TRANE™

Maintenance HCOM-M-4

Library	**Service Literature**
Product Section	**Refrigeration**
Product	**Reciprocating Compressor - Condenser Units**
Model	**Semi-Hermetic M**
Literature Type	**Maintenance**
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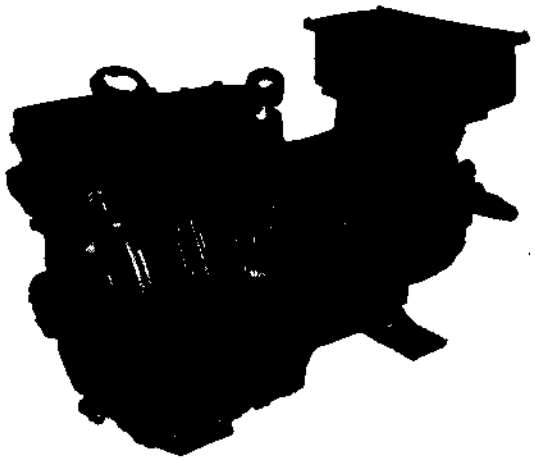
HERMETIC RECIPROCATING COMPRESSORS

COMPRESSOR SERVICE AND OVERHAUL

MODEL M
3-4-5 AND 6 CYLINDERS



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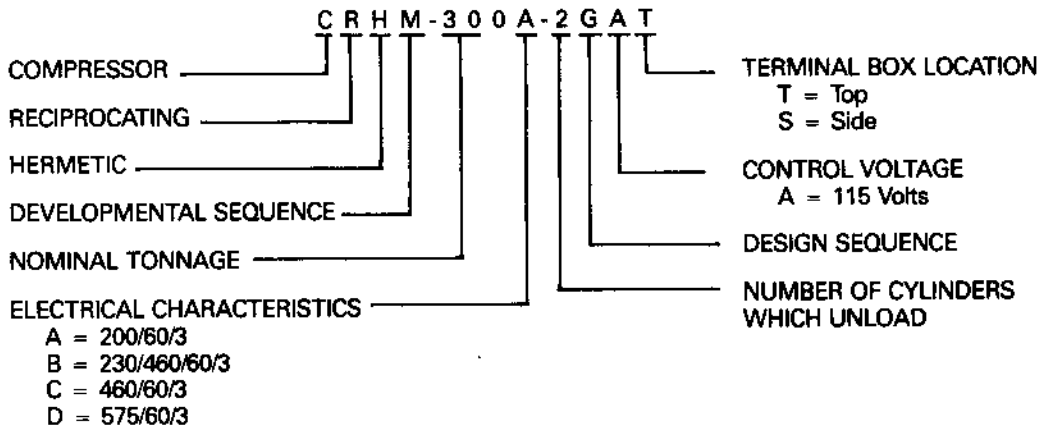
The Trane Company
La Crosse, Wisconsin 54601-7599
Printed in U.S.A.

UNIT MODEL NUMBER DESCRIPTION



The Trane Company urges that when servicing Trane equipment, or any other manufacturer's equipment, every effort should be made to eliminate the emissions of CFC, HCFC and HFC refrigerants to the atmosphere resulting from installation, operation, routine maintenance or major repair of the equipment. Conservation of refrigerants is important even when working with acceptable alternative refrigerants.
Conservation and emission reduction can be accomplished by following recommended Trane operation, maintenance, and service procedures with specific attention to the following:

1. Refrigerant used in any type of air-conditioning or refrigerating equipment should be recovered for reuse, recovered and/or recycled for reuse, reprocessed (reclaimed), or properly destroyed, whenever it is removed from the equipment.

2. Always determine possible recycle or reclaim requirements of the recovered refrigerant before beginning recovery by any method. (Questions about recovered refrigerants and acceptable refrigerant quality standards are addressed in ARI Standard 700)

3. Use approved containment vessels and safety standards for the storage or transporting of new or used refrigerant. Comply with all applicable transportation standards when shipping refrigerant containers.

4. To minimize refrigerant emissions use recycling equipment when recovering refrigerant. Use methods which will pull the lowest possible system vacuum while recovering and condensing refrigerant into containment.

5. When leak checking with trace of refrigerant and nitrogen, use HCFC-22 (R-22) rather than CFC-12 (R-12) or any other fully halogenated refrigerants. Remain aware of any new leak test methods which eliminate refrigerants as a trace gas.

6. When cleaning system components avoid using chemicals that have ozone depletion capability. Properly dispose of used materials in accordance with the manufacturers recommendations.

7. Take extra care to properly maintain all service equipment directly supporting refrigerant service work such as gages, hoses, vacuum pumps, and recycling equipment.

8. Remain aware of unit enhancements, conversion refrigerants, compatible parts and manufacture's recommendations which will reduce refrigerant emissions and increase equipment operating efficiencies. Follow specific manufacturers guidelines for conversion of existing systems.

9. In order to assist in reducing power generation emissions, always attempt to improve equipment performance with improved maintenance and operations which will help conserve energy resources.

WARNING
To prevent injury or death from parts being propelled by the internal pressure in the compressor and striking persons working on or observing the work insure that the internal pressure in the compressor is at atmospheric pressure before prior to opening the compressor for service. This can be done by checking the internal pressure as measured at the backseat port on the service valve(s).
Before opening the compressor for service, operate the system to pumpdown the compressor and then close the service valves. If the compressor cannot be operated, close the service valves. After the compressor has been isolated with the service valves remove the refrigerant with a refrigerant recovery device. Follow the refrigerant recovery device manufacturer's operating instruction for proper operation.

Open the system disconnect switch and lock in that position or remove the fuses from the switch. As the suction and discharge service valves are disconnected from the housing, support the lines to prevent undue strain on the piping and joints. Plug the control lines to prevent entry of foreign matter and tag or mark the electrical leads for ease of reassembly.

If the compressor needs to be lifted or removed from a unit, a simple chain can be used successfully. It can be attached to the lifting holes with eye bolts or regular bolts and washers. The compressor will not lift level if equal lengths of chain are used. Therefore it is necessary to attach the lifting device closer to the pump end of the chain. Lifting locations will vary depending on the compressor size. Exact length relation can be determined by shifting attachment point.

Preselection fit is not required with Trane Model M Compressor parts. All parts may be replaced with standard stock items.

As parts are removed, do the following:

1. Clean each part with a refrigeration part cleaner.
2. Inspect each part for wear, breakage or copper plating, repair or replace as necessary. As a guide for replacement, Table 1 lists tolerances and wear limits.

When reinstalling parts, do the following:

1. Use new gaskets and "O" rings.
2. Use a torque wrench when tightening bolts or nut and bolt combinations. Improper tightening may cause premature failure of a part. Table 2 lists the torques to be followed.
3. Lubricate ALL bearing surfaces with clean compressor oil before placing in the machine. This will enable the compressor to run with lubrication when it is first started and before oil pressure is built up.

The following procedures detail methods of removing, inspecting and reinstalling assemblies of the compressor. While the sequence given is correct for complete compressor teardown, individual assemblies may be removed and services as required. For instance, the oil pump, suction and discharge valves may be serviced without complete compressor disassembly.

TABLE 1 - Recommended Wear Limits And Tolerances

Part Name	Original Spec.	Recommended Limits	Maximum Recommended Diametral Clearance
Main Bearings Crankshaft - Mains	2.1250 - 2.1270 2.1225 - 2.1235	2.1295 2.1210	.0055
Crankshaft End Play Thrust Bearing	.008 - .031 .063 - .065	.008 - .035 .060	—
Con Rod - Crankpin Crankshaft - Crankpin	2.0005 - 2.0015 1.9975 - 1.9985	2.0045 1.9950	.007
Piston Pin Con Rod - Pin Bore	.8745 - .8747 .8750 - .8753	.8741 .8755	.0011
Cylinder Bore In Housing Piston	2.6875 - 2.6880 2.6820 - 2.6825	2.6895 2.6800	.006
Motor Air Gap (Max. Variation)	.009	.011	—
Piston Rings (Gap In 2.6875 GA.)	.003 - .013	.025	—
Valves (Disch.)	Valves are .033" - .035" thick - Valves should be replaced when seat groove wear depth exceeds .008" (.025" thinnest section).		
Valve Springs (Disch.)	Whenever compressor is disassembled for servicing, discharge valve springs should be replaced where they have operated in excess of 5,000 hours.		
Unloader Piston Unloader Piston Bore	1.497 - 1.498 1.500 - 1.501	1.494 1.503	.006
Unloader Valve Stem Unloader Valve Stem Bore	.4300 - .4315 .4365 - .4380	.4285 .4390	.0085
Unloader Check Valve Stem Unloader Check Valve Bore	.6205 - .6220 .6250 - .6260	.6195 .6265	.006
Unloader & Check Valve Filled Teflon Seals	Whenever compressor is disassembled for servicing, unloader seals (Filled teflon) should be replaced where they have operated in excess of 5,000 hours.		

Notes:
1. The above recommended wear rates are for individual parts. For mating parts, the maximum recommended diametral clearance should predominate. In most cases, this would mean that both of the mating parts should not each be at the recommended limit dimension.
2. These recommended wear limits are intended as a guide for parts replacement during normal service rebuilding of compressors, and not as a guide to determine the point at which rebuild is required. Use of this wear limit guide is considered good practice for normal service rebuilding of compressors which will be reliable when put back into service.

TABLE 2 — Bolt Torques

Item	Torque Ft./Lbs.
Discharge Valve Cage Assembly Locknuts	15
Discharge Valve Cage To Valve Plate Bolts	12
Cylinder Head Bolts	52
Unloader Solenoid Valves To Mounting Plate Bolts	6
Unloader Valve Plate To Cylinder Head Bolts	14
Check Valve Plugs	100
Check Valve Stem Nuts	8
Unloader Valve Stem Seal & Retainer Nuts	6
Unloader Valve Stem Stop Washer Nuts	5
Unloader Valve Access Plug	100
Unloader Valve Access Cover	14
Suction Service Valve	58 (3-4 Cyl.)
Mounting Bolts	135 (5-6 Cyl.)
Discharge Service Valve	12 (3-4 Cyl.)
Mounting Bolts	58 (5-6 Cyl.)
Terminal Plate To Housing Bolts	24
Terminal Stud Hex Nuts	2 - 2½
Handhole Cover Bolts	52
Stator Mounting Bolt (Two Piece)	40
Stator Mounting Bolt (One Piece)	175
Rotor Bolt	90
Suction Cover Bolts	52
Oil Pump Cover Bolts	14
Bearing Head Bolts	24
Connecting Rod Bolts	12
Oil Level Sight Glass Mounting Bolts	6
Crankcase Heater Mounting Bolts	6

TABLE 3 — OPERATING DATA

Nominal Tonnage	No. Cyl.	Bore	Stroke	R.P.M.	Service Valve Connections		Weight	Normal Oil Pressure	Oil Capacity (Pints)	Refrigerant
					Suction	Discharge				
10	3	2 11/16	2¼	1750	1⅝	1⅛	410	20-40	11	R-12
13	4	2 11/16	2¼	1750	1⅝	1⅛	430	20-40	11	R-12
15	3	2 11/16	2¼	1750	1⅝	1⅛	410	20-40	11	R-22
16	6	2 11/16	1.88	1750	2⅛	1⅜	495	20-40	13	R-12
19	6	2 11/16	2¼	1750	2⅛	1⅜	520	20-40	13	R-12
20	4	2 11/16	2¼	1750	1⅝	1⅛	430	20-40	11	R-22
25	6	2 11/16	1.88	1750	2⅛	1⅜	495	20-40	13	R-22
30	6	2 11/16	2¼	1750	2⅛	1⅜	520	20-40	13	R-22

Note:
Refer to Service Bulletin HCOM-SB-4 "Recommended Oils and Oil Charges for Reciprocating and Scroll Compressors" for the approved field replacement oils.

Cylinder Head and Valve Plate Assembly

The cylinder head and valve plate assembly are held to the housing with bolts which are common to both components. Gasketing is provided between the cylinder head and valve plate and also between the valve plate and housing. The gaskets between the valve plates and housing are the same for each bank of cylinders and, therefore, interchangeable. Because of compressor unloading, the gaskets between the heads and valve plates are different for each bank of cylinders and, therefore, not interchangeable.

To Remove:

1. Remove the cylinder head bolts (Figure 1).
2. Lift the cylinder head and valve plate assembly (Figure 2) off the housing. The suction valves, on the bottom side of the valve plate may fall away when the plate is lifted off the housing.
3. Use a brass hammer to jar the head and valve plate if they are stuck to the housing.
4. Figures 3, 4 and 5 illustrate the three types of cylinder heads and gaskets used on Model M compressors.

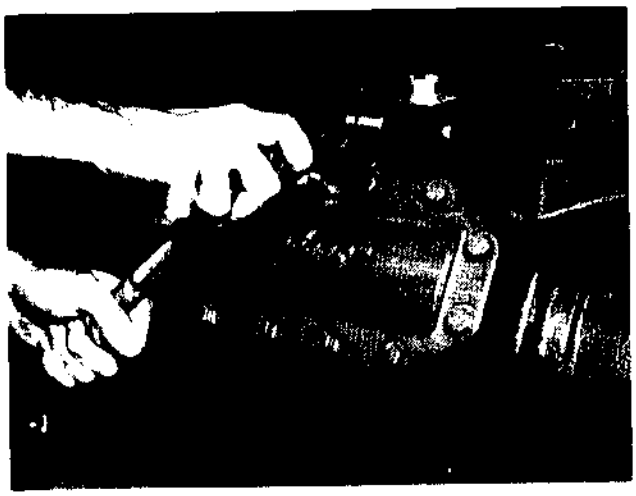


Figure 1

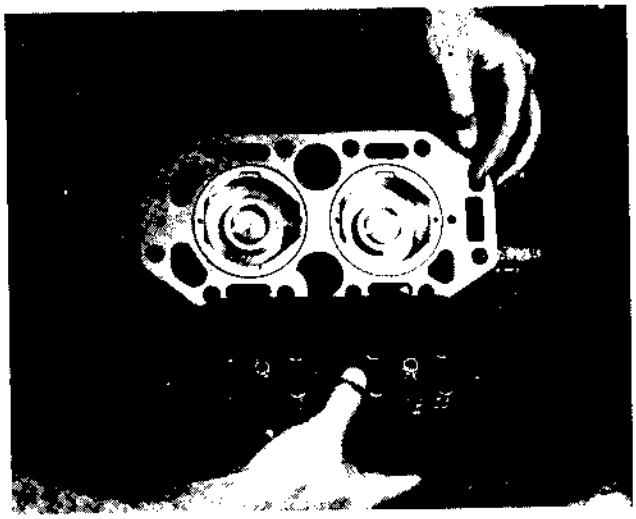


Figure 2

Inspection:

Inspect the cylinder head and valve plate assembly sealing surfaces for nicks and grooves that would cause leaks. Replace if necessary.

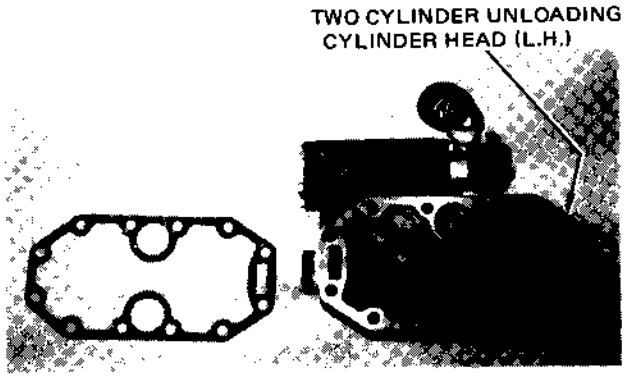


Figure 3

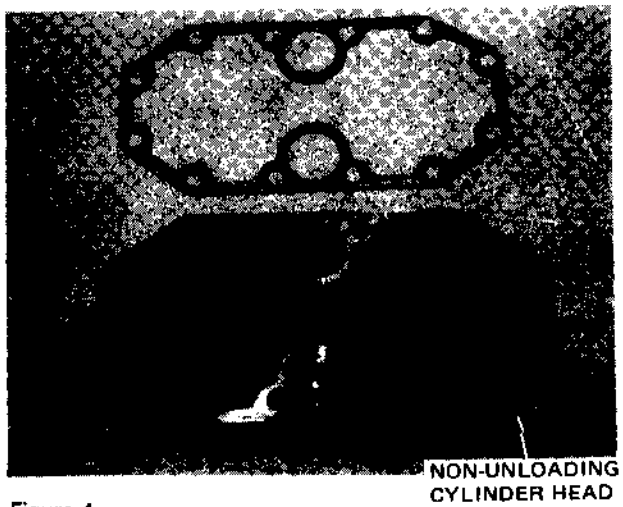


Figure 4

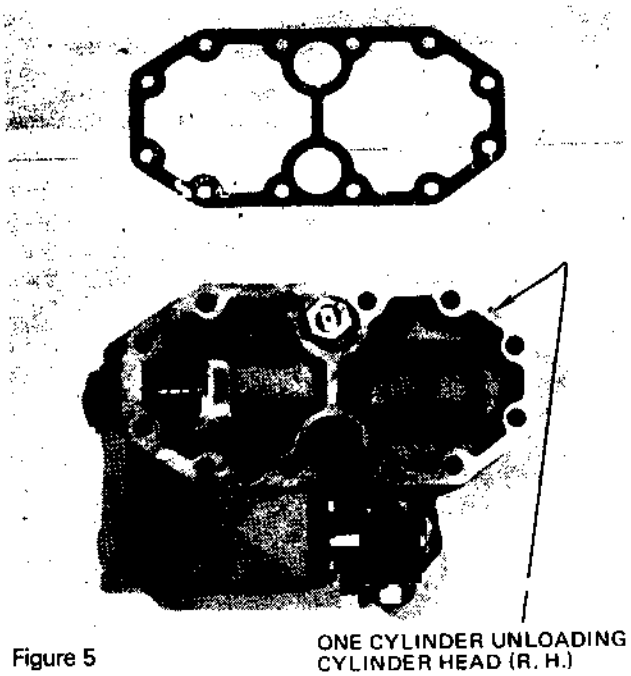


Figure 5

Figure 6

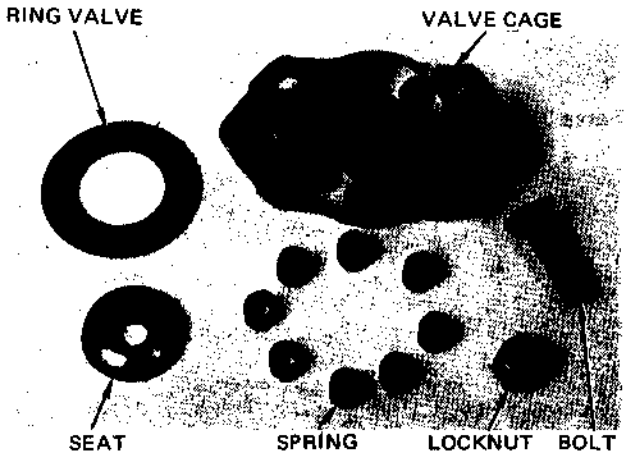


Figure 7

Discharge Valve Cage Assembly

To Disassemble:

1. Remove the four Allen head bolts which hold the discharge valve cage assembly to the valve plate. Lift the cage assembly off the valve plate (Figure 6).
2. Remove the lock nut and discharge valve cage bolt.
3. Remove valve seat, ring valve and springs from the valve cage. Figure 7 illustrates a disassembled discharge valve cage assembly.

Inspection:

Inspect the discharge and suction valves for evidence of copper plating, liquid slugging or wear. Also, inspect valve cage springs and spring pockets for wear. See Table 1 for wear limits and spring replacement data.

To Assemble:

1. Set the discharge valve springs in the valve cage spring pockets.
2. Lay the ring valve in position on the springs.
3. Place the seat on the ring valve and insert the bolt into the cage.
4. Attach the locknut and tighten to final torque making sure the ring valve registers in the cage properly. Check valve movement to be sure it is free to operate. TORQUE - 15 FT. LBS.
5. Position cage assembly on the valve plate, insert the four bolts and lock washers. Tighten to final torque. TORQUE - 12 FT. LBS.

Relief Valve

If compressor discharge pressure becomes excessive and other safety devices fail to function, a pressure relief valve within the compressor will open. When this happens, hot gas is directed back into the suction side of the compressor.

The compressor relief valve is located inside one of the cylinder heads (Figures 4 and 5), which is marked. If the relief valve has opened, check the compressor for internal damage.

Cylinder Head and Valve Plate Assembly

To Install:

1. Run a bead of oil around the suction valve locating pins on the valve plate assembly and install the suction valves to the plate. (Figure 8).
2. Install the valve assembly and gasket to the compressor housing. DO NOT OIL THIS GASKET.
3. Lightly oil both sides of the cylinder head-to-valve plate gasket with compressor oil and place it on the valve plate assembly. BE SURE CORRECT GASKET IS USED.
4. Set the cylinder head on the valve plate assembly. Insert the head bolts and tighten to final torque. TORQUE - 52 FT. LBS.

NOTE: When installing right and left hand cylinder heads with unloaders, be sure the unloader is on the upper side of the head as shown in Figure 9. The unloader must be in this position to provide drainage of oil for proper operation.

Figure 6

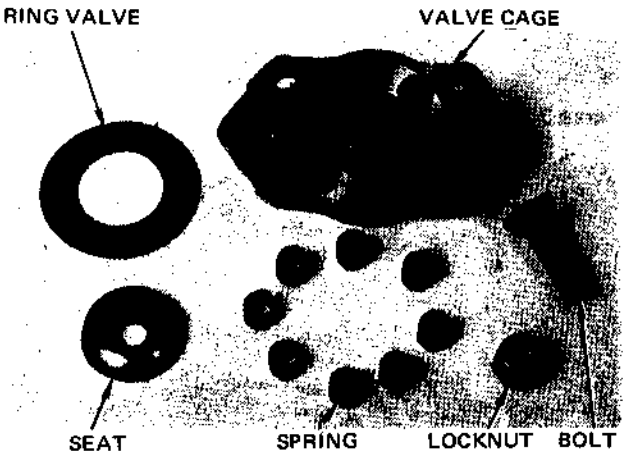


Figure 7

Discharge Valve Cage Assembly

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Inspection:

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To Assemble:

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2. Lay the ring valve in position on the springs.
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To Install:

1. Run a bead of oil around the suction valve locating pins on the valve plate assembly and install the suction valves to the plate. (Figure 8).
2. Install the valve assembly and gasket to the compressor housing. DO NOT OIL THIS GASKET.
3. Lightly oil both sides of the cylinder head-to-valve plate gasket with compressor oil and place it on the valve plate assembly. BE SURE CORRECT GASKET IS USED.
4. Set the cylinder head on the valve plate assembly. Insert the head bolts and tighten to final torque. TORQUE - 52 FT. LBS.

NOTE: When installing right and left hand cylinder heads with unloaders, be sure the unloader is on the upper side of the head as shown in Figure 9. The unloader must be in this position to provide drainage of oil for proper operation.

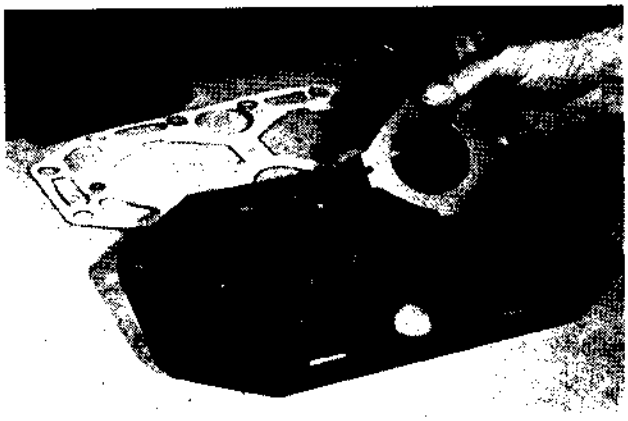

Figure 8

Figure 9

Compressor Capacity Control

Compressor unloading is accomplished by means of by-passing uncompressed discharge gas from a cylinder or cylinders back to the suction side of the compressor. This is done through an unloader valve which is an integral part of the cylinder head.

FIGURE 3 - ILLUSTRATES A CYLINDER HEAD WHICH UNLOADS TWO CYLINDERS.

FIGURE 4 - ILLUSTRATES A CYLINDER HEAD WITH NO UNLOADING.

FIGURE 5 - ILLUSTRATES A CYLINDER HEAD WHICH UNLOADS ONE CYLINDER.

Solenoid Valve Unloading

Two Cylinder Unloading Head In Loaded Position (Figure 10, View 1)

1. Unload valve solenoid coil is de-energized and solenoid valve is closed.
2. Discharge gas from the cylinders enters chamber "C" at the top of the cylinder head as a compressed gas.
3. High pressure gas in Chamber "C" holds the unloader valve seal closed, preventing gas from Chamber "C" being dumped back to the suction side of the compressor which is represented by Chamber "B"
4. High pressure gas in Chamber "C" keeps the check valve to Chamber "A" open.
5. High pressure gas in Chamber "C" enters discharge Chamber "A" and continues out through the discharge port.

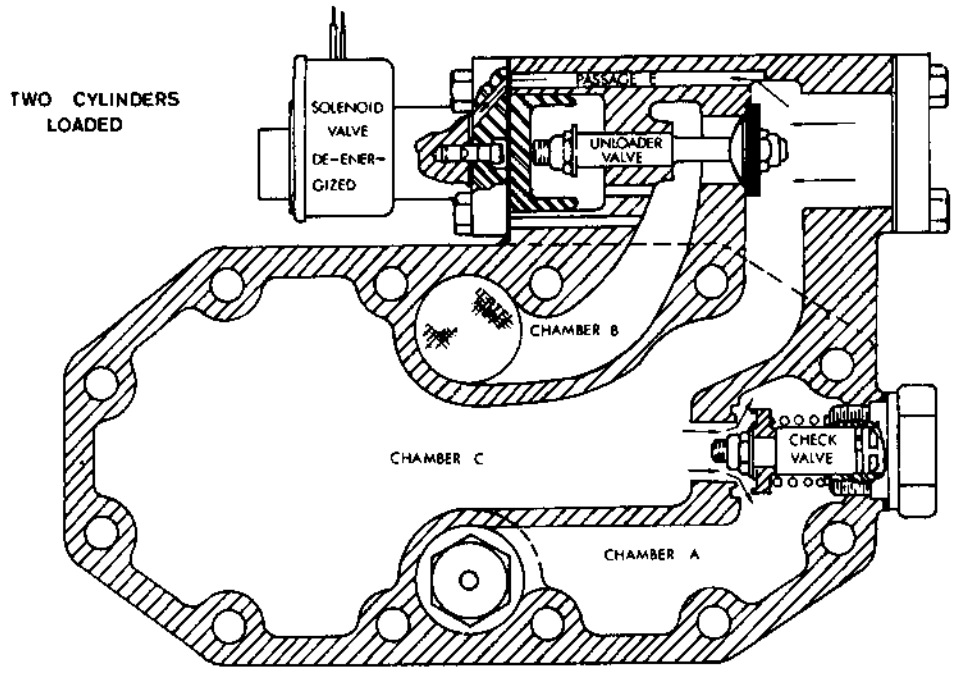

Figure 10 — View 1

Two Cylinder Unloading Head In Unloaded Position (Figure 10, View 2)

1. Unloader valve solenoid coil is energized.
2. Solenoid valve opens permitting the high pressure gas in passage "E" to flow into Chamber "D".
3. Equal pressure is now applied to both the unloader valve seal and the piston in Chamber "D".
4. Pressure on the larger area of the piston forces the valve open.
5. High pressure gas from Chamber "C" is dumped into the suction side of the compressor represented by Chamber "B".
6. Pressure in Chamber "C" decreases and the check valve to Chamber "A" closes preventing the entire compressor from unloading since Chamber "A" is common to all cylinders.
7. Discharge gas from the cylinders entering Chamber "C" will not be compressed as long as the unloader valve remains open and the gas is dumped back into the suction side of the compressor.

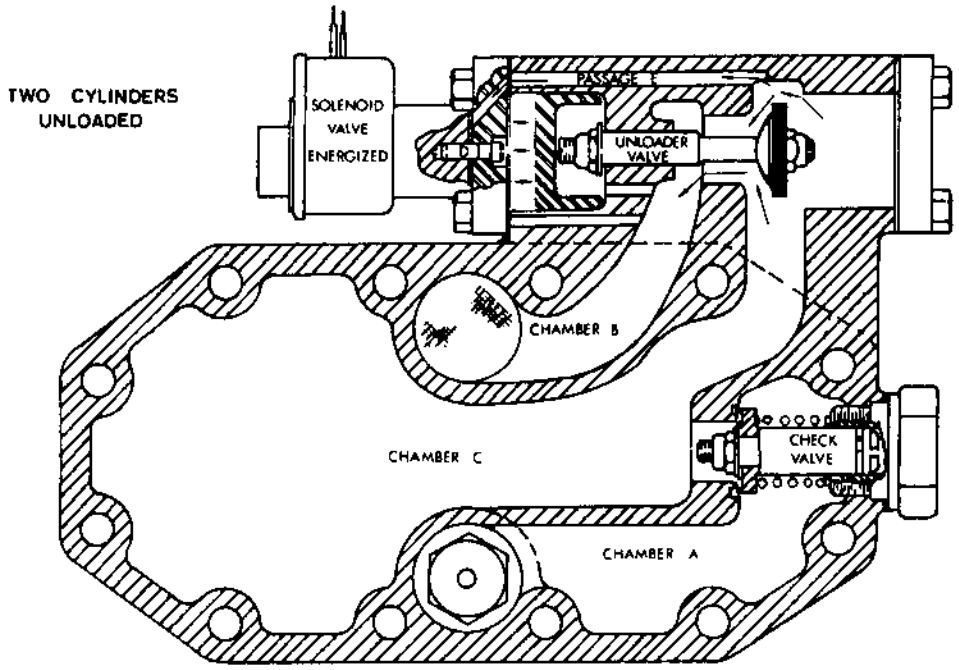

Figure 10 — View 2

To Complete The Cycle, De-Energize The Unloader Valve Solenoid (Figure 10, View 3)

1. The solenoid valve closes Passage "E" to Chamber "D".
2. Gas trapped in Chamber "D" is relieved to Chamber "B" by leaking past the piston and through Passage "G" to the suction side of the compressor - Chamber "B".
3. Gas in Chamber "C" is higher in pressure than gas in Chamber "B" closing the unloader valve seat.
4. With the unloader valve closed, Chamber "C" gas pressure increases and opens the check valve to Chamber "A".
5. The cylinders operate loaded until the unloader valve solenoid is energized.

One Cylinder Unloading Cylinder Head (Figure 11)

One cylinder unloading is the same as two cylinder unlading; the only difference being in the arrangement of the cylinder head passages. Figure 11, View 1, shows the cylinder head from the valve plate side.

View 2 is a section view showing the internal passages in the cylinder head. Chamber "A" receives compressed gas from the non-unloading cylinder. Compressed gas from the unloading cylinder enters Chamber "C" (View 2) and is controlled the same as a two cylinder unloading cylinder head.

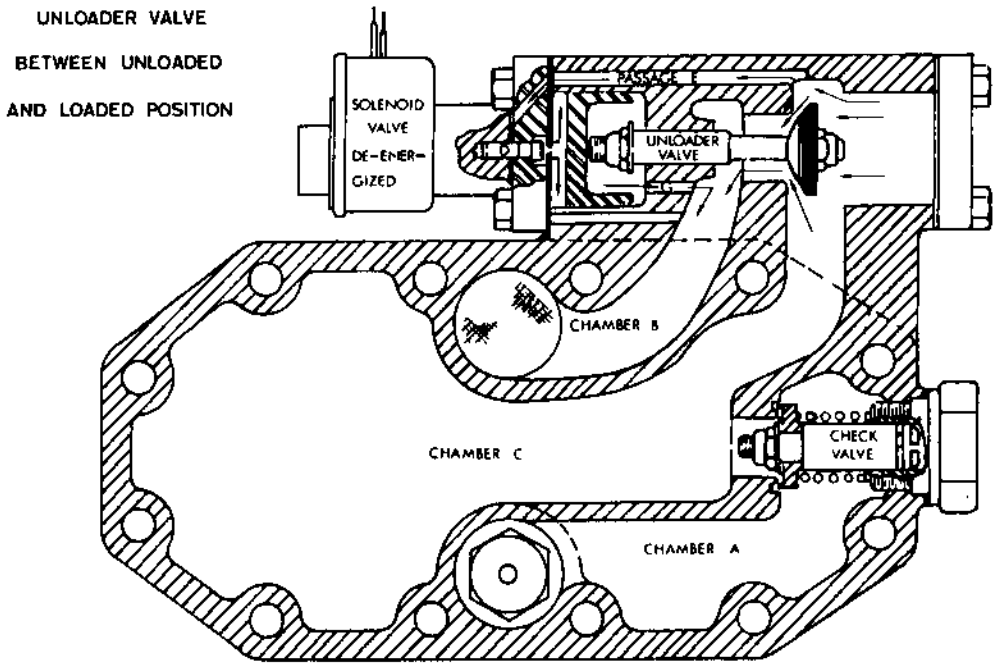

Figure 10 — View 3

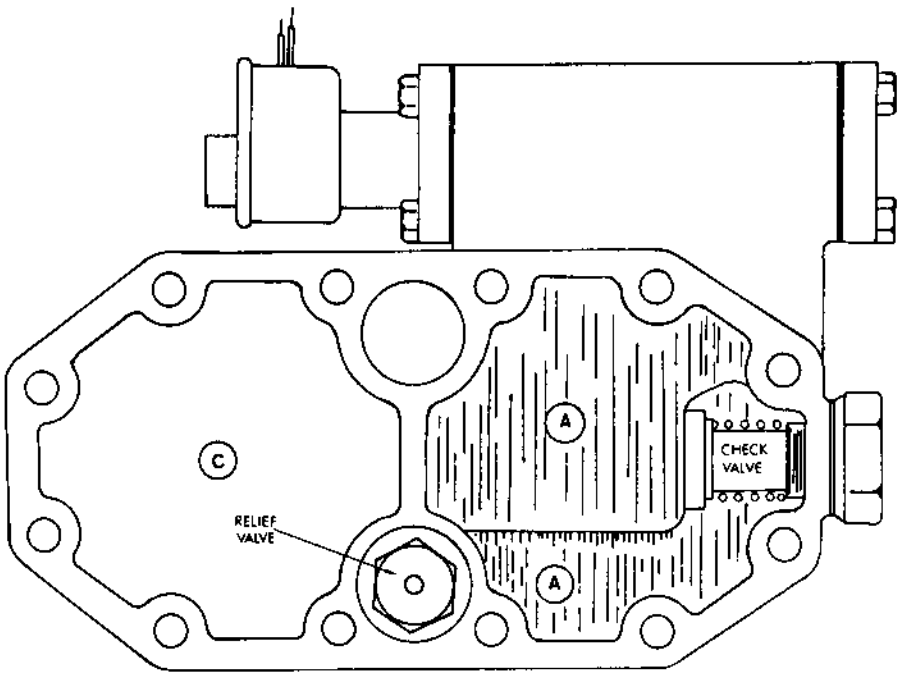

Figure 11 — View 1

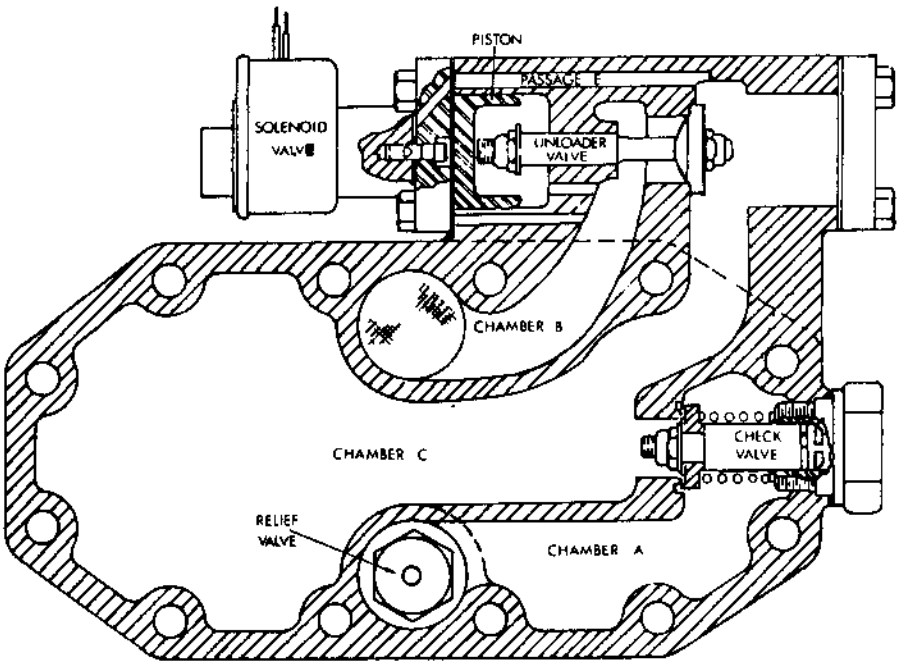

Figure 11 — View 2

Solenoid Valve Assembly

To Remove:

1. Remove the retainer on the end of the valve stem and pull the solenoid valve coil and housing off the stem (Figure 12).
2. Remove the four mounting bolts and pull the valve body, mounting plate and gasket away from the unloader valve housing (Figure 13).
3. Remove the two Allen head bolts which hold the valve body to the mounting plate (Figure 14).
4. Figure 14 illustrates the disassembled solenoid valve assembly.

Figure 13

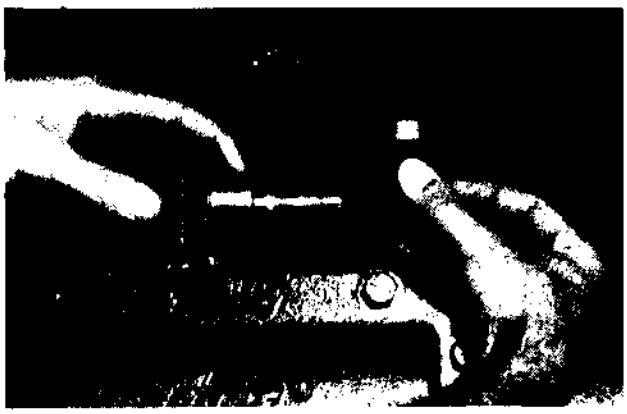

Figure 12

Figure 14

To Install:

1. Attach the valve body and round gasket to the mounting plate. Be sure the holds in the mounting plate gasket and valve body match. Tighten the Allen head bolts to final torque. TORQUE - 6 FT. LBS.

2. Install the mounting plate and square gasket to the unloader housing. The large hole in the gasket must match the drilled hole in the mounting plate and the top drilled hole in the unloader housing (Figure 16). Tighten the mounting bolts to final torque. TORQUE - 14 FT. LBS.

3. Install the coil and housing over the valve stem and fasten in place with the coil retainer.

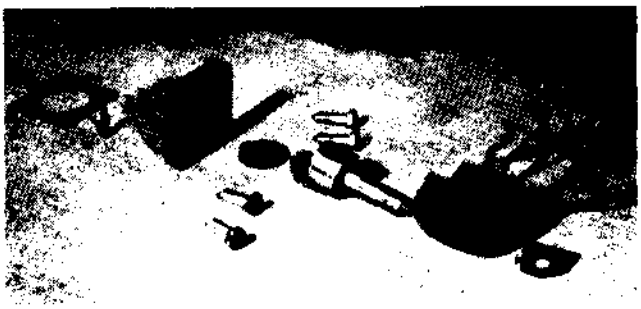

Figure 15

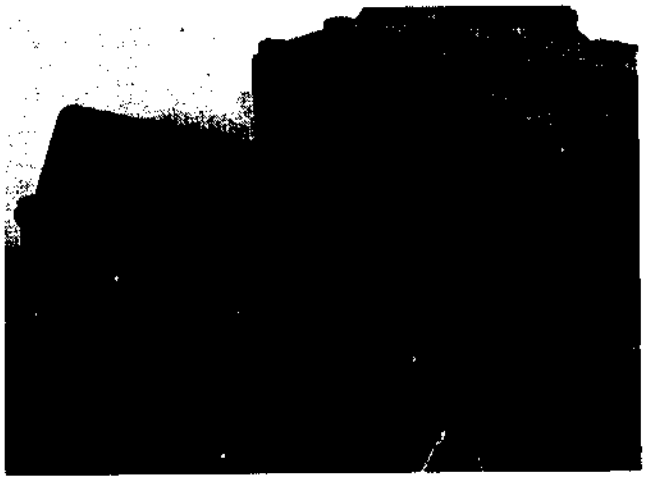

Figure 16

Unloader Valve Assembly

Figure 17 illustrates the unloader valve and related components in the unloader housing. Note the torque of the lock nuts located on both ends of the valve stem. To remove the unloader valve, the lock nut located on the piston end of the valve stem must be removed.

To Remove:

1. Remove solenoid valve assembly.

2. Remove unloader valve assembly access plate or plug (Figure 18).

3. Push piston into unloader housing until it stops.

4. Push sharply on unloader valve retainer and seal driving piston out of housing.

5. Remove unloader piston (Figure 19).

6. Remove the lock nut and washer at the piston end of the valve stem (Figure 20). This is the nut with the 5 FT. LBS. torque (Figure 17).

   NOTE: If the nut holding the retainer and seal breaks loose first, remove the retainer and seal and install a collett-type stud remover to the valve stem and remove the lock nut and washer from the piston end (Figure 21).

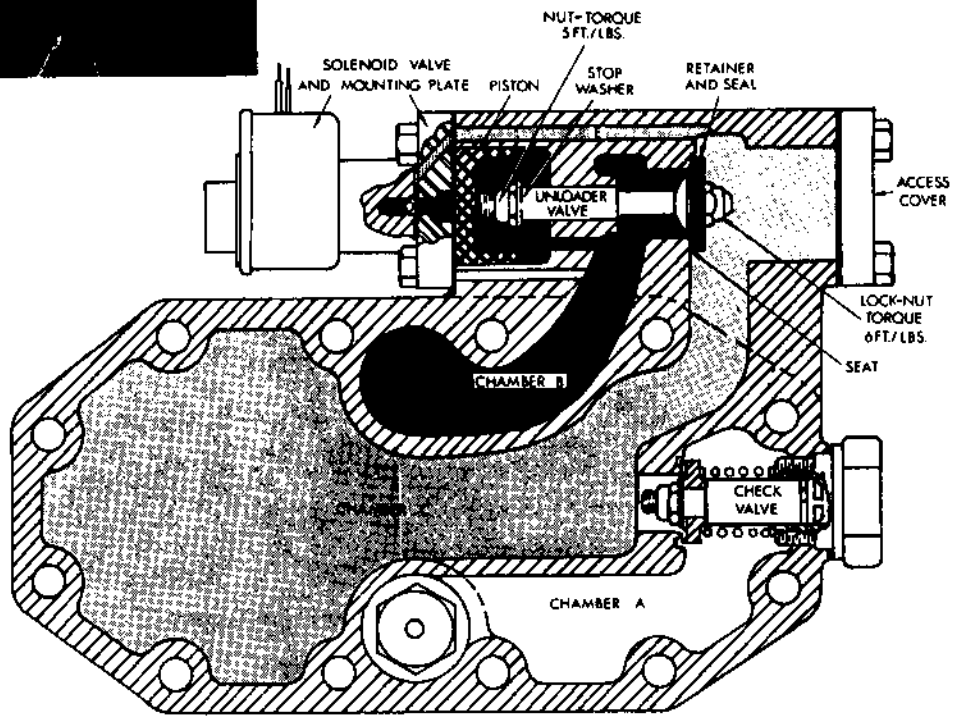

Figure 17

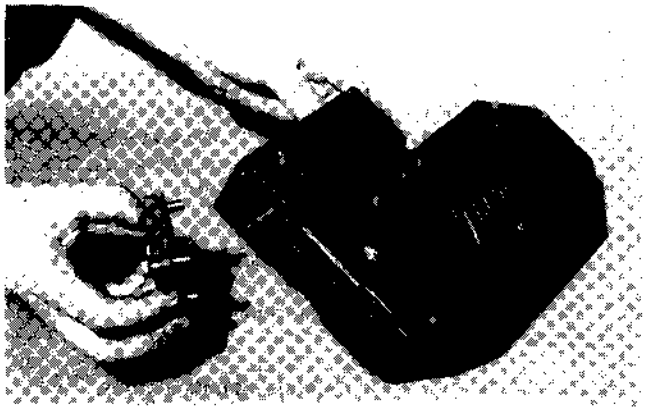

Figure 18

Figure 19

Figure 20

Figure 21

Stud Remover Ordering Information:
Snap On Tools Corporation P.O. Box 46, 21155 162 Street New Berlin, Wisconsin 53151 Housing - No. CG-500-2 Collet 5/16 x 24 - No. CG-500-6

7. Remove the unloader valve from the unloader valve housing, (Figure 22).

8. Disassemble the unloader valve retainer and seal from the valve stem. Two lands are provided on the valve stem for the purpose of removing the lock nut. (Figure 23). Use an open end wrench on the slots. DO NOT USE A VISE GRIP OR SIMILAR TOOL which could mar the close tolerance surfaces of the valve. Figure 24 illustrates the dis-assembled unloader valve assembly.

Figure 22

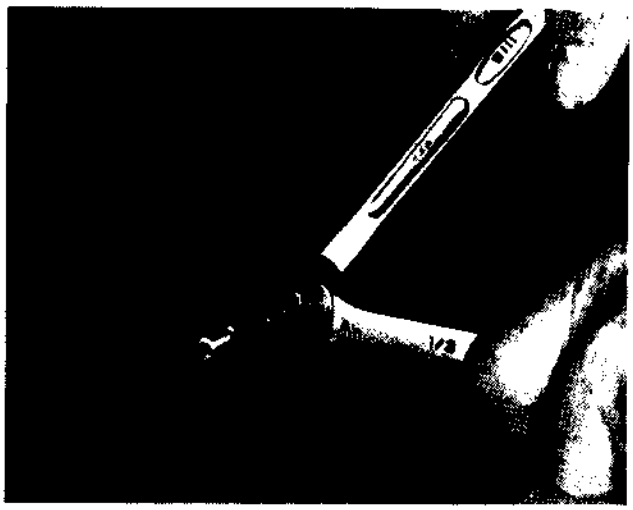

Figure 23

Inspection:

1. Check the unloader valve stem and piston for nicks, burrs, scoring or wear. Table 1 lists wear limits for the unloader valve stem.

2. Check the seal and retainer for wear (Figure 24). Replace if necessary.

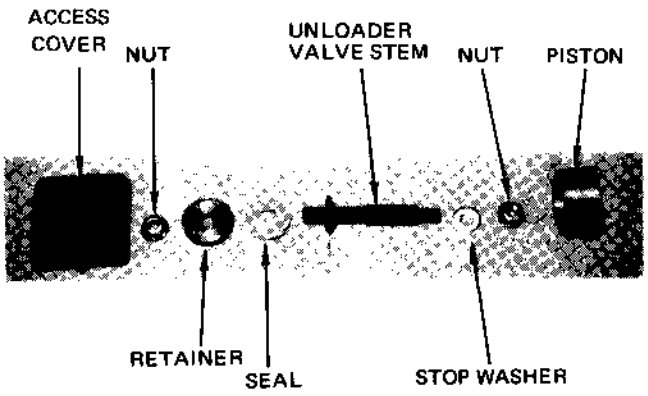

Figure 24

To Install:

1. Attach the retainer and seal to the unloader valve stem. Flat surfaces are provided on the valve stem to aid in tightening the lock nut. Use an open end wrench. Do not use a tool which could mar the close tolerance surface of the valve. Tighten the lock nut to final torque (Figure 25). TORQUE - 6 FT. LBS.

2. Install the unloader valve in the unloader housing.

3. Attach the washer and lock nut at the piston end of the valve stem. Tighten the lock nut to final torque (Figure 26). TORQUE - 5 FT. LBS.

4. Check movement of the valve to be sure it slides freely in the unloader housing.

5. Insert the piston into the unloader valve housing (Figure 19). Check the movement of the piston to be sure it slides freely in the housing.

6. Install access cover (Figure 18). Tighten bolts to final torque. TORQUE - 14 FT. LBS. If older model compressor with access plug - replace plug and tighten to final torque. TORQUE 100 FT. LBS.

Figure 25

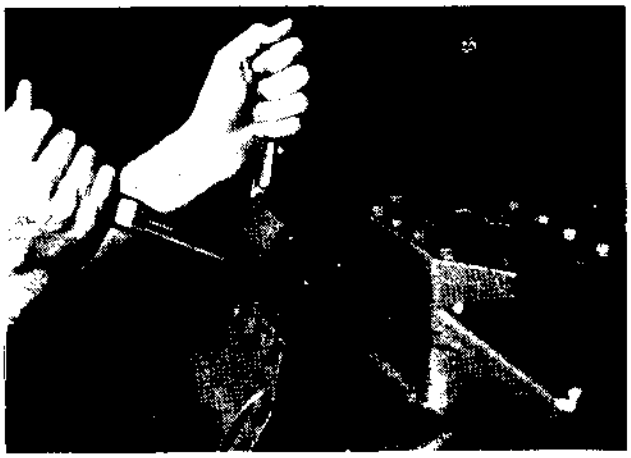

Figure 26

Unloader Check Valve Assembly

To Remove:

1. Loosen the check valve plug and pull the plug, gasket, spring and valve assembly out of the cylinder head (Figure 27).

2. Disassemble the valve retainer and seal from the valve stem. Figure 28 illustrates the disassembled check valve.

Inspection:

1. Inspect valve seal, stem and bore for wear (Table 1).

To Install:

1. Attach the retainer and seal to the check valve stem. Tighten the lock nut to final torque. TORQUE - 8 FT. LBS.

2. Install the plug, gasket, spring and valve stem assembly in the cylinder head (Figure 27). Tighten the plug to final torque. TORQUE - 100 FT. LBS.

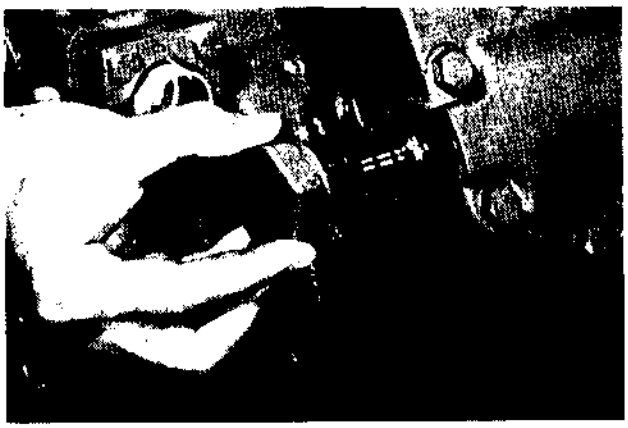

Figure 27

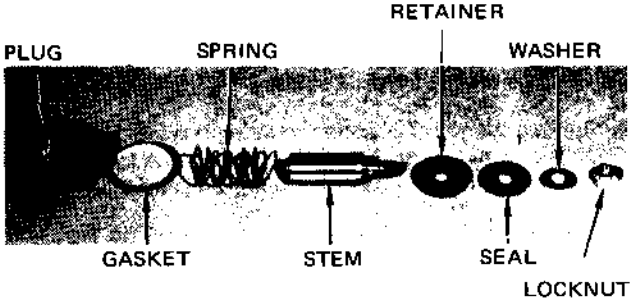

Figure 28

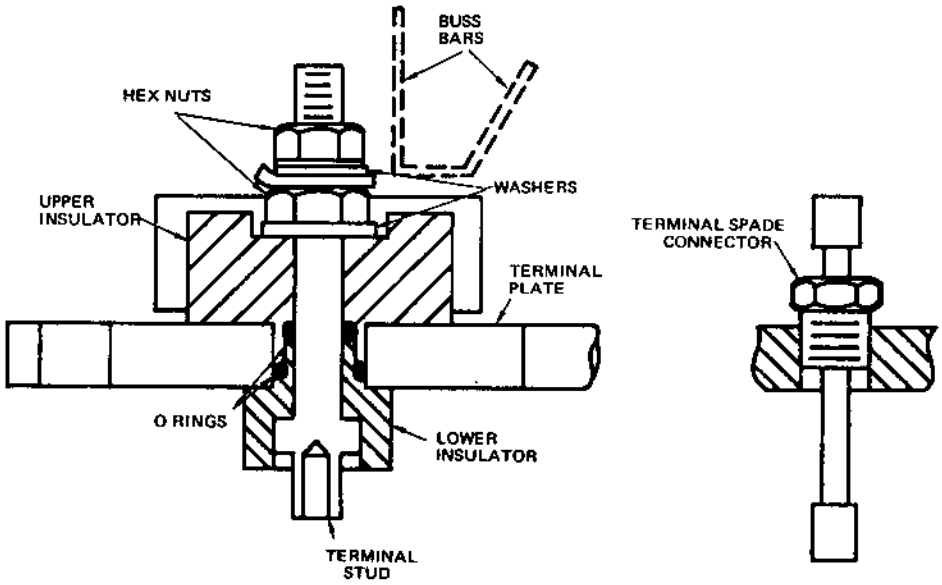

Figure 29

Motor Terminal Plate

Figure 29 illustrates the motor terminal plate and terminal assemblies.

To Remove:

1. Remove the junction box cover and junction box from the terminal plate.
2. Disassemble the hex nuts, washers and buss bars from the top of the terminal studs (Figure 30).

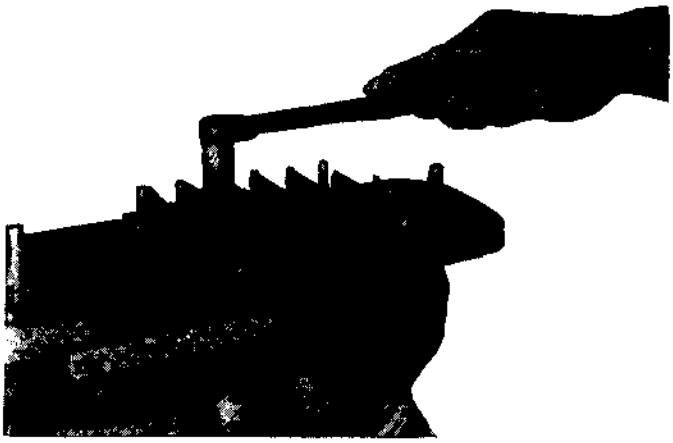

Figure 30

3. Pull the upper insulators off the terminal studs. Work the "O" rings off the terminal studs.
4. Remove the terminal plate mounting bolts (Figure 31). Lift the plate and gasket and disconnect the four hermetic terminal spade connections (Figure 32).
5. Remove the terminal plate and gasket, working the terminal studs out of the plate carefully to avoid damage.
6. Pull the lower insulators and "O" rings off the terminals.

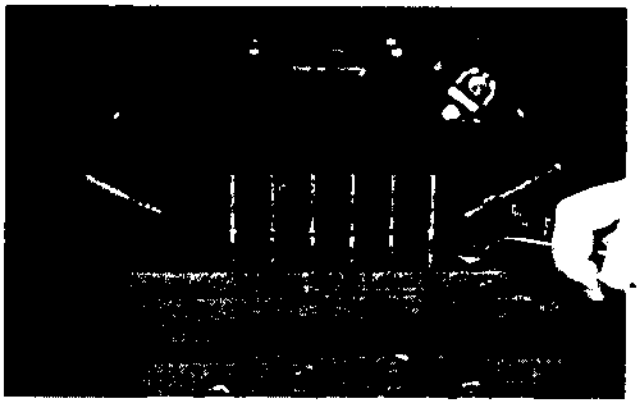

Figure 31

Figure 32

To Install:

1. Set the lower insulators in place on the terminal plate (Figure 33).

2. Oil the large insulator "O" rings and install the "O" rings to the lower insulators using an upper insulator to push them in place (Figure 34).

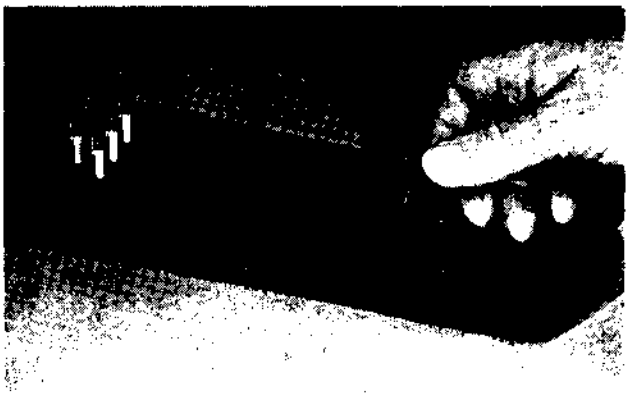

Figure 33

3. Lightly oil the terminal plate gasket and set it in place on the suction cover.

4. Set terminal plate, with lower insulators installed, on the motor barrel. Install the motor studs to the plate (Figure 35). Numbers on the motor leads must match with numbers on the terminal plate.

5. Connect the terminal space connectors. Attach the color coded lead to the common or "C" terminal connection. The other three leads attach to any of the other three terminal connectors S1, S2 and S3 (Figure 32).

6. Push the terminal plate into position on the suction cover and install two mounting bolts at opposite ends, finger tight. Do not use the four bolts that mount the junction box. All studs at the same height will insure they are located properly in the lower insulators (Figure 36).

7. Oil and install the small "O" rings. Follow with the upper insulators, washers and hex nuts. Tighten the nuts finger tight.

Figure 34

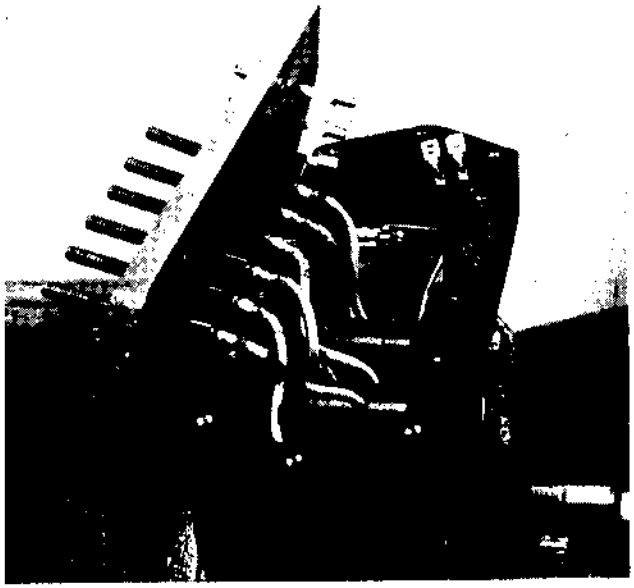

Figure 35

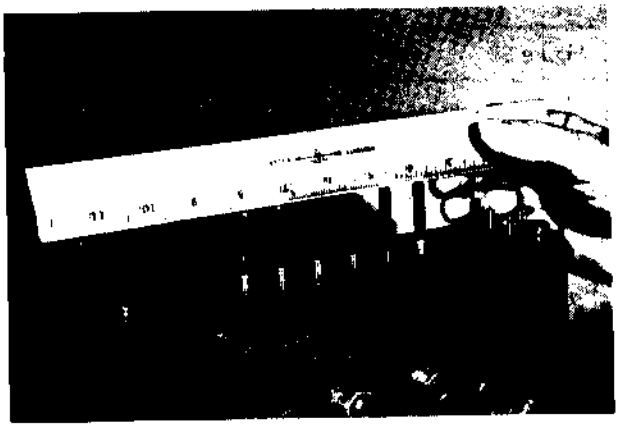

Figure 36

8. Hold the end of the stud while pushing the upper insulator in place (Figure 37).

9. Tighten the hex nuts to final torque. TORQUE - 2-2½ FT. LBS.

Figure 37

10. Install the junction box and remainder of the terminal plate mounting bolts. Tighten to final torque.
TORQUE - 24 FT. LBS. (⅜"-16 bolt)
TORQUE - 14 FT. LBS. (5/16"-18 bolt)

11. Install the buss bars, washers and hex nuts. Tighten to final torque. TORQUE - 2-2½ FT. LBS.

12. Install the junction box cover. Figures 38 and 39 illustrate 6 and 9 wire lead connections to the terminals.

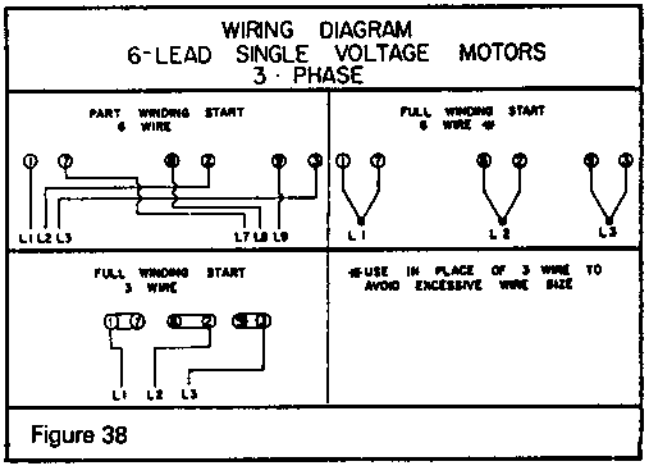

Figure 38

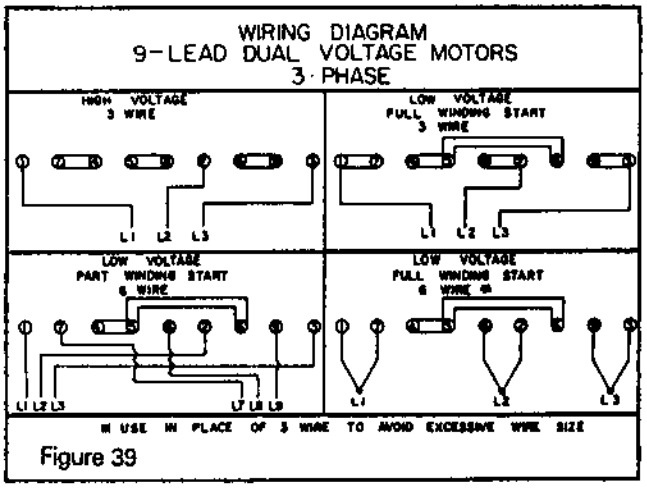

Figure 39

Suction Service Valve and Suction Strainer

To Remove:
1. Remove the suction valve mounting bolts and lift the valve off the suction cover. Remove gasket and pull the suction strainer out of the suction cover (Figure 40).

Inspection:
1. Check the strainer for dirt or damage. Clean or replace as necessary.

To Install:
1. Slide the suction strainer into the suction cover.

2. Place a new, lightly oiled gasket in position and attach the suction valve to cover. Tighten the mounting bolts to final torque.
TORQUE - 58 FT. LBS. (3-4 cy.)
TORQUE - 135 FT. LBS. (5-6 cy.)


Figure 40

Suction Cover and Motor

To Remove:
1. Remove the motor terminal plate.

2. Remove suction service valve and suction strainer.

3. Remove the suction cover bolts and the two nuts from the studs at the top of the cover (Figure 41).


Figure 41

4. Pull the suction cover away from the housing, guiding the motor leads down through the cover to prevent damage (Figure 42).

5. To remove the rotor bolt, it will be necessary to keep the crankshaft from turning. Blocking a piston with a cylinder head is one way of accomplishing this without the aid of special tools (Figure 43). The valve plate assembly must be removed from the housing and spacers equal to the plate thickness installed under the cylinder head mounting to bolt heads.

6. Remove the rotor bolt and washers.

Figure 42

Figure 43

7. Ease the rotor off the crankshaft. A rotor crankshaft key will slide with the rotor (FIGURE 44).

8. At the top of the motor barrel, remove the socket head stator plug - dowel pin arrangement. This frees the stator (Figure 45A). Figure 45B illustrates the old style of dowel pin arrangement.

Figure 44

Figure 45A — New Style Motor Dowel

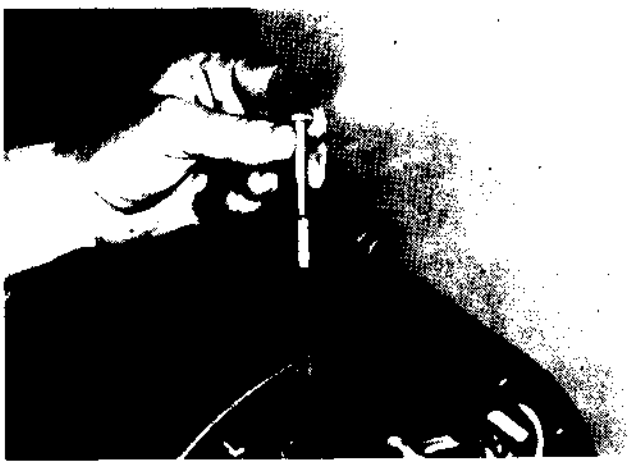

Figure 45B — Old Style Motor Dowel

9. Grasp the stator windings with both hands and pull the stator out of the housing (Figure 46). It may be necessary to place boards or some other support device below the stator when removing since the weight is great enough to make this operation difficult. A sharp rap on the side of the motor barrel with a plastic hammer may be necessary to start the stator moving.

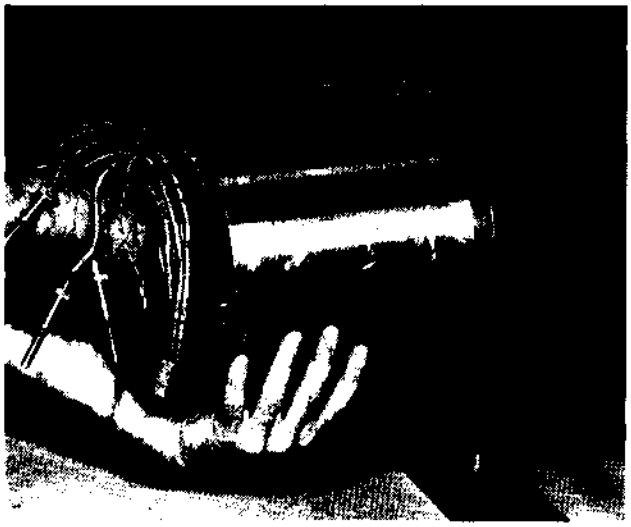

Figure 46

10. Set the rotor and stator in a clean, dry area where the windings will be protected from damage. If the crankshaft and connecting rod piston assemblies are to be removed, it will be advantageous to set the compressor up on the suction end of the housing. For this reason, remove the studs at the suction end of the housing. This can be accomplished by turning on two nuts and tightening against each other. To remove the stud, turn the bottom nut with a wrench counter clockwise as shown in Figure 47.

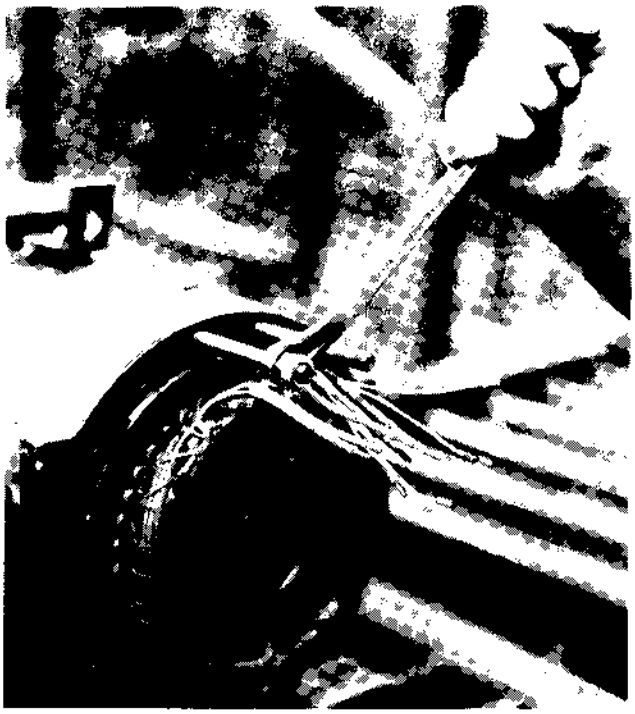

Figure 47

To Install:
As an aid in positioning the stator in the housing, scribe a guideline from the center of the dowel pin hole, across the stator laminations in the direction opposite the motor leads (Figure 48).

1. Using added support under the stator, start the stator into the housing (Figure 48). Locate the guideline in the motor housing dowel pin hole. Follow the guideline until the dowel pin hole in the stator and housing match.

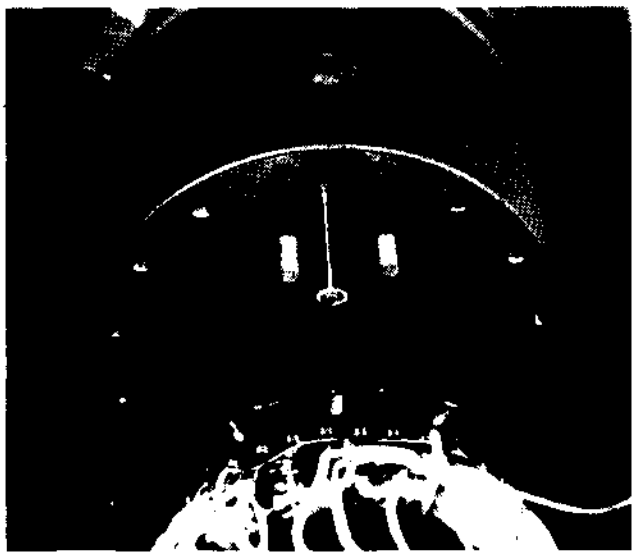

Figure 48

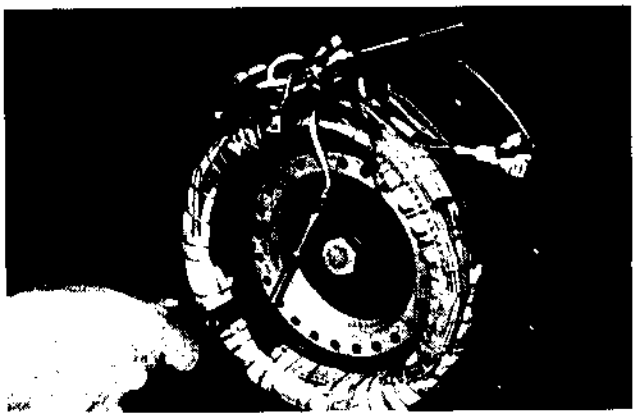

Figure 49

2. Install the stator plug - dowel pin. (Figure 45).
3. Place the rotor on the crankshaft and push into position, lining the key ways.
4. Insert the key and tap into position.
5. Install the rotor bolt, washer and lock washer.
6. Install a compressor head to block a piston, locking the crankshaft (Figure 43).
7. Tighten the rotor bolt to final torque. TORQUE - 90 FT. LBS.
8. Check the air gap variation between the rotor and stator with a feeler gauge (Figure 49). ALLOWABLE AIR GAP VARIATION - .008 MAX.

9. Install the two studs in the suction end of the housing if they were removed. (Figure 47).

10. Lightly oil both sides of the suction cover gasket and carefully place over the studs and against the end of the housing.

11. Using the top two studs as installation guides, set the suction cover over the ends of the studs. If the studs are not long enough to hold suction cover in place, threaded rods 7/16 N.C. and about 8 inches in length will support the cover while the terminals are threaded in or out of the suction cover. Check the motor lead location on the terminal plate to determine the correct location of the motor leads in each section in relation to the openings in the top of the cover.

12. Guide the motor leads through the openings and push the cover up against the housing, being careful not to damage the leads. (Figure 42).

13. Install the suction cover bolts and the nuts on the ends of the studs (Figure 41). Tighten to final torque. TORQUE - 52 FT. LBS.

Oil Pump

The oil pump is driven by a roll pin in the end of the crankshaft and is held in position with a spring-loaded cover.

To Remove:

1. Remove all but two cover bolts at opposite sides of the cover.

2. Back off the two remaining bolts two or three turns (Figure 50). If the cover does not follow the bolts, jar the cover with a plastic hammer to break the gasket seal.

Figure 50

3. Remove the last two bolts and lift off the cover and spring (Figure 51).

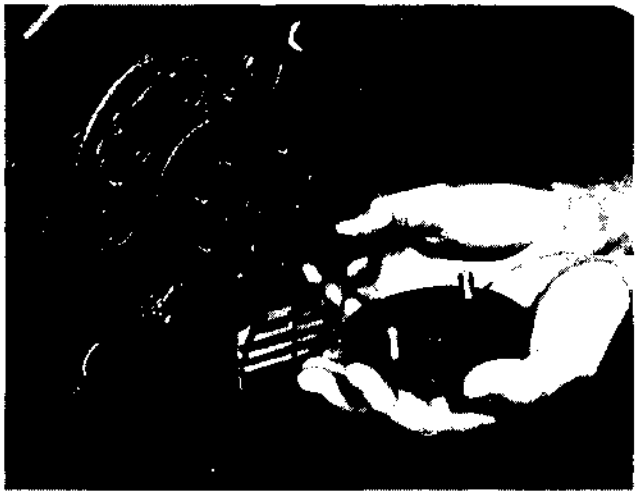

Figure 51

4. Pull the oil pump plate off the oil pump assembly (Figure 52).

Figure 52

5. Remove the oil pump assembly from the bearing head (Figure 53).

6. Figure 54 illustrates the oil pump assembly.

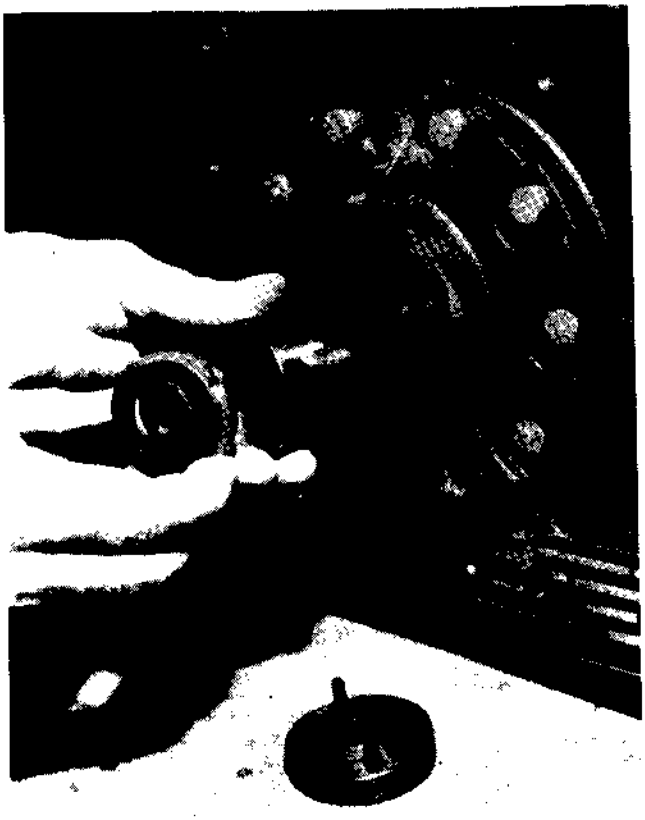

Figure 53

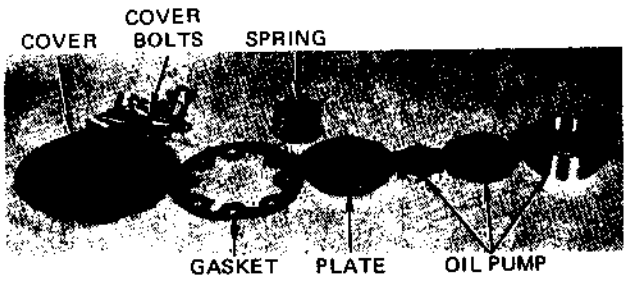

Figure 54

Inspection:

1. Clean the oil pump assembly and inspect for wear. The machined surfaces must be flat and free of nicks and burrs.

To Install:

1. Place the oil pump assembly in the bearing head against the crankshaft. The outside ring of the pump has a notch which fits a pin on the end of the crankshaft (Figure 55).

2. Set the oil pump plate in position against the pump. The plate must be installed with the slot (kidney port) at the top and the pin in the plate must fit the recess in the rotor retainer (Figure 52).

3. Lightly oil both sides of the cover gasket and place on the cover. Be sure the cover and gasket bolt holes match. Insert two bolts in the cover and gasket at opposite sides of the cover.

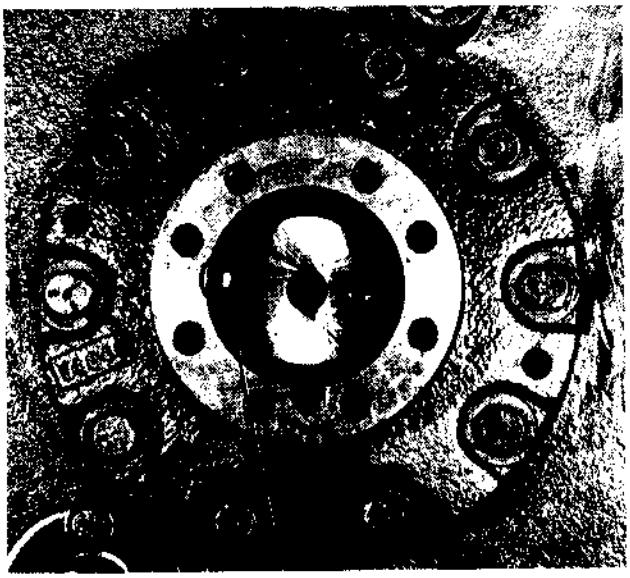

Figure 55

4. Place the spring over the protruding knob on the oil pump plate (Figure 51). Hold in position while placing the cover and bolts up against the bearing head. Push the cover toward the bearing and engage the two bolts.

   NOTE: The two register pins on the oil pump plate must fit into matching holes in the cover.

5. Tighten the two bolts evenly, placing the oil pump under spring tension. Insert the remaining bolts and tighten all bolts to final torque. TORQUE - 14 FT. LBS.

Handhole Cover and Oil Strainer

To Remove:

With motor, suction cover and the two suction cover studs removed, set the compressor in a vertical position, resting on the motor barrel end.

1. Remove the handhole cover mounting bolts (Figure 56).

Figure 56

2. Lift the cover and gasket off the housing and set aside (Figure 57). If the cover sticks to the housing, jar the cover with a plastic mallet.

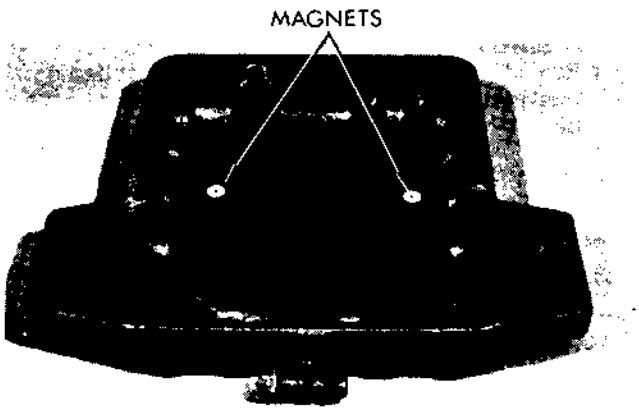

Figure 57

3. To remove the oil strainer, turn strainer assembly to one side and pull the strainer oil tube out of the housing. (Figure 59).

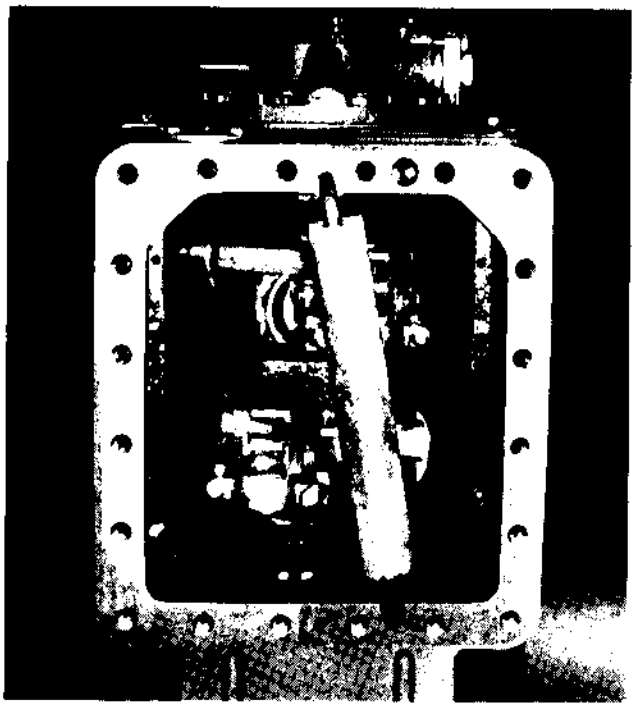

Figure 58

Inspection:

1. It is recommended that when the compressor is disassembled for service that the oil strainer screen be replaced.

2. Check the sealing surfaces of the handhole cover and housing for nicks or grooves.

3. Remove and clean the two magnets laying in the bottom of the handhole cover. Note their location in Figure 57.

To Install:

The oil strainer assembly must be positioned as shown in Figure 58 to fit between the ribs of the handhole cover.

1. Set the oil strainer in position and push the oil tube into the housing (Figure 59). Spring tension will hold the strainer in place.

2. Lightly oil the handhole cover gasket and place it on the cover. Note the gasket and handhole cover have a filled in area which will close off an oil return hole in the housing. Be sure the cover and gasket are properly matched before reinstalling.

3. Position the gasket and handhole cover on the housing, insert the mounting bolts and tighten to final torque. TORQUE - 52 FT. LBS.

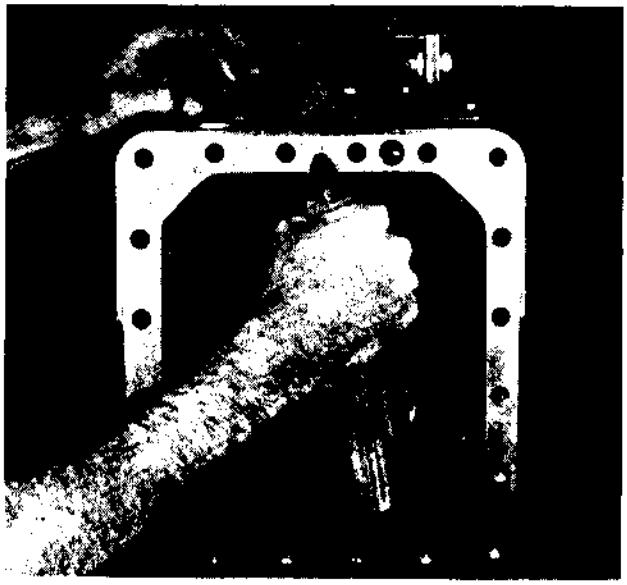

Figure 59

Bearing Head

To Remove:

1. Remove the bearing head cap screws (Figure 60).

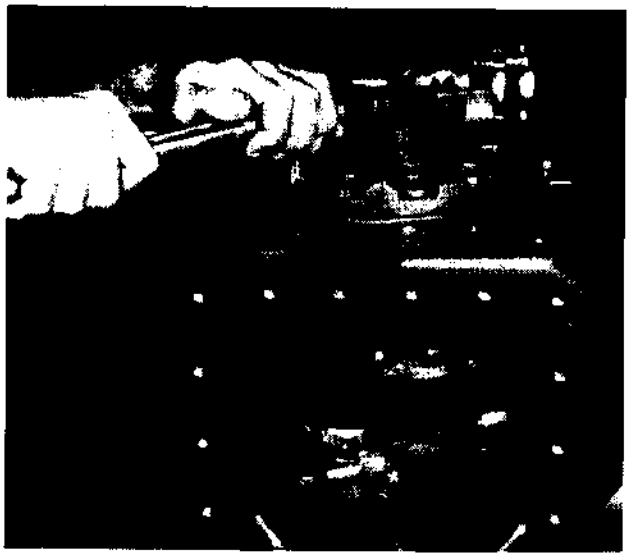

Figure 60

2. To break the gasket seal, use two oil pump cover screws in the jack-screw holes provided in the bearing head (Figure 61).

3. Lift the bearing head and gasket off the housing. The thrust bearing will come with the bearing head. If it does not, lift the thrust bearing off the end of the crankshaft. Figure 62 illustrates the bearing head, gasket and thrust bearing.

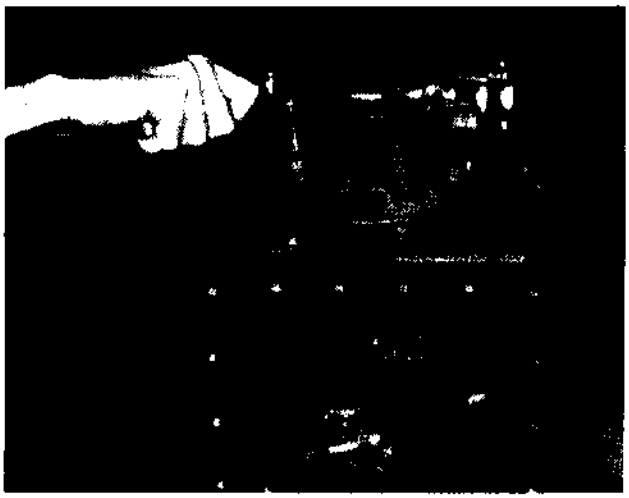

Figure 61

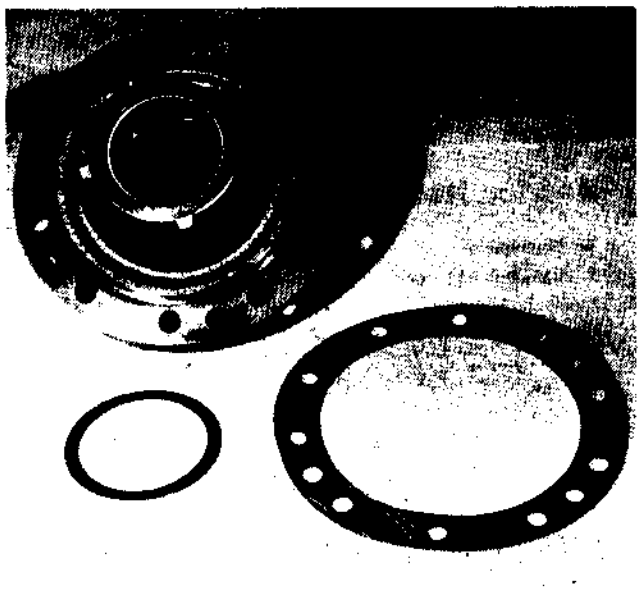

Figure 62

Inspection:

1. Examine the bearing insert for damage or copperplating. Clean the oil passages if necessary. Table 1 lists bearing wear limits.

To Install:

1. Run a bead of oil on the bearing head thrust bearing mating surface. Set the thrust bearing in place on the bearing head.

2. Lightly oil both sides of the gasket and place it on the bearing head. Be sure the holes in the gasket and bearing head match.

3. Oil the bearing surface of the bearing head. Set the bearing head with thrust washer and gasket over the crankshaft and push it into the compressor housing. Match the bearing head oil supply hole, at the bottom of the bearing head, with the oil supply hole in the compressor housing.

4. Insert and tighten the mounting bolts to final torque. TORQUE - 24 FT. LBS.

5. Measure crankshaft end play - .009" - .035". Push the shaft against the motor end thrust bearing. Using a feeler gauge, measure the distance between the shoulder of the shaft and the thrust bearing at the oil pump end of the shaft. Repeat the measurement of the motor end thrust bearing after pushing the shaft against the pump end thrust bearing. The measurement should be identical at both ends of the crankshaft. If it varies, check the position of one or both thrust bearings. When replacing bearings, replace both bearings as a set. Table 1 lists thrust bearing wear limits.

CRANKSHAFT END PLAY .009" - .035"

Bearing Removal and Installation

To Remove:

1. Use bearing removal tool illustrated in Figure 63.

2. Insert tool into bearing and draw both bearing inserts out by turning nut on the steel bar end of threaded rod as in Figure 64.

NOTE: Both motor end and head and bearings can be removed in the same manner.

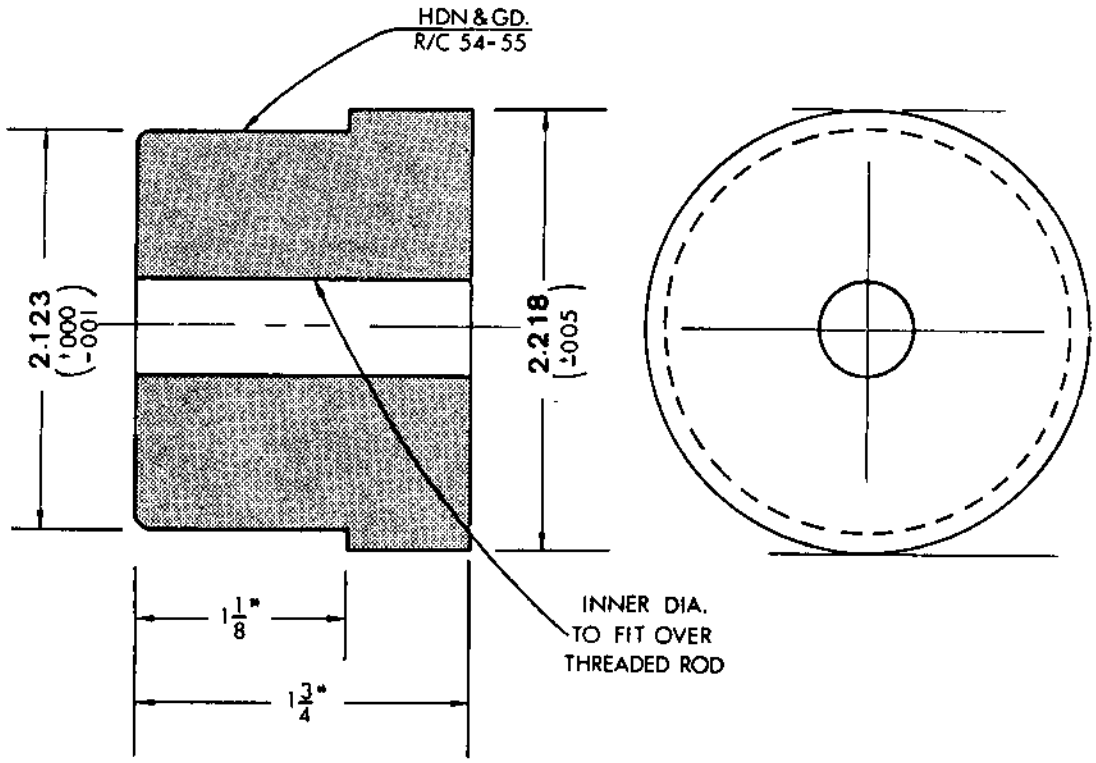

Figure 63 — Bearing Removal Tool

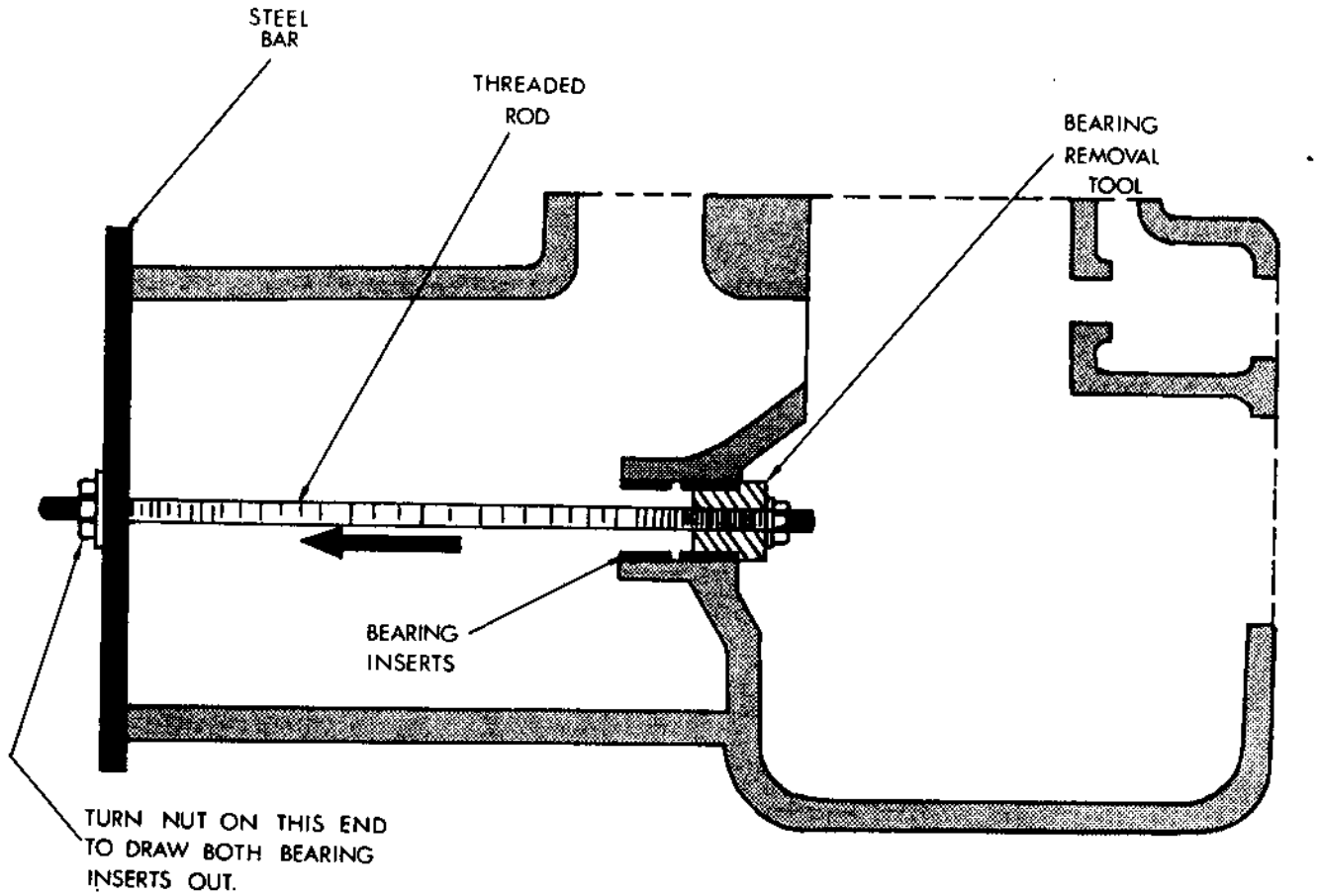

Figure 64 — Bearing Insert Tool

To Install:

1. Bearing installation tool is illustrated in Figure 65.
2. Place bearing insert over installation tool and lubricate the insert with light oil.
3. Run a threaded rod through bearing casting and tool with insert in place.
4. Turn nuts on to end of rod at tool end and bar end.
5. Turning nut on bar end will draw bearing insert into casing until the positive stop on tool is against casing. See Figure 66.
6. Change mechanism around to draw second insert into opposite end of casing in same manner as previously described.

NOTE: Both motor end and head end bearings may be installed with this procedure.

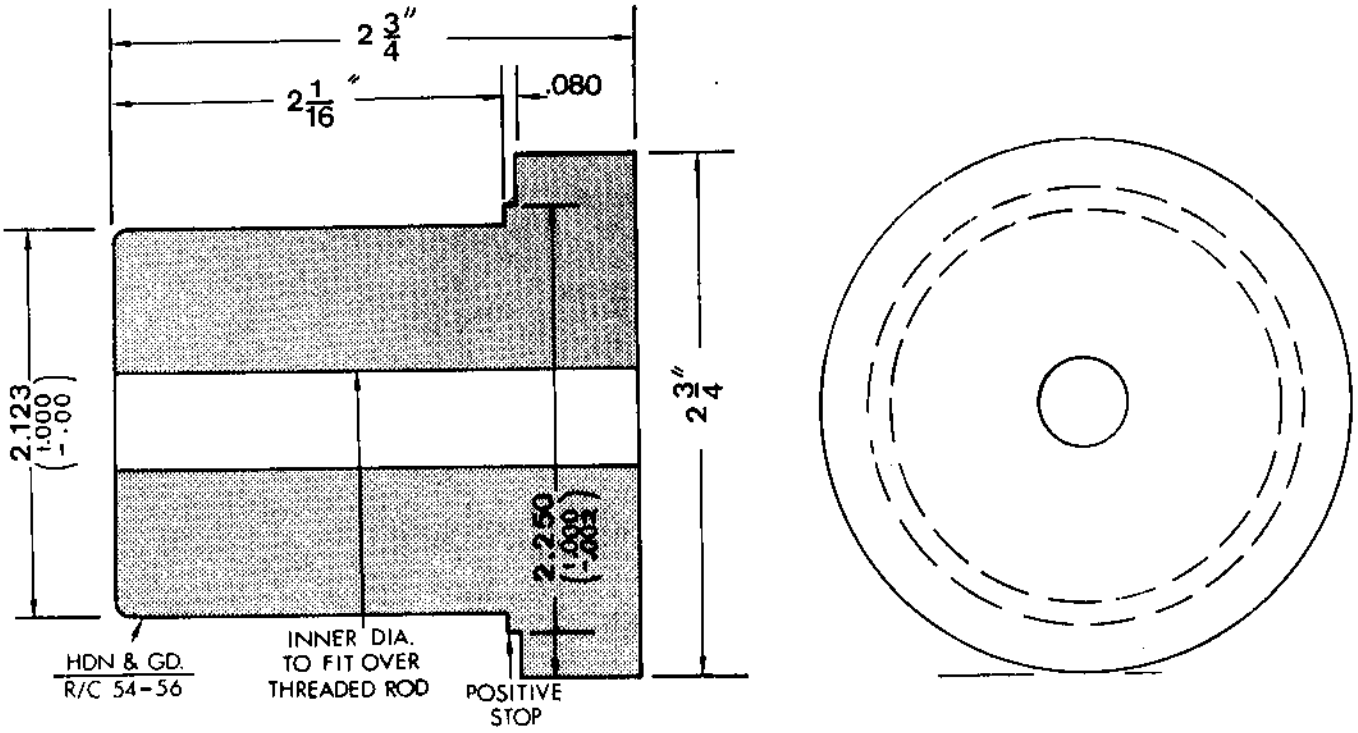

Figure 65 — Bearing Installation Tool

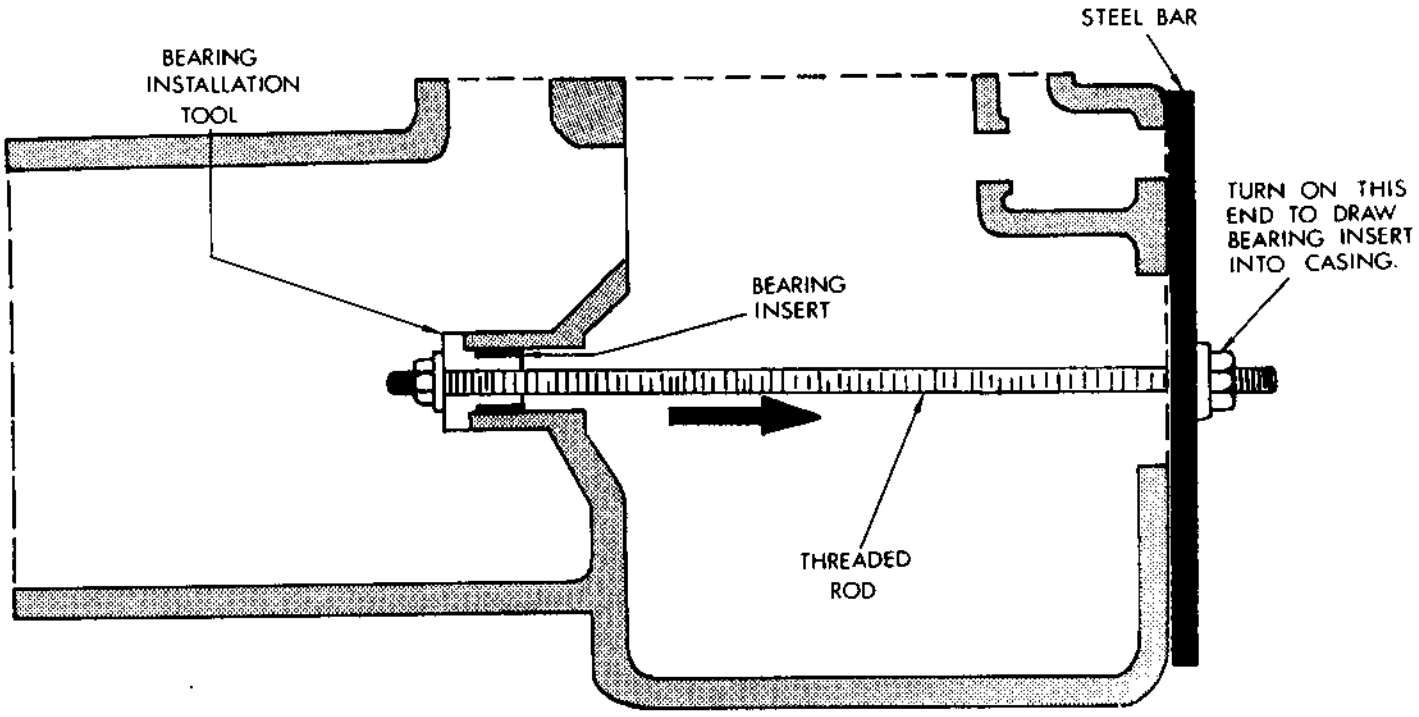

Figure 66 — Bearing Insert Installation

Crankshaft

To provide clearance when removing the crankshaft, the connecting rod and piston assemblies must be pushed back into the cylinders after removing the connecting rod caps (Figure 67).

Connecting rod and cap assemblies must be matched marked with matching cylinder numbers and marks denoting the side of the rod facing the discharge end of the compressor to insure proper fit in reassembly. (Figure 68). When assembled to the crankshaft, the match marks must be on the same side facing the pump end of the compressor. When reusing rods and caps, reassemble them in the same cylinders they were removed from. For this reason, when match marking the connecting rods it is wise to use the cylinder number.

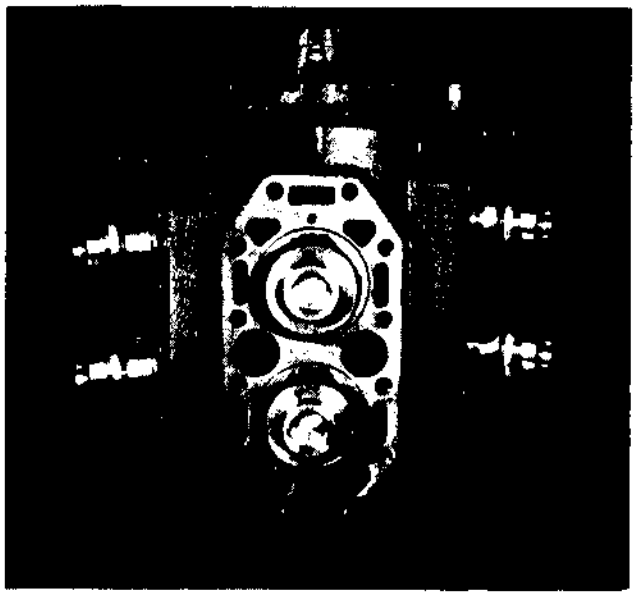

Figure 67

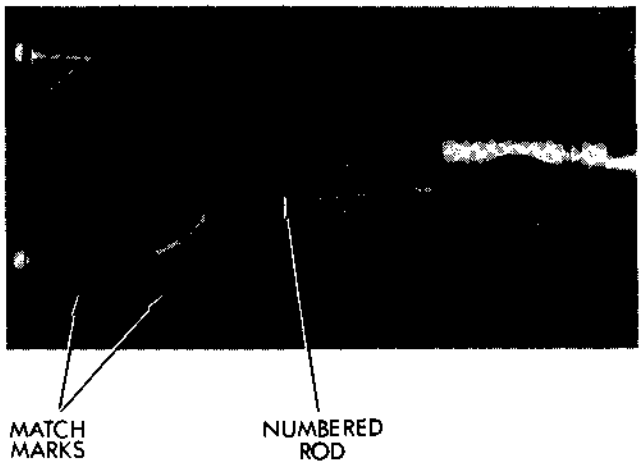

Figure 68

To Remove:

1. Loosen the connecting rod bolts 2-3 turns (Figure 69). Tap the screw head with a brass rod, pushing the rod away from the cap. Complete the removal of the bolts and remove the cap.

2. Push the connecting rods and pistons out of the cylinders to provide crankshaft clearance.

Figure 69

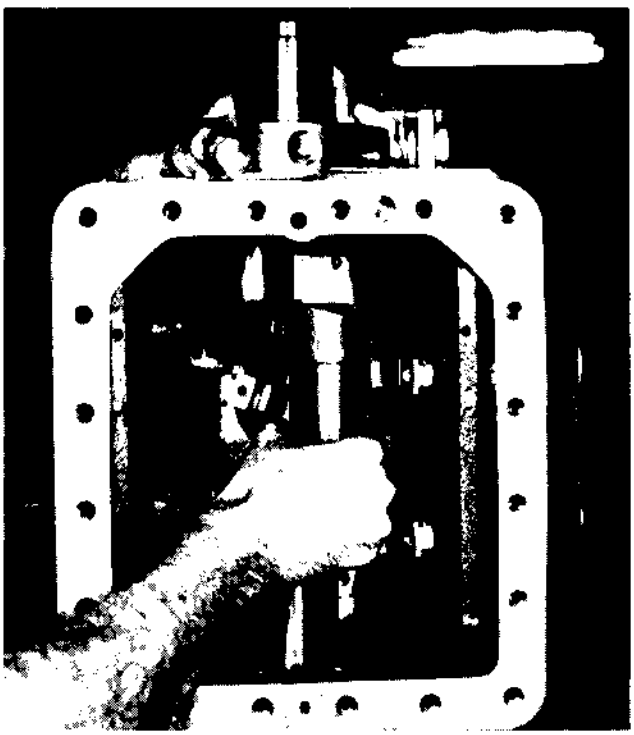

Figure 70

3. Lift the crankshaft out of the housing (Figures 70 and 71).

4. Remove the thrust bearing on the motor end bearing (Figure 72).

NOTE: It is not mandatory to remove the stator while the compressor is turned on end to remove the crankshaft. The suction cover can be replaced to protect the motor end turns and the compressor stood on end. The rotor must be removed for this operation.

Inspection:
Examine the crankshaft journals and bearing surfaces for damage or copper plating. Remove the plugs and check the oil passages, clean if necessary. Table 1 lists crankshaft wear limits.

To Install:
1. Oil the motor end thrust bearing and place it on the motor end bearing (Figure 72).

2. Oil all bearing surfaces of the crankshaft.

3. Lower the crankshaft into the housing through the pump end bearing opening (Figures 70 and 71). When inserting the shaft in the motor end bearing, use caution to prevent damage to the thrust bearing and main bearing surfaces.

4. Reinstall the pump end bearing head and check crankshaft end play as described previously.

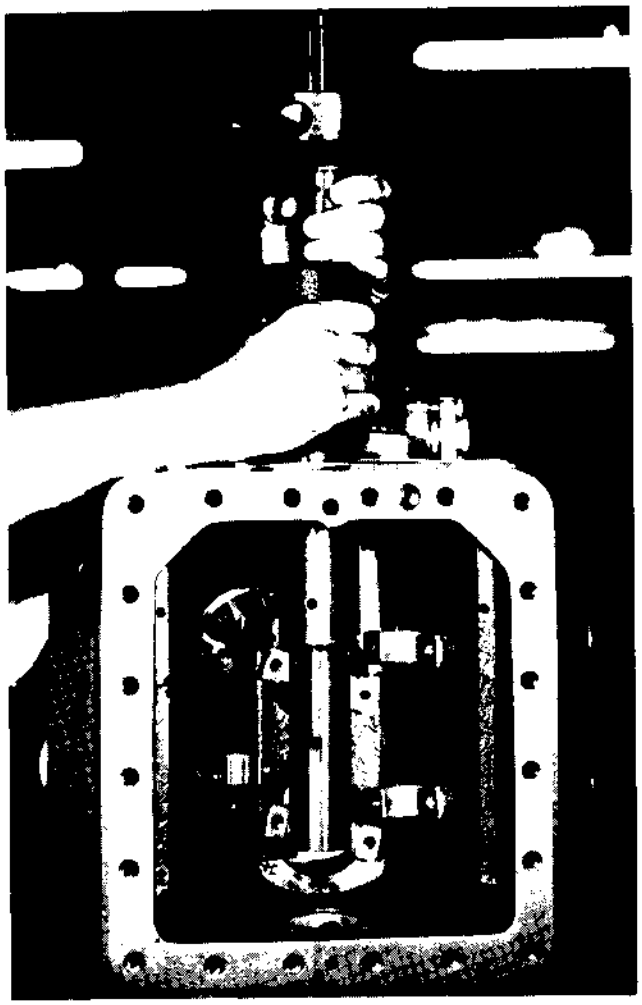

Figure 71

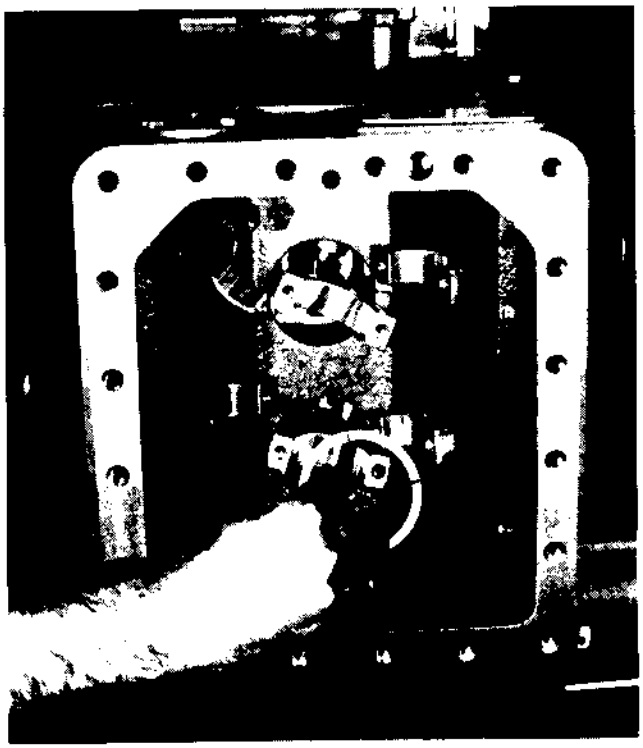

Figure 72

Connecting Rod and Piston Assemblies

To Remove:
1. With the piston as shown in Figure 67, work the piston rings off the pistons (Figure 73).

Figure 73

2. Pull the connecting rod and piston assemblies out of the cylinders through the crankcase opening (Figure 74).

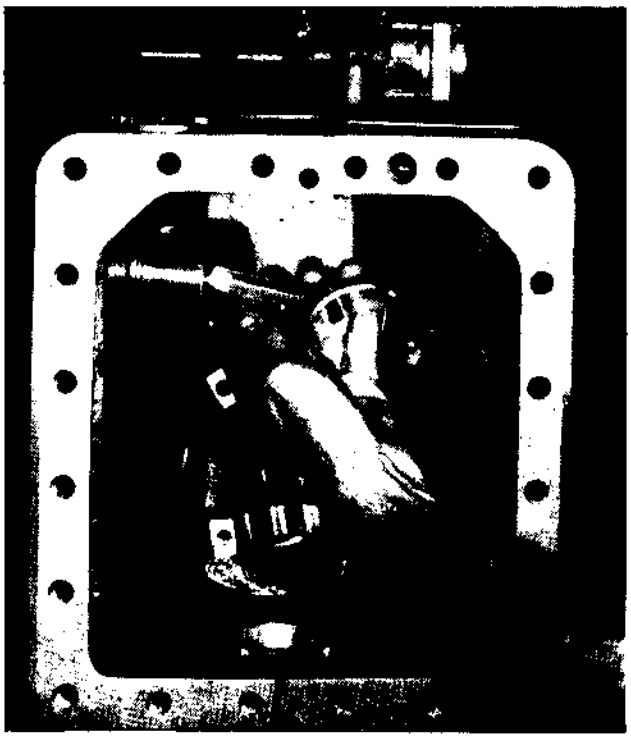

Figure 74

To Disassemble Piston and Connecting Rods

1. Remove the wrist pin Tru-Arc rings (Figure 75).

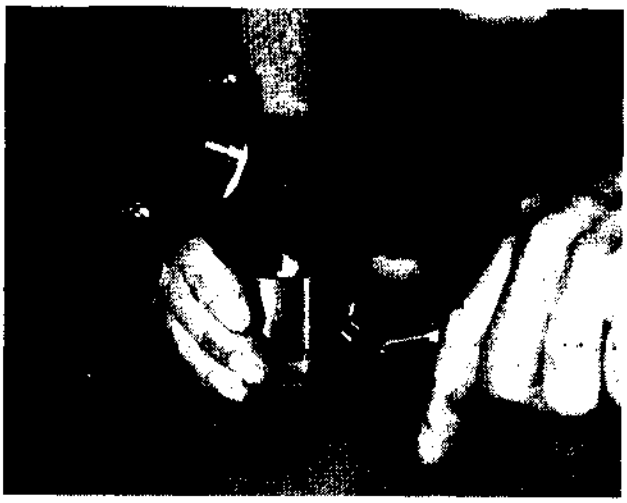

Figure 75

2. Push the wrist pin out of the piston and connecting rod (Figure 76). Lift the connecting rod out of the piston (Figure 77). Figure 78 illustrates the piston, connecting rod and rod cap assembly.

Inspection:

1. Check the piston wrist pin and pin bore tolerances as listed in Table 1. Replace the piston and pin as an assembly if necessary.

Figure 76

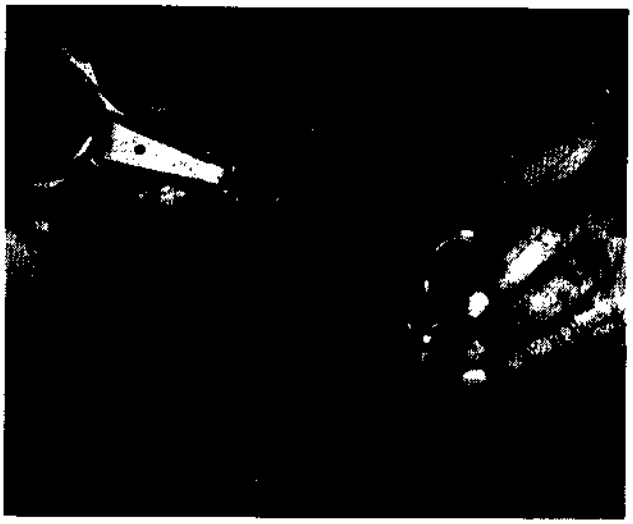

Figure 77

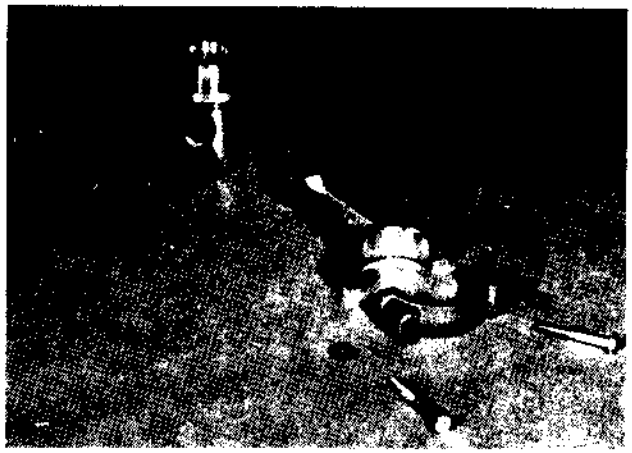

Figure 78

2. The ring grooves must be clean and free of nick or burns. Roll the back edge of the upper ring in both grooves to make sure the rings fit freely. Table 1 lists wear limits.

To Assemble Piston and Connecting Rods

1. Place the connecting rods in the piston (Figure 77).
2. Push the wrist pin into the piston and fasten in place with the two Tru-Arc rings (Figure 75).

To Install:

1. Reaching the handhole opening, place the piston and connecting rod assembly into the correct cylinder (Figure 74). Turn the rod so the match mark faces the pump end of the compressor.
2. With the pistons protruding out of the cylinder openings, install the piston rings (Figure 67). When replacing piston rings, replace them as a set. A set is for one piston and consists of two compression rings - an upper ring and a lower ring (Figure 79). Both the upper and lower rings are marked "top" for proper positioning on the piston.
3. Install the crankshaft as described previously.

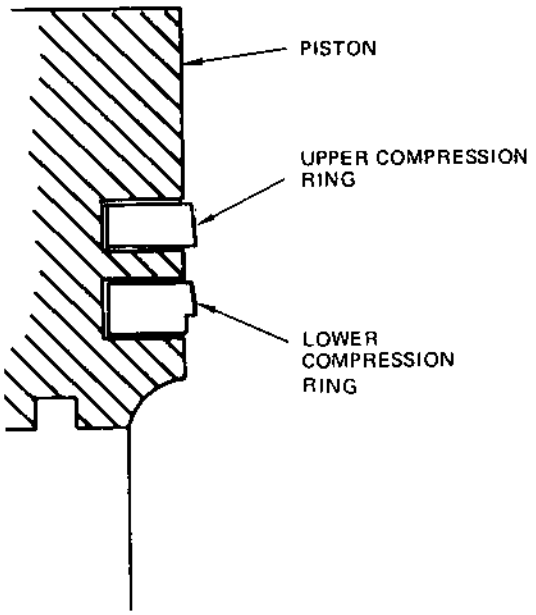

Figure 79

4. Using an automotive ring compressor to compress rings (Figure 80), work the piston and rings into the cylinder, guiding the connecting rod so it seats properly on the crankshaft.
5. Seat the connecting rod on the crankshaft journal and attach the connecting rod cap. Make sure the cap and rod match marks face the discharge end and the matching numbers are the same (Figure 68). Install the connecting rod bolts and washers and tighten to final torque. TORQUE - 12 FT. LBS.
6. Turn crankshaft to check connecting rod to journal fit.
7. Repeat above procedure on next lowest cylinder. Continue until all assemblies are complete.

Figure 80

Oil Level Sight Glass

To Remove:

1. Remove the three sight glass mounting bolts.
2. Lift the sight glass and "O" ring off the housing (Figure 81).

To Install:

1. Oil the "O" ring and place it in the sight glass "O" ring groove.
2. Place the sight glass against the housing, install and tighten the bolts to final torque. TORQUE - 6 FT. LBS.

Figure 81

Crankcase Heater

To Remove:

1. Remove the crankcase heater cover (Figure 82).
2. Remove the mounting bolt which holds the heater to the handhole cover. Pull the heater out of the cover.

To Install:

1. Insert the heater in the handhole cover. Install and tighten the mounting bolt to final torque. TORQUE - 6 FT. LBS.
2. Re-install the heater cover.

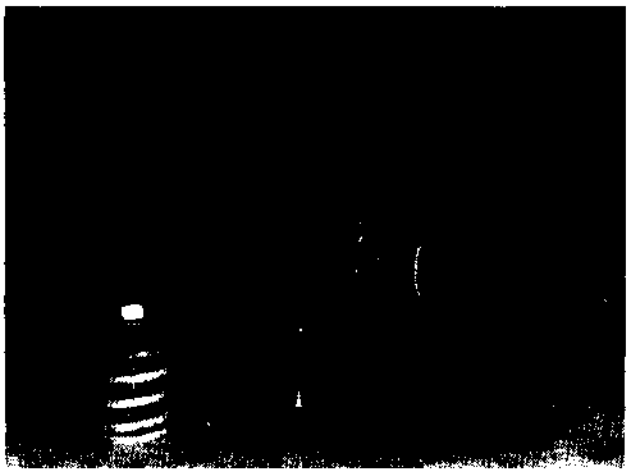

Figure 82