



# INSTRUCTIONS

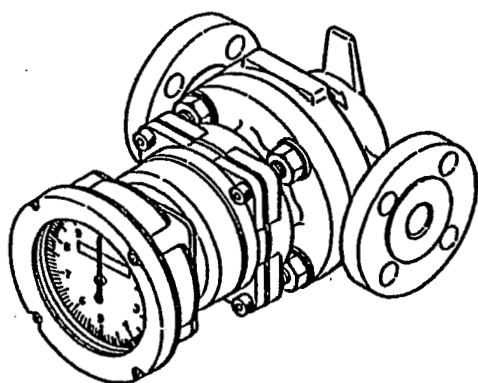
Ins. No. B-228-1-E

Double-case construction with magnetic coupling system "2"

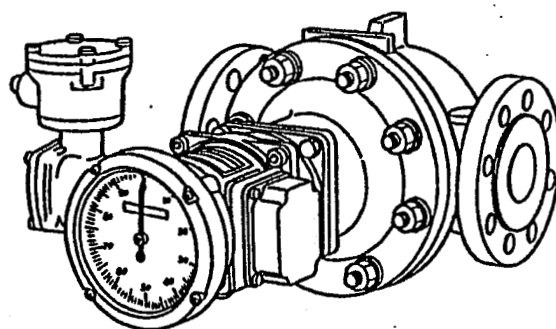
## OVAL FLOWMETER

### SIZES 52, 53, 55, 56 & 57

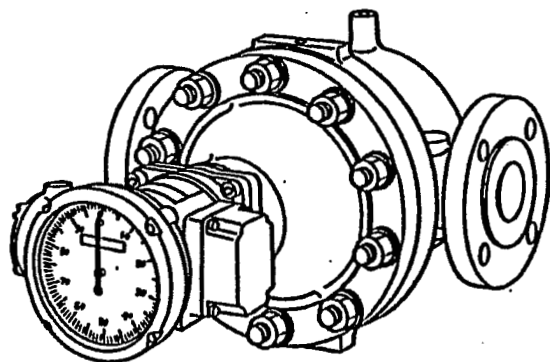
Standard, high-, and low-temp. service



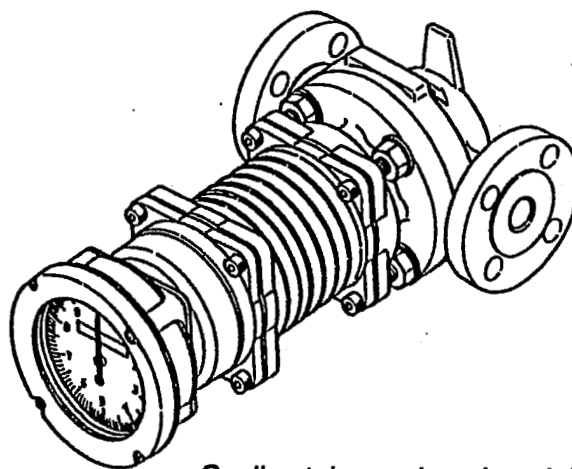
*Sizes 52 and 53*



*Sizes 55 and 56*



*Size 57*



*Cooling tube equipped model*

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

#### ◆ About Meter Size Designation ◆

The size of OVAL positive-displacement flowmeters is basically identified by a two-digit code. For details, see the product code explanation in the general specifications.

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## 1. GENERAL

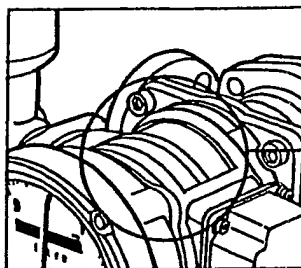
These industrial meters have been specifically designed to fill the industrial processing requirements for accurate and dependable measurement of process flows. In these meters, a powerful magnetic coupling system is incorporated to assure accuracy of measurement and trouble free operation over extended periods of time.

### Design Features

1. Accurate to  $\pm 0.5\%$  or  $\pm 0.2\%$
2. Complete compatibility of integral registers and pulse generators
3. Increased endurance
4. Low pressure loss
5. Easy maintenance

## 2. OPERATING CONDITIONS

To fully enjoy the high accuracy and long durability of the meter, make sure that temperature, pressure and flowrate are within the recommended specifications as stamped on the meter register nameplate.



OVAL FLOW METER			
MODEL			SIZE
FLOW RANGE	INT	CONT	
PRESS. MAX		TEMP MAX	
SERIAL No.			DATE
TAG No.			
FLUID			
<small>Note</small> When measuring other liquids consult us. When installing this meter, pay attention to keep the dialplate be vertical. see our instruction manual.			
OVAL Corporation			MADE IN JAPAN MMP-E-109

## 3. ABOUT THIS AND RELEVANT INSTRUCTION MANUALS

This instruction manual describes in most part the primary elements of OVAL Flowmeters. For detailed information on related subassemblies, such as pulse generators and registers, please refer to respective instruction manuals:

- |   |                           |                    |
|---|---------------------------|--------------------|
| (1) Pulse generators .....              | Prefix T (e.g. T-519-5)   | Instruction Manual |
| (2) Registers .....                     | Prefix R (e.g. R-401-3)   | "                  |
| (3) Accuracy adjustors .....            | Prefix G (e.g. G-003-AG1) | "                  |
| (4) Cooling tubes .....                 | Prefix A (e.g. G-901-8)   | "                  |
| (5) Air/liquid substitution operation.. | G-011                     | "                  |

## 4. INSTALLATION

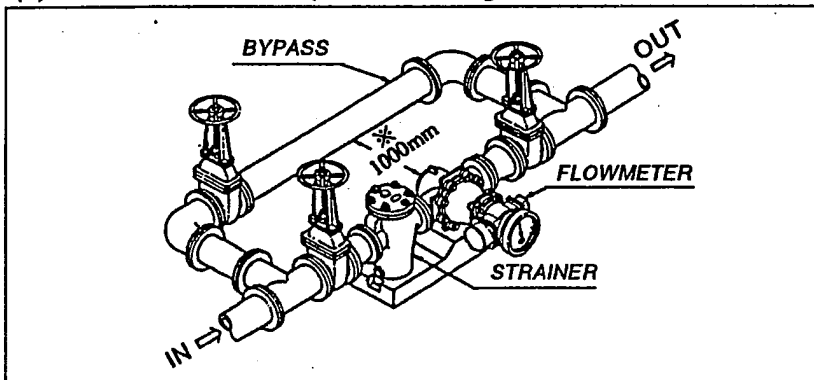
### 4.1 Piping Precautions

- (1) Install the meter carefully to avoid pipe strains.
- (2) The meter must be installed on the discharge side of the pump.
- (3) In tank head operation, give it a head greater than the pressure loss of the meter.
- (4) Adjust the flow direction to the arrow on the meter body.
- (5) Install the strainer on the upstream side of, and as close to, the meter as possible. Illustrated below are typical installations of this meter.

### 4.2 Standard Installation, Horizontal Line      4.3 Standard Installation, Vertical Line

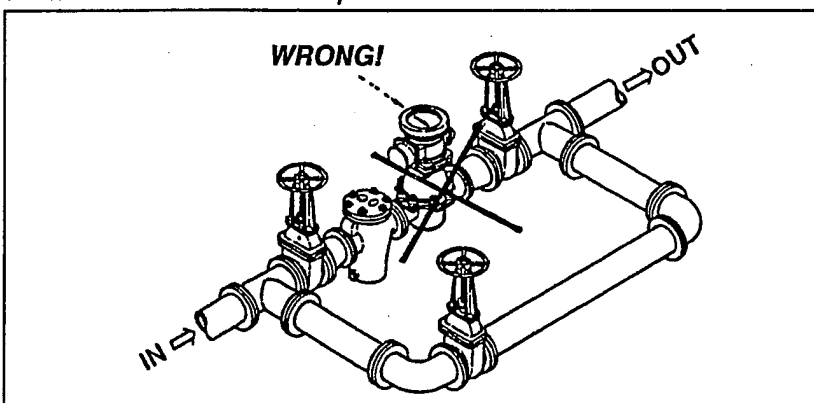
Marked ※ is the space required for disassembly and inspection.

- (1) In case flow direction is from R to L, change places of meter and strainer.
- (2) Arrange piping so as to facilitate drainage.
- (3) Strainer should be inspected on a regular basis.

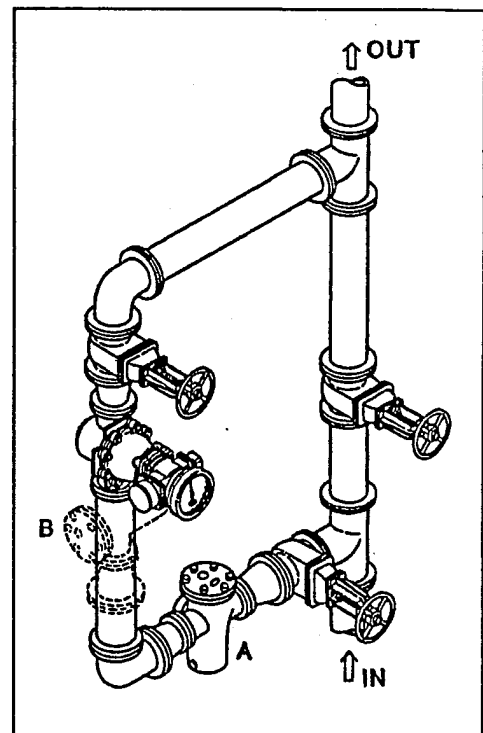


### 4.4 Example of Faulty Piping

Do not install the meter in a position like this.

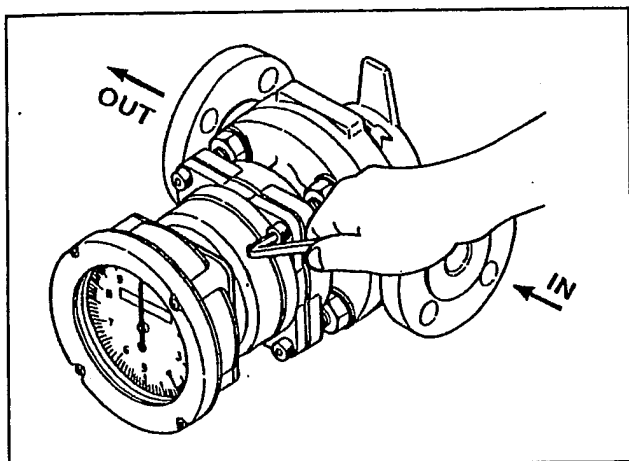



- (1) Install in the bypass line to prevent scales falling from top of the piping assembly.
- (2) If the flow direction is from top to bottom, change places of meter and strainer.
- (3) Locating the strainer at position A makes net reinstallation difficult; locating it at position B is therefore suggested.

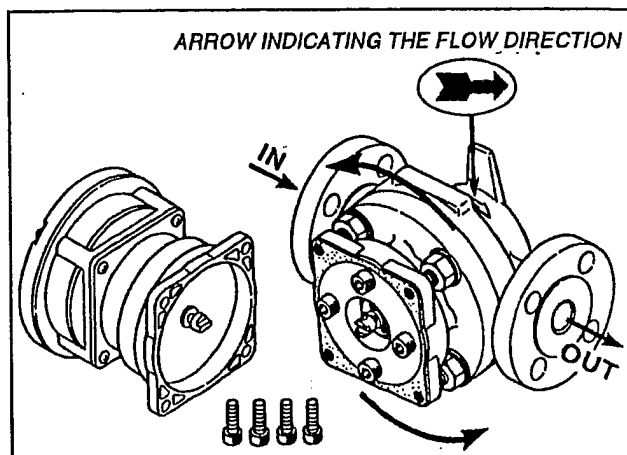


**NOTE:** For outline dimensions and connecting pipe dimensions, refer to the approval drawing (delivery specification) or general specification.

## 5. HOW TO CHANGE METER FLOW DIRECTIONS



① Following flowmeter removal from the piping assembly, remove the 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.

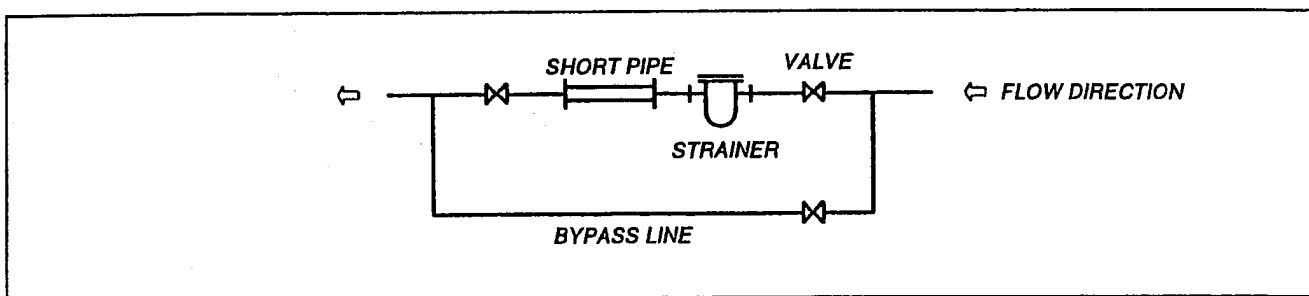


② Adjust the register face direction for correct viewability and secure the register to the meter housing with bolts. The same procedure applies to changing flow directions from right-to-left to top-to-bottom or bottom-to-top.

## 6. FLUSHING THE PIPING ASSEMBLY

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

**⚠ CAUTION:** 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.



## 7. OPERATING INSTRUCTIONS

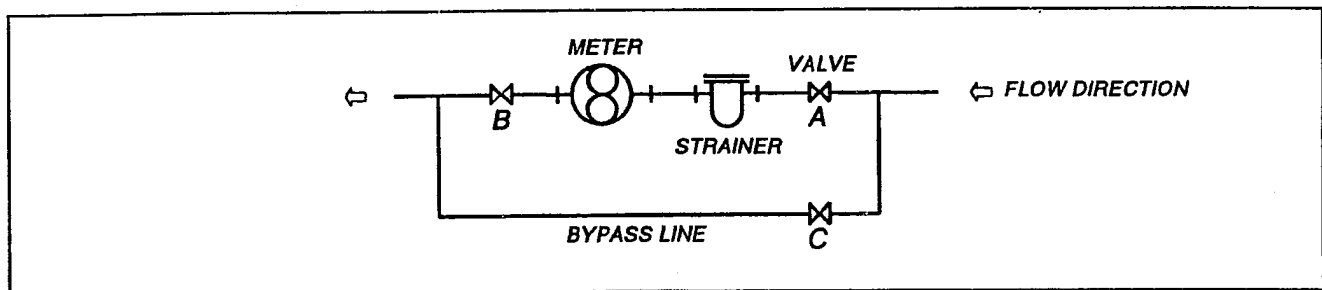
### ⚠ 7.1. Operation

- (1) Read well the information stated on the nameplate before commencing operation and make sure the operating conditions conform to the specification.
- (2) Carefully follow the valve operations sequence given below (refer to the piping diagram below):
  - ① Shut off the valves (A) and (B).
  - ② Progressively open the valve (C) to allow the fluid in the bypass line.
  - ③ Slightly open the valves (A) and (B). If necessary, slightly close the valve (C). The flowrate at this point is correct if the register pointer moves slightly.
  - 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 the valve (C) in the bypass line and progressively open the valves (A) and (B) until the rated flow is reached.
  - ⑥ Flowrate should be regulated with the valve (B) downstream of the meter and should be held within the rating.
- (3) The strainer net should be inspected for condition and cleaned on a regular basis. On a new installation, in particular, inspect daily first and, according to the clogged condition of the net being observed, inspection intervals may be reduced progressively to, say, once in two or three days.

### How to Measure the Flowrate

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

$$\text{Flowrate } Q \text{ (L/h)} = \frac{3600 \times \text{Volume by one pointer rev.} = 1 \text{ or } 10 \text{ liters}}{\text{Time required for one pointer revolution (sec)}}$$



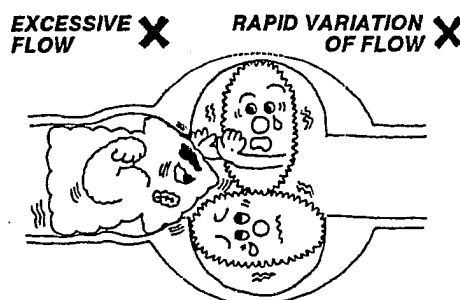
## ⚠ 7.2 Operating Precautions

### (1) When changing flowrates

In applications where the flowrate varies or where shutoff valve opening and closure takes place in batch operation, avoid rapid changes in flowrate across the meter.

As a rule of thumb, one second per 25 millimeters (1") in connecting pipe diameter is acceptable as the permissible changes in flowrate.

Operating the meter at flowrates in excess of the maximum allowable flowrate will nullify the guaranteed accuracy, reduce the meter life and may result in faulty conditions, such as the seizure of bearings or the rotor-to-measuring chamber contact.



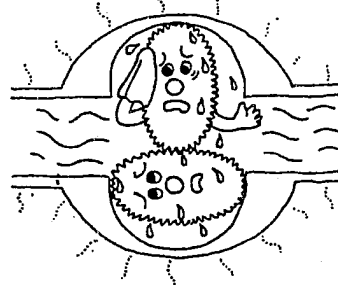
### (2) Where the temperature of metered fluid changes

Avoid rapid temperature changes in the meter. Temperature changes of the fluid in the meter should be held within 3°C per minute.

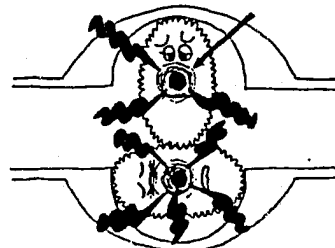
Extra care should be used particularly when making a flow measurement in batch operation without the provision of heat tracing of the piping where the fluid temperature differs from atmospheric temperature.

If rapid temperature changes are anticipated, heat trace the piping assembly as well as the meter.

**RAPID TEMPERATURE CHANGES X**



**TAKE PRECAUTIONS AGAINST BEARING SEIZURE!**



### (3) Liquids of low steam pressure

Temperature and pressure of LPG, polyvinyl chloride monomers or anything with low viscosity and low steam pressure that are too ready to vaporize should strictly be controlled.

During operation, the temperature of bearings in the meter is usually higher than that of the metered fluid. Vapors around the bearings can be causes of faulty conditions, including generation of unusual noise and bearing seizure.

### (4) Corrosive liquids

When you make a measurement of highly corrosive liquids, such as nitric acid and sulfuric acid, appropriate materials should be used for tanks and piping assembly. Heterogeneous materials originally contained in the metered fluid or corrosive substances liquated out from tanks and pipes of inappropriate materials may lead to costly downtime, as a result of locked rotors, for example, when they are allowed into the measuring chamber.



### **⚠ 7.3 Precautions at Operation Shutoff**

**(1) Valves should be closed progressively.**

Rapid valve closure could, under certain piping conditions, cause a sharp pressure rise by water hammer, or hydraulic shock, resulting in damage to the meter.

**(2) Precautions against pressure buildup on closure**

Complete closure of valves upstream and downstream of the meter makes the affected section a totally enclosed chamber and a pressure buildup relative to a rise in atmospheric temperature could lead to an unexpected damage to the meter.

**(3) Liquids ready to adhere or gel at zero flow velocity**

Liquids that tend to adhere and solidify or gel at flow velocities around zero must thoroughly be washed away from the meter interior with running cleaning fluid before shutdown. Negligence of this instruction may leave the meter as an immovable unit when the operator attempts to resume meter operation the next time.



## 8. TROUBLESHOOTING

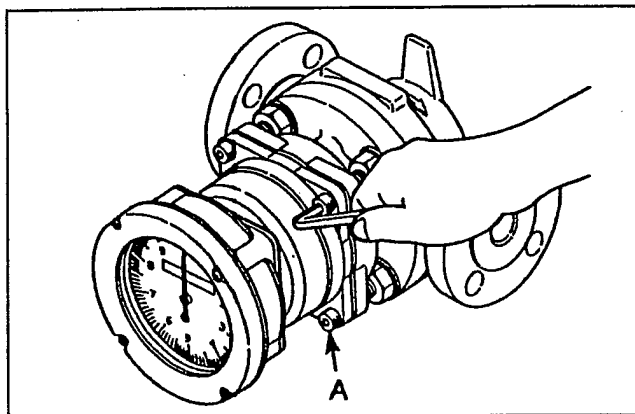
Symptom	Treatment
Process fluid suddenly fails to flow.	Disassemble the meter body (measuring assembly).
With the register integral with the cooling tube removed, the internal transmission gear train fails to turn in response to process fluid flow.	Disassemble the magnetic coupling (following magnet)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

## 9. DISASSEMBLY AND INSPECTION

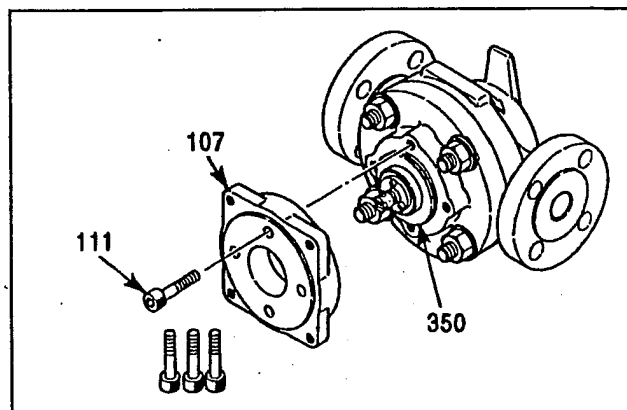
- ⊙ Although service intervals may vary with the given operating conditions, it is suggested that the meter be disassembled for inspection regularly once a year in normal use.

**⚠ CAUTION:** Before disassembling the meter, be sure to close the valves completely in the flow line upstream and downstream of the meter.

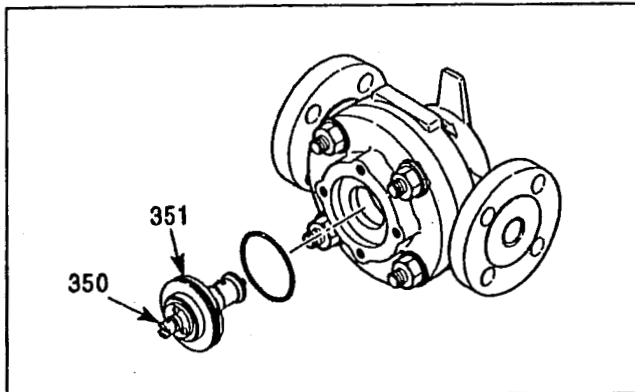
### 9.1 Sizes 52 and 53 Meter Body Disassembly and Inspection



(2) Separate the register assembly complete with the transmission gear box: Remove the hex socket head bolts (A) with hex wrench. Holding the register assembly with both hands, slide it until it is separated from the meter body.

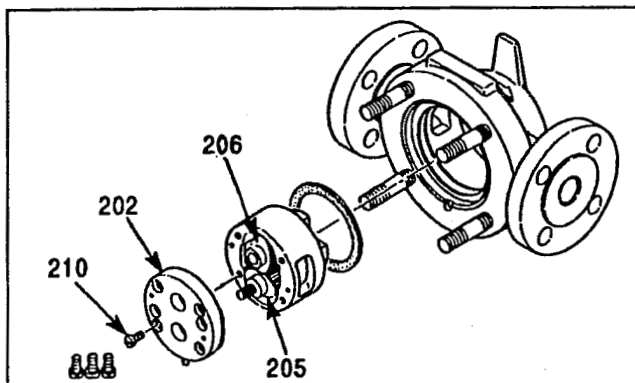


(2) Remove the magnetic coupling assembly (350): take off the four hex socket head bolts (111) with hex wrench. The sealing flange (107) is now ready for removal.

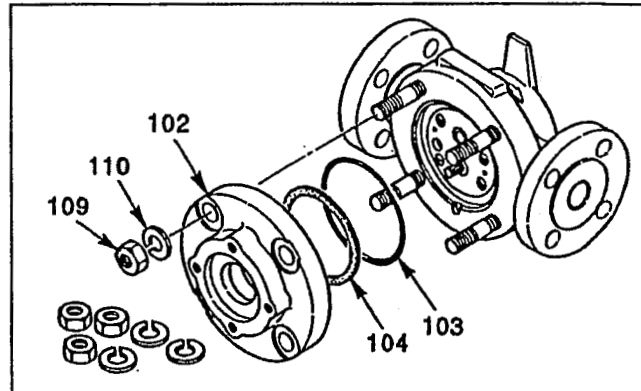


(3) Pull the magnetic coupling assembly (300) out by evenly applying the tip of screwdriver to the external groove of the bulkhead (351).

- ➡ **NOTES:**
- ① Be careful not to damage the gears as the rotors and magnetic coupling assembly are in mesh.
  - ② Receive the residual fluid left inside the meter body with an appropriate receptacle.



(5) Separate the inner case top cover (202): Take off the four fitting bolts (210) securing the inner case top cover. If it is difficult to separate the inner case top cover, lightly tap the flanged surface with plastic mallet.



(4) Remove the meter front cover (102): Take off hex nuts (109) and washers (110) (4 each) and the front cover will be ready for removal. Be careful not to damage the gasket (103) during this operation.

(6) Inspect and wash clean the Oval rotors and measuring chamber in approved solvent, observing the following points:

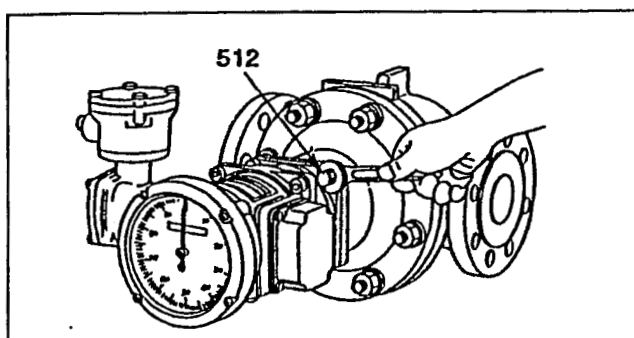
- ① Oval rotors (206) are not jammed with foreign matter.
- ② Wash clean the component parts and ensure that they are completely free of foreign particles when reassembled.

**⚠ CAUTION**

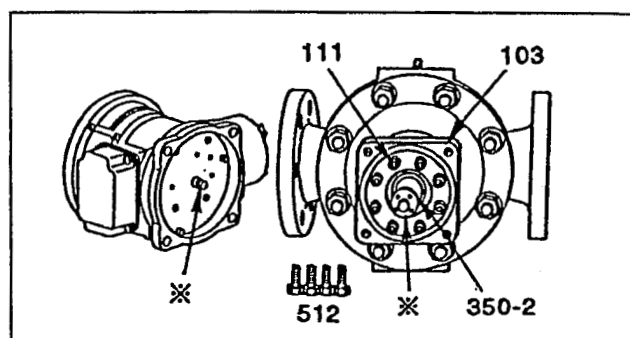
- (1) Score marks, scratches, high spots due to impressions, or other flaws should be reconditioned flat with oil stone or other tool.
- (2) If the areas which have been forcibly in contact with front cover jacking bolts are distorted outwardly, recondition it flat with oil stone.

☞ NOTE: Size 56 meter body is shown here. The same procedure applies to other models.

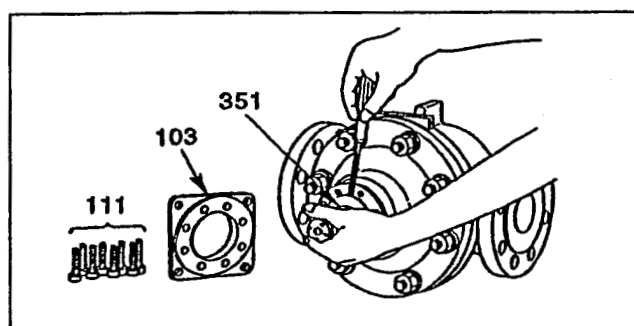
## 9.2 Sizes 55, 56 and 53 Meter Body Disassembly and Inspection



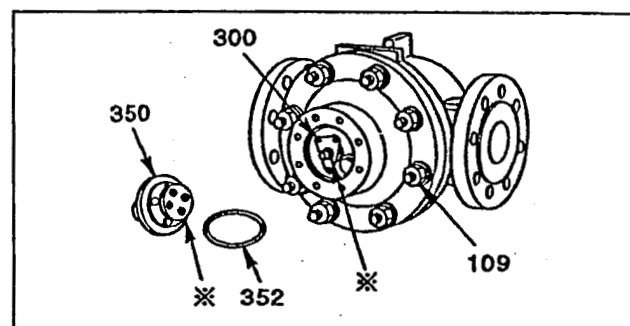
(2) Using wrench, take off four bolts (512). Holding the adaptor and transmission gear assembly (or cooling tube) with both hands, carefully separate from the meter body.



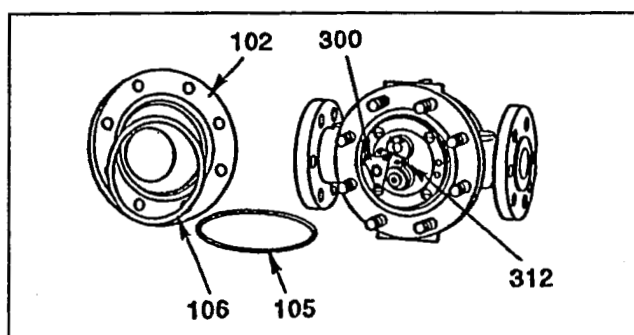
(2) Taking off eight bolts (111), remove sealing flange (103). Exercise care not to bump against following magnet assembly (350-2) at this time. At assembly, ensure that two coupling (marked \*) are engage properly.



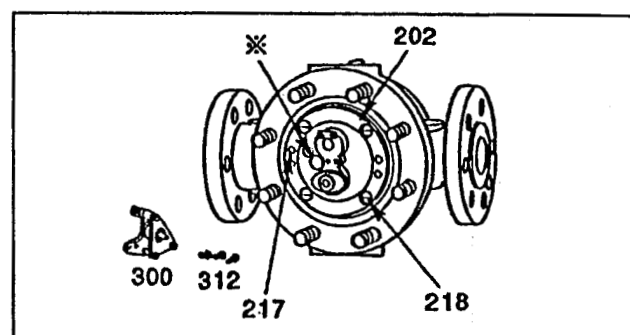
(3) Holding the following magnet assembly in one hand as shown, apply a screwdriver tip into the external groove of pressure-tight sealing plate (351), force it out uniformly.



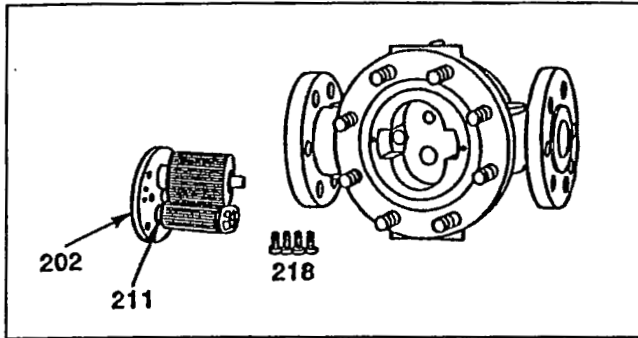
(4) With magnetic coupling assembly (350) removed, the reduction gear assembly (300) is now accessible. Following installation of two O-rings (352), and exercising care for engagement (marked \*) of two gears, ensure that they are properly in mesh.



(5) Take off eight nuts (109) and separate front cover (102). Then, taking off three screws (312), remove reduction gear assembly (300).



(6) Taking off four screws (218), draw out top cover (202) integral with the 1st and 2nd rotor horizontally. At assembly, ensure that pressure vent hole (marked \*) faces in the upstream side.



(7) OVAL rotors are now ready inspection. Wash clean OVAL rotors, measuring chamber, and top cover with cleansing oil, exercising care to keep dirt and other contaminants out of the assembly. Also use care to avoid damaging thrust rings (211).

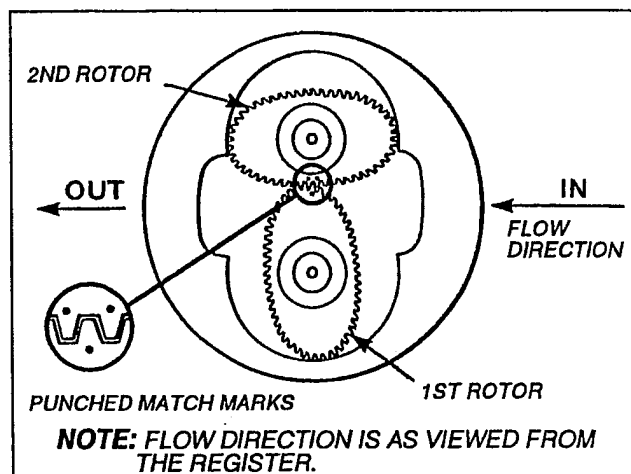
**⚠ CAUTION**

- (1) Score marks, scratches, high spots due to impressions, or other flaws should be reconditioned flat with oil stone or other tool.
- (2) If the areas which have been forcibly in contact with front cover jacking bolts are distorted outwardly, recondition it flat with oil stone.

### 9.3 Assembly Procedure

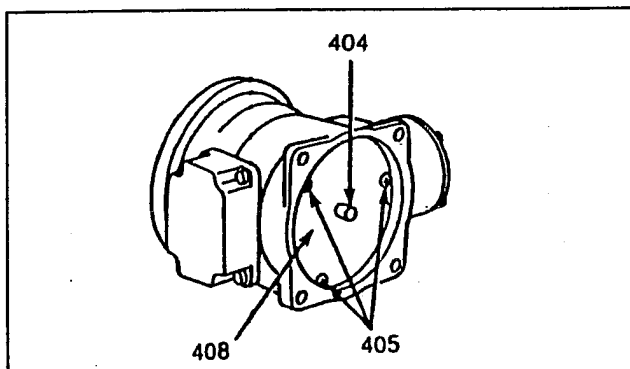
Reassemble in the reverse order of disassembly, closely adhering to the following points:

- (1) Align the match marks stamped on the rotors and make at least two complete revolutions to ensure proper rotor gear engagement.
- (2) Install the inner case top cover with a pressure relief slot facing the inlet side of the meter.
- (3) If the flow direction is from right to left, the first rotor installs under the second.

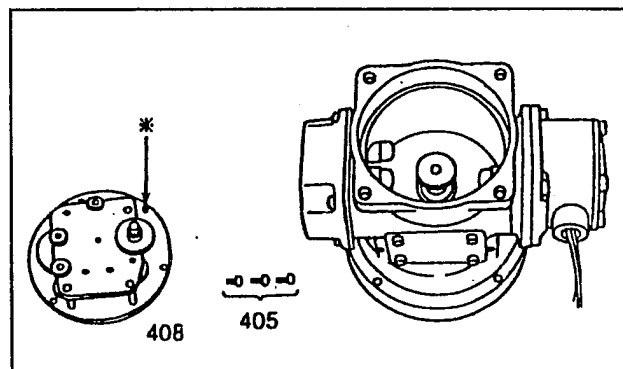


### 9.4 Transmission Gear Box Inspection

- ➡ **NOTE:** If an accuracy adjustor (AG2) is incorporated, refer to instruction manual No. G-003-TS-2-E.



- ② Take off three setscrews (405). Draw the coupling (404) out horizontally by hand and the whole assembly of transmission gear train (408) will follow. A dowel pin exists and will cause the assembly to slant; do not force while drawing the assembly out.



- ② 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.

### ⚠ CAUTION

Because the Oval flowmeter is a precision instrument, disassembly and inspection should be performed indoors as a rule. If it is desired to disassemble and inspect the meter as installed in the field, completely reduce the pressure in the piping assembly, fully close valves upstream and downstream of the meter, drain the assembly and place a suitable fluid receptacle immediately below the Oval flowmeter.

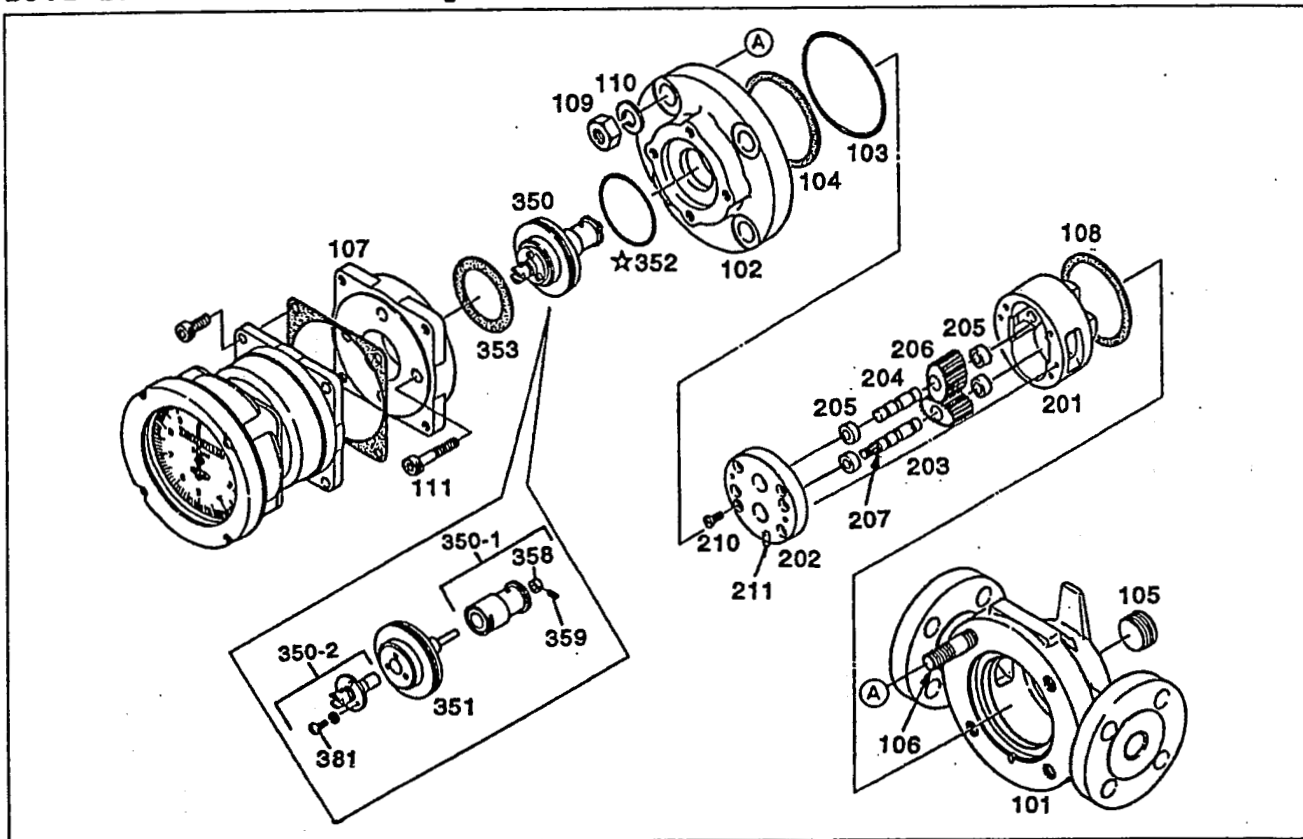
Exercise care to keep out dust and grime from individual disassembled members.



## 10. DEXPLODED VIEW AND PARTS LIST

- When ordering replacement parts, specify the meter model No., product No. (confirm by nameplate), instruction manual No., symbol No., part name and the quantity of parts desired.

### 10.1 Sizes 52 and 53 Exploded View and Parts List



#### ■ Sizes 52 and 53 Parts List Meter Body

Sym. No.	Part Name	Q'ty	Remarks
1 0 1	Meter Body	1	
1 0 2	Front Cover	1	
▲ 1 0 3	O-Ring	1	JIS G 95
▲ 1 0 4	Inner Case Top Gasket	1	※ 1
1 0 5	Plug	1	R1
1 0 6	Front Cover Stud Bolt	4	M16
1 0 7	Sealing Flange	1	
▲ 1 0 8	Inner Case Bottom Gasket	1	φ86×φ72×t
1 0 9	Front Cover Fitting Nut	4	M16
1 1 0	Front Cover Fitting Washer	4	
1 1 1	Sealing Flange Bolt	4	M10

▲: Recommended replacement parts

☆: In models for high temperature service, a sheet gasket (same as No. 353) replaces an O-ring.

※ 1: F6 (63K) type is provided with a "spiral gasket."

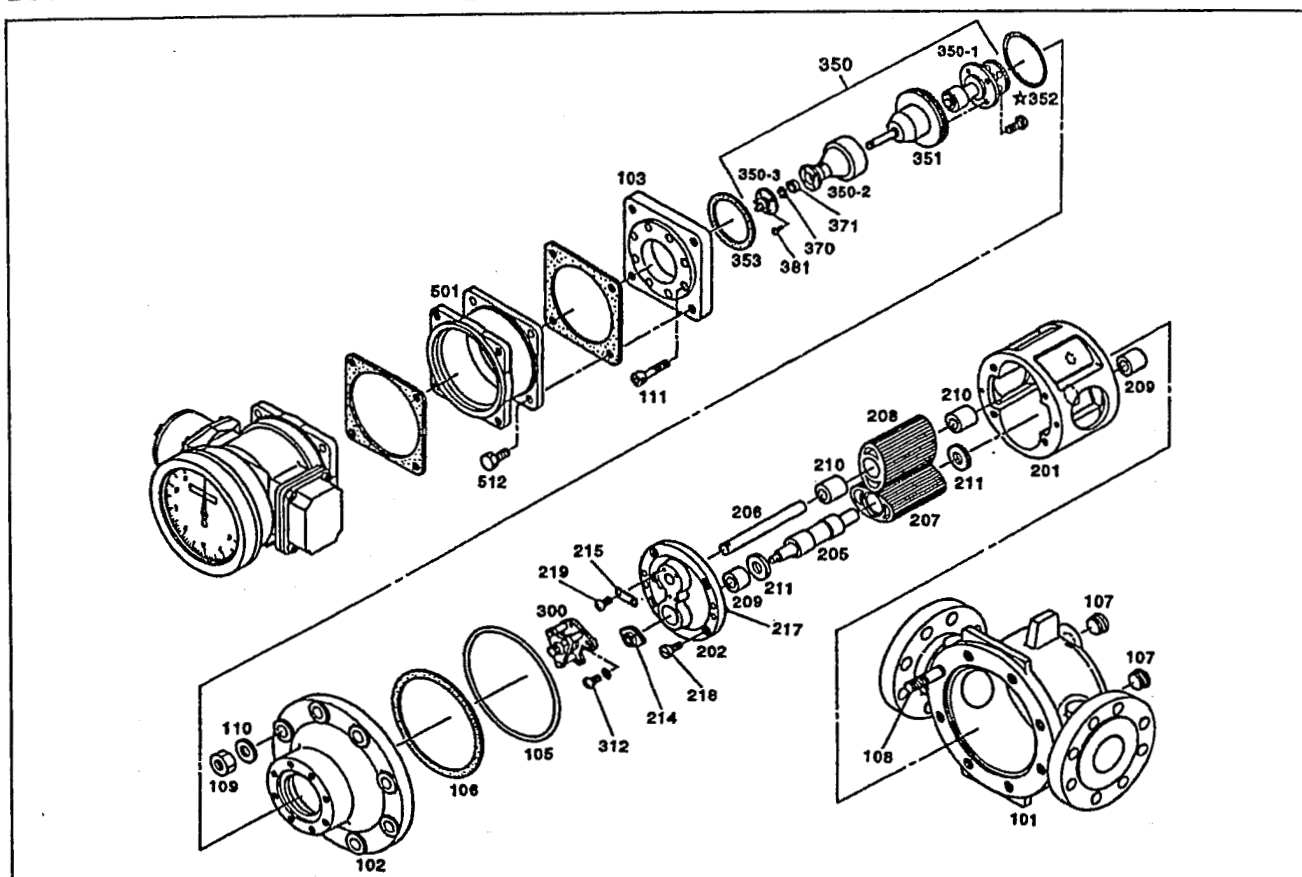
#### Inner Case

Sym. No.	Part Name	Q'ty	Remarks
2 0 1	Inner Case	1	
2 0 2	Top Cover, Inner Case	1	Top cover locating pin (211) provided
2 0 3	First Rotor Shaft	1	
2 0 4	Second Rotor Shaft	1	
▲ 2 0 5	Rotor Bearing	4	
2 0 6	Rotor	2	
2 1 0	Top Cover Fitting Bolt	4	M6

#### Magnetic Coupling Assembly

Sym. No.	Part Name	Q'ty	Remarks
3 5 0	Magnetic Coupling Ass'y	1	
3 5 0-1	Drive Magnet Assembly	1	
3 5 0-2	Following Magnet Ass'y	1	
3 5 1	Pressure-tight Sealing Plate	1	
☆ 3 5 2	O-Ring	1	JIS G65
3 5 3	Gasket	1	
3 5 8	Stop Ring	1	
3 5 9	Pin	1	
3 8 1	Fitting Screw	4	

## 10.2 Sizes 55 and 56 Dexploded View and Parts List



### Sizes 55 and 56 Parts List

#### Meter Body

Sym. No.	Part Name	Q'ty	Remarks		
1 0 1	Outer Case	1			
1 0 2	Front Cover	1			
▲ 1 0 3	Sealing Flange	1			
1 0 5	O-Ring	1	JIS S. 55 G120 (S. 56 G150) ※1		
1 0 6	Inner Case Top Gasket	1			
1 0 7	Plug	2	R3/4		
		Size	30K type	63K type	
1 0 8	Front Cover Stud Bolt	55	8 × M16	8 × M16	
		56	8 × M16	12 × M20	
1 0 9	Front Cover Fitting Nut	55	8	8	
		56	8	12	
1 1 0	Front Cover Washer	55	8	8	
		56	8	12	
1 1 1	Sealing Flange Bolt	8	M8		
5 0 1	Adaptor	1			
5 1 2	Adaptor Fitting Bolt	4			

#### Reduction Gear Assembly

Sym. No.	Part Name	Q'ty	Remarks
3 0 0	Reduction Gear Assembly	1	
3 1 2	Fitting Screw	3	Washer provided

▲: Recommended replacement parts

☆: In the models for high temperature service, a sheet gasket (Sym. No. 353) replaces the O-ring.

※1: F6 (63K) type is provided with a "spiral gasket."

#### Inner Case

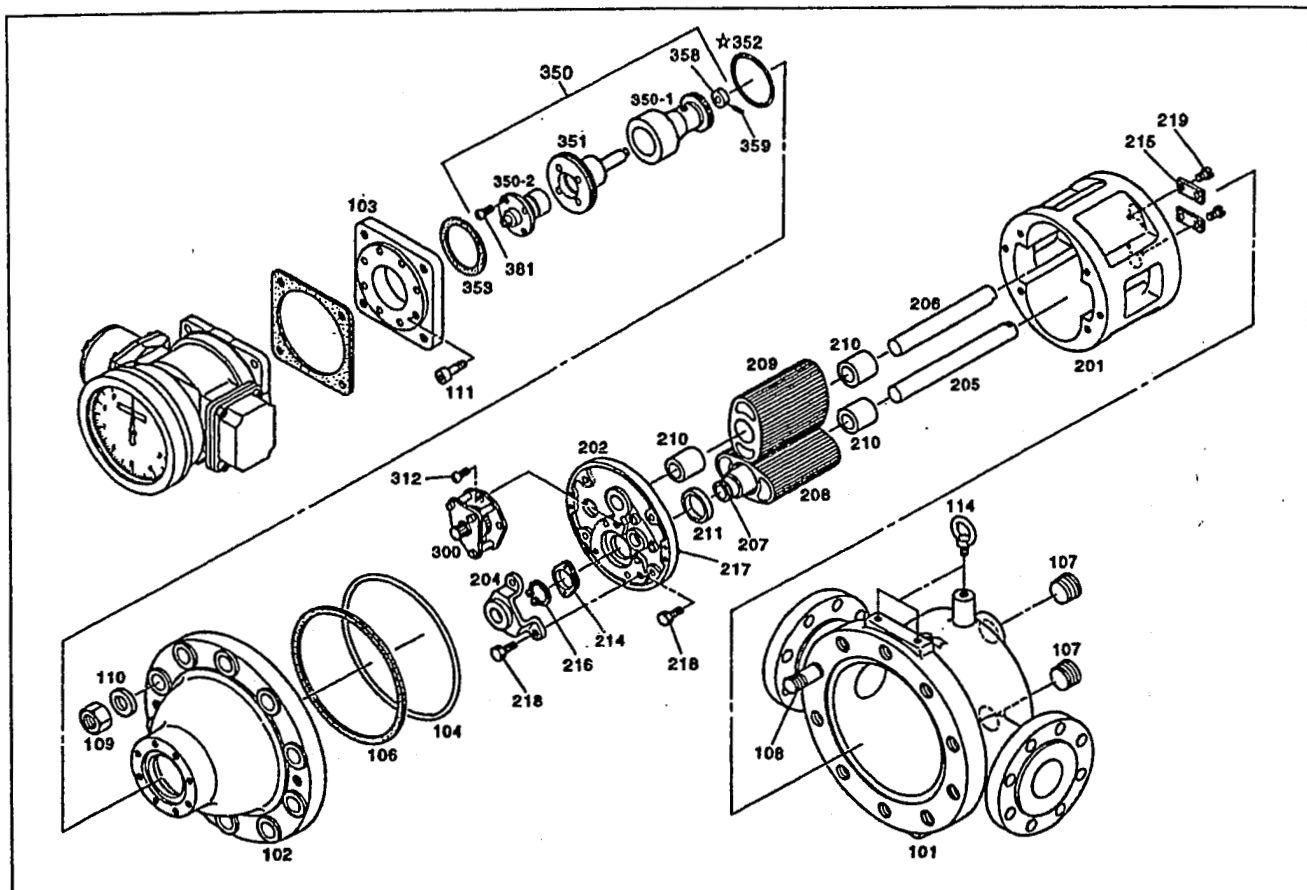
Sym. No.	Part Name	Q'ty	Remarks
2 0 1	Inner Case	1	
2 0 2	Top Cover	1	Top cover locating pin (217) provided
2 0 5	1st Rotor Shaft	1	
2 0 6	2nd Rotor Shaft	1	
2 0 7	1st Rotor	1	
2 0 8	2nd Rotor	1	
▲ 2 0 9	Rotor Bearing A	2	
▲ 2 1 0	Rotor Bearing B	2	
▲ 2 1 1	Thrust Ring	2	
2 1 4	Uniform Motion Drive Gear	1	
2 1 5	Shaft Non-turn Strip	1	
2 1 8	Top Cover Fitting Bolt	4	M6
2 1 9	Non-turn Strip Fitting Screw	2	M4

#### Magnetic Coupling Assembly

Sym. No.	Part Name	Q'ty	Remarks
3 5 0	Magnetic Coupling Ass'y	1	
3 5 0-1	Drive Magnet Assembly	1	
3 5 0-2	Following Magnet Ass'y	1	
3 5 0-3	Coupling Assembly	1	
3 5 1	Pressure-tight Sealing Plate	1	
☆ 3 5 2	O-Ring	1	JIS G65
3 5 3	Gasket	1	
3 7 0	E-Ring	1	
3 7 1	Spacer	1	
3 8 1	Fitting Screw	4	



## 10.3 Size 57 Exploded View and Parts List



### Size 57 Parts List

#### Meter Body

Sym. No.	Part Name	Q'ty	Remarks
101	Outer Case	1	
102	Front Cover	1	
103	Sealing Flange	1	
▲104	O-Ring	1	JIS G200 ※1
▲106	Inner Case Top Gasket	1	
107	Plug	2	R1
108	Front Cover Stud Bolt	10	M20
		30K type	63K type
109	Front Cover Fitting Nut	10 × M20	16 × M24
110	Front Cover Washer	10 × M20	16 × M24
111	Sealing Flange Bolt	8 × M10	8 × M16 stud bolt
114	Eyebolt	3	2

#### Magnetic Coupling Assembly

Sym. No.	Part Name	Q'ty	Remarks
350	Magnetic Coupling Ass'y	1	
350-1	Drive Magnet Assembly	1	
350-2	Following Magnet Ass'y	1	
351	Pressure-tight Sealing Plate	1	
☆352	O-Ring	1	JIS G75
353	Gasket	1	
358	Stop Ring	1	
359	Pin	1	
381	Fitting Screw	4	

#### Inner Case

Sym. No.	Part Name	Q'ty	Remarks
201	Inner Case	1	
202	Top Cover	1	Top cover locating pin (217) provided
204	Longer Shaft Holder	1	
205	1st Rotor Shaft	1	
206	2nd Rotor Shaft	1	
207	Uniform Motion Gear Boss	1	
208	1st Rotor	1	
209	2nd Rotor	1	
▲210	Rotor Bearing	3	
▲211	Thrust Ring	1	
214	Uniform Motion Drive Gear	1	
215	Shaft Non-turn Strip	2	
216	Stop Ring	1	
218	Top Cover Fitting Screw	7	M8
219	Non-turn Strip Fitting Screw	2	M4

#### Reduction Gear Assembly

Sym. No.	Part Name	Q'ty	Remarks
300	Reduction Gear Assembly	1	
312	Fitting Screw	3	Washer provided

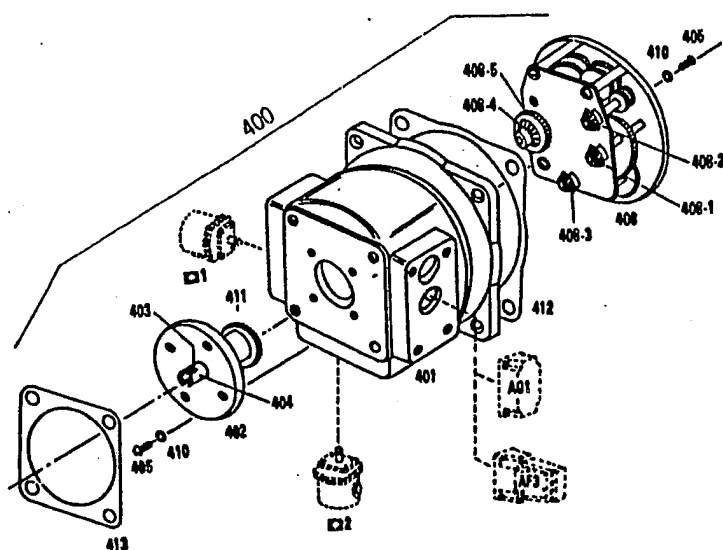
▲: Recommended replacement parts

☆: In the models for high temperature service, a sheet gasket (Sym. No. 353) replaces the O-ring.

※1: F6 (63K) type is provided with a "spiral gasket."

## 10.4 Exploded View of Transmission Gear Box

➡ **NOTE:** If an accuracy adjustor (AG2) is incorporated, refer to instruction manual No. G-003-TS-2-E.



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	C 2 Input Bevel Gear	1
408-4	C 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 rear 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)

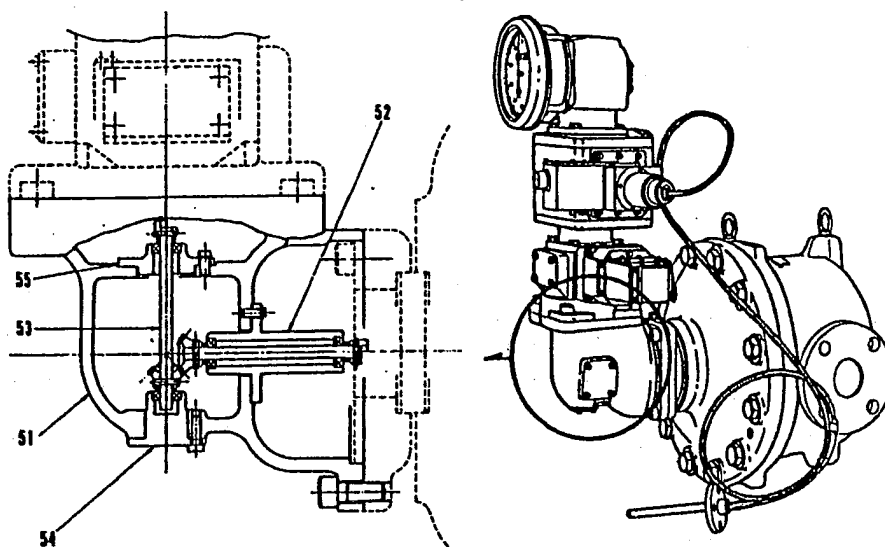
AF 3: Continuous accuracy adjustor unit (No. G 003 F3-1)

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

## 10.5 Right-angle Adaptor (Model CB1)

In applications where an automatic temperature compensator and/or register, such as LW42, are integrally mounted, this adaptor (90° ELBOW-CB1) is used to orient the output shaft perpendicularly.

Sym. No.	Part Name	Q'ty
5 1	Adaptor	1
5 2	Input Shaft Ass'y	1 set
5 3	Output Shaft	1 set
5 4	Bearing Ass'y A	1 set
5 5	Bearing Ass'y B	1 set



## 11. ABOUT LUBRICATION

- Do not fail to use proper lubricants, or equivalent, shown below at dis-assembly 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 +260 °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 (JX Nippon Oil & Energy Trading Corp.)
G2	300/25 °C	300 °C -	Moly Hi-temp Grease No.1 (Sumico Lubricant Co., Ltd.)

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