SELFJECTOR

MITSUBISHI

SELFJECTOR

EXCELLENT-SERIES

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* * SJ20-SJ60T. P. EH * * *

INSTRUCTION MANUAL

IE-9210-EH

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PREFACE

This Instruction Manual describes the construction, operation, dismantling, assembling, maintenance and inspection etc. of MITSUBISHI SELFJECTOR EXCELLENT SERIES (briefly called "SJ-E Series; hereinafter "SELFJECTOR"). It is desired that this Manual be fully understood and SELFJECTOR be handled safe and in such manner that its functions may be exhibited fully.

Since this Manual has been compiled on the basis of the cases where SELFJECTOR is used for purification of fuel oil and lubricating oil, please use this Manual as a reference when it is used for chemical industry or other applications.

The specifications for SELFJECTOR can be classified largely into the following three types as shown in the following table. As this Manual describes these specifications as to their common parts and parts varying with specifications separately, please bear in mind that no mistake be made in this respect.

No.	Specification		* Symbol
1	Total discharge type	Automatic type	T
2	Partial discharge type (with total discharge function)	Automatic type	P
3	E-HIDENS II type	E-HIDENS II type	EH

*: The letters "T", "P" and "EH" are added to the model numbers to indicate the respective types. (SJ20T, SJ20P, SJ20 EH, etc.).

Further, with regard to E-HIDENS II specification, refer to the Part "Partial discharge type" of this Manual along with the separate "E-HIDENS II Instruction Manual".

NOTE:
We have fully paid our attention to the revision of this manual. However, as a result of improvements of this machine, it may happen that drawings or illustrations in this manual partly differ from our actually delivered machine. Please bear this in mind in advance.

CONTENTS

PART 1 GENERAL

1. Cautions in safety

The bowl of SELFJECTOR revolves at high speed, causing great centrifugal force to act. As erroneous handling causes great danger, handle with due cautions in operation, dismantling, assembling, maintenance and inspection, etc. in accordance with this manual.

1. Perform assembling perfectly

SELFJECTOR has many parts connected with nuts, bolts and screws. When assembling it, make sure that they are fully tightened. Extreme care must be exercised to tighten the bowl nut, disc nut, clamp nut, vertical shaft cap nut, frame cover lock handle, etc. positively.

Please note thoroughly that it is very dangerous to operate SELFJECTOR without tightening its parts firmly. With regard to such parts as bowl, etc. provided with tally mark, be sure to confirm that marks are in coincidence with each other.

On the other hand, if tally marks are misaligned when bowl nut, etc. were tightened, contact us or our service agent.

2. Stop immediately when vibration is great.

Though the vibration of Selfjector will differ depending on the effect of imbalance and besides the vibration of hull or the installing condition of Selfjector, the undermentioned Table shall be complied with Stop SELEFJECTOR immediately when vibration has become great. In that case, do not perform sludge discharge.

After confirming complete stop, proceed to dismantling, cleaning and inspection.

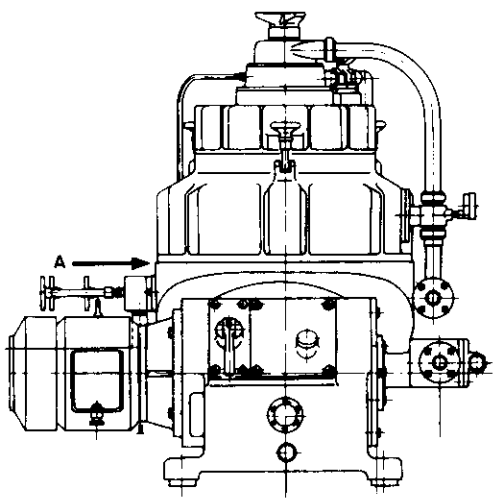
Table 1.1 Standard of Vibration Allowance

Condition of operation	When engine has stopped operation	When engine is operating	Operation or action to be taken
Excellent	Below 30	Below 40	Continuous operation permissible
Good	31 ~ 49	41 ~ 59	Continuous operation permissible
Passable	50 ~ 69	60 ~ 79	Inspection be conducted at an early stage
Very poor	Above 70	Above 80	Inspection will be made at once

(Unit: μm)

Vibration measurement shall be conducted in the frame part of SELFJECTOR (at point "A").

Fig. 1.1



3. After confirming complete stop, loosen the parts.

After confirming that the bowl completely stopped revolving, loosen the parts and dismantle.

On the other hand, whether or not revolution has stopped completely can be confirmed at the gear pump and horizontal shaft connection (safety joint) or motor fan.

4. Handle parts carefully.

As SELFJECTOR is a precision machine, take due cautions in handling of the parts, etc. so as to avoid impact and high heat.

5. Take caution against corrosion and erosion periodically check for damage, if any, due to corrosion or erosion. With regard to *unidentifiable points, contact us or our service agent.*

6. Others

(1) Before dismantling, be sure to switch off power to starter.

(2) When treating liquid different from the liquid originally planned to be treated please contact us or our service agent.

(3) Since the bowl has been adjusted in balance, it is preferrable to avoid replacement of bowl parts even in the case of the same model.

2. Definition of terms

Density (ρ):	Mass per unit volume.
Specific gravity (γ):	With mass of water per unit volume as 1, ratio of mass of the same volume; the value varies with temperature.
Feed rate:	Volume of untreated feed liquid to be fed to a purifier per unit time, being expressed in ℓ/h or m^3/h.
Actual capacity:	Throughput capacity of a purifier as calculated on the basis of SM Standard Specification (exclusive of sludge with specific gravity of more than 1.8 and a diameter of more than 2 microns). (Refer to "Feed rate", above).
Feed liquid:	Non-separated oil to be fed to the purifier.
Light liquid:	Purified oil as treated with the purifier.
Heavy liquid:	Separated water content and heavy content of oil or simply "water".
Sludge:	In a narrow sense, solids accumulated within a bowl and, in a broad sense, solids, water and oil mixture as discharged from the bowl.
Interface:	Boundary between heavy liquid and light liquid within a bowl.
Purifying operation: (Refer to par. "Purifying operation")	3-phase (liquid-liquid-solid) separating operation for spearation into oil content, water content and solid content. This machine is called "purifier".

Clarifying operation: (Refer to par. "Clarifying operation")	Two-phase (liquid-solid) separating operation for separation into oil content and solid content. This machine is called "clarifier".
Parallel operation: (Refer to par. "Parallel operation")	A number of purifiers arranged in parallel and operated with oil fed in dividing specified volume.
Series operation: (Refer to par. "Series operation")	Operation of a number of purifiers arranged in series.
Total discharge type:	A purifier so constructed that total quantity within the bowl is discharged.
Partial discharge : type	A purifier of the so-called "partial discharge" construction that discharges only water and solid content within the bowl. On the other hand, this machine also has the total discharge function.
E-HIDENS II type:	This is a Selfjector with clarifier specification which is incorporated into E-HIDENS II System and is used in combination with Water Detector. The structure of Selfjector is such that it performs a partial discharge of sludge.
Abbreviations — ℓ:	Liter representing volume. 1 liter = 1/1000 m^3
h:	1 hour
r.p.m.:	Revolution speed per minute
Hz:	Hertz; number of cycles per second.
ϕ:	Diameter; unit (mm)
cSt:	Centistoke; oil viscosity unit (0.01 cm^2/sec.)
ISO:	Standards established by the International Organization for Standardization
VG:	Indication of viscosity of lubricating oil in accordance with ISO.
μ:	Micron; unit (1/1000 mm)

1. Outline

The outline of structure of SELFJECTOR is as shown in Fig. 2·1.

Driving power from the motor is transmitted to the horizontal shaft through the friction clutch. And the vertical shaft is accelerated by spiral gear installed on the horizontal shaft and pinion gear on the vertical shaft.

The vertical shaft is supported by upper and lower bearings and further the upper and lower bearings are supported by springs.

The bowl is installed on the top of vertical shaft and revolves at the revolution speed of vertical shaft.

Furthermore, SELFJECTOR is composed of the liquid contact parts such as feed liquid inlet, light liquid outlet, heavy liquid outlet and the chute of discharging sludge, etc. and frame and frame cover.

Also a suction pump (gear pump) feeding dirty oil to SELFJECTOR is connected with the horizontal shaft through safety joint. Further, for discharge of light and heavy liquids, centripetal pumps (impellers) are installed respectively on the top of bowl.

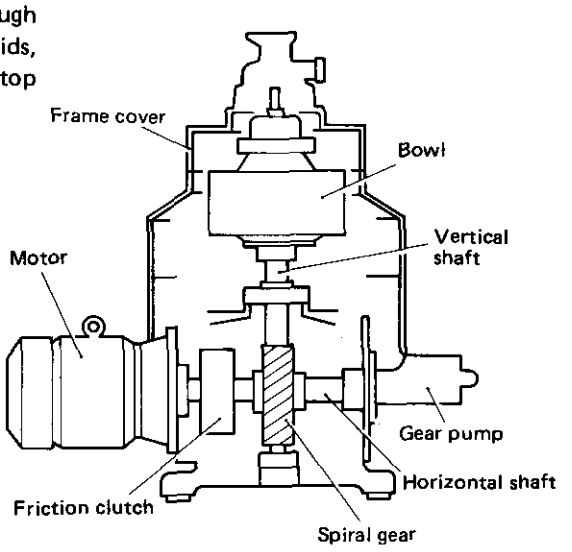


Fig. 2·1

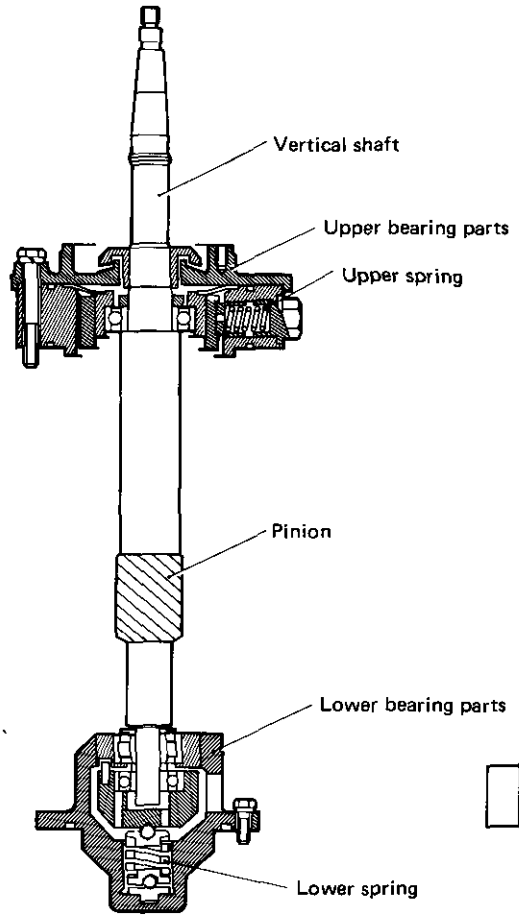


Fig. 2·2 Vertical shaft parts

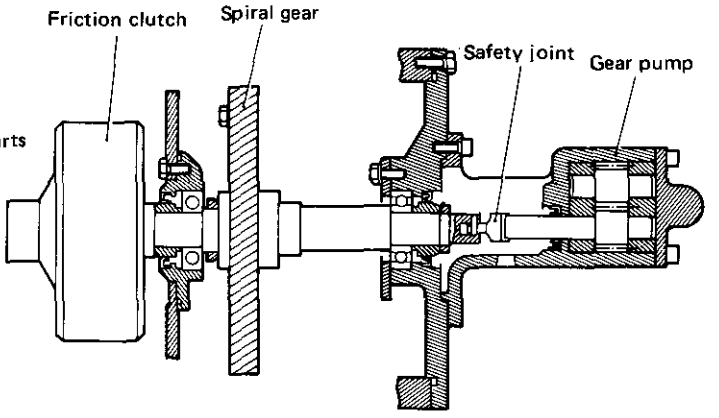


Fig. 2·3 Horizontal shaft parts

2. Driving system

2.1 Horizontal shaft parts

Friction clutch is installed between motor and horizontal shaft to connect them.

The horizontal shaft is supported at two points by Bearing housing (3) and Bearing houseing (4) with built-in ball bearings and spiral gear is installed between them. Bearing housing (3) and (4) are provided with oil seals, respectively, to prevent leakage of gear oil.

A groove has been cut at the pump side end of horizontal shaft so that the safety joint may enter.

2.2 Vertical shaft parts

The vertical shaft is supported by upper and lower bearing parts and a pinion is provided between them.

The upper bearing parts is provided with flat spring and the lower bearing parts with lower spring so as to absorb vibration in vertical direction.

Further, the upper bearing parts is supported by upper springs at 6 points in a radial direction for absorption of vibration in horizontal direction.

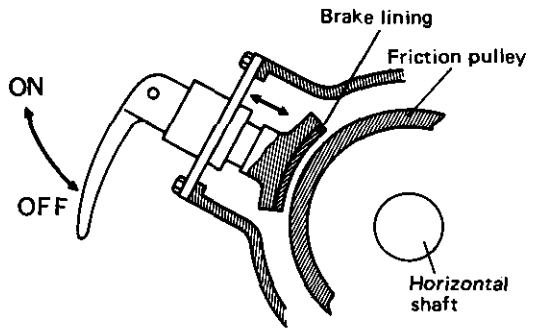


Fig. 2·4

2.3 Brake

The brake is so constructed that brake is applied by causing brake lining to be pressed against the outside of friction pulley with a spring.

Normally it is desirable to stop without using brake, but only when prompt stopping is desired in case of emergency or for repair and inspection, brake can be applied.

2.4 Friction clutch

The friction clutch is used to effect slow starting and acceleration so as to prevent motor overload.

The motor shaft is equipped with friction block and friction boss and the horizontal shaft, with friction pulley.

After start-up, the motor attains its rated rotation instantly, friction block lining is pressed under centrifugal force against the inside of friction pulley, slip occurs between friction pulley and lining, and driving force is transmitted to the friction pulley (horizontal shaft side).

The bowl is so designed that normally it attains its rated rotation in about 5 to 10 minutes.

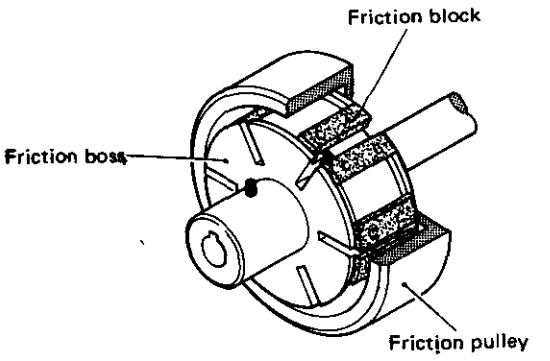


Fig. 2·5

3. Bowl

The bowl is composed of bowl body, bowl hood and bowl nut which form a container. In the inside of bowl, the separation chamber composed of discs and top disc, and distributor leading dirty oil from bowl inlet to sepration chamber are incorporated. Further, SELFJECTOR has main cylinder sliding up and down hydraulically in order to discharge solids separated and accumulated on the inside wall of bowl during operation.

Further, pilot valve assemblies to control sliding of main cylinder are provided at 2 points on the periphery of bowl body.

Dirty oil led to separation chamber from dirty oil inlet through distributor passes through spaces between discs, with solids and water being separated midway, and thus becomes purified oil which is discharged outside continuously by centripetal pump [impeller (1)] on the upper part of bowl, while separated water is similarly discharged continuously by centripetal pump [impeller (2)].

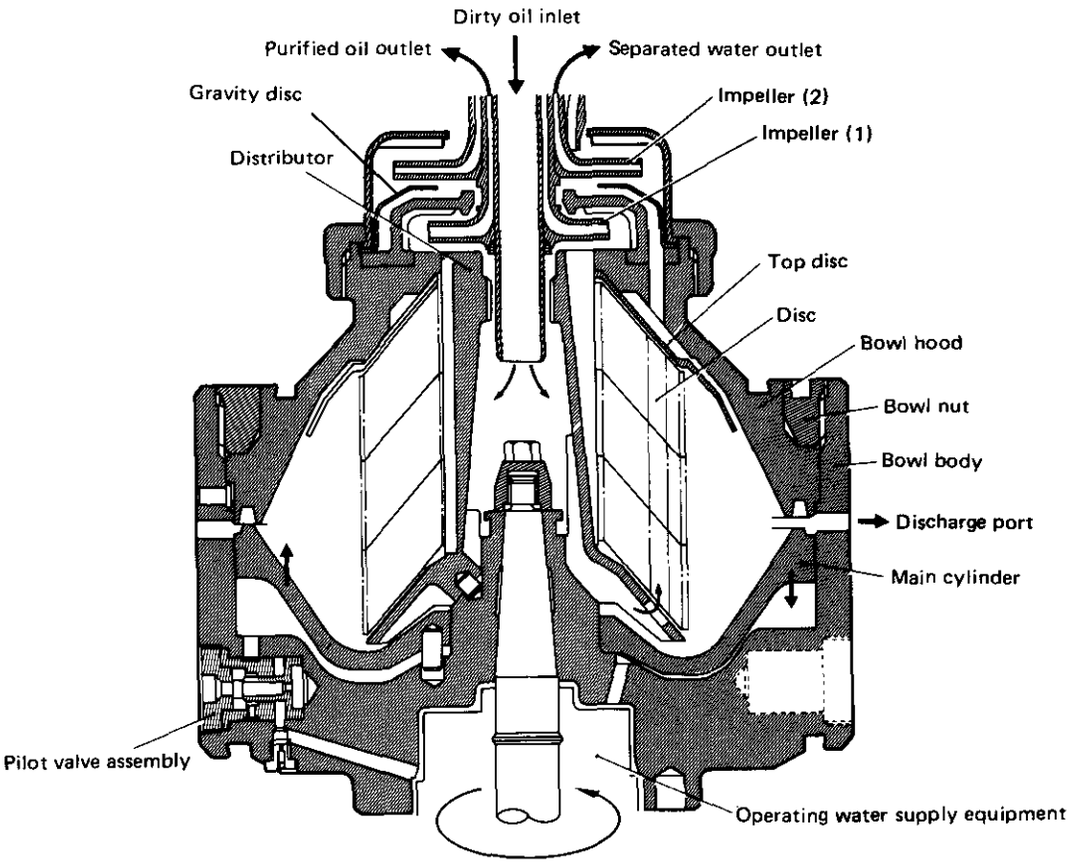


Fig. 2-6

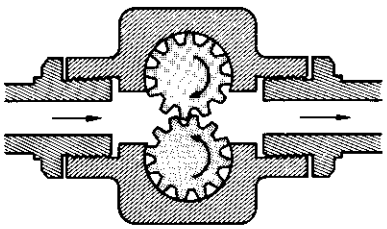


Fig. 2·7

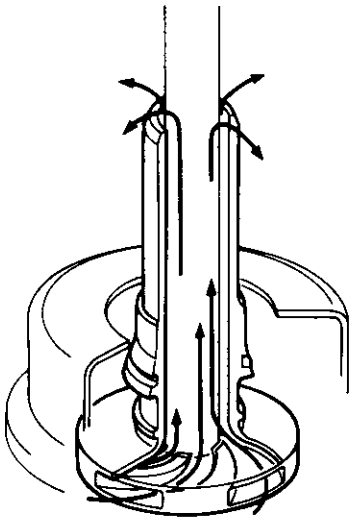


Fig. 2·8

4. Pump

4.1 Gear pump

This pump is used as a suction pump to feed dirty oil to the purifier.

It is connected via safety joint to the horizontal shaft.

4.2 Centripetal pump

The centripetal pump is a spiral impeller provided on the top of bowl to transfer light and heavy liquids out of the machine.

This pump is provided with a spiral groove or radial hole in a disc with certain thickness, dipped in liquid revolving with the bowl and the liquid will be discharged by its own turning force along groove or hole.

PART 3 DISCHARGE MECHANISM

CHAPTER 1. TOTAL DISCHARGE TYPE

1. Operating water supply equipment

To supply operating water for control of bowl sludge discharge to each water pressure chamber (water pressure chamber for opening bowl, water pressure chamber for closing bowl.), the operating water supply equipment is installed in the lower part of the bowl.

Operating water for opening bowl is supplied from part "A" in Fig. 3-1 and enters the water pressure chamber for opening bowl. On the other hand, water for water pressure chamber for closing bowl is supplied from the part "B" and enters the water pressure chamber for closing bowl.

Operating water for closing bowl is normally (when main cylinder is closed) supplied and operating water of water pressure chamber for closing bowl is revolving with the bowl and therefore, pressure generated under its centrifugal force and head pressure from low-pressure operating water tank are balanced and water level is stabilized at a certain position.

On the other hand, operating water is, for closing bowl, supplied from the low-pressure operating water tank.

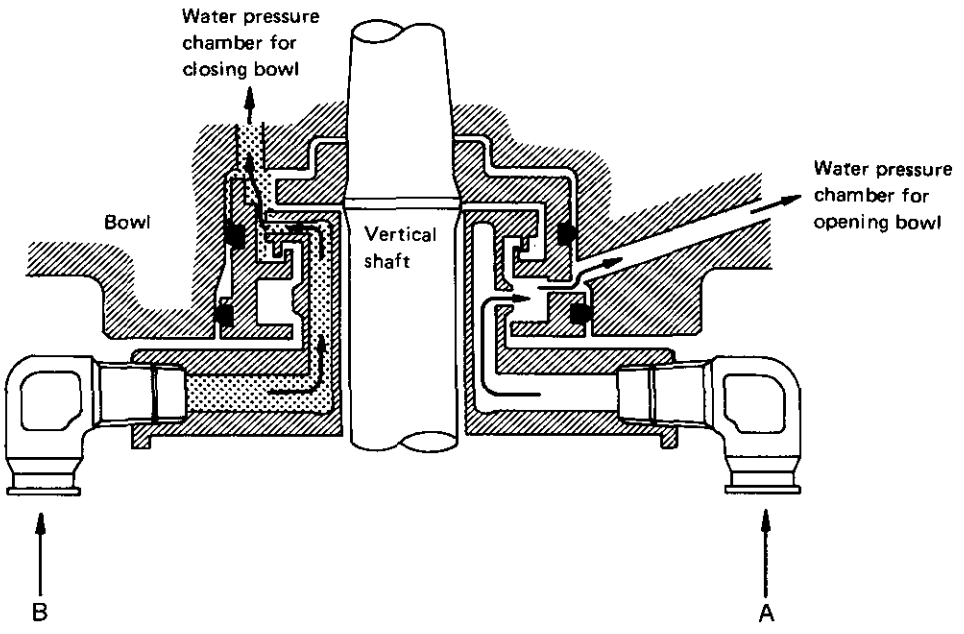


Fig. 3-1

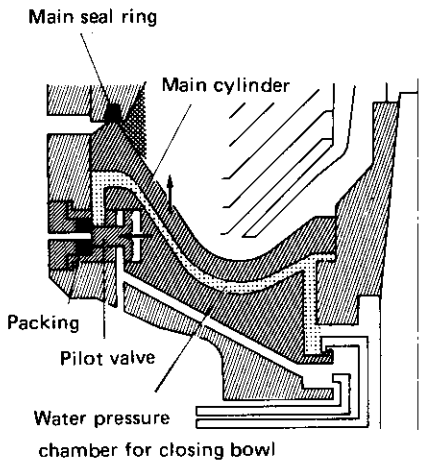


Fig. 3-2

2. Discharge mechanism

Sludge discharge is performed as follows.
Under centrifugal force acting on pilot valve, packing part is sealed and operating water is filled in water pressure chamber for closing bowl. Under pressure of the operating water, main cylinder is pushed up to seal main seal ring for purifying operation.

On the other hand, though operating water for closing bowl is constantly supplied to the water pressure chamber for closing bowl, operating water within the water pressure chamber for closing bowl rotates with the bowl, and therefore pressure generated under centrifugal force and head pressure of operating water to be supplied are balanced to cause water level to be stable at a certain position.

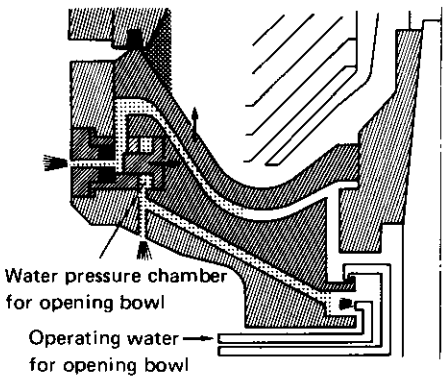


Fig. 3-3

Operating water for opening bowl is fed for a certain time to the water pressure chamber for opening bowl. Part thereof passes through, but remaining water is filled in the water pressure chamber for opening bowl. Under pressure of the operating water, pilot valve slides in counterradial direction.

Seal in the packing part is broken and operating water for closing bowl, flows out of the bowl.

If operating water for closing bowl passes through, there is no more force pushing up the main cylinder and the main cylinder is pushed down by liquid pressure within the bowl.

Seal in the main seal ring part is broken and sludge is instantly discharged out of the bowl.

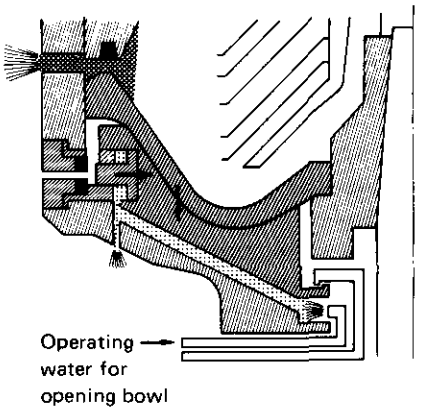


Fig. 3-4

On completion of sludge discharge, operating water for closing bowl is delivered to the water pressure chamber for closing bowl.

If operating water is filled therein, main cylinder is pushed up to seal the main seal ring part.

At this time the packing part is already sealed.

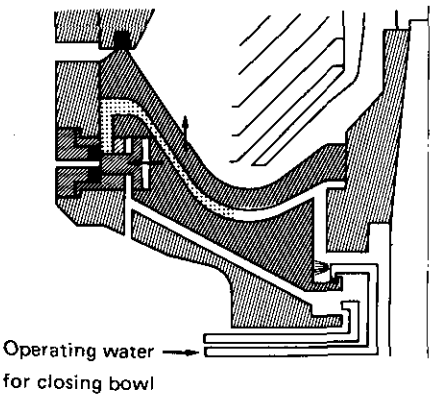


Fig. 3-5

CHAPTER 2. PARTIAL DISCHARGE TYPE

1. Operating water supply equipment

For supply of operating water to control bowl sludge discharge to each water pressure chamber (water pressure chamber for opening bowl, water pressure chamber for closing bowl), operating water supply equipment is installed in the lower part of the bowl.

The water supply equipment of the partial discharge type comprises the operating water supply equipment for partial discharge and the operating water supply piping connected for total discharge.

From the point A in Fig. 3·6 is supplied operating water for closing bowl and operating water for opening bowl for partial discharge, while operating water for opening bowl for total discharge is supplied from the point B.

In the case of partial discharge, operating water supplied from the point A enters the water pressure chamber for closing bowl, overflows when the chamber is filled up, and flows into water pressure chamber for opening side for partial discharge. In the case of total discharge, operating water supplied from the point B enters directly into the water pressure chamber for opening bowl for total discharge. As operating water for partial discharge and total discharge, pressure water as boosted with air within the operating water tank is used. Operating water for closing bowl is also supplied from the same operating water tank, but it is reduced in pressure by the reducing valve within the operating water piping and becomes low-pressure water and therefore, when it is supplied to water pressure chamber for closing bowl, it won't overflow into water pressure chamber for opening bowl side.

On the other hand, operating water for closing bowl is controlled with a timer and supplied intermittently.

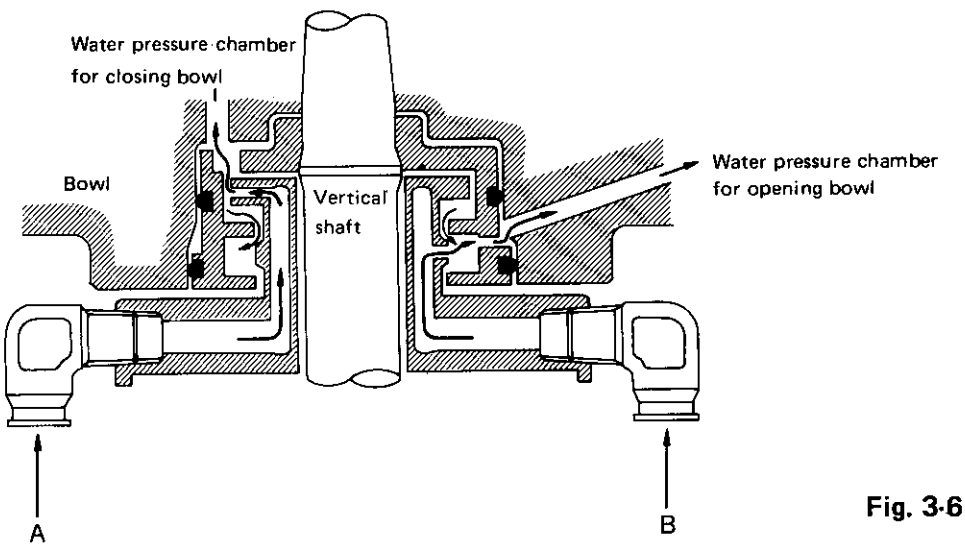


Fig. 3·6

2. Discharge mechanism

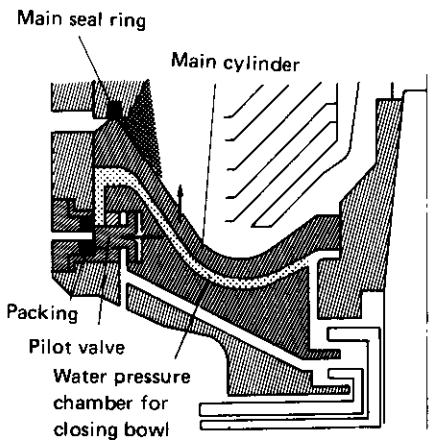


Fig. 3-7

In the case of the partial discharge type, both partial discharge and total discharge are possible, but here only the partial discharge will be described. For total discharge refer to the discharge mechanism of total discharge type mentioned above.

Sludge discharge is performed as follows.

Under centrifugal force acting on pilot valve, paking part is sealed and water pressure chamber for closing bowl is filled with operating water. Main cylinder is pushed up by pressure of operating water to seal main seal ring part and perform purifying operation.

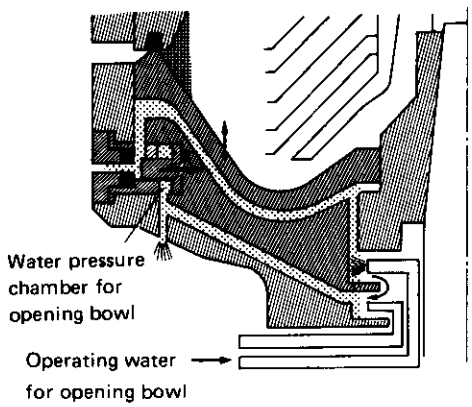


Fig. 3-8

Operating water for opening bowl (pressure water) is supplied through open-valve operating water inlet. Operating water thus supplied first enters water pressure chamber for closing bowl and when the chamber is filled up, overflows and enters into water pressure chamber for opening bowl.

When water pressure chamber for opening bowl is filled with operating water, pilot valve slides opposite to radial direction, packing part seal is burst and a part of operating water for closing bowl flows out of bowl. For this reason, liquid pressure within bowl overcomes pressure by operating water for closing bowl main cylinder is pushed down and sludge is discharge.

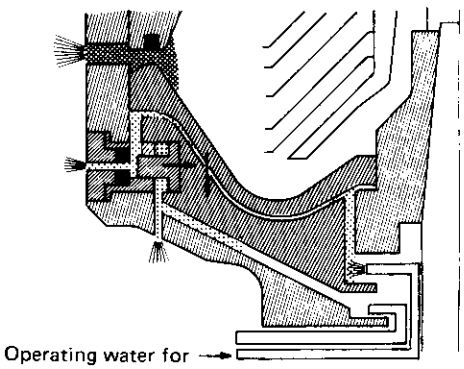


Fig. 3·9

By stopping the supply of operating water for opening a main cylinder, the supply of operating water into water pressure chamber for opening the main cylinder is stopped and a packing part is sealed. Moreover, since operating water for closing a main cylinder is supplied continuously for a fixed time ever after the ending of discharge operation, the main cylinder will be closed by the liquired pressure of water pressure chamber for closing the main cylinder simultaneously with the ending of sludge discharge.

As main cylinder is opened and closed quickly owing to sludge discharge, oil will not be discharged. Accordingly, feeding of dirty oil is continued during sludge discharge process, too.

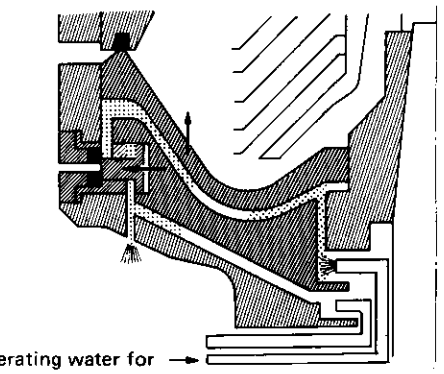


Fig. 3·10

CHAPTER 3.
E-HIDENS II TYPE

In E-HIDENS II Type, when discharging separated water, a partial discharge is conducted and when discharging sludge, a total discharge is conducted. Accordingly, since the operating water supply equipment and the discharge mechanism of E-HIDENS II Type are both the same as those of Partial Discharge Type, refer to the preceding chapter.

PART 4 ELECTRIC MOTOR AND STARTER

1. Electric motor

The specification for the electric motor is as given in the following. Accordingly, when the motor is purchased from a manufacturer other than our Company, the motor shall meet the same specification.

Regarding its power source, since at present low voltage three-phase AC is commonly used, description will be given only in the case of three-phase squirrel cage type induction motor of Class B insulation.

For DC motor, the customers are requested to make inquiries separately.

1.1 Characteristics of motor

1.1.1 Starting characteristics

The instant load of motor at start-up is not so big since SELFJECTOR is driven by means of centrifugal friction clutch. Namely, at first the motor attains rated speed, and as the bowl is accelerated, torque of the friction clutch increases and soon the bowl attains the rated speed.

Therefore, it is necessary to use a motor designed to withstand start-up overload for several minutes.

Table 4-1

Overload	Time
25% overload	30 minutes
50% "	15 "
75% "	5 "
100% "	1 minute

1.1.2 Characteristic curve at start-up

The characteristic curve at start-up may differ somewhat according to the type of machine and conditions of the friction clutch. The curve shown in Fig. 4-1 is one example for reference to select the motor.

NOTE:

1. Generally the value of electric current attains a peak prior to completion of start-up, but for some machines this is not clear.
2. The value of electric current differs according to the feed rate.
3. On sludge discharge, at time of feeding of sealing water and replacement water, the value of electric current shows an increase. It takes about one minute until the value of electric current returns to original value after discharge.

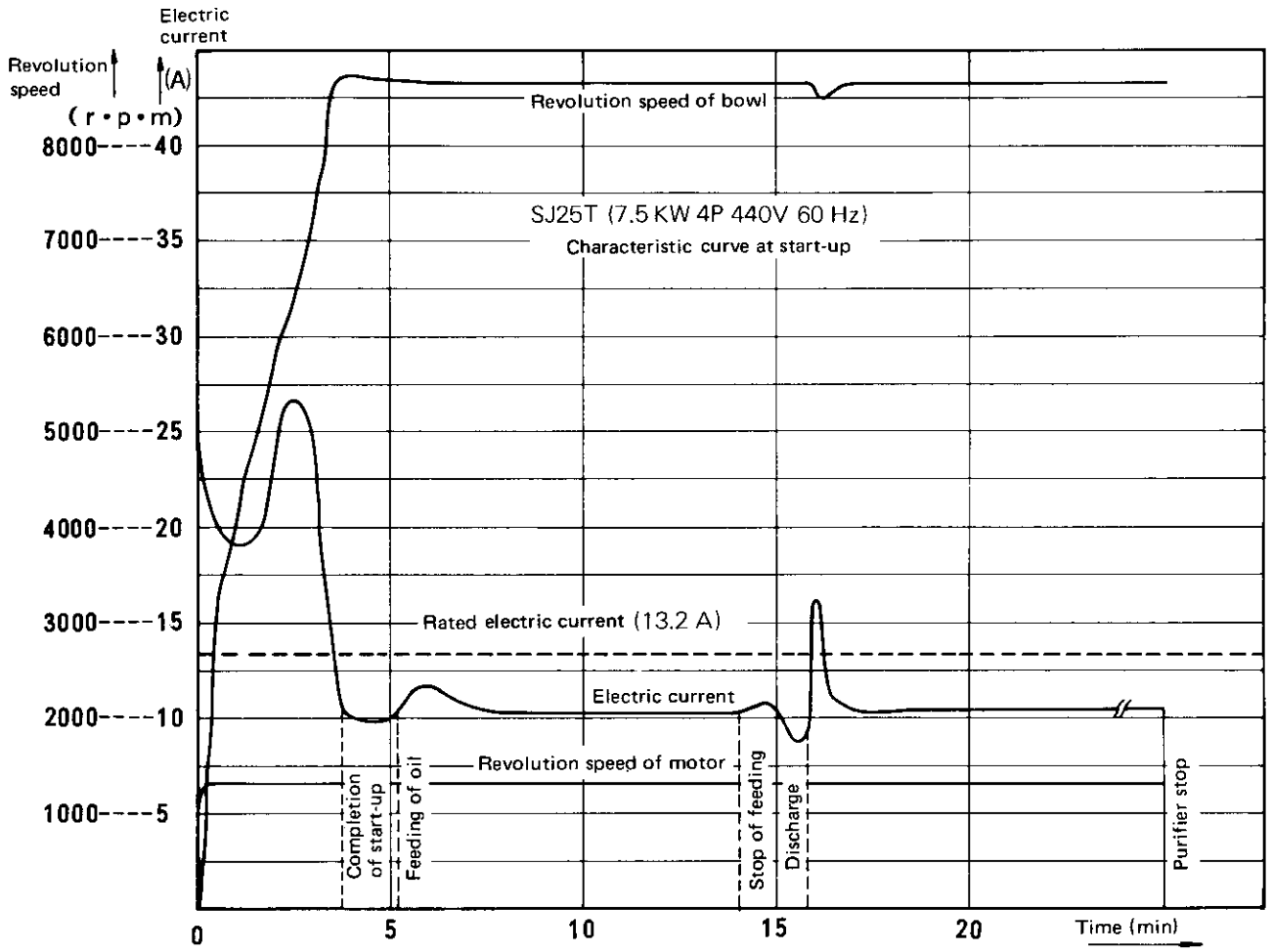


Fig. 4-1

1.1.3 Output and revolution speed

In case the revolution speed of SELFJECTOR is lowered, its capacity is reduced and when it excessively rises, its safety decreases in terms of strength and vibration, etc., so the revolution speed shall conform to Table 4-2.

Table 4-2

Model	Rated output kW	Number of poles	Synchronous speed (r.p.m.)	
			50 Hz	60 Hz
SJ 20T,P,EH	5.5	4	1500	1800
SJ 25T,P,EH	7.5	4	1500	1800
SJ30T,P,EH	11	4	1500	1800
SJ40T,P,EH	15	4	1500	1800
SJ60T,P,EH	18.5	4	1500	1800

1.1.4 Others

Our standard motor is of Class B insulation and continuous rating. The ambient temperature should be below 50°C and even if supply voltage varies within 10% of rated voltage, the motor shall have no difficulty in practical use.

1.2 Structure of motor

1.2.1 Type

Our standard motor is of flange installing, horizontal, totally enclosed fan-cooled type (indoor type). The direction of revolution shall be counter-clockwise as seen from the load side.

1.2.2 Structure of service entrance for electric wire

As for those for marine use, the service entrance shall be of the structure (waterproof gland) in compliance with JIS F 8801 "Marine watertight cable glands (for electric appliance)".

1.3 Rated current

Table 4-3

Model / Rated output / Voltage	SJ20T, P, EH	SJ25T, P, EH	SJ30T, P, EH	SJ40T, P, EH	SJ60T, P, EH
	5.5kW	7.5kW	11kW	15kW	18.5kW
440V	9.9A	13.2A	19A	25A	31A
220V	19.8A	26.4A	38A	50A	62A

2. Starter

The starter also complies with the following specification as the standard. Accordingly, when the starter is purchased from a manufacturer other than our Company, the starter shall meet the same specification.

2.1 Structure of starter

The casing box shall be of steel make, drip-proof, wall-hanging type. Installation shall be made on rear side at four upper and lower corners of the casing box and shall be round holes for upper part and slots for lower part so as to permit easy installation. Further, for introduction of external wires, coamings are provided.

2.2 Components

Ammeter, push buttons and indicating lights are installed at the door and electromagnetic contactor, overload relay, time limit relay, auxiliary relay, fuse and terminals, etc., in the box.

2.2.1 Ammeter

The ammeter able to measure current directly above or approx. 120% of rated current, with the maximum scale of 3-time extension, is employed.

On the other hand, as the ammeter is required to monitor the operating conditions of SELFJECTOR, it must be installed.

2.2.2 Overload relay (thermal relay)

This shall be of a manual return type with time limit characteristics, and the current settings shall be rated current values given in Table 4·3.

2.2.3 Time limit relay (timer)

In connection with the characteristics of SELFJECTOR, starting current of the following types will be overcurrent of about 150% for several minutes at the time of start-up, so a division circuit is provided for prevention of actions of overload relay by installing Timer (variable timer for 10 minutes).

2.3 Wiring of starter

For reference, the SELFJECTOR starter internal connection at AC 440V is shown in Fig. 4-2.

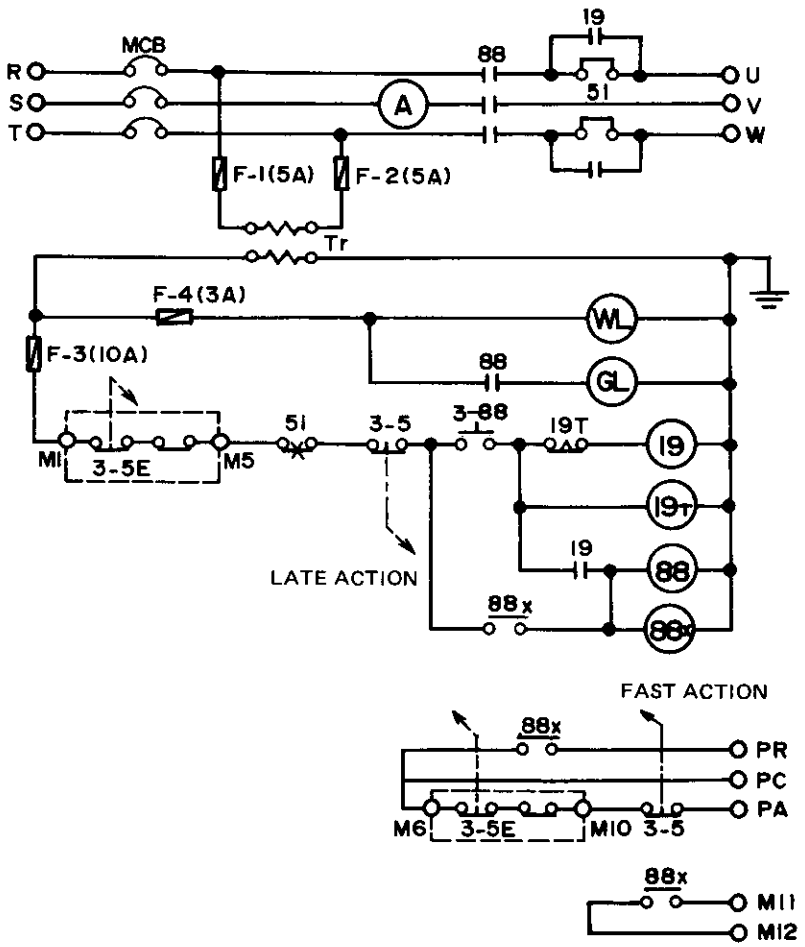


Fig. 4-2

NOTES:

1. Terminals No. PR, PC and PA serve for external indication and shall be connected to monitor panel.
2. Terminals M11, 12, M1, 5 and M6, 10 are to be connected to the automatic control panel.

PART 5 OPERATION

1. Preparations for operation

1.1 Feed rate

For efficient operation of SELFJECTOR, an appropriate fed rate must be maintained.

In the case of fuel oil, it is a normal method to take the quantity about 15% more than fuel consumption at the time of engine MCR as the throughput capacity of SELFJECTOR and to select SELFJECTOR having an actual capacity more than that (Refer to "Definition of Terms" in COMMON PART). Therefore, actual capacities shown in Table 5·1 (or 5·2) will be the maximum feed rates.

On the other hand, in the case of lubricating oil, it is the actual condition that feeding is conducted at considerably reduced rate. The optimum feed rate is shown in Table 5·1 and Table 5·2.

TOTAL DISCHARGE TYPE/PARTIAL DISCHARGE TYPE **Table 5.1**

Model	Actual capacity (ℓ/h)							
	Diesel oil	Heavy fuel oil				Lubrication oil		
		Viscosity				Cross-head		Trunk-piston
	cSt/40°C	cSt/50°C				Premium	Detergent	Detergent
	14	180	380	500	700	100 cSt/40°C	100 cSt/40°C	150 cSt/40°C
Separating temperature	40°C	98°C				74–90°C	74–90°C	83–90°C
SJ20T,P	6,700 6,400	3,250 3,100	2,300 2,200	1,850 1,750	1,500 1,450	4,400 4,200	2,600 2,500	2,150 2,050
SJ25T,P	8,850 8,750	4,250 4,250	3,050 3,000	2,400 2,400	1,950 1,950	5,750 5,700	3,400 3,400	2,800 2,800
SJ30T,P	11,400 11,500	5,450 5,550	3,900 3,950	3,100 3,150	2,500 2,550	7,400 7,500	4,350 4,400	3,600 3,650
SJ40T,P	14,200 14,200	6,850 6,850	4,900 4,850	3,850 3,850	3,150 3,150	9,250 9,250	5,450 5,450	4,500 4,500
SJ60T,P	22,000 21,900	10,600 10,600	7,550 7,500	6,000 5,950	4,850 4,850	14,400 14,300	8,400 8,400	6,950 6,900

Upper stage: 60 Hz
Lower stage: 50 Hz

E-HIDENS II TYPE

Table 5.2

Model	Actual capacity (ℓ/h)					
	Heavy fuel oil			Lubrication oil		
	Viscosity			Cross-head		Trunk-piston
	cSt/50°C			Premium	Detergent	Detergent
	380	500	700	100 cSt/40°C	100 cSt/40°C	150 cSt/40°C
Separating temperature	98°C			74–90°C	74–90°C	83–90°C
SJ20EH	2,450 2,350	1,950 1,850	1,600 1,500	4,850 4,650	2,850 2,750	2,350 2,250
SJ25EH	3,200 3,150	2,550 2,500	2,050 2,050	6,300 6,300	3,750 3,700	3,100 3,050
SJ30EH	4,150 4,200	3,300 3,300	2,650 2,700	8,200 8,300	4,800 4,900	4,000 4,050
SJ40EH	5,200 5,150	4,100 4,100	3,350 3,350	10,300 10,200	6,100 6,000	4,950 4,950
SJ60EH	8,050 8,000	6,350 6,350	5,200 5,150	16,000 15,900	9,400 9,400	7,750 7,750

Upper stage: 60 Hz
Lower stage: 50 Hz

NOTE:
Premium oil: Lubricating oil with rust preventive and oxidation inhibitor added.
Detergent oil: Lubricating oil with rust preventive, oxidation inhibitor and detergent dispersant, etc. added.

1.2 Separating temperature

As the throughput capacity of an oil purifier is governed by viscosity, it is necessary for efficient use of this machine to lower the viscosity by heating the oil.

However, for reasons of economy, deterioration of oil due to heating and adverse effects on purifier due to heating and so on, the optimum viscosity is set to 24 cSt and the highest heating temperature, to 98°C (below 100°C).

For the relations between temperature and viscosity for various kinds of oil refer to Fig. 5-1. For reference, the separating temperatures for various kinds of oil are given in the following.

Table 5-3

Type of oil		Separating temperature (°C)
Diesel oil	13 cSt／40℃	40 ℃
	20 cSt／50℃	46 ℃
Heavy fuel oil	180~600cSt／50℃	98 ℃
Lubricating oil	150 cSt／40℃ (VG150)	83°C~90°C
	100cSt／40℃ (VG100)	74°C~90°C

How to obtain the separating temperature from Fig.5-1:

[EXAMPLE]

In case fuel oil of 45 cSt (50°C) is purified, draw a parallel line (dotted line) passing a point of 45 cSt (Point A) on vertical line of 50°C. Then draw a vertical line downwards from the intersection (Point B) of the parallel line and the horizontal line of 24 cSt and read the temperature, then the value 67°C will be obtained.

Accordingly, this fuel oil may be fed at 67°C.

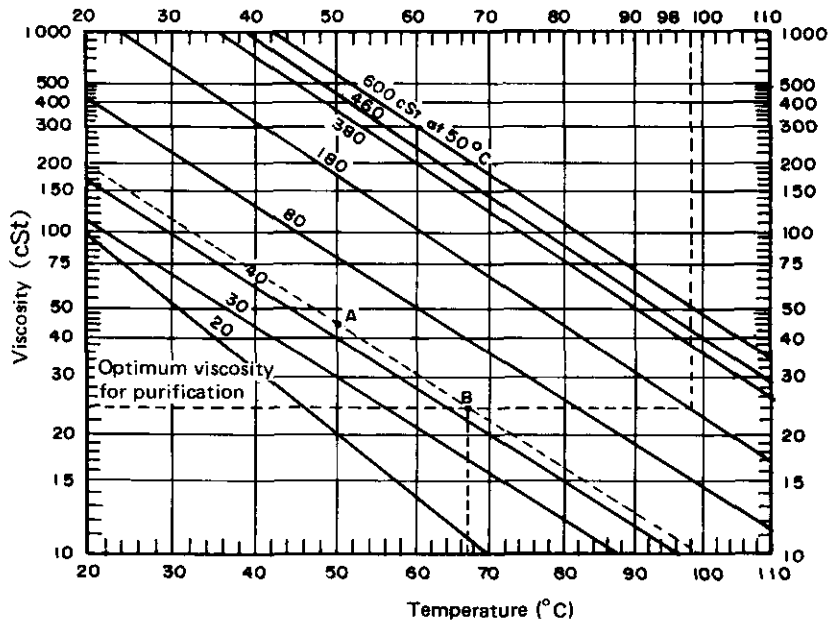


Fig. 5-1

1.3 Gravity disc

In the case of purifier operation, it is required to position the light liquid/heavy liquid interface in the bowl within certain limits and, in the case of SELFJECTOR, the adjustment is made by changing the heavy liquid side outlet diameter (using gravity discs different in diameter).

If a gravity disc larger in diameter is incorporated, the interface moves outwards and if a gravity disc smaller in diameter is incorporated, it moves inwards.

Selecting an appropriate gravity disc is one of the most important itmes in the use of SELFJECTOR and therefore, take due cautions so as to avoid any mistake in selection.

On the other hand, at time of delivery of SELFJECTOR, the gravity disc is packaged separately from the bowl and therefore, in accordance with the "procedure for selection of gravity disc", below, an appropriate gravity disc must be selected an incorporated in the bowl.

1.3.1 Supply of gravity disc

The types of gravity disc are as shown in Table 5·4, 5·5. The scope of supply varies with feed liquid; the details are shown on the separate drawings for approval, etc.

On the other hand, in the case of E-HIDENS II type, parts for clarifier (gravity discs for clarifier) are mounted in place of gravity disc.

Table 5·4

Model	Inside diameter (mm) of gravity disc												
SJ20T,P	72	73	74	75	76	77.5	79	81	84	88	93		
SJ25T,P	82	83	84	85	86.5	88	90	92	95	99	104		
SJ30T,P	90	91	92	93	94.5	96	98	101	104.5	109.5	116		
SJ40T,P	106	107	108	109	110.5	112.5	115	118	122	127	134		
SJ60T,P	116	117	118	119	120.5	122	124	126	129	132	137	143	151.5

(for purifier)

Table 5·5

Model	Inside diameter (mm) of gravity disc
SJ20EH	42
SJ25EH	50
SJ30EH	52
SJ40EH	62
SJ60EH	68

(for clarifier)

1.3.2 Main points of selection of gravity disc

For selection of gravity discs, referring to the example shown in Fig. 5·2, the selection will be made on the basis of Fig. 5·3—Fig. 5-7 according to the respective model numbers.

Further, bear in mind that the way of using the nomogram on selection of gravity disc is somewhat different between the case 1 where specific gravity at 15°C of oil to be treated is known and the case 2 where it is not known.

○ Example of selection of gravity disc (In case of SJ20T, P)

Case 1

Separating condition:

- ○ Specific gravity of oil to be treated: 0.905 *at 15°C.*
- ○ Separating temperature: 70°C
- ○ Feed rate: 3000 ℓ/h

Selection Method

Draw a straight line ② to the right from the point of intersection of the curve ① from specific gravity = 0.905 and a vertical line from 70°C.
Extend it to the point of 100°C ②.
Then connect with feed rate 3000 ℓ/h, ③.
The intersecting point indicates the inside diameter of gravity disc desired (ϕ 84).

Case 2

Separating condition:

- ○ Specific gravity of oil to be treated: 0.944 *at 50°C.*
- ○ Separating temperature: 98°C
- ○ Feed rate: 1800 ℓ/h

Selection Method

Draw the curve ⑤ from the point of intersection (to be converted into specific gravity at 15°C) of the curve ④ from specific gravity 0.944 and a vertical line from 50°C, and draw a straight line from the point of intersection with 98°C.
Next, connect with feed rate 1800 ℓ/h ⑥.
The intersecting point indicates the inside diameter of gravity disc desired. (ϕ 77.5).

SELECTION NOMOGRAM OF GRAVITY DISC

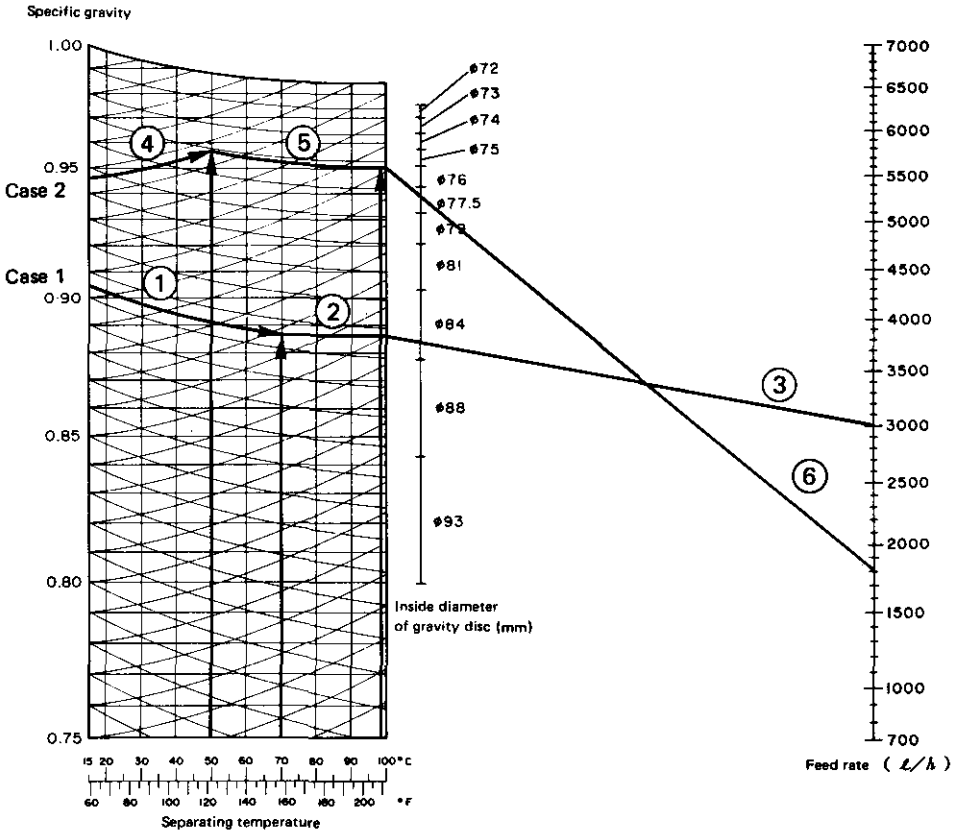


Fig. 5·2

SELECTION NOMOGRAM OF GRAVITY DISC, MODEL SJ 20T, P

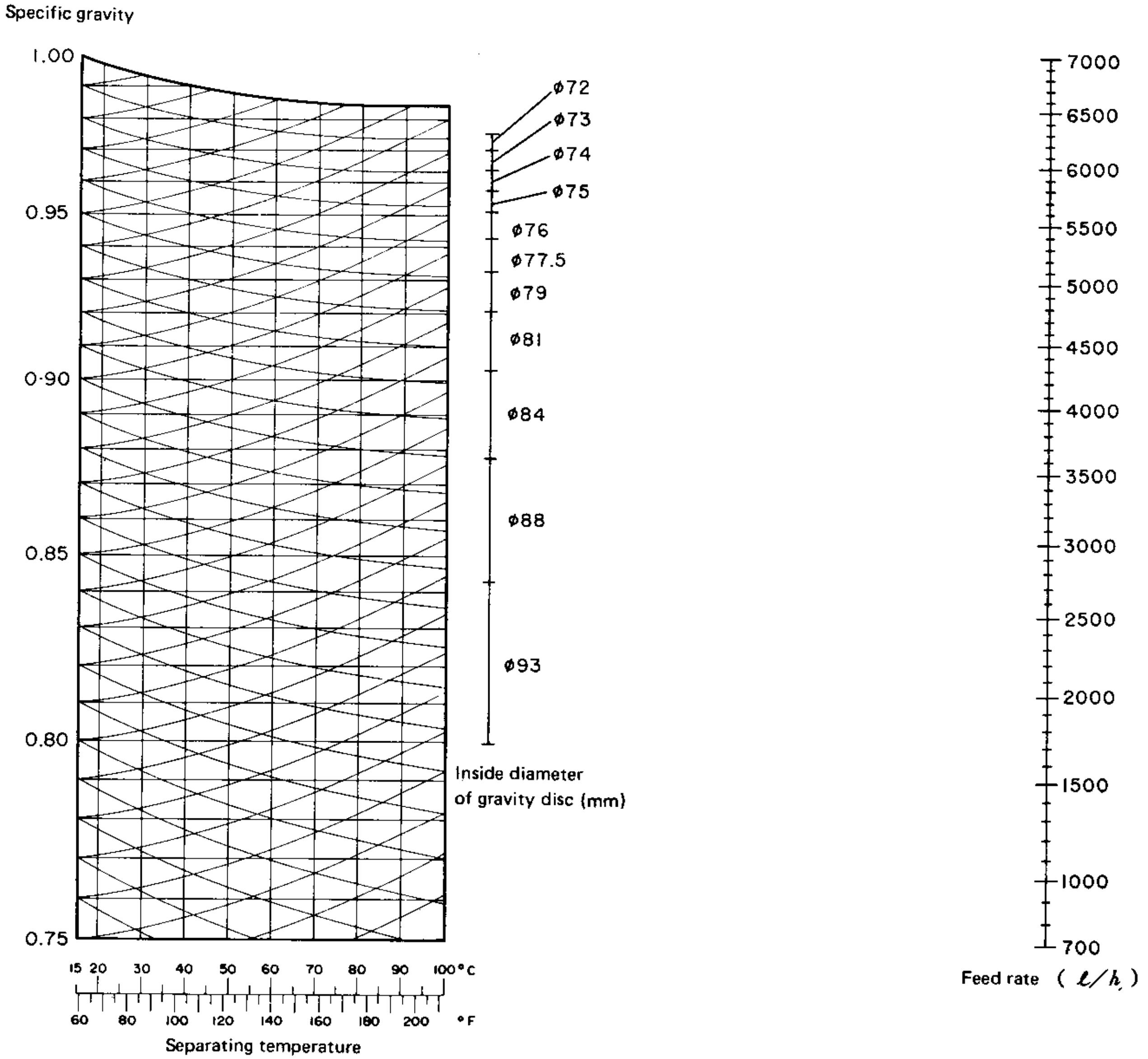


Fig. 5-3

SELECTION NOMOGRAM OF GRAVITY DISC, MODEL SJ 25T, P

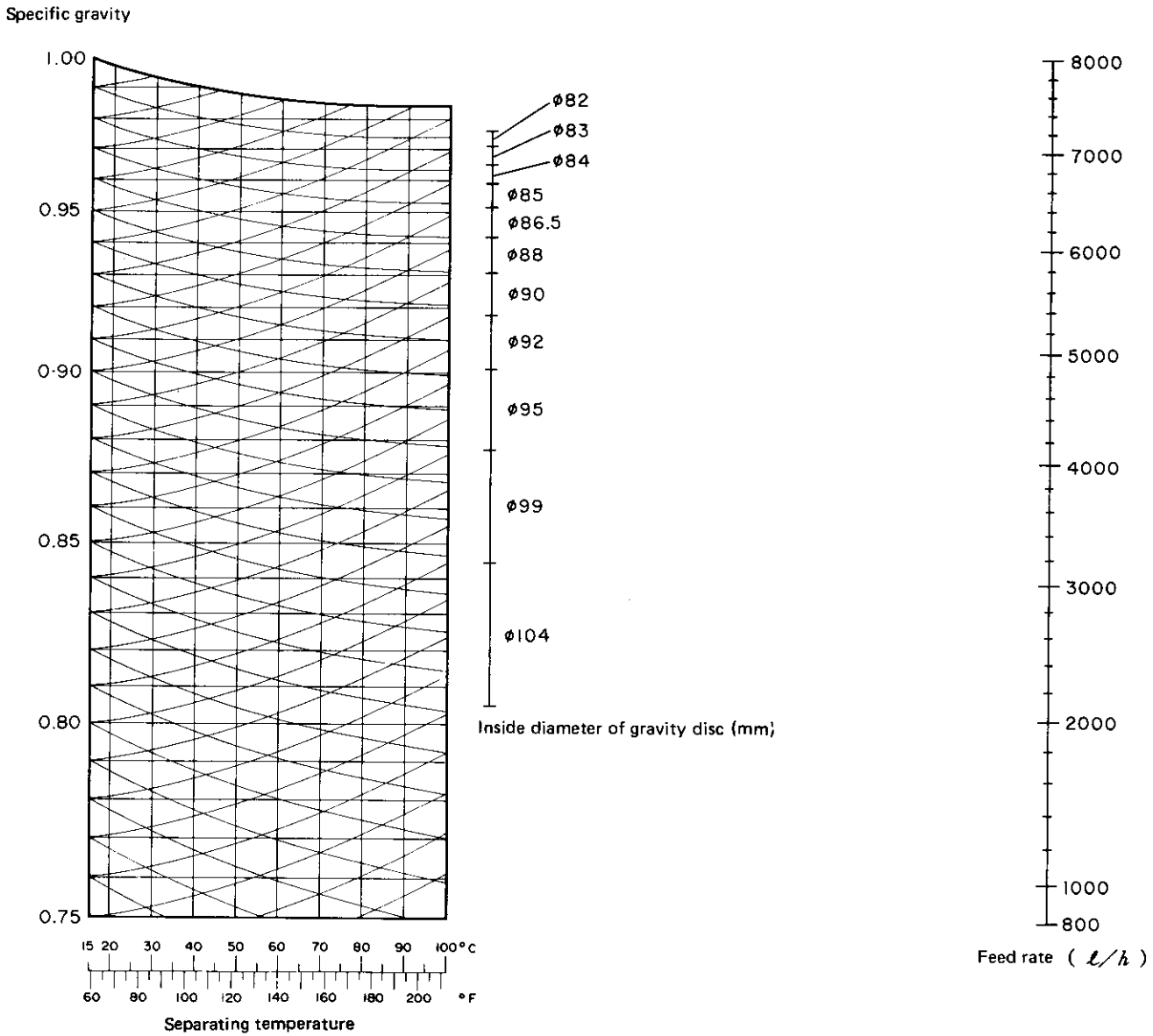


Fig. 5-4

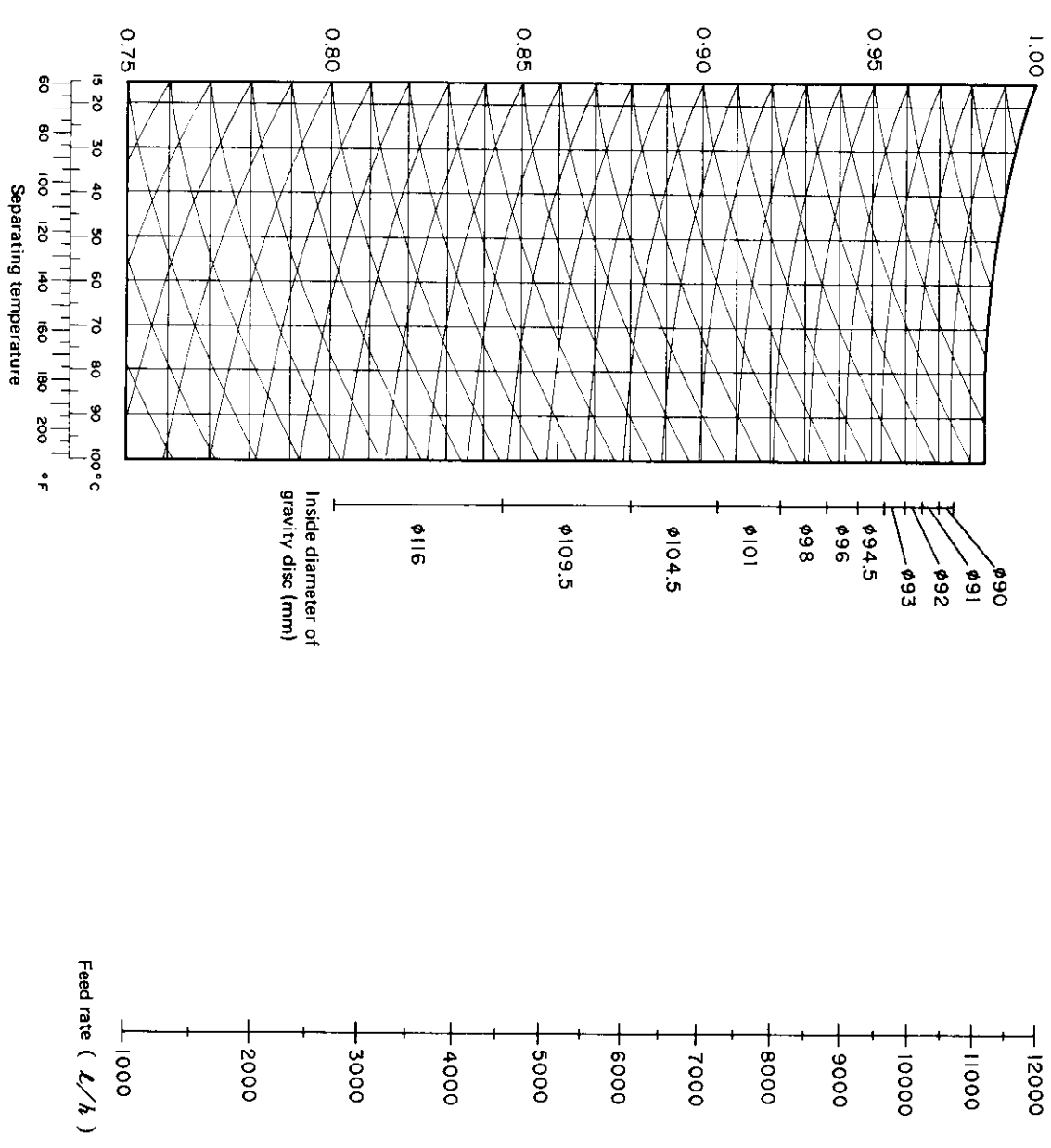

SELECTION NOMOGRAM OF GRAVITY DISC,
MODEL SJ 30T, P
Specific gravity
1.00
0.95
0·90
0.85
0.80
0.75
Separating temperature
°C
°F
Inside diameter of gravity disc (mm)
ø90
ø91
ø92
ø93
ø94.5
ø96
ø98
ø101
ø104.5
ø109.5
ø116
Feed rate (L/h)
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000

Fig. 5·5

SELECTION NOMOGRAM OF GRAVITY DISC, MODEL SJ 40T, P

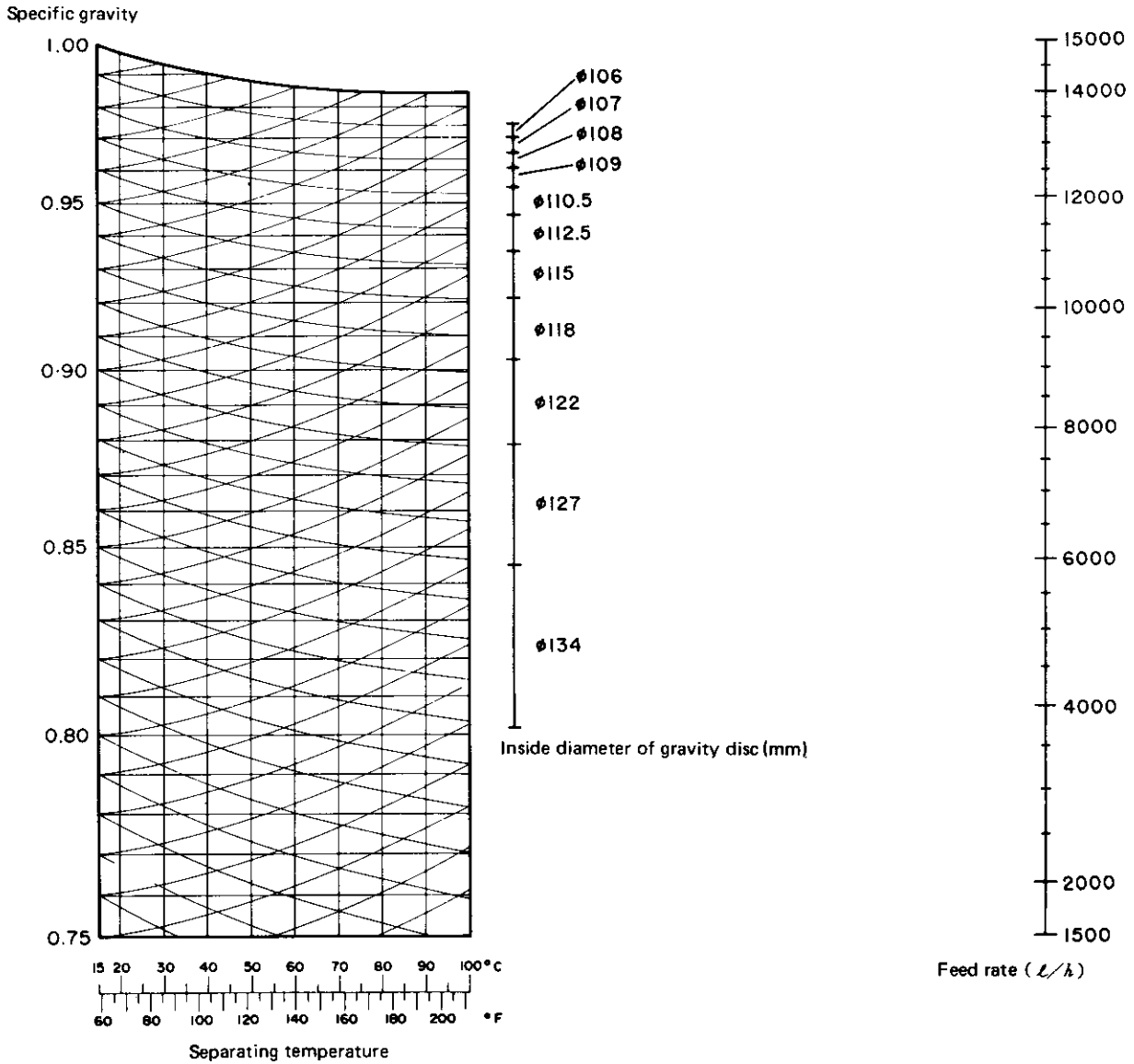


Fig. 5-6

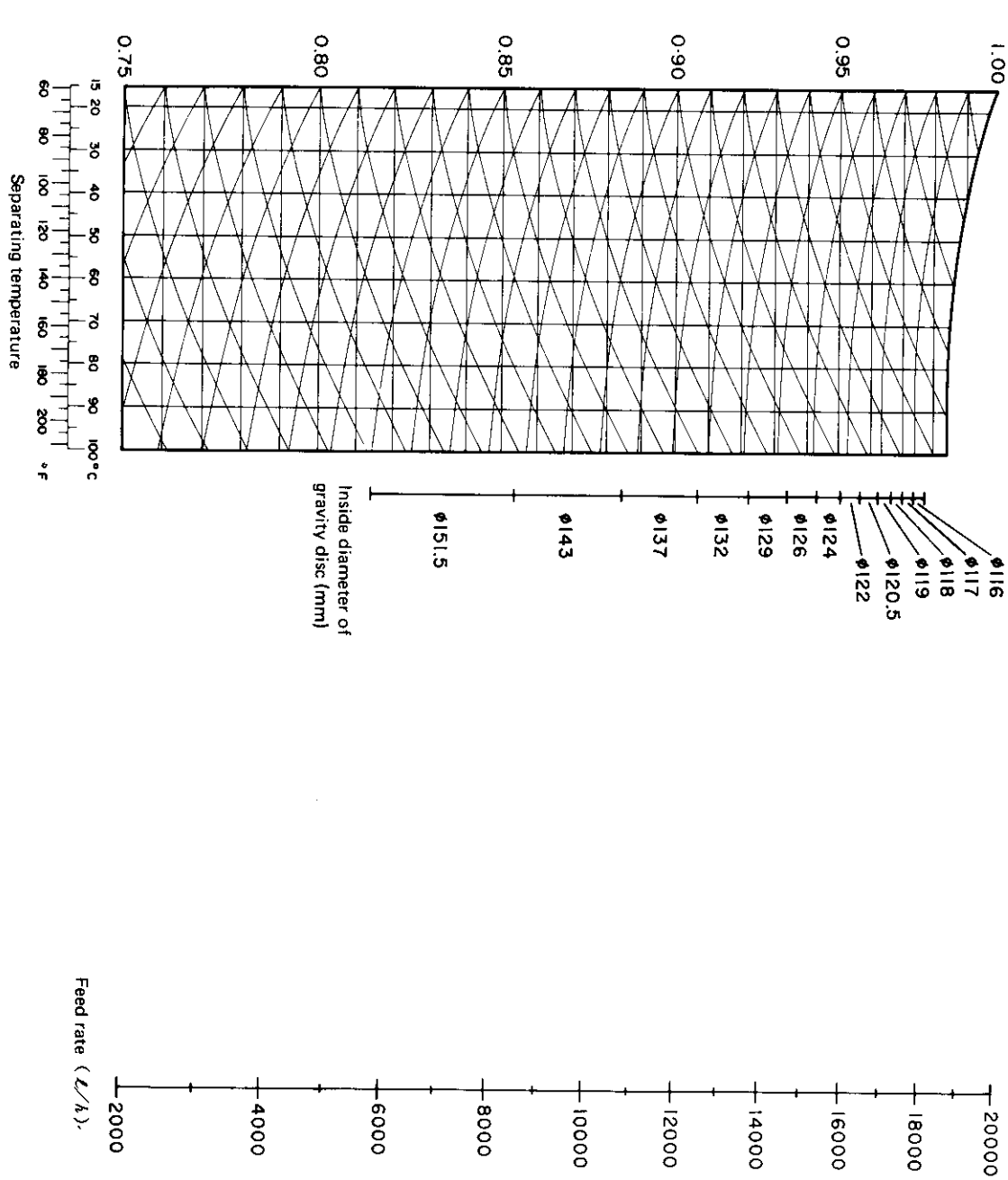

SELECTION NOMOGRAM OF GRAVITY DISC,
MODEL SJ 60T, P
Specific gravity
1.00
0.95
0·90
0.85
0.80
0.75
Separating temperature
°C
°F
Inside diameter of gravity disc (mm)
φ116
φ117
φ118
φ119
φ120.5
φ122
φ124
φ126
φ129
φ132
φ137
φ143
φ151.5
Feed rate (ℓ/h)
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000

Fig. 5·7

1.4 Lubricating oil

Lubrication system of bearings and gears of vertical and horizontal shafts is of oil bath and splash lubrication by spiral gear.

Since the maintenance and control of lubricating oil have direct influence on the durability of each part of driving section, a close attention must be paid to its handling. Further, oiling shall be performed by removing the gear cover of Fig. 5·8 or plug (PF1) attached to the gear cover.

1.4.1 Optimum viscosity

Lubricating oil having proper viscosity shall be selected according to ambient temperature and in compliance with Table 5·6.

Table 5·6

Ambient temperature	ISO viscosity grade (cSt at 40°C)
Above 20°C	ISO VG 220 (198 ~ 242)
Below 20°C	ISO VG 150 (135 ~ 165)

Kind of lubricating oil to be used shall be gear oil or turbine oil equivalent to viscosity given in Table 5·9 and of good quality having excellent stability against oxidation.

Such oil as is hard to emulsify with water shall be empolyed.

1.4.2 Quantity of lubricating oil

The quantity of lubricating oil is as shown in Table 5·7.

When SELFJECTOR is stationary, fill oil up to the red line on the oil gage by reference to the caution plate.

(Refer to Fig. 5·9)

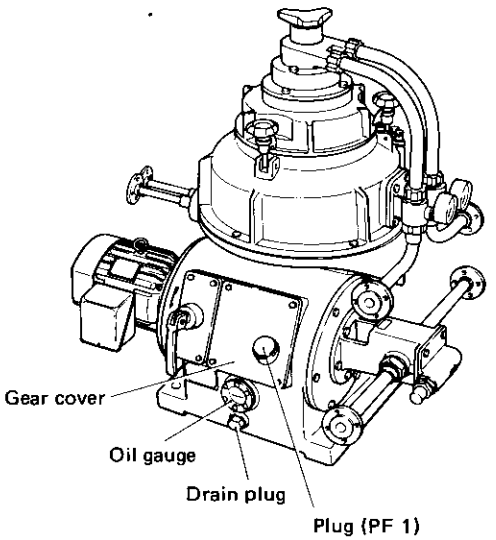


Fig. 5·8

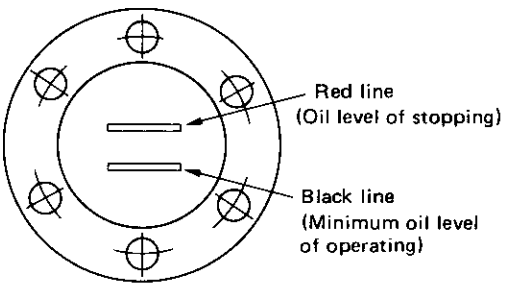


Fig. 5·9

Table 5·7

Model	SJ20T,P,EH	SJ25T,P,EH	SJ30T,P,EH	SJ40T,P,EH	SJ60T,P,EH
Quantity of oil (ℓ)	7.5	8	11	16	19.5

1.4.3 Time for replacement

Table 5-8

Number of times	Time of replacement	Remarks
1st replacement	After 2-week (about 300 hours) operation	Until contact faces of gears become adaptable, about 2 weeks will be required.
2nd replacement	After 1-month (about 600-hours) operation	
3rd & subsequent replacement	Every 3 months	

NOTES:

1. When spiral gear was replaced, oil replacement shall be newly started from the above first step.
2. In case oil becomes remarkably dirty, replacement shall be performed earlier than the above schedule in Table 5-8.
3. in case water or sludge is mixed into the gear case, oil shall be drained and inside of gear case be cleaned. Then oil shall be replaced with new lubricating oil. (Although emulsion is caused by water mixture, if a drain plug is removed before that time, water mixture can be confirmed by water coming out).

1.4.4 Recommended brands

The recommended brands (in case of ambient temperature of over 20°C) are as shown in Table 5-9. When using those other than the recommended brands, please consult us beforehand.

Table 5-9

OIL MAKER	OIL NAME	VISCOSITY cST @ 40°C	REMARKS
BP	ENERGOL GR-XP220 HLP 220	210 220	(GR 280-XP) (HLP 300)
CALTEX	MEROPA LUBRICANT 220 URSA OIL P220	209 203	
CASTROL	CASTROL ALPHA SP220	220	
CHEVRON	NL GEAR COMPOUND 220 EP MACHINE OIL 220 AW MACHINE OIL 220	220 210 210	
ESSO	SPARTAN EP 220	214	
GULF	GULF EP LUBRICANT HD 220	206	
IDEMITSU	DAPHNE SUPER GEAR OIL 220 DAPHNE MARINE OIL SM50 DAPHNE MARINE OIL SX50	219.6 185.1 192.0	
MITSUBISHI	DIAMOND GEAR LUBE SP220 DIAMOND LUBE RO220	209 224	
MOBIL	MOBIL GEAR 630	198~220	
NIPPON OIL	BONNOC SP220 FBK OIL RO220	228 230	
SHELL	OMARA OIL 220	220	
TEXACO	MEROPA LUBRICANT 220 REGAL OIL R&O 220	209 207	

1.5 Time interval for sludge discharge

As for the time interval for sludge discharge, the more timely the interval is, the more effective operation can be attained. However, it is difficult to decide the proper interval generally because it is affected by many factors such as model of oil purifier, mode of operation or properties of oil to be treated and other vaiours conditions (in the case of lubricating oil, for instance, the type and output of engine and capacity of sump tank, etc.).

When the time interval is too long, sludge discharge becomes difficult due to adhesion of sludge and so on, whereas if too short, the operating efficiency becomes worse.

When selecting a Selfjector, it is desirable to give a fundamental consideration about the sludge discharge interval and determine a proper discharge interval according to the density of sludge of oil to be treated.

Here, we would like to show you a general discharge interval which will be applicable when treating a fuel oil and a lurbicating oil.

Table 5-.10

			Fuel oil				Lubricating oil			
			Diesel oil		Heavy fuel oil (380cSt/50°C)		Crosshead engine		Trunk piston engine	
			max.	nor.	max.	nor.	max.	nor.	max.	nor.
Total discharge type	Sludge discharge interval (C615)	min.	240	120	120	60	240	120	120	60
Partial discharge type	Sludge discharge interval (C615)	min.	30	30	20	20	30	30	20	20
	Total discharge setting counter (C621)	times	16	8	12	6	16	8	12	6
E-HIDENS II type	Sludge discharge interval (C615)	min.	240	120	120	60	240	120	120	60
	Total discharge setting counter (C621)	times	1	1	1	1	1	1	1	1
	Monitering time (C622)	min.	30	30	20	20	30	30	20	20

NOTE

In the following cases, since a rise of sludge density of the liquid to be treated is anticipated in lubricating oil purifier, we wish to recommend you to further shorten the sludge discharge interval than the guide line (standard numerical values) of the above Table and perform an operation at least for about twelve hours.

(1) After stopping the operation of both engine and oil purifier because of ship anchoring or entering a dock, when operation is resumed. (This is a case in which the lubricating oil purifier was not operated for over twelve hours.)

(2) After stopping the operation of oil purifier under the condition that engine was being operated, when the operation is resumed. (This is a case in which the lubricating oil purifier was not operated for over six hours.)

Further, in order to avoid the above troublesome procedures and ensure a stable operation, it is desirable to conduct a continuous operation of lubricating oil purifier even when the engine is not working.

1.6 Operating water

When operating a Selfjector, the operating water, sealing water and replacement water to open or close a main cylinder are used. As regards these fresh water, it is necessary to set correctly the pressure and flow rate.

1.6.1 Operating water for opening bowl

In the total discharge type using a pressure water the operating water for opening the main cylinder is directly supplied from the high pressure water line, while in the partial discharge type, the operating water is supplied by way of the pressure tank (operating water tank).

Table 5·11

Model No.	Operating water for opening bowl (kgf/cm^2)
SJ20P, EH ~ 60P, EH	1.5 ~ 3.5
SJ20T ~ 60T	2.5 ~ 5.0

In Partial Discharge Type, before the operation, the pressure of operating water to open the main cylinder will be set at 2 kgf/cm^2 and after that it shall be reset at a proper pressure depending on the amount of discharge.

1.6.2 Operating water for closing bowl, replacement water and Sealing Water

In the operating water for closing bowl, replacement water and sealing water, a low pressure water is used. In the total discharge type, the water is supplied from the head tank and in the Partial Discharge Type, after setting the flow rate (pressure) as shown in the following Table 5.12, the water is supplied from the pressure tank (Operating Water Tank) with a Reducing Valve.

Table 5·12

Model No.	Flow Rate (ℓ/min.)	Pressure (kgf/cm^2)
SJ20P, EH SJ25P, EH SJ30P, EH	6 ~ 7	0.2 ~ 0.4 (Reference value)
SJ40P, EH SJ60P, EH	9 ~ 10	0.3 ~ 0.5 (Reference value)

NOTE

1. When setting the pressure of Reducing Valve, remove the sealing water pipe (copper pipe), open the solenoid valve SV_3 by hand and set the flow rate within the scope of the above Table.
2. The pressure of Reducing Valve is the pressure at the time of water running.

1.7 Adjustment of Automatic Control Panel

Automatic control panel controls automatically each action of Selfjector. The control panel is provided with a built-in Timer and etc. which control each solenoid valve. Proper setting of Timer and the like will enable a normal and efficient operation. Though the setting time of Timer will differ depending on the flow rate of operating water. The standard setting time at each operation mode is shown in the following Table 5.13 ~ Table 5·15:

1.7.1 Automatic Control Panel for Total Discharge Type

Table 5·13

Item		Model	SJ20T	SJ25T	SJ30T	SJ40T	SJ60T
Quantity of Water Supply	Quantity of Replacement Water	ℓ/time	1.5	2.0	2.6	4.0	5.9
	Quantity of Sealing Water	ℓ/time	2.3	3.3	4.4	7.3	8.4
Set Value of Timer Counter	Interval T600 T600	sec.	10				
	Main Cylinder Opening T601	sec.	5				
	Replacement Water T602	sec.	15	20	26	40	59
	Sealing Water T603	sec.	23	33	44	73	84
	LD Valve Opening Interval C614	min.	15				
	LD Valve Opening T616	sec.	10				
	Sludge Discharge Interval C615	min.	Refer to Table 5·10				

NOTE

Since the setting time of sealing water and replacement water in the above Table is the value based on the assumption that each flow rate is 6 ℓ/min., in case of actual setting, after actually measuring the flow rate, a proper value shall be set.

1.7.2 Automatic Control Panel for Partial Discharge Type

Table 5·14

Item		Model	SJ20P	SJ25P	SJ30P	SJ40P	SJ60P
Quantity of Water Supply	Quantity of Replacement Water (Total)	ℓ/time	1.5	2.0	2.6	4.0	5.9
	Quantity of Sealing Water (Total)	ℓ/time	2.3	3.3	4.4	7.3	8.4
	Quantity of Replacement Water (Partial)	ℓ/time	1.1	1.4	1.9	2.8	4.5
	Quantity of Sealing Water (Partial)	ℓ/time	1.2	1.7	2.4	3.8	2.9
	Flow rate of Replacement Water, Sealing Water	ℓ/min.	6 ~ 7			9 ~ 10	
Set Value of Timer, Counter	Interval T600	sec.	10				
	Main Cylinder Opening (Total) T601	sec.	5				
	Replacement Water (Total) T602	sec.	15	20	26	27	40
	Sealing Water (Total) T603	sec.	23	33	44	49	56
	Main Cylinder Opening (Partial) T611	sec.	0.6				
	Replacement Water (Partial) T612	sec.	11	14	19	19	30
	Sealing Water (Partial) T613	sec.	12	17	24	26	20
	LD Valve Opening Interval C614	min.	10				
	LD Valve Opening T616	sec.	10				
	Sludge Discharge Interval C615	min.	Refer to Table 5·10				
	Total Discharge Setting Counter C621	times	Refer to Table 5·10				

NOTE

The set values of Timer for sealing water and replacement water in the above Table are respectively those based on the following flow rate. Accordingly, when setting the actual values, be sure to actually measure the flow rate and set a proper value.

SJ20P ~ 30P ..... 6 ℓ/min.
SJ40P ~ 60P ..... 9 ℓ/min.

1.7.3 Automatic Control Panel for E-HIDENS II Type

1.7.3.1 Automatic control panel for Selfjector

Table 5·15

Item \ Model			SJ20EH	JS25EH	SJ30EH	SJ40EH	SJ60EH
Quantity of Water Supply	Quantity of Replacement Water	ℓ/time	0.8	1.0	1.4	2.1	3.3
	Flow Rate of Replacement Water	ℓ/min.	6 ~ 7			9 ~ 10	
Set Value of Timer, Counter	Interval T600	sec.	10				
	Main Cylinder Opening (Total) T601	sec.	5				
	Replacement Water (Total) T602	sec.	8	10	14	14	22
	Sealing Water (Total) T603	sec.	0				
	Main Cylinder Opening (Partial) T611	sec.	0.6				
	LD Valve Opening Interval C614	min.	10				
	LD Valve Opening T616	sec.	10				
	Sludge Discharge Interval C615	min.	Refer to Table 5·10				
	Total Discharge Setting Counter C621	times	1				
	Monitoring Time C622	min.	Refer to Table 5·10				
	Waiting Time for Operating Water Tank being filled T610	sec.	120				

NOTE

The set values of Timer for replacement water in the above Table are respectively those based on the following flow rate. Accordingly, when setting the actual values, actually measure the flow rate and set a proper value.

SJ20EH ~ 30EH . . . . . 6 ℓ/min.
SJ40EH ~ 60EH . . . . . 9 ℓ/min.

1.7.3.2 Water detector control panel

NOTE

Since Water Detector uses a sensor of electrostatic capacity, be sure to apply a back pressure of 1.8 ~ 2.0 kgf/cm^2 to oil outlet side so as to prevent a wrong action. Further, the change of back pressure, oil temperature and flow rate dwing the operation shall be within the following scope to preset value.

Back pressure ± 0.1 kgf/cm^2
Oil temperature ± 5 ℃
Flow rate ± 5%

Table 5·16

Counter	times	6
Timer A	sec.	90
Timer B	min.	30
Water content preset value	%	0.30

2. Inspection before operation

Before starting SELFJECTOR, confirm whether piping work has been performed as shown in the attached drawing in par. "Start-up and stop", below, and further the following items shall be inspected.

On the other hand, in the case of first operation after completion of installation work, etc. or operation after a long-term suspension, perform all steps from No.1 to No. 7.

When operating again after suspension of operation for cleaning of the bowl, dismantling and assembling, be sure to check No. 1 through No. 5 and confirm that all parts are tightened positively.

Table 5·17

Condition	No.	Operation	Items to be confirmed	Remarks
Before bowl is mounted in body	1	Manually operating valve handle, confirm that operating water flows out of water supply equipment.	In case of partial discharge type, switch on power to starter and confirm that operating water tank internal pressure is boosted up to specified pressure.	Refer to par. "Operating water". remove water seal piping (copper tube) and confirm quantity of seal water and replacement water. (See Table 5.12)
	2	Inject appropriate brand of lubricating oil into gear case.	Confirm that quantity of Lubricating oil fill oil up to the red line.	Refer to par. "Lubricating oil".
After bowl is mounted in body	3	Check bowl for height and confirm that bowl can be manually turned lightly.	Confirm that cap nut is installed securely to vertical shaft.	Refer to par. "Dismantling, assembling". Refer to par. "Maintenance & inspection procedures".
	4	Select a proper gravity disc, mount impeller, heavy and light liquid chambers, etc. and install frame cover.	When installing heavy liquid chamber and tightening disc nut, align the tally marks.	Refer to par. "Selection of gravity disc". Refer to par. "Dismantling, assembling". (In case of clarifier operation, install parts for clarifier).
	5	Confirm that frame cover and pipings are tightened firmly.	**Confirm that the clamp nut is tightened positively.**	For aligment of the clamp nut tally marks, refer to para. "Dismantling, assembling".
	6	Turn on starter power, press start button, then immediately press stop button and confirm the direction of revolution at the motor.	Confirm that brake is in non-braking position (with handle facing down).	When revolving direction is incorrect, make connection by interchanging two of three wires connected to the motor and confirm again.
Before oil feed operation	7	Perform flushing of piping.	Confirm that there is no damage to gear pump, no breakage of safety joint nor damage to valve seat surface. Confirm that oil passage is a circulation line.	Avoid the flushing by using the gear pump attached to oil purifier because it will lead to the damage of gear and the damage of breaking of safety joint.

3. Start-up and stop

3.1 Cautions in start-up and stop

3.1.1 Cautions in start-up

At time of starting, pay attention to the following.

Table 5·18

No.	Condition	Action to be taken
1	Abnormal noise	Immediately stop and check up.
2	Abnormal vibration.	Immediately stop and check up. However, when the bowl passes through a critical speed before reaching its rated revolution speed, vibration arises momentarily and this is not an abnormal condition.
3	Even after the lapse of specified time from starting, revolution speed does not and attain the rated speed.	Immediately stop and check friction clutch and gear case inside for leak of oil, if any.
4	Others	After commencement of feeding of liquid, confirm pressure at various parts, check whether electric current value is normal and check bowl and piping clamp points for leak of oil or water.

NOTE:
For inspection refer to par. **"CAUSE OF TROUBLES AND COUNTERMEASURES".**

3.1.2 Cautions in stop

1) When the bowl stops, too, it passes through a critical speed, but different from the time of starting, the passing time is relatively long and vibration may become somewhat greater and this is not abnormal vibration.
2) Be sure to perform dismantling after confirming that the bowl has stopped completely (to be confirmed by observing the gear pump safety joint or motor fan).

3.2 Total discharge type

3.2.1 Start-up

Perform start-up by reference to Fig. 5·10 and in accordance with the procedures given in Table 5·19. On the other hand, in the case of manual operation, use manual handle for solenoid valves, etc. In particular, supply sealing water and replacement water in measuring the time.

Table 5·19

No.	Operation	Items to be confirmed	Remarks
1	Turn on power to starter, then press push button "START" to start SELFJECTOR.	Prior to starting, confirm that the valves are in the following positions: Fully open: V4, V6, V7, V8, V9, V10 Fully closed: V11, CV1 After starting, confirm that electric current value settles to about 50–70% of rated current.	Refer to Table 4·3 (Table of rated current)
2	Operate the oil heater.		There are cases where heater is not required as in the case of diesel oil etc.
3	After confirming that feed liquid has been heated up to specified temperature, turn on power switch on automatic control panel and press push button "AUTO. RUNNING".		
4	After confirming that purifying operation has started, adjust bypass valve V4 and flow control valve V6 to specified feed rate.		Refer to par. "Feed Rate".

3.2.2 Stop

Perform stopping by reference to Fig. 5·10 and in accordance with the procedures given in Table 5·20.

Table 5·20

No.	Operation	Items to be confirmed	Remarks
1	Stop oil heater.		
2	Press push button "AUTO. STOP" on automatic control panel.	Confirm that feed valve CV1 is closed and the process proceeds automatically in the order of replacement water injection, sludge discharge and stop. On the other hand, it is effective to operate manual handles for solenoid valves SV1, SV2 and SV3 to perform sealing water injection and drain again for flushing of bowl.	As required, apply brake.
3	After confirming that SELFJECTOR has stopped completely, close dirty oil inlet valve V8 and butterfly valve V10.	Confirm that various other valves and cocks are closed. Also confirm that operating water tank power is switched off.	Stop of SELFJECTOR can be confirmed at safety joint on horizontal shaft gear pump side.

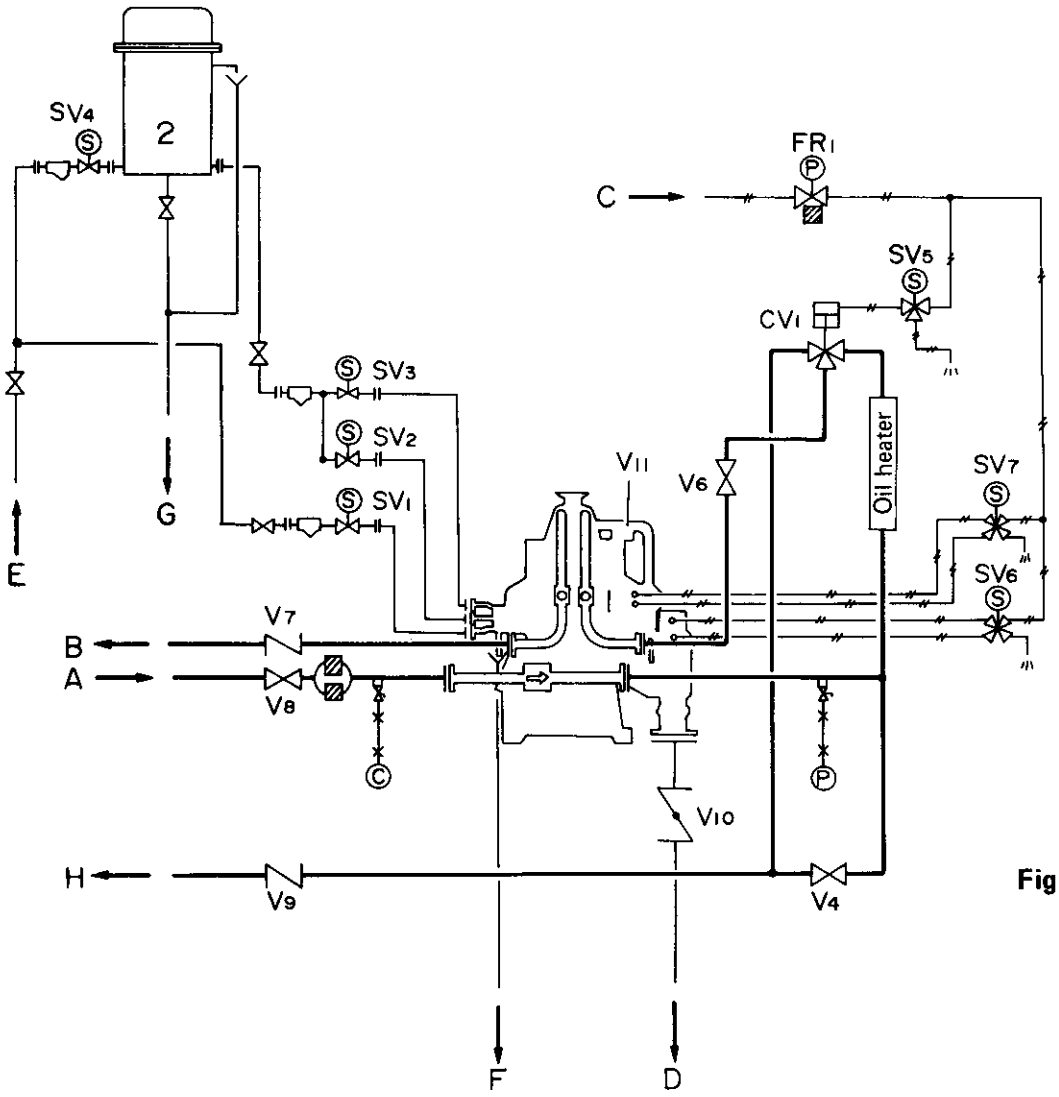


Fig. 5·10

1 : SELFJECTOR
2 : Operating water tank

A : Dirty oil inlet
B : Purified oil outlet
C : Compressed air inlet
D : Sludge & separated water outlet
E : Fresh water inlet
F : Operating water drain outlet
G : Operating water tank drain
H : Circulation

V4 : Bypass valve
V6 : Flow control valve
V7 : Purified oil outlet valve
V8 : Dirty oil inlet valve
V9 : Circulation line valve
V10 : Butterfly valve
V11 : Water shut valve (automatic ball valve)
SV1 : Solenoid valve for water (for opening bowl)
SV2 : Solenoid valve for water (for closing bowl)
SV3 : Solenoid valve for water (for sealing water & replacement water)
SV4 : Solenoid valve for water (for operating water tank)
SV5 : 3-way solenoid valve (for feed valve)
SV6 : 4-way solenoid valve (for leakage detector)
SV7 : 4-way solenoid valve (for water shut valve)
FR1 : Air filter regulator (for feed valve)
CV1 : Feed valve

3.3 Partial discharge type

3.3.1 Start-up

Perform start-up by reference to Fig. 5·11 and in accordance with the procedures given in Table 5·21. On the other hand, valves shown in Fig. 5·11 are not always those being supplied by us.

Table 5·21

No.	Operation	Items to be confirmed	Remarks
1	After turning on the starter power switch, press push button "START" to start SELFJECTOR.	Prior to starting, confirm that the valves are in the following positions: Fully open: V4, V6, V7, V8, V9, V10 Fully closed: V11, CV1 After starting, confirm that electric current value settles to about 50–70% of rated current.	Refer to Table 4·3 (Table of rated current)
2	Operate the oil heater.		There are cases where oil heater is not required as in the case of diesel oil, etc.
3	Turn on power to automatic control panel.	Confirm that operating water tank is filled up and boosted in pressure. Further, confirm that operating water tank pressure and reducing valve setting pressure.	Refer to par. "Operating water".
4	After confirming that dirty oil has been heated up to the specified temperature, press push button "AUTO. RUNNING" on the automatic control panel.		
5	After confirming that purifying operation started, adjust bypass valve V4 and flow control valve V6 to specified feed rate.		Refer to par. "Feed rate".

3.3.2 Stop

Perform stopping by reference to Fig. 5·11 and in accordance with the procedures given in Table 5·22.

Table 5·22

No.	Operation	Items to be confirmed	Remarks
1	Stop oil heater.		
2	Press push button "AUTO. STOP" on the automatic control panel.	Confirm that feed valve CV1 is closed and the process proceeds automatically in the order of replacement water injection, sludge discharge and stop.	As required, apply brake.
3	After confirming that SELFJECTOR has stopped completely, close dirty oil inlet valve V8 and butterfly valve V10.	Confirm that other various valves and cocks are closed. When automatic control panel power is turned off, confirm that operating water tank boosting air is purged.	Stop of SELFJECTOR can be confirmed at safety joint on horizontal shaft pump side.

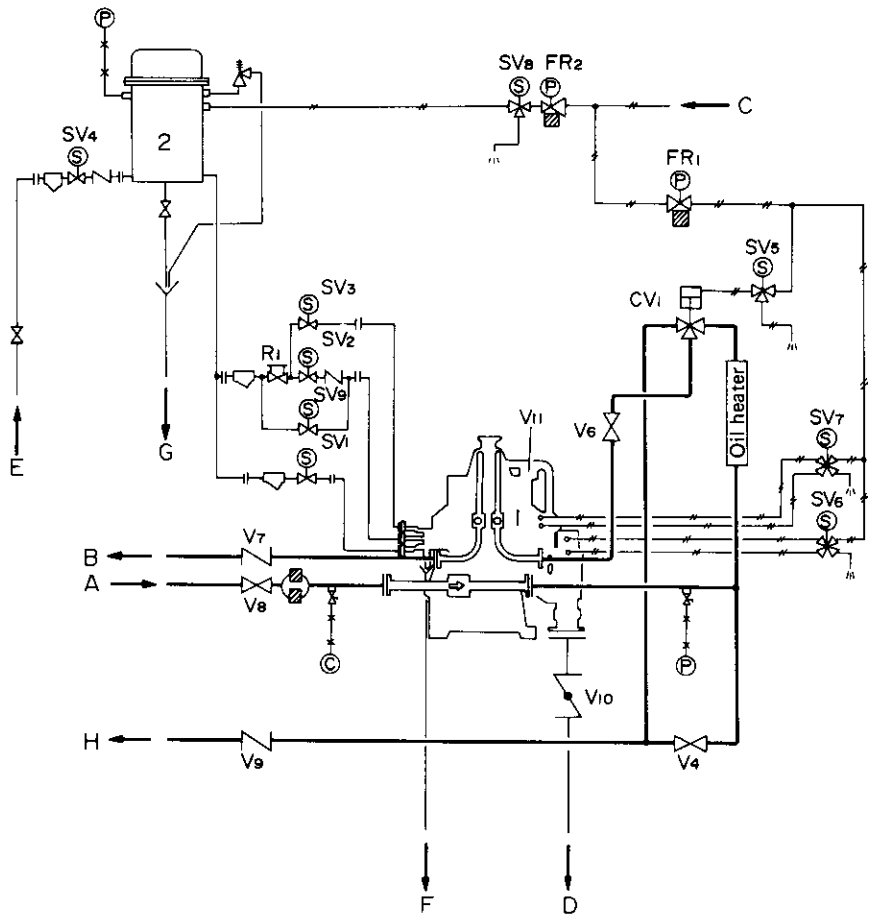


Fig. 5-11

1 : SELFJECTOR
2 : Operating water tank

V4 : Bypass valve
V6 : Flow control valve
V7 : Purified oil outlet valve
V8 : Dirty oil inlet valve
V9 : Circulation line valve
V10: Butterfly valve
V11: Water shut valve (automatic ball valve)
SV1: Solenoid valve for water (for opening bowl, total discharge)
SV2: Solenoid valve for water (for closing bowl)
SV3: Solenoid valve for water (for sealing water, replacement water)
SV4: Solenoid valve for water (for operating water tank)
SV5: 3-way solenoid valve (for feed valve)
SV6: 4-way solenoid valve (for leakage detector)
SV7: 4-way solenoid valve (for water shut valve)
SV8: 3-way solenoid valve (for operating water tank)
SV9: Solenoid valve for water (for opening bowl, partial discharge)
FR1: Air filter regulator (for feed valve)
FR2: Air filter regulator (for operating water tank)
R1 : Reducing valve

A : Dirty oil inlet
B : Purified oil outlet
C : Compressed air inlet
D : Sludge & separated water outlet
E : Fresh water inlet
F : Operating water drain inlet
G : Operating water tank drain
H : Circulation

3.4 E-HIDENS II type

3.4.1 Start-up

Perform start-up by reference to Fig. 5·12 and in accordance with the procedures given in Table 5·23. On the other hand, valves shown in Fig. 5·12 are not always those being supplied by us.

Table 5·23

No.	Operation	Items to be confirmed	Remarks
1	After turning on the starter power switch, press push button "START" to start SELFJECTOR.	Prior to starting, confirm that the valves are in the following positions: Fully open: V4, V6, V7, V8, V9, V10, V11 Fully closed: CV1 After starting, confirm that electric current value settles to about 50–70% of rated current.	Refer to Table 4·3 (Table of rated current)
2	Operate the oil heater.		There are cases where oil heater is not required as in the case of diesel oil, etc.
3	Turn on power to automatic control panel.	Confirm that operating water tank is filled up and boosted in pressure. Further, confirm that operating water tank pressure and reducing valve setting pressure.	Refer to par. "Operating water".
4	After confirming that dirty oil has been heated up to the specified temperature, press push button "AUTO. RUNNING" on the automatic control panel.		
5	After confirming that purifying operation started, adjust bypass valve V4 and flow control valve V6 to specified feed rate.		Refer to par. "Feed rate".
6	After stabilizing a treating temperature and a throughput, adjust the backpressure valve V11 and give a backpressure of 1.8 ~ 2.0 kg/cm^2 on oil side.	Confirm with the Pressure gauge attached to Selfjector.	Refer to the paragraph of E-HIDENS II System Automatic Control Panel.
7	After turning on the switch of power source of Water Detector Control Panel, press the push button switch of "START".		In case the changeover switch of MAN/AUTO is turned on the side of "MAN".

3.4.2 Stop

Perform stopping by reference to Fig. 5·12 and in accordance with the procedures given in Table 5·24.

Table 5·24

No.	Operation	Items to be confirmed	Remarks
1	Stop oil heater.		
2	Press push button "AUTO. STOP" on the automatic control panel.	Confirm that feed valve CV1 is closed and the process proceeds automatically in the order of replacement water injection, sludge discharge and stop.	As required, apply brake.
3	After confirming that SELFJECTOR has stopped completely, close dirty oil inlet valve V8 and butterfly valve V10.	Confirm that other various valves and cocks are closed. When automatic control panel power is turned off, confirm that operating water tank boosting air is purged.	Stop of SELFJECTOR can be confirmed at safety joint on horizontal shaft pump side.

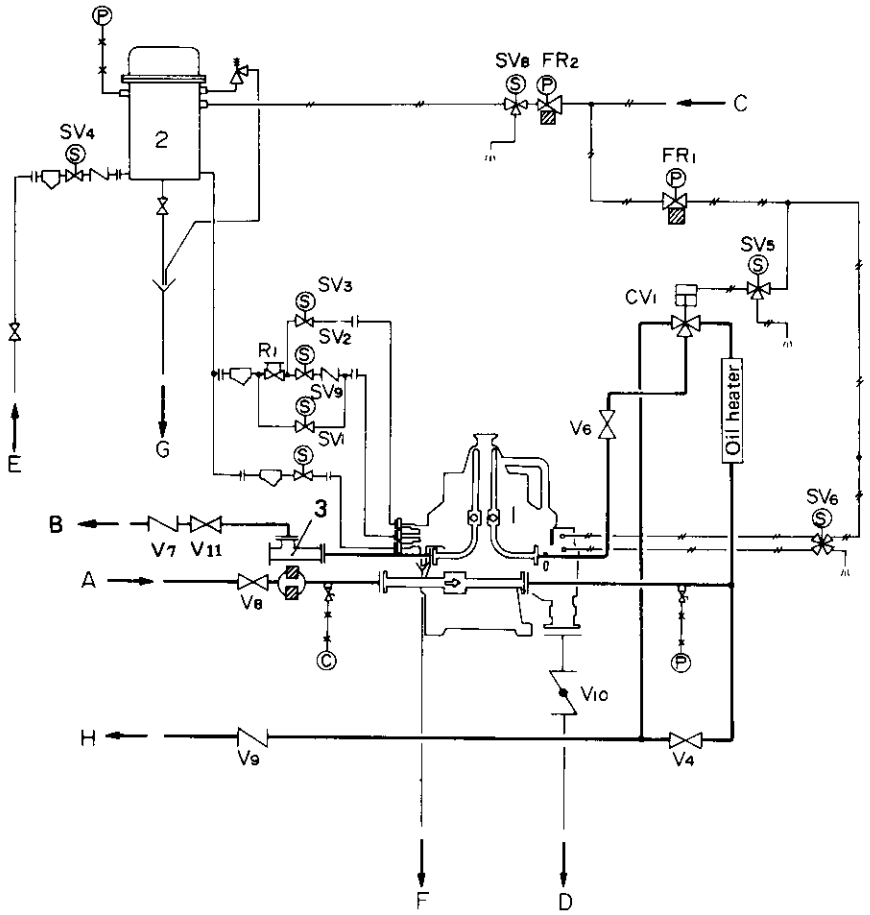


Fig. 5·12

1 : SELFJECTOR
2 : Operating water tank
3 : Water detector
V4 : Bypass valve
V6 : Flow control valve
V7 : Purified oil outlet valve
V8 : Dirty oil inlet valve
V9 : Circulation line valve
V10: Butterfly valve
V11: Back pressure valve
SV1: Solenoid valve for water (for opening bowl, total discharge)
SV2: Solenoid valve for water (for closing bowl)
SV3: Solenoid valve for water (for replacement water)
SV4: Solenoid valve for water (for operating water tank)
SV5: 3-way solenoid valve (for feed valve)
SV6: 4-way solenoid valve (for leakage detector)
SV8: 3-way solenoid valve (for operating water tank)
SV9: Solenoid valve for water (for opening bowl, partial discharge)
FR1: Air filter regulator (for feed valve)
FR2: Air filter regulator (for operating water tank)
R1 : Reducing valve

A : Dirty oil inlet
B : Purified oil outlet
C : Compressed air inlet
D : Sludge & separated water outlet
E : Fresh water inlet
F : Operating water drain inlet
G : Operating water tank drain
H : Circulation

4. Adjusting operation (SJ-P, EH)

The adjusting operation is performed for adjustment of the quantity of sludge discharge. Start SELFJECTOR in accordance with the starting procedure given in the preceding par. "Start-up & stop" and after confirming that purifying operation has commenced, adjust the quantity of discharge in accordance with the following procedures.

Table 5·25

No.	Operation	Items to be confirmed	Remarks
1	After confirming that purifying operation has started, press push button "DISCHARGE TEST" on automatic control panel.	Confirm if the pressure of Operating Water Tank is 2 kg/cm^2 or if the Set values of Reducing Valve is proper.	Reducing valve setting should be made while letting the water flow. Refer to Table 5·12.
2	After sludge discharge was conducted, before ending the time of supplying sealing water, measure the amount of sludge accumulated in Leakage Detector.	Measure the amount of sludge accumulated in the Leakage Detector with a measuring bar attached to the Leakage Detector and confirm if it is within the scope of Table 5·26.	Even when discharge is performed, sludge accumulates in the leakage detector, but by manually operating the 4-way solenoid valve, sludge can be discharged to the sludge outlet side.
3	In case sludge discharge quantity is less (more) than the specified one, raise (lower) operating water tank pressure and perform operation again from Item No. 1 and measure the quantity.		Rise or fall the tank pressure about 0.2 kgf/cm^2 little by little.

NOTE:

1. Before conducting "Discharge Test", push manually the Solenoid Valve SV6 for about ten (10) seconds and lift up the cylinder valve and keep the LD tank completely empty, thereby the amount of sludge accumulated in the leakage Detector can be accurately measured.
2. Even in the case of the same Model, sludge discharge quantity varies depending on small difference in pressure and so on and therefore, measure discharge quantity per SELFJECTOR.

Table 5·26

Model	SJ20P, EH	SJ25P, EH	SJ30P, EH	SJ40P, EH	SJ60P, EH
Discharge quantity (ℓ)	1.6 to 2.0	2.2 to 3.0	3.0 to 4.0	5.2 to 7.0	5.9 to 8.0

5. Suspension

When suspending operation of SELFJECTOR for a long period, irrespective of its inspection period, careful inspection and cleaning of all parts shall be performed and then the following steps be taken.

1) After cleaning of frame, frame cover and leakage detector, wipe off water carefully and apply antirust oil to the whole area of inside face.
2) The bowl shall be assembled by applying lubricating oil after being cleaned. Apply antirust oil to the outside face of the bowl and wrap with oily paper. The bowl shall not be fixed on vertical shaft.
3) Apply grease to all the surfaces of vertical and horizontal shaft parts.
4) Draw out lubricating oil in gear case.
5) Gear pump shall be assembled after cleaning and application of grease.
6) Close master valves of each piping system and discharge oil and water, etc. remaining in the piping completely.
7) The operating water tank shall be kept empty.
8) Close butterfly valve at sludge outlet.
9) "O"-rings, etc. which are used for essential points shall be renewed when the operation is started again.

Further, when stopping a Selfjector as spare SJ, in order to prevent rusting of bearings and etc., enforce strictly the following matters:

1) Close the butterfly valve provided at the sludge discharge port.
2) In case operating water drain outlet is connected by piping to the sludge tank and etc., cut off the line.
3) Perform an idle running for about 15 minutes a day. (It is desirable to take off in advance the safety joint connected to the Gear Pump.)

6. Purifying operation, clarifying operation

6.1 Purifying operation

The purifying operation refers to 3-phase (liquid-liquid-solid) separating operation, being the mode of operation, being the mode of operation used most frequently.

Fig. 5·13 is a sectional view of bowl of SELFJECTOR in purifying operation.

Feed liquid enters feed liquid inlet (1), passes through distributor (A) and is fed to outer periphery of disc (B). Heavy liquid (water) and solids are separated towards outer periphery of bowl, while light liquid moves inward between the discs and is discharged by impeller (1) (D). Further, heavy liquid passes outside of top disc (C) and, past the gravity disc (E), is discharged out of the machine by impeller (2) (F).

The interface (G) must be positioned within certain limits and its control is effected by changing the inside diameter of gravity disc.

Accordingly, when specific gravity of light liquid or feed rate changes, normally it is necessary to reselect a proper gravity disc.

Further, prior to commencement of feeding of liquid, it is necessary to perfrom water sealing beforehand so that oil will not flow out to the heavy liquid outlet side.

Sealing water is supplied from (4) and, past the gravity disc, passes through the outside of top disc and is accumulated on the periphery within the bowl.

1. Feed liquid inlet
2. Light liquid outlet
3. Heavy liquid outlet
4. Sealing water inlet
A. Distributor
B. Disc
C. Top disc
D. Impeller (1)
E. Gravity disc
F. Impeller (2)
G. Interface

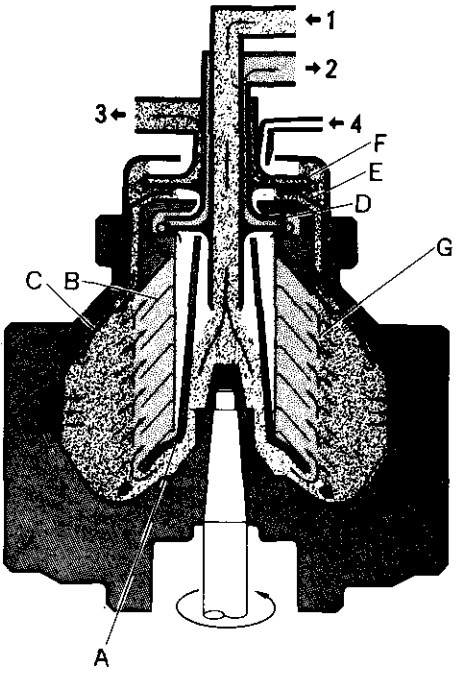


Fig. 5·13

6.2 Clarifying operation

The clarifying operation refers to a liquid-solid two-phase separating operation.

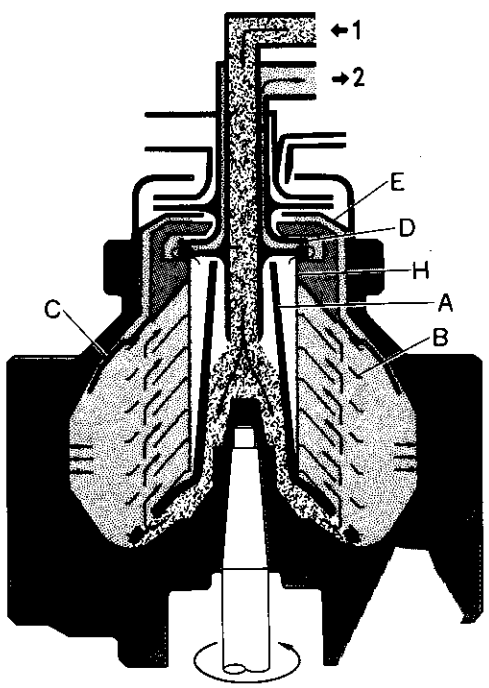
Fig. 5·14 is a sectional view of bowl of SELFJECTOR in clarifying operation.

Feed liquid enters the feed liquid inlet (1), passes through distributor (A) and is fed to the periphery of the disc (B). The solid content is separated towards the periphery within the bowl, while light liquid moves inward between the discs and is discharged by impeller (1) (D).

Light liquid also passes the outside of top disc (C) and reaches the part for clarifier (E), but the inside diameter of the part for clarifier is smaller than the inside diameter of disc (light liquid outlet weir) (H) and therefore it won't flow out of the machine beyond the part for clarifier.

On the other hand, sealing water or replacement water is not supplied.

In the case of E–HIDENS II type will be run in clarifying operation.



1. Feed liquid inlet
2. Light liquid outlet
A. Distributor
B. Disc
C. Top disc
D. Impeller (1)
E. Parts for clarifier (gravity disc for clarifier)
H. Light liquid outlet weir (inside diameter of disc)

Fig. 5·14

7. Parallel operation, series operation

Basically, under the present situations, if feed rate is within the actual capacity, SELFJECTOR is fully capable in a one-unit one-stage purifying operation.

However, when it is required to raise the purification effect (as in the case of low grade fuel oil), a spare unit may also be utilized.

Available as such mode of operation are parallel operation and series operation and, with regard to the separating performance, normally the parallel operation is better, but there are cases where the series operation is preferrable. Especially, when treating low grade fuel oil, etc., it is safe to provide such piping as makes possible both parallel and series operations. These operating procedures will be described here and for details refer to our Company.

7.1 Parallel operation

The parallel operation refers to the mode of operation in which two or more units of SELFJECTOR are arranged and operated in parallel, in which case feed rate to each machine will be throttled.

[NOTE]

In case of parallel operation with 2 units of SELFJECTOR, feed rate to each machine will be ½ of the required quantity, respectively. An example of piping in parallel operation is shown in Fig. 5·15.

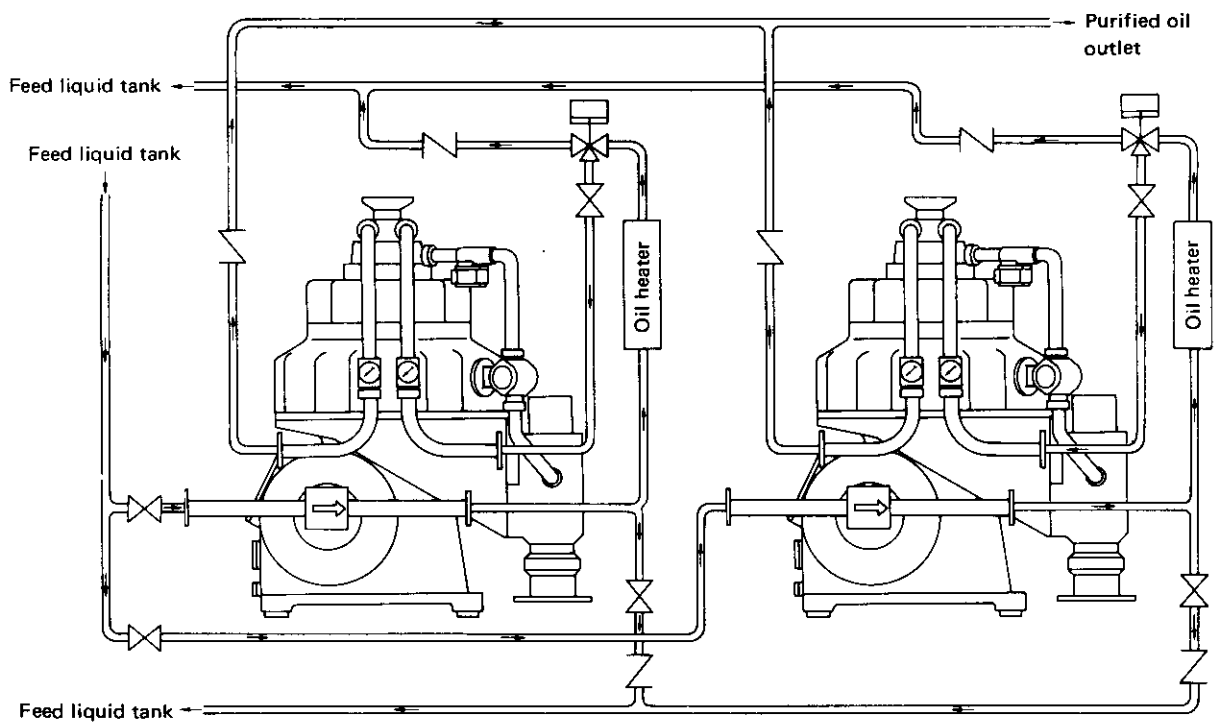


Fig. 5·15

7.2 Series operation

The series operation refers to the mode of operation in which two or more units of SELFJECTOR are arranged in series and operated, in which case the feed rate will be that in the case of one-unit one-stage purification. Further, normally the first stage will be purifying operation and the second stage, clarifying operation. In this case, sealing water and replacement water will not be supplied to the second stage SELFJECTOR.

[NOTE]

In the case of a series operation with 2 units of SELFJECTOR, the safety joint for the second stage SELFJECTOR shall be removed. An example of piping in series operation is given in Fig. 5·16.

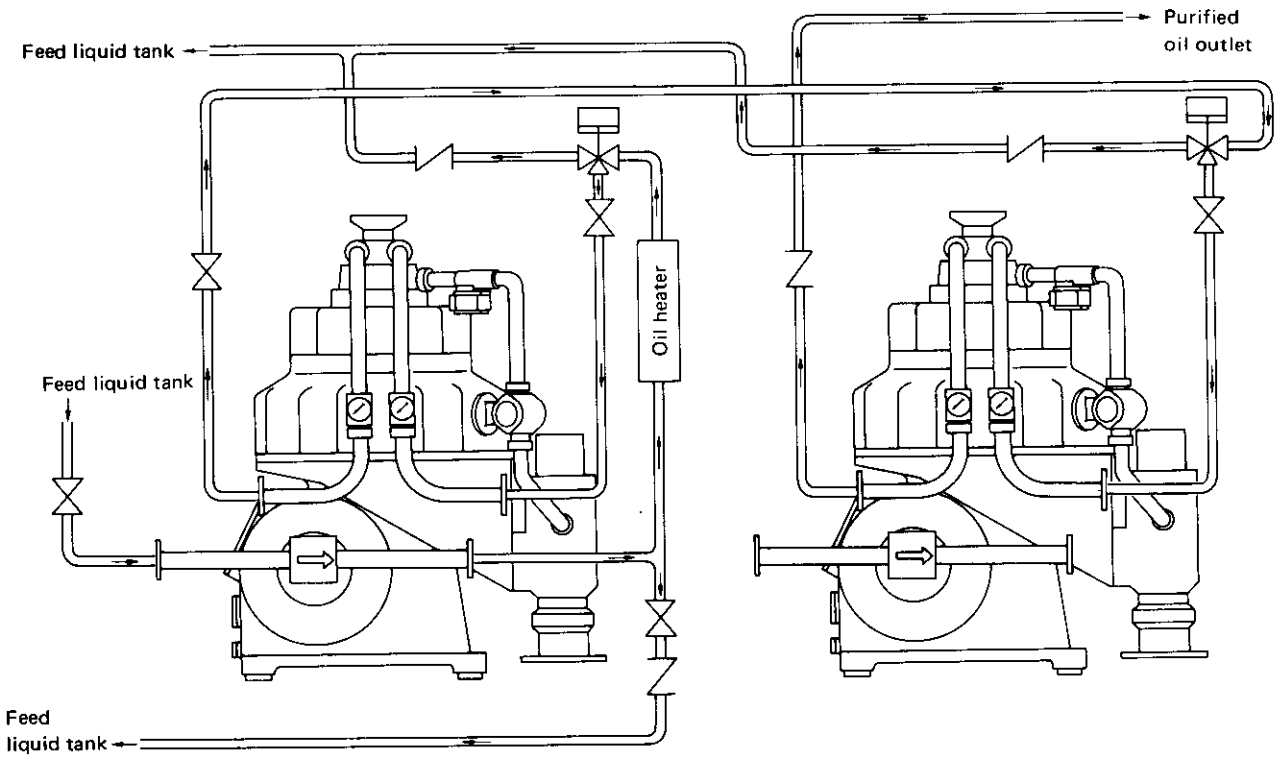


Fig. 5·16

PART 6 DISMANTLING AND ASSEMBLING

CHAPTER 1. Dismantling

CHAPTER 2. Assembling

CHAPTER 1. DISMANTLING

Upon dismantling, the structure of SELFJECTOR shall be well understood in advance according to cross sectional views of the machine which are shown in "Drawings for Completion", thereby secure and effective dismantling can be assured.

Before dismantling, confirm that SELFJECTOR is completely stopped. Further, attention must be paid not to lose dismantled small parts such as packings and bolts, etc. during dismantling.

As for the inspection of various parts, refer to Part 7 "Maintenance and Inspection Procedures".

For tools refer to Illustration of Tools (Fig. 6-46) at the end of this Chapter.

1. Frame cover

After removing the plug, remove clamp nut (1) with a wooden hammer and pull out lock ring (2) by loosening socket head screw (3) with a hexagon bar spanner.

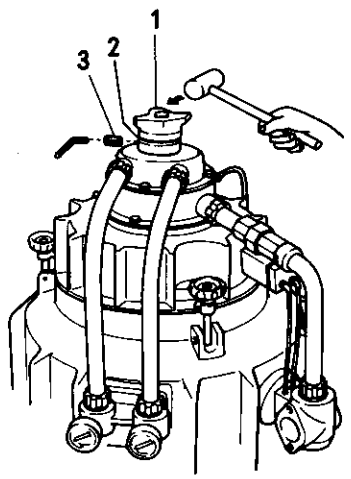


Fig. 6-1

Remove cap nuts on connection pipes (1) (6, 7) and connection pipe (2) (8) with hook spanner (T-17).

Be careful not to lose orifice for adjusting the flow rate inserted in the part marked with arrow. Remove copper tube (9) for sealing water.

Further, loosen cap nuts (10, 11, 12) at the bottom of each connection pipe with hook spanner (T-17) and turn pipes sideways so that they will not obstruct removal of frame cover.

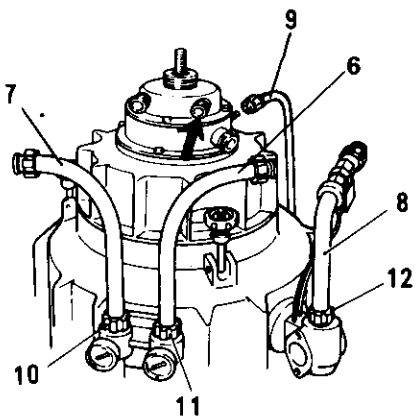


Fig. 6-2

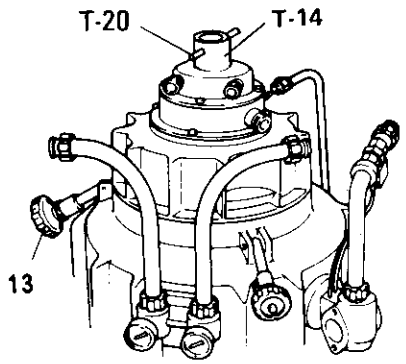


Fig. 6-3

Loosen the lock handle (13) and install jack (6) (T—14) and handle bar (T—20) to the frame cover top.

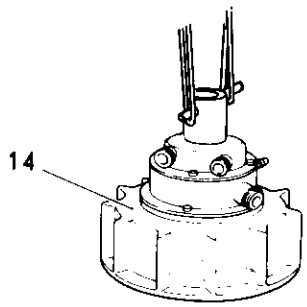


Fig. 6-4

Fit wire to handle bar of jack (6) and, using chain block, slowly pull out frame cover (14) in vertical direction.

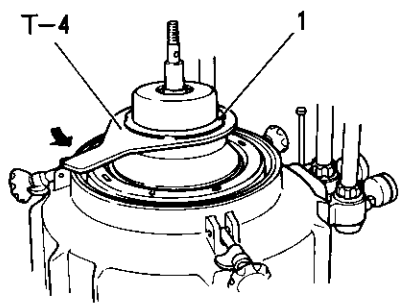


Fig. 6-5

2. Bowl

2.1 Drawing-out of gravity disc

Put disc nut spanner (T-4) on disc nut (1) and, pressing it down with hand so that it may not slip out of the grooves, and striking it with hammer in the direction of arrow, remove disc nut.

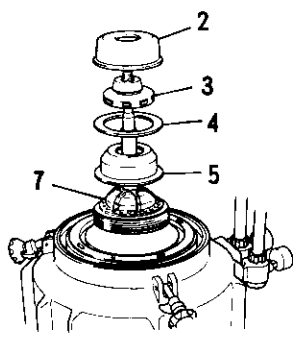


Fig. 6-6

Pull out heavy liquid chamber (2), impeller (2) (3), packing (4) and gravity disc (5).

* For removal of gravity disc, no operation other than those mentioned above will be required.

Using push bolts (3) (T-10), remove light liquid chamber (7).

NOTE:
As, at this time, O-ring (6) is also taken out, be careful not to give damage to it.

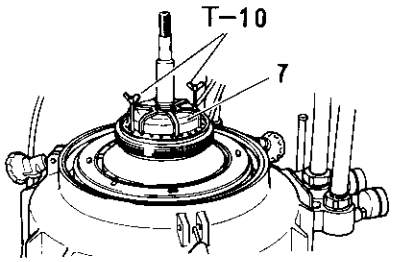


Fig. 6·7

Pull by hand impeller (1) (8) and liquid inlet pipe (10).

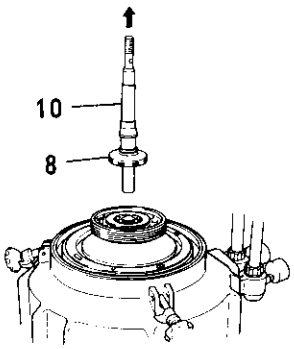


Fig. 6·8

2.2 Drawing-out of bowl

Install dismantling stand (T-1) at dismantling place by inserting bolts in four holes.

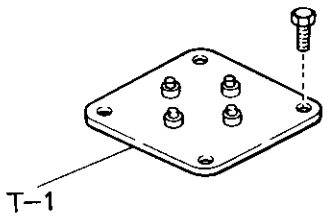


Fig. 6·9

Remove cap nut (26) fastening bowl to vertical shaft with cap nut spanner (T-7).

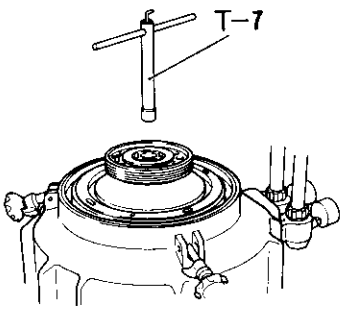


Fig. 6·10

• How to use cap nut spanner

Insert cap nut spanner into bowl, mount spanner on cap nut and screw in threaded bar of spanner into threaded hole of cap nut (a).

Then, turning handle of spanner (b) and pull up, then the cap nut attached to spanner will be drawn out (Fig. 6·11).

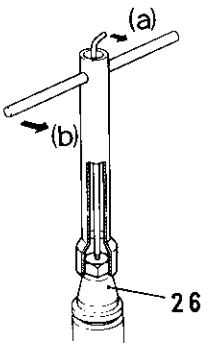


Fig. 6·11

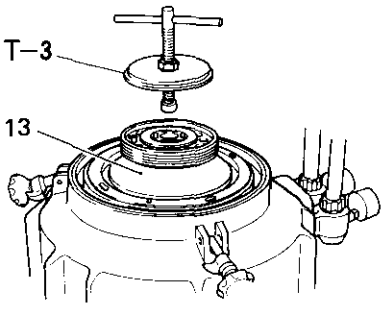


Fig. 6-12

Place jack (1) (T-3) on top of bowl hood (13).

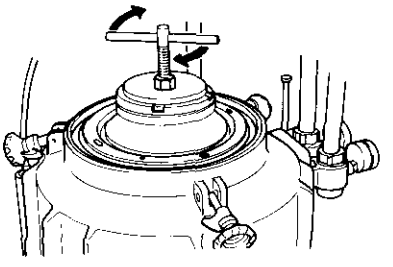


Fig. 6-13

Install disc nut and hold down jack (1) (T-3).

Tighten jack (1) (T-3) handle bar (1) (T-20) until bowl is lifted up a little.

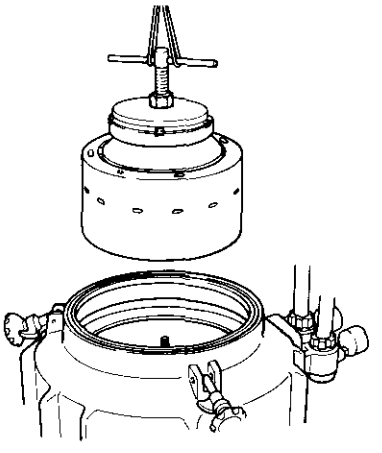


Fig. 6-14

Install wire on handle bar (1) of jack (1) (T-3) and, using chain block, slowly draw out bowl in vertical direction.

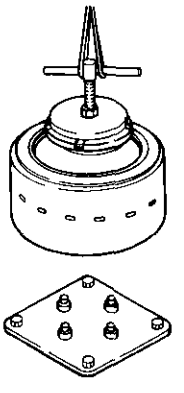


Fig. 6-15

Place the hoisted bowl on dismantling stand. At this time, make sure that 4 pins of dismantling stand are put in holes of lower part of bowl body.

Remove jack (1).

2.3 Dismantling of bowl nut and removal of discs

Disc clamp plate (T-6) into distributor (20) and tighten with nut. (Tighten nut firmly by hitting with a hammer).

By compressing bowl discs, bowl nut can be removed simply.

Before tightening nut, confirm that bolts of disc clamp plate are screwed firmly into distributor.

NOTE:
If bowl nut is removed directly without using disc clamp plate, excessive force will be applied to bowl hood, resulting in damage thereto. Therefore, be sure to perform this procedure.

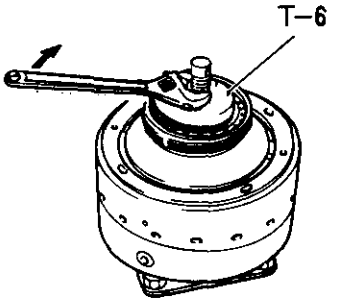


Fig. 6-16

After fixing bowl nut spanner (T-2) to bowl nut (11) with bolt, turn it by hitting with a hammer and remove bowl nut.

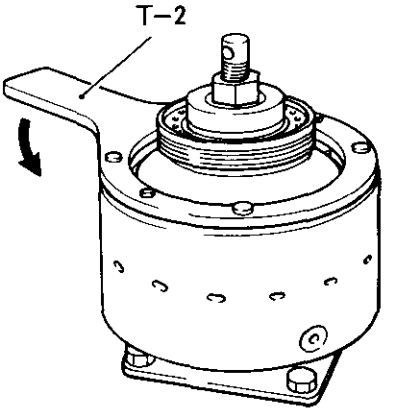


Fig. 6-17

Loosen hexagon nut and remove disc clamp plate (T-6).

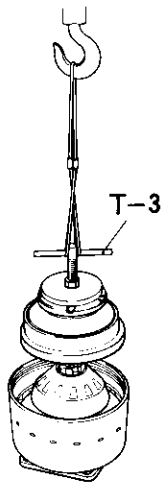


Fig. 6-18

Using jack (1) (T-3), remove bowl hood. (When top disc (15) has been removed along with hood, remove it by tapping with wooden hammer).

As main seal ring (23) is installed beneath bowl hood, be careful not to give damage to seal surface in the case of dismantling.

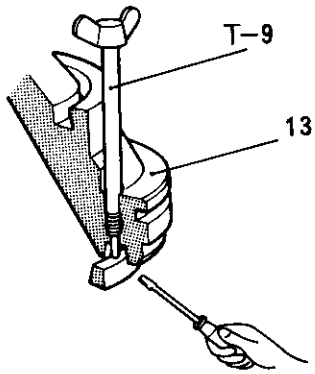


Fig. 6-19

*** How to remove main seal ring**

Lay bowl hood (13) on its side and, among bowl hood tool holes at 2 points, screw in push bolt (4) (T-9).

When main seal ring is lifted from groove, instantly insert a screwdriver or the like into the clearance and, moving it in circumferential direction, remove main seal ring.

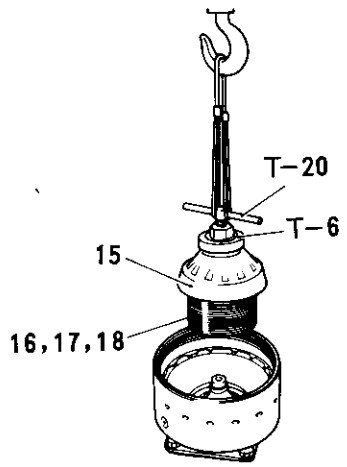


Fig. 6-20

Install disc clamp plate (T-6) and handle (T-20) to distributor and pull up; disc (1) (16), disc (2) (17), disc (3) (18) and top disc (15) as mounted in distributor will come off.

NOTE:

Discs with small diameter (disc (2)) are installed in the lower part of discs. It is, however, not provided in the case of SJ 10T, P and EH.

On the other hand, disc (3) (18) provided with distance pieces on inside and outside is incorporated in the lowermost part.

After installing protective plate (T-11) in bowl body cap nut mounting part, fix jack (2) (T-5) to main cylinder with hexagon nuts, tighten with push bolt (1) (T-21), jack (5) (T-12), push bolt (6) (T-23) and handle bar (1) (T-20) and remove.

NOTE:

(1) When removing a main cylinder, after installing jack (2) (T-5) uniformly all around with a protective plate and get down completely the main cylinder and pull up the main cylinder with a jack (5) (T-12).

(2) Be careful not to give damage to seat surface and sliding portion.

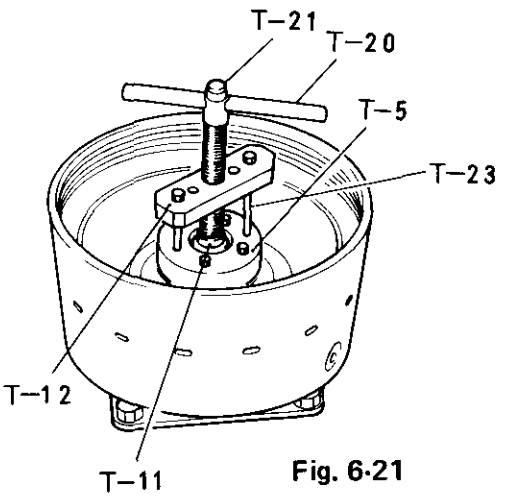


Fig. 6-21

2.4 Drawing-out of pilot valve assembly

Using hexagon bar spanner, remove valve nut (38).

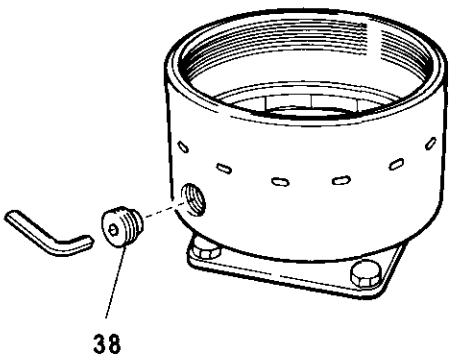


Fig. 6-22

Press jack (3) (T-8) against pilot valve part and, after screwing jack bolt into valve guide (35) and hexagon bolt, into pilot valve (32), respectively, tighten hexagon nut and remove. Draw out the other in the same manner.

NOTE:

Be careful not to give damage to packing (37) mounted in valve guide, and pilot valve seat surface.

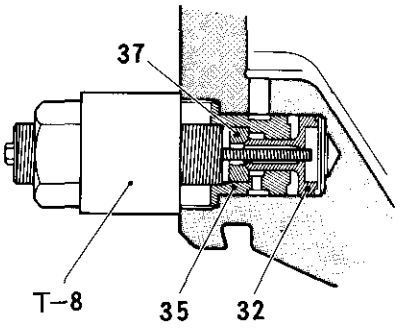


Fig. 6-23

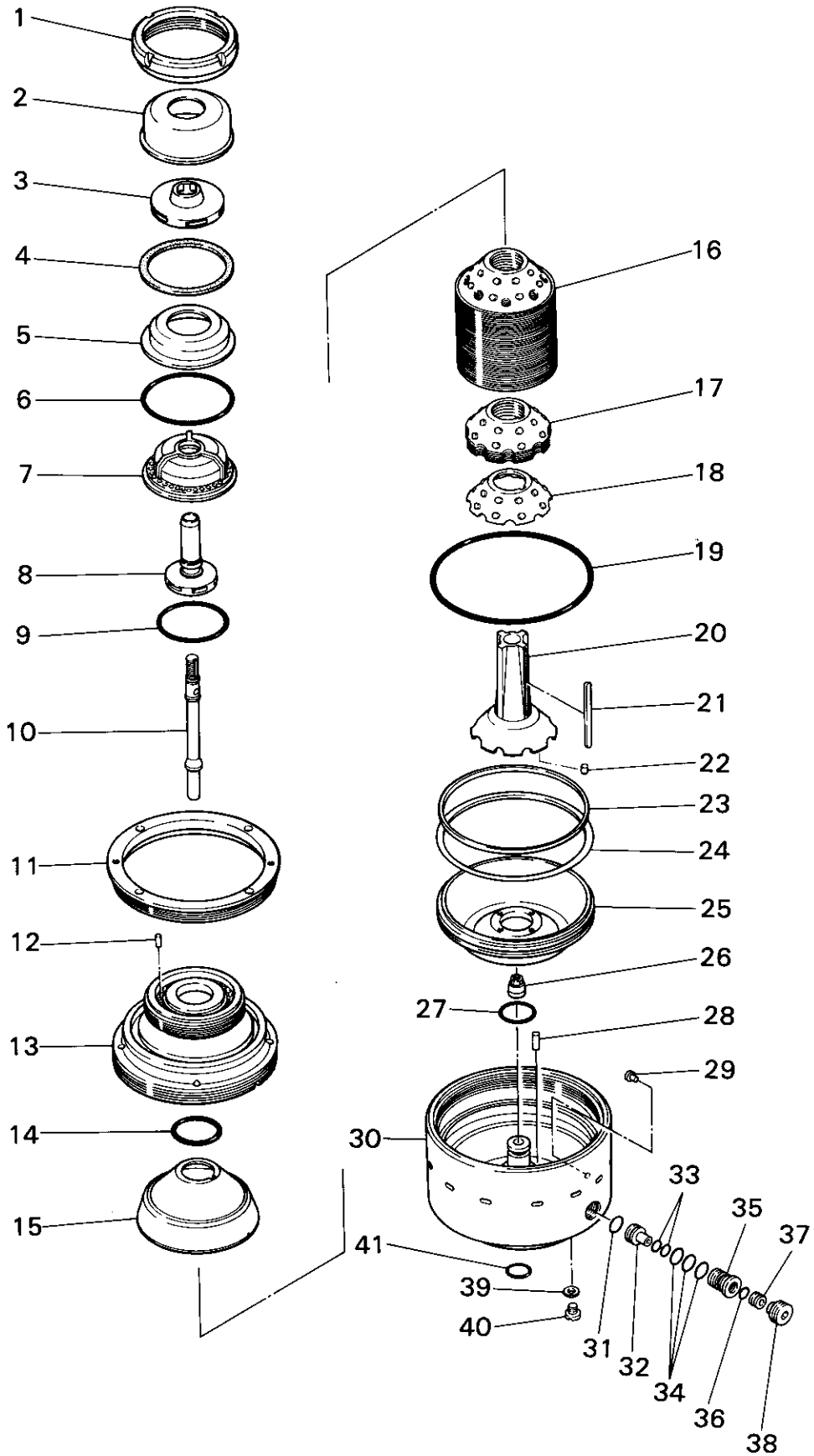


Fig. 6-24 Illustration of bowl parts

List of bowl parts

Table 6-1

No.	Parts name	Quantity	No.	Parts name	Quantity
1	Disc nut	1	21	Key	1
2	Heavy liquid chamber	1	22	Pin	1
3	Impeller (2)	1	23	Main seal ring	1
4	Packing	1	24	O-ring	1
5	Gravity disc	1 set	25	Main cylinder	1
6	O-ring	1	26	Cap nut	1
7	Light liquid chamber	1	27	O-ring	1
8	Impeller (1)	1	28	Pin	1
9	O-ring	1	29	Knock pin	1
10	Inlet pipe	1	30	Bowl body	1
11	Bowl nut	1	31	O-ring	2
12	Pin	1	32	Pilot valve	2
13	Bowl hood	1	33	O-ring	4
14	O-ring	1	34	O-ring	4
15	Top disc	1	35	Valve guide	2
16	Disc (1)	1 set	36	O-ring	2
17	Disc (2)	1 set	37	Valve seat	2
18	Disc (3)	1	38	Valve nut	2
19	O-ring	1	39	Seat packing	2
20	Distributor	1	40	Drain nozzle	2
			41	O-ring	1

When ordering parts, please specify the part no., parts name and quantity by reference to the list of parts on the drawing of completion.

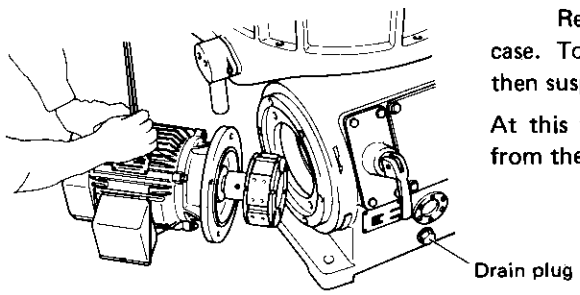


Fig. 6-25

3. Horizontal shaft

Remove drain plug to drain lubricating oil from within gear case. To remove electric motor, unfasten connecting wire and then suspending it by chain block, remove set bolts of motor.

At this time, take care that the friction block does not fall off from the motor.

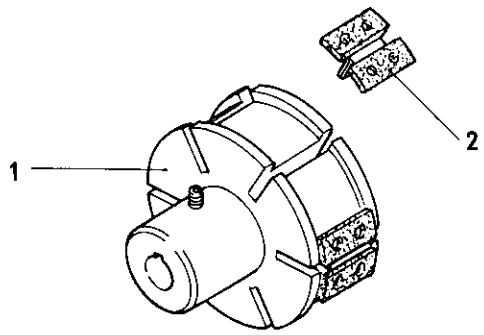


Fig. 6-26

Remove friction blocks (2) which have been inserted into friction boss (1) installed on electric motor shaft.

To remove gear pump out of SELFJECTOR, remove attached pipings and set bolts.

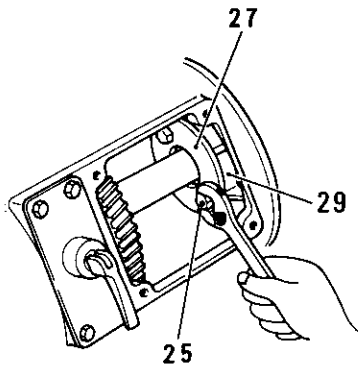


Fig. 6-27

Remove gear cover and take off bolt (25) fixing bearing retainer (27) to bearing housing (3) (29).

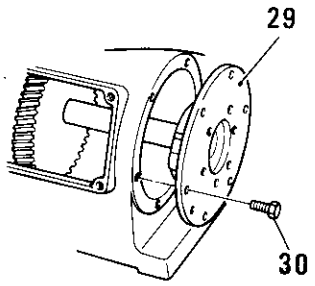


Fig. 6-28

Remove bolt (30) fixing bearing housing (3) (29) and, using it as push bolt, pull out bearing housing (3).

Remove bolt (4) fixing friction pulley (9) to horizontal shaft, after erecting pawl of tongued washer (5), with T-type wrench along with pulley washer (6).

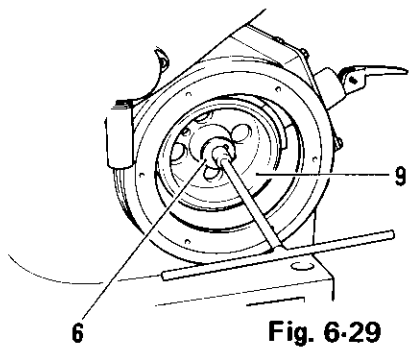


Fig. 6-29

Using jack (5) (T-12), push bolt (2) (T-23), push bolt (1) (T-21) and handle bar (1) (T-20), pull out friction pulley.

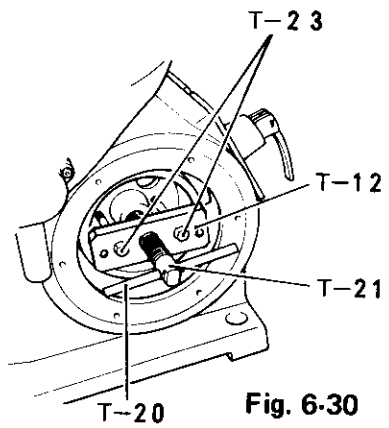


Fig. 6-30

Draw out horizontal shaft to pump side. In case it is hard to draw out, place a copper bar or wood piece to the pulley side of horizontal shaft and tap slightly, while paying attention not to damage threaded part of horizontal shaft and oil seal (11) by knock pin and key (7) inserted to the shaft.

(In drawing out horizontal shaft, as there is fear that spiral gear (20) may be damaged, tapping must be done while other person is supporting the shaft).

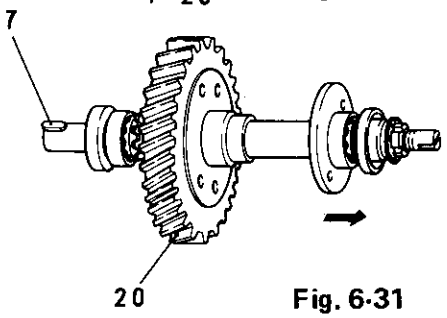


Fig. 6-31

Remove spiral gear from gear boss.

To remove pump side bearing (15), remove socket set screw (24) and safety joint, then remove lock washer (32), lock nut (33) and, using jack (5) (T-12), jack (8) (T-16), push bolt (2) (T-22), push bolt (1) (T-21) and handle bar (1) (T-20), draw out the bearing together with collar (31).

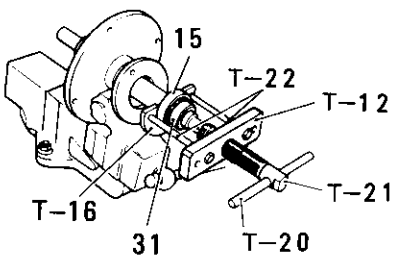


Fig. 6-32

NOTE:
Using an adapter between horizontal shaft end and push bolt (T-21), disassemble with care not to damage the horizontal shaft end.

Similarly, draw out pulley side bearing (15) together with collar (10).

Remove lock washer (17) and lock nut (16) holding gear boss and, supporting gear boss with pipe, etc., pull out gear boss from horizontal shaft by hitting with copper hammer from pulley side of horizontal shaft.

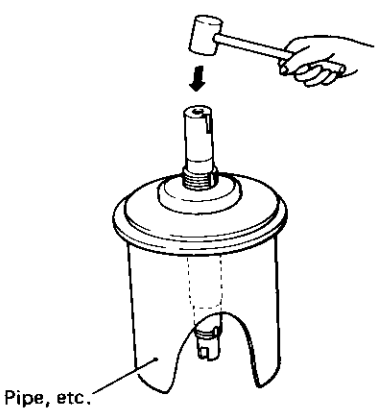


Fig. 6-33

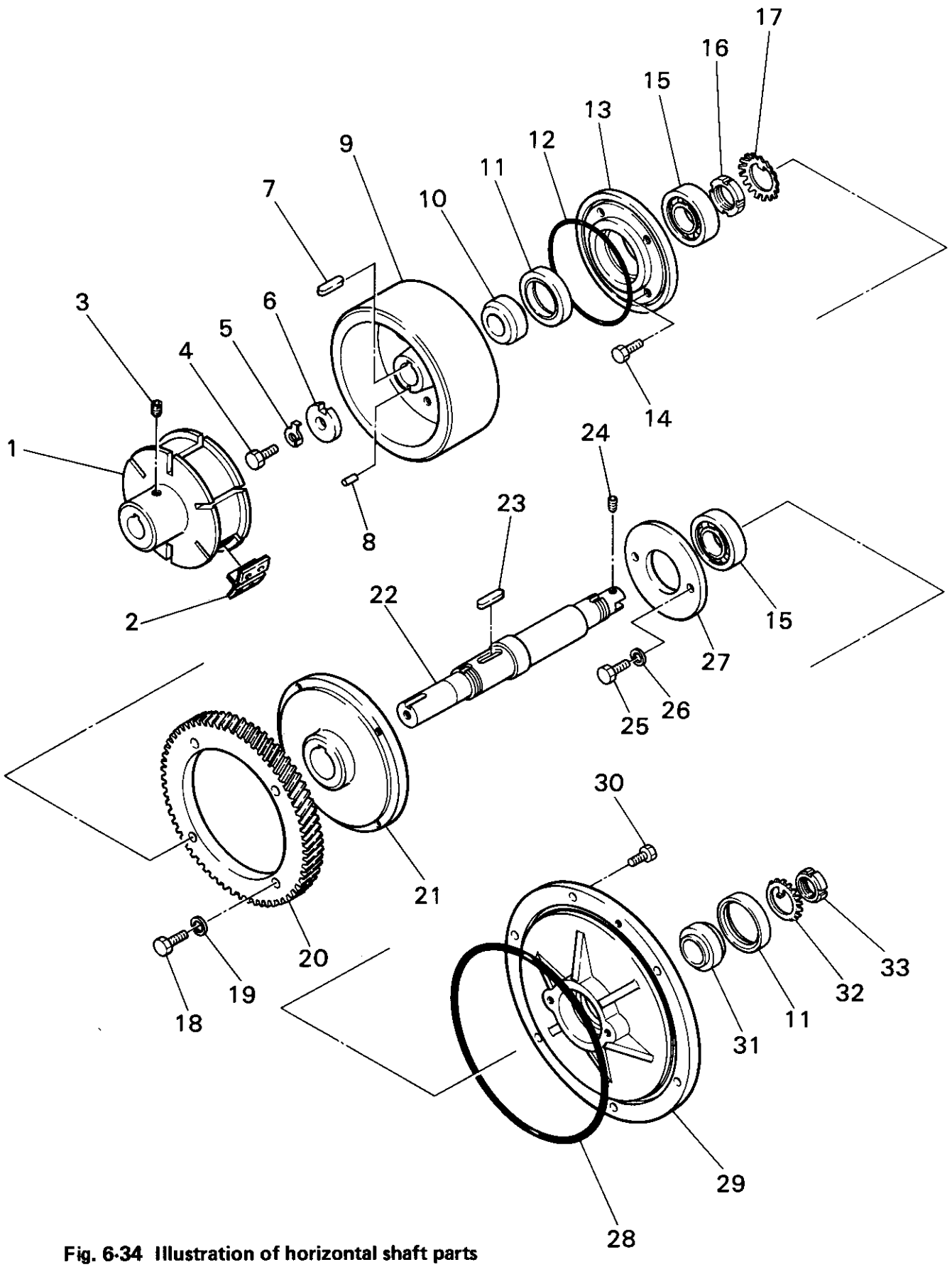


Fig. 6-34 Illustration of horizontal shaft parts

List of horizontal shaft parts

Table 6-2

No.	Parts name	Quantity	No.	Parts name	Quantity
1	Friction boss	1	18	Bolt	4
2	Friction block	*	19	Spring washer	4
3	Socket set screw	1	20	Spiral gear	1
4	Bolt	1	21	Gear boss	1
5	Tongued washer	1	22	Horizontal shaft	1
6	Pulley washer	1	23	Key	1
7	Key	1	24	Socket set screw	1
8	Knock pin	1	25	Bolt	2
9	Friction pulley	1	26	Spring washer	2
10	Collar	1	27	Bearing retainer	1
11	Oil seal	2	28	O-ring	1
12	O-ring	1	29	Bearing housing (3)	1
13	Bearing housing (4)	1	30	Socket cap screw	6
14	Bolt	4	31	Collar	1
15	Ball bearing	2	32	Lock washer	1
16	Lock nut	1	33	Lock nut	1
17	Lock washer	1			

(*Refer to Table 6-3)

When ordering parts, please specify the part no., parts name and quantity by reference to the list of parts on the drawing of completion.

Table of standard number of friction blocks

Table 6-3

Model	SJ20T, P, EH	SJ25T, P, EH	SJ30T, P, EH	SJ40T, P, EH	SJ60T, P, EH
50Hz	6	4	6	4	6
60Hz	4	3	4	3	4

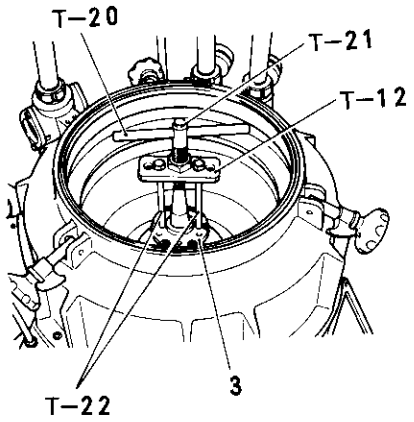


Fig. 6·35

4. Operating water supply equipment

Remove copper tube connected to union installed to operating water disc (10).

Remove socket cap screws (11) at 3 points of operating water disc with hexagon bar spanner.

Loosen socket set screw (4).

Place jack (5) (T-12) on top of vertical shaft and assemble push bolt (1) (T-21), handle bar (1) (T-20) and push bolt (2) (T-22) and thereafter screw tip of push bolt (2) (T-22) into chamber cover (3) and tighten the handle bar (1). Thereupon, the operating water supply equipment is lifted as a whole and can be pulled out of vertical shaft.

Remove bolts (1) at 6 points of operating water chamber (7), using box screwdriver.

Remove socket cap screw (12) below operating water disc with hexagon bar spanner.

Remove operating water nozzle (5) from operating water chamber (7).

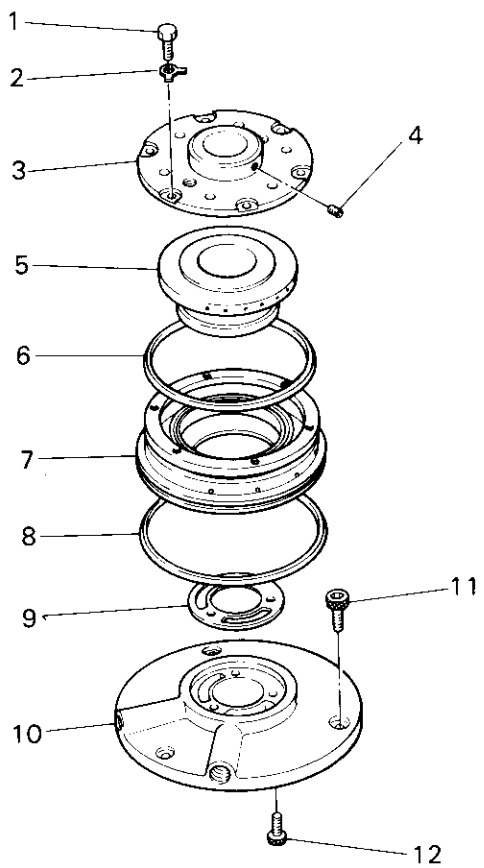


Fig. 6·36 Illustration of operating water supply equipment parts

List of operating water supply equipment parts

Table 6·4

No.	Parts name	Quantity
1	Bolt	6
2	Double-tongued washer	6
3	Chamber cover	1
4	Socket set screw	1
5	Operating water nozzle	1
6	O-ring	1
7	Operating water chamber	1
8	O-ring	1
9	Packing	1
10	Operating water disc	1
11	Socket cap screw	3
12	Socket cap screw	3

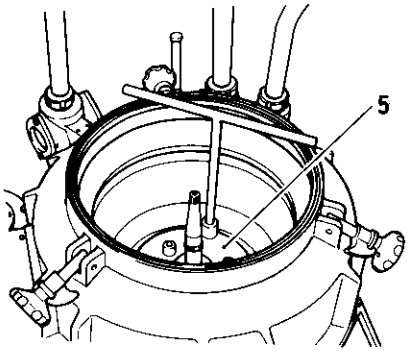


Fig. 6-37

5. Vertical shaft

Remove 3 bolts (3) of bearing cover (1) (5) with T-type wrench and take out bearing cover (1) along with bearing cap (2) and also take out flat spring (7) and spacer (8).

Pull out bearing housing (1) (12) by using the mounting bolt of bearing housing (1) as push bolt. (shut out SJ20)

Remove spring retainer (1) (15) and pull out upper spring (14), spring case (13) and bearing sleeve (11).

NOTE:
This dismantling shall not be performed except when upper springs are replaced.

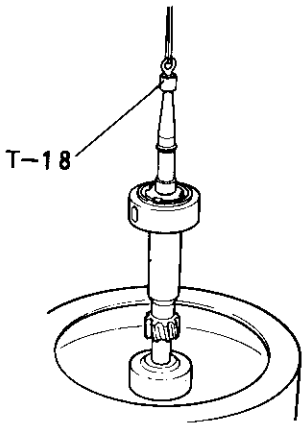


Fig. 6-38

Install jack (9) (T-18) to screw on top of vertical shaft (20) and gradually draw it out in vertical direction by chain block.

Remove bearing case (1) (9) by tapping with lead or copper hammer so as not give damage thereto.

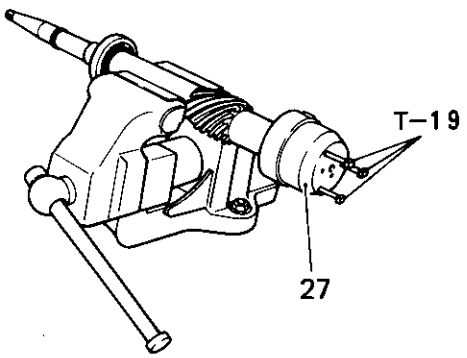


Fig. 6-39

Take out steel ball (½") (29), spring seat (30), spring (31) and retainer from bearing housing (2) (32).

Screw evenly 3 push bolts (3) (T-19) into bearing case (3) and pull out bearing case (3) and spacer (2), (37).

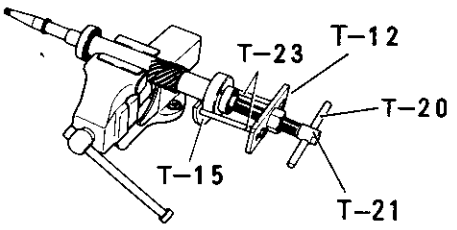


Fig. 6-40

Assemble jack (7) (T-15), jack (5) (T-12), push bolt (6) (T-23), push bolt (1) (T-21) and handle bar (1) (T-20), and pull out bearing case (2) (23), bearing cover (2) (21), collar (25), roller bearing (22) and ball bearing (3) (26) together.

Remove lock washer (18) and lock nut (17) for upper bearing with hook spanner (T-17).

Remove upper ball bearing (1) (19) by tapping inner race so as not to give damage to vertical shaft.

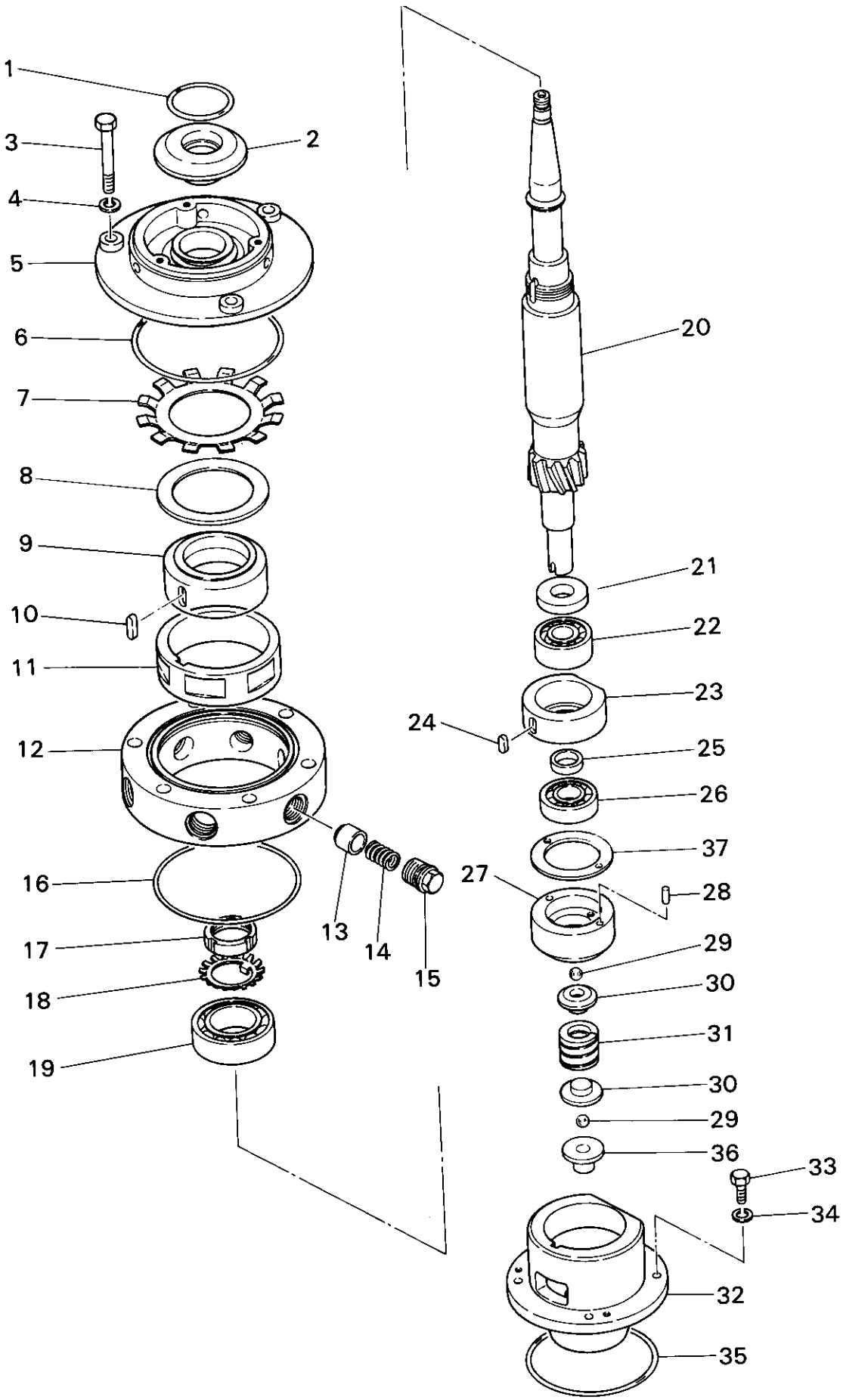


Fig. 6-41 Illustration of vertical shaft parts

List of vertical shaft parts

Table 6-5

No.	Parts name	Quantity	No.	Parts name	Quantity
1	O-ring	1	20	Vertical shaft	1
2	Bearing cap	1	21	Bearing cover (2)	1
3	Bolt	3	22	Roller bearing	1
4	Spring washer	3	23	Bearing case (2)	1
5	Bearing cover (1)	1	24	Key	1
6	O-ring	1	25	Collar	1
7	Flat spring	1	26	Ball bearing (3)	1
8	Spacer	1	27	Bearing case (3)	1
9	Bearing case (1)	1	28	Pin	2
10	Key	1	29	Steel ball (½")	2
11	Bearing sleeve	1	30	Spring seat	2
12	Bearing housing (1)	1	31	Lower spring	1
13	Spring case	6	32	Bearing housing (2)	1
14	Upper spring	6	33	Bolt	4
15	Spring retainer (1)	6	34	Spring washer	4
16	O-ring	1	35	O-ring	1
17	Lock nut	1	36	Retainer	1
18	Lock washer	1	37	Spacer (2)	1
19	Ball bearing	1			

When ordering parts, please specify the part no., parts name and quantity by reference to the list of parts on the drawing of completion.

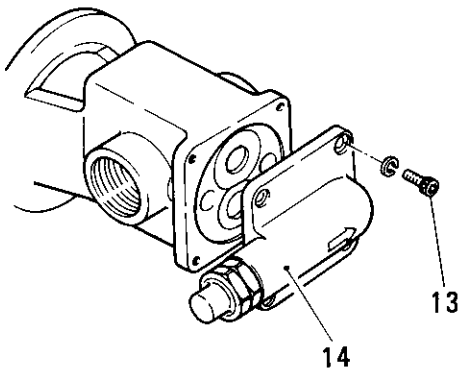


Fig. 6-42

6. Gear pump

Remove 4 hexagon socket cap screws (13) and take off valve case (14).

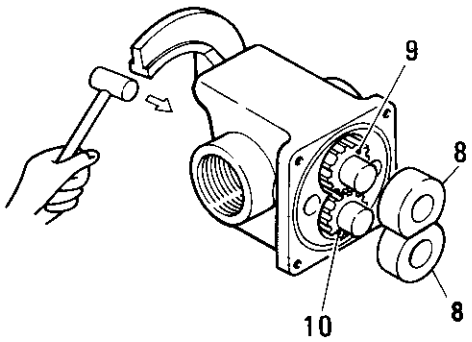


Fig. 6-43

Tap safety joint side of drive gear (10) with copper hammer and draw out valve case side bushes (1), (2) (8) and driven gear (9) along with drive gear.

Pull out safety joint side bushes (1), (2) (8).

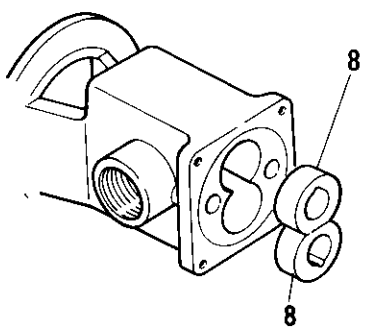


Fig. 6-44

*** Replacement of safety joint**

For replacement of safety joint, gear pump need not be removed from SELFJECTOR frame. After removing socket set screw with hexagon bar spanner, push in safety joint to horizontal shaft side, pull it in that condition laterally, pull out and replace with a new one.

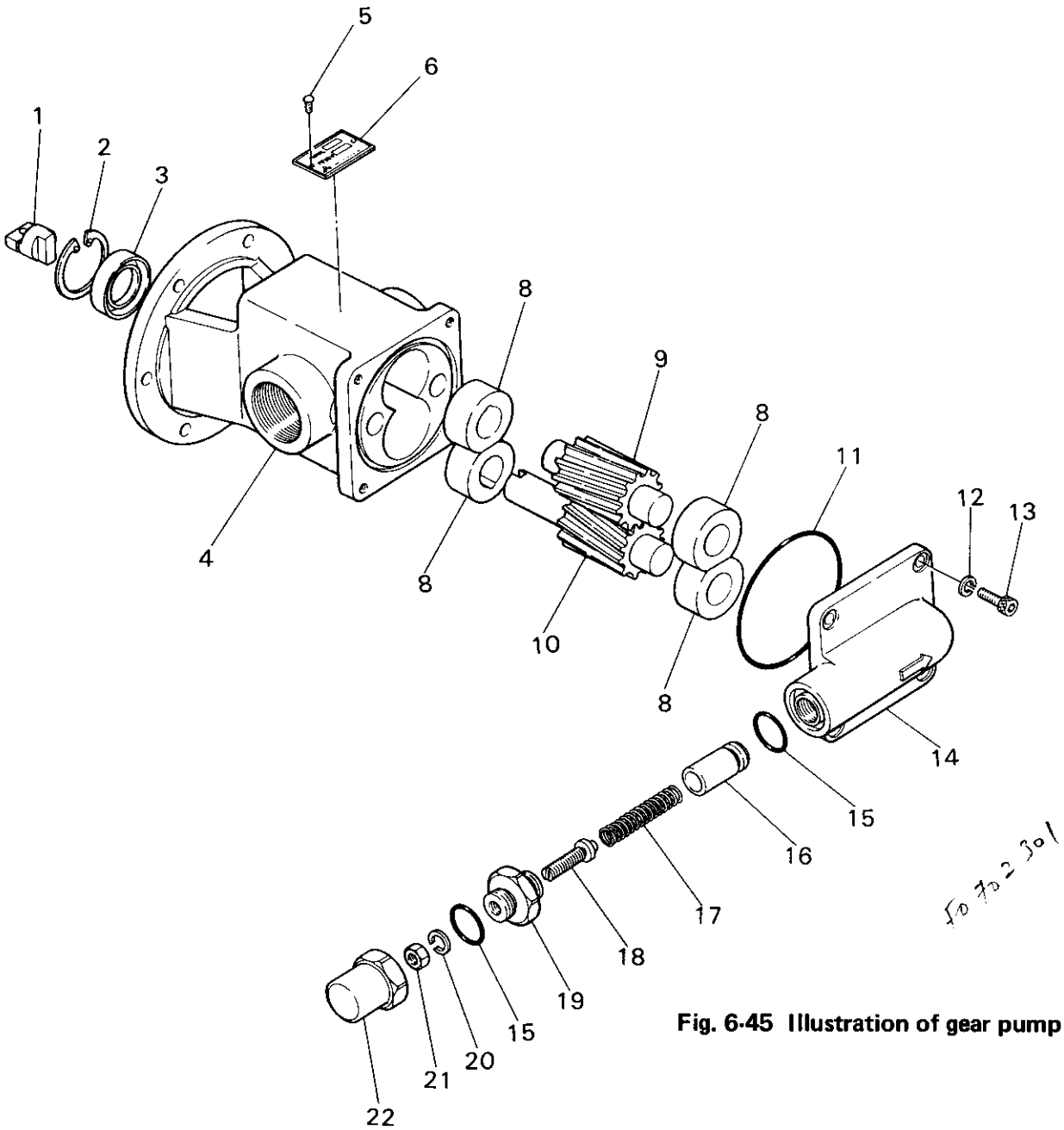


Fig. 6-45 Illustration of gear pump parts

List of gear pump parts

Table 6-6

No.	Parts name	Quantity	No.	Parts name	Quantity
1	Safety joint	1	12	Spring washer	4
2	Retaining ring (C)	1	13	Socket cap screw	4
3	Oil seal	1	14	Valve case	1
4	Pump housing	1	15	O-ring	2
5	Machine screw	2	16	Valve stem	1
6	Nameplate	1	17	Valve spring	1
7	–		18	Adjusting screw	1
8	Bush	4	19	Nipple	1
9	Driven gear	1	20	Spring washer	1
10	Drive gear	1	21	Nut	1
11	O-ring	1	22	Cap nut	1

When ordering parts, please specify the part no., parts name and quantity by reference to the list of parts on the drawing of completion.

DISMANTLING AND ASSEMBLING

7. Tool

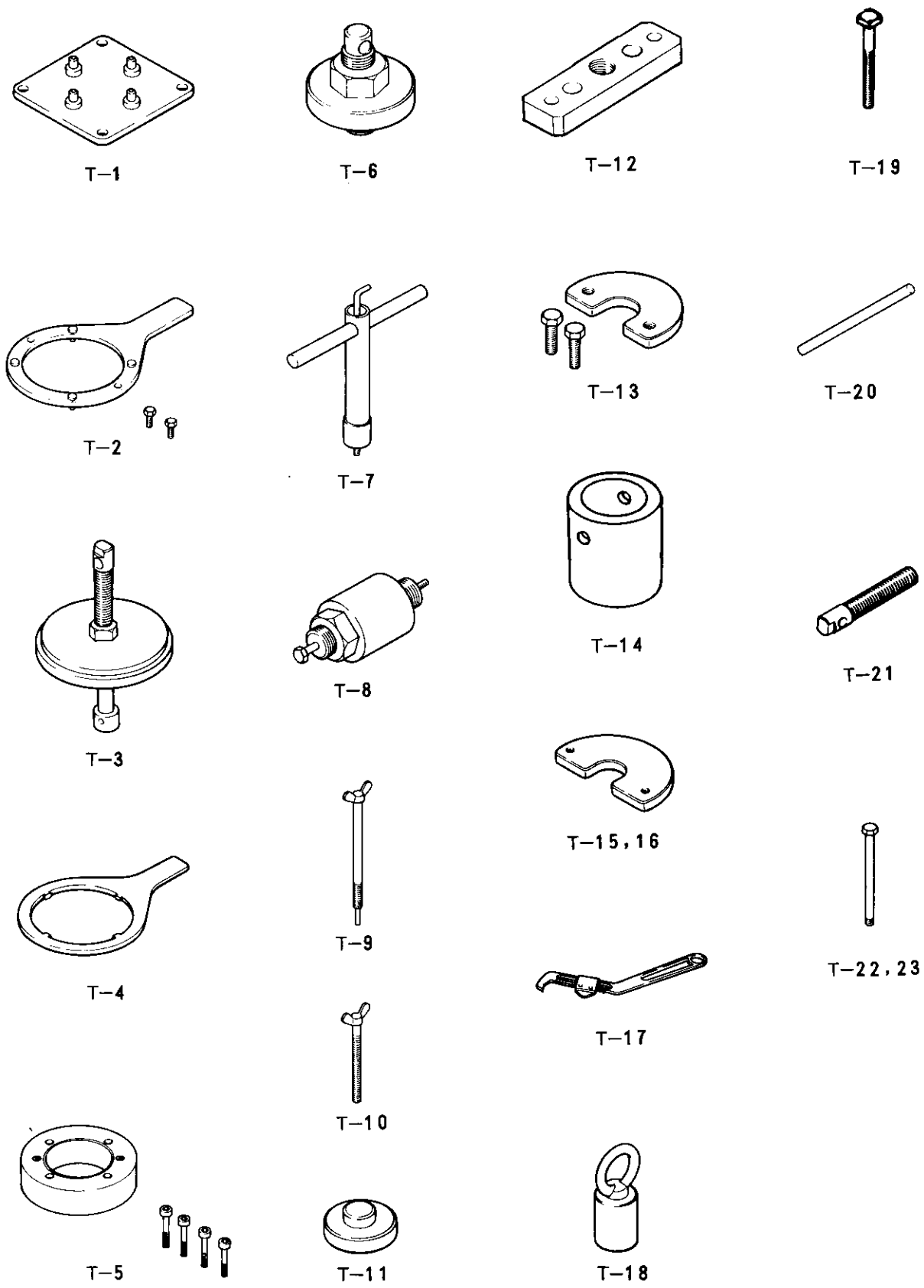


Fig. 6-46 Illustration of tools

List of tools

Table 6-7

No.	Name	Quantity	No.	Name	Quantity
T–1	Dismantling stand	1	T–13	Jack (4)	1
T–2	Bowl nut spanner	1	T–14	Jack (6)	1
T–3	Jack (1)	1	T–15	Jack (7)	1
T–4	Disc nut spanner	1	T–16	Jack (8)	1
T–5	Jack (2)	1	T–17	Hook spanner	1
T–6	Disc clamp plate	1	T–18	Jack (9)	1
T–7	Cap nut spanner	1	T–19	Push bolt (5)	3
T–8	Jack (3)	1	T–20	Handle bar (1)	1
T–9	Push bolt (4)	2	T–21	Push bolt (1)	1
T–10	Push bolt (3)	2	T–22	Push bolt (2)	2
T–11	Protective plate	1	T–23	Push bolt (6)	2
T–12	Jack (5)	1			

When ordering tools, please specify the part no., parts name and quantity by reference to the list of tools on the drawing of completion.

CHAPTER 2. ASSEMBLING

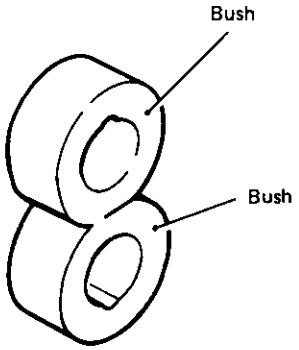


Fig. 6-47

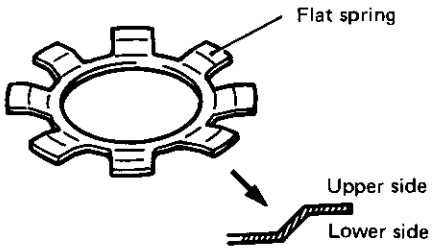


Fig. 6-48

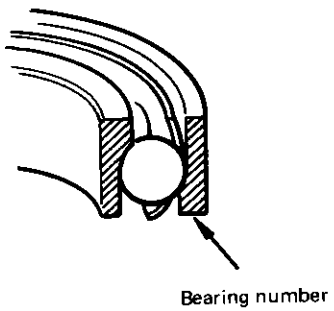


Fig. 6-49

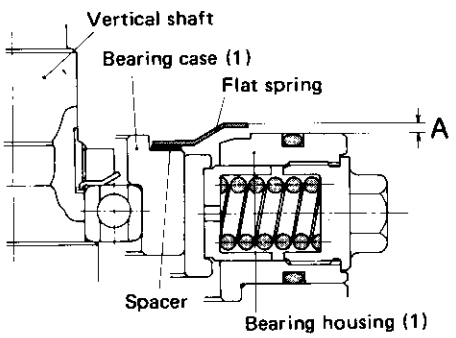


Fig. 6-50

The assembling work shall be performed in the reverse order of dismantling, and here only cautions in assembling will be described. For standard dimensions in assembling refer to details given in Part 7 (Maintenance and inspection procedures).

When performing the assembling work, be sure to tighten the nuts, bolts and screws positively.

1. Gear pump

(1) When installing bushes in pump housing, with bush inside with groove facing inside (on the side of gear.). (Refer to Fig. 5-48)
(2) When mounting gear, apply grease to bush.
(3) Tighten adjusting screw of relief valve to specified point.
(4) After assembling, confirm that it can be rotated lightly and then install it on SELFJECTOR.

2. Vertical shaft

(1) Incorporation of vertical shaft parts into frame shall be performed prior to incorporating horizontal shaft parts.
(2) Install flat spring and angular contact ball bearing using care not to place them upside down. (Refer to Fig. 6-48 and 6-49.)

Before installing the flat spring, install spacer on the top of bearing housing (1). The spacer is available in four thickness; 0.5 mm, 1.0 mm, 1.5 mm and 2.0 mm. Select spacer of an appropriate thickness so that the dimension "A" in Fig. 6-50 will conform to the applicable dimension in Table 6-8.

When dimension A is measured, remove O-ring installed under the bearing housing.

(3) Spring retainer shall be fastened securely to bearing case.
(4) After mounting in frame, confirm easy turning by hand.

Table 6·8

Model	SJ20T, P, EH	SJ25T, P, EH	SJ30T, P, EH	SJ40T, P, EH	SJ60T, P, EH
Dimension "A"	1.5–2.0	1.5–2.0	0–0.5	1.0–1.5	1.0–1.5

3. Horizontal shaft

(1) After assembling vertical shaft parts, assemble horizontal shaft parts.
(2) Install bearing retainer on bearing housing (3) side of horizontal shaft before installing the bearing.
(3) Contact surface of gear boss and spiral gear shall be completely adhered.
(4) In installing horizontal shaft, attention must be paid not to damage lip surface of oil seal.
(5) Install bearing retainer in tightening it evenly.
(6) If oil is adhering to friction pulley inside and friction block lining, wipe oil off completely (in which case avoid washing with highly volatile oil such as gas oil, etc.).
(7) When installing friction block to friction boss and then to frame along with electric motor, it is recommended to hold with rubber ring, etc. to prevent falling of friction block (Refer to Fig. 6·51).
(8) After assembling horizontal shaft, confirm that it can be rotated by hand.

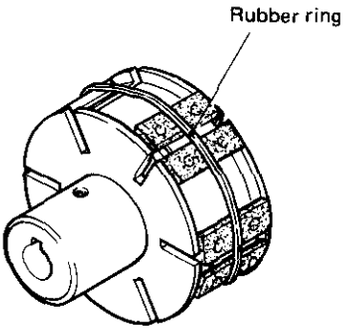


Fig. 6·51

4. Operating water supply equipment

(1) In installing O-ring on operating water chamber, be careful not to cause O-ring to twist.
(2) After installing the operating water supply equipment on vertical shaft, tighten socket tighten socket set screw of operating water chamber and confirm rotation along with vertical shaft.

5. Bowl

(1) Each O-ring must be installed with care not to cause it to twist.
(2) In incorporating main cylinder in bowl body, it is recommended to apply lubricating oil to sliding part of main cylinder.
(3) Be sure to apply Molykote to each threaded part.
(4) Knock and key of each part shall be completely put together.
(5) To assemble discs, place disc (3), provided with a distance piece on inside surface as well as on outside surface, at the lowest position, and assemble discs (2) on disc (3). Assemble all other discs one by one in order of their original assembly as much as possible with care to hold each disc firmly. (Refer to Fig. 6.52)

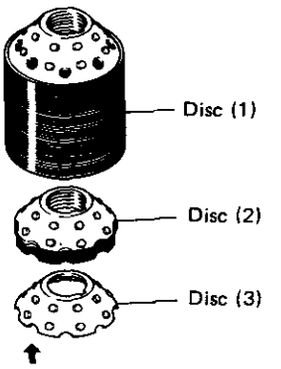


Fig. 6·52

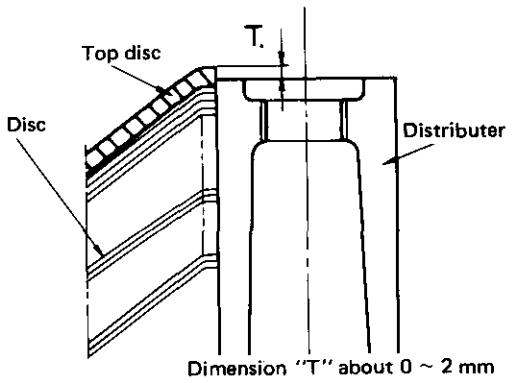


Fig. 6·53

(6) Since Disc is apt to cause a play owing to phenomenon, in such a case, incorporate a proper number of pieces of spare Disc in addition according to Fig. 6·53.

(7) In incorporating the bowl in SELFJECTOR, for prevention of causing damage to O-ring of operating water chamber, apply lubricating oil to operating water chamber of operating water supply equipment.

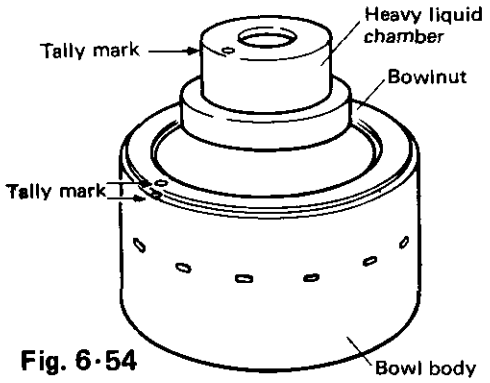


Fig. 6·54

(8) In order to prevent unbalance, align the tally mark of bowl nut and heavy liquid chamber with the tally mark of bowl body. (Refer to fig. 6.54)

(9) After assembling bowl in SELFJECTOR, use cap nut spanner to tighten cap nut positively.

6. Frame cover

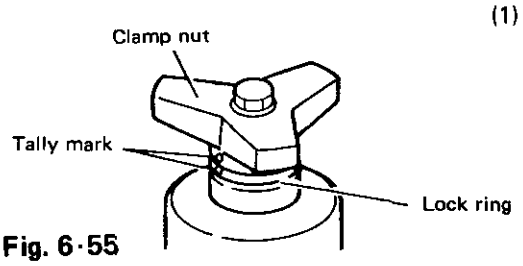


Fig. 6·55

(1) Install frame cover and secure it with lock handle. Then install lock ring to inlet pipe, using care to align socket cap screw of lock ring with groove of inlet pipe.
Install and hand tighten clamp nut. Check that the top end of the inlet pipe is flush with or higher than the top surface of the clamp nut. Then, using a wooden hammer, tighten it until alignment of tally marks is achieved.

NOTE
As taper of impeller breaks in or wears, tally marks on clamp nut and lock ring tend to advance. However, this kind of shift of tally *marks is no problem even if it occurs. Be sure to tighten clamp nut* positively until it is firmly seated.
If, however, tally mark shift is 180 deg. or more, replace faulty parts with new ones.

Tighten socket cap screw of lock ring fully until it comes in contact with inlet pipe, and finally install and tighten plug.

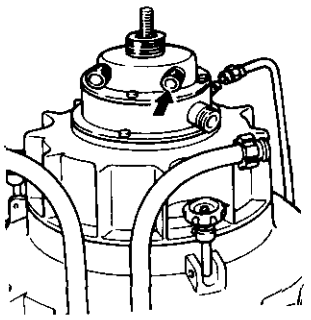


Fig. 6·56

(2) In case of assembling, be sure to fit orifice to the positic of arrow in Fig. 6·56, Fig. 6·57. (If orifice is not install flowmeter won't indicate correct flow rate).

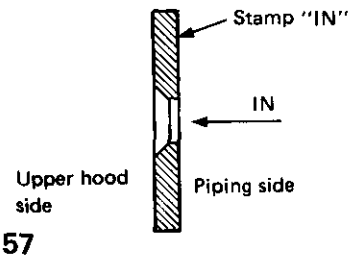


Fig. 6·57

PART 7 MAINTENANCE AND INSPECTION PROCEDURES

1. List of inspection

Table 7-1

Item		Part	Contents	Time *7		
				3 months 2,000H	1 year 8,000H	2 years 16,000H
Frame & frame cover	Upper frame	Inside Operating water drain outlet	Perform inspection and cleaning in paying special attention to adhesion of sludge to frame inside, etc.	*1		
	Impeller (1) Impeller (2)	Tapered part Impeller	Perform cleaning.	*1		
Bowl	All parts		Perform cleaning in accordance with maintenance procedures.	*2		
	Discs	Inside and outside	Inspect for corrosion, missing of distance piece, cracking in key groove, etc.	*1		
		Set of discs	In case of shortage of elasticity of the set, take necessary steps in accordance with maintenance procedures.	*2		
	Bowl body	Inside	Inspect for corrosion of flaws.	*1		
		Fitting part with vertical shaft	Inspect for flaws on tapered part.	*1		
		Threaded part	Inspect for traces of flaws or seizure. When any abnormality is found, take necessary steps in accordance with maintenance procedures.	*1		
		Sliding part	Inspect for flaws of sliding part with main cylinder. When any abnormality is found, take necessary steps in accordance with maintenance procedures.	*1		
	Bowl hood	Inside	Inspect for corrosion or flaws. When any abnormality is found, take necessary steps in accordance with maintenance procedures.	*1		
	Distributor	Inside and outside	Inspect for corrosion. When any abnormality is found, take necessary steps in accordance with maintenance procedures.	*1		
		Key	Inspect for deformation on top of key. When any abnormality is found, take necessary steps in accordance with maintenance procedures.	*1		

Item		Part	Contents	Time *7		
				3 months 2,000H	1 year 8,000H	2 years 16,000H
Bowl	Various O-rings	Outside	In case of extreme damage due to aging, abrasion or cracking, replace by a new one.	*1 *8		
	Main seal ring	Outside	In case of extreme damage due to aging, abrasion or cracking, etc., take necessary steps in accordance with maintenance procedures.	*1 *8		
	Main cylinder	Sealing surface	Inspect for flaws. When any abnormality is found, take necessary steps in accordance with maintenance procedures.	*1		
	Pilot valve	Sliding part	Inspect for flaws in sliding part with valve guide and bowl body. When any abnormality is found, take necessary steps in accordance with maintenance procedures.	*1		
		Sealing surface	Inspect for flaws. When any abnormality is found, take necessary steps in accordance with maintenance procedures.	*1		
	Valve seat	Outside	In case of extreme damage due to aging, abrasion or cracking, etc., replace by a new one.	*1 *8		
Vertical shaft parts	Vertical shaft (with pinion attached)	Fittfing part with bowl Threaded part	Inspect for corrosion or flaws. When any abnormality is found, take necessary steps in accordance with maintenance procedures.	*1		
		Fitting part with bearings	Inspect for abrasion due to aging. When any abnormality is found, take necessary steps in accordance with maintenance procedures.		○	
		Gear tooth	Inspect for tooth touch. When any abnormality is found, take necessary steps in accordance with maintenance procedures.	*3		
	Bearing		Replace by a new one.		*4	
	Upper springs		Inspect for any damages, and measure free length. When any abnormality is found, take necessary steps in accordance with maintenance procedures.		○	
	Spring retainer (2) and Retainer	Contact part with steel ball (1/2")	Inspect for abrasion. When any abnormality is found, take necessary steps in accordance with maintenance procedures.		○	
	Flat spring		Inspect for any damage and shortage of elasticity. When any abnormality is found, take necessary steps in accordance with maintenance procedures.		○	

Item		Part	Contents	Time *7		
				3 months 2,000H	1 year 8,000H	2 years 16,000H
Vertical shaft parts	Bearing case (3)	Contact part with steel ball (1/2")	Inspect for abrasion. When any abnormality is found, take necessary steps in accordance with maintenance procedures.		○	
	Steel ball (1/2")	Outside	Inspect for abrasion or damages. When any abnormality is found, take necessary steps in accordance with maintenance procedures.		○	
	Lower spring		Inspect for any damages, and measure free length. When any abnormality is found, take necessary steps in accordance with maintenance procedures.		○	
Horizontal shaft parts	Spiral gear	Gear tooth	Inspect for abrasion or damages. When any abnormality is found, take necessary steps in accordance with maintenance procedures.	*3		
	Bearing		Replace by a new one.			*5
	Horizontal shaft	Key groove Safety joint groove	Inspect for flaws of threaded part and key groove, and abrasion of safety joint groove. When any abnormality is found, take necessary steps in accordance with maintenance procedures.		○	
	Friction block	Frictional surface	Inspect for abrasion. When any abnormality is found, take necessary steps in accordance with maintenance procedures.		*6 *8	
Lubricating oil			Replace or replenish in accordance with maintenance procedures.	○		
Brake	Brake lining	Frictional surface	Inspect for abrasion. When any abnormality is found, take necessary steps in accordance with maintenance procedures.		*6	
Operating water supply equipment	Waterchamber cover and waterchamber	Operating water passage	Cleaning shall be performed in accordance with maintenance procedures	*1		
	Operating water disc			*1		
	Operating water nozzle			*1		
Protective equipments	Leakage detector	Sliding part Seal surface	Take necessary steps in accordance with maintenance procedures.	○		
	Sludge discharge switch	Bearing Oil seal Spring	Take necessary steps in accordance with maintenance procedures.	○		
	Various switches and solenoid valves	Seal surface		○		
General items	Various oil seals	Lip surface Spring	In case damages and deformation are found, replace by new ones.		*8	

NOTE:
Those signs used in the above table have the following meanings:

*1. Since the cleaning interval of bowl differs according to the properties of oil to be treated, the inspection shall be conducted according to the cleaning schedule of bowl.

*2. Six months after ship has entered into service, and at time of dismantling and assembling.

*3. Inspection interval for vertical and horizontal shaft parts shall be one year and two years, respectively. However, since they can be visually observed when lubricating oil is replaced, the inspection shall be conducted at the time of replacement.

*4 Vertical shaft is primarily designed for high speed rotation and considerably gets affected by variation of load and furthermore once bearings are damaged, it greatly affects other parts, so the bearings for vertical shaft parts shall be replaced with new ones every year or 8,000 hours, whichever occurs first.

*5 As horizontal shaft has low speed rotation and less variation of load, bearing shall be replaced every two years or 16,000 hours, whichever occurs first.

*6. Abrasion extent differs according to the number of times of starting and stopping and the frequency of use, so the inspection period shall be decided upon actual results.

*7. As inspection interval may vary greatly with oil to be treated and so on, the "Time" in this table shall be regarded as a standard.

*8. As the packing is a consumable part, with the exception of those being provided as spares, please an order separately.

2. Maintenance and inspection procedures

2.1 Bowl

Though the life of each part of bowl cannot be generally determined because it is related to the property of oil to be treated and operating conditions, we will show you as a tentative standard the scope of possible repairs and the limit of use requiring replacement, which are as follows.

Moreover, it is impossible to express a limit to corrosion in definite value. Originally, corrosion is greatly governed by the environment of use and using conditions. Even in the case of marine use, the extent of corrosion is multifarious depending on the property of oil to be treated. Especially, in the case of fuel oil treatment, since the mixing-in of sea water may happen, we should consider the corrosion environment to be severe and the maintenance and inspection should be performed carefully.

1) Inspection points
   a) As corrosion is liable to happen at the part where sludges adhere and accumulate, in order to prevent corrosion, it is requested to set, a proper discharge interval and at the same time enforce strictly a cleaning at the time of overhauling.
   b) The parts of bowl, except for a part, are made of stainless steel, but it does not necessarily follow that no corrosion will happen for bowl parts under severe conditions. It will happen as pitting. Further, since bowl is exposed to high stress, there is a possibility that fine cracking originating from pitting will happen. Consequently, inspection must be conducted with great care.
2) Inspection procedures
   a) Perform thorough cleaning and remove adhering matter.
   b) Visual inspection
   c) Liquid penetrant examination
3) Actions to be taken against corrosion
   a) As for pitting, remove corroded portion with grinder, confirm by visual inspection and liquid penetrant examination, and in case no abnormality is found, the bowl parts can be used further.
   The limit of removal with grinder shall be less than 0.5% and after applying a grinder, buffing (more than #250) shall be performed.
   b) In case lineal defect (cracking) occurred or grind-finishing was applied a great deal, it is necessary for you to contact our Company or service agent and perform replacement of parts and balance adjustment. Anyhow, do not repair by welding such parts as have cracking, pinhole or corrosion, etc.

2.1.1 Discs

1) In case corrosion is found, depending on the degree of corrosion, replace by a new one.
2) In case more than two distance pieces next to each other spot-welded on outside of disc (in case of disc set in the lowest part, both inside and outside) are missing, the disc shall be replaced by new one.
3) Cracked ones shall be replaced. Do not repair by welding.
4) In case key groove has been deformed, repair or replace it.
   a) Those whose side has been torn off as shown in Fig. 7-1 shall be repaired by striking with a hammer. However, striking shall not be performed so strongly as making the thickness so thin or as damaging its original shape.
   b) Those which have been so torn off as causing crack shall be replaced. Deformation of key groove is mainly observed for 4th to 5th disc counting from the top. This is caused by the fact that in setting discs in distributor, the discs have not been pressed well. So, full attention must be paid in setting discs in bowl.

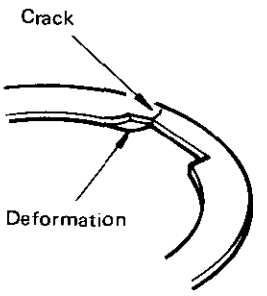


Fig. 7-1

5) In case elasticity of disc set has become short, new discs (normally one or so) shall be added. Those discs being piled up and not in close contact condition at the time of manufacture will gradually be brought into close contact while they are tightened with bowl nut and subjected to centrifugal force. As a result, a gap is formed between top disc and disc. This will not only worsen separating efficiency but also will cause unbalance. Accordingly, in order to fill the gap, new discs must be added. At the time of overhauling a bowl, be sure to confirm the number of piece of Disc in accordance with the Fig. 6·53 and insert in addition a proper number of pieces of Disc as required.

2.1.2 Bowl body

1) Clean every O-ring groove. If the grooves are rough, repair with fine sandpaper. In case repair by sandpaper is impracticable, the groove width may be widened by machining if it is less than 0.5 mm.
2) In case passing holes of operating water and both water chambers for opening and closing are clogged with scale, they shall be fully cleaned.
3) In case sludge is piled up at sludge discharge ports, thorough cleaning shall be performed.
4) In case abnormal shock acts on bowl by dropping it from a high position or by falling ,down of heavy object, the inspection shall be conducted by us.
5) Inspect if there is any trace of flaws of slip generated between bowl body and vertical shaft and contact area with vertical shaft. In case the contact area on both sides is more than 2/3, it shall be used as it is.

2.1.3 Bowl hood

1) Fitting part with bowl nut.
2) Fitting part with bowl body.
3) Threaded part.
4) Fitting part with heavy liquid chamber and light liquid chamber.
5) Grooved parts for O-ring (Inspection shall be conducted when O-ring is removed).

In case any flaws are found for the above parts, they shall be repaired with a set of files or oilstone.

2.1.4 Distributor

1) In case the upper end of key is deformed, it shall be repaired or replaced according to the degree of deformation.

2.1.5 Various O-rings

O-ring is, among consumables, one of the parts which are most consumed. Its life differs according to the various conditions such as properties of oil to be treated, separating temperature and the number of times of starting and stopping of SELFJECTOR. Judgment of life and inspection shall be performed according to the following method, but even in case of no abnormality, those O-rings used for one year shall be replaced by new ones. Furthermore, in fitting O-rings, O-ring grooves must be cleaned without fail.

1) Life of O-ring
   By bending back the O-ring by fingers in the circumferential direction, inspect if there are any flaws, cracks or abrasion in O-ring and in case no abnormality is found, push it by nail and if it returns to original status, it shall be used again and in case any abnormality is found, it shall be replaced by a new one.
2) O-ring in light liquid chamber
   Except for abnormal cases such as leaking of sealing water or aging of O-ring, no replacement is required.

2.1.6 Main seal ring

The service life of main seal ring varies with the operating conditions of SELFJECTOR (in particular, sludge discharge interval and properties of sludge). With main seal ring installed on bowl hood, its sealing surface shall be cleaned and carefully inspected. Normally, the packing will be deformed as shown in Fig. 7·2, but if "A" is less than about 0.5 mm, it can be used as it is. On the other hand, when metal powder is entangled in sealing surface and its size exceeds 60% of sealing surface length (B), replace. (It is better not to remove metal powder entangled).

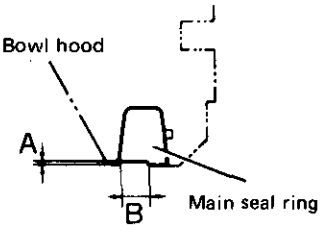


Fig. 7·2

2.1.7 Main cylinder

1) Inspect if any flaws are on sealing surface (in contact with main seal ring). In case there are flaws, they would damage main seal ring and cause leak of sealing water and disturb normal operation. Since the surface is often damaged in the case of dismantling, take special caution in its handling. In case of minor flaws, these shall be repaired with oilstone.
2) The sliding surface between bowl body is plated with hard chrome and seldom gets flawed. If it gets flawed, take due caution as wear of O-ring will be accelerated.

2.1.8 Pilot valve

1) Inspect for flaws in sliding surface between valve guide and bowl body. If there is any flaw, bear in mind that wear of O-ring will be accelerated thereby. Further, in the case of dismantling and assembling of pilot valve assembly, be careful not to give damage to O-ring. In case of minor flaws, repair with oilstone.
2) Inspect sealing surface (in contact with valve seat) for flaws, if any. If there is any flaw, it will cause damage to valve seat and operating water will leak, making normal operation impossible. In case of minor flaws, repair with oilstone.
3) Valve seat
   Take out valve seat from pilot valve assembly, clean the sealing surface and inspect carefully. If foreign matter is entangled or the seat is deformed (more than 0.3 mm), replace by a new one.

2.2 Vertical shaft parts

The vertical shaft parts drive bowl which is heavy and rotates at high speed by means of friction force of conical part on top of vertical shaft. Accordingly, a satisfactory maintenance is very important as it would directly affect the balance of bowl, contact of bowl with frame, vibration and damages of various parts. The life of vertical shaft parts, different from that of each part of bowl, is not governed by the properties of oil to be treated, but they are composed of many parts requiring replacement after it is put into operation for certain fixed hours.

2.2.1 Vertical shaft

1) Since corrosion may happen on the part above the upper bearing fitting part, it shall be inspected well and shall be replaced according to the degree of corrosion.
2) In case there are partial flaws on fitting part with bowl, they shall be repaired and smoothed with a set of files and sandpaper. If the flaws are formed in a continuous ring shape, it shall be replaced.
3) In case threaded part has partial struck flaws, it must be repaired and smoothed with a set of files and sandpaper.
4) As for abrasion of fitting part with bearings, if the inner race of bearing is slippery, it must be replaced.
5) If the teeth of pinion are rough and have slight abrasion, they shall be repaired with a set of files, sandpaper and oilstone. In case of abnormal abrasion, it shall be replaced together with spiral gear.
6) Center deviation of vertical shaft shall be measured at tapered part, fitting part with lower bearing and middle part of the shaft. It shall be limited to less than 5/100 mm and if it is over 5/100 mm, the shaft must be replaced.

2.2.2 Upper spring

1) Even when only one spring has been broken or cracked, all must be replaced by new ones.
2) If there is any spring whose measured free length is shorter by more than 1 mm than regular dimension, all shall be replaced by new ones. One set of springs shall be six having a uniform installing load (Refer to Table 7-2).

Table 7-2

Model	SJ20T,P,EH	SJ25T,P,EH	SJ30T,P,EH	SJ40T,P,EH	SJ60T,P,EH
Regular dimension	34	35	36	44	46

(m/m)

2.2.3 Spring retainer (2), bearing case (3), steel ball (½")

In case the dimension of spring retainer (2), steel ball (½") and bearing case (3) as assembled is smaller by more than 1 mm than the dimension "A or B", recheck these parts and if there is any abnormality, replace by new ones (Refer to Table 7-3).

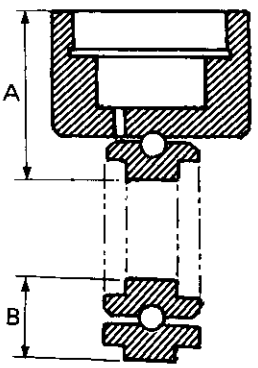


Fig. 7-3

Table 7-3

Model	SJ20T,P,EH	SJ25T,P,EH	SJ30T,P,EH	SJ40T,P,EH	SJ60T,P,EH
Dimension "A"	61.5	61.5	66.5	75.5	76.5
Dimension "B"	31	31	33	37	37

(m/m)

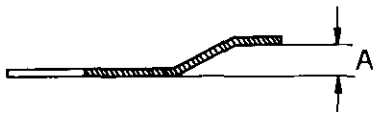


Fig. 7·4

2.2.4 Flat spring

1) Broken or cracked spring shall be replaced by new one.
2) Measure height of spring as in Fig. 7·4 and if it is less than "A" mm, replace by new one. (Refer to Table 7·4).

Table 7·4

Model	SJ20T,P,EH	SJ25T,P,EH	SJ30T,P,EH	SJ40T,P,EH	SJ60T,P,EH
Dimension "A"	3	3	1.5	6	6

(m/m)

2.2.5 Steel ball (½")

1) Those having a deep ring-shaped flaw at the part contacting spring retainer (2), etc. shall be replaced.

2.2.6 Lower spring

1) One which has been broken or cracked shall be replaced by a new one.
2) In case the measured free length is shorter by more than 1 mm than regular dimension, replace by a new one. (Refer to Table 7·5).

Table 7·5

Model	SJ20T,P,EH	SJ25T,P,EH	SJ30T,P,EH	SJ40T,P,EH	SJ60T,P,EH
Regular dimension	33	37	43.5	55.5	60.5

(m/m)

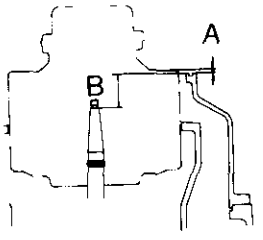


Fig. 7·5

2.2.7 Height of vertical shaft

The standard height after installation of vertical shaft shall be as shown in Table 7·6. Inspection of various parts mentioned above shall be conducted so that height of vertical shaft will meet the standards (Refer to Fig. 7·5).

Table 7·6

Model	SJ20T,P,EH	SJ25T,P,EH	SJ30T,P,EH	SJ40T,P,EH	SJ60T,P,EH
Dimension "A"	0 ± 1.0	0 ± 1.0	0 ± 1.0	0 ± 1.0	9 ± 1.0
Dimension "B"	60 ± 1.0	60 ± 1.0	75 ± 1.0	84 ± 1.0	83 ± 1.0

(m/m)

2.2.8 Height of flat spring

Whenever the lower spring retainer, angular bearing case, steel ball or flat spring is replaced with a new one or the height of flat spring (dimension "A" in Fig. 6·50) is lower than that specified in Table 6·8, replace the spacer to obtain the correct spring height.

2.3 Horizontal shaft parts

Horizontal shaft parts transmit driving force to gear pump and, through vertical shaft, to bowl. Though the structure is not particularly complicate and its maintenance interval is longer than other parts, full attention must be paid as improper maintenance might make its operation impossible.

The life of horizontal shaft parts, like that of vertical shaft parts, is not governed by the properties of oil to be treated, but they are composed of many parts requiring replacement after being put into operation for certain fixed hours.

2.3.1 Spiral gear

1) The life of spiral gear cannot be decided uniformly since it is governed by various conditions, but in case of good gear teeth touch and normal abrasion, the spiral gear can be used until the thickness of abraded gear teeth becomes 2/3 of the normal dimension.
2) At initial stage of operation and after replacement of spiral gear, the abrasion may go on temporarily until the gear teeth get used to, and after a certain period it will become fixed, and this is a normal phenomenon.
   In case the abrasion goes on extremely, an inspection is necessary because some discrepancies are in other parts.

2.3.2 Horizontal shaft

1) In case threaded part has partial struck flaws, it must be repaired and smoothed with a set of files and sandpaper.
2) As for abrasion of fitting part with bearings, if the inner race of bearings is slippery, replace by a new one.
3) In case the key groove has been abraded and widened, it must be replaced.
4) If the shaft diameter of sliding surface between oil seal and collar is worn by more than 0.5 mm than regular dimension, it must be replaced by a new one. (Refer to Table 7·7).

Table 7·7

Model	SJ20T,P,EH	SJ25T,P,EH	SJ30T,P,EH	SJ40T,P,EH	SJ60T,P,EH
Regular dimension	55	62	62	70	70

(m/m)

2.3.3 Friction lining

As the life of friction lining is governed by the number of times of starting and stopping, it cannot be decided uniformly. If the thickness of any lining is found to have been abraded to 3.5 mm (original thickness 7 mm), all linings shall be simultaneously replaced with new ones.

2.4 Gear pump

Generally speaking, except for periodical inspection, dismantling inspection is unnecessary, but in case of abnormal sound or short capacity or oil leakage, the pump must be dismantled and checked, and if any abnormality is found, it must be replaced with a new one.

2.4.1 Safety joint

In checking safety joint by peeping through the clearance between SELFJECTOR frame and unremoved pump outside, if deformation or breakage is found, it must be replaced with a new one.

2.4.2 Pump gear, shaft and bush

Peeping through the clearance from the frame outside, if it is found rotating eccentrically or abnormal sound is heard, dismantle it for inspection.

Inspection shall be made for gear teeth touch, clearance between shaft and bush, abrasion or clogging with foreign objects. In case of small flaws, the tooth surface shall be repaired with oilstone and if repair is impossible, it shall be replaced with a new one.

2.4.3 Relief valve

When the capacity becomes short or in case of suction impossibility, it is mostly due to foreign objects clogged in the relief valve. In that case the valve shall be dismantled and cleaned well. Further, it is necessary to confirm the position of the adjusting screw (adjusting pressure to be 4.0 kg/cm^2). If the screw is fastened too tight, pressure would rise unnecessary high and it would cause overload. If fastened too loose, it would cause suction impossibility.

2.5 Lubricating oil

In handling the lubricating oil, attention must be paid to the following points.

1) When changing the lubricating oil, stop SELFJECTOR, then drain lubricating oil and those matters adhering to the inside wall of gear case should be cleaned out.
2) In changing the lubricating oil with new one for reasons of abnormal phenomena such as emulsification, etc., it is helpful to sample small amount of old lubricating oil as data upon making a study.
3) In pouring the lubricating oil, attention must be paid so that foreign objects may not mix in and when necessary, it shall be poured in through filter net.

2.6 Brake equipment

Except when early stopping is required, it is desirable not to apply the brake as far as possible.

If SELFJECTOR has been stopped by brake, it must be released without fail in order to avoid overload of motor upon starting again.

2.6.1 Brake lining

As the life of brake lining differs greatly according to the number of times of use and cannot be decided uniformly, the lining shall be inspected periodically.

If the thickness of brake lining is found to have been abraded to 6.5 mm (original thickness 10 mm), it shall be replaced with a new one.

2.7 Operating water supply equipment

This equipment supplies operating water to the bowl opening and closing mechanism which automatically discharges the sludge settled in the bowl.

Since clogging with fur or parking and O-ring damage will cause decrease in water pressure, shortage of water, and make bowl opening and closing inoperative, it is necessary to make checking and cleaning with good care.

2.8 Protective equipments

In operating SELFJECTOR, the trouble which happened at the starting of operation can be found by the operator. However, after the machine is put into continuous running, the operator would normally leave the place of installation. Accordingly, in case a trouble happens during his absence, unless the trouble is found at an early stage, it would bring about a great damage. Therefore, in order to detect the abnormal condition and to give an alarm or to stop the supply of oil to be treated, SELFJECTOR is provided with the following protective equipments.

Table 7·8

Name of equipment	Purpose of use	Remarks
Leakage detector	To detect abnormal condition when the oil to be treated flows out at sludge outlet or heavy liquid outlet due to some reason.	Called "leakage detector" (L.D.).
Sludge discharge switch	To detect whether sludge has been discharged from the bowl or not.	Called "sludge discharge switch (S.D.).

2.8.1 Leakage detector (Refer to Fig. 7·6)

This detector consists of tank, cylinder and float switch. During operation, the cylinder is closed and if oil leaking for some reason or other accumulates within the tank, the float is pushed up and actuates a microswitch to inform the outside of the trouble. During sludge discharge, the cylinder is opened so as to cause discharged sludge to flow out to the sludge tank.

The tank inside may be corroded with contamination due to sludge. In the electrical circuit, insulation failure due to disconnection or poor contact may arise.

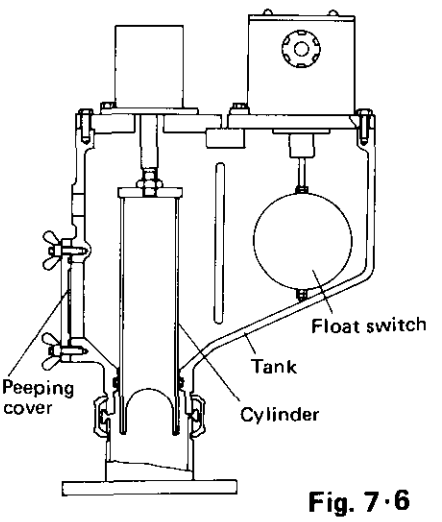


Fig. 7·6

In case of defective functions, the following steps shall be taken.

1) Confirm air cylinder control air pressure (4 ~ 5 kg/cm^2).
2) Inspect float switch and for disconnection of wire or poor contact in the solenoid valve electrical circuit and if any failure is found, repair or replace.

   When the whole float switch was removed and pushed upward, if the LED (No. 0) provided in the Automatic Control Panel is lighted, there is no abnormality in the electric circuit except solenoid valve (SV6).
3) Clean up the tank inside, check for float contamination, corrosion or damage, etc. and if any abnormality is found, repair or replace.
4) Inspect O-ring of valve rod and if seal failure is found, replace by a new one.
5) Inspect spring for damage and if defective, replace by a new one.

[NOTE]
Do not open the peeping cover during operation.

2.8.2 Sludge discharge switch (Refer to Fig. 7-7)

This detector is composed of a part functioning by the collision with sludge discharged from the bowl and a part converting the motion into electric change, and confirms discharge of sludge.

As for the mechanical part, corrosion or damage may happen for bearings and spring due to sludge adhesion and sludge entering into the inside, or poor insulation may happen for electric circuit due to snapping of wire, poor contact and sludge entering.

After SELFJECTOR completely stopped its running, the functions shall be confirmed by removing this detector and by checking if the lever can be easily rotated in the counterclockwise direction by fingers and be returned to its original position when released. In addition, confirm limit switch operation.

In case of defective functions, after washing out the stains due to sludge entering by light oil, the following steps shall be taken.

Moreover, at this time comfirm the working condition of Microswitch by turning on or off the light of LED (No. 1) of Automatic Control Panel.

1) Inspect if there are flaws or aging for oil seal and if any abnormality is found, it shall be replaced with a new one.
2) Inspect if there is any damage or corrosion for the spring, and in case any abnormality is found, it shall be replaced.
3) Inspect if there is any damage or corrosion for the bearing, and in case any abnormality is found, it shall be replaced.
4) Inspect if there is any corrosion on the shaft, and in case any abnormality is found, it shall be replaced.
5) Inspect if there is any snapping of wire, poor contact or poor insulation, and if any abnormality is found, it shall be repaired or replaced.
6) Even after completion of above actions, if the detector would not recover its good condition, the whole shall be replaced with new one.

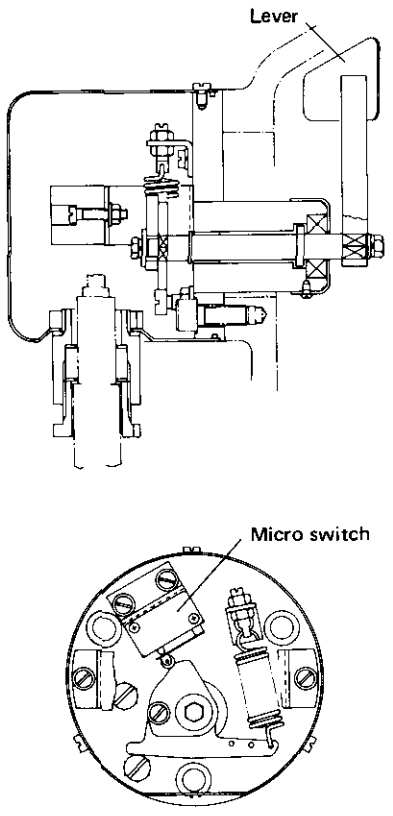


Fig. 7-7

PART 8 CAUSES OF TROUBLE AND COUNTERMEASURES

Phenomenon	Cause	Countermeasure		Remarks
		Action to be taken	Matters for confirmation	
Oil flows out to heavy liquid outlet side	Amount of sealing water is a little.	To be proper amount of sealing water (Adjust the sealing water timer). Clean up Y type strainer.		Refer to Table 5·13~ Table 5·15
		Regulating valve pressure setting is low.	Setting the pressure of Reducing Valve is set to 6 or 9 ℓ/min. while letting the water flow.	
		Inspect water shut valve.		
	Wrong selection of graviry disc (Inside diameter is too big)	Replace with proper gravity disc.	Conform oil temperature and specific gravity. Confirm feed rate.	Refer to Fig. 5·3~ Fig. 5·7
	Oil temperature has dropped.	Raise the temperature to the temperature designed at the time when gravity disc was selected.	Perform repair of heater and temperature control valve. Inspect electric or steam system.	Refer to Table 5•3
	Discharge pressure on light liquid outlet side is high.	Open the discharge valve.	Normally, discharge pressure on oil side is designed to be less than 2 kg/cm^2.	
	Sealing water is leaking.	Replace main seal ring with new one. Repair damaged part on surface of main cylinder.	When sealing water is supplied confirm if it flows to sludge discharge part.	
	Revolution speed of bowl has lowered.	As friction clutch is slipping, friction block shall be adjusted or replaced. In single phase operation.	Investigate the condition of abrasion of friction lining. Inspect gear case for leak from oil seal. Check up wiring connection.	
	Excessive amount of discharge	Adjust operating water pressure.	Perform measurement of sludge discharge quantity. (For partial discharge type only).	Refer to Table 5·25~ Table 5·26
	Bowl has not been closed completely.	Inspect solenoid valve. Clean up operating water disc. Clean up Y type strainer. Replace O-ring with new one.		
Oil flows out to sludge outlet side.	Bowl has not been closed completely.	Refer to the action to be taken as described in the above "phenomenon" column (Oil flows out to heavy liquid outlet side).		
	Damaged main seal ring.	Replace with new one.		
	Damaged pilot valve.	Repair damage on pilot valve and O-ring seat surface.		
	Amount of operating water for closing bowl is a little.	Inspect the Strainer of Solenoid Valve (SV2) Set the Timer long (T600)		
	Operating water for closing bowl drains off.	Inspect it plug screw with nozzle is clogged Replace "O-ring" with new one.		

CAUSES OF TROUBLES AND COUNTERMEASURES

Phenomenon	Cause	Countermeasure		Remarks
		Action to be taken	Matters for confirmation	
Water is mixing in oil	Quantity of sealing water or replacement water is large.	Actually measure the flow rate of sealing water and replacement water and adjust the timer of sealing water or replacement water.		Refer to Table 5·13~ Table 5·15
	Bowl cannot opened.	Replace bowl O-rings.		
		Clean up bowl and operating water supply equipment.		
		Raise operating water pressure.	Confirm operating water for opening bowl timer. (For partial discharge type only).	Refer to Table 5·11
	Water outlet of bowl is clogged.	Shorten the sludge discharge interval. Clean up the bowl. Adjust discharge quantity.	Find a proper sludge discharge interval based on sludge content in oil to be treated and trials.	Refer to Table 5·10 Table 5·26
	Wrong selection of gravity disc.	Replace with proper gravity disc.	Confirm temperature, specific gravity and feed rate.	Refer to Fig. 5·3~ Fig. 5·7
	Improper oil temperature	Adjust to proper oil temperature.	Perform repair of heater and temperature control valve. Inspect electric or steam system.	Refer to Fig. 5·3
	Feed rate is too much.	Adjust to proper feed rate.		Refer to Fig. 5·1~ Fig. 5·2
	Revolution speed of bowl has lowered.	As friction clutch is slipping, friction block shall be adjusted or replaced.	Confirm whether any leakage from oil seal in gear case is happening or not.	
Feed rate is reducing.	Relief valve of gear pump has worked.	Adjust relief valve.		
	Capacity of gear pump has lowered.	Inspect and replace defective parts.		
	Air has been sucked midway in pipings.	Retighten joint part and valve gland.		
	Strainer has been clogged.	Clean up strainer.		
	Revolution speed has lowered.	As friction clutch is slipping, friction block shall be adjusted or replaced.	Confirm whether any leakage from oil seal in gear case is happening or not.	
	Safety joint is broken.	Replace with new one.	Check for any compulsion in pipings or mixture of foreign matter.	
Electric motor is overloaded.	Defects in driving system	Adjust friction clutch.		
		Replace bearings. Perform reassembling.	Check up the installation height of flat spring.	
	Electric motor is out of order.	Repair electric motor. In single phase operation.	Check up wiring connection.	
	Oil to be treated is leaking from bowl.	Refer to actions described in the column "Oil flows out to sludge outlet side".		
	Relief valve of pump has been fastened excessively.	Adjust relief valve.		

Phenomenon	Cause	Countermeasure		Remarks
		Action to be taken	Matters for confirmation	
Abnormal vibration or abnormal sound happens.	Discharge interval is too long.	Set properly the discharge interval.	Confirm the existance of sludge remaining in the bowl.	Refer to Table 5·10
	Quantity of discharge is too small.	Set the Quantity of discharge properly.	Confirm the existance of sludge remaining in the bowl. (Only Partial Discharge Type.)	Refer to Table 5·26
	Amount of water opening main cylinder is small.	Inspect the Solenoid Valve and Strainer.	Confirm the existance of sludge remaining in the bowl.	Refer to Table 5·11
	Failure in bowl	Clean up bowl.		
		Add one or more discs.		Refer to Fig. 6·53
		Assemble correctly tally marks, key groove or knock pin.		Refer to Fig. 6·54
		Remove contact with non-rotating parts.		
		Readjust the balance of bowl.		Refer to Table 1·1
	Defects in vertical shaft parts	Replace ball bearings with new ones.	Inspect the amount of lubricating oil and degree of deterioration.	
		Tighten spring retainers properly.	Check spring itself for fatigue.	
	Defects in horizontal shaft	Replace ball bearings with new ones.	Inspect the amount of lubricating oil and degree of deterioration.	
		Retighten spiral gear fixing bolts.		
		Replace horizontal shaft key with new one.		
	Rubber plate has hardened.	Replace with new one.	Confirm if anchor bolts are fastened uniformly.	
	Supporting base is weak.	Reinforced robust structure.	The vibration of oil purifier will differ when the ships at sea and at anchor. Moreover, it will also differ depending on the R.P.M. of main engine.	
Lubricating oil has been emulsified or amount of lubricating oil has been reduced.	Water mixed into gear case	Replace lubricaitng oil.	Confirm whether the lubricating oil complies with our recommendation or not.	Refer to Table 5·9
		Clean up operating water drain outlet.		
	Oil seal for horizontal shaft is abraded or damaged.	Replace oil seal with new one.		
		Supply additional lubricating oil.	Confirm whether amount of oil is proper or not on oil level gauge.	Refer to Table 5·7 Fig. 5·9

Phenomenon	Cause	Countermeasure		Remarks
		Action to be taken	Matters for confirmation	
Alarm of Water Detector gives a warning frequently (E-HIDENS II Type)	Backpressure is not acting upon the oil side.	Give a backpressure of 1.8 ~ 2.0 kg/cm^2		Refer to the Instruction Manual of Water Detector too.
	Variation of set value is great.	Backpressure ± 0.1 kg/cm^2 Oil temperature ± 5°C Flow rate ± 5% Adjustment shall be made so as to attain the backpressure, oil temperature and flow rate within the above scope.		
	Set value of Control Panel is not correct.	Reset the value in accordance with the Paragraph of 1.7.3.		

Remarks: Single or plural causes and actions are considered for one phenomenon.

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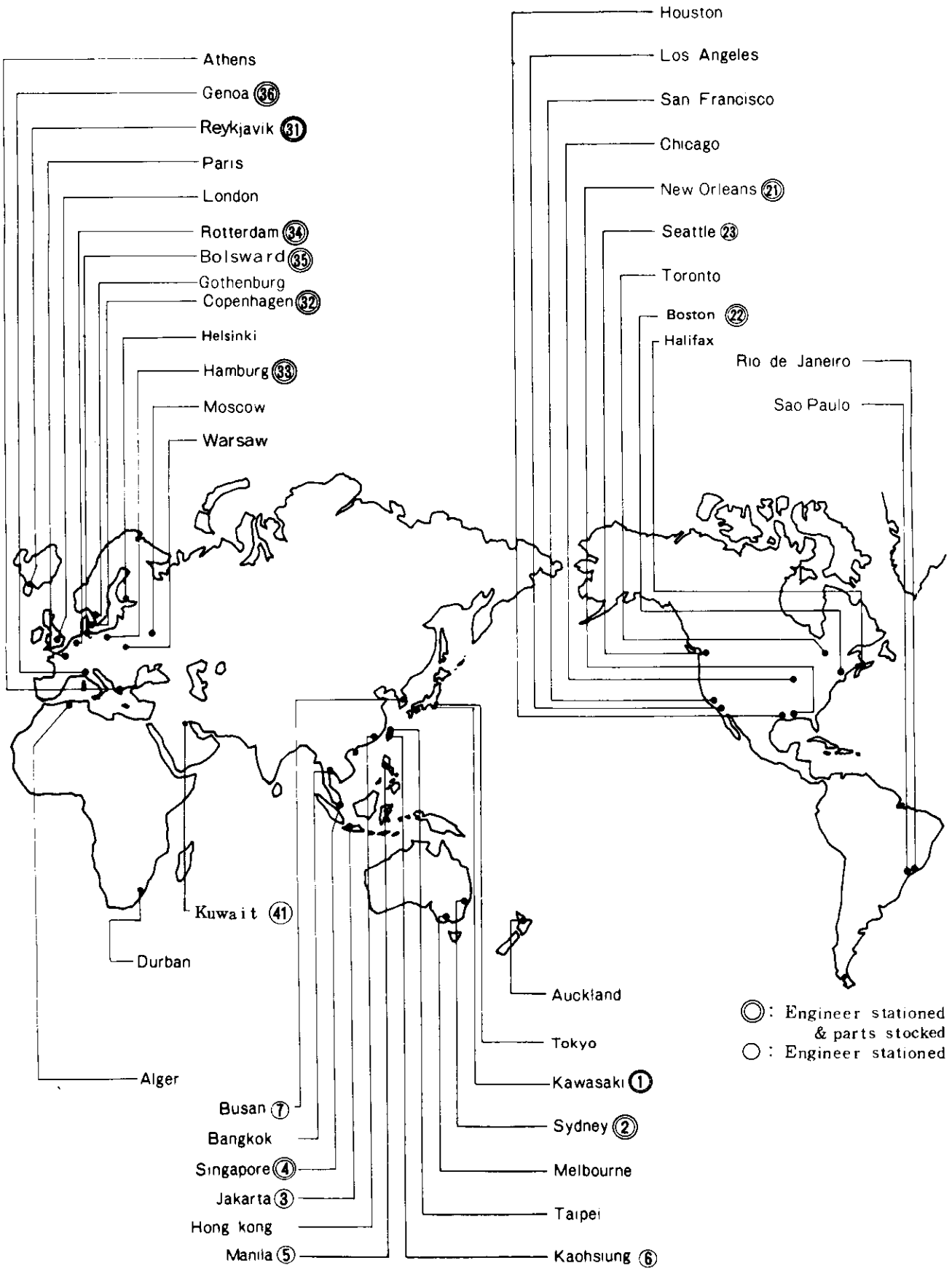

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	Mitsubishi International Corporation, Seattle Branch, Mach. Div.	Suite 2828, Seattle First National Bank Bldg., 1001, 4 Ave., Seattle, Washington 98154, U.S.A.	206-682-0744	328752	MITSUBISHI SEATTLE WASH
	Mitsubishi International Corporation, Houston Branch, Mach. Div	2 Houston Center, Suite 3800, Houston, Texas 77002, U.S.A.	713-654-4474	775442	MITSUBISHI HOUSTON TEX
	Mitsubishi Canada Ltd., Toronto Office, Mach. Dept.	Suite 2181, Commerce Court, West Tronto 111, Ontario, Canada	416-362-6731	065-24288	MITSUBISHI TORONTOONT
	Mitsubishi Canada Ltd., Vancouver Office, Mach. Dept.	28 Fl., Granville Square, 200 Granville St., Vancouver B.C. V6C1G6 Canada	604-682-0666	04-51327	
	Mitsubishi Corporado Brazil, S.A.	Rua Libero Badaro, 425, 35/37 Andar, Sao Paulo, Brazil	229-1411	1121927	
	Mitsubishi Corporation do Brazil, S.A. Filial do Rio De Janeiro Depto Maquinas e Projectos	Avenida Rio Branco, 123 8-Andar Rio De Janeiro R.J.	224-6632	2123390	MITSUBISHI RIODEJANEIRO

EUROPE

	Office or Works	Address	Phone	Telex	Cable Address
(31)	The Federation of Icelandic Fishing Vessel Owners (LIU)	Hafnarhvoli Vid Tryggragötu, Iceland P.O. Box 893 Reykjavik	29500	2090	
(32)	HI-PRES	373 Park Alle Box 40, DK-2600, Glostrup, Copenhagen, Denmark	02-45-2122	33302	TECNICONTRACT COPENHAGEN
(33)	SRS Consulting Engineering Office	2000 Hamburg 63, Hummelsbütteler Kirchenweg 71. West Germany	040-501096 040-501097	2174316	
(34)	Golten Service B.V.	Welplaatkade 19, Rotterdam-Botlek, the Netherlands P.O. Box 7340, 3000 HH Rotterdam	010-167900	28565	
(35)	ETO services B.V.	Postbus 101, 8700 AC Bolsward Indastriepark 4, 8701 PN Bolsward the Netherlands	05157-2300 05157-4380	46641	
(36)	Luigi Lupi	Salita S. Nicolo, 2R 16125, Genoa, Italy	010 29 8223	270060	
	Mitsubishi Corporation, London Branch, Mach. Dept.	Bow-Bells House, Bread Street, London EC4M 9BQ, United Kingdom	01-236-2060	888251	MITSUBISHI LONDON EC4
	Mitsubishi France (S.A.) Mach. Dept B	3 Avenue Hoche, 75008 Paris, France	755-9724	650000	MITSUBISHI PARIS
	Mitsubishi Hellas A.E.E. Business Dept. A	3, Mitropoleos Street, Athens, Greece	32-48115	215332	MITSUBISHI ATHENS
	Mitsubishi Corporation, Warsaw Office	Pensjonat Zgota 00-031 Warszawa, U1 Szpitalna 6, Poland	27-8421	814319	MITSUBISHI WARSZAWA
	Mitsubishi Corporation, Moscow Office	Room 706-708, Dom 12 Krasnopresnenskaja, Naberezhnaja Moscow 123610, U.S.S.R.	253-8286 253-8279	413387	MITSUBISHI MOSCOW

MIDDLE EAST & AFRICA

	Office or Works	Address	Phone	Telex	Cable Address
(41)	House of Trade & Contracting CO.W.L.L.	P.O Box 2518 Safat, 13026 Safat Kuwait	(965)-3986194 (965)-3986197 (965)-3986198	30014 30138	
	Mitsubishi Corporation, Bureau de Liasion d'Alger, Algeria	12, Rue Docteur Lucien Reynaud Alger, Algeria	607511 607489	52689	

MITSUBISHI SELFJECTOR EXCELLENT-SERIES
INSTRUCTION MANUAL

MODEL	SJ20T,	SJ20P,	SJ20EH
	SJ25T,	SJ25P,	SJ25EH
	SJ30T,	SJ30P,	SJ30EH
	SJ40T,	SJ40P,	SJ40EH
	SJ60T,	SJ60P,	SJ60EH

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MITSUBISHI KAKOKI KAISHA, LTD.
MACHINERY DESIGN DEPARTMENT

Kawasaki Works: 2–1, Okawa-cho, Kawasaki-ku,
Kawasaki-shi, Kanagawa, JAPAN

TEL: (044) 333–5357
TELEX: 3842–129