

11.5 QUILL AND SPINDLE

11.5.1 Quill Feed Counter Adjustment

The quill feed counter, a graduated dial, is located on the bottom of the quill feed drive motor cover (77-0189). To reset the dial proceed as follows:

1. The quill must be in the home position (maximum up).
2. Loosen the setscrew (1-01-1260) that secures the dial (2-10-0117) to the adapter (66-5852).
3. Rotate the dial on the adapter and line up the zero graduation mark on the dial with the indicator (66-5851) mounted on the cover (77-0189).
4. Hold this position and lock the setscrew (1-01-1260).

11.5.2 Quill Drive Motor Replacement

1. Disconnect power to the machine by throwing the main circuit breaker to the OFF position.
2. Remove four screws and remove the plate on the top of the stepping motor.
3. Disconnect the electrical wiring and remove the cable from the motor.
4. Loosen the setscrew (1-01-1260) and remove the quill counter dial (2-10-0117) from the adapter (66-5852).
5. Loosen the setscrew (1-01-1260) and remove the adapter (66-5852) from the extension (66-5853).
6. Remove the screws (two 1-71-1492) and lift the pulley cover (77-0189) off the motor mounting bracket (77-0161).
7. Remove the four screws (1-01-1053) that hold the drive motor to the motor mounting bracket (77-0163).
8. Slide the timing belt (1-65-2110) off the motor pulley (2-77-0134).
9. Loosen the setscrew (1-01-1260) and pull the motor pulley (2-77-0134) off the motor shaft.



Keep the motor and the heat sink in one piece. The annular gap between the motor outside diameter and the heat sink inside diameter between O-rings is filled with silicone grease.

Do not remove the armature. Magnetic characteristics of the motor are destroyed if the armature is removed.

10. Lift the drive motor off the motor mounting bracket (77-0161).
11. Install the replacement motor.
12. After the drive motor is installed, set the proper belt tension. Refer to Section 11.5.3. Set the quill feed counter. Refer to Section 11.5.1.

NOTE

After reassembly, run the Z axis in JOG. If the Z axis moves in the wrong direction, shut down the power and interchange the wires to motor terminals 1 and 3.

11.5.3 Quill Drive Belt Adjustment

1. Loosen the setscrew (1-01-1260) and remove the quill counter dial (3D-112) from the adapter (66-5852).
2. Loosen the setscrew (1-01-1260) and remove the adapter (66-5852) from the extension (66-5853).
3. Remove the screws (two 1-71-1492) and lift the pulley cover (77-0189) off the mounting bracket (77-0161).
4. Loosen, but do not remove, the four screws (1-01-1053) that secure the drive motor to mounting bracket (77-0161).
5. Adjust the belt tension. Pulling the motor away from the head will increase the belt tension. Pushing the motor toward the head will decrease the tension.

NOTE

The belt should have a tension of 66 pounds or should deflect, in the middle on one side, 1/8 inch with 5 pounds force applied.

6. Tighten the four motor mounting screws when the proper tension is obtained.

11.5.4 Quill Drive Belt Removal

1. Turn OFF the power to the machine.
2. Loosen the setscrew (1-01-1260) and remove the quill counter dial (2-10-0117) from the adapter (66-5852).
3. Loosen the setscrew (1-01-1260) and remove the adapter (66-5852) from the extension (66-5853).
4. Remove two screws (1-71-1492) and lift the pulley cover (77-0189) off the motor mounting bracket (77-0161).
5. Remove the four screws (1-01-1053) that hold the drive motor to the motor mounting bracket (77-0161).
6. Slide the timing belt (1-65-2110) off the motor pulley (2-77-0134).
7. Loosen the setscrew (1-01-1260) and pull the motor pulley (2-77-0134) off the motor shaft.
8. Lift the drive motor off the motor mounting bracket (77-0161).
9. Remove four hex head bolts (77-0260) and remove the control cover (77-0191).
10. Remove four socket head cap screws (1-01-1035) and remove the front cover (77-0160).
11. Note and record the color and location of all six limit switch wires.
12. Remove the six wires from the three limit switches.
13. Remove two socket head cap screws (1-01-1040 and 1-01-1044) and remove the right side cover (77-0166).

14. Attach the head removal tool (Figure 11-1), to the bearing cap (2-18-0094) using three 1/4-20x.750 screws.
15. Support the head with a hoist attached to the tool (ST-6921).
16. Remove four socket head cap screws (1-01-1075) that connect the quill housing (77-0159) to the motor mounting bracket (77-0161).
17. Lift the upper head assembly 2 to 2-1/2 inches.
18. Disconnect the oil line to the left of the meter unit (1-41-3210).
19. Remove the upper head assembly.
20. Support the spindle in the up position.
21. Remove four bearing retainer screws (1-01-1082).
22. Remove the metering unit (1-41-3210) from lower bearing support (77-0177).



If the ball nut is rotated off of the ball screw, the ball screw assembly will be destroyed. A new ball screw assembly will then be needed.

23. Rotate the ball nut assembly on the ball screw, only enough to raise pulley (77-0181) above the quill housing (77-0159).
24. Lift the belt (77-0232) up over the spindle and out of the machine.

NOTE

The area must be kept free of any contaminating elements.

25. Assemble the machine in the opposite order of disassembly. A special assembly procedure for the quill housing (77-0159) and the drive motor housing (77-0161) is given in Section 11.5.2.
26. Set the quill feed belt (1-66-2110) tension. Refer to Section 11.5.3.
27. Set the quill feed counter. Refer to Section 11.5.1.

11.5.5 Ball Quill Extension Removal

Special Tools:

1. ST-4921 (Figure 11-1)
2. 2 inch adjustable spanner wrench
3. 3-1/2 inch diameter adjustable hook spanner wrench

Procedure:

1. Follow the disassembly procedure for the Quill Drive Belt Removal, per Section 11.5.4, steps 1 through 22.
2. The ball quill extension has a total travel of 5 inches.



Should this distance be exceeded, the balls will fall out of the assembly and a new ball quill extension will have to be purchased.

3. Rotate the ball quill extension nut far enough up to remove six socket head cap screws (1-01-1021), but not to exceed 5 inches of travel.
4. Rotate the ball quill extension back down and remove from the spindle.
5. Remove the bearing retainer (77-0177) and bearings (77-0118) by removing the lock washer (77-0150) and nut (77-0149). Use a 2 inch adjustable spanner wrench and a 3-1/2 inch adjustable hook spanner wrench.
6. Remove two snap rings (1-01-0879) and the pulley (77-0181).
7. Before installation, inspect and clean the ball quill extension assembly. Refer to Section 11.8.

NOTE

CLEANLINESS is of great importance. Be sure that no chips or dirt get to the quill or ball quill extension.

8. After the assembly is complete, perform the following settings:
 - a. Align the motor mounting housing (77-0161) to the quill housing (77-0159). Refer to Section 11.5.2.
 - b. Set the quill feed belt (77-0232) tension. Refer to Section 11.5.3.
 - c. Check and if necessary reset the quill limit switches:
 1. Positive stop switch (home). Refer to Section 11.6.1.
 2. Deceleration switch. Refer to Section 11.6.2.
 3. Lower position switch. Refer to Section 11.6.3.
 - d. Set the quill feed counter. Refer to Section 11.5.1.

NOTE

The bearings must be installed in the same orientation as they were. Use the V on the outside diameter as a guide for correct orientation of these bearings. Note that the shields of the bearings are toward the outside.

11.5.6 Quill Removal



The quill outside diameter and the quill housing bore are a matched fit. The only occasion on which a quill should be removed is in the event that it has been severely damaged by scoring through lack of lubrication or other causes.

1. Follow the procedure for the ball quill extension removal. Refer to Section 11.5.5, steps 1 through 4.
2. The quill will fall out of the housing when the blocks supporting it are removed.
3. For installation notes and settings refer to Section 11.5.5, steps 7 and 8.

11.5.7 Spindle Removal

1. Lower the quill one inch from the upper position (home position).
2. Remove the spindle nose setscrew (1-01-1221) located on the quill outside diameter.
3. Move the quill to the upper position (home position). Lower the knee to the full down position.
4. Place blocks under the spindle to prevent it from dropping when loosened from the quill. Remove the spindle nose locknut (2-19-0514) from the quill (Figure 11-2). The spindle is now free to be removed from the quill.
5. If the spindle does not drop out, then tap on the end of the spindle with a soft mallet through the opening on the top of the variable speed assembly. This will force the spindle bearing out of the bore of the quill.

WARNING

To prevent injury keep your hands out from between the spindle and support blocks. When the spindle bearings clear the bore in the quill; the spindle will drop out of the quill rapidly.

11.6 QUILL LIMIT SWITCHES

11.6.1 Home Switch Adjustment—Figures 8-4, 8-5 and 11-3

Preliminary Steps

1. Lower the quill approximately one inch. Turn OFF the power.
2. Remove the quill feed counter dial and the adapter (66-8582).
3. Remove the quill feed motor pulley cover (77-0189) by removing the screws (two 1-71-1492).
4. Remove the screws (four 1-01-1035) and lift the quill limit switch cover (77-0160) off the quill housing.

Adjustment Procedure

1. Loosen the hex nut (1-01-1709) on the positive stop adjusting screw (1-66-5897).
2. Place a .020 inch shim on the top of the trip stop (77-0179) in the quill housing slot and up to the quill.
3. Turn the drive pulley by hand, cranking the quill to its full up position until you feel a slight resistance on the shim.
4. Turn the positive stop screw (1-66-5897) until the switch (1-66-5809) is actuated. Hold this position and lock the hex lock nut (1-01-1705).
5. Remove the shim and set the deceleration limit switch.

11.6.2 Deceleration Switch Adjustment

The positive stop switch (1-66-5809) must be set before the deceleration switch (1-66-5105) is set. First follow the steps in setting the home switch. (Section 11.6.1.)

1. Place a .400 inch shim on the top of the trip stop (77-0179) in the quill housing slot and up to the quill.
2. Turn the drive pulley by hand, cranking the quill up until you feel a slight resistance on the shim.
3. Loosen two screws (77-0121) that secure the deceleration switch to the mounting bracket (77-0185). Adjust the switch until it is just actuated on the top of the switch trip dog (77-0187). Hold this position and lock the two screws.
4. Remove the shim.
5. Adjust the bottom position switch. Refer to Section 11.6.3.

11.6.3 Bottom Position Switch Adjustment

The positive stop limit switch must be set before the bottom position limit switch (1-66-5105) is set.

1. Remove four screws (1-01-1044 and 1-01-1040) and lift the quill limit switch cover (1-78-0087) off the quill housing. Position the quill in the full up position (home).
2. Loosen the two screws (77-0121) that secure the bottom position switch (1-66-5105) to the mounting bracket (77-0185).
3. Move the quill down 5.020 inches from the home position.
4. Adjust the bottom position switch until it is just actuated on the bottom of the switch trip stop (77-0187). Hold this position and lock the two screws (77-0121).
5. Return the quill to the full up position (home).
6. Reverse the procedure given under preliminary steps, Section 11.6.1.
7. Set the quill feed counter. Refer to Section 11.5.1.

1. Remove (3) screws from locknut.

2. Screw on nut assembly as far as possible—
then back off 1 turn

3. Insert standard Quick Change adapter and
tighten locknut.

4. Screw in longest button head screw (dog point)
in hole that permits greatest amount of rotation
for unlocking (this is usually the hole closest to
a locking ear.)

5. Rotate nut back to load position. This is when
locking ears and keys are in line.

6. Insert cadmium plated screw in hole that is in
line with locking ear. This is identifying screw
so operator knows how to load adapters.

7. Put remaining screw in only open hole. Spindle
is now ready to use.

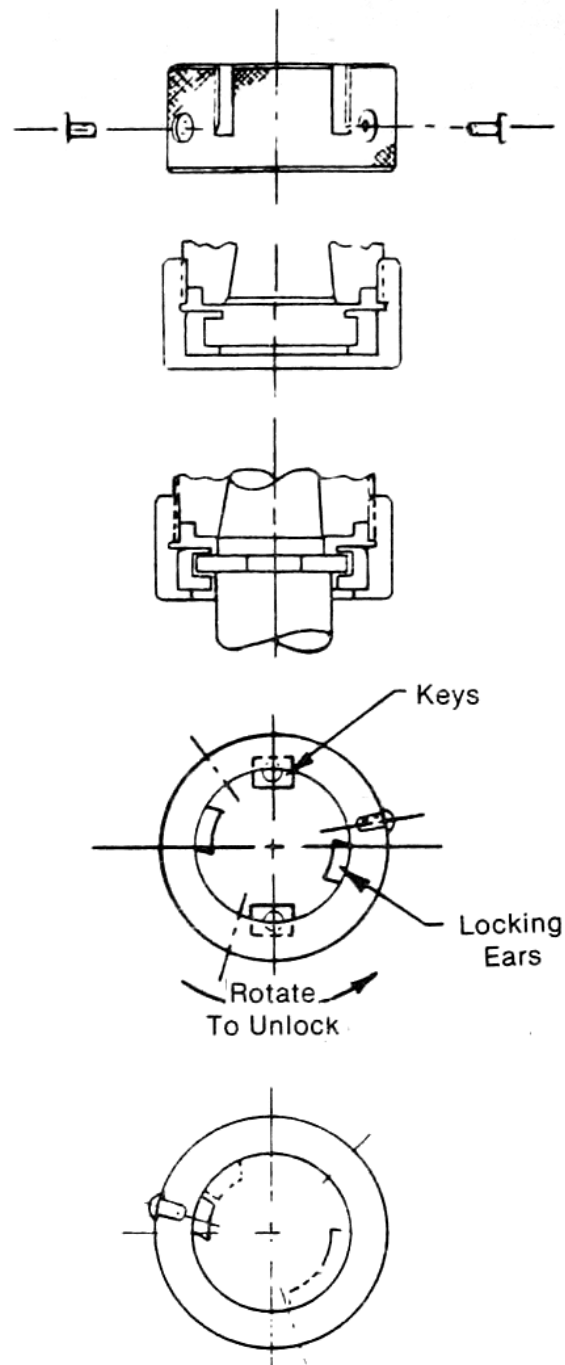


Figure 11-2 Quick Change Locknut Assembly

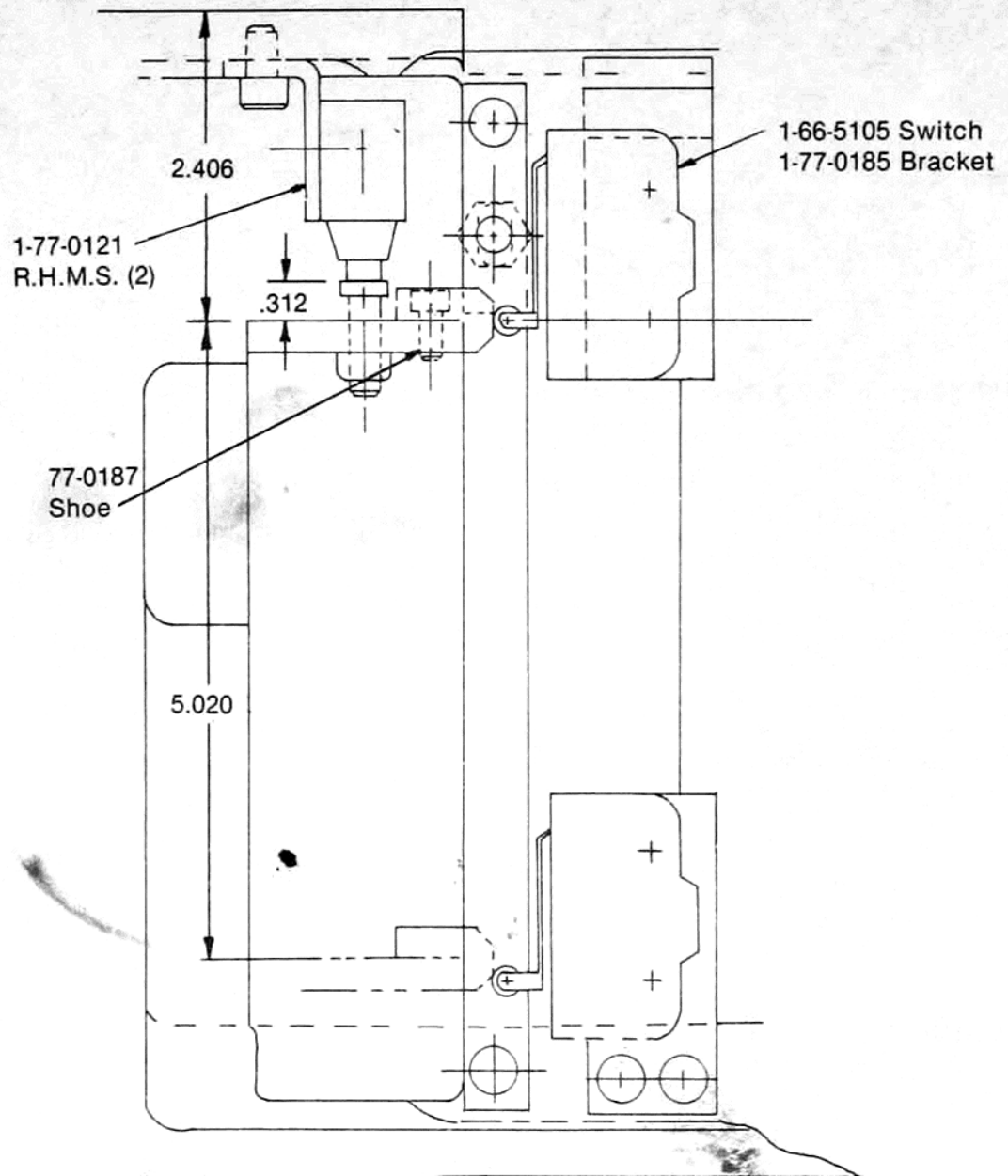


Figure 11-3 Quill Limit Switch Assembly

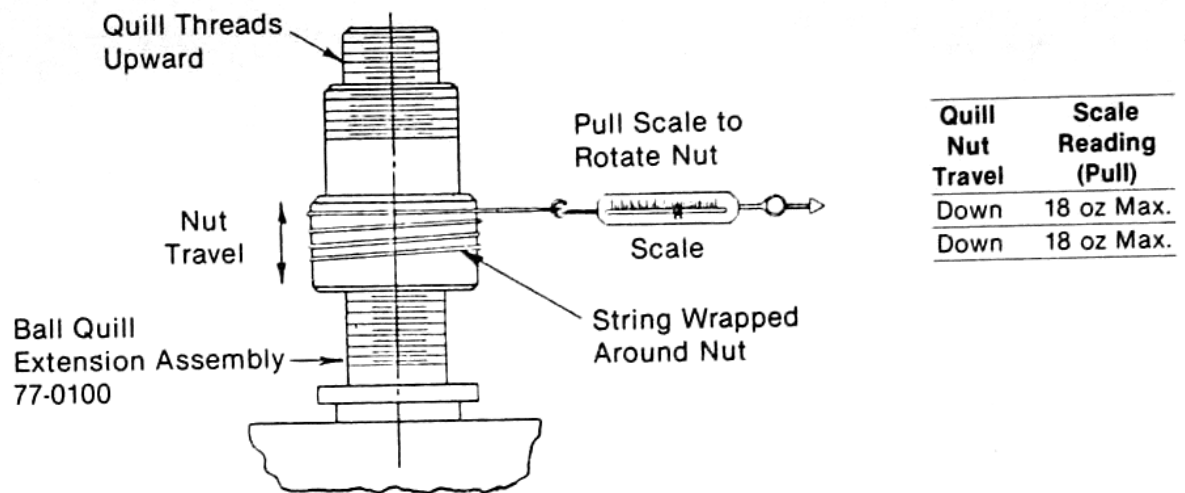


Figure 11-4 Ball Quill Extension Torque on Nut Setup

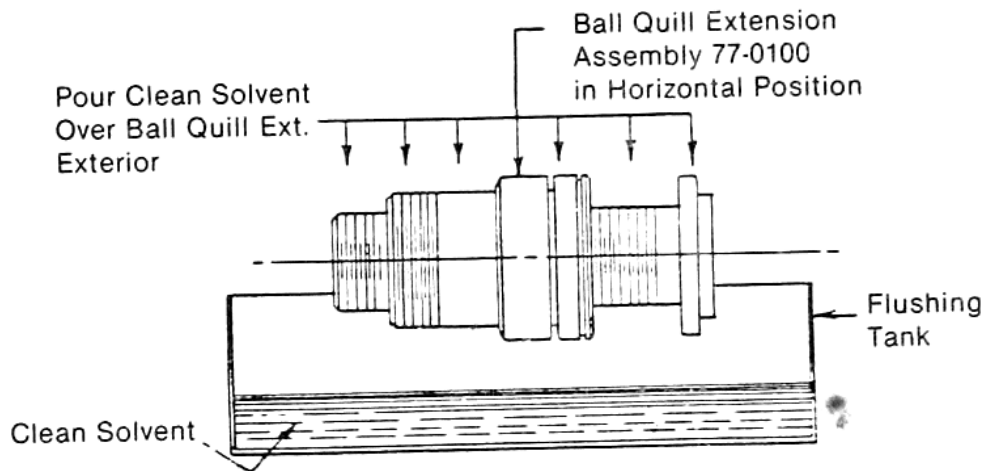


Figure 11-5 Ball Quill Extension Flushing

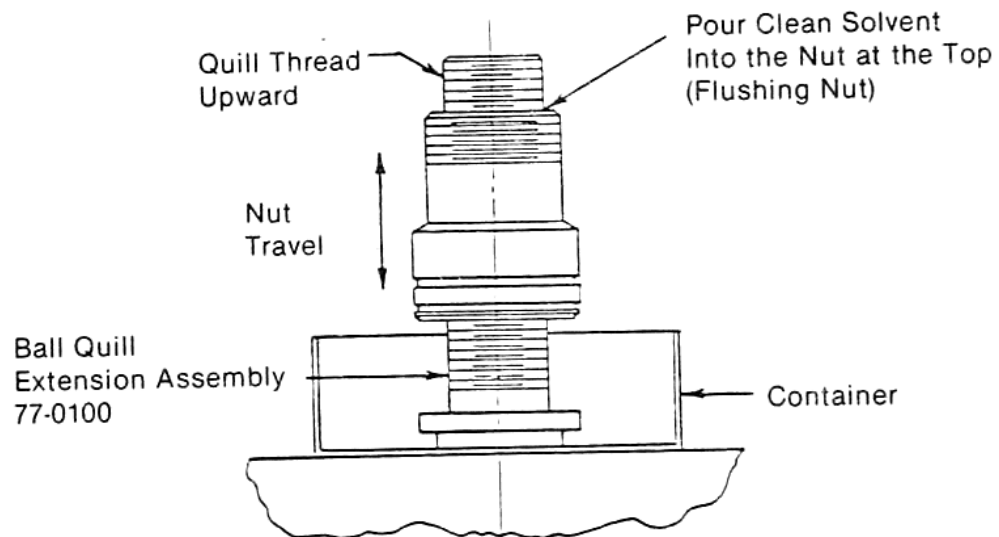


Figure 11-6 Ball Quill and Nut Flushing

11.7 ALIGNMENT OF QUILL HOUSING TO DRIVE MOTOR HOUSING

Perform this procedure whenever the ball quill extension assembly or the motor mounting housing (77-0161) has been moved.

1. Install the four screws (1-01-0426) that secure the bearing support (77-0177) and bearing support cover (77-0178) to the quill housing (77-0159). Leave them loose.
2. Use the belt (77-0232) to move the quill up and down along its travel and return to home position. This should allow the bearing support (77-0177) to float and align itself with the quill housing (77-0159). Tighten the four screws (1-01-0426).
3. Check for proper alignment. Tie a string around the belt and tie a measuring scale on the end of the string. Pull on the scale, moving the quill up or down to obtain a reading.
4. Repeat this procedure to obtain a reading over the entire up and down travel of the quill.
5. Minimize the reading on the scale by repeating steps 2 and 4.
6. Tighten the four socket head cap screws (1-01-0426) securing the bearings to the quill housing (77-0159).
7. Mount the motor mounting housing (77-0161), mounted to a complete variable speed assembly, on to the quill housing (77-0159). Take care not to damage the splines on the spindle (77-0109) or gear hub (2-18-0111).
8. Install four screws (1-01-1075) but leave them loose.
9. Repeat step 2 to float the motor mounting housing (77-0161) into place. Tighten the four screws (1-01-1075).
10. Repeat step 3. The reading on the scale with the quill moving up should not exceed 40 ounces maximum pull. With the quill moving down it should not exceed 28 ounces maximum pull.

11.8 BALL QUILL EXTENSION INSPECTION



CLEANLINESS is of great importance in this operation. Your hands and clothing must be free of any dirt and oil. The test equipment, fixtures and tables must be free of dirt, dust chips and oil. The inspection area or room must be free of any air contaminating equipment, such as grinding machines, exhaust blowers, etc.

11.8.1 Ball Quill Extension Preload Torque on Nut—Figure 11-4

1. The ball quill extension shaft and nut must be free of any foreign material.
2. Set the ball quill extension assembly (77-0100) in an upright position, with the ball threads facing upward and the mounting flange downward.

3. Wrap a string around the ball nut's large outside diameter (pulley mounting diameter).
4. Tie a measuring scale on the end of the string.
5. Pull on the scale, rotating the quill nut, to obtain a reading.
6. Repeat this procedure to obtain a reading over the entire up and down the travel of the ball nut on the ball shaft.
7. The reading on the scale with the nut moving up should not exceed 18 ounces maximum pull. The reading on the scale with the nut moving down should not exceed 18 ounces maximum pull.
8. If the scale readings exceed the limits or if there is any excessive drag or nut hang up on the shaft, then clean and flush the ball nut and shaft. Refer to Section 11.8.2.
9. If, after the nut is cleaned, the scale readings are still over the limits or a drag or hang up still exists, replace the ball quill extension assembly (77-0100, BOSS 6; 77-0364, BOSS 6.2).

11.8.2 Cleaning and Flushing the Ball Quill Extension Assembly—Figures 11-5 and 11-6

1. Set the ball quill extension assembly (77-0100, BOSS 6; 77-0364, BOSS 6.2) in a horizontal position and place over a flushing tank. (Figure 11-5.)
2. Pour an oil dissolving solvent over the ball threads and ball nut. This will remove any contaminated oil, chips or foreign material from the ball quill extension assembly. Remove from the flushing tank.
3. Set the ball quill extension assembly in an upright position, with the ball threads facing upward and the mounting flange downward, in a container (Figure 11-6).
4. Pour an oil dissolving solvent over the ball threads and into the top of the nut. At the same time rotate the nut over its total travel. This will remove any contaminated oil on the threads and flush any chips or foreign material lodged in the ball nut tracks.
5. After cleaning apply a film of light machine oil over the threads and into the ball nut.

11.9 REMOVAL OF BRAKE LOCK MARK II—Figure 11-7

1. Turn the speed changer to 60 rpm with the motor running.
2. Turn the motor off and turn OFF the power.
3. Remove the two lower socket head cap screws 1-01-1037 (3) on the speed changer housing. (Manual speed changer 77-0176 or pneumatic speed changer 77-0800)
4. Remove in the following order:
 - a. Four button head cap screws 1-98-0449 (4).
 - b. Cover 77-0195 (5).
 - c. Snap ring 1-01-0880 (6).
 - d. Socket setscrew 1-01-1222 (7).
 - e. Pulley 77-0082 (8).
 - f. Key 2-55-0007 (9).

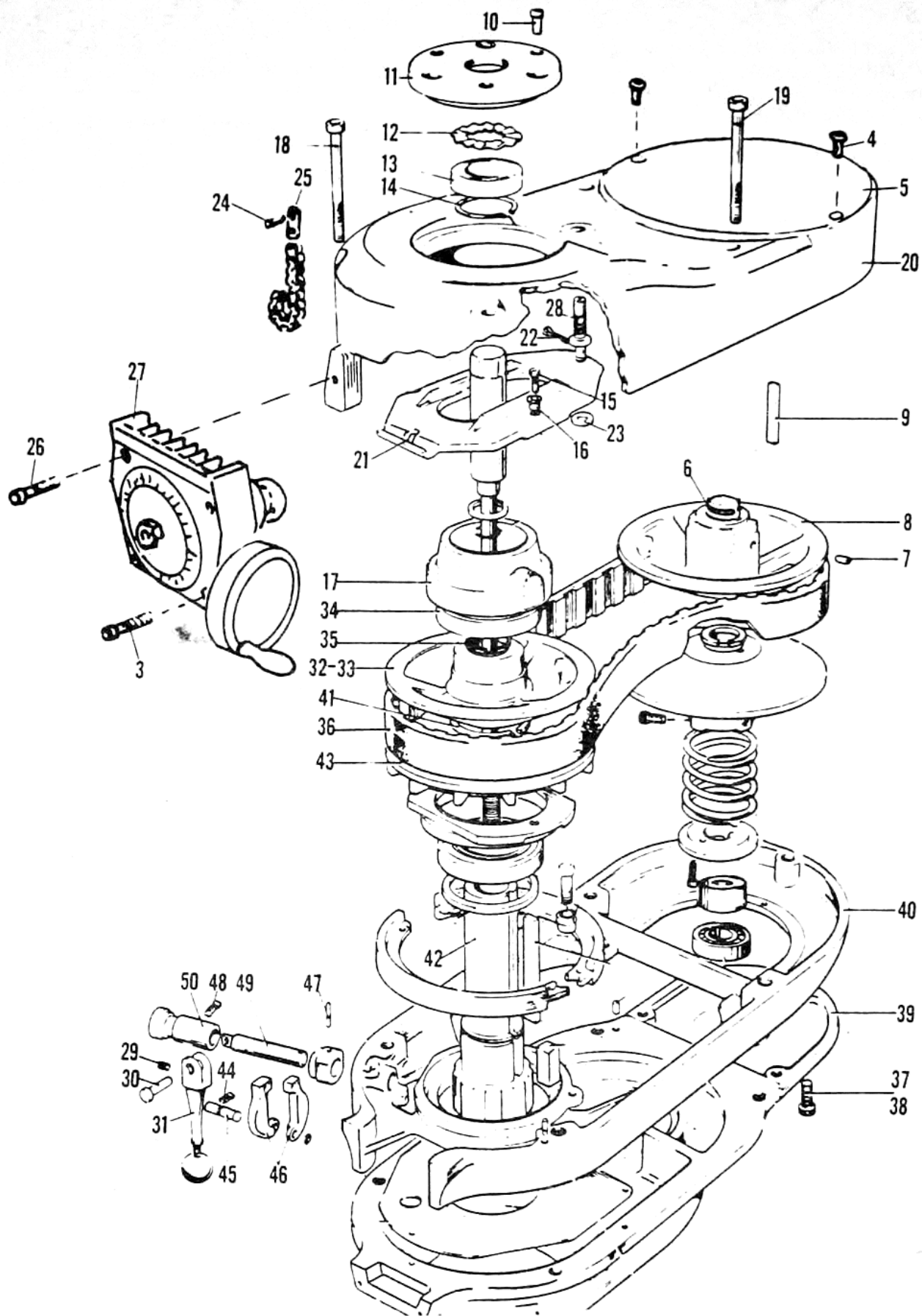


Figure 11-7 Removal of Brake Lock Mark II

NOTE

The socket setscrew (1-01-1222) should be loosened slowly to minimize the spring back of the pulley. When the socket setscrew is completely loose the pulley should spring approximately 1/2".

5. Remove the following items in order:
 - a. Three socket head cap screw 1-01-1033 (10).
 - b. Bearing cap 2-18-0094 (11).
 - c. Spring washer 1-18-1977 (12).
 - d. Bearing 1-08-0252 (13).
 - e. Retaining ring (1-18-0848).
6. Next remove the two socket head cap screws (1-01-1125) and sleeves (2-18-0089) from the upper pulley bearing cap.
7. The two socket head cap screws (1-01-1069) and three socket head cap screws (1-01-1065) can now be removed from the top of the belt housing (77-0164).
8. The belt housing can now be removed, exposing the speed changer plate (2-18-0058).
9. When the belt housing is removed, take off the cotter pin (1-01-0604) and washer (2-18-0095) to remove the speed changer plate.
10. Remove the chain stud (2-18-0066) from the speed changer plate by sliding the pin (1-01-0534) to one side with a pair of pliers.
11. Remove the remaining two socket head cap screws (1-01-1037) from the speed changer housing.
12. The speed changer assembly is now free to be removed from the 2 hp head.
13. Remove the pulley (2-18-0081). This will also remove the items on the pulley:
 - a. Housing (2-18-0056).
 - b. Key (1-18-2122).
 - c. Bearing (1-18-0253).
 - d. Two Bushings (1-18-2124).
14. The belt (1-18-2120) can now be removed.
15. Remove two socket head cap screws (1-01-1056) and three socket head cap screws (1-71-1060) from the gear housing (77-0162).
16. Separate the belt housing base (77-0163) from the gear housing (77-0162).
17. Remove the retaining ring 1-18-0855 (41).
18. Support the belt housing base with a wooden 2 x 4 and press the hub 2-55-0012 (42) downward.
19. When the hub is removed, turn the belt housing base over and support it with the 2 x 4; remove the retaining ring (1-18-0855) and press the pulley 2-18-0082 (43) out.



When removing the pulley do not damage the belt housing base.

20. Next remove the brake lock assembly in the following order:
 - a. Bottom socket setscrew 1-01-1287 (44).
 - b. Shaft 2-18-0083 (45).
 - c. Fingers 2-18-0072 (46).
 - d. Pin 1-01-0534 (47).
 - e. Top socket setscrew 1-01-1287 (48).
21. The lock shaft 77-0194 (49) and sleeve 77-0193 (50) can now be removed.
22. If the lock shaft (77-0194) was shimmed, discard the shims.
23. No shims are required for the pneumatic brake lock.

11.10 REASSEMBLY OF BRAKE LOCK MARK II—Figure 11-7 and 11-8

1. Install the shaft 77-0350 (49, Figure 11-11) and sleeve 77-0349 (50) into the belt housing base.
2. Assemble in the following order:
 - a. Top socket set screw 1-01-1287 (48).
 - b. Pin 1-01-0534 (47).
 - c. Fingers 2-18-0072 (46).
 - d. Shaft 2-18-0083 (45).
 - e. Bottom socket set screw 1-01-1287 (44).
3. Support the belt housing base 77-0163 (40) with wood 2 x 4, and press in the pulley 2-18-0082 (43).
4. Install the retaining ring (1-18-0855).



When installing the pulley do not damage the belt housing base.

5. Turn the belt housing base over, and support it with a wood 2 x 4.
6. Press in the hub 2-55-0012 (42).
7. Mount the belt housing base (77-0163) to the gear housing 77-0162 (39) with two socket head cap screws 1-01-1056 (37) and three socket head cap screws 1-72-1060 (38).
8. Install the belt 1-18-2120 (36).
9. Next install the pulley 2-18-0081 (32) and its related items:
 - a. Two bushings 1-18-2124 (35).
 - b. Bearing 1-18-0253 (34).
 - c. Key 1-18-2122 (33).
 - d. Housing 1-18-2124 (17).
10. Assemble the pneumatic speed changer 77-0800 or manual speed changer 77-0176 (Figure 11-8) to the belt housing base (77-0163) with two socket head cap screws 1-01-1037 (3, Figure 11-7).

11. Insert the chain stud 2-18-0066 (24) and pin 1-01-0534 (25) into the slot on the speed changer plate 2-18-0058 (21).
12. Center the pin 1-01-0534 (25) through the chain stud by using a pair of pliers.
13. Slide the speed change plate 2-18-0058 (21) over the pivot 2-18-0074 (28) and secure it with washer 2-18-0095 (23) and pin 1-01-0604 (22).
14. The belt housing (20) can now be mounted to the 2 hp head with two socket head cap screws 1-01-1069 (18) and three socket head cap screws 1-01-1065 (19).
15. Attach the speed change plate 2-18-0058 (21) to the housing (17) with two sleeves 2-18-0089 (16) and two socket head cap screws 1-01-1125 (15).
16. Attach the following items in order:
 - a. Retaining ring 1-18-0848 (14).
 - b. Bearing 1-18-0252 (13).
 - c. Spring washer 1-18-1977 (12).
 - d. Bearing cap 2-18-0094 (11).
 - e. Three socket head cap screws 1-01-1033 (10).
17. Secure the speed changer to the belt housing 77-0164 (20, Figure 11-7) with two socket head cap screws 1-01-1037 (26).
18. Install the following items in order:
 - a. Pulley 77-0082 (8).
 - b. Key 2-55-0007 (9).
 - c. Snap ring 1-01-0880 (6).
 - d. Socket set screw 1-01-1222 (7).
 - e. Cover 77-0195 (5).
 - f. Four button head cap screws 1-98-0449 (4).

11.10.2 Mounting Pneumatic Brake Lock (Figure 11-9)

NOTE

Tighten screws only when instructed.

1. Attach the adjustment coupling 77-0755 (10) to the brake shaft with a socket head cap screw 1-01-1034 (15).
2. Mount the cylinder 77-1631 (8) to the brake cylinder clevis 77-1629 (5) with the brake cylinder pin 77-1633 (7) and snap ring 1-18-0818 (6).
3. Press the dowel pin 1-01-0758 (9) through the brake lever 77-1632 (13) and clevis block 77-0352 (14) and screw the clevis block onto the cylinder shaft.
4. Attach bracket 77-1630 (4) to machine head using two socket head cap screws 1-01-1030 (1) and tighten.
5. Attach brake cylinder clevis 77-1629 (5) to bracket 77-1630 (4) with one socket head cap screw 1-01-1017 (3) and lock washer 1-63-1925 (2).
6. Slide the lever 77-1632 (13) over the coupling 77-0755 (10).
7. Secure lever 77-1632 (13) with socket head cap screw 1-01-1034 (11).
8. Thread socket setscrew 1-98-1471 (12) into coupling 77-0755 (10) and tighten.
9. Tighten screws 1-01-1017 (3), 1-01-1034 (11), and 1-01-1034 (15).
10. Thread the male elbow 66-5685 (16) into position as shown. The assembly procedure is now completed.

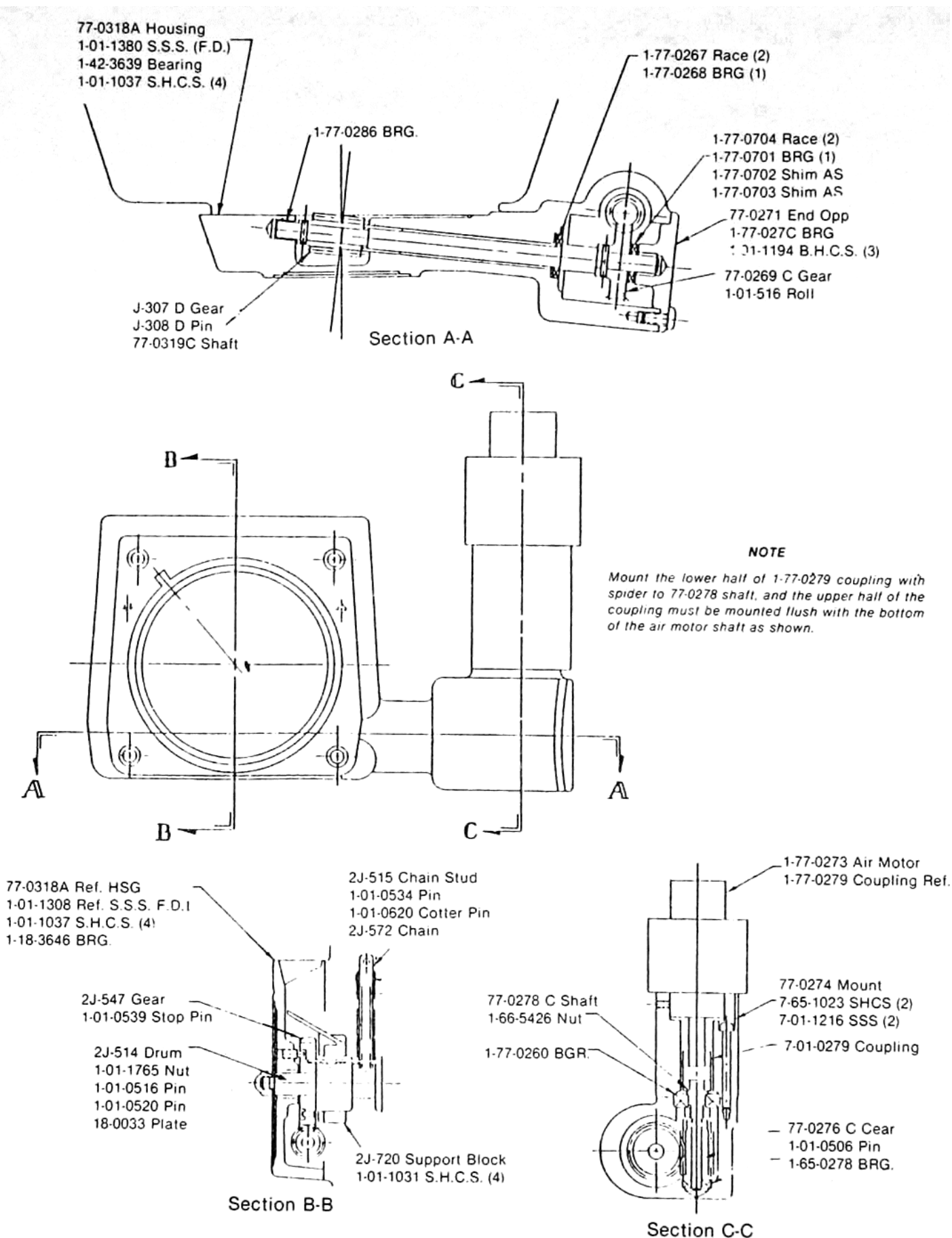
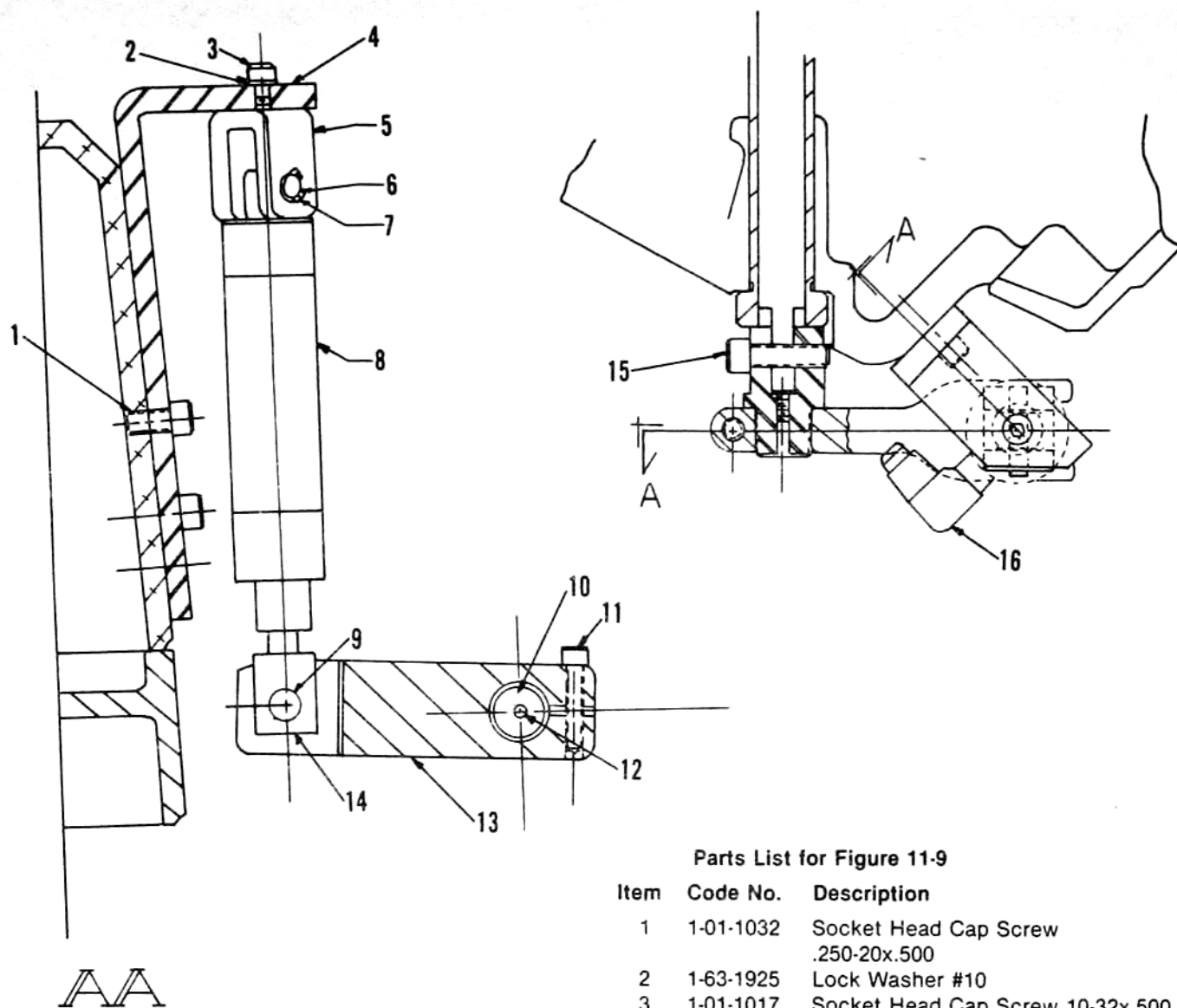


Figure 11-8 Pneumatic Speed Changer—Mark II



Parts List for Figure 11-9

Item	Code No.	Description
1	1-01-1032	Socket Head Cap Screw .250-20x.500
2	1-63-1925	Lock Washer #10
3	1-01-1017	Socket Head Cap Screw 10-32x.500
4	2-77-1630	Bracket
5	2-77-1629	Brake Cylinder Clevis
6	1-18-0818	Retaining Ring #510
7	2-77-1633	Brake Cylinder Pin
8	1-77-1631	Cylinder Brake Bimba
9	1-01-0758	Dowel Pin .375x1.250
10	2-77-0755	Brake Adjust
11	1-01-1034	Socket Head Cap Screw .250-20x.875
12	1-98-1471	Socket SetScrew 10-24x.500
13	2-77-1632	Brake Lever
14	2-77-0352	Clevis Block
15	1-01-1034	Socket Head Cap Screw .250-20x.875
16	1-66-5685	Male Elbow 149 F4-2

Figure 11-9 Pneumatic Brake

SECTION 12

OPTIONAL EQUIPMENT

12.1 INTRODUCTION

Listed below are the options and code numbers for the II CNC. Descriptions of the Y-Axis reed clamp and disconnect Cushman and Hofmann rotary tables, indexing and coolant options are included in this section.

Code	Option	Description
3656002		Y-Axis Reed Clamp (Section 12.2)
3800031		Y-Axis Disconnect (Section 12.3)
2521000	A3	12" Dia. Cushman Rotary Table (Section 12.4)
2520111	A4	10" Dia. Hofmann Rotary Table with Chuck and Tailstock (Section 12.5)
1570550	H1	#30 Quick Change Tool Kit
Ref. Only	H2	#200 Universal Tool Kit
1570551	H10	#30 Quick Change Tool Kit
3771550	I4	Indexing Control Installed (Section 12.6)
356XXXX	K	Coolant (Section 12.7)
3665650	K10	Chip and Coolant Shield
2652043	P15	APT Postprocessor (IBM 360)
2652044	P16	APT Postprocessor (UNIVAC 1108)
2652045	P17	APT Postprocessor (CDC 6600)
3575000*	S2	#200 Universal Spindle (Installed)

12.2 INSTALLATION OF Y-AXIS REED CLAMP— Figure 12-1

1. Turn OFF the power.
2. Remove the cover (1) and remove the X-axis drive motor. Refer to Section 10.3.3, X-Axis Drive Motor Replacement.
3. Remove the motor mounting bracket (2).
4. Remove the saddle hold down (3) and install new clamp (3) provided with tapped holes. Torque the mounting to 33 ft. lbs.
5. Remove the knee-column hold down clamp (4) and install new clamp (4) provided with tapped holes.
6. Install the new X-axis drive motor bracket (2).
7. Mount the brake block (5), binding strip (6) and spacer (7) to the knee and saddle with all mounting screws loose.
8. Install the saddle locking shaft (8) through the X-axis motor mounting bracket (2).
9. Install the front binding strip mounting bracket (9) to the binding strip (6) and clamp it to the knee.

10. Turn on the power and drive Y-axis full travel. Snug up all capscrews, changing the position of the bracket (9) if necessary. Ensure free travel without binding or friction. Tighten all capscrews and drill and tap the front of the knee per Figure 12-1. Install the capscrews.
11. Recheck the alignment with all capscrews tight by moving the saddle in and out without interference.
12. Turn OFF the power.
13. Drill 1/8 inch diameter x 5/16 inch deep for the rollpins in brackets from the pilot holes provided. Install the rollpins.
14. Finish installing the X-axis drive motor.
15. Install the cover (1).
16. Install the saddle lock handle (10) and check the proper action of the Y-axis clamp.

12.3 Y-AXIS DISCONNECT CABLE INSTALLATION (FOR USE WITH ROTARY TABLE)—Figures 12-2, 12-3.

1. Turn OFF the power.

NOTE

The rotary table electrical adapter option requires that a bracket be mounted on the left side of the knee.

2. Use Figure 12-2 to locate the holes to be drilled for the bracket. The dimensions are approximate.
3. Mount the cable shield.

When the Y-axis is to be used

4. Attach the Y-axis motor to the drive cable using the MS connector which is affixed to the cable shield and the mating MS connector on the Y-axis step motor cable.

When the rotary table is to be used

5. Disconnect the Y-axis motor cable from the drive cable and connect the rotary table cable via its MS connector to the drive table.



When using the rotary table, the Y-axis slide must have a locking mechanism present to prevent inadvertent Y-axis motion.

When the Y-axis step motor is not in use, insure that the MS connector end of the motor cable remains under the

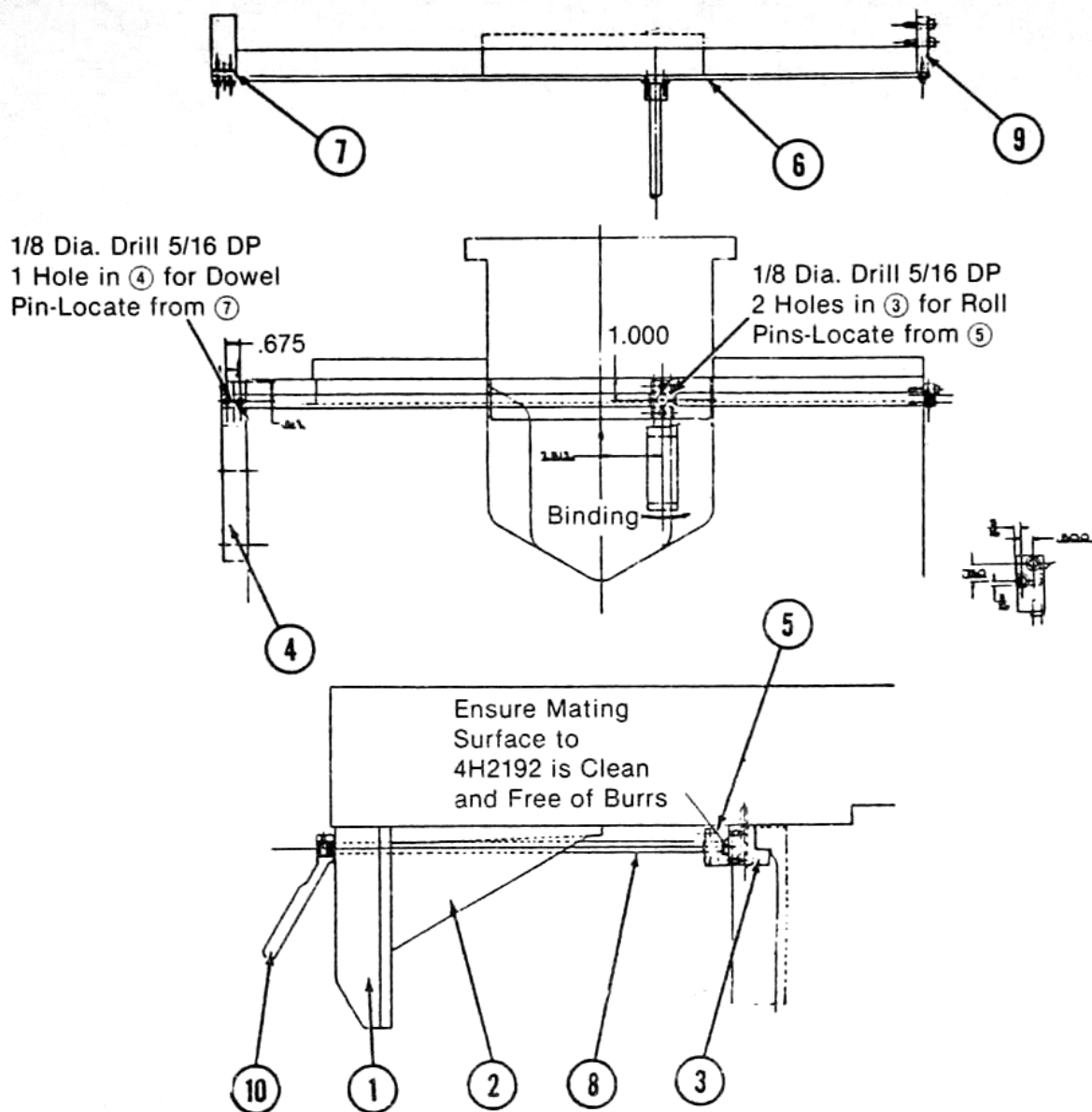


Figure 12-1 Y-Axis Reed Clamp Installation

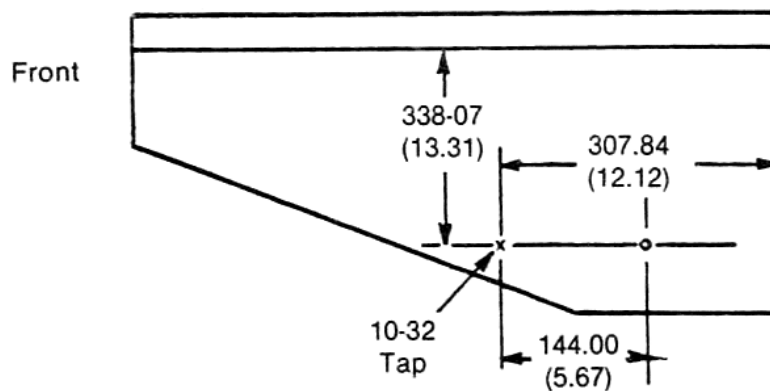


Figure 12-2 Hole Locations for Y-Axis Disconnect Cable Bracket

cable shield to prevent contamination by coolant and/or chips. Correct placement of the cable clamp will provide the necessary tension on the cable to keep it under the shield when removed. Refer to Figure 12-3.

12.4 OPTION A3: CUSHMAN 12" ROTARY TABLE AND DRIVE

12.4.1 Description

The 12" diameter Cushman rotary table is driven by a worm gear arrangement with a 180:1 ratio. Power is supplied by a stepmotor compatible with the drive of all Bridgeport Series II CNC machines (Table assy. code 2521000). The counter incorporated into the drive system is capable of being read to 0.01 degrees, the resolution of the total system. The rotary table can be driven from the control output to one of the linear axes. Suitable special provision has been made to utilize the Y-axis output to drive the rotary table instead of its normal output to the saddle drive motor. A special Y-axis reed clamp (3656002) and disconnect (3800031) are then made available and installed at the factory. For field installation use 2656002 and 2800031 respectively.

Depending on the requirements, the table can be mounted vertically on the left side of the machine table, or with its working face horizontal. Note that when the table face is mounted vertically (axis of rotation horizontal), mounting holes are provided to suit the T-slot spacing. Bridgeport Tailstock 2520003 may be used when this rotary table is mounted vertically.



To prevent damage to the table do not apply excessive end load with the tailstock. Make sure that the table face is not distorted when clamping the workpiece.

12.4.2. General Information

Rotary Table—12" Cushman 180:1 ratio right angle standup

Counter and motor bracket—4H-2245

Motor—Bridgeport Control's Step Motor Square flange B-018642

Revolution—(1) Step Motor Pulse 0.01 degrees

12.4.3 Specifications

Table Diameter 12"

T-Slots (4) 9/16" Wide

Keyways 11/16" Wide

Weight (Approx.) 150 lbs.

Profile Height 4-7/8"

Weight Carrying Capacity

Central 150 lbs.

Off Center 150 lbs. @ 3"

Right Angle 600 Inch lbs.

Max Backlash (adj) .002" @ 6" Radius

Squareness of Table—Base to Right Angle Pad .002" in Total Height

Center Hole Dimension 1.000"

Center Hole-runout.0008" TIR

Center Bore to Vertical Mount 8.50"

Static and Rotary Flatness .0005" TIR

Drive Ratio 180:1

Angular Accuracy 25 Sec.

Resolution 0.01 Deg. (36 Sec.)

Repeatability 25 Sec.

Torque Requirement for Rotation of Table 110 oz. in.

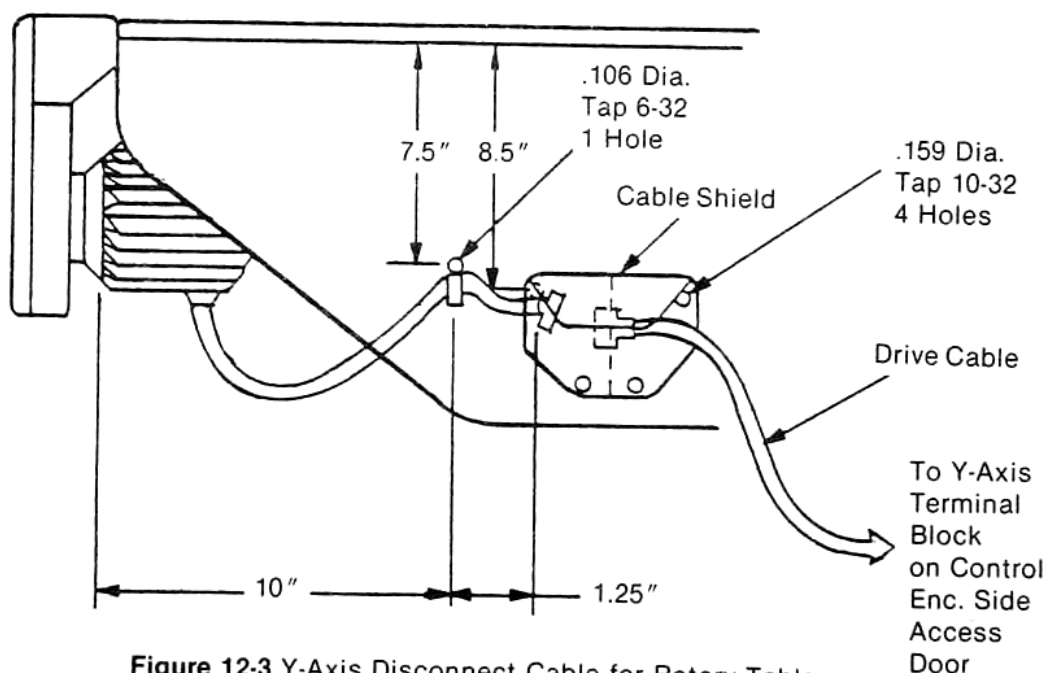


Figure 12-3 Y-Axis Disconnect Cable for Rotary Table

Volume of Oil in Unit 1/2 pint

Recommended Oil Good grade SAE 20 with Rust Preventative

Cable and 6-pin MS-Connector provided.

12.4.4 Method of Adjusting Backlash

1. Loosen binding SCR
2. Remove (4) Mtg Bkt screws
3. Loosen rotation stop screw nut.
4. Apply ccw pressure on the mounting bracket to keep the worm shaft against the rotation stop screw.
5. Turn the rotation stop screw ccw to decrease the backlash. (Recommended backlash: Max. .002 in 6" radius of table)
6. Tighten rotation stop screw nut (Hold the Screw in position).
7. Tighten the binding screw.
8. Replace (4) Mtg. Bkt. screws.

12.4.5 Wiring Information

+ Z Direction C. W. Rotary Table Rotation
(12) ft. of (6) Conductor Cable supplied

12.4.6 Terminating in MS Connector Shown

TB IN NEMA
ENCLOSURE
BULKHEAD CONNECTOR —
503667

MS CONNECTOR
ELBOW CONNECTOR —
503662
CABLE CLAMP —
503663

12.4.7 Parts

Item	Code No.	Description
1	2-52-5001	Assy, Counter with Motor
2	1-01-1902	Washer, Flat .375 Wrought
3	1-01-1075	Socket Head Cap Screw .375-16x1.250
4	1-01-1056	Socket Head Cap Screw .312-18x1.250
5	1-52-0195	Motor-Rotary Table
6	1-65-3460	Rotary Table

12.5 OPTION A4: HOFMANN ROTARY TABLE WITH STEP MOTOR DRIVE

12.5.1 Description

This option consists of a general purpose Kit for rotary milling purposes. There is a 10" diameter rotary milling table with step motor drive, a 3-jaw chuck of 160mm (6.3") diameter and a tail stock of fixed elevation of 160mm (6.3") height with adjustable dead center.

The motor drives a worm through a 2:1 reduction by toothed belt; the worm drives its gear with a 90:1 reduction. The overall ratio of 180:1 therefore makes programming compatible with options A1 and A3 for

another table. Setup positioning to the output resolution of 0.01 degrees can be verified by degree increments on the perimeter of the table and 200 scribed lines on a dial attached to the motor shaft and visible through a sight glass. The rapid traverse is 100 ipm or 5.55 deg./min.

12.5.2 Installation

The rotary table may be mounted with its axis vertical or horizontal. In the case of the latter, hole spacing for securing to the T-slots is on 8.75" centers and therefore suited to all Bridgeport N/C products. Since the latter have 3-axis controls only, one must be used to drive the rotary table. Though the Z-axis on the Series II CNC can be used, the Y-axis is the generally accepted output to the table drive motor. The additional equipment required for Y-axis clamping and Y-axis electrical disconnect for the CNC II, BOSS 6 are clamp 2/3-65-6002 and Disconnect 2/3-80-0031. The code numbers show a 2 or 3 as the first digit representing a Kit of parts for field installation or factory installed, respectively.

12.5.3 Specifications

Table Diameter	9.843" (250mm)
T-Slots (4)	5/8" wide
Keys (2)	5/8" wide
Table Weight	180 lbs.
Lifting Eyes	2 supplied
Table Depth	8.071" (205mm)
Drive Ratio	180:1
Max. Thrust on Spindle	800 lbs.
Faceplate C'Bore	1.500" dia.
C'Bore Runout	.0005" TIR
Spindle Thru Hole	1-1/8" dia.
Thru Hole Mount	#4 Morse
Backlash @4.5" R	.0005" TIR
Face Square to Base	.0005" TIR
Face Parrallel to Back	.0005" TIR
Rotary Flatness	.0005" TIR
3-Jaw Chuck Dia.	6.299" (160mm)
Chuck ID Jaws	1.5"-6.75"
Chuck OD Jaws	.125"-7.0"
Chuck Weight	25 lbs.
Chuck Key	1 supplied
Axis Height	6.299" (160mm)
Tailstock	1 supplied
Max. Vert. Load on ctrs	330 lbs.

Performance Unloaded

Angular Accuracy	± 30 ARC SECS
Repeatability	20 ARC SECS
Resolution	36 ARC SECS

Performance Metalcutting

Equiv. Metal Removal	1 H.P.
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NOTE

Motor Cable and 6-pin MS connector supplied. For details see Manual M-145.

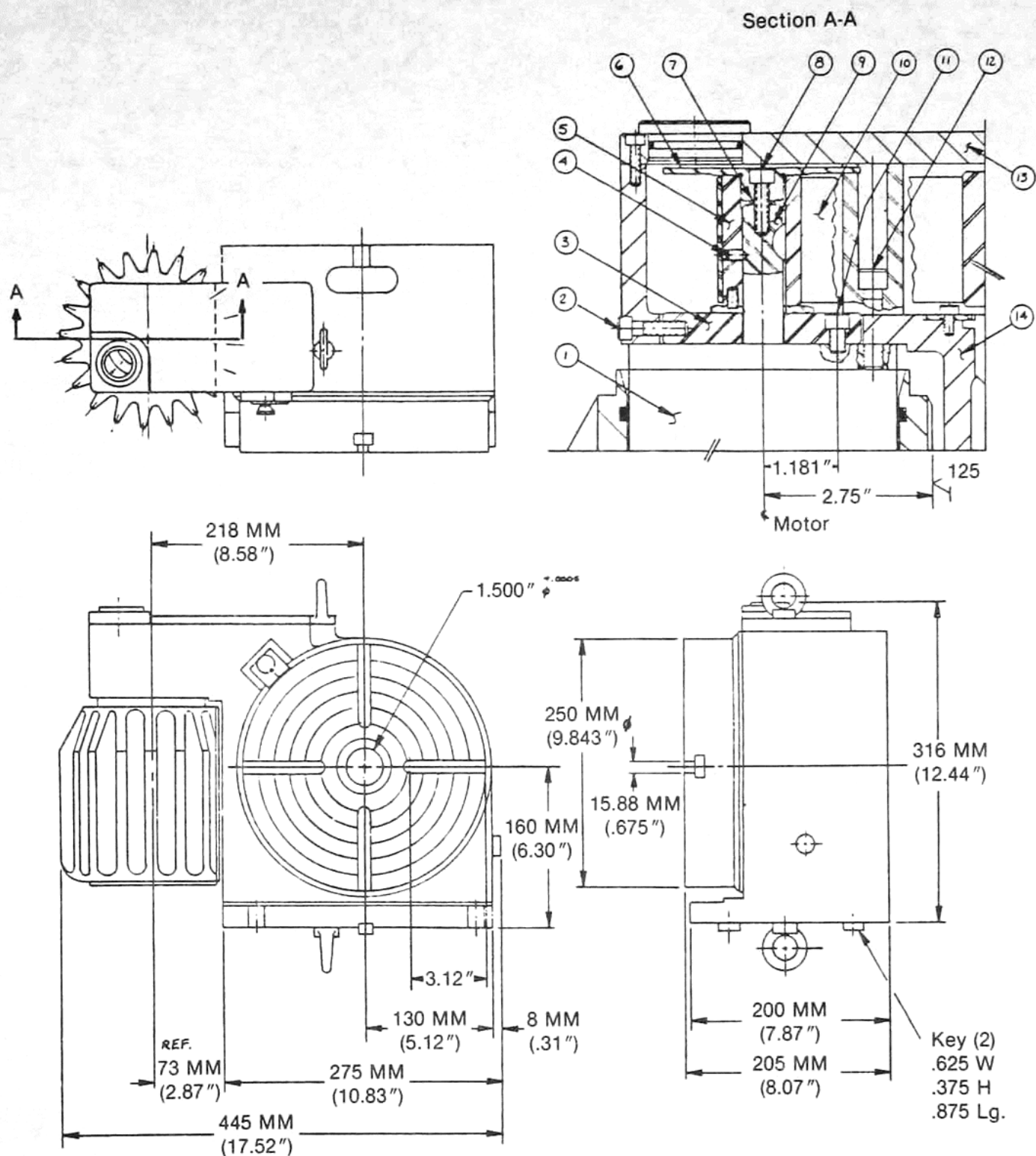


Figure 12-5 Hofmann 10" Rotary Table

12.5.4 Motor Installation Instruction

A. Index of Parts Ref. Section "A-A" of Figure 12-5

Detail No.	Description	Qty	Supplied By
1	Motor Assy. BMI #1-93-2968	1	BC
2	SCR-SHC-.250-20 x.750	1	BC
3	Flange-Motor-HOF #1281-11-108	1	HOF
4	SCR-SOC SET M4x8 DIN 914	1	HOF
5	Pulley Timing Belt- HOF #1281-11-109	1	HOF
6	Ring-Graduated-HOF #1281-11-106	1	HOF
7	Washer-DIN 988	3	HOF
8	SCR-SHC-.250-20 x.750	1	BC
9	Shaft-Motor-Ref	Part of DET #1	
10	Belt-Timing- #150XL200 Uniroyal or Eq.	1	HOF
11	SCR-SHC-.250-20 x .375	4	BC
12	SCR-SHC-.312 - 18 x 1.250	4	BC
13	Cover-Housing	1	HOF
14	Housing-Rotary Table	1	HOF

The following parts - supplied by Hofmann will **Not** be used:

SCR - M6 x 10 DIN 912 4

SCR - M6 x 20 DIN 912 2

B. Additional Machining—To be done by BC

1. Drill & tap detail #3 flange for DET#2 screw
2. Drill & tap DET #9 shaft for DET #8
3. Drill & tap DET #1 motor for DET #11 screw
(Do Not Break Thru)

C. Assembly

1. Remove DET #13 cover from DET #4 housing
2. Fasten DET #3 flange to DET #1 motor with (4) DET #11 screws
3. Mount DET #5 pulley onto DET #9 shaft, leaving approx .0004" clearance between flange of pulley & DET #3 motor flange. Spot DET #9 shaft & secure DET #5 pulley in position with DET #4 set screw.
4. Mount DET #1 motor (with pulley) to DET #14 housing with DET #12 screws (4). Do **Not** tighten screws.
5. Install DET #10 timing belt on pulleys & tighten to .070" defl'n/5 lb-force @ Mid-span with DET #2 screw
6. Tighten DET #12 screws.
7. Mount DET #6 ring to DET #9 shaft, using DET #7 washers as required to obtain approx .0004" clearance between ring & DET #5 pulley, set zero on dial to 360° on table perimeter. Secure ring with DET #8 set screw.

8. Re-install DET #13 cover

9. Test assembly at rapid traverse in both directions i.e. at rate of 6.67RPM (120 IPM BOSS 6 SER I CNC)

Note

*The detail numbers in ballons, shown in Figure 12-5, Section A-A refer to "Index of Parts", and are **not** the same as the item numbers in the Bill of Material.*

Assembly Bill of Material

Item No.	BMI Code No.	Qty	Description
1	1-01-1028	4	SHCS .250-20 x .375
2	1-01-1033	2	SHCS .250-20 x .750
3	1-01-1056	4	SHCS .312-18 x 1.250
4	1-52-0255	1	Rotary Table, 10 in, CNC, Chuck, T-Stk
5	1-93-2968	1	Motor Assy

NOTE: #1-52-0255 Includes:

- 1-52-0150 Table Only
- 1-52-0151 Chuck Only
- 1-52-0152 Tailstock Only
- 1-52-0153 Wrench (for chuck) (10mm Sq.)
- 1-52-0154 Lifting Eye (2 reqd)
- 1-52-0155 Key .625W. (4 reqd)
- 1-52-0156 ID Jaws Only (set of 3)
- 1-52-0157 OD Jaws Only (set of 3)
- 1-52-0158 SCR-Key Ret (4 reqd) (M6 PAN-HD)

12.6 OPTION 1.4: Indexing

12.6.1 Description

This option permits miscellaneous function M51 to be programmed in conjunction with the use of a suitable Indexing Table on the Series II CNC machines. A suitable index table is one that inhibits data transfer and therefore prevents operation of the machine axes while the indexing operation takes place (e.g. Erickson 450 or 600 Indexer with oil tight limit switches LS-1 and LS-2).

This function can be installed on the BOSS 6, or 6.1 machine provided that the interface is supplied on the data transfer card as follows:

ZDI Card (B6, 6.1) PN 1928110 BL2 or higher (S/N 675 or higher)

This indexing interface with these cards become standard equipment on the Series II CNC Control S/N 7275 and higher.

12.6.2 Installation

The unit is located approximately eight inches behind the brake manifold. The package resembles the pneumatic brake manifold. It incorporates the same cover, mounting plate dimensions, mounting bracket, and hardware.

The mounting plate uses a single solenoid valve, a 24 VDC DPDT relay, and a Weidmuller terminal strip. The control cable is fed through the ram with existing cables and terminates in the control cabinet. This cable will enter near the quill switch cable, and workspace is available in the control cabinet to make retrofitting possible.

Main air is supplied to the index control by a tee located in the main air line. A 7.5" hose is available to continue the main air to the brake manifold. The field retrofit kit is: 1932415 R-Ram.

12.6.3 Operation

A programmed M51 code will cause the solenoid to be energized after the motion in the same block is complete. The energization of the solenoid will cause the valve spool to shift and "cock" the indexer. The "cocking" action changes the state of LS-2 first, throwing an INHIBIT into the system (WAIT status lamp ON) and preventing the system from executing the next block of data in the program. At the end of the cocking stroke, LS-1 changes state, resetting the function and therefore de-energizing the solenoid. The solenoid will now port air to the index cylinder which permits the shotpin to engage at the end of its stroke. The shotpin restores LS-2 to its original state, removing the INHIBIT and permitting the machine to proceed by allowing the next block of data to be executed.

Wire list and typical timing diagram for M51:

M51

CR Control Relay
Relay Coil
Reset NC
Reset NO
Inhibit NC
Inhibit NO



Transients caused by non-suppressed reactive loads connected to the relay contacts may cause malfunction. Transient suppression of external equipment is the responsibility of the user.

12.7 OPTION K: COOLANT SYSTEM

12.7.1 Description

With the Auxiliary Control Group option, the coolant will be turned ON/OFF with the spindle. A separate AUTO/OFF switch is provided. Refer to Part III, Parts Lists, for photos and parts lists of nozzle and tank kits.

12.7.2 Specifications

All coolants must be ordered as Coolant Tank Kits and as Nozzle Kit Assemblies, either loose 2-56-XXXX or Installed 3-56-XXXX. All tank units are designed as 115/1/50 or 115/1/60 units and all heads will have 1 flood nozzle.

The method of ordering the XXXX number is shown in Table 12-1.

Table 12-1: Ordering Data

	Flood	Mist
Nozzle Kit	0069	0076
Tank Kits	0065 (60Hz floor) 0079 (50Hz floor)	0067 (1 gal) 0068 (5 gal)

12.7.3. Ratings

Flood Coolant Ratings:

Electrical	Transformers 115V secondary & Triac (4ASB fuse)
Motor	115 volts, 1 phase, 50/60 Hz, 3450 RPM
Flow	Zero flow 16ft., 20gpm at 6ft. head (water soluble oil)
Tank Capacity	5 Gallons

Mist Coolant Ratings:

Solenoid	115 volts, 60 Hz AC 0.2 amps in-rush, 0.1 amps holding (Triac driven 1ASB fuse)
Air	1 cpm free air @30 psi operating pressure, 125 psi max supply
Liquid	2-3 Oz./hr./jet (Max. 60 oz./hr./jet)

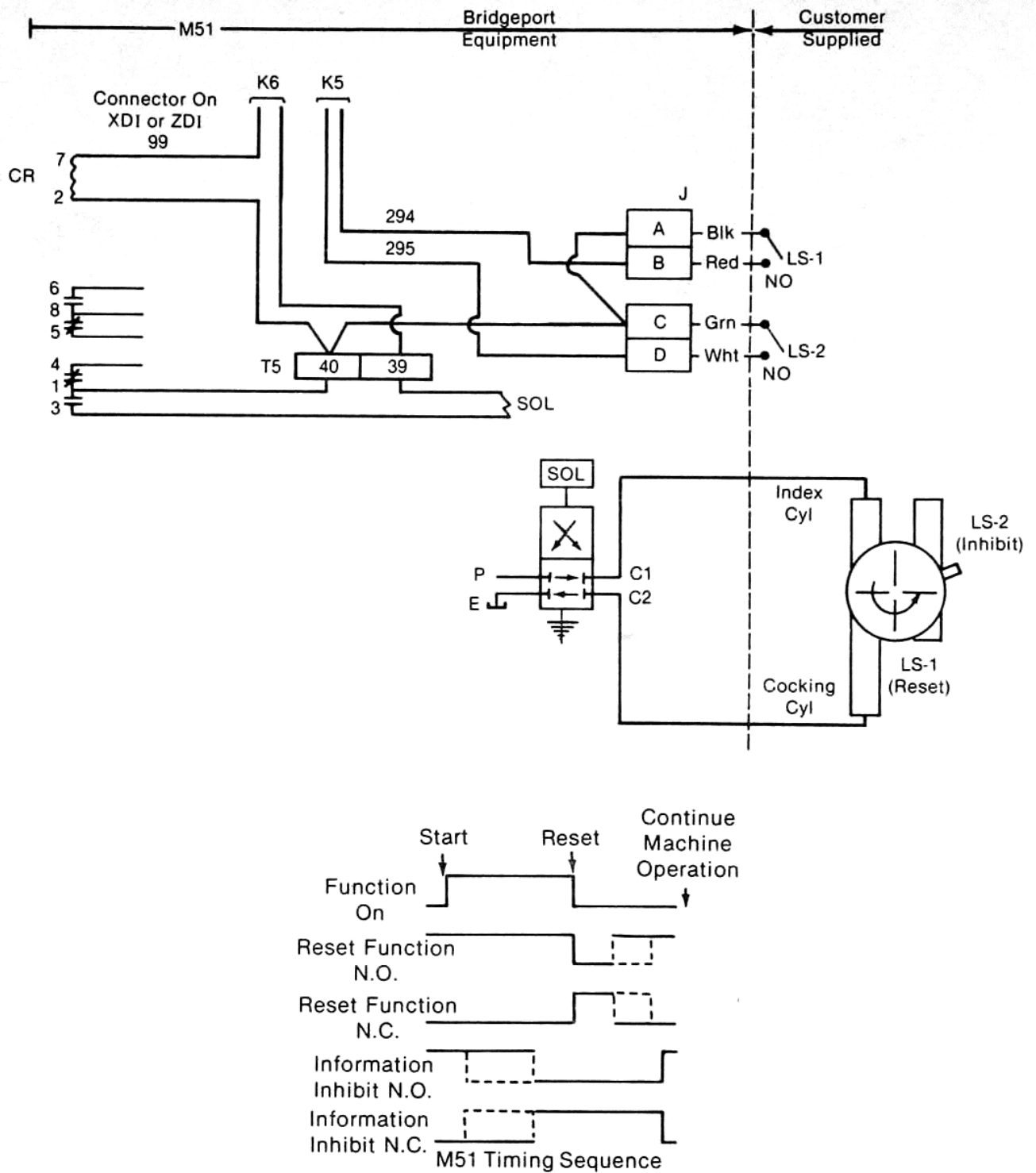


Figure 12-6 Indexer Timing Sequence and Wiring

Figure 13-16 ZCK Board (P/N 2924112)

SECTION 13

PARTS LISTS—CONTROL

13.0 CONTROL

13.1 OPERATOR'S CONTROL PANEL

13.1.1 Electro-Mechanical Parts

Keyboard	1926393
Pot Operator, Feedrate	1504017
Potentiometer, 10K	1508128
Pushbutton, Hold	1504166
Pushbutton, Illuminated	1919298
Selector, 3 each	1505851
Selector, X,Y,Z	1505852
Sel Pushbutton	1504479

13.1.3 Buttons

CE	1506343	2	1506325
N	1507647	3	1506326
G	1506345	4	1506327
X	1506346	5	1506328
Y	1506347	6	1506320
Z	1506348	7	1506330
F	1506349	8	1506331
M	1506350	9	1506332
O	1506323	- =	1506351
1	1506324	Black	1506352

13.1.2 Printed Circuit Boards

UFP Board	1926365
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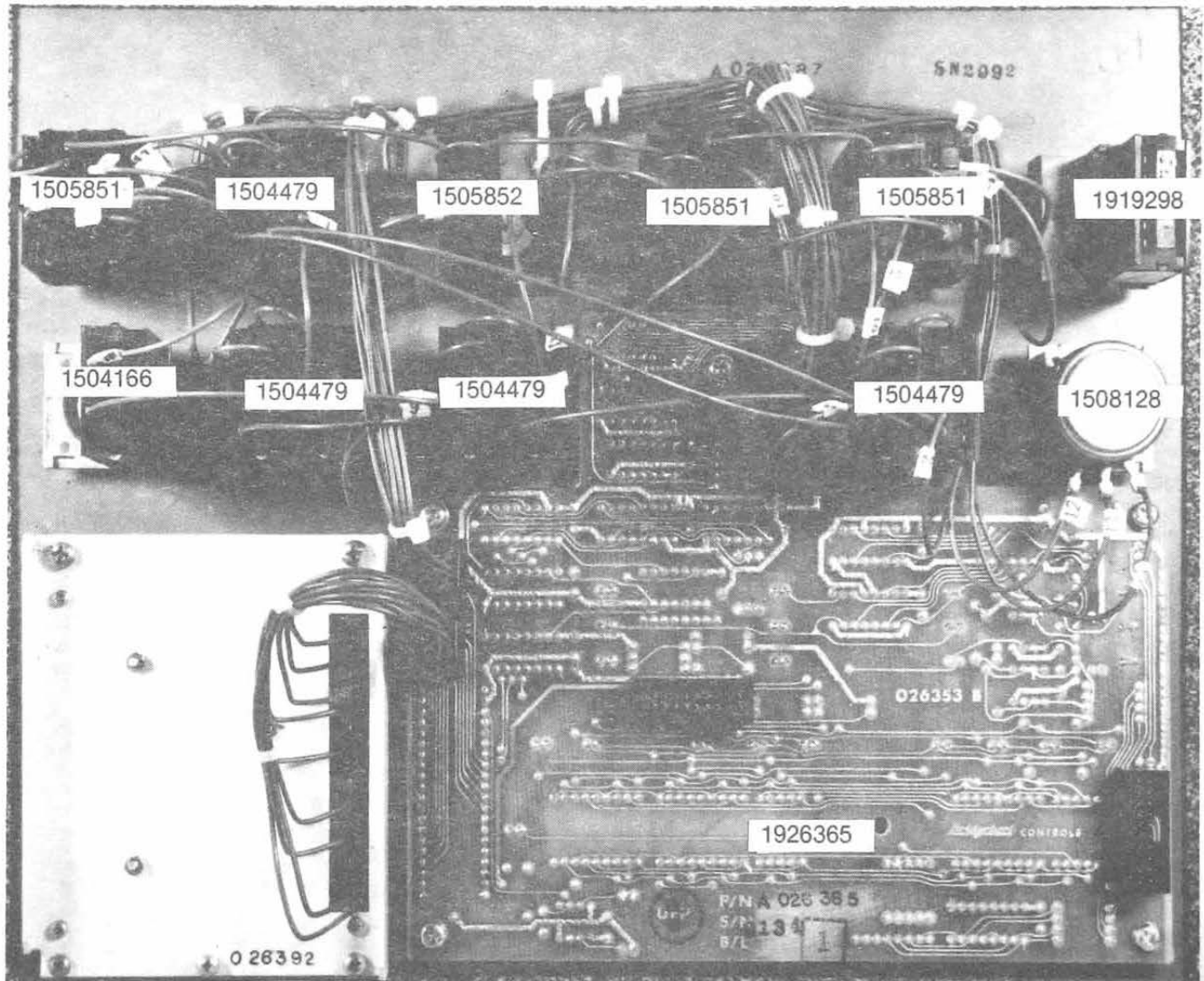


Figure 13-1 Operator's Control Panel Rear View

13.2 CONTROL EQUIPMENT ENCLOSURE

13.2.1 Electro-Mechanical Parts

Fan Motor, 3 each	1503460
Relay, 12V, 3PDT, KRP, 14D, CR1	1501091
Relay, 24V, 3PDT, KRP, 14D, CR2	1505074

13.2.2 Printed Circuit Boards

ACC Board Assembly	1918568
FPS Board Assembly	1924086
ICD Board Assembly	1926734
JMM Board Assembly	1927113
SMD Board Assembly, 3 each	1927015
SMS Board Assembly	1028843

13.2.3 Card Complement BOSS 6.0

ERS	1928472
ZCK	1930730
ZDI	1928110
NTP Wire Wrap	1927484
NTP PC Board	1930399
LSI-11	1927323
RRS	1933083

13.2.4 Card Complement BOSS 6.2

ZDI	1928110
LSI-11/2	1929889
RRS	1933083
ZCK	1932676
NTP	1932918

13.2.5 Capacitors

2200 uF, 75 VDC, C1	1503678
3500 uF, 50 VDC, C2	1502062
5500 uF, 200 VDC, 6 ea, C3,4,5,6,7,8	1503518
16500 uF, 50 W VDC, C10	1501509
84000 uF, 25 W VDC, C11	1506289
1000 uF, 25 W VDC, C12	1505030

13.2.6 Resistors

1K Ohm, 10W, R3	1503674
750 Ohm, 50W, R4	1503665
560 Ohm, 5%, 1W, R18	1500883
100 Ohm, 5%, 1W, R24	1500679
1.2K Ohm, 5%, 5W, R15	1500725
0.33 Ohm, 3%, 5W, 2 ea, R16, R17	1506297
0.5 Ohm, 3%, 5W, R14	1506307
0.25 Ohm, 3%, 5W, 6 ea, R19,20,21,22,23,25	1507235
120 Ohm, 5%, 10Wm R26	1503882

13.2.7 Semiconductors

Diode, Type 1N3211, 6 ea, D1,2,4,5,7,8*	1500027
Diode, Type 1N3313, 2 ea, D3, D6*	1506291
Diode, Type 1N4554, D9*	1506290
Diode, Type 1N4722	1503473
Diode, Type 1N4003, 4 ea. D13,14,15,16*	1500029
Diode, Type 1N457A, 4 ea. D1,2,3,4	1500025
Transistor, Type 2N3055, 9 ea, Q5-Q13*	1500083
Transistor, Type 2N6251, (4 per SMD Bd) Q1-Q4*	1507944
Silicone Grease* AR	1506468
Mica Insulator, For Diodes, 2 Per Diode*	1500313
Bushing, .257 1D X .312 OD X .058 THK.*	1507689
Rectifier, Bridge, 4 ea. BR1,3,4,5	1503860
Rectifier, Bridge, 2 ea. BR2	1502684
Mica Insulator, For Transistors, 1 Per Tran	1506149
Insulation Skewing, AR*	1508379
Bushing*, For Transistor Q1-Q4, 2 Per Tran	1507698

*MOUNTING NOTES:

Silicone grease (thermal compound) applied to both sides of mica insulators (D1-D9 of regulated power supply Q1-A13). 2 Teflon bushing per D4, D5, D7, D8, 1 per D1-D3, D6, D9. Insulation Sleeve used on LEDs of D13-D16, Q1-Q4, 2 bushings (1507698) per Q1-Q4.

13.2.8 Inductive Components

Transformer T6	1508469
Transformer, T7	1504349
Transformer, T8 (For 50 Hz units only)	1924871
Transformer, T8 (For 60 Hz units only)	1924032
Filter, Low pass, FIL-1, FIL-2, 2 ea.	1506310

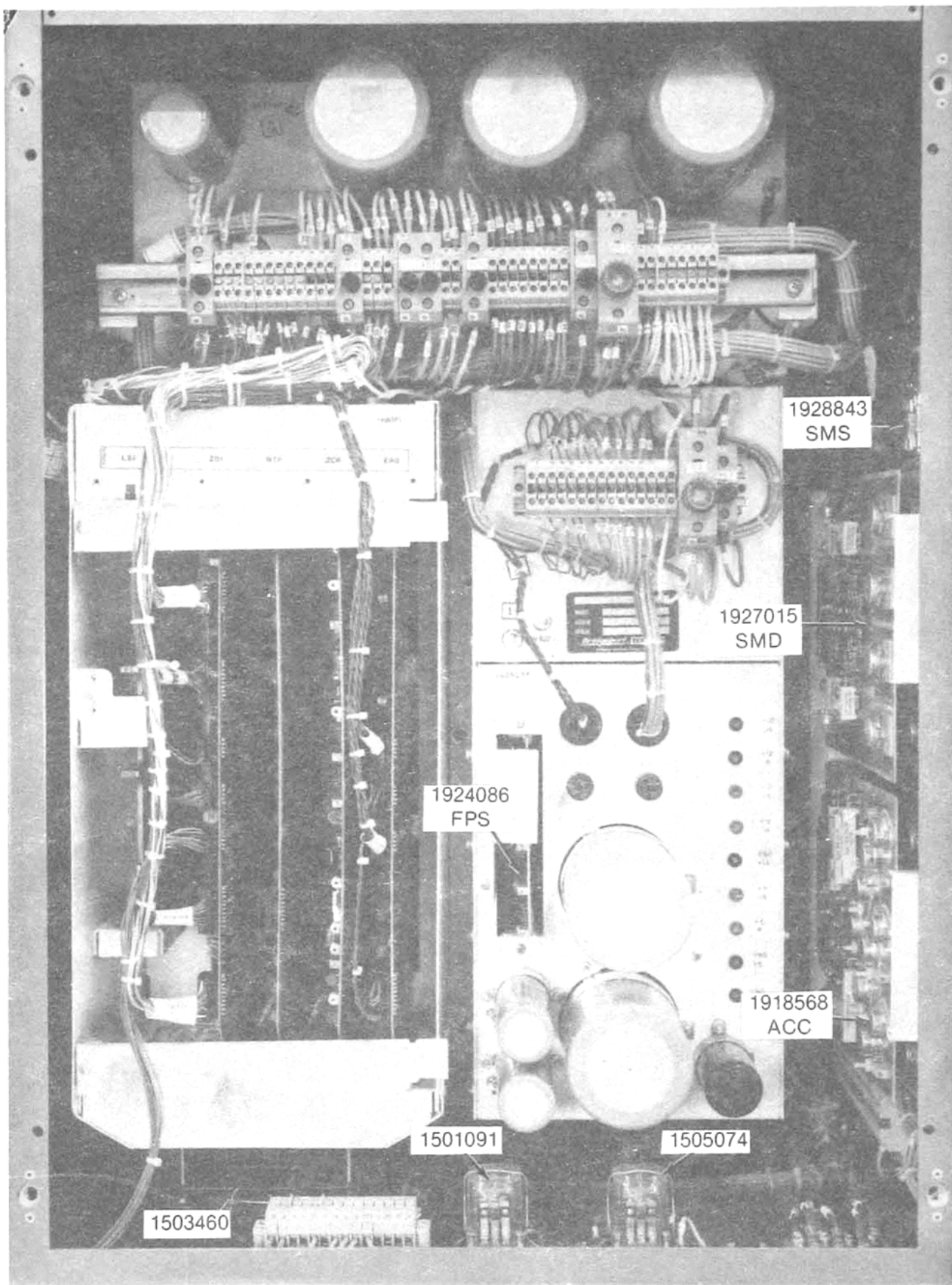


Figure 13-2 Control Equipment Enclosure

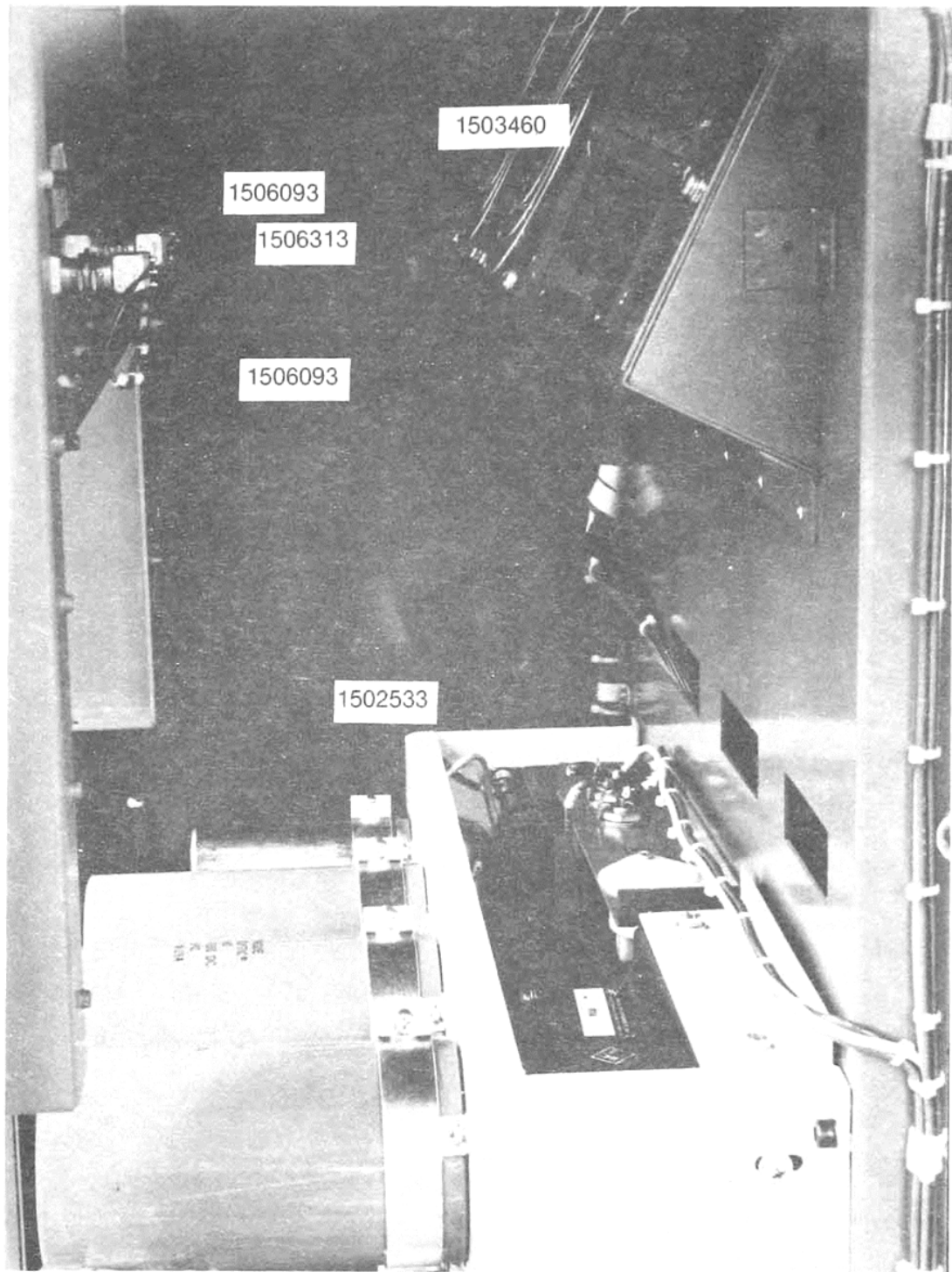


Figure 13-3 Control Equipment Enclosure (Detail)