OVAL INSTRUCTIONS

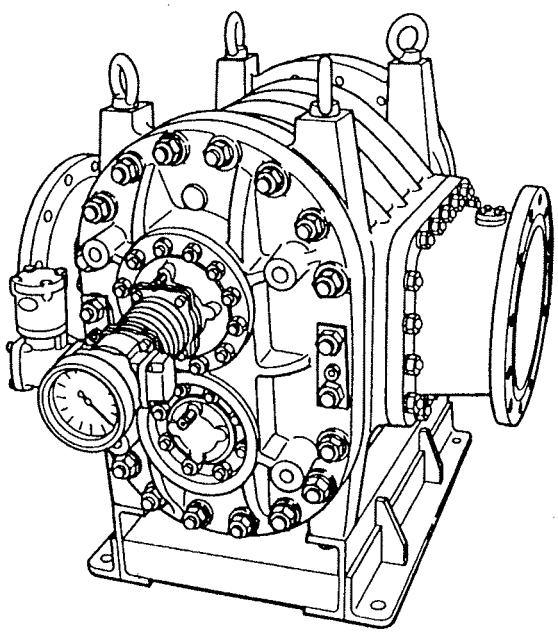
Ins. No. B-402-1-E

OVAL FLOWMETER SIZE 65

Bearings: Type 1

GENERAL

In many process industries today, the demand for accurate, large-sized flowmeters is holding firm in pace with the trend for building larger plants. Compactly built, the Size 65 is a positive displacement meter capable of handling large quantities of process fluid at flowrates up to 1,000 cubic meters per hour.



FEATURES

1. Simple design and ruggedly built.
2. Accurate through to the high-end of flow range.
3. Easy to maintain.
   a. One-piece housing construction simplifies disassembly and inspection.
   b. So little is the quantity of process fluid remaining in the meter at servicing; disassembly and inspection is facilitated.
   c. Small space requirements for disassembly and inspection.
4. Complete compatibility with all types of OVAL flowmeter generators, accuracy adjustors, and registers.
5. Exceptionally small pressure loss.
6. All connections are of reducer type; accepts alterations in flange size.

ABOUT INSTRUCTION MANUALS

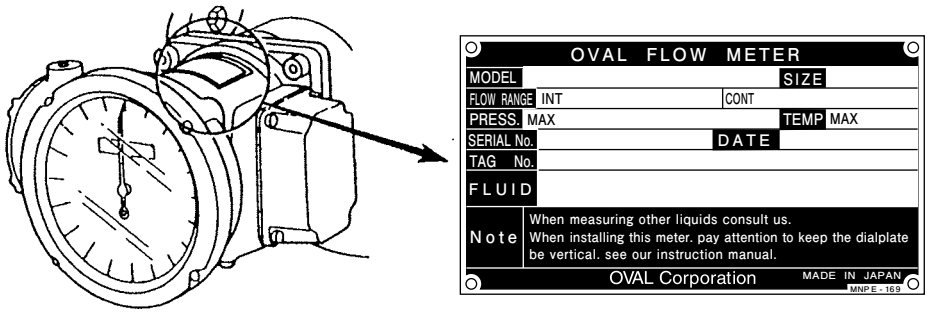
Every OVAL Flowmeter is fabricated and shipped from our factory under stringent quality control program. In order to maintain its design performance throughout the life of your meter, this manual offers the operator the necessary installation, operation and maintenance information. Be well familiar with these instructions before you place your meter in service and retain a copy of this manual at the field location for ready reference.

This instruction manual describes in most part the primary elements of the Oval flowmeter. For detailed information on related subassemblies, such as pulse generator and register, please refer to individual instruction manuals:

(1) Pulse generator	Prefix T (e.g. T-519-5)	Instruction Manual
(2) Register	Prefix R (e.g. R-401-3)	〃
(3) accuracy adjustor	Prefix G (e.g. G-003-AG1)	〃
(4) Cooling tube	Prefix A (e.g. G-901-8)	〃
(5) Air/liquid substitution operation..	G-011	〃

■ OPERATING CONDITIONS

To derive maximum performance in accuracy and service life from this meter, make sure that the flowrate, pressure, temperature, and viscosity are held within the ratings stated on the meter nameplate. Confirm these operating conditions before you place the meter in service.



■ PIPING INSTRUCTIONS

➡ See "TYPICAL INSTALLATION on page" 5.

1. Transportation Consideration

(1) To safeguard the two air vent valves (134) on the rear cover against damage, two eyebolts (123) are provided on the rear cover before shipment from factory. At installation or removal, use these eyebolts by installing them on top as shown in Fig. 1.
When you return the meter to the factory for servicing or other purposes, install these top two eyebolts back on the rear cover before shipment.

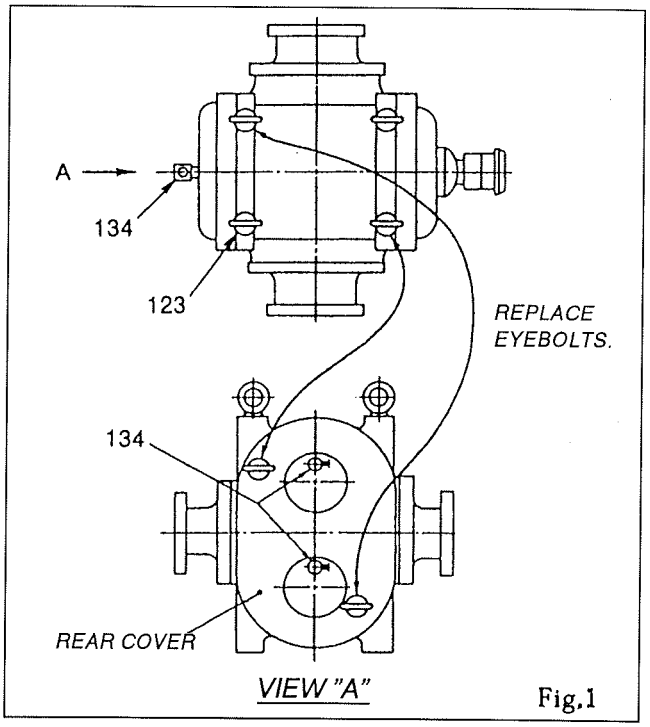


Fig.1

(2) Transport the meter to the installation location, exercising care not to give impact shocks, by hoisting with a wheel crane, or similar device (capacity 2.5 tons min.). See Fig. 2.

➡ **NOTE:** Total mass of the flowmeter weighs 2.3 tons approx. A 30k model has a total mass of 2.7 tons approx., requiring a wheel crane capable of lifting 3 tons or greater.

⚠ **IMPORTANT**

At first-time process fluid run, air vent valves should be adjusted.

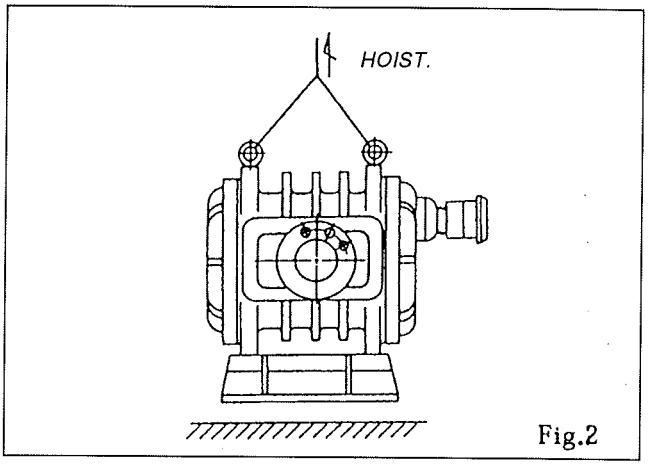


Fig.2

2. FLOWMETER INSTALLATION

(1) Avoid pipe strains when installing the meter.
(2) The meter must be installed on the discharge side of the pump.
(3) In tank head operation, a head greater than the pressure loss of the meter should be given.
(4) The flow direction must conform to the arrow on the meter body.
(5) The strainer should be located upstream of, and close to the meter. Illustrated on page 5 is a typical installation of this meter.

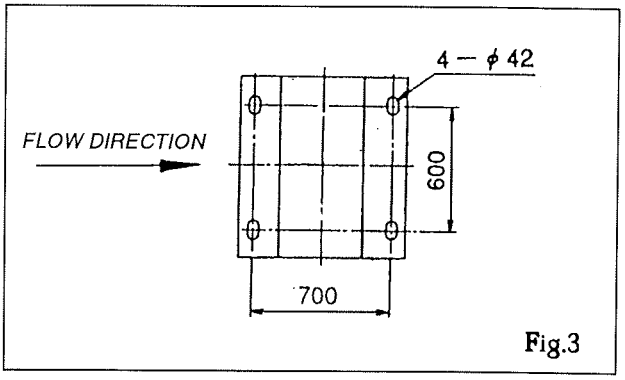


Fig.3

➡ **See "FLUSHING THE PIPING ASSEMBLY" on page 5.**

3. ABOUT THE STRAINER

(1) Install directly coupled to, or in close proximity of, the meter.
(2) To make strainer net cleaning easy, secure a space about the same height of the meter above it.
(3) To facilitate disassembly and inspection, provide a drain valve and a pipe for drainage.
(4) A clogged strainer may cause to produce bubbles when measuring volatile liquids.
(5) Provide a pressure gage upstream and downstream of the strainer. They will serve as a differential pressure gage with which you can detect a clogged strainer net and take precautionary measures to protect the net from damage. If ruptured, a damaged net can jam with the rotor teeth and lead to a costly downtime.

4. ABOUT THE AIR ELIMINATOR

(1) Install on the discharge side of the pump and upstream of the meter.
(2) The rule to follow is not to provide any device that will restrict the free flow of the process fluid, such as a reducing valve or an orifice, between the air eliminator and flowmeter. Such a device may cause bubbles when metering volatile liquids.

➡ **For outline dimensions, see "OUTLINE DIMENSIONS" and approval drawing on page 18.**

■ HOW TO CHANGE METER FLOW DIRECTIONS

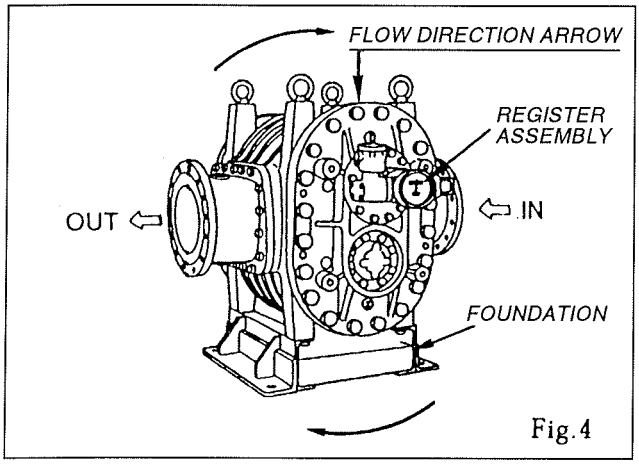


Fig.4

(1) Remove the flowmeter from the piping assembly and remove the foundation and register assembly. Adjust the arrow mark (⬅) indicating the flow direction to the new flow direction. To change flow directions from right-to-left to left-to-right, reverse the meter body by turning it round and then install it in the piping assembly again.

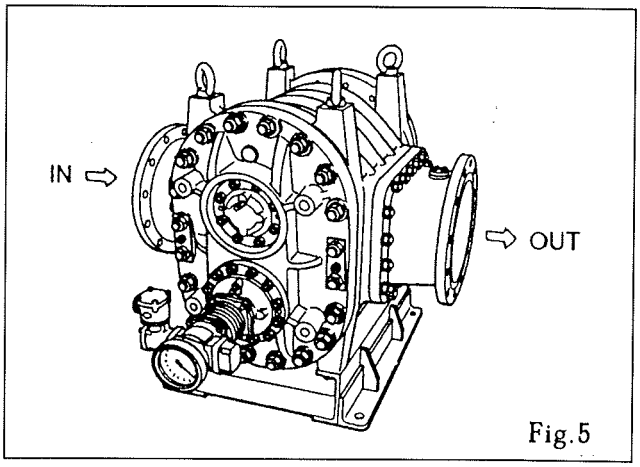
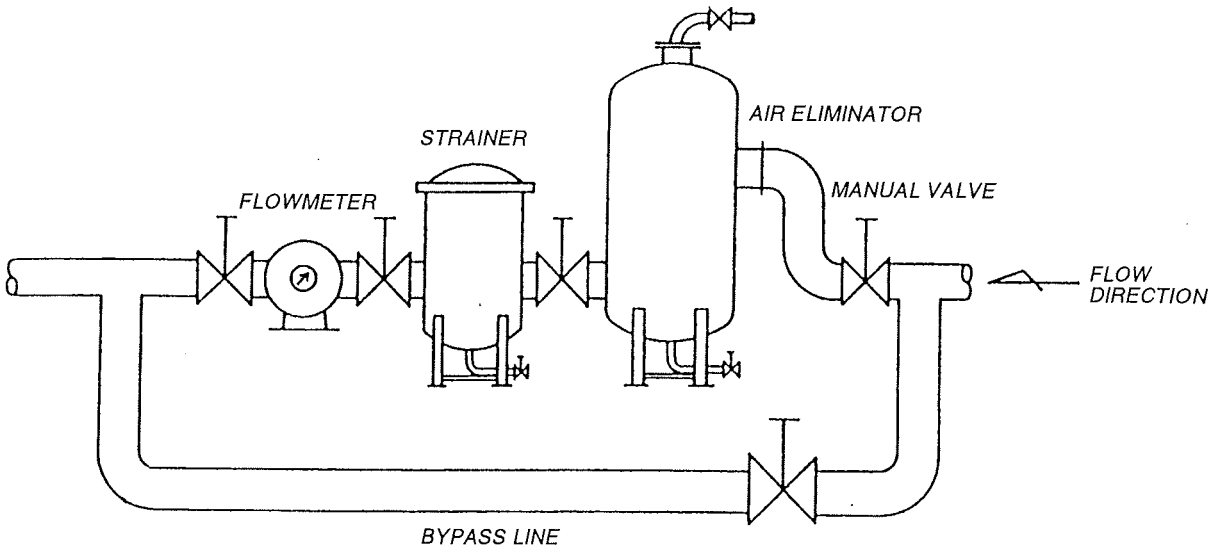


Fig.5

(2) Adjust the register orientation for correct viewability as shown and secure the register to the meter housing with bolts.

➡ **NOTE: When the flow direction is from right to left, the register assembly mounts above the centerline of the pipe line; when it is from left to right, the register assembly mounts below it.**

■ TYPICAL INSTALLATION



NOTE: WE SUGGEST TO PROVIDE A CRANE ABOVE THE EQUIPMENT FOR TRANSPORTATION.

Fig.6

For outline dimensions, see "OUTLINE DIMENSIONS" and approval drawing on page 18.

■ FLUSHING THE PIPING ASSEMBLY (See the figure below.)

Do not fail to remove the meter from the piping assembly and install a short pipe section in place of the meter before you attempt to flush the piping assembly. Costly damage to the meter could result if you attempt to flush away construction debris and other foreign matter with the meter in place.

⚠ **CAUTIONS**

(1) **Do not allow water to run across the meter, for it will cause internal components to gather rust and in time, retard freely rotor rotation.**

(2) **Following the flushing, be sure to clean the strainer net. Scale or other foreign matter in the net, if they go unnoticed by the operator, can damage the flowmeter while in operation.**

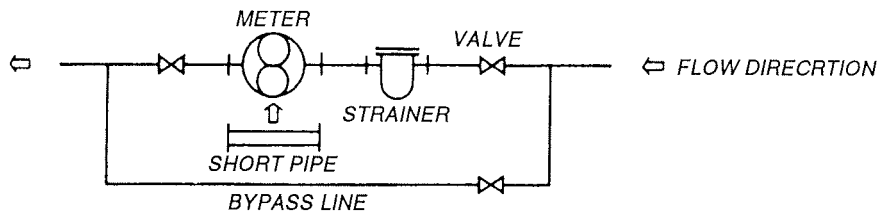


Fig.7

■ OPERATING INSTRUCTIONS

1. Read well the information stated on the nameplate before commencing operation and make sure the operating conditions conform to the specifications.
2. Carefully follow the valve operations sequence given below (refer to the piping diagram below):
   (1) Keep valves (A) and (B) closed.
   (2) Progressively open valve (C) to allow the fluid in the bypass line.
   (3) Slightly open valves (A) and (B). If necessary, slightly close valve (C). The flowrate at this point is correct if the register pointer moves slightly.

⚠ **CAUTION At this point, open the air vent valves at four places to let the air in the bearing assemblies out. Air left in the bearings can cause shaft and bearing seizure or other damage.**

   (4) In applications where temperature exceeds 80°C, run the meter at least for 10 minutes in the conditions (3) to ensure uniform heat distribution in the measuring chamber.
   (5) Following the preheating period above, progressively close valve (C) in the bypass line and progressively open valves (A) and (B) until the rated flow is reached.
   (6) Flowrate should be regulated with valve (B) downstream of the meter and should be held within the rating specified.
3. The strainer net should be inspected for condition and cleaned on a regular basis. On a newly installed piping assembly, in particular, inspect daily first and, according to the clogged condition of the net being inspected, inspection intervals may be reduced progressively to, say, once in two or three days.

How to Measure the Flowrate

When a total counter is connected, the flowrate is determined by the formula below, using a stopwatch:

$$\text{Flowrate } Q \text{ (kL/h)} = \frac{3600 \times \text{Total flow (liters)}}{\text{Time required for one pointer revolution (sec)} \times 1000}$$

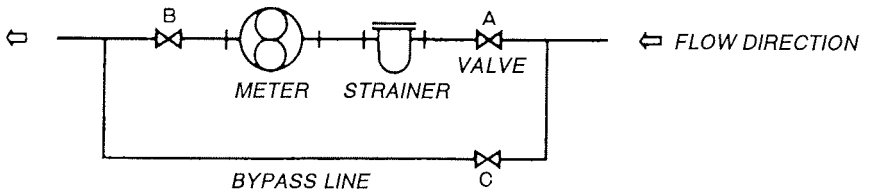


Fig.8

⚠ **IMPORTANT: Be sure to make air vent valve adjustment before allowing the process fluid for the first time.**

TROUBLESHOOTING

SYMPTOM	*TREATMENT*
Process fluid suddenly fails to flow.	*Disassemble the meter body (measuring assembly).*
With the register integral with the cooling tube removed, the output shaft connected to the internal transmission gear train fails to turn in response to process fluid flow.	*Disassemble the magnetic coupling (following magnet) assembly and inspect for condition.*
The input shaft of the transmission gear box will not turn or is hard to rotate by hand.	*Disassemble and Inspect the register assembly and transmission gear box.*
The input shaft does turn but the pointer and total counter drums fail to advance.	

■ DISASSEMBLY AND INSPECTION

◎ **Although service intervals may vary with the given operating conditions, it is suggested that the meter be disassembled and inspected regularly – once a year in normally encountered conditions.**

(1) ① Shut off valves upstream and downstream of the flowmeter.
② Remove drain blind plugs (117) on the rear covers (103) (top and bottom) of the flowmeter and allow the standing process fluid to drain.

➡ **NOTE:** The flowmeter body has an internal capacity of 262 liters approx.

③ Separate the register assembly and transmission gear box. To do this, take off four bolts (A) with hex wrench key and, holding the register assembly, separate it horizontally.
④ Remove the flowmeter body from the piping assembly.
⑤ Of the eight bolts (116) on the three blind covers (104), leave two semifixed and take off the remaining six (Fig. 9).

(2) Using the four eyebolts (123) furnished, place the flowmeter body upright with front cover (102) up (Fig. 10).

➡ **NOTE:** Securing a clearance of 30 centimeters approx. between the rear cover and the floor, position on a level plane at this time.

(3) Taking off twelve bolts (116), remove skirt (105).

⚠ **CAUTION: While removing the skirt, exercise care not to damage the transmission gear. The drive magnet shaft is protruding; be extremely careful not to distort it.**

(4) ① Remove reduction plate (301). To do this, take off four fitting bolts (310); install two of them into threaded slots; screwing them in will force the place to come off.

⚠ **CAUTION: The reduction gear assembly is gear coupled; exercise care not to damage gears, shafts and other related members when removing the assembly.**

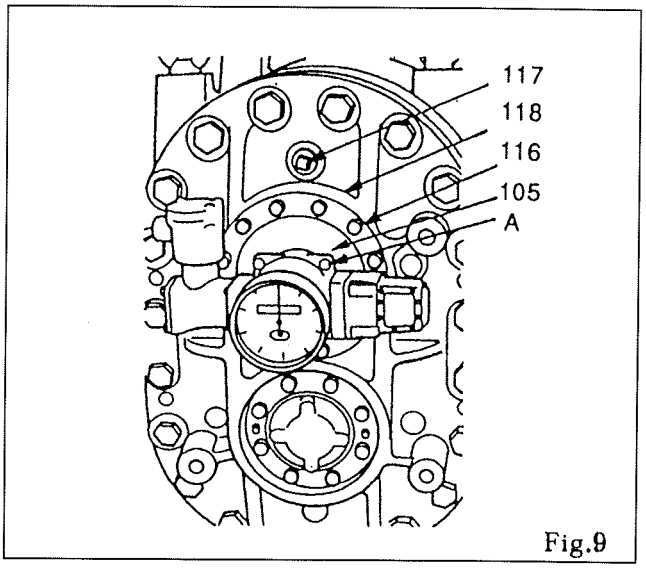


Fig.9

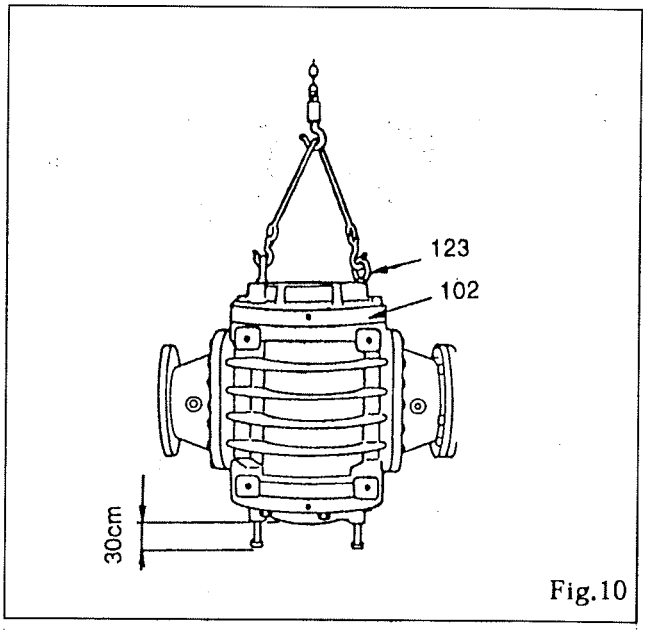


Fig.10

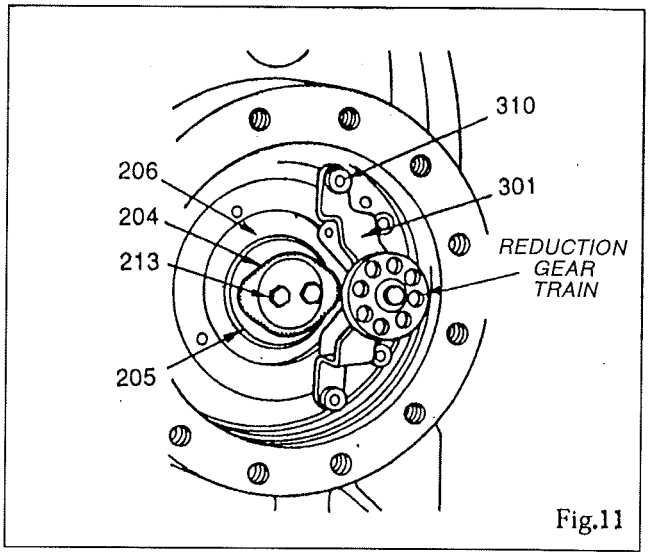


Fig.11

② Remove driving uniform-motion gear (204). To dot this, take off two bolts (213) and remove driving uniform-motion gear (204) complete with its boss (205).

③ Draw bearing holder A (206) out. To do this, take off two bolts and, making use of the two slots (M12) provided for removing the bearing holder, draw it out (Fig. 11).

➡ **NOTE:** Bolts (M12) for removal should be 130 millimeters or longer under the head.

(5) Draw front and rear bearing holders B (207) out. To do this, Secure the removing tool (G3) to the bearing holder with four bolts. At this point, install the removing tool so that the end of forcing screw comes concentric with the center hole of the rotor shaft. Turning the handle clockwise will cause the bearing holder to come off (Figs. 12 and 13),

(6) Draw rear cover bearing holder B (207) out. To do this, take off two bolts (116) semifixing blind cover (104) in place and the blind cover and bearing holder will be ready to come off.

⚠ **CAUTION: Be careful in handling the blind cover and bearing holder which weighs 22 kilograms. It is good practice to spread a cushioning sheet over the floor and making them come off and down on it.**

(7) Remove front cover (102). To do this, take off twenty bolts (115) and remove locating straight pin retainer (109). Of the two nuts screwed into the straight pin, screw one into the straight pin retainer as shown in the figure. Draw it until completely out (Figs. 14 and 15).

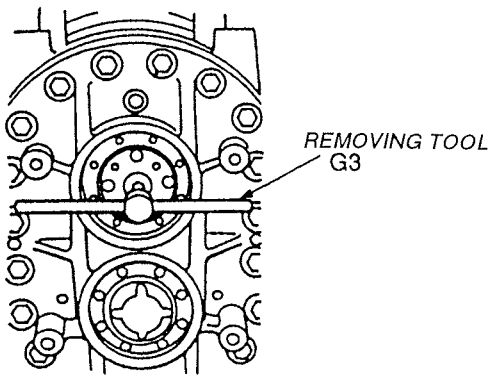
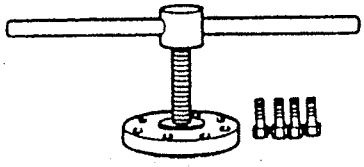


Fig.12



REMOVING TOOL G3 Fig.13

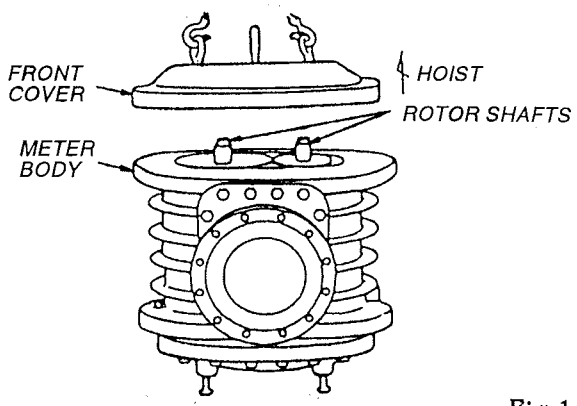
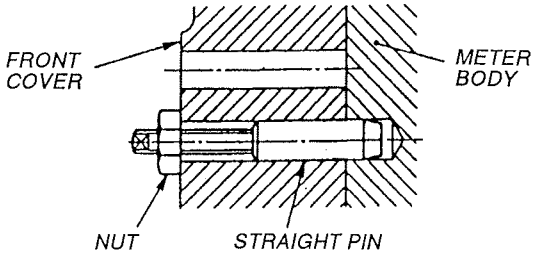


Fig.14



LOCATING STRAIGHT PIN Fig.15

(8) Remove Oval rotors (201). Install eyebolts on the end face of rotor shafts (202 and 203) and, using a wheel crane or similar equipment, carefully lift them out (Fig. 16).

➡ **NOTES:**

a. Each rotor weighs 182 kilograms approx.

b. It is a good idea to mark identification markings to thrust rings and their locations to ensure correct installation at assembly.

c. The thrust rings on the rear cover may come sticking to the rotors; be careful not to damage them.

d. To safeguard rotor bushings against damage, remove bearing holders B on the rear cover before rotors are drawn out.

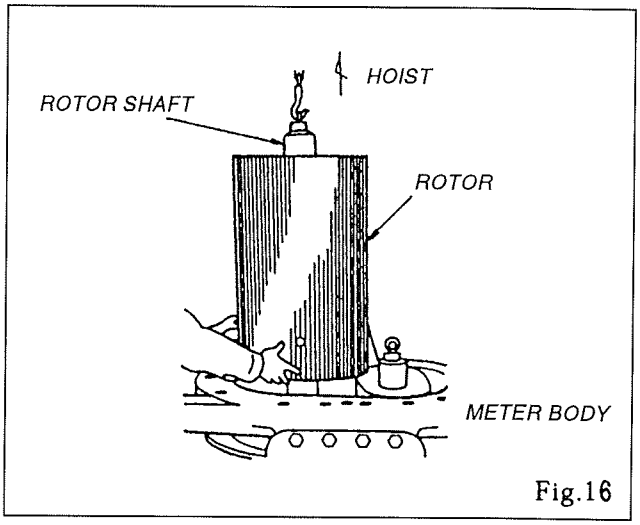


Fig.16

Internal components are now ready for inspection.

⚠ **IMPORTANT: Thoroughly wash clean the rotors, bearings, measuring chamber, covers and other related members, exercising care to keep grit and dust out.**

2. ASSEMBLY

● **The assembly procedure is reverse of the removal procedure. But careful attention must be paid to the following instructions:**

① Bearing holders B (207) and blind covers (104) on the rear covers should be installed before the rotors are installed.

➡ **NOTES**

a. Rotors can best be installed with the meter body placed sideways.

b. The orientation of oil grooves (V-grooves) in the rotor shafts should conform to Fig. 17.

c. Install rotors in line with non-turn setscrews (213) of the bearing holder.

② Be sure to align match marks on the tooth end face when installing the Oval rotors (Fig. 18).

③ Apply grease to thrust rings for attachment before their installation on the rear covers.

➡ **NOTE:** Be sure to install thrust rings with match marks aligned. Incorrect installation might result in faulty measuring chamber-to-rotor clearance (see NOTE (8) in DISASSEMBLY AND INSPECTION).

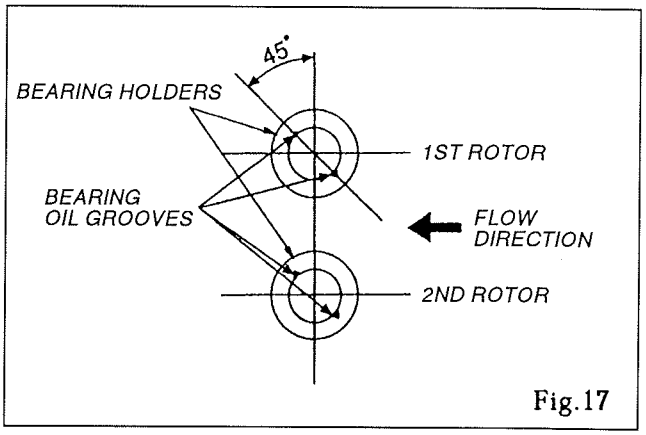


Fig.17

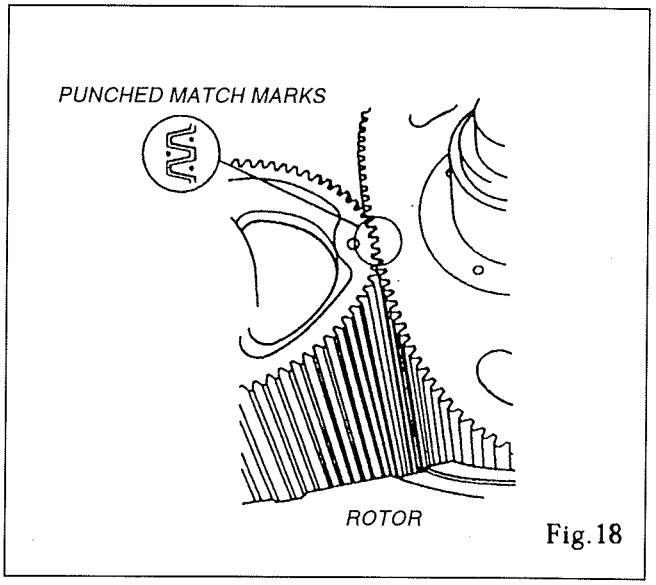


Fig.18

④ Inspect O-rings (106) for the covers for condition. We recommended their replacement every six months of service operation.

⑤ Install the front covers before bearing holders A and B are inserted into place. Drive the front cover locating tapered pin with wooden mallet until the screw end of straight pin is 21 millimeters approx. from the exterior surface of retainer.

⑥ When installing the reduction gear train (300), be sure to align the match marks on the uniform-motion gears (Fig. 19).

⑦ Do not fail to test for proper gear engagement by manually making at least one complete revolution to ensure freely rotation of rotors and uniform-motion gears.

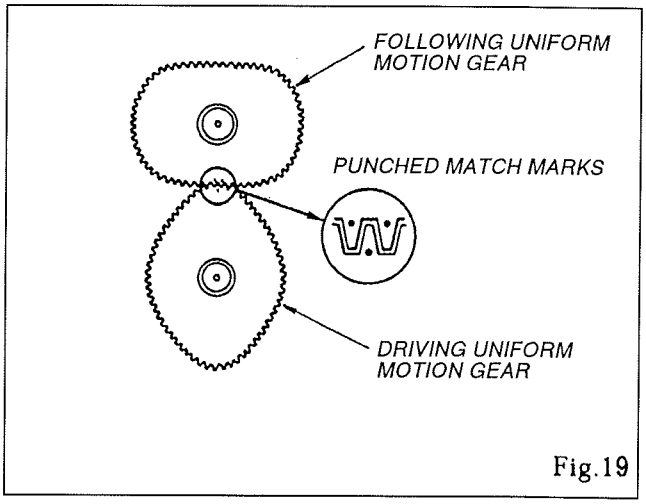


Fig.19

⚠ **DANGER**

Beware of the crushing points of Oval rotors in which hands might be caught or injured.

3. TRANSMISSION GEAR BOX INSPECTION

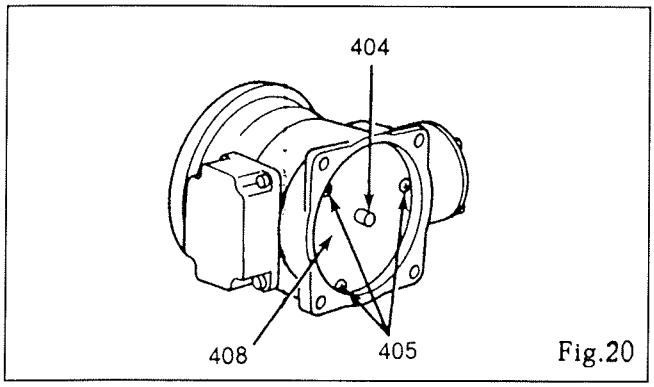


Fig.20

Take off three setscrews (405). The transmission gear train (408) can be drawn out by taking the coupling (404) out horizontally by hand. Do not force at this time as a dowel pin causes the assembly to become slanted (Fig. 20).

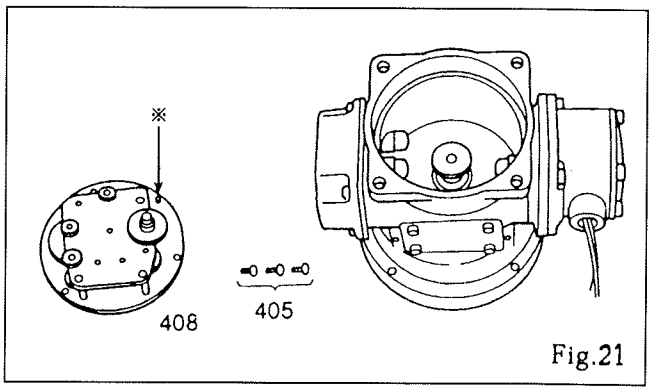


Fig.21

Inspect the transmission gear train (408) for condition. At assembly, careful attention must be paid to the location of dowel pin (marked ※). For further details, see "EXPLODED VIEW OF TRANSMISSION GEAR BOX" on page 17.

■ SIZE 65 OVAL FLOWMETER ASSEMBLY DRAWING (FRONT VIEW)

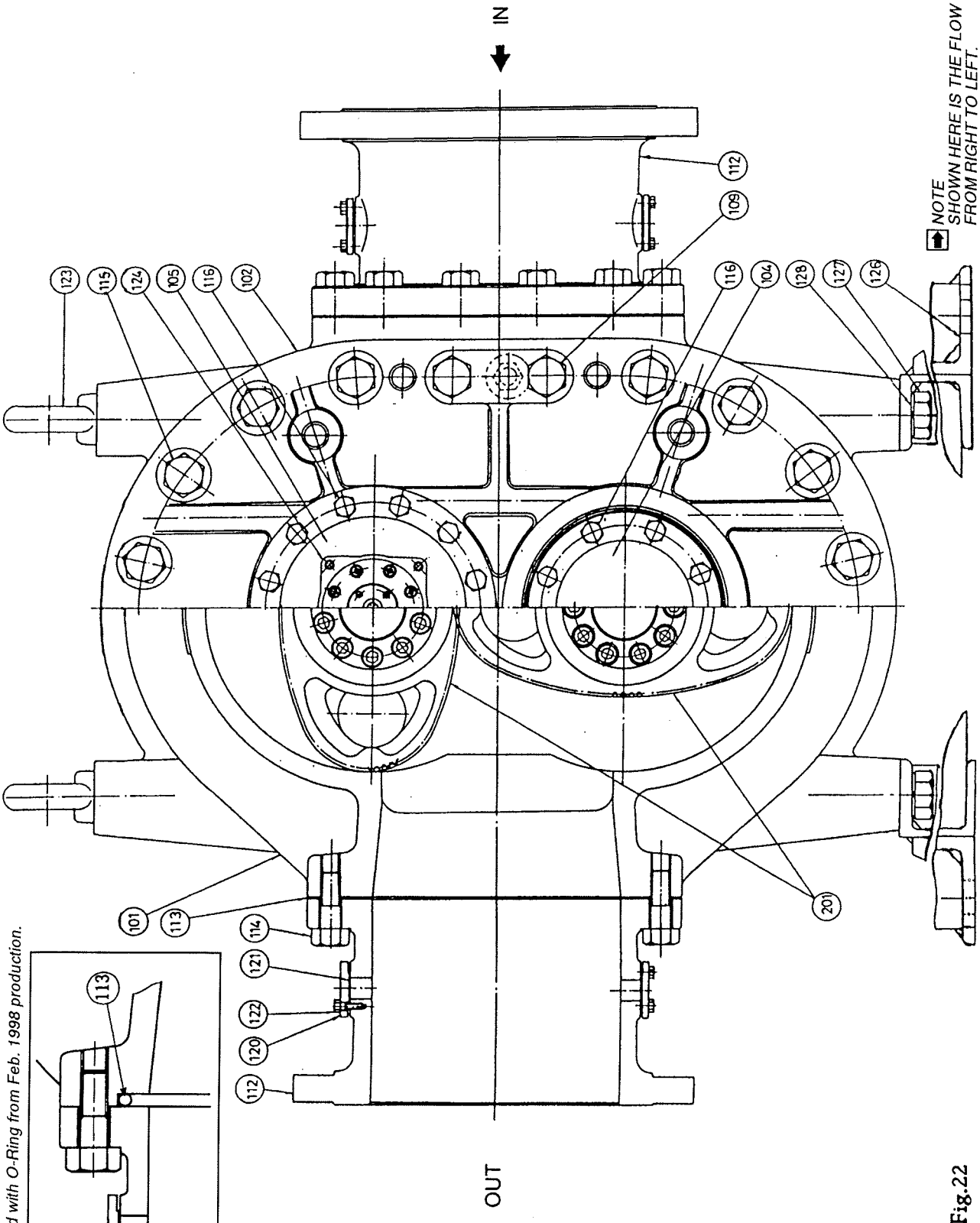
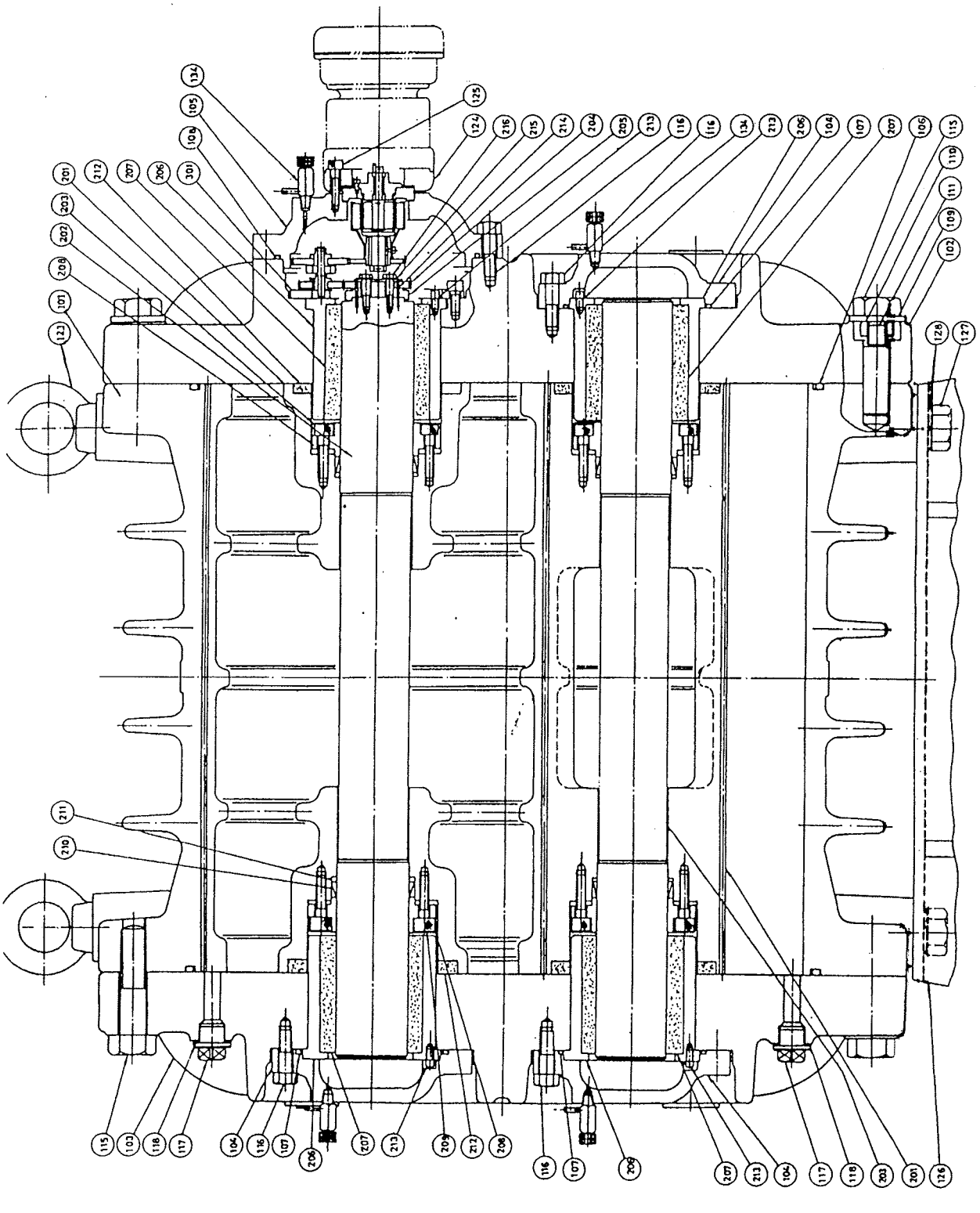


Fig.22

Fig.23

■ SIZE 65 OVAL FLOWMETER ASSEMBLY DRAWING (SIDE VIEW)



■ PARTS LIST

● *WHEN ORDERING REPLACEMENT PARTS, SPECIFY THE MODEL CODE NO., PRODUCT NO., INSTRUCTION MANUAL NO., SYMBOL NO., PART NAME AND QUANTITY DESIRED.*

Meter Body

▲: *Replacement parts*

Sym. No.	Part Name	Q'ty	Remarks
101	Meter Body	1	
102	Front Cover	1	
103	Rear Cover	1	
104	Skirt	3	
105	Blind Cover	1	
▲106	O-Ring, Cover	2	Special
▲107	O-Ring, Blind Cover	3	JIS-G165
▲108	O-Ring, Skirt	1	JIS-G230
109	Straight Pin Retainer	4	
110	Straight Pin Nut	4	
111	Locating Straight Pin	4	
112	Reducer	2	
※113	Reducer Gasket	2	
114	Reducer Bolt	36	M24
115	Bolt, Meter Body Cover	40	M30
116	Bolt, Blind Cover	36	M16
※113	Reducer O-Ring	2	ϕ 510

Sym. No.	Part Name	Q'ty	Remarks
117	Drain Bolt	2	G1"
118	Gasket, Drain Bolt	2	
120	Thermometer Blind Cover	8	
121	Blind Cover Gasket	4	
122	Blind Cover Fitting Bolt	16	M8
123	Eyebolt	4	M30
124	Sealing Flange	1	
125	Sealing Flange Bolt	8	
126	Foundation	1	
127	Foundation Mounting Bolt	4	M30
128	Washer	4	M30
130	3/4" Blind Slot Bolt	8	G3/4"
131	Gasket, Blind Slot Bolt	8	
133	O-Ring Groove Pin	4	
134	Air Vent VAlve	4	

※ ➡ *NOTE: Replaced with O-Ring from Feb. 1998 production.*

Inner Case Assembly

▲: *Replacement parts*

Sym. No.	Part Name	Q'ty	Remarks
201	Rotor	2	
202	1st Rotor Shaft	1	
203	2nd Rotor Shaft	1	
204	Drive Uniform Motion Gear	1	
205	Boss, Uniform Motion Gear	1	
206	Bushing Holder	4	(Bearing)
▲207	Rotor Bushiong	4	
208	Flange	4	
209	Flange Fitting Bolt	40	M16

Sym. No.	Part Name	Q'ty	Remarks
210	Ring	4	
211	Spacer Sleeve	4	
▲212	Thrust Ring	4	
213	Non-turn Screw	4	M10
214	Locating Pin, Gear	2	
215	Retainer, Gear	1	
216	Uniform Motion Gear Bolt	2	M10
217	Spring Washer, Gear	2	M10

Reduction Gear Train

Sym. No.	Part Name	Q'ty	Remarks
300	Reduction Gear Train	1 set	
301	Transmission Gear Frame	1	
302	Follow. Uniform Motion Gear	1	
303	Transmission Gear	1	
304	Transmission Gear Shaft	1	
305	Bearing	2	
306	Gear Boss	2	
307	Locating Pin	2	
308	Non-turn Pin	2	
309	Non-turn Pin	2	
310	Bolt	4	M12

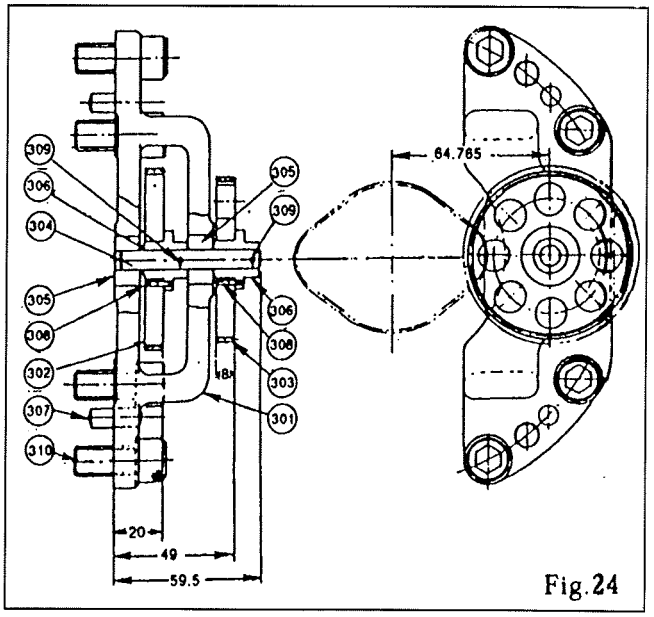


Fig.24

Magnetic Coupling Assembly

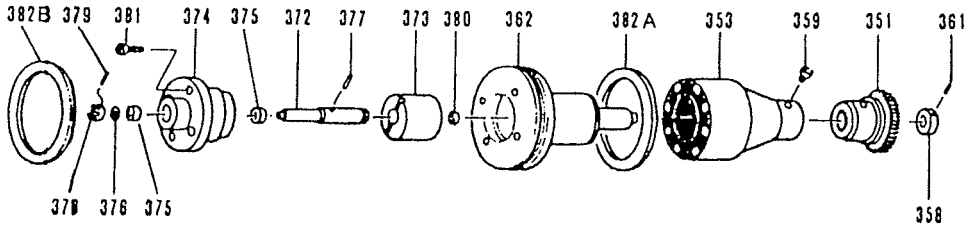


Fig.25

Sym. No.	Part Name	Q'ty	Remarks
350	Magnetic Coupling Ass'y	1 set	
351	Drive Magnet Bearing Holder	1 set	w/gear, bearing, bushing
353	Drive Magnet	1 set	w/holder
358	Stopper	1	
359	Pan Head Screw	4	
361	Straight Pin	1	
362	Bulkhead	1	
372	Following Magnet Shaft	1	
373	Following Magnet	1	

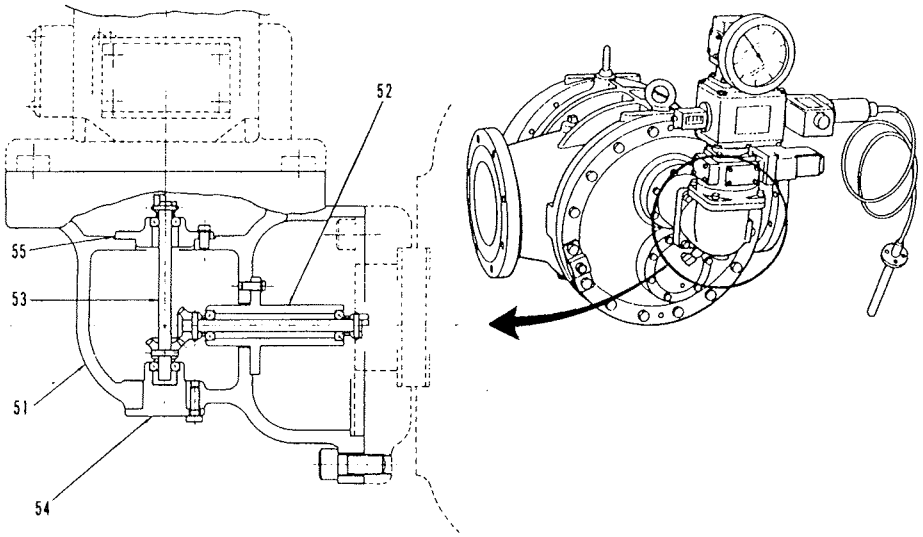
Sym. No.	Part Name	Q'ty	Remarks
374	Bearing Holder	1	
▲375	Ball Bearing	2	NMBL-1680ZZ
376	Thrust Spacer b	1	
377	Pin	1	
378	Transmission Coupling	1	
379	Pin	1	
380	E-Ring	1	
381	Pan Head Screw	4	
▲382A	Gasket	1	
▲382B	Gasket	1	

▲: Replacement parts

■ RIGHT ANGLE ADAPTOR Model CB1

To permit integral installation of an auto temperature compensator and register, Model LW-42, for example, a 90-deg. elbow is required to change the direction of turning effort of the output shaft.

Sym.No	Part or Assembly Name	Q'y
5 1	Adaptor	1
5 2	Input Shaft Assembly	1
5 3	Output Shaft Assembly	1
5 4	Bearing Assembly "A"	1
5 5	Bearing Assembly "B"	1



■ ABOUT LUBRICATION

- Do not fail to use proper lubricants, or equivalent, shown below at disassembly and inspection.

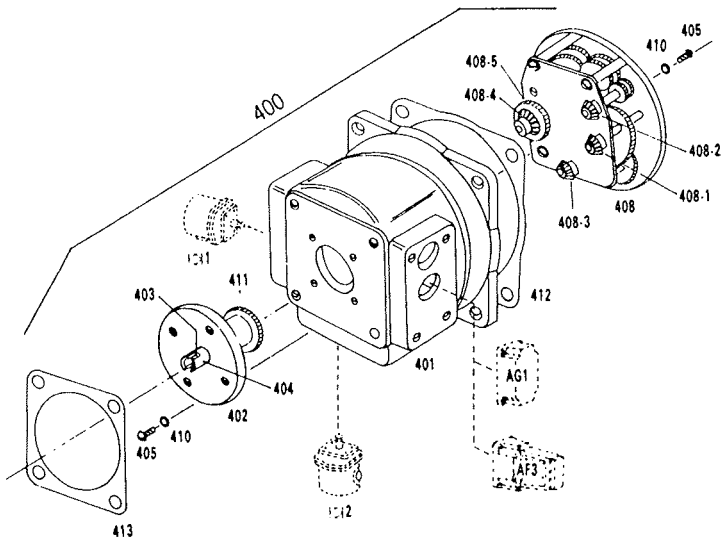
Lubrication Point	Fluid Temperature	Gears		Bearings		Couplings
		Plain	Bevel	Plain	Ball	
Following Magnet Assembly	−10 to +120°C	G2			L3	G2
	+120 to +300°C	G2		☆		
Transmission Gear Box	−10 to +120°C	L3	G2	L3	L3	

- Lubrication Oil Specifications and Examples of Products

Symbol	Viscosity or Consistency	Pour Point or Drop Point	Example of Products by Trade Name
L3	36.4 cst/30°C	− 37.5°C	Nisseki Launa 40 (Nippon Oil Co., Ltd.)
G2	300/25°C	300°C −	Jun BG Grease (Nihon Tokushu-koyu Co., Ltd.)

L: Lubricating oil G: Grease ☆: Do not lubricate plain bearings.

EXPLODED VIEW OF TRANSMISSION GEAR BOX



SYM. NO.	PART NAME	Q'TY
400	Transmission Gear Box	1 set
401	Housing, Transmission Gear Box	1
402	Bearing Retainer	1
403	Output Shaft	1
404	Coupling	1
405	Plate Holder Setscrew	7
※408	Transmission Gear Train	1 set
408-1	AG1 Input Bevel Gear	1
408-2	AG1 Output Bevel Gear	1
408-3	⊠2 Input Bevel Gear	1
408-4	⊠1 Input Bevel Gear	1
408-5	Output Gear	1
410	Washer	7
411	Gear, Output Shaft	1
412	Gasket A	1
413	Gasket B	1

※ *Varies with individual specifications. State the figures stamped on the plate when you order replacement.*

⊠ *1: Pulse generator of an engineering unit system provided (for remote total counter)*
⊠ *2: Pulse generator of nonengineering unit system provided (for remote indicator)*
AG 1: Accuracy adjustor gear unit (No. G 003 AG-1)
AF 3: Continuous accuracy adjustor unit (No. G 003 F3-1)

For details of the units above, see respective instruction manuals.

■ OUTLINE DIMENSIONS

➡ For outline dimensions, see OUTLINE DIMENSIONS on this page and approval drawing.

➡ NOTE: Figures in brackets ( ) show dimensions of the 30k rated model.