M.I. 1145

Maintenance Instruction

Service Department

ELECTRO-MOTIVE

AIR COMPRESSOR CLUTCH

DESCRIPTION

The air compressor clutch is a spring applied — air pressure released stationary cylinder type dry plate clutch. The clutch is used on locomotive applications as a measure to conserve energy (fuel) by disengaging the air compressor from the engine during periods of unloaded operation (high air system pressure).

The clutch application and releasing functions are controlled by high and low settings of a pressure switch. The high pressure setting will disengage, and the low pressure setting will engage the clutch.

MAINTENANCE

Due to the design of the air compressor clutch, routine maintenance is limited to periodic inspections and functional tests of the clutch and its air control system during normal shutdown periods for servicing, as specified in the Scheduled Maintenance Program.

The air compressor clutch should be disassembled at the interval specified in the Scheduled Maintenance Program or sooner if evidence of a failure exists or excessive wear of the friction plates is determined by measuring the gap between the cylinder face and the back of the thrust plate, Fig. 1, with clutch fully engaged. Friction plates, springs, drive shell bearings, and O-ring seals should be replaced at time of overhaul. All other parts should be carefully cleaned and inspected for wear or damage.

CLUTCH REMOVAL

1. Disconnect flexible air line from clutch, Fig. 2, and remove air compressor clutch guard (2 pieces) along with attached compressor unloader air line bracket(s).

2. Remove anti-rotational stop from support on top of sill.

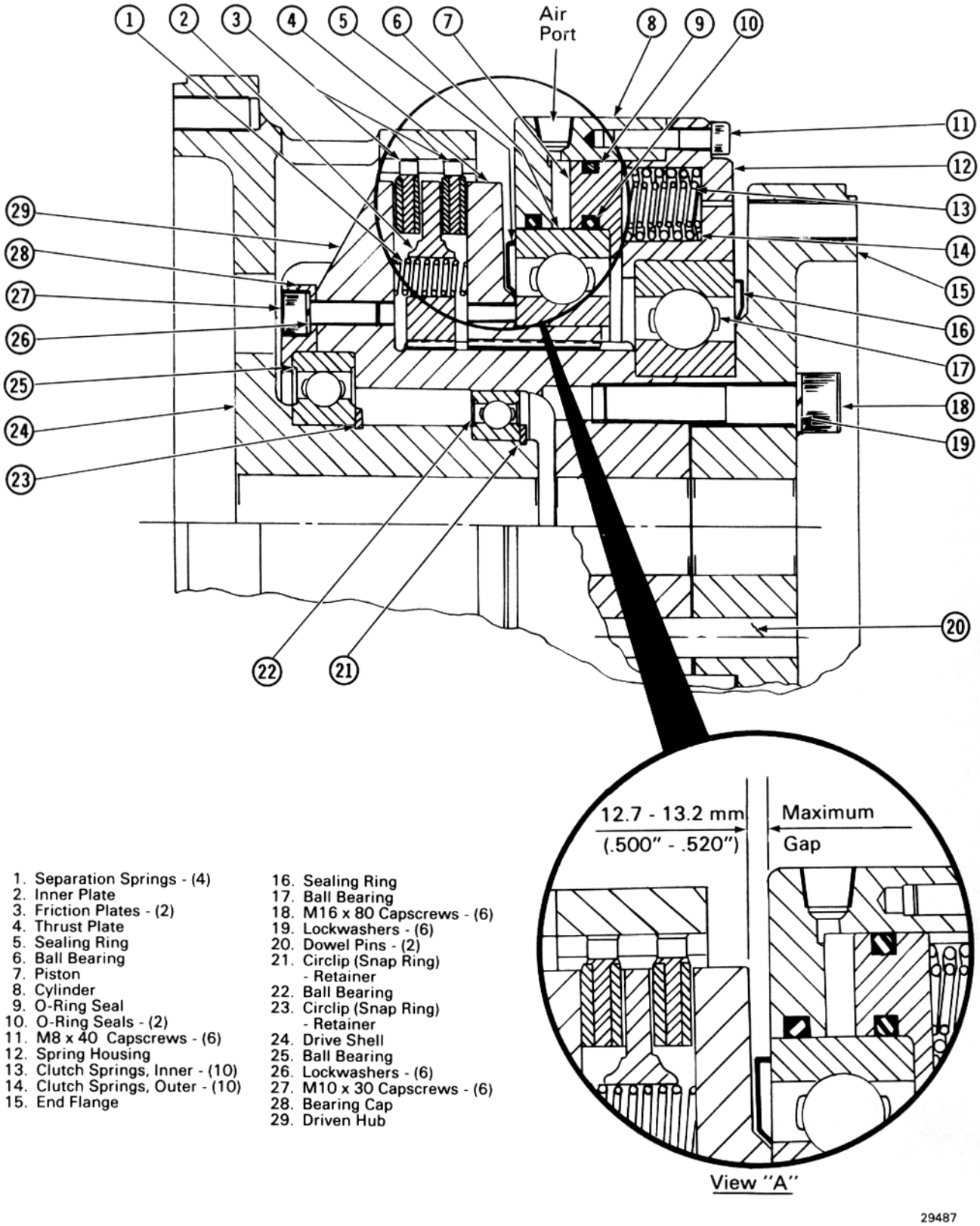
3. Using an outside (or house) air supply of at least 758 kPa (110 psi), apply air pressure at cylinder air port to disengage the clutch and rotate the drive and/or driven flange of clutch as necessary to align lifting holes in a near vertical position, Fig. 3. Apply 5/8″-11 lifting eyebolt in each lifting hole and attach suitable lifting device to support the clutch and remove it from the locomotive.

NOTE

Clutch assembly weight is approximately 109 kg (240 lbs).

4. Position a jack stand beneath compressor drive shaft or otherwise support shaft with sling and/or hoist.

5. On units with spacer and coupling assembly on air compressor, the spacer is used to join the compressor coupling to the clutch. Disassembly of the spacer from the clutch provides the necessary clearance to remove the clutch without a need to move the air compressor.



1. Separation Springs - (4)
2. Inner Plate
3. Friction Plates - (2)
4. Thrust Plate
5. Sealing Ring
6. Ball Bearing
7. Piston
8. Cylinder
9. O-Ring Seal
10. O-Ring Seals - (2)
11. M8 x 40 Capscrews - (6)
12. Spring Housing
13. Clutch Springs, Inner - (10)
14. Clutch Springs, Outer - (10)
15. End Flange
16. Sealing Ring
17. Ball Bearing
18. M16 x 80 Capscrews - (6)
19. Lockwashers - (6)
20. Dowel Pins - (2)
21. Circlip (Snap Ring) - Retainer
22. Ball Bearing
23. Circlip (Snap Ring) - Retainer
24. Drive Shell
25. Ball Bearing
26. Lockwashers - (6)
27. M10 x 30 Capscrews - (6)
28. Bearing Cap
29. Driven Hub

Fig.1 – Compressor Clutch Cross-Section

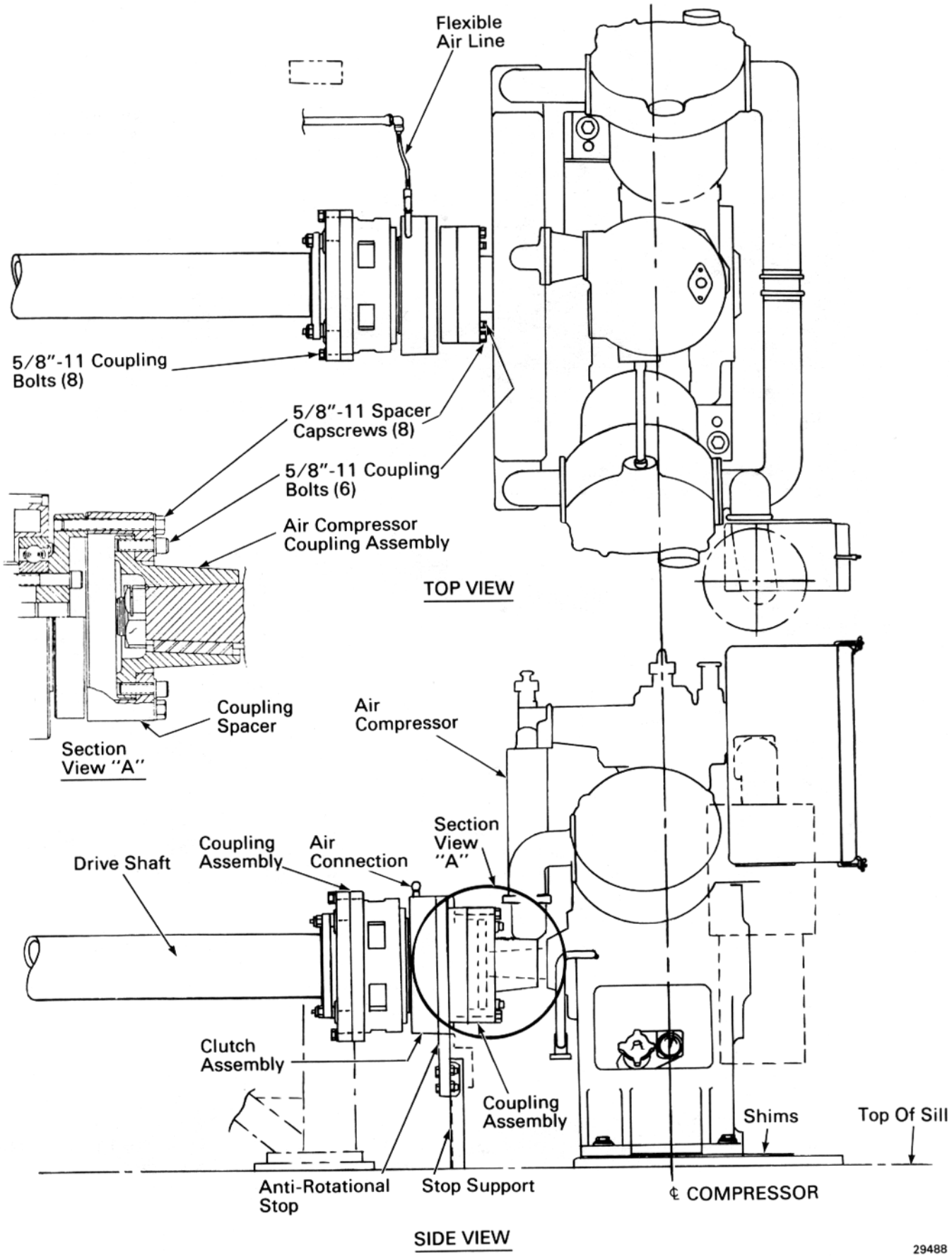


Fig.2 – Air Compressor Clutch Installation

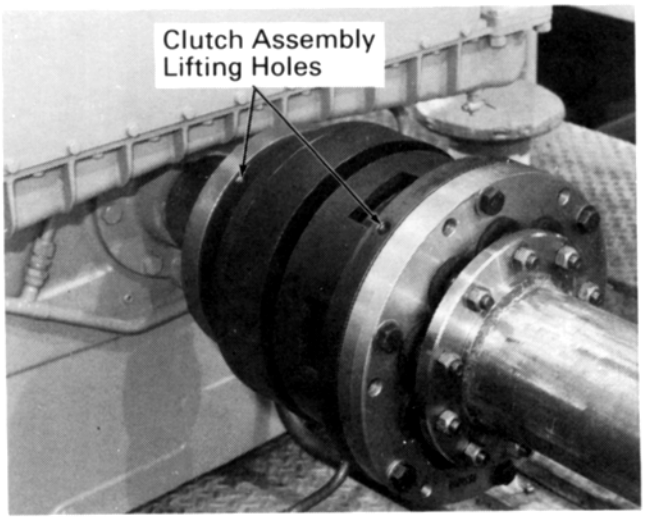


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Fig.3 – Clutch Positioning For Removal

On units without spacer and coupling assembly on air compressor, disconnect air, water, and oil piping from air compressor. Remove compressor mounting bolts and dowel pins so that compressor can be moved approximately 51 mm (2.00″) away from engine in order to separate clutch from compressor and drive shaft for removal.

NOTE

If air compressor is to be moved, mark or otherwise group compressor mounting shims as originally applied so compressor can be returned to original mounting position without a need for realignment.

6. On units with spacer and coupling assembly on air compressor, remove 5/8″-11 coupling bolts (8) and spacer capscrews (8) from compressor side of clutch, and 5/8″-11 coupling bolts (6) from engine side of clutch. Slide spacer back on compressor coupling.

NOTE

If spacer is bound tight on coupling, use two 5/8″-11 jacking screws in extraction holes provided to press spacer back on coupling.

On units without spacer and coupling assembly on compressor, remove 5/8″-11 coupling bolts from both ends of clutch and slide compressor back (away from engine).

7. Remove clutch assembly from locomotive to a clean working area. Blow clutch assembly out with compressed air to remove excess friction plate particles and other contaminants.

CLUTCH DISASSEMBLY

WARNING

Protective gloves should be worn when handling clutch components to guard against injury from machining burrs and sharply worn edges.

DRIVE SHELL REMOVAL FROM DRIVEN HUB

NOTE

A house air supply of at least 758 kPa (110 psi) is required to disengage the clutch in order to rotate the drive shell as required in the following procedures.

1. Apply air pressure at cylinder air port to release drive shell from engaged position, then rotate shell to align six clearance holes with M10 × 30 bearing cap retaining screws. Remove screws and lockwashers, Fig. 4.

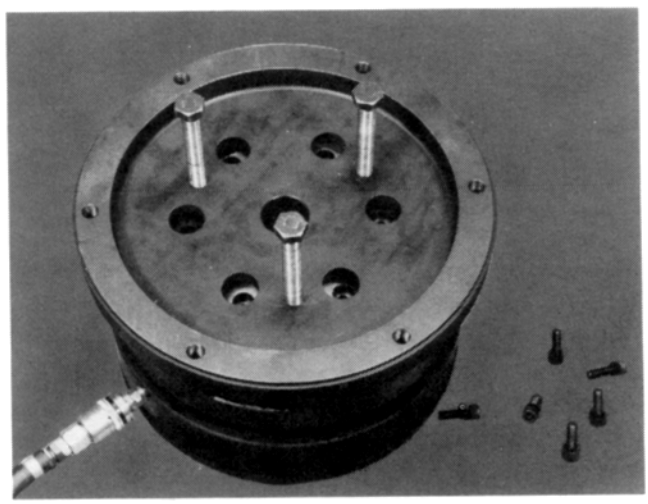

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Fig.4 – Drive Shell Retaining Screws Removal

2. Align three 5/8″-11 jacking screw holes in drive shell with clearance holes in bearing cap. Apply three jacking screws and turn in evenly against flange of driven hub until pieces separate, Fig. 5. Release air pressure from cylinder.

3. Remove drive shell with sealed ball bearings and bearing cap. Release circlips (snap rings), Fig. 6, to remove each bearing from drive shell. Discard both sealed bearings.

4. Press or drive out dowel (spring) pins from driven hub end through end flange using a brass pin driver, Fig. 7.

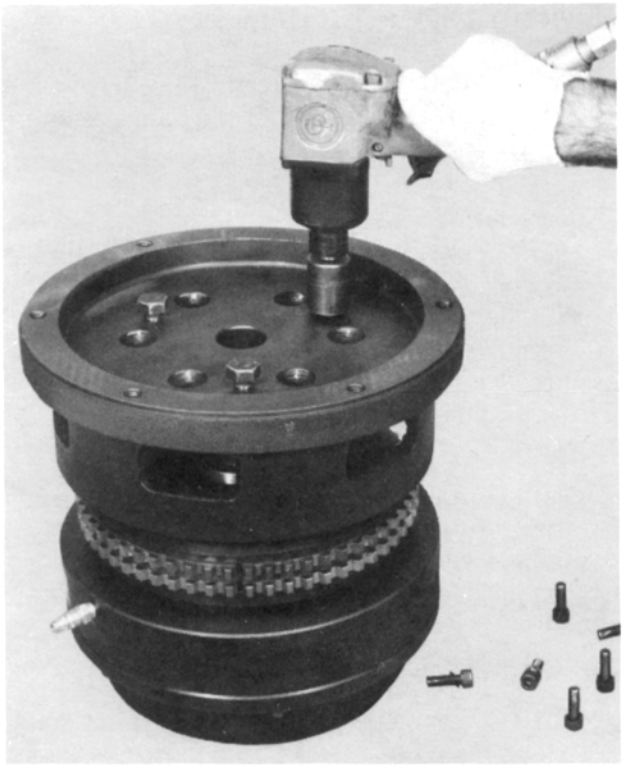

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Fig.5 – Removing Drive Shell Using Jacking Screws

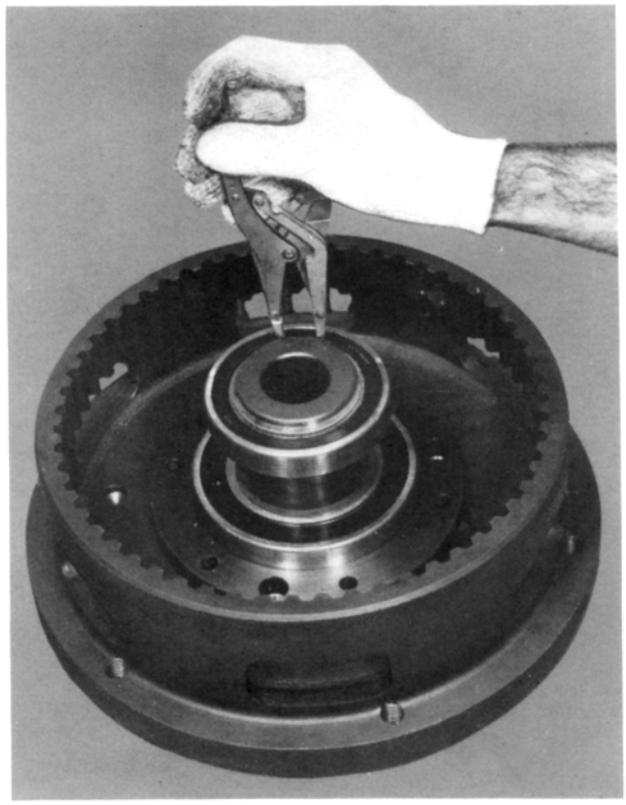

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Fig.6 – Removing Sealed Bearings

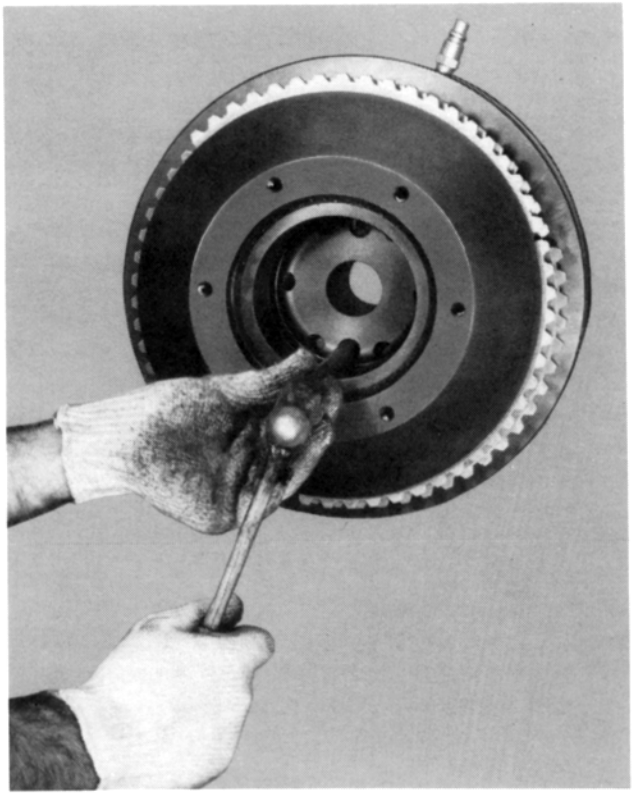

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Fig.7 – Removing Dowel (Spring) Pins

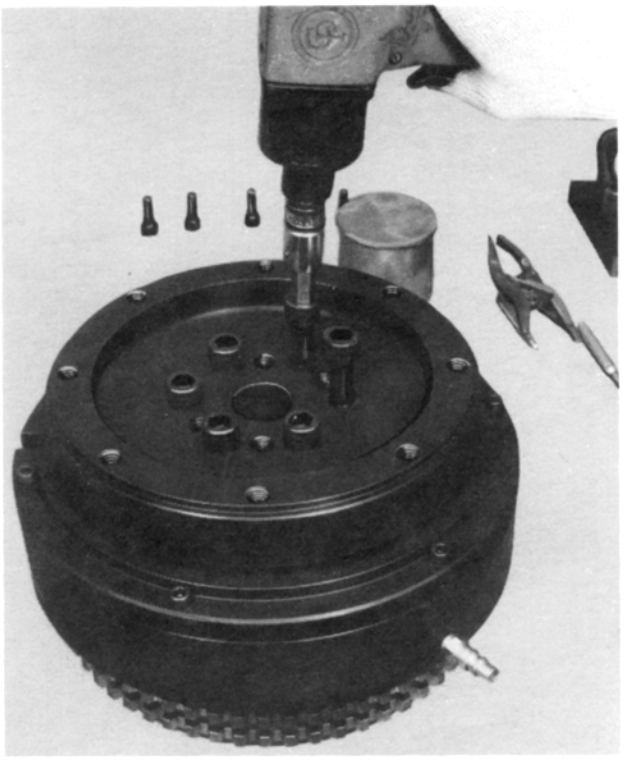

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Fig.8 – Removing End Flange Retaining Screws

REMOVAL OF FRICTION PLATES

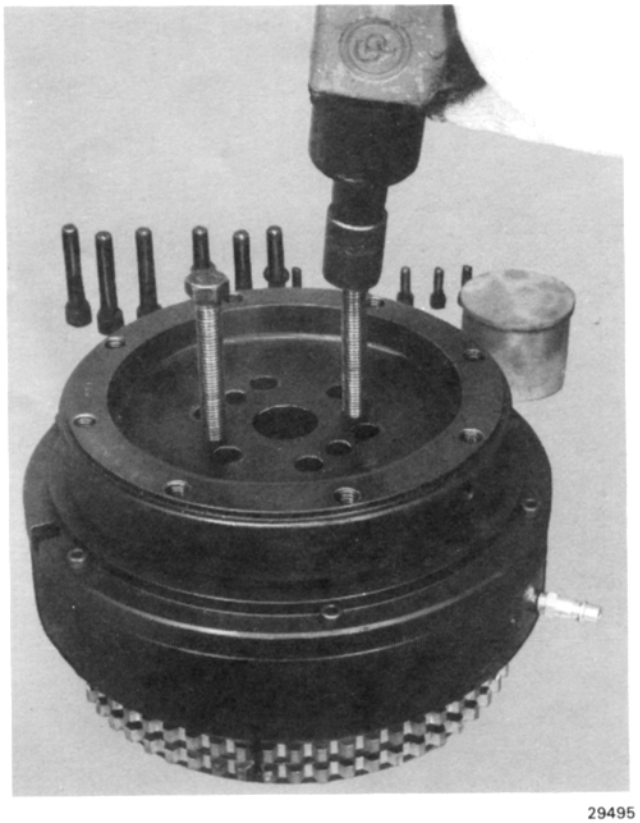
1. With clutch assembly resting on driven hub face, remove six M16 × 80 end flange retaining screws and lockwashers, Fig. 8.

2. Insert two 5/8″-11 jacking screws into tapped holes provided in the end flange. Turn jacking screws in evenly against driven hub until pieces separate, Fig. 9. Remove end flange and sealing ring from assembly.

NOTE

Jacking screws may be used in two of the end flange coupling mounting holes directly opposite each other to bear against spring housing, if necessary, to assist in separating pieces.

3. Position assembly so that outer portion of cylinder end face is supported in a pressing jig, then press out the driven hub to separate components.



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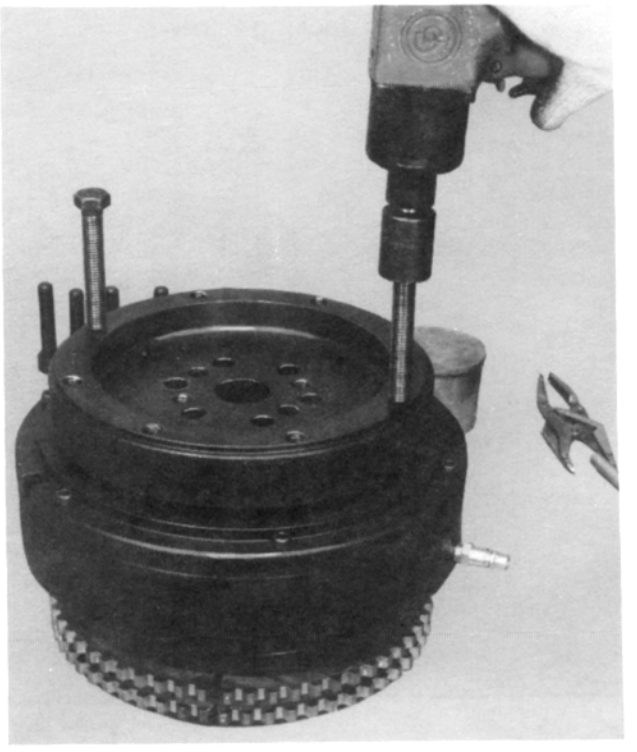
Jacking Screws Against Hub End



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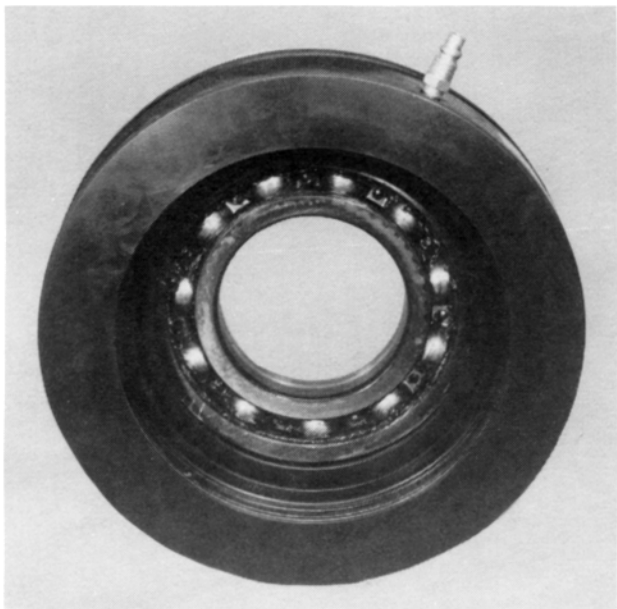
Jacking Screws Against Spring Housing

Fig.9 – Removing End Flange Using Jacking Screws



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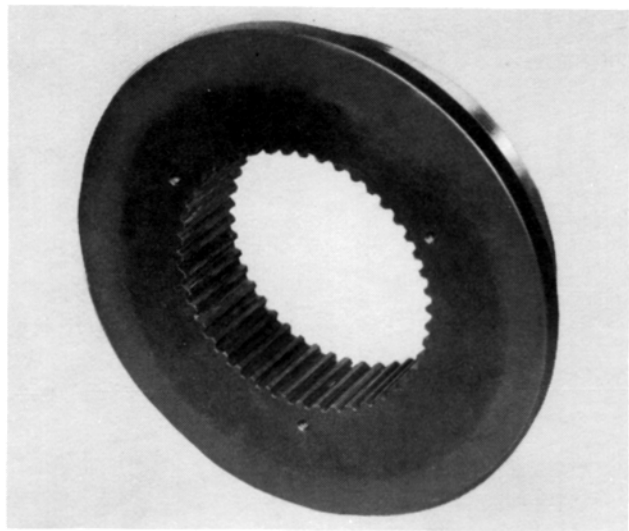
Cylinder Assembly
(W/Ball Bearing)



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Thrust Plate Assembly
(W/Ball Bearing)

Fig.10 – Cylinder And Thrust Plate Assemblies

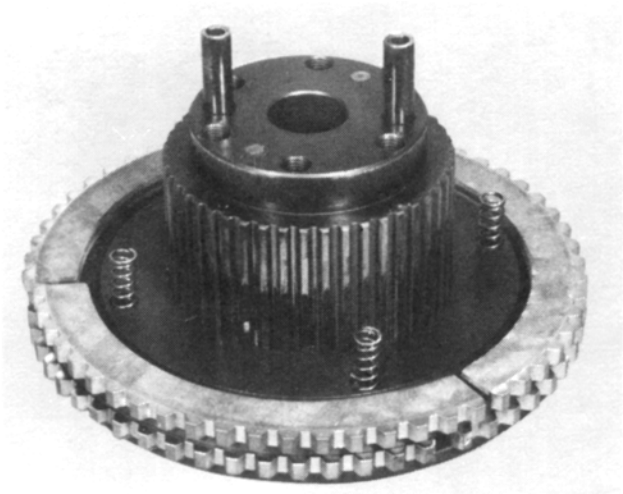

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Fig.11 – Clutch Support Springs Removal

4. Lay aside the cylinder and thrust plate assemblies, Fig. 10, and remove four separation springs from the clutch inner plate, Fig. 11.

5. Remove and discard friction plate sections (two plates, three sections each).

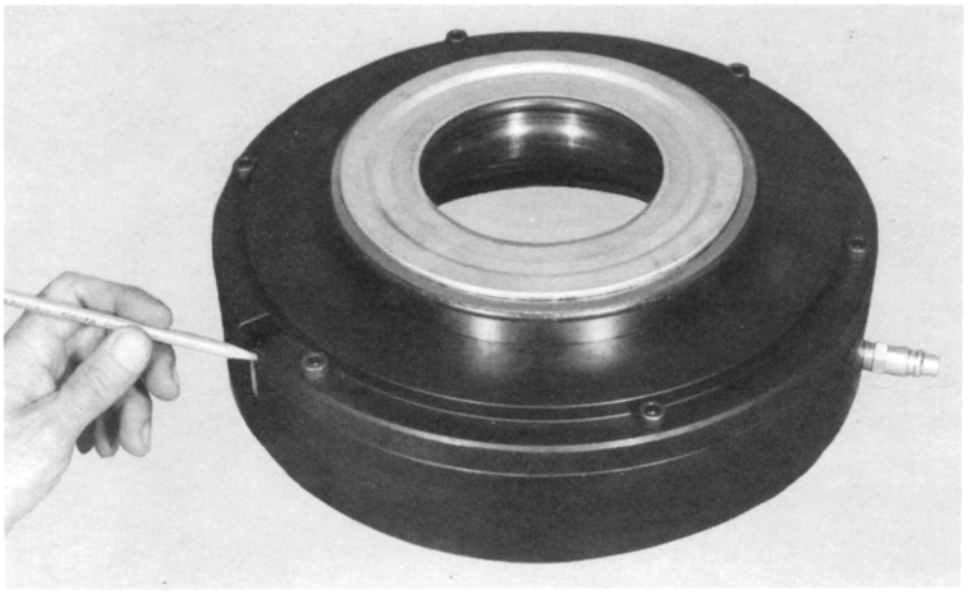

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Fig.12 – Marking Position Of Anti-Rotational Slot

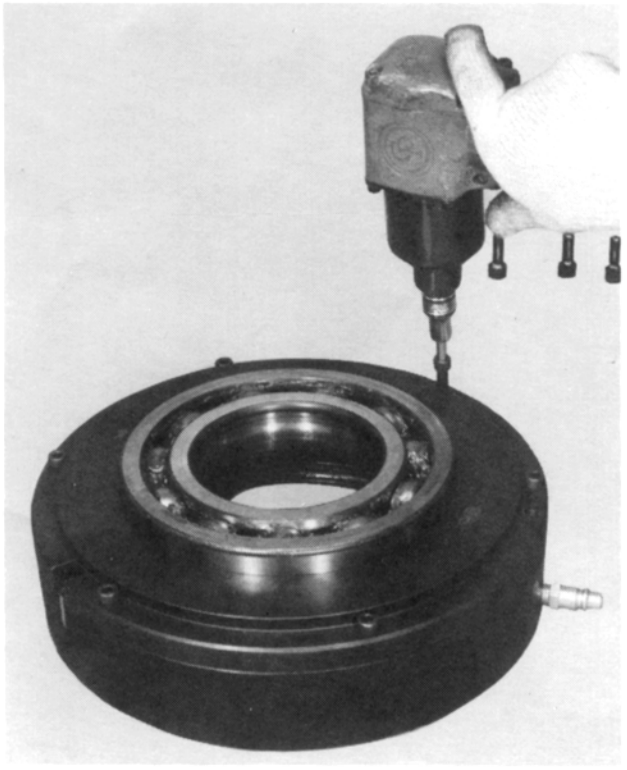

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Fig.13 – Housing Retaining Screws Removal

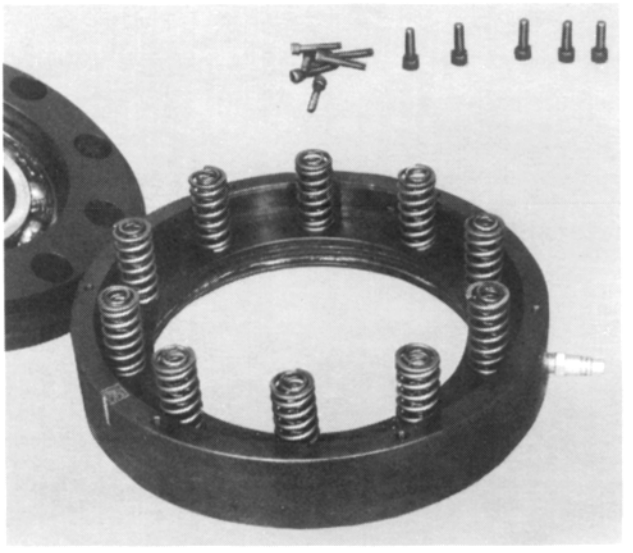

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Fig.14 – Spring Housing Removed (W/Ball Bearing)

6. Mark position of anti-rotational slot in spring housing relative to cylinder for proper orientation of air port during reassembly, Fig. 12.

7. Remove six M8 × 40 spring housing retaining screws from cylinder assembly by turning screws out evenly to gradually relax the clutch springs within the assembly, Fig. 13.

8. Remove spring housing with large ball bearing, Fig. 14.

9. Remove and discard clutch springs (inner and outer).

10. Press out thrust plate with large ball bearing from cylinder, if not previously separated during removal of driven hub assembly.

11. Insert three M8 jacking screws into tapped holes in thrust plate. Turn jacking screws in evenly against large ball bearing until pieces separate, Fig. 15.

12. Remove piston from cylinder and three O-ring seals from grooves in piston (2) and cylinder (1). Discard O-ring seals, Fig. 16.

13. Clean and inspect cylinder and piston surfaces, and ball bearings for signs of wear or damage. Press bearing out of spring housing, if replacement is necessary.

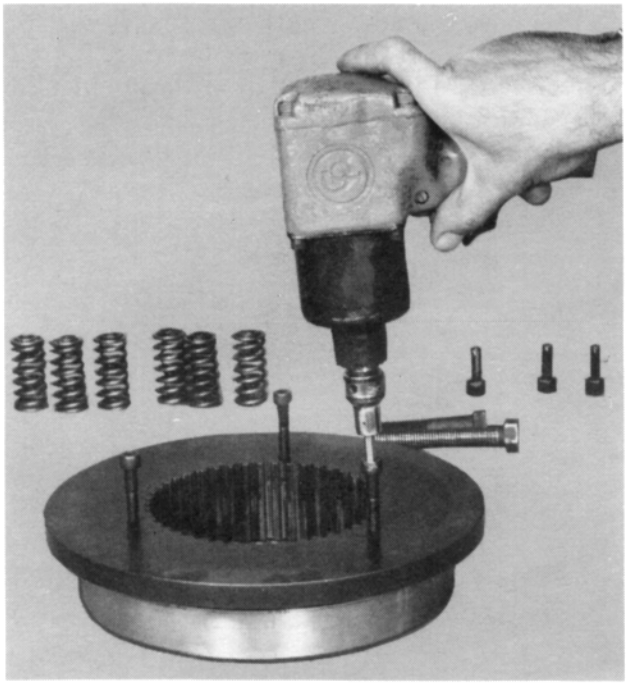

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Fig.15 – Removing Ball Bearing From Thrust Plate Using Jacking Screws

CLUTCH REASSEMBLY

CAUTION

Extra care should be exercised during clutch reassembly procedures to avoid contamination of the friction plate surfaces with any grease or lubricant. Work bench area should be clean and free of any debris accumulated during clutch disassembly or other previous work. O-rings, bearings and sealing rings should be kept clean and protected after lubrication — prior to their use in reassembly.

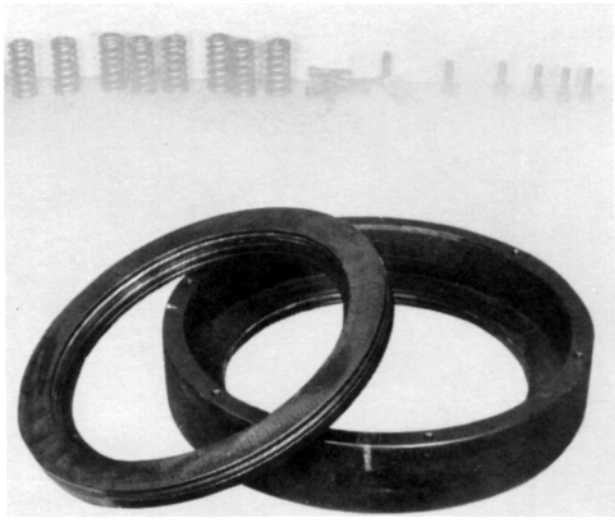

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Fig.16 – Piston Removed From Cylinder

1. Apply a light coat of Dow Corning No. 55M silicone lubricant to the new piston and cylinder O-ring seals, Fig. 17, and on their respective contact surfaces. Each O-ring seal groove should be partially filled with the same lubricant to provide for lubrication during run-in.

2. Repack large ball bearings with Esso Unirex N3 grease — using 43g (1.52 ozs.) in bearing for spring housing and 45.6g (1.61 ozs.) in bearing for thrust plate. Each bearing seal ring should be partially filled with a quantity of the same grease to provide for lubrication during run-in, Fig. 18.

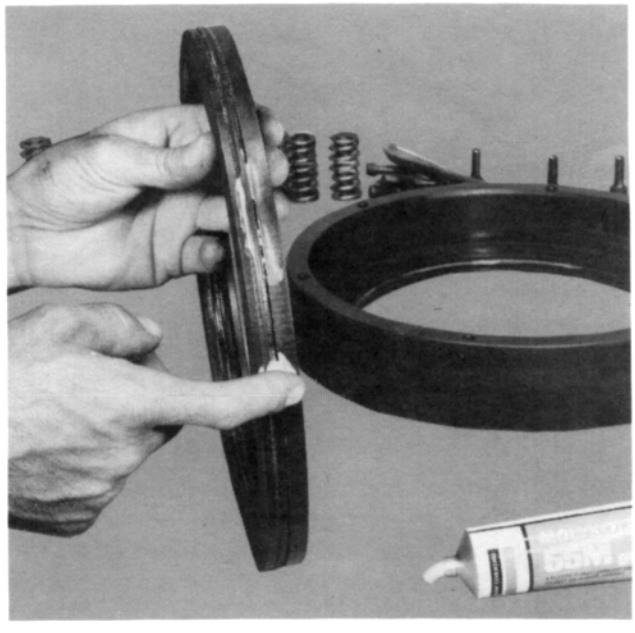

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Fig.17 – Lubricating O-Ring Seals (Piston Shown)

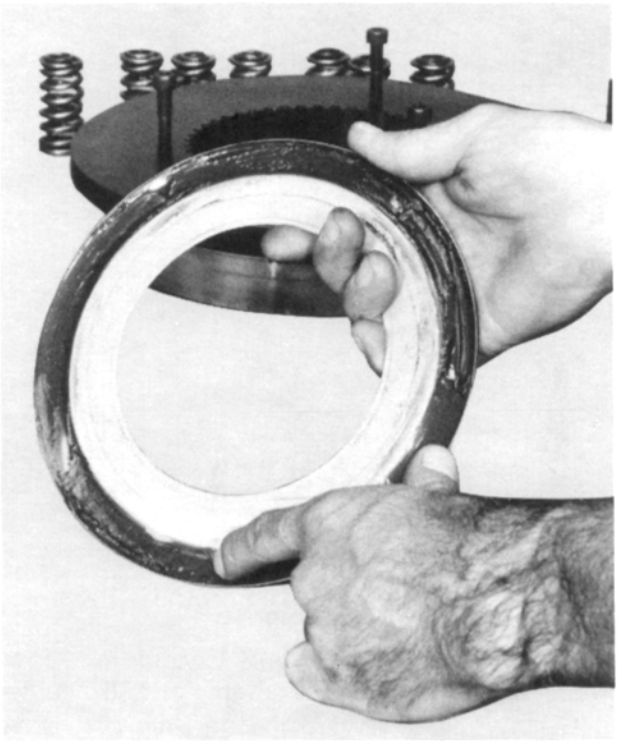

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Fig.18 – Repacking Ball Bearing Sealing Ring

3. Press repacked bearing with filled sealing ring onto sleeve of thrust plate until seated on shoulder. Press packed replacement bearing (if used) into spring housing until fully seated.

4. Carefully insert piston, with lubricated O-ring seals, into cylinder, Fig. 19.

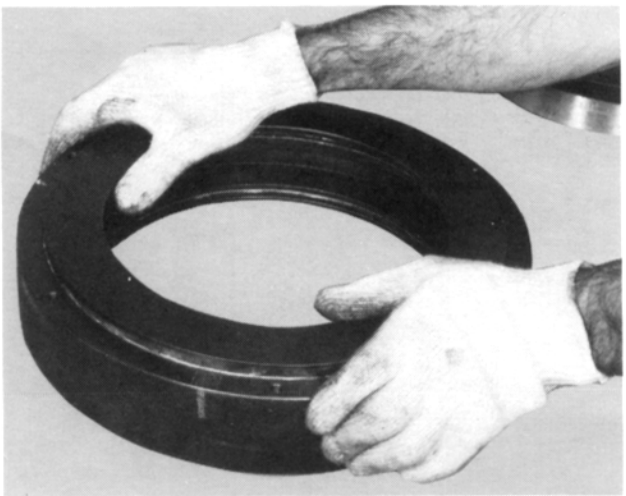

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Fig.19 – Inserting Piston Into Cylinder

5. Apply cylinder and piston over bearing on thrust plate, Fig. 20. Use extreme care to avoid pinching or rolling O-ring seals.

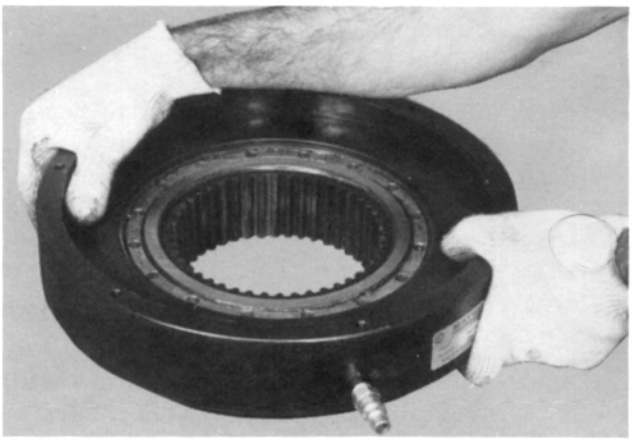

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Fig.20 – Application Of Cylinder Assembly To Thrust Plate

6. Position ten new clutch springs (inner and outer) into pockets of spring housing, Fig. 21. Carefully lower thrust plate and cylinder assembly over spring housing and align anti-rotational slot as marked during disassembly.

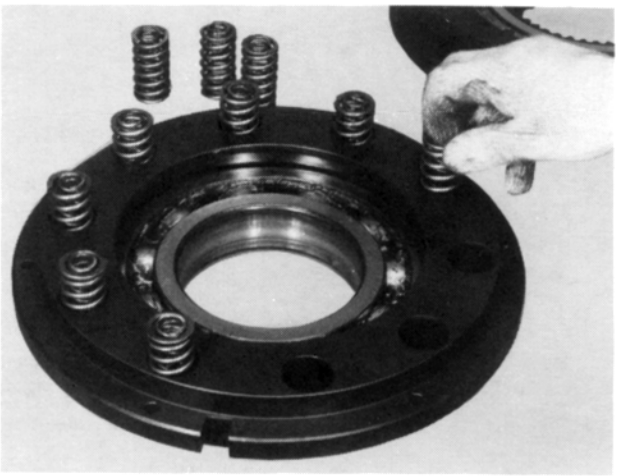

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Fig.21 – Applying Clutch Springs To Spring Housing

7. Slide assembly over to edge of work bench and allow a portion to overhang edge at one of six retaining screw hole positions, Fig. 22. Start M8 × 40 retaining screws one at a time, rotating assembly over edge of bench to next position.

8. Turn assembly over to rest on thrust plate and proceed to turn screws in evenly to avoid distorting springs during compression, Fig. 23. Final torque screws to 54.2 N·m (40 ft-lbs), Fig. 24.

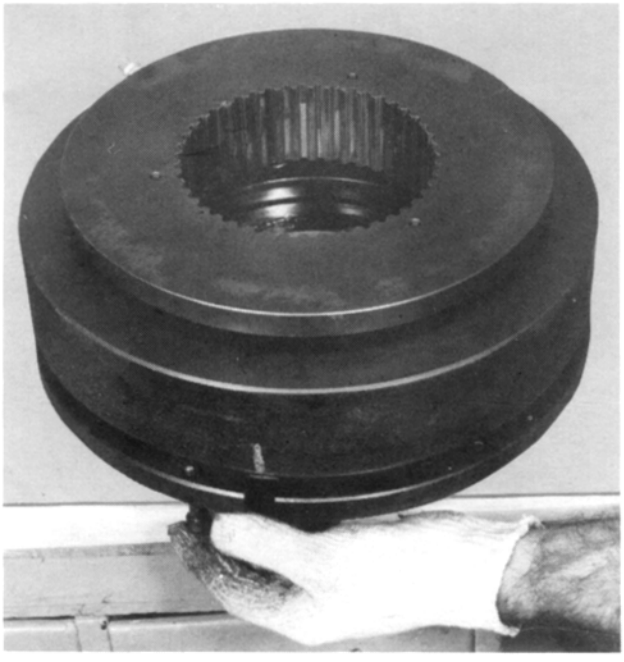

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Fig.22 – Applying Spring Housing Retaining Screws Over Edge Of Work Bench

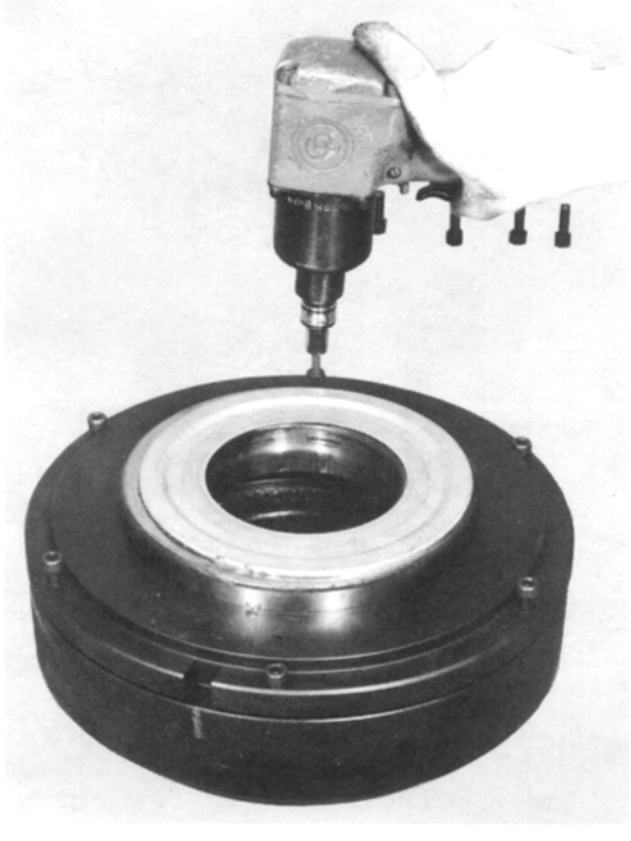

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Fig.23 – Drawing Down Spring Housing Retaining Screws

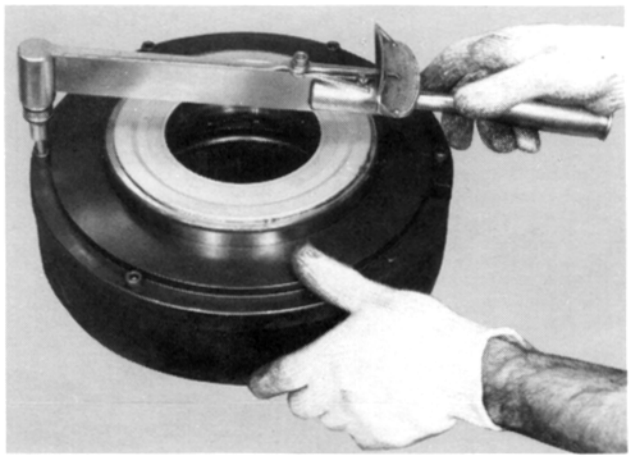

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Fig.24 – Torquing Retaining Screws

9. Clean friction plate surfaces of thrust plate, inner plate (both sides), and driven hub with a suitable solvent or degreasing agent to remove any traces of grease, lubricant, or other contaminants. Apply new friction plate sections into position on driven hub, Fig. 25, along with inner plate and four new separation springs, Fig. 26. Apply second set of friction plate sections with plate teeth and split lines in approximate alignment with first set, Fig. 27.

10. Assemble cylinder and thrust plate over splined end of driven hub, Fig. 28. Check to be certain bearing is started straight on driven hub end.

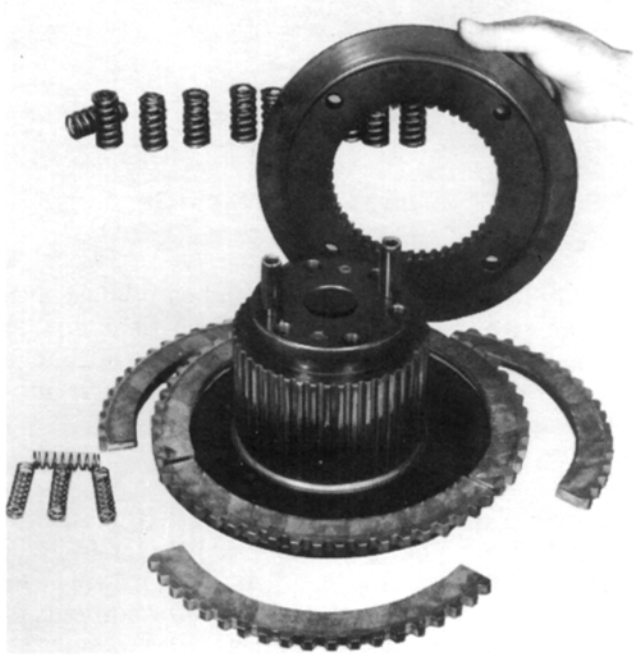

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Fig.25 – Applying Friction Plate Sections And Inner Plate On Driven Hub

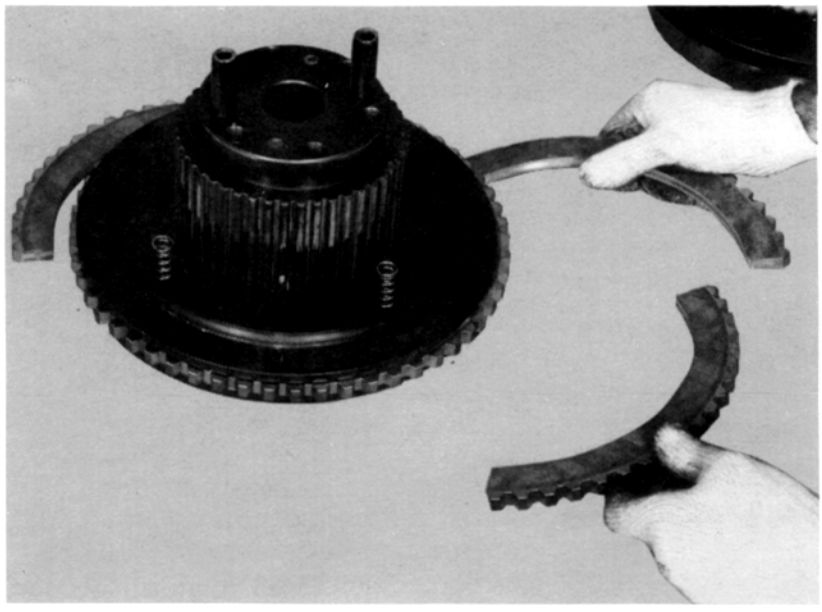

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Fig.26 – Inner Plate And Support Springs Installed On Driven Hub

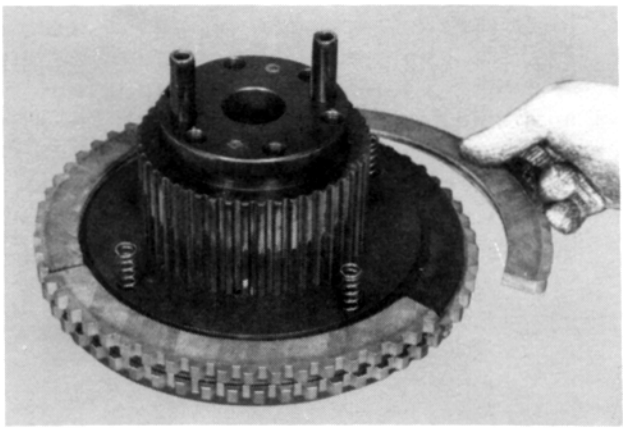

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Fig.27 – Applying Friction Plate Sections To Inner Plate

11. Apply bearing sealing ring and end flange with the two dowel holes aligned to the corresponding holes in driven hub. Tap end flange into place with a rubber mallet, Fig. 29, until flange and hub are seated in bearing.

NOTE

Dowel (spring) pins may be started into position in end of driven hub to help facilitate alignment of end flange, but extra effort will be required to position end flange before threads of retaining screws will engage. Screws must then be used to draw flange down by turning in evenly.

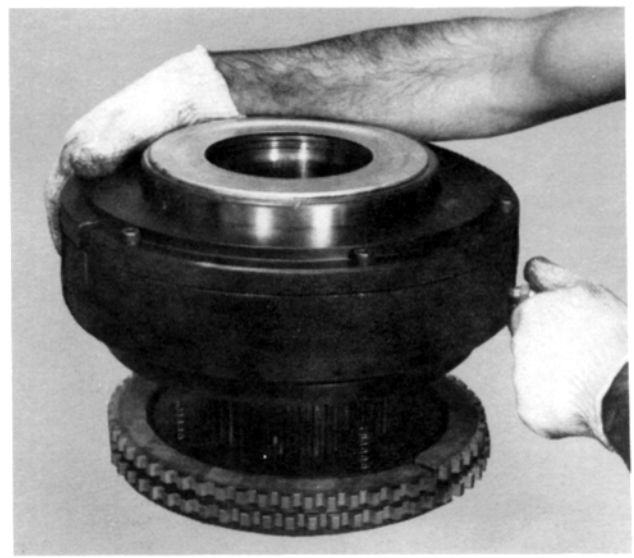

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Fig.28 – Assembling Cylinder And Thrust Plate To Driven Hub

12. Apply M16 × 80 retaining screws and lockwashers, Fig. 30, and torque to 427 N·m (315 ft-lbs).

13. Press or drive dowel (spring) pins in using a brass pin driver until ends are flush with end flange. Check to be certain that dowel (spring) pins do not protrude into cavity of driven hub where they could interfere with the drive shell and bearings.

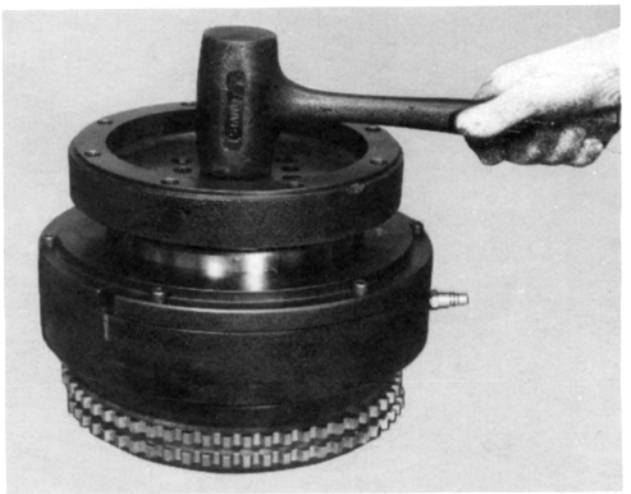

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Fig.29 – Tapping End Flange Into Position Using Rubber Mallet

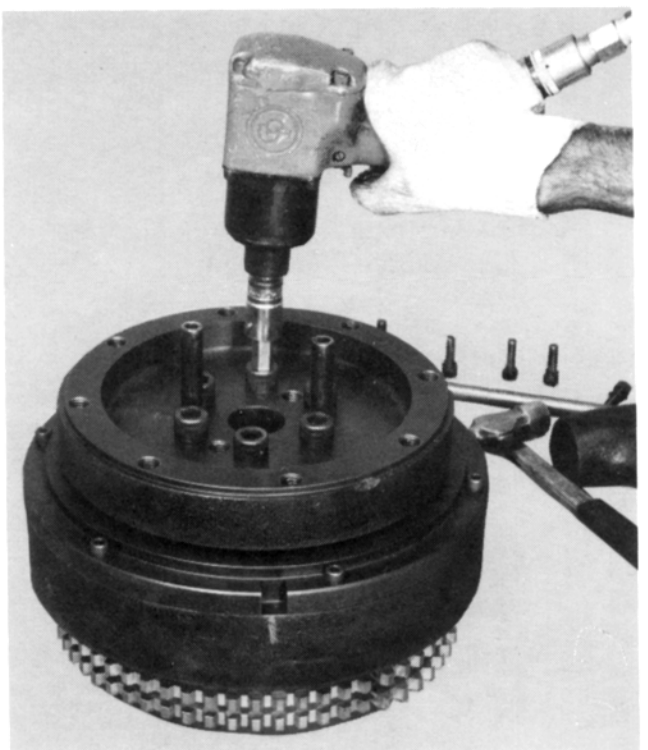

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Fig.30 – Applying End Flange Retaining Screws And Lockwashers

14. Apply new large sealed bearing with bearing cap and new small sealed bearing to hub of drive shell and secure each in position with circlip (snap ring) retainer, Fig. 31.

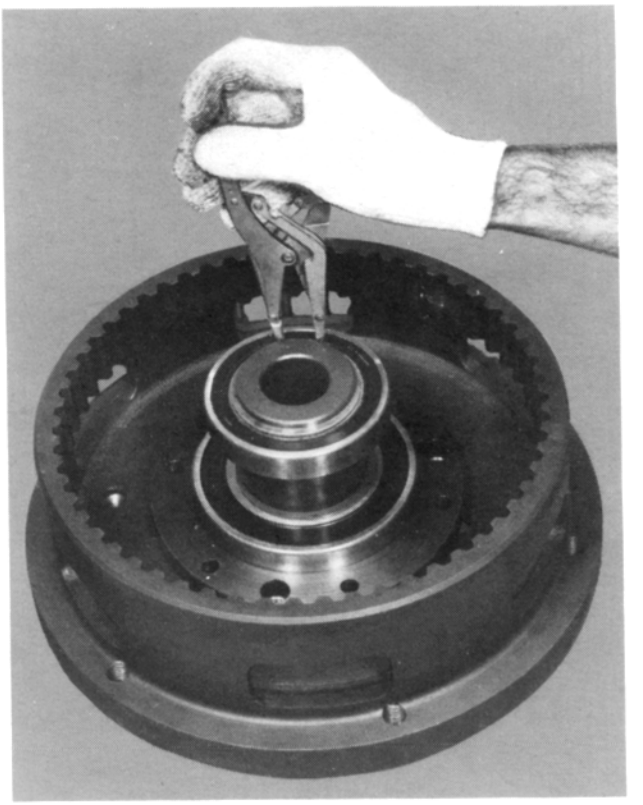

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Fig.31 – Applying Circlip (Snap Ring) To Secure Sealed Bearing

15. Carefully lower cylinder and thrust plate assembly into drive shell using a hoist and appropriate lifting fixture, Fig. 32.

NOTE

If more convenient, the above procedure can be performed in reverse with cylinder and thrust plate assembly resting on end flange. Carefully apply drive shell assembly into hub of cylinder and thrust plate assembly using a hoist and appropriate lifting fixture.

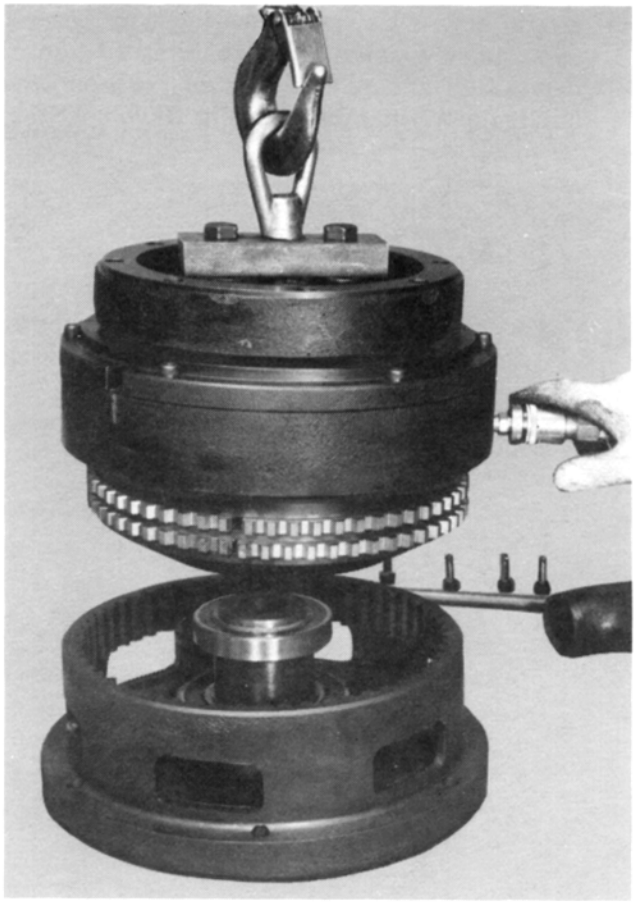

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Fig.32 – Cylinder And Thrust Plate Assembly Into Drive Shell

16. Apply air pressure to port on cylinder to free friction plates while lowering assemblies together, Fig. 33, moving friction plate sections as necessary to engage teeth with splines of drive shell.

17. With air pressure still applied, rotate shell to align six clearance holes in shell with screw holes in bearing cap and tapped holes in driven hub, Fig. 34. Apply M10 × 30 retaining screws with lockwashers and torque to 95 N·m (70 ft-lbs).

18. Perform a bench function test on the completed clutch assembly by applying and releasing the air pressure to ensure that drive

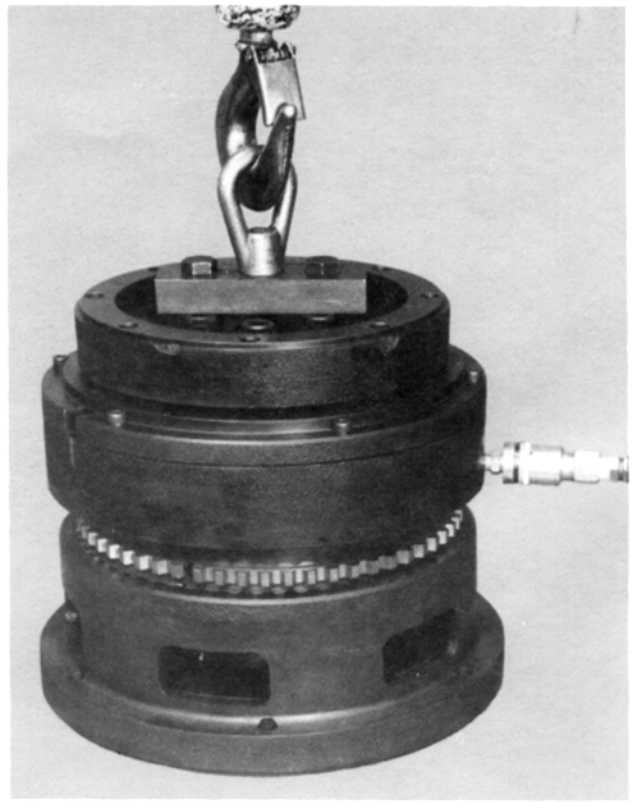

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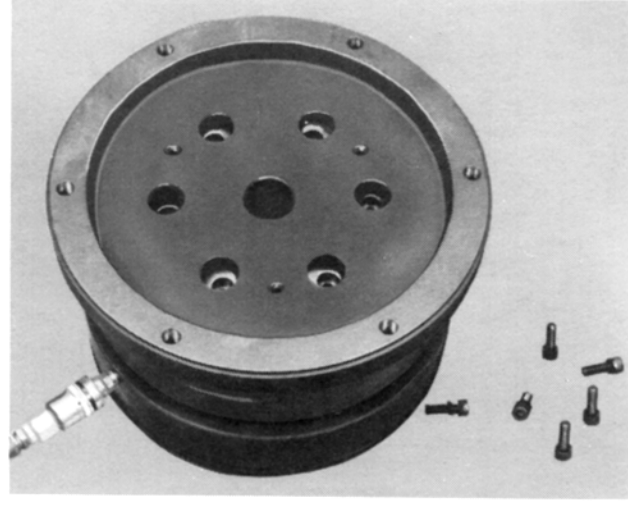
Fig.33 – Applying Air Pressure To Align Clutch Plate Teeth



29521

Fig.34 – Aligning Clearance Holes For Application Of Retaining Screws

shell and end flange disengage and engage properly while turning one end or the other. Check cylinder for leakage using an air pressure testing arrangement, as typically shown in Fig. 35. The allowable leakage rate should not exceed 0.69 kPa (0.1 psi) in a ten minute period.

NOTE

Check all connections in the test apparatus to ensure against possible leaks and use a good quality pressure gauge with scale divisions appropriate for the leak rate measurement of 0.69 kPa (0.1 psi).

19. With test air pressure still applied, rotate the drive and/or driven flange end of clutch as necessary to align lifting holes, then release air pressure to engage clutch. Remove test apparatus.

CLUTCH INSTALLATION

1. Apply 5/8″-11 lifting eye bolts and suitable lifting device to support clutch assembly and move it into position in the locomotive.

2. On units with flange and coupling assembly on air compressor, slide flange forward into position on compressor coupling. Apply flange to coupling and flange to clutch bolts, as well as clutch to drive shaft bolts on engine side. Torque all coupling bolts to 163 N·m (120 ft-lbs).

On units without flange and coupling assembly on air compressor, slide air compressor forward into position and apply coupling bolts at both engine and compressor side of clutch. Torque coupling bolts to 163 N·m (120 ft-lbs). Remount compressor using original shims and dowel pins to return unit to its original position, as aligned. Torque mounting bolts to 224 N·m (165 ft-lbs).

3. Reconnect air, water, and oil piping to air compressor, if removed, and mount anti-rotational stop to support on top of sill. Rotate clutch until stop can be engaged in slot of clutch spring housing flange.

NOTE

A nominal clearance of 1.5 mm (0.06″) is to be maintained between the top and back of the anti-rotational stop in the slot provided.

4. Connect flexible air line to clutch and replace clutch guard with attached compressor unloader air line bracket(s)

CLUTCH FUNCTIONAL TESTS

After a clutch has been rebuilt and reinstalled in a locomotive, or during routine inspections of the compressed air system, a functional test of the clutch operation and control system should be performed. The engaged and disengaged operating modes of the clutch are controlled by the compressor control logic and pressure settings of the control switch (CCS), Fig. 36.

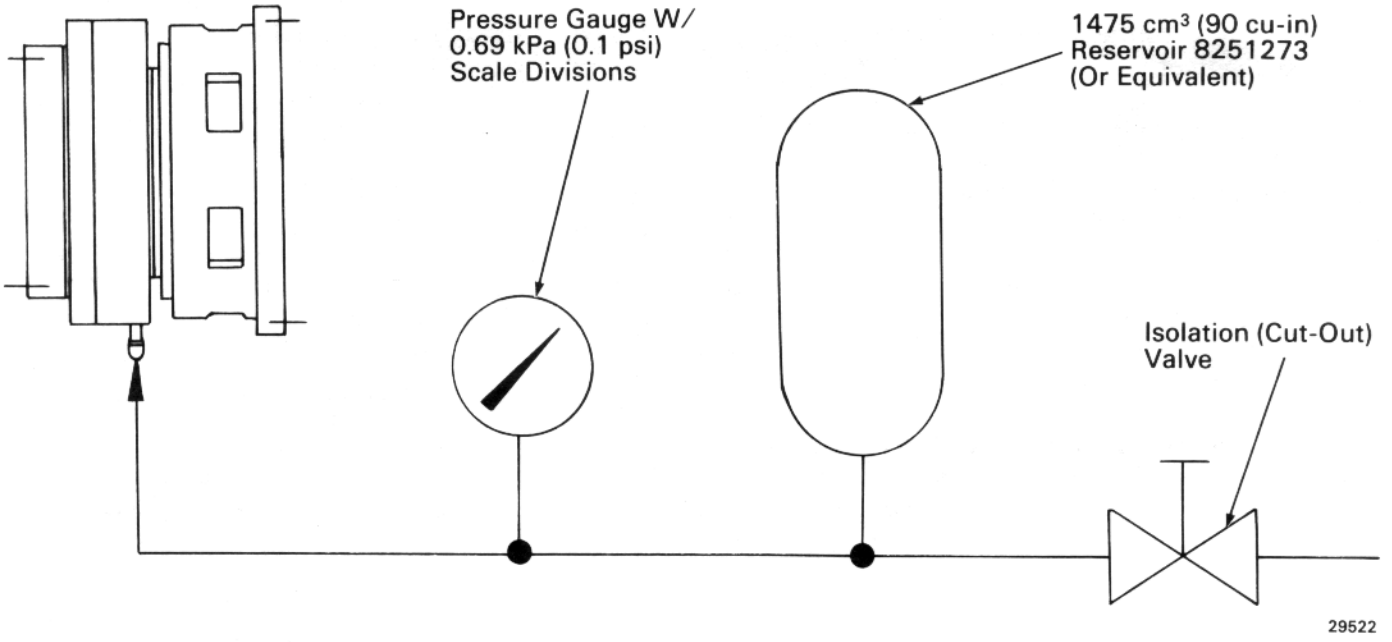


Fig.35 – Clutch Cylinder Leakage Test Arrangement

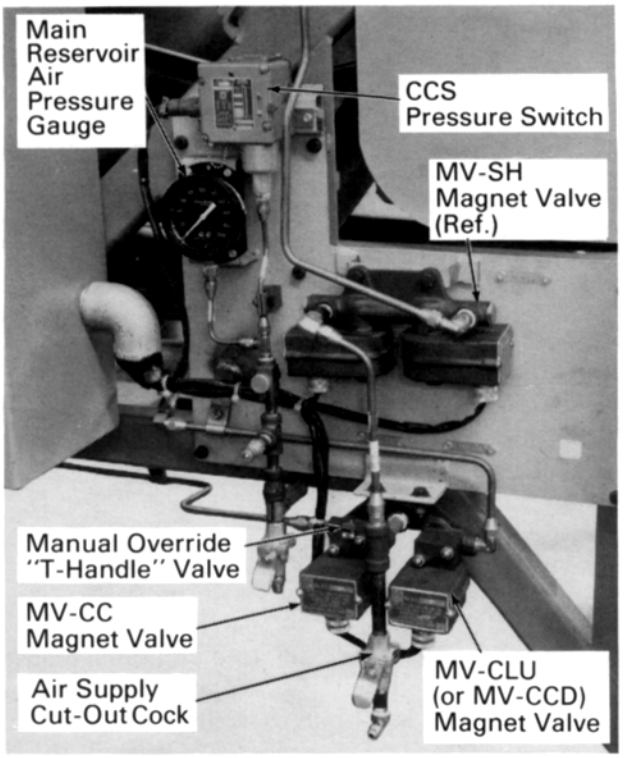


Fig.36 – Typical Compressor Control Panel

CLUTCH ENGAGED

This operating mode exists when any of the following conditions are present:

- there is no air in the locomotive compressed air system;
- there is a requirement for air to be supplied to the locomotive compressed air system;
- the clutch control system has failed.

Spring force from the ten clutch springs pushes the thrust plate against the hub, clamping the friction plates together with the inner plate to provide the clamp load necessary to transmit drive torque from the engine to the air compressor.

CLUTCH DISENGAGED

This operating mode exists only when there is no air requirement in the locomotive compressed air system. Under this condition, air is supplied to the stationary clutch cylinder through a flexible air line. The air pressure overcomes the force of the ten clutch springs to allow separation of the thrust plate from the friction plates, the inner plate, and the driven hub. This separation action is assisted by the force of four springs in the inner plate. Upon separation, the drive shell and friction plates continue to rotate with the drive shaft from the engine while the drive hub, the inner plate and thrust plate, and the end flange stop with the air compressor.

COMPRESSOR CONTROL LOGIC

The air compressor control circuit, as used on units with a compressor clutch, represents a modification to a basic compressor control system. In addition to the standard circuit components, including the compressor control magnet valve (MV-CC) and pressure switch (CCS), a clutch control magnet valve (MV-CLU or MV-CCD) and a time delay compressor control (TDCC) function are added, Fig. 37, for 50 Series locomotives, or Fig. 38 for 60 Series locomotives.

NOTE

The compressor time delay function is performed by the computer control system on "60 Series" locomotives or by a time delay relay on non-computer control locomotives.

The clutch control magnet valve (MV-CLU or MV-CCD), when energized, provides air to disengage the clutch. When de-energized, air pressure to the clutch is exhausted to enable clutch to engage. The time delay function delays dropout of the compressor control magnet valve (MV-CC) for three seconds to allow clutch to engage the compressor while it is still unloaded.

NOTE

The computer control system on "60 Series" locomotives incorporates a feature to limit compressor clutch operations to three disengagements per minute.

CLUTCH FUNCTION TEST

1. Using an outside air supply, charge the locomotive air system with at least 758 kPa (110 psi) air pressure.

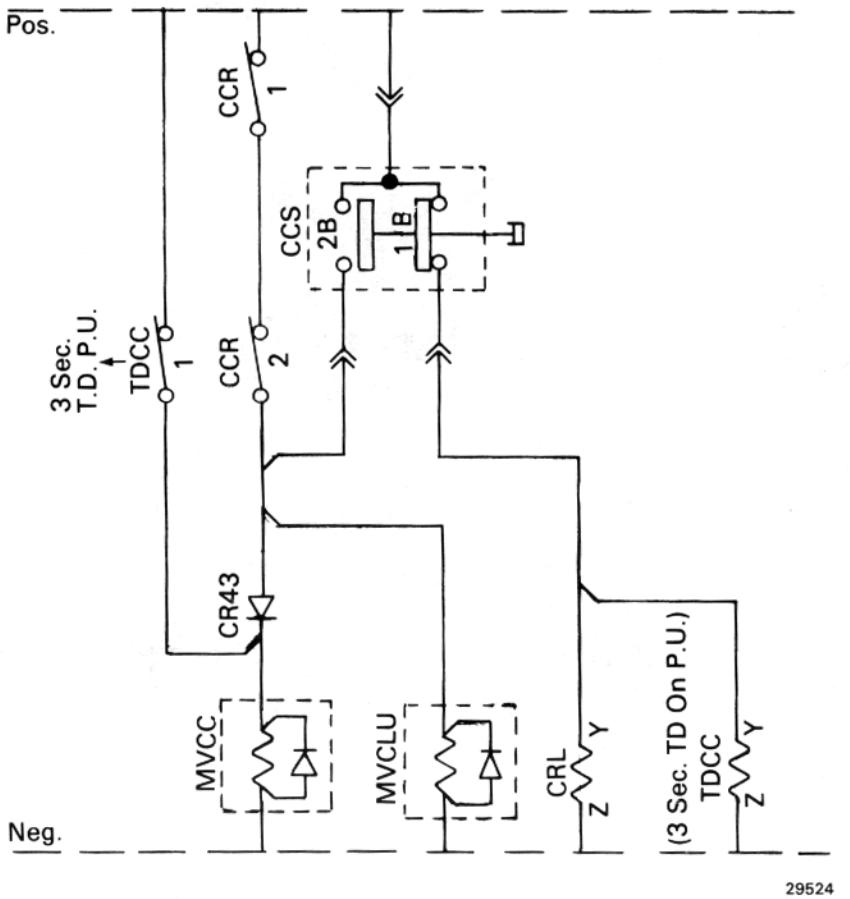


Fig.37 – Typical Air Compressor Clutch Control Circuit
(For 50 Series Locomotives)

2. Energize or manually override the clutch control magnet valve. The clutch should disengage, as indicated by axial movement of the thrust plate, when observed through slot in clutch guard.

3. With magnet valve still overridden, check entire clutch air supply line and components for signs of air leakage at this time.

4. De-energize the clutch magnet valve or release manual override (if used) to cut out clutch. Air supply should cut off and air in line to the clutch should exhaust. Clutch should engage, as indicated by movement of the thrust plate, when observed through slot in clutch guard.

5. With engine running, check for normal clutch operation:

   - Check main reservoir cut-out and cut-in pressure indications on compressed air pressure gauge (on compressor control panel) as clutch disengages and engages.

NOTE

Actual pressure settings of compressor control switch (CCS) will vary from railroad-to-railroad based on design characteristics of the locomotives compressed air system.

   - Check time delay compressor control function (TDCC) to ensure that clutch engages and runs compressor for from 3 to 5 seconds before compressor control magnet valve (MV-CC) picks up to load the compressor.

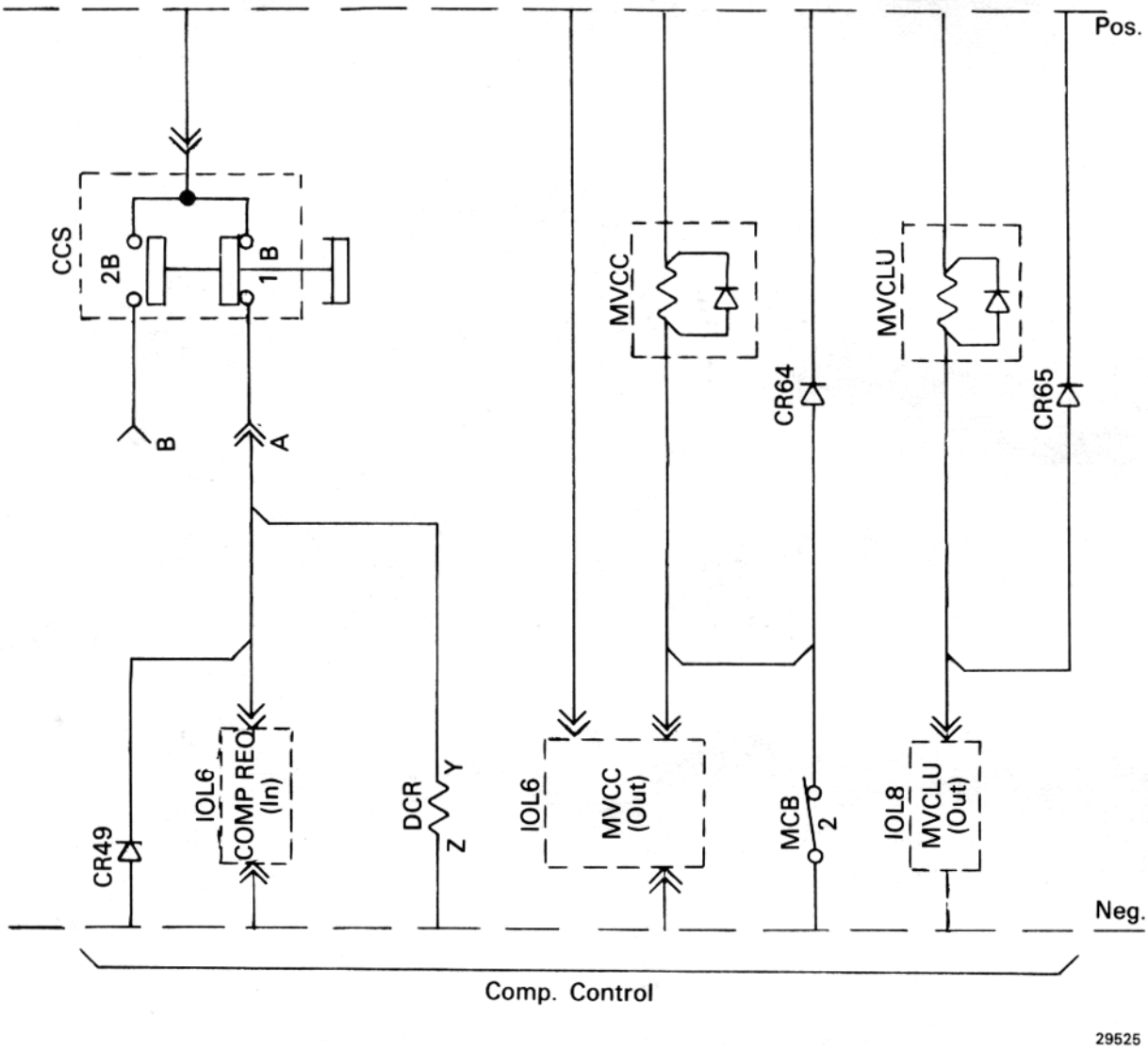


Fig.38 – Typical Air Compressor Clutch Control Circuit
(For 60 Series Locomotives)