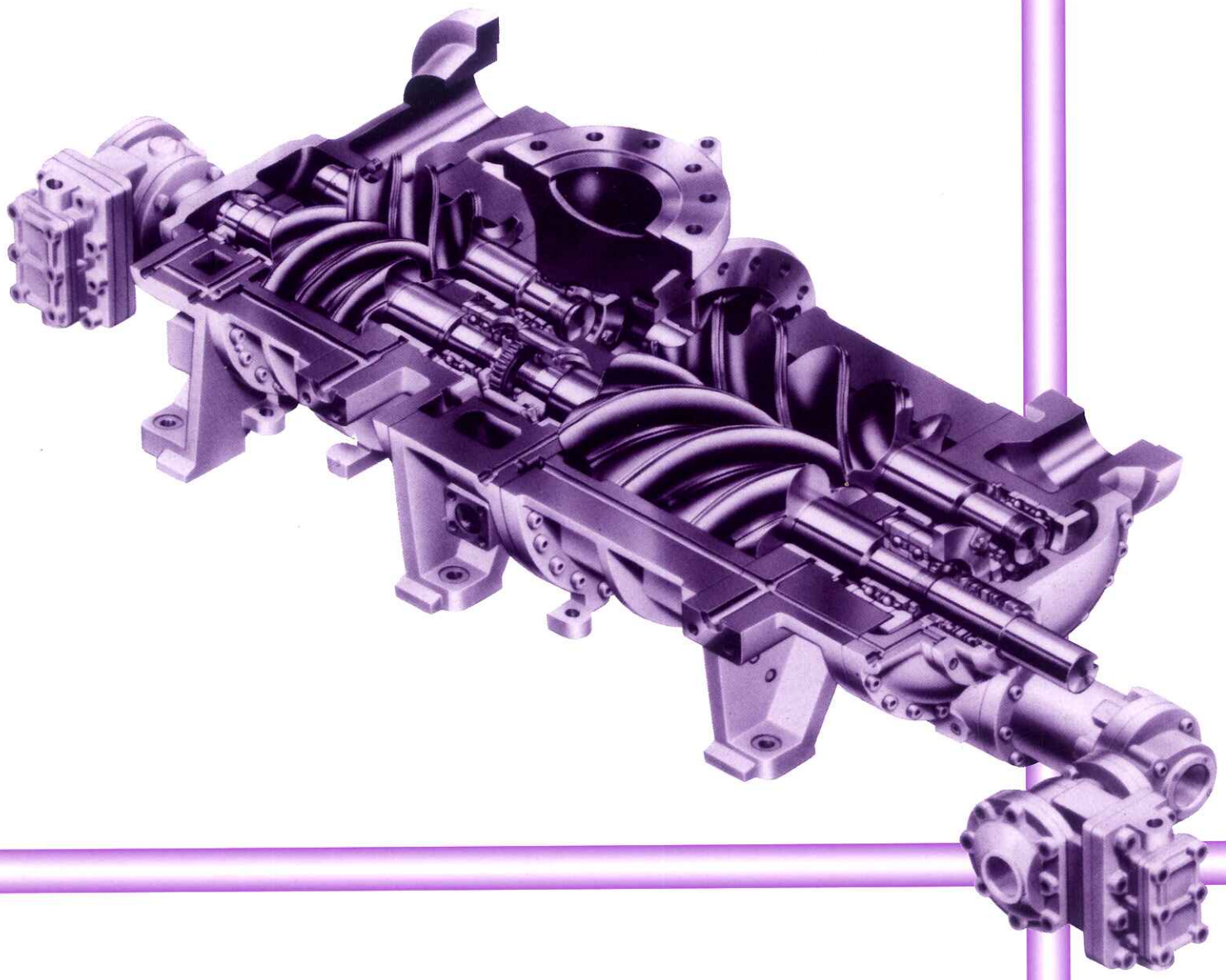
MYCOM

2520C, 3225C

Compound Type Two-stage Screw Compressor Instruction Manual



MAYEKAWA MFG. CO., LTD.

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1 Refrigeration Screw Compressor

1. General Description of Refrigeration Screw Compressor

The compound two-stage screw compressor incorporates two standard screw compressor into a single unit.

Before attempting disassembly and inspection, a thorough knowledge of the structure and characteristics of this machine is essential. Read the following carefully before undertaking any work on the system.

A variety of compressors are used for refrigeration purposes. Among them, the screw compressor is classified as a positive displacement rotary type. It compresses gas continuously by the rotating-motion of two screw-shaped rotors in contrast to the reciprocating compressor, which compresses gas by the reciprocating motion of a piston in a cylinder.

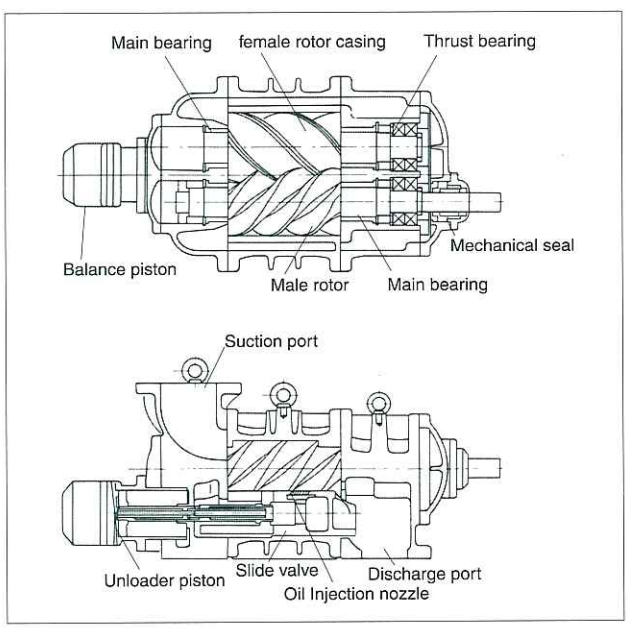


Fig.1 S.T.D. Screw Compressor, Cross Sectional View

As shown in Figs. 1 and 2, the rotating portion of the screw compressor consists of two mating helically grooved rotors, one having four lobes and the other having six. These rotors are mounted in bearings located at either end of the compressor casing.

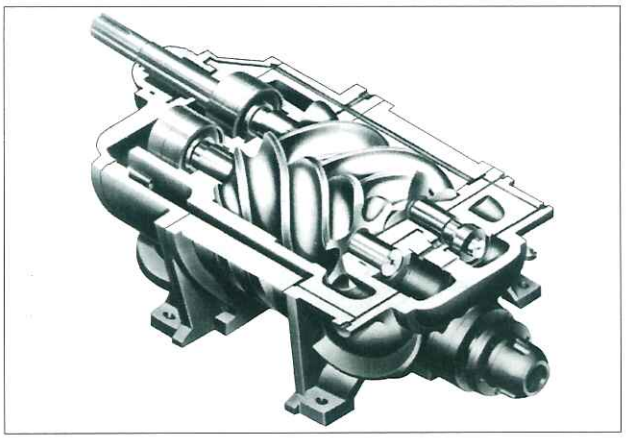


Fig. 2 S.T.D. Screw Compressor, Oblique Sectional View

The rotor with four lobes is termed the "male" rotor while the rotor with six lobes is called the "female" rotor. The leading edges of the male and female rotors correspond to the pitch circle. The rotors rotate at a rate of 2:3, that is, for every three rotations of the male rotor, the female rotor turns two times.

The shaft of the male rotor constitutes the drive shaft of the system. When the compressor is operated at a speed of 3000/3600rpm (50Hz/60Hz), the male rotor turns at a speed of 3000/3600 rpm while the female rotor turns at a speed of 2000/2400.

The rotor lobes have an unsymmetric profile designed to provide maximum compression efficiency. The clearance between the lobes and between the leading edges of the rotors and the casing are sealed by oil injected into the compressor. This oil also serves to cool the rotating portions of the compressor. Because there is no direct metal-to-metal contact between the rotors and the casing, rotor wear is negligible.

Let's look at the how the compressor functions starting with what is called the "gas compression phase."

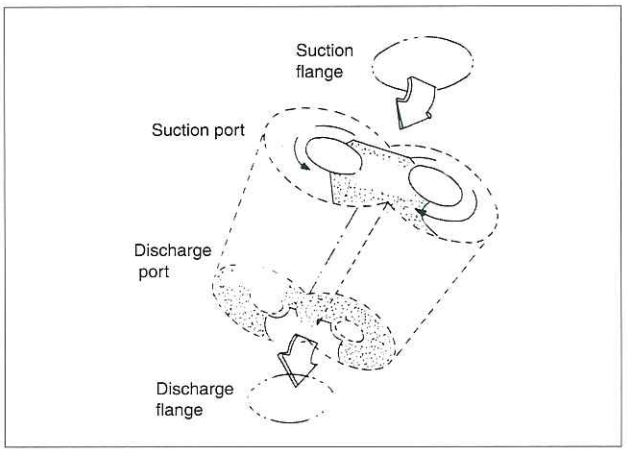


Fig.3-1

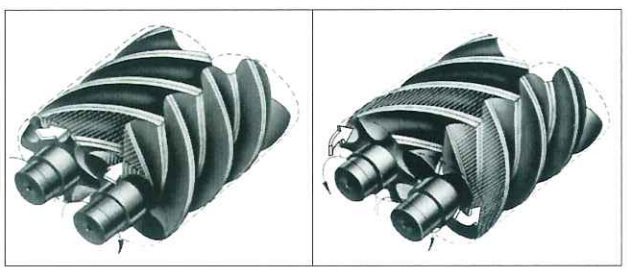


Fig.3-2A Fig.3-2B

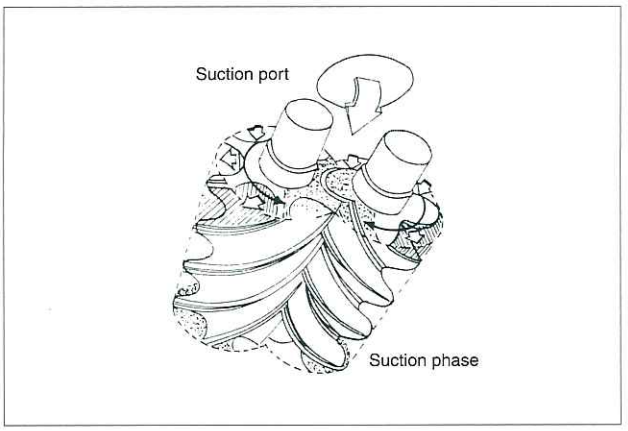


Fig.3-3

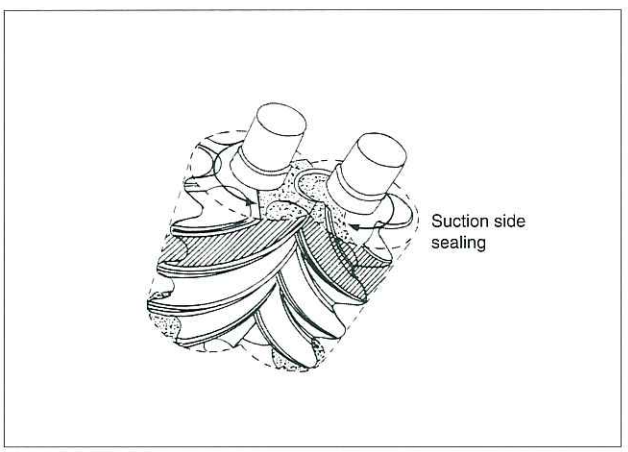


Fig.3-4

Fig. 3-1 gives a view of the rotor casing. All portions except the dropout sections at the end faces of the casing, termed the "Suction Port" and the "Discharge Port," are enclosed by a wall of the casing.

Fig. 3-2 illustrates the "gas suction phase." When the male rotor is in the position shown in Fig. 3-2A, clearance between the rotor causing and the suction side male and female lobes expands gradually (area indicated by hatching). Gas flows into this space from the suction port and expands as shown in Fig. 3-2B.

Fig. 3-3 illustrates the "sealing phase." There is an angle at which the clearance between the rotors reaches the maximum as the rotors turn. When the rotors reach this angle, as shown in Fig. 3-4, the suction side becomes a sealing wall and the clearance between the lobes is sealed peripherally and at both ends.

Fig. 3-5 illustrates the "compression phase." As the rotors turn further, the lobes mesh from the suction side, the sealing line moves toward the discharge side and the volume between the lobes decreases, resulting in compression of the gas.

Fig. 3-6 illustrates the "discharge phase."

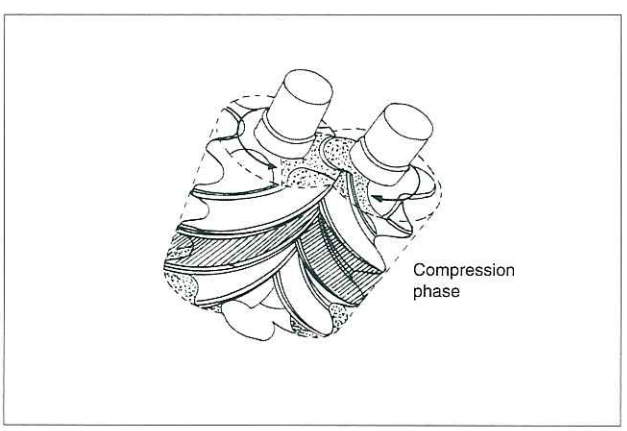


Fig.3-5

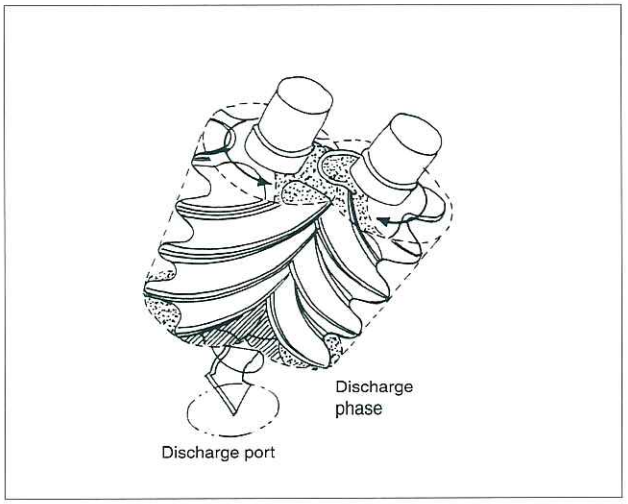


Fig. 3-1～3-6 Compression Phase

As the rotors turn, further decreasing the volume, the chamber formed is linked with the discharge port at a designed volume ratio (explained later) and the compressed gas is move to the discharge side where it is completely purged to finish the process. The compressor continuously performs suction, compression and discharge as the rotor lobes mesh. Since the gas flow in one direction with the motion of rotation, the screw compressor exhibits no vibration.

As well, because it is a positive displacement type machine, stable operation under a wide range of operating conditions is assured.

Note: The volume ratio, indicated as L, M and H in MYCOM catalogues and other publications, represents the ratio of suction volume to volume just before discharge. The following volume ratios are standard at

MYCOM :
L = 2.63
M = 3.65
H = 5.80

$$Vi = \frac{\text{Volume of suction gas when comression begins}}{\text{Volume of same amount of gas at discharge side}}$$

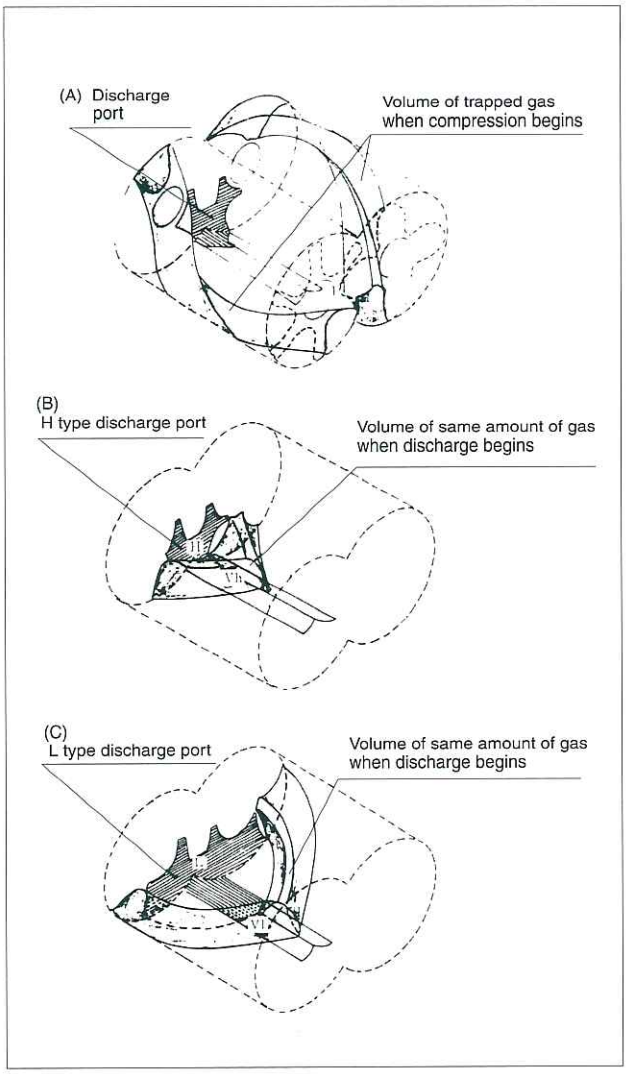


Fig. 4 Vi Explanatory Drawing

In general :$(Vi)K = \pi i = Pd/Ps$
where K = Cp/Cr of refrigerant gas
Vi = Design volume ratio
πi = Design compression ratio

Consequently, selection of the L, M or H volume ratios should be determined according to operating pressure requirements. This must, of course, be decided prior to production of the compressor as no alteration can be carried out to the machine, although in the case of a single-stage compressor, a variable Vi mechanism is a vailable.

Remember that use of a compressor with an inappropriate Vi will result in wasteful power consumption or a shortage of capacity.

a) When design conditions match operational conditions.

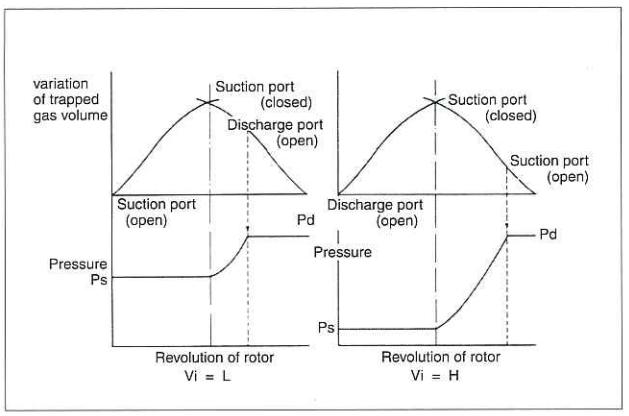


Fig. 5 Volume Between Lobes and Manometric Diagram

b) When design conditions do not match operational conditions.

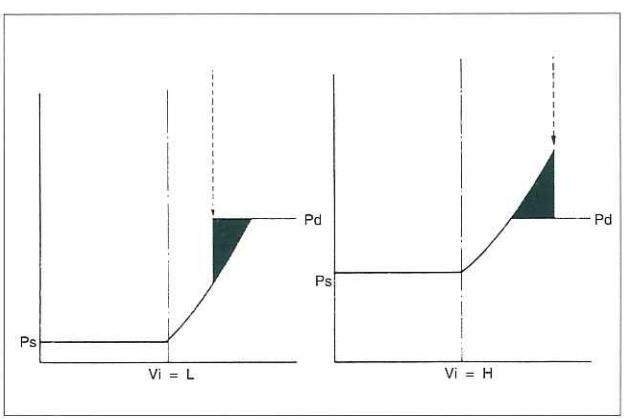


Fig. 6 Manometric Diagram

Structure of the Screw Compressor

The screw compressor consists of male and female rotors, main, side and thrust bearings which support the rotors, a casing which encloses the rotors, a shaft seal for sealing, the power transmission shaft, a capacity control slide valve and a capacity control actuating mechanism.

a) Bearings

The bearings used are a sleeve type lined with, high grade white metal to absorb radial load on the rotors and a face-to-face duplex angular contact ball bearing to absorb axial load.

As the male rotor is a helical gear and thrust resulting from discharge pressure acts on it to a greater extent than on the female rotor, a hydraulic piston is incorporated with the ball bearing to handle axial load.

b) Shaft Seal

The shaft seal is composed of a fixed ring of carbon, a rotating ring of sintered alloy and a Teflon V-ring packing. The entire seal rotates in oil for improve sealing and cooling. The standard seal is an unbalanced type.

A specially constructed balance type seal is also available for applications with large pressure differences and for helium gas compression (ref. 13).

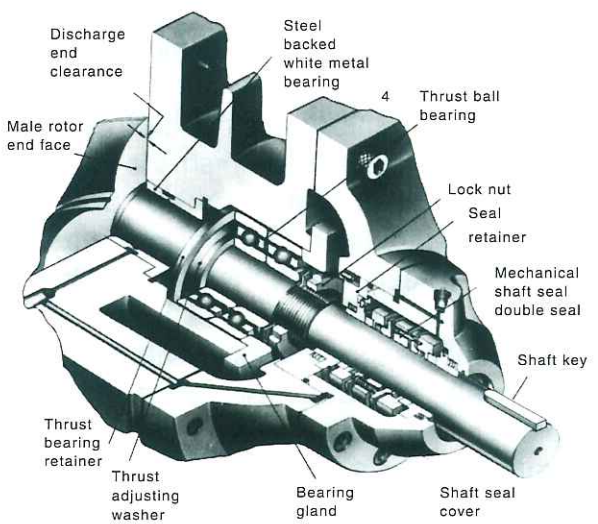


Fig. 7 Shaft Seal, Oblique Sectional View

c) Capacity Control Mechanism

A slide valve mechanism is fitted to the compressor to control load at start-up and during normal operation.

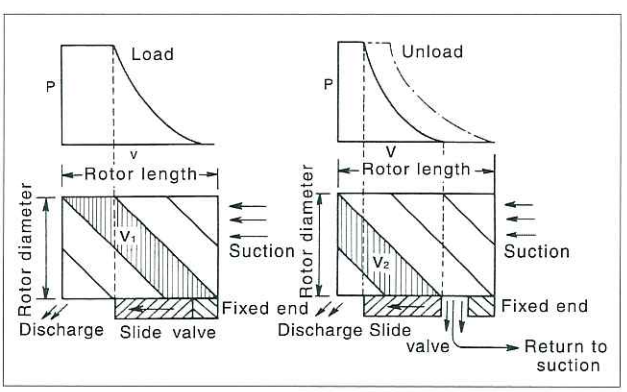


Fig. 8-1 Capacity Control

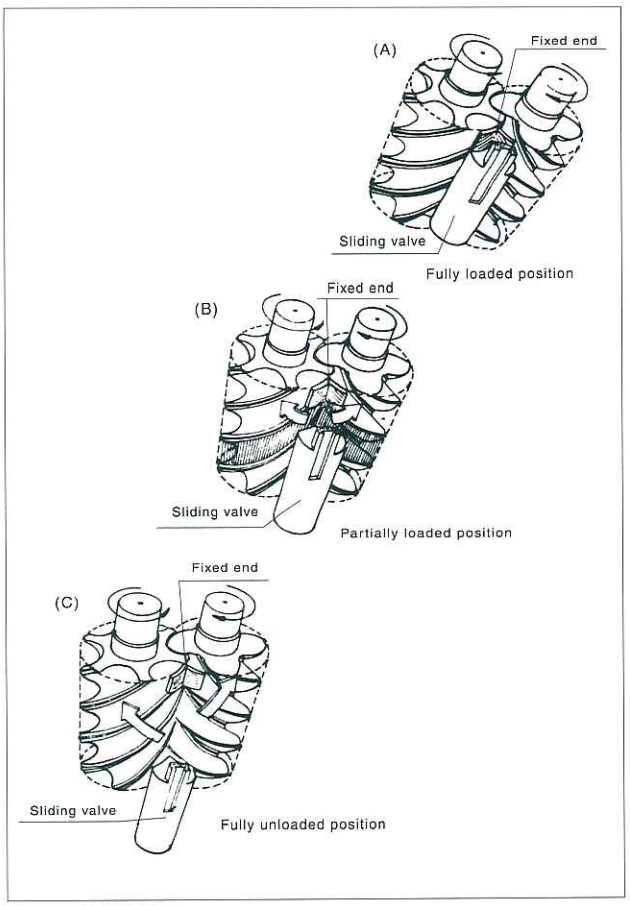


Fig. 8-2 Slide Valve

A portion of the meshing side wall of the rotor casing functions as a slide valve, moving parallel to the rotor axis to bypass gas after sealing (ref. Fig. 8) to the suction side and thus reduce the amount of gas compressed.

The slide valve is actuated by a hydraulic cylinder and piston, the movement of which is converted to rotating motion by a cam. The angle of rotation is indicated on a dial and by electrical resistance.

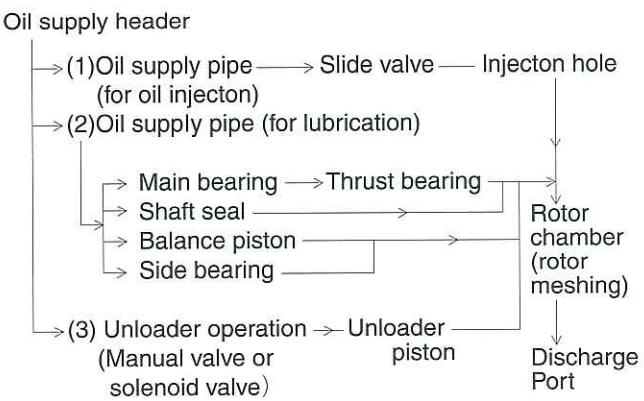
Oil Flow in Standard Refrigeration Compressor

The screw compressor utilizes one kind of oil for lubrication, sealing and injection (cooling).

Oil pressurized to 1.5~3.0kg/cm^2 above the refrigerant gas discharge pressure is required to operate the unloader piston and the balance piston (ref. Fig. 9). This is accomplished by an oil pump.

An oil tank is positioned at the high-pressure side of the compressor. Pressure in the oil charging portion of the compressor is less than pressure in the oiltank, therefore oil charging can be accomplished either by using the pressure difference or using the oil pump. The method used is dependent upon the usage of the compressor. Oil flow is generally the same.

Lubrication oil flow inside of the compressor. Lubricating oil follows three paths through the compressor and is discharged with the gas.



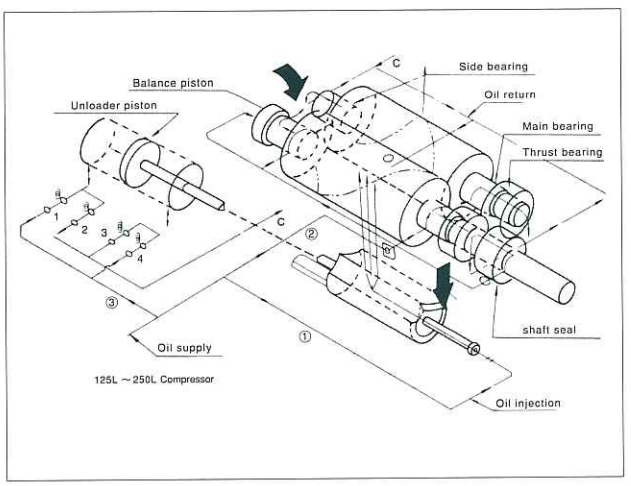


Fig. 9 Hydraulic System Diagram

2. Compound Type Two-stage Refrigeration Screw Compressor

Since oil injection into the compressor to seal and cool the rotors results in a comparatively low discharge gas temperature, the compound type two-stage compressor does not require a gas intercooler. The two sets of rotors are effectively combined into one machine providing two-stage compression.

A) Current models manufactured and sold by MYCOM are as shown in Table 1.

This manual describes Models 2520 and 3225 of the series. Other manuals are 1612.

Table 1 shows the models and types currently manufactured. Although some columns in the table remain blank, most models and types are available on order.

This manual is applicable to new models and types not currently manufactured but which may be available in future.

B) Compound Type Two-stage Compressor Model Interpretation

This compressor series is divided broadly into two models; the 2520C and the 3225C.

These two models are further subdivided according to the combination of compressors. The designations 2520 and 3225 are codes designating the nominal rotor diameter of the low-stage and high-stage sides.

There are three rotor length savailable with the same rotor diameter. These are indicated as:

L = L / D = 1.65
M = L / D = 1.38
S = L / D = 1.10

The subsequent figures indicate the driving system, with 51/61 representing a direct coupled motor drive.

In the case of a standard compressor, the Vi port is also indicated. For two-stage compressors, however, a combination of high-stage M port and low-stage M port is the standard, although other combinations may be ordered to meet application requirements.

1) Standard
   1610C, 1612C... MB-L port
   2016C, 2520C, 3225C...MB-M port
2) Ports other than standard are available.

Table 1 Compound Type Two-stage Screw Compressors

Classification	Type / Model	2520	3225
Standard type (Common for R and NH3)	SSC	☆	☆
	MSC	☆	
	SLC	☆	☆
	MSL	☆	☆
	MMC	☆	☆
	LSC	☆	☆
	LMC	☆	
	LLC	☆	☆
Helium type (Helium only)	SSC	☆	
	MSC	☆	
	LSC	☆	☆
	LMC	☆	
	LLC		☆

3. Parts List

Some parts for the high- and low-stage sides of the compressor may differ according to rotor length.

Care should be taken when ordering parts marked P as parts numbers differ according to model (rotor length).

Parts number given in the parts list are for 2520LSC and 3225LSC models. When ordering parts, please specify the Model and Serial Number.

Reference

The compound type two-stage screw compressor is used for various applications other than standard. Consequently, the main body of the compressor is partially modified according to the application. Main modifications include the following:

❶ Oil return circuit with external piping

The routing of the external piping is arranged based on the application. Oil in the high pressure side balance piston and in the side bearing feeds to the low-stage rotor casing through the high-stage side suction cover via external piping and from the low-stage side bearing cover to the low-stage side rotor casing. In this case the internal oil passage is blind.

❷ When the refrigerant used is R-22, some models are designed to use the high-stage side return oil for rotor sealing only and the oil injection circuit in the low-stage side is closed. The decrease in shaft power without any decrease in volumetric efficiency results in higher performance efficiency. An "A" is added to the end of the model designation to indicate this type.

❸ He (Helium) Compressors

O-rings are installed on the mechanical shaft seal and unloader cam seal.

The mechanical shaft seal used is a special balance type provided with an external lubrication system.

❹ Oil supply is by one of two systems according to the design specifications of the compressor unit.

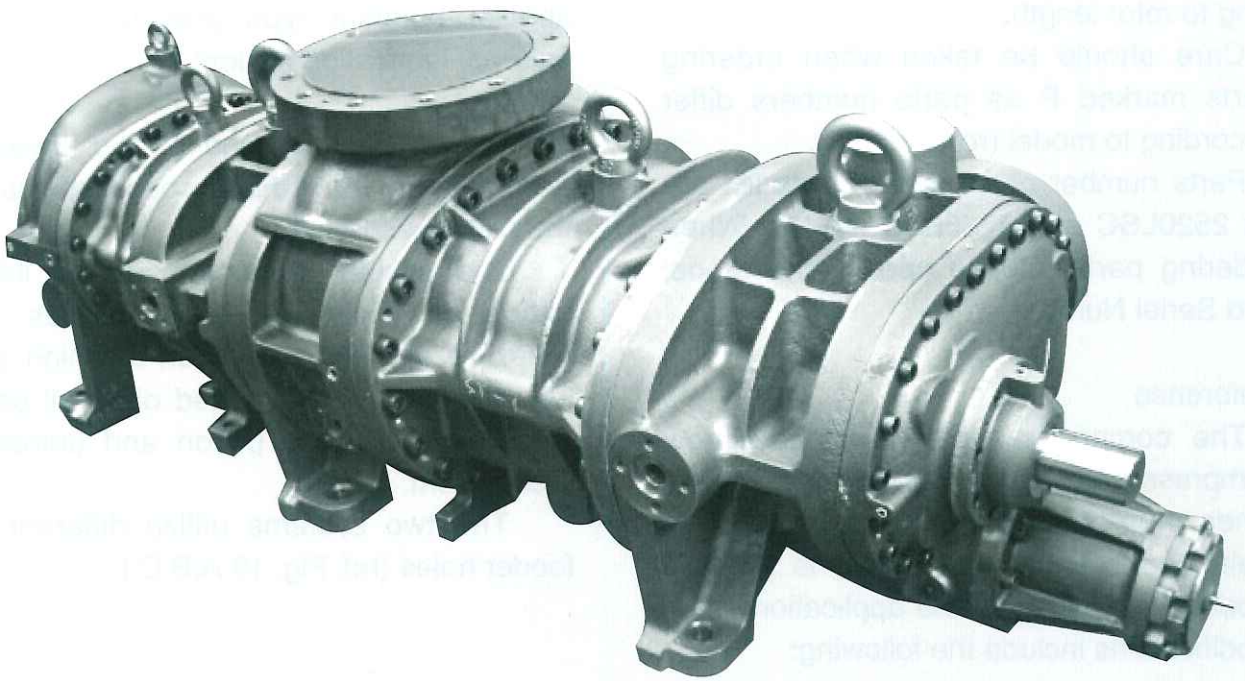
One system pressurmises all lubrication oil while the other utilizes the pressure difference between the high and low pres-sure sides to feed oil to all parts except the balance piston and unloader mechanism.

The two systems utilize different oil feeder holes (ref. Fig. 19 A.B.C.).

4. Exploded Views

Parts List

2520**C



2520**C PARTS LIST

No.		Parts Name	Code No.	Q.ty	Remarks	LSC	LMC	MMC	MSC	SLC	SMC	SSC
1-1		Main Rotor Casing (1)	CS0010-FL	1	250L**	1	1					
1-1		Main Rotor Casing (1)	CS0010-FM	1	250M**			1	1			
1-1		Main Rotor Casing (1)	CS0010-FS	1	250S**					1	1	1
1-2		Main Rotor Casing (2)	CS0010-ES	1	200L**					1		
1-2		Main Rotor Casing (2)	CS0010-EM	1	200M**		1	1			1	
1-2		Main Rotor Casing (2)	CS0010-ES	1	200S**	1			1			1
2-1		Hexagon Socket Head Cap Screw	NB3520-060	66	M20×60							
2-2		Hexagon Socket Head Cap Screw	NB3516-050	50	M16×50							
3-1		Alignment Pin	NE2016-070	4	φ16×70							
3-2		Alignment Pin	NE2016-055	4	φ16×55							
4-1		Hanger Bolt	NB6000-024	1	M24							
4-2		Hanger Bolt	NB6000-020	1	M20							
5-1		Suction Cover (1)	CS0050-L1	1	2520**C							
5-2		Suction Cover (2)	CS0050-L2	1	2520**C							
6-1		Gasket, Suction Cover (1)	CS0061-F	1	250***							
6-2		Gasket, Suction Cover (2)	CS0061-E	1	200***							
7-1		Hanger Bolt	NB6000-012	2	M12							
7-2		Hanger Bolt	NB6000-012	1	M12							

No.		Parts Name	Code No.	Q.ty	Remarks	LSC	LMC	MMC	MSC	SLC	SMC	SSC
8-1		Spring Pin (1)	NE3206-012	2	φ6×12							
8-2		Spring Pin (2)	NE3206-012	2	φ6×12							
9		O-ring	PA2401-040	1	JISB2401 1A P40							
10-1	A	Plug	NF0600-10	1	R3/8							
10-1	B	Plug	NF0600-15	1	R1/2							
10-2	A	Plug	NF0600-10	1	R3/8							
10-2	B	Plug	NF0600-08	1	R1/4							
10-2	C	Plug	NF0600-15	1	R1/2							
11-1		Bearing Head (1)	CS0110-L1	1	2520**C							
11-2		Bearing Head (2)	CS0110-L2	1	2520**C							
12-1		Gasket, Bearing Head (1)	CS0121-F	1	250***							
12-2		Gasket, Bearing Head (2)	CS0121-E	1	200***							
13-1		Hanger Bolt	-	1	M36							
13-2		Hanger Bolt	-	1	M36							
14-1		Spring Pin	NE3206-012	2	φ6×12							
14-2		Spring Pin	NE3206-012	2	φ6×12							
15-1		Plug	NF0600-20	1	R3/4							
16		Bearing Cover	CS0160-L	1	2520**C							
17-1		Gasket, Bearing Cover (1)	CS0171-L1	1	2520**C							
17-2		Gasket, Bearing Cover (2)	CS0171-L2	1	2520**C							
18-1		Hexagon Socket Head Cap Screw	NB3516-050	20	M16×50							
18-2		Hexagon Socket Head Cap Screw	NB3520-060	33	M20×60							
19-1		Alignment Pin	NE2010-050	2	φ10×50							
19-2		Alignment Pin	NE2016-070	2	φ16×70							
20		Spring Pin	NE3203-010	1	φ3×10							
21		Plug	NF0600-04	1	R1/8							
22		Balance Piston Cover	CS0220-L	1	2520**C							
23		Gasket, Balance Piston Cover	CS0231-L	1	2520**C							
24		Hexagon Socket Head Cap Screw	NB3516-050	18	M16×50							
25-1		Male Rotor (1)	CS0250-L1L	1	2520L*C	1	1					
25-1		Male Rotor (1)		1	2520M*C			1	1			
25-1		Male Rotor (1)		1	2520S*C					1	1	1
25-2		Male Rotor (2)		1	2520*LC					1		
25-2		Male Rotor (2)		1	2520*MC		1	1			1	
25-2		Male Rotor (2)		1	2520*SC	1			1			1
26-1		Female Rotor (1)		1	250L**	1	1					
26-1		Female Rotor (1)		1	250M**			1	1			
26-1		Female Rotor (1)		1	250S**					1	1	1
26-2		Female Rotor (2)		1	200L**					1		
26-2		Female Rotor (2)		1	200M**		1	1			1	
26-2		Female Rotor (2)		1	200S**	1			1			1
27-1		Main Bearing (1)	CS0270-FRT	2	250***							
27-2		Main Bearing (2)	CS0270-ERT	2	200***							
28-1		Side Bearing (1)	CS0280-FRT	2	250***							
28-2		Side Bearing (2)	CS0280-ERT	2	200***							
29-1		Stop Ring (1)	NG1100-160	4	H160							

No.		Parts Name	Code No.	Q.ty	Remarks							
						LSC	LMC	MMC	MSC	SLC	SMC	SSC
29-2		Stop Ring (2)	NG1100-130	4	H130							
30		Balance Piston	CS0300-L	1	2520**C							
31		Key, Balance Piston	CS0310-E	1	200***							
32		Stop Ring	NG1200-065	1	S65							
33		Sleeve, Balance Piston	CS0330-L	1	2520**C							
34		Set Screw	NA8608-015	2	M8×15							
35		O-ring	PA2401-140	1	JISB2401 1A P140							
37		Stop Ring	NG1100-150	1	H150							
38-1		Thrust Bearing (1)	CS0380-F	2set	7317AFADFC7P5a							
38-2		Thrust Bearing (2)	CS0380-E	2set	7313AFADFC7P5a							
39-1		Lock Nut (1)	NG3100-17	2	AN17							
39-2		Lock Nut (2)	NG3100-13	2	AN13							
40-1		Lock Washer (1)	NG3200-17	2	AW17							
40-2		Lock Washer (2)	NG3200-13	2	AW13							
41-2		Spacer, Thrust Bearing Outer Race (2)	CS0410-E	2	200***							
42-1		Spacer, Thrust Bearing Alignment (1)	CS0420-1F	2	250***, Booster							
42-2		Spacer, Thrust Bearing Alignment (2)	CS0420-E	2	200***							
43-1		Thrust Bearing Gland (1)	CS0430-F	2	250***							
43-2	A	Thrust Bearing Gland (2) A	CS0430-E	2	200***							
43-2	B	Thrust Bearing Gland (2) B	CS0430-L2B	1	2520**C							
43-2	C	Thrust Bearing Gland (2) C	CS0430-L2C	1	2520**C							
43-2	D	Thrust Bearing Gland (2) D	CS0430-L2D	1	2520**C							
45-1		Hexagon Head Bolt	NB1516-045	8	M16×45							
45-2		Hexagon Head Bolt	NB1412-035	8	M12×35							
46-1		Lock Washer (1)	CS0460-F	8	250***							
46-2		Lock Washer (2)	CS0460-E	8	200***							
48		Retainer, Oil Seal	CS0480-FV	1	250V**							
49		O-ring	PA2402-135	1	JISB2401 1A G135							
50		Oil Seal	CS0501-FV	1	SA1J 75×100×13							
51		Seal Cover	CS05010-FB	1	250***							
51		Seal Cover	CS0510-EHE	1	250***							
52		Gasket, Seal Cover	CS0521-F	1	250***							
53		Hexagn Socket Head Cap Screw	NB3512-030	8	M12×30							
54-1		Unloader Slide Valve (1-1)(L Port)		1	2520L*C	1	1					
54-1		Unloader Slide Valve (1-1)(M Port)		1	2520L*C	1	1					
54-1		Unloader Slide Valve (1-1)(L Port)		1	2520M*C			1	1			
54-1		Unloader Slide Valve (1-1)(M Port)		1	2520M*C			1	1			
54-1		Unloader Slide Valve (1-1)(L Port)		1	2520S*C					1	1	1
54-1		Unloader Slide Valve (1-1)(M Port)		1	2520S*C					1	1	1
54-2		Unloader Slide Valve (1-2)(L Port)		1	2520*SC	1			1			1
54-2		Unloader Slide Valve (1-2)(M Port)		1	2520*SC	1			1			1
54-2		Unloader Slide Valve (1-2)(L Port)		1	2520*MC		1	1			1	
54-2		Unloader Slide Valve (1-2)(M Port)		1	2520*MC		1	1			1	
54-2		Unloader Slide Valve (1-2)(M Port)		1	2520*LC					1		
55-1		Unloader Slide Valve (2-1)		1	250L**	1	1					
55-1		Unloader Slide Valve (2-1)		1	250M**			1	1			

No.		Parts Name	Code No.	Q.ty	Remarks	LSC	LMC	MMC	MSC	SLC	SMC	SSC
55-1		Unloader Slide Valve (2-1)		1	250S**					1	1	1
55-2		Unloader Slide Valve (2-2)		1	200L**					1		
55-2		Unloader Slide Valve (2-2)		1	200M**		1	1			1	
55-2		Unloader Slide Valve (2-2)		1	200S**	1			1			1
58-1		Hexagon Socket Head Cap Screw	NB3512-040	4	M12×40							
58-2		Hexagon Socket Head Cap Screw	NB3510-030	4	M10×30							
59		O-ring	PA2401-026	1	JISB2401 1A P26							
60-1		Unloader Cylinder (1)	CS0600-L1	1	2520LSC	1	1	1	1	1	1	1
60-2		Unloader Cylinder (2)	CS0600-L2	1	2520LSC	1	1	1	1		1	1
60-2		Unloader Cylinder (2)	-	1	2520SLC					1		
61-1		Hexagon Socket Head Cap Screw	NB3516-140	9	M16×140							
61-2		Hexagon Socket Head Cap Screw	NB3512-090	9	M12×90							
63-1		O-ring	PA2402-150	1	JISB2401 1A G150							
63-2		O-ring	PA242-150	1	JISB2401 1A G150							
64-1		Unloader Piston (1)	CS0640-L	1	2520**C							
64-2		Unloader Piston (2)	CS0641-E	1	200***							
65-1		O-ring	PA2401-125	1	JISB2401 1A P125							
65-2		O-ring	PA2401-125	1	JISB2401 1A P125							
66-1		Cap Seal	CS0660-E	1	200***							
66-2		Cap Seal	CS0660-E	1	200***							
67-1		Push Rod,Unloader Slide Valve (1)	CS0670-L1	1	2520LSC	1	1	1	1	1	1	1
67-2		Push Rod,Unloader Slide Valve (2)	CS0670-L2	1	2520LSC	1			1			1
67-2		Push Rod,Unloader Slide Valve (2)	-	1	2520LMC		1	1			1	
67-2		Push Rod,Unloader Slide Valve (2)	-	1	2520SLC					1		
68-1		Guide Pin	CS0680-05	1	φ5×12							
68-2		Guide Pin	CS0680-05	1	φ5×12							
69-1		Lock Nut (1)	NG3100-08	1	AN08							
69-2		Lock Nut (2)	NG3100-07	1	AN07							
70-1		Lock Washer (1)	NG3200-08	1	AW08							
70-2		Lock Washer (2)	NG3200-07	1	AW07							
71-1		Lock Nut (1)	NG3100-08	1	AN08							
71-2		Lock Nut (2)	NG3100-07	1	AN07							
72-1		Lock Washer (1)	NG3200-08	1	AW08							
72-2		Lock Washer (2)	NG3200-07	1	AW07							
73-1		O-ring	PA2402-035	1	JISB2401 1A G35							
73-2		O-ring	PA2402-030	1	JISB2401 1A G30							
74-1		Unloader Cylinder Cover (1) (Explosion-Proof Type)	CS0740-EB	1	200***							
74-2		Unloader Cylinder Cover (2)	CS0740-E	1	200***							
75		O-ring	PA2402-135	2	JISB2401 1A G135							
76		Hexagon Socket Head Cap Screw	NB3510-025	16	M10×25							
77-1		Indicator CAM (1)	CS0770-L	1	2520LSC	1	1					
77-1		Indicator CAM (1)	CS0770-LM	1	2520MSC			1	1			
77-1		Indicator CAM (1)	CS0770-L1	1	2520SSC					1	1	1
77-2		Indicator CAM (2)	CS0770-EL	1	200L**					1		
77-2		Indicator CAM (2)	CS0770-EM	1	200M**		1	1			1	

No.		Parts Name	Code No.	Q.ty	Remarks	LSC	LMC	MMC	MSC	SLC	SMC	SSC
77-2		Indicator CAM (2)	CS0770-ES	1	200S**	1			1			1
78		Ball Bearing	CS0780-E	2	#6000							
79		Stop Ring	NG1200-010	2	S10							
80		Bearing Gland	CS0800-E	2	200***							
81		Hexagon Socket Head Cap Screw	NB3506-015	6	M6×15							
82		V-ring	CS0820-EB	2set	20×10×12							
83		Spring	CS0830-E	2	200***							
84		Retainer,Indicator Cam Spring	CS0840-E	2	200***							
85		Oil Injection Pipe	CS0850-FL	1	250L**	1	1					
85		Oil Injection Pipe	-	1	2520MSC			1	1			
85		Oil Injection Pipe	-	1	2520SSC					1	1	1
86		O-ring	PA2402-025	1	JISB2401 1A G25							
87-1		Guide Block (1)	CS0870-F	1	250***							
87-2		Guide Block (2)	CS0870-E	1	200***							
88-1		Stem, Guide Block (1)		1	200&250***							
88-2		Stem, Guide Block (2)		1	200&250***							
89		O-ring	PA2401-020	4	JISB2401 1A P20							
91		Shaft Key	CS0910-F	1	250***							
100		Mechanical Seal Assembly	CS1001-FV	1set	250V** BOS-E1							
120-1		Unloader Indicator Assembly (1)	CS1209-0EF	1set	200***							
120-2		Unloader Indicator Assembly (2)	CS1209-0EF	1set	200***							
128		Set Screw	NA8604-005	2	M4×5							
141	A	Glass, Unloader Indicator Cover	CS1410-E	1	1612LSC							
151		Driven Sleeve		1	2520LSC							
152		Drive Sleeve		1	2520LSC							
153		Driven Hub		1	2520LSC							
154		Stopper, Drive Sleeve	CS1540-L	2	2520LSC							
155		Stop Ring	CS1540-L11	2	FRS-110							
157		Key, Driven Hub	CS1570-L	1	FRS-110							
158		Key, Drive Hub	CS1581-L	1	FRS-110							
159		Set Screw	NA8612-020	1	M12×20							
160		Lock Nut	NG3100-13	1	AN13							
161		Lock Washer	NG3200-13	1	AW13							
162		Hexagon Socket Head Cap Screw	NB3512-045	5	M12×45							
163		O-ring	PA2402-035	1	JISB2401 1A G35							
164		Retainer, Oil Injection Pipe	CS1640-L	1	2520LSC							
165		O-ring	PA2402-030	1	JISB2401 1A G30							
166		Hexagon Socket Head Cap Screw	NB3508-030	4	M8×30							
168		Pipe Guide, Oil Injection	-	1	2520LSC							
197		O-ring	PA2401-050	1	JISB2401 1A P50							
200		Casting Assembly, Unloader Indicator (1)	-	1set	2520LSC(1)							
200	A	Casting, Unloader Indicator(A)	CS2000-LA	1	2520LSC							
200	B	Casting, Unloader Indicator(B)	CS2000-LB	1	2520LSC							
237-1		Torsional Slip Washer (1)	CS2370-F	2	250***							
237-2		Torsional Slip Washer (2)	CS2370-E	2	200***							
245		Spring Washer	ND3300-12	5	M12							

No.		Parts Name	Code No.	Q.ty	Remarks	LSC	LMC	MMC	MSC	SLC	SMC	SSC
250-1		Thrust Washer (1)	CS2500-F	2	250***							
250-2		Thrust Washer (2)	CS2500-E	2	200***							
267-1		Special Spring Washer	-	4	M12							
267-2		Special Spring Washer	-	4	M10							
278	A	Cylinder, Guide Unloader(A)	-	1	2520LSC							
278	B	Cylinder, Guide Unloader(B)	-	1	2520LSC							
279		O-ring	PA2402-130	1	JISB2401 1A G130							
432-1		O-ring	PA2402-135	4	JISB2401 1A G135							
432-2		O-ring	PA1517-022	4	JIS W1516 1A G22							
433-1		O-ring	PA2402-135	4	JISB2401 1A G135							
433-2		O-ring	PA1517-022	4	JIS W1516 1A G22							
528		Sleeve, Oil Seal	CS5280-FV	1	250V**							
529		Set Screw	NA8606-008	2	M6×8							
605-1		Plug		1	R 1"							
605-2		Plug		1	R3/4							
607		Plug		2	R1/4							
92-1		Suction Flange (1)	NX2320-250	1	JIS20K 250A(10")							
92-2		Suction Flange (2)	NX2320-150	1	JIS20K 150A(6")							
93-1		Gasket, Suction Flange (1)	CS7121-250	1	JIS20K 250A(10")							
93-2		Gasket, Suction Flange (2)	CS7121-150	1	JIS20K 150A(6")							
94-1		Hexagon Head Bolt	-	12	M24×65							
94-2		Hexagon Head Bolt	NB1522-055	12	M22×55							
95-1		Discharge Flange (1)	NX2320-150	1	JIS20K 150A(6")							
95-2		Discharge Flange (2)	NX2320-100	1	JIS20K 100A(4")							
96-1		Gasket, Discharge Flange (1)	CS7121-150	1	JIS20K 150A(6")							
96-2		Gasket, Discharge Flange (2)	CS7121-100	1	JIS20K 100A(4")							
97-1		Hexagon Head Bolt	NB1522-055	12	M22×55							
97-2		Hexagon Head Bolt	NB1520-055	8	M20×55							
215-1		Flange, Lubrication Oil Supply (1)	NX2320-025	1	JIS20K 25A(1")							
215-2		Flange, Lubrication Oil Supply (2)	NX2320-020	1	JIS20K 20A(3/4")							
216-1		Gasket, Lubrication Oil Supply Flange (1)	CS7121-025	1	JIS20K 25A(1")							
216-2		Gasket,Lubrication Oil Supply Flange (2)	CS7121-020	1	JIS20K 20A(3/4")							
217-1		Hexagon Head Bolt	NB1516-045	4	M16×45							
217-2		Hexagon Head Bolt	NB1412-035	4	M12×35							
218		Flange, Injection Oil Supply	NX2320-015	1	JIS20K 15A(1/2")							
219		Gasket, Injection Oil Supply Flange	CS7121-015	1	JIS20K 15A(1/2")							
220		Hexagon Head Bolt	NB1412-035	4	M12×35							

Parts List

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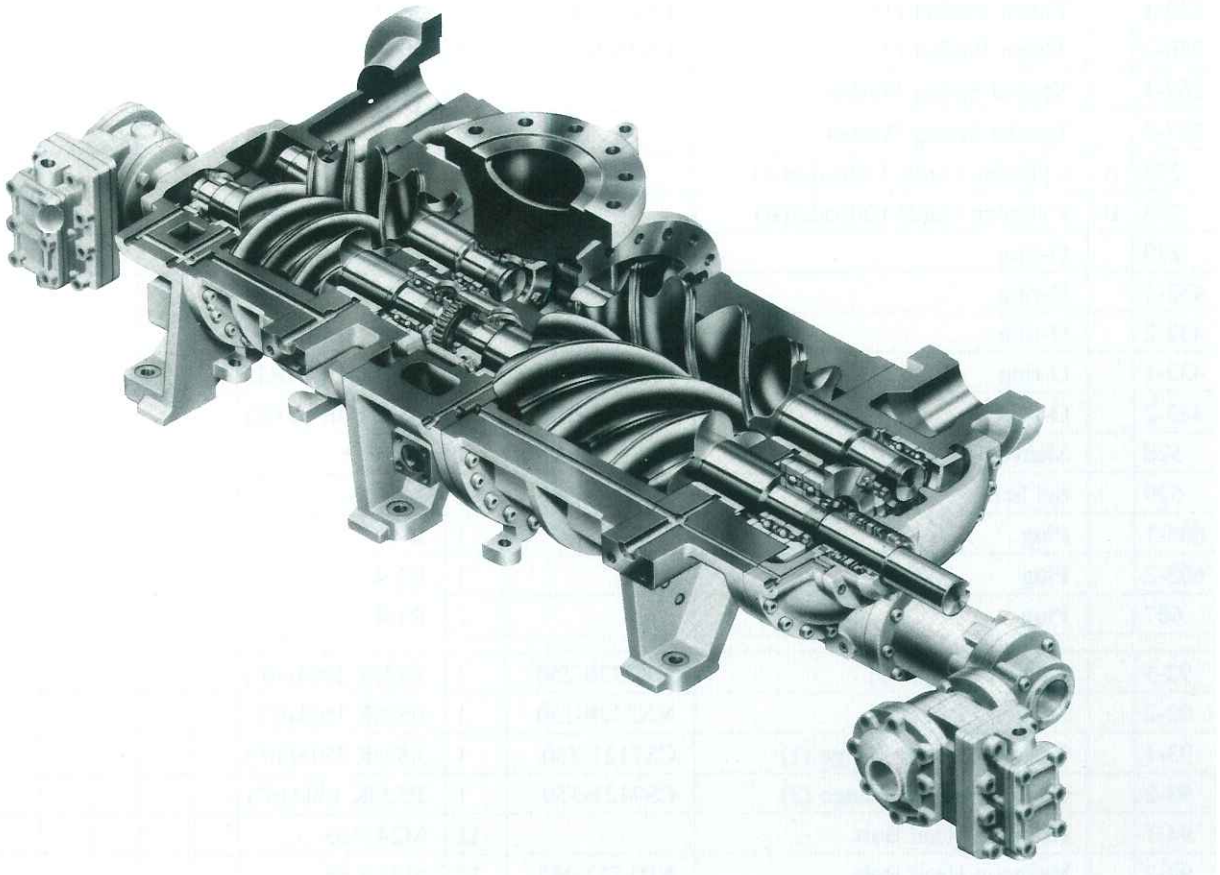


3225**C PARTS LIST

No.		Parts Name	Code No.	Q.ty	Remarks	LSC	LLC	MMC	MSC	SLC	SSC
1-1		Main Rotor Casing (1)	CS0010-ML1	1	3225L*C	1	1				
1-1		Main Rotor Casing (1)	-	1	3225M*C			1	1		
1-1		Main Rotor Casing (1)	-	1	3225S*C					1	1
1-2		Main Rotor Casing (2)	CS0010-FL	1	250L**		1			1	
1-2		Main Rotor Casing (2)	CS0010-FM	1	250M**			1			
1-2		Main Rotor Casing (2)	CS0010-FS	1	250S**	1			1		1
2-1		Hexagon Socket Head Cap Screw	NB3522-080	52	M24×80						
2-2		Hexagon Socket Head Cap Screw	NB3520-060	66	M20×60						
3-1		Alignment Pin	NE2025-080	4	φ25×80						
3-2		Alignment Pin	NE2016-070	4	φ16×70						
4-1		Hanger Bolt	NB6000-030	2	M30						
4-2		Hanger Bolt	NB6000-024	1	M24						
5-1		Suction Cover (1)	-	1	3225**C						
5-2		Suction Cover (2)	CS0050-M2	1	3225**C						
6-1		Gasket, Suction Cover (1)	CS0061-G	1	320***						
6-2		Gasket, Suction Cover (2)	CS0061-M2	1	3225**C						
7-1		Hanger Bolt	NB6000-016	2	M16						
7-2		Hanger Bolt	-	1	M36						
8-1		Spring Pin (1)	NE3206-018	2	φ6×18						
8-2		Spring Pin (2)	NE3206-012	2	φ6×12						

No.		Parts Name	Code No.	Q.ty	Remarks	LSC	LLC	MMC	MSC	SLC	SSC
10-1	A	Plug	NF0600-20	1	R3/4						
10-2	A	Plug	NF0600-20	1	R3/4						
10-2	B	Plug	NF0600-08	1	R1/4						
10-2	C	Plug	NF0600-15	1	R1/2						
11-1		Bearing Head (1)	CS0110-M1	1	3225**C						
11-2		Bearing Head (2)	CS0110-M2	1	3225**C						
12-1		Gasket, Bearing Head (1)	CS0121-G	1	320***						
12-2		Gasket, Bearing Head (2)	CS0121-F	1	250***						
13-1		Hanger Bolt	-	2	M36						
13-2		Hanger Bolt	NB6000-012	1	M12						
14-1		Spring Pin	NE3206-018	2	φ6×18						
14-2		Spring Pin	NE3206-012	2	φ6×12						
15	A	Plug	NF0600-10	1	R3/8						
15	B	Plug	NF0600-32	1	R1"1/4						
16		Bearing Cover	CS0160-M	1	3225**C						
17-1		Gasket, Bearing Cover (1)	CS0171-M	1	3225**C						
17-2		Gasket, Bearing Cover (2)	CS7331-M	1	3225**C						
18-1		Hexagon Socket Head Cap Screw	NB3520-070	20	M20×70						
18-2		Hexagon Socket Head Cap Screw	NB3520-065	24	M20×65						
19-1		Alignment Pin	NE2013-050	2	φ13×50						
19-2		Alignment Pin	NE2016-070	2	φ16×70						
20		Spring Pin	-	1	φ3×16						
22		Balance Piston Cover	CS0220-FVD	1	250V**						
23		Gasket, Balance Piston Cover	CS0231-F	1	250***						
24		Hexagon Socket Head Cap Screw	NB3512-030	11	M12×30						
25-1		Male Rotor (1)		1	3225L*C	1					
25-1		Male Rotor (1)		1	3225LLC		1				
25-1		Male Rotor (1)		1	3225M*C			1	1		
25-1		Male Rotor (1)		1	3225SLC					1	
25-1		Male Rotor (1)		1	3225S*C						1
25-2		Male Rotor (2)		1	3225LLC		1			1	
25-2		Male Rotor (2)		1	3225*MC			1			
25-2		Male Rotor (2)		1	3225*SC	1			1		1
26-1		Female Rotor (1)		1	320L**	1	1				
26-1		Female Rotor (1)		1	320M**			1	1		
26-1		Female Rotor (1)		1	320S**					1	1
26-2		Female Rotor (2)		1	3225LLC		1			1	
26-2		Female Rotor (2)		1	3225MMC			1			
26-2		Female Rotor (2)		1	3225*SC	1			1		1
27-1		Main Bearing (1)	CS0270-GRT	2	320***						
27-2		Main Bearing (2)	CS0270-FRT	2	250***						
28-1		Side Bearing (1)	CS0280-GRT	2	320***						
28-2		Side Bearing (2)	CS0280-FRT	2	250***						
29-1		Stop Ring (1)	NG1100-200	4	H200						
29-2		Stop Ring (2)	NG1100-160	4	H160						
30		Balance Piston	CS0300-F	1	250***						
31		Key, Balance Piston	CS0310-F	1	250***						
32		Stop Ring	NG1200-080	1	S80						
33		Sleeve, Balance Piston	CS0330-F	1	250***						
34		Set Screw	NA8608-020	2	M8×20						

No.	Parts Name	Code No.	Q.ty	Remarks	LSC	LLC	MMC	MSC	SLC	SSC
35	O-ring	PA2401-150	1	JISB2401 1A P150						
36	Spacer	CS0360-F	1	250***						
37	Stop Ring	NG1100-160	2	H160						
38-1	Thrust Bearing (1)	CS0380-G	2set	7321AFADF+KL16BC2						
38-2	Thrust Bearing (2)	CS0380-F	2set	7317AFADFC7P5a						
39-1	Lock Nut (1)	NG3100-21	2	AN21						
39-2	Lock Nut (2)	NG3100-17	2	AN17						
40-1	Lock Washer (1)	NG3200-21	2	AW21						
40-2	Lock Washer (2)	NG3200-17	2	AW17						
42-1	Spacer, Thrust Bearing Alignment (1)	CS0420-1G	2	320***, Booster						
42-2	Spacer, Thrust Bearing Alignment (2)	CS0420-F	2	250***						
43-1	Thrust Bearing Gland (1)	CS0430-G	2	320***						
43-2	Thrust Bearing Gland (2) A	CS0430-F	2	250***						
45-1	Hexagon Head Bolt	NB1520-055	8	M20×55						
45-2	Hexagon Head Bolt	NB1516-045	8	M16×45						
46-1	Lock Washer (1)	CS0469-G	8	320***						
46-2	Lock Washer (2)	CS0469-F	8	250***						
48	Retainer, Oil Seal	CS0480-GV	1	320V**						
49	O-ring	PA2402-160	1	JISB2401 1A G160						
50	Oil Seal	CS0501-GV	1	SA1J 95×120×13						
51	Seal Cover	CS0510-GB	1	320***						
52	Gasket, Seal Cover	CS0521-G	1	320***						
53	Hexagn Socket Head Cap Screw	NB3516-040	8	M16×40						
54-1	Unloader Slide Valve (1-1) (L Port)		1	3225L*C	1	1				
54-1	Unloader Slide Valve (1-1) (M Port)		1	3225L*C	1	1				
54-1	Unloader Slide Valve (1-1) (L Port)		1	3225M*C			1	1		
54-1	Unloader Slide Valve (1-1) (M Port)		1	3225M*C			1	1		
54-1	Unloader Slide Valve (1-1) (L Port)		1	3225S*C					1	1
54-1	Unloader Slide Valve (1-1) (M Port)		1	3225S*C					1	1
54-2	Unloader Slide Valve (1-2) (L Port)		1	250L**		1			1	
54-2	Unloader Slide Valve (1-2) (M Port)		1	250L**		1			1	
54-2	Unloader Slide Valve (1-2) (L Port)		1	250S**	1			1		1
54-2	Unloader Slide Valve (1-2) (M Port)		1	250S**				1		1
54-2	Unloader Slide Valve (1-2) (M Port)		1	3225*MC			1			
55-1	Unloader Slide Valve (2-1)		1	320L**	1	1				
55-1	Unloader Slide Valve (2-1)		1	320M**			1	1		
55-1	Unloader Slide Valve (2-1)		1	320S**					1	1
55-2	Unloader Slide Valve (2-2)		1	250L**		1			1	
55-2	Unloader Slide Valve (2-2)		1	250M**			1			
55-2	Unloader Slide Valve (2-2)		1	250S**	1			1		1
58-1	Hexagon Socket Head Cap Screw	NB3516-050	4	M16×50						
58-2	Hexagon Socket Head Cap Screw	NB3512-040	4	M12×40						
59	O-ring	PA2401-032	1	JISB2401 1A P32						
60-1	Unloader Cylinder (1)	CS0600-M	1	3225**C	1	1	1	1		
60-1	Unloader Cylinder (1)	-	1	3225SSC					1	1
60-2	Unloader Cylinder (2)	CS0600-FM	1	250M**			1			
60-2	Unloader Cylinder (2)	CS0600-FS	1	250S**	1	1		1	1	1
61	Hexagon Socket Head Cap Screw	NB3516-040	2	M16×40						
62-1	Hexagon Socket Head Cap Screw	NB3520-070	8	M20×70						
62-2	Hexagon Socket Head Cap Screw	NB3516-090	6	M16×90						

No.		Parts Name	Code No.	Q.ty	Remarks	LSC	LLC	MMC	MSC	SLC	SSC
63-1		O-ring	PA2402-170	1	JISB2401 1A G170						
63-2		O-ring	PA2402-190	1	JISB2401 1A G190						
64-1		Unloader Piston (1)	CS0640-M	1	3225**C						
64-2		Unloader Piston (2)	CS0641-F	1	250***						
65-1		O-ring	PA2401-140	1	JISB2401 1A P140						
65-2		O-ring	PA2401-155	1	JISB2401 1A P155						
66-1		Cap Seal	CS0660-M	1	CAP-3BE140						
66-2		Cap Seal	CS0660-F	1	CAP-3BE155						
67-1		Push Rod, Unloader Slide Valve (1)	CS0670-M1	1	3225L*C, M*C	1	1	1	1		
67-1		Push Rod, Unloader Slide Valve (1)	-	1	3225S*C					1	1
67-2		Push Rod, Unloader Slide Valve (2)	-	1	3225*LC		1			1	
67-2		Push Rod, Unloader Slide Valve (2)	-	1	3225*MC			1			
67-2		Push Rod, Unloader Slide Valve (2)	CS0670-M2	1	3225*SC	1			1		1
68-1		Guide Pin	CS0680-06	1	φ6×16						
68-2		Guide Pin	CS0680-05	1	φ5×12						
69-1		Lock Nut (1)	NG3100-10	1	AN10						
69-2		Lock Nut (2)	NG3100-08	2	AN08						
70-1		Lock Washer (1)	NG3200-10	1	AW10						
70-2		Lock Washer (2)	NG3200-08	2	AW08						
71		Lock Nut (1)	NG3100-12	1	AN12						
72		Lock Washer (1)	NG3200-12	1	AW12						
73-1		O-ring	PA2401-044	1	JISB2401 1A P44						
73-2		O-ring	PA2402-035	1	JISB2401 1A G35						
74-1		Unloader Cylinder Cover (1)	-	1	3225**C						
74-1		Unloader Cylinder Cover (1) (Explosion-Proof Type)	-	1	3225**C						
74-2		Unloader Cylinder Cover (2)	CS0740-F	1	250***						
74-2		Unloader Cylinder Cover (2) (Explosion-Proof Type)	CS0740-FB	1	250***						
75-1		O-ring	PA2402-150	1	JISB2401 1A G150						
75-2		O-ring	PA242-170	1	JISB2401 1A G170						
76-1		Hexagon Socket Head Cap Screw	NB3512-035	8	M12×35						
76-2		Hexagon Socket Head Cap Screw	NB3512-030	8	M12×30						
77-1		Indicator CAM (1)	CS0770-M1	1	3225L*C	1	1				
77-1		Indicator CAM (1)	CS0770-MM	1	3225M*C			1	1		
77-1		Indicator CAM (1)	CS0770-MS	1	3225S*C					1	1
77-2		Indicator CAM (2)	CS0770-FM	1	250M**			1			
77-2		Indicator CAM (2)	CS0770-FS	1	250S**	1	1		1	1	1
78		Ball Bearing	CS0780-E	2	#6000						
79		Stop Ring	NG1200-010	2	S10						
80		Bearing Gland	CS0800-E	2	200***						
81		Hexagon Socket Head Cap Screw	NB3506-015	6	M6×15						
82		V-ring	CS0820-EB	2set	20×10×12						
83		Spring	CS0830-E	2	200***						
84		Retainer,Indicator Cam Spring	CS0840-E	2	200***						
85		Oil Injection Pipe	-	1	320L**	1	1				
85		Oil Injection Pipe	-	1	320M**			1	1		
85		Oil Injection Pipe	-	1	3225SSC					1	1
86		O-ring	PA2402-030	1	JISB2401 1A G30						
87-1		Guide Block (1)		1	320***						

No.		Parts Name	Code No.	Q.ty	Remarks	LSC	LLC	MMC	MSC	SLC	SSC
87-2		Guide Block (2)		1	250***						
88-1		Stem, Guide Block (1)		1	320***						
88-2		Stem, Guide Block (2)		1	200&250***						
89-1		O-ring	PA2401-024	2	JISB2401 1A P24						
89-2		O-ring	PA2401-020	2	JISB2401 1A P20						
91		Shaft Key	CS0910-G	1	320***						
99		Coupling Assembly	-	1set	IUS-A-30						
100		Mechanical Seal Assembly	CS1000-GV	1set	320*** BOS-E1						
120-1		Unloader Indicator Assembly (1)	CS1209-0JF	1set	1612C						
120-2		Unloader Indicator Assembly (2)	CS1209-0K	1set	200***						
150		O-ring	PA2402-220	2	JISB2401 1A G220						
151		Drive Sleeve	-	1	3225LSC						
152		Drive Hub	-	2	3225LSC						
154		Stopper, Drive Sleeve	CS1540-M	2	3225LSC						
155		Stop Ring	CS1540-M13	4	FRS-130						
157		Key, Driven Hub	-	2	20×12×84						
159		Set Screw	-	1	M10×16						
160		Lock Nut	NG3100-15	1	AN15						
161		Lock Washer	NG3200-15	1	AW15						
162		Hexagon Socket Head Cap Screw	NB3512-050	5	M12×50						
164		Retainer, Oil Injection Pipe	CS1640-M	1	3225**C						
165		O-ring	PA2401-040	1	JISB2401 1A P40						
166-1		Hexagon Socket Head Cap Screw	NB3506-015	4	M6×15						
166-2		Hexagon Socket Head Cap Screw	NB3505-012	4	M5×12						
168		Pipe Guide, Oil Injection	CS1680-M	1	3225**C						
197		O-ring	PA2401-058	1	JISB2401 1A P58						
237-1		Torsional Slip Washer (1)	CS2370-G	2	320***						
237-2		Torsional Slip Washer (2)	CS2370-F	2	250***						
245		Spring Washer	ND3200-12	5	M12						
250-1		Thrust Washer (1)	CS2500-G	2	320***						
250-2		Thrust Washer (2)	CS2500-F	2	250***						
267-1		Special Spring Washer	-	4	M16						
267-2		Special Spring Washer	-	4	M12						
326-1		Gland, O-ring (1)	CS3260-M1	1	3225**C						
326-2		Gland, O-ring (2)	CS3260-M	1	3225**C						
328		O-ring	PA2401-046	1	JISB2401 1A P46						
329		Spring Pin	NE3204-010	1	φ4×10						
420		Spacer, Unload Position (High Stage)	-	1	250M/S**(30%Load)	1		1	1		1
421		O-ring	PA2401-046	2	JISB2401 1A P46						
423		Spacer, Unload Position (Low Stage)	-	1	3225M*C			1	1		
432-1		O-ring	PA2402-165	4	JISB2401 1A G165						
432-2		O-ring	PA2402-135	4	JISB2401 1A G135						
433-1		O-ring	PA2402-165	4	JISB2401 1A G165						
433-2		O-ring	PA2402-135	4	JISB2401 1A G135						
528		Sleeve, Oil Seal	CS5280-GV	1	320V**						
529		Set Screw	NA8606-008	2	M6×8						
605		Plug	NF0600-25	1	R 1"						
607		Plug	NF0600-08	2	R 1/4						

No.		Parts Name	Code No.	Q.ty	Remarks	LSC	LLC	MMC	MSC	SLC	SSC
92-1		Suction Flange (1)	-	1	JIS20K 350A(14")						
92-2		Suction Flange (2)	NX2320-200	1	JIS20K 200A(8")						
93-1		Gasket, Suction Flange (1)	CS7121-350	1	JIS20K 350A(14")						
93-2		Gasket, Suction Flange (2)	CS7121-200	1	JIS20K 200A(8")						
94-1		Hexagon Head Bolt	-	16	M30×80						
94-2		Hexagon Head Bolt	-	12	M22×60						
95-1		Discharge Flange (1)	NX2320-200	1	JIS20K 200A(8")						
95-2		Discharge Flange (2)	NX2320-150	1	JIS20K 150A(6")						
96-1		Gasket, Discharge Flange (1)	CS7121-200	1	JIS20K 200A(8")						
96-2		Gasket, Discharge Flange (2)	CS7121-150	1	JIS20K 150A(6")						
97-1		Hexagon Head Bolt	NB1522-055	12	M22×55						
97-2		Hexagon Head Bolt	NB1522-055	12	M22×55						
215-1		Flange, Lubrication Oil Supply (1)	NX2320-040	1	JIS20K 40A(1"1/2)						
215-2		Flange, Lubrication Oil Supply (2)	NX2320-025	1	JIS20K 25A(1")						
216-1		Gasket, Lubrication Oil Supply Flange (1)	CS7121-040	1	JIS20K 40A(1"1/2)						
216-2		Gasket, Lubrication Oil Supply Flange (2)	CS7121-025	1	JIS20K 25A(1")						
217-1		Hexagon Head Bolt	NB1516-045	4	M16×45						
217-2		Hexagon Head Bolt	NB1516-045	4	M16×45						
218		Flange, Injection Oil Supply	NX2320-020	1	JIS20K MYK20A(3/4")						
219		Gasket, Injection Oil Supply Flange	CS7121-020	1	JIS20K MYK20A(3/4")						
220		Hexagon Head Bolt	NB1512-035	4	M12×35						
350		Flange, Balance Piston Oil Return Piping	NX2320-020	1	JIS20K 20A(3/4")						
351		Gasket, Balance Piston Oil Return Piping Flange	CS7121-020	1	JIS20K 20A(3/4")						
352		Hexagon Head Bolt	NB1512-035	4	M12×35						
353		Flange, Bearing Cover Oil Return Piping	NX2320-032	1	JIS20K 32A(1"1/4)						
354		Gasket, Bearing Cover Oil Return Piping Flange	CS7121-032	1	JIS20K 32A(1"1/4)						
355		Hexagon Head Bolt	NB1516-045	4	M16×45						
356		Flange, Rotor Casing Oil Return Piping	NX2320-032	1	JIS20K 32A(1"1/4)						
357		Gasket, Rotor Casing Oil Return Piping Flange	CS7121-032	1	JIS20K 32A(1"1/4)						
358		Hexagon Head Bolt	NB1516-045	4	M16×45						

5. Longitudinal Assembly Drawing

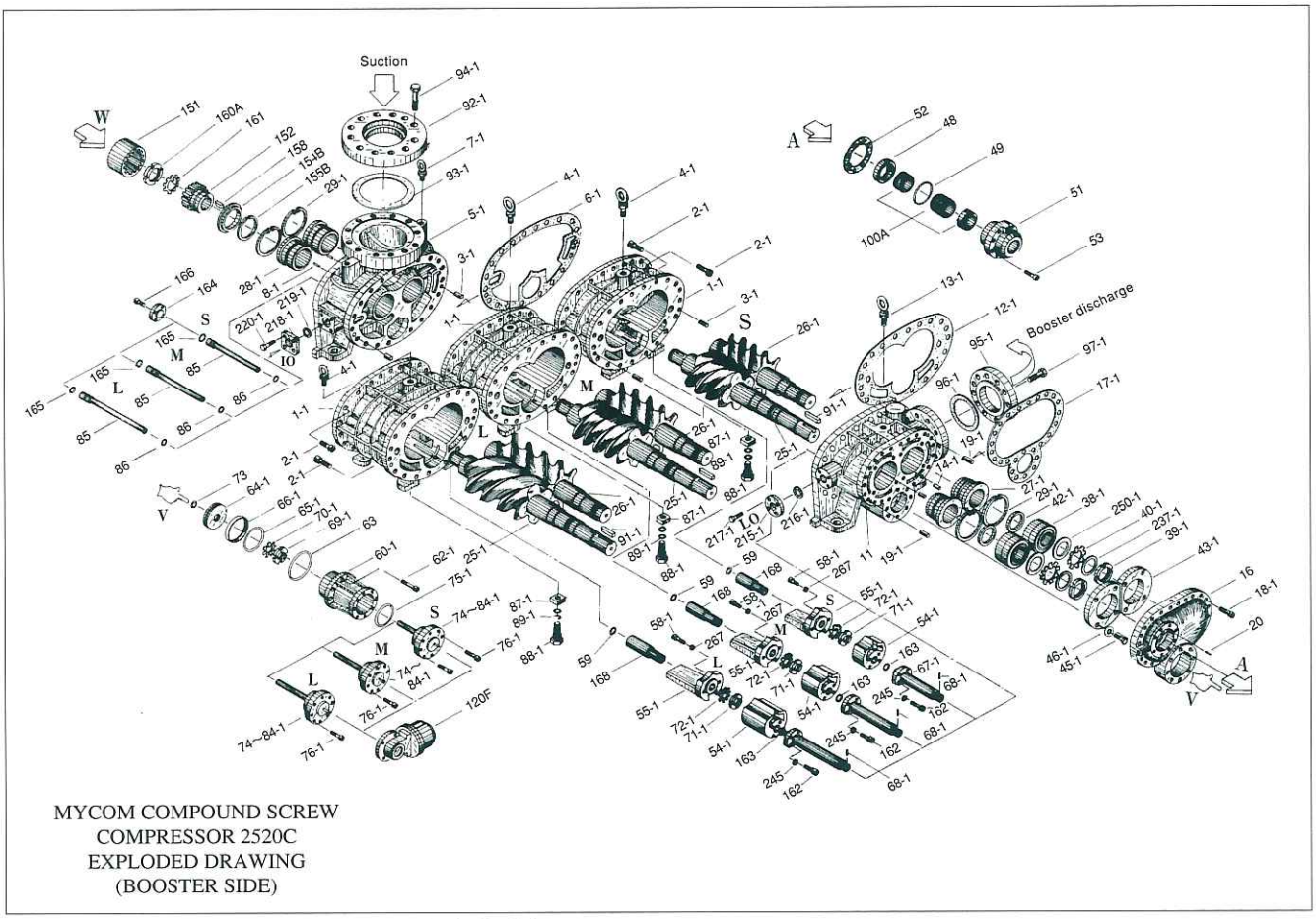
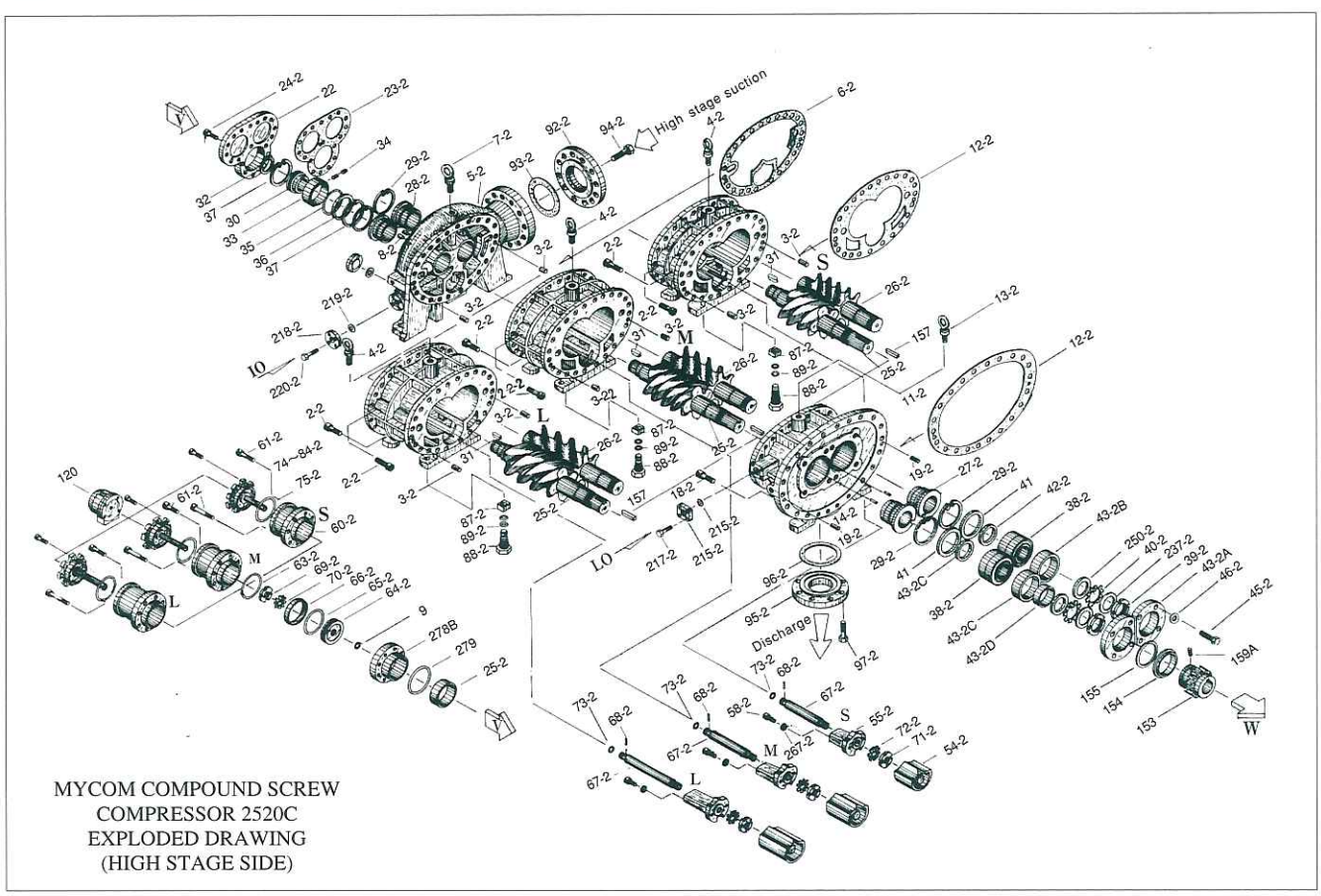


Fig.10 2520C High- and Low-stages, Exploded View



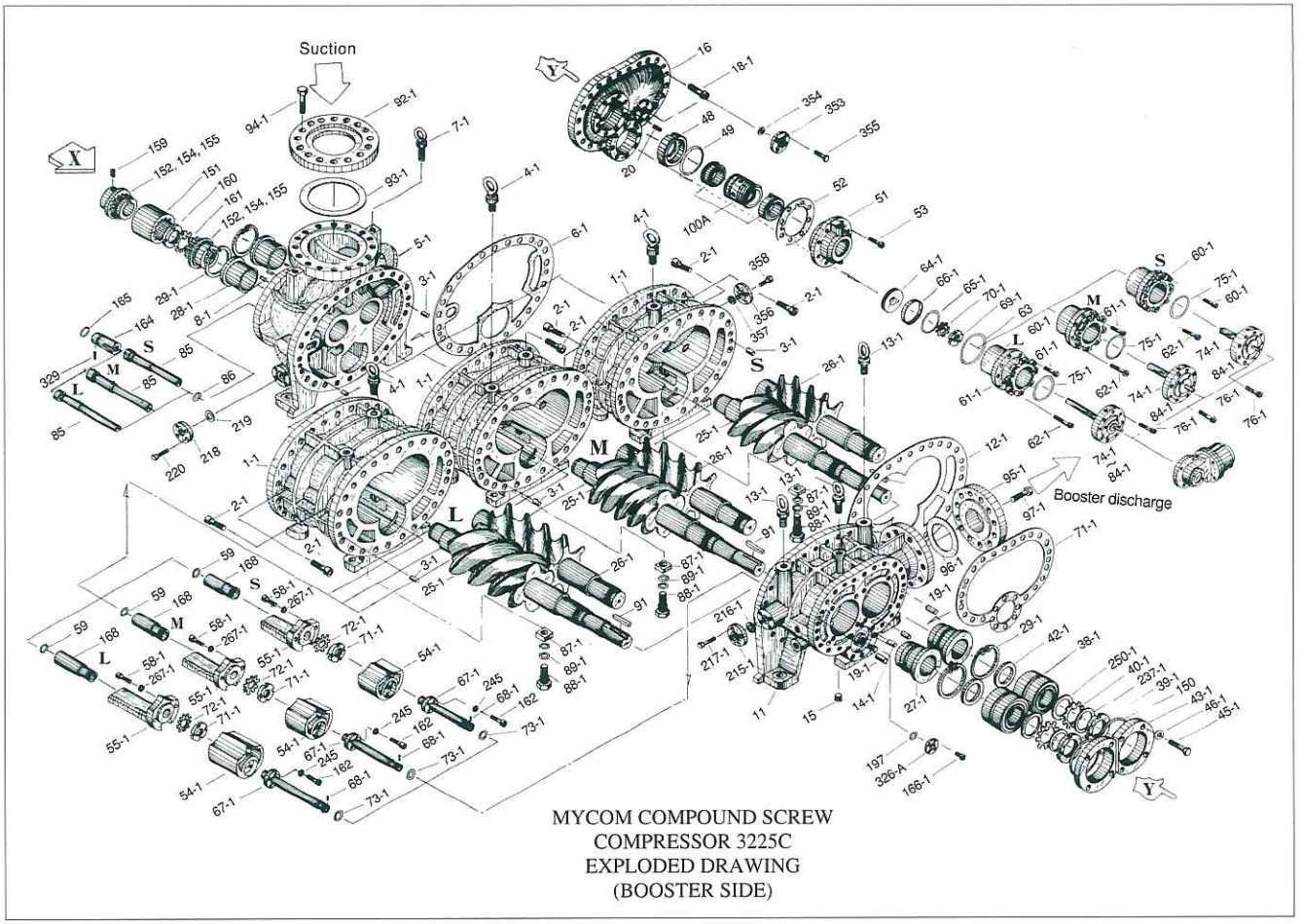
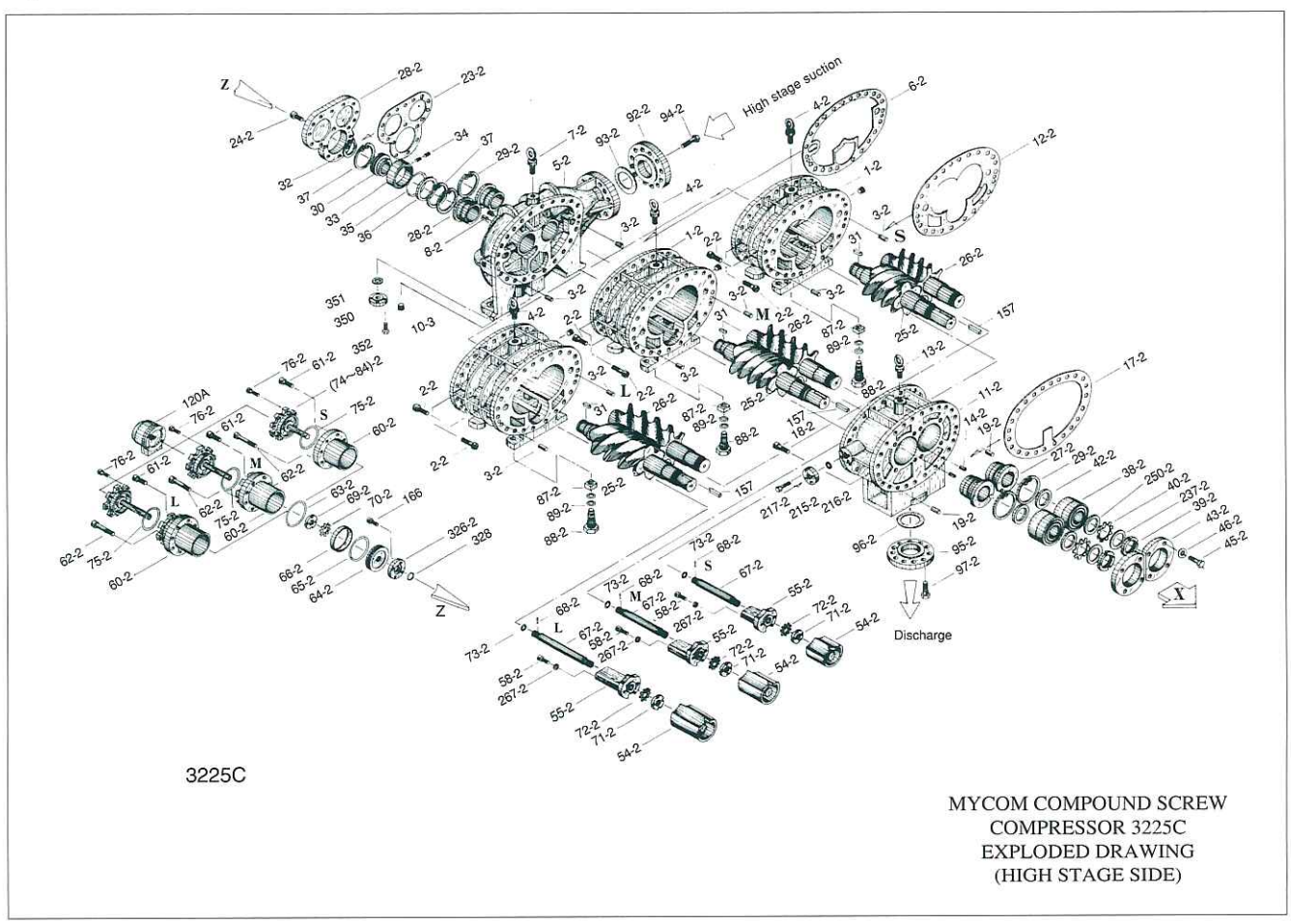


Fig.11 3225C High- and Low-stages, Exploded View



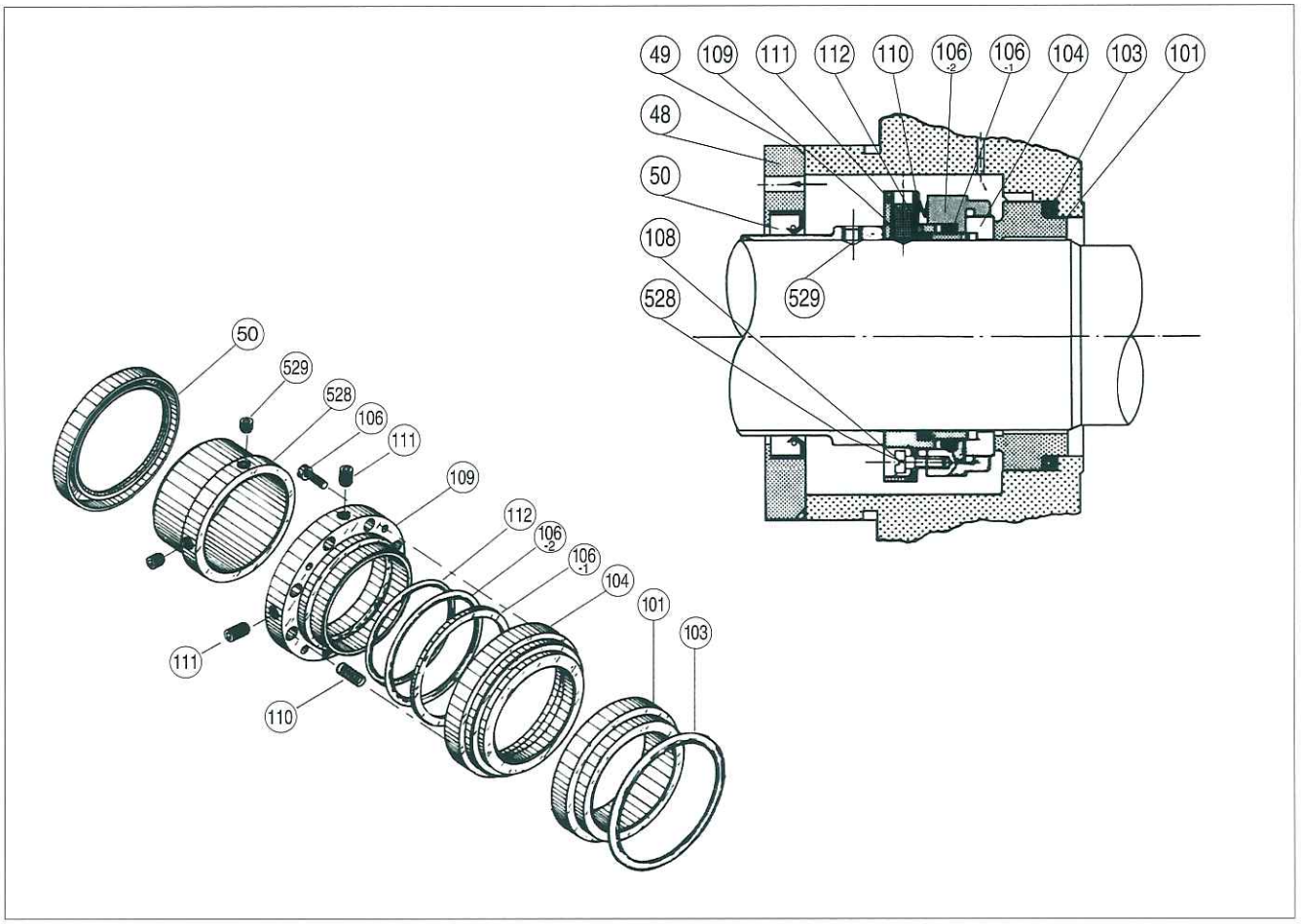


Fig.12 Standard Mechanical Seal

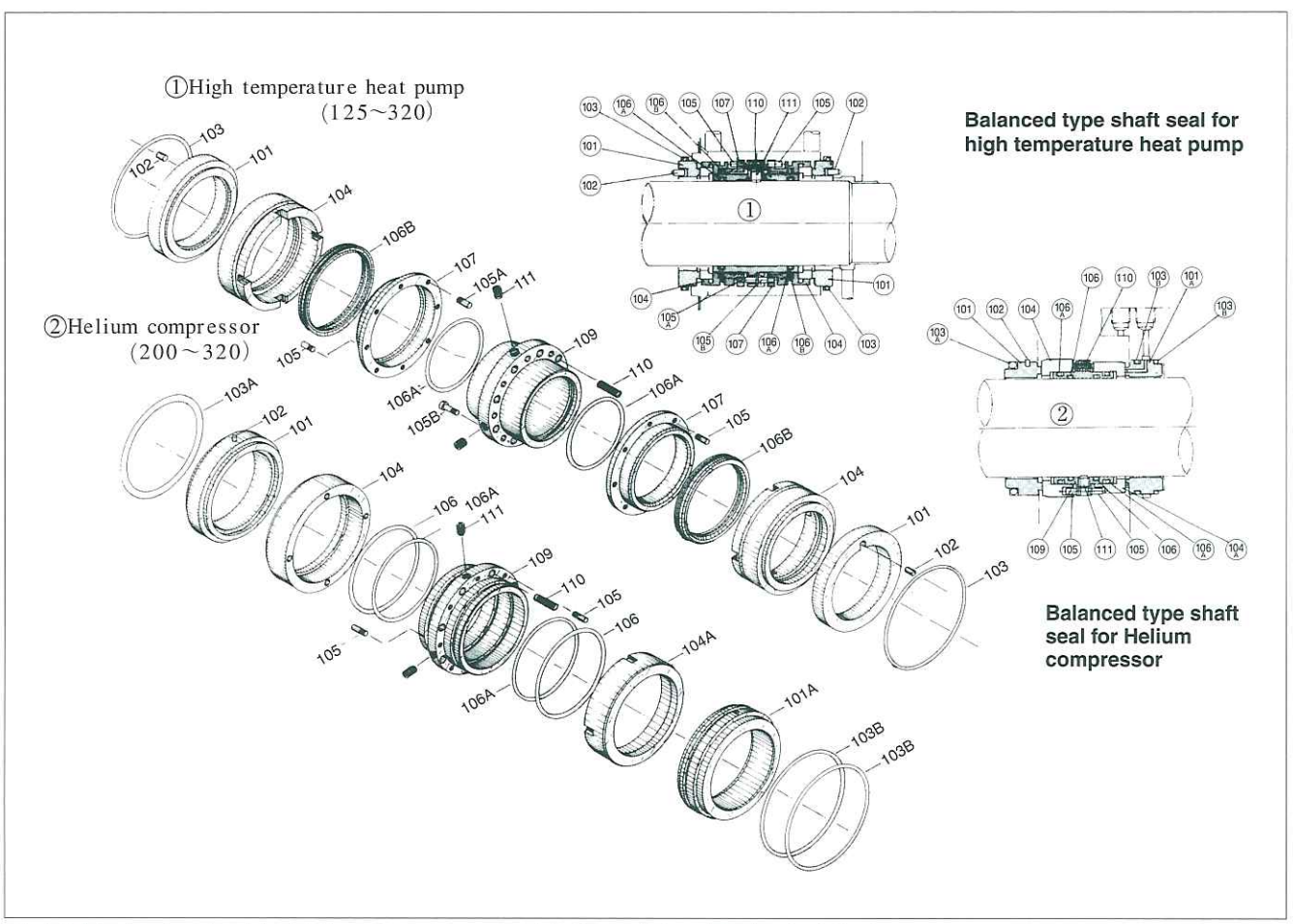


Fig.13 Mechanical Seal for Helium Compressor and Balanced Type Mechanical Seal

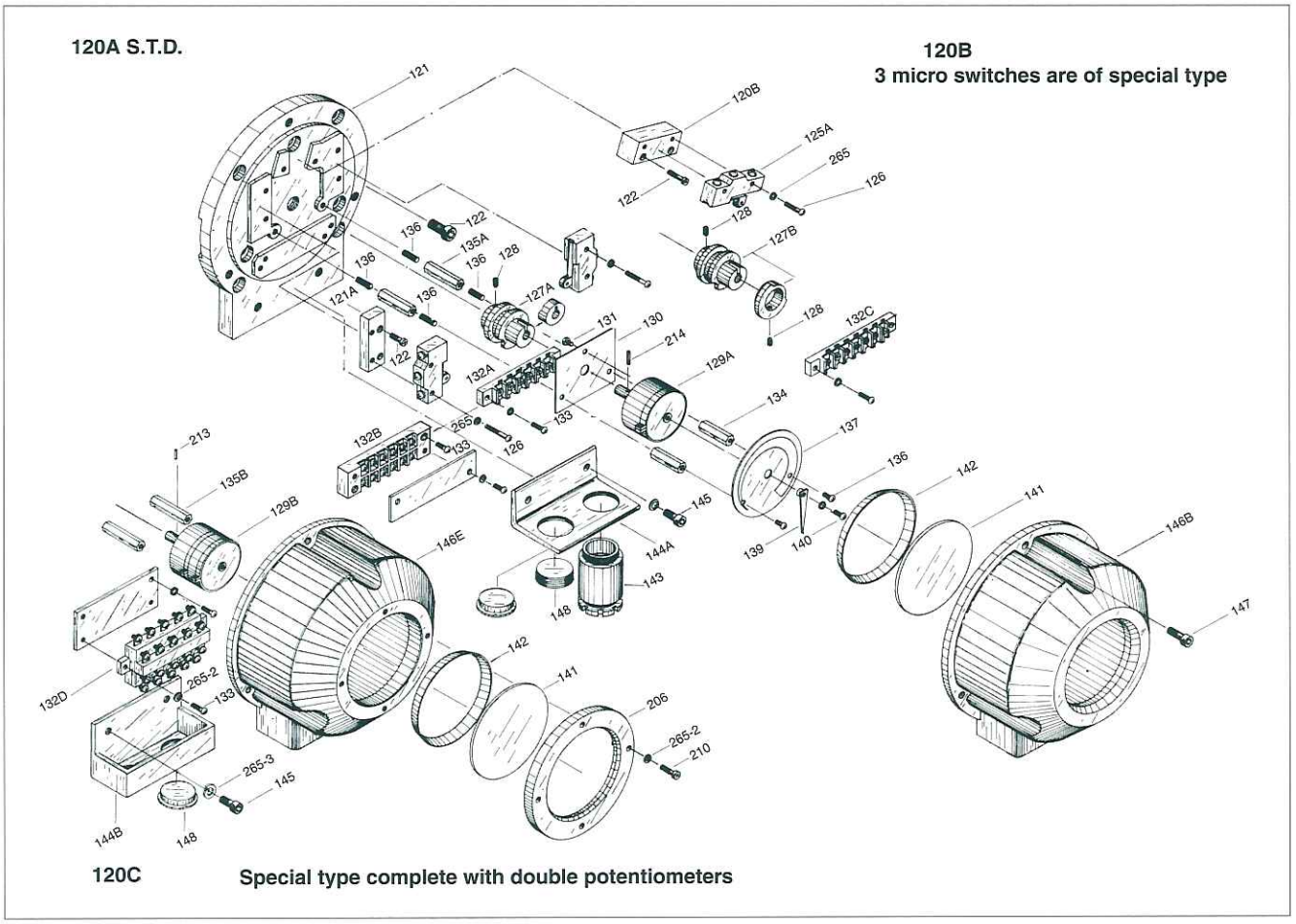


Fig.14 Standard Unloader Indicator

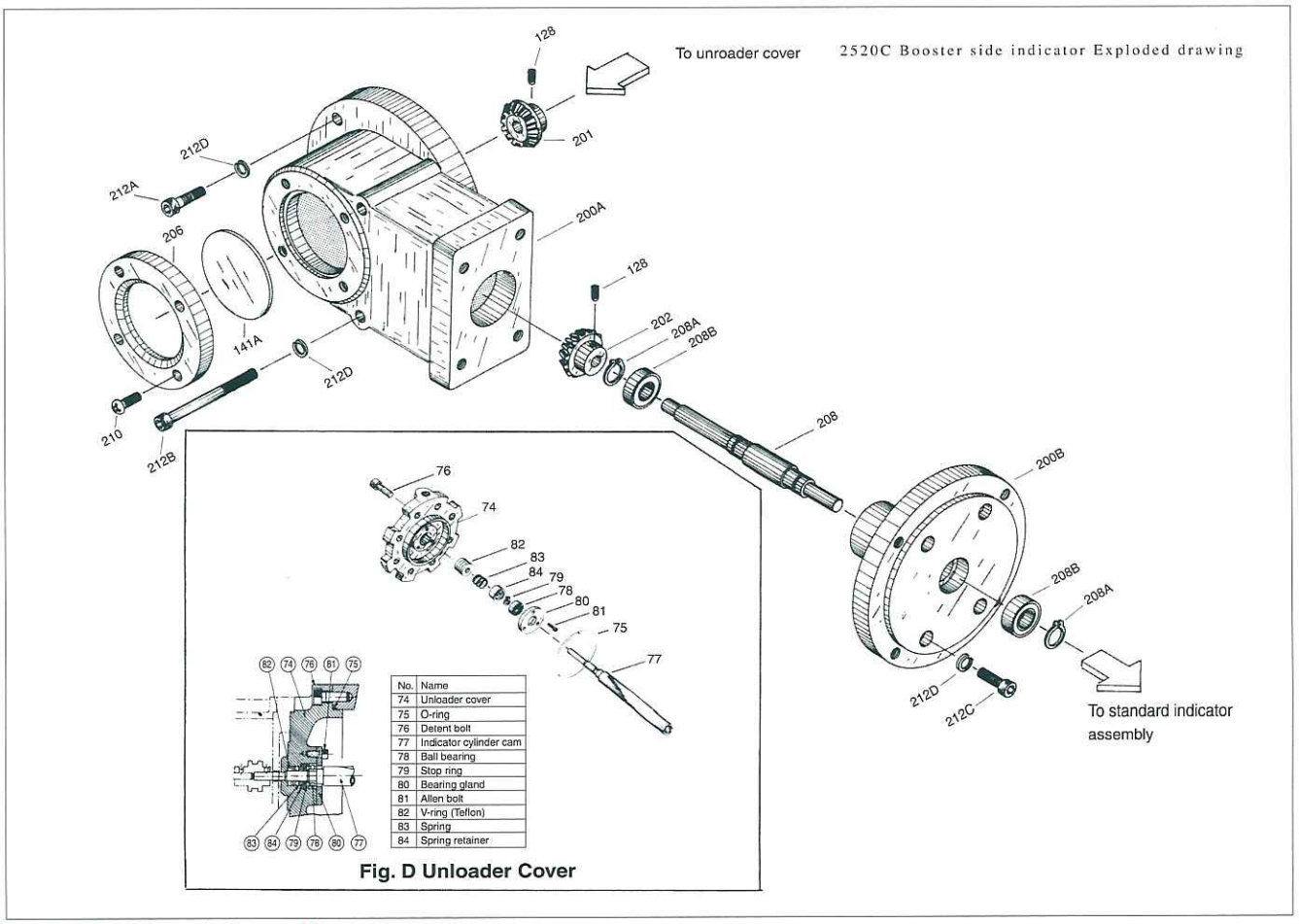


Fig.15A Unloader Indicator Mount

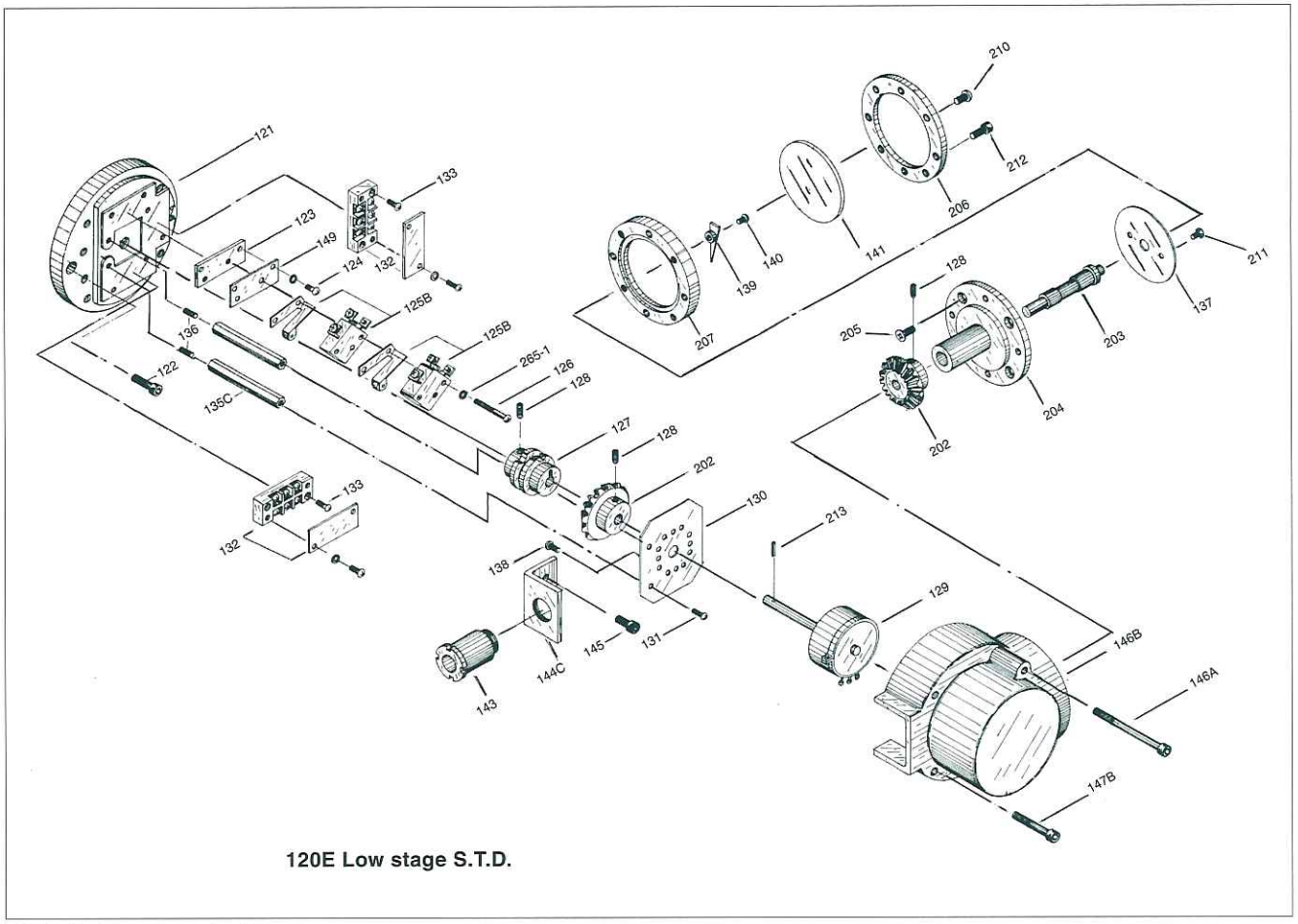


Fig.15B Low-stage Indicator

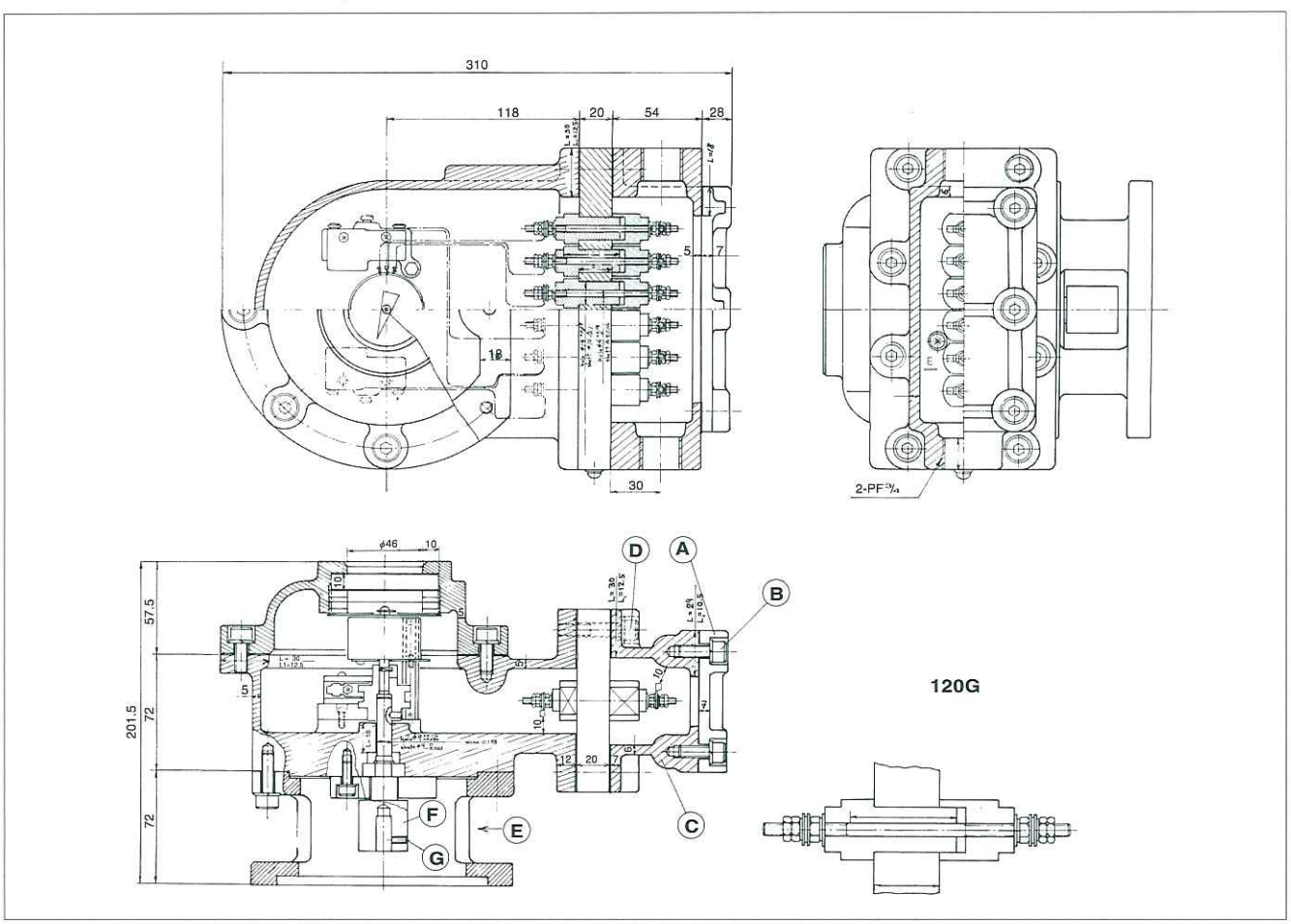


Fig.15C Explosion-proof Indicator

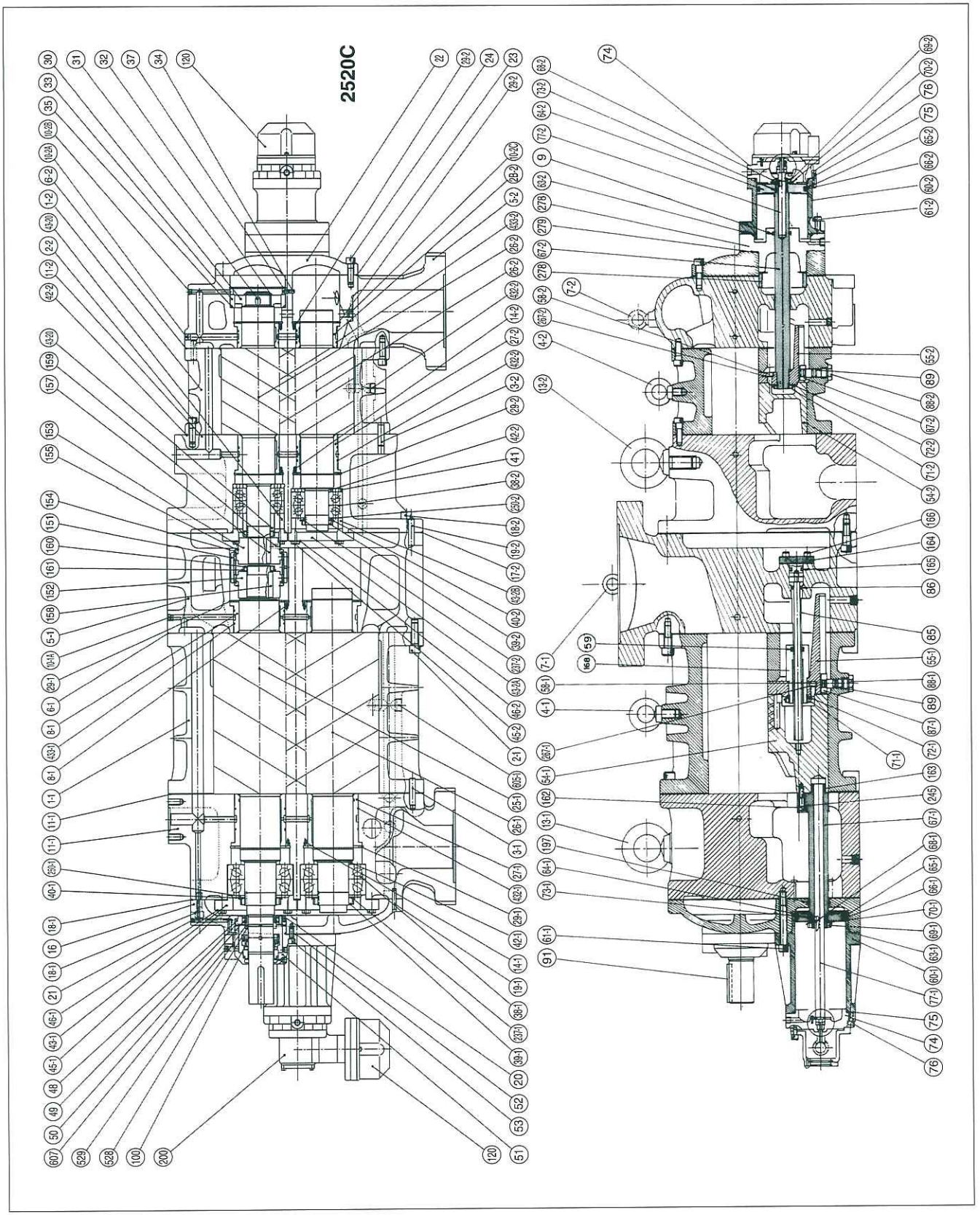


Fig.16 2520C Compressor, Cross Sectional View

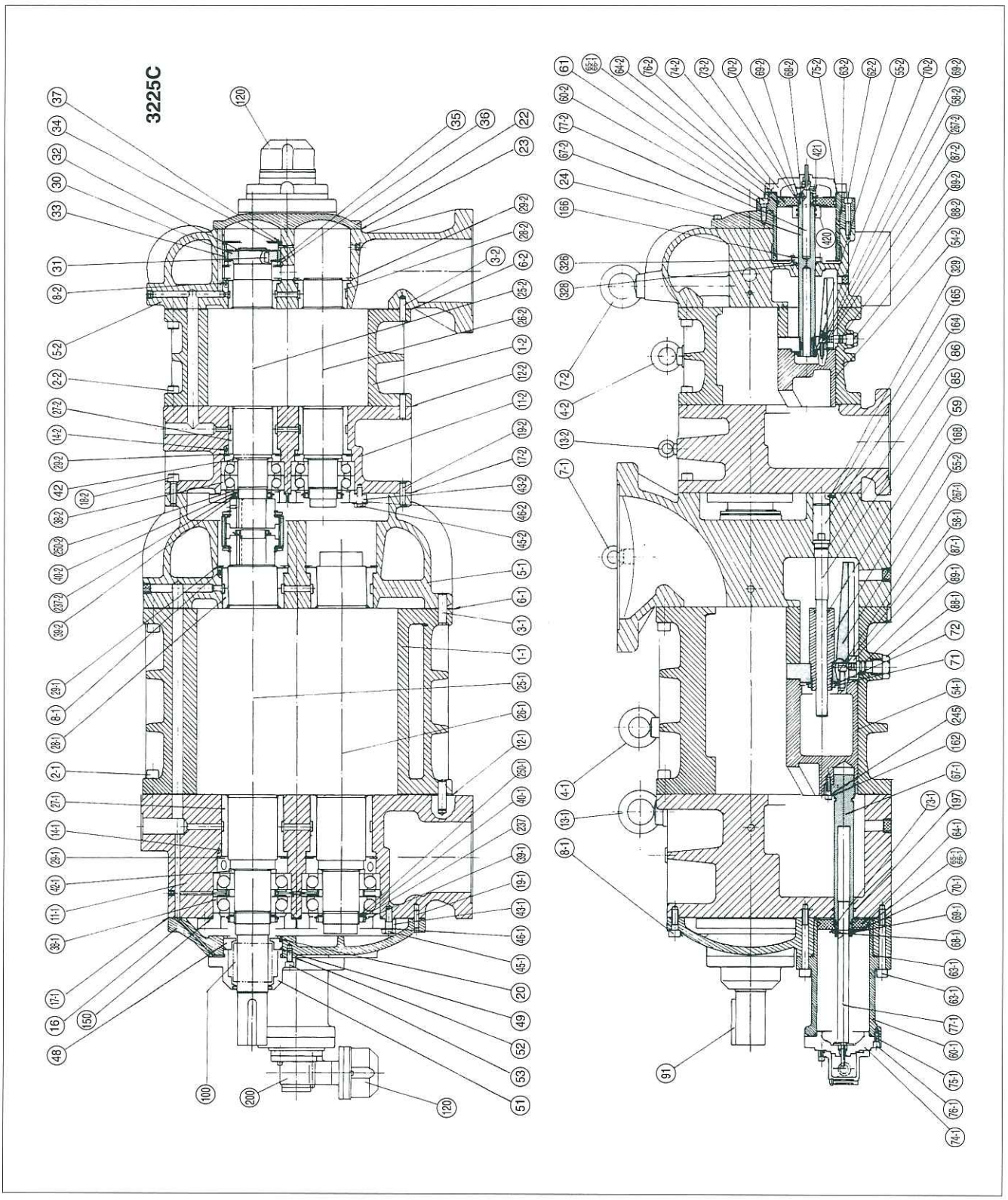


Fig.17 3225C Compressor, Cross Sectional View

6. Hand Tool Kit

Table 4 Hand Tools for Model 2520LSC Screw Compressor

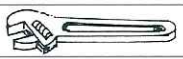
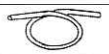
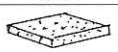
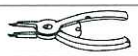
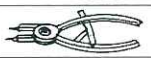
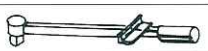
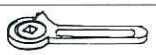
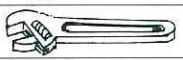
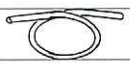
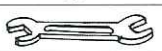
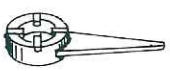
No.	Name	Illustration	Specifications	Q.ty	Use
1	Ratchet handle		1/4"	1	Gauges & valves
2	Monkey wrench		250mm	1	General purpose
3	Screw driver (+)		75mm	1	-do-
4	Screw driver (-)		75mm	1	-do-
5	Pipehandle		15φ×200mm	1	Allen wrench
6	Vinyl hose		15φ×20φ×720L	1	Oil drain
7	Sponge		160×160×20mm	1	Washing Parts
8	Double ended wrench		17×19	2	Joints
9	Double offset wrench		30×32	1	Suction and discharge
10	Double offset wrench		30×36		flanges
11	Stop ring Pliers		Medium	1	Stoprings
12	-do-		Large	1	-do-
13	Lock nut wrench		AN17	1	Bearing nuts
14	-do-		AN13	1	Gear coupling
15	-do-		AN08	1	Bearing nuts
16	-do-		AN07	1	-do-
17	Eyebolt		M8×250mm	1	Unloader piston, Seal retainer
18	Socket wrench		19	1	Thrust bearing
19	-do-		24	1	Retainer bolts
20	Torque wrench		0~920Kg·cm	1	Socket wrench
21	Allen wrench		2mm	1	Allen wrench
22	-do-		3mm	1	-do-
23	-do-		4mm	1	-do-
24	-do-		5mm	1	-do-
25	-do-		6mm	1	-do-
26	-do-		8mm	1	-do-
27	-do-		10mm	1	-do-
28	-do-		14mm	1	-do-
29	-do-		17mm	1	-do-

Table 5 Hand Tools for Model 3225LSC Screw Compressor

No.	Name	Illustration	Specifications	Q.ty	Use
1	Ratchet handle		1/4"	1	Adjusting gauges & valves
2	Monkey wrench		250mm	1	General purpose
3	Screw driver (+)		75mm	1	-do-
4	Screw driver (-)		75mm	1	-d0-
5	Pipehandle		20φ×300mm	1	Allen wrench
	-do-		25φ300mm	1	-do-
6	Vinyl hose		15φ×20φ×1500L	1	Oil drain
7	Sponge		160×160×20mm	1	Washing Parts
8	Double ended wrench		17×19	2	Joints
9	Double offset wrench		30×32	1	Suction and discharge
10	Double offset wrench		30×36	1	flanges
11	Single head offset wrench		46	1	Compressor fitting
12	Stop ring Pliers		Small ST-3	1	Stoprings
13	-do-		Large RT-4	1	-do-
14	Lock nut wrench		AN21	1	Bearing nuts
15	-do-		AN17	1	-do-
16	-do-		AN12	1	-do-
17	-do-		AN10	1	-do-
18	-do-		AN08	1	-do-
19	-do-		AN15 (long)	1	Gear coupling
20	Eyebolt		M8×250mm	1	Unloader piston, Seal retainer
21	Socket wrench		24	1	Thrust bearing
22	-do-		30	1	Retainer bolts
23	Torque wrench		0~1300Kg·cm	2	Socket wrench
24	Allen wrench		2mm	1	Allen screw
25	-do-		3mm	1	-do-
26	-do-		4mm	1	-do-
27	-do-		5mm	1	-do-
28	-do-		6mm	1	-do-
29	-do-		8mm	1	-do-
30	-do-		10mm	1	-do-
31	-do-		14mm	1	-do-
32	-do-		17mm	1	-do-
33	-do-		19mm	1	-do-

2 Compound Type Two-stage Refrigeration Screw Compressor Mechanisms

2-1 Gas Flow

The structure of a standard screw compressor is explained in Chapter 1.

With a two-stage machine, the rotor sets of two compressors are aligned along the same axis, with the low-stage side compressor at the shaft drive end. Gas enters a central suction port ❶ and is compressed by the low-stage side rotors ❷. It is then discharged through the low-stage discharge Port ❸ and via connecting piping enters the high-stage side suction port as ❸ and ❹ are connected to each other. Midway along this piping gas from the liquid intercooler enters and is mixed with the low-stage side discharge gas. Gas compressed by the high-stage side rotors ❺ is finally sent to the condenser via the oil separator through the compressor discharge port ❻.

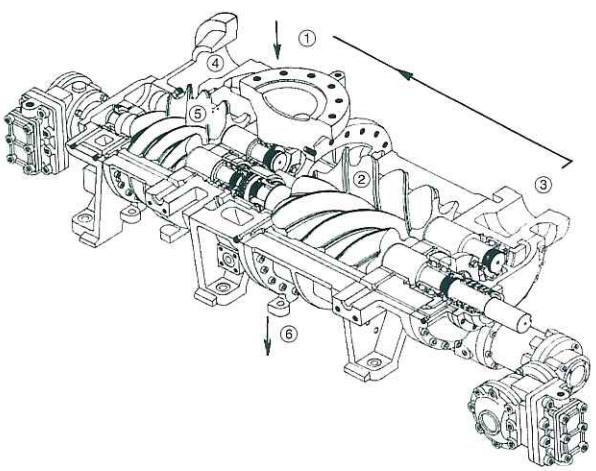


Fig.18 3225C Compressor with Explosion-proof Indicator, Oblique Sectional View

2-2 Capacity Control

The structure of the capacity control mechanism is explained in Chapter 1.

Unloader devices for reducing load at start-up or reducing and increasing load as required during operation are mounted on the high-stage and low-stage sides.

Since the high- and low-stage sides commence operation simultaneously and the high-stage side discharges more oil than the low-stage side, a spacer is provided on the unloader push rod of the high-stage side to ensure that minimum load does not drop below 20% of the slide valve on model 2520C or 30% on model 3225C.

Various systems are used for operating the capacity control devices on the compressor.

Refer to the instruction manual provided for the compressor package.

Please note that intermediate pressure is dependent upon the balance between high- and low-stage side displacements and this pressure changes in the balancing direction when capacity control is actuated.

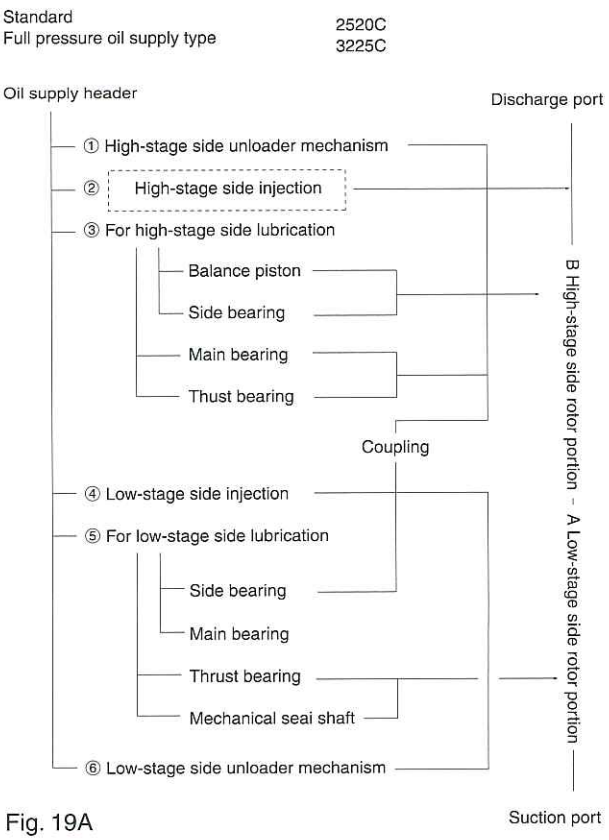
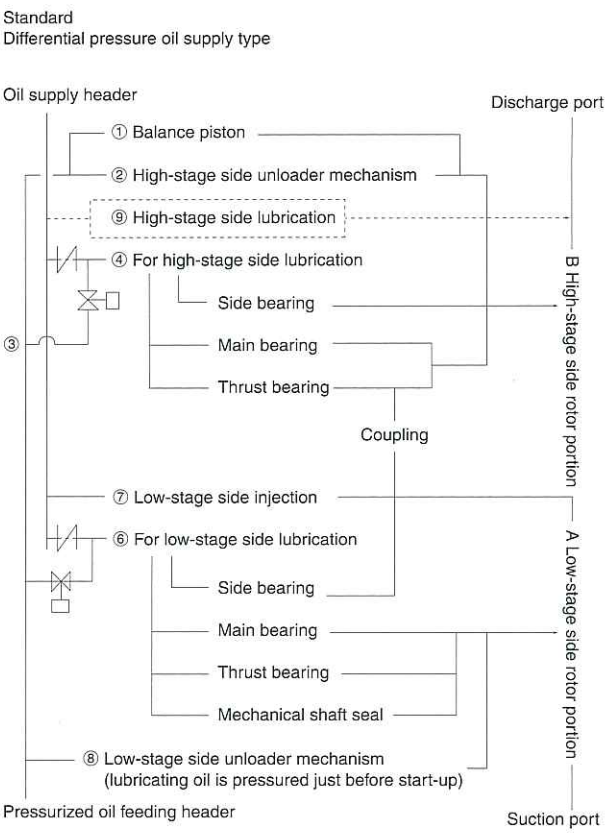


Fig. 19A

2-3 Oil Flow

In principle, oil flow in the two-stage compressor is the same as in a single-stage unit with the exception that high-stage side injection is eliminated because oil is entrained in the low-stage side discharge gas already. Also, the balance piston normally provided on the low-stage side is replaced by a coupling and pressure is the same as that on the high-stage side thrust bearing. In the case of the Model 320 series, an independent lubrication line is provided for the duplex thrust bearing to ensure proper lubrication.

On some types, external oil piping is arranged for return oil from the high-stage side to the low-stage side. This is done to prevent too much oil from passing into the high-stage side compressor, which would otherwise result in oil compression when, for example, the unit is started up after long-term shutdown.



Remarks: Oil circuit differs according to specifications and type of compressor

Fig. 19B

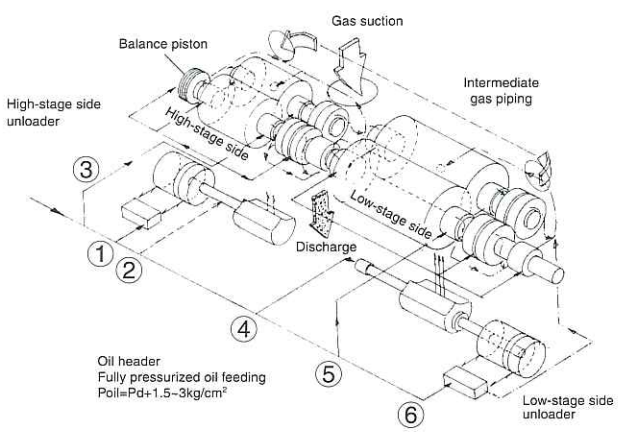


Diagram A

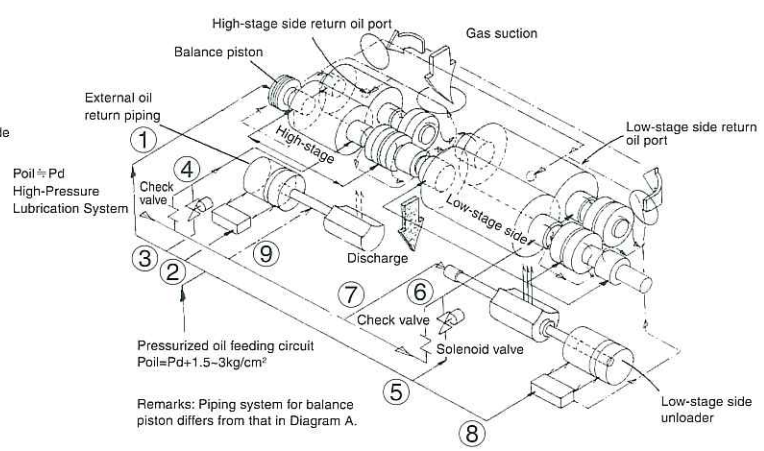


Diagram B

Fig. 20 Pressure Lubrication System (Diagram A) and Pressure Difference Lubrication System (Diagram B)

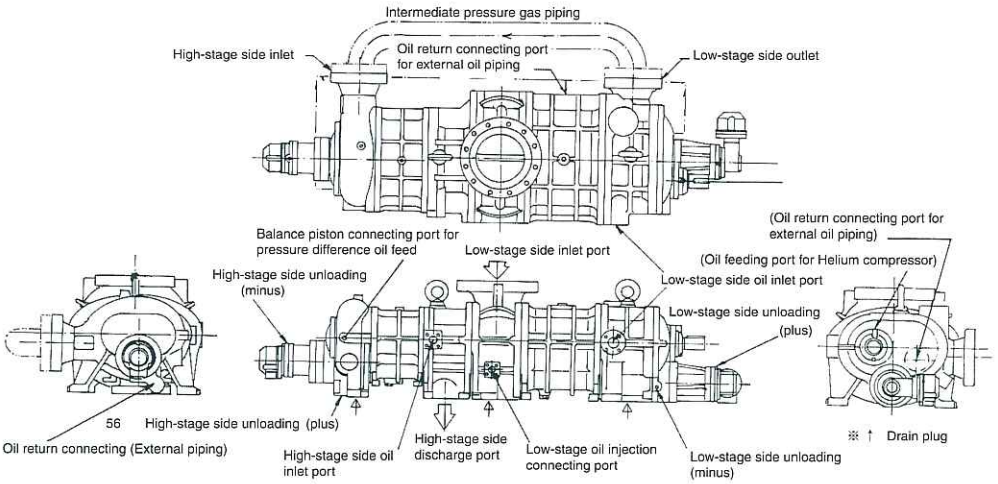


Fig. 21 Piping Connection Indications

Standard
Full pressure oil supply type with external piping 3225C

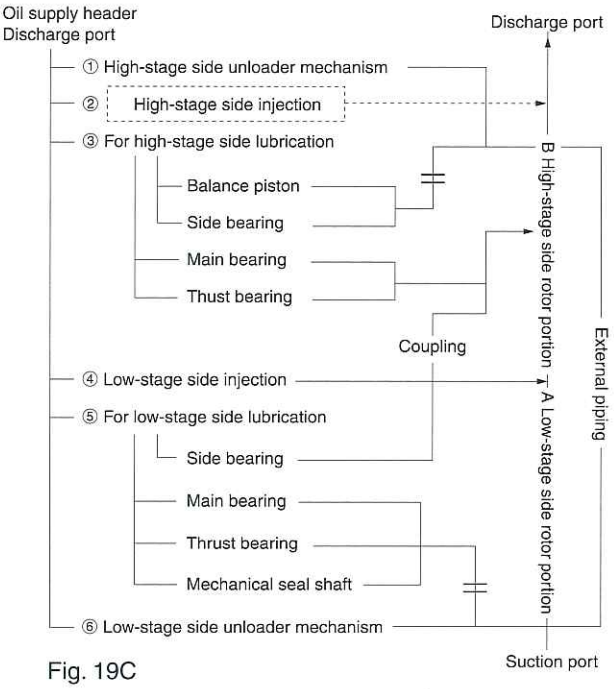


Fig. 19C

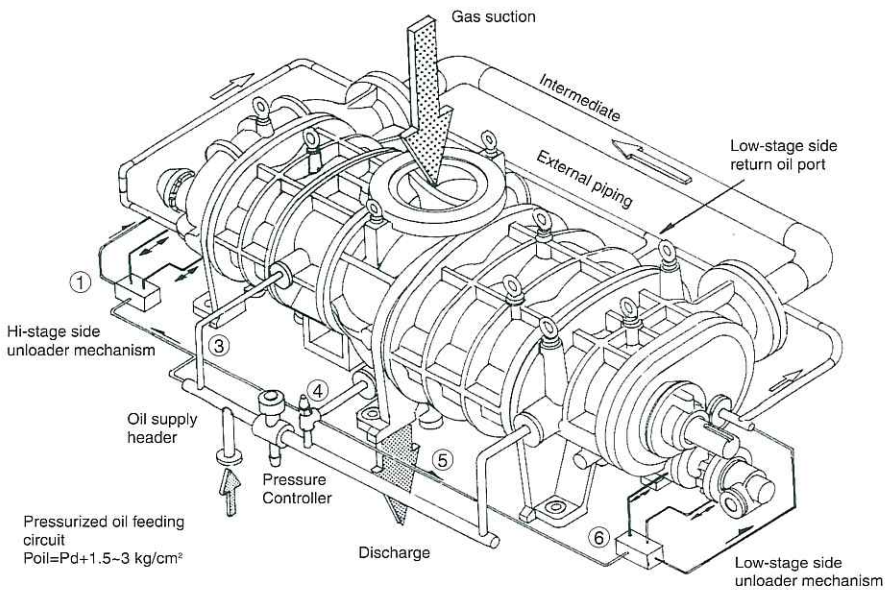


Fig. 21A External oil piping circuit 3225C

3 Preparations for Disassembly of Compound Type Two-stage Refrigeration Screw Compressor

Preparations for Disassembly

While the screw compressor offers extremely high reliability, it is, after all, composed of moving parts subject to friction, damage from foreign matter, etc. It is therefore essential that the machine be disassembled and inspected at specified intervals. This chapter explains disassembly procedures and points out the parts which must be inspected.

If at all possible, the compressor should be disconnected from the system and transported to a fully equipped maintenance shop for disassembly and inspection. When maintenance work must be carried out on-site, the procedures explained herein should be closely followed. Periodic inspection should be carried out with the compressor removed from its base.

3-1 Hand Tools and Work Site

Be sure to have all the necessary disassembly tools for the 2520C or 3225C available (ref. Tables 4, 5). Especially, a locknut wrench should be available for removing the bearing.

Hand tools such as a hammer, pliers, spatula for removing packing and gaskets, etc. and supplies such as emery paper, waste cloth, etc., should be on hand, as well as a container for catching oil, a pan of kerosene for cleaning parts and lubrication oil in.

Work is best performed on a large, solid metal plate of some sort raised about 70cm above the floor. The ideal size of such an iron surface plate is 1,000mm×1,500mm.

Be sure to keep the work area dry and free from dust, sand or other contaminants.

3-2 Disconnecting Compressor Unit from the System

Before commencing disassembly, the compressor unit must be disconnected from the refrigeration system.

First, close the gas/liquid stop valves connecting the compressor to the system. Manipulate the suction valve, discharge valve, intercooler liquid supply valve, etc. to seal off the compressor, being sure that no liquid is sealed between valves.

If your system contains only one compressor unit, it need hardly be said that refrigerant should be recovered into the receiver before commencing repair or maintenance work as well as any maintenance required after long-term stoppage.

3-3 Recovering Refrigerant Gas in the Unit

A considerable quantity of refrigerant gas will unavoidably be sealed in the compressor. This gas must be released.

1) If a small refrigerant recovery device is fitted for maintenance purposes, refrigerant in the unit should be recovered using this device.

2) When two or more compressors are included in the system and are connected with bypass piping, gas in one unit can be recovered by operating the other compressor.

3) When only one compressor is installed, the unit should be stopped only after refrigerant recovery for long term stopping has been carried out. Gas in the unit should be released to the low-stage side.

4) The above work should be carried out slowly and deliberately. If pressure in the unit drops suddenly because operation is too rapid, refrigerant dissolved in the oil may vaporize, causing foaming, and an excessive amount of oil may carried by the gas. This will result in restarting difficulty.

5) Refrigerant gas should be recovered until the internal pressure of the unit is below atmospheric pressure or lower.

6) As some refrigerants, if released into the atmosphere, contribute to the depletion of the Ozone layer protecting the earth, never discharge refrigerant gas directly into the atmosphere.

Ammonia refrigerant poses less serious a danger than Freon but its strongly irritant nature contributes to environmental pollution. If ammonia must be released into the atmosphere, pipe it into a container of water. Water will absorb up to 600 times its weight in ammonia gas. When purging ammonia into a water container, work slowly as there is a possibility that water may be sucked into the hose and then into the system.

3-4 Removing Refrigeration Compressor from the Unit

1) Disconnect the suction and discharge piping before removing the compressor from its base. Be careful not to damage the insulated suction pipe end.

Be sure to cover the exposed ends of all pipes to prevent contamination.

The suction strainer mounted on the check valve is heavy so care should be taken when disconnecting and removing this device.

After removing, cover the suction port to prevent contamination .

Remove the flange bolts.

2) Remove the driveshaft coupling. The most commonly used coupling is a multi-plate flexible coupling with spacer.

Loosen and remove the bolts holding the plates to the spacer and then loosen the compressor side coupling hub locking screw to remove the hub.

3) Detach the lubrication piping from the oil header and remove the unloader actuating pipings and the connecting pipes between the solenoid valve and the compressor. Do not forget to record to locations of the individual pipes in order to facilitate reassembly.

4) Remove the control wiring of the unloader indicator (ref. 5-2).

5) Remove the connecting pipe between the low-stage discharge and high-stage suction ports or the branch piping from the liquid sub-cooler.

6) Remove the external oil return piping (if attached) between the low-stage rotor casing and the high-stage suction cover.

* When removing the oil system piping, always place a container under the joint being loosened to catch any oil remaining in the pipe. The unloader cylinder, in particular, will contain a considerable quantity of oil. Also tag or mark all electrical connections and piping joints to prevent misconnection during reassembly.

7) Remove all of the bolts from the compressor base.

3-5 Hanging the Refrigeration Compressor

1) Eyebolts are provided on the top of the compressor and should always be used when the machine is to be lifted. Adjust the length of the hanging wire or chain carefully to ensure that the compressor is horizontal when lifted (ref. Fig. 22).

2) Remove the 6-8 bolts securing the bearing head (11-1, 11-2) to the rotor casing (1-1, 1-2) and the suction cover (5-1, 5-2) before lowering the compressor onto the work table; several of the bolts are only accessible when the machine is raised. As the compressor is unstable when suspended, position a forklift under the machine when doing this work or support the compressor on a stand (ref. Fig. 22).

3) A considerable amount of oil remains in the compressor. Remove the blind plug located at the bottom of the suction cover (5-1 , 5-2) to drain the oil.

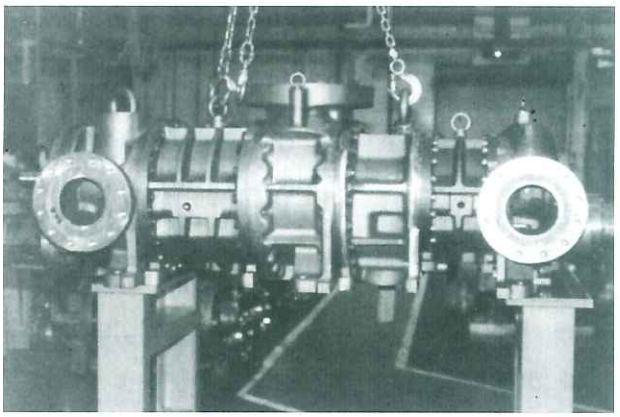


Fig. 22 Lifting the Compressor

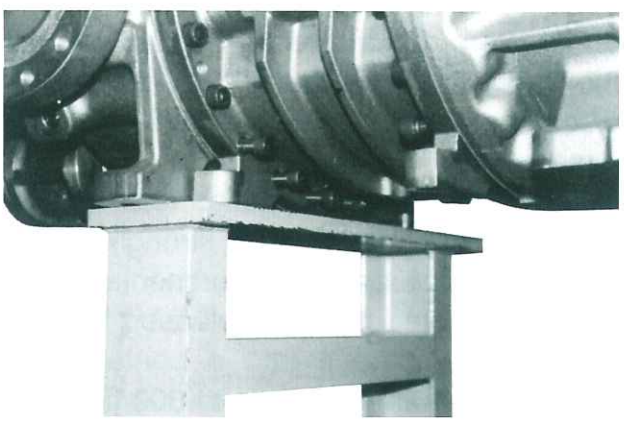


Fig. 23 Drawing Out Lower Flange Fitting Bolt

4 Disassembly Sequence Illustration

The standard disassembly sequence is shown on the left side of the illustration below. The compressor can also be disassembled in the sequence shown at right.

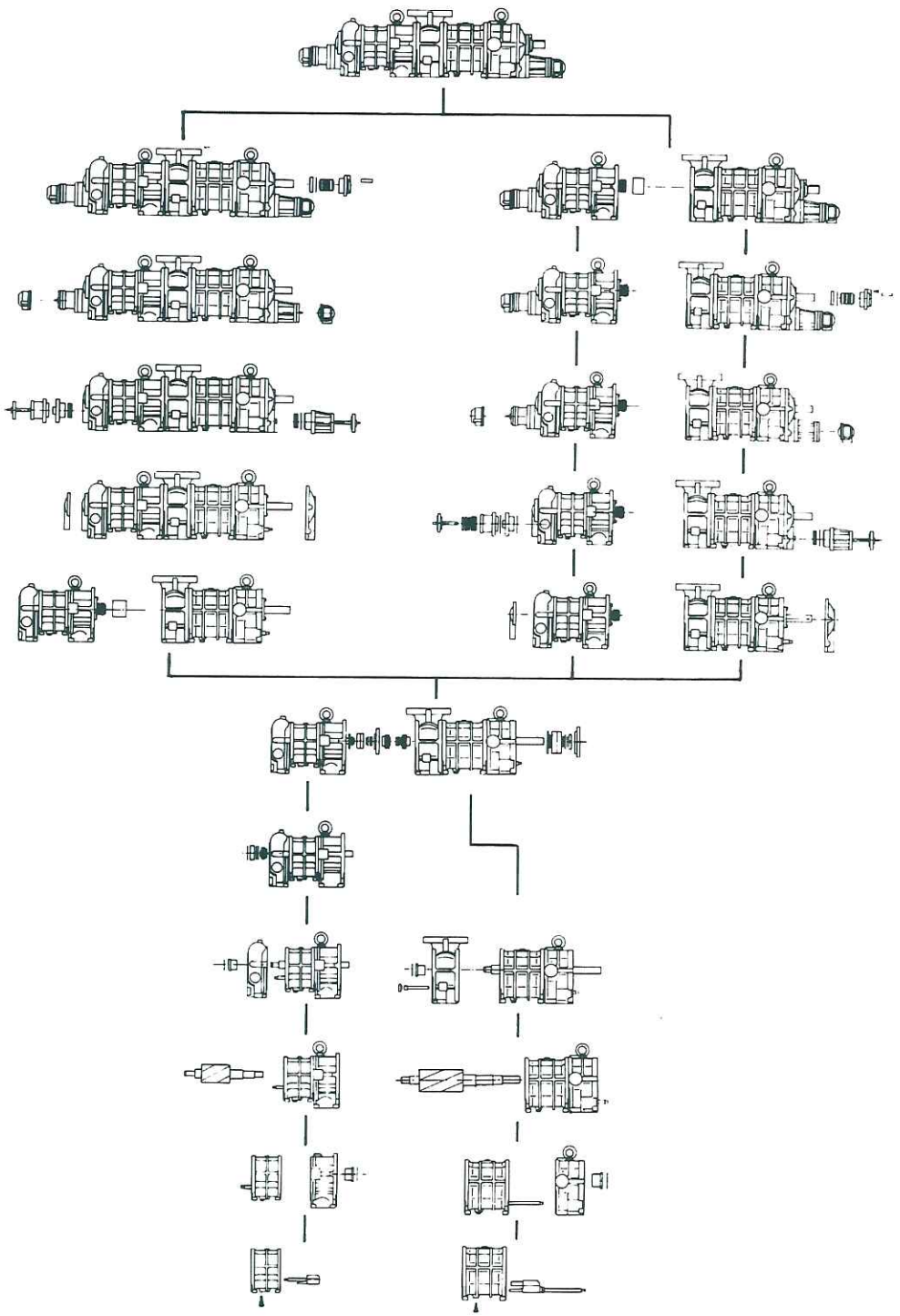


Fig. 24 Disassembly Sequence

5 Disassembly and Inspection

5-1 Mechanical Shaft Seal (100)

1) Disassembly

A new balance type single seal (100) is incor-porated into the screw compressor. A combination of tungsten carbide and carbon graphite is used for the frictional surface of the seal and an O-ring is provided for packing. As shown in Fig. 26, the balance type mechanical seal functions well under a wide range of conditions. An oil seal (50) is fitted to the inside of the seal to act as an oil retainer. Because the frictional portion of the seal is subject to wear due to the rapid rotation of the shaft, a sleeve (528) is provided on Models 2016LSC so that the friction portion can be replaced.

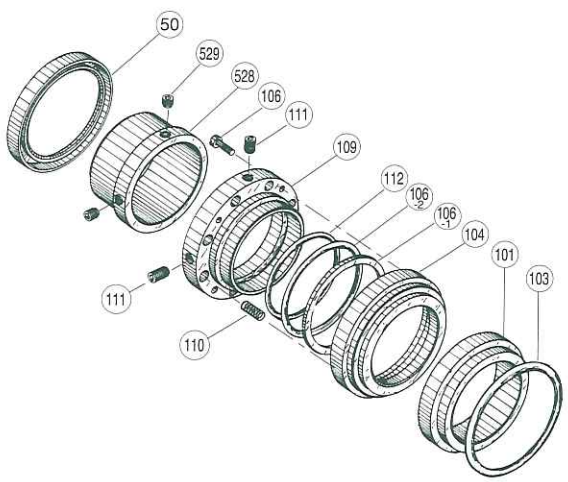


Fig. 25 Exploded view of mechanical seal (100)

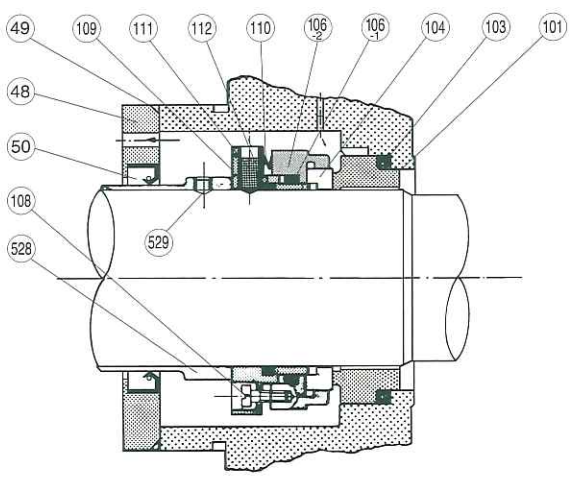


Fig. 26 Cross-sectional view of mechanical seal (100)

Component parts of mechanical seal assembly

(48)	Seal retainer	(106-2)	O-ring
(49)	O-ring	(108)	Drive pin
(50)	Oil seal	(109)	Shaft seal collar
(101)	Carbon insert	(110)	Spring
(103)	O-ring	(111)	Set screw
(104)	Seal ring	(528)	Sleeve, oil seal
(112)	O-ring	(529)	Socket detent screw
(106-1)	Back-up ring		

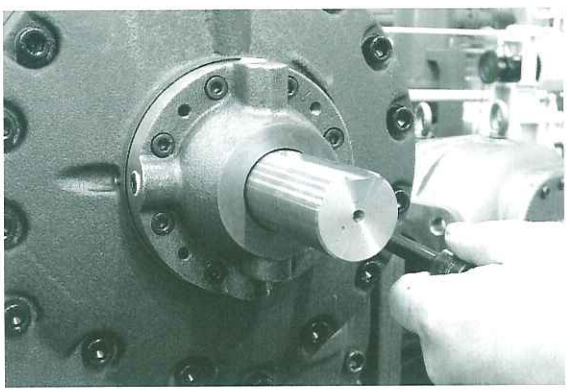


Fig. 27 Seal cover portion

a) Remove four of the six hex-head socket cap screws (53) securing the seal cover (51), leaving two symmetrically positioned screws. Now loosen the remaining two screws alternately, allowing the shaft seal spring (110) to push off the cover slightly. If the cover adheres to the gasket, free it manually after the screws have been loosened.

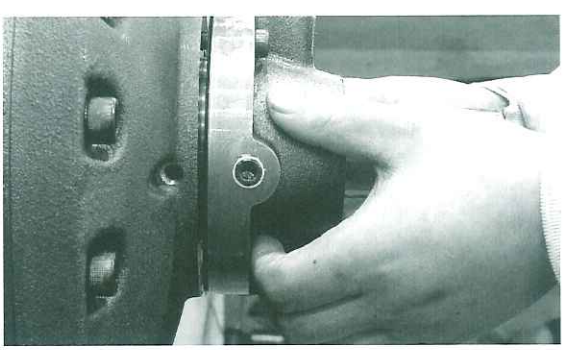


Fig. 28 Removing seal cover (51)

b) Remove the seal cover. A carbon insert (101) is fitted inside the cover. Draw the cover out over the end of the shaft, being careful to prevent the carbon from hitting the shaft. Next remove the O-ring (49) between the seal cover (51) and the seal retainer (48).

c) After the seal cover has been removed, wipe off the shaft and inspect it closely. If any scratches are observed on the shaft surface, finish with fine emery paper in order to prevent damage to the O-ring when it is pulled out of the seal.

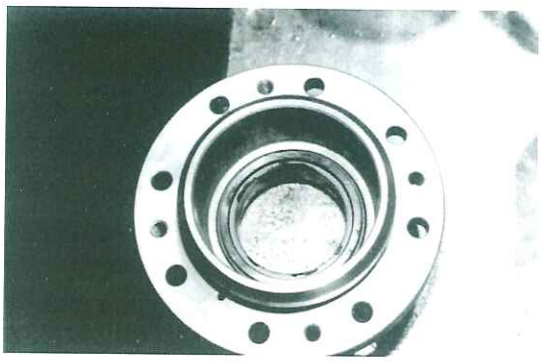


Fig. 29 Shaft seal cover (51)

d) Loosen the set screws (111) securing the shaft seal collar (109).
In the case of Model 160, the plugs must first be removed from the bearing cover before a hex wrench can be inserted. In the case of Model 200 and above, start from the seal cover disassembly procedure.
Loosen the set screws 3-4 turns (do not remove completely) until the end clears the shaft and enters the seal collar.

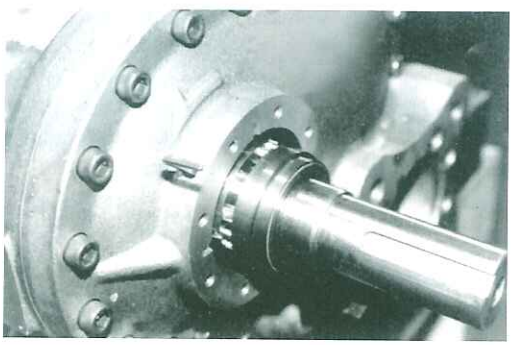


Fig. 30 Loosening seal collar set screws

e) Grasp the seal collar (109) with your fingertips and withdraw carefully, making sure that the set screw points do not catch on the shaft and scratch it.

f) Insert two eye bolts into the screw holes in the seal retainer (48) and draw it off parallel to the shaft. Be careful not to tilt the retainer when withdrawing.

g) Remove the sleeve of the oil seal (528) afterloosening the two set screws (529).

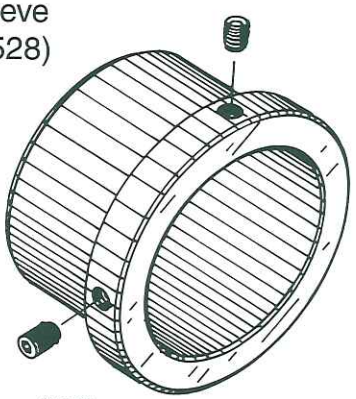


Fig. 30A Oil seal sleeve (528)

2) Inspection

a) Inspect the frictional surfaces of the carbon and seal ring (104). A carbon with a smooth, unblemished face can be reused but if there are any signs of damage or peeling, replace the carbon, otherwise oil leakage may result.

b) Inspect the O-rings. With Freon refrigerant systems, the O-rings may suffer from swelling or deformation. If any abnormality is observed in an O-ring, replace it. A total of four O-rings are used for the seal cover, seal carbon and seal collar.

c) Inspect the frictional surface of the oil seal sleeve (528). If any wear is found, replace the oil seal and the sleeve with new parts. Since the oil seal is specially designed for the compressor, only genuine parts should be used.

Fig. 30B Shaft seal assembly

d) If the seal cover gasket (527) proves difficult to remove when the seal is being disassembled, replace with a new one.

5-2 Unloader Indicator

5-2-1 Structure

Unloader indicators are fitted on the high-stage and low-stage sides of the compressor. The indicator on the high-stage side is identical to that found on a single-stage machine.

The indicator surface on the low-stage side unloader indicator is fitted with a 90° fitting (200) and faces the motor end of the unit to allow easy observation (Fig. 31).

This indicator is a standard type but has an extended shaft and a set of bevel gears installed. The indicator (120E) without these dedicated parts (200) may be used on the low-stage side if desired.

Each unloader indicator is fitted with a potentiometer, two micro-switches, one micro-switch driving cam, one retainer, a dial, a pointer and a terminal block inside an aluminum cover (Fig.14).

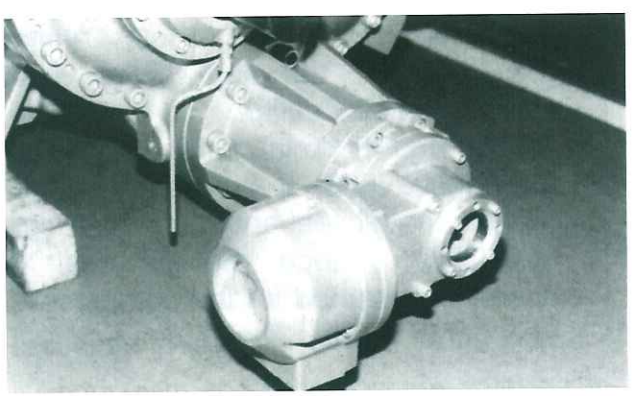


Fig. 31 Use of Indicator Mount (Low-stage side)

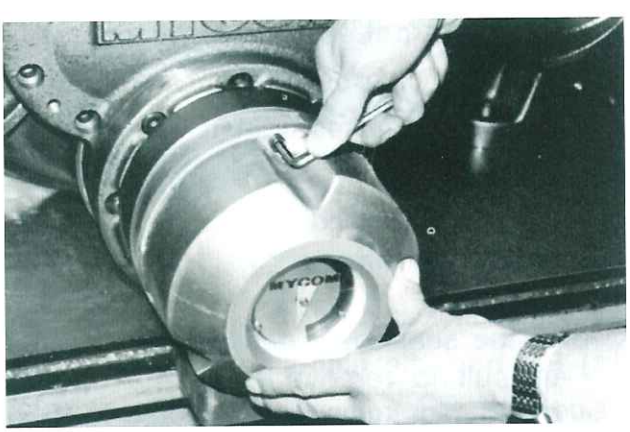


Fig. 32 Removing Indicator Cover

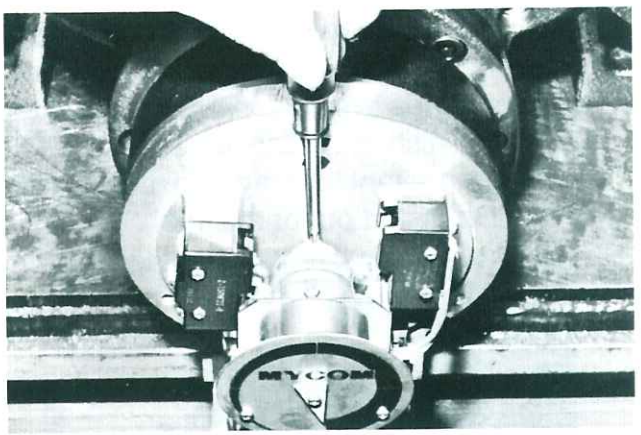


Fig. 33 Loosening Micro-switch Cam Fixing Screw

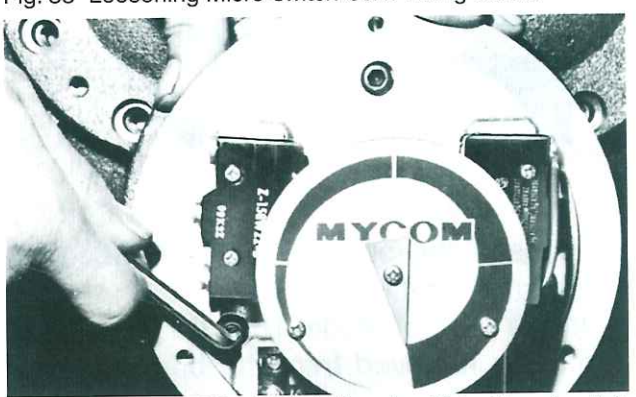


Fig. 34 Loosening Micro-switch Mounting Plate Clamping Bolt

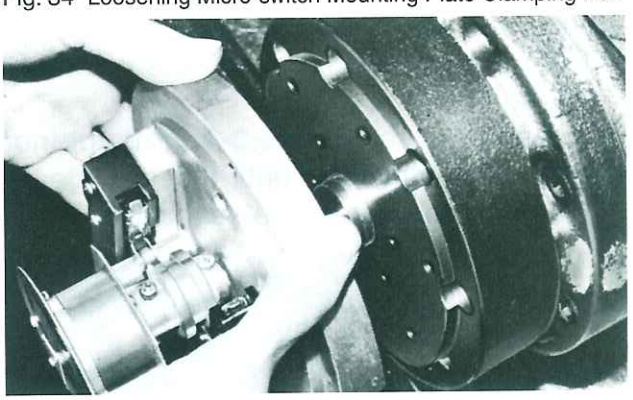


Fig. 35 Removing Indicator Component

5-2-2 Disassembly

(A)The external wiring to the unloader indicators should be disconnected prior to removing the compressor from the base.

Standard Type Unloader Indicator

· Two-stage Compressor Low-stage Side Unloader Indicator

1) For both the high-stage and low-stage side indicators, remove the Allen bolts (147) on the aluminum cover (146) and remove the cover.

2) External wiring is connected to the terminal block under the cover. Detach the wiring, recording the location of each wire to facilitate reassembly.

· Two-stage Compressor Low-stage Side Unloader Indicator

1) Loosen the indicator glass retainer hex. socket head cap screws (212) (do not loosen the Phillips screw [210] on the same side) and the assembly composed of (141), (202)-(207), (210) and (211) can be removed.

[(2)type cover is for automatic control]

2) Remove the Allen bolts (147) which secure the indicator cover (146) [1] and [2] and remove the cover.

3) Remove the plastic plate and disconnect the wiring from the terminal block.

(B) Further Disassembly

1) Remove the potentiometer, micro-switches and indicator needle as an assembly.

2) Loosen the Phillips screw (126) holding the micro-switch cam (127) to the cylinder cam three turns.

3) Loosen and remove the Allen bolts (122) securing the micro-switch set plate (123) to the unloader cover.

4) The assembly can now be pulled off in the axial direction.

5) For the low-stage side indicator, remove the Allen bolts (212, A, B) to remove the assembly.

6) Loosen the Allen bolts (128) holding the bevel gears (201) to the cylinder cam (77) and remove the gears.

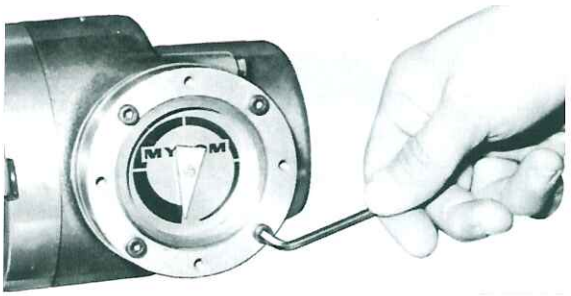


Fig. 36 Removing Low-stage side Indicator Cover Clamping Bolt

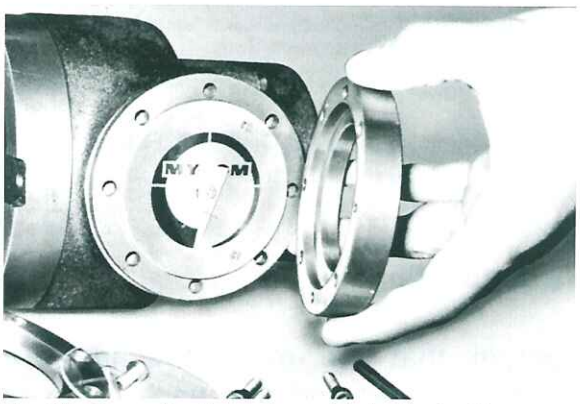


Fig. 37 Removing Low-stage side Indicator Cover

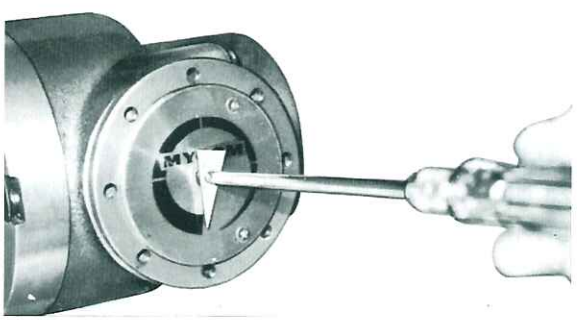


Fig. 38 Removing Pointer of Low-stage side Indicator

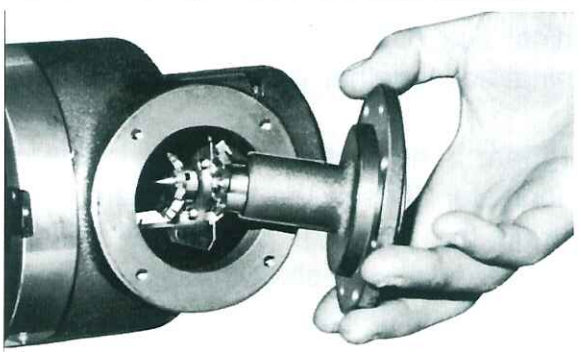


Fig. 39 Removing Indicator Assembly

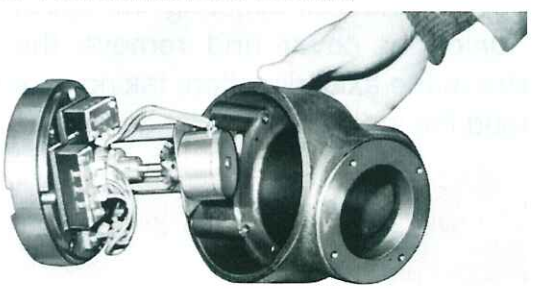


Fig. 40 Removing Low-stage side Indicator Cover

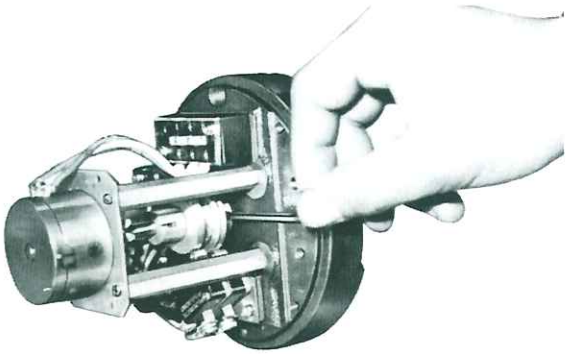


Fig. 41 Loosening Micro-switch Cam Fixing Screw

5-2-3 Inspection

Confirm that the micro-switches are securely mounted and that each piece of the indicator is properly fitted and secured.

•Explosion-proof Indicator (ref. Fig. 15C)

1) Unscrew the Allen bolts (B) of the terminal box cover (A) to allow removal of the cover.

2) Disconnect the wiring from the terminals and remove the Allen bolts (D) of the terminal box (C) to permit removal of the terminal box together with the cable gland.

3) If there is no problem with the inside of the indicator, loosen the locking screw (G) securing the indicator bar (F) to the indicator cylinder cam shaft through the hole in the indicator spacer (E).

4) Pull out the bolt securing the spacer to the unloader cover and remove the indicator in the axial direction, taking care not to bend the indicator cylinder cam shaft.

5-3 Unloader Cover

5-3-1 Structure

The unloader cover is provided with an indicator cylinder cam which changes the linear movement of the unloader slide valve to rotary motion and a V-ring seal which maintains airtightness.

The indicator cylinder cam is supported by bearings fixed in the cover by a bearing gland.

The V-ring is held in place by a spring between the indicator cylinder cam and the cover (for Helium applications a block provided with an O-ring is provided) (Fig. 74).

The indicator cylinder cam incorporates a 340' spiral groove equal in length to the distance the slide valve moves. The cam shaft therefore rotates as the unloader push rod pin slides along the groove.

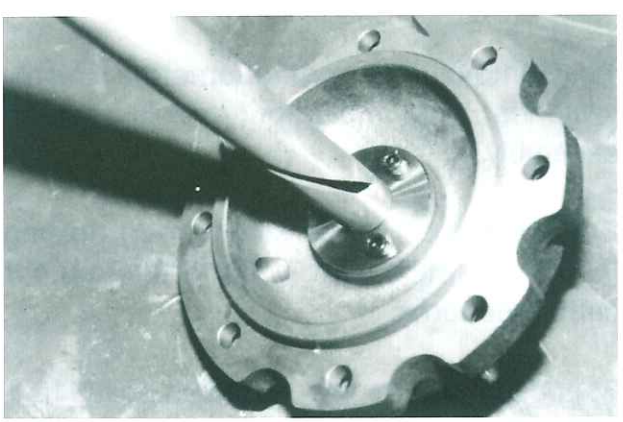


Fig. 42 Unloader Cover with Indicator Cam

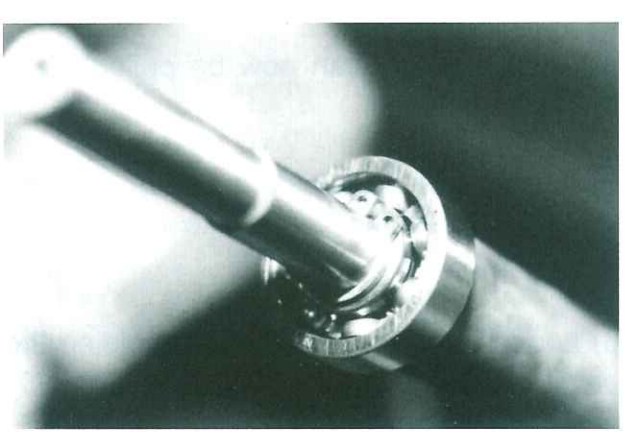


Fig. 43 Indicator Cylinder Cam Bearing

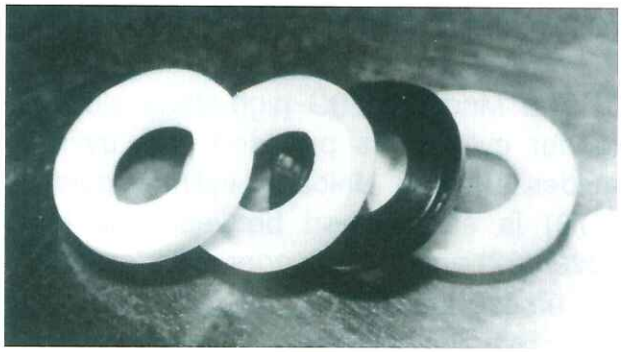


Fig. 44 Indicator Component V-ring

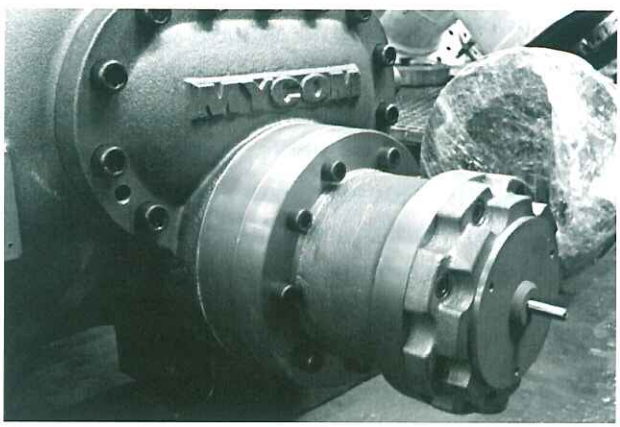


Fig. 45 High-stage side Unloader Cover

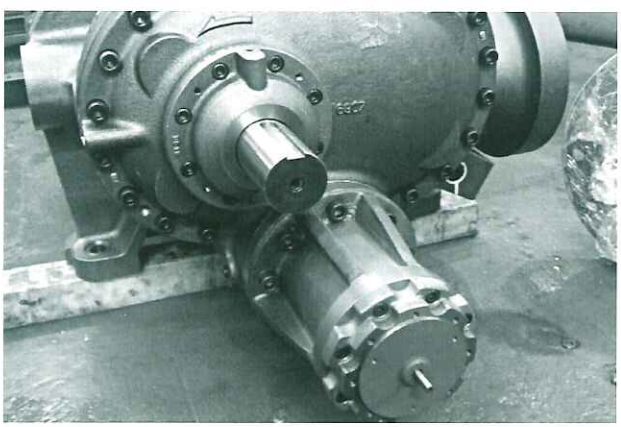


Fig. 46 Low-stage side Unloader Cover

5-3-2 Disassembly

1) Loosen the unloader cover detent bolts (76-1) (76-2) and remove.

2) Pull the cover off in line with the cam shaft center. The indicator cylinder cam is mated with the unloader push rod (67-1, 67-2) as shown in Fig. 42.

When pulling out the indicator cylinder cam, care should be taken not to twist or bend the shaft as deformation of the cam groove may result.

3) If the indicator cylinder cam cannot be pulled out smoothly, remove the bearing gland (80) and Allen bolts (81) to separate the cam from the cover, then pull the indicator cylinder cam and the snap ring out as an assembly.

The spring, spring retainer and V-ring can now be disassembled.

5-3-3 Inspection

1) If the indicator needle (139) does not operate normally, the indicator cylinder cam groove, bearing and slotted pin (unloader push rod side [86]) should be inspected and replaced if any damage or defect is found.

2) If the seal is leaking, inspect the shaft of the indicator cylinder cam, the packing and the edge of the V-ring for damage. Also inspect the O-ring for defects or damage.

3) Because the outer face of the V-ring sticks to the cover, it is liable to be damaged during removal. For this reason it is advisable not to remove the V-ring other than for replacement purposes.

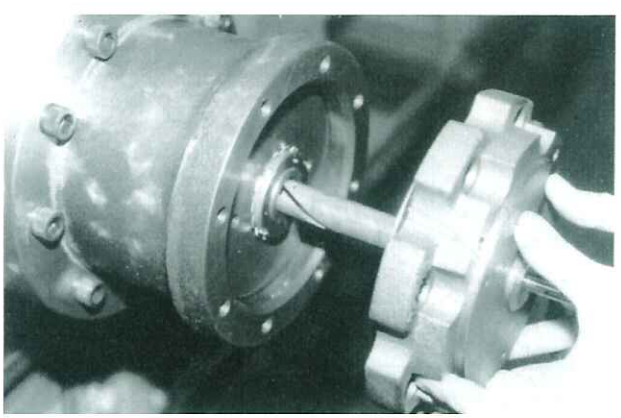


Fig. 47 Unloader Cover and Indicator Cylinder Cam

5-4 Unloader Piston and Cylinder

5-4-1 Structure

The unloader piston (64), fitted in the unloader cylinder, is provided with a cap seal (66) and an O-ring (65) secured to the unloader push rod by a locknut (69).

5-4-2 Disassembly

(A) Unloader Piston (64)

1) Pull out the unloader piston to the end (for the high-stage side this is full-load while for the low-stage side this is the no-load position). This is accomplished by screwing two eyebolts in the tapped holes provided in the unloader piston face and positioning the piston as necessary.

2) Straighten the claw of the locking washer of the locknut securing the pushrod to the piston and loosen and remove the locknut (71).

3) Pull out the piston completely using the eyebolts.

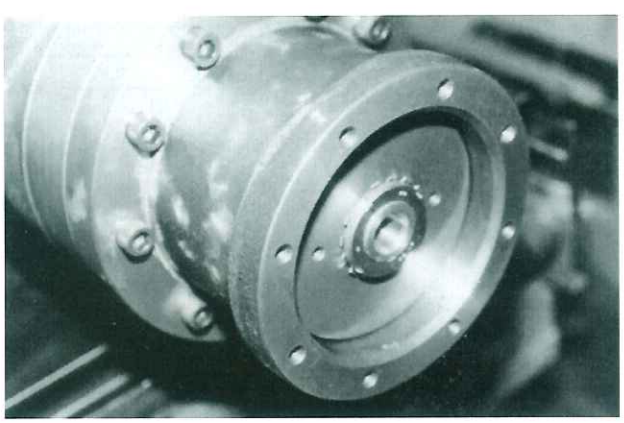


Fig. 48 Unloader Piston

(B) Unloader Cylinder

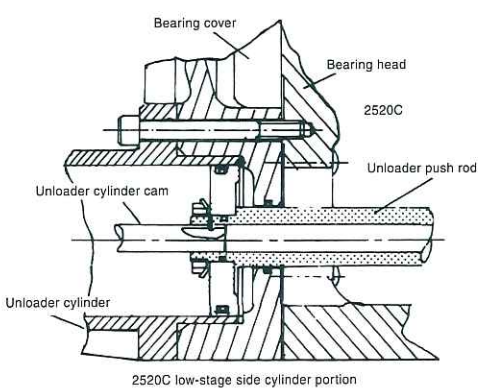
1) The Model 2520C high-stage side unloader cylinder is provided with cylinder guides A and B. Unloader cylinder guide B (278) is sandwiched between the blind cover (22) and the unloader cylinder (60).

Remove the cylinder Allen bolt (62-2) to allow removal of Cylinder Guide B.

2) In the case of the Model 3225C high-stage side, the cylinder is secured to the blind cover by two short Allen bolts and to the suction cover by six long Allen bolts.

If it is not necessary to disassemble the blind cover and cylinder (except for O-ring replacement), these short Allen bolts need not be removed.

3) The low-stage side cylinder is secured to the bearing head by two long bolts, sandwiching the bearing cover between the cylinder and the head. As the cylinder is closely fitted to the bearing cover, it will not



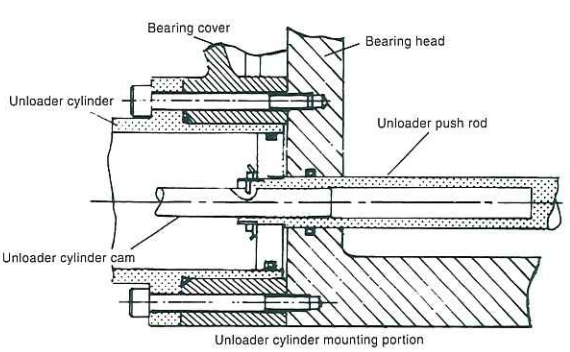


Fig. 49 Low-stage side Unloader Cylinder Fitting Section, Sectional View

come off even if all bolts are removed. Pull off the cylinder by grasping and pulling on the flange portion.

5-4-3 Inspection

1) Inspect the cap seal (66) on the unloader piston for wear and cracking and check the O-ring for deformation or loss of elasticity. Replace any damaged or defective parts. When considering replacement, estimate the durability of the parts until the next periodic inspection.

2) Check for scratches or other damage on the inner surface of the unloader cylinder which may damage the cap seal and, if found, repair using emery paper or a fine grindstone.

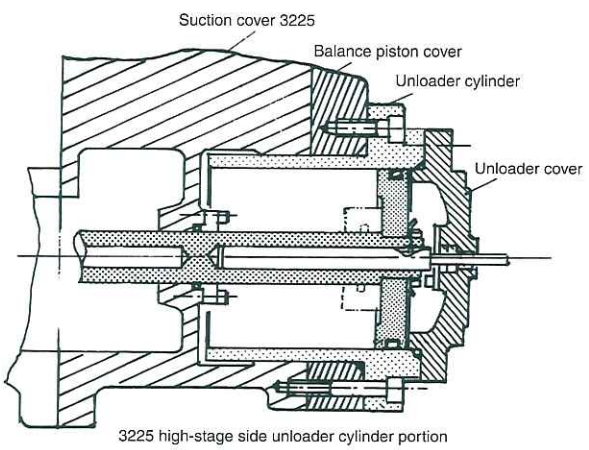


Fig. 50 High-stage side Unloader Cylinder Fitting Section, Sectional View

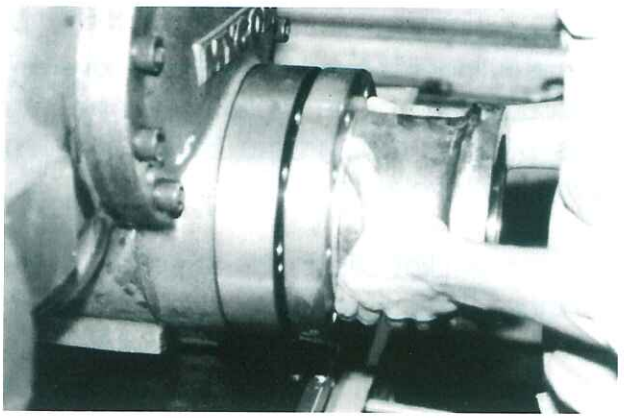


Fig. 51 Removing Unloader Cylinder

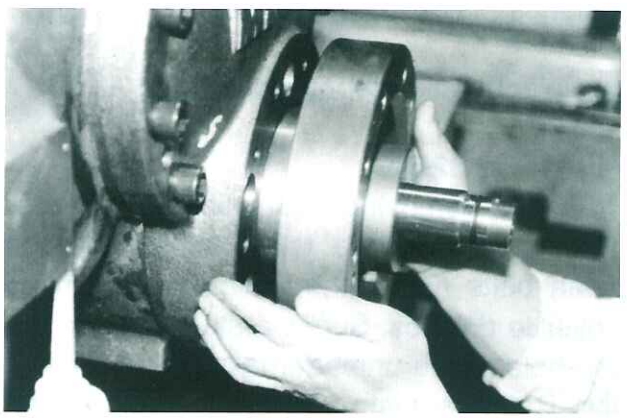


Fig. 52 Removing Unloader Cylinder Guide B

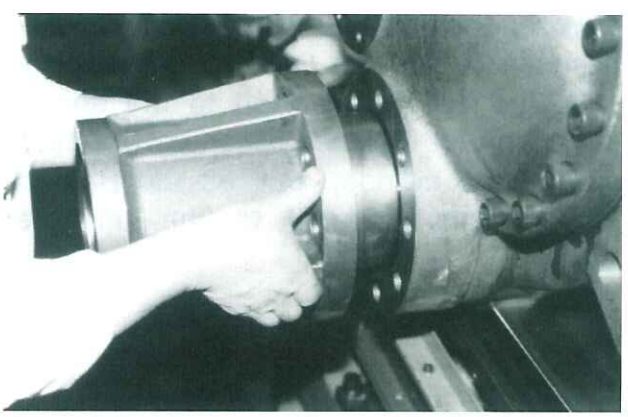


Fig. 53 Low-stage side Unloader Cylinder

5-5 High-stage side Balance Piston Cover (22) and Bearing Cover (16)

5-5-1 Disassembly

As mentioned earlier, disassembly procedures for Models 2520C and 3225C are somewhat different.

(A) Model 2520C

1) The cylinder is fixed to the blind cover by short bolts and to the suction cover by long bolts passing through the Balance piston cover. Remove all these bolts.

2) If the gasket sticks, tap the side of the Balance piston cover lightly with a hammer.

Since the unloader cylinder guide A is mounted between the suction cover and the Balance piston cover, the Balance piston cover will not drop off. Pull off the Balance piston cover parallel to the shaft.

3) Pull out unloader cylinder guide A.

(B) Model 3225C

1) When removing the unloader cylinder (60), care must be taken to remove the Allen bolts (61) without allowing the blind cover to drop off. Screw a stud bolt into the top hole of the unloader cylinder to prevent the Balance piston cover from dropping suddenly when all the bolts are removed.

2) When the unloader cylinder (60) remains assembled with the Balance piston cover (22), the cylinder is fixed to the suction cover and the Balance piston cover rotates around the cylinder. Pull off the Balance piston cover parallel to the unloader cylinder.

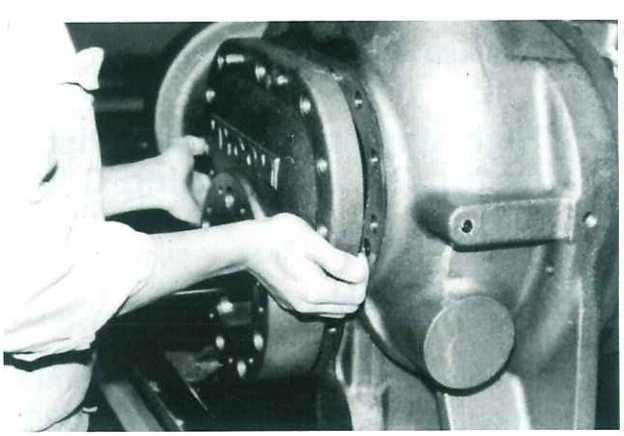


Fig. 54 Balance piston cover

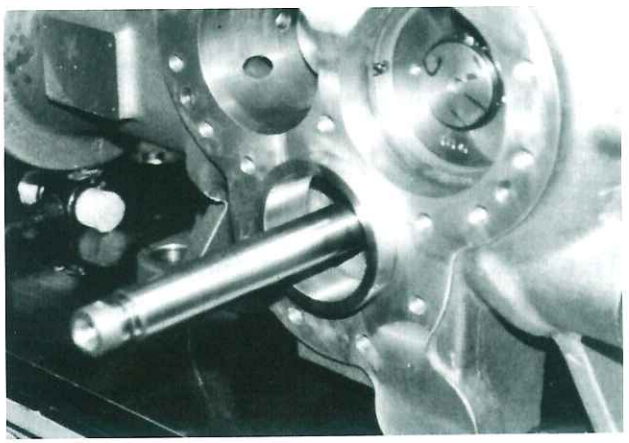


Fig. 55 Unloader Cylinder Guide A

5-5-2 Inspection

In the case of Model 2520C, for which the O-ring of the cylinder guide and the Balance piston cover gasket should be checked for damage or deformation and replaced if necessary.

5-5-3 Structure of Bearing Cover (16)

The structure of this part ditfers somewhat between Models 2520C and 3225C.

Unlike on a single-stage machine, the unloader push rod (167) passes through the bearing cover because the unloader cylinder is fitted to this cover (16). In the case of Models 2520C, however, an unloader push rod guide hole is provided in the bearing cover, while Model 3225C has an unloader push rod guide hole in the bearing head (11-1, 11-2) as well (ref. Fig. 57).

5-5-4 Disassembly

1) Remove all of the Allen bolts (18). The bearing cover is held to the bearing head by a parallel pin (19-1). Insert headless stud bolts into the top holes.

2) Screw Allen bolts (18) into the two threaded blind holes provided in the bearing cover to press off the bearing cover. When sufficient clearance is created, separate the gasket from the bearing cover, leaving it attached to the bearing head.

Care should be taken to prevent bending of the unloader push rod. When the parallel pin comes free, pull off the bearing cover in line with the shaft center. Care should be taken to prevent the bearing cover from striking the shaft at any time during removal.

5-5-5 Inspection

1) Check the O-ring (328) in the unloader push rod hole for damage or deformation and replace if necessary.

2) Check the bearing cover gasket for damage and replace if necessary.

5-6 Separation of High-stage and Low-stage Components

The high- and low-stage components must be separated to allow removal of the gear coupling, the high-stage side thrust bearing, main bearing and the rotors.

Separation can be commenced from this point without going through the disassembly procedures noted previously (ref. Fig. 24).

5-6-1 Disassembly

1) Loosen the lower Allen bolts with the compressor raised to allow easy removal (ref. Paragraph 3-4). When lifting the compressor, take all necessary measures to assure safety.

2) Remove the Allen bolts (18-2) securing the high-stage bearing head and low-stage suction cover.

3) Drive the parallel pins (19-2) through to the suction cover side with a drive pin. If this is impractical, screw several bolts into the threaded blind holes provided symmetrically around he flange of the high-stage bearing head to separate. All separation work should be carried out while assuring that the flange face is not tilted, or damage to the shafts could result.

4) When the high-stage and low-stage components are separated, the drive sleeve (152) for the gear coupling located in-between can be readily removed.

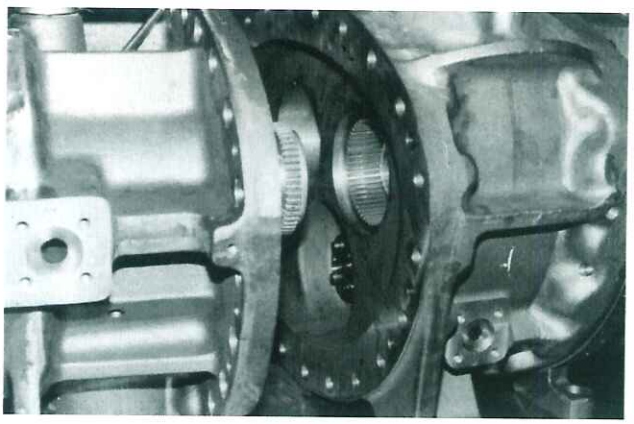


Fig. 56 Separation of High-stage and Low-stage sides

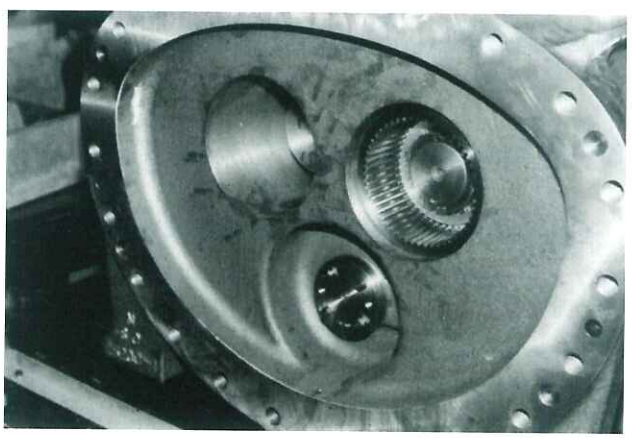


Fig. 57 Gear Coupling Section

5-6-2 Inspection

1) Carefully inspect the bearing head gasket (12-1, 12-2).

2) Inspect the condition of the gear coupling teeth and the drive sleeve.

5-7 Gear Coupling

5-7-1 Disassembly of High-stage Side Shaft

The high-stage side gear coupling and driven hub (153) are fixed to the rotor shaft by a key (157) and Allen bolt set screws (159). Loosen the set screws and pull off the coupling driven head and gear. The parts should come free easily but if it is stuck, utilize the threaded blind hole or a pulley puller.

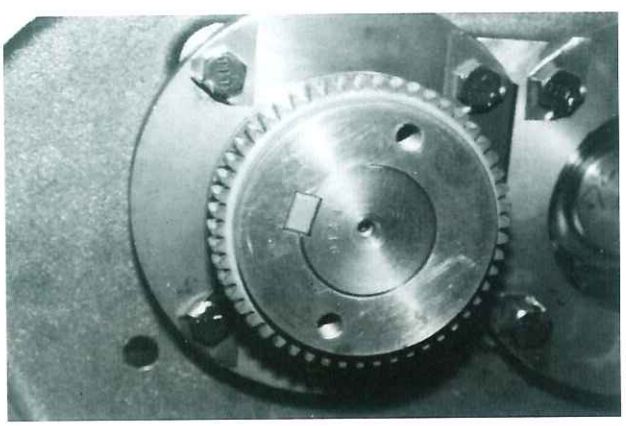


Fig. 58 High-stage side Gear Coupling

5-7-2 Inspection

Check the coupling gear teeth for wear.

5-7-3 Disassembly of Low-stage Side Gear Coupling and Injection Pipe

The drive side gear coupling is mounted on the low-stage side male rotor to transfer power to the high-stage through the drive sleeve (152).

1) Since the drive sleeve is provided between the driven hub gear and the drive hub gear, the sleeve was removed when the high-stage and low-stage components were separated.

2) Straighten the claw on the drive gear lock washer and loosen the locknut (Fig. 60).

3) Screw eyebolts into the blind hole to force the gear off the shaft (Fig. 61).

4) A low-stage side oil injection pipe is fitted at the bottom but the arrangement and assembly method of the pipe differ according to the model (Fig. 62).

Remove the oil injection pipe retainer (164) and screw a bolt into the threaded hole in the injection pipe to force it off.

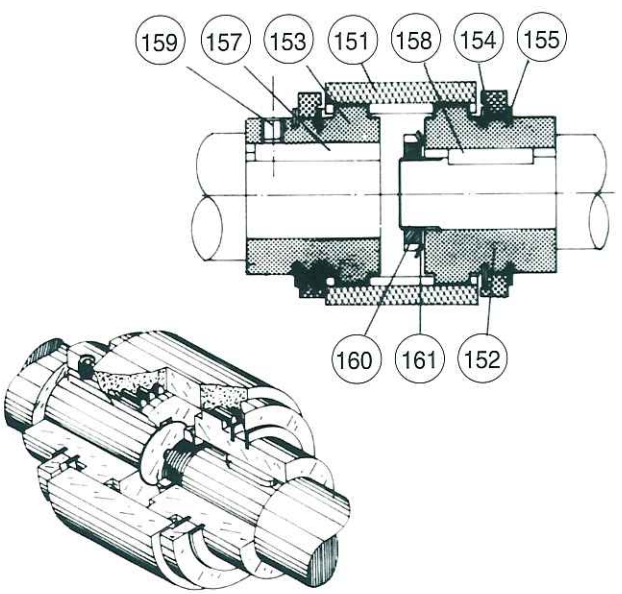


Fig. 59 Gear Coupling, Cross Sectional View

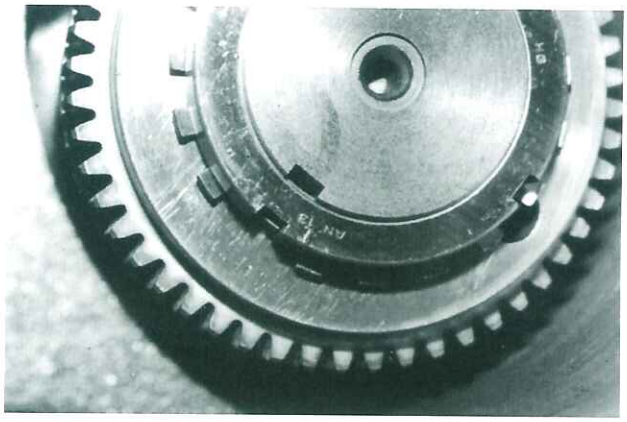


Fig. 60 Low-stage side Gear Coupling Hub

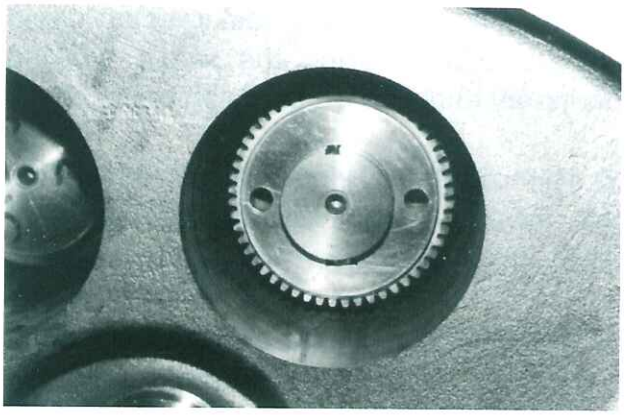


Fig. 61 Tapped Holes on High-stage side Gear Coupling Hub for Pulling Out Hub

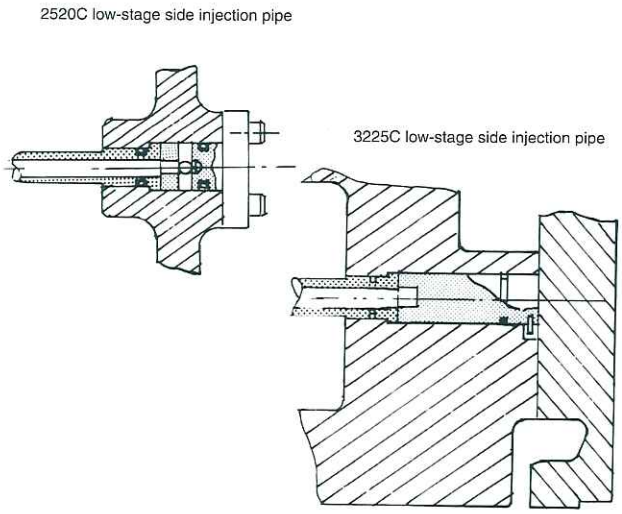


Fig. 62 Oil Injection Section, Sectional View

5-7-4 Inspection

1) Inspect the gear teeth for wear.

Inspect clearance by loosely fitting the driven sleeve.

2) Inspect the O-rings of the injection pipe.

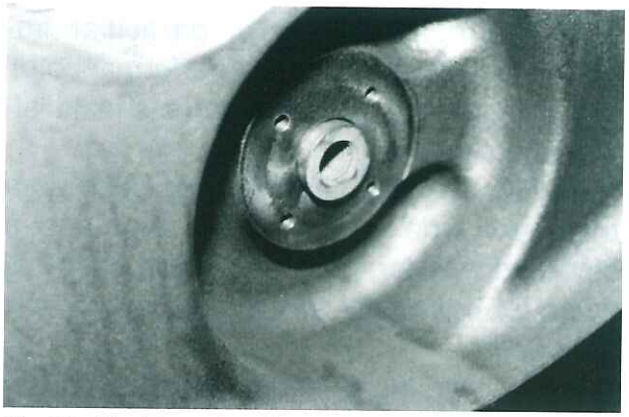


Fig. 63 After Removing Oil Injection Pipe Retainer (164)

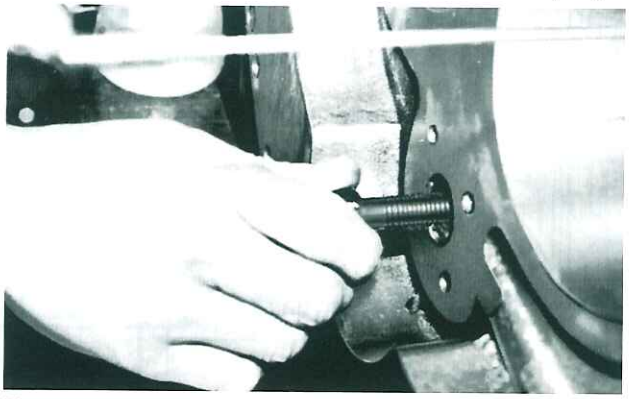


Fig. 64 Drawing Out Oil Injection Pipe

5-8 Thrust Bearing

5-8-1 Structure

The thrust bearing is one of the most important parts of the compressor, determining axial load resulting from pressure differences caused by gas compression and positioning of the rotor shaft (discharge side thrust clearance).

An angular contact type face-to-face duplex bearing (Fig. 66) with a high speed, high accuracy special retainer is used for most applications.

This bearing receives thrust load only; radial load cannot be supported because of the loose fit of the periphery.

In order to maintain the specified clearance between the end face of the rotor and the discharge face of the bearing head, the bearing balls are selected to assure rotation not only in the axial direction but in the perpendicular direction against the screw rotor by pre-loading.

As the bearings are of particular importance in maintaining the performance of the compressor, genuine parts should always be used.

Various bearing combinations such as a triple-row type for the male rotor and a standard type for the female rotor, standard types for both male and female rotors, etc. are used.

When ordering bearings, clearly indicate the bearing number, compressor model and serial number of the machine and high- or low-stage rotor application.

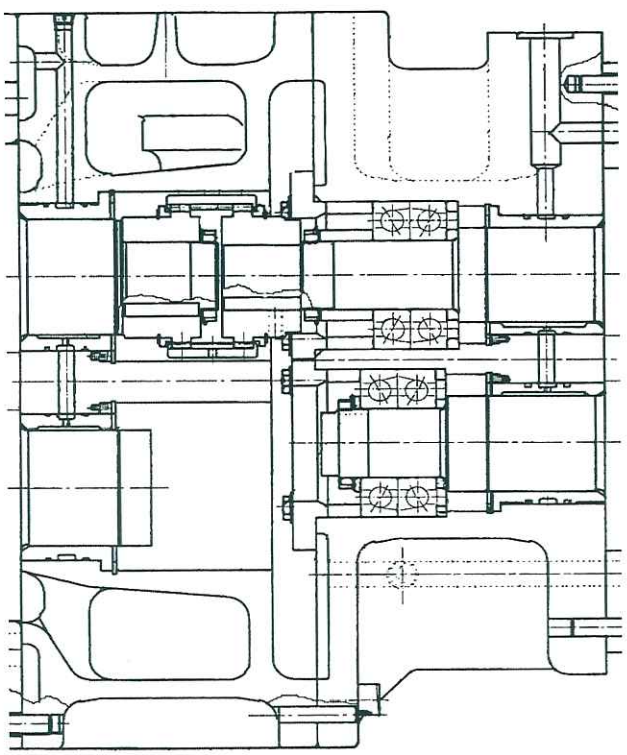
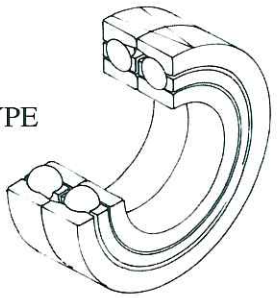


Fig. 65 2520C (High-stage), Sectional View

Fig. 66 Standard Thrust Bearing Combination



5-8-2 Disassembly of High-stage Side Thrust Bearing

1) Straighten the claws of the spring washer (46-2) on the thrust bearing gland (43-2A, 2B) securing the thrust bearing periphery and remove the Allen bolts (45-2).

2) Remove the O-ring (150) fitted behind the retainer (not provided on standard type). Take care not to misplace the O-ring.

3) Straighten the claws on the lock washer (40-2) and remove the locknut (39-2) securing the thrust bearing to the shaft using a locknut wrench (Fig. 67).

4) The periphery of the thrust bearing outer race and the bearing head as well as the bearing and the rotor shaft are clearance fitted.

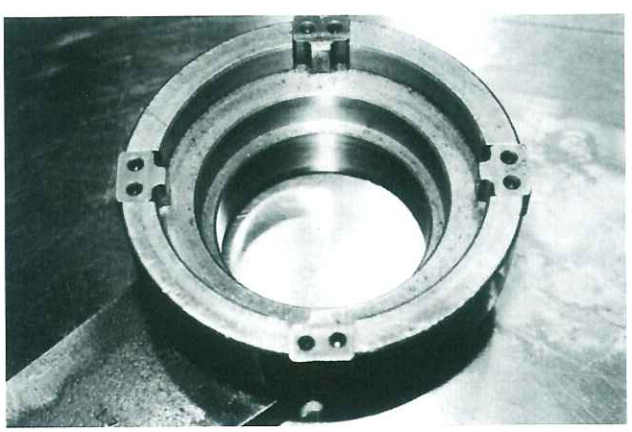


Fig. 67 Bearing Lock Nut Wrench

Insert a 1-2 mm dia. wire with a flat bent point into the clearance between the outer race and the ball retainer, hook the ball retainer and pull out the bearing (ref. Fig. 72).

5) The thrust bearing should come out as a unit. If it comes out in pieces, store in the order of removal for later reassembly.
6) A thrust adjusting washer (42-1, 42-2) and thrust bearing bracket metal (41-1, 42-2) (for 2520C only) are provided behind the thrust bearing. The parts are embossed with an "M" for the male rotor and "F" for the female rotor.

7) The bearings and washers should be grouped together with their respective rotor and stored for later reassembly.

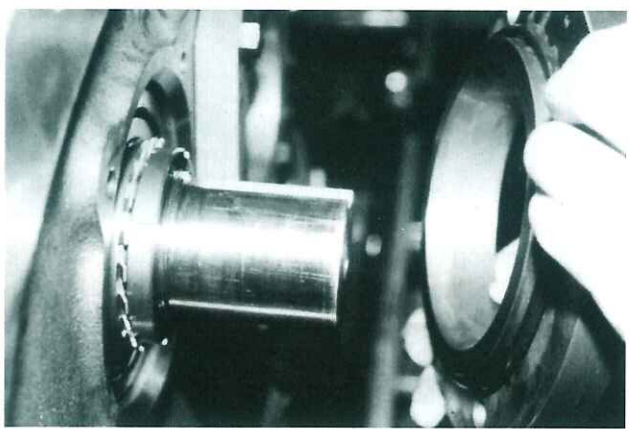


Fig. 68 Removing Bearing Gland

Fig. 69 Thrust Bearing Gland B

5-8-3 Inspection

1) The bearing service life has been calculated at more than 30,000 hours of continuous operation under certain specified operating conditions (calculated service life is the probable time at which one out of ten bearings will fail). The theoretical service life may, however, be reduced somewhat depending upon actual operating conditions.

For this reason it is recommended that the bearings be replaced after 20,000 hours of operation even if visual inspection reveals no abnormalities.

2) After washing the bearing in kerosene, hold the inner race securely and spin the outer race. Any abnormal vibration will be felt through the fingers. This may be caused by dust in the bearing or a defect in the rolling contact surface. Clean the bearing once again with compressed air. If abnormal vibration remains, replace the bearing.

3) Are the bearing balls lustrous? If the balls appear dull or striped or if their are burrs on the retainer holes, replace the bearing.

4) All bearings are carefully inspected by the manufacturer. The ball retainer is made of a special material. Even if the type and number of a bearing are exactly the same as for the bearing removed from the compressor, unless it is a genuine replacement bearing the quality and durability may be insufficient.

Use of non-genuine bearings may lead to serious damage not only to the bearing itself but to major components of the compressor.

Use of non-genuine bearings invalidates the warranty.

5) If the inner and outer races can be separated easily, the bearing is worn out and should be replaced with a new bearing.

5-8-4 Low-stage side Thrust Bearing

Three kinds of thrust bearing are used, as mentioned above. As rotor shaft diameter increases as rotor diameter increases, use of a larger thrust bearing is necessary. As a consequence, the rotation speed of the balls increases. Model 3225C is therefore provided with an oiling spacer between the bearings to improve lubrication at the higher speeds.

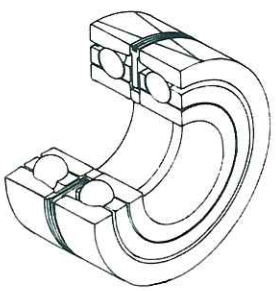
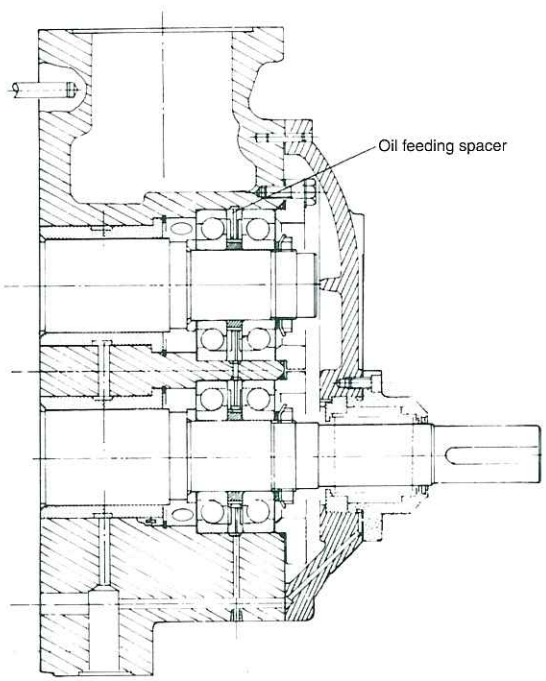


Fig. 70 Thrust Bearing for Model 320, Sectional View



5-8-5 Disassembly of Low-stage side Thrust Bearing

1) Straighten the claws of the lock washers on the bearing glands (43) securing the periphery of the bearing and remove the hex. head socket bolts (81) and bearing glands.

2) Straighten the claw of the bearing inner race lock washer and remove the locknut.

3) Pull out the bearings (Fig. 72).

4) Store the bearings, thrust adjusting washer and O-ring for the bearing gland together with the respective rotor.

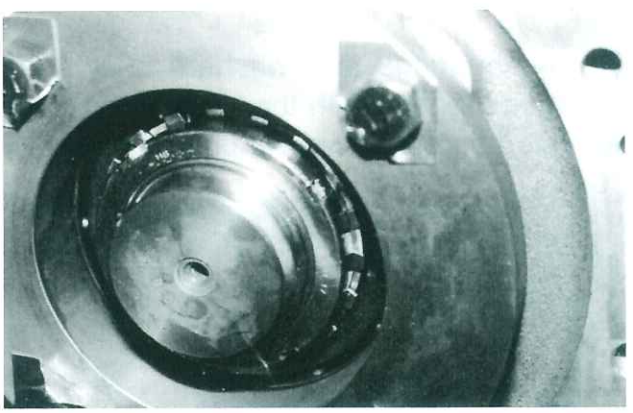


Fig. 71 Bearing Gland Fixing Bolt Lock Washer

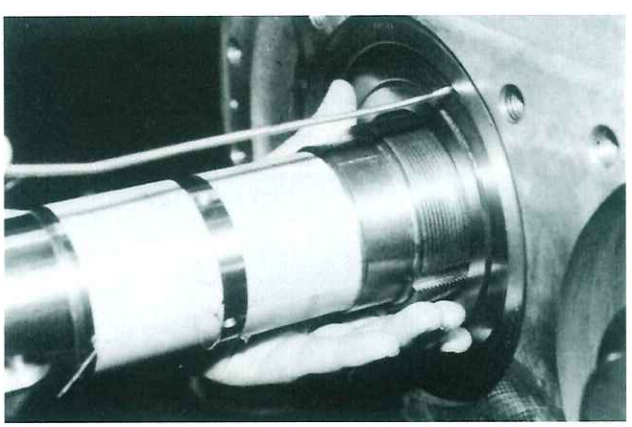


Fig. 72 Removing Thrust Bearing

5-8-6 Inspection

Check the bearing in the same manner as for inspection of the high-stage side thrust bearing.

5-9 Balance Piston

5-9-1 Structure

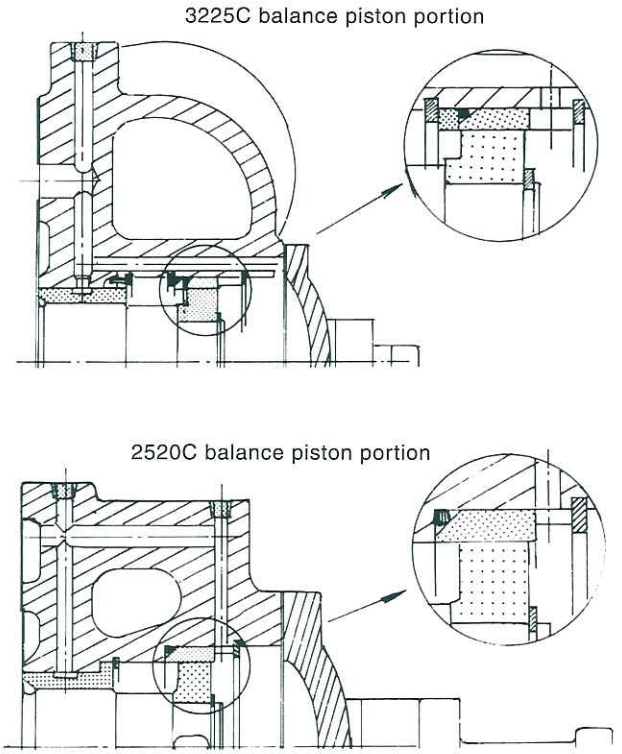


Fig. 73 Balance Piston Section

As mentioned earlier, the rotors of a screw compressor are subject to axiai loads.

Especially, as the compression ratio increases, load on the male rotor increases more in comparison than that on the female rotor. As well, since the male rotor rotates at a speed 50% higher than that of the femafe rotor, use of the same thrust bearing for both rotors would result in a significant difference in the service lives of the bearings. A balance piston which off-sets load on the rotor hydraulically is therefore installed.

The arrangement and mounting of the balance piston sleeve (33) differ according to the compressor model because there are two different balance pistons with different outer diameters. One set-up uses a balance piston having an outer diameter equal to the diameter of the side bearing collar and is fitted with a snap ring (37) and an O-ring retainer (36) while the other uses a balance piston with an inner diameter equal to the inner diameter of the side bearing collar and utilizes the stepped portion of the suction cover as the O-ring retainer (Fig. 73).

5-9-2 Disassembly of Balance Piston

1) Using a pair of snap ring pliers, remove the stop ring (32) holding the balance piston to the shaft.

2) Screw a pair of eyebolts into the blind holes in the balance piston face and draw out the piston. Leave the balance piston key (31) as it is.

3) Remove the balance piston sleeve retaining snap ring (37) with a pair of snap ring pliers.

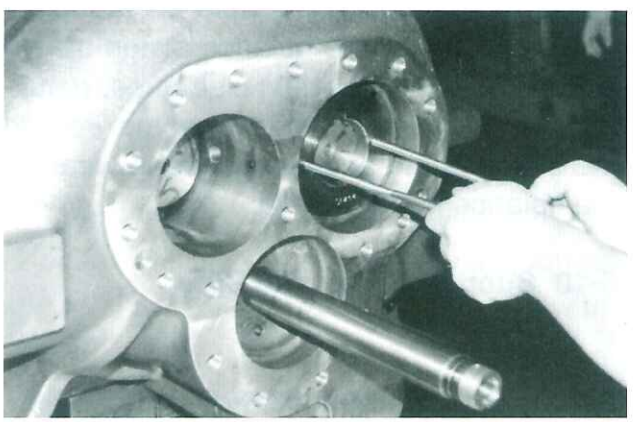


Fig. 74 Pulling Out Balance Piston

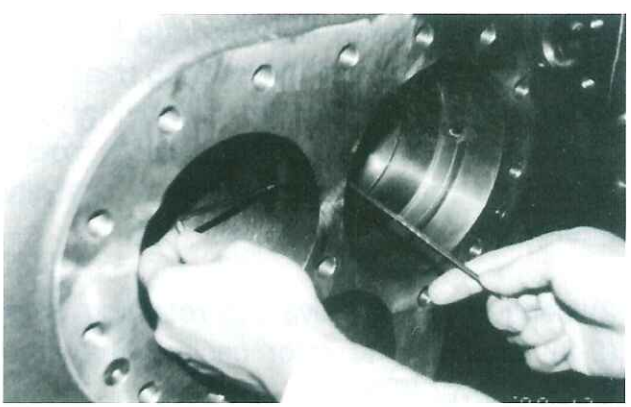


Fig. 75 Removing Balance Piston Sleeve Lock Screws

4) Allen bolts (34) are screwed in from both sides to prevent rotation of the balance piston sleeve (33). Loosen and remove the sleeve side Allen bolts.

5) Since the balance piston sleeve presses on the O-ring, clearance at the back allows for a hold to pull the sleeve out.

Remove the O-ring retainer (36) and snap ring (37) (if installed).

5-9-3 Inspection

The balance piston itself is not easily damaged but the balance piston sleeve may be scored by the balance piston because the clearance between the piston and sleeve is smaller than the clearance between the side bearing and the shaft.

In addition, side bearing wear will contribute to balance piston wear, resulting in excessive oil flow from this portion. For these reasons, if balance piston wear exceeds service limits it should be replaced. The periphery of the balance piston sleeve is provided with a certain clearance, resulting in no load even if there is some wear to the side bearing and no excessive wear on the balance piston sleeve.

5-10 Suction Cover and Side Bearing

5-10-1 Disassembly of High-stage side

1) The high-stage side rotor casing is low in height and installed like a bridge between the suction cover and the bearing head.

Consequently, before removing the suction cover, position supporting blocks under the rotor casing to assure stability after separation of the parts.

2) Loosen and remove the retaining bolts (2-2) securing the rotor casing (5-2) and suction cover (6-2).

The suction cover will not drop down when the bolts are removed because a parallel pin (3-3) is fitted and the side bearing and rotor shaft hold the cover up.

3) Screw bolts into the blind holes provided in the rotor casing flange and press the suction cover off evenly. When a sufficient gap is created, separate the gasket from the suction cover with a gasket remover so that it remains attached to the rotor casing.

4) When the suction cover is pressed off, the parallel pin will also come out but the rotor shaffs and the side bearings will remain in the casing. Pull off the suction cover parallel to the rotor shaft. Since the thrust bearing has already been removed, the rotors are apt to come out together with the suction cover due to friction between the side bearing and rotor shaft. The rotor should be left in the rotor casing.

5) A side bearing is fitted to the suction cover from the blind cover side. Remove the stop ring (29-2) and push out the side bearing from the rotor side using a cushioning block.

5-10-2 Inspection

1) The suction cover itself has no parts which can normally be damaged. If the thrust bearing is worn out, however, scratches or abnormal wear caused by contact with the rotor may be observed. In such a case replace the suction cover.

If a compound type two-stage compressor is operated for a long time under excessively high intermediate pressure conditions, suction cover damage is possible due to excessive wear of the thrust bearing.

2) Inspect the friction surface of the side bearing and measure the clearance between the side bearing and the rotor shaft. The rotor shaft may be worn out even if the bearing inner diameter is within allowable tolerances.

One of the causes is impurities embedded in the bearing metal. If the bearing metal surface has a gray appearance, inspect carefully and replace if necessary.

* For special applications such as gas compressors, etc., a special bearing metal composed of silver, carbon, etc. is utilized. In this case, contact a MYCOM subsidiary or service center.

3) The high-stage side is normally not provided with an oil injection mechanism. Even if such a mechanism is fitted, it is generally not utilized.

4) Model 3225C is provided with a hole for the push rod in the suction cover. This hole is sealed by an O-ring fitted with an O-ring retainer. Remove the O-ring and inspect for deformation or other damage.

Model 2520C is fitted with a sealing O-ring in the unloader cylinder guide B but no O-ring is provided in the suction cover.

5-10-3 Disassembly of Low-stage side

1) Remove the retaining bolts (2-1) as was done for the high-stage side.

2) Screw bolts into the blind holes provided in the rotor casing flange and press the suction cover off evenly. When a sufficient gap is created, separate the gasket from the suction cover with a gasket remover so that it remains attached to the rotor casing.

3) After removing the parallel pin, pull out the suction cover parallel to the shaft. The rotor may come out together with the suction cover due to friction between the side bearing and the rotor shaft.

4) Remove the snap ring and push out the side bearing from the rotor side.

5-10-4 Inspection

Check the side bearing in the same manner as that in the high-stage side (ref. 5-10-2).

5-11 Rotors and Rotor Casing

5-11-1 Disassembly of High-stage side

The high-stage side utilizes 200S, M or L and 250S, M or L rotors. Rotors up to 200S and M are light enough to be handled manually but a chain block, forklift or crane should be used for larger sizes to assure safety.

1) As the rotors are freed when the suction cover is removed, they can easily be pulled out by pulling on the shaft. Either the male or the female rotor may be pulled out first but it is easier to remove the male rotor first because it has a longer shaft.

2) Raise the shaft slight and pull out the rotor to about two-thirds of its length while turning it clockwise.

3) Wrap a nylon or other fabric belt around the rotor at the center and pull the remainder of the way out while holding the female rotor back.

4) Do not place the rotor directly on a hard surface, or the lobe edges may be damaged. Rest on a wood plate or support the rotor shaft ends on V-blocks.

5) Pull out the female rotor in the same manner.

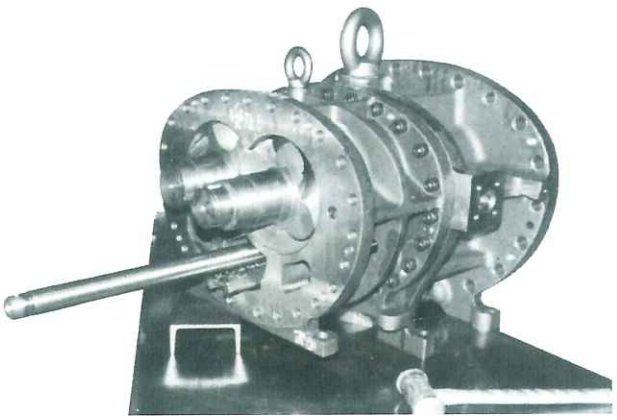


Fig. 76 High-stage side Rotor Casing

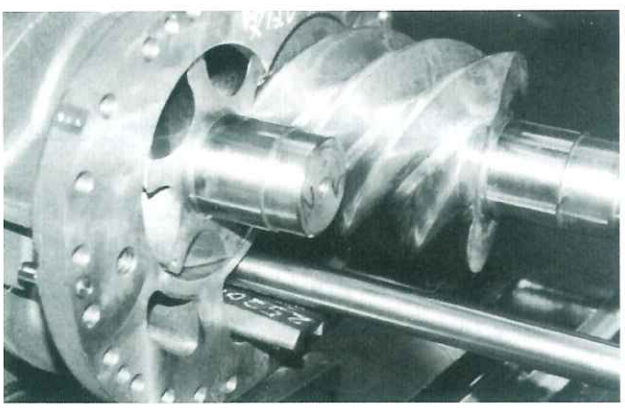


Fig. 77 Drawing Out Male Rotor

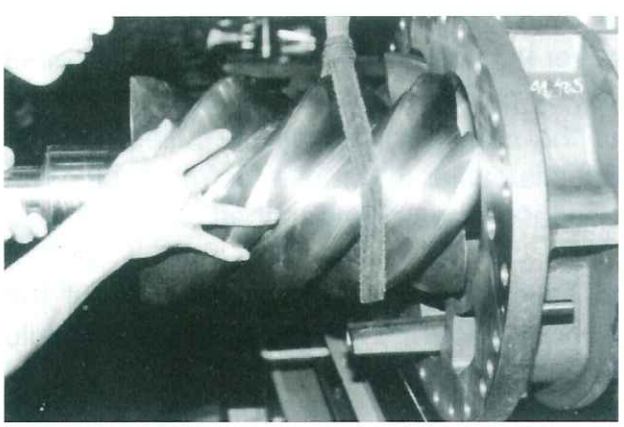


Fig. 78 Lifting Male Rotor

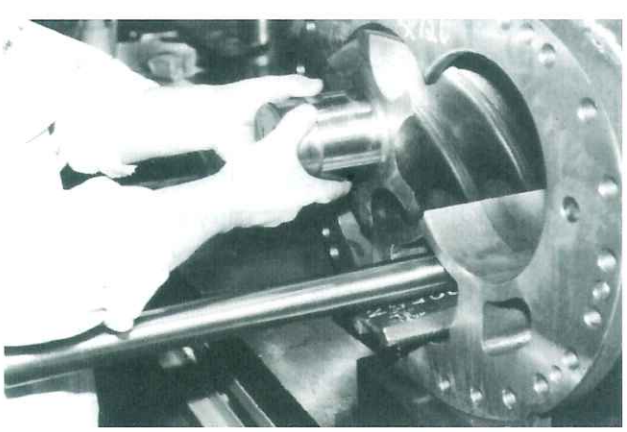


Fig. 79 Drawing Out Female Rotor

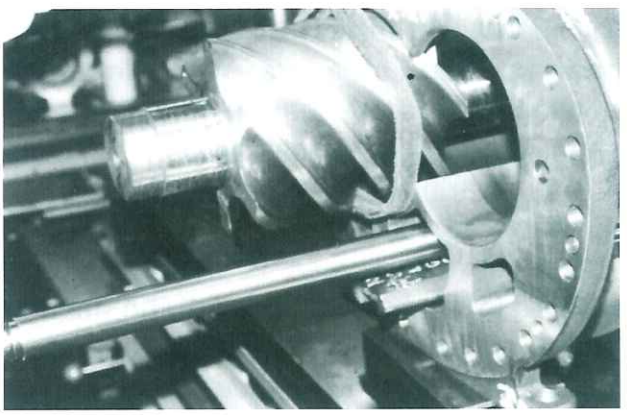


Fig. 80 Lifting Female Rotor

5-11-2 Inspection

1) The circumferential surfaces of the rotor lobes are usually not damaged under normal operating conditions but linear scratches may be visible. The surfaces of the lobes may also be discolored by dirt in the suction gas or oil.

Polish any scratches on the rotors with emery paper or a grindstone.

2) If the compressor is used with ammonia refrigerant or is used as a gas compressor, the non-contact surfaces of the rotors may be discolored by rust or other deposits. Finish the surfaces with emery paper.

3) Inspect the rotor journals. According to the refrigerant used and the operating conditions, two types of journal are utilized. The standard specification type is by high frequency hardening while the special specification type is polished after hard chrome plating.

The journals are almost never worn out unless the compressor is operated for a long time with soiled oil or if hard particles of dirt are embedded in the metal.

Inspect the dimensions of the journals.

4) Check for traces of rotation on the inner race of the thrust bearing fitted portion. If signs of rotation are visible, repair and reassemble with care.

5) Inspect the inside of the rotor casing for traces of scoring on the circumference and discharge face. Visible scoring is due to an excessively worn bearing and/or shaft. Determine the true cause.

Check the sealing edges of the rotor lobe circumferences. While performance will remain unchanged with wear up to approx. 3% of the diameter, excessive wear of the leading edges will result in a drop in performance. Check with your local MYCOM service center about maximum wear permissible for your application.

5-11-3 Low-stage side Rotors and Rotor Casing

Disassembly work is essentially the same as for the high-stage side. As the 320 and 250 rotors are much heavier than the rotors of the high-stage side, care should be taken when handling.

Inspection of the low-stage side rotors and casing is essentially the same as for the high-stage side.

The low-stage side rotors are assembled with a shaft seal so special attention should be paid to the shaft portion.

5-12 Bearing Head and Main Bearing

5-12-1 Disassembly of High-stage side

1) Remove all Allen bolts (2-2) securing the casing and the bearing head. The legs of the casing should be supported on stays.

2) Screw bolts into the blind holes provided and press the bearing head off evenly. When a sufficient gap is created, separate the gasket from the suction cover with a gasket remover so that it remains attached to the rotor casing.

After removing the parallel pin, the bearing head and rotor casing can be separated.

3) The main bearing is press fitted into the bearing head. Remove the stop ring (29-2) and push out the main bearing from the rotor side. If the bearing is tight, tap out using an aluminum or plastic hammer.

4) The unloader slide valve can be removed from the bearing head side of the casing. Push on the push rod to remove.

5) The guide block is fitted on the guide block stem screwed in from below. If no damage is evident, do not disassemble.

5-12-2 Inspection

1) Inspect the main bearing in the same manner as for the side bearing.

2) Inspect the discharge end face of the main bearing head and repair any damage found. If occasional oil compression is encountered during operation, check the discharge port carefully for abnormality.

3) Inspect the stepped joint portion between the unloader slide valve and the rotor casing. Normally, the slide valve is lower than the rotor casing. If any scratches or scoring are found on the top of the slide valve, consider slide valve, rotor casing or bearing wear as probable causes. In such case, contact your local MYCOM service center.

4) Inspect the O-ring of the unloader push rod (163), the unloader guide pin (68) and the groove in the indicator cylinder cam (77) for wear.

5-12-3 Disassembly of Low-stage side

Remove all Allen bolts (2-1).

Screw bolts into the blind holes provided in the flange and press the cover off evenly, removing the parallel pin (3-1, 3-2).

Separate the unloader push rod fitted to the bearing head.

5-12-4 Inspection

Inspect in the same manner as for the high-stage side.

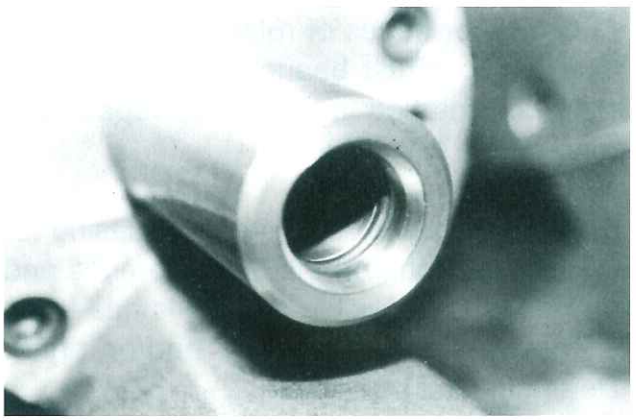


Fig. 81 Oil Injection Pipe Guide

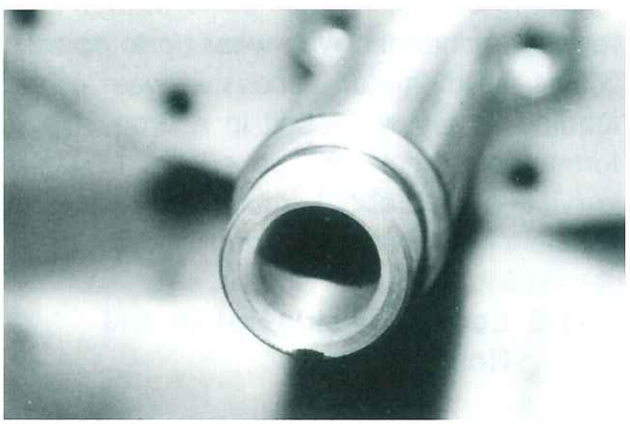


Fig. 82 End of Unloader Push Rod

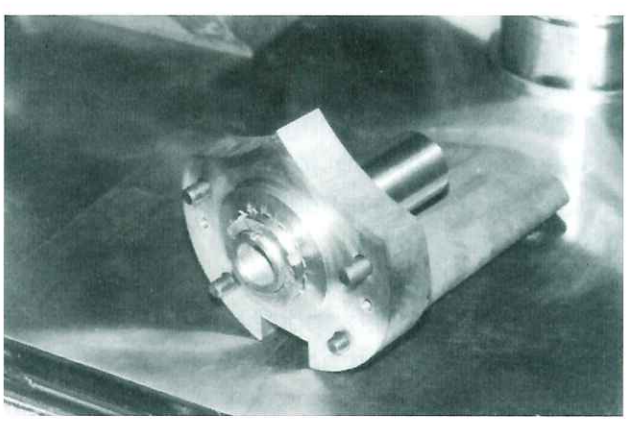


Fig. 83 Unloader Slide Valve (2pcs.) (55)

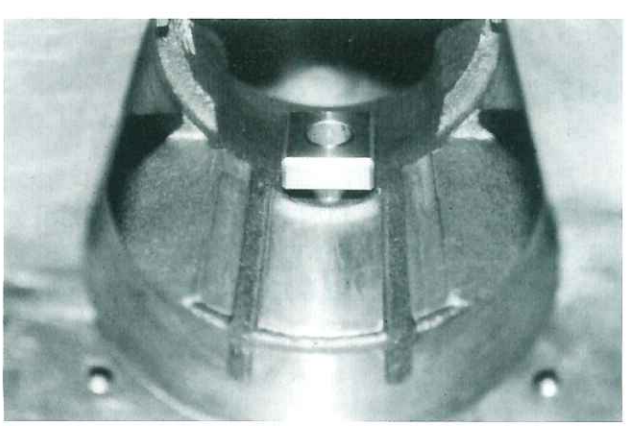


Fig. 84 Guide Block

6 Reassembly

When disassembly and inspection have been completed and it has been determined which parts are to be replaced, reassembly work may be commenced.

Before commencing reassembly confirm that all new parts are correct.

As O-rings used for three or more years lose elasticity and become less effective in assuring airtightness, it is recommended that they be replaced.

Clean all gasket contact faces, removing any residue with a gasket remover.

Reassembly work is carried out in the reverse order of disassembly.

Always clean the work table or surface plate being used as well as all tools before commencing work. Parts should also be washed in kerosene or light oil, dried with compressed air and lubricated with compressor oil before assembly.

O-rings which are to be reused should not be washed but simply wiped with a lint-free cotton cloth. Note that two types of O-ring material are used, nitrile rubber and fluoro-rubber. While fluoro-rubber rings are used in Halocarbon refrigerant systems, they cannot be used with ammonia. Incorrect selection of O-rings may lead to gas leakage and malfunction due to deterioration of the ring material.

Apply oil to the face of gaskets before assembling. If possible, apply a mixture of graphite powder and oil to the gasket before assembly to facilitate separation during future overhaul.

6-1 Unloader Slide Valve

1) Normally, the unloader slide valve guide block stem is not disassembled. If it is, be sure to install the O-ring when reassembling.

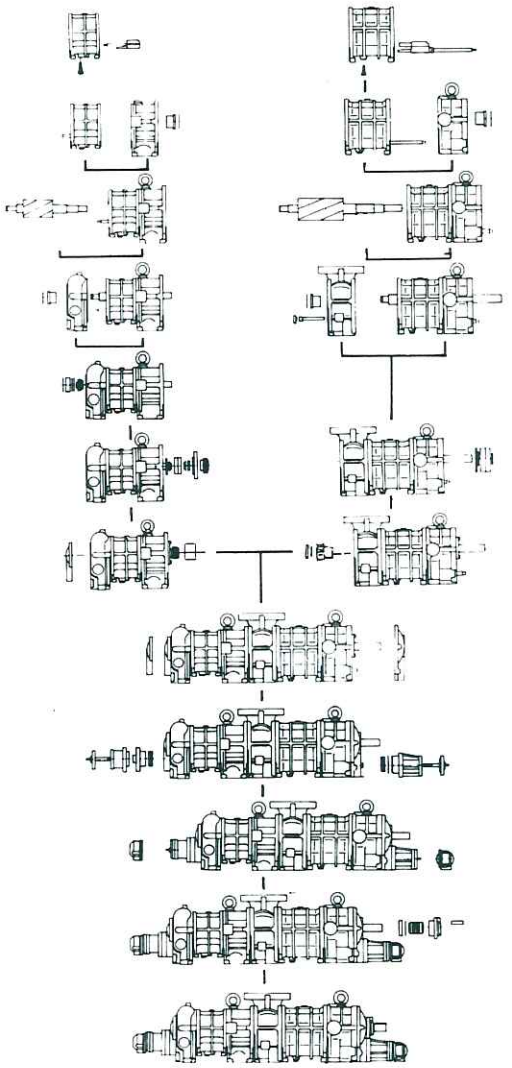


Fig. 85 Assembly Sequences

2) Position the guide block. Some early compressors have embossed marks on the slide valve and guide block. In such case, align these parts with the marks facing you.

3) If the unloader slide valve has been disassembled, be sure to use the special spring washer for the retainer bolt. This washer has an outer diameter smaller than an ordinary spring washer.

4) Confirm smooth movement of the unloader slide valve and unloader push rod. Also confirm that the top of the slide valve is level with or slightly below the edge of the rotor casing. If a difference in level is found, reverse the guide block and check again.

5) Confirm proper positioning of the unloader piston side O-ring (65) of the unloader push rod and the O-ring (165) for the injection pipe.

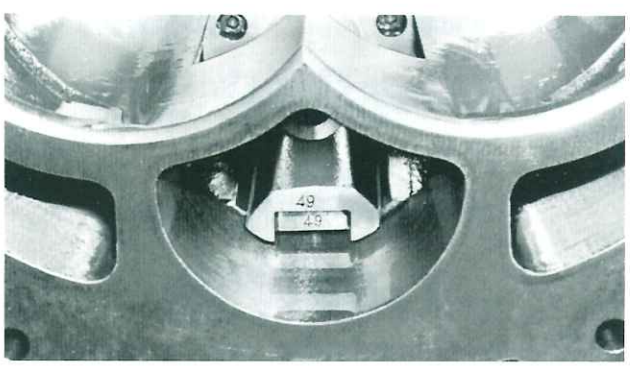


Fig. 86 Slide Valve and Guide Block

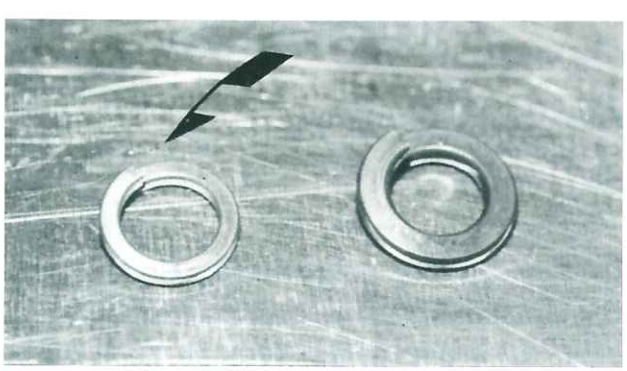


Fig. 87 Spring Washer for Unloader Slide Valve

6-2 Bearing Head and Main Bearing

1) Insert the main bearing.

As the tolerance is 1/100-6/100, the bearing can only be inserted straight in. The main bearing is positioned by the notch on the collar of the main bearing and the pin in the bearing head (Fig .88).

Insert the guide bar or a small pipe into the pin on the bearing then insert the bearing so that the notch fits with the pin. Do not strike the bearing metal directly with a hammer but cushion with a block of wood or aluminum.

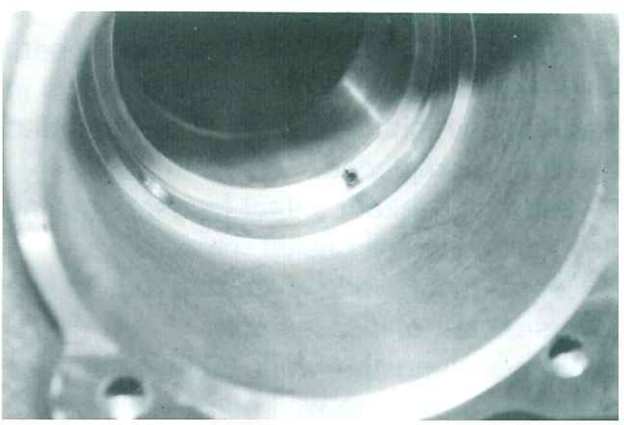


Fig. 88 Main Bearing Locking Pin

Fig. 89 Main Bearing and Notch

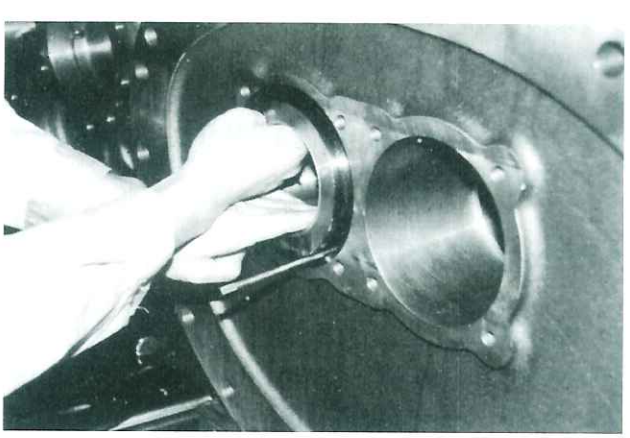


Fig. 90 Main Bearing Assembly Guide

2) After inserting the bearing fully, position the stop ring.

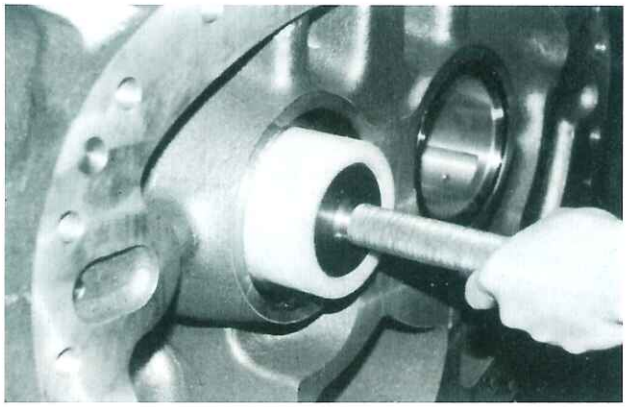
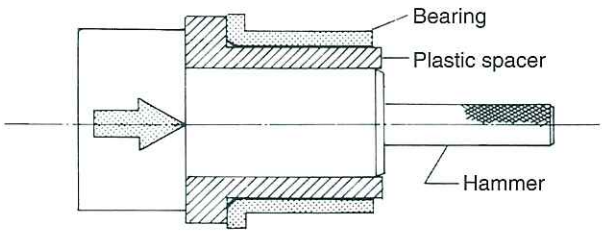


Fig. 91 Press Fitting Tool for Bearings (Example)



3) If an unloader push rod hole is provided, insert the O-ring and lubricate with oil.

(Reference)

To facilitate press fitting of the bearing, use a plastic jig with a collar and tap the collar to drive in the bearing (ref. Fig. 91).

6-3 Bearing Head and Rotor Casing

1) As the bearing head gasket (12) is unsymmetrical, care should be taken to position correctly.

Apply oil to both sides of the gasket and attach to the rotor casing side face (ref. Fig. 102).

Drive the parallel pins (19-1,19-2) into the rotor casing side (ref. Fig. 94).

2) In the case of Model 3225C, fit the O-ring to the unloader push rod hole.

3) For the high-stage side, the shaft center may not align properly because the legs of the rotor casing are short. Raise the shaft center with the bottom support used during disassembly (Fig. 95).

4) Align the low-stage side unloader push rod to meet the hole and slide the rotor casing on the work surface to mate the head and casing.

5) Screw in the retainer bolts slightly, drive in the positioning parallel pin and secure the head on the casing, tightening the bolts to the proper torque in a symmetrical crisscross pattern.

6) After tightening the bolts, reciprocate the slide valve to confirm smooth movement.

7) If the gasket has been replaced, the new gasket may protrude inside the rotor casing.

Trim the excess with a knife. If this is not done, the rotor discharge side gap may be affected and insufficient performance result.

8) The bolts on the bottom need not be tightened until the compressor is later suspended for reinstallation in the system.

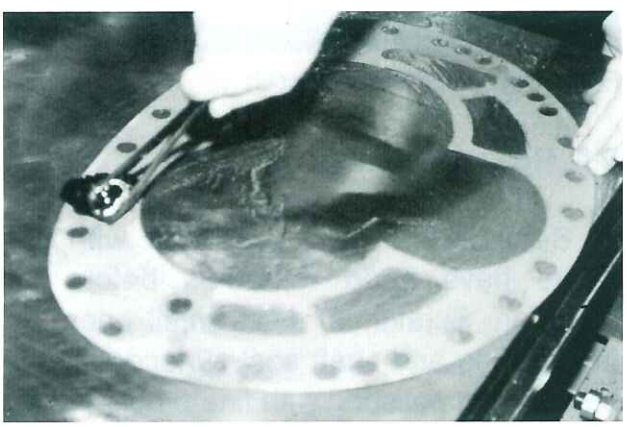


Fig. 92 Oiling Gasket

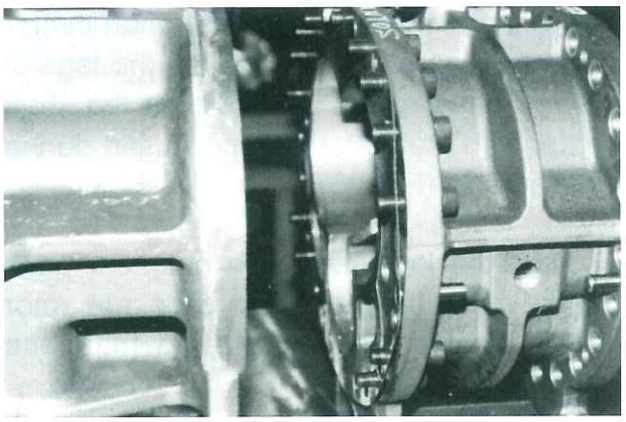


Fig. 93 Fitting Gasket

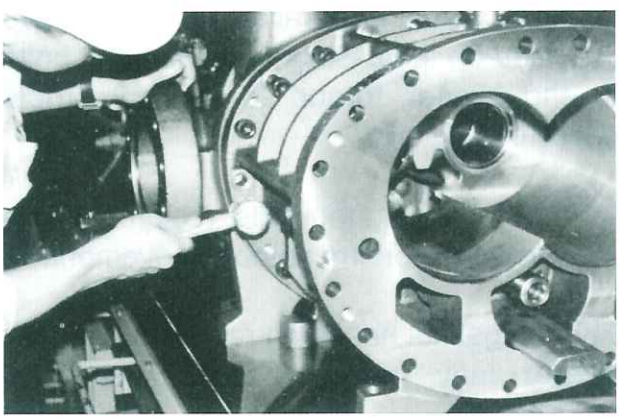


Fig. 94 Driving In Parallel Pin

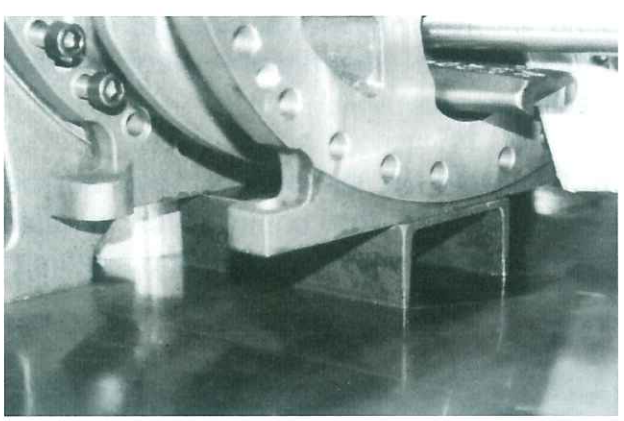


Fig. 95 High-stage Casing Support

6-4 Rotor Assembly

1) Be sure that any problems with the rotors have been remedied before installation. Scratches, even small ones, on the bearing and shaft seal surfaces should be carefully polished with fine emery paper. Before installing the rotors, cover the seal surface of the shaft with cloth tape to protect it (Fig. 96).

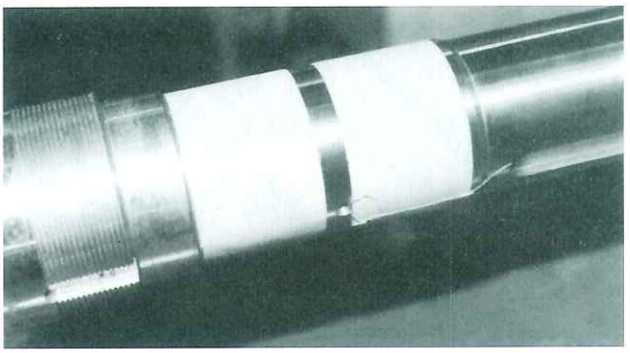


Fig. 96 Shaft Protection

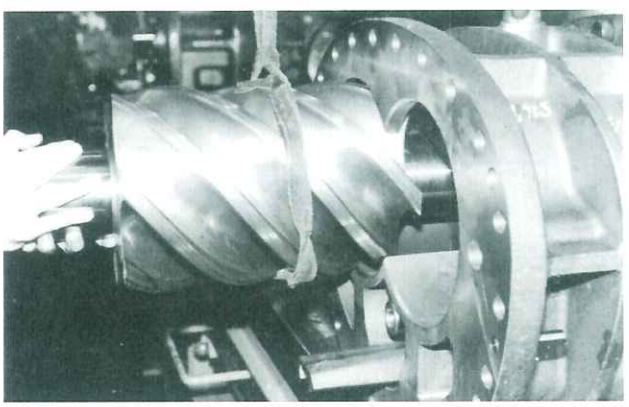


Fig. 97 Female Rotor Assembly

2) The male and female rotors should be mated according to the specified combination. With four and six lobes respectively, two possible mating combinations are possible. The numbers (1) and (2) are stamped on suction side of the female rotor lobes (Fig. 98). The figure (1) is stamped on the discharge end of a male rotor lobe.

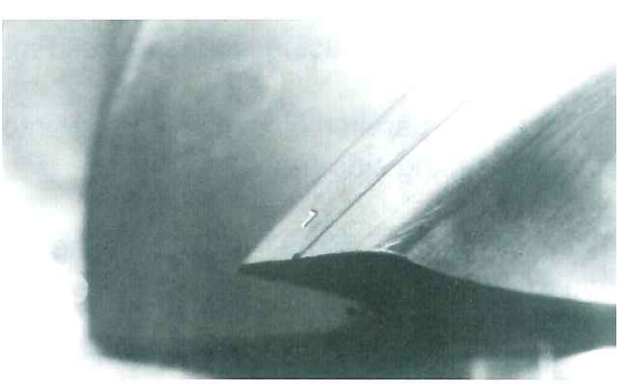


Fig. 98 Die-mark on Female Rotor Leading Edge

3) Position the female rotor in the casing first. Suspend it from a strap and push it into the casing manually.

4) Position the female rotor with the (1) and (2) number stamps pointing towards the center of the casing. Suspend the male rotor and insert into the casing with the (1) number stamped lobe between the (1) and (2) number stamped lobes of the female rotor.

5) At this time the rotor should not be revolved as the lobe edges are in contact with the casing.

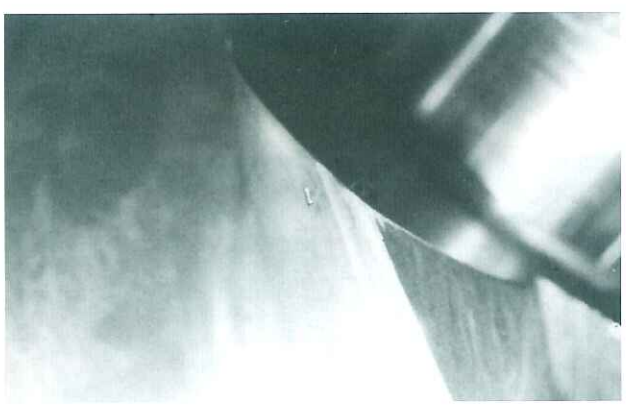


Fig. 99 Die-mark on Male Rotor Leading Edge

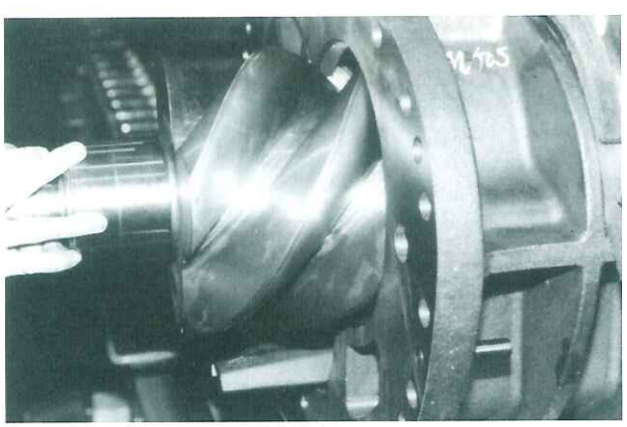


Fig. 100 Assembling Male Rotor

6-5 Suction Cover and Side Bearing

1) Insert the guide bar or a small pipe into the pin prepared for the bearing mounting portion of the suction cover (same as for mounting main bearing) to align the notch of the bearing metal with the pin. If the mounting position is not correct, do not turn the side bearing but pull off and repeat the above again from the beginning.

2) Install the snap ring.

3) For the low-stage side, mount the oil injection pipe, making sure that the O-rings of the pipe and pipe retainer are properly positioned.

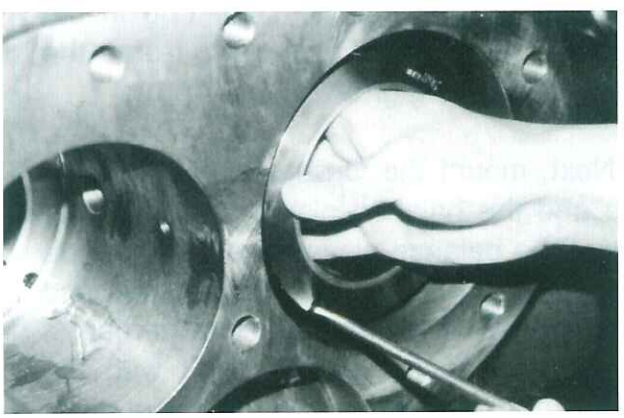


Fig. 101 Side Bearing Assembly Guide

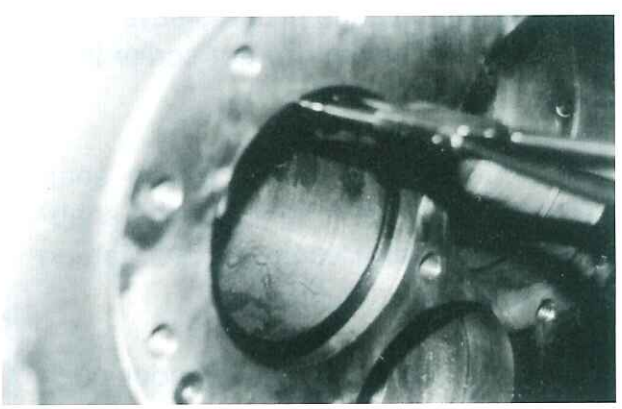


Fig. 102 Setting Stop Ring

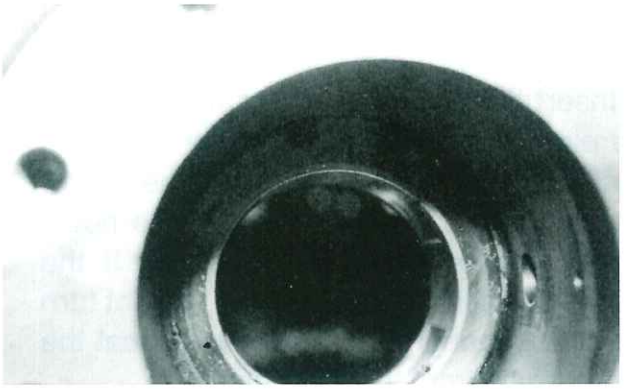


Fig. 103 Setting Stop Ring

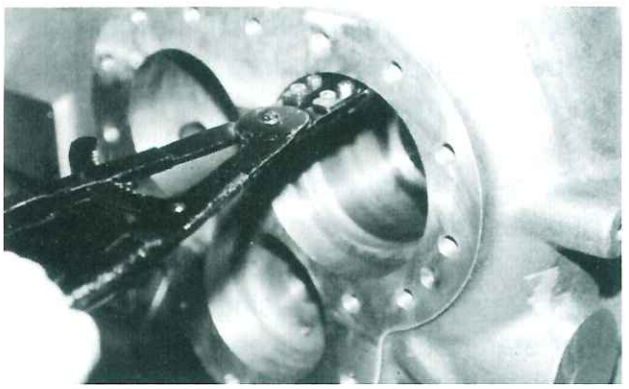


Fig. 104 Setting Stop Ring

6-6 Balance Piston Sleeve

1) For the high-stage side suction cover, an additional balance piston sleeve must be assembled.

For the 3225C, fit the snap ring in the groove separately provided from the bearing snap ring groove.

2) Next, mount the O-ring retainer, the O-ring and the balance piston sleeve in that order. The balance piston sleeve should be mounted so as to contact the beveled face to the O-ring. Mount the notched portion of the balance piston sleeve to fit with the detent and the lubrication oil outlet port. For Model 2520C, mount the O-ring and balance piston sleeve together.

3) Screw in the balance piston sleeve Allen bolt (34) and fix it with the set screw from the rear.

4) Insert the balance piston sleeve snap ring. The O-ring is very tight and the snap-ring will not fit easily into the groove. Tap on the O-ring as shown in Fig.101.

5) Mount the O-ring for the unloader push rod.

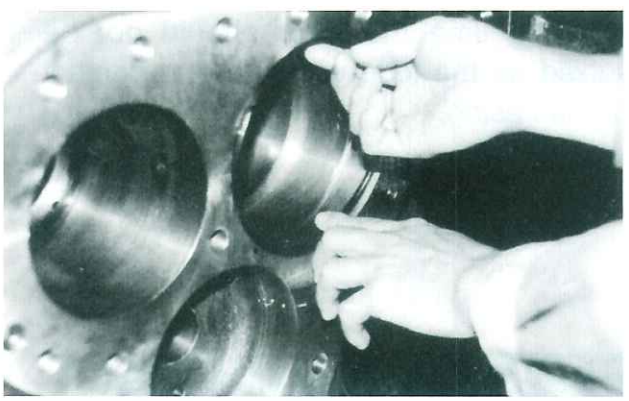


Fig. 105 O-ring for Balance Piston Sleeve

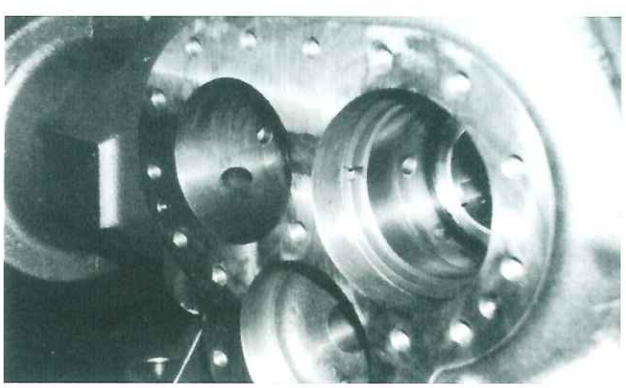


Fig. 106 Balance Piston Sleeve

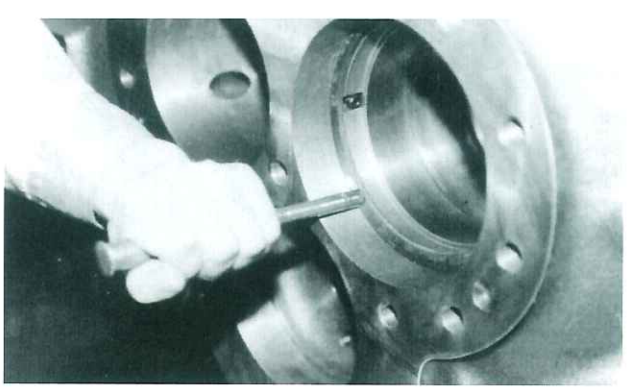


Fig. 107 Snap Ring for Balance Piston Sleeve

6-7 Suction Cover and Rotor Casing

1) Apply oil to both sides of the suction cover gasket (6-1, 6-2) and position the gasket on the rotor casing side. Drive the parallel pin into the rotor casing side flange.

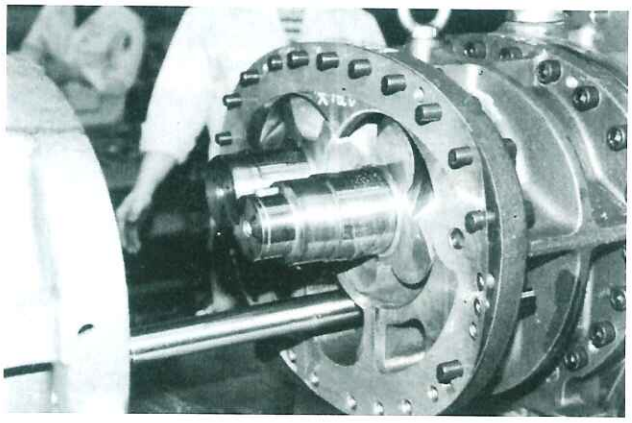


Fig. 108 Mounting Gasket on Rotor Casing

2) Slide the suction cover over the unloader push rod and rotor shaft, taking care not to damage the bearing with the end of the shaft. For the high stage side, be careful to ensure that the cover and casing are at the same height.

3) After pushing the rotor shaft into the side bearing up to the flange face, secure several flange bolts loosely, drive the parallel pin in, screw in the remaining bolts and then tighten the specified torque.

4) For the high-stage side, fit the balance piston on the rotor shaft and secure with the snap ring.

5) For the low-stage side, fit the drive hub for the gear coupling, attach the lock washer and locknut, tighten the nut and then bend the claws of the lock washer.

6) For the low-stage side, fit the oil injection pipe and injection pipe retainer.

7) Reciprocate the unloader push rods manually to confirm smooth movement.

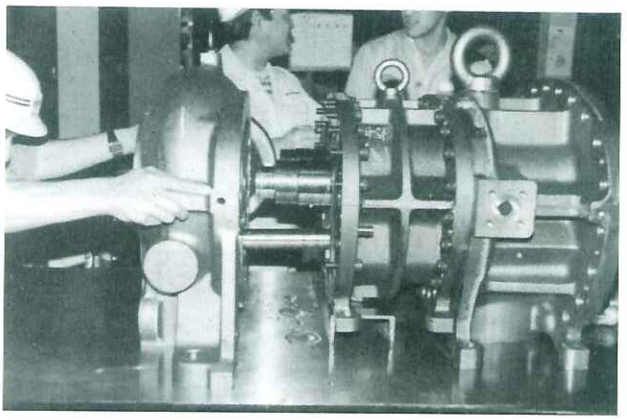


Fig. 109 Assembling Suction Cover

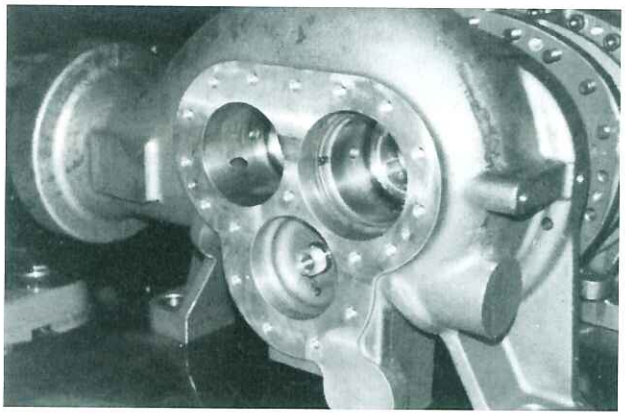


Fig. 110 Suction Cover, High-stage side

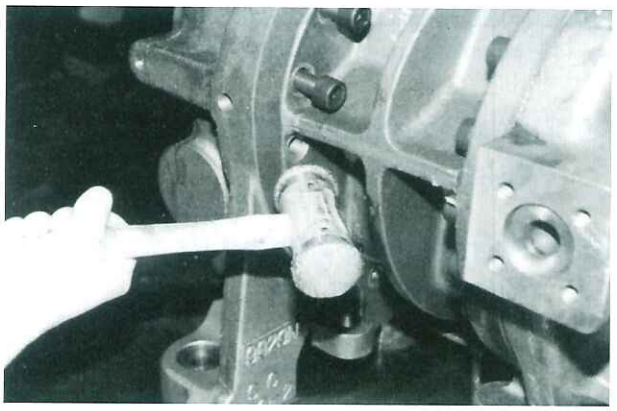


Fig. 111 Driving In Parallel Pin

8) Rotate the male rotor shaft manually to confirm smooth movement and existence of axial play.

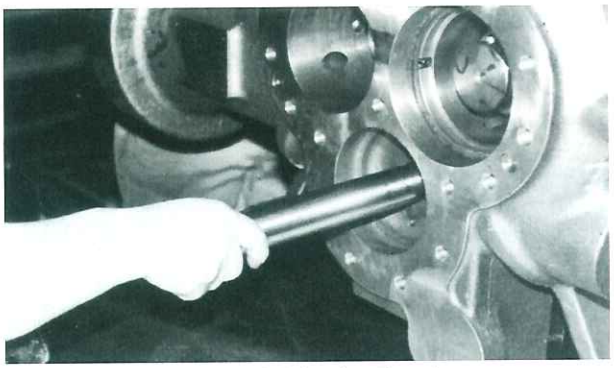


Fig. 112 Confirmation of Unloader Function

Fig. 113 Securing Balance Piston

Fig. 114 Mounting Low-stage side Suction Cover

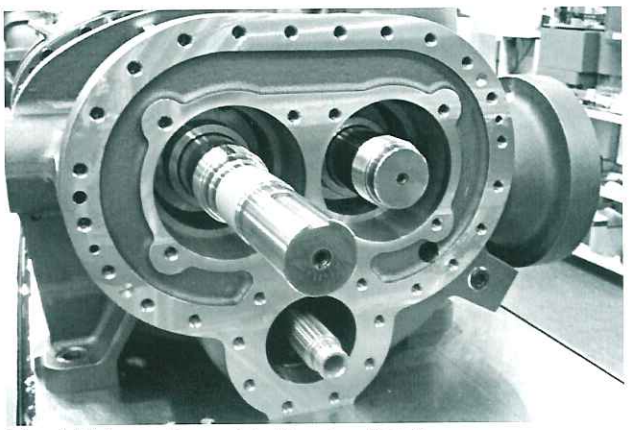


Fig. 115 Low-stage side Bearing Head

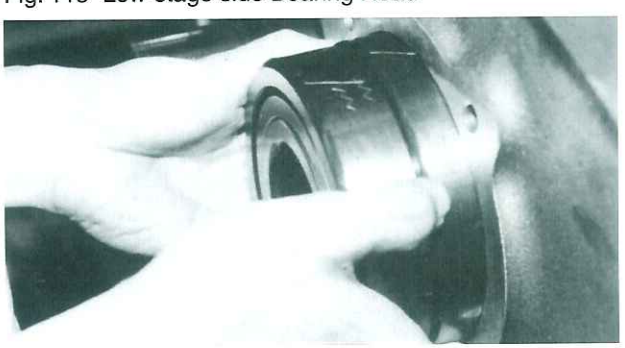


Fig. 116 Assembling Thrust Bearing

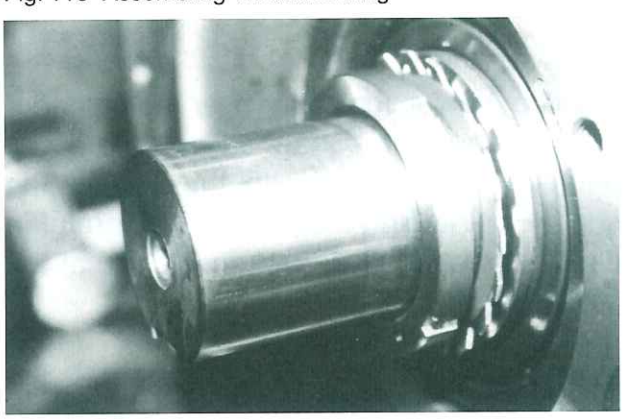


Fig. 117 Mounting and Securing Thrust Bearing Inner Ring

6-8 Thrust Bearing Assembly and Adjustment

6-8-1 Reassembly without Bearing Replacement

1) Confirm the hallmarks on the thrust bearing washer (for Model 2520C high-stage side only) and the thrust adjusting washer (42-1 or 42-2), then install them in place with the large chamfered face in contact with the step on the rotor shaft and the small chamfered face in contact with the thrust bearing.

2) Resetting Thrust Bearings

The thrust bearings are stamped with a A mark to indicate the direction and M and F marks to indicate which rotor they are used for.

Mount the bearings in the same direction and on the same rotor as before disassembly.

3) Clean the spaces between the washers and the bearing spacers and between the bearing head and bearing. If there is residue or dust present, end-clearance may be affected.

(mm)

	End Clearance (mm)			
	Model	S	M	L
Low -stage	2520C	0.40~0.44	0.45~0.49	0.50~0.54
	3225C	0.70~0.76	0.73~0.79	0.77~0.83
High -stage	2520C	0.05~0.07		
	3225C	0.08~0.11		

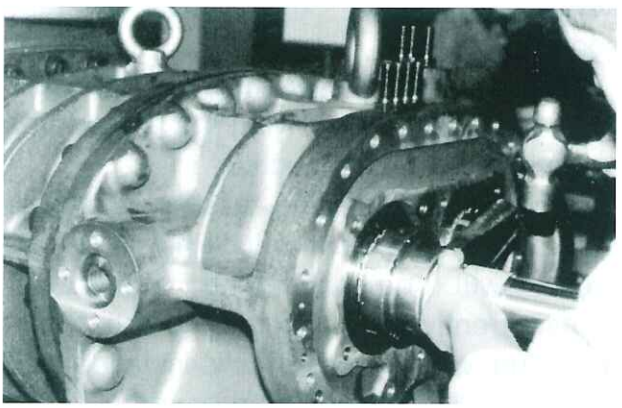


Fig. 118 Fastening Lock Nut

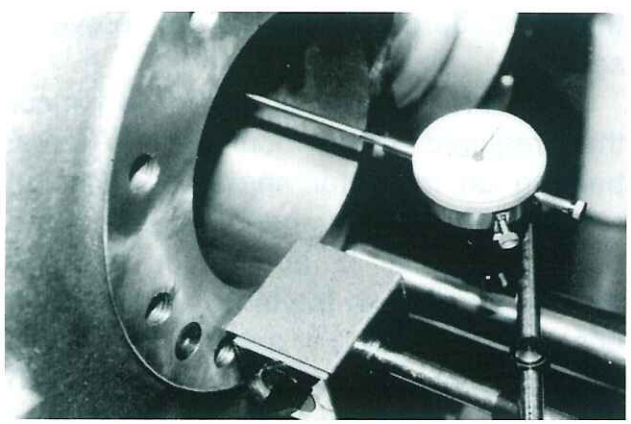


Fig. 119 Setting Dial Indicator

4) Fit the thrust bearing washer (250), lock washer (40), fitting strip (237) and lock nut (39), then fit the inner race.

If at all possible, utilize new lock washers and lock nuts.

5) After securing the inner race, rotate the shaft to confirm smooth movement. Also check play in the axial direction.

6) Push the rotor from the suction end to the bearing head end to establish "0" clearance.

7) Position a dial indicator on the suction side rotor end and adjust the dial to "0."

8) Secure the thrust bearing outer race on the bearing head using the bearing gland (43) (ref. Fig. 120). Tighten the four bolts evenly to the specified torque.

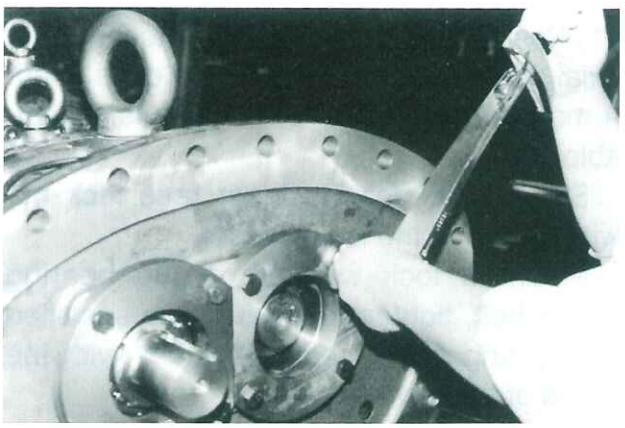


Fig. 120 Fastening Thrust Bearing Gland

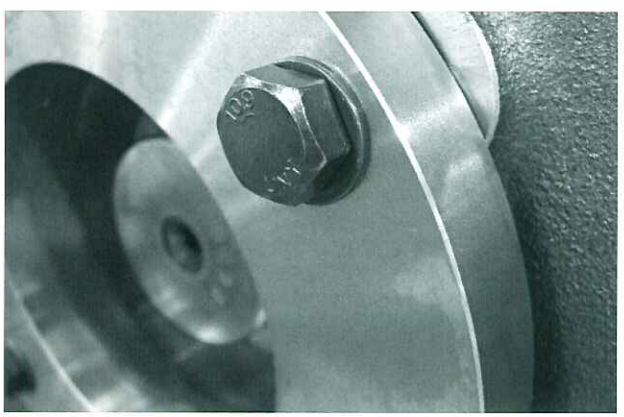


Fig. 121 Fastening Bolt Lock Washer

9) Fasten the thrust bearing gland (43) with the hex-head screw (45) and washer (46), then torque to the value given in the table below.

Model	Fastening-torque	
2520C High-stage	500kgf-cm	50N·m
2520C Low-stage 3225C High-stage	600kgf-cm	60N·m
3225C Low-stage	1200kgf-cm	120N·m

10) The reading on the dial indicator at this time is the clearance at the discharge end face of the rotor, what is commonly termed the "end clearance."

If the indicated value is within the limits of the range specified, clearance is acceptable (see table at end of this manual).

11) Position the dial indictor to measure the axial deflection of the low-stage drive shaft. A maximum deflection of 0.03mm is acceptable.

Secure the bearing inner race lock nut with a claw of the lock washer.

Mount a lock washer on the bearing clamp bolt, tighten the bolt to the specified torque and finally secure the bolt with the claws of the lock washer.

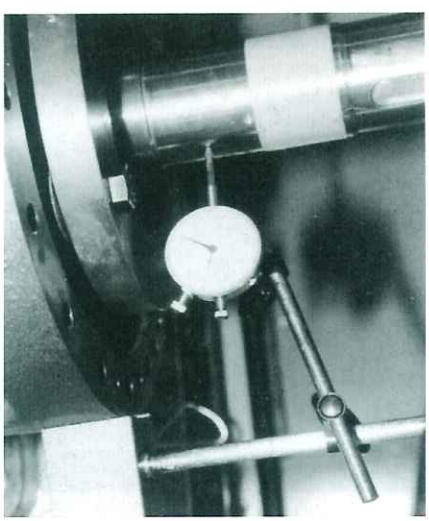


Fig. 122 Checking Shaft Deflection

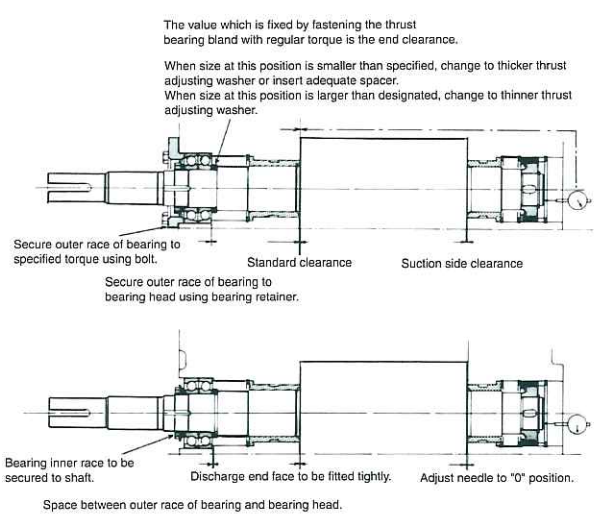


Fig. 123 Adjusting End Clearance

6-8-2 Reassembly When Thrust Bearing and / or Rotor(s) Replaced

1) If the thrust bearing is being replaced with a new one there will be a subtle difference in the tolerance values of the inner and outer bearing race faces. Consequently, the thickness of the thrust adjusting washer must be carefully considered.

Initially, mount the bearing and measure the end clearance following the procedures given in the previous section.

If the thrust adjusting washer is thinner than required, when the lock nut is secure there will be no end clearance. Consequently, it is doubtful if the thrust adjusting washer previously installed can be used with the new thrust bearing.

Check the end clearance according to the procedures given in the previous section.

If the thrust adjusting washer is thinner than required, when mounting the thrust bearing on the rotor shaft, the lock nut should not be tightened, otherwise the outer race only is in contact with the bearing head while the inner race remains unsecured, resulting in scoring of the balls between the outer and inner races which may lead to serious damage to the bearing.

Tighten the lock nut only slightly, turn the rotor to confirm that the outer race is free, then secure the inner race.

If the rotor shaft becomes difficult to turn, the thrust adjusting washer is too thin. In this case replace the thrust adjusting washer with a new one of greater thickness.

2) A new washer always creates excessive clearance between the rotor end face and the discharge end face to the bearing head.

Perform 1) through 2) in the preceding section to establish the proper clearance.

3) Read the value on the dial indicator after fitting the thrust bearing gland.

Dial reading minus specified end clearance equals washer grind-off allowance.

4) Finish the thrust adjusting washer to the required thickness by grinding and polishing.

5) After finishing the thrust adjusting washer, perform 1) through 11) of the preceding section.

6-9 High-stage side Gear Coupling Hub and Balance Piston Cover

1) After completing thrust bearing assembly, mount the gear coupling hub on the high-stage side male rotor and secure with the lock washers and Allen bolts.

2) Prior to fitting the Balance Piston cover, screw a stud bolt into the face and position the gasket.

3) For 2520C units, mount the unloader sleeve guide A.

4) In the case of Model 3225C units, there are two bolts for securing the Balance Piston cover to the unloader cylinder. Also, in the case of Model 3225C units, the unloader cylinder must be mounted on the suction cover. The unloader cylinder is therefore first mounted and the bolts secured after confirming the mounting position of the Balance Piston cover with the unloader cylinder (ref. Assembly Cross-sectional Drawing and Fig. 62).

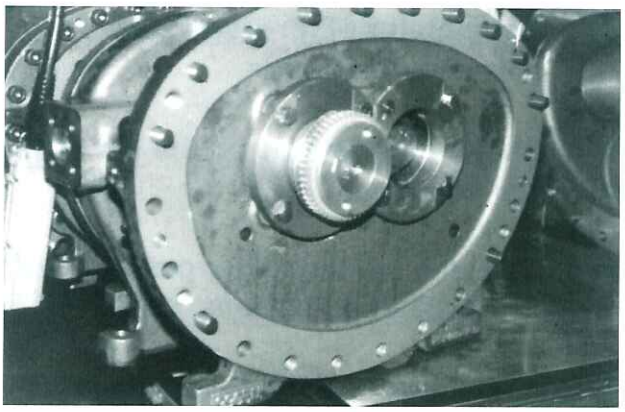


Fig. 124 High-stage side Bearing Head

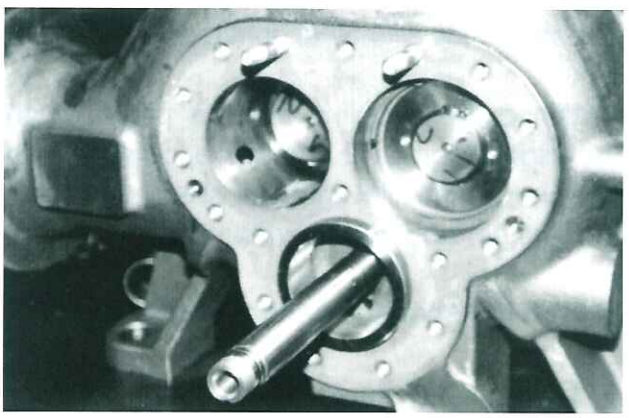


Fig. 125 Unloader Sleeve Guide A

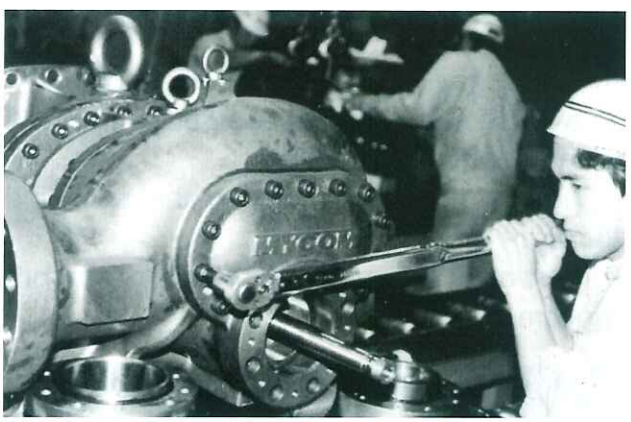


Fig. 126 Fastening Balance Piston Cover

6-10 Assembling High-stage side and Low-stage side

1) Mount the drive sleeve on the low-stage side gear coupling.

2) Position the bearing cover gasket (17-2) on the high-stage side bearing head.

3) Push the high-stage and low-stage side components together on the working table. Match the drive sleeve with the high-stage side driven hub and rotate the gears of the low-stage side slightly to obtain gear meshing.

4) When the coupling fits into place, push the high-stage and low-stage components together in parallel with the shaft, drive in a parallel pin and secure with bolts.

5) Turn the shaft to confirm smooth rotation.

6) Tighten all bolts to the specified torque.

7) Insert the drain plug in the bottom of the compressor.

8) Fit the gasket on the shaft seal cover. The notch in the gasket should be matched to the bearing cover seat.
Tighten the Allen bolts to the specified torque.

9) Revolve the rotor to confirm smooth movement.

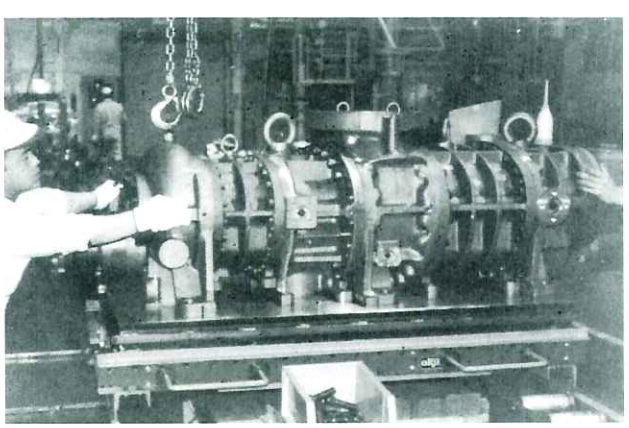


Fig. 127 Assembling High-stage and Low-stage side Components

6-11 Low-stage side Bearing Cover

1) Confirm that the thrust bearing is stable and secure, then position the bearing cover gasket on the bearing head, holding it in place with the parallel pin.

2) Screw in a hanger bolt and suspend the blind cover from the bolt while aligning the parallel pin and hole in the cover. Fit the cover to the bearing head by tapping with a soft hammer.

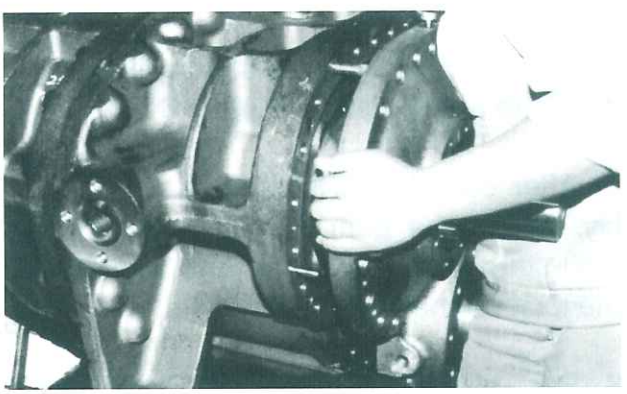


Fig. 128 Mounting Bearing Cover

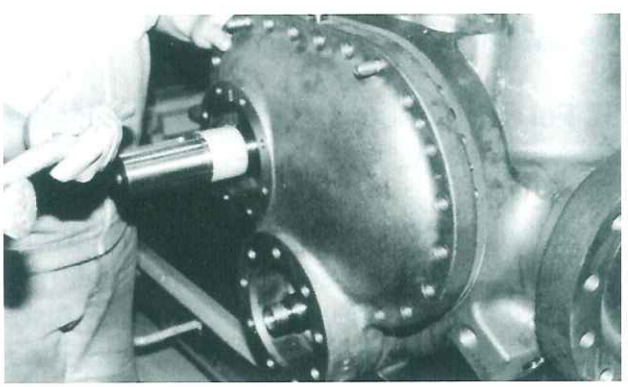


Fig. 129 Aligning Bearing Cover Parallel Pin

3) Insert and tighten the Allen bolts to the specified torque.

6-12 Unloader Cylinder

6-12-1 Unloader Cylinder, Piston and Cover

1) Position the O-ring on the unloader piston and cover with the cap seal.

2) Position the unloader piston in the unloader cylinder up to half of its length and fit the unloader push rod in the unloader cylinder. Locate the unloader push rod at its most extended position (full load position the case of high-stage side and no load position in the case of low-stage side) and then mount the unloader cylinder. The unloader piston comes out with the unloader push rod.

In the case of Model 3225C high-stage side, the unloader cylinder is already mounted on the unloader blind cover. Insert the unloader piston into the unloader cylinder and then mount the unloader push rod.

3) Secure the unloader piston to the unloader push rod with the lock washer and lock nut.

4) Reciprocate the unloader piston several times using an eyebolt screwed into the face to confirm smooth movement.

5) After confirming smooth movement,

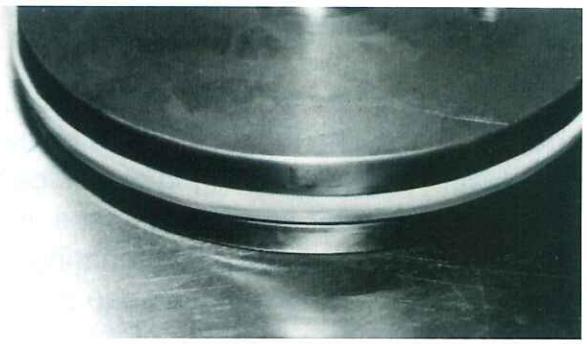


Fig. 130 Unloader Piston

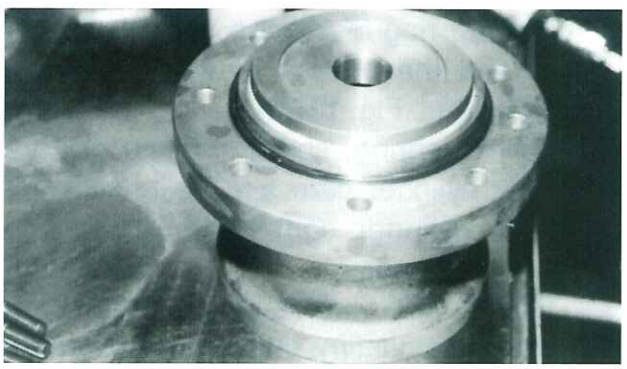


Fig. 131 Assembling Unloader Piston (High-stage)

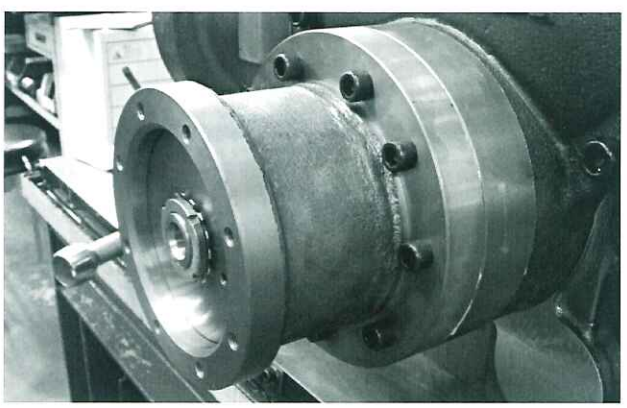


Fig. 132 Low-stage Cylinder and Unloader Piston

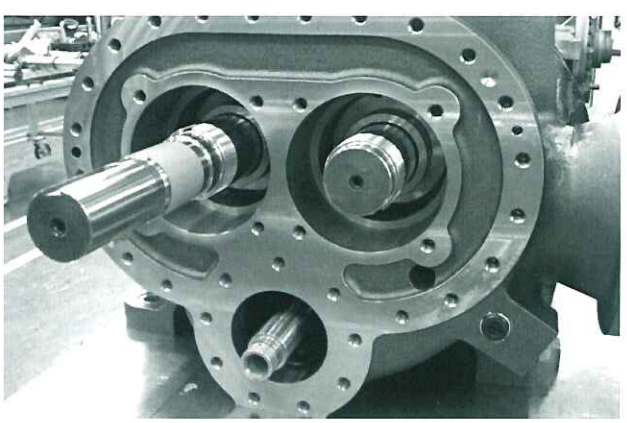


Fig. 133 Confirmation of Unloader Mechanism Function (Low-stage)

6-12-2 Unloader Cover

1) If the cylinder cam disassembled, it should be following the procedures below.

a) Insert the ball bearing in the unloader indicator cylinder cam. In this case, push on the inner race of the ball bearing and secure the bearing with the snap ring.

b) The standard seal is a Teflon V-ring (82). Apply oil to the V-ring and fit in the unloader cover, positioning the top of the "V" of the ring facing the unloader cover (74) and the bottom of the "V" facing outward (ref. Fig. 134A).

c) Fit the spring, spring retainer and indicator cylinder cam and secure the indicator cylinder cam bearing with the bearing retainer.

Rotate the indicator cylinder cam manually to confirm smooth movement.

d) For Helium compressors, fit the block with an O-ring in place of the V-ring.

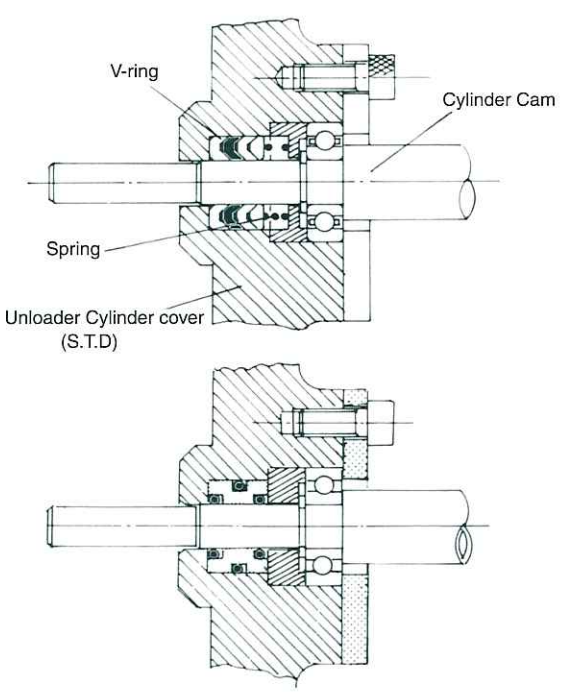


Fig. 134A Unloader Indicator Cylinder Cam Portion (Helium Compressor)

2) Fit the O-ring to the unloader cover and position the groove on the indicator cylinder cam with the unloader push rod pin. While pushing in on the cylinder cam, mount the unloader cover so that the oil pressure port in the cover is located in the same position as before disassembly and secure the cover bolts.

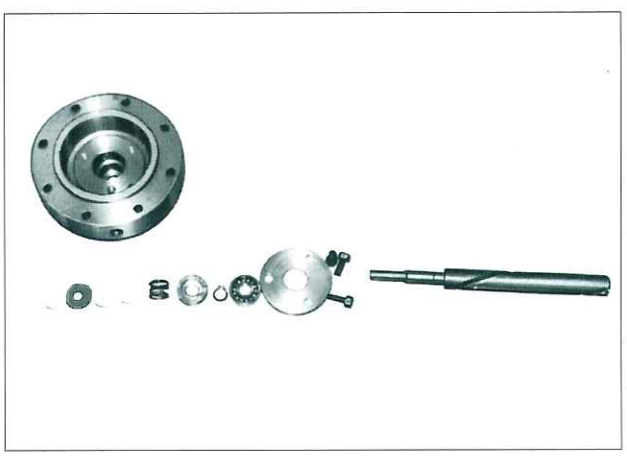


Fig. 134B Unloader Indicator Cylindrical Cam Portion, Disassembled View

6-13 Unloader Indicator (ref. Exploded View Drawing)

6-13-1 Indicator with Indicator Mounting Base (Low-stage side)

1) If a standard type indicator is used on the low-stage side, fit the indicator mounting base.

Confirm that the unloader slide valve is located at the "0%" position. The "Zero" position of the unloader slide valve can be confirmed by the position of the unloader piston. If the piston is at the maximum outer position or the countersink portion of the micro-switch cam is at the 12 o'clock point, the valve is at "Zero" load.

2) Mount the bevel gears on the indicator cylinder cam with the set screw. Next, mesh the bevel gears (202) of the indicator bar (208) with the microswitch cam. The countersink on the indicator bar (209) for

mounting the microswitch cam should be positioned 8-10 degrees above the level point. If the microswitch base plate (121) is mounted at this position, the indicator needle (139) will show the "Zero%" position and normal activation of the microswitch is assured. If any error is observed in the indicator position, adjust the mesh of the bevel gear.

6-13-2 Fitting Indicator (High-stage side and Low-stage side Standard Type)

The procedures for fitting the indicator are the reverse of disassembly. Adjustment after assembly is important.

1) Position the unloader piston (64) at the very end of the unloader cylinder (60). In this case, the position is 100% load for the high-stage side and "Zero%" load for the low-stage side.

2) Mount the microswitch base plate (121) on the unloader cover (74) with Philips screws (126). If this portion has not been disassembled, position the screw of the microswitch cam to fit the countersink in the indicator cylinder cam (8-10 degrees to the upper right), then tighten.

3) The unloader piston should be moved manually to confirm the position of the pointer and actuation of the microswitch. Function can be tested by blowing compressed air through the oil pressure piping connector hole to move the piston in the cylinder to show the full 0%~100% range.

For the high-stage side of Model 2520C, a block is incorporated to prevent movement of the piston in the cylinder to the 0% level. If a block is fitted, fully unloaded operation cannot be obtained.

4) Wiring to the unloader indicator should be attached after the compressor is installed on the base.

5) Mount the indicator cover temporarily to protect the device until wiring is completed.

6-13-3 Low-stage side Indicator

1) This indicator is smaller than the standard type and is assembled with the indicator mounting plate. Fit the microswitch mounting plate on the unloader cover as in the case of the standard type. Secure the microswitch cam and confirm proper actuation.

2) The work described in 3) and 4) below should be carried out after the compressor has been mounted on its base.

3) Next, mount the unloader indicator cover and then mount the indicator needle shaft bearing assembly (204). Adjust the bevel gear to the specified level on the indicator needle and secure the indicator assembly. Adjustment of the indicator needle can also be carried out after mounting the indicator assembly.

4) Finally, mount the indicator glass and indicator glass gland (206).

6-14 Mechanical Shaft Seal

1) The contact surfaces of the seal must be cleaned before reassembling.

2) Before positioning the seal assembly on the shaft, confirm that the shaft surface and particularly, the edge of the seal contact surface of the shaft, are free of scars.

3) Confirm normal placement of the seal gland. The seal gland should be positioned so that the oil hole is above the shaft. Confirm that it is locked into position by turning the gland.

The seal gland will not turn if the pin is properly seated.

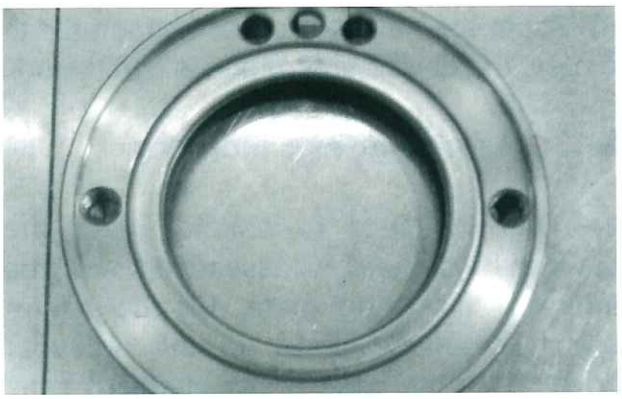


Fig. 135 Seal retainer & oil seal

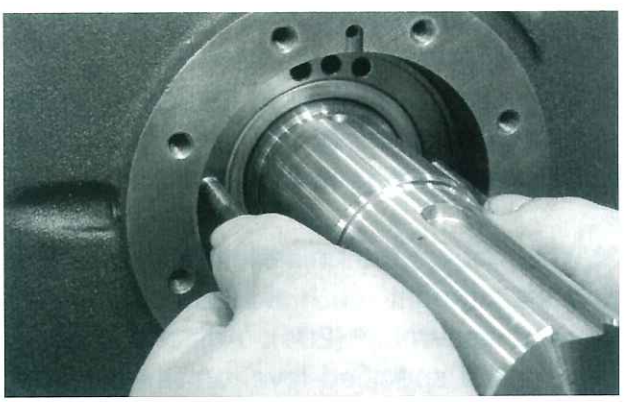


Fig. 136 Fitting O-ring

4) Do not forget to fit the O-ring

5) It is best to position each part separately in the reverse order of disassembly. In this way the Teflon ring will not be deformed when put in place, oil must be applied to each part before assembly.
For the single seal assembly, push the seal collar over the step of the shaft and then fix firmly in the correct position. The bolt holes of the seal cover must match accurately with the counter-sinkings on the shaft.

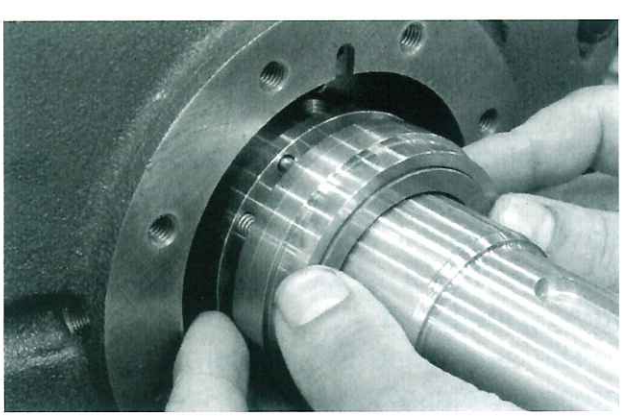


Fig. 137 Installing seal assembly

6) When in line, position the seal spring and the other parts accordingly. Confirm that the spring is in position by pushing the seal ring several times.

7) Fit the oiled gasket on the seal cover and correct the gasket position to match the oil holes. Lubricating oil for the seal passes through a channel in the seal cover from the top left side of the bearing cover. The seal cover must be positioned so that the oil holes are on the top left and bottom left of the seal cover when facing the compressor. (Ref. Fig.138)

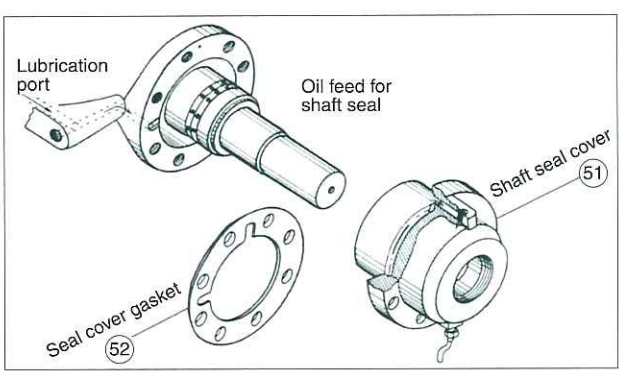


Fig. 138 Oil flow for seal

8) Care should be taken to avoid damaging the carbon seal when positioning the seal cover.

The seal cover cap bolts must be tightened alternately to seat the cover properly.

7 Reference

Fastening Torque Values and Bolt Sizes

	Location	Model	Dimensions
2	Rotor casing and suction cover	200	M16x50
		250	M20x60
		320	M24x80
2	Rotor casing and bearing head	200	M16x50
		250	M20x60
		320	M24x80
18	Bearing cover	250	M16x50
		320	M20x70
24	Balance Piston	200	M12x30
		250	M12x30
61	Balance Piston cover unloader cylinder	200	M12x30
		250	M16x40
		320	M16x40
61	Unloader cylinder	200	M12x75
		250	M16x90
		320	M20x170
76	Unloader cover	200	M10x25
		250	M12x30
		320	M12x35
53	Shaft seal cover	250	M12x30
		320	M16x40
45	Thrust bearing retainer	200	M12x35
		250	M16x45
		320	M20x55

Lock Nut Locations and Torque Values

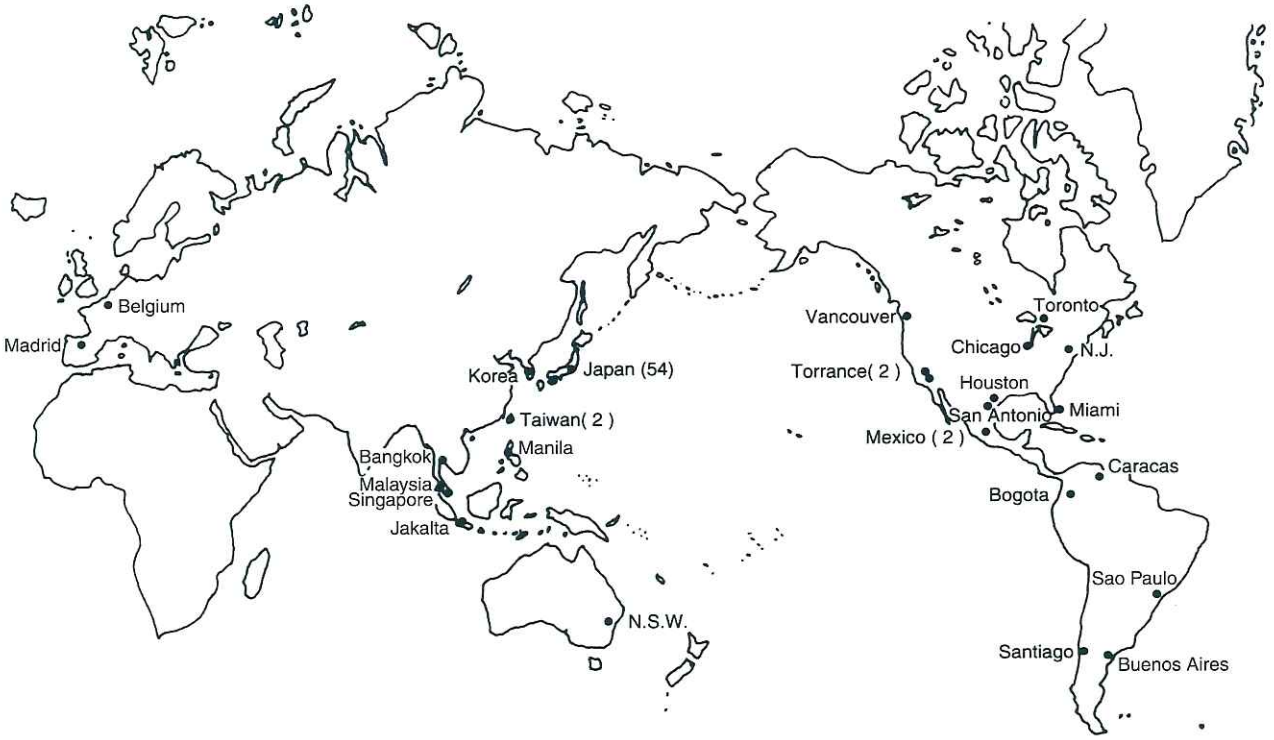
Standard	Position of Locknut		Torque
AN07	———	2520C high-stage unloader piston	120 N·m
AN08	3225C high-stage unloader piston	2520C low-stage unloader piston	140 N·m
AN10	3225C low-stage unloader piston	———	180 N·m

O-ring List

Part No.	Location	2520C	3225C
9	Balance piston sleeve	P40	-
35	Balance piston sleeve	P140	P150
49	Seal retainer	G135	G160
59-1	Injection pipe (for slide valve)	P26	P32
63-1	Unloader cylinder	G150	G170
63-2		G150	G190
65-1	Unloader piston	P125	P140
65-2		P125	P155
73-1	Unloader push rod	G35	G35
73-2		G30	P44
75-1	Unloader cylinder cover	G135	G150
75-2		G135	G170
86	Oil injection pipe	G25	G30
89-1	Guide block stem	P20	P24
89-2		P20	P20
150	Bearing retainer	P140	G220
163	Unloader push rod	G35	-
197	Unloader push rod bearing cover	P50	P58
279	Unloader cylinder guide	G130	-
165	Injection pipe retainer	G30	P40
328	Unloader push rod retainer	-	P46
82-3	Cylinder cam for Helium Comp.	P16	P16
82-4		P10A	P10A

MYCOM Worldwide After-sales Service Networks

Outside Japan : 48 subsidiaries
In Japan : 54 subsidiaries



We reserve the right to change design specifications according to technical developments and improvements without notice.

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