE WIDTH 12" (304.8 mm)

DOVE-TAILS

Size 3/4" (19.05 mm)
 Kind of Gib Tapered

MOTORS

NEMA C Face Frame (Special) 56
 Horsepower Recommended 1/2 or 3/4
 Speeds Recommended (RPM) 1725 or 1140
 Special Shaft Length (from Face of Flange) 4 1/2" (103.98 mm)

OVERALL DIMENSIONS

Height (including 1/2 HP Motor) 73 1/2" (1866.9 mm)
 Width 37 3/4" (958.85 mm); Front to Rear 33 3/4" (857.25 mm)

CABINET BASE DIMENSIONS

Width 17 1/2" (444.5 mm)
 Front to Rear 26 1/2" (673.1 mm)

SHIPPING WEIGHT WITH ELECTRICALS

(Approx.) 780 lbs. (353.8 kg)

STANDARD EQUIPMENT

Basic Milling Machine includes storage type cabinet base with door, combination spindle brake and lock, draw bolt for collets, side cover guards, V belt and motor pulley with 3/4" or 1/2" bore.

INSTALLATION

UNPACKING

The Vertical Milling Machine is shipped completely assembled and mounted to a heavy wooden skid. Allow the skid to remain in place until the mill is moved to its permanent shop location. For convenience in packaging, the head is tilted 45 degrees. Loosen the two HEAD CLAMPING SCREWS and turn the HEAD TILTING SCREW until the head is vertical. Use a dial indicator for perfect 90 degree positioning of the spindle, as shown in Fig. 2.

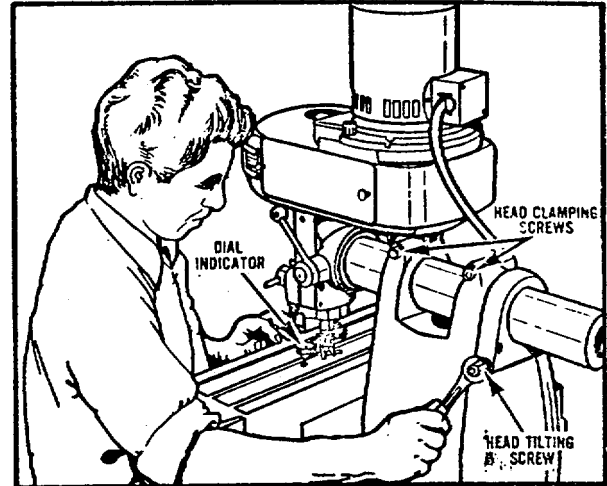


Fig. 2.

CLEANING THE MILL

The ways and all other machined and unpainted surfaces of the mill are protected with a coating of rust preventive. This coating may be removed with a soft cloth moistened with kerosene (do not use acetone, gasoline or lacquer thinner for this purpose.) After cleaning, lubricate all exposed ways and unpainted surfaces with a light film of good machine oil. Then move each unit to the opposite limit stop and similarly clean and lubricate the exposed ways. Loosen the two head clamping screws to unlock the ram, and move it forward and backward its full length in order to clean and lubricate.

SELECTING FLOOR SPACE

Vibration transmitted through inadequately constructed floors by adjacent machinery or other sources can impair the accuracy of your mill. Therefore it is of utmost importance that the mill be mounted to a solid, level foundation, preferably concrete.

Unless substantially constructed, a wood floor should be braced against sagging and transmission of vibration.

LEVELING THE MILL

Proper leveling is an important factor to consider when setting up the machine. A long spirit level should be mounted on the table, both longitudinally and transversely. The floor should be as smooth as possible, and tapered wedges should be inserted in any openings so that the base receives as much foundation as possible. Lag screw holes are provided for securing the machine to the floor after leveling. See Fig. 3.

When setting machine on a floor that has any surface irregularities, shims should be used to correct this condition to the greatest extent possible. See Fig. 3.

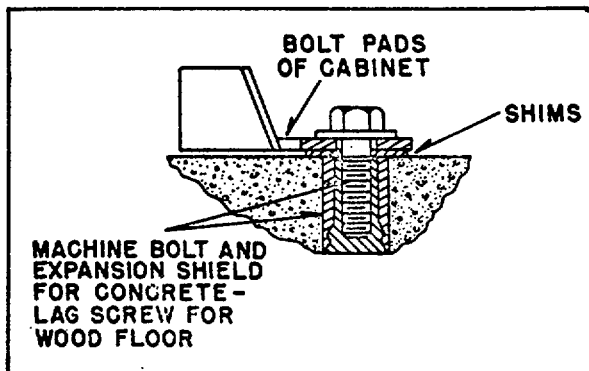
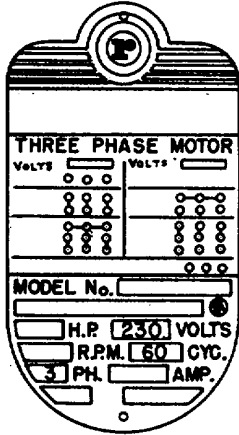


Fig. 3.

ELECTRICAL RECOMMENDATIONS

Constant speed 1/2 hp, 1140 or 1725 rpm or a 3/4 hp, 1725 rpm motor is recommended. The motor pulley supplied with the mill is designed to fit a motor shaft 5/8" in diameter. The mounting dimensions of the mill accommodate a NEMA C Face Frame # 56 Motor, having a special shaft length of 4 3/32" from the face of the flange to the end of the shaft. Wiring diagrams are included with the Switch kits made available for use with this milling machine.



Nameplate on motor.

Make sure electrical characteristics are the same.



To connect to power source use heavy enough wire.

**3 PHASE
230 VOLT
60 CYCLE
POWER
SOURCE**

Your power source.

H.P.	1 Phase	3 Phase
1/2		
3/4	#14	#14

NOMENCLATURE CHART

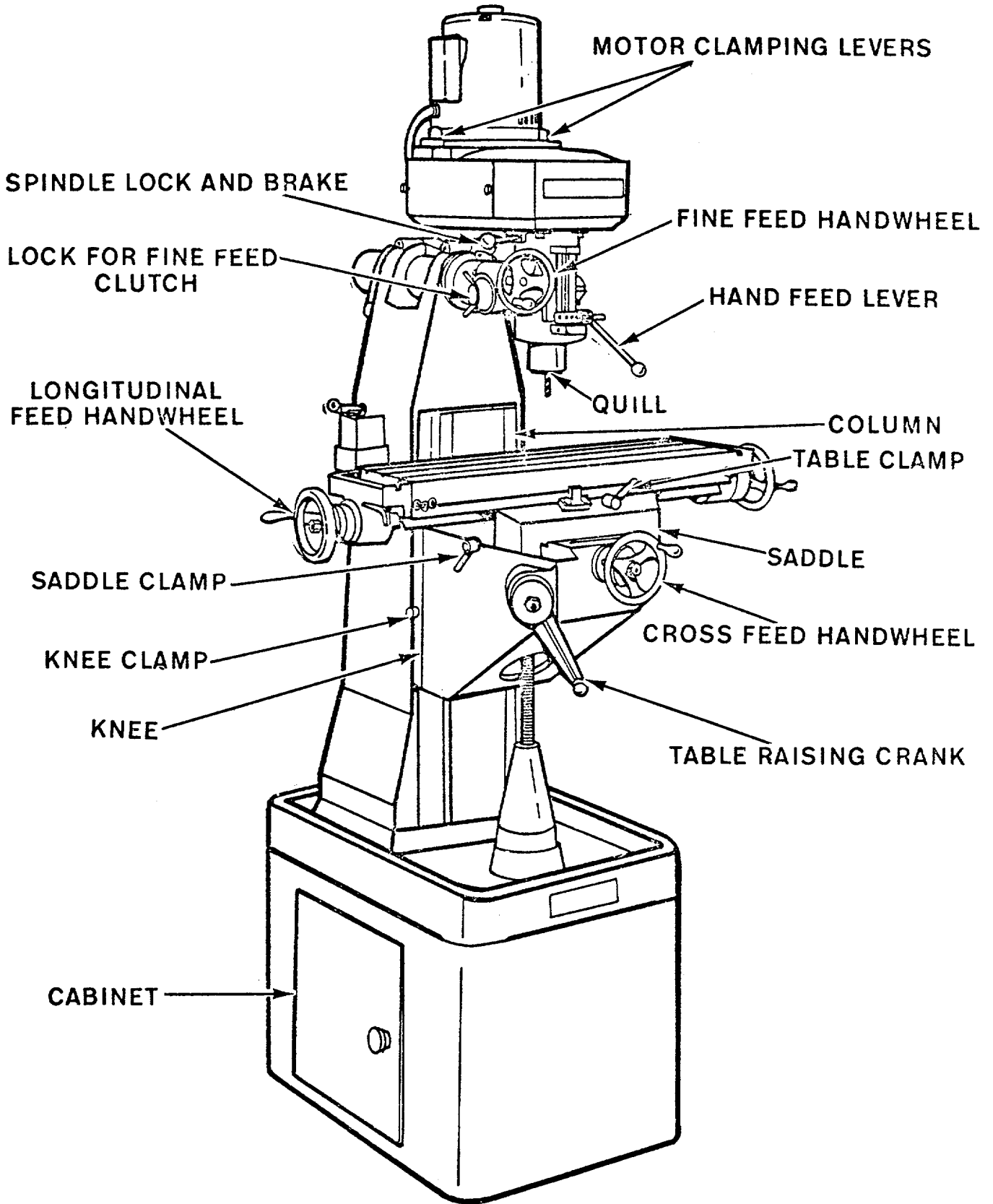


Fig. 4.

OPERATION AND CONTROLS

The following is an explanation of the operating controls of the Vertical Milling Machine. An experienced operator knows that there is always some difference between the location and type of control between different models, even though the purpose of the controls is similar between one mill and another. The novice should study these explanations carefully before turning on the power, to avoid damage to the mill or injury to himself.

All operators will profit by a knowledge of how the controls operate and how they are to be set for standard milling operations.

HEAD POSITIONING CONTROLS

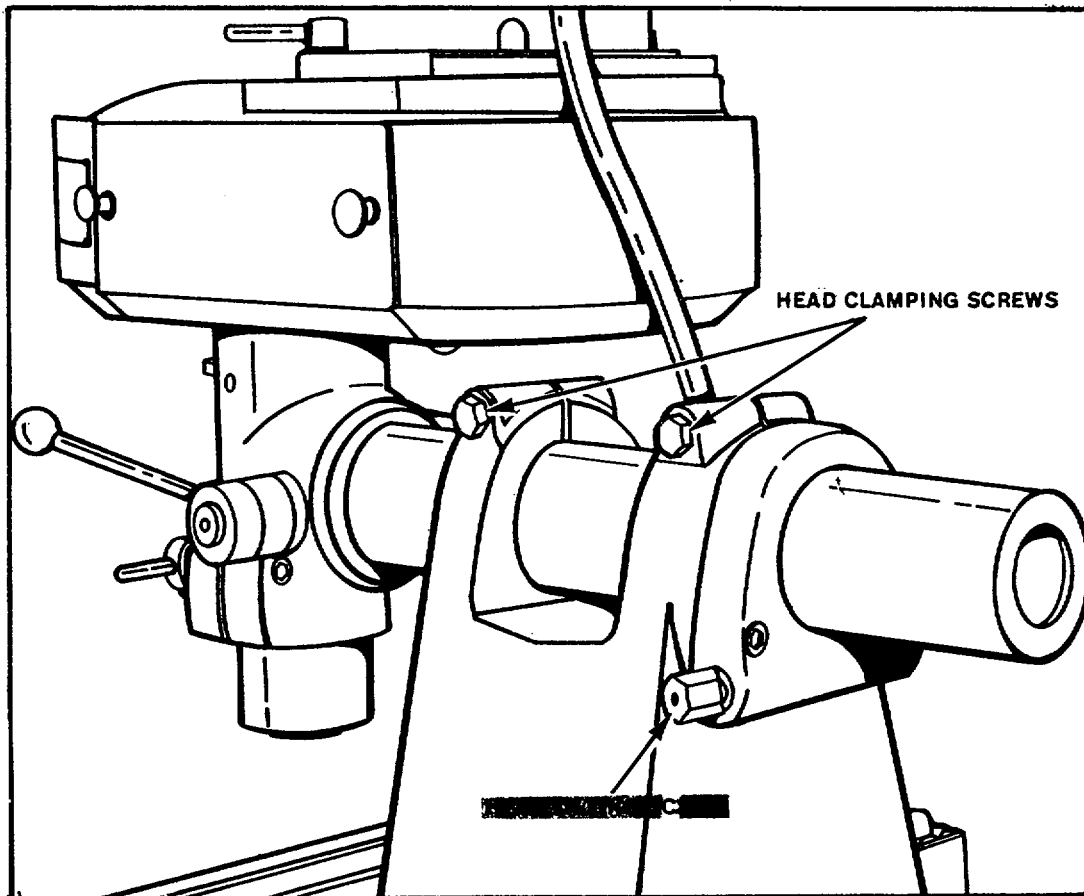


Fig. 5.

Horizontal movement of the head can be accomplished by loosening the two HEAD CLAMPING SCREWS and moving the head in or out as desired. Tilting the head to any angle can be easily achieved without danger of the head falling by loosening the two HEAD CLAMPING SCREWS and turning the HEAD TILTING SCREW clockwise or counterclockwise until the desired angle is obtained.

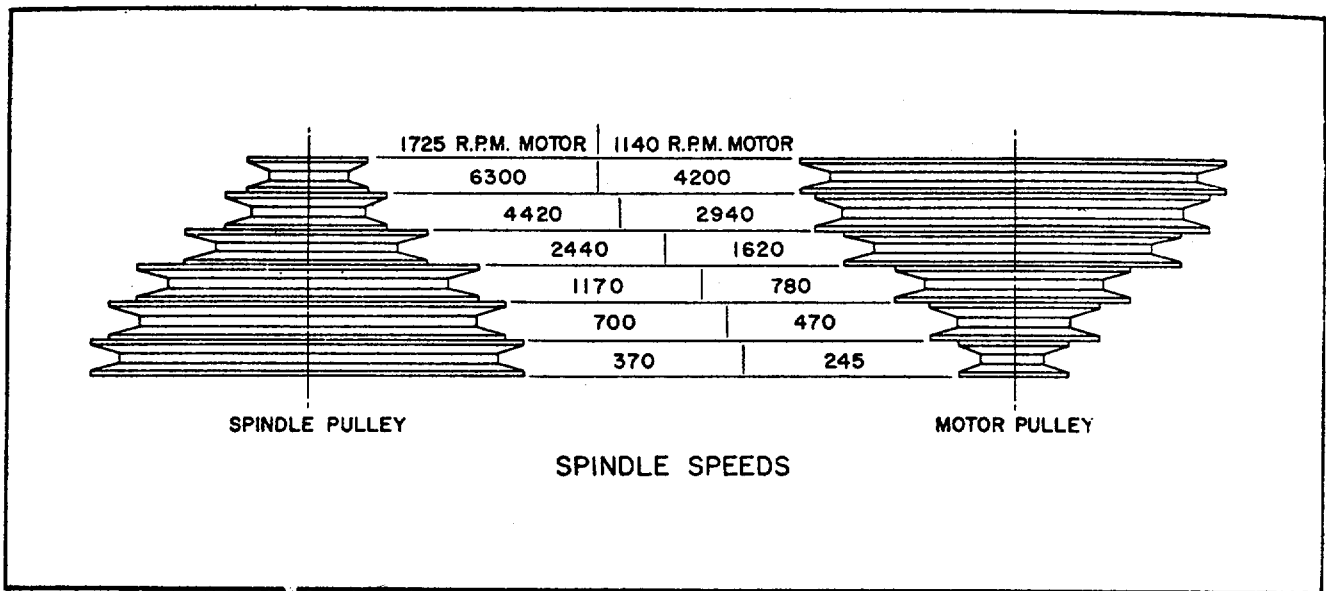


Fig. 6.

When a 1725 rpm motor is used spindle speeds of 370, 700, 1170, 2440, 4420, and 6300 rpm can be obtained.

With an 1140 rpm motor, spindle speeds of 245, 470, 780, 1620, 2940, and 4200 rpm can be obtained.

To change spindle speeds, loosen the two MOTOR CLAMPING LEVERS and swivel the motor forward to release tension. Move the V BELT to the desired step on the MOTOR PULLEY and SPINDLE PULLEY and swivel the motor to the rear until sufficient tension is obtained and tighten the two MOTOR CLAMPING LEVERS.

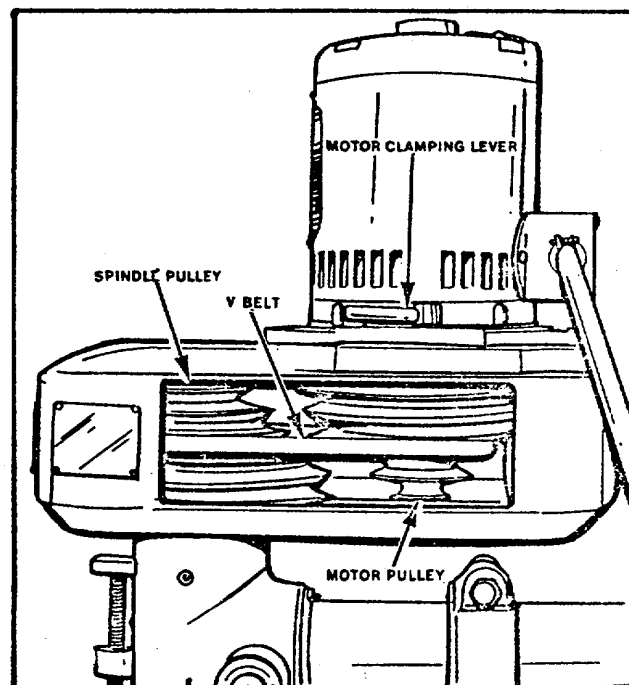


Fig. 7.

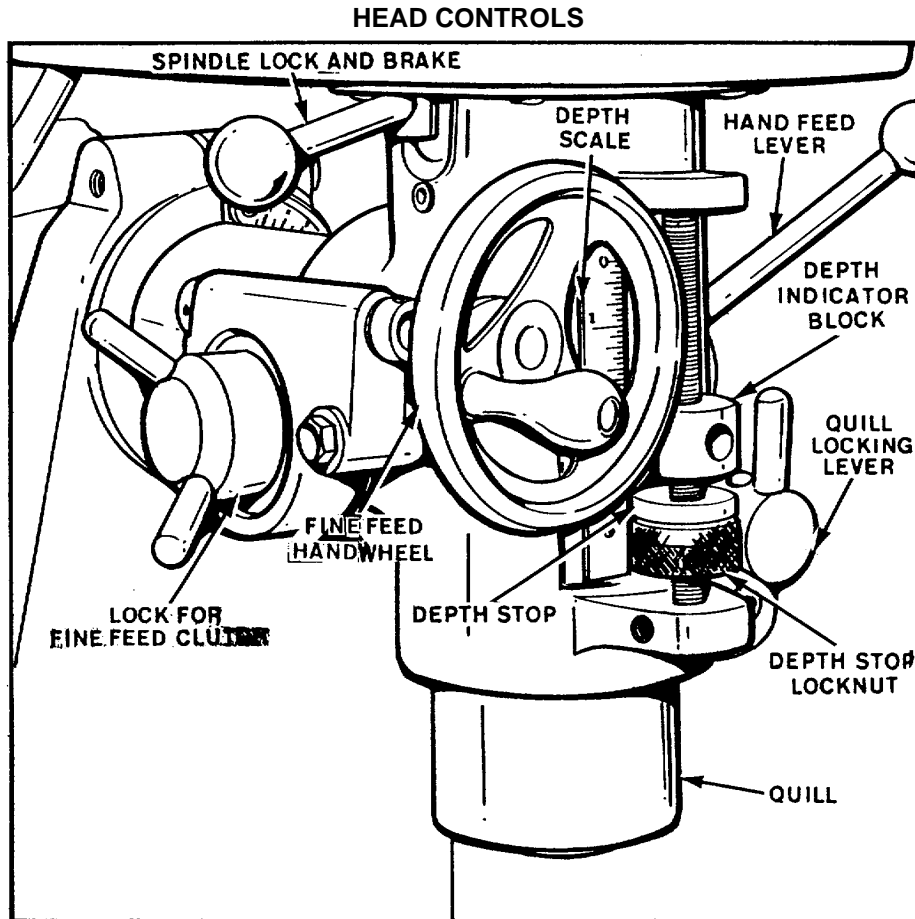


Fig. 8.

With the Vertical Mill you have a choice of rapid or fine feed depending on the type of job you are doing.

For rapid feeding, the LOCK FOR FINE FEED CLUTCH is loosened (turned counterclockwise) and the HAND FEED LEVER is used.

For fine feeding, first tighten the LOCK FOR FINE FEED CLUTCH by turning it clockwise. Then the QUILL can be moved up or down by turning the FINE FEED HANDWHEEL. Many operators will bring the milling cutter down to the work with the HAND FEED LEVER, and continue from there with the FINE FEED HANDWHEEL.

To set the DEPTH STOP for any quill travel from zero to the maximum (2 ½ ") proceed as follows:

1. Feed the QUILL down until the top of the DEPTH INDICATOR BLOCK is in line with the desired calibration on the DEPTH SCALE.
2. Thread the DEPTH STOP up until it firmly contacts the bottom of the DEPTH INDICATOR BLOCK.

3. Feed the QUILL back up to bring the DEPTH INDICATOR BLOCK out of contact with the DEPTH STOP.
4. Lock the DEPTH STOP in place by tightening the DEPTH STOP LOCK NUT very firmly against it.
5. Feed the QUILL down against the stop to prove out the setting, and make minor correction of the setting if necessary.

NOTE

Failure to execute step 3 before step 4 , will trick you into not having the DEPTH STOP and DEPTH STOP LOCKNUT locked against each other, because of the normal play in the threads.

In order to lock the QUILL in a stationary position, turn the QUILL LOCKING LEVER to the right. This will lock the QUILL and allow the operator to make his cut by moving the table.

The SPINDLE LOCK AND BRAKE is used for locking the spindle when changing collets and also for quick stopping of the spindle after the switch is turned off.

TABLE CONTROLS

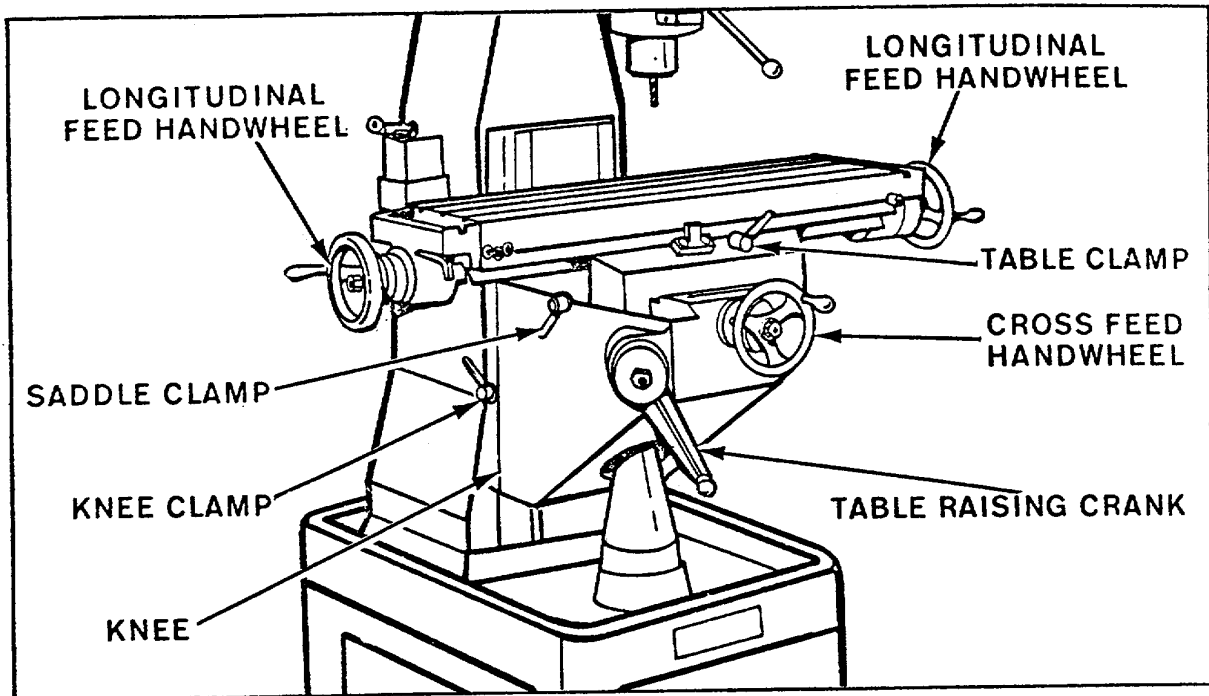


Fig. 9.

To locate the work in a definite relation to the cutter, it is necessary to move the table either longitudinally, transversely, or vertically. Each of these movements is controlled by a handle or handwheel which can be reached easily from the front of the machine.

Lengthwise or longitudinal movement of the table is accomplished by turning either one of the LONG FEED HANDWHEELS. These handwheels are connected to the table feed screw which is mounted in the table and extends from end to end. When the handle is turned, the screw rotates in a compound feed nut in the saddle and moves the table lengthwise.

Crosswise or transverse movement of the table is accomplished by turning the CROSS FEED HANDWHEEL which is mounted on the end of the cross feed screw. Clockwise rotation of the CROSS FEED HAND moves the table toward the column, while counterclockwise rotation moves the table away from the column.

Vertical movement of the table is obtained by rotating the TABLE RAISING CRANK clockwise to raise and counterclockwise to lower the table. One complete rotation of the crank moves the table up or down 1/10". To avoid the possibility of the table changing its height setting during a cut, always approach the final height setting by raising the table with its full weight on the elevating mechanism parts, instead of coming down to the desired setting.

CLAMPS are provided for locking the table, knee, and saddle in position when these parts are not used to feed the work to the cutter. The CLAMPS for these units should be loosened before feeding. Considerably more effort will be required to move the parts when the CLAMPS are tight and the bearing surfaces are very likely to become scored.

The KNEE CLAMP should be loosened before the KNEE is raised or lowered. The SADDLE CLAMP should be loose when the table is moved in or out. The TABLE CLAMP should be loose before the table is moved lengthwise. Clamps on all members not being used to feed the work should be tightened when cuts are in progress.

A micrometer collar is mounted on each screw used to move the table in its three directions: lengthwise, crosswise, and vertically. The outer circumference of the collars is evenly divided into graduations which measure the movements of the table in thousandths of an inch.

The graduated collar provides micrometer adjustment for setting or feeding the work in relation to the milling cutter.

When the collar is clamped to the feed screw, it becomes an integral part of the feed screw. Thus when the feed screw is turned to move the table, the distance is measured on the collar.

SERVICE ADJUSTMENTS CHANGING POSITION OF QUILL LOCKING LEVER

Proper adjustment of the quill locking lever is made at the factory; however, after considerable use the position of the quill locking lever may have to be changed.

If the quill locking lever is turned to the right and does not properly lock the quill, proceed as follows:

1. Unscrew and remove the lever (A) Fig. 10, from the hub (B). Then remove the hub.

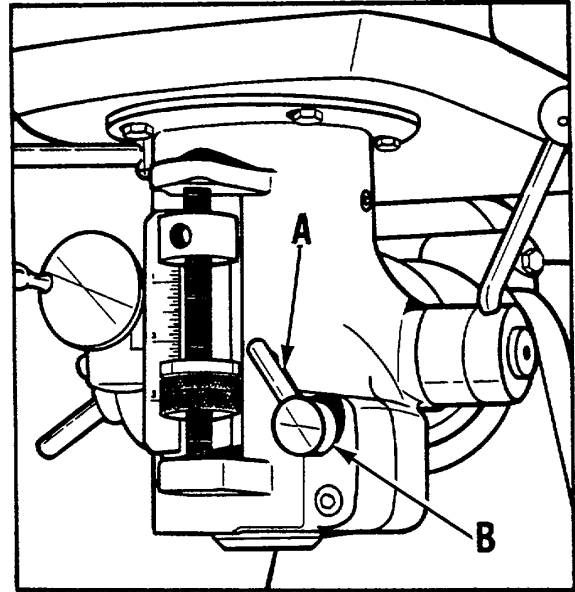


Fig. 10.

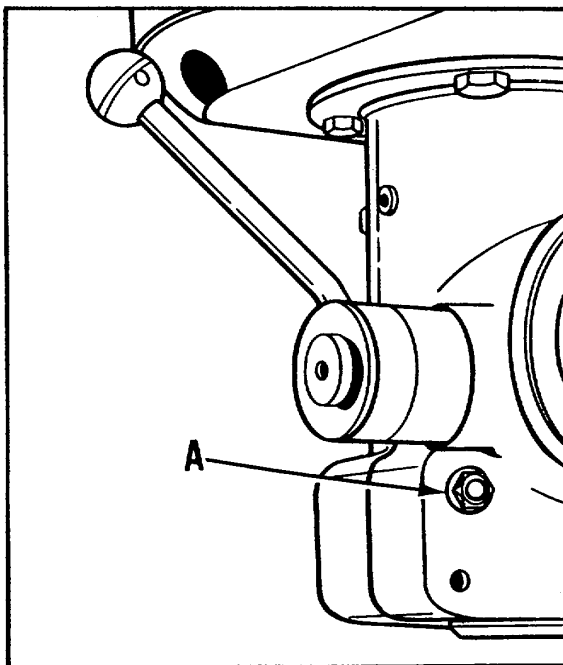


Fig. 11.

2. Push the screw (A) Fig. 11 out toward the rear of the head casting until the hexagon head of the screw (A) is free from its housing.
3. Turn the hexagon head screw (A) Fig. 11 until the head of the screw is turned one or two positions and replace it in its housing.
4. Replace the hub (B) and lever (A) Fig. 10, and check to see if the quill locks properly when the quill locking lever (A) and hub (B) Fig. 10 are turned to the right.
5. If further adjustment is necessary repeat Steps 1, 2, 3, and 4.

ADJUSTING THE QUILL

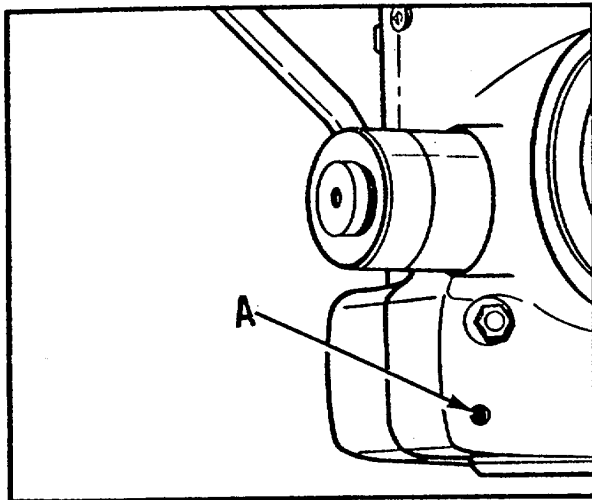


Fig. 12.

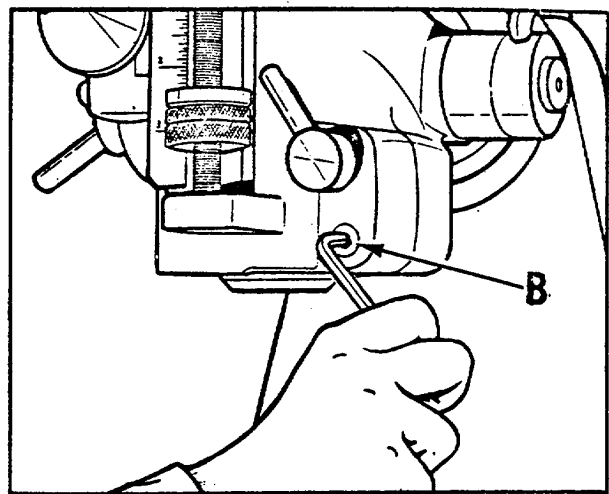


Fig. 13.

The quill in your milling machine will remain accurate if kept clean and lubricated according to instructions.

Any play which might develop between the quill and head casting after considerable use, can be taken up by loosening the socket head set screw (A) Fig. 12, and partially tightening screw (B) Fig. 13, as shown. When correct adjustment of the quill is obtained tighten the socket head set screw (A) Fig. 12.

GIB ADJUSTMENT FOR TABLE, SADDLE, AND KNEE

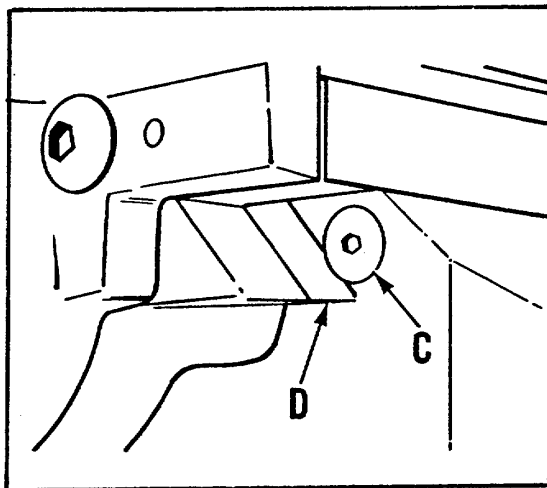


Fig. 14.

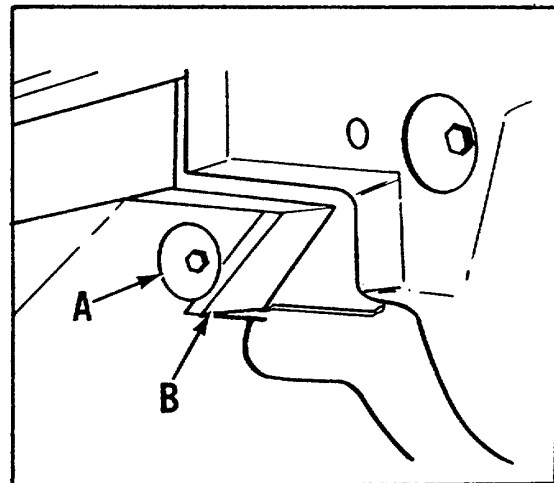


Fig. 15.

A gib is provided to take up all the play between the mating dove-tail ways of the table and saddle, the saddle and knee, and the knee and column.

If the table, saddle, or knee move too freely or bind, it is necessary to readjust the gib.

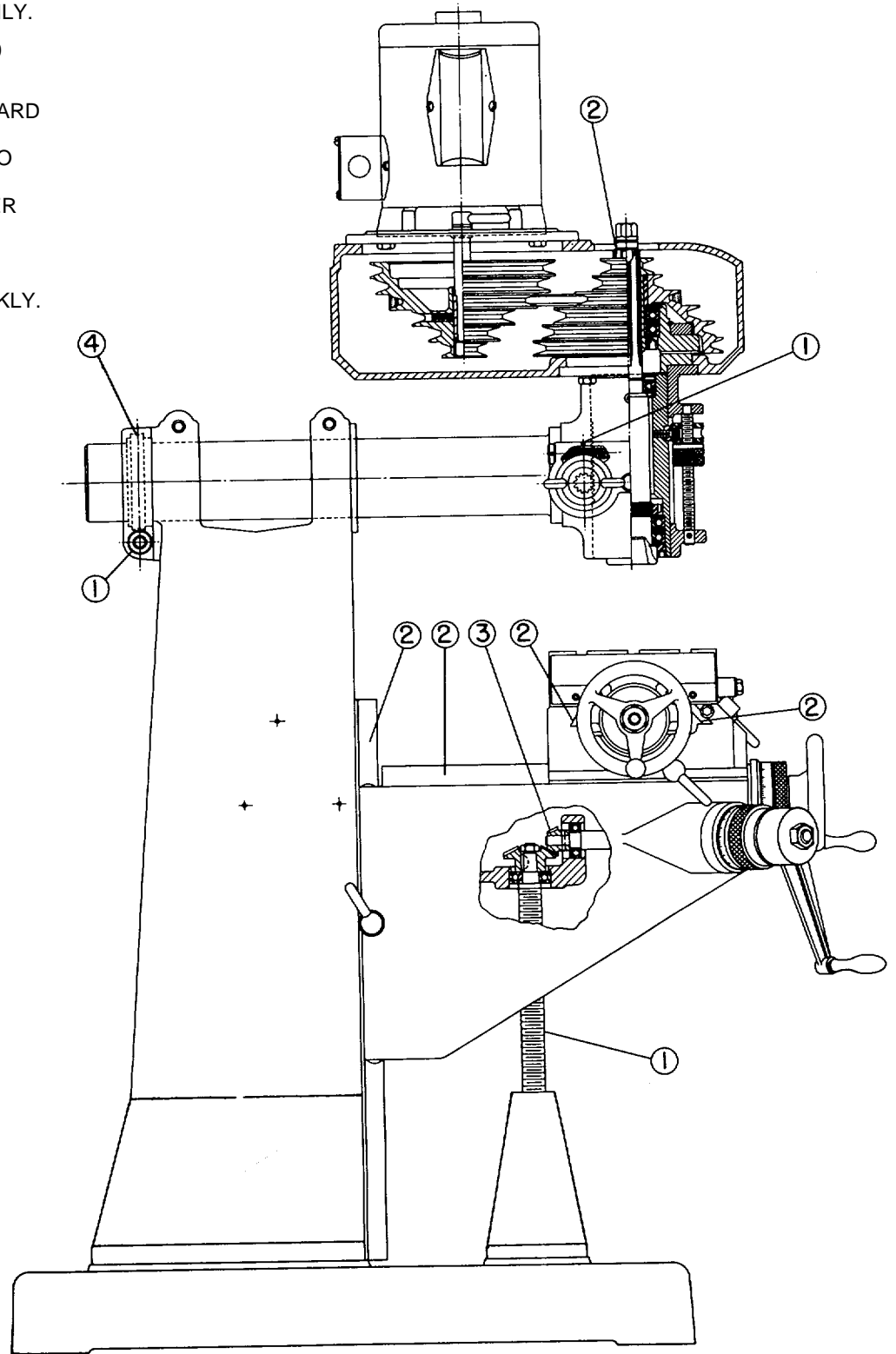
1. To tighten the gib, loosen the screw (A) on the small end of the tapered gib (B) Fig. 15. Turn in on screw (C) Fig. 14 on the large end of the tapered gib (D), until a good, snug, sliding fit is obtained.

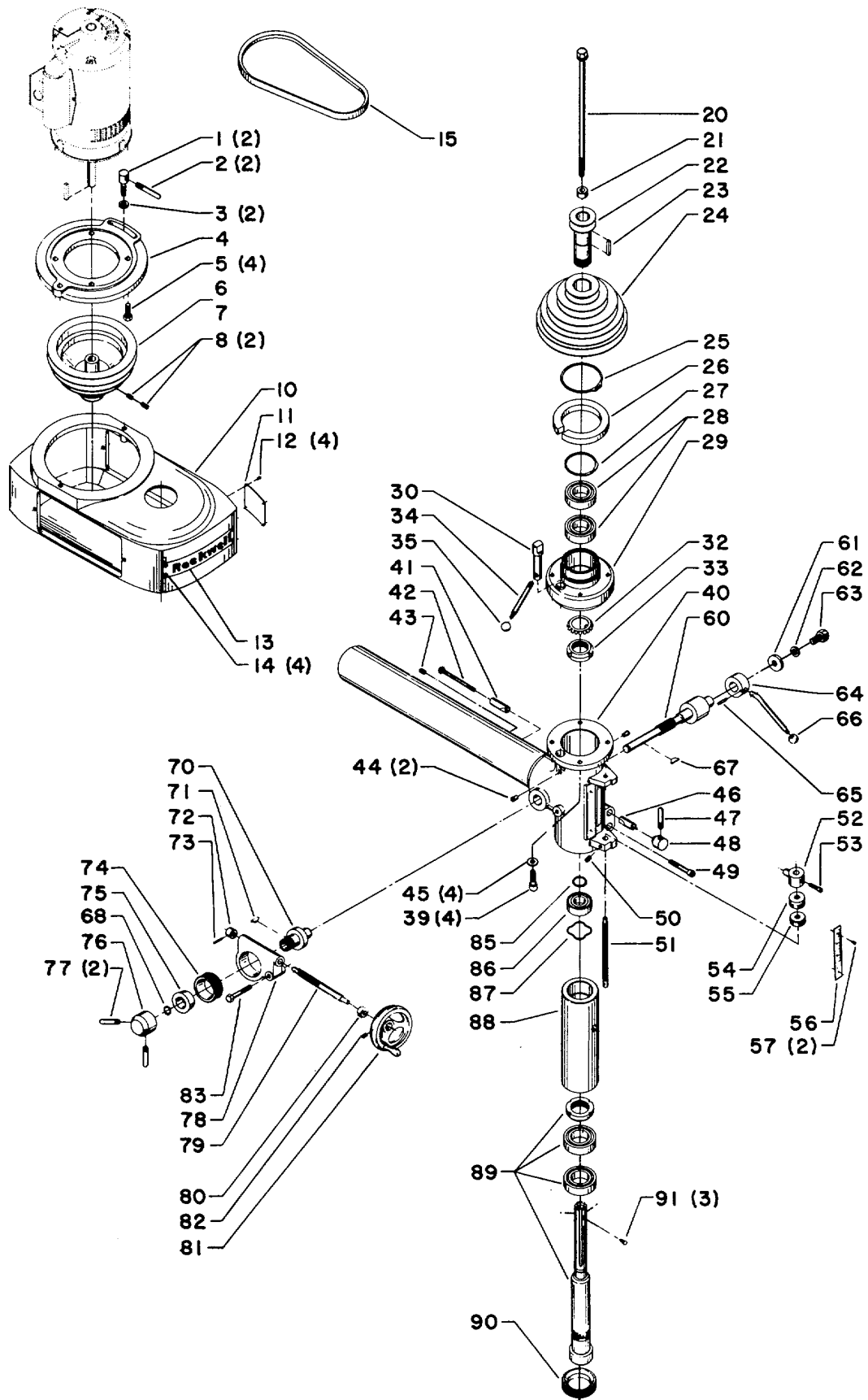
When this is done, tighten screw (A) Fig. 15, recheck and make minor adjustments if necessary.

3. To loosen the gib, loosen the screw (C) on the large end of the tapered gib (D) Fig. 14. Turn in on screw (A) on the small end of tapered gib (B) Fig. 15, until a good, snug, sliding fit is obtained. When this is done, tighten screw (C) Fig. 14, recheck and make minor adjustment if necessary.

LUBRICATION

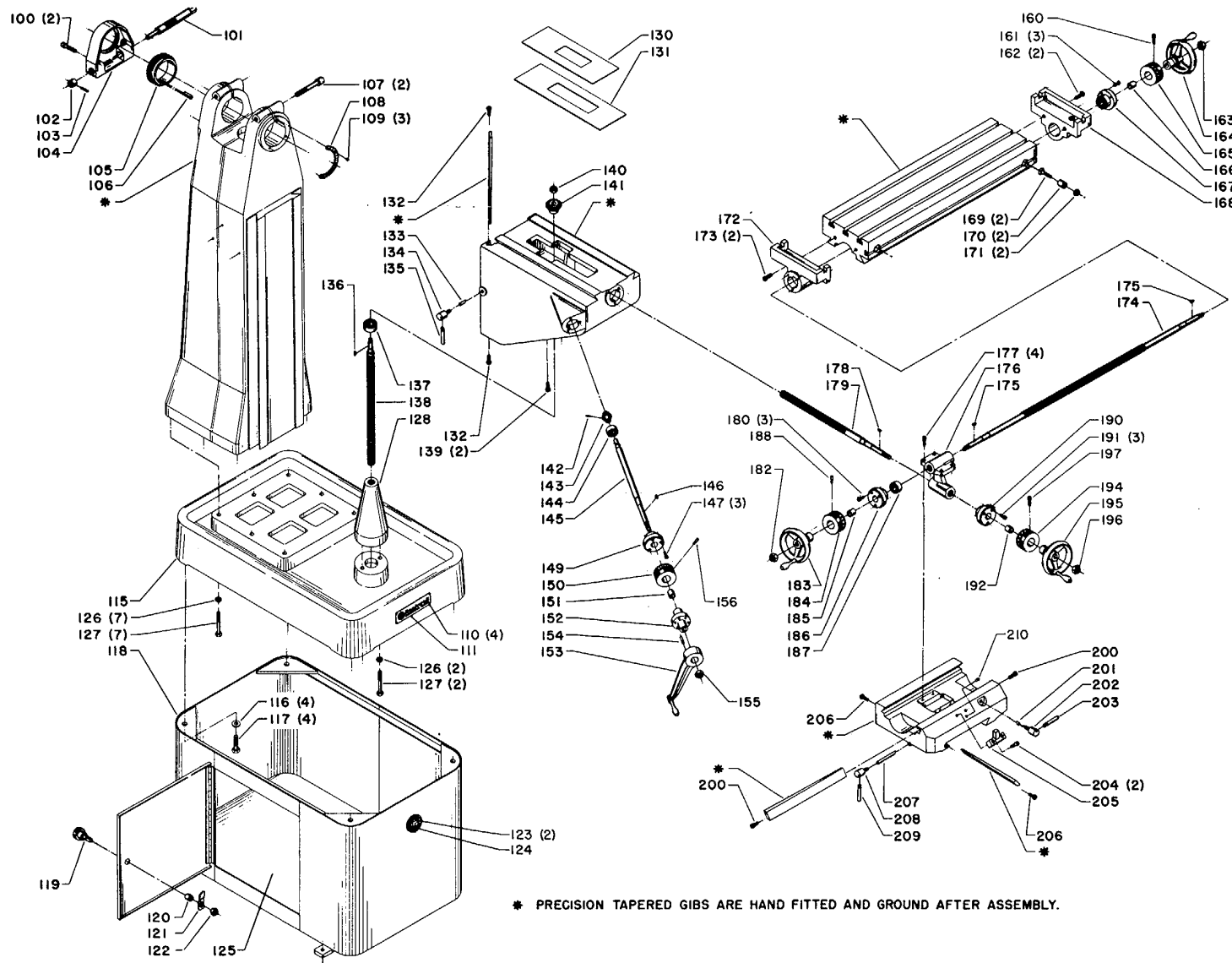
- (1) OIL WITH S.A.E.-10 OIL DAILY.
- (2) GREASE WITH MARFAK #0 GREASE WEEKLY.
- (3) MOVE CROSS SLIDE TOWARD COLUMN UNTIL LOWER SHIELD BEGINS TO MOVE. SLIDE UPPER SHIELD BACK TO UNCOVER LEAD SCREW AND BEVEL GEARS. GREASE BEVEL GEARS WITH MARFAK #0 GREASE WEEKLY.
- (4) PACK WITH MARFAK #0 GREASE AS REQUIRED.





Replacement Parts

Ref. No.	Part No.	Description	Ref. No.	Part No.	Description
1	450-01-112-5005	Motor Clamping Screw	50	901-04-150-6215	1/4-20 x 3/8 Hex. Soc. Set Scr.
2	450-01-108-5002	Lever for Motor Clamping Scr.	51	450-01-112-5004	Screw for Depth Stop
3	904-01-031-5737	13/32 x 3/4-x 1/8 Flat Washer	52	450-01-407-0001	Depth Indicator Block
4	450-01-372-0001	Motor Mounting Plate	53	SP-755	1/4-20 x 3/4 Soc. Hd. Cap Scr.
5	901-01-060-3069	3/8-16 x 7/8 Hex. Hd. Cap Scr.	54	902-08-061-5461	Depth Stop
6	Cat. #41-893	Motor Pulley-5/8"Bore, Including	55	902-08-061-5466	Depth Stop Lock Nut
8	901-04-150-6202	5/16-18 x 3/8 Hex. Soc. Set Scr.	56	951-02-011-8258	Depth Scale
7	Cat. #41-894	Motor Pulley-3/4"Bore, Including	57	SP-2250	#4 x 3/16 Drive Screw
8	001-04-150-6202	5/16-18 x 3/8 Hex. Soc. Set Scr.	60	450-01-106-5006	Quill Hand Feed Pinion
10	450-01-354-0001	Belt Guard	61	904-01-031-7717	21/64 x 1 1/16 x 3/32 Spec. Flat Washer
11	960-04-011-8336	Speed Chart			
12	SP-2250	#4 x 3/16 Drive Screw	62	SP-1703	5/16 Lockwasher
13	960-02-012-0050	Name Plate	63	SP-606	5/16-18 x 5/8 Hex. Hd. Cap Scr.
14	SP-2250	#4 x 3/16 Drive Screw	64	450-01-408-0001	Quill Hand Feed Lever, Including:
15	Cat. #272	V Belt	65	905-04-010-4056	3/16 x 3/4 Dowel Pin
20	450-01-304-0001	Draw Bar	66	931-01-021-6390	1" Dia. Black Knob-1/4-20
21	450-01-104-5003	Draw Bar Spacer	67	SP-2606	#504 Hi Pro Key
22	450-01-107-5001	Hub for Spindle Pulley	68	904-15-011-7129	Retaining Ring
23	927-03-021-8004	3/16 x 3/16 x 1 1/8 Key	70	450-01-107-5005	Feed Clutch Hub
24	926-06-041-8716	Spindle Pulley	71	SP-2606	#504 Hi-Pro Key
•	450-01-357-5001	Pulley Bearing Retainer Assy , Consisting of:	72	904-10-071-5976	Collar for Fine Feed Handwheel
25	904-15-011-7127	Retaining Ring	73	SP-2704	1/8 x 3/4 Roll Pin
26	450-01-015-5001	Brake Shoe	74	450-01-051-5001	Gear for Fine Feed Clutch
27	904-15-101-7128	Retaining Ring	75	450-01-028-5001	Cone for Fine Feed Clutch
28	920-04-102-0953	Bearing Set (Duplexed)	76	450-01-107-5004	Lock for Fine Feed Clutch
29	450-01-079-5001	Pulley Bearing Retainer	77	450-01-108-5003	Handle for Lock for Fine Feed
30	450-01-106-5001	Shaft for Spindle Lock & Brake	78	450-01-312-0001	Fine Feed Housing
32	904-04-010-7225	Bearing Lockwasher	79	1085268	Fine Feed Worm Shaft
33	902-07-010-7180	Bearing Lock Nut	80	904-10-031-2078	Collar
34	450-01-106-5005	Lever for Spindle Lock & Brake	81	DJ-28-S	Handwheel, including:
35	931-01-021-6390	1" Dia. Black Knob-1/4-20	82	SP-201	5/16-18 x 5/16 Hex. Soc. Set Scr
39	SP-750	5/16 - 18 x 1 Soc. Hd. Cap Scr.	83	901-01-060-9504	5/16-18 x 1 3/4 Hex. Hd. Cap Scr.
40	450-01-357-0001	Head	•	450-01-377-5001	Quill Assembly, Consisting of:
41	450-01-105-5003	Sleeve for Quill Lock-Inner	85	SP-7424	Retaining Ring
42	901-01-060-5483	1/4-20 x 3 Hex. Hd. Cap Scr.	86	920-04-021-6578	Upper Spindle Bearing
43	901-04-150-6202	5/16-18 x 3/8 Hex. Soc. Set Scr.	87	928-06-021-8852	Preload Spring
44	907-01-010-5234	5/16 Ball Oiler	88	450-01-377-0001	Quill
45	TAM-185	5/16 x 5/8 x 1/16 Flat Washer	89	450-01-385-5002	Spindle W/Bearings & Lock Nut
46	450-01-105-5004	Sleeve for Quill Lock-Outer	90	450-01-079-5004	Bearing Retainer
47	450-01-108-5003	Handle for Quill Locking Lever	91	TAB -175	Bumper
48	450-01-108-5004	Quill Locking Lever	•	Not Shown Assembled	
49	SP-3371	5/16-18 x 1 3/4 Soc. Hd. Cap Scr.			



Replacement Parts

Ref. No.	Part No.	Description	Ref. No.	Part No.	Description
100	SP-799	3/8-16 x 1 1/2 Soc. Hd. Cap Scr.	156	SP-755	1/4-20 x 3/4 Soc. Hd. Cap Scr.
101	450-01-379-0001	Gear Housing Assy. consisting of:	160	SP-755	1/4-20 x 3/4 Soc. Hd. Cap Scr.
	450-01-106-5003	Head Tilting Screw	161	SP-715	1/4-20 x 1/2 Fil. Hd. Screw
102	450-01-103-5001	Collar for Head Tilting Scr.	162	901-03-040-8086	3/8-16 x 7/8 Button Hd. Socket Cap Screw
103	SP-2733	5/32 x 7/8 Roll Pin			
104	450-01-379-0002	Gear Housing	163	902-01-010-9115	1/2-20 Hex. Nut
105	450-01-051-5002	Worm Gear for Head Tilting Scr.	164	930-01-991-9029	Longitudinal Feed Handwheel
106	927-03-021-8005	1/4 x 1/4 x 1 1/16 Key	165	450-01-337-0001	Micrometer Collar (200)
107	901-03-010-0794	1/2-13 x 2 3/4 Soc. Hd. Cap Scr.	166	450-01-104-5001	Bearing Spacer
108	951-02-011-8259	Head Tilting Scale	167	450-01-379-5001	Bearing Holder W/Bearing
109	SP-2250	#4 x 3/16 Drive Screw	168	450-01-314-0001	End Bracket
110	SP-2250	#4 x 3/16 Drive Screw	169	SP-2365	5/16-18 x 1 1/4 Sq. Hd. Bolt
111	960-02-012-1401	Nameplate	170	450-01-088-5002	Table Stop Barrel
115	450-01-305-0005	Base	171	902-01-040-1030	5/16-18 Hex. Nut
116	DDL-174	29/64 x 1 x 1/8 Washer	172	450-01-314-0001	End Bracket
117	SP-3080	7/16 - 14 x 1 1/2 Hex. Hd. Cap Screw	173	901-03-040-8086	3/8-16 x 7/8 Button lid. Soc. Cap Screw
118	450-01-318-5001	Cabinet, Including:	174	450-01-112-5003	Table Screw
119	931-02-121-6392	Latch Knob	175	SP-2607	#404 Woodruff Key
120	450-01-104-5002	Latch Sleeve	176	450-01-012-5002	Feed Nut Body
121	450-01-068-5002	Latch	177	SP-755	1/4-20 x 3/4 Soc. Hd. Cap Scr.
122	902-01-020-9143	1/2 - 20 Hex. Jam Nut	178	SP-2607	#404 Woodruff Key
123	SP-2252	#2 x 3/16 Drive Screw	179	450-01-112-5001	Cross Feed Screw
124	960-02-012-0028	Nameplate	180	SP-715	1/4-20 x 1/2 Fil. Hd. Screw
125	450-01-415-0001	Shelf	182	902-01-010 9115	1/2-20 Hex. Nut
126	SP-1704	3/8 Lockwasher	183	930-01-991-9029	Longitudinal Feed Handwheel
127	901-01-061-9849	3/8-16 x 2 1/2 Hex. Hd. Cap Scr.	184	450-01-337-0001	Micrometer collar (200)
128	450-01-305-0006	Elevating Screw Housing	185	450-01-104-5001	Bearing Spacer
130	450-01-084-5001	Shield	186	450-01-079-5002	Bearing Holder
131	450-01-084-5002	Shield	187	920-04-010-7273	Bearing
132	901-03-042-0801	5/16-18x7/8 Button Hd. Soc. Cap Screw	188	SP-755	1/4-20 x 3/4 Soc. Hd. Cap Scr.
133	450-01-074-0002	Thread Seat	190	450-01-379-5001	Bearing Holder W/Bearing
134	450-01-068-5001	Knee Clamp	191	SP-715	1/4-20 x 1/2 Fil. Hd. Screw
135	450-01-108-5002	Handle for Knee Clamp	192	450-01-104-5001	Bearing Spacer
136	SP-2607	#404 Woodruff Key	194	450-01-337-0001	Micrometer Collar (200)
137	920-05-011-6621	Bearing	195	930-01-991-9029	Cross Feed Handwheel
138	450-01-112-5002	Elevating Screw	196	902-01-010-9115	1/2-20 Hex. Nut
139	901-03-040-8086	3/8-16 x 7/8 Button Hd. Soc. Cap Screw	197	SP-755	1/4-20 x 3/4 Soc. Hd. Cap Scr.
140	902-01-010-9114	7/16-20 Hex. Nut	200	901-03-042-0801	5/16-18 x 7/8 Button Hd. Soc. Cap Screw
141	450-01-051-5003	Bevel Gear	201	450-01-074-0001	Thread Seat
142	SP-2704	1/8 x 3/4 Roll Pin	202	450-01-068-5001	Table Clamp
143	450-01-051-5004	Bevel Gear	203	450-01-108-5002	Handle for Table Clamp
144	920-04-010-7273	Bearing	204	SP-762	5/16-18 x 5/8 Soc. Hd. Cap Scr.
145	450-01-106-5004	shaft for Table Raising Crank	205	450-01-388-0002	Table Stop
146	SP-2607	#404 Woodruff Key	206	901-03-042-0801	5/16-18 x 7/8 Button Hd. Soc. Cap Screw
147	SP-715	1/4-20 x 1/2 Fil. Hd. Screw	207	450-01-074-0003	Thread Seat
149	450-01-379-5001	Bearing Holder W/Bearing	208	450-01-068-5001	Saddle Clamp
150	450-01-337-0002	Micrometer Collar (100)	209	450-01-108-5002	Handle for Saddle Clamp
151	450-01-104-5001	Bearing Spacer	-210	907-01-010-5234	5/16 Ball Oiler
152	450-01-105-5001	Gear Shaft Clutch Sleeve			
153	450-01-333-5001	Table Raising Crank, Including:			
154	HBS-731	1/4 x 13/16 Knurled Pin			
155	902-01-010-9115	1/2-20 Hex. Nut			

• Not Shown Assembled

**ELECTRICAL WIRING DIAGRAMS
FOR
VERTICAL MILLING MACHINES**

The wiring diagram shown on page 47, applies to all Vertical Mill and Vertical Mill Head Attachments wired for Cat. Nos. 49-473, 49-476, 49-688 and 49-689 Reversing Manual Drum Switch Control for 115 Volt Single Phase Motors.

The wiring diagram shown on page 48 applies to all Vertical Mill and Vertical Mill Head Attachments wired for Cat. Nos. 49-473, 49-476, 49-688 and 49-689 Reversing Manual Drum Switch Control for 230 Volt Single Phase Motors.

The wiring diagram shown on page 49 applies to all Vertical Mill Head Attachments wired for Cat. Nos. 49-691 and 49-692 Reversing Manual Drum Switch Control for Three Phase Motors.

The wiring diagram shown on page 50 applies to all Vertical Mills wired for Cat. Nos. 49-489 and 49-490 Reversing Manual Drum Switch Control with Overload Switch for 115 Volt Single Phase Motors.

The wiring diagram shown on page 51 applies to all Vertical Mills wired for Cat. Nos. 49-489 and 49-490 Reversing Manual Drum Switch Control with Overload Switch for 230 Volt Single Phase Motors.

The wiring diagram shown on page 52 applies to all Vertical Mills wired for Cat. Nos. 49-479 and 49-482 Reversing Manual Drum Switch Control with Overload Switch for Three Phase Motors.

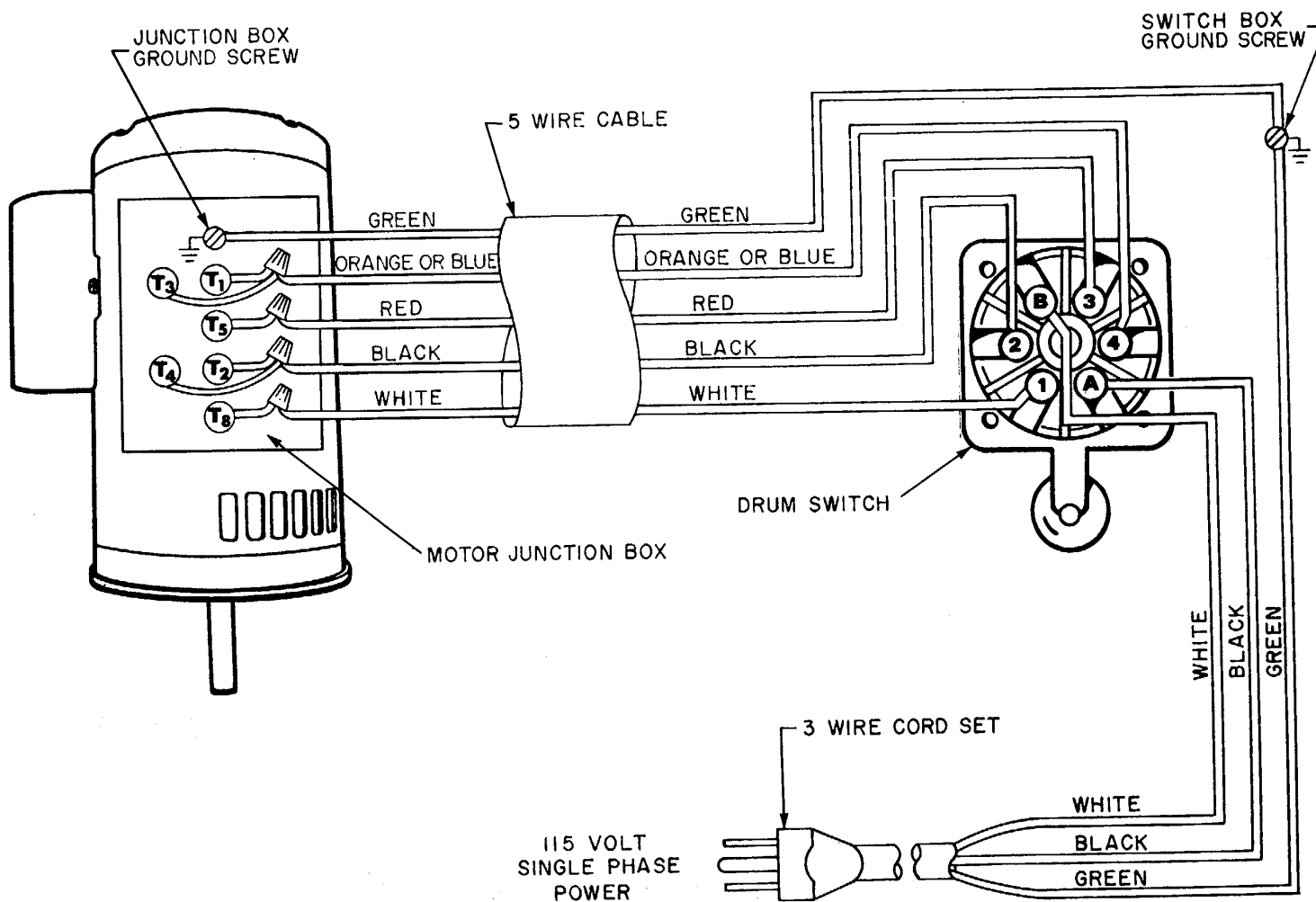
The wiring diagram shown on page 53 applies to all Vertical Mills wired for Cat. Nos. 49-475 and 49-477 Reversing Drum Switch and Magnetic Starter with Full Voltage Control for 115 Volt Single Phase Motors.

The wiring diagram shown on page 54 applies to all Vertical Mills wired for Cat. Nos. 49-475 and 49-477 Reversing Drum Switch and Magnetic Starter with Full Voltage Control for 230 Volt Single Phase Motors.

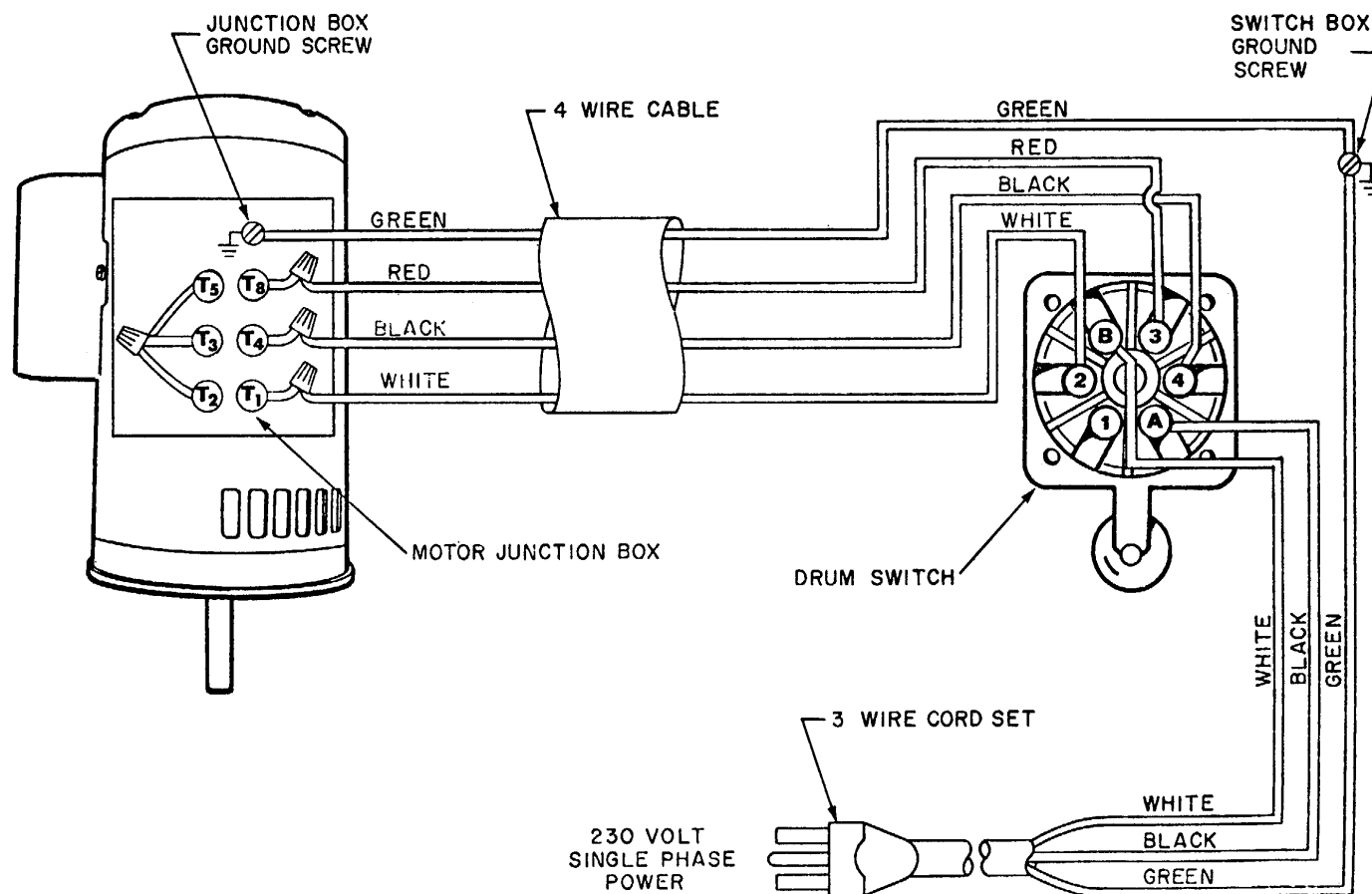
The wiring diagram shown on page 55 applies to all Vertical Mills wired for Cat. Nos. 49-481 and 49-483 Reversing Drum Switch and Magnetic Starter with Full Voltage Control for Three Phase Motors.

The wiring diagram shown on page 56 applies to all Vertical Mills wired for Cat. Nos. 49-679 and 49-680 Reversing Drum Switch and Magnetic Starter with Low Voltage Control for Three Phase Motors.

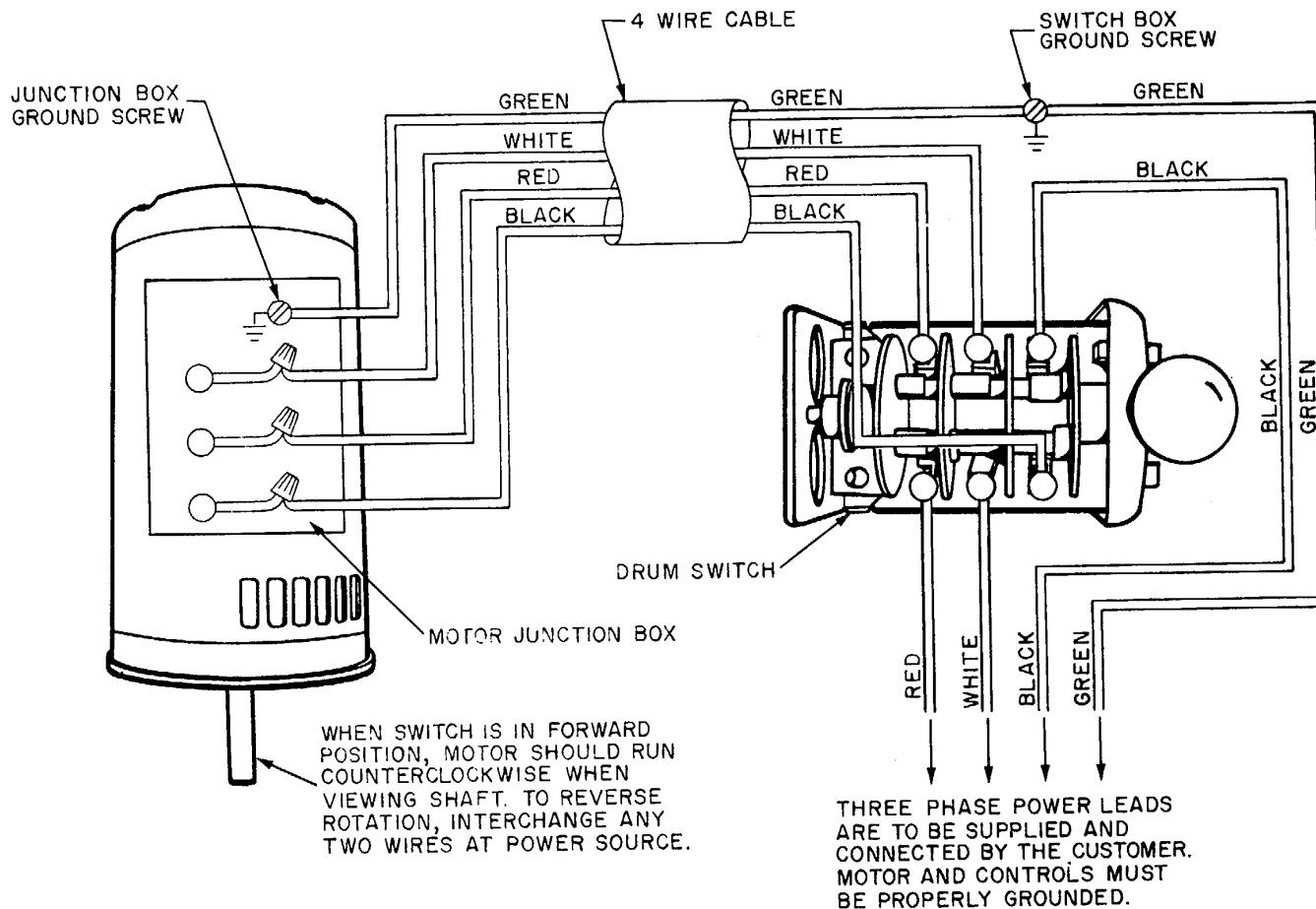
**REVERSING MANUAL DRUM SWITCH CONTROL
FOR 115 VOLT SINGLE PHASE MOTORS**



**REVERSING MANUAL DRUM SWITCH CONTROL
FOR 230 VOLT SINGLE PHASE MOTORS**

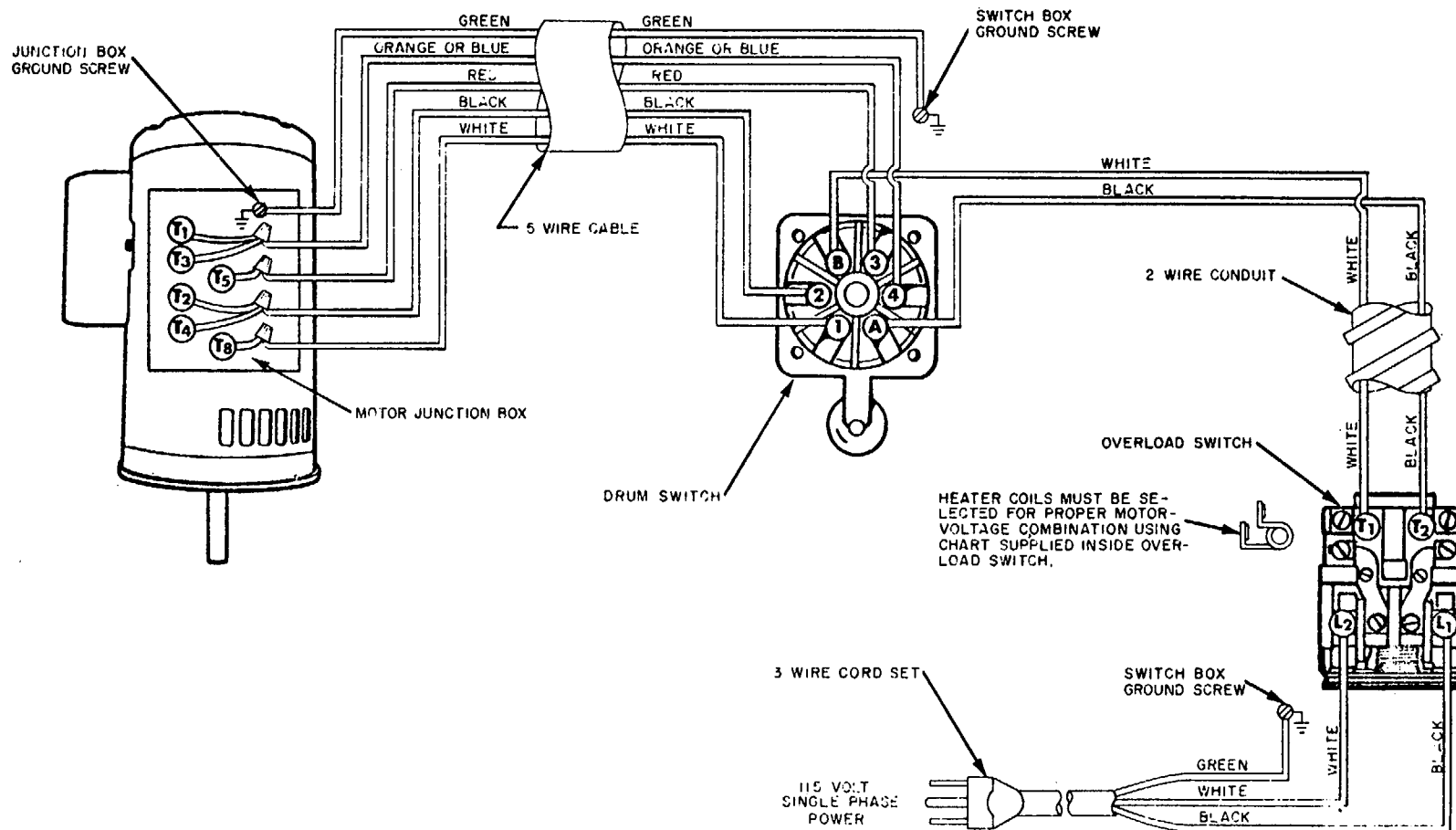


**REVERSING MANUAL DRUM SWITCH CONTROL
FOR THREE PHASE MOTORS**

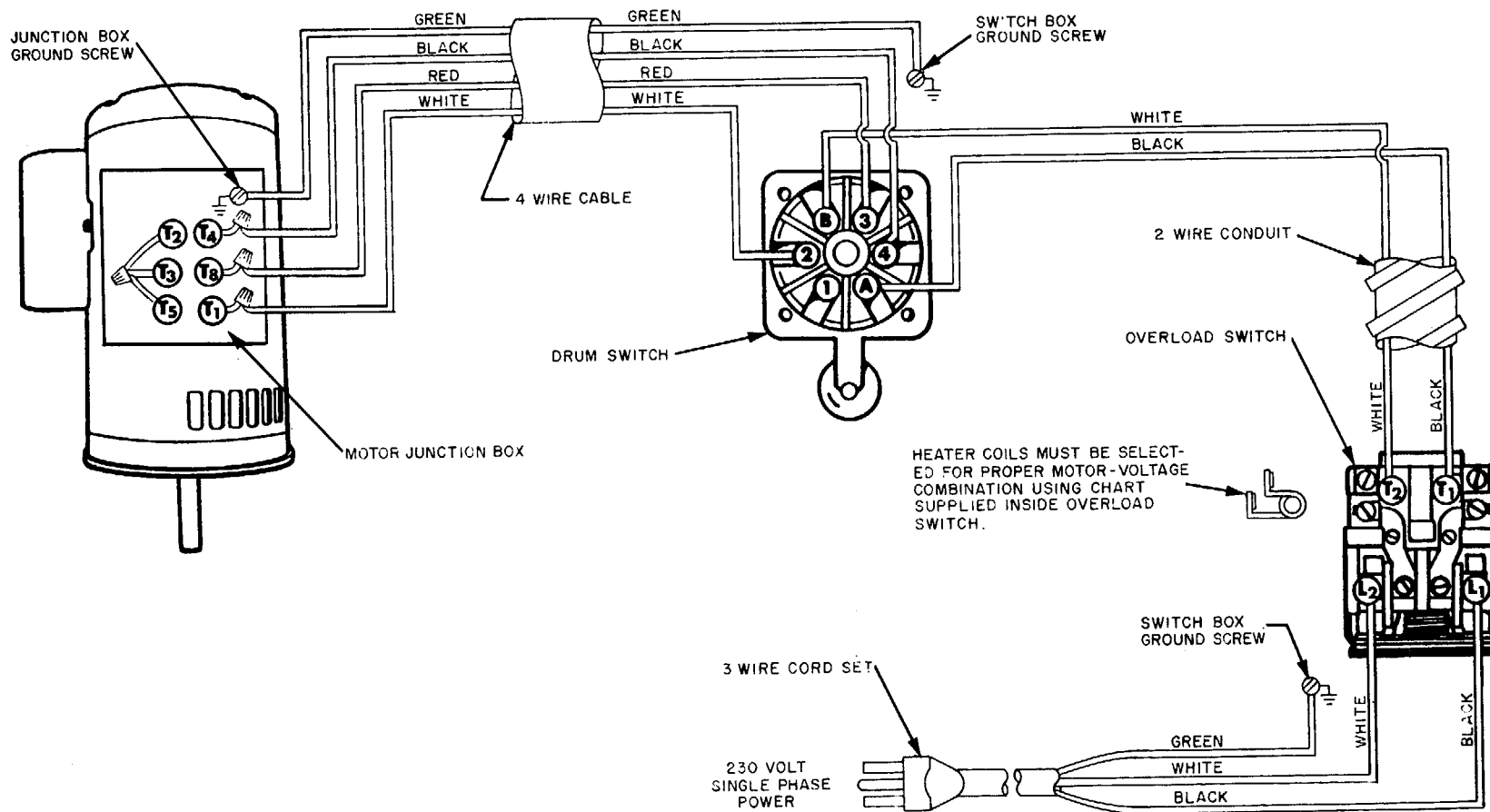


IMPORTANT- THIS DIAGRAM SHOWS THREE MOTOR LEADS. SOME MOTORS HAVE MORE THAN THREE LEADS. MAKE SURE MOTOR LEADS ARE CONNECTED FOR CORRECT VOLTAGE ACCORDING TO MOTOR NAMEPLATE.

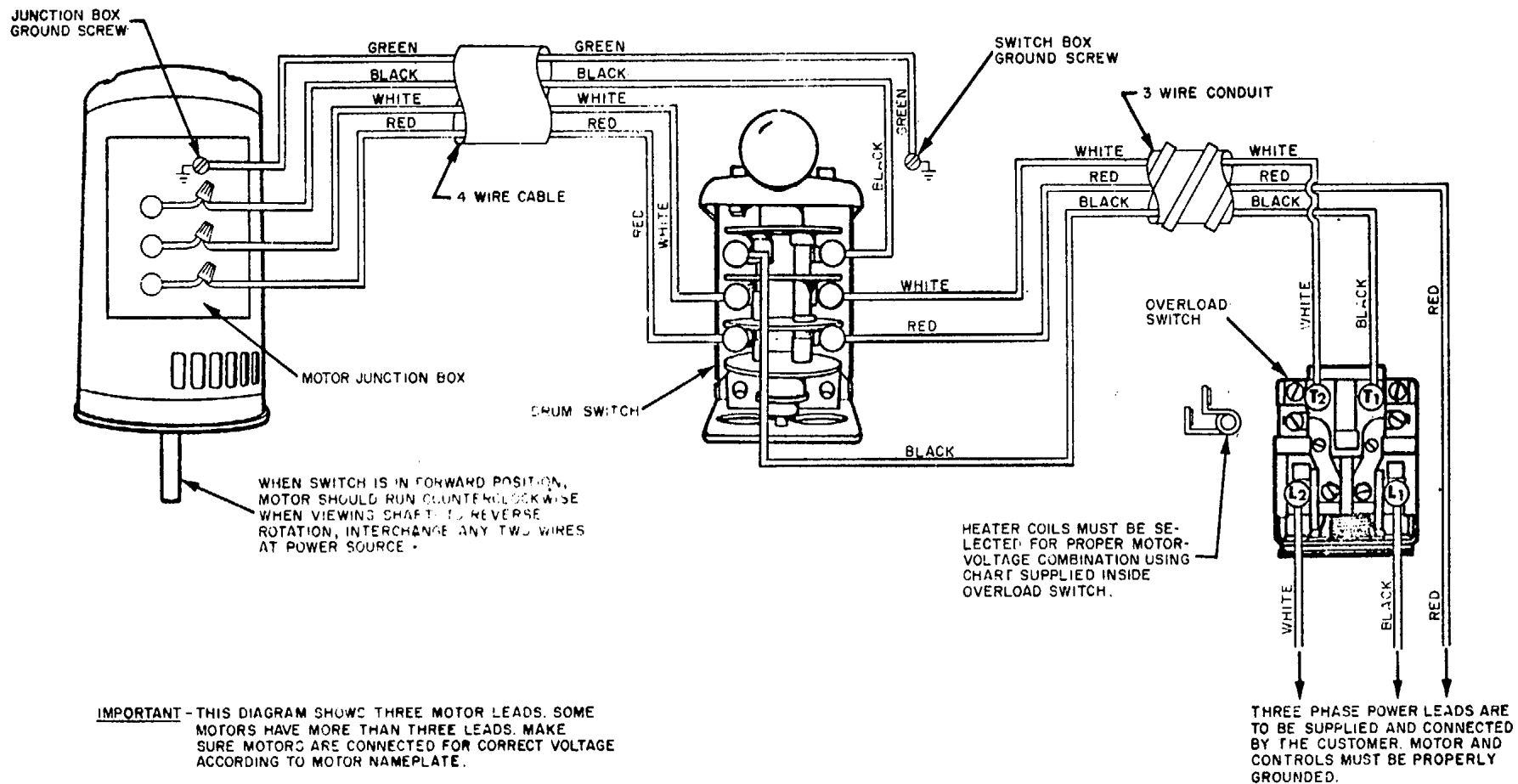
**REVERSING MANUAL DRUM SWITCH CONTROL
WITH OVERLOAD SWITCH
FOR 115 VOLT SINGLE PHASE MOTORS**



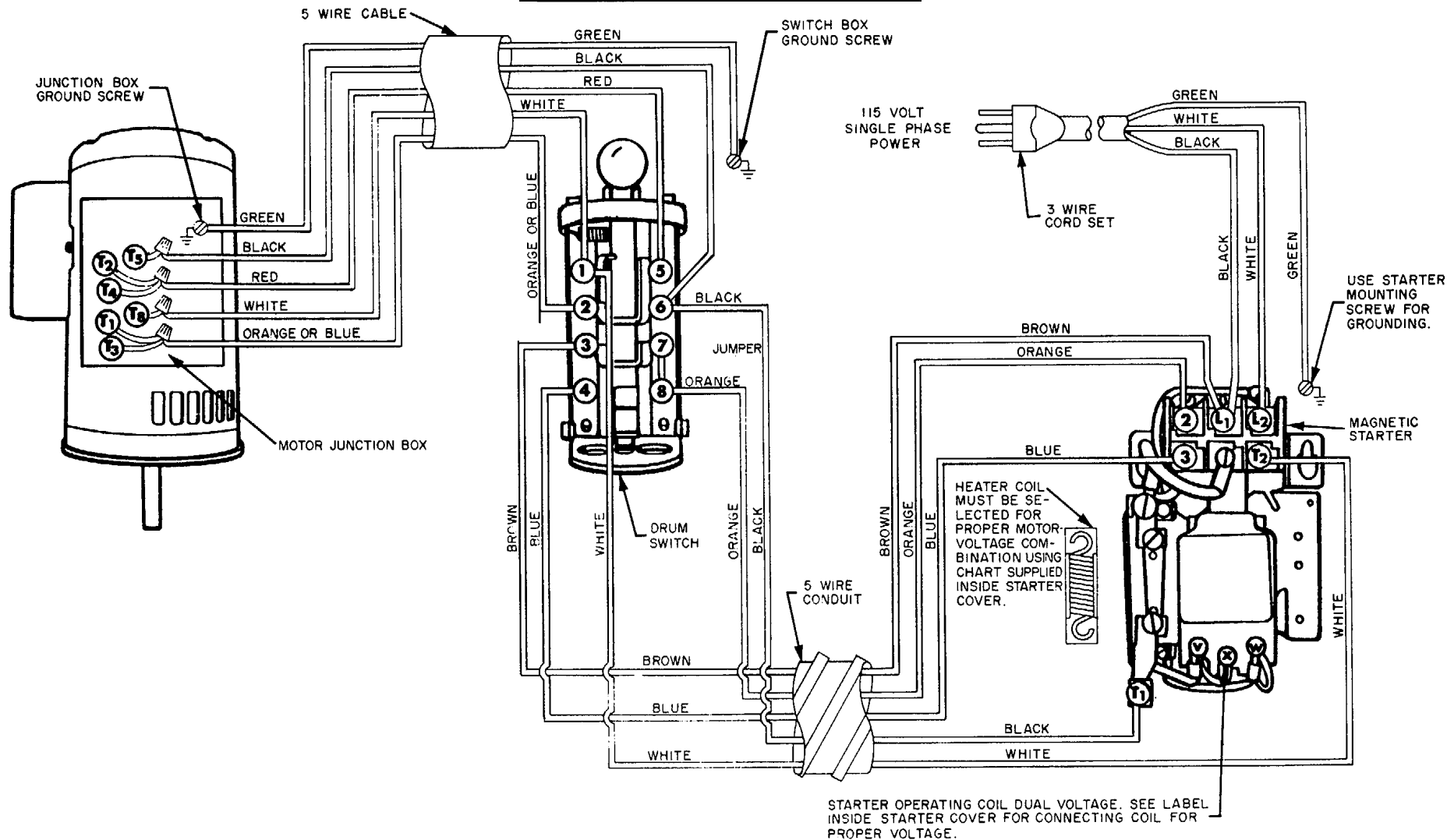
**REVERSING MANUAL DRUM SWITCH CONTROL
WITH OVERLOAD SWITCH
FOR 230 VOLT SINGLE PHASE MOTORS**



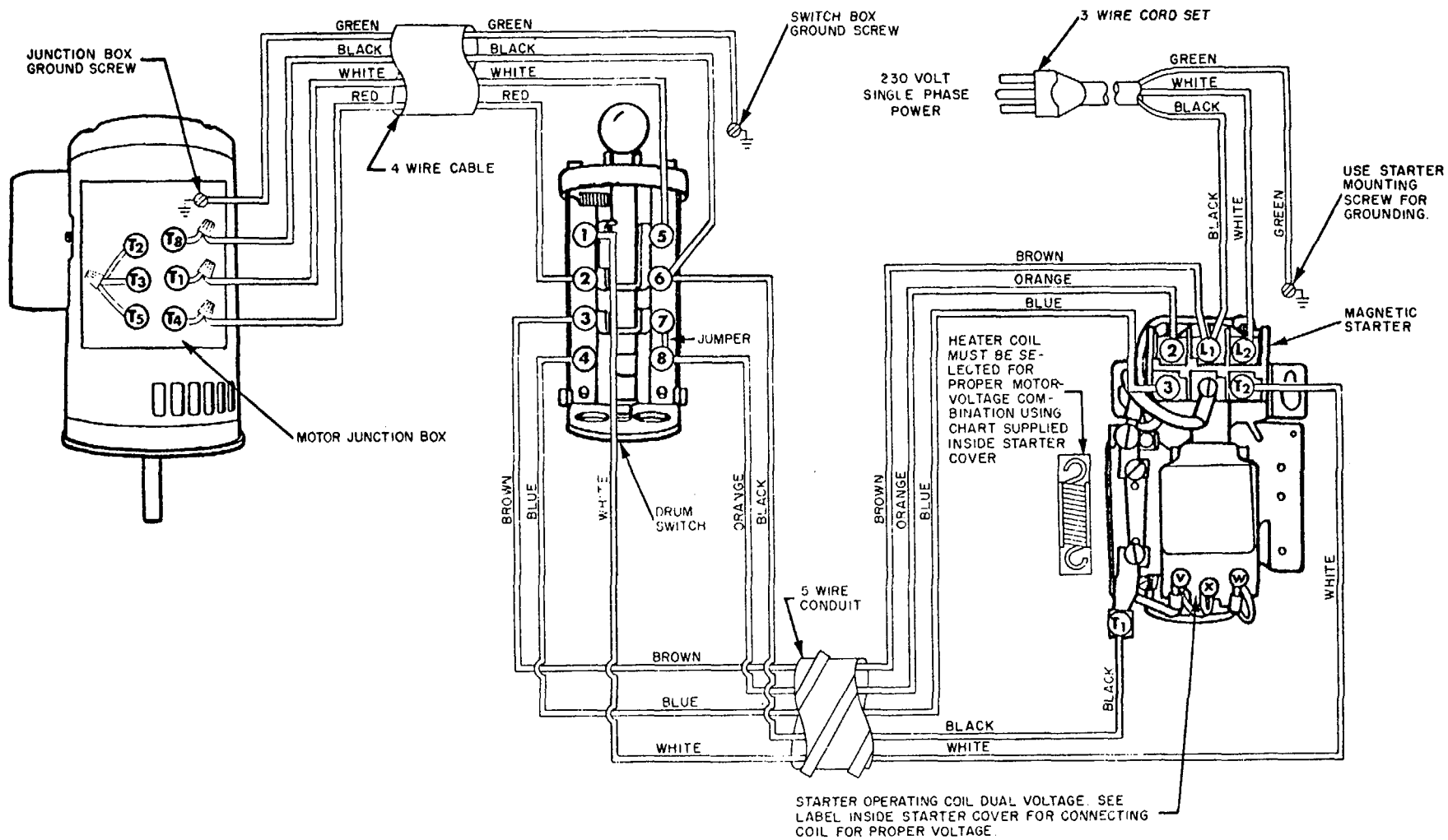
**REVERSING MANUAL DRUM SWITCH CONTROL
WITH OVERLOAD SWITCH
FOR THREE PHASE MOTORS**



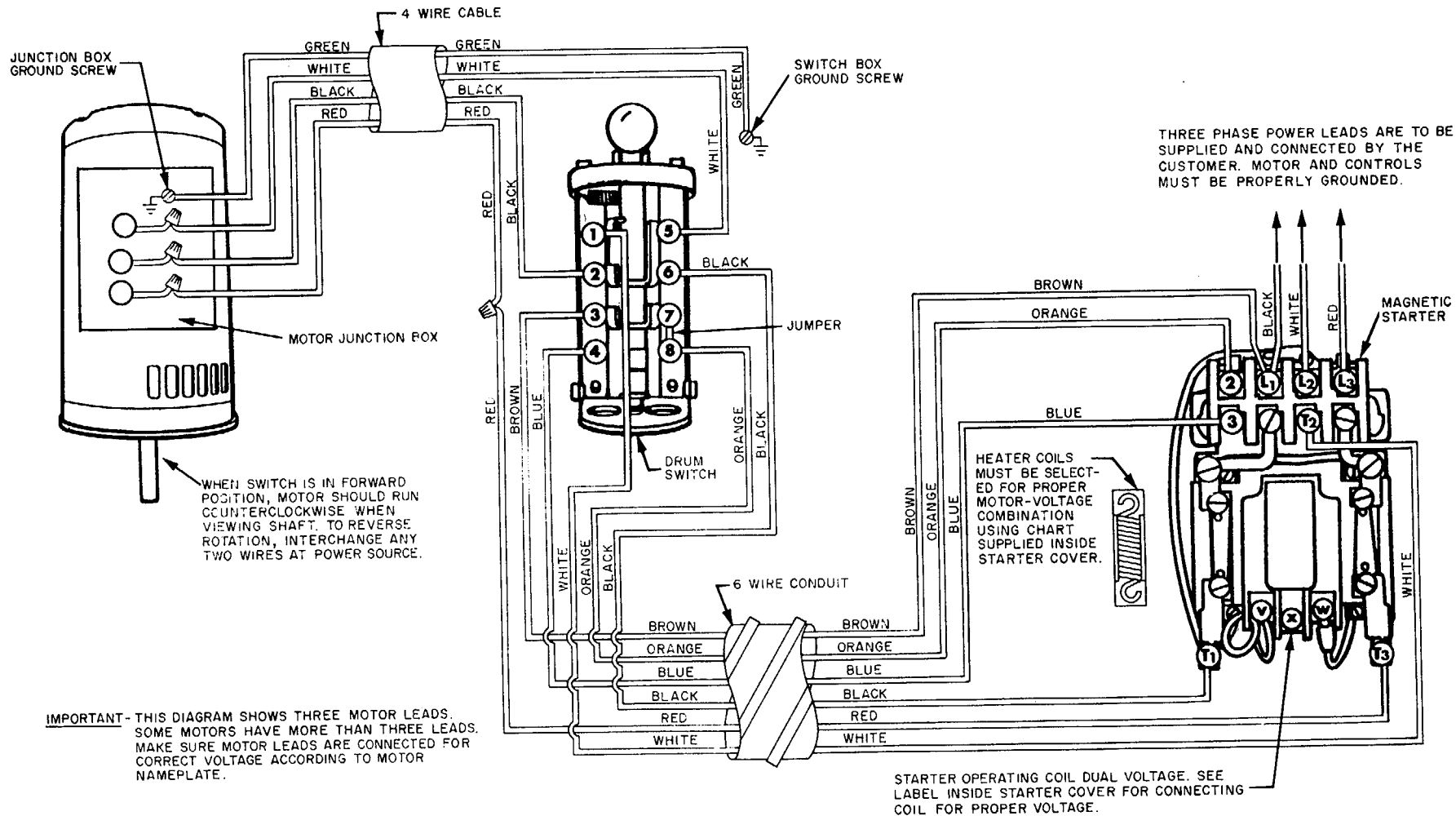
**REVERSING DRUM SWITCH AND MAGNETIC STARTER
WITH FULL VOLTAGE CONTROL
FOR 115 VOLT SINGLE PHASE MOTORS**



**REVERSING DRUM SWITCH AND MAGNETIC STARTER
WITH FULL VOLTAGE CONTROL
FOR 230 VOLT SINGLE PHASE MOTORS**

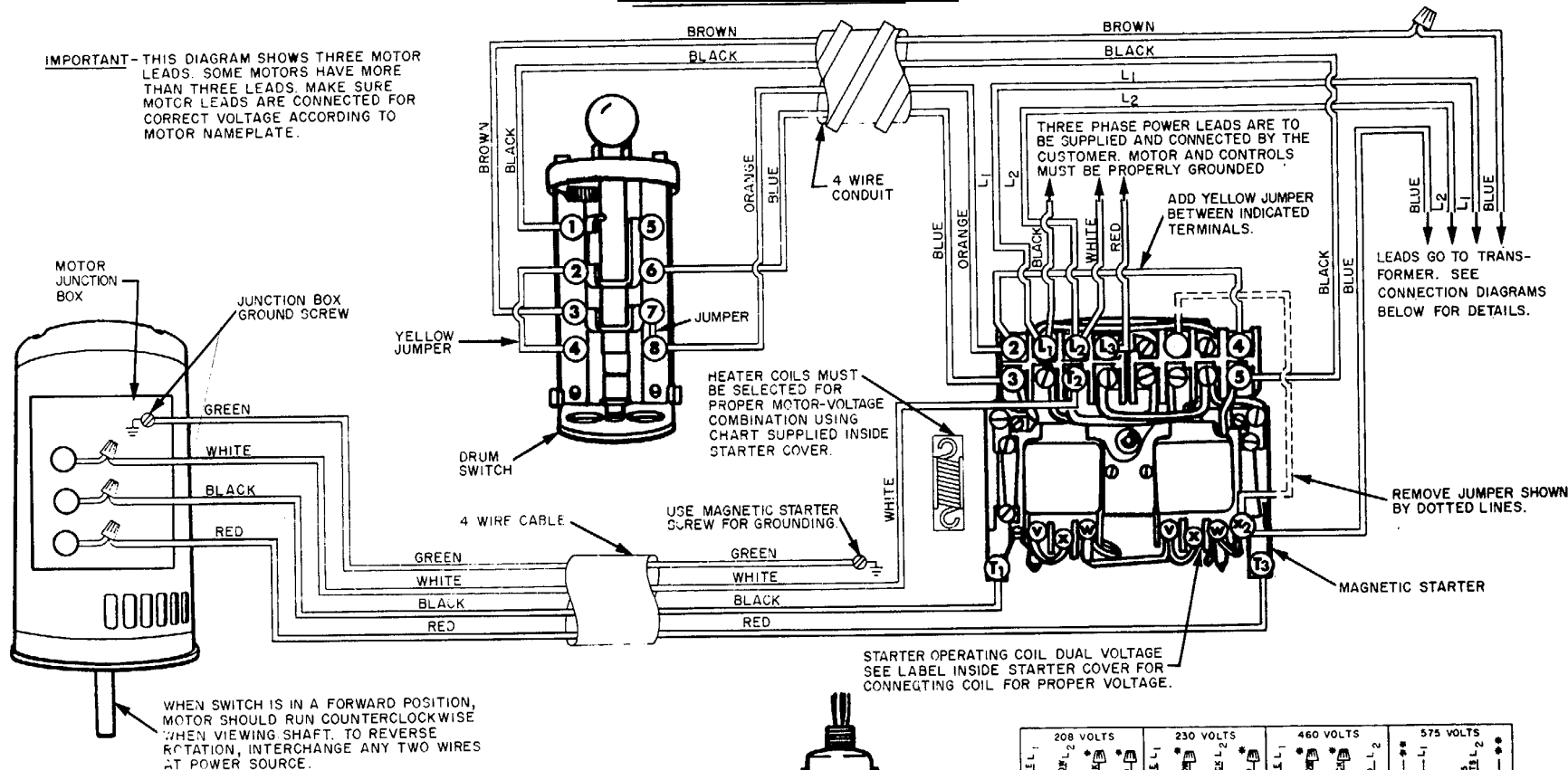


**REVERSING DRUM SWITCH AND MAGNETIC STARTER
WITH FULL VOLTAGE CONTROL
FOR THREE PHASE MOTORS**

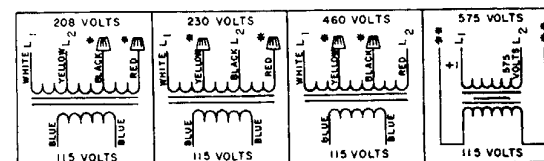


REVERSING DRUM SWITCH AND MAGNETIC STARTER WITH FULL VOLTAGE CONTROL FOR THREE PHASE MOTORS

IMPORTANT- THIS DIAGRAM SHOWS THREE MOTOR LEADS. SOME MOTORS HAVE MORE THAN THREE LEADS. MAKE SURE MOTOR LEADS ARE CONNECTED FOR CORRECT VOLTAGE ACCORDING TO MOTOR NAMEPLATE.



TYPICAL TRANSFORMER FOR CONNECTIONS, SEE PANELS AT RIGHT.



♦ INSULATE AND SECURE THESE LEADS.
♦♦ THESE LEADS ARE TO REPLACE THE BLUE TRANSFORMER LEADS SHOWN, AND ARE TO BE CONNECTED AT THE SAME TWO LOCATIONS

**21-820 VARIABLE RATE POWER TABLE FEED
FOR
MILLING MACHINES**

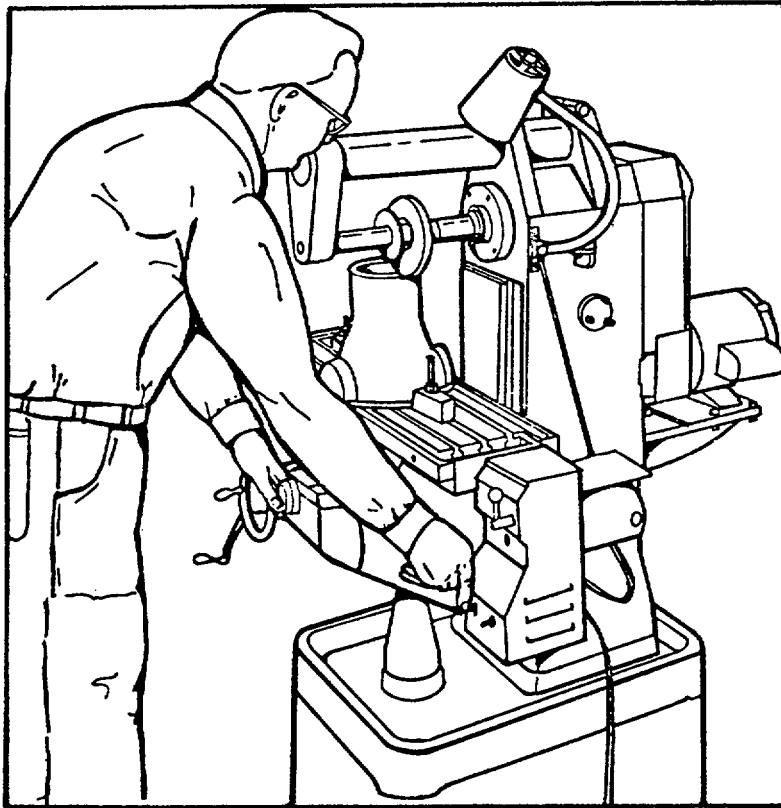


Fig. 1.

INTRODUCTION

The 21-820 Variable Rate Power Table Feed can be adapted to any Milling Machine. It has an extra wide feed range, from .5 to 22 inch/minute, which means that you can handle an exceptionally wide range of materials. You can select a very slow feed for hardened alloy steels, or a very fast feed for soft non-ferrous metals.

The power feed fits in place of the right table handwheel. The left table handwheel remains on the mill and should be used to feed the table manually when the power feed clutch lever is in the manual feed position.

The power table feed operates on regular 115V, 60 cycle, A.C., Single phase current only.

Cat. No. 21-838 Table Travel Limit Switch Kit is an excellent accessory to be used in conjunction with the Power Table Feed. It automatically shuts off the motor of the Table Feed if the machine is left unattended.

INSTALLATION

1. Remove hex nut (A), right handwheel assembly (B), and woodruff key (C) Fig. 2.
2. Remove the two button head socket cap screws (D) Fig. 2. The end bracket (E), bearing holder with bearing (F), and spacer (G), may now be removed from the table.

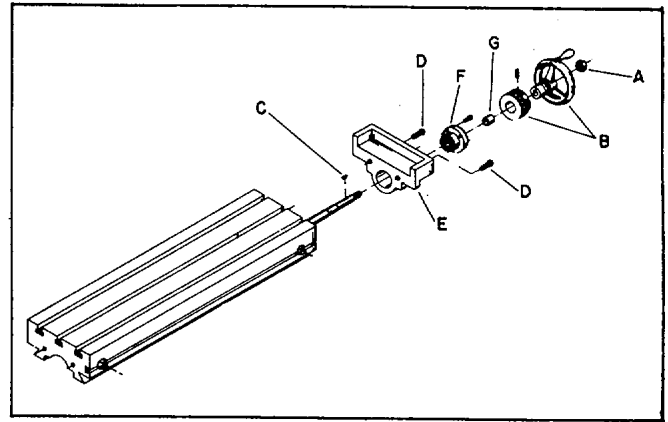


Fig. 2.

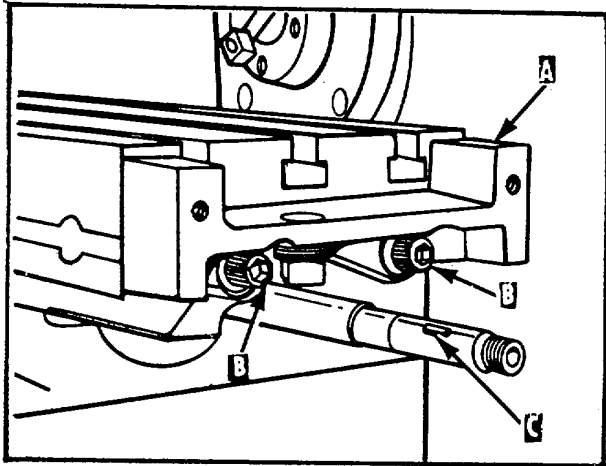


Fig. 3.

3. Assemble the adapter bracket (A) Fig. 3, to the table as shown using the two screws (B) which are supplied with the power table feed.
4. Replace the key (C) Fig. 3, to the table lead screw. This key was removed in STEP 1.

5. Assemble the power feed unit to the adapter bracket (A) Fig. 4, using the two screws supplied. One of the screws can be seen at (B) Fig. 4.

CAUTION

When assembling the power feed unit to the adapter, care should be taken so the key in the lead screw engages the keyway in the sleeve in the power feed unit.

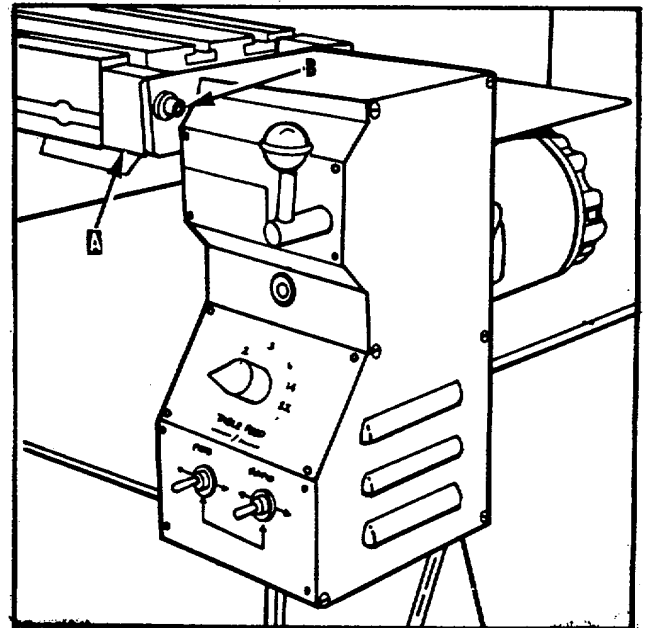


Fig. 4.

OPERATION

The clutch lever (A) Fig. 5, is moved to the vertical position for power feeding and to the horizontal position for manual operation. Select the desired table feed, by rotating the feed selector knob (D) Fig. 5. Place the clutch lever in the vertical position, and push the feed switch (B) in the direction desired. At any time the rapid switch (C) can override the selected feed in either direction. To switch to manual feed, merely flip the clutch lever (A) to the horizontal position and feed manually with the table handwheel.

ADJUSTING THE FEED SELECTOR KNOB

1. Operate the power feed.
2. Measure the distance the table travels in one minute.
3. Loosen set screw in the feed selector knob (D) Fig. 5, rotate the knob until it points to the corresponding feed on the chart, and tighten set screw.

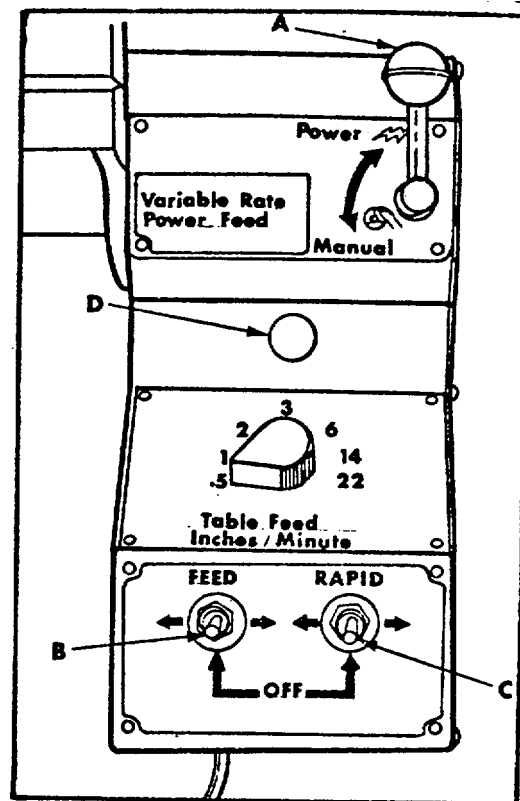
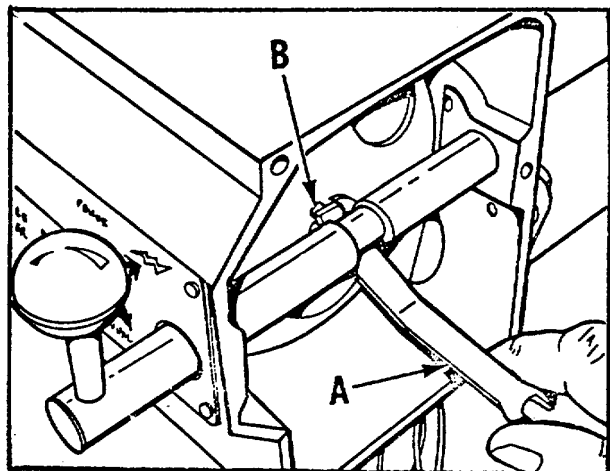


Fig. 5.

OVERLOAD AND) SHIORT CIRCUIT PROTECTION

The motor used on your power table feed is equipped with an integral automatic reset thermal overload protector. This device will cause the motor to shut off when overloaded. After the motor cools three to five minutes, it will automatically reset itself and the table will resume feeding.

The table feed is protected against short circuit by a Type 313-4 Amp. fuse. If short circuit occurs replace the fuse ref. #63 on page 60.



CLUTCH ADJUSTMENT

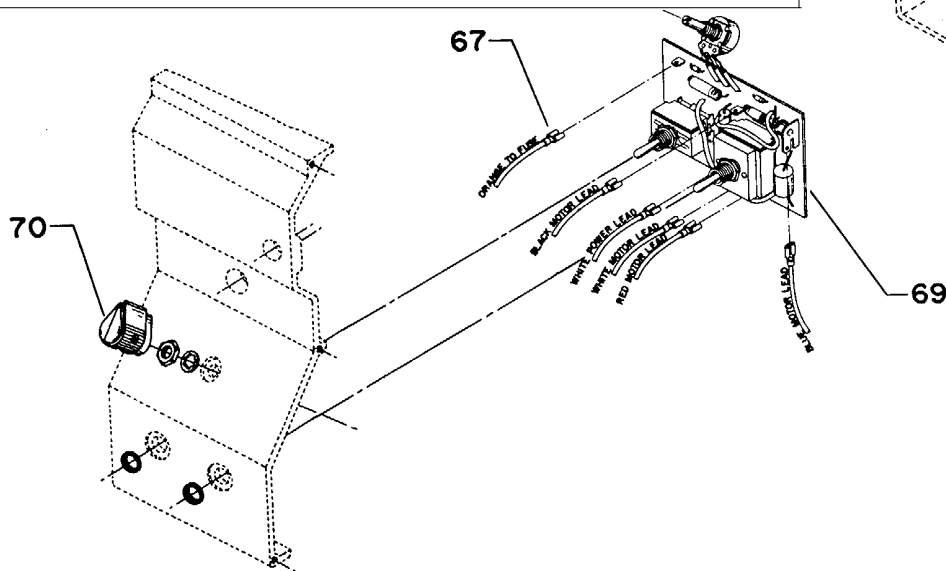
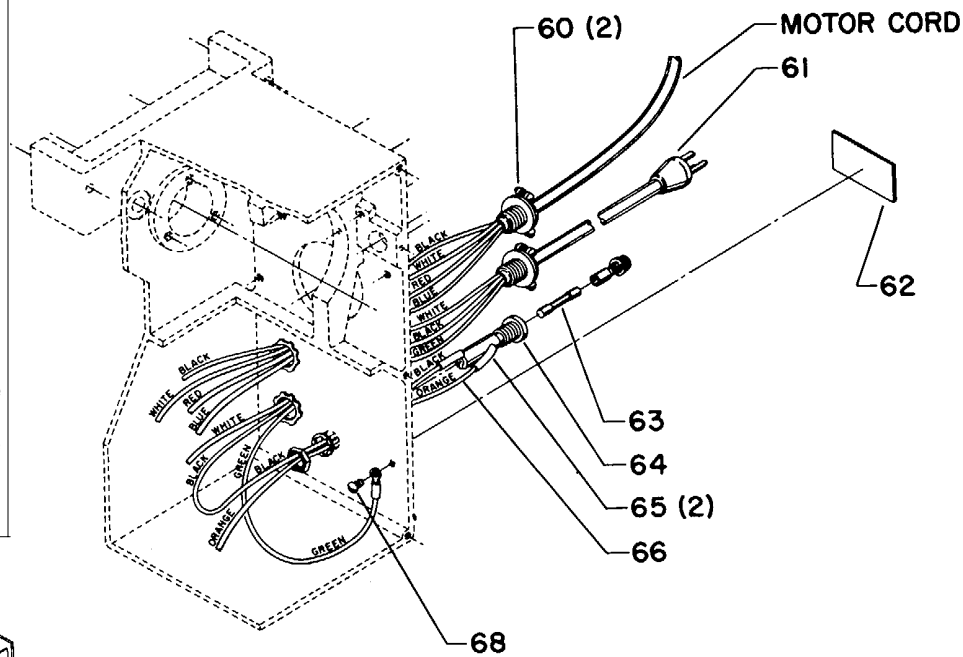
The clutch used on the power table feed is adjustable from 0 to maximum feed pressure. It may be adjusted to slip under any predetermined load, e.g., to, slip at the end of the table travel to avoid damage to the mechanism, to sense dull tools, and to protect motor and gears. If adjustment of the clutch is necessary, proceed as follows:

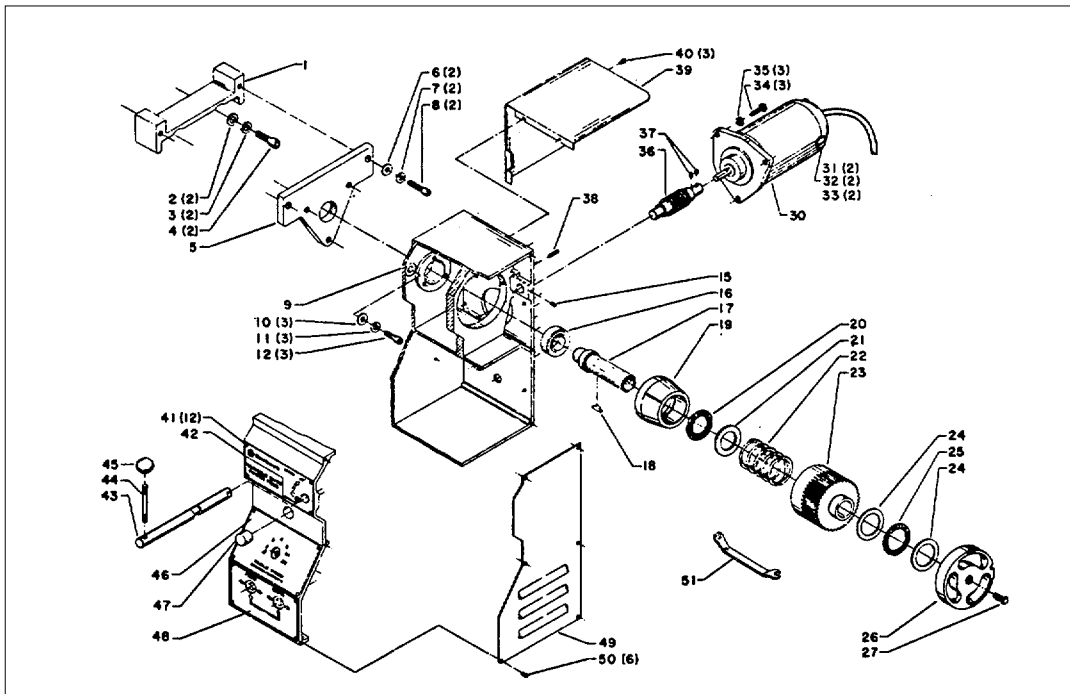
1. Remove the end cover plate from the power feed.
2. Using the special wrench (A) Fig. 6, supplied with the power feed, turn the clutch adjusting screw (B) counterclockwise to increase or clockwise to decrease the clutch pressure. CAUTION: Do not adjust the clutch too tight.

Replacement Parts

Rel. No.	Part. No.	Description
60	SP-2480	Cable Clamp
61	438-01-302-0168	Power Cord w/Terminals
62	960-03-012-0410	Fuse Warning Decal
63	438-01-027-0007	Fuse, Type 313-4 Amp - 1/4 x 1 1/2
64	438-01-007-0037	Fuse. Holder w/Lockwasher, Lock Nut, and Knob
65	438-01-011-0028	Insulator
66	438-01-320-0065	12" Orange Wire Assembly, incl.:
67	438-01-018-0032	Terminal
68	SP-558	#8-32 x 1/4 Rd. Hd. Mach. Scr.
69	438-01-307-0009	Circuit Board Assembly
* 69	438-01-307-0010	Circuit Board Assembly w/Terminals and Wire Nut
70	931-01-022-0476	Knob w/#8-32 x 1/4 Hex. Soc. Set Scr.

** Due to a recent improvement in the power feed circuit, the old circuit board and the component parts are no longer available. The customer with the old style power feed circuit should order the 438-01-307-0010. Circuit Board Assembly, which includes all necessary parts for conversion to the new circuit. See page 67 for: information on installation of the new circuit.

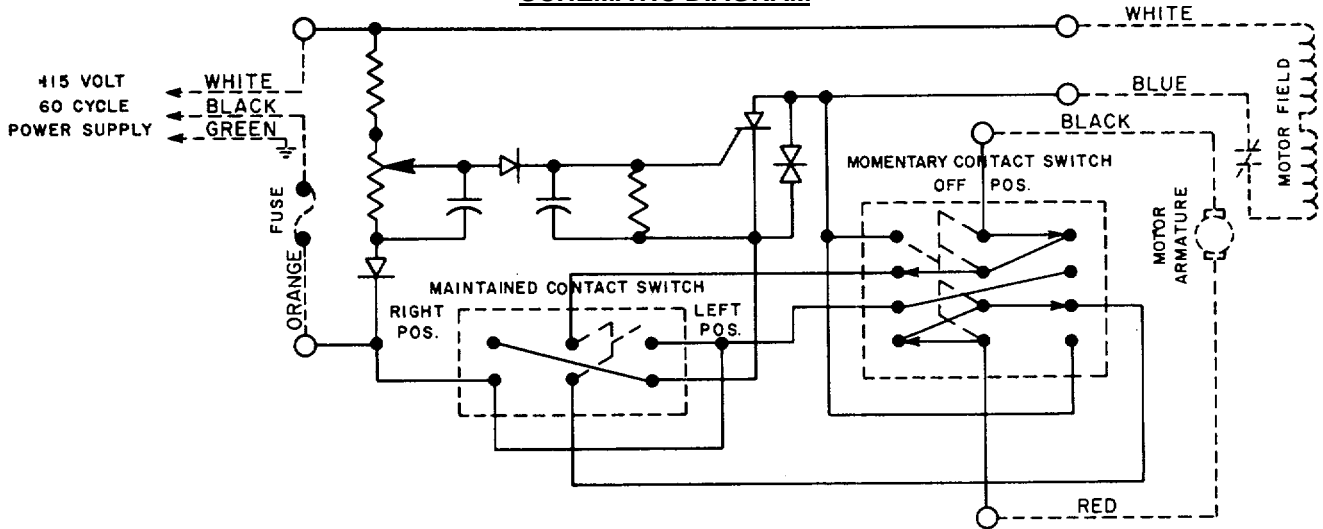




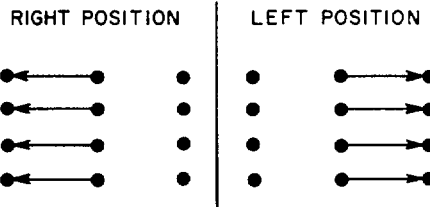
Replacement Parts

Ref. No.	Part No.	Description	Ref. No.	Part No.	Description
1	450-02-001-0006	Adapter	32	438-02-011-0007	Brush Holder (General Electric #625A679ABG1)
2	SP-1615	13/32 x 13/16 x 1/16" Washer	32	438-02-011-0014	Brush Holder Assembly (Robbins & Myers #7025285000)
3	SP-1704	3/8" Split Lockwasher	33	438-02-011-0008	Brush Holder Cap (General Electric #8701254)
4	SP-775	3/8-16 x 1" Soc. Hd. Cap Scr.	33	438-02-011-0015	Brush Holder Cap (Robbins & Myers #7025279001)
5	450-02-072-0003	Adapter Plate	34	SP-S26	1/4-20 x 3/4" Hex. Hd. Scr.
6	SP-1604	5/16 x 3/4 x 1/16" Washer	35	SP-1702	1/4" Split Lockwasher
7	SP-2086	5/16" Split Lockwasher	36	450-02-406-0001	Worm Shaft Assembly. incl:
8	901-03-010-3315	5/16-18 x 1" Soc. Hd. Cap Scr.	37	901-04-150-9417	#10-32 x 3/16 Soc. Set Scr.
9	450-02-013-0002	Gear Box	38	SP-6715	3/16 x 5/8" Roll Pin
10	SP-1604	5/16 x 3/4 x 1/16" Washer	39	450-02-354-0002	Guard
11	SP-2086	5/16" Split Lockwasher	40	SP-558	#8-32 x 1/4" Rd. Hd. Scr.
12	SP-757	5/16-18 x 3/4" Soc. Hd. Cap Screw	41	SP-2250	#4 - 3/16" Drive Screw
15	SP-286	#8-32 x 1/4" Soc Set Scr.	42	960-02-012-0032	Power Feed Plate
16	920-04-051-6667	Ball Bearing	43	450-02-406-0002	Clutch Shaft, including:
17	450-02-105-0014	Sleeve	44	450-02-111-0001	Stud
18	SP-2605	#505 Hi-Pro Key	45	MK-5448	Knob
19	450-02-028-0002	Clutch	46	960-02-012-0033	Table Feed Dial Plate
20	920-45-001-6553	Needle Thrust Bearing	47	920-23-012-0962	Needle Roller Bearing
21	921-04-011-6556	Race	48	960-02-012-0034	Power Feed Switch Plate
22	928-01-041-5871	Spring	49	450-02-331-0003	Gear Box Cover
23	450-02-051-0007	Gear	50	SP-558	#8-32 x 1/4" Rd Hd Scr.
24	920-45-022-0961	Race	51	450-02-101-0001	Clutch Adjusting Wrench
25	920-45-011-8061	Needle Thrust Bearing	*	450-02-061-0001	2 oz. Tube Grease (Esso Nebula #2)
26	450-02-089-0003	Clutch Support Plate			
27	901-04-021-6258	5/16-18 x 5/8" Adjustment Scr. with Nyllok Insert			
30	438-02-314-0402	Motor Assembly, including:			
31	438-02-007-0002	Brush Assembly (General Electric #625A619AHG5)			
31	438-02-007-0007	Brush Assembly (Robbins & Myers #7025285000)			
					Not shown

SCHEMATIC DIAGRAM



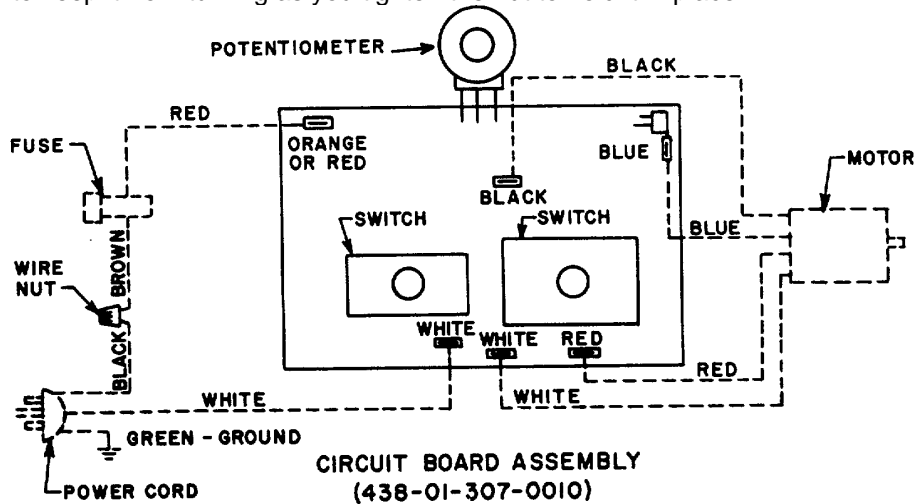
MOMENTARY CONTACT SWITCH CIRCUITRY
(VIEWED FROM REAR)



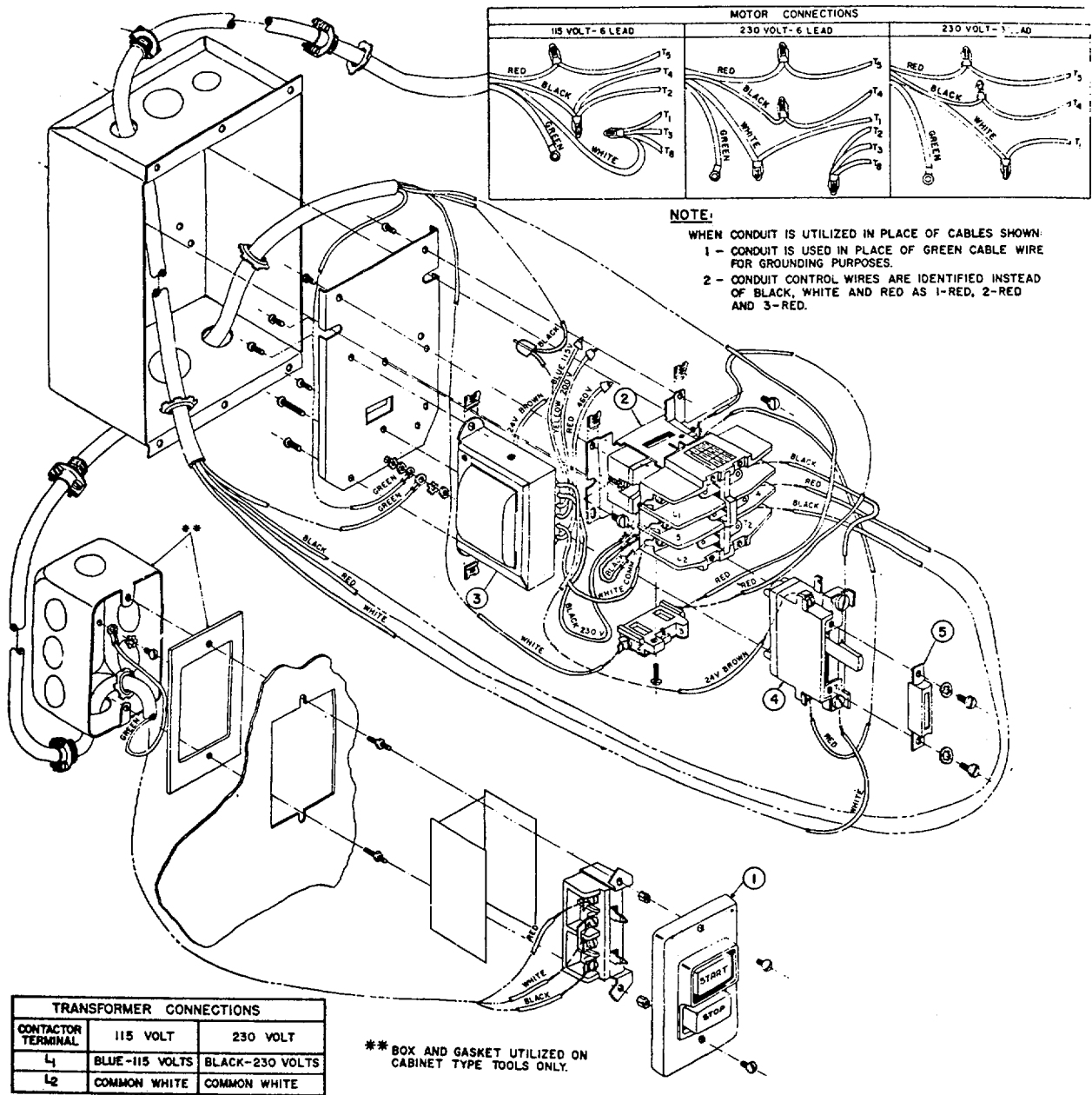
**ASSEMBLING NEW CIRCUIT BOARD ASSEMBLY
TO POWER FEEDS WITH THE OLD STYLE POWER FEED CIRCUIT**

Remove old circuit board assembly, switches, relay and relay socket. Install the new terminals on the white power cord lead, the four motor leads and the red wire on the fuse holder. Use the wire nut to connect the black power cord lead to the brown fuse lead. Plug in the terminals to the proper connections on the board1 (See printing on board and the diagram below.)

The board is now ready for installation in the Gear Box. This is a simple matter of inserting the switches and potentiometer in the proper holes. The board is held in place by the nuts used on the three parts. Care must be taken to hold the potentiometer by hand to keep it from turning as you tighten the nut to hold it in place.



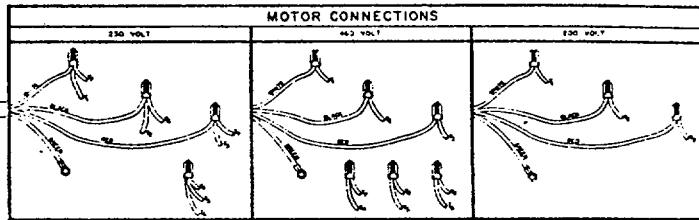
NO. 2 24 VOLT SINGLE PHASE MAGNETIC STARTER MOTOR CONTROL SYSTEM



REPLACEMENT PARTS

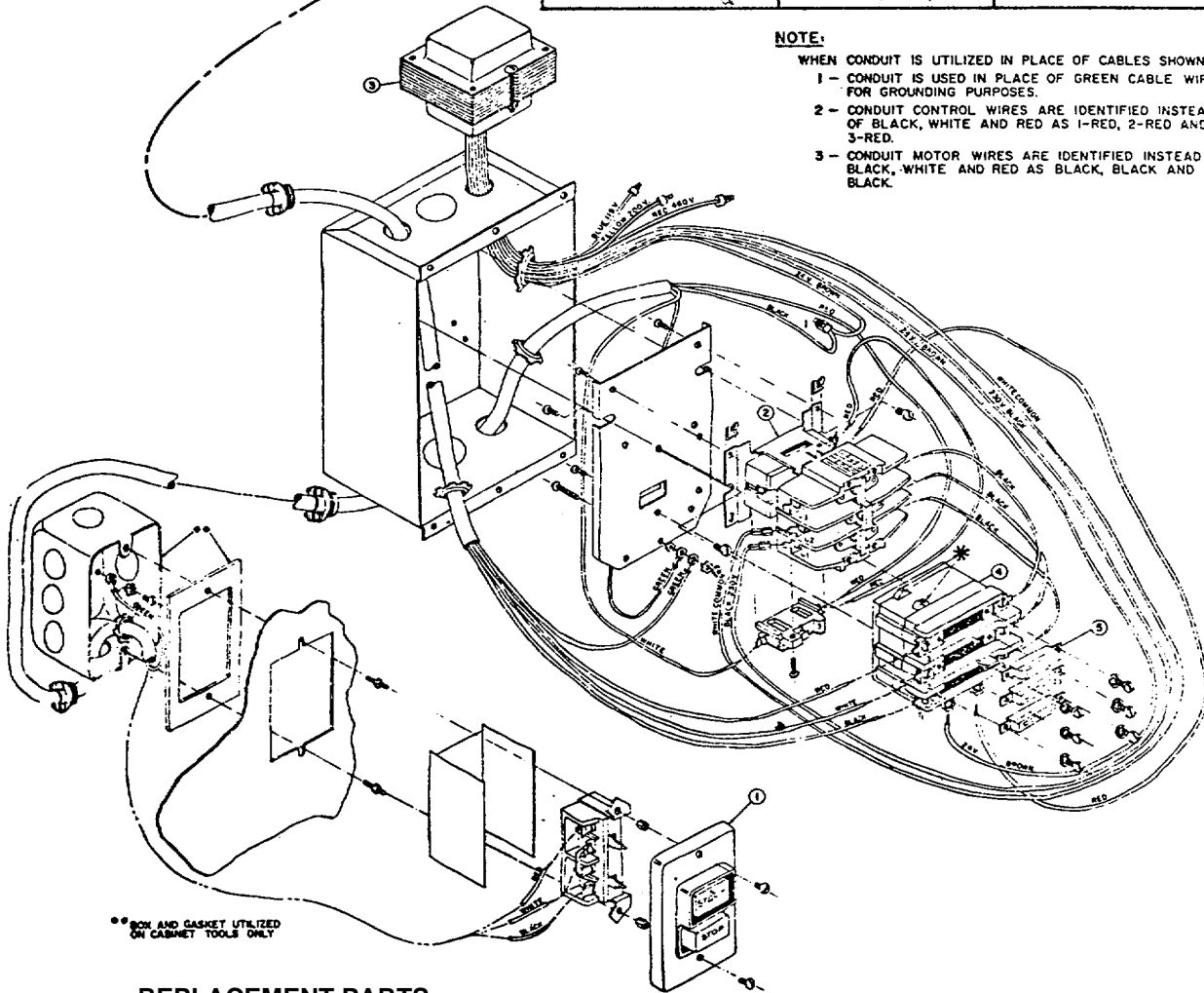
- | | | |
|---|-------------|-----------------|
| 1 | 52-348 | Control Station |
| 2 | 1225237 | Contractor |
| 3 | 1086720 | Transformer |
| 4 | 1225250 | Overload Block |
| 5 | Specify No. | Heater |

NO. 3 24 VOLT THREE PHASE MAGNETIC STARTER MOTOR CONTROL SYSTEM



NOTE:

- WHEN CONDUIT IS UTILIZED IN PLACE OF CABLES SHOWN:
- 1 - CONDUIT IS USED IN PLACE OF GREEN CABLE WIRE FOR GROUNDING PURPOSES.
 - 2 - CONDUIT CONTROL WIRES ARE IDENTIFIED INSTEAD OF BLACK, WHITE AND RED AS 1-RED, 2-RED AND 3-RED.
 - 3 - CONDUIT MOTOR WIRES ARE IDENTIFIED INSTEAD OF BLACK, WHITE AND RED AS BLACK, BLACK AND BLACK.

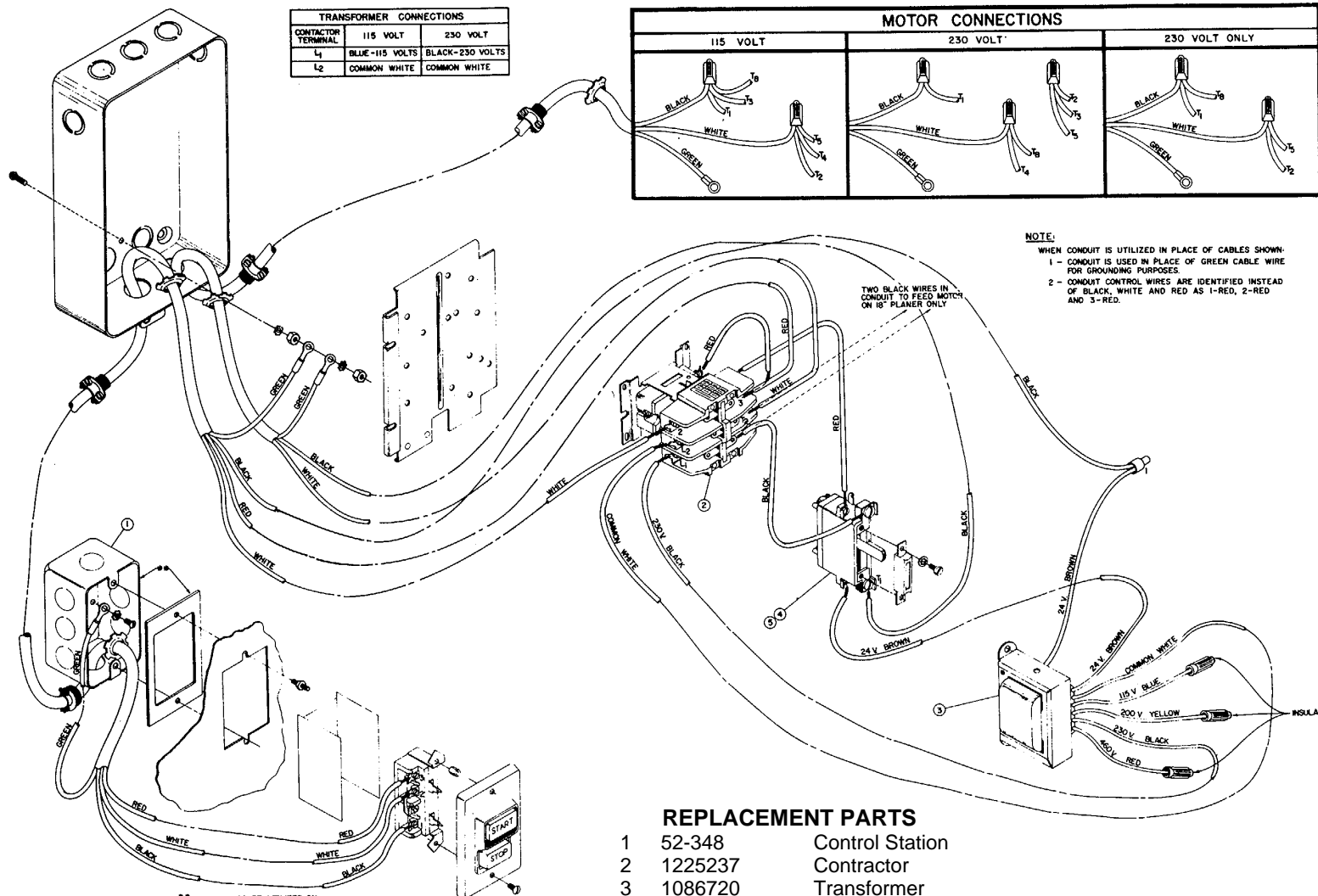


REPLACEMENT PARTS

- | | | |
|---|-------------|-----------------|
| 1 | 52-348 | Control Station |
| 2 | 1225237 | Contractor |
| 3 | 1086753 | Transformer |
| 4 | 1225235 | Overload Block |
| 5 | Specify No. | Heater |

TRANSFORMER CONNECTIONS			
CONTACTOR TERMINAL	230 VOLT	460 VOLT	200 VOLT
L ₁	BLACK-230 VOLTS	RED-460 VOLTS	YELLOW-200 VOLTS
L ₂	COMMON WHITE	COMMON WHITE	COMMON WHITE

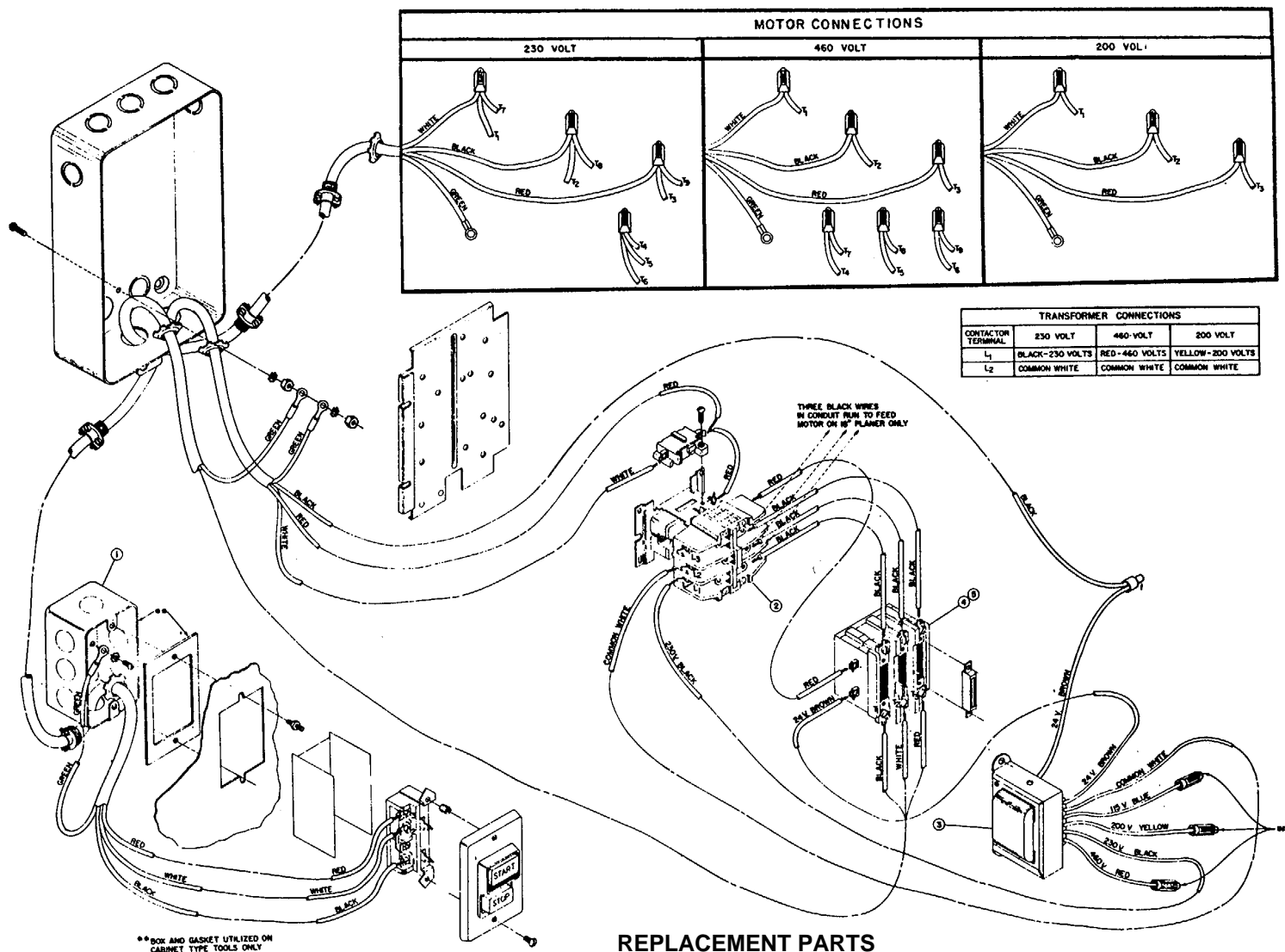
NO. 4 24 VOLT SINGLE PHASE MAGNETIC STARTER MOTOR CONTROL SYSTEM



REPLACEMENT PARTS

- | | | |
|---|-------------|-----------------|
| 1 | 52-348 | Control Station |
| 2 | 1225237 | Contractor |
| 3 | 1086720 | Transformer |
| 4 | 1225250 | Overload Block |
| 5 | Specify No. | Heater |

NO. 5 24 VOLT THREE PHASE MAGNETIC STARTER MOTOR CONTROL SYSTEM



MOTOR CONNECTIONS		
230 VOLT	460 VOLT	200 VOLT

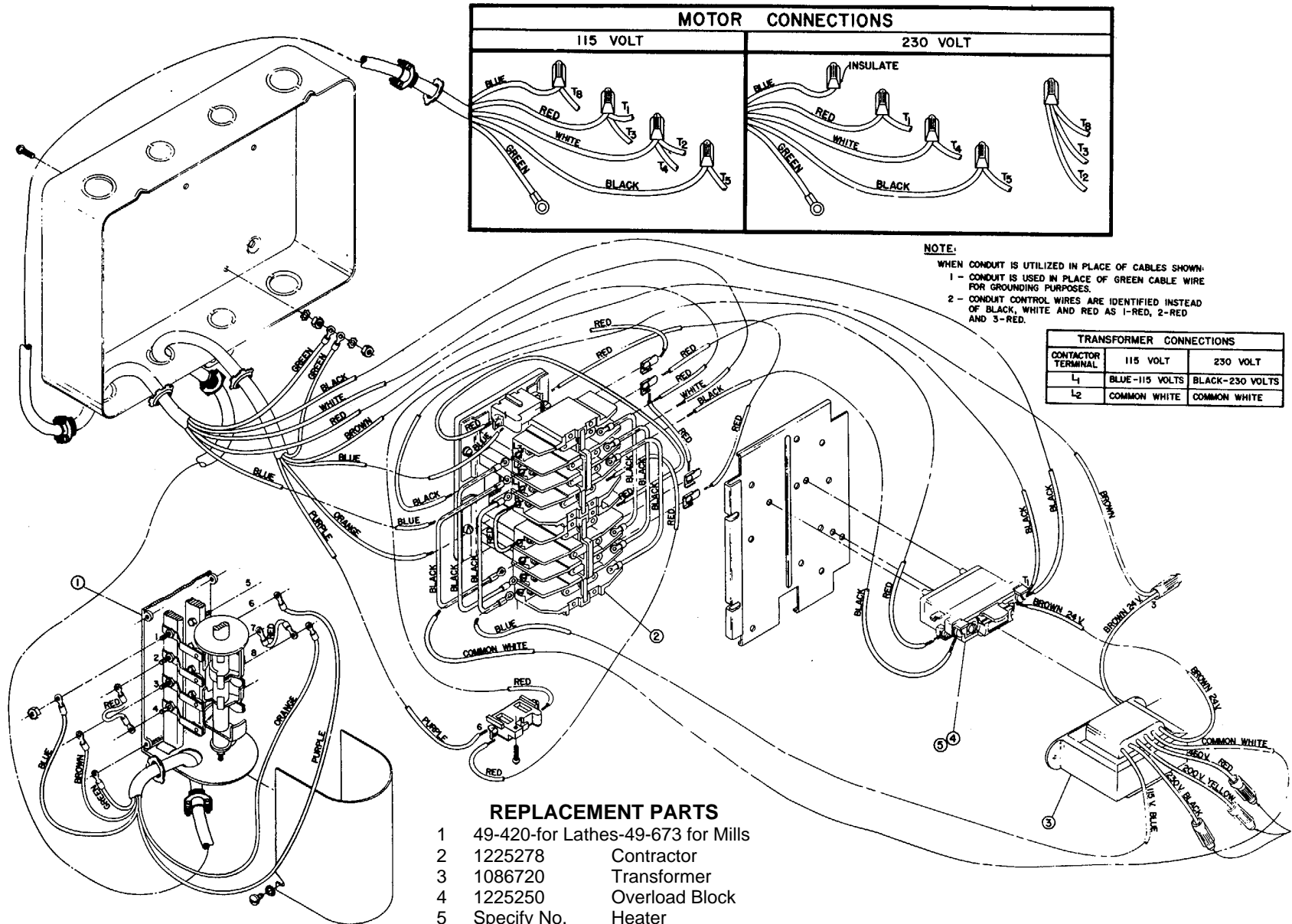
TRANSFORMER CONNECTIONS			
CONTACTOR TERMINAL	230 VOLT	460-VOLT	200 VOLT
L ₁	BLACK-230 VOLTS	RED-460 VOLTS	YELLOW-200 VOLTS
L ₂	COMMON WHITE	COMMON WHITE	COMMON WHITE

**BOX AND GASKET UTILIZED ON CABINET TYPE TOOLS ONLY

- REPLACEMENT PARTS**
- 1 52-348 Control Station
 - 2 1225237 Contractor
 - 3 1086720 Transformer
 - 4 1225235 Overload Block
 - 5 Specify No. Heater

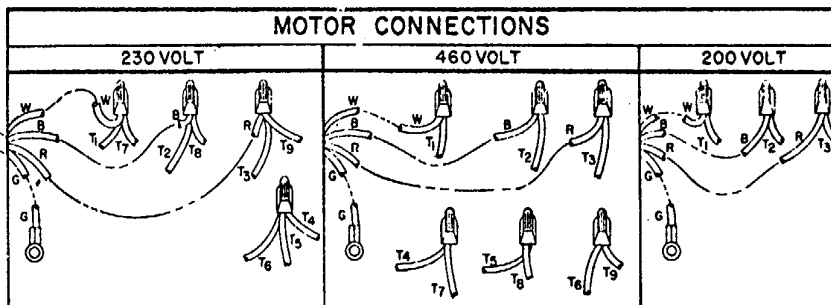
NOTE:
 WHEN CONDUIT IS UTILIZED IN PLACE OF CABLES SHOWN:
 1 - CONDUIT IS USED IN PLACE OF GREEN CABLE WIRE FOR GROUNDING PURPOSES
 2 - CONDUIT CONTROL WIRES ARE IDENTIFIED INSTEAD OF BLACK, WHITE AND RED AS 1-RED, 2-RED AND 3-RED
 3 - CONDUIT MOTOR WIRES ARE IDENTIFIED INSTEAD OF BLACK, WHITE AND RED AS BLACK, BLACK AND BLACK

NO. 6 24 VOLT SINGLE PHASE REVERSING MAGNETIC STARTER MOTOR CONTROL SYSTEM



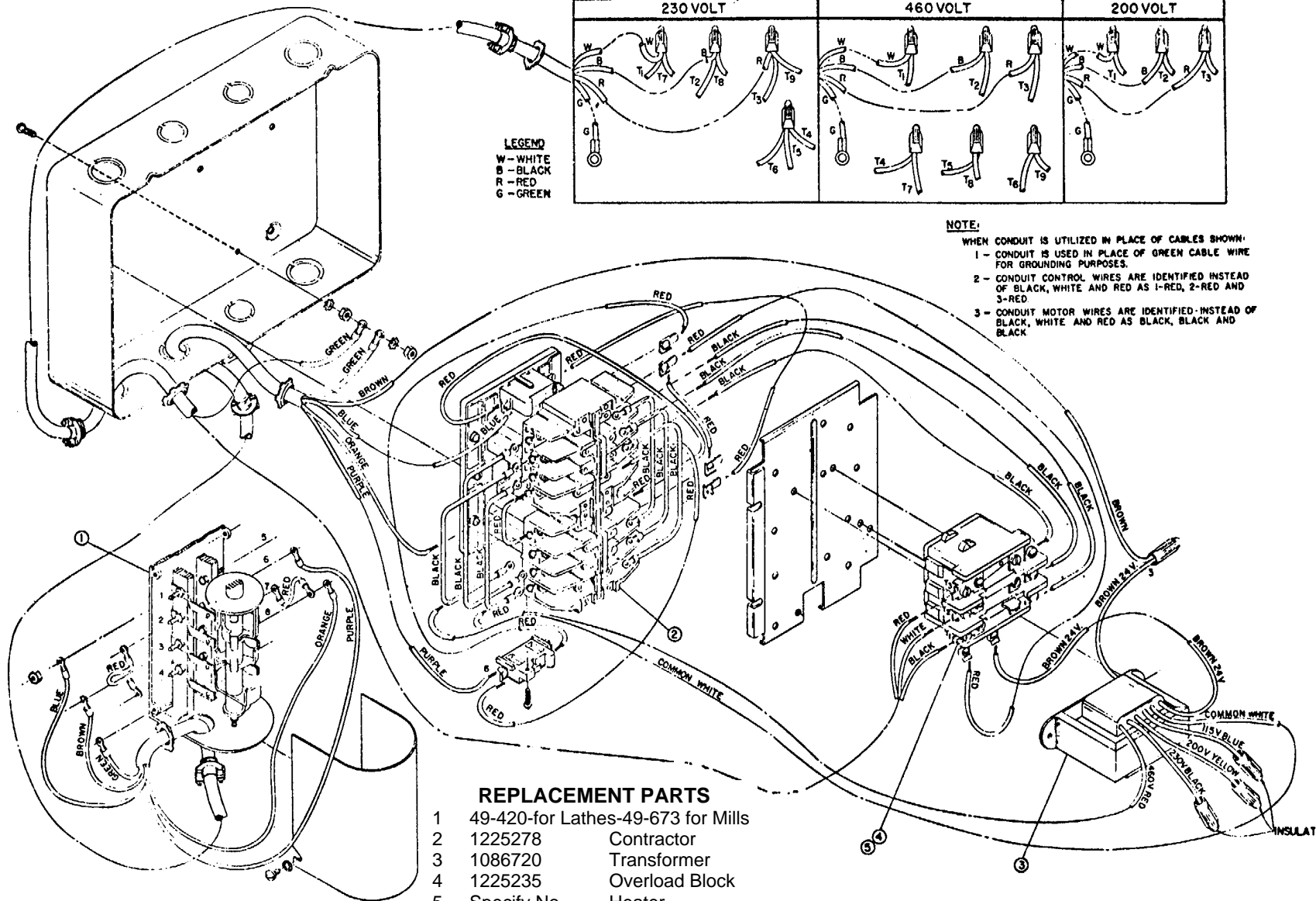
NO. 7 24 VOLT THREE PHASE REVERSING MAGNETIC STARTER MOTOR CONTROL SYSTEM

TRANSFORMER CONNECTIONS			
CONTACTOR TERMINAL	230 VOLT	460 VOLT	200 VOLT
L ₁	BLACK-230 VOLTS	RED-460 VOLTS	YELLOW-200 VOLTS
L ₂	COMMON WHITE	COMMON WHITE	COMMON WHITE

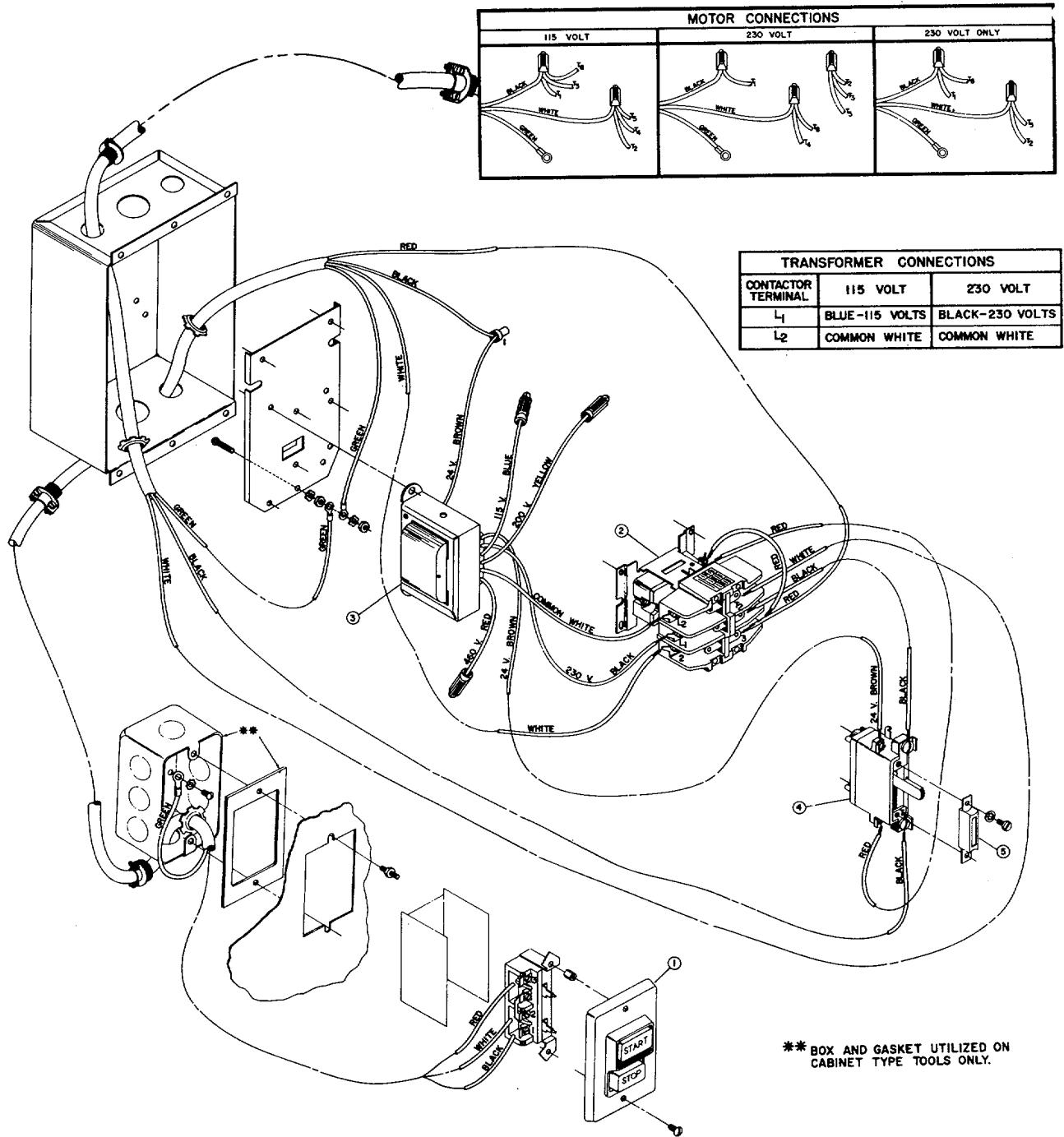


LEGEND
 W - WHITE
 B - BLACK
 R - RED
 G - GREEN

NOTE:
 WHEN CONDUIT IS UTILIZED IN PLACE OF CABLES SHOWN:
 1 - CONDUIT IS USED IN PLACE OF GREEN CABLE WIRE FOR GROUNDING PURPOSES.
 2 - CONDUIT CONTROL WIRES ARE IDENTIFIED INSTEAD OF BLACK, WHITE AND RED AS 1-RED, 2-RED AND 3-RED.
 3 - CONDUIT MOTOR WIRES ARE IDENTIFIED INSTEAD OF BLACK, WHITE AND RED AS BLACK, BLACK AND BLACK.



NO. 8 24 VOLT SINGLE PHASE MAGNETIC STARTER MOTOR CONTROL SYSTEM



TRANSFORMER CONNECTIONS		
CONTACTOR TERMINAL	115 VOLT	230 VOLT
L ₁	BLUE-115 VOLTS	BLACK-230 VOLTS
L ₂	COMMON WHITE	COMMON WHITE

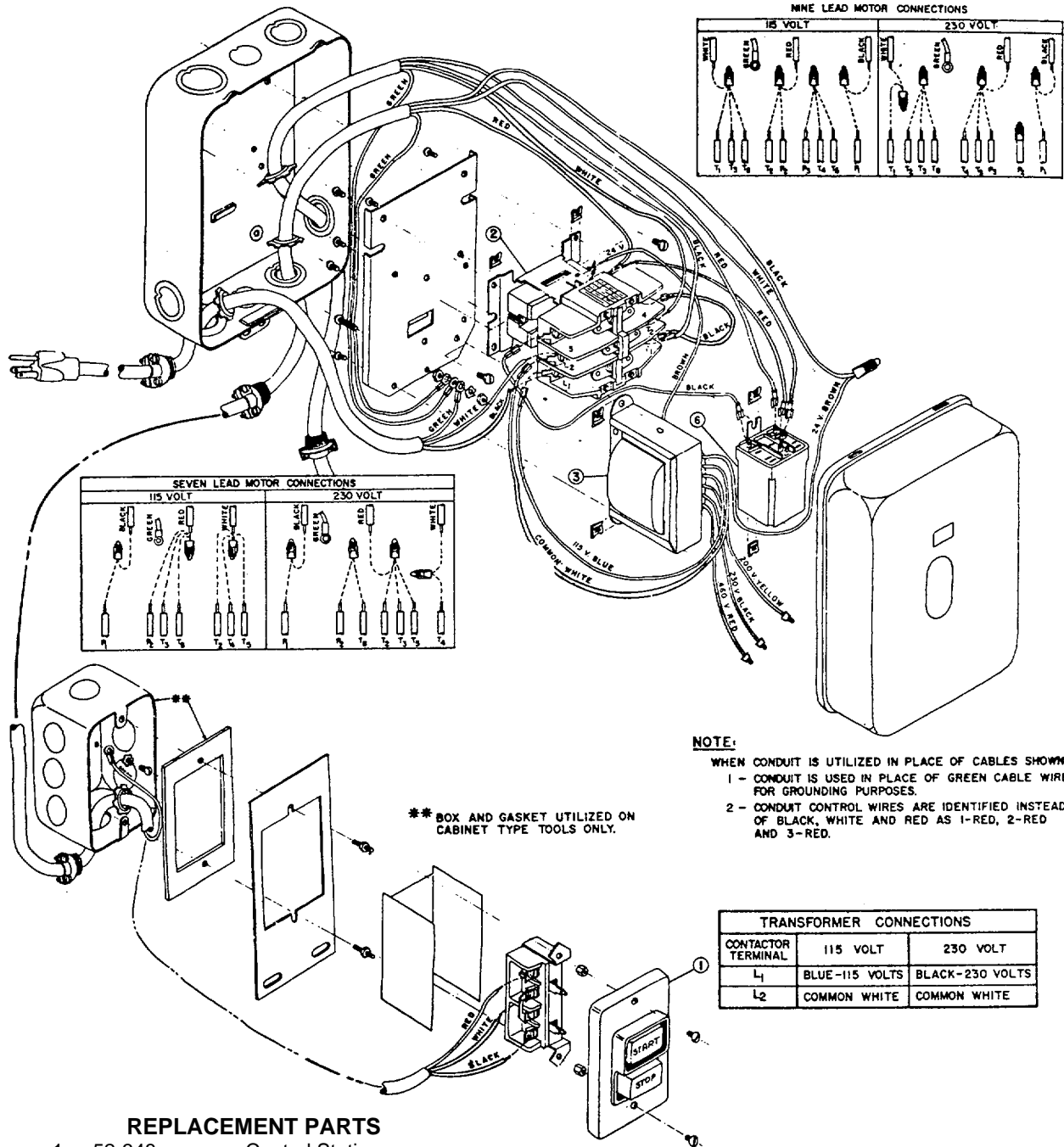
REPLACEMENT PARTS

- | | | |
|---|-------------|-----------------|
| 1 | 52-348 | Control Station |
| 2 | 1225237 | Contractor |
| 3 | 1086720 | Transformer |
| 4 | 1225250 | Overload Block |
| 5 | Specify No. | Heater |

NOTE:

- WHEN CONDUIT IS UTILIZED IN PLACE OF CABLES SHOWN:
- 1 - CONDUIT IS USED IN PLACE OF GREEN CABLE WIRE FOR GROUNDING PURPOSES.
 - 2 - CONDUIT CONTROL WIRES ARE IDENTIFIED INSTEAD OF BLACK, WHITE AND RED AS 1-RED, 2-RED AND 3-RED.

NO. 9 24 VOLT SINGLE PHASE INTEGRAL MOTOR OVERLOAD PROTECTION MAGNETIC MOTOR CONTROL SYSTEM



NINE LEAD MOTOR CONNECTIONS

115 VOLT			230 VOLT		
BLACK	RED	BLACK	BLACK	RED	BLACK
GREEN	WHITE	BLACK	BLACK	RED	BLACK
RED	WHITE	BLACK	BLACK	RED	BLACK
GREEN	WHITE	BLACK	BLACK	RED	BLACK
RED	WHITE	BLACK	BLACK	RED	BLACK
GREEN	WHITE	BLACK	BLACK	RED	BLACK

SEVEN LEAD MOTOR CONNECTIONS

115 VOLT			230 VOLT		
BLACK	RED	WHITE	BLACK	RED	WHITE
GREEN	WHITE	WHITE	BLACK	RED	WHITE
RED	WHITE	WHITE	BLACK	RED	WHITE
GREEN	WHITE	WHITE	BLACK	RED	WHITE
RED	WHITE	WHITE	BLACK	RED	WHITE
GREEN	WHITE	WHITE	BLACK	RED	WHITE

NOTE:
 WHEN CONDUIT IS UTILIZED IN PLACE OF CABLES SHOWN:
 1 - CONDUIT IS USED IN PLACE OF GREEN CABLE WIRE FOR GROUNDING PURPOSES.
 2 - CONDUIT CONTROL WIRES ARE IDENTIFIED INSTEAD OF BLACK, WHITE AND RED AS 1-RED, 2-RED AND 3-RED.

** BOX AND GASKET UTILIZED ON CABINET TYPE TOOLS ONLY.

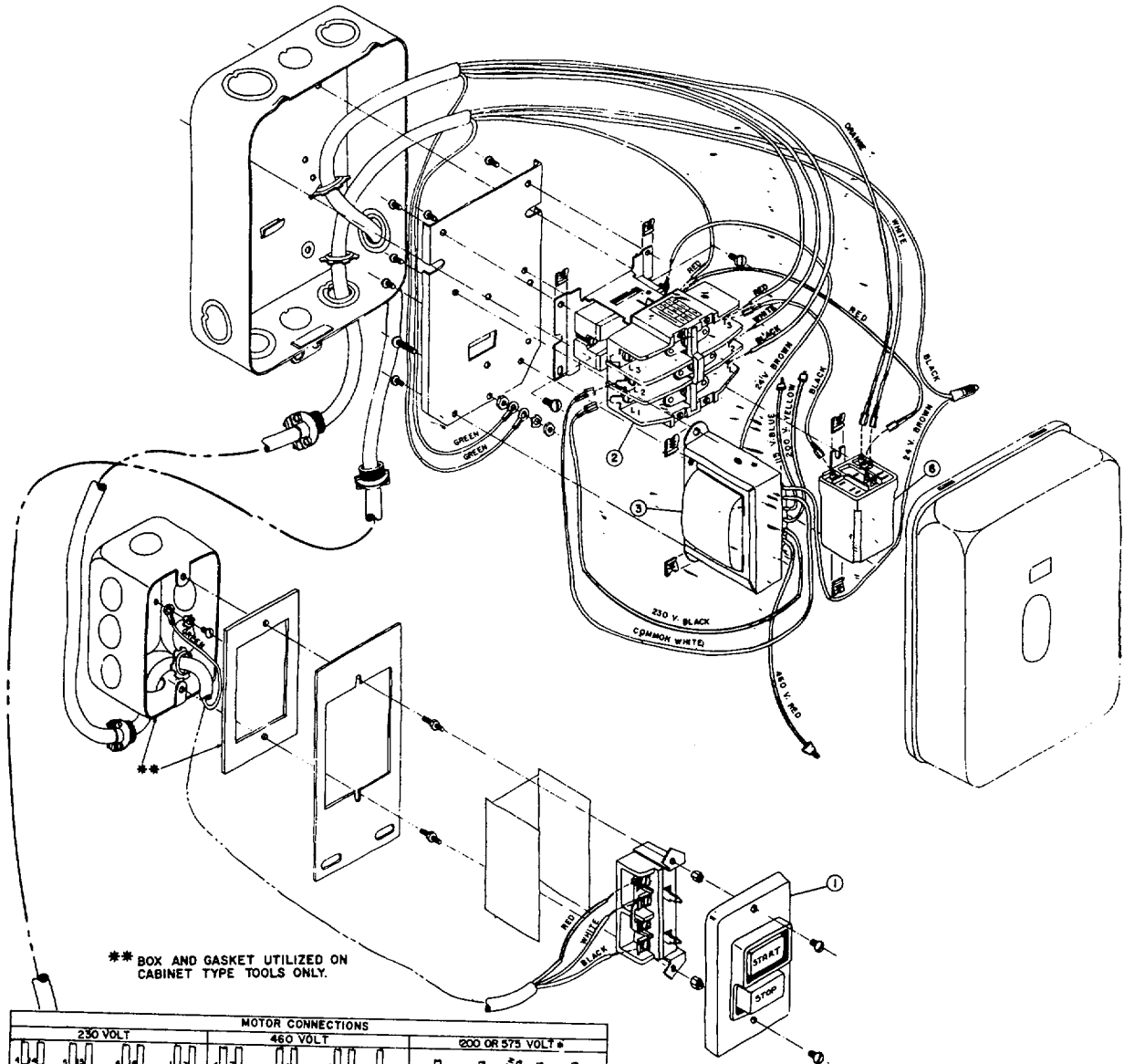
TRANSFORMER CONNECTIONS

CONTACTOR TERMINAL	115 VOLT	230 VOLT
L ₁	BLUE-115 VOLTS	BLACK-230 VOLTS
L ₂	COMMON WHITE	COMMON WHITE

REPLACEMENT PARTS

- 1 52-348 Control Station
- 2 1225237 Contactor
- 3 1086720 Transformer
- 4 1225234 Relay

NO. 10 24 VOLT THREE PHASE INTEGRAL MOTOR OVERLOAD PROTECTION MAGNETIC MOTOR CONTROL SYSTEM



MOTOR CONNECTIONS		
230 VOLT	460 VOLT	200 OR 575 VOLT*
* ANY SINGLE VOLTAGE MOTOR		

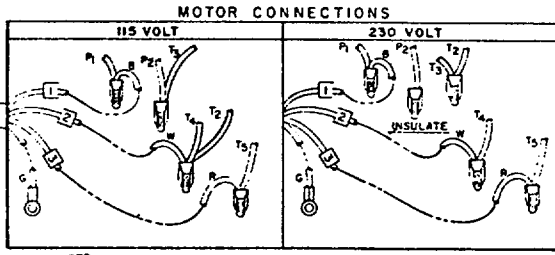
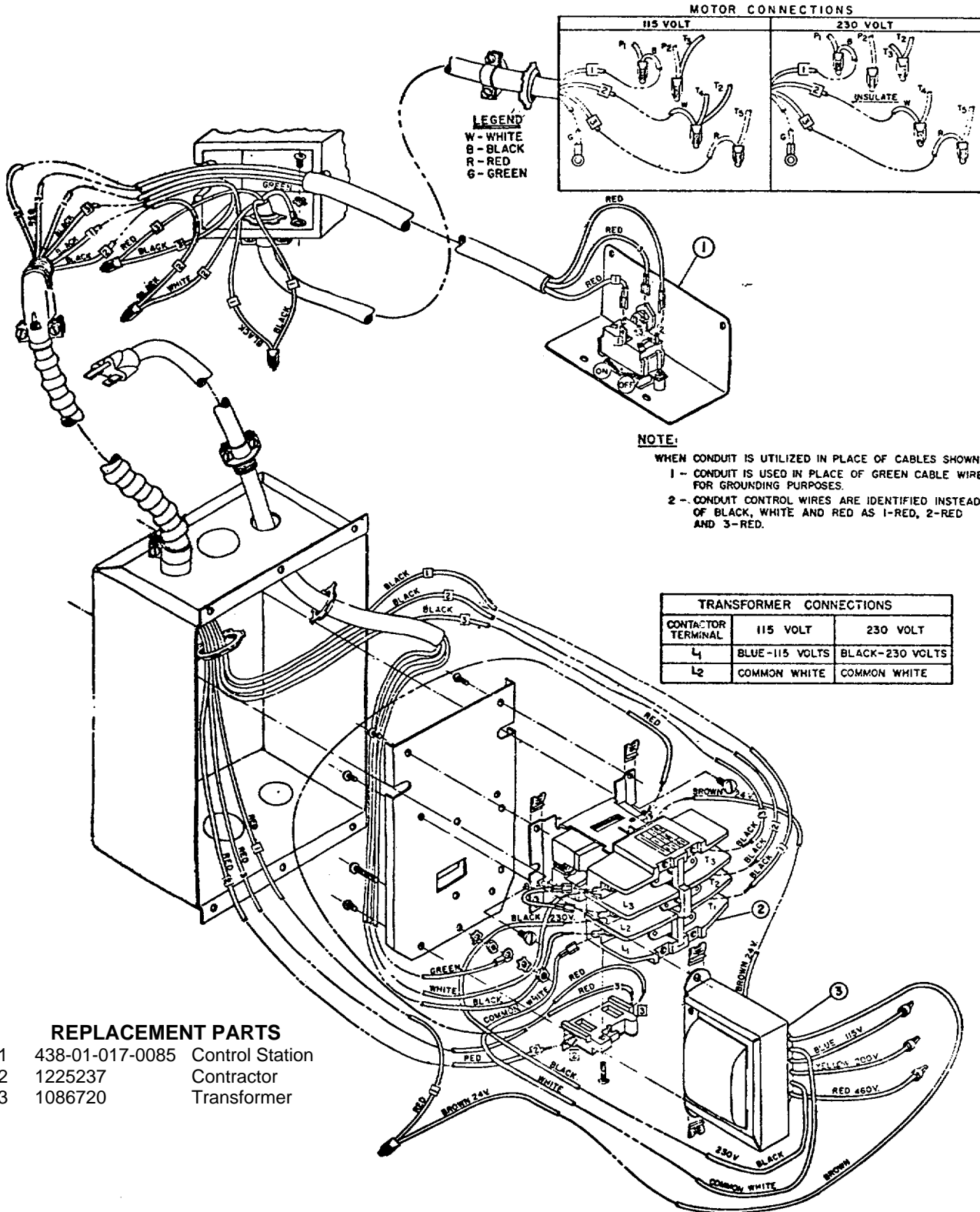
NOTE:
 WHEN CONDUIT IS UTILIZED IN PLACE OF CABLES SHOWN:
 1 - CONDUIT IS USED IN PLACE OF GREEN CABLE WIRE FOR GROUNDING PURPOSES.
 2 - CONDUIT CONTROL WIRES ARE IDENTIFIED INSTEAD OF BLACK, WHITE AND RED AS 1-RED, 2-RED AND 3-RED.
 3 - CONDUIT MOTOR WIRES ARE IDENTIFIED INSTEAD OF BLACK, WHITE AND RED AS BLACK, BLACK AND BLACK.

REPLACEMENT PARTS

- 1 52-348 Control Station
- 2 1225237 Contractor
- 3 1086720 Transformer
- 4 1225234 Relay

TRANSFORMER CONNECTIONS			
CONTACTOR TERMINAL	230 VOLT	460 VOLT	200 VOLT
L ₁	BLACK-230 VOLTS	RED-460 VOLTS	YELLOW-200 VOLTS
L ₂	COMMON WHITE	COMMON WHITE	COMMON WHITE

NO. 11 24 VOLT SINGLE PHASE INTEGRAL MOTOR OVERLOAD PROTECTION MAGNETIC MOTOR CONTROL SYSTEM



LEGEND
 W - WHITE
 B - BLACK
 R - RED
 G - GREEN

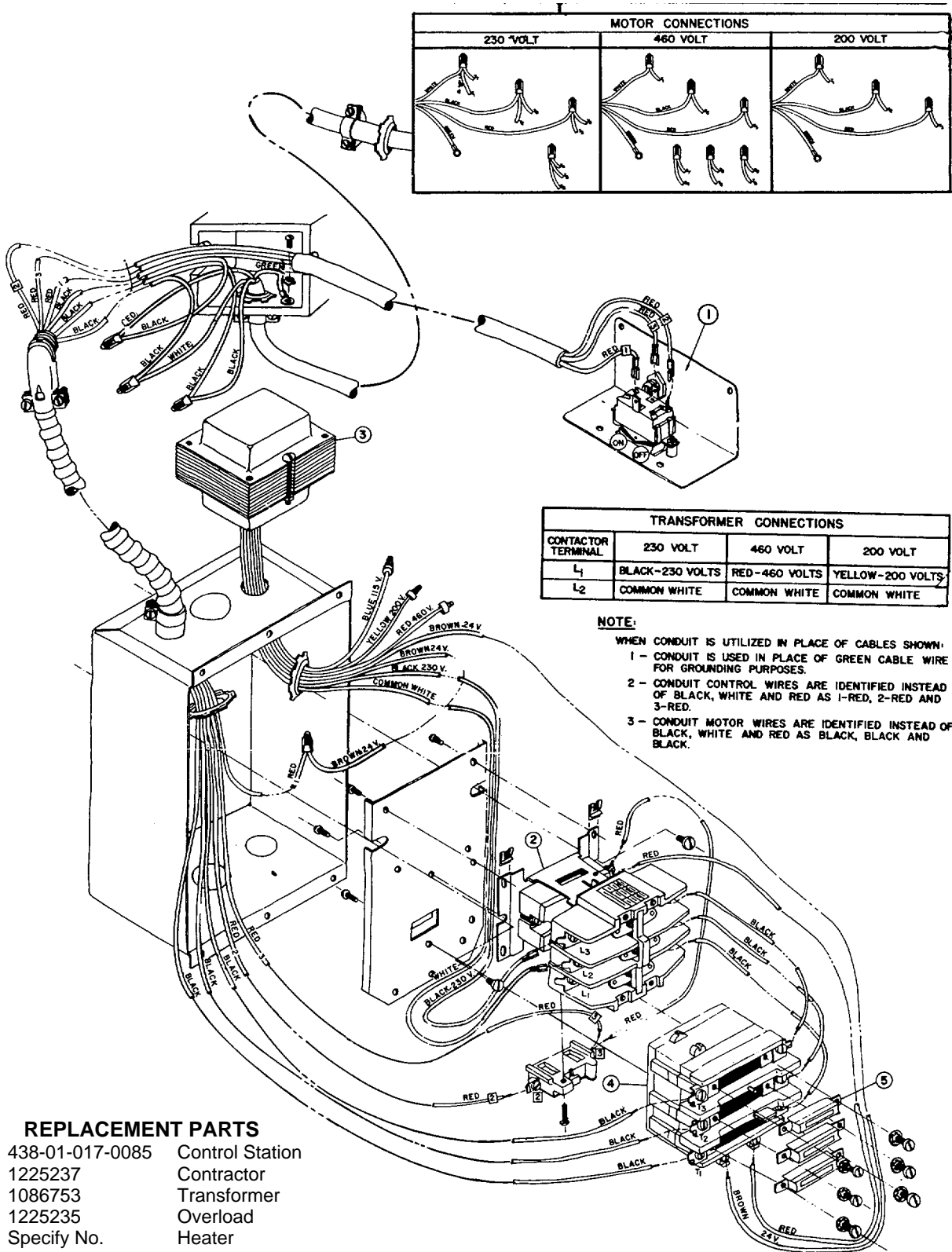
NOTE:
 WHEN CONDUIT IS UTILIZED IN PLACE OF CABLES SHOWN:
 1 - CONDUIT IS USED IN PLACE OF GREEN CABLE WIRE FOR GROUNDING PURPOSES.
 2 - CONDUIT CONTROL WIRES ARE IDENTIFIED INSTEAD OF BLACK, WHITE AND RED AS 1-RED, 2-RED AND 3-RED.

TRANSFORMER CONNECTIONS

CONTACTOR TERMINAL	115 VOLT	230 VOLT
L1	BLUE-115 VOLTS	BLACK-230 VOLTS
L2	COMMON WHITE	COMMON WHITE

- REPLACEMENT PARTS**
- 1 438-01-017-0085 Control Station
 - 2 1225237 Contractor
 - 3 1086720 Transformer

NO. 12 24 VOLT THREE PHASE MAGNETIC STARTER MOTOR CONTROL SYSTEM



NOTES ON TROUBLESHOOTING

Occasionally trouble may develop with your Power Tools. Usually, the trouble can be spotted immediately and corrected. It is possible, however, a vibration, unusual noise, etc., may develop that would indicate a future malfunction of the machine. Naturally, immediate correction of this situation will, in most cases, prevent a costly breakdown. These trouble spots are not always easy to find, but if the following steps are followed the trouble can usually be located and corrected.

1. Disconnect the motor from the belt, gearbox or cutter-head and turn it on. If the trouble is in the motor, it will become immediately evident (a bad bearing or line voltage loss).
2. Examine the condition of the belts and pulleys. If the pulley is cracked or broken, replace it. An out of balance pulley will soon create other problems. If the belt is frayed or excessively worn, replace it and find the cause.
3. Check the tightness of set screws. A loose set screw sounds like a bad bearing.
4. Check the alignment of the pulleys.
5. Check the arbor or the spindle. If the bearings are rough or the spindle is bent, replace same.
6. Examine the cutting tool or the blade. A dull blade will put undue strain on the machine.

If, after all these steps have been followed and the problem has not been corrected, contact your distributor for assistance.

HORIZONTAL/VERTICAL MILLING MACHINE

CATALOG LISTING

No. 21-122 Horizontal-Vertical Milling Machine on cabinet, less electricals. Consists of 21-120 Horizontal Mill with hand **50W** feed table, plus 21-816 Vertical Head, shipped separately. 1,050 lbs.

60 hertz with 8-foot grounding type cord and plug. Available factory mounted and wired on Horizontal-Vertical Milling Machine. Instructions for field mounting are included. Fits in place of right table hand wheel, but left table hand wheel still can be used. No. 21-838 Table Travel Limit Switch Kit is recommended. 28 lbs.

VARIABLE RATE TABLE FEED

No. 21-820 Variable Rate Power Table Feed for 115 V, single phase.

**MOTORS AND CONTROLS (Factory Mounted and Wired—NEMA 145T)
HORIZONTAL MILLING MACHINE**

MOTOR	MOTOR CONTROL	HERTZ AND MOTOR RPM	MOTOR VOLTAGE	SHIP. WT. LBS.	CATALOG NUMBER	CAT. NO. 200 V
Single Phase, 1½ Horsepower	LVC CONTROL—24 V Push Button Reversing Station, Magnetic Starter, Transformer and Overload Protection	60-1725	115/230	70	49-697	
Three Phase, 1½ Horsepower	LVC CONTROL—24 V Push Button Reversing Station, Magnetic Starter, Transformer and 3-Leg Overload Protection	60-1725	230/460	64	149-774	152-193

NOTE: Three phase electricals will be supplied wired for 230 V, unless 460 V is specified. Single phase electricals will be supplied wired for 230 V only, cannot be supplied wired for 115 V. Power cord and plug supplied for single phase only. Where electrical controls must

comply with ANSI B-11 Series Machine Tool Standards, NFPA 79 Standard or JIC Standards, the No. 49-001 Electrical Kit must be ordered in addition to the Catalog Number of the designated Electrical Package.

VERTICAL MILLING HEAD

(Vertical Milling Head Uses Special C Flange Motor)

Order From Chart Below.)

MOTOR	MOTOR CONTROL	HERTZ AND MOTOR RPM	MOTOR VOLTAGE	SHIP. WT. LBS.	CATALOG NUMBER	CAT. NO. 200 V
Single Phase, ½ Horsepower	Full Voltage Drum Reversing Switch	60-1140	115/230	40	49-668	
	LVC CONTROL—24 V Push Button Reversing Station, Magnetic Starter, Transformer and Overload Protection	60-1140	115/230	65	52-019	
Single Phase, ¾ Horsepower	Full Voltage Drum Reversing Switch	60-1725	115/230	45	49-689	
	LVC CONTROL—24 V Push Button Reversing Station, Magnetic Starter, Transformer and Overload Protection	60-1725	115/230	70	52-020	
Three Phase, ½ Horsepower	Full Voltage Drum Reversing Switch	60-1140	230/460	34	49-691	52-177
	LVC CONTROL—24 V Push Button Reversing Station, Magnetic Starter, Transformer and 3-Leg Overload Protection	60-1140	230/460	55	52-021	52-023
Three Phase, ¾ Horsepower	Full Voltage Drum Reversing Switch	60-1725	230/460	39	49-692	52-178
	LVC CONTROL—24 V Push Button Reversing Station, Magnetic Starter, Transformer and 3-Leg Overload Protection	60-1725	230/460	60	52-022	52-032

NOTE: Single phase electricals will be supplied wired for 115 V, unless 230 V is specified. Three phase electricals will be supplied

wired for 230 V, unless 460 V is specified. Power Cord and plug supplied for single phase only.

MACHINE DATA TABLE

Working Surface 6½ x 24" (165.1 x 609.6 mm)
 No. of T-Slots 3 Size of T-Slots 7/16" (11.1 mm)
 Spacing of T-Slots (Center to Center) 2" (50.8 mm)
 Height from Floor (Lowest Position) 33" (838.2 mm)
 Micrometer Collars 2¾" (60.3 mm) Dia.;
 Graduated to001" (.0254 mm)
 Travel for each revolution of hand wheel200" (5.08 mm)

RANGE

Table Longitudinal Travel
 With Hand Screw Feed 16" (406.4 mm)
 With Variable Rate Power Feed 15½" (393.7 mm)
 Table Cross Travel 6¾" (171.45 mm)
 Table Vertical Travel 16½" (419.1 mm)
 Table to C of Spindle 0 to 15" (0 to 381 mm)
 Cutter Dia. (Maximum with Overarm) 8" (203.2 mm)
 Spindle Nose to Arbor Support (Max.) 12¾" (323.85 mm)
 Maximum Arbor Length (Shoulder to Nut) 11" (279.4 mm)
 Bottom of Overarm Bracket to C of Spindle 1" (25.4 mm)

POWER TABLE FEED RATES (Inches/mm Per Minute)

Infinitely Variable from 0 to 22" (0 to 558.8 mm)
 Jog or Rapid Approach 30" (762 mm)

SADDLE WIDTH 12" (304.8 mm)

DOVE-TAILS

Size ¾" (19.05 mm) Kind of Gib Tapered

STANDARD EQUIPMENT

Basic Milling Machine includes storage type cabinet with door, guards for V belts and pulleys, draw bolt threaded ½" —13, overarm support for Style A arbors, V belts (2), motor pulley (¾" bore), two 1¼" open end wrenches, and oil for spindle bearings, plus No. 21-816 Vertical Head. Without arbors and electricals.

SPINDLE

Taper NMTB #30 Hole 7/8" (16.67 mm)
 Precision Timken Roller Bearings (Oil-bath lubricated) 2

OVERARM ARBOR SUPPORT BRACKET

..... Takes Style A Arbors with 7/8" (18.26 mm) Pilot

DRIVE

Motor to Ball Bearing Countershaft 8M Belt
 Countershaft to Spindle 8M Belt
 Back Gears (Alloy Steel, Heat Treated) Oil Bath Lubricated

SPEEDS (With 1725 rpm Motor)

Gear Drive 60, 135, 240, 300 and 385 rpm
 Direct Drive 375, 845, 1500, 1875 and 2400 rpm

MOTORS

Accommodates Frame Sizes Delta #8½ and NEMA #182
 Horsepower Recommended 1½

OVERALL DIMENSIONS

Height 57½" (1460.5 mm)
 Width (Table in center position) 37¾" (958.85 mm)
 Front to Rear (Motor mounted) 51" (1295.4 mm)

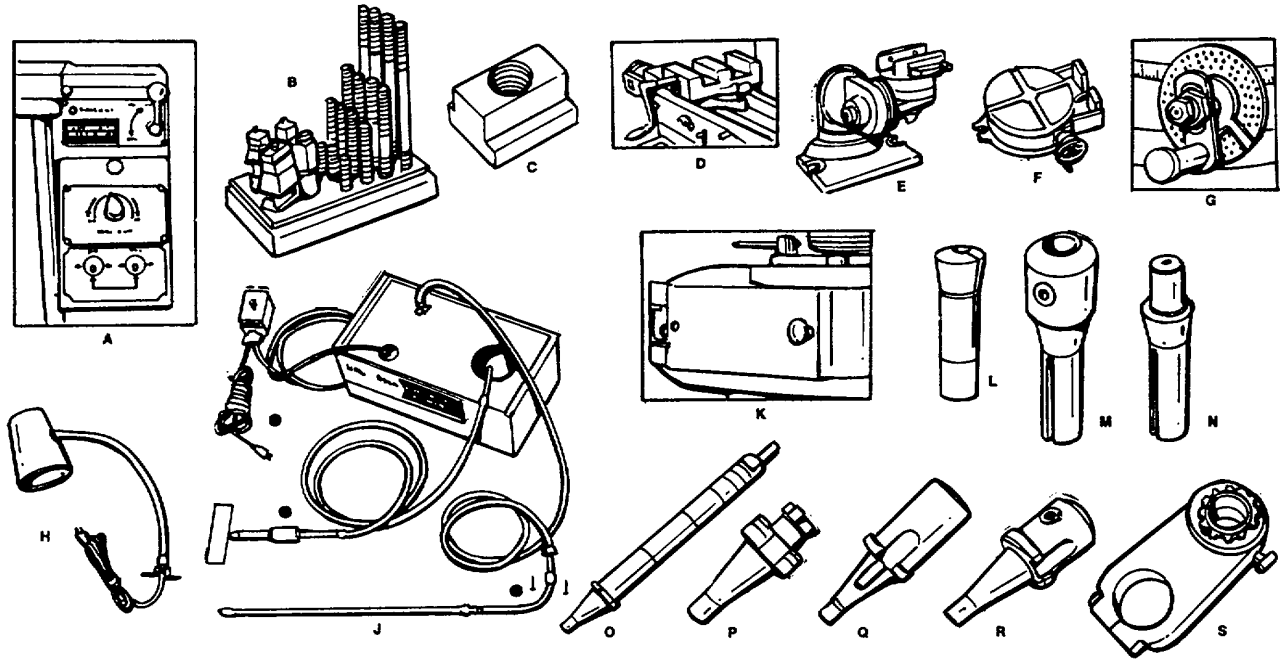
CABINET BASE DIMENSIONS

Width 17½" (444.5 mm) Front to Rear 26½" (670.6 mm)

SHIPPING WEIGHT WITH ELECTRICALS

(Approx.) 975 Lbs. (442.3 kg)

For Machine Data for No. 21-816 Vertical Head, See Page on Horizontal Milling Machine.



DO MORE JOBS WITH THESE

HORIZONTAL AND VERTICAL MILLING MACHINE ACCESSORIES

A VARIABLE RATE POWER TABLE FEED for 115 V, single phase, 60 hertz, with 8-foot grounding type cord and plug. Available factory mounted and wired on all Mills. Instructions for field mounting are included. Fits in place of right table hand wheel, but left table hand wheel still can be used. (No. 21-838 Table Travel Limit Switch Kit is recommended.) 28 lbs. NO. 21-820

TABLE TRAVEL LIMIT SWITCH KIT. Automatically shuts off motor of 21-820 Table Feed (on Horizontal or Vertical Milling Machine) if machine is left unattended. Includes Antenna type limit switch, utility box, receptacle, 8-foot power cord with 115 V 3-prong grounding type-plug, wire and instructions for field mounting. 2 lbs. NO. 21-838

B T-NUT AND STUD SET, to clamp vises, fixtures or workpieces to milling machine table. Set provides four clamping arrangements from 2" to 10" or two clamping arrangements to 16". Set consists of the following heat treated nuts tapped 1/4"-16: four 7/16" T-Nuts, four flanged nuts and four coupling nuts plus stressproof steel 3/4"-16 studs in the following lengths: four 2", four 3", four 4" and four 6", together with a convenient holder. 4 lbs. NO. 21-001

C EXTRA T-NUTS, to fit milling machine table. Package of five heat treated 7/16" T-Nuts with a 3/4"-16 tapped hole. 1/2 lb. NO. 21-002

D MACHINE VISE, Lov Boy design, 4" maximum opening. Includes 360° swivel base, 1 1/4" x 4 1/2" steel jaws, crank type wrench and two removable 7/16" keys for table slot. 23 lbs. NO. 21-811

E UNIVISE. Universal vise for grinding, drilling and milling. Can be set at any angle desired. Vise can be returned exactly to its original setting for duplicate grinding. Each station has a 360° circular scale. 16 lbs. NO. 24-902

F 8" ROTARY TABLE, with base for horizontal or vertical use. Includes two removable 7/16" keys for milling machine table slots. Table top is calibrated in 1" increments, with an adjustable pointer for accurate indexing, and has two T-slots for 1/2" bolts. Micrometer collar on crank shaft is graduated to 1/20 degree (3 min.) and has a thumb screw for locking the collar or setting it to 0° at the start of the job. The horizontal, as well as the vertical base pad, has a 1/4" x 3/4" keyway and the overall height of the table in the horizontal position is only 3 3/4". Although especially recommended for use on Milling Machines, this versatile table provides fast set up and accurate indexing for boring, drilling, reaming, tapping, grinding and other jobs. (No. 21-836 Attachment for Positive Indexing is recommended for the No. 21-835 Table.) 35 lbs. NO. 21-835

G ATTACHMENT FOR POSITIVE INDEXING, for use with No. 21-835 Table. This attachment replaces the regular table hand wheel and includes two interchangeable disks, each with three circles of equally spaced holes. One disk provides a choice of 24, 30 and 36 holes while the other has a selection of 25, 34 and 40 holes. The two pre-selector fingers are fully adjustable and the attachment adds both convenience and accuracy to the indexing of the table. 1 lb. NO. 21-836

COOLANT TROUGHS for table, one pair. 12 lbs. NO. 21-837

H DELUXE LAMP ATTACHMENT for 115V. Includes 18" flexible gooseneck, reflector and 8-foot cord with 2-prong plug. Uses standard bulb (not included) up to 75 watts. 3 lbs. NO. 25-857

J 5-GALLON COOLANT SYSTEM FOR MILLING MACHINES. For 115 V, 60 hertz, single phase. Includes submersible pump with 1/4" male outlet, 5-gallon tank with baffle, 6-foot plastic hose, two L-shaped lengths of 1/2" pipe with one swivel type clamp, 18" flexible pipe with nozzle and valve, non-ferrous screen for end cap of Milling Machine table and plastic drain hose with fittings. In addition, all necessary wiring, with grommets, is included consisting of a 6-foot 3-conductor power cord with 3-prong, 115 V grounding plug, a junction box (for mounting on column of mill) with on-and-off toggle switch and a power cord to connect switch to pump motor. Complete instructions are included for easy field mounting. 50 lbs. NO. 49-623

MILLING MACHINE ACCESSORIES

VERTICAL MILLING MACHINE ACCESSORIES

K GUARDS (two) for side openings of belt guard. 2 lbs.	NO. 21-813
COLLETS , set of six, from 1/4" to 3/8" by 16ths, style R8. 9 lbs.	NO. 21-800
COLLETS , set of five, from 1/2" to 3/4" by 16ths, style R8. 7 lbs.	NO. 21-810
COLLET , 1/2", 2 lbs.	NO. 21-889
COLLET , 3/4", 2 lbs.	NO. 21-890
COLLET , 1/2", 2 lbs.	NO. 21-891
COLLET , 3/4", 2 lbs.	NO. 21-892
COLLET , 1/2", 2 lbs.	NO. 21-893

L COLLET , 7/16", 2 lbs.	NO. 21-894
COLLET , 1/2", 2 lbs.	NO. 21-895
COLLET , 3/4", 2 lbs.	NO. 21-896
COLLET , 1/2", 2 lbs.	NO. 21-897
COLLET , 1 1/16", 2 lbs.	NO. 21-898
COLLET , 3/4", 2 lbs.	NO. 21-899

3/4" END MILL HOLDER , style R8. 2 lbs.	NO. 21-803
3/4" END MILL HOLDER , style R8. 2 3/4 lbs.	NO. 21-804
1/2" END MILL HOLDER , style R8. 2 1/2 lbs.	NO. 21-805

M 5/8" END MILL HOLDER , style R8. 2 3/4 lbs.	NO. 21-806
3/4" END MILL HOLDER , style R8. 3 lbs.	NO. 21-807
7/8" END MILL HOLDER , style R8. 3 1/4 lbs.	NO. 21-808
*1" END MILL HOLDER , style R8. 3 1/2 lbs.	NO. 21-809

ARBOR, for drill chucks with No. 3 Jacobs female taper, style R8. 3 lbs. NO. 21-801

N ARBOR, for drill chucks with No. 33 Jacobs female taper, style R8. 3 lbs. NO. 21-802

HORIZONTAL MILLING MACHINE ACCESSORIES

DRILL CHUCK, 3-jaw type, 0 to 1/2" capacity, with No. 2 M.T. shank. Includes chuck key. 2 1/2 lbs. NO. 46-968

DRILL CHUCK, same as No. 46-968 except with No. 3 M.T. shank. 3 lbs. NO. 17-820

ARBOR, 7/8", 10", length shoulder to nut, style A with assorted spacers. 5 lbs. NO. 21-821

Q ARBOR, 1", 10", length shoulder to nut, style A with assorted spacers. 10 lbs. NO. 21-822

ARBOR, 3/4", for shell end mills. 4 lbs. NO. 21-831

P ARBOR, 1", for shell end mills. 4 lbs. NO. 21-832

ARBOR, 1 1/4", for shell end mills. 7 lbs. NO. 21-833

Q SPINDLE ADAPTER, No. 3 M.T. 2 lbs. NO. 21-823

SPINDLE ADAPTER, No. 2 M.T. 2 lbs. NO. 21-824

3/4" END MILL HOLDER. 2 lbs. NO. 21-825

1/2" END MILL HOLDER. 2 lbs. NO. 21-826

R 3/4" END MILL HOLDER. 3 lbs. NO. 21-827

3/4" END MILL HOLDER. 3 lbs. NO. 21-828

3/4" END MILL HOLDER. 5 lbs. NO. 21-829

1" END MILL HOLDER. 5 lbs. NO. 21-830

S OVERARM ARBOR SUPPORT BRACKET with bearing and draw-in nut. Fits running bushings with 1 1/4" O.D. Required for style B arbors or may be used for extra rigidity in addition to style A arbor support bracket, which is supplied as standard equipment. Includes instructions for boring in line with spindle for field installation, or will be completely machined at factory when ordered with a new Horizontal Milling Machine. 3 lbs. NO. 21-834

SPINDLE AND WAY OIL, Velocite-E, 1/2 pint can. 2 lbs. NO. 24-812

***NOTE:** For single end mills only.

By Order of the Secretary of the Army:

Official:

ROBERT M. JOYCE
Brigadier General, United States Army
The Adjutant General

E. C. MEYER
General, United States Army
Chief of Staff

RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL PUBLICATIONS



SOMETHING WRONG WITH THIS PUBLICATION?

THEN... JOT DOWN THE DOPE ABOUT IT ON THIS FORM, CAREFULLY TEAR IT OUT, FOLD IT AND DROP IT IN THE MAIL!

FROM: (PRINT YOUR UNIT'S COMPLETE ADDRESS)

DATE SENT

PUBLICATION NUMBER

PUBLICATION DATE

PUBLICATION TITLE

BE EXACT... PIN-POINT WHERE IT IS

PAGE NO.	PARA-GRAPH	FIGURE NO.	TABLE NO.
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IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT:

TEAR ALONG PERFORATED LINE

PRINTED NAME, GRADE OR TITLE, AND TELEPHONE NUMBER

SIGN HERE:

DA FORM 2028-2
1 JUL 79

PREVIOUS EDITIONS ARE OBSOLETE.

P.S.—IF YOUR OUTFIT WANTS TO KNOW ABOUT YOUR RECOMMENDATION MAKE A CARBON COPY OF THIS AND GIVE IT TO YOUR HEADQUARTERS.

PIN: 049923-000