MYCOM

FM160 SERIES
SCREW COMPRESSOR
INSTRUCTION MANUAL

MAYEKAWA MFG. CO., LTD.

TOKYO, JAPAN

Safety Information

This manual has been prepared to assure safe and effective utilization of FM Series screw compressors.
Before commencingf disassembly and reassembly service work on the compressor, read carefully and understand the contents of this manual, which explains the structure of and work methods appropriate for FM Series screw compresors.
Any service work which disregards the instructions given in this manual may possibly result in a serious accident.
Most accidents and problems encountered during operation are the result of negligence in observing basic safety precautions or insufficient inspection or maintenance.
Read this manual carefully and have a thorough understanding of all the safety precautions and instructions provided before carrying out operation, inspection or maintenance of an FM series screw compressor

Safety and precautionary warnings provided in this instruction manual are classified into the following catagories:

„DANGER“ indicates a hazardous situation in which failure to observe all safety precautions will lead to death or serious injury and major damage to the compressor system.

„WARNING“ indicates a hazardous situation in which failure to observe all safety precautions may lead to death or injury and major damage to the compressor system.

„CAUTION“ indicates a hazardous situation in which failure to observe all safety precautions could lead to injury or damage to the compressor.

„IMPORTANT“ indicates that the compressor may be damaged or the life of the system shortened if the instructions given are not followed precisely.

The safety and precautionary warnings contained in this instruction manual establish the minimum level of safety required to perform maintenance work on the compressor. System operators and maintenance personnel are advised to implement at their own responsibility any further safety activities in line with the particular environment or location of the compressor system.

Table of Contents

1. Safety

1.1 Basic Safety Warnings

The FM160 Series Screw Compressor Instruction Manual has been prepared in order to assure maximum effective operation of the equipment as well as to ensure the safety of those involved in operating, maintaining and overhauling the equipment.

Read this manual carefully in order to familiarize yourself with the structure and operating principles and procedures undertaking disassembly and reassembly of this compressor. Failure to follow the instruction given in this manual may result in possble personal injury and/or serious compressor damage.

! WARNING

Should this machine be operated carelessly and in disregard to the instructions given in this manual, death or serious injury may result. This manual must therefore be kept in a convenient, easily-accesseible location near the system and should be studied periodically by those working with the system.

- Maintenance work on this compressor should not be undertaken without a thorough understanding of the instruction given in this manual.
- Prior to commencing any inspection or maintenance work on the compressor, read the safety warnings provided at the beginning of this manual.
- Keep this manual in a convenient, easily-accessible location near the system and study frequently.
- If this manual is lost or damaged, a replacement should be obtained immediately from Mayekawa Mfg. Co., Ltd. Or the nearest representative in your area.
- If ownership of the compressor passes to another party, this instruction manual should always accompany the compressor.
- Mayekawa Mfg. Co. Ltd Reserves the right to make changes or improvements to its products without notice. It is possible, therefore, that some explanations given in this manual may not apply a particular machine. If any uncertainty exists on the part of the compressor operator, contact Mayekawa Mfg .Co., Ltd. Or the nearest representative in your area.
- Any questions regarding this manual or the compressor should be addressed to Mayekawa Mfg.Co., Ltd. or the nearest representative in your area.

1.2 Safety warnings in this manual

The following safety warnings are used in this manual.
All safety warnings are to be strictly followed. Failure to heed any safety warning may result in serious injury or death.

4. Disassembly

! WARNING

Disassembly work must be carried out based on a full understanding of the compressor and details of the disassembly work procedures.

This instruction manual introduces disassembly procedures for compressor maintenance work only, not for complete disassembly of the entire compressor.

If complete disassembly and reassembly work on the entire compressor is required, contact your nearest MYCOM office or dealer for details.

If non-genuine or modified parts are installed in the compressor, the performance may be degraded and unexpected problems result. Never attempt to modify the compressor.

4.1 Preparations for Disassembly

! WARNING

The safety apparel noted here is the minimum required to perform the work.

Disassembly work begins with the removal of the compressor from the unit.

An appropriate location should be chosen in which to work on the compressor after removal from the unit. A sturdy elevated platform such as a surface plate is ideal.

Disassembly work should only be commenced after all safety precautions have been confirmed and the workers are wearing all necessary safety apparel suited to the environment.

4.2 Hand Tool Kit

! WARNING

Hand tools should not be modified. Unreasonable modification of a tool may result in damage to the compressor or parts when the tool is used.

4.3 Removing the Compressor from the Unit

! WARNING

Confirm that the compressor internal pressure is the same as ambient air pressure before disconnecting.

The compressor is mounted together with the motor spacer and motor as a set. If only the compressor is removed, the motor and motor spacer left in the unit will become unstable, representing a serious hazard.

4.3.2 Disconnecting Auxiliary Equipment

! DANGER

Be sure to disconnect the power to the motor and control system before disconnecting the drive connection and control connection.

If the motor connection and control connection are disconnected before cutting the power supply, electric shock or compressor rotation may occur, endangering life.

! CAUTION

Residual oil on the compressor will drain out when the oil and refrigerant piping is detached. Have a pan ready to catch this oil when disconnecting the piping.

4.3.3 Lifting and Moving the Compressor

! WARNING

Compressor lifting and moving work should be carried out only by qualified personnel.

If the compressor is fitted by means other than the above, it may be damaged. Always use the method instructed.

If the compressor is not stabilized horizontally on the work bench, it may fall when being worked on.

If not properly supported, parts such as the coupling and shaft may be deformed by stress.

4.4.1 Motor and Motor Spacer

! CAUTION

This work should be carried out with the compressor firmly stabilized in a horizontal position.

4.4.12 Rotors

! CAUTION

When drawing out the rotors from the rotor casing, support with a sling to maintain balance.

The bearing head connected with the rotors should be positioned horizontally on square timbers to prevent it falling over.

The lobes of the M and F rotors are finaly machined and the lobe edges are extrremely sharp. When manipulating a rotor, always hold onto the shaft portion only.

4.5 Parts Inspection

! CAUTION

If the compressor and/or any parts are modified without the consent of MYCOM or non-genuine parts are used, the performance of the compressor will be seriously degraded.

1.3 Units

SI and conventional units of measurements are used in this manual. Unless otherwise indicated, all pressure values given are gauge pressure.

2. Otline of Compressor.

The FM160 Series screw compressor is incorporated a flange face for mounting a NEMA or IEC standard flange type motor. This feature eliminates the necessity of compressor/motor alignment work. A suction check valve, suction gas strainer and capacity control solenoid valve are incorporated into the bare compressor.

An important feature of FM160 Series compressor is use of a new O-rotor profile and roller type bearings. These improvements enhance the performance and durability of the compressor. In particular, use of roller type bearings in most cases eliminates the necessity of installing an oil pump.

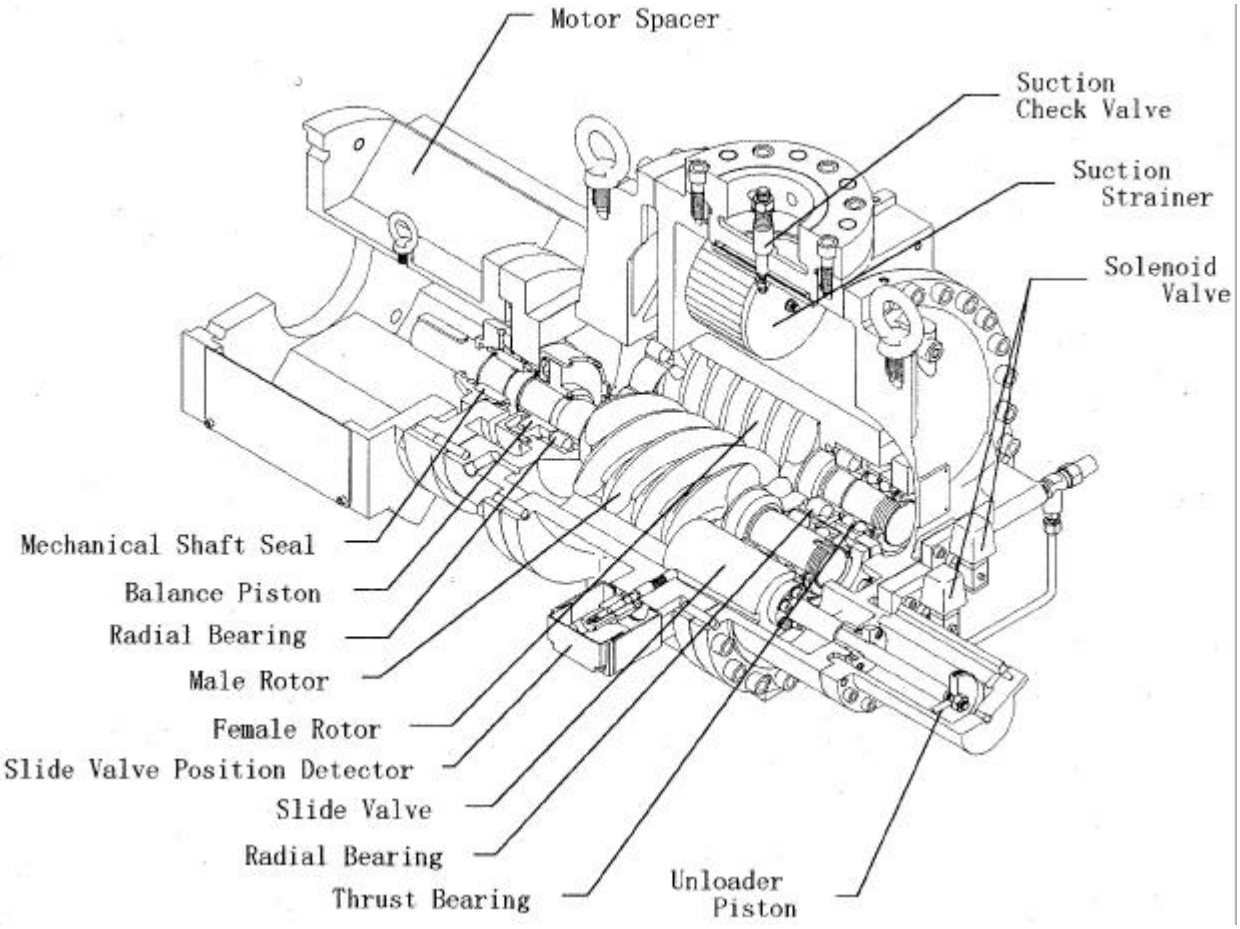


Fig. 2-1 General Structure of FM160

2.1 General Introduction of the FM160 Series Compressor.

This screw compressor is classified as a positive displacement rotary type compressor.

The pressure refrigerant gas trapped in the closed space between the rotors increases as the volume decreases and the refrigerant is discharged as high pressure gas. Refrigerant is compressed continuously be the changing volume of the space between the lobes of the two meshing screw rotors.

As shown in Fig. 2-1, male and female screw rotors having different lobe profiles are mounted in a casing. This is the main portion of the compressor which compresses the refrigerant. The rotor having four (4) convex lobes is termed the „male“ or „M“ rotor while the rotor with six (6) concave lobes is termed the „female“ or „F“ rotor.

The M rotor is turned by a motor connected to the M rotor shaft. The motor is generally a 2-pole type connected directly the rotor to drive the compressor at a speed of 2,950 (50 Hz) or 3,550 rpm (60 Hz).

Compressor efficiency is related directly to the profile of the rotor lobes. In the case of FM160 Series units, the usual unsymmetric rotor profile has been improved to give greater efficiency. The new lobe profile successfully reduces the size of the trangular blow-hole located between the compressor side casing and the two rotors by 60%, thus decreasing the amount of leakage due to pressure differential between the lobes.
The clearance between the lobes and the casing is determined by the shape of the rotor lobe edges. It is here that sealing is accomplished by a pressurized oil film during rotation.

2.1.1 Suction Stage

As shown in Figs. 2-3 and 2-4, rotors of different lobe shape mesh and the volume between the M rotor lobe, female rotor groove and compressor casing increases gradually from the suction side as the rotors turn. At a certain point the volume reaches the maximum. The rotors continue to turn, isolating the volume trapped between the compressor casing and rotors from the suction port.

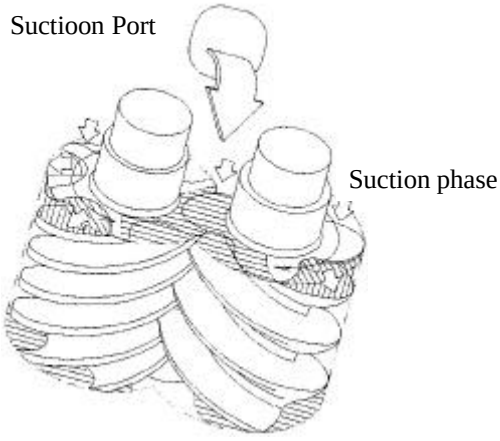


Fig. 2-3 Suction stage

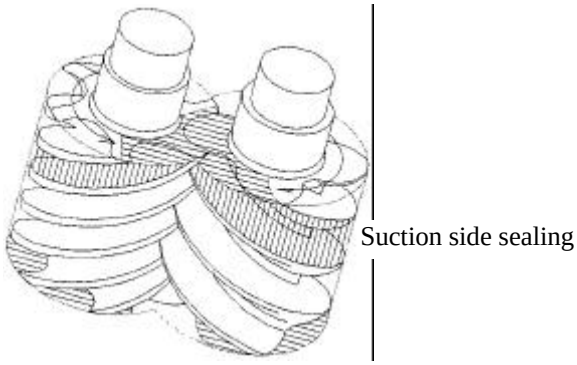


Fig. 2-4 Suction side sealing

2.1.2 Compression Stage

As the rotors turn further, the volume between the lobes is decreased, compressing the trapped gas, while the sealing line moves toward the discharge side.

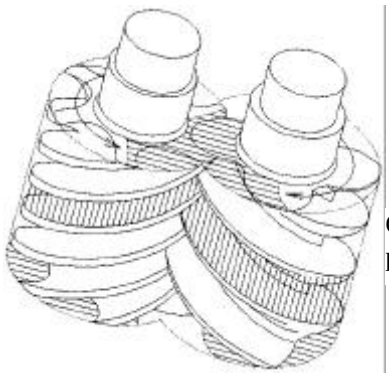


Fig. 2-5 Compression stage

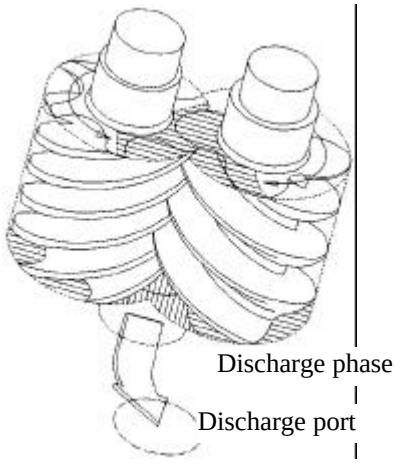


Fig. 2-6 Discharge stage

2.1.3 Discharge Stage

The volume between the lobes arez decreased to a value determined by the built-in ratio corresponding to the suction and discharge pressure conditions during the compression cycle. As the rotors turn, the compressed gas is forced from the discharge port to the discharge side of the system.

2.2 Outline of Compressor Structure

2.2.1 Compressor Gas Flow

Before entering the compressor via the suction port, the refrigerant gas is filtered through a suction gas strainer and then passes through a suction check valve to the compressor where it is compressed by the rotors and then discharged through the suction port.

Suction temperature and pressure measuring instrument connections are provided in the compressor casing just after the suction port, while discharge temperature and pressure measuring instrument connections are located just before the discharge port.

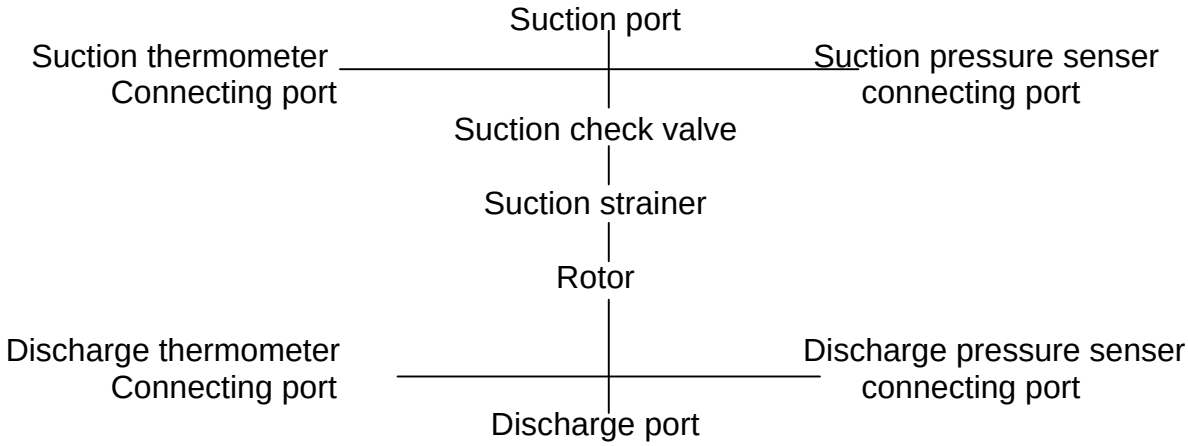


Fig. 2-7 Gas Flow Diagram

2.2.2 Suction Check Valve

A large diameter suction check valve with low pressure loss is provided.

2.2.3 Suction Strainer

A large strainer having a velocity of 10 m/s is provided

2.2.4 Bearings

In the radial bearings, high load capacity cylindrical roller bearings are used on the discharge and the suction side of the rotor.
In the thrust bearings, angular contact ball bearings are used on the male and the female rotor. For getting the long bearing life still unused oil pump, balance piston is used on the male rotor.
Bei den radialen Lagern benutzt man Zylinderwalzlager an den Verdichtungs-und Saugseiten des Rotors.

2.2.5 Capacity Control Mechanism

The capacity control mechanism of 160S, M qnd L compressors is a continuous control type making use of a slide valve mounted beside the M rotor to give continuous control from 25% to 100% of capacity.

2.2.6 Capacity Control Solenoid Valve

Two three-way solenoid valves made of material compatible with both ammonia and Freon are incorporated.
As the oil pressure lines to and from these solenoid valves are incorporated in the compressor casing, no additional external piping is required.
When the compressor is stopped, the slide valve is always in the unloaded position because oil from the unloader cylinder returns to the low pressure chamber just before the suction check valve.

2.2.7 Slide Valve Position Detecting Mechanism

Slide valve position feedback is achieved by means of an inductive proximity sensor. This system contains no moving or mechanical parts such as potentiometer or limit switch.
The unloader pushrod moves within a circular transformer and, depending on its position, linear inductive coupling is achieved.
The system requires a dedicated electronic amplifier circuit board. Several means of execution are available depending on the chosen concept.

2.2.8 Shaft Seal

A new balance type mechanical seal is used on the shaft to prevent refrigerant leakage. An O-ring with high air tightness performance is fitted in the packing and the combination of friction proof material developed by MYCOM and the friction surface of the seal provide strong resistance to wear and abrasion while assuring maximum sealing.

2.2.9 Compressor Oil Flow

In most cases the lubricating and injection oil is supplied from a high pressure oil tank by pressure differential, however, an oil pump may sometimes be required by some system configurations.
Oil is injected into the compressor from a fixed point on the rotor casing.
Lubricating oil is supplied to the compressor from a 20A flange and connection provided on the side of the compressor.
FM160 series units have one connection point and lubricating oil supply for injection, bearing lubrication and capacity control branches off of this.

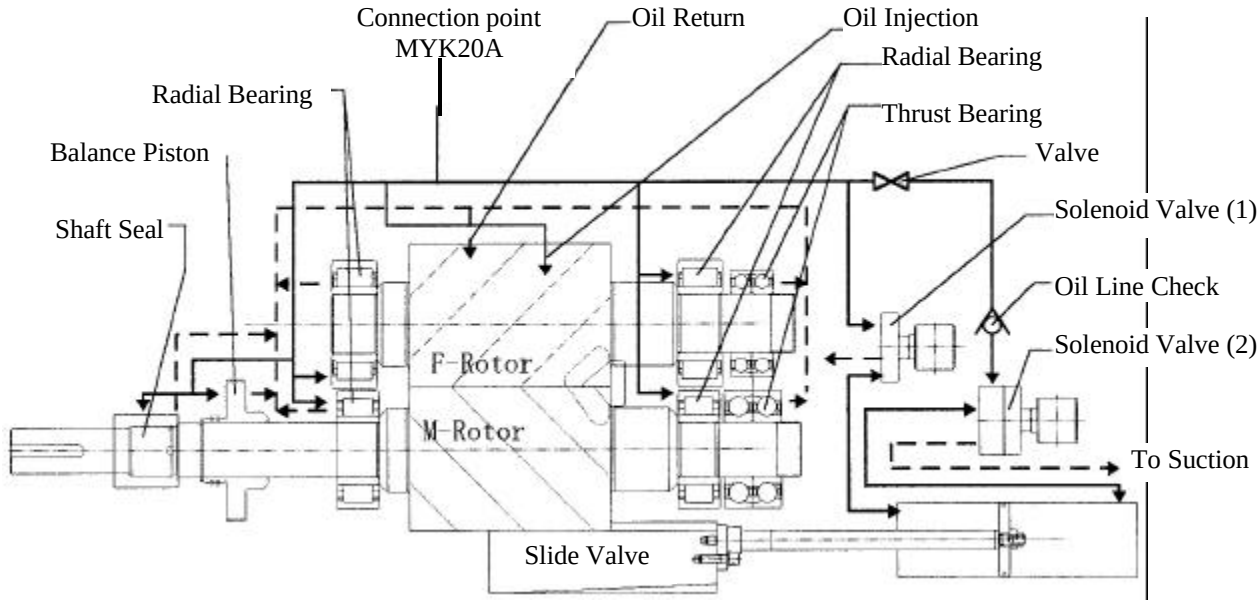


Fig. 2.8 Lubricating Oil Flow, Inside of Compressor.

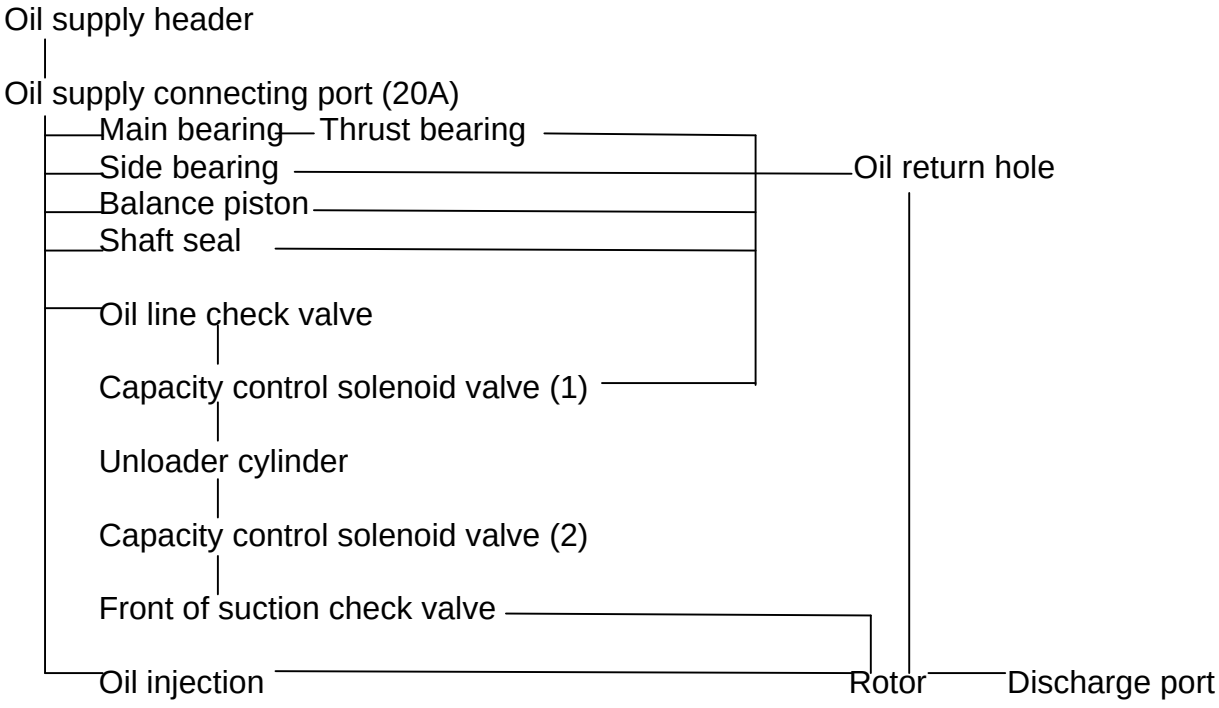


Fig. 2.9 Lubricating Oil Flow Diagram, Model FM160

3. Component Parts

3.1 Exploded View of Part

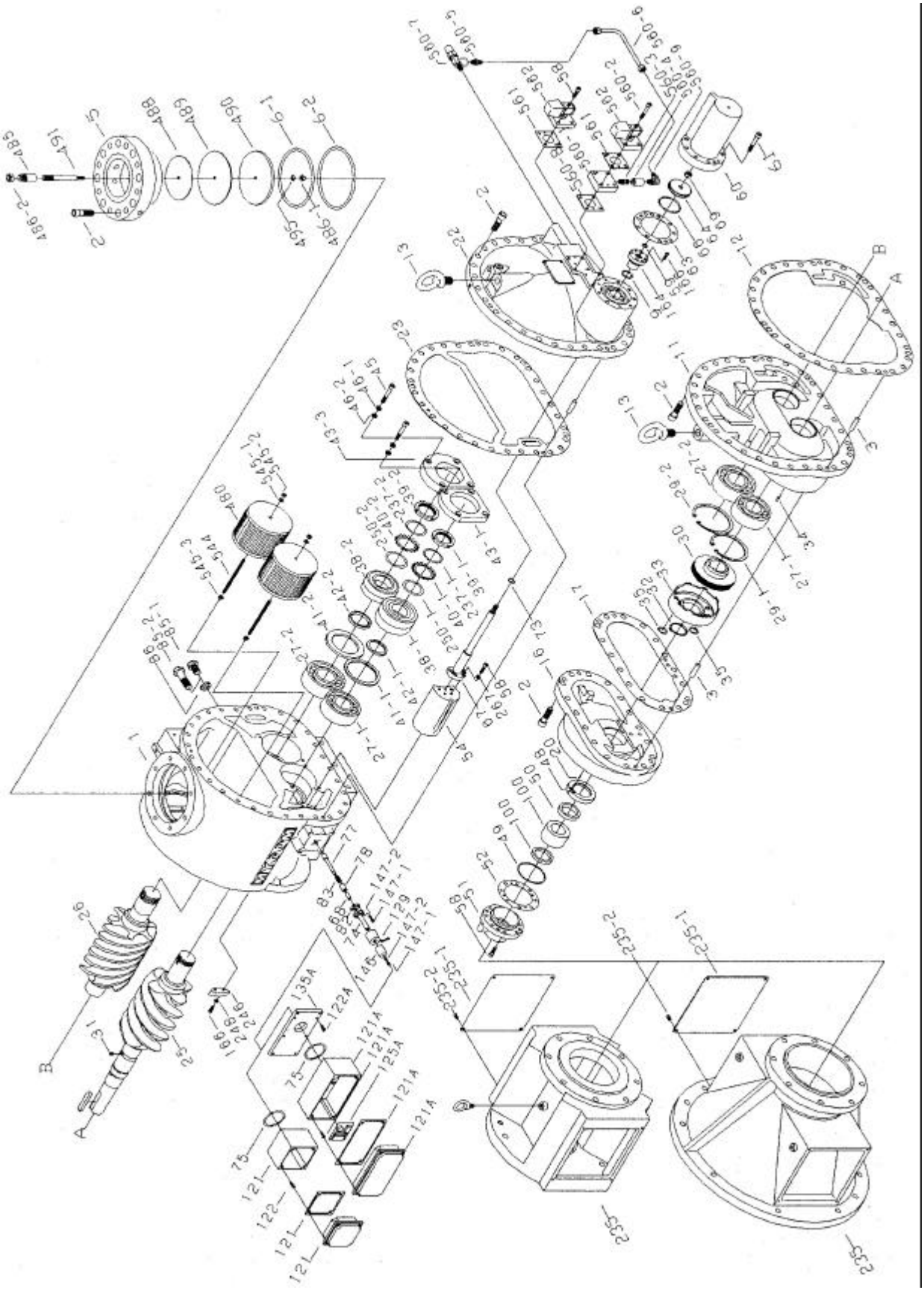


Fig. 3.1 Exploded View of Compressor, Modell FM 160

3.2 Parts List

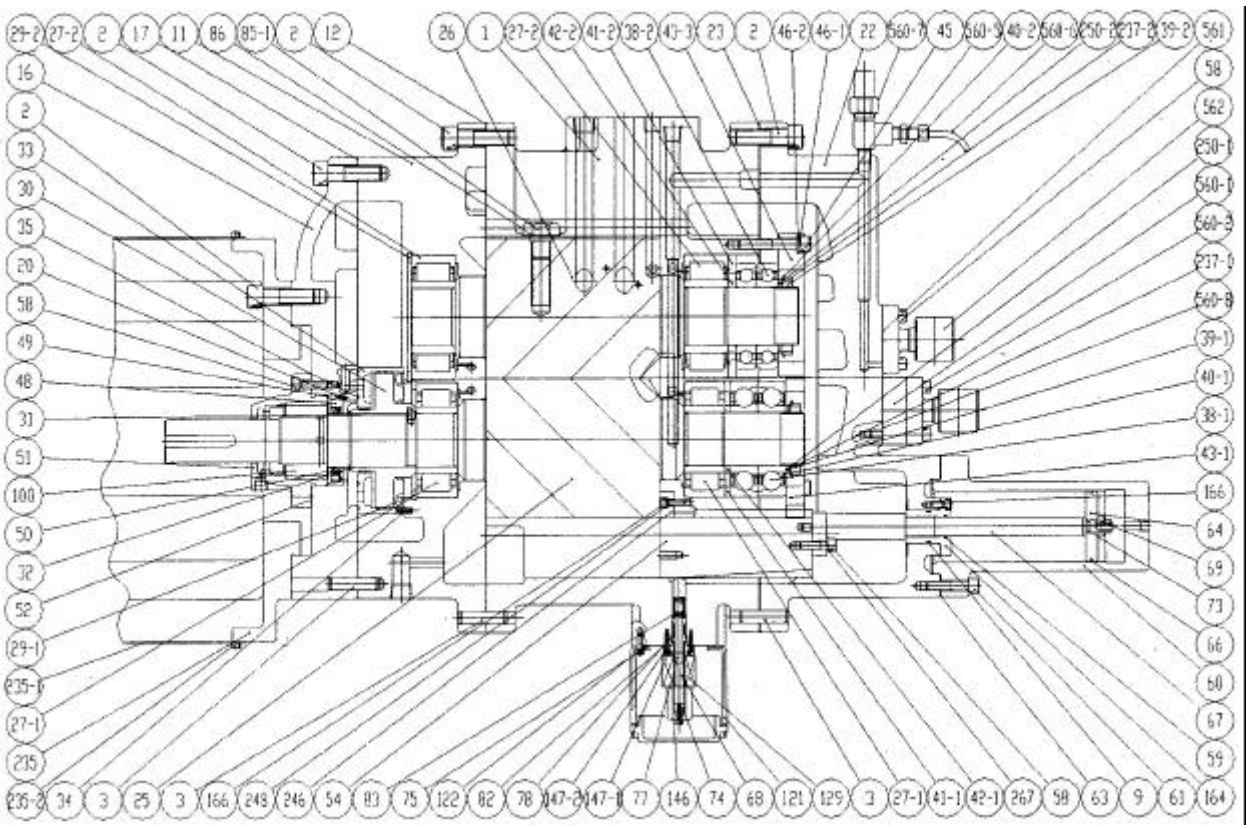
Nr.	Name
1	Rotor Casing
2	Allen Bolts
3	Positioning Pin
5	Suction Adapter
6-1	O Ring
6-2	O Ring
9	O Ring
11	Bearing Head
12	Gasket, Bearing Head
13	Eye Bolt
16	Bearing Cover
17	Gasket, Bearing Cover
20	Spring Pin
22	End Cover
23	Gasket, End Cover
25	M Rotor
26	F Rotor
27-1	Radial Bearing M
27-2	Radial Bearing F
29-1	Stop Ring
29-2	Stop Ring
30	Balance Piston
31	Set Screw
32	Stop Ring
33	Sleeve, Balance Piston
34	Spring Pin
35	O Ring
38-1	Thrust Bearing M
38-2	Thrust Bearing F
39-1	Lock Nutr
39-2	Lock Nut
q	Lock Washer
40-2	Lock Washer
41-1	Bearing Spacer M
41-2	Bearing Spacer F
42-1	Adjusting Washer, Thrust bearing M
42-2	Adjusting Washer, Thrust bearing F
43-1	Bearing Gland M
43-3	Bearing Gland F
45	Allen Bolt
46-1	Spring Washer
46-2	Flat Washer
48	Seal Retainer
49	O Ring
50	Oil Seal
51	Seal Cover
52	Gasket, Seal Cover
54	Unloader Slide Valve
58	Allen Bolt
59	O Ring
60	Unloader Cylinder
61	Allen Bolt
63	Gasket, Unloader Cylinder
64	Unloader Piston
66	Slipper Seal
67	Unloader Push Rod
68	Differential Transmitter Iron Core
69	Lock Nut

Nr.	Name
73	O Ring
74	Position Detector
75	Packing, Transmitter Box
77	Unloader Sensor Rod
78	Linear Bushing
82	Gasket, Detecting Element
83	Spring, Unloader sensor
85-1	Hex Head Bolt
85-2	Hex Head Bolt (Op 2 oil connection)
100	Mechanical Seal Assy.
121	Differential Transmitter Box
121-A	Differential Transmitter Boxd (Op /A)
122	Allen Bolt
122-A	Allen Bolt (Op /A)
125	Amp Board
125-A	Amp Board (Op /A)
129	Differential Transmitter
135-A	Box Plate (Op /A)
146	Differential Transmitter Gland
147-1	Allen Bolt
147-2	Spring Washer
164	Unloader Stopper
166	Allen Bolt
235	Motor Spacer (U.S. Spec.) Motor Spacer (U.S. 200HP Spec.) Motor Spacer (Europa Spec.)
235-1	Motor Spacer Plate
235-2	Allen Bolt
237	Spacer Plate
246	Unloader Slide Valve Guide
248	Spring Washer
250-1	Thrust Bearing Washer M
250-2	Thrust Bearing Washer F
267	Spring Washer
480	Strainer Element
485	Spring, Check Valve
486-1	Hex Nut
486-2	Hex Nut
488	Seat Stopper
489	Seat (1)
490	Seat (2)
491	Check Valve Stem
495	O Ring
544	Tie Rod
545-1	Flat Washer
545-2	Hex Nut
545-3	Hex Nut
560-1	Solenoid Valve Plate
560-2	Allen Bolt
560-3	Oil Line Check Valve
560-4	Socket
560-5	„I“ Half Union
560-6	Piping
560-7	Angle Valve
560-8	Gasket, Solenoid Valve Plate
560-9	„L“ Half Union
561	Gasket, Solenoid Valve
562	Solenoid Valve

*Op : Option

No.	Name	Qty.
562	Solenoid valve	2
	* Select one type of solenoid valve from the following four (4) types according to the voltage used. 100 V 120 V 200 V 280~240 V	

3.3 Cross-sectional Views



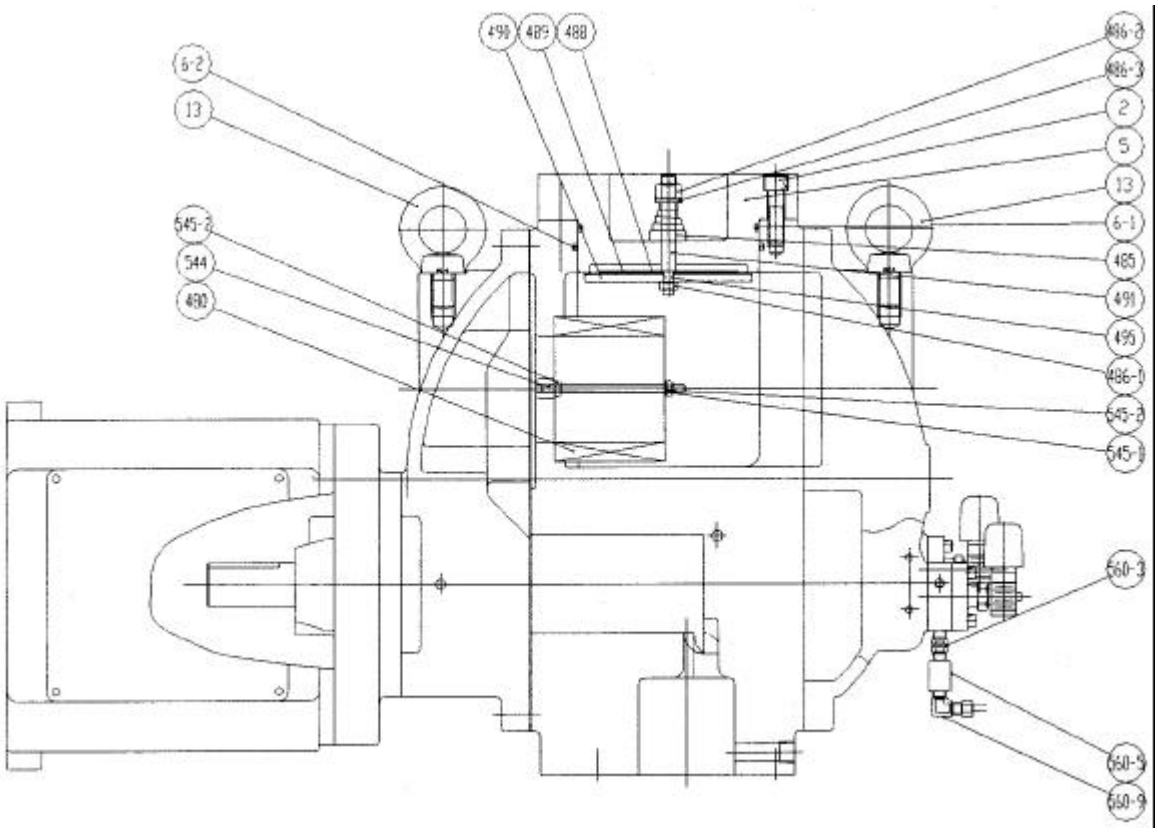


Fig. 3-2 Cross-sectional vuew of FM 160

3.4 External Dimensions

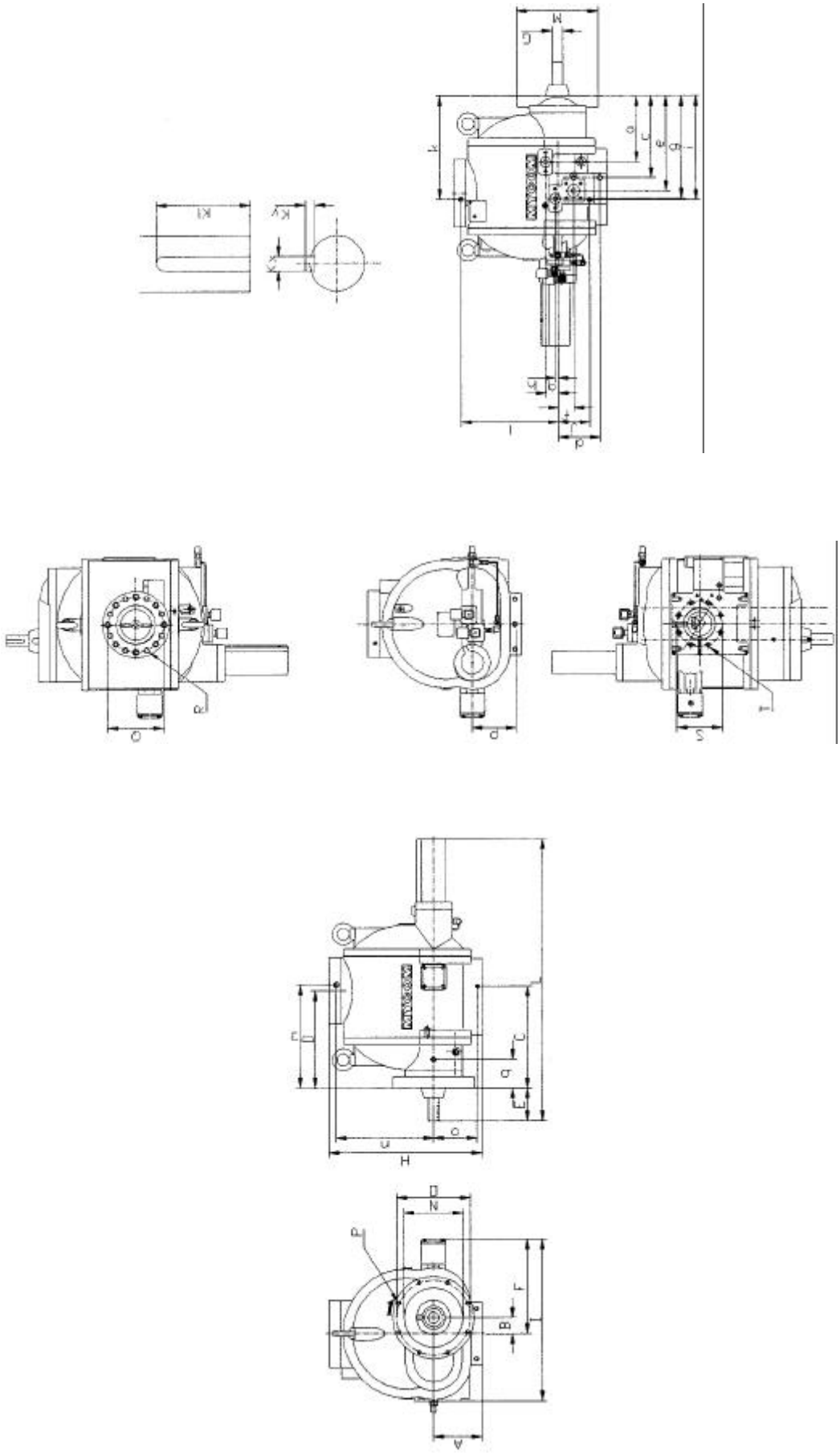


Fig. 3.3 External Dimensions of Compressor FM160

Table 3.1 External Dimensions and Net Weight

	Model			Remark
	S	M	L	
A	197			
B	64			
C	366	411	456	
D	348	393	438	
E	133			
F	380			
G	Ø 45 -0.005~+0.011			
H	623			
I	651			
Kl	75			
Kx	12 +0.018~+0.036			
Ky	8 -0.036~0			
L	1028	1143	1188	
M	Ø 332			
N	Ø 240 00.072			
O	PCD300			
P	8-M16			
Q	PCD225			JIS16K125A Suction Port
R	8-M22			
S	PCD185			JIS16K100A Discharge Port
T	8-M20			
Weight	540	567	593	Kg

Table 3.2 Connecting Port Dimensions

	Model			Connection
	S	M	L	
A	268			MYK20A Lubrication
B	50			
C	306	331	357	Rc1/2 Oil Injection
D	171			
E	348	384	420	MYK25A Elektromizer
F	64			
G	373	415	457	MYK20A Aquamizer (I1)
H	11			
I	377	420	463	Rc3/8 Aquamizer (I2)
J	130			
K	373	418	463	Rc1/2 Suction Temperature
L	396			
M	373	418	463	Rc1/2 Suction Pressure
N	396			
O	177			Rc1/4 Discharge Pressure
P	174			Rc1/2 Discharge Temperature
Q	114.5			Rc1/2 Pressure Drop

4. Disassembly

Disassembly work at the installation site is limited to the shaft seal, unloader cylinder, suction adapter and check valve. Disassembly work on other components should only be carried out after the compressor has been removed from the unit and can be worked on in a clean, safe environment.
Disassembly, inspection and handling of the parts should be done only with a full understanding of the construction of the compressor and the instruction manual should be referred to frequently as the work proceeds.

! WARNING

Disassembly work must be carried out based on a full understanding of the compressor and details of the disassembly work procedures.

This instruction manual introduces disassembly procedures for compressor maintenance work only, not for complete disassembly of the entire compressor.

If complete disassembly and reassembly work on the entire compressor is required, contact your nearest MYCOM office or dealer for details.

If disassembly work is carried out carelessly, human life may be endangered and the performance of the compressor may be degraded.

If non-genuine or modified parts are installed in the compressor, the performance may be degraded and unexpected problems result. Never attempt to modify the compressor.

4.1 Preparations for Disassembly

All workers engaged in disassembly work should be trained in advance and shoud be provided with appropriate safety apparel such as safety goggles, helmet, steel-toed shoes and coveralls.

Fig. 4-1 Personal safety apparel

! WARNING

The safety apparel noted here is the minimum required to perform the work.

Disassembly work begins with the removal of the compressor from the unit.

An appropriate location should be chosen in which to work on the compressor after removal from the unit. A sturdy elevated platform such as a surface plate is ideal.

Disassembly work should only be commenced after all safety precautions have been confirmed and the workers are wearing all necessary safety apparel suited to the environment.

4.2 Hand Tool Kit

Disassembly work must be carried out using the recommended tools. Modification of the compressor or any of its component parts should be strictly avoided, as should the use of non-genuine parts.

The tools listed in Section 6, „Reference: 6-10 Hand Tool Kit“ are required for disassembly work. These tools may be ordered from your nearest MYCOM office or dealer. Standard tools such as hammers, files, scrapers, emery and sandpaper should also be made available. Cleaning fluid, fresh new lubricating oil, cans, waste and a crane or alternate lifting device and sling should also be prepared.

If a surface plate is not available, any steel sheet of 800 x 1,000mm may be used. The plate should be raised off the floor to a comfortable height for the workers.
The work area should be brightly lit, dry and free of airborne dust, sand or other contaminants.

! WARNING

Hand tools should not be modified. Unreasonable modification of a tool may result in damage to the compressor or parts when the tool is used

4.3 Removing the Compressor from the Unit.

The pressure in the compressor is higher than the ambient air pressure. Be sure to recover all refrigerant from the compressor before commencing work.

The FM Series screw compressor is a flange motor type. Consequently, the compressor, motor spacer and motor should be removed from the unit together.

! WARNING

Confirm that the compressor internal pressure is the same as ambient air pressure before disconnecting.

The compressor is mounted together with the motor spacer and motor as a set. If only the compressor is removed, the motor and motor spacer left in the unit will become unstable, representing a serious hazard.

4.3.1 Refrigerant Recovery

The compressor unit is charged with refrigerant up to the check valve. Compressor internal pressure should be reduced to the ambient air pressure level or lower.
The compressor internal pressure should not be a vacuum when being removed. Also, the temperature should be the same or slightly lower than the ambient air temperature.
If the compressor is removed when internal pressure is in a vacuum condition or the air temperature is higher than the ambient temperature, dew may form on the internal surface of the compressor, promoting rust.
There are several different ways of reducing the pressure in the compressor, depending on the type of refrigeration unit.
If the system uses Freon refrigerant, the following methods should be used to ensure that no gas is released into the atmosphere.

a. Transfer all refrigerant in the unit to the low pressure side through the bypass valve.

b. If two refrigeration sets are installed, extract the refrigerant from one unit by operating the other compressor.

c. Recover the refrigerant using a small portable compressor.

4.3.2 Disconnecting Auxiliary Equipment

Detach the suction pipe and oil supply pie connected to the compressor qnd any other piping such as that for liquid injection or an economizer. Next detach the motor and the control connections.

! DANGER

Be sure to disconnect the power to the motor and control system before disconnecting the drive connection and control connection.

If the motor connection and control connection are disconnected before cutting the power supply, electric shock or compressor rotation may occur, endangering life.

Remove the bolts on the discharge piping flange and the motor fixing bolts after attaching the necessary lifting equipment to the motor.

! CAUTION

Residual oil in the compressor will drain out when the oil and refrigerant piping is detached. Have a pan ready to catch this oil when disconnecting the piping.

☆ IMPORTANT

The compressor is connect to the motor qnd supported by the discharge piping and the legs of the motor.
When the flange connection bolts are removed, the compressor will become unstable. The bolts should be removed only after supporting the compressor with an appropriate lifting device.

Loosen the bolts only slightly before attaching the lifting device.

4.3.3 Lifting and Moving the Compressor

Lifting and removing the compressor from the unit should be carried out with reference to the photos below.
Use a chain block to lift the compressor, adjusting the length of the sling to ensure that the compressor remains horizontal.

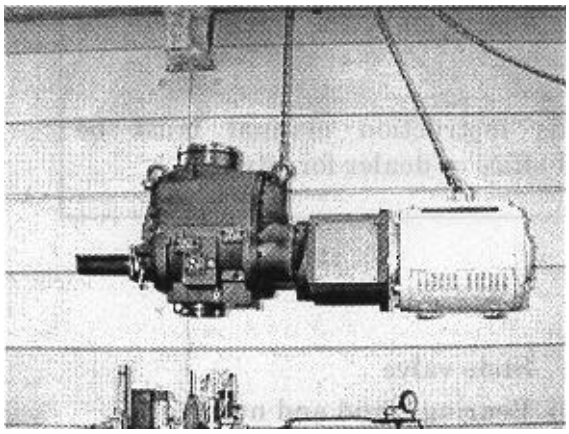


Fig 4-2 Lifting the Compressor, Motor Spacer and Motor

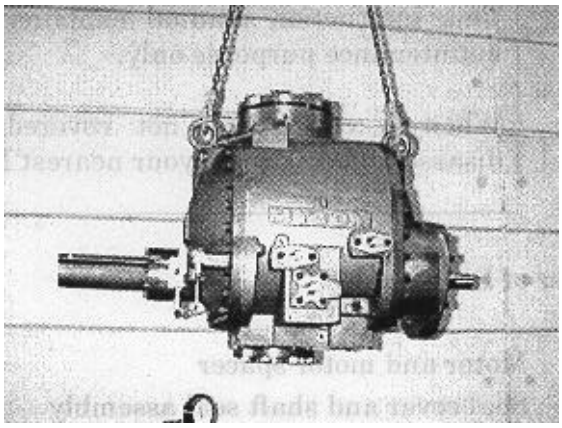


Fig 4-4 Lifting the Compressor

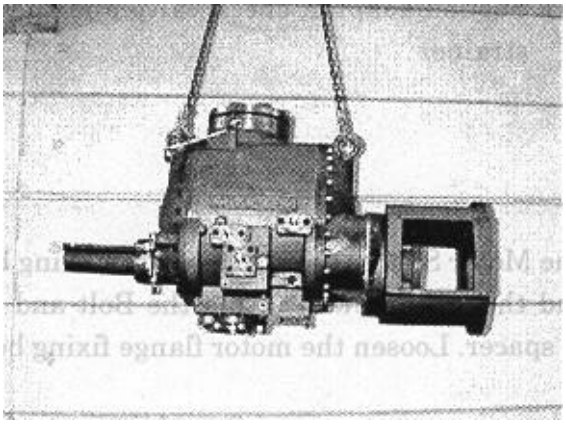


Fig 4-3 Lifting the Compressor and Motor Spacer

Wooden blocks should be placed on the work bench underneath the compressor or compressor and motor to cushion and stabilize them.

⚠ WARNING

Compressor lifting and moving work should be carried out only by qualified personnel.

If the compressor is lifted by means other than the above, it may be damaged. Always use the method instructed.

If the compressor is not stabilized horizontally on the work bench, it may fall when being worked on.

If not properly supported, parts such as the coupling and shaft may be deformed by stress.

4.4 Disassembly Procedures

Nevertheless, all FM160 Series Compressors are to be disassembled based on the following procedures.

☆ IMPORTANT

This instruction manual explains how to disassemble the compressor for maintenance purposes only.

When a component not covered by this instruction manual must be disassembled, contact your nearest MYCOM office or dealer for advice.

Order of Disassembly

1. Motor and motor spacer
2. Seal cover and shaft seal assembly
3. Bearing cover
4. Balance piston
5. Unloader sensor
6. Unloader
7. Solenoid valve Unloader
8. End cover
9. Slide valve
10. Bearing gland and nut
11. Bearing head
12. Rotors
13. Radial Bearing
14. Suctioin adapter, check valve and suction strainer

4.4.1 Motor and Motor Spacer

Remove the cover Plate (235-1) enclosing the Motor Spacer (235). Loosen the fixing bolt on the Compressor side of the Coupling qnd the Set Screw securing the Bolt qnd the Key. Shift the ring and remove the coupling spacer. Loosen the motor flange fixing bolts and remove the motor

! CAUTION

This work should be carried out with the compressor firmly stabilized in a horizontal position.

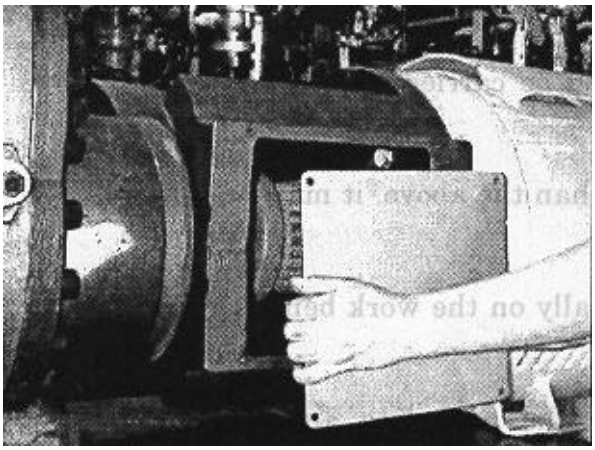


Fig 4-5 Remove the Spacer Plate

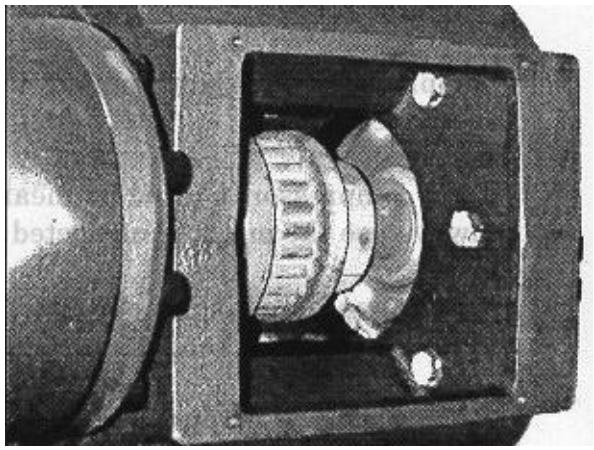


Fig 4-6 Motor Spacer and coupling

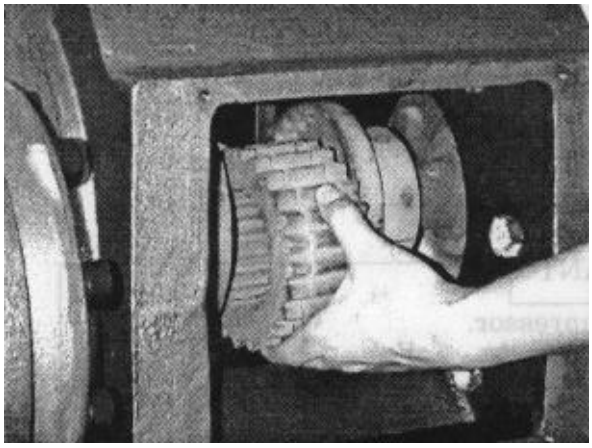


Fig. 4-7 Removing the Coupling spacer

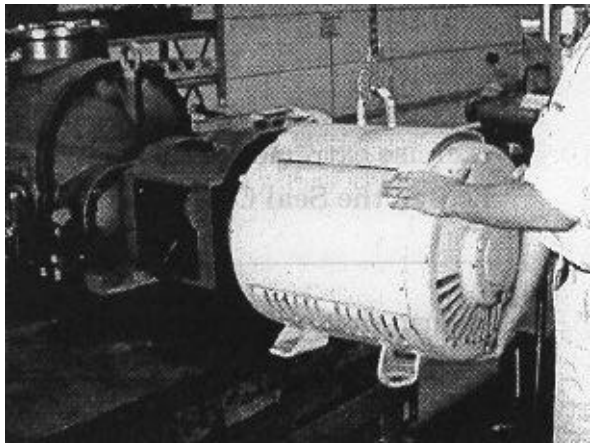


Fig. 4-8 Removing the Motor

Support the weight of the Motor Spacer (235) on the stud bolts. Loosen the bolts, then draw out the Spacer using the jack bolt while maintaining balance using the lifting accessory.

Loosen the fixing bolt and draw it out, then remove the Coupling Key (32).

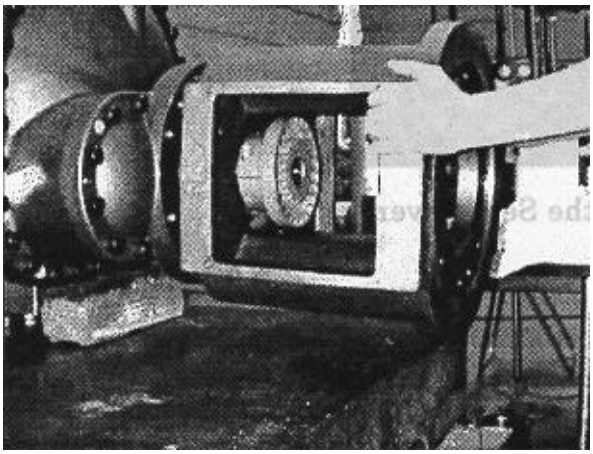


Fig. 4-9 Removing the Motor Spacer

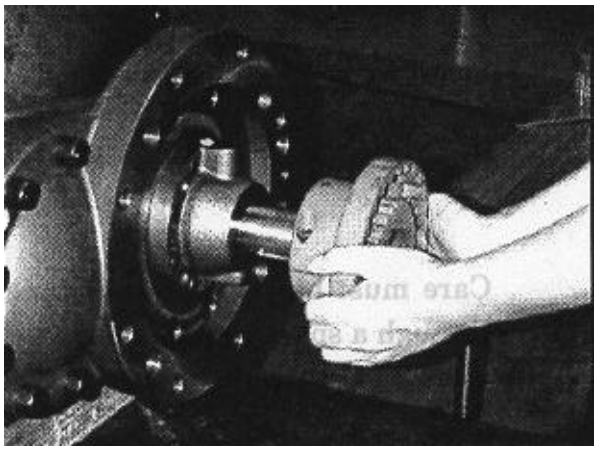


Fig. 4-10 Removing the Coupling

4.4.2 Seal cover and Shaft Seal Assembly

When disconnecting the compressor, residual pressure may remain in the compressor; exercise extreme caution.
Loosen the Seal cover (51) fixing bolt (58) and remove the Seal Cover (51).

☆ IMPORTANT

Confirm that no pressure remains in the compressor.

As a safety precaution, leave two or three bolts loosely threaded (three turns or so) when first freeing the seal cover. This will prevent the cover from being forced free due to residual internal pressure.

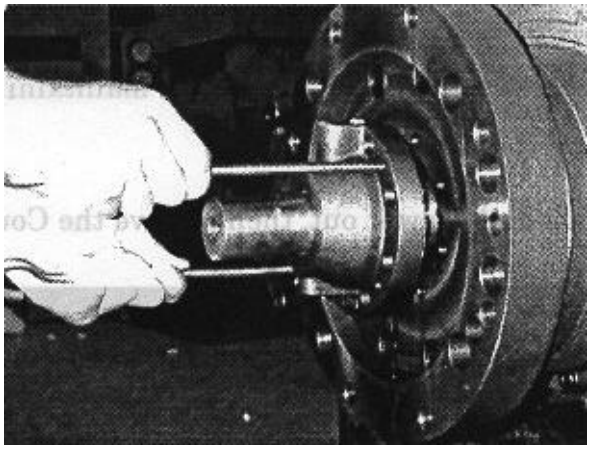


Fig. 4-11 Removing the Seal Cover

Care must be taken at this time as lubricating oil may overflow from the shaft seal through a space equivalent to the shrinkage allowance of the Shaft Seal (100).
Remove the seal cover carefully, taking care to protect the carbon insert positioned in the cover.
Remove the O-Ring (49) and then remove the Seal Retainer (48).

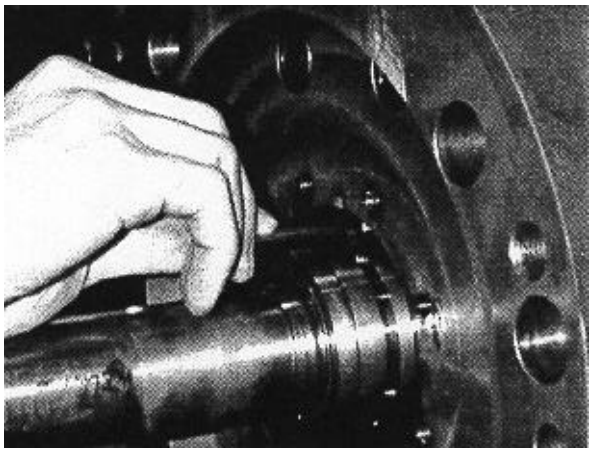


Fig. 4-12 Removing the Seal Collar

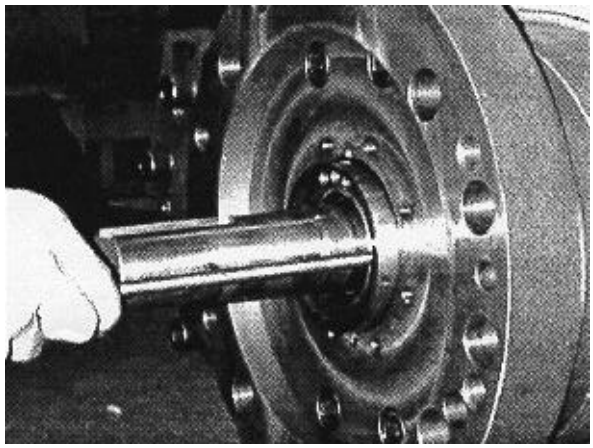


Fig. 4-13 Removing the Seal Retainer

4.4.3 Bearing Cover

Loosen the Bolts (2) securing the bearing Cover (16) while supporting the weight of the cover on the stud bolt.

Arrange removal to ensure that the Positioning Pin (3) remains on the cover side.

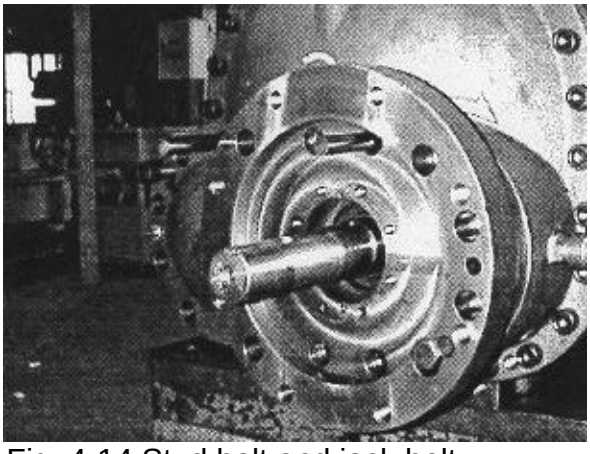


Fig. 4-14 Stud bolt and jack bolt

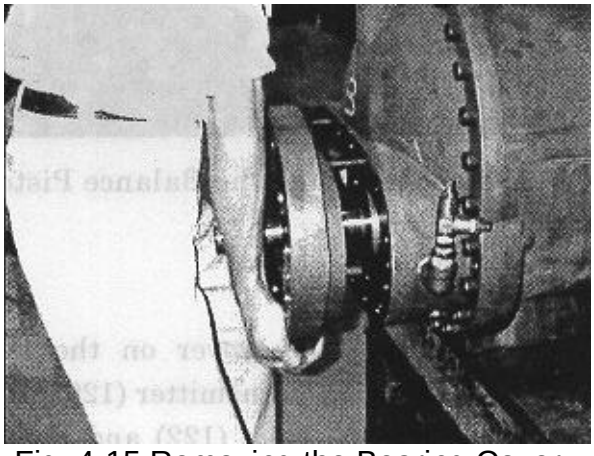


Fig. 4-15 Removing the Bearing Cover

4.4.4 Balance Piston

Remove the Stop Ring (32) with a snap ring pliers
Pull out Balance Piston Sleeve (33) and Balance Piston (30).

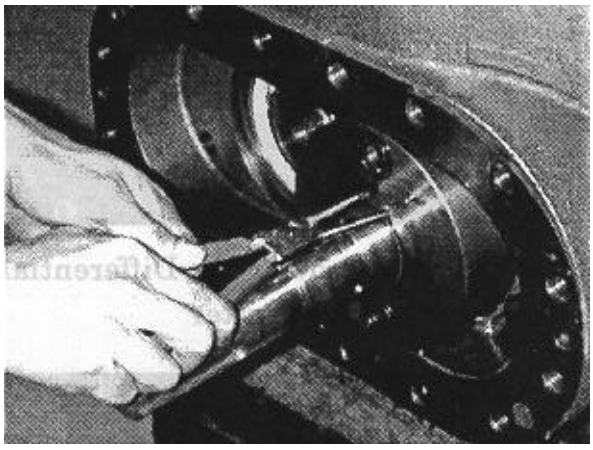


Fig. 4-16 Removing the Stop Ring

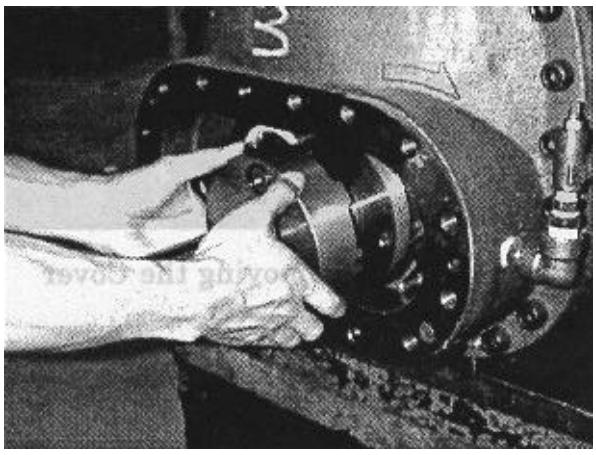


Fig. 4-17 Removing Balance Piston Sleeve

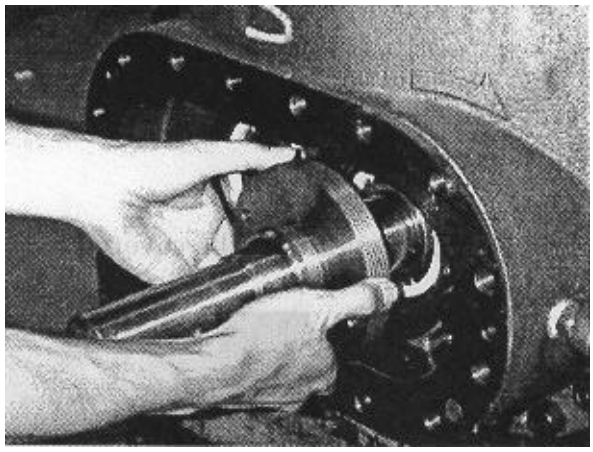


Fig. 4-18 Removing the Balance Piston

4.4.5 Unloader Sensor

Take off the cover on the Differential Transmitter box (121) and remove the Differential Transmitter (129) after removing the Differential Transmitter Gland (146). Loosen the bolts (122) and remove the Differential Transmitter Box (121) from the compressor body.

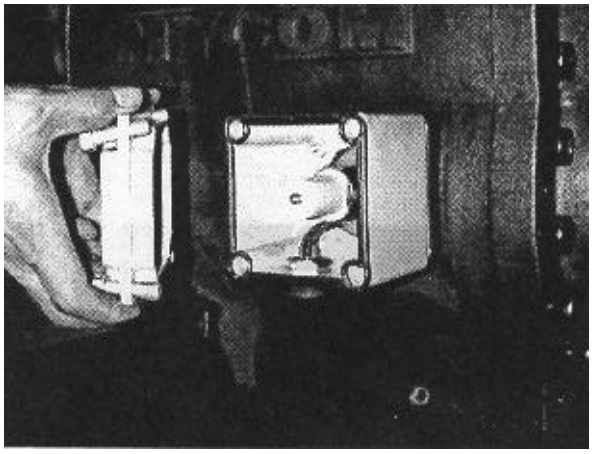


Fig. 4-19 Removing the Cover

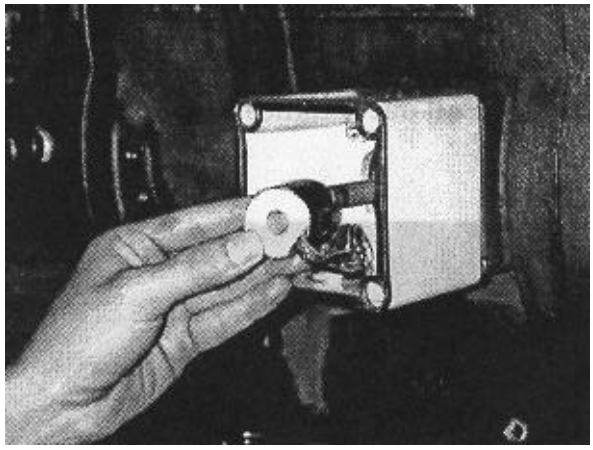


Fig. 4-21 Removing the Differential Transmitter

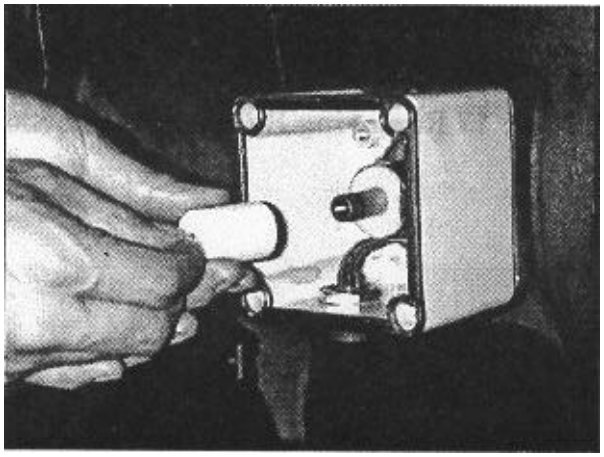


Fig 4-20 Removing the Transmitter Gland

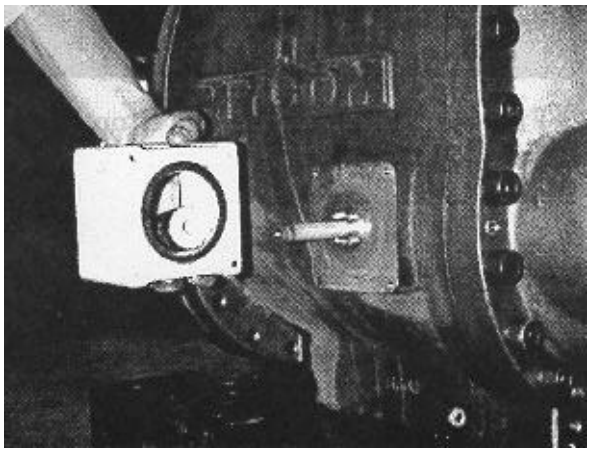


Fig. 4-22 Removing the Differential Transmitter Box

Remove the Position Detector.
Remove the Differential Transmitter Iron Core (68) and the Sensor Rod Assembly (77).

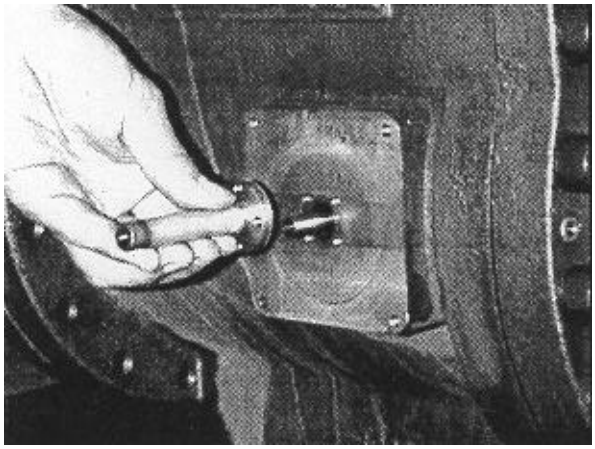


Fig. 4-23 Removing the Position Detector

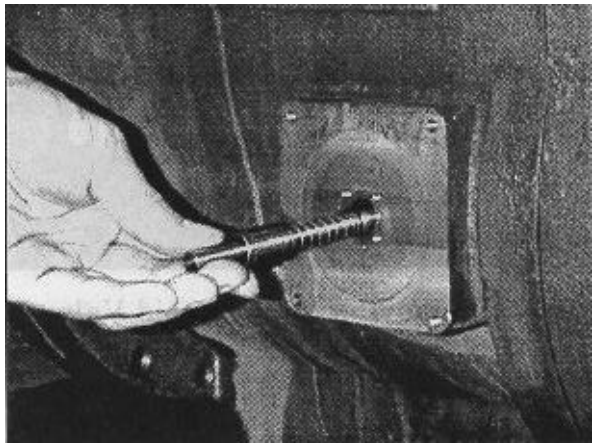


Fig. 4-24 Removing the Sensor Rod Assembly

4.4.6 Solenoid Valve

Remove the Piping (560-6) between Angle Valve (560-7) and Oil Line Check Valve (560-3).
Remove the two sets of Solenoid Valves (562) mounted on the End Cover (22) and Solenoid Valve Plate (560-1).

☆ IMPORTANT

Confirm that no pressure remains in the compressor.

As a safety precaution, leave two or three bolts loosely threaded (three turns or so) when first freeing the seal cover. This will prevent the cover from being forced free due to residual internal pressure.

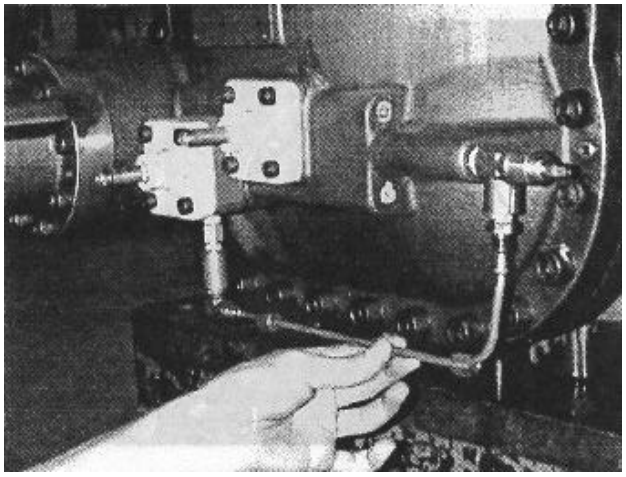


Fig. 4-25 Removing the Piping

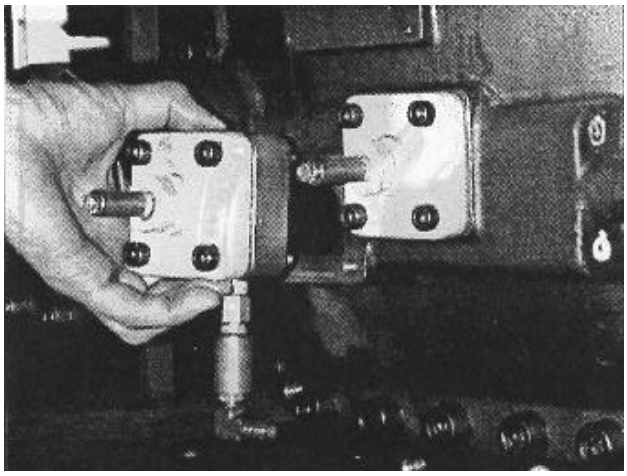


Fig. 4-2 Removing the Solenoid valve and Solenoid Valve Plate.

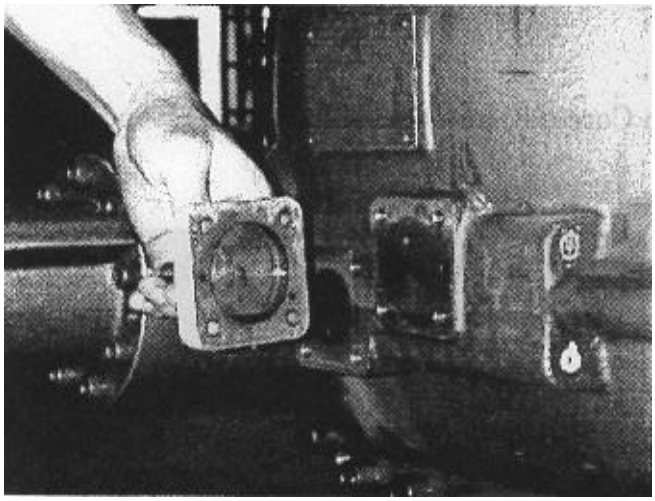


Fig. 4-27 Removing the Solenoid Valve

4.4.7 Unloader

Loosen the bolts (45) on the Unloader Cylinder (60).
Draw out the Unloader Cylinder in the sliding direction of the Unloader Piston (64).

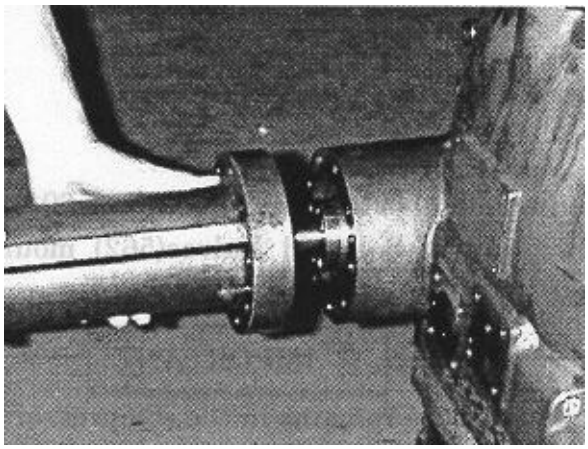


Fig. 4-28 Removing the Unloader Cylinder

Remove the Lock Nut (69) securing the Unloader Piston.
Remove the Unloader Piston (64).

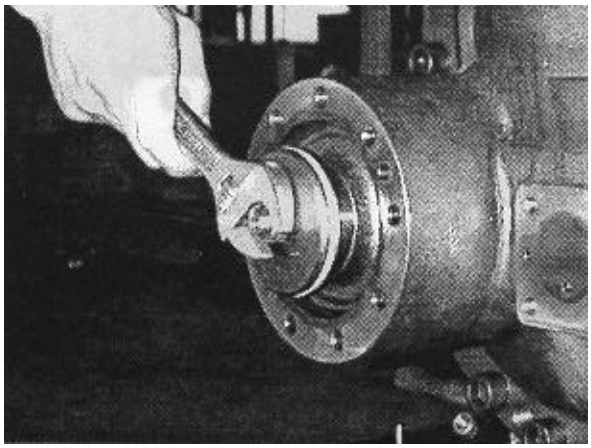


Fig. 4-29 Removing the Lock Nut

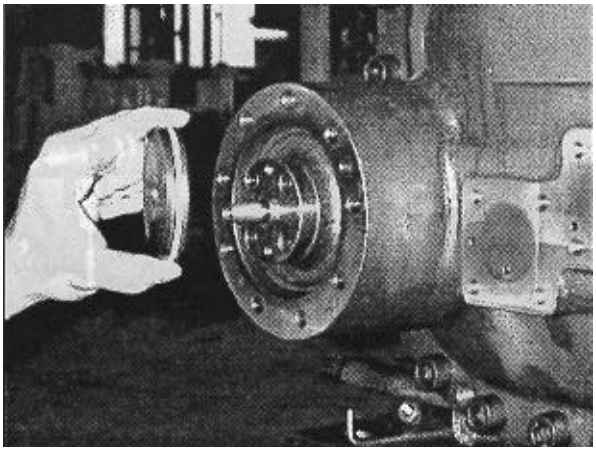


Fig. 4-30 Removing the Unloader Piston

Loosen the Bolts (166) on the Unloader Stopper (164) and remove the Unloader Stopper using the jack bolt.

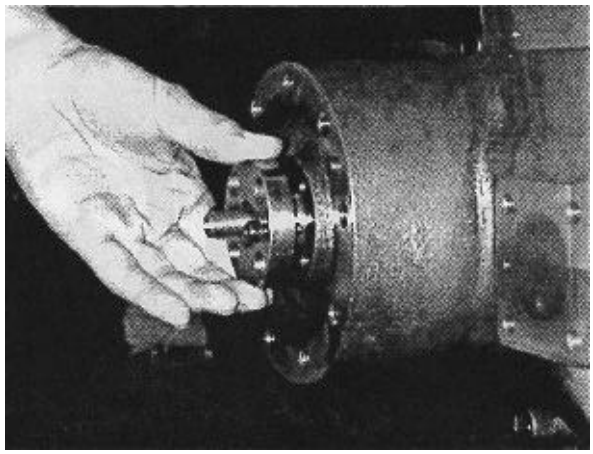


Fig. 4-31 Removing the Unloader Stopper

4.4.8 End Cover

Loosen the Bolts (2) on the End Cover (22) while supporting the weight of the cover on the stud bolt.

Arrange proper measures to ensure that the Positioning Pin (3) remains on the cover side and remove the End Cover using the jack bolt.

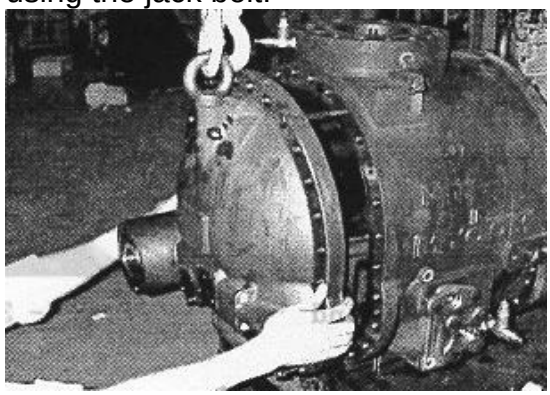


Fig. 4-32 Removing the End Cover

4.4.9 Slide Valve

Draw out the Slide Valve (54) from the Rotor Casing (1).

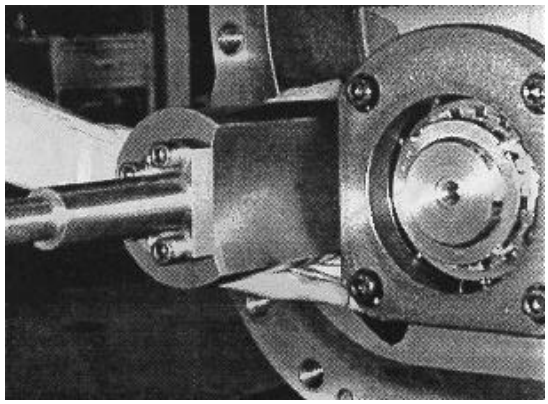


Fig. 4-33 Removing the Slide Valve

4.4.10 Bearing Gland and Bearing Nut

Remove the Bearing Gland (43-1, 43-3) and straighten the crwas on the Lock Washer (40-&, 40-2).

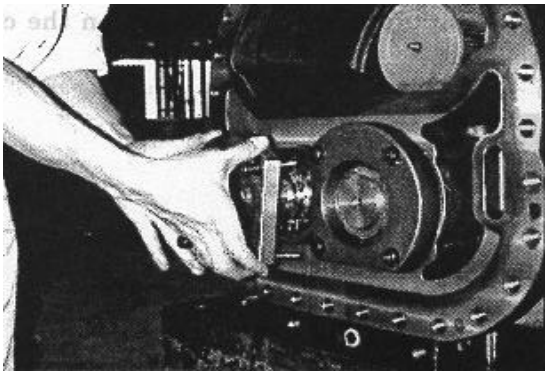


Fig. 4-34 Removing the Bearing Gland

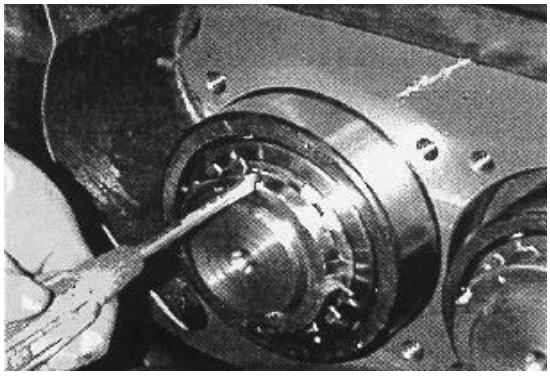


Fig. 4-35 Lock Washer claws

Loosen and remove the Lock Nut (39) using the specified tool.
Remove the Lock Washer (40-1, 40-2), the Fitting Slip (237-1, 237-2) and the Thrust Washer (250-1, 250-2).

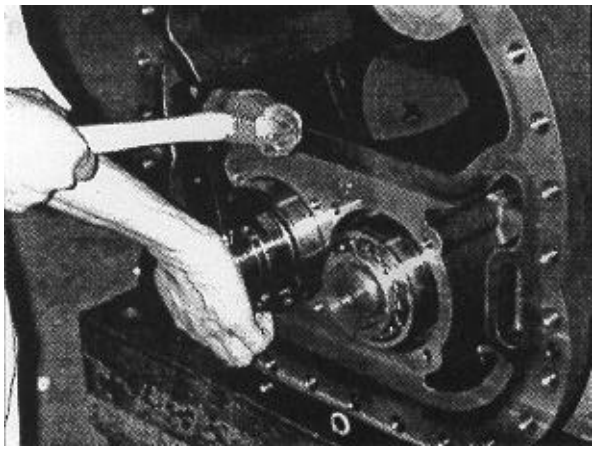


Fig. 4-36 Loosening the Lock Nut

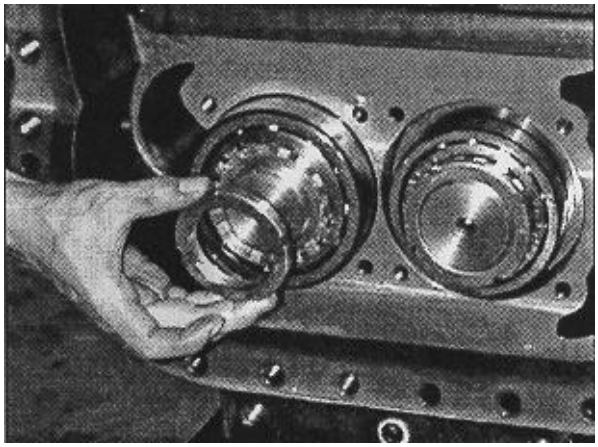


Fig. 4-37 Removing the Lock Nut

Pull out outer race and the inner race of the Thrust Bearing (38-1, 38-2) in order.
Remove the Thrust Spacer (41-1, 41-2) and Thrust Adjusting Spacer (42-1, 42-2)

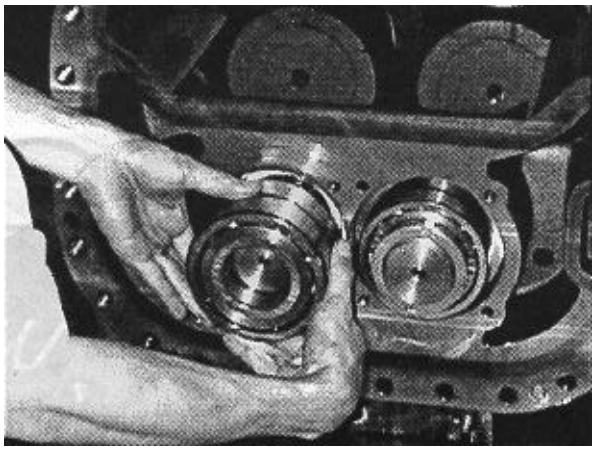


Fig 4-38 Removing the Thrust Bearing

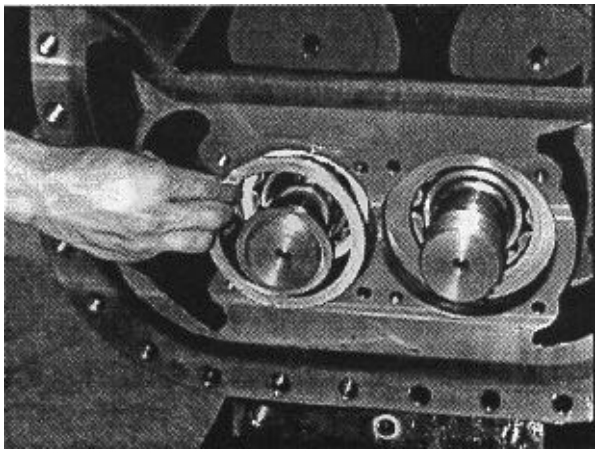


Fig. 4-39 Removing the Thrust Spacer and Adjusting Spacer.

4.4.11 Bearing head

Loosen the Bolts (2) on the Bearing Head (11) while supporting the weight of the Bearing Head on the stud bolt.
Arrange removal to ensure that the Positioning Pin (3) remains on the Rotor Casing side.
Remove the Bearing Head using the jack bolt.

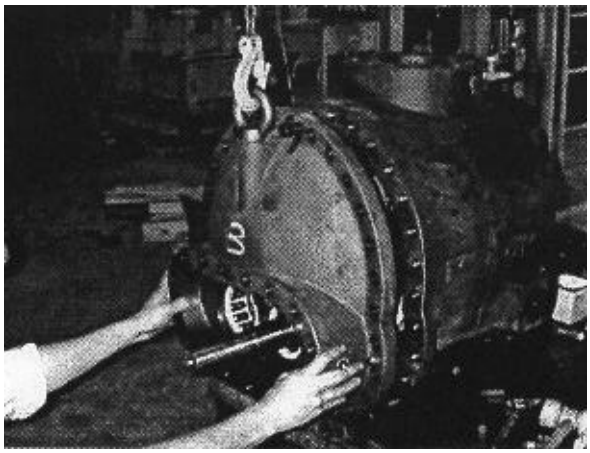


Fig. 4-40 Removing the Bearing Head

Remove the Stop Ring (29-1, 29-2) with a snap ring pliers.
Draw out the Radial Bearing (27-1, 27-2) outer ring.

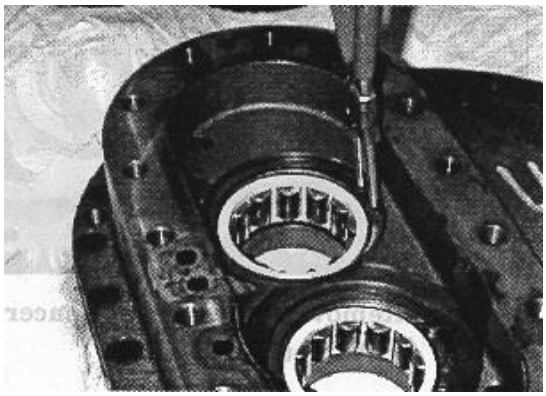


Fig. 4-41 Removing the Stop Ring

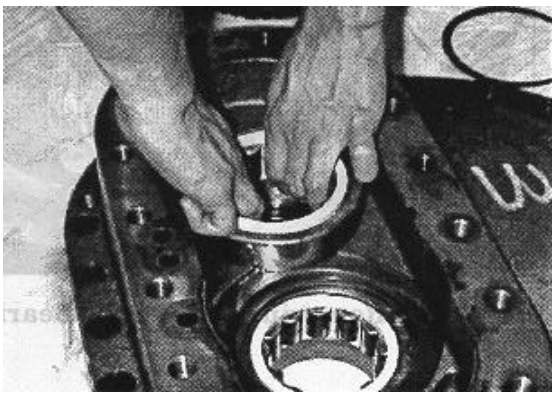


Fig. 4-42 Removing the Bearing outer ring

4.4.12 Rotors

Draw out the rotors (25, 26) using a sling for support.

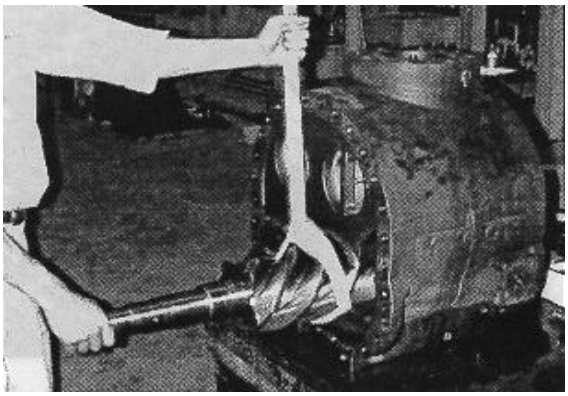


Fig. 4-43 Removing the Rotor

! CAUTION

Hen drawing out the rotors from the rotor casing, support with a sling to maintain balance.

The bearing head connected with the rotors should be positioned horizontally on square timbers to prevent it falling over.

The lobes of the M and F rotors are finely machined and the lobe edges are extremely sharp. When manipulating a rotor, always hold onto the shaft portion only.

☆ IMPORTANT

Method for Removing the Rotors.
As the rotors are very heavy, preparations must be made to suspend the each rotor as it is withdrawn using a hemp rope or nylon sling. Either the M or the F rotor may be withdrawn first. When drawing out the M rotor (25), turn clockwise as you pull it out of the casing. When two-thirds of the rotor length is free of the casing, attach the sling to the center and draw it completely out, lifting the end slightly to aid movement.

Do not lay a rotor directly on a hard surface. To protect the rotor lobe blades from damage, support the shaft ends on V-blocks.

Draw out the other rotor in the same manner.

4.4.13 Radial Bearing

Draw out the inner and outer rings of the Radial Bearing (27-1, 27-2)

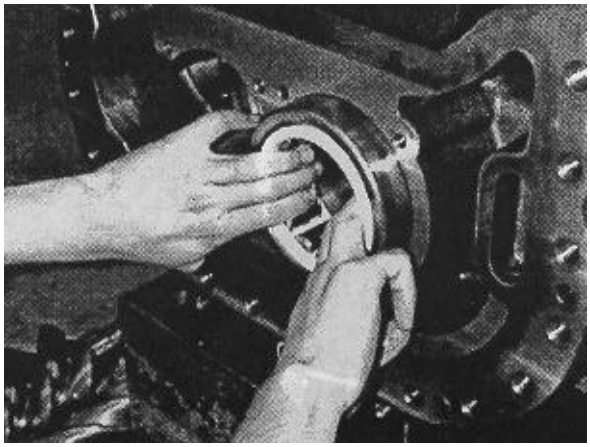


Fig. 4-44 Removing the outer ring of the Radial Bearing

4.4.14 Suction Adapter, Check Valve and Suction Strainer

Loosen the Bolts (2) on the Suction Adapter (5) with the Check Valve Assembly.

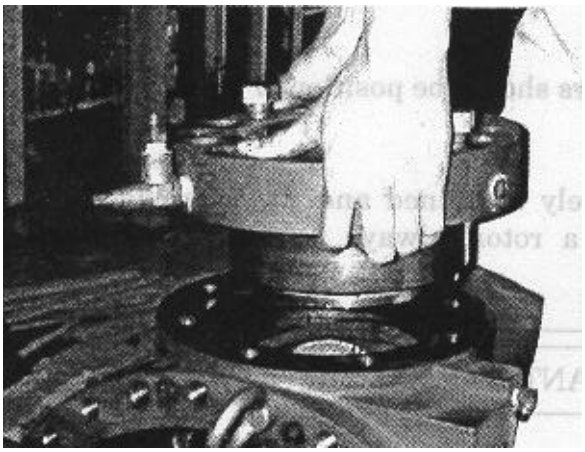


Fig. 4-45 Removing the Suction Adapter

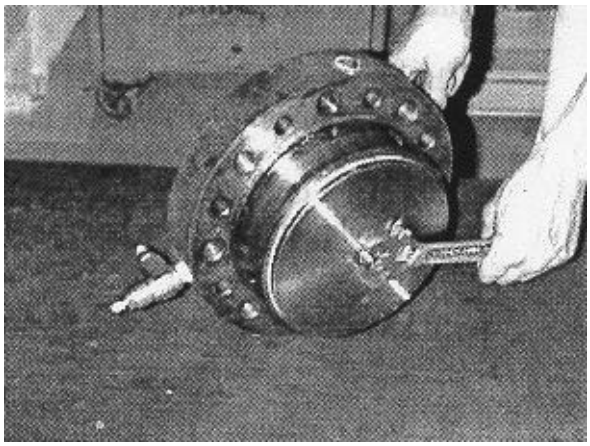


Fig. 4-46 Disassembling the check valve assembly

Loosen the Lock Nut (545-2) and remove the Strainer Element (480)

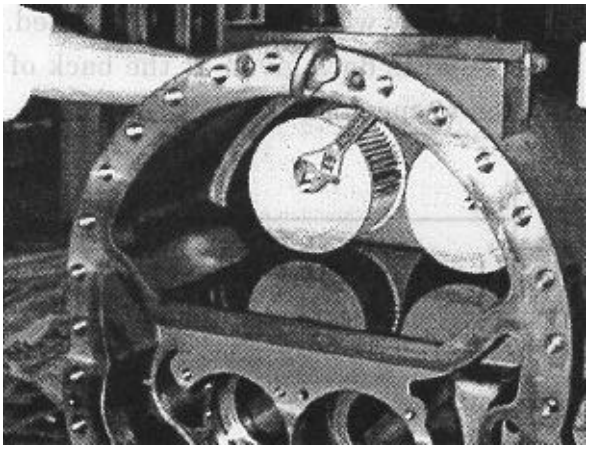


Fig. 4-47 Removing the Lock Nut

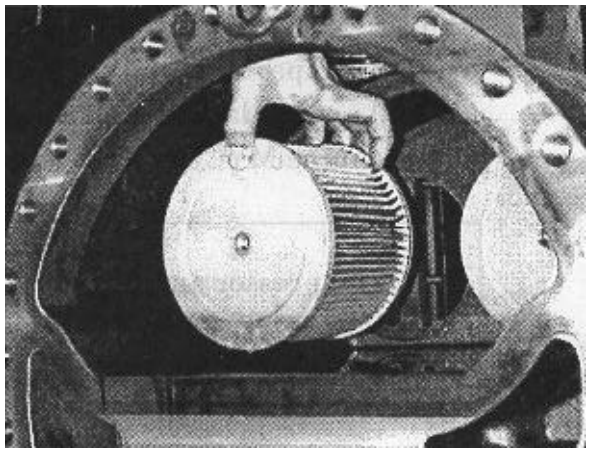


Fig. 4-48 Removing the Strainer Element

Maintenance disassembly work is now completed.

4.5 Parts Inspection

All parts should be carefully inspected after disassembly work has been completed.
Check each part carefully referring to the service limits data given at the back of this manual and replace all parts which do not conform to specifications.

! CAUTION

If the compressor and/or any parts are modified without the consent of MYCOM or non-genuine parts are used, the performance of the compressor will be seriously degraded.

4.5.1 Casing and Cover

a) Sealing surface of the casing and the O-ring
Inspect the sealing surface of the gasket and the surface of the O-ring carefully for damage. If any significant damage is found, replace with new parts, otherwise air leakage may occur when the compressor is reassembled.
After disassembly, clean the gasket face of the casing and cover thoroughly, removing all gasket fragments.

b) Inner surface of Rotor Casing.
Inspect the inside of the Rotor Casing. The wall of the casing should be clean and smooth. If traces of rotor contact are observed, there is something wrong with the bearing.

4.5.2 Seals such as Gaskets and O-rings

Many gaskets and O-rings are used in the compressor for sealing and they are vital in maintaining air tight integrity.
Inspect all gaskets and O-rings based on the following:

a) Gaskets
If there is evidence of pealing or tearing, replace the gasket when reassembling the compressor. A gasket which has cleanly separated may be reused if the compressor operating time is short.
Replace gaskets with new ones according to the periodic maintenance schedule.

b) O-rings
O-rings are liable to distortion and deformation when used in Freon refrigerant systems. If an O-ring is found to be deformed, distorted or worn, replace.
Replace gaskets with new ones according to the periodic maintenance schedule.

4.5.3 Mechanical Shaft Seal

a) Carbon and seal ring
Inspect the sliding surface of the carbon and the seal ring.
These parts may be reused if the wear traces are uniform and the contact is smooth. If there are any signs of irregular contact, replace the carbon and seal with new parts, otherwise, leakage will occur when the compressor is reassembled.

b) Oil Seal
Inspect the sliding surface of the Oil Seal and the shaft.
If the oil seal is found to be worn, replace with a new one.
Since the oil seal is a high precision part, use only a genuine replacement. The shaft oil seal contact area may sometimes be repaired by plating with chrome. For details, contact your nearest MYCOM office.

4.5.4 Unloader Sensor

a) Sensor Rod Assembly
Check the Rod for smooth movement.
If movement is not smooth or foreign matter is found in the Linear Bushing, replace the bushing. If flaws or indentations are visible in the sliding surface, the Linear Bushing should be replaced.
The Sensor Rod Assembly can be repaired after removing the Iron Core from the rod.
To remove the Iron Core, grip it securily with a pair of pliers and turn counterclockwise.
To remount, apply Lock-tight to the threaded portion of the shaft end of the Sensor Rod and screw on the Iron Core.

4.5.5 Unloader

a) Unloader Piston
Inspect the Slipper Seal fitted on the periphery and replace if wear or deformation is found. Always replace the Slipper Seal every two years.

b) Unloader Cylinder
If the Cylinder is scored or oil residue is found inside the Cylinder, finish the cylinder with emery paper.

c) Unloader Slide Valve
If wear or scoring is found on the periphery of the Unloader Slide Valve replace with a new one.

d) Push Rod and Unloader Stopper
If wear or scoring is found on the shaft of the Push Rod replace with a new one.
If major axial flaws are found, these have probably been caused by foreign matter trapped by the Push Rod. If scars or scoring are found on the inner surface of the Unloader Stopper, the Unloader Stopper should be replaced.

4.5.6 Unloader Oil Pressure Controls

a) Solenoid Valve
If abnormal actuation is experienced during operation, the probale cause is clogging of the hole on the Solenoid Valve with foreign matter. If the foreign matter cannot be completely removed by cleaning, the Solenoid Valve should be replaced.

b) Oil Line Check
If a slide valve malfunction has been diagnosed, the probable cause is trouble with the Oil Line Check.
If there is foreign matter in the Oil Line Check or seat surface wear is found after disassembly the Oil Line Check, the part should be replaced.

4.5.7 Thrust and Radial Bearings

a) External appearance
Wash the bearings in solvent and dry with compressed air.
Inspect the roller surfaces for uniform gloss and look for burrs on the corners of the retainer. Also check the space between the rollers and the retainer.

b) Periodic replacement
Though the service life of the bearings depends on the compressor operating conditions, it is best to replace every 25,000 hours or every five years. This period may be shortened if the oil is soiled, the bearings have been exposed to very high temperatures or load conditions have changed. If any suspicious symptoms are found, no matter how small, replace the bearings.

c) Radial bearing inner ring
The radial bearing inner ring should be replaced with the side bearing on the rotor shaft facing down. Draw out the radial bearing inner ring while heating with a blow torch. At the M rotor suction side bearing draw out the inner ring after removing set screw.

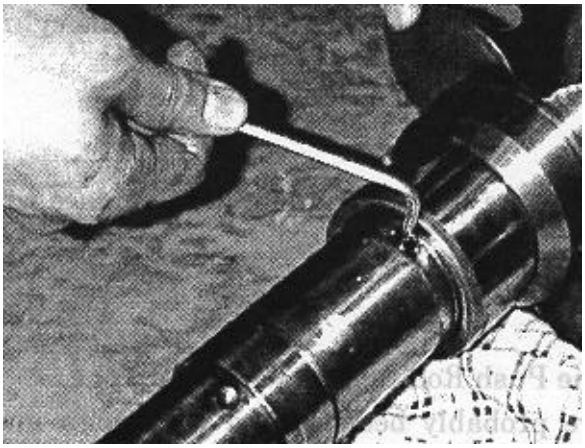


Fig. 4-49 Removing the Set Screw

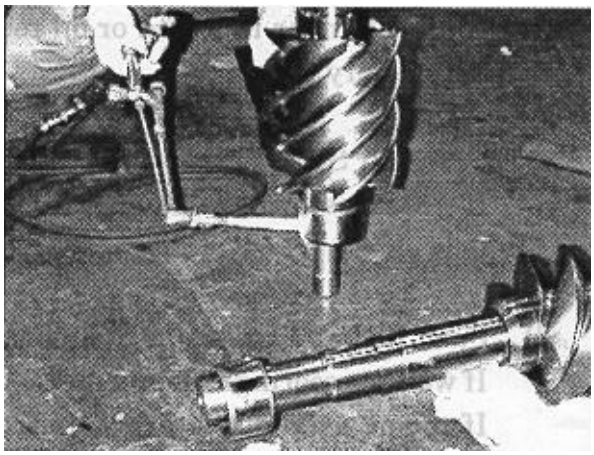


Fig. 4-50 Drawing out the Radial Bearing Inner ring

4.5.8 Rotors

a) Shaft
Inspect the shaft of each rotor.
Inspect the shaft carefully for scoring. The shaft oil seal contact area may sometimes be repaired by plating with chrome. For details, contact your nearest MYCOM office.

b) Rotor lobes
Inspect the lobe contact condition and wear on the periphery. If operation has been normal, no abnormalities should be found. If scars are found on rotor lobes, the most porbable cause is foreing matter entry into the compressor. In this case, the Suction Strainer should be carefully inspected.

4.5.9 Suction Strainer

a) Suction Strainer
The Suction Strainer can be reused after cleaning. Remove from the mounting seat and clean off any matter which has adhered to the mesh. If the Strainer is deformed or crushed, replace with a new one.

4.5.10 Suction Check Valve

a) Check valve
Inspect the Check Valve Stem (491).
If a Check Valve malfunction is found during disassembly, the probable cause is a bent stem, waer or contamination with foreign matter. If a problem is found, replace the Check Valve Stem.

b) Seat and Seat Stopper
Scoring or deformation of the Seat will result in a malfunction of the Check Valve. If the Seat or Seat Stopper are found to be damaged or deformed, the probable cause is O-ring leakage. Replace the Seat and Seat Stopper if necessary

☆ IMPORTANT

The component parts of the compressor should be free of dirt and rust.

Begin reassembly work as soon as possible after completion of disassembly, inspection, repair and replacement and cleaning. If parts must be left disassembled for some time before the compressor is reassembled, they should be protected from dirt and moisture.

5. Reassembly

5.1 Preparations for Reassembly

Begin reassembly immediately after completion of inspection and repair.

Reconfirm which parts must be replaced and prepare the replacement parts referring to paragraph 4.5, Inspection of Parts.

Reassembly is essentially carried out in the reverse order of disassembly and all safety equipment and hand tools are the same. All tools needed for reassembly should be cleaned and all compressor parts cleaned thoroughly and coated with lubricating oil just before starting the work.

☆ IMPORTANT

The compressir casing and many of the parts have numerous drilled holes, small indentations, recessed corners, etc., which should be cleaned carefully to ensure that no residue remains when the compressor is assembled. Particular care should be taken to ensure that small holes are clear of debris. Foreign matter contamination of the bearings, rotors or seals will shorten the service life of the compressor significantly.

5.2 Reassembly and Adjustment of Parts

During reassembly, always tighten bolts and nuts to the torque values specified.

During reassembly, make frequent reference to the cross-sectional drawing, exploded view and parts list provided in order to assure that the compressor is being assembled properly. Genuine replacement parts should always be used and modification should be strictly avoided.

☆ IMPORTANT

If the compressor or any component parts are modified without the consent of the manufacturer or non genuine replacement parts are used, the designed performance level of the compressor cannot be maintained and there is a real danger of an unexpected accident.

Reihenfolge der Wiedermontage

1) Suction Strainer, Check Valve and Suction Adapter
2) Radial Bearing
3) Rotors
4) Bearing Head
5) Thrust Bearing
6) End clearance adjustment
7) Slide Valve
8) End Cover
9) Solenoid Valve
10) Unloader
11) Unloader Sensor
12) Balance Piston
13) Bearing Cover
14) Shaft Seal Assembly and Seal Cover
15) Motor Spacer and Motor

5.2.1 Suction Strainer, Check Valve and Suction Adapter

Confirm that Tie Rod (544) is fixed to Rotor Casing.
Fix the Strainer Element (480) on the Rotor Casing (1) with the Lock Nut (545-2) and Flat Washer (545-1)

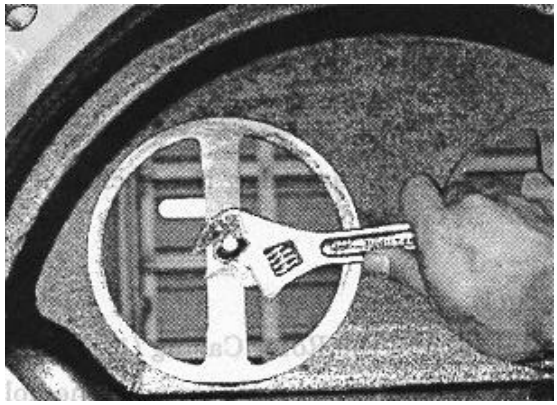


Fig. 5-1 Confirming the Tie Rod

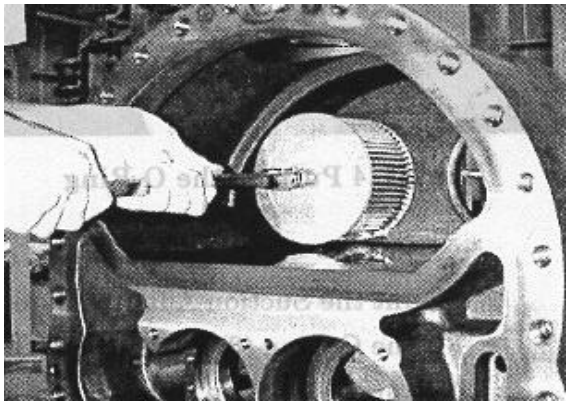


Fig. 5-2 Fixing the Strainer Element

Assembly the Ceck Valve.
Mount the Check Valve Stem (491) with Check Valve Spring (485) to Suction Adapter (5).
Mount the Seat Stopper (488) and the Seat-1 (489) to Check Valve Stem (491).
Put the O-ring (495) into the groove of Check Valve Stem after mounting Seat Stopper (488) and Seat-1 (489).
Mount the Seat-2 (490) and fasten the Lock Nut (486-1).
Confirm smooth movement of the Check Valve.

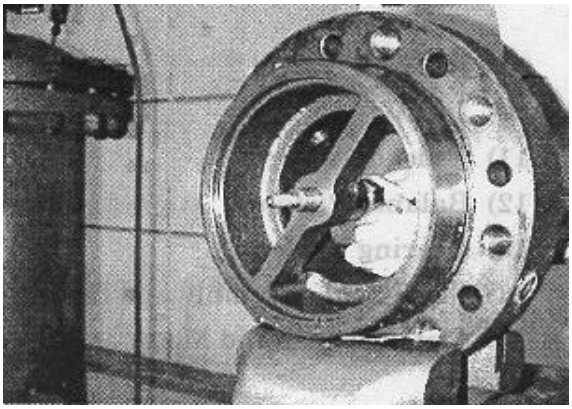


Fig. 5-3 Suction Adapter and Stem

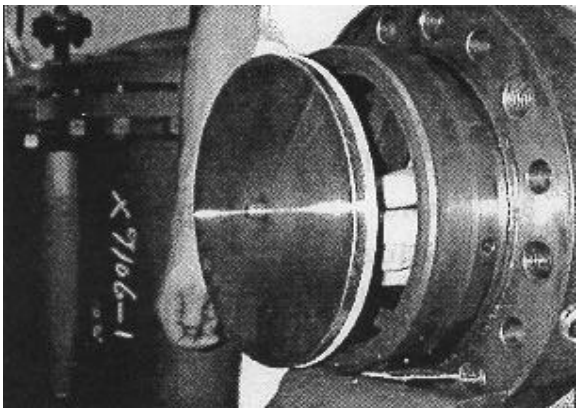


Fig. 5-5 Mounting the Seat

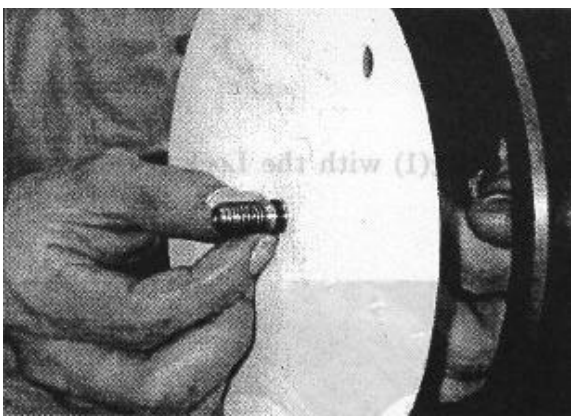


Fig. 5-4 Putting the O-Ring

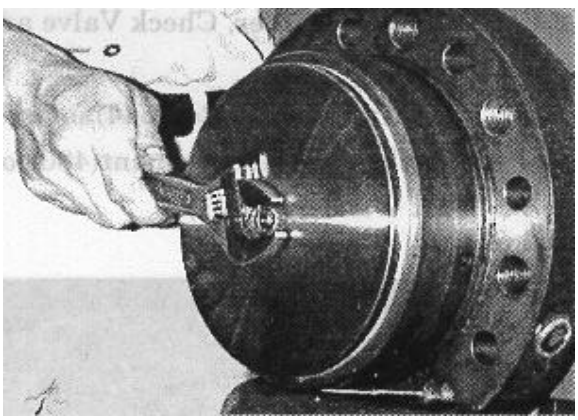


Fig 5-6 Fastening the Lock Nut

Mount the Suction Adapter (5) to Rotor Casing (1).
Fit the O-Ring (6) between the Suction Adapter (5) and the Rotor Casing (1).
Mount the Suction Adapter while aligning the hole under the Adapter with the hole in the Rotor Casing and tighten the bolts to the specified torque.

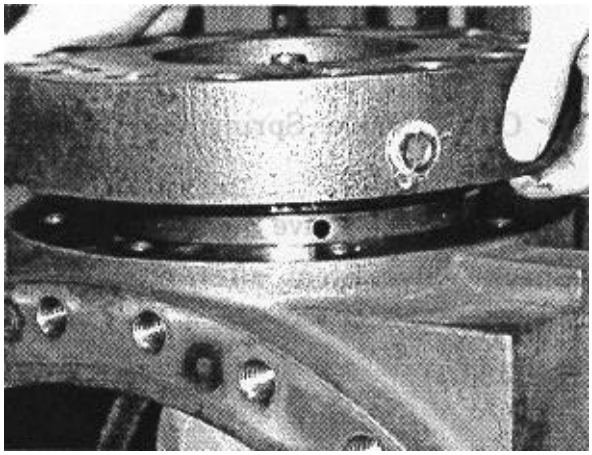


Fig. 5-7 Suction Adapter hole

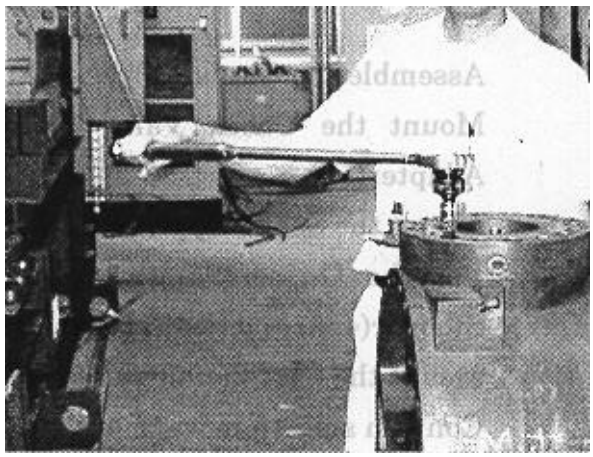


Fig. 5-8 Mounting the Suction Adapter

5.2.2 Radial Bearing

Position the Radial Bearing (27-1, 27-2) in the Rotor Casing (1) and drive in using a soft hammer, taking care not to damage the bearing or retainer.

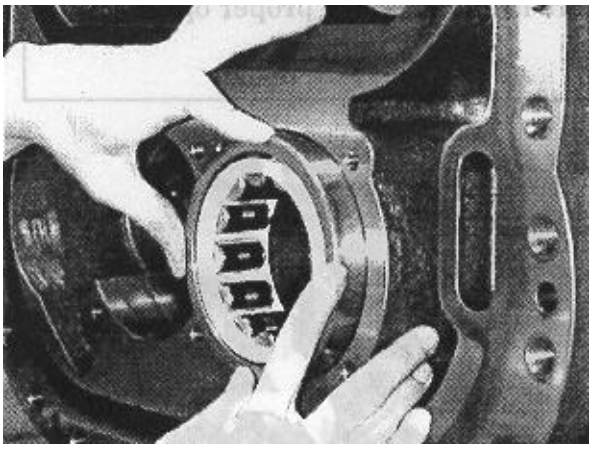


Fig. 5-9 Inserting the Radial Bearing

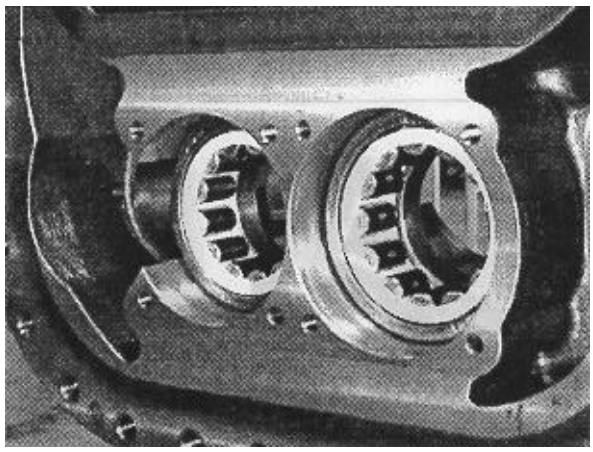


Fig. 5-10 Mounting the Radial Bearing

☆ BEDEUTEND

Insert the Radial Bearing in the casing carefully, taking care not to hit the retainer, which is made of punched steel plate. Damage of the retainer will cause the bearing to fail.

5.2.3 Rotors

Mounting the Rotors (25, 26) to the Rotor Casing (1).

a) Apply lubricating oil to the bearing and rotor shaft.

b) Mount the M Rotor (25) first after applying lubricating oil to the bearing and the rotor shaft. Suspend the rotor from a lifting device using a sling, push the rotor in approximately half way, remove the sling and then push the rotor in the remainder of the way.

c) The numbers „1“ and „2“ are stamped on one lobe of the F rotor (26) at the discharge end. Position this lobe facing the M Rotor side.

d) One lobe of the M Rotor is stamped with the number „1“. Rotate the M Rotor so that the number faces the F Rotor side.

e) Suspend the F Rotor from a sling and insert approximately half way into the casing, guiding the rotor so that the „1“ on the M Rotor fits between the „1“ and „2“ on the M Rotor. When the rotors are mated, push the F Rotor into the casing, rotating it as you do.

☆ IMPORTANT

Correct mating of the male and female rotors is essential for proper operation of the compressor

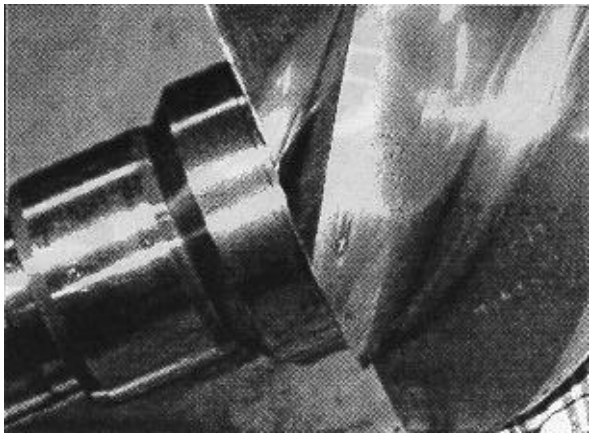


Fig. 5-11 Stamp marks on M Rotor lobe ends

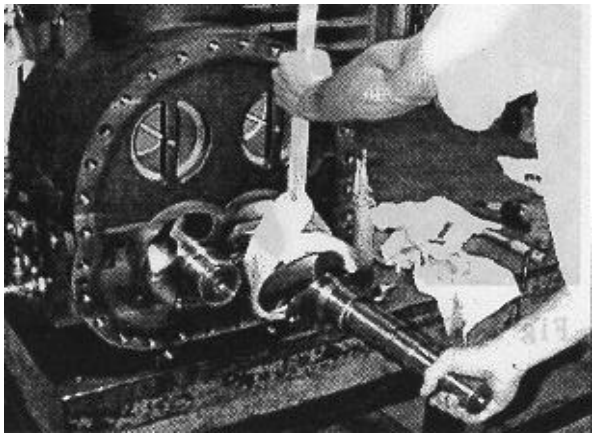


Fig. 5-13 Mounting Rotor

Fig. 5-12 Stamp marks on F Rotor

5.2.4 Bearing Head

Mount the Bearing Head (11) on the Rotor Casing (1).
Mount the Bearing Head on the stud bolts while supporting the weight of the Bearing Head with a lifting device.
When mounting the Bearing Head, care should be taken to prevent damage to the Rotor shaft.
Position the Bearing Head as close to the Rotor Casing as possible and tighten the fitting Bolts (2) temporarily.
Drive in the Positioning Pin (3) and tighten the bolts to the specified torque.

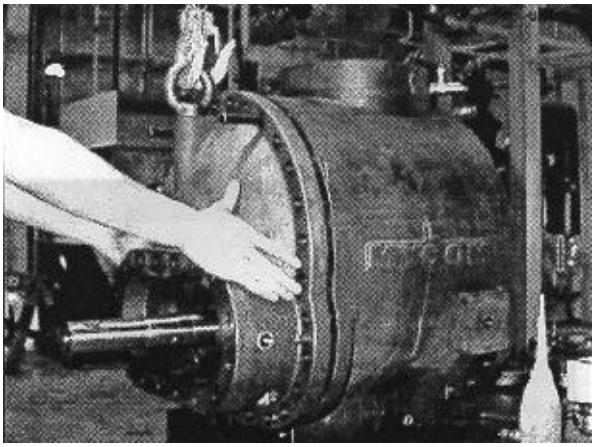


Fig. 5-14 Mounting the Bearing Head

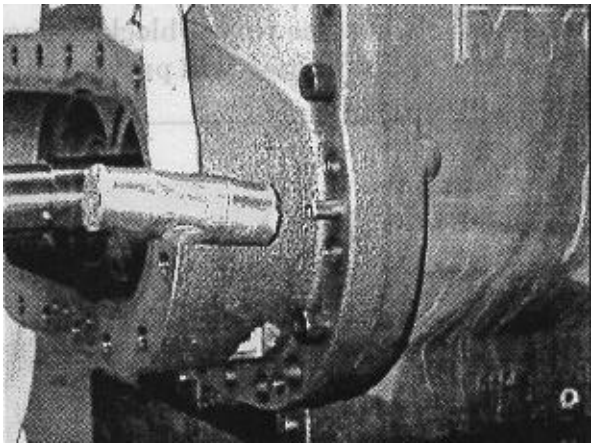


Fig. 5-15 Driving the Positioning Pin

Mount the Radial Bearing (27-1, 27-2) to the Bearing Head (11).
Mount the Stop Ring (29-1, 29-2) with the snap ring plires.

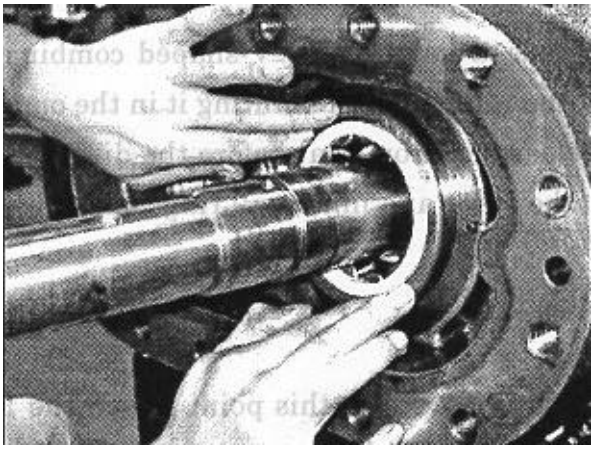


Fig. 5-16 Mounting the Radial Bearing

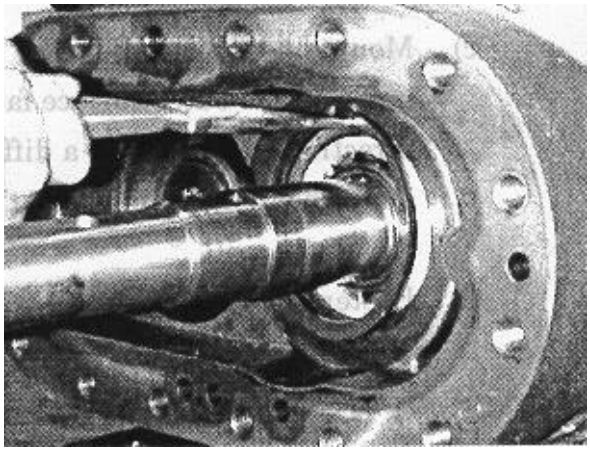


Fig. 5-17 Mounting the Stop Ring

5.2.5 Thrust Bearing

a) When putting back the Thrust Bearing (38-1, 38-2) that has been removed instead of a replacement, mount it in the same combination as when it was removed.

b) Even when mounting the same bearing, make sure there is no foreign matter such as a small fragment of paint left between the Thrust Bearing Adjust Washer and the Thrust Bearing Adjust Liner, or between the Liner and the Thrust Bearing Washer. Otherwise, the parts will not fit in properly.
Mount the Bearing Spacer (41-1, 41-2) to outer ring side of Radial Bearing.

☆ IMPORTANT

When mounting the thrust bearing adjust washer/adjust liner on the rotor, care should be taken to prevent foreign matter from contaminating the space between the thrust blocking face of the rotor and the liner/washer.
Contamination will prevent precise adjustment.

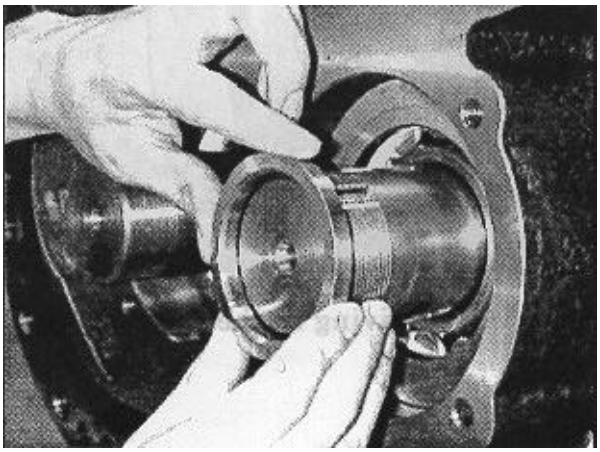


Fig. 5-18 Mounting the Thrust Bearing Adjust Washer.

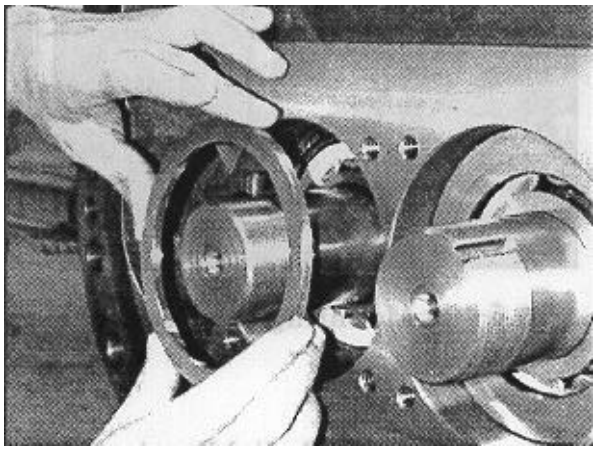


Fig. 5-19 Mounting the Bearing Spacer

c) Mount the Thrust Bearing so that the edges point of the V-shqped combination mark on the outer surface faces toward the rotor side. Mounting it in the opposite direction will result in a different end clearance from that before the disassembly, since the distance between the sides of the outer and inner rings will differ.

c) Fasten the Lock Nut (39-1, 39-2) in its place.

e) If the Thrust Bearing (38-1, 38-2) has been replaced, at this point loosen the Lock Nut little by little, and confirm that there is some end clearance.
Even with a new bearing having the specified distance between the outer face of the outer ring and the inner ring, there may not be any thrust end clearance at all. In such case, excessively tightening the Lock Nut will force the balls against the rotating side and denting it.
If there is insufficient end clearance, refer to Section 5.2.6 „End Clearance Adjustment“ to adjust the clearance to within the proper range.

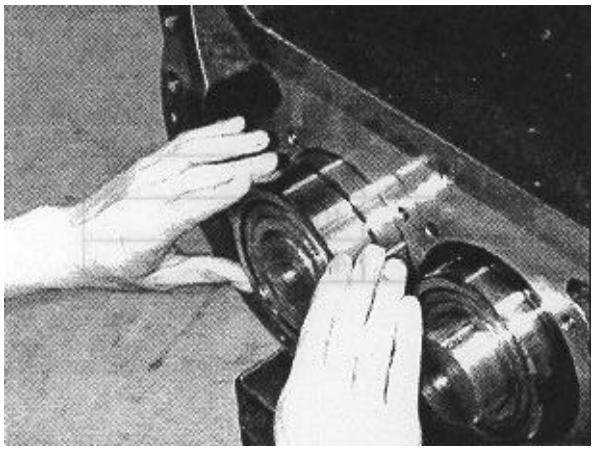


Fig. 5-20 Mounting the Thrust Bearing

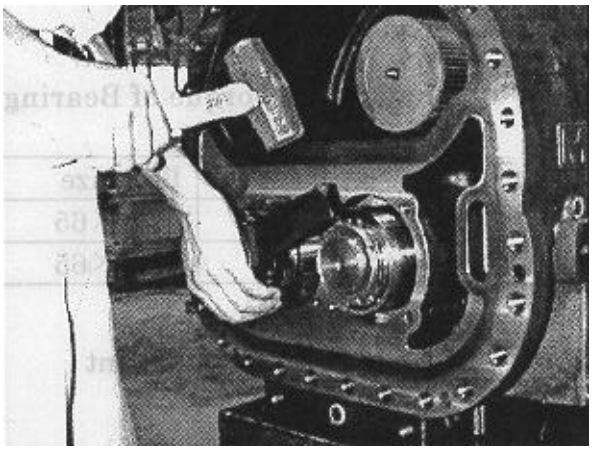


Fig. 5-21 Fastening the Lock Nut

f) With the inner ring fixed on the Rotor shaft, press on the rotor from the suction side towards the discharge side end face.

g) When the Rotor is pressed against the discharge side end, prepare to mount the Bearing Gland (43-1, 43-2). Mount a dial gauge on the suction side end of the rotor and set the indicator to the „0“ position.

☆ IMPORTANT

Confirm that the discharge side end face of the rotor is pressing firmly against the casing before commencing thrust adjustment.
If clearance exists, proper adjustment cannot be achieved.

h) Press the thrust bearing gland lightly against the thrust bearing end face. Fasten the retaining bolts temporarily so that they are not fixed unevenly. Tighten the Bearing Gland retaining bolt with a torque wrench to a specified torque. Measure the end clearance value by reading the dial indicator.

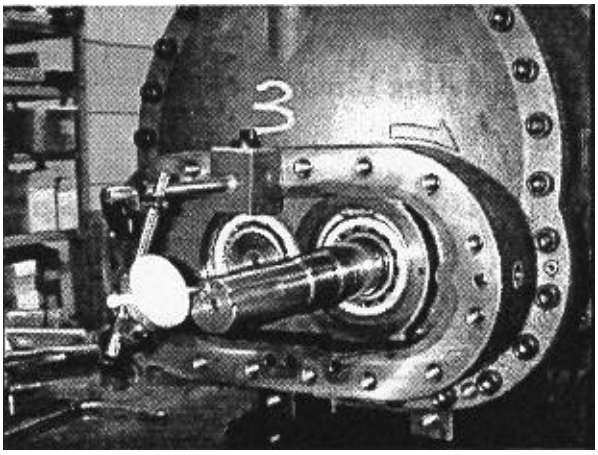


Fig. 5-22 Measuring the End Clearance

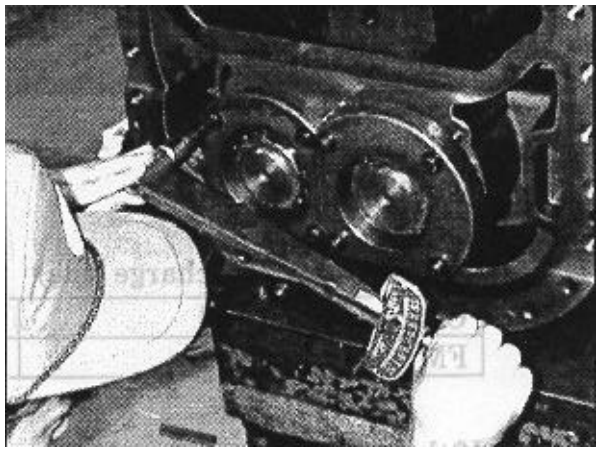


Fig. 5-23 Fixing the Bearing Gland

Table 5-1 Fastening Torque of Bearing Gland

	Bolt size	N-m	Kgf-cm
M Rotor	M10X65	39.2	400
F Rotor	M10X65	39.2	400

5.2.6 End Clearance Adjustment

The clearance between the discharge side face and the Rotor (25, 26) and the Casing (1) should be adjusted by the thickness of the Thrust Adjusting Liner fitted between the Thrust Adjust Washer (42-1, 42-2) and the Thrust Bearing (38-1, 38-2).

Always use a genuine MYCOM Thrust Adjusting Liner.
Five sizes – 0.03, 0.05, 0.1, 0.3 and 0.5 (mm) – of Thrust Adjusting Liner are available.

Use the 0.5mm liner first to adjust clearance and if the proper value cannot be obtained, select a liner of the most appropriate size.

Place the Thrust Bearing Adjusting Washer (42-1, 42-2) and the Adjusting Liner on the Rotor.

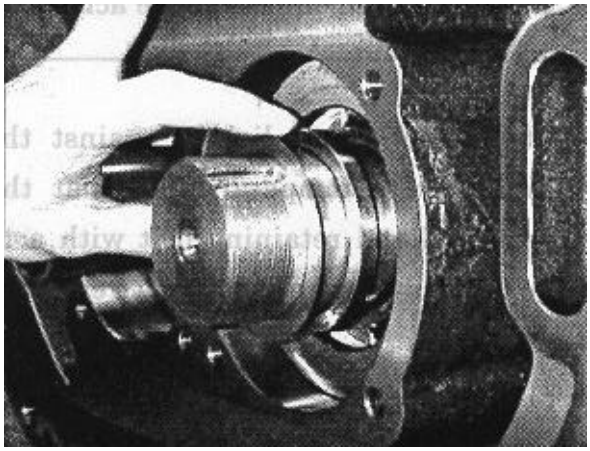


Fig. 5-24 Placing the Thrust Adjusting Liner

Table 5-2 End Clearance

☆ End clearance (Discharge side)

Compressor Model	Single stage (mm)
FM160	0.07~0.13

If the adjustment value does not agree with the specified value, change the Adjusting Liner to one of a more appropriate thikness and repeat the adjustment process again.
To determine the adjustment value, read the extent of travel by positioning the dial gauge on the suction side rotor end face.

☆ IMPORTANT

End clearance adjustment work should be repeated several times in order to confirm repeatability.

After completion of adjustment, rotate the Rotor manually. While rotation will initially be very stiff, it should become light within a very short time. After confirming that rotor rotation is smooth, secure the Lock Nut by folding down the claw of the Lock Washer.

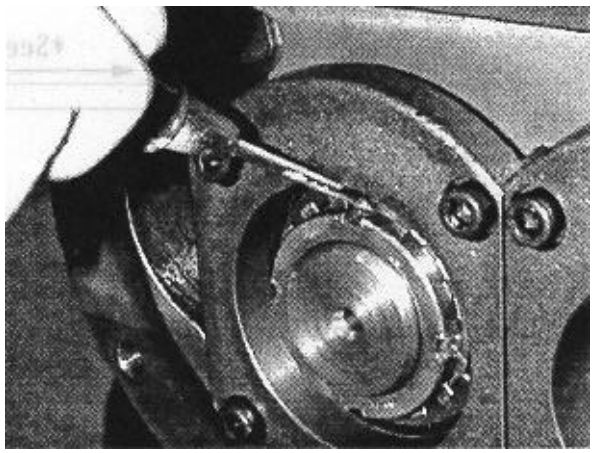


Fig. 5-25 Folding down the lock washer claw

5.2.7 Slide Valve

For FM&§à units, the slide valve (54) is used for capacity control.
The Slide Valve should be mounted in the Rotor Casing (1) as assembly combined with the Push Rod (67).
Mount the Slide Valve by inserting in the sliding direction.

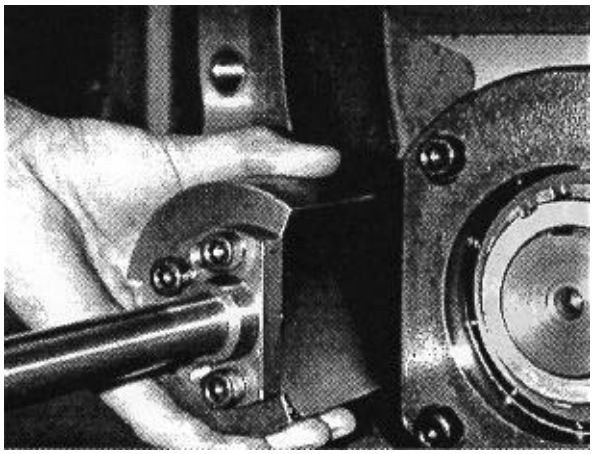


Fig. 5-26 Mounting the Slide Valve

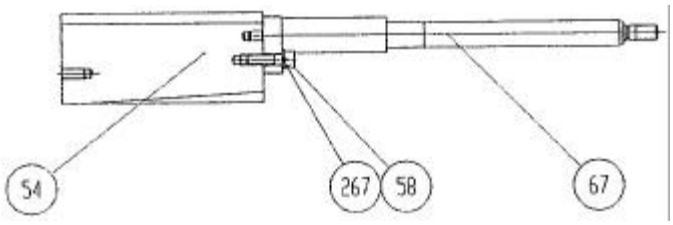


Fig. 5-27 Slide Valve and Push Rod

When mounting the Slide Valve (54) into the Rotor Casing (1), care should be taken to prevent the Slide Valve Side end face of the Push Rod from striking the Unloader Slide Valve Guide (246) mounted in the Rotor Casing.

☆ IMPORTANT

The position of the unloader slide valve guide is adjusted at the factory before shipment. A strong blow may alter the position of the guide and lead to a malfunction of the slide valve.

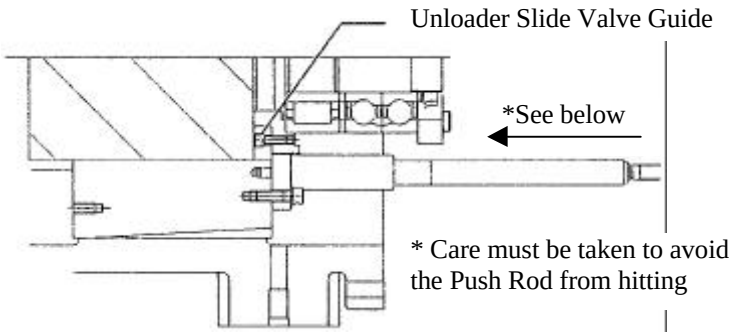


Fig. 5-28 Slide Valve and Unloader Slide Valve Guide

5.2.8 End Cover

Mount the End Cover (22) on the Rotor Casing (1).

Insert the stud bolts into the Casing and mount the End Cover, taking care not to damage the Push Rod. Place the End Cover on the Rotor Casing and secure the Bolts (2) temporarily. Drive in the Positioning Pin (3) using a copper hammer, then tighten all bolts to the specified torque.

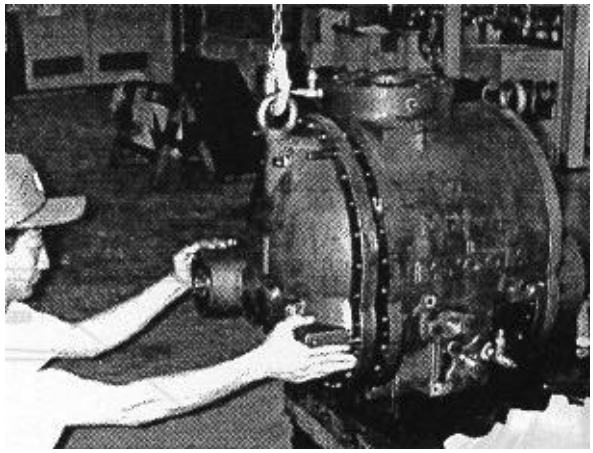


Fig. 5-29 Mounting the End Cover

5.2.9 Unloader

Asseble the Unloader Cylinder (60) of the Slide Valve actuator and the Piston (64).
Mount the Unloader Stopper (164) on the End Cover (22) after confirming that the O-Rings (9, 59) are fitted properly on the outer and inner peripheries of the Unloader Stopper.

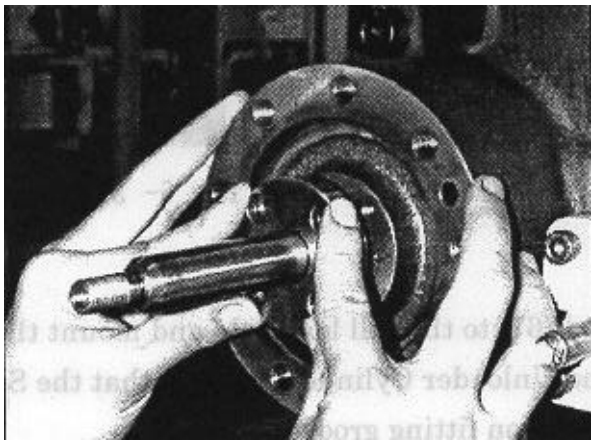


Fig. 5-30 Mounting the Unloader Stopper

Mount the Slipper Seal (66) on the Unloader Piston (64).
The Slipper Seal consists of a square rubber ring and a Teflon ring. Fit the rubber ring first, then fit the Teflon ring.
Apply grease to the piston and the Teflon ring.

☆ IMPORTANT

If the Teflon ring is deformed, it cannot be restored to its proper shape and must be replaced.
When fitting the Teflon ring, care should be taken to prevent bending or elongation.

Mount the Unloader Piston (64) after confirming that the O-Rings (73) are fitted properly on the Push Rod (67), then secure the Lock Nut (69).

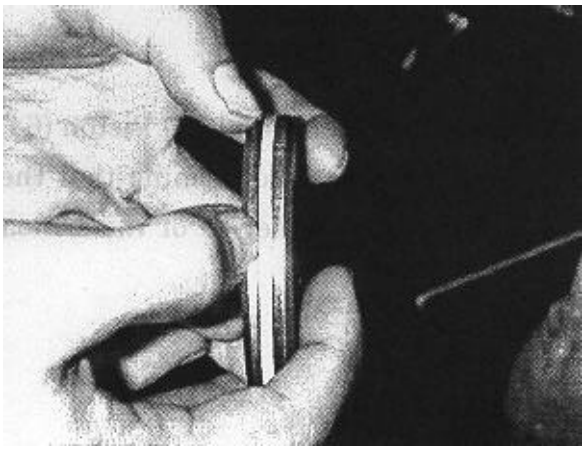


Fig. 5-31 Mount the Slipper Seal.

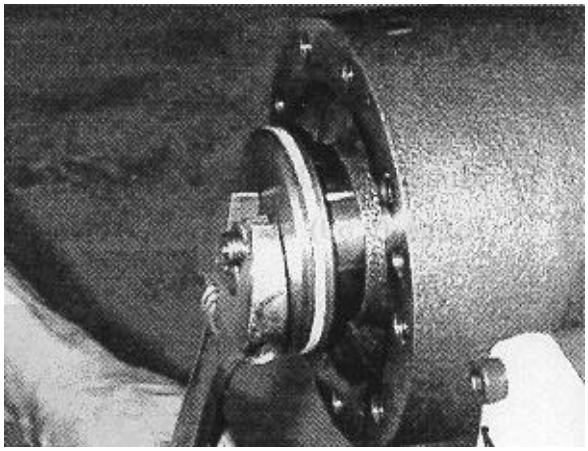


Fig. 5-32 Mounting the Unloader Piston.

Insert the Push Rod (67) to the full load side and mount the Unloader Cylinder (60).
When mounting the Unloader Cylinder, confirm that the Slipper Seal is not protruding from the Unloader Piston fitting groove.

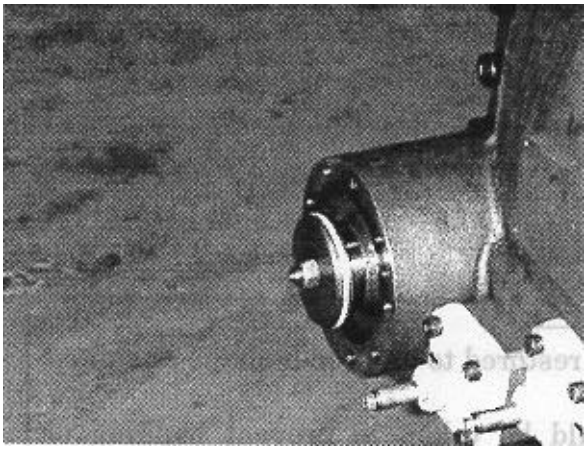


Fig. 5-33 Positioning the Push Rod.

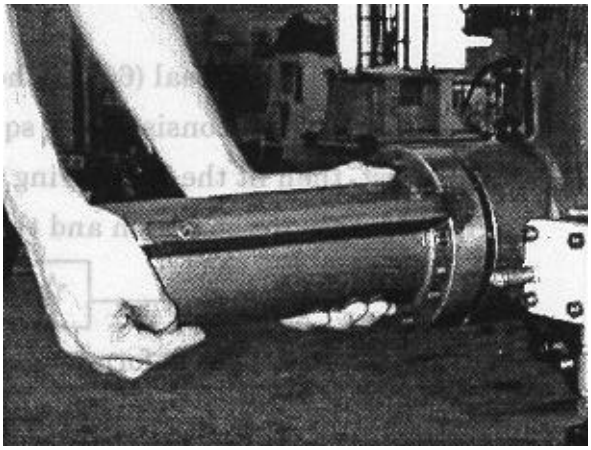


Fig. 5-34 Mounting the Unloader Cylinder.

☆ IMPORTANT

Mount the unloader cylinder with the unloader piston pushed to the full load side.
If the unloader piston projects to the unloaded side, the cylinder cannot be set straight and the inner surface of the cylinder may be damaged by the corner of the unloader piston when it is mounted.
Scratches or scoring of the inner cylinder surface will reduce sealing efficiency and the functional life of the component.

5.2.10 Unloader Sensor

Place the Sensor Rod Assembly in the Rotor Casing (1). Reciprocate the rod manually before mounting to confirm smooth operation.

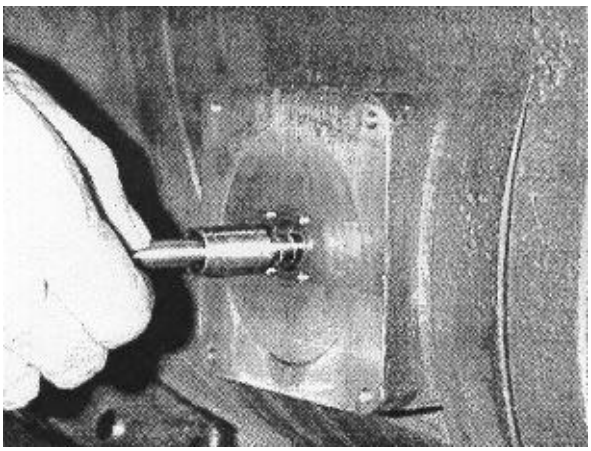


Fig. 5-35 Mounting the Sensor Rod Assembly.

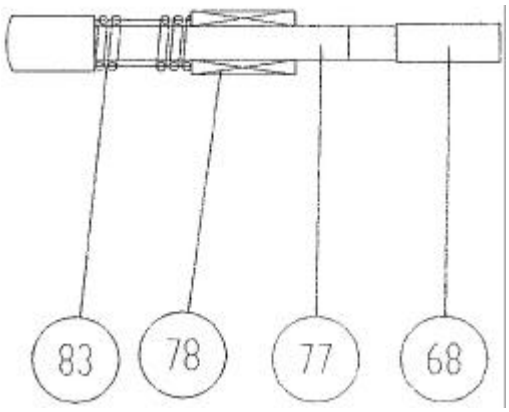


Fig. 5-36 Sensor Rod Assembly

Screw the Slide Valve Operational Rod into the tapped hole in the end of the slide Push Rod (67) and reciprocate the slide valve through the full stroke to confirm smooth operation.
Position a dial gauge on the End of The Iron Core (68) of the Sensor Rod and measure the stroke when the slide is moved through the full range.
The stroke allowance is 8 ± 0.5mm.
If the stroke exceed the specified value, probable causes are improper mounting of the Unloader Piston (64), Push Rod (67) wear, improper Unloader Stopper (164) stroke or foreign matter contamination.
Disassemble the components and examine them carefully, replace any faulty parts and reassemble.

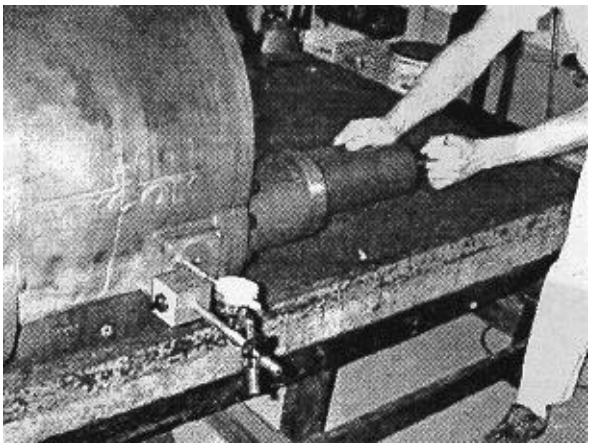


Fig. 5)37 Measuring Slide Valve stroke.

Mount the Position Detector (74).
Since the Detector is constructed of a thin tubing material, care should be taken to prevent damaging it.

☆ IMPORTANT

Handle the position detector carefully to prevent damage or deformation.
Any damage to the detector will result in malfunction or gas leakage.

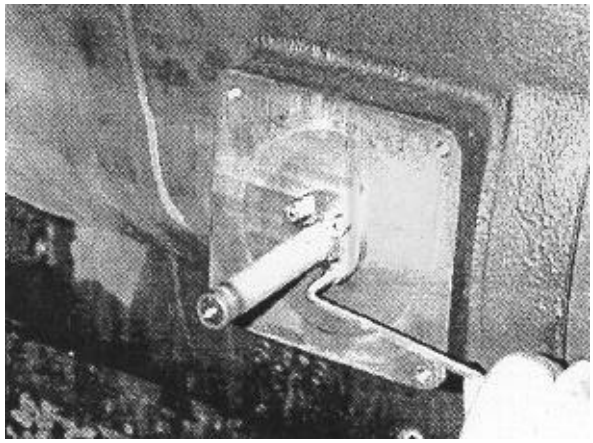


Fig. 5-38 Mounting the Position Detector.

Mount the Differential Transmitter Box (121).
Position the Differential Transmitter (129) in the Position Detector (74) and fit the Differential Transmitter Gland.
Fit the Differential Transmitter so that the signal cord extends ouside the Box.

☆ IMPORTANT

Handle the inner portion of the transmitter box with clean hands only.
Oil or metal fragments contamination may cause deterioration and failure of the electrical components, resulting in transmitter failure.

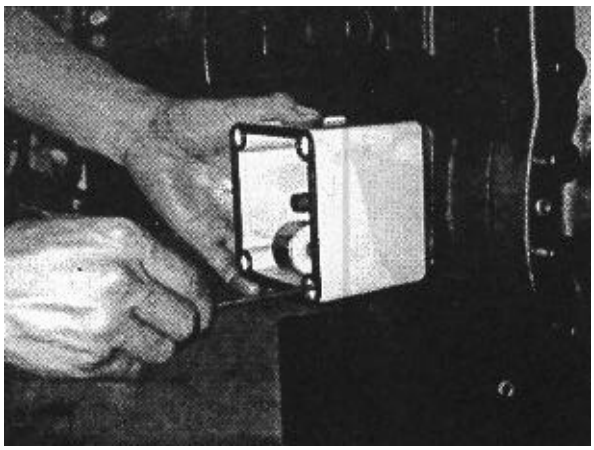


Fig. 5-39 Mounting the Differential Transmitter Box

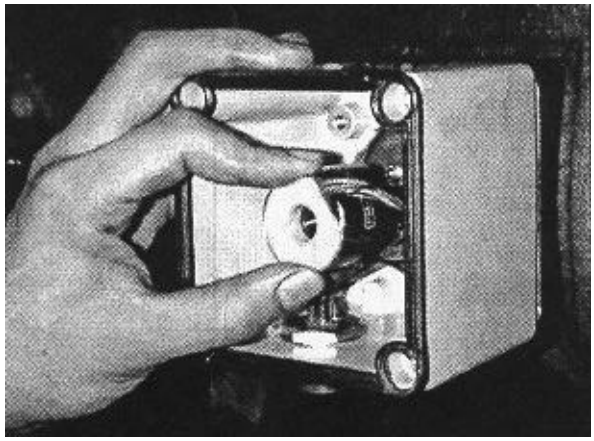


Fig. 5-40 Mounting the Differential Transmitter

5.2.11 Solenoid Valve

Mount the Solenoid Valve (562) after confirming that the gasket aligns properly with the hole in the Solenoid Valve (562) and Solenoid Valve Plate (560-1).
Mount the left side Solenoid Valve with the Solenoid Valve Plate (560-1)
The use the Solenoid Valve Plate Gasket (560-8) between the End Cover (22) and the Solenoid Valve Plate (560-1).
Connect the Piping (560-6) from Angle Valve (560-7) to Socket (560-4).

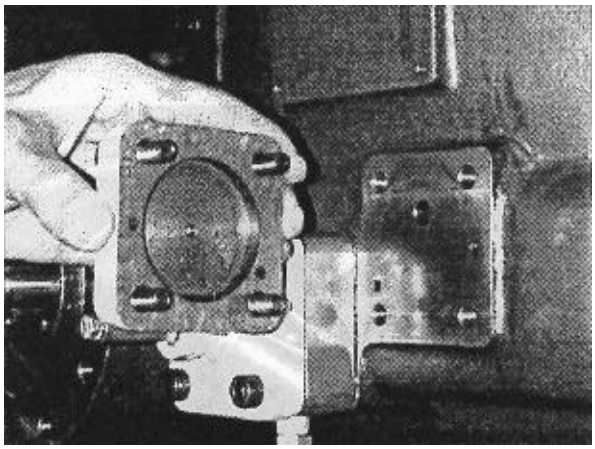


Fig. 5-41 Confirming the position of oil hole

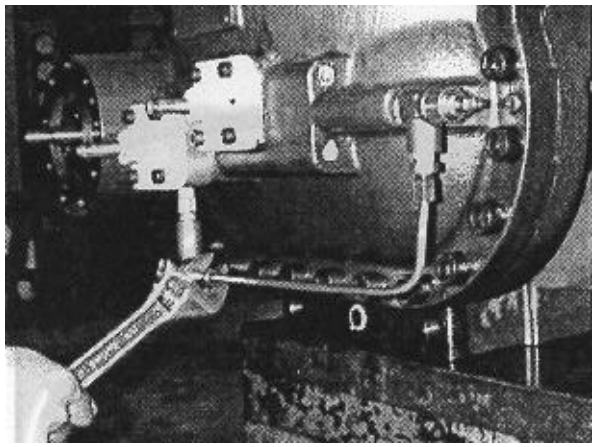


Fig. 5-43 Connecting the Piping

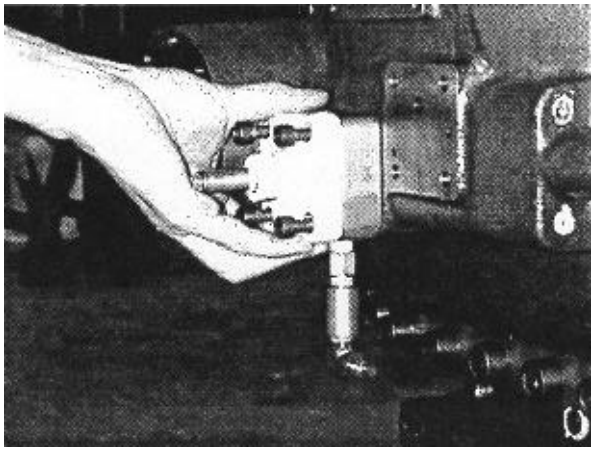


Fig. 5-42 Mounting the Solenoid Valve with the Solenoid Valve Plate

5.2.12 Balance Piston

Fix the Set Screw (31) to thread hole of M-Rotor (25).
Mount the Balance Piston (30) while matching the groove of Piston to the Set Screw.
Mount the Balance Piston Sleeve (33).
Fix the Balance Piston by the Stop Ring (32).

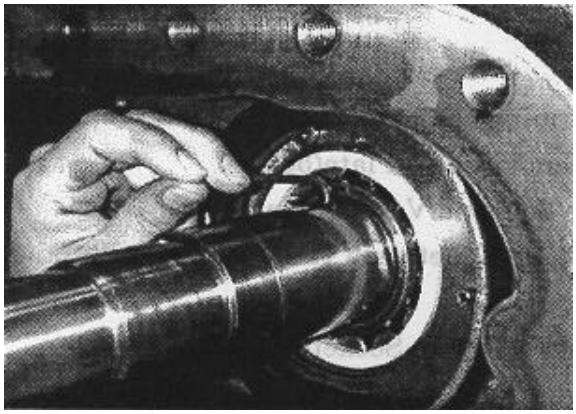


Fig. 5-44 Fixing the Set Screw

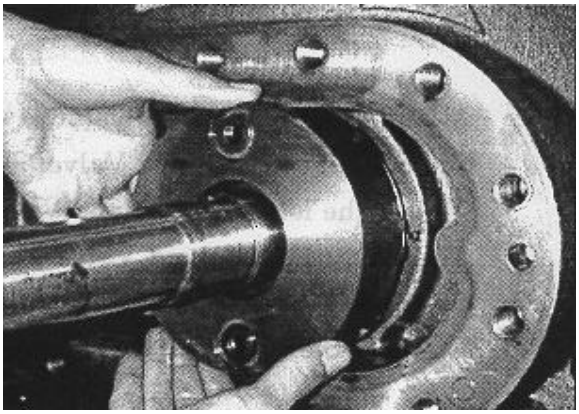


Fig. 5-46 Mounting the Piston Sleeve

Fig. 5-45 Mounting the Balance Piston

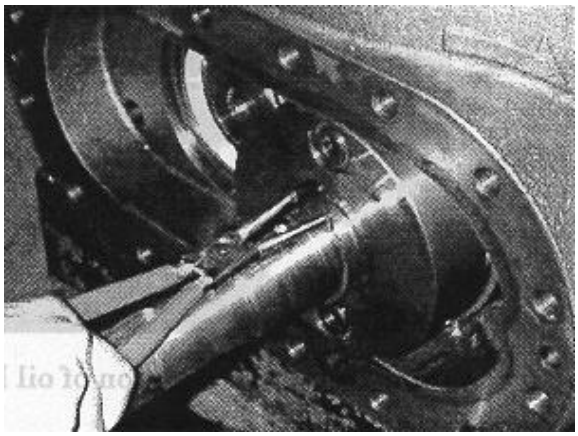


Fig. 5-47 Mounting the Stop Ring.

5.2.13 Bearing Cover

Mount the Bearing Cover (16) on the Bearing Head (11).
Confirm that O-Ring (35) places in up and down side groove of Balance Piston Sleeve (33).
Mount the Cover using the stud bolts, taking care to align the cover carefully and to prevent damaging the Rotor Shaft.
Position the Cover as close to the Bearing Head as possible and secure the fitting Bolts (2) temporarily.
Drive in the Positioning Pin (3) and then tighten the Bolts (2) to the specified torque.

Fig. 5-48 Mounting the O-Ring

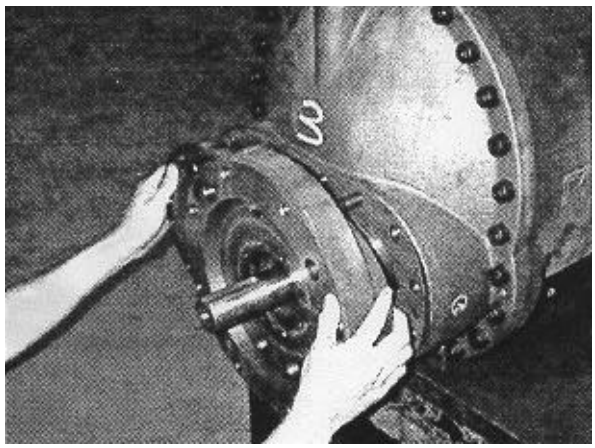


Fig. 5-49 Mounting the Bearing Cover

5.2.14 Shaft Seal Assembly and Seal Cover

Mount the Oil Seal (50) on the Oil Seal Retainer (48) and then mount in the Bearing Cover. The mounting use an eye bolt.
A locking Spring Pin (20) is provided in the casing. Align the notch in the Oil Seal Retainer with the Pin in the Bearing Cover.

After mounting the Oil Seal Retainer (48), turn the shaft in the direction of rotation to confirm that the Pin and the notch are aligned.
Fit the O-ring (49) so that it is fits the Oil Seal Retainer and the corner of the casing closely.

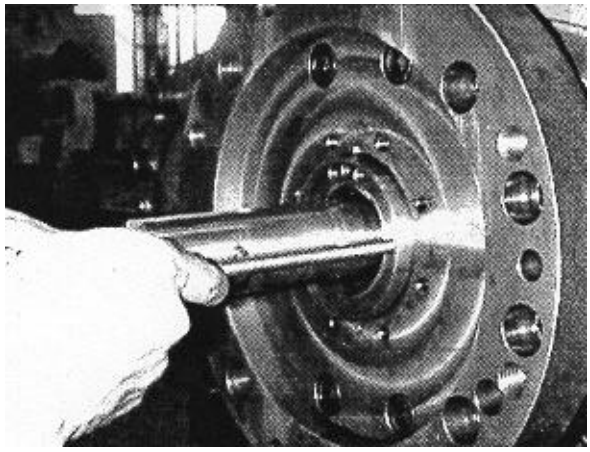


Fig. 5-50 Mounting the Oil Seal Retainer

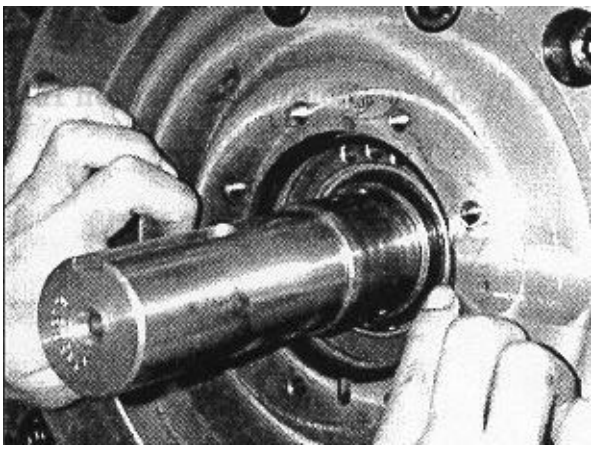


Fig. 5-51 Inserting the O-Ring

Mount the Mechanical Shaft Seal (100) on the Rotor (25). The orientation of the Mechanical Shaft Seal and the Rotor is dertermined by an Allen Bolt.

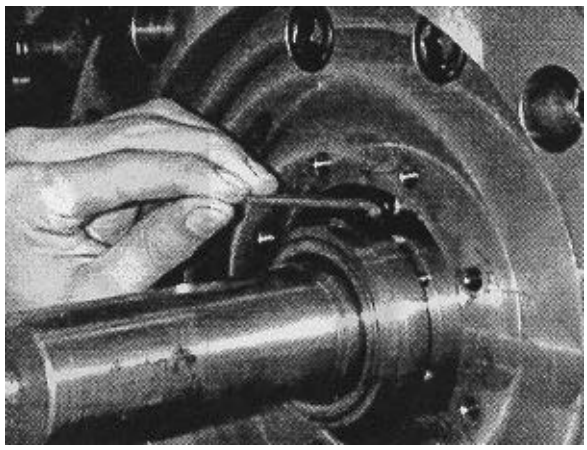


Fig. 5-52 Mounting the Mechanical Shaft Seal

Position the Carbon Insert in the Seal Cover (51) by hand after applying oil to the O-Ring.
Mount the Seal Cover (51) in the Bearing Cover.

Fig. 5-53 Positioning the Carbon Insert

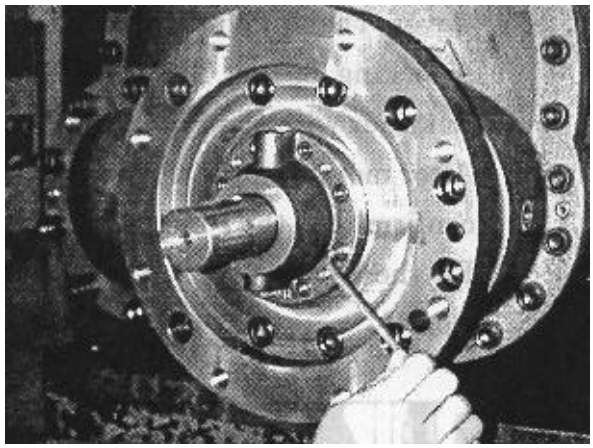


Fig 5-54 Mounting the Seal Cover

5.2.15 Motor Spacer and Motor

Mount the Coupling Hub on the Compressor Shaft.
Mount the Motor Spacer (235) on the compressor stud bolts, using a lifting device to support the weight of the Spacer.

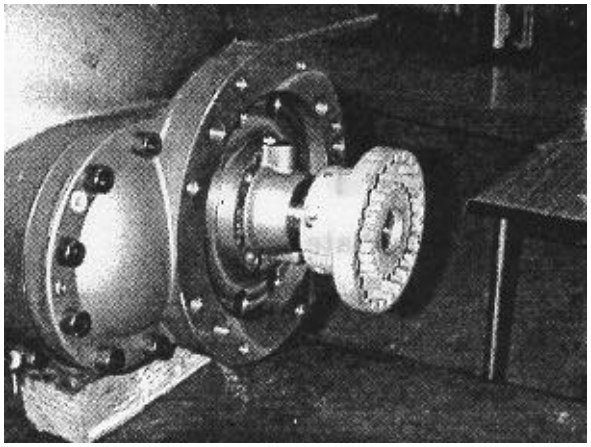


Fig. 5-55 Mounting the coupling

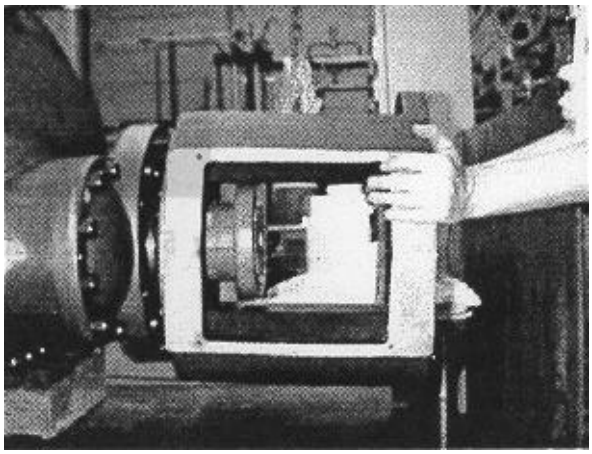


Fig. 5-56 Mounting the Motor Spacer

Connect the Motor to the Motor Spacer (235).
Mount the Coupling Spacer.
Mount the Coupling Hub on the Spacer and then secure the coupling with the fixing bolts.

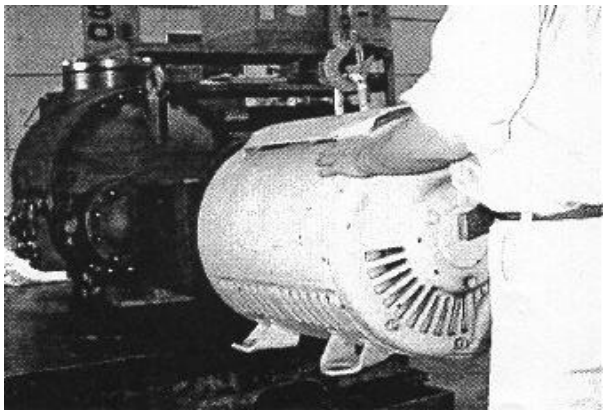


Fig. 5-57 Mounting the Motor

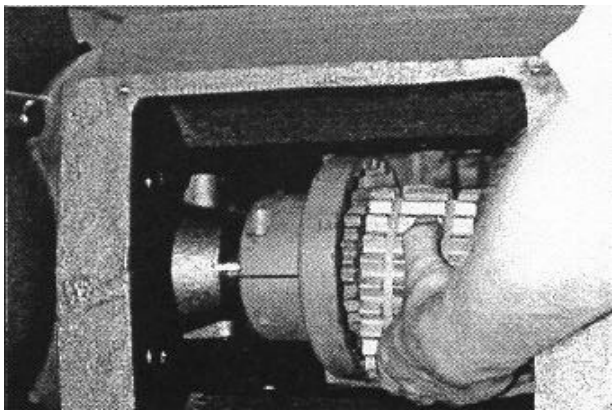


Fig. 5-58 Mounting the Coupling Spacer

Mount the Motor Spacer Plate (235-1).

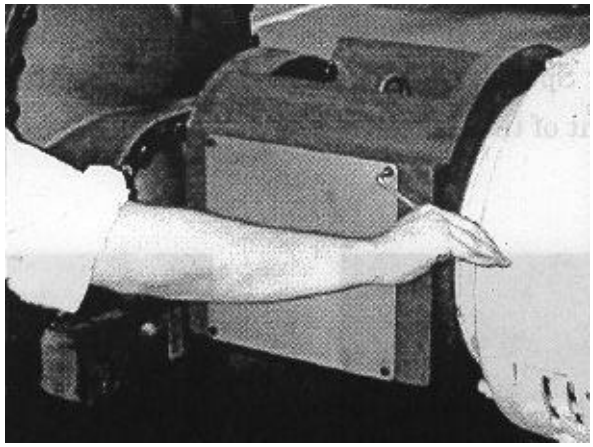


Fig. 5-59 Mounting the Motor Spacer Plate

Reassembly the Compressor is now completed.

6. Reference

6.1 Usability Limits

The screw compressor is subject to predermined usability limits, as shown below. For further details consult the technical information available for the FM Series screw compressor.

No.	Item	Critical value
1	Max. discharge pressure	1.863 Mpa (195gf/cm^{2}G)
2	Max. suction pressure	0.490 Mpa (5kgf/cm^{2}G)
3	Min. suction pressure	-0.079 Mpa (-60cmHg)
4	Min. gigh/low differential pressure	0.490 Mpa (5kgf/cm^2)
5	Max. lubrication pressure	Discharge pressure +0.196MPa (+2.0kgf/cm^2)
6	Min. lubrication pressure	Discharge pressure -0.196Mpa (-2.0kgf/cm^2)
7	Max. discharge temperature	95°C
8	Suction superheat	5~20°C
9	Max. lubrication temperature	60°C
10	Min. lubrication temperature	30°C
11	Max. revolution speed (M rotor)	4500 rpm
12	Min. revolution speed (M rotor)	1000 rpm
13	Refrigerants	NH3, R-22, R-134a

6.2 End Clearance

☆ Rotor discharge end clearance in milimeters.

Model	Value
FM160	0.10 ± 0.03

6.3 Mechanical Seal Type

Model	Type
FM160	BOS-T1

6.4 Bolt Sizes

Application			Bolt size		
No.	Name	Qty	No.	Size	Qty
5	Suction Adapter	1	2	M16x55	8
11	Bearing Head	1	2	M16x55	30
16	Bearing Cover	1	2	M16x55	16
22	End Cover	1	2	M16x55	30
43-1	Bearing Gland M	1	45	M10x65	4
43-3	Bearing Gland F	1	46	M10x65	4
51	Seal Cover	1	58	M8x30	8
60	Unloader Cylinder	1	45	M10x30	9
67	Unloader Push rod	1	68	M8x30	4
74	Position Detector	1	147-1	M4x13	4
121	Differential Transmitter Box	1	122	M5x15	4
146	Differential Transmitter Gland	1	147-1	M4x13	1
164	Unloader Stopper	1	166	M6x20	4
235	Motor Spacer (U.S. spec)	1	2	M16x55	8
	Motor Spacer(U.S. 200HP spec)	1	2	M16x55	8
	Motor Spacer (Europe spec)	1	2	M16x55	8
235-1	Motor Spacer Plate	2	235-2	M16x10	2x4
246	Unloader Slide Valve Guide	1	166	M6x20	2
560-1	Solenoid Valve Plate and Valve (562)	1	560-2	M8x55	4
562	Solenoid Valve	1	58	M8x30	4

6.5 Bolt Torque Values

	N-m	Kgf-cm		N-m	Kgf-cm
M4	3.720	38	M12	84.34	860
M5	7.356	75	M14	121.6	1.240
M6	15.69	160	M16	176.5	1.800
M8	31.38	320	M20	294.2	3.000
M10	54.92	560	M24	451.1	4.600

☆Bearing Gland Allen bolt torque values

Model	Bolt size	N.m	Kgf.cm
FM160	M10x45	39.2	400

6.6 Lock Nuts

Figures in parenthesis indicate number used.

Application	Nut Sizes
Bearing M	AN11 (1)
Bearing F	AN12 (1)
Suction Strainer	M8/2/
Unloader Piston	M12 (1)
Check Valve Stem	M16
Check Valve Stem	M10

6.7 Lock Nut Torque Values

Size	Normal		Maximum	
	N-m	Kgf-cm	N-m	Kgf-cm
AN11	305.8	3.120	882.0	3.900
AN12	399.8	4.080	499.8	5100
M8	1.96	20	3.92	40
M10	19.6	200	39.2	400
M12	19.6	200	39.2	400
M16	19.6	200	39.2	400

6.8 O-ring Sizes

No.	Application	No.	Size	Material	Qty
1	Rotor casing/ Suction adapter (5)	6-1	JIS B2401 G180	NBR	1
1	Rotor casing/ Suction adapter (5)	602	JIS B2401 G190	NBR	1
22	End cover/ Unloader stopper (164)	9	JIS B2401 030	NBR	1
48	Seal retainer/Seal cover (51)	49	JIS B2401 G90	NBR	1
67	Unloader push rod/ Unloader stopper (164)	59	JIS B2401 P20	NBR	1
64	Unloader piston/ Unloader push rod (67)	73	JIS B2401 P9	NBR	1
490	Seat (2)/ Check valve rod (491)	495	JIS B2401 P7	NBR	1

6.9 Compressor Lubricating Oil

Function and Properties

The quality of lubricating oil significantly affects the performance and life of the compressor. Important requirements of refrigeration system lubricating oil include suitable voscosity over a wide temperature range, low fluidity and high flash point.
Taking the above-mentioned characteristics of lubricating oil into consideration, oil used should satisfy the following requirements:

Proper viscosity should be maintained within the potential working temperature range.
Low fluidity should be maintained at low temperature.
The oil should be chemically stable, with no corrosion effect on metal and no effect on system parts made of rubber.
The oil should not experience wax separation at low temperature.
The oil should not generate sludge or carbon under high temperature conditions.
The oil should be free from moisture and foreign matter.
The oil should be able to provide the necessary lubricating effect for a long period of time.

Selection of Compressor Oil

First consider the lubrication requirements of the compressor. Obviously, oil of proper viscosity must be supplied to the moving parts at all times.

Next, consider oil circulation throughout the system. Contradictory factors such as high oil viscosity in the evaporator and low oil viscosity in the compressor must be reconciled.

When using Halocarbon refrigerant, even though the proper initial viscosity was secured, a considerable change in viscosity is inevitable because under certain operating conditions the refrigerant will desolve in the oil. For this reason ISO-VG46 (JIS K2211) grade oil is recommended.

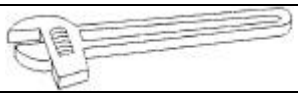
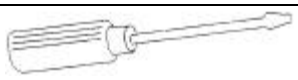
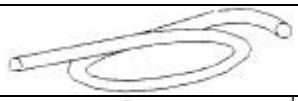
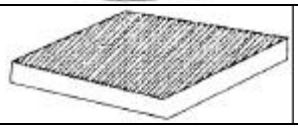
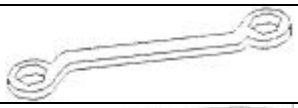
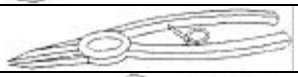
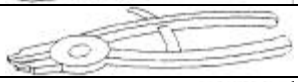
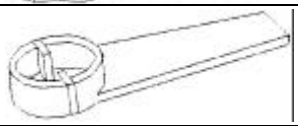
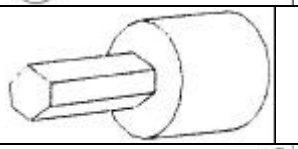
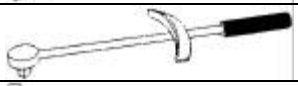
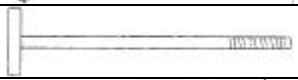
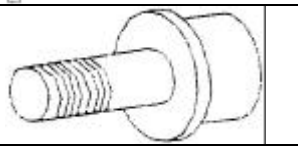
Changing Compressor Oil Brands

When changing from a brand of oil normally used to a new brand, unexpected problems may be encountered due to incompatibility of the old and new oils when they are mixed. Exercise care when changing oil brands.

If the new oil is produced by a different manufacturer, consult with both makers to determine if the change will cause any problem.

Changing the viscosity grade of the same maker’s oil is acceptable, e.g., SUNISO 4GS -> SUNISO 5GS.

6.10 Hand Tool Kit (Option)

Name	Appearance	Remarks
Ratchet wrench (1/4“)		O
Crescent wrench		O
Screwdriver (+)		O
Screwdriver (-)		O
Pipe handle (mm)		Ø 15 x L300
Vinyl hose (mm)		ø 15 x L300
Sponge (160mm x 160mm x 20mm)		O
Double ended wrench (17mm x 19mm)		O
Double offset wrench (30mm x 32mm)		O
Snap ring pliers (Medium for shaft)		O
Snap ring pliers (Large for hole)		O
Lock nut wrench (nut dimensions)		AN-11 AN-12
Eye bolt M8 (2pcs./set)		O
Hex head Socket (widht across flat)		8 mm
Socket wrench handle		O
Torque wrench (max. torque)		920kgf cm
Slide valve operational rod M6		O
Removing Bolt & Washer of Positioning Pin		O
Allen wrench (width across flat) 3 mm 4 mm 5 mm 6 mm 8 mm 14 mm		O O O O O O