

DUAL LINE LUBRICATING SYSTEMS

MODEL : KEP-16L

MOTOR-DRIVEN LUBRICATING PUMPS

INSTRUCTION MANUAL

**KWK** KOWA CORPORATION

## Introduction

Thank you very much for purchasing the DUAL LINE LUBRICATING SYSTEMS.

This instruction Manual has been compiled as a practical guide for the operation and maintenance of the lubricating system which incorporates the Model KEP-16L motor-driven lubricating pump.

All descriptions contained herein are based on the standard system, which may, therefore, be different from those of purchased system. Such a problem can be solved by referring to the final specifications. However, it is required to understand that some changes caused by the modification of equipment may not be described in the final specifications.

## Guarantee

The guaranteed period this system will be one year from the commencement of operation. Any defect or failure occurring during the guaranteed period, for which KWK is liable in design and manufacturing, shall be corrected and / or eliminated by KWK without compensation. However, any defect or failure caused by improper operation which is not described in this Instruction Manual shall not guaranteed, even though the defect or failure occurs within the guaranteed period.

## PRECAUTIONS OF SAFETY

Before the installation, operation, maintenance and inspection, read carefully this instruction manual and other accompanying documents for correct service.

Familiarize with the knowledge of equipment, information of safety and all of cautionary instructions for service.

The precautions of safety is shown in each equipment of the centralized lubricating system by using safety mark.

Particular attention should be called to the places where these safety marks are given.

The safety marks are divided into "WARNING" and "CAUTION".



If mishandled; In case a dangerous situation may occur, it could result in death or serious injury



If mishandled; In case a middle injury or light injury, and in case a physical damage may occur.

For the matter being mentioned in the CAUTION, it may result in an importance according to circumstances. The important content is given to all of safety mark, and obey it without fail.

This system provides the max. working pressure 21MPa(210kg/cm<sup>2</sup>). When each equipment is disassembled and inspected, stop the operation of pump, and release the pressure to perform the operation as 0MPa(0kg/cm<sup>2</sup>).

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## 1. General description of DUAL LINE LUBRICATING SYSTEMS (loop type)

### 1-1 Outline of lubricating equipment

This system comprises motor-driven lubricating pump unit which will supply grease or oil to high pressure, external piping, measuring and control panel which is used to operate the lubricating system.

The schematic diagram of this system is as shown in Fig.1.

All the following descriptions are for the type used for greasing. When used for oil lubrication, the measuring valve and the tank of the pump are changed but all the other parts are commonly.

The motor-driven lubricating pump unit consists of pump body, electric motor, and hydraulic-operated reversing valve, all of which are mounted on a common base made of steel plate.

A reservoir made of steel plate is installed on the top of the lubricating pump, on which a level rod is provided to indicate the amount of grease stored in the reservoir.

A pressure gauge is also attached to the lubricating pump unit to show the discharge pressure of the pump.

The outside piping consists of the two lubricating mains of parallel piping from the two outlets on the hydraulic-operated reversing valve of the lubricating pump and the branch piping from the main piping to the measuring valve and lube piping from the measuring valve to the lubricating points.

The optimum type of measuring valve is selected according to the number of lubricating port.

In addition, a control panel is provided for automatic operation of the lubricating pump.

Also installed is lubricating pump which serves to supply grease into the reservoir.

## 1-2 Out line of lubricating circuit

The schematic diagram of the lubricating circuit is as show in Fig.2 (A and B).

Fig.2 (A) indicates that the discharged grease from lubricating pump is transferred in the arrow direction through the hydraulic-operated reversing valve (KRV).

While Fig.2 (B) shows that the grease transferred to No.2 line and No.1 line are open to the reservoir.

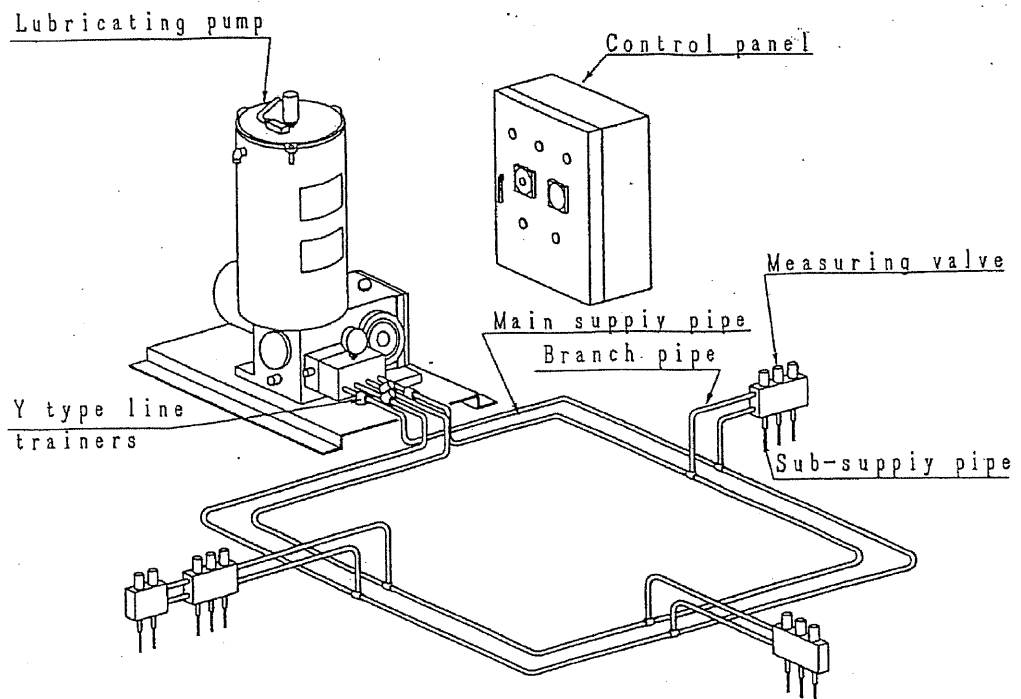


Fig.1 Schematic diagram of lubricating circuit

In Fig.2 (A), grease discharged from the lubricating pump passes through the hydraulic-operated reversing valve and flows through the line No.1 in the direction of arrow. The grease is then fed under pressure into each measuring valve through the upper side inlet (supply port) to complete one lubricating operation.

Upon completion of lubricating operation, the hydraulic-operated reversing valve is changed over by the pressurized grease at the return port of the No.1 line. This allows the lubricating circuit to from a circuit shown in Fig.2 (B). Simultaneously with the above, a limit switch attached the reversing valve is actuated to stop the lubricating pump drive motor. When the motor is restarted, grease is supplied under pressure through the No.2 discharge line in the direction of arrow shown in Fig.2 (B).

The grease is then fed under pressure into each measuring valve through the lower side inlet (supply port) to perform the second lubricating operation.

Upon completion of the second lubricating operation, the hydraulic-operated reversing valve is changed over again by pressurized grease at the return port of the No.2 line.

This allows the lubricating system to from the circuit shown in Fig.2 (A).

Simultaneously, the limit switch is actuated to stop the lubricating pump. The lubricating cycles described and illustrated in Fig.2 (A) and (B) are alternately repeated until the lubricating operation is completed.

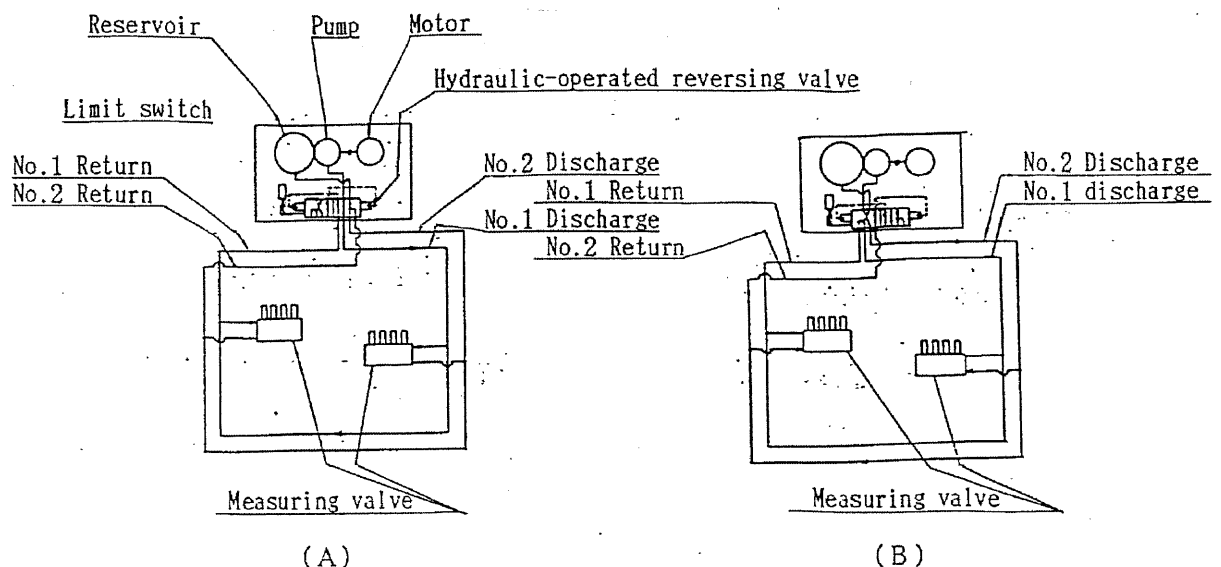


Fig.2 Lubricating circuit

### 1-3 Specifications of equipment

#### (1) Specifications of lubricating pump

Nomenclature	Item	Lubricating pump model and specifications
		KEP-16L
Pump	Applicable grease	NLGI No.00~No.1
	Discharge capacity (cm <sup>3</sup> /min)	37/50Hz, 45/60Hz
	Discharge pressure (MPa)	Max.20.6 *
	Pump's revolutions (rpm)	75/50Hz, 90/60Hz
Gear motor	Type	Totally enclosed, three-phase induction motor, continuous rating, class "E" insulation
	Output × No. of poles	0.1kW × 4P
	Voltage, Frequency	3 φ - AC200/220V, 50/60Hz *
		3 φ - AC400/440V, 50/60Hz *
	Reduction gear ratio	1/20
Reservoir	Capacity (Lit.)	6
	Level switch	Low level switch 1 stage *
Hydraulic-operated reversing valve	Model	KRV-22L
	Pressure range (MPa)	4~18
	External pipe joints	2×Rc(PT)3/8
Total mass (kg)		43

- ① For the outside dimensions and the internal structure, please refer to the drawings of the principal equipment at the end of this manual.
- ② Check the column with asterisk mark (\*) referring to the final specifications.
- ③ Order by code

KEP-16 -

— Voltage of elect. motor

25 : AC200V, 50Hz, 3 φ

26 : AC220V, 60Hz, 3 φ

45 : AC400V, 50Hz, 3 φ

46 : AC440V, 60Hz, 3 φ

— Piping system

SL : Short loop system

L : Loop system

(2) Specifications of measuring valve

Measu ring valve size	Model	Discha rge ports	Discharge capacity cm³/stroke		Adjustable amount cm³/one revolution of screw	Mounting bolts (Attachme nt)	Mass (kg)	Pipe joints	
			Max.	Min.				Inlet	Discha rge
KS-30	KS-31	1	1.2	0.2	0.06	M8×65L	1.2	PT3/8	PT1/4
	KS-32	2					2.0		
	KS-33	3					2.8		
	KS-34	4					3.7		
KS-40	KS-41	1	2.5	0.6	0.10		1.4		
	KS-42	2					2.3		
	KS-43	3					3.2		
	KS-44	4					4.0		
KS-50	KS-51	1	5.0	1.2	0.15		1.5		
	KS-52	2					2.5		
	KS-53	3					3.5		
	KS-54	4					4.6		
KW-30	KW-32	2	1.2	0.2	0.06	M8×75L	1.5		
	KW-34	4					2.5		
	KW-36	6					3.5		
	KW-38	8					4.5		
	KW-310	10					5.5		
KW-50	KW-52	2	5.0	1.2	0.15		1.5		
	KW-54	4					2.5		
	KW-56	6					3.5		
	KW-58	8					4.5		

① The working pressure is 1MPa or lower.

② Working pressure : 21MPa

[The maximum working pressure of measuring valve using oil should be 10MPa.]

③ Applicable grease : NLGI No.00~No.1

## 2. Installation of equipment and piping procedure

### 2-1 Installation of lubricating pump

The lubricating pump is designed so as to be used indoor. It should be kept in mind that the pump is to be accommodated in a shed or housing capable of protecting the machine from weather, when being installed outdoor.

Maintenance of the machine should be easy even during operation, and the place should be free from excessive dust, temperature change and moisture.

Install the lubricating pump horizontally on a sturdy channel or concrete foundation.

Note that if stresses are locally applied to the lubricating pump frame when the foundation bolts are tightened, it may cause deflection of the pump center alignment and early damage to unit.

In either case, the pump base should be raised more than 50mm above the floor surface in order to facilitate the maintenance, inspection and water draining. Set up the control panel in place where the lubricating pump can be easily operated and controlled.

### 2-2 Piping procedure

#### (1) General precautions

As shown in Fig.1, the piping consists of the main supply pipes coming from the hydraulic-operated reversing valve of the lubricating pump unit, branch pipes running from the main supply pipes to the measuring valve, and the sub-supply pipes from the outlets of the measuring valve to lubricating points or bearing to be lubricated. All pipes should be supported properly so as to prevent them from being damaged by vibration, and should not be laid on locations where the pipes may be damaged by other obstacles.

#### (2) Connection of main supply pipes and branch pipes

The main supply pipes and branch pipes between the lubricating pump and measuring valve are subject to pressures as high as 21MPa. This fact requires that pipe material incorporated in the above pipe lines should safely withstand the pressure and should have an inside diameter which allow grease to flow smoothly.

Use the steel pipes of STPG 38 (schedule 80) or of more higher grade.

The lubricating pump is operated at the maximum discharge pressure of 10MPa or 21MPa.

If the use at the maximum pressure of 21MPa is predetermined, the pump is delivered with the specifications for 10MPa. In this case, STPG 38 (schedule 40)

may be used as the piping material.

If the lubricated points of a machine include any moving part which slides or swings, flexible hoses is used for the sub-supply pipes.

To the moving parts of the main supply pipes and branch pipes, use the high-pressure rubber hoses for the maximum working pressure 21MPa.

Where the hoses surface may possibly be worn out by sliding, use wire braided hoses on the surface.

(a) Installation of pressure gauge.(Recommendation)

Install the pressure gauge near the hydraulic-operated reversing valve for No.1 and No.2 return lines of the main supply pipes as in Fig.3 in order to check the grease pressure.

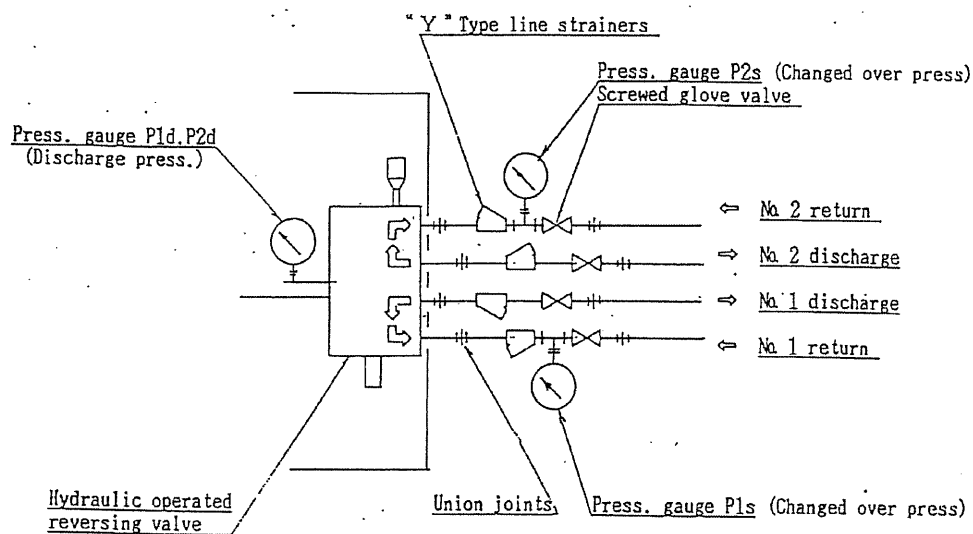


Fig.3

(b) "Y" type line strainers and glove valves.

As shown in Fig.3, the "Y" type line strainers should be installed on the discharge and return pipes of the hydraulic-operated reversing valve.

It should be kept in mind that the strainer is to be installed so that it can be removed and cleaned easily, with its installation direction corresponding to the flow direction of grease.

Also, be sure to install the screwed globe valves and pressure gauge as illustrated in order to check the lubricating pump performance and to provide convenience when the system is out of order.



(c) Attaching 2-way check valve

When the main supply pipe rises from the lubricating pump level more than 5 meters or when oil is used, attach 2-way check valve near the lubricating pump in series with the “Y” type line strainers to prevent reverse flow of the grease.

(3) Mounting measuring valve

- (a) It isn't advisable to attach the measuring valves directly to the main supply pipes. Unlike the case attached to the branch pipes, direct attaching to the main supply pipes makes it difficult to continue operation of the system when the measuring valves must be removed for piping line improvement in future or for troubles. It also can cause error motion of the whole system due to air allowed into the main pipes.
- (b) When measuring valves are connected in series, limit the number of pieces to about 3, in principle. When more than three measuring valves are used, branch a separate pipe from the main pipe for the piping connection. If the spacing between measuring valves is 0.5 meter or shorter, however, up to 5 measuring valves can be attached.
- (c) The measuring valve should be mounted on a support exclusively used for this purpose or separately fabricated base plate equivalent to the aforementioned support. The measuring valve should be installed at the location as close to the lubricating point as possible, where its indicator rods can be seen easily from the surrounding areas, and where the amount of supplied grease can be adjusted easily.
- (d) The measuring valve should be protected with a steel plate cover, when being installed at the dusty location often splashed with water and subject to a high radiation heat.
- (e) Blank the ends of the measuring valves attached to the branch pipes and main supply pipes with a high-pressure plug.
- (f) To confirm the lubricating operation of measuring valve easily, the branch pipes should be connected correctly to the measuring valves so that the indicator rod of the respective measuring valves move in same direction. In a more detailed explanation, all pipes branched from No.1 discharge line should be connected to the upper ports of the respective measuring valves. (The same result may be obtained even if the pipes branched from No.1 line are connected to the lower ports of the measuring valves.)

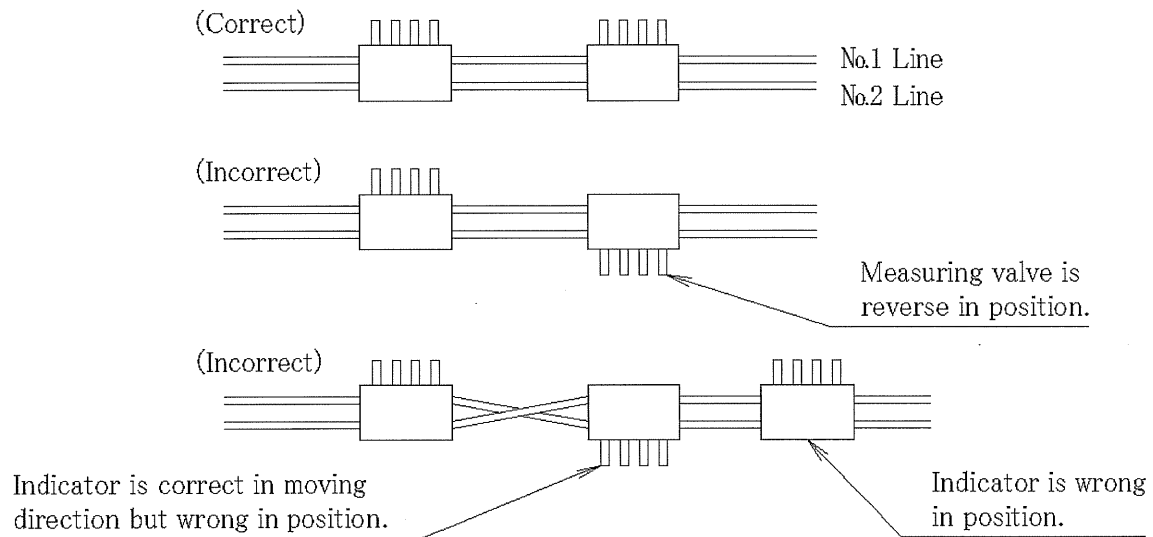


Fig.4 Connection of measuring valve

#### (4) Connection of sub-supply pipes (Lube piping)

- (a) Since the pressure required for greasing against the back pressure of bearings and resistance of the sub-supply pipes reaches the maximum operating pressure, it is necessary to use the material which withstands the pressure of 3MPa for the piping from the measuring valves to the points of lubrication.

For the piping, 8A (1/4B) steel pipes or 6  $\phi$  and 8  $\phi$  copper pipes are used.

- (b) When the bearings are submitted to a high back-pressure, prevent reverse flow of grease and error motion of the measuring valves by using check valves or inverseflow check valves. (Select the piping material carefully as the withstand pressure of the sub-supply pipes also changes in this case.)
- (c) Bearings must be composed so as to ensure discharge of old grease.  
For sealed type bearings, it is necessary to lead the filled grease to the outside by attaching a relief valve to the bearings.
- (d) When the lubricated points of a machine include any moving part which slides a flexible hoses must be used.

### 3. Construction and function of lubricating pump

#### 3-1 Construction of pump

As for sectional assembly drawing of the lubricating pump proper, refer to Fig.9. The lubricating pump proper is placed below the reservoir and the driving power of the motor is transferred to the cam shaft in pump casing through the coupling to turn the two cams. Rotation of the cams reciprocates the two plungers to draw grease from the reservoir through the check mechanism and to discharge the grease through the discharge port.

Grease is drawn in plunger return process by the guide plate and discharging is made in push-out process by the cams.

Through lubricating is made alternatively by two plungers, only one discharge port is provided as the lubricant path is shorted in pump.

#### 3-2 Pressure relief valve

This pressure relief valve is mounted on the side part of reversing valve. The pressure relief valve serves to release the inner pressure when the pipe clogged for some reason. The pressured grease, released from the pipe, is admitted into the reservoir to protect the lubricating system from being damaged.

The pressure relief valve is available in the following 2 types.

Lubricating pump model	Maximum discharge pressure	Relief valve set pressure
KEP-16L	21MPa	23MPa $\pm$ 0.5MPa
KEP-16SL-K	10MPa	11MPa $\pm$ 0.5MPa

The pressure relief valve has been adjusted in KWK factory in accordance with the specifications at the time of concluding the agreement, before being delivered. Therefore, it is recommended that relief valve should not be adjusted at the site. The pressure relief valve which has been set at 11MPa can be distinguished from other valves by the mark stamped on the cap and by red paint.

### 3-3 Reservoirs

#### (1) Reservoir

The reservoir is to store grease. A follower plate is provided in the reservoir so as to level out the grease surface along with grease consumption and to shut off the outside air.

On the center of the follower plate, a level rod is placed vertically going through the cover at the top of the reservoir and a cylindrical cam for level switch is provided on level rod.

A grease overflow port is also provided at the upper part for overflow of excessively filled grease.

#### (2) Low level switch

If grease is consumed until the reservoir is emptied, air is admitted into the pump, and may also be admitted into pipe line. Once air is admitted into the pipe, the lubricating operation becomes extremely unstable.

In the extreme case, grease must be drained completely from the pipe line in order to purge air, and the pipe line must be refilled with new grease.

A low level switch is provided at the upper part of the reservoir as the standard specification so that the pump operation stops and alarm is given when the grease is consumed to certain limit.

The cam to operate the low-level switch is at the upper end of the level rod.

When the grease is used and the follower plate comes down to certain level, the level rod directly connected to the follower plate also comes down, and the cam actuates the low level switch.

The signals from the low level switch is transferred to the control through the terminal box of the pump to issue alarm and to stop the motor.

### 3-4 Hydraulic-operated reversing valve

#### (1) Construction and function

This reversing valve serves to feed grease discharged from the pump alternately to the two main supply pipes. The grease fed by the pump pass through the reversing valve, and is sent to one main supply pipes, and actuates measuring valves. And the pressure in piping becomes high. The grease with which pressure became high returns to the reversing valve through its return port, actuate the valve piston. The aforementioned piston movement changes over the grease passage so as to be connected to the other main supply pipe.

The composition is as shown in Fig.5.

A slide block and two main pistons and a pilot piston are provided in the reversing valve.

The slide block is pressed down by the spring through the kink. And has the structure of holding change pressure.

(2) Function

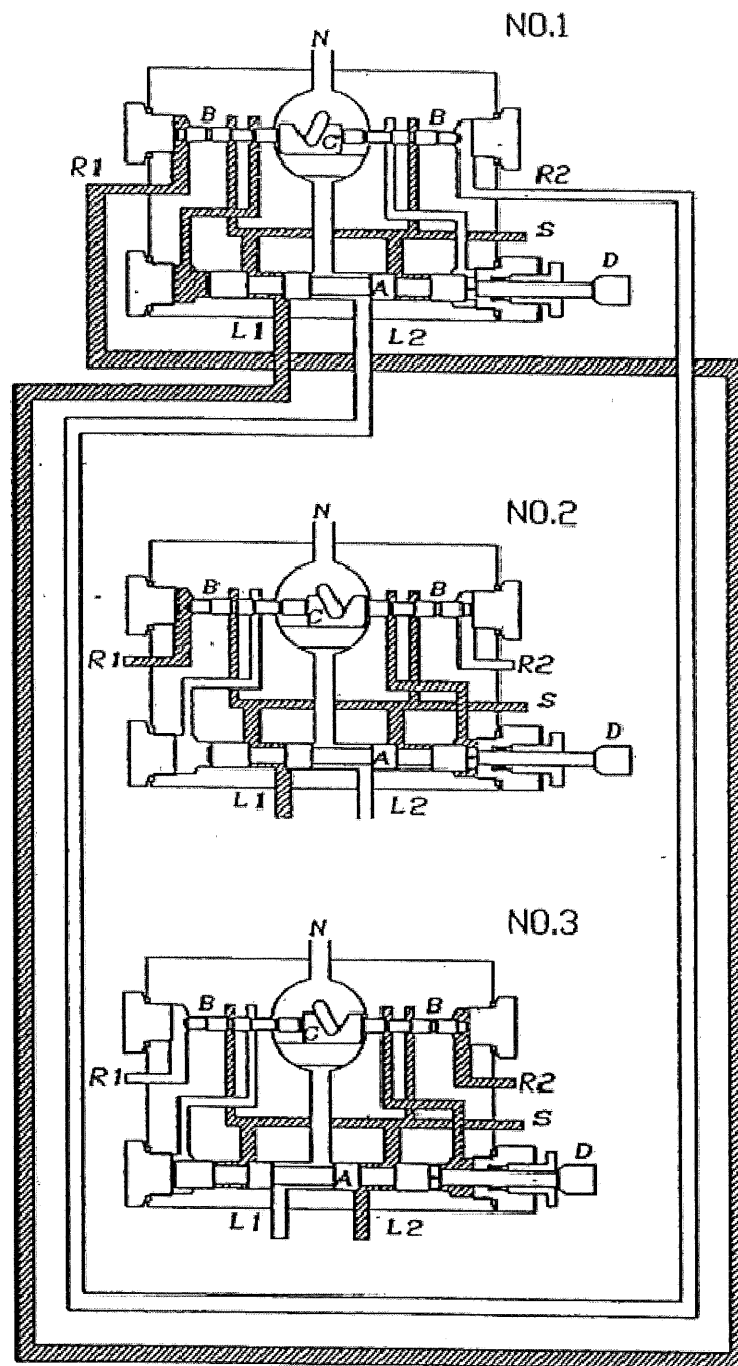


Fig.5

- (a) In No.1 of Fig.5, grease pressurized by the pump passes through the inlet S and is forced into the main supply pipe L1 by means of the piston A. At this time, the other main supply pipe L2-R2 is connected to the reservoir through N.

The darkened part of Fig.5 shows the existence of pressurized grease.

When the inner pressure of the main supply pipe L1 is raised, and all measuring valves complete their operations, the pressure at the end of the return pipe R1 from L1 begins to increase.

- (b) When the pressure in R1 exceeds the set value, the rack piston B is moved to the right as shown in the No.2 of Fig.5. During this movement, grease entering into the cylinder through the inlet S is forced against the right end of piston A by the movement of piston B.

At the same time, the left end part of the piston A is connected to the relief line N.

- (c) Grease entering the cylinder through the inlet S and pressurized by the pump moves the piston A to the left, as shown in the No.3 of Fig.5. Upon completion of the above movement, the main supply pipe L1 and its return pipe R1 are connected to the relief line N. During this movement, the grease from the inlet S is fed to the main supply pipe L2. The piston A is provided with a switch lever D, as shown in Fig.5, so that the line reversing operations can be observed from the outside.

The switch lever D actuates the limit switch when moving to the right and left, by which the lubricating pump is stopped.

When the lubricating pump is started again, grease is admitted into the main supply pipe L2 as shown in No.3 of Fig.5.

After all the measuring valves have been actuated by grease pressurized by the pump, the pressure exceeds the set value, the piston B is moved to the left. With the movement of the piston B, the pressurized grease from the inlet S is forced against the left end of the piston A. This allows the piston A to move to the right as shown in No.1 of Fig.5. At this time, the limit switch is actuated by means of the switch lever D, and the lubricating pump stops.

Adjustment of this oil pressure change valve adjusts the pressure of a pipe end required in order to move the slide plate C in the opposite direction with piston B.

The line reversing pressure of the hydraulic-operated reversing valve has

been adjusted at 4MPa KWK factory before delivery.

### 3-5 Difference between lubricating pumps of 21MPa and 10MPa

The KEP model motor-driven lubricating pump is available in two different types ; 21MPa and 10MPa types according to the discharge pressure of the system. These two types of lubricating pump are completely similar appearance, but are different in the following three points.

#### (1) Pressure gauge

Lubricating pump	Pressure gauge indication, max.
21MPa type	35MPa
10MPa type	20MPa

#### (2) Name plate

Identifications marked with [ ] are different as follows.

Identification	21MPa	10MPa
MODEL KEP-16L [ ]	Blanked	Stamped with "K"
DIS. PRESSURE [ ] MPa	21	10

#### (3) Relief valve

The respective type of lubricating pump are distinguished from each other paint color of the cap.

21MPa type ; Coated with paint, whose color is the same as the pump body's

10MPa type ; Coated with red paint, and the edge surface is stamped with "110K"



#### 4. Trial operation

##### 4-1 Confirmation before operation

- (1) Check the installation, piping and wiring before test operation.
  - (a) Unions and flanges of main supply pipe and branch pipe operation.
  - (b) Sub-supply pipes connected to all bearings to be lubricated.
  - (c) Plug of measuring valve.
  - (d) Electric wiring on the primary and secondary sides.
- (2) Lubricant replenishment to the motor with reduction gear.

Before shipment, grease is already sealed in the gear casing of the motor with reduction gear.

Lubricating pump model	Reduction gear casing	Recommended brand
KEP-16L	0.5kg	SHELL ALVANIA EP-R000

##### (3) Direction of pump rotation

- (a) Turn on the power source switch and control source switch. Depress the pushbutton switch for manual starting, and confirm the direction of motor rotation.

Follow the arrow mark on the cooling fan cover. The correct rotation is to the clockwise from the cooling fan side.

##### (b) When turns is reverse direction

If the pump turns in reverse direction, stop it immediately without keeping operation for a long time. (Check the rotational direction within a short time and with no load as the cam and the piston are broken if turned in reverse way while applying load to the pump.)

- (c) If the rotating direction is reversed, the motor should be rewired by interchanging the 2 lines of 3 power lines.

#### 4-2 Grease selection

There are quite a different kinds of grease of different quality and characteristics. Select a suitable grease to the operating conditions out of the recommended kinds of grease given below.

Ordinarily, any grease is applicable within the range of NLGI standard No.00 No.1 (fluidity 430 to 310).

Note:

##### 1. Molybdenum or graphite-filled grease

Solid lubricant is on will affect the life of the pump (wear).

If the particle size is 1 $\mu$ m or less, it can be used almost without problems.

If the particle size is about 1~3 $\mu$ m, it can be used . But wear becomes violently.

It can not be used if the particle size is greater than 3 $\mu$ m. (Pump life will be extremely short.)

##### 2. Grease containing metals in powder form such as copper and zinc can not be used.

Name of company	Brand
ESSO Standard oil Co.	LITHTAN No.0~No.1 LITHTAN EP No.0~No.1
Shell International Petroleum Co.	ALVANIA EP GREASE No.0~No.1 ALVANIA GREASE No.0~No.1 EP GREASE No.0~No.1
Mobil Oil Co.	MOBIL PLEX 45,46 MOBILUX 1

#### 4-3 Grease filling

(As the grease for filling, use the same brand as the one used for each customer.)

##### (1) Filling reservoir with grease

Fill the grease into the reservoir by the pump with care not to allow intrusion of dust or air from the filling port (snap-on coupling) on the side of lubricating pump unit.

NOTE : The reservoir should never be filled with grease from the upper side, with the top cover and the follower plate removed. Such a filling manner may cause unexpected trouble during operation.

(2) Filling sub-supply pipe (Lube Line) with grease.

The sub-supply pipe ranging from the discharge port of measuring valve to the lubricating point should be filled with grease by means of a grease gun, before commencing the operation.

After filling grease, connect the sub-supply pipes to the measuring valves.

(3) Filling main supply and branch pipes with grease.

(a) Preparation

- a) Remove the plugs at the end of No.1 and No.2 lines of the hydraulic-reversing valve so that the grease and air in the piping can be drawn out. Fully close the screw type glove valve near the pump.
- b) Remove the measuring valve plugs (R3/8) at the end of the branch supply pipe to let out the air.
- c) Receive the grease coming out from the points where the plugs are removed in the above a) and b) with a vinyl bag, pail or waste cloth.
- d) For grease filling, it is necessary to operate the lubricating pump for several hours or longer in continuity. Since the maximum setting of the protective timer is 30 minutes, alarm is given and the pump stops when operation for more than 30 minutes. To prevent the alarm only for the test run, remove the protective timer on the control panel.  
(The alarm is given only at empty reservoir or motor overload when the pump is operated under this condition.)

This isn't necessary when a filling pump is used for grease filling.

NOTE : Be sure to attach the protective timer to the original condition when grease filling completes.

(b) Filling procedure

- a) Turn the power switch to 「ON」 to operate the lubricating pump.
- b) Air is drawn out through the measuring valves where the plugs (R3/8) are removed, then the grease comes out but refrain from plugging the measuring valves soon. Take out the grease coming out to compare with new grease and plug the measuring valves only after making sure that equally clean grease to unused grease comes out.
- c) When grease is filled into the main supply pipe and returns to the return port of the hydraulic-operated reversing valve, check for no inclusion of foreign matter in the same way as for the preceding item, and stop the lubricating pump after measuring the pipe fluid

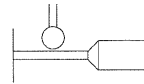
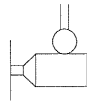
resistance.

d) Pipe fluid resistance measurement

When there is no pressure gauge near the tail end of the main supply piping, as shown in Fig.3, prepare for the changed over adjusting work as described below, and measure the pipe fluid resistance for recording. During the work of item c), check the pressure of the lubricating pump and record the point of the highest pressure when the grease comes out of the tail end of the main supply piping.

e) Piping system check

For judgment of grease discharge by No.1 line of No.2 line, the switch cam of the hydraulic-operated reversing valve is checked.

Discharge line	Switch cam position	
No.1 line	Out	
No.2 line	In	

f) Operate the lubricating pump, then the grease is discharged again through the filled line (No.2 line for example), and the pressure increase little by little this time because the piping is connected.

By the pressure the hydraulic-operated reversing valve is operated eventually and the switch cam is pushed out. Then the limit switch functions to transmit greasing completes signal and the lubricating pump motor comes to a stop.

g) Operate the lubricating pump again. Since the hydraulic operated reversing valve is changed, No.1 line is filled this time.

Fill in the grease in the same procedure as for No.2 line and plug the tail end of the main supply piping at the end, and mark sure that the hydraulic-operated reversing valve is changed and the lubricating pump cams to a stop automatically.

(c) After filling

When both lines are filled completely, turn off the power switch and attach the protective timer which was removed in the procedure 4-3-(3)-(a)-d).

Also clean the joints and plugs of the measuring valve in preparation for the following grease leak test. The filter of the "Y" type line strainer shall be cleaned as well.

4-4 Leak test

This is check the line for no grease leakage from the pipe joints when the maximum discharge pressure 21MPa of the lubricating pump is applied.

Carry out the test in the following order.

- (1) Set the protective timer at about 15 minutes and operate the lubricating pump.
- (2) Loosen the lock nut of the hydraulic-operated reversing valve, are increase the pressure by controlling the pressure adjust screw so that the selector may not be switched.
- (3) The pointer of the pressure gauge to lubricating pump goes up slowly reaching 23MPa in due course. (As the hydraulic-operated reversing valve is not changed, the pressure in the piping line goes up and the relief valve of the lubricating pump functions.)
- (4) The protective timer function 15 minutes later to give over time signal and the lubricating pump comes to a stop.
- (5) Turn off operation power switch to reset the alarm then turn on the switch soon again.
- (6) By controlling the pressure adjust screw of the hydraulic-operated reversing valve to lower the pressure slowly, then the selector is changed and the grease pump comes to a stop.
- (7) Operate the lubricating pump again to test leakage of the other line in the same procedure.
- (8) When the alarm is given and the lubricating pump comes to a stop, turn off the control power and go around the whole piping to check for no leakage.
- (9) Loosen the adjust screw to the original condition (condition of no spring pulling) to adjust the change-over pressure.

4-5 Measurement and adjustment of discharge pressure (change-over pressure) and pipe end pressure (P1e and P2e) (See Fig.3)

- (1) While operating the grease pump, record the highest reading of the pipe end pressure (P1e and P2e) and the discharge pressure (P1d and P2d) immediately before the end of greasing, then wait for automatic stopping.

Discharge line	Discharge pressure	Piping end pressure
No.1 line	P1d=MPa	P1e=MPa
No.2 line	P2d=MPa	P2e=MPa

- (a) Discharge pressure . . . . Read the pressure gauge of the lubricating pump.
- (b) Changed over pressure . . . . Read the pressure gauge attached near to the end of piping in Fig.3.

NOTE : Judge discharging to No.1 line or No.2 line by checking the switch cam of the hydraulic operated reversing valve. (Fig.11)

- (2) Operate the grease pump again and increase the change-over pressure gradually by controlling the pressure adjust screw of the selector. After making sure that the pipe end pressure (P1e and P2e) is up to about 4MPa, wait for automatic stopping. Check the position of the indicator rod in preparation for the next operation check of the measuring valve.

4-6 Measuring valve operation check

- (1) Check whether the indicator rod each measuring valve is out or in and mark all the measuring valves with pencil stone or chalk. Operate the lubricating pump and wait for completion of lubricating and automatic stop.
- (2) After making sure that the changed over pressure (P1e and P2e) is up to about 4MPa, check the indicator rod position of each measuring valve.

The rod should be moved to the opposite side of the position marking is above item (1). Erase the marks where the indicator rod is moved.

- (3) Where the indicator rod position does not coincide, the indicator rod is not moved.
- (4) Operate the pump again and record the discharge pressure of the other line.  
By this operation, the indicator of the measuring valve returns to the original position.
- (5) For any measuring valve of which indicator rod does not move, refer to paragraph 4-8.

#### 4-7 Changed over pressure adjustment

When the indicator rods of all the measuring valves are operated, adjust the changed over pressure in the following manner so that the measuring valve operate exactly for the next lubricating.

##### (1) Adjusting method

Loosen the lock nut of the hydraulic-operated reversing valve and adjust the changed over pressure by turning the adjust screw while watching the pressure gauges (P1e and P2e). Operate the pump while checking the changed over pressure.

(Left turn of the adjust screw increases the changed over pressure.)

##### (2) Increase the changed over pressure by 1MPa.

After the adjustment, the reversing pressure (Pn) becomes as follows.

$$P1n = P1e + 1$$

$$P2n = P2e + 1$$

##### (3) When the pressure gauge P1e and not provided :

If there are no pressure gauge P1e and P2e are provided near the pipe end, it isn't possible to know the changed over pressure directly. In this case, the pressure is obtained by following equation. Pump discharge pressure (P1d and P2d) pipe fluid resistance = pipe end pressure. As the pipe fluid resistance, the valve measured in 4-3, (3)-(b)-d) (Page 18) is used. To increase the pressure by 1MPa, therefore the pressure adjust screw shall be turned so that the peak pressure becomes equal to P1d and P2d measured in paragraph 4-6, (1) plus 1MPa.

##### (4) Minimum operating changed over pressure.

As described above, the changed over pressure must be set for use at least at 5MPa. (4MPa+1MPa or up when delivered)

(5) Lock nut locking

After the pressure adjustment, be sure to fasten the lock nut. If neglected, the pressure adjust screw is turned by vibration and the changed over pressure may be disordered.

4-8 For any measuring valve with non-operating indicator rod

- (1) When the bearings are subjected to back pressure, particularly for hydraulic turbines of power plants, the indicator rod may sometimes fail to operate unless the changed over pressure is increased.

Changed over pressure = back pressure + approx. 40kg/cm<sup>2</sup>.

Approximately the pressure given by the above equation is required.

- (2) For the indicator rod (piston) of no operation, remove the sub-supply pipes.  
(3) Operate the lubricating pump, wait for automatic stop, then check for operation.

(a) When operated

The sub-supply pipes and bearings are in trouble.

- a) Check the sub-supply pipe for no breakage.  
b) Set a pressure gauge at the top end of a grease gun to feed grease directly from the sub-supply pipe to the bearings and check the back pressure.

The conceivable causes are :

- b)-1 Back pressure is high by nature and high back pressure is normal.

(take the measure of (3)-(b)-b) )

- b)-2 Measuring valve piston fails to operate as the bearing is filled fully with grease and there is no grease relief. Attach a relief valve to the bearing in this case.

- b)-3 Inadequate design or machining of bearing.

(b) When operation fails

- a) In most cases, the piston is sticking due to foreign substance in the piping and allowed into the measuring valve. (Normal measuring valve operates at 10kg/cm<sup>2</sup> or lower.)

- b) Take the following measure.

- b)-1 Increase the change-over pressure little by little to the point where the indicator rod moves, set the pressure adjust screw at the change-over pressure plus 10 to 20kg/cm<sup>2</sup>.

Set the screw within the change-over pressure adjust range of 40 to 180kg/cm<sup>2</sup>.



b)-2 If the operation still fails even with increased pressure, clean the measuring valve.

Refrain from grinding the piston with sand paper at the cleaning as the discharge efficiency is lowered.

#### 4-9 Record of test run

At the end of the test run, carry out the check in accordance with the test run record shown at the end of this manual for final confirmation.

- (1) Lubricating time, discharge pressure (changed over pressure).

Operate the lubricating pump for several times of lubricating and record the average time and pressure.

- (2) Checking automatic start-up of pump.

Put the start timer pointer close to 0 hour as much as possible and make sure that the pump starts automatically.

- (3) Alarm buzzer and alarm check (while operating the pump)

- (a) Grease low level

Check by the pushing the low level switch by hands.

- (b) Set the protective timer at a timer shorter than the lubricating time recorded in (1), and operate the pump to check the buzzer and lamp.

- (c) Motor overload

Move the test lever of the thermal relay horizontally for checking. After testing, push the set lever then normal condition is restored.

- (4) Timer set

- (a) Start timer

Set the operating interval in accordance with our specifications and the machine maker instructions.

- (b) Protective timer

Set the timer at the lubricating time measured in (1) plus 5 minutes.

## 5. Maintenance and inspection

### 5-1 Grease replacement for motor with reduction gear (see paragraph 4-1 (2) )

Although the reduction gear is filled with grease with before shipment, please the grease with new one at 20,000 hours (4 to 5 years) of operation.

### 5-2 Precautions for adding grease

- (1) The reservoir should be filled with grease by means of a filling pump.  
It should be kept in mind that grease is to be supplied through the filling port of the pump. A strainer provided in the filling port should be cleaned periodically.
- (2) Grease may be deteriorated if it has been mixed with another brand of grease. To prevent this, it is recommended to obtain the adequate instructions from a grease manufacturer when using a different brand of grease.

### 5-3 Spare parts

It is recommended that the following spare should be provided to minimize the shutdown period of the system in the case of emergency.

- (1) For pump
  - (a) Cylinder plunger set
  - (b) Various packing
  - (c) Pressure gauge and limit switch
  - (d) Hydraulic-operated reversing valve KRV-2S
- (2) Various types of measuring valves
- (3) For control panel
  - (a) Signal lamps
  - (b) Fuse elements
  - (c) Auxiliary relays
  - (d) Timers
- (4) Miscellaneous
  - (a) Flexible hoses
  - (b) Pipes and joints

### 5-4 Inspection

The following items should be inspected periodically.

- (1) Operation time of lubricating pump, discharge pressure, pipe end pressure.
- (2) Reversing operation of hydraulic-operated reversing valve. (Switch cam movement)
- (3) Operation of measuring valve

- (4) Grease leakage from pipe
- (5) Damage of respective equipment
- (6) Amount of grease remaining in reservoir and grease storage can

#### 5-5 Maintenance of bearing

A strong and superior bearing is employed for bearing. However, when the abnormality of noise, vibration and temperature from bearing portion occurs, promptly replace it.

## 6. Trouble shooting and remedy

It is recommended for better results that the cause of a trouble or failure should be detected by tracing simple defects first.

No.	Descriptions	Causes	Remedies
(1)	Pump motor fails to start, even if push-button switch is depressed.	a. Power supply is not on.	a-1. Turn on main power switch and operation power switch. a-2. Check the primary voltage (between R.S.T.) with a taster.
		b. Fuse is blown.	b-1. Turn on the no-fuse breaker. b-2. Replace the cylindrical fuse.
		c. Motor wiring is discontinued.	c. Reconnect the wire.
(2)	The alarm buzzer sounds. The buzzer sounds and pump operation fails even when the operating power switch is turned off once and then turn to on again.	a. The tank is empty.	a. Supply grease with a filling pump.
		b-1. The motor is over-loaded.	b-1. Check and repair.
		b-2. Sticking of reduction gear (Insufficient lubricant) b-3. Disconnection of motor circuit (Voltage is applied to two phases only of the three.)	b-2. Replace the reduction gear. b-3. Check and repair the wiring or replace the motor.
(3)	Pointer of pump pressure gauge deflects too much.	a. Air is trapped in main pipe and branch pipe.	a. Disconnect the piping at several points and operate the pump to draw the air.
		b. Refer to item (4) if grease retard alarm is given.	

(4)	Alarm buzzer sounds.  When the control power switch is turned off once and to ON again, the pump operates but the buzzer sounds again soon and the pump comes to a stop.	Grease retarding is resulted.	
		a. Sticking or breakage of plunger. (Inclusion of foreign substance)	a. Replace the cylinder and plunger.
		b. Insufficient discharge quantity or discharge pressure due to wear of cylinder or plunger.	b. Replace the cylinder and plunger.
		c. Dust is caught by the check valve.	c. Overhauling.
		d. Air is trapped in the pump.	d. Tighten the air vent plug of the level rod. Draw out the air from the reservoir.
		e. The grease used is too hard to be absorbed.	e. Change the grease with softer one.
		f. Mis-connection of the piping system.	f. Check and correct the piping.
		g. Grease leakage from the main or branch pipe.	g. Check and repair the piping.
		h. Excessive air allowed in the main or branch pipe.	h. Disconnect the piping at several points, and operate the pump to draw out the air.
		i. Dust is caught by the relief valve.	i. Overhauling.
		j. Malfunction of hydraulic-operated reversing valve, sticking of piston, or loosening due to wear.	j. Disassemble for repair or replace.
		k. High pressure due to inadequate adjustment of the changeover pressure of hydraulic-operated reversing valve.	k. Replace the cylinder and plunger.

		l. Inadequate setting of protective timer.	l. Set the timer at lubricating time +5 minutes.
		m. Malfunction of limit switch or mis-wiring.	m. Check the limit switch (push by hands) or repair.
(5)	Operating noise of pump is too high or not normal.	a. Wear.	a. Replace the reduction gear and the lubricating pump proper.
(6)	Water stays in the reservoir.	a. Quality of the supplied grease is not good.	a. Check the grease and check the quality with the grease maker.
		b. The pump is wet with water.	b. Attach a cover.
		c. Check valve is defective (for hydraulic turbin).	c. Overhaul the check valve or replace.
		d. Check valve attaching is neglected (for hydraulic turbin).	d. Attach the check valve.
(7)	Indicator stem of some measuring valves fail to operate.	a. Bearings are blocked.	a. Check the bearings and improve.
		b. Lube pipes are broken.	b. Check and changed over pressure.
		c. Changed over pressure of hydraulic operated reversing valve is too low.	c. Adjust the changed over pressure.
		d. Sticking of measuring valve due to dust clogging.	d. Overhaul the measuring valve or replace.
		e. Branch pipe is too long.	e. Lower the flow resistance by increasing the changed over pressure or by making the branch pipe larger.
(8)	All the measuring valves fail to operate.	Refer to above item (4) in this case as alarm is given.	

## 7. Disassembly & assembly

### 7-1 Replacement of Cylinder · Plunger set

Since the cylinder plunger is precisely machined, perform the replacement in the set without fail.

- (1) Method of removal of cylinder plunger set washing oil, waste cloth as well as tools are used.

Select a clean working place. With incorporation, care must be exercised not to mix the foreign matter.

- a. Remove the grease in the reservoir.

Take out the joint at the supply port, and push in the level rod of reservoir, and the grease flows out.

- b. Remove the reduction gear motor.

Since the grease remaining in the reservoir flows out, receive it using the waste cloth etc.

- c. Cylinder is set by using C-type snap-ring from the inside. Hence it is readily pulled out by cutting pliers for snap-ring.

- (2) Method of incorporation of cylinder plunger set

- a. Apply the grease to the periphery of cylinder set, and smoothly put it in the body.

- b. Put the cylinder set, and set C-type snap-ring by using the cutting pliers for snap-ring. Then, the attention should be taken not to deform extremely C-type snap-ring.

- c. Set so that the suction port of grease can provide the upper part.

- d. Apply the grease to the periphery of plunger set, and smoothly put it in the cylinder. Place the plunger guide therein to incorporate it in the cylinder.

- e. Alternately push the plunger by hands, and make sure that it moves smoothly to right and left.

- f. When the octagonal nut of cylinder set moves in the paragraph b, slightly fix the cylinder set, and again fix by the set-screw.

### 7-2 Incorporation of Reduction Gear motor

- a. Make sure that the cam is securely fixed to the shaft.
- b. Incorporate the reduction gear motor in the body to prevent the plunger and cam from the failure.
- c. Tighten four (4) bolts diagonally, and avoid the unequal fastening.

### 7-3 Hydraulic-operated reversing valve assembling

- a. Be sure to assemble while referring to the drawing (at the end of this manual, Fig.11) as the changed over is easily misassembled.
- b. After assembling the arm and the pinion, move the arm by hand to make sure the arm transfer angle is symmetrical around the center of the hydraulic-operated valve body.

### 7-4 Reservoir removing

- a. First remove the level switches in the reservoir.
- b. After removing the coupling at the feed inlet, draw out the grease in the reservoir completely. (The grease can be drawn out easily by removing the coupling at the feed inlet and by supplying compressed air through the overflow port of the reservoir.)
- c. Remove the cover and pull out the fixing bolts on the reservoir bottom by using a hexagon wrench for M8.



## 8. Operation Record of KWK DUAL LINE LUBRICATING SYSTEMS

Specifications		
Type of pump	Grease filling method : Concentrated filling, Exclusive pump, etc.	
Pump No.	Type of filling pump	
Motor voltage	Name of grease used	
Type of control panel	Type of measuring valve used	
Control system	Auto/Manual start	Number of measuring valve used
Details of test operation		
Lubricating pump		Control panel
Lubricating pump & Reduction gear box oil volume : good / bad		Voltage, motor : ____ V / control : ____ V
		Pilot lamp (power supply) : good / bad
Motor rotating direction : normal / reverse		Pilot lamp (operation) : good / bad
Lubricating pump operation noise : normal / excessive		Pilot lamp (alarm) : good / bad
		Auto start of pump : good / bad
Lubricating time (No.1 line) : min. ____ sec.		Auto stop of pump : good / bad
		Alarm buzzer (low level switch) : good / bad
Lubricating time (No.2 line) : min. ____ sec.		Alarm buzzer (over time) : good / bad
		Overload of alarm buzzer motor : good / bad
Discharge pressure (No.1 line) : ____ kg/cm <sup>2</sup>		Timer setting (for start) : hrs.
		Timer setting (for protection) : hrs.
Discharge pressure (No.2 line) : ____ kg/cm <sup>2</sup>		Measuring valve
		All operations : good / bad
Changed over pressure (No.1 line) : ____ kg/cm <sup>2</sup>		
Changed over pressure (No.2 line) : ____ kg/cm <sup>2</sup>		
Others	Grease leakage from piping : yes / no	Damage of piping : yes / no
Special notes		



DUAL LINE LUBRICATING SYSTEMS

MODEL : KEP-16SL

MOTOR-DRIVEN LUBRICATING PUMPS

INSTRUCTION MANUAL

**KWK** KOWA CORPORATION

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## Introduction

Thank you very much for purchasing the DUAL LINE LUBRICATING SYSTEMS.

This instruction Manual has been compiled as a practical guide for the operation and maintenance of the lubricating system which incorporates the Model KEP-16SL motor-driven lubricating pump.

All descriptions contained herein are based on the standard system, which may, therefore, be different from those of purchased system. Such a problem can be solved by referring to the final specifications. However, it is required to understand that some changes caused by the modification of equipment may not be described in the final specifications.

## Guarantee

The guaranteed period this system will be one year from the commencement of operation. Any defect or failure occurring during the guaranteed period, for which KWK is liable in design and manufacturing, shall be corrected and / or eliminated by KWK without compensation. However, any defect or failure caused by improper operation which is not described in this Instruction Manual shall not guaranteed, even though the defect or failure occurs within the guaranteed period.

## PRECAUTIONS OF SAFETY

Before the installation, operation, maintenance and inspection, read carefully this instruction manual and other accompanying documents for correct service.

Familiarize with the knowledge of equipment, information of safety and all of cautionary instructions for service.

The precautions of safety is shown in each equipment of the centralized lubricating system by using safety mark.

Particular attention should be called to the places where these safety marks are given.

The safety marks are divided into "WARNING" and "CAUTION".



If mishandled; In case a dangerous situation may occur, it could result in death or serious injury



If mishandled; In case a middle injury or light injury, and in case a physical damage may occur.

For the matter being mentioned in the CAUTION, it may result in an importance according to circumstances. The important content is given to all of safety mark, and obey it without fail.

This system provides the max. working pressure 21MPa(210kg/cm<sup>2</sup>). When each equipment is disassembled and inspected, stop the operation of pump, and release the pressure to perform the operation as 0MPa(0kg/cm<sup>2</sup>).

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Drawing ..... End of a manual

Fig. 8: Lubricating pump                      KEP-16SL

Fig. 9: Assembly for pump body              KEP-16

Fig. 10: Assembly for reservoir              6Lit.

Fig. 11: Assembly for hydraulic operated reversing valve KRV-2S

Fig. 12: KS measuring valve

Fig. 13: KW measuring valve

## 1. General description of DUAL LINE LUBRICATING SYSTEMS (Short loop type)

### 1-1 Outline of lubricating equipment

This system comprises motor-driven lubricating pump unit which will supply grease or oil to high pressure, external piping, measuring and control panel which is used to operate the lubricating system.

The schematic diagram of this system is as shown in Fig.1.

All the following descriptions are for the type used for greasing. When used for oil lubrication, the measuring valve and the tank of the pump are changed but all the other parts are commonly.

The motor-driven lubricating pump unit consists of pump body, electric motor, and hydraulic-operated reversing valve, all of which are mounted on a common base made of steel plate.

A reservoir made of steel plate is installed on the top of the lubricating pump, on which a level rod is provided to indicate the amount of grease stored in the reservoir.

A pressure gauge is also attached to the lubricating pump unit to show the discharge pressure of the pump.

The outside piping consists of the two lubricating mains of parallel piping from the two outlets on the hydraulic-operated reversing valve of the lubricating pump and the branch piping from the main piping to the measuring valve and lube piping from the measuring valve to the lubricating points.

The optimum type of measuring valve is selected according to the number of lubricating port.

In addition, a control panel is provided for automatic operation of the lubricating pump.

Also installed is lubricating pump which serves to supply grease into the reservoir.



### 1-2 Out line of lubricating circuit

The schematic diagram of the lubricating circuit is as show in Fig.2 (A and B).

Fig.2 (A) indicates that the discharged grease from lubricating pump is transferred in the arrow direction through the hydraulic-operated reversing valve (KRV).

While Fig.2 (B) shows that the grease transferred to No.1 line and No.1 lines open to the reservoir.

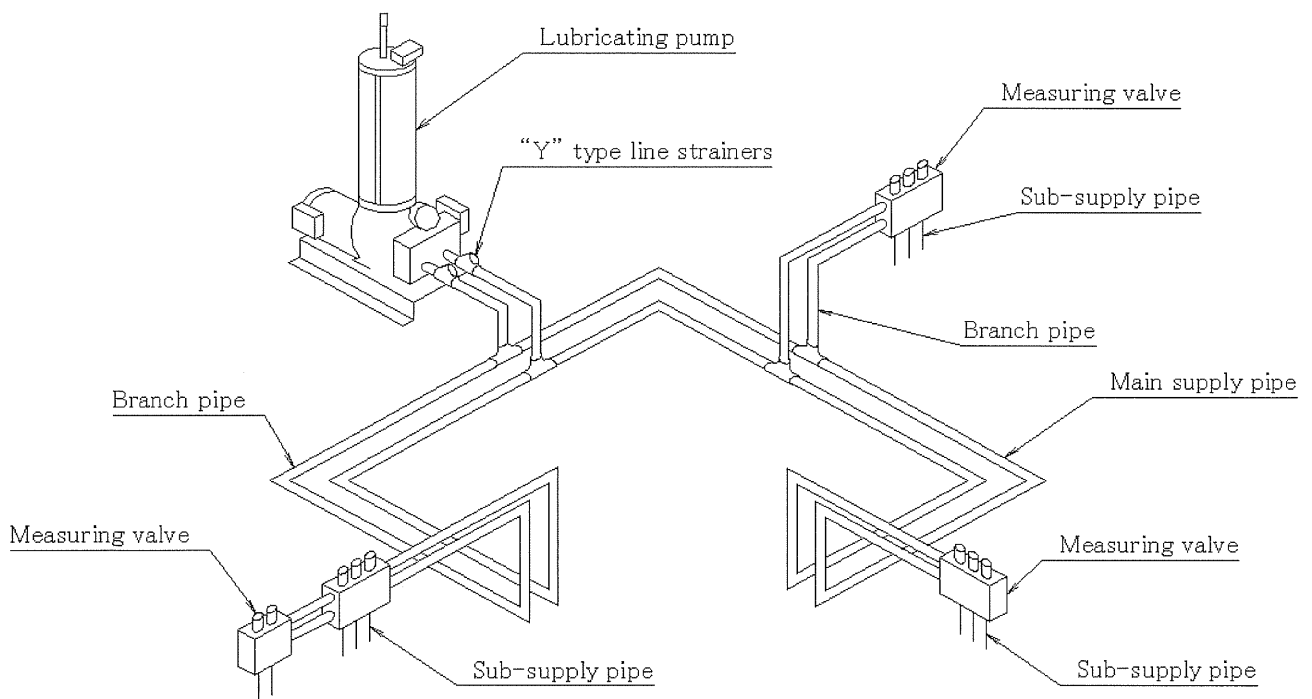


Fig.1 Schematic diagram of lubricating circuit

In Fig.2 (A), grease discharged from the lubricating pump passes through the hydraulic-operated reversing valve and flows through the line No.1 in the direction of arrow. The grease is then fed under pressure into each measuring valve through the upper side inlet (supply port) to complete one lubricating operation.

When the measuring valve at the end of No.1 line completes its lubricating operation, the internal pressure of No.1 line goes up to change the hydraulic-operated reversing valve by the grease pressure transferred through the changed over line in the hydraulic-operated reversing valve to the condition of Fig.2 (B). Simultaneously with the above, a limit switch attached to the reversing valve is actuated to stop the lubricating pump drive motor. When the motor is restarted, grease is supplied under pressure through the No.2 discharge line in the direction of arrow shown in Fig.2 (B). The grease is then fed under pressure into each measuring valve through the lower side inlet (supply port) to perform the second lubricating operation.

Upon completion of the second lubricating operation, the hydraulic-operated reversing valve is changed over again by pressurized grease at the return port of the No.2 line.

This allows the lubricating system to from the circuit shown in Fig.2 (A) and (B) are alternately repeated until the lubricating operation is completed.

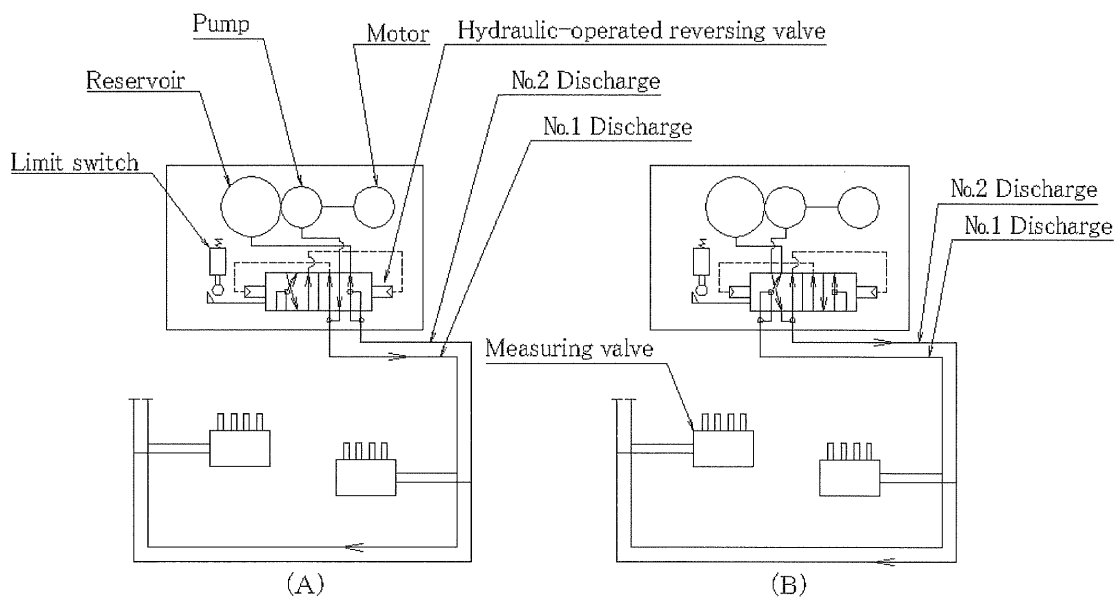


Fig.2 Lubricating circuit

### 1-3 Specifications of equipment

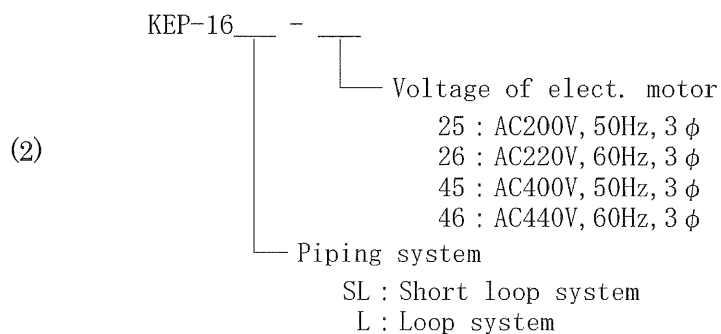
#### (1) Specifications of lubricating pump

Nomenclature	Item	Lubricating pump model and specifications
		KEP-16SL
Pump	Applicable grease	NLGI No.00~No.1
	Discharge capacity (cm <sup>3</sup> /min)	37/50Hz, 45/60Hz
	Discharge pressure (MPa)	Max.20.6 *
	Pump's revolutions (rpm)	75/50Hz, 90/60Hz
Geard motor	Type	Totally enclosed, three-phase induction motor, continuous rating, class "E" insulation
	Output × No. of poles	0.1kW × 4P
	Voltage, Frequency	3 φ - AC200/220V, 50/60Hz *
		3 φ - AC400/440V, 50/60Hz *
	Reduction gear ratio	1/20
Reservoir	Capacity (Lit.)	6
	Level switch	Low level switch 1 stage *
Hydraulic-operated reversing valve	Model	KRV-22SL
	Pressure range (MPa)	4~18
	External pipe joints	2×Rc(PT)3/8
Total mass (kg)		43

① For the outside dimensions and the internal structure, please refer to the drawings of the principal equipment at the end of this manual.

② Check the column with asterisk mark (\*) referring to the final specifications.

③ Order by code



(2) Specifications of measuring valve

Measu ring valve size	Model	Discha rge ports	Discharge capacity cm³/stroke		Adjustable amount cm³/one revolution of screw	Mounting bolts (Attachme nt)	Mass (kg)	Pipe joints	
			Max.	Min.				Inlet	Discha rge
KS-30	KS-31	1	1.2	0.2	0.06	M8×65L	1.2	PT3/8	PT1/4
	KS-32	2					2.0		
	KS-33	3					2.8		
	KS-34	4					3.7		
KS-40	KS-41	1	2.5	0.6	0.10		1.4		
	KS-42	2					2.3		
	KS-43	3					3.2		
	KS-44	4					4.0		
KS-50	KS-51	1	5.0	1.2	0.15		1.5		
	KS-52	2					2.5		
	KS-53	3					3.5		
	KS-54	4					4.6		
KW-30	KW-32	2	1.2	0.2	0.06	1.5			
	KW-34	4				2.5			
	KW-36	6				3.5			
	KW-38	8				4.5			
	KW-310	10				5.5			
KW-50	KW-52	2	5.0	1.2	0.15	1.5			
	KW-54	4				2.5			
	KW-56	6				3.5			
	KW-58	8				4.5			

① The working pressure is 1MPa or lower.

② Working pressure : 21MPa

[The maximum working pressure of measuring valve using oil should be 10MPa.]

③ Applicable grease : NLGI No.00~No.1

## 2. Installation of equipment and piping procedure

### 2-1 Installation of lubricating pump

The lubricating pump is designed so as to be used indoor. It should be kept in mind that the pump is to be accommodated in a shed or housing capable of protecting the machine from weather, when being installed outdoor.

Maintenance of the machine should be easy even during operation, and the place should be free from excessive dust, temperature change and moisture.

Install the lubricating pump horizontally on a sturdy channel or concrete foundation.

Note that if stresses are locally applied to the lubricating pump frame when the foundation bolts are tightened, it may cause deflection of the pump center alignment and early damage to unit.

In either case, the pump base should be raised more than 50mm above the floor surface in order to facilitate the maintenance, inspection and water draining. Set up the control panel in place where the lubricating pump can be easily operated and controlled.

### 2-2 Piping procedure

#### (1) General precautions

As shown in Fig.1, the piping consists of the main supply pipes coming from the hydraulic-operated reversing valve of the lubricating pump unit, branch pipes running from the main supply pipes to the measuring valve, and the sub-supply pipes from the outlets of the measuring valve to lubricating points or bearing to be lubricated. All pipes should be supported properly so as to prevent them from being damaged by vibration, and should not be laid on locations where the pipes may be damaged by other obstacles.

#### (2) Connection of main supply pipes and branch pipes

The main supply pipes and branch pipes between the lubricating pump and measuring valve are subject to pressures as high as 21MPa. This fact requires that pipe material incorporated in the above pipe lines should safely withstand the pressure and should have an inside diameter which allow grease to flow smoothly.

Use the steel pipes of STPG 38 (schedule 80) or of more higher grade.

The lubricating pump is operated at the maximum discharge pressure of 10MPa or 21MPa.

If the use at the maximum pressure of 21MPa is predetermined, the pump is delivered with the specifications for 10MPa. In this case, STPG 38 (schedule 40)

may be used as the piping material.

If the lubricated points of a machine include any moving part which slides or swings, flexible hoses is used for the sub-supply pipes.

To the moving parts of the main supply pipes and branch pipes, use the high-pressure rubber hoses for the maximum working pressure 21MPa.

Where the hoses surface may possibly be worn out by sliding, use wire braided hoses on the surface.

(a) Installation of pressure gauge.

Near the ends of No.1 and No.2 line piping of the main supply piping, attach a pressure gauge as shown in Fig.3 to check the switching pressure.

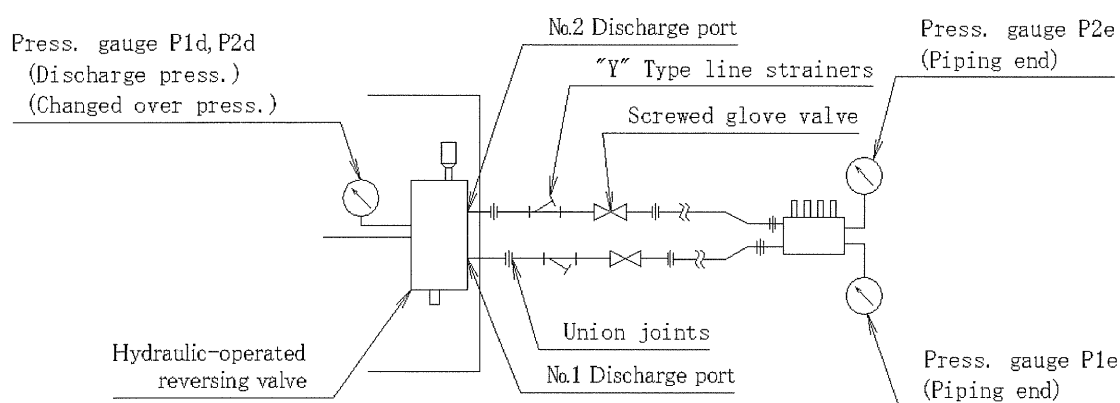


Fig.3

(b) “Y” type line strainers and glove valves.

As shown in Fig.3, the “Y” type line strainers should be installed on the discharge pipes of the hydraulic-operated reversing valve.

It should be kept in mind that the strainer is to be installed so that it can be removed and cleaned easily, with its installation direction corresponding to the flow direction of grease.

Also, be sure to install the screwed globe valves and pressure gauge as illustrated in order to check the lubricating pump performance and to provide convenience when the system is out of order.

(c) Attaching 2-way check valve

When the main supply pipe rises from the lubricating pump level more than 5 meters or when oil is used, attach 2-way check valve near the lubricating pump in series with the “Y” type line strainers to prevent reverse flow of the grease.

(3) Mounting measuring valve

- (a) It isn't advisable to attach the measuring valves directly to the main supply pipes. Unlike the case attached to the branch pipes, direct attaching to the main supply pipes makes it difficult to continue operation of the system when the measuring valves must be removed for piping line improvement in future or for troubles. It also can cause error motion of the whole system due to air allowed into the main pipes.
- (b) When measuring valves are connected in series, limit the number of pieces to about 3, in principle. When more than three measuring valves are used, branch a separate pipe from the main pipe for the piping connection. If the spacing between measuring valves is 0.5 meter or shorter, however, up to 5 measuring valves can be attached.
- (c) The measuring valve should be mounted on a support exclusively used for this purpose or separately fabricated base plate equivalent to the aforementioned support. The measuring valve should be installed at the location as close to the lubricating point as possible, where its indicator rods can be seen easily from the surrounding areas, and where the amount of supplied grease can be adjusted easily.
- (d) The measuring valve should be protected with a steel plate cover, when being installed at the dusty location often splashed with water and subject to a high radiation heat.
- (e) Blank the ends of the measuring valves attached to the branch pipes and main supply pipes with a high-pressure plug.
- (f) To confirm the lubricating operation of measuring valve easily, the branch pipes should be connected correctly to the measuring valves so that the indicator rod of the respective measuring valves move in same direction. In a more detailed explanation, all pipes branched from No.1 discharge line should be connected to the upper ports of the respective measuring valves. (The same result may be obtained even if the pipes branched from No.1 line are connected to the lower ports of the measuring valves.)

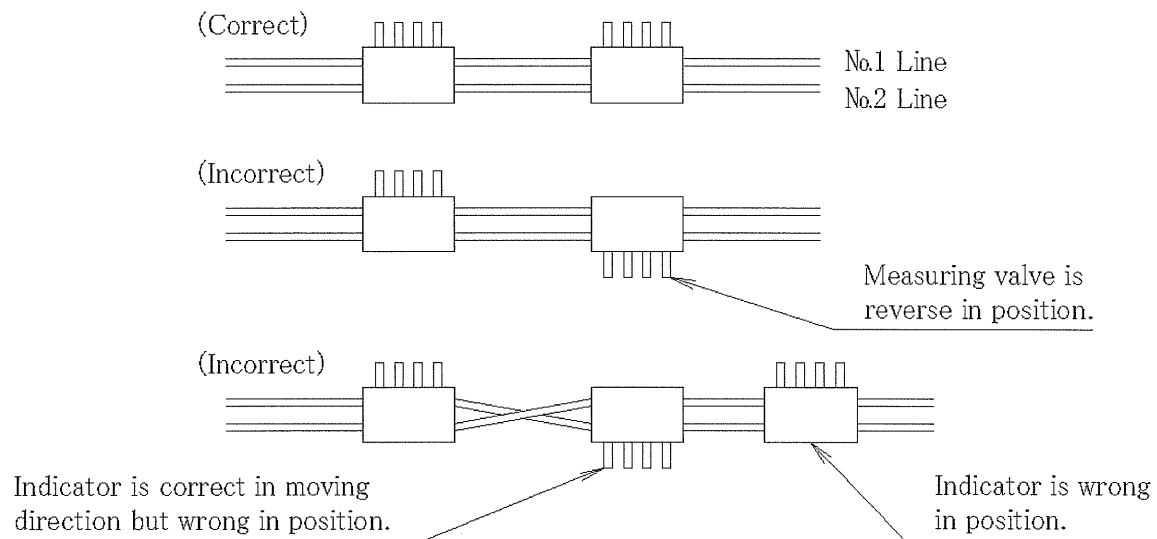


Fig.4 Connection of measuring valve

#### (4) Connection of sub-supply pipes (Lube piping)

- (a) Since the pressure required for greasing against the back pressure of bearings and resistance of the sub-supply pipes reaches the maximum operating pressure, it is necessary to use the material which withstands the pressure of 3MPa for the piping from the measuring valves to the points of lubrication.

For the piping, 8A (1/4B) steel pipes or 6  $\phi$  and 8  $\phi$  copper pipes are used.

- (b) When the bearings are submitted to a high back-pressure, prevent reverse flow of grease and error motion of the measuring valves by using check valves or inverseflow check valves. (Select the piping material carefully as the withstand pressure of the sub-supply pipes also changes in this case.)
- (c) Bearings must be composed so as to ensure discharge of old grease.  
For sealed type bearings, it is necessary to lead the filled grease to the outside by attaching a relief valve to the bearings.
- (d) When the lubricated points of a machine include any moving part which slides a flexible hoses must be used.



### 3. Construction and function of lubricating pump

#### 3-1 Construction of pump

As for sectional assembly drawing of the lubricating pump proper, refer to Fig.9. The lubricating pump proper is placed below the reservoir and the driving power of the motor is transferred to the cam shaft in pump casing through the coupling to turn the two cams. Rotation of the cams reciprocates the two plungers to draw grease from the reservoir through the check mechanism and to discharge the grease through the discharge port.

Grease is drawn in plunger return process by the guide plate and discharging is made in push-out process by the cams.

Through lubricating is made alternatively by two plungers, only one discharge port is provided as the lubricant path is shorted in pump.

#### 3-2 Pressure relief valve

This pressure relief valve is mounted on the side part of reversing valve. The pressure relief valve serves to release the inner pressure when the pipe clogged for some reason. The pressured grease, released from the pipe, is admitted into the reservoir to protect the lubricating system from being damaged.

The pressure relief valve is available in the following 2 types.

Lubricating pump model	Maximum discharge pressure	Relief valve set pressure
KEP-16SL	21MPa	23MPa $\pm$ 0.5MPa
KEP-16SL-K	10MPa	11MPa $\pm$ 0.5MPa

The pressure relief valve has been adjusted in KWK factory in accordance with the specifications at the time of concluding the agreement, before being delivered. Therefore, it is recommended that relief valve should not be adjusted at the site. The pressure relief valve which has been set at 11MPa can be distinguished from other valves by the mark stamped on the cap and by red paint.

### 3-3 Reservoirs

#### (1) Reservoir

The reservoir is to store grease. A follower plate is provided in the reservoir so as to level out the grease surface along with grease consumption and to shut off the outside air.

On the center of the follower plate, a level rod is placed vertically going through the cover at the top of the reservoir and a cylindrical cam for level switch is provided on level rod.

A grease overflow port is also provided at the upper part for overflow of excessively filled grease.

#### (2) Low level switch

If grease is consumed until the reservoir is emptied, air is admitted into the pump, and may also be admitted into pipe line. Once air is admitted into the pipe, the lubricating operation becomes extremely unstable.

In the extreme case, grease must be drained completely from the pipe line in order to purge air, and the pipe line must be refilled with new grease.

A low level switch is provided at the upper part of the reservoir as the standard specification so that the pump operation stops and alarm is given when the grease is consumed to certain limit.

The cam to operate the low-level switch is at the upper end of the level rod.

When the grease is used and the follower plate comes down to certain level, the level rod directly connected to the follower plate also comes down, and the cam actuates the low level switch.

The signals from the low level switch is transferred to the control through the terminal box of the pump to issue alarm and to stop the motor.

### 3-4 Hydraulic-operated reversing valve

#### (1) Construction and function

This reversing valve serves to feed grease discharged from the pump alternately to the two main supply pipes. The grease fed by the pump actuates all measuring valves from one main supply pipe after passing through the reversing valve. After that, the grease returns to the reversing valve through its return port, actuating the valve piston by the pressure of the returning grease. The aforementioned piston movement changes over the grease so as to be connected to the other main supply pipe.

The composition is as show in Fig.5.

Two pistons are provided in the reversing valve. On one of the pistons, a rack is

provided at the center part, which is engaged with a pinion. A lever and spring are attached to the pinion in order to retain the passage reversing pressure.

A cam is provided on the tip of the other piston to actuate a limit switch.

## (2) Function

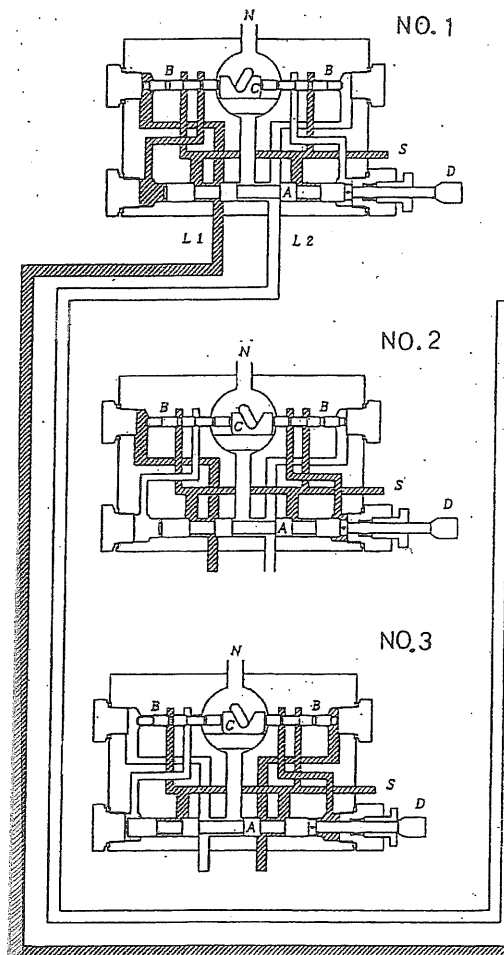


Fig.5 Function of hydraulic-operated reversing valve

- (a) In No.1 of Fig.5, grease pressurized by the pump passes through the inlet S and is forced into the main supply pipe L1 by means of the piston A. At this time, the other main supply pipe L2 is connected to the reservoir through N.

The darkened part of Fig.5 show the existence of pressurized grease.

When the inner pressure of the main supply pipe L1 is raised, and all measuring valves complete their operations, the pressure at the end of the return pipe R1 from L1 begins to increase.

- (b) When the pressure in L1 exceeds the set valve, the rack piston B is moved to the right as shown in the No.2 of Fig.5. During this movement, grease entering into the cylinder through the inlet S is forced against the right end of the piston A by the movement of piston B. At the same time, the left end part of the piston A is connected to the relief line N.

- (c) Grease entering the cylinder through the inlet and pressurized by the pump moves the piston A to the left, as shown in the No.3 of Fig.5. Upon completion of the above movement, the main supply pipe L1 are connected to the relief line N.

During this movement, the grease from the inlet S is fed to the main supply pipe L2. The piston A is provided with a switch lever D, as shown in Fig.5, so that the line reversing operations can be observed from the outside.

The switch lever D actuates the limit switch when moving to the right and left, by which the lubricating pump is stopped.

When the lubricating pump is started again, grease is admitted into the main supply pipe L2 as shown in No.3 of Fig.5.

After all the measuring valve have been actuated by grease pressurized by the pump, the pressure at the end of L2 line. When the pressure exceeds the set value, the piston B is moved to the left. With the movement of the piston B, the pressurized grease from the inlet S is forced against the left end of the piston A. This allows the piston A to move to the right as shown in No.1 of Fig.5. At this time, the limit switch is actuated by means of the switch lever D, and the lubricating pump stops. The line reversing pressure of this hydraulic-operated reversing valve can be adjusted by means of a spring tension adjustment screw attached to the pinion C. In other words, the adjustment can be accomplished by changing the pressure at the extreme end of the pipe which is used to move piston B meshed with pinion C to the opposite side.

The line reversing pressure of the hydraulic-operated reversing valve has been adjusted at 10MPa in KWK factory before delivery.

### 3-5 Difference between lubricating pumps of 21MPa and 10MPa

The KEP model moter-driven lubricating pump is available in two different types ; 21MPa and 10MPa types according to the discharge pressure of the system. These two types of lubricating pump are completely similar appearance, but are different in the following three points.

#### (1) Pressure gauge

Lubricating pump	Pressure gauge indication, max.
21MPa type	35MPa
10MPa type	20MPa

(2) Name plate

Identifications marked with [ ] are different as follows.

Identification	21MPa	10MPa
MODEL KEP-16SL [ ]	Blanked	Stamped with "K"
DIS. PRESSURE [ ] MPa	21	10

(3) Relief valve

The respective type of lubricating pump are distinguished from each other paint color of the cap.

21MPa type ; Coated with paint, whose color is the same as the pump body's

10MPa type ; Coated with red paint, and the edge surface is stamped with "110K"

#### 4. Trial operation

##### 4-1 Confirmation before operation

- (1) Check the installation, piping and wiring before test operation.
  - (a) Unions and flanges of main supply pipe and branch pipe operation.
  - (b) Sub-supply pipes connected to all bearings to be lubricated.
  - (c) Plug of measuring valve.
  - (d) Electric wiring on the primary and secondary sides.

- (2) Lubricant replenishment to the motor with reduction gear.

Before shipment, grease is already sealed in the gear casing of the motor with reduction gear.

Lubricating pump model	Reduction gear casing	Recommended brand
KEP-16SL	0.5kg	SHELL ALVANIA EP-R000

- (3) Direction of pump rotation

- (a) Turn on the power source switch and control source switch. Depress the pushbutton switch for manual starting, and confirm the direction of motor rotation.

Follow the arrow mark on the cooling fan cover. The correct rotation is to the clockwise from the cooling fan side.

- (b) When turns is reverse direction

If the pump turns in reverse direction, stop it immediately without keeping operation for a long time. (Check the rotational direction within a short time and with no load as the cam and the piston are broken if turned in reverse way while applying load to the pump.)

- (c) If the rotating direction is reversed, the motor should be rewired by interchanging the 2 lines of 3 power lines.

#### 4-2 Grease selection

There are quite a different kinds of grease of different quality and characteristics. Select a suitable grease to the operating conditions out of the recommended kinds of grease given below.

Ordinarily, any grease is applicable within the range of NLGI standard No.00 No.1 (fluidity 430 to 310).

Note:

1. Molybdenum or graphite-filled grease

Solid lubricant is on will affect the life of the pump (wear).

If the particle size is 1 $\mu$ m or less, it can be used almost without problems.

If the particle size is about 1~3 $\mu$ m, it can be used . But wear becomes violently.

It can not be used if the particle size is greater than 3 $\mu$ m. (Pump life will be extremely short.)

2. Grease containing metals in powder form such as copper and zinc can not be used.

Name of company	Brand
ESSO Standard oil Co.	LITHTAN No.0~No.1 LITHTAN EP No.0~No.1
Shell International Petroleum Co.	ALVANIA EP GREASE No.0~No.1 ALVANIA GREASE No.0~No.1 EP GREASE No.0~No.1
Mobil Oil Co.	MOBIL PLEX 45,46 MOBILUX 1

#### 4-3 Grease filling

(As the grease for filling, use the same brand as the one used for each customer.)

(1) Filling reservoir with grease

Fill the grease into the reservoir by the pump with care not to allow intrusion of dust or air from the filling port (snap-on coupling) on the side of lubricating pump unit.

NOTE : The reservoir should never be filled with grease from the upper side, with the top cover and the follower plate removed. Such a filling manner may cause unexpected trouble during operation.

(2) Filling sub-supply pipe (Lube Line) with grease.

The sub-supply pipe ranging from the discharge port of measuring valve to the lubricating point should be filled with grease by means of a grease gun, before commencing the operation.

After filling grease, connect the sub-supply pipes to the measuring valves.



(3) Filling main supply and branch pipes with grease.

(a) Preparation

- a) Remove the plugs at the end of No.1 and No.2 lines of the hydraulic-reversing valve so that the grease and air in the piping can be drawn out. Fully close the screw type glove valve near the pump.
- b) Remove the measuring valve plugs (R3/8) at the end of the branch supply pipe to let out the air.
- c) Receive the grease coming out from the points where the plugs are removed in the above a) and b) with a vinyl bag, pail or waste cloth.
- d) For grease filling, it is necessary to operate the lubricating pump for several hours or longer in continuity. Since the maximum setting of the protective timer is 30 minutes, alarm is given and the pump stops when operation for more than 30 minutes. To prevent the alarm only for the test run, remove the protective timer on the control panel.  
(The alarm is given only at empty reservoir or motor overload when the pump is operated under this condition.)

This isn't necessary when a filling pump is used for grease filling.

NOTE : Be sure to attach the protective timer to the original condition when grease filling completes.

(b) Filling procedure

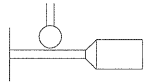
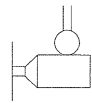
- a) Turn the power switch to 「ON」 to operate the lubricating pump.
- b) Air is drawn out through the measuring valves where the plugs (R3/8) are removed, then the grease comes out but refrain from plugging the measuring valves soon. Take out the grease coming out to compare with new grease and plug the measuring valves only after making sure that equally clean grease to unused grease comes out.
- c) When grease is filled into the main supply pipe and returns to the return port of the hydraulic-operated reversing valve, check for no inclusion of foreign matter in the same way as for the preceding item, and stop the lubricating pump after measuring the pipe fluid resistance.

d) Pipe fluid resistance measurement

When there is no pressure gauge near the tail end of the main supply piping, as shown in Fig.3, prepare for the changed over adjusting work as described below, and measure the pipe fluid resistance for recording. During the work of item c), check the pressure of the lubricating pump and record the point of the highest pressure when the grease comes out of the tail end of the main supply piping.

e) Piping system check

For judgment of grease discharge by No.1 line of No.2 line, the switch cam of the hydraulic-operated reversing valve is checked.

Discharge line	Switch cam position	
No.1 line	Out	
No.2 line	In	

f) Operate the lubricating pump, then the grease is discharged again through the filled line (No.2 line for example), and the pressure increase little by little this time because the piping is connected.

By the pressure the hydraulic-operated reversing valve is operated eventually and the switch cam is pushed out. Then the limit switch functions to transmit greasing completes signal and the lubricating pump motor comes to a stop.

g) Operate the lubricating pump again. Since the hydraulic operated reversing valve is changed, No.1 line is filled this time.

Fill in the grease in the same procedure as for No.2 line and plug the tail end of the main supply piping at the end, and mark sure that the hydraulic-operated reversing valve is changed and the lubricating pump comes to a stop automatically.

(c) After filling

When both lines are filled completely, turn off the power switch and attach the protective timer which was removed in the procedure 4-3-(3)-(a)-d).

Also clean the joints and plugs of the measuring valve in preparation for the following grease leak test. The filter of the “Y” type line strainer shall be cleaned as well.

4-4 Leak test

This is check the line for no grease leakage from the pipe joints when the maximum discharge pressure 21MPa of the lubricating pump is applied.

Carry out the test in the following order.

- (1) Set the protective timer at about 15 minutes and operate the lubricating pump.
- (2) Loosen the lock nut of the hydraulic-operated reversing valve, and increase the pressure by controlling the pressure adjust screw so that the selector may not be switched.
- (3) The pointer of the pressure gauge to lubricating pump goes up slowly reaching 23MPa in due course. (As the hydraulic-operated reversing valve is not changed, the pressure in the piping line goes up and the relief valve of the lubricating pump functions.)
- (4) The protective timer function 15 minutes later to give over time signal and the lubricating pump comes to a stop.
- (5) Turn off operation power switch to reset the alarm then turn on the switch soon again.
- (6) By controlling the pressure adjust screw of the hydraulic-operated reversing valve to lower the pressure slowly, then the selector is changed and the grease pump comes to a stop.
- (7) Operate the lubricating pump again to test leakage of the other line in the same procedure.
- (8) When the alarm is given and the lubricating pump comes to a stop, turn off the control power and go around the whole piping to check for no leakage.
- (9) Loosen the adjust screw to the original condition (condition of no spring pulling) to adjust the change-over pressure.

4-5 Measurement and adjustment of discharge pressure (change-over pressure) and pipe end pressure (P1e and P2e) (See Fig.3)

- (1) While operating the grease pump, record the highest reading of the pipe end pressure (P1e and P2e) and the discharge pressure (P1d and P2d) immediately before the end of greasing, then wait for automatic stopping.

Discharge line	Discharge pressure	Piping end pressure
No.1 line	P1d=MPa	P1e=MPa
No.2 line	P2d=MPa	P2e=MPa

- (a) Discharge pressure . . . . Read the pressure gauge of the lubricating pump.  
(b) Changed over pressure . . . . Read the pressure gauge attached near to the end of piping in Fig.3.

NOTE : Judge discharging to No.1 line or No.2 line by checking the switch cam of the hydraulic operated reversing valve. (Fig.11)

- (2) Operate the grease pump again and increase the change-over pressure gradually by controlling the pressure adjust screw of the selector. After making sure that the pipe end pressure (P1e and P2e) is up to about 4MPa, wait for automatic stopping. Check the position of the indicator rod in preparation for the next operation check of the measuring valve.

4-6 Measuring valve operation check

- (1) Check whether the indicator rod each measuring valve is out or in and mark all the measuring valves with pencil stone or chalk. Operate the lubricating pump and wait for completion of lubricating and automatic stop.  
(2) After making sure that the changed over pressure (P1e and P2e) is up to about 4MPa, check the indicator rod position of each measuring valve.

The rod should be moved to the opposite side of the position marking is above item (1). Erase the marks where the indicator rod is moved.

- (3) Where the indicator rod position does not coincide, the indicator rod is not moved.
- (4) Operate the pump again and record the discharge pressure of the other line.  
By this operation, the indicator of the measuring valve returns to the original position.
- (5) For any measuring valve of which indicator rod does not move, refer to paragraph 4-8.

#### 4-7 Changed over pressure adjustment

When the indicator rods of all the measuring valves are operated, adjust the changed over pressure in the following manner so that the measuring valve operate exactly for the next lubricating.

##### (1) Adjusting method

Loosen the lock nut of the hydraulic-operated reversing valve and adjust the changed over pressure by turning the adjust screw while watching the pressure gauges (P1e and P2e). Operate the pump while checking the changed over pressure.

(Left turn of the adjust screw increases the changed over pressure.)

##### (2) Increase the changed over pressure by 1MPa.

After the adjustment, the reversing pressure (Pn) becomes as follows.

$$P1n = P1e + 10$$

$$P2n = P2e + 10$$

##### (3) When the pressure gauge P1e and not provided :

If there are no pressure gauge P1e and P2e are provided near the pipe end, it isn't possible to know the changed over pressure directly. In this case, the pressure is obtained by following equation. Pump discharge pressure (P1d and P2d) pipe fluid resistance = pipe end pressure. As the pipe fluid resistance, the valve measured in 4-3, (3)·(b)·d) (Page 18) is used. To increase the pressure by 1MPa, therefore the pressure adjust screw shall be turned so that the peak pressure becomes equal to P1d and P2d measured in paragraph 4-6, (1) plus 1MPa.

##### (4) Minimum operating changed over pressure.

As described above, the changed over pressure must be set for use at least at 5MPa. (4MPa+1MPa or up when delivered)

(5) Lock nut locking

After the pressure adjustment, be sure to fasten the lock nut. If neglected, the pressure adjust screw is turned by vibration and the changed over pressure may be disordered.

4-8 For any measuring valve with non-operating indicator rod

- (1) When the bearings are subjected to back pressure, particularly for hydraulic turbines of power plants, the indicator rod may sometimes fail to operate unless the changed over pressure is increased.

Changed over pressure = back pressure + approx. 40kg/cm<sup>2</sup>.

Approximately the pressure given by the above equation is required.

- (2) For the indicator rod (piston) of no operation, remove the sub-supply pipes.  
(3) Operate the lubricating pump, wait for automatic stop, then check for operation.

(a) When operated

The sub-supply pipes and bearings are in trouble.

- a) Check the sub-supply pipe for no breakage.  
b) Set a pressure gauge at the top end of a grease gun to feed grease directly from the sub-supply pipe to the bearings and check the back pressure.

The conceivable causes are :

- b)-1 Back pressure is high by nature and high back pressure is normal.  
(take the measure of (3)-(b)-b) )  
b)-2 Measuring valve piston fails to operate as the bearing is filled fully with grease and there is no grease relief. Attach a relief valve to the bearing in this case.  
b)-3 Inadequate design or machining of bearing.

(b) When operation fails

- a) In most cases, the piston is sticking due to foreign substance in the piping and allowed into the measuring valve. (Normal measuring valve operates at 10kg/cm<sup>2</sup> or lower.)

- b) Take the following measure.

- b)-1 Increase the change-over pressure little by little to the point where the indicator rod moves, set the pressure adjust screw at the change-over pressure plus 10 to 20kg/cm<sup>2</sup>.

Set the screw within the change-over pressure adjust range of 40 to 180kg/cm<sup>2</sup>.

b)-2 If the operation still fails even with increased pressure, clean the measuring valve.

Refrain from grinding the piston with sand paper at the cleaning as the discharge efficiency is lowered.

#### 4-9 Record of test run

At the end of the test run, carry out the check in accordance with the test run record shown at the end of this manual for final confirmation.

(1) Lubricating time, discharge pressure (changed over pressure).

Operate the lubricating pump for several times of lubricating and record the average time and pressure.

(2) Checking automatic start-up of pump.

Put the start timer pointer close to 0 hour as much as possible and make sure that the pump starts automatically.

(3) Alarm buzzer and alarm check (while operating the pump)

(a) Grease low level

Check by the pushing the low level switch by hands.

(b) Set the protective timer at a timer shorter than the lubricating time recorded in (1), and operate the pump to check the buzzer and lamp.

(c) Motor overload

Move the test lever of the thermal relay horizontally for checking. After testing, push the set lever then normal condition is restored.

(4) Timer set

(a) Start timer

Set the operating interval in accordance with our specifications and the machine maker instructions.

(b) Protective timer

Set the timer at the lubricating time measured in (1) plus 5 minutes.

## 5. Maintenance and inspection

### 5-1 Grease replacement for motor with reduction gear (see paragraph 4-1 (2) )

Although the reduction gear is filled with grease with before shipment, please the grease with new one at 20,000 hours (4 to 5 years) of operation.

### 5-2 Precautions for adding grease

- (1) The reservoir should be filled with grease by means of a filling pump.  
It should be kept in mind that grease is to be supplied through the filling port of the pump. A strainer provided in the filling port should be cleaned periodically.
- (2) Grease may be deteriorated if it has been mixed with another brand of grease. To prevent this, it is recommended to obtain the adequate instructions from a grease manufacturer when using a different brand of grease.

### 5-3 Spare parts

It is recommended that the following spare should be provided to minimize the shutdown period of the system in the case of emergency.

- (1) For pump
  - (a) Cylinder plunger set
  - (b) Various packing
  - (c) Pressure gauge and limit switch
  - (d) Hydraulic-operated reversing valve KRV-2S
- (2) Various types of measuring valves
- (3) For control panel
  - (a) Signal lamps
  - (b) Fuse elements
  - (c) Auxiliary relays
  - (d) Timers
- (4) Miscellaneous
  - (a) Flexible hoses
  - (b) Pipes and joints

### 5-4 Inspection

The following items should be inspected periodically.

- (1) Operation time of lubricating pump, discharge pressure, pipe end pressure.
- (2) Reversing operation of hydraulic-operated reversing valve. (Switch cam movement)
- (3) Operation of measuring valve



- (4) Grease leakage from pipe
- (5) Damage of respective equipment
- (6) Amount of grease remaining in reservoir and grease storage can

#### 5-5 Maintenance of bearing

A strong and superior bearing is employed for bearing. However, when the abnormality of noise, vibration and temperature from bearing portion occurs, promptly replace it.

## 6. Trouble shooting and remedy

It is recommended for better results that the cause of a trouble or failure should be detected by tracing simple defects first.

No.	Descriptions	Causes	Remedies
(1)	Pump motor fails to start, even if push-button switch is depressed.	a. Power supply is not on.	a-1. Turn on main power switch and operation power switch. a-2. Check the primary voltage (between R.S.T.) with a taster.
		b. Fuse is blown.	b-1. Turn on the no-fuse breaker. b-2. Replace the cylindrical fuse.
		c. Motor wiring is discontinued.	c. Reconnect the wire.
(2)	The alarm buzzer sounds. The buzzer sounds and pump operation fails even when the operating power switch is turned off once and then turn to on again.	a. The tank is empty.	a. Supply grease with a filling pump.
		b-1. The motor is over-loaded.	b-1. Check and repair.
		b-2. Sticking of reduction gear (Insufficient lubricant) b-3. Disconnection of motor circuit (Voltage is applied to two phases only of the three.)	b-2. Replace the reduction gear. b-3. Check and repair the wiring or replace the motor.
(3)	Pointer of pump pressure gauge deflects too much.	a. Air is trapped in main pipe and branch pipe.	a. Disconnect the piping at several points and operate the pump to draw the air.
		b. Refer to item (4) if grease retard alarm is given.	

(4)	Alarm buzzer sounds.  When the control power switch is turned off once and to ON again, the pump operates but the buzzer sounds again soon and the pump comes to a stop.	Grease retarding is resulted.	
		a. Sticking or breakage of plunger. (Inclusion of foreign substance)	a. Replace the cylinder and plunger.
		b. Insufficient discharge quantity or discharge pressure due to wear of cylinder or plunger.	b. Replace the cylinder and plunger.
		c. Dust is caught by the check valve.	c. Overhauling.
		d. Air is trapped in the pump.	d. Tighten the air vent plug of the level
		e. The grease used is too hard to be absorbed.	e. Change the grease with softer one.
		f. Mis-connection of the piping system.	f. Check and correct the piping.
		g. Grease leakage from the main or branch pipe.	g. Check and repair the piping.
		h. Excessive air allowed in the main or branch pipe.	h. Disconnect the piping at several points, and operate the pump to draw out the air.
		i. Dust is caught by the relief valve.	i. Overhauling.
		j. Malfunction of hydraulic-operated reversing valve, sticking of piston, or loosening due to wear.	j. Disassemble for repair or replace.
		k. High pressure due to inadequate adjustment of the changeover pressure of hydraulic-operated reversing valve.	k. Replace the cylinder and plunger.

		l. Inadequate setting of protective timer.	l. Set the timer at lubricating time +5 minutes.
		m. Malfunction of limit switch or mis-wiring.	m. Check the limit switch (push by hands) or repair.
(5)	Operating noise of pump is too high or not normal.	a. Wear.	a. Replace the reduction gear and the lubricating pump proper.
(6)	Water stays in the reservoir.	a. Quality of the supplied grease is not good.	a. Check the grease and check the quality with the grease maker.
		b. The pump is wet with water.	b. Attach a cover.
		c. Check valve is defective (for hydraulic turbin).	c. Overhaul the check valve or replace.
		d. Check valve attaching is neglected (for hydraulic turbin).	d. Attach the check valve.
(7)	Indicator stem of some measuring valves fail to operate.	a. Bearings are blocked.	a. Check the bearings and improve.
		b. Lube pipes are broken.	b. Check and changed over pressure.
		c. Changed over pressure of hydraulic operated reversing valve is too low.	c. Adjust the changed over pressure.
		d. Sticking of measuring valve due to dust clogging.	d. Overhaul the measuring valve or replace.
		e. Branch pipe is too long.	e. Lower the flow resistance by increasing the changed over pressure or by making the branch pipe larger.
(8)	All the measuring valves fail to operate.	Refer to above item (4) in this case as alarm is given.	

## 7. Disassembly & assembly

### 7-1 Replacement of Cylinder · Plunger set

Since the cylinder plunger is precisely machined, perform the replacement in the set without fail.

- (1) Method of removal of cylinder plunger set washing oil, waste cloth as well as tools are used.

Select a clean working place. With incorporation, care must be exercised not to mix the foreign matter.

- a. Remove the grease in the reservoir.

Take out the joint at the supply port, and push in the level rod of reservoir, and the grease flows out.

- b. Remove the reduction gear motor.

Since the grease remaining in the reservoir flows out, receive it using the waste cloth etc.

- c. Cylinder is set by using C-type snap-ring from the inside. Hence it is readily pulled out by cutting pliers for snap-ring.

- (2) Method of incorporation of cylinder plunger set

- a. Apply the grease to the periphery of cylinder set, and smoothly put it in the body.

- b. Put the cylinder set, and set C-type snap-ring by using the cutting pliers for snap-ring. Then, the attention should be taken not to deform extremely C-type snap-ring.

- c. Set so that the suction port of grease can provide the upper part.

- d. Apply the grease to the periphery of plunger set, and smoothly put it in the cylinder. Place the plunger guide therein to incorporate it in the cylinder.

- e. Alternately push the plunger by hands, and make sure that it moves smoothly to right and left.

- f. When the octagonal nut of cylinder set moves in the paragraph b, slightly fix the cylinder set, and again fix by the set-screw.

### 7-2 Incorporation of Reduction Gear motor

- a. Make sure that the cam is securely fixed to the shaft.
- b. Incorporate the reduction gear motor in the body to prevent the plunger and cam from the failure.
- c. Tighten four (4) bolts diagonally, and avoid the unequal fastening.

### 7-3 Hydraulic-operated reversing valve assembling

- a. Be sure to assemble while referring to the drawing (at the end of this manual, Fig.11) as the changed over is easily misassembled.
- b. After assembling the arm and the pinion, move the arm by hand to make sure the arm transfer angle is symmetrical around the center of the hydraulic-operated valve body.

### 7-4 Reservoir removing

- a. First remove the level switches in the reservoir.
- b. After removing the coupling at the feed inlet, draw out the grease in the reservoir completely. (The grease can be drawn out easily by removing the coupling at the feed inlet and by supplying compressed air through the overflow port of the reservoir.)
- c. Remove the cover and pull out the fixing bolts on the reservoir bottom by using a hexagon wrench for M8.

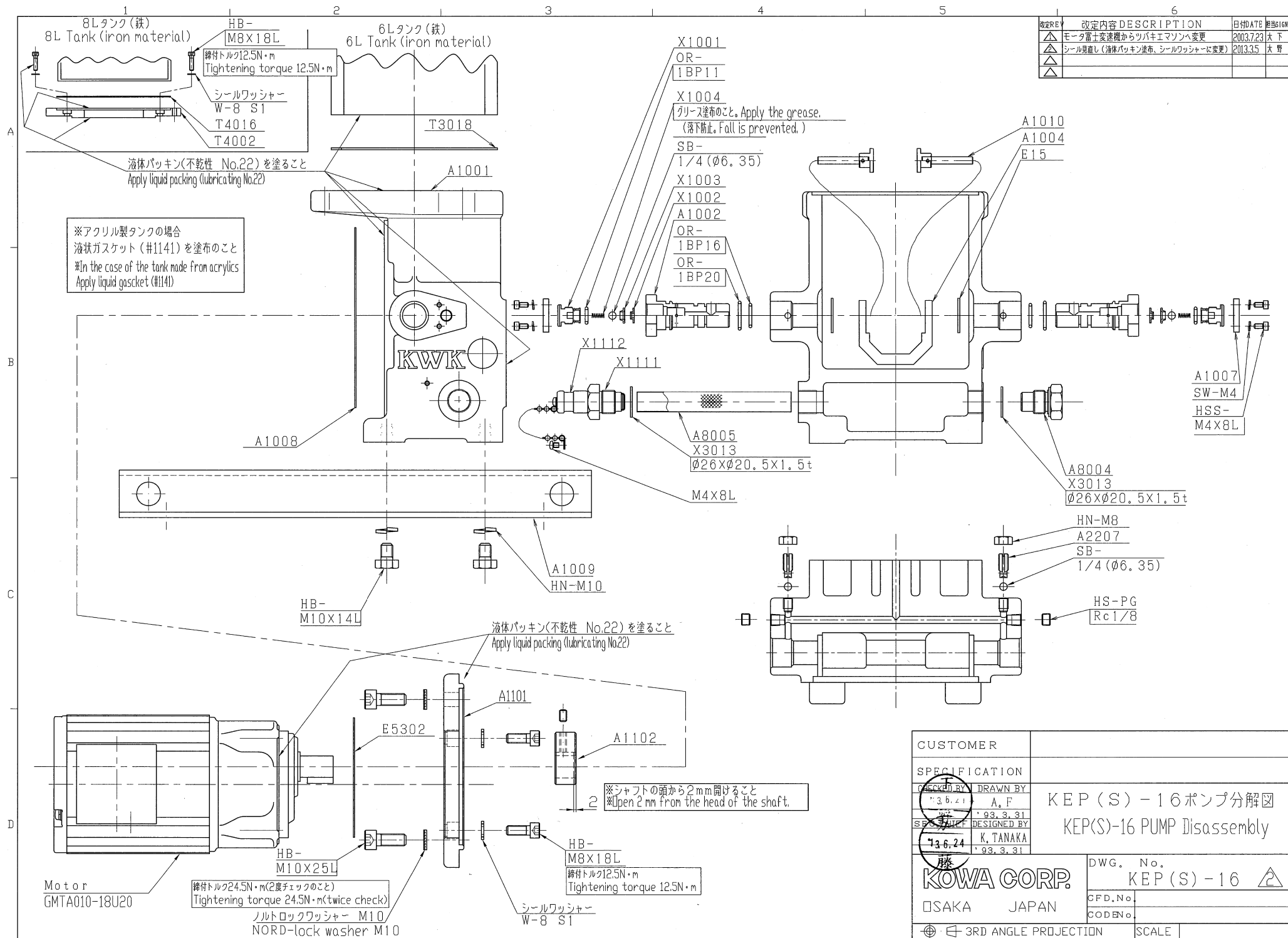
8. Structure of geared motor

- (1) As for sectional assembly drawing of the geared motor, refer to Fig.7.

## 9. Operation Record of KWK DUAL LINE LUBRICATING SYSTEMS

Specifications		
Type of pump	Grease filling method : Concentrated filling, Exclusive pump, etc.	
Pump No.	Type of filling pump	
Motor voltage	Name of grease used	
Type of control panel	Type of measuring valve used	
Control system	Auto/Manual start	Number of measuring valve used
Details of test operation		
Lubricating pump		Control panel
Lubricating pump & Reduction gear box oil volume : good / bad		Voltage, motor : _____ V / control : _____ V
		Pilot lamp (power supply) : good / bad
Motor rotating direction : normal / reverse		Pilot lamp (operation) : good / bad
Lubricating pump operation noise : normal / excessive		Pilot lamp (alarm) : good / bad
		Auto start of pump : good / bad
Lubricating time (No.1 line) : min. _____ sec.		Auto stop of pump : good / bad
		Alarm buzzer (low level switch) : good / bad
Lubricating time (No.2 line) : min. _____ sec.		Alarm buzzer (over time) : good / bad
		Overload of alarm buzzer motor : good / bad
Discharge pressure (No.1 line) : _____ kg/cm <sup>2</sup>		Timer setting (for start) : hrs.
		Timer setting (for protection) : hrs.
Discharge pressure (No.2 line) : _____ kg/cm <sup>2</sup>		Measuring valve
		All operations : good / bad
Changed over pressure (No.1 line) : _____ kg/cm <sup>2</sup>		
Changed over pressure (No.2 line) : _____ kg/cm <sup>2</sup>		
Others	Grease leakage from piping : yes / no	Damage of piping : yes / no
Special notes		





DUAL LINE LUBRICATING SYSTEMS  
MOTOR DRIVEN LUBRICATING PUMP  
MODEL : KEP-16SL-8L

INSTRUCTION MANUAL

KOWA CORPORATION

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## Introduction

Thank you very much for purchasing the DUAL LINE LUBRICATING SYSTEMS.

This instruction Manual has been compiled as a practical guide for the operation and maintenance of the lubricating system which incorporates the Model KEP-16SL motor-driven lubricating pump.

All descriptions contained herein are based on the standard system, which may, therefore, be different from those of purchased system. Such a problem can be solved by referring to the final specifications. However, it is required to understand that some changes caused by the modification of equipment may not be described in the final specifications.

## Guarantee

The guaranteed period this system will be one year from the commencement of operation. Any defect or failure occurring during the guaranteed period, for which KWK is liable in design and manufacturing, shall be corrected and / or eliminated by KWK without compensation. However, any defect or failure caused by improper operation which is not described in this Instruction Manual shall not guaranteed, even though the defect or failure occurs within the guaranteed period.

## PRECAUTIONS OF SAFETY

Before the installation, operation, maintenance and inspection, read carefully this instruction manual and other accompanying documents for correct service.

Familiarize with the knowledge of equipment, information of safety and all of cautionary instructions for service.

The precautions of safety is shown in each equipment of the centralized lubricating system by using safety mark.

Particular attention should be called to the places where these safety marks are given.

The safety marks are divided into "WARNING" and "CAUTION".



If mishandled; In case a dangerous situation may occur, it could result in death or serious injury



If mishandled; In case a middle injury or light injury, and in case a physical damage may occur.

For the matter being mentioned in the CAUTION, it may result in an importance according to circumstances. The important content is given to all of safety mark, and obey it without fail.

This system provides the max. working pressure 21MPa(210kg/cm<sup>2</sup>). When each equipment is disassembled and inspected, stop the operation of pump, and release the pressure to perform the operation as 0MPa(0kg/cm<sup>2</sup>).

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## 1. General description of DUAL LINE LUBRICATING SYSTEMS (Short loop type)

### 1-1 Outline of lubricating equipment

This system comprises motor-driven lubricating pump unit which will supply grease or oil to high pressure, external piping, measuring valves and control panel which is used to operate the lubricating system.

The schematic diagram of this system is as shown in Fig.1.

All the following descriptions are for the type used for greasing. When used for oil lubrication, the measuring valve and the tank of the pump are changed but all the other parts are commonly.

The motor-driven lubricating pump unit consists of pump body, electric motor, and hydraulic-operated reversing valve, all of which are mounted on a common base made of steel plate.

A reservoir made of steel plate is installed on the top of the lubricating pump, on which a level rod is provided to indicate the amount of grease stored in the reservoir.

A pressure gauge is also attached to the lubricating pump unit to show the discharge pressure of the pump.

The outside piping consists of the two lubricating mains of parallel piping from the two outlets on the hydraulic-operated reversing valve of the lubricating pump and the branch piping from the main piping to the measuring valve and lube piping from the measuring valve to the lubricating points.

The optimum type of measuring valve is selected according to the number of lubricating port.

In addition, a control panel is provided for automatic operation of the lubricating pump.

Also installed is lubricating pump which serves to supply grease into the reservoir.

## 1-2 Out line of lubricating circuit

The schematic diagram of the lubricating circuit is as show in Fig.2 (A and B).

Fig.2 (A) indicates that the discharged grease from lubricating pump is transferred in the arrow direction through the hydraulic-operated reversing valve (KRV).

While Fig.2 (B) shows that the grease transferred to No.1 line and No.1 lines open to the reservoir.

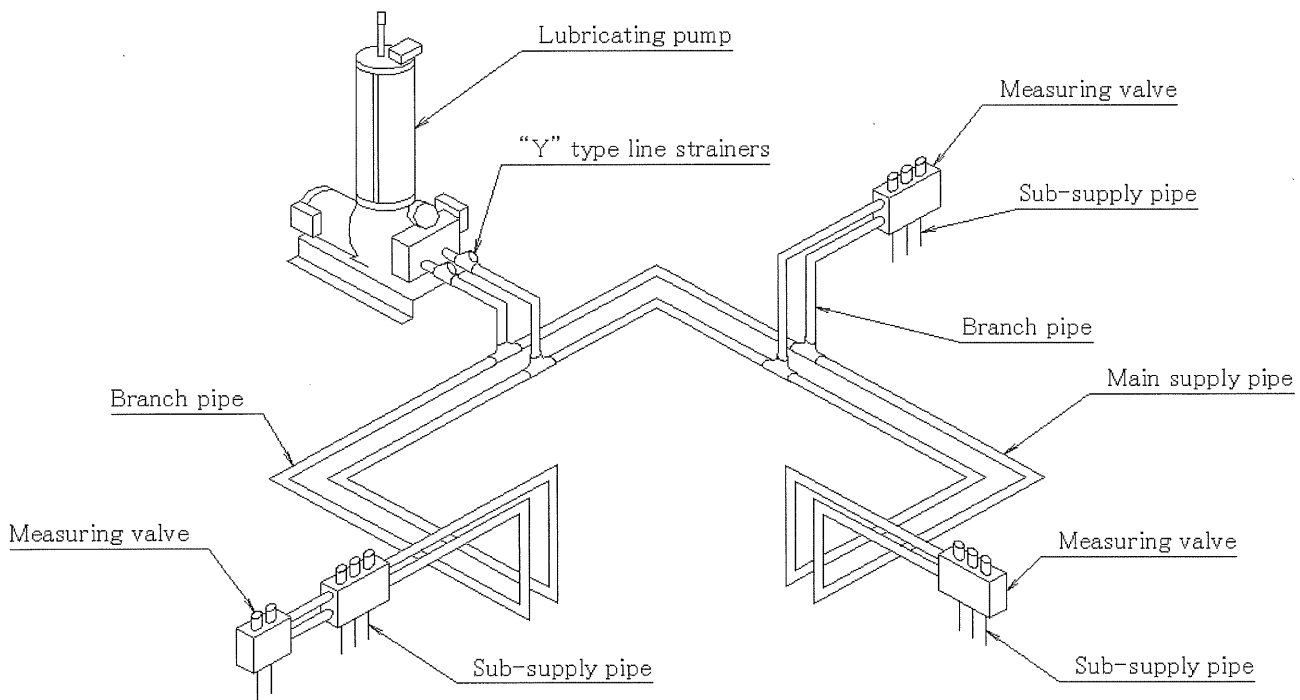


Fig.1 Schematic diagram of lubricating circuit



In Fig.2 (A), grease discharged from the lubricating pump passes through the hydraulic-operated reversing valve and flows through the line No.1 in the direction of arrow. The grease is then fed under pressure into each measuring valve through the upper side inlet (supply port) to complete one lubricating operation.

When the measuring valve at the end of No.1 line completes its lubricating operation, the internal pressure of No.1 line goes up to change the hydraulic-operated reversing valve by the grease pressure transferred through the changed over line in the hydraulic-operated reversing valve to the condition of Fig.2 (B). Simultaneously with the above, a limit switch attached to the reversing valve is actuated to stop the lubricating pump drive motor. When the motor is restarted, grease is supplied under pressure through the No.2 discharge line in the direction of arrow shown in Fig.2 (B).

The grease is then fed under pressure into each measuring valve through the lower side inlet (supply port) to perform the second lubricating operation.

Upon completion of the second lubricating operation, the hydraulic-operated reversing valve is changed over again by pressurized grease at the return port of the No.2 line.

This allows the lubricating system to from the circuit shown in Fig.2 (A). Simultaneously, the limit switch is actuated to stop the lubricating pump.

The lubricating cycles described and illustrated in Fig.2 (A) and (B) are alternately repeated until the lubricating operation is completed.

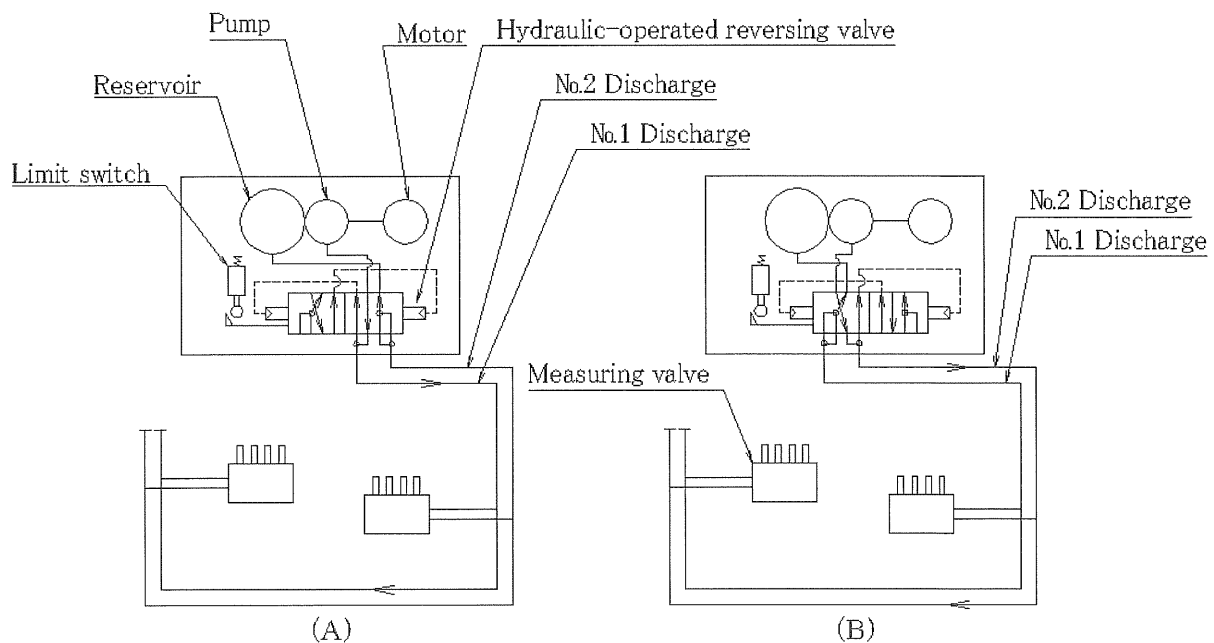


Fig.2 Lubricating circuit

### 1-3 Specifications of equipment

#### (1) Specifications of lubricating pump

Nomenclature	Item	Lubricating pump model and specifications	
		KEP-16SL-8L	
Pump	Applicable grease	NLGI No.00~No.1	
	Discharge capacity (cm <sup>3</sup> /min)	37/50Hz	45/60Hz
	Discharge pressure (MPa)	Max.20.6	
	Pump's revolutions (rpm)	75/50Hz	45/60Hz
Geard motor	Type	Totally-enclosed, three-phase induction motor, continuous rating, class "E" insulation	
	Output × No. of poles	0.1kW × 4P	
	Voltage, Frequency	3 φ ·AC200/220V×50Hz/60Hz	*
		3 φ ·AC400/440V×50Hz/60Hz	*
Reservoir	Reduction gear ratio	1/20	
	Capacity (Lit.)	8	
Hydraulic-operated reversing valve	Level switch	Low level switch 1 stage	*
	Model	KRV-22SL	
	Pressure range (MPa)	4~18	
Total mass (kg)	External pipe joints	2×Rc(PT)3/8	
		58	

- ① For the outside dimensions and the internal structure, please refer to the drawings of the principal equipment at the end of this manual.
- ② Check the column with asterisk mark (\*) referring to the final specifications.

(2) Specifications of measuring valve

Measuring valve size	Model	Discharge ports	Discharge capacity cm³/stroke		Adjustable amount cm³/one revolution of screw	Mounting bolts (Attachment)	Mass (kg)	Pipe joints	
			Max.	Min.				Inlet	Discharge
KS-30	KS-31	1	1.2	0.2	0.06	M8×65L	1.2	PT3/8	PT1/4
	KS-32	2					2.0		
	KS-33	3					2.8		
	KS-34	4					3.7		
KS-40	KS-41	1	2.5	0.6	0.10		1.4		
	KS-42	2					2.3		
	KS-43	3					3.2		
	KS-44	4					4.0		
KS-50	KS-51	1	5.0	1.2	0.15		1.5		
	KS-52	2					2.5		
	KS-53	3					3.5		
	KS-54	4					4.6		
KW-30	KW-32	2	1.2	0.2	0.06	M8×75L	1.5		
	KW-34	4					2.5		
	KW-36	6					3.5		
	KW-38	8					4.5		
	KW-310	10					5.5		
KW-50	KW-52	2	5.0	1.2	0.15		1.5		
	KW-54	4					2.5		
	KW-56	6					3.5		
	KW-58	8					4.5		

① The working pressure is 1MPa or lower.

② Working pressure : 21MPa

[The maximum working pressure of measuring valve using oil should be 10MPa.]

③ Applicable grease : NLGI No.00~No.1

## 2. Installation of equipment and piping procedure

### 2-1 Installation of lubricating pump

The lubricating pump is designed so as to be used indoor. It should be kept in mind that the pump is to be accommodated in a shed or housing capable of protecting the machine from weather, when being installed outdoor.

Maintenance of the machine should be easy even during operation, and the place should be free from excessive dust, temperature change and moisture.

Install the lubricating pump horizontally on a sturdy channel or concrete foundation.

Note that if stresses are locally applied to the lubricating pump frame when the foundation bolts are tightened, it may cause deflection of the pump center alignment and early damage to unit.

In either case, the pump base should be raised more than 50mm above the floor surface in order to facilitate the maintenance, inspection and water draining. Set up the control panel in place where the lubricating pump can be easily operated and controlled.

### 2-2 Piping procedure

#### (1) General precautions

As shown in Fig.1, the piping consists of the main supply pipes coming from the hydraulic-operated reversing valve of the lubricating pump unit, branch pipes running from the main supply pipes to the measuring valve, and the sub-supply pipes from the outlets of the measuring valve to lubricating points or bearing to be lubricated. All pipes should be supported properly so as to prevent them from being damaged by vibration, and should not be laid on locations where the pipes may be damaged by other obstacles.

#### (2) Connection of main supply pipes and branch pipes

The main supply pipes and branch pipes between the lubricating pump and measuring valve are subject to pressures as high as 21MPa. This fact requires that pipe material incorporated in the above pipe lines should safely withstand the pressure and should have an inside diameter which allow grease to flow smoothly.

Use the steel pipes of STPG 38 (schedule 80) or of higher grade.

The lubricating pump is operated at the maximum discharge pressure of 10MPa or 21MPa. If the use at the maximum pressure of 21MPa is predetermined, the pump is delivered with the specifications for 10MPa. In this case, STPG 38 (schedule 40) may be used as the piping material.

If the lubricated points of a machine include any moving part which slides or swings, flexible hoses is used for the sub-supply pipes.

To the moving parts of the main supply pipes and branch pipes, use the high-pressure rubber hoses for the maximum working pressure 21MPa.

Where the hoses surface may possibly be worn out by sliding, use wire braided hoses on the surface.

(a) Installation of pressure gauge.

Near the ends of No.1 and No.2 line piping of the main supply piping, attach a pressure gauge as shown in Fig.3 to check the switching pressure.

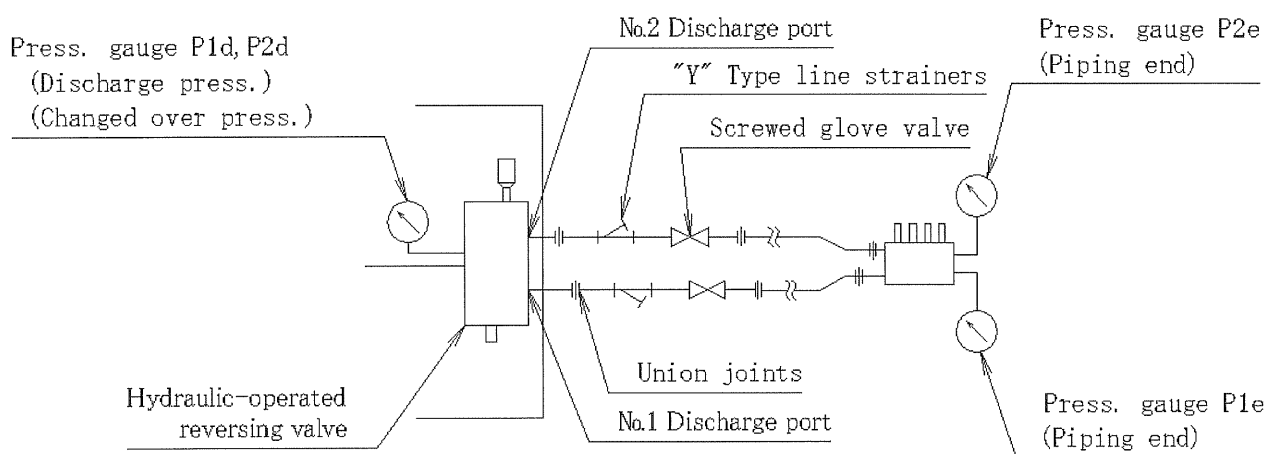


Fig.3

(b) "Y" type line strainers and glove valves.

As shown in Fig.3, the "Y" type line strainers should be installed on the discharge pipes of the hydraulic-operated reversing valve.

It should be kept in mind that the strainer is to be installed so that it can be removed and cleaned easily, with its installation direction corresponding to the flow direction of grease.

Also, be sure to install the screwed globe valves and pressure gauge as illustrated in order to check the lubricating pump performance and to provide convenience when the system is out of order.

(c) Attaching 2-way check valve

When the main supply pipe rises from the lubricating pump level more than 5 meters or when oil is used, attach 2-way check valve near the lubricating pump in series with the "Y" type line strainers to prevent reverse flow of the grease.

(3) Mounting measuring valve

- (a) It isn't advisable to attach the measuring valves directly to the main supply pipes. Unlike the case attached to the branch pipes, direct attaching to the main supply pipes makes it difficult to continue operation of the system when the measuring valves must be removed for piping line improvement in future or for troubles. It also can cause error motion of the whole system due to air allowed into the main pipes.
- (b) When measuring valves are connected in series, limit the number of pieces to about 3, in principle. When more than three measuring valves are used, branch a separate pipe from the main pipe for the piping connection.  
If the spacing between measuring valves is 0.5 meter or shorter, however, up to 5 measuring valves can be attached.
- (c) The measuring valve should be mounted on a support exclusively used for this purpose or separately fabricated base plate equivalent to the aforementioned support. The measuring valve should be installed at the location as close to the lubricating point as possible, where its indicator rods can be seen easily from the surrounding areas, and where the amount of supplied grease can be adjusted easily.
- (d) The measuring valve should be protected with a steel plate cover, when being installed at the dusty location often splashed with water and subject to a high radiation heat.
- (e) Blank the ends of the measuring valves attached to the branch pipes and main supply pipes with a high-pressure plug.
- (f) To confirm the lubricating operation of measuring valve easily, the branch pipes should be connected correctly to the measuring valves so that the indicator rod of the respective measuring valves move in same direction. In a more detailed explanation, all pipes branched from No.1 discharge line should be connected to the upper ports of the respective measuring valves.

(The same result may be obtained even if the pipes branched from No.1 line is connected to the lower ports of the measuring valves.)

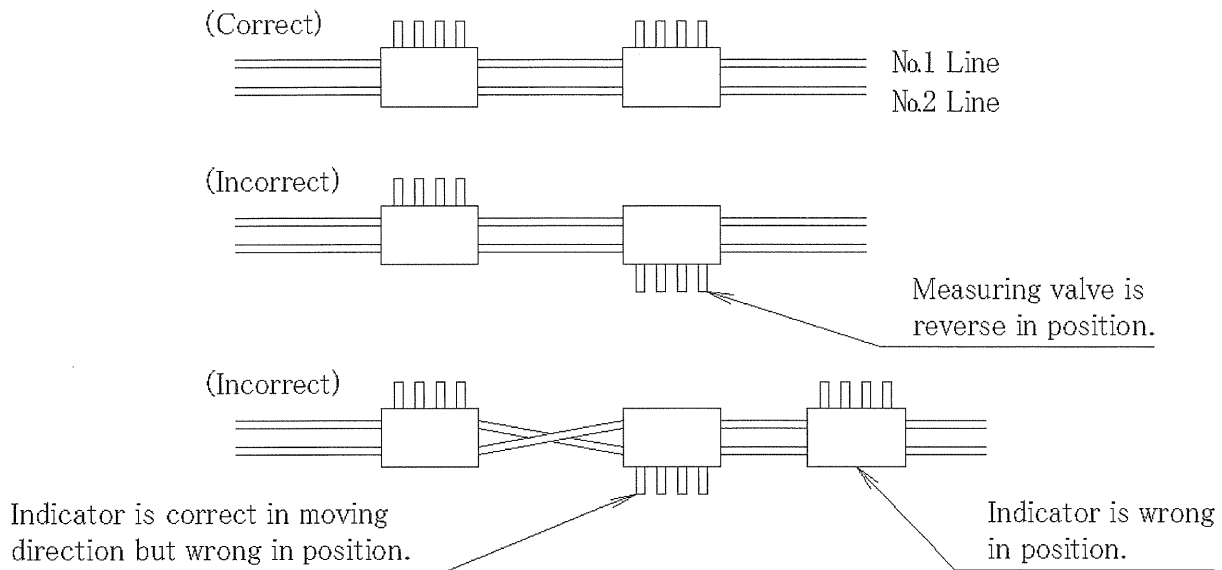


Fig.4 Connection of measuring valve

#### (4) Connection of sub-supply pipes (Lube piping)

- (a) Since the pressure required for greasing against the back pressure of bearings and resistance of the sub-supply pipes reaches the maximum operating pressure, it is necessary to use the material which withstands the pressure of 3MPa for the piping from the measuring valves to the points of lubrication.

For the piping, 8A (1/4B) steel pipes or 6  $\phi$  and 8  $\phi$  copper pipes are used.

- (b) When the bearings are submitted to a high back-pressure, prevent reverse flow of grease and error motion of the measuring valves by using check valves or inverse flow check valves. (Select the piping material carefully as the withstand pressure of the sub-supply pipes also changes in this case.)

- (c) Bearings must be composed so as to ensure discharge of old grease.

For sealed type bearings, it is necessary to lead the filled grease to the outside by attaching a relief valve to the bearings.

- (d) When the lubricated points of a machine include any moving part which slides flexible hoses must be used.

### 3. Construction and function of lubricating pump

#### 3-1 Construction of pump

As for sectional assembly drawing of the lubricating pump proper, refer to Fig.9. The lubricating pump proper is placed below the reservoir and the driving power of the motor is transferred to the cam shaft in pump casing through the coupling to turn the two cams. Rotation of the cams reciprocates the two plungers to draw grease from the reservoir through the check mechanism and to discharge the grease through the discharge port.

Grease is drawn in plunger return process by the guide plate and discharging is made in push-out process by the cams.

Through lubricating is made alternatively by two plungers, only one discharge port is provided as the lubricant path is shorted in pump.

#### 3-2 Pressure relief valve

This pressure relief valve is mounted on the side part of reversing valve. The pressure relief valve serves to release the inner pressure when the pipe clogged for some reason. The pressured grease, released from the pipe, is admitted into the reservoir to protect the lubricating system from being damaged.

Lubricating pump model	Maximum discharge pressure	Relief valve set pressure
KEP-16SL	21MPa	23MPa $\pm$ 0.5MPa

The pressure relief valve has been adjusted in KWK factory in accordance with the specifications at the time of concluding the agreement, before being delivered. Therefore, it is recommended that relief valve should not be adjusted at the site.



### 3-3 Reservoirs

#### (1) Reservoir

The reservoir is to store grease. A follower plate is provided in the reservoir so as to level out the grease surface along with grease consumption and to shut off the outside air.

On the center of the follower plate, a level rod is placed vertically going through the cover at the top of the reservoir and a cylindrical cam for level switch is provided on level rod.

A grease overflow port is also provided at the upper part for overflow of excessively filled grease.

#### (2) Low level switch

If grease is consumed until the reservoir is emptied, air is admitted into the pump, and may also be admitted into pipe line. Once air is admitted into the pipe, the lubricating operation becomes extremely unstable.

In the extreme case, grease must be drained completely from the pipe line in order to purge air, and the pipe line must be refilled with new grease.

A low level switch is provided at the upper part of the reservoir as the standard specification so that the pump operation stops and alarm is given when the grease is consumed to certain limit.

The cam to operate the low-level switch is at the upper end of the level rod.

When the grease is used and the follower plate comes down to certain level, the level rod directly connected to the follower plate also comes down, and the cam actuates the low level switch.

The signal from the low level switch is transferred to the control through the terminal box of the pump to issue alarm and to stop the motor.

### 3-4 Hydraulic-operated reversing valve

#### (1) Construction and function

This reversing valve serves to feed grease discharged from the pump alternately to the two main supply pipes. The grease fed by the pump actuates all measuring valves from one main supply pipe after passing through the reversing valve. After that, the grease returns to the reversing valve through its return port, actuating the valve piston by the pressure of the returning grease. The aforementioned piston movement changes over the grease so as to be connected to the other main supply pipe.

The composition is as show in Fig.5.

The inside of the hydraulic-operated reversing valve is provided with a slide block and two main pistons & one pilot piston at its ends. The slide block is depressed by using spring via a link to maintain the reversing pressure constriction. The end of the pilot piston is provided with the cam for actuating the limit switch in order to obtain the reversing valve.

## (2) Function

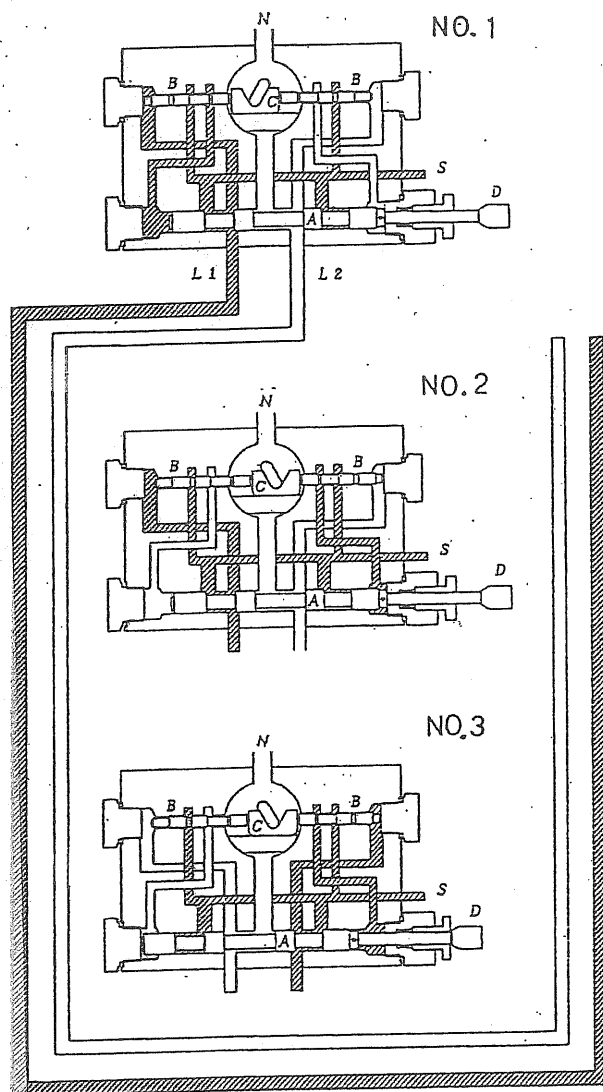


Fig.5 Function of hydraulic-operated reversing valve

- (a) In No.1 of Fig.5, grease pressurized by the pump passes through the inlet S and is forced into the main supply pipe L1 by means of the piston A. At this time, the other main supply pipe L2 is connected to the reservoir through N. The darkened part of Fig.5 shows the existence of pressurized grease.

When the inner pressure of the main supply pipe L1 is raised, and all measuring valves complete their operations, the pressure at the end of the pipe L1 begins to increase.

- (b) When the pressure in L1 exceeds the set valve, the piston B is moved to the right as shown in the No.2 of Fig.5. During this movement, grease entering into the cylinder through the inlet S is forced against the right end of the piston A by the movement of piston B. At the same time, the left end part of the piston A is connected to the relief line N.

- (c) Grease entering the cylinder through the inlet S and pressurized by the pump moves the piston A to the left, as shown in the No.3 of Fig.5. Upon completion of the above movement, the main supply pipe L1 is connected to the relief line N.

During this movement, the grease from the inlet S is fed to the main supply pipe L2. The

piston A is provided with a switch cam rod D, as shown in Fig.5, so that the line reversing operations can be observed from the outside.

The switch cam rod D actuates the limit switch when moving to the right and left, by which the lubricating pump is stopped.

When the lubricating pump is started again, grease is admitted into the main supply pipe L2 as shown in No.3 of Fig.5.

After all the measuring valve have been actuated by grease pressurized by the pump, the pressure at the end of L2 line. When the pressure exceeds the set value, the piston B is moved to the left. With the movement of the piston B, the pressurized grease from the inlet S is forced against the left end of the piston A. This allows the piston A to move to the right as shown in No.1 of Fig.5. At this time, the limit switch is actuated by means of the switch cam rod D, and the lubricating pump stops. The line reversing pressure of this hydraulic-operated reversing valve can be adjusted by means of a spring tension adjustment screw attached to the block C.

The line reversing pressure of the hydraulic-operated reversing valve has been adjusted at 10MPa in KWK factory before delivery.

#### 4. Trial operation

##### 4-1 Confirmation before operation

- (1) Check the installation, piping and wiring before test operation.
  - (a) Unions and flanges of main supply pipe and branch pipe operation.
  - (b) Sub-supply pipes connected to all bearings to be lubricated.
  - (c) Plug of measuring valve.
  - (d) Electric wiring on the primary and secondary sides.

- (2) Lubricant replenishment to the motor with reduction gear.

Before shipment, grease is already sealed in the gear casing of the motor with reduction gear.

Lubricating pump model	Reduction gear casing	Recommended brand
KEP-16SL	0.27kg	NIPPON GREASE NIGHTIGHT LMS No.000

- (3) Direction of pump rotation

Turn on the power source switch and control source switch. Depress the pushbutton switch for manual starting, and confirm the direction of motor rotation.

The problem is not in both a right rotation and a left rotation.

#### 4-2 Grease selection

There are quite different kinds of grease of different quality and characteristics. Select suitable grease to the operating conditions out of the recommended kinds of grease given below.

Ordinarily, any grease is applicable within the range of NLGI standard No.00 No.1 (fluidity 430 to 310).

Note:

##### 1. Molybdenum or graphite-filled grease

Solid lubricant is on will affect the life of the pump (wear).

If the particle size is 1 $\mu$ m or less, it can be used almost without problems.

If the particle size is about 1~3 $\mu$ m, it can be used . But wear becomes violently.

It can not be used if the particle size is greater than 3 $\mu$ m. (Pump life will be extremely short.)

##### 2. Grease containing metals in powder form such as copper and zinc can not be used.

Name of company	Brand
ESSO Standard oil Co.	LITHTAN No.0~No.1
	LITHTAN EP No.0~No.1
Shell International Petroleum Co.	ALVANIA EP GREASE No.0~No.1
	ALVANIA GREASE No.0~No.1
	EP GREASE No.0~No.1
Mobil Oil Co.	MOBIL PLEX 45,46
	MOBILUX 1

#### 4-3 Grease filling

(As the grease for filling, use the same brand as the one used for each customer.)

##### (1) Filling reservoir with grease

Fill the grease into the reservoir by the pump with care not to allow intrusion of dust or air from the filling port (snap-on coupling) on the side of lubricating pump unit.

NOTE : The reservoir should never be filled with grease from the upper side, with the top cover and the follower plate removed. Such a filling manner may cause unexpected trouble during operation.

(2) Filling sub-supply pipe (Lube Line) with grease.

The sub-supply pipe ranging from the discharge port of measuring valve to the lubricating point should be filled with grease by means of a grease gun, before commencing the operation.

After filling grease, connect the sub-supply pipes to the measuring valves.

(3) Filling main supply and branch pipes with grease.

(a) Preparation

- a) Remove the plugs at the end of No.1 and No.2 lines of the hydraulic reversing valve so that the grease and air in the piping can be drawn out. Fully close the screw type glove valve near the pump.
- b) Remove the measuring valve plugs (R3/8) at the end of the branch supply pipe to let out the air.
- c) Receive the grease coming out from the points where the plugs are removed in the above a) and b) with a vinyl bag, pail or waste cloth.
- d) For grease filling, it is necessary to operate the lubricating pump for several hours or longer in continuity. Since the maximum setting of the protective timer is 30 minutes, alarm is given and the pump stops when operation for more than 30 minutes. To prevent the alarm only for the test run, remove the protective timer on the control panel.

(The alarm is given only at empty reservoir or motor overload when the pump is operated under this condition.)

This isn't necessary when a filling pump is used for grease filling.

NOTE : Be sure to attach the protective timer to the original condition when grease filling completes.

(b) Filling procedure

- a) Turn the power switch to 「ON」 to operate the lubricating pump.
- b) Air is drawn out through the measuring valves where the plugs (R3/8) are removed, then the grease comes out but refrain from plugging the measuring valves soon. Take out the grease coming out to compare with new grease and plug the measuring valves only after making sure that equally clean grease to unused grease comes out.
- c) When grease is filled into the main supply pipe and returns to the return port of the hydraulic-operated reversing valve, check for no inclusion of foreign matter in the same way as for the preceding item, and stop the lubricating pump after measuring the pipe fluid resistance.

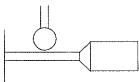

d) Pipe fluid resistance measurement

When there is no pressure gauge near the tail end of the main supply piping, as shown in Fig.3, prepare for the changed over adjusting work as described below, and measure the pipe fluid resistance for recording.

During the work of item c), check the pressure of the lubricating pump and record the point of the highest pressure when the grease comes out of the tail end of the main supply piping.

e) Piping system check

For judgment of grease discharge by No.1 line of No.2 line, the switch cam of the hydraulic-operated reversing valve is checked.

Discharge line	Switch cam position	
No.1 line	Out	
No.2 line	In	

f) Operate the lubricating pump, then the grease is discharged again through the filled line (No.2 line for example), and the pressure increase little by little this time because the piping is connected.

By the pressure the hydraulic-operated reversing valve is operated eventually and the switch cam is pushed out. Then the limit switch functions to transmit greasing completes signal and the lubricating pump motor comes to a stop.

g) Operate the lubricating pump again. Since the hydraulic operated reversing valve is changed, No.1 line is filled this time.

Fill in the grease in the same procedure as for No.2 line and plug the tail end of the main supply piping at the end, and mark sure that the hydraulic-operated reversing valve is changed and the lubricating pump cams to a stop automatically.



(c) After filling

When both lines are filled completely, turn off the power switch and attach the protective timer which was removed in the procedure 4-3-(3)-(a)-d).

Also clean the joints and plugs of the measuring valve in preparation for the following grease leak test. The filter of the "Y" type line strainer shall be cleaned as well.

4-4 Leak test

This is check the line for no grease leakage from the pipe joints when the maximum discharge pressure 21MPa of the lubricating pump is applied.

Carry out the test in the following order.

- (1) Set the protective timer at about 15 minutes and operate the lubricating pump.
- (2) Loosen the lock nut of the hydraulic-operated reversing valve, and increase the pressure by controlling the pressure adjust screw so that the selector may not be switched.
- (3) The pointer of the pressure gauge to lubricating pump goes up slowly reaching 23MPa in due course. (As the hydraulic-operated reversing valve is not changed, the pressure in the piping line goes up and the relief valve of the lubricating pump functions.)
- (4) The protective timer function 15 minutes later to give over time signal and the lubricating pump comes to a stop.
- (5) Turn off operation power switch to reset the alarm then turn on the switch soon again.
- (6) By controlling the pressure adjust screw of the hydraulic-operated reversing valve to lower the pressure slowly, then the selector is changed and the grease pump comes to a stop.
- (7) Operate the lubricating pump again to test leakage of the other line in the same procedure.
- (8) When the alarm is given and the lubricating pump comes to a stop, turn off the control power and go around the whole piping to check for no leakage.
- (9) Loosen the adjust screw to the original condition (condition of no spring pulling) to adjust the change-over pressure.

#### 4-5 Measurement and adjustment of discharge pressure (change-over pressure)

and pipe end pressure (P1e and P2e) (See Fig.3)

- (1) While operating the grease pump, record the highest reading of the pipe end pressure (P1e and P2e) and the discharge pressure (P1d and P2d) immediately before the end of greasing, then wait for automatic stopping.

Discharge line	Discharge pressure	Piping end pressure
No.1 line	P1d=MPa	P1e=MPa
No.2 line	P2d=MPa	P2e=MPa

- (a) Discharge pressure . . . . Read the pressure gauge of the lubricating pump.
- (b) Changed over pressure . . . . Read the pressure gauge attached near to the end of piping in Fig.3.

NOTE : Judge discharging to No.1 line or No.2 line by checking the switch cam of the hydraulic operated reversing valve. (Fig.11)

- (2) Operate the grease pump again and increase the change-over pressure gradually by controlling the pressure adjust screw of the selector. After making sure that the pipe end pressure (P1e and P2e) is up to about 4MPa, wait for automatic stopping. Check the position of the indicator rod in preparation for the next operation check of the measuring valve.

#### 4-6 Measuring valve operation check

- (1) Check whether the indicator rod each measuring valve is out or in and mark all the measuring valves with pencil stone or chalk. Operate the lubricating pump and wait for completion of lubricating and automatic stop.
- (2) After making sure that the changed over pressure (P1e and P2e) is up to about 4MPa, check the indicator rod position of each measuring valve.

The rod should be moved to the opposite side of the position marking is above item (1).  
Erase the marks where the indicator rod is moved.

- (3) Where the indicator rod position does not coincide, the indicator rod is not moved.
- (4) Operate the pump again and record the discharge pressure of the other line.

By this operation, the indicator of the measuring valve returns to the original position.

- (5) For any measuring valve of which indicator rod does not move, refer to paragraph 4-8.

#### 4-7 Changed over pressure adjustment

When the indicator rods of all the measuring valves are operated, adjust the changed over pressure in the following manner so that the measuring valve operate exactly for the next lubricating.

##### (1) Adjusting method

Loosen the lock nut of the hydraulic-operated reversing valve and adjust the changed over pressure by turning the adjust screw while watching the pressure gauges (P1e and P2e). Operate the pump while checking the changed over pressure.

(Left turn of the adjust screw increases the changed over pressure.)

- (2) Increase the changed over pressure by 1MPa.

After the adjustment, the reversing pressure (Pn) becomes as follows.

$$P1n=P1e+10$$

$$P2n=P2e+10$$

- (3) When the pressure gauge P1e and not provided :

If there are no pressure gauge P1e and P2e are provided near the pipe end, it isn't possible to know the changed over pressure directly. In this case, the pressure is obtained by following equation. Pump discharge pressure (P1d and P2d) pipe fluid resistance = pipe end pressure. As the pipe fluid resistance, the valve measured in 4-3, (3)-(b)-d (Page 18) is used. To increase the pressure by 1MPa, therefore the pressure adjust screw shall be turned so that the peak pressure becomes equal to P1d and P2d measured in paragraph 4-6, (1) plus 1MPa.

- (4) Minimum operating changed over pressure.

As described above, set the end pressure to at least 5MPa.

(4MPa+1MPa or up when delivered)

(5) Lock nut locking

After the pressure adjustment, be sure to fasten the lock nut. If neglected, the pressure adjust screw is turned by vibration and the changed over pressure may be disordered.

4-8 For any measuring valve with non-operating indicator rod

- (1) When the bearings are subjected to back pressure, particularly for hydraulic turbines of power plants, the indicator rod may sometimes fail to operate unless the changed over pressure is increased.

Changed over pressure = back pressure + approx. 40kg/cm<sup>2</sup>.

Approximately the pressure given by the above equation is required.

- (2) For the indicator rod (piston) of no operation, remove the sub-supply pipes.  
(3) Operate the lubricating pump, wait for automatic stop, and then check for operation.

(a) When operated

The sub-supply pipes and bearings are in trouble.

- a) Check the sub-supply pipe for no breakage.  
b) Set a pressure gauge at the top end of a grease gun to feed grease directly from the sub-supply pipe to the bearings and check the back pressure.

The conceivable causes are :

- b)-1 Back pressure is high by nature and high back pressure is normal.

(take the measure of (3)-(b)-b) )

- b)-2 Measuring valve piston fails to operate as the bearing is filled fully with grease and there is no grease relief. Attach a relief valve to the bearing in this case.

- b)-3 Inadequate design or machining of bearing.

(b) When operation fails

- a) In most cases, the piston is sticking due to foreign substance in the piping and allowed into the measuring valve. (Normal measuring valve operates at 1MPa or lower.)

- b) Take the following measure.

- b)-1 Increase the change-over pressure little by little to the point where the indicator rod moves, set the pressure adjust screw at the change-over pressure plus 1 to 2 MPa.

Set the screw within the change-over pressure adjust range of 4 to 18 MPa.

b)-2 If the operation still fails even with increased pressure, clean the measuring valve.

Refrain from grinding the piston with sand paper at the cleaning as the discharge efficiency is lowered.

#### 4-9 Record of test run

At the end of the test run, carry out the check in accordance with the test run record shown at the end of this manual for final confirmation.

(1) Lubricating time, discharge pressure (changed over pressure).

Operate the lubricating pump for several times of lubricating and record the average time and pressure.

(2) Checking automatic start-up of pump.

Put the start timer pointer close to 0 hour as much as possible and make sure that the pump starts automatically.

(3) Alarm lamp and alarm check (while operating the pump)

(a) Grease low level

Check by the pushing the low level switch by hands.

(b) Set the protective timer at a timer shorter than the lubricating time recorded in (1), and operate the pump to check the lamp.

(c) Motor overload

Move the test lever of the thermal relay horizontally for checking. After testing, push the set lever then normal condition is restored.

(4) Timer set

(a) Start timer

Set the operating interval in accordance with our specifications and the machine maker instructions.

(b) Protective timer

Set the timer at the lubricating time measured in (1) plus 5 minutes.

## 5. Maintenance and inspection

### 5-1 Grease replacement for motor with reduction gear (see paragraph 4-1 (2) )

Although the reduction gear is filled with grease with before shipment, please the grease with new one at 20,000 hours (4 to 5 years) of operation.

### 5-2 Precautions for adding grease

- (1) The reservoir should be filled with grease by means of a filling pump.

It should be kept in mind that grease is to be supplied through the filling port of the pump. A strainer provided in the filling port should be cleaned periodically.

- (2) Grease may be deteriorated if it has been mixed with another brand of grease. To prevent this, it is recommended to obtain the adequate instructions from a grease manufacturer when using a different brand of grease.

### 5-3 Spare parts

It is recommended that the following spare should be provided to minimize the shutdown period of the system in the case of emergency.

- (1) For pump
  - (a) Cylinder plunger set
  - (b) Various packing
  - (c) Pressure gauge and limit switch
  - (d) Hydraulic-operated reversing valve KRV-22SL
- (2) Various types of measuring valves
- (3) For control panel
  - (a) Signal lamps
  - (b) Fuse elements
  - (c) Auxiliary relays
  - (d) Timers
- (4) Miscellaneous
  - (a) Flexible hoses
  - (b) Pipes and joints

### 5-4 Inspection

The following items should be inspected periodically.

- (1) Operation time of lubricating pump, discharge pressure, pipe end pressure.
- (2) Reversing operation of hydraulic-operated reversing valve. (Switch cam movement)

- (3) Operation of measuring valve
- (4) Grease leakage from pipe
- (5) Damage of respective equipment
- (6) Amount of grease remaining in reservoir and grease storage can

## 6. Trouble shooting and remedy

It is recommended for better results that the cause of a trouble or failure should be detected by tracing simple defects first.

No.	Descriptions	Causes	Remedies
(1)	Pump motor fails to start, even if push-button switch is depressed.	a. Power supply is not on.	a-1. Turn on main power switch and operation power switch. a-2. Check the primary voltage (between R.S.T.) with a taster.
		b. Fuse is blown.	b-1. Turn on the no-fuse breaker. b-2. Replace the cylindrical fuse.
		c. Motor wiring is discontinued.	c. Reconnect the wire.
(2)	The alarm lights up. The alarm lights up and pump operation fails even when the operating power switch is turned off once and then turn to on again.	a. The tank is empty.	a. Supply grease with a filling pump.
		b-1. The motor is over-loaded. b-2. Sticking of reduction gear (Insufficient lubricant)	b-1. Check and repair. b-2. Replace the reduction gear.
(3)	Pointer of pump pressure gauge deflects too much.	a. Air is trapped in main pipe and branch pipe.	a. Disconnect the piping at several points and operate the pump to draw the air.
		b. Refer to item (4) if grease retard alarm is given.	
(4)	Alarm buzzer sounds. When the control power switch is	Grease retarding is resulted.	
		a. Sticking or breakage of plunger. (Inclusion of foreign substance)	a. Replace the cylinder and plunger.



	turned off once and to ON again, the pump operates but the buzzer sounds again soon and the pump comes to a stop.	b. Insufficient discharge quantity or discharge pressure due to wear of cylinder or plunger.	b. Replace the cylinder and plunger.
		c. Dust is caught by the check valve.	c. Overhauling.
		d. Air is trapped in the pump.	d. Tighten the air vent plug of the level
		e. The grease used is too hard to be absorbed.	e. Change the grease with softer one.
		f. Miss-connection of the piping system.	f. Check and correct the piping.
		g. Grease leakage from the main or branch pipe.	g. Check and repair the piping.
		h. Excessive air allowed in the main or branch pipe.	h. Disconnect the piping at several points, and operate the pump to draw out the air.
		i. Dust is caught by the relief valve.	i. Overhauling.
		j. Malfunction of hydraulic-operated reversing valve, sticking of piston, or loosening due to wear.	j. Disassemble for repair or replace.
		k. High pressure due to inadequate adjustment of the changeover pressure of hydraulic-operated reversing valve.	k. Replace the cylinder and plunger.
		l. Inadequate setting of protective timer.	l. Set the timer at lubricating time +5 minutes.

		m. Malfunction of limit switch or miss-wiring.	m. Check the limit switch (push by hands) or repair.
(5)	Operating noise of pump is too high or not normal.	a. Wear.	a. Replace the reduction gear and the lubricating pump proper.
(6)	Water stays in the reservoir.	a. Quality of the supplied grease is not good.	a. Check the grease and check the quality with the grease maker.
		b. The pump is wet with water.	b. Attach a cover.
		c. Check valve is defective (for hydraulic turbin).	c. Overhaul the check valve or replace.
		d. Check valve attaching is neglected (for hydraulic turbin).	d. Attach the check valve.
(7)	Indicator stem of some measuring valves fail to operate.	a. Bearings are blocked.	a. Check the bearings and improve.
		b. Lube pipes are broken.	b. Check and changed over pressure.
		c. Changed over pressure of hydraulic operated reversing valve is too low.	c. Adjust the changed over pressure.
		d. Sticking of measuring valve due to dust clogging.	d. Overhaul the measuring valve or replace.
		e. Branch pipe is too long.	e. Lower the flow resistance by increasing the changed over pressure or by making the branch pipe larger.
(8)	All the measuring valves fail to operate.	Refer to above item (4) in this case as alarm is given.	

## 7. Disassembly & assembly

### 7-1 Replacement of Cylinder · Plunger set

Since the cylinder plunger is precisely machined, perform the replacement in the set without fail.

- (1) Method of removal of cylinder plunger set washing oil, waste cloth as well as tools is used.

Select a clean working place. With incorporation, care must be exercised not to mix the foreign matter.

- a. Remove the grease in the reservoir.

Take out the joint at the supply port, and push in the level rod of reservoir, and the grease flows out.

- b. Remove the reduction gear motor.

Since the grease remaining in the reservoir flows out, receive it using the waste cloth etc.

- c. Cylinder is set by using C-type snap-ring from the inside. Hence it is readily pulled out by cutting pliers for snap-ring.

- (2) Method of incorporation of cylinder plunger set

- a. Apply the grease to the periphery of cylinder set, and smoothly put it in the body.

- b. Put the cylinder set, and set C-type snap-ring by using the cutting pliers for snap-ring. Then, the attention should be taken not to deform extremely C-type snap-ring.

- c. Set so that the suction port of grease can provide the upper part.

- d. Apply the grease to the periphery of plunger set, and smoothly put it in the cylinder.  
Place the plunger guide therein to incorporate it in the cylinder.

- e. Alternately push the plunger by hands, and make sure that it moves smoothly to right and left.

- f. When the octagonal nut of cylinder set moves in the paragraph b, slightly fix the cylinder set, and again fix by the set-screw.

### 7-2 Incorporation of Reduction Gear motor

- a. Make sure that the cam is securely fixed to the shaft.

- b. Incorporate the reduction gear motor in the body to prevent the plunger and cam from the failure.

- c. Tighten four (4) bolts diagonally, and avoid the unequal fastening.

### 7-3 Hydraulic-operated reversing valve assembling

- a. Be sure to assemble while referring to the drawing (at the end of this manual, Fig.11) as the changed over is easily misassembled.
- b. After assembling the arm and the pinion, move the arm by hand to make sure the arm transfer angle is symmetrical around the center of the hydraulic-operated valve body.

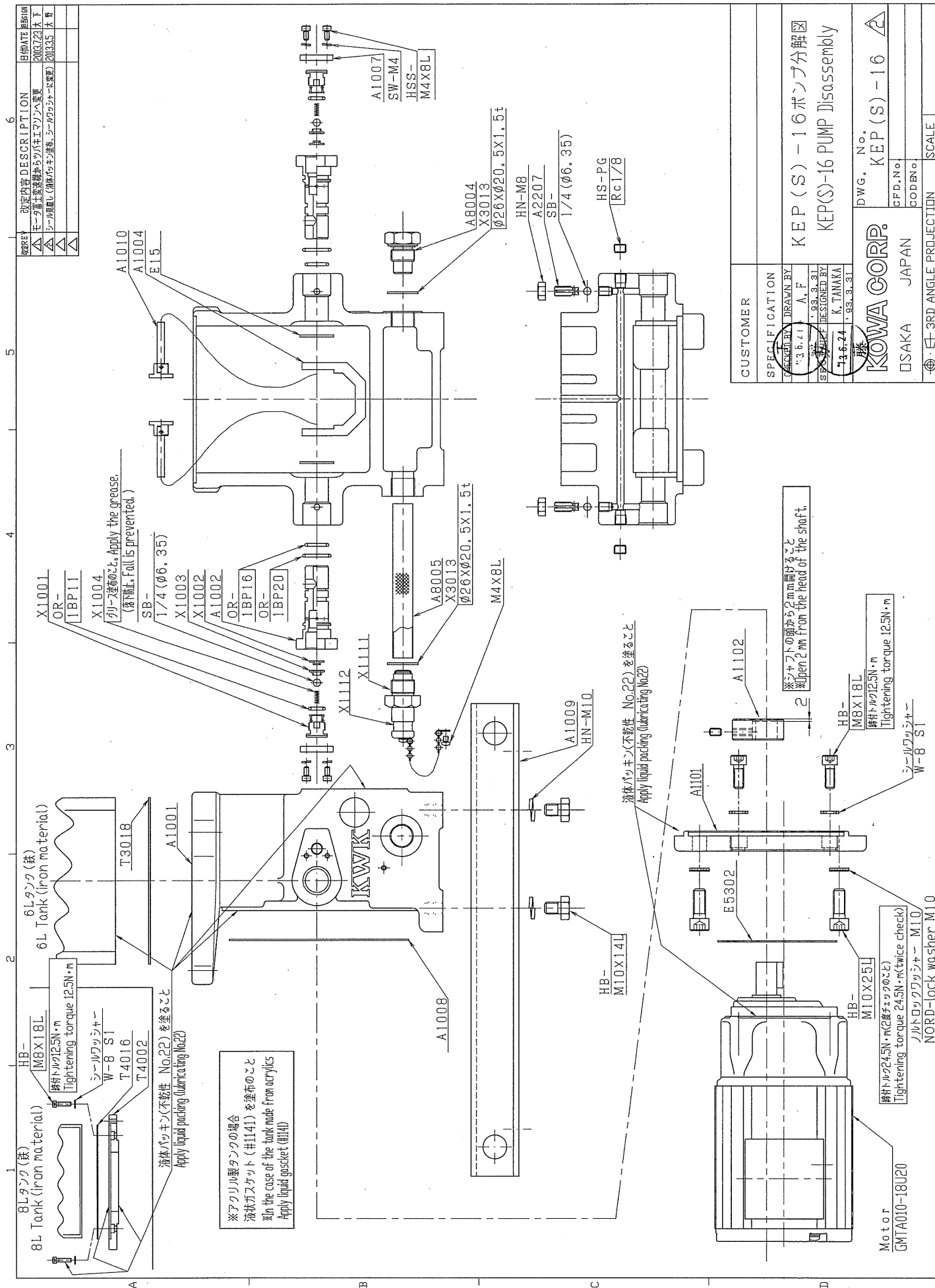
### 7-4 Reservoir removing

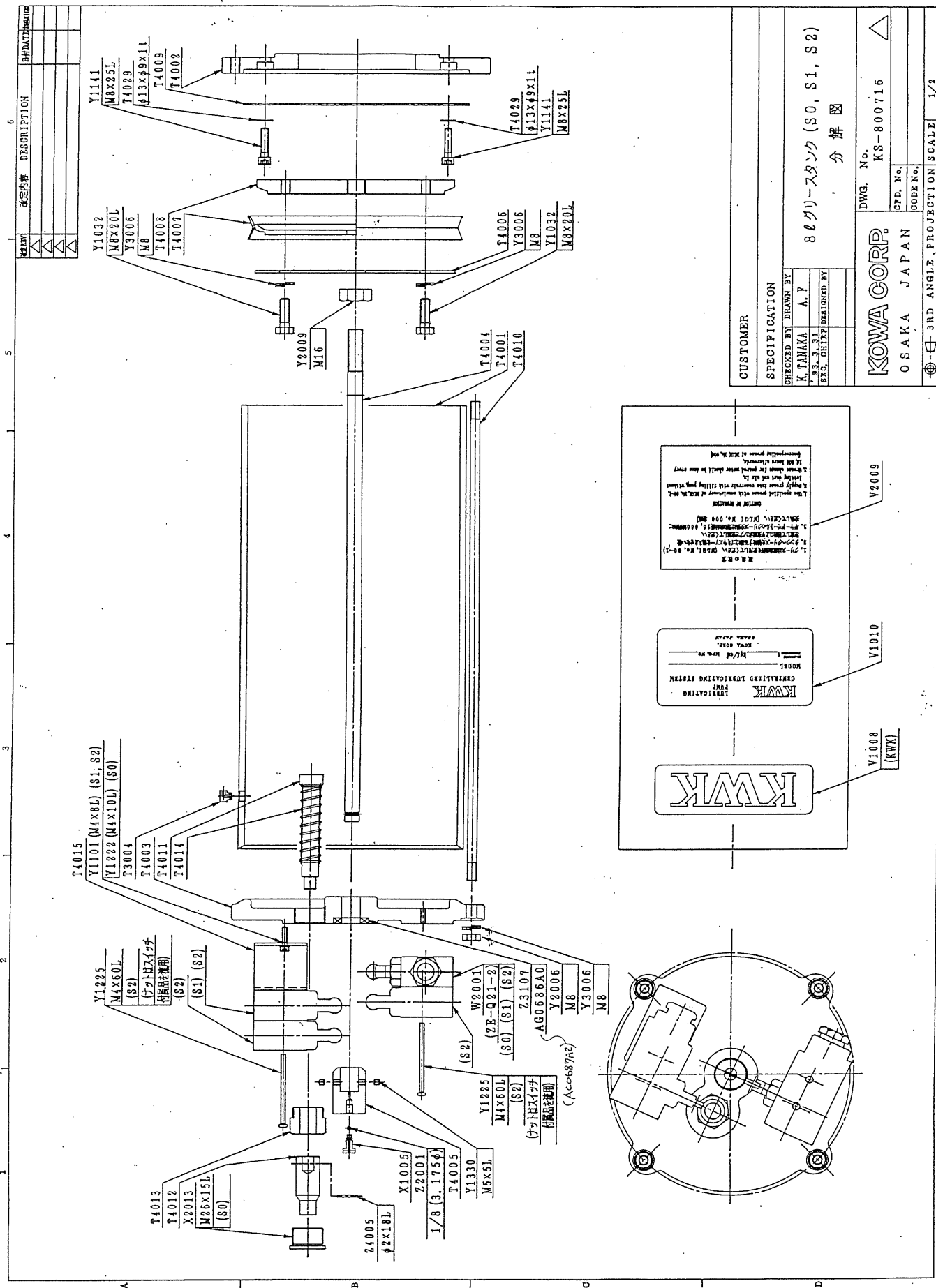
- a. First remove the level switches in the reservoir.
- b. After removing the coupling at the feed inlet, draw out the grease in the reservoir completely. (The grease can be drawn out easily by removing the coupling at the feed inlet and by supplying compressed air through the overflow port of the reservoir.)
- c. Remove the cover and pull out the fixing bolts on the reservoir bottom by using a hexagon wrench for M8.

## 8. Operation Record of KWK DUAL LINE LUBRICATING SYSTEMS

Specifications					
Type of pump		Grease filling method : Concentrated filling, Exclusive pump, etc.			
Pump No.		Type of filling pump			
Motor voltage		Name of grease used			
Type of control panel		Type of measuring valve used			
Control system      Auto/Manual start		Number of measuring valve used			
Details of test operation					
Lubricating pump		Control panel			
Lubricating pump & Reduction gear box oil volume : good / bad		Voltage, motor : _____V／control : _____V			
		Pilot lamp (power supply) :                  good / bad			
Motor rotating direction : normal / reverse		Pilot lamp (operation) :                  good / bad			
Lubricating pump operation noise  : normal / excessive		Pilot lamp (alarm) :                  good / bad			
		Auto start of pump :                  good / bad			
Lubricating time (No.1 line)  : min._____sec.		Auto stop of pump :                  good / bad			
		Alarm (low level switch) :                  good / bad			
Lubricating time (No.2 line)  : min._____sec.		Alarm (over time) :                  good / bad			
		Alarm (overload) :                  good / bad			
Discharge pressure (No.1 line)  : _____MPa		Timer setting (for start) :                  hrs.			
		Timer setting (for protection) :                  hrs.			
Discharge pressure (No.2 line)  : _____MPa		Measuring valve			
		All operations :                  good / bad			
Changed over pressure (No.1 line)  : _____MPa					
Changed over pressure (No.2 line)  : _____MPa					
Others	Grease leakage from piping :    yes / no		Damage of piping :                  yes / no		
Special notes					

Figure 1 is a schematic diagram of the test apparatus. It shows a horizontal pipe with two tanks labeled "8L Tank (iron material)" and "6L Tank (iron material)". The pipe is supported by a stand. A valve is located between the two tanks. The pipe is labeled "HB-18L" and "X1001". The valve is labeled "Tightening torque 12.5N・m".





CUSTOMER	SPECIFICATION		DWG. No.		△
	CHECKED BY		KS-800716		
	DRAWN BY				
	A. P				
	K. TANAKA		CFD. No.		1/2
	'83.3.31				
	DESIGNED BY		CODE No.		
	SEC. CHIEF				
800716-1 スタンク (S0, S1, S2)			分解図		
KOWA CORP.			3RD ANGLE PROJECTION		
OSAKA JAPAN					

