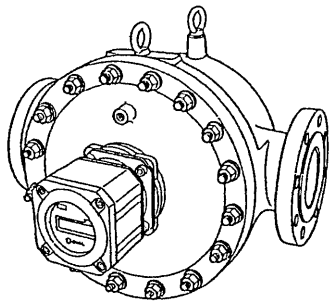
OVAL INSTRUCTIONS

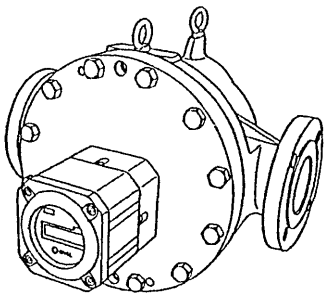
Ins. No. B-319-2-E

Smart Type ULTRA OVAL

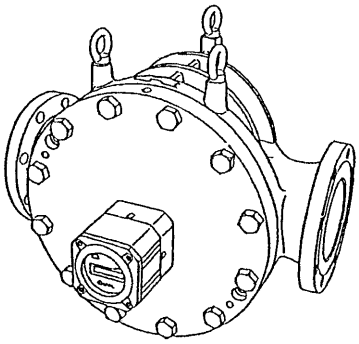
METER SIZES 28, 29, 60 & 31 32, 33 & 34



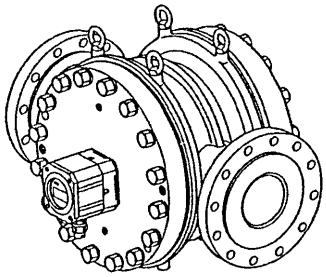
Meter Sizes 28, 29, 60, and 31
Double-case Construction



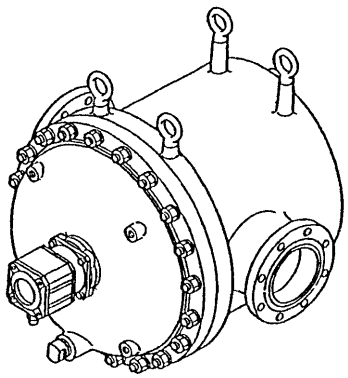
Meter Size 29
Single-case Construction



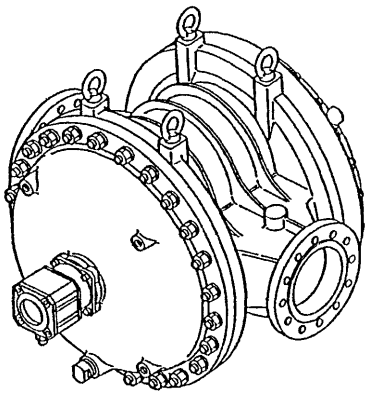
Meter Sizes 60 and 31
Single-case Construction



Meter Sizes 32 and 33
Single-case Construction



Meter Sizes 32 and 33
Double-case Construction



Meter Size 34
Single-case Construction

Every Smart Type ULTRA 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 these instructions 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 the ULTRA OVAL (OVAL positive-displacement flowmeters) is basically identified by a two-digit code.

CONTENTS

The indications **NOTE**, **CAUTION**, and **WARNING** shown throughout this manual are to draw your attention to specific items:

NOTE

Notes are separated from the general text to bring user's attention to important information.

⚠ CAUTION

Caution statements call attention to user about hazards or unsafe practices that could result in minor personal injury or property damage.

⚠ WARNING

Warning statements call attention to user about hazards or unsafe practices that could result in serious personal injury or death.

1. BEFORE YOU BEGIN

Every Ultra OVAL flowmeter is thoroughly tested before it leaves the factory. When received, it should be thoroughly inspected for indication of rough handling during transit. Necessary handling precautions are described in this section; read the instructions carefully.

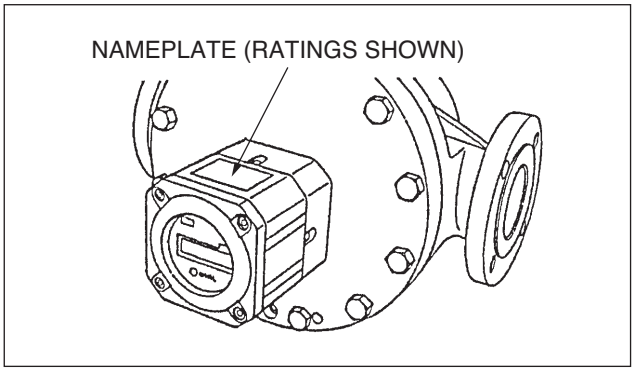
As for other information, find the respective sections from "CONTENTS" on pages 2.

For any inquiries, contact your nearest OVAL designated sales office.

⚠ CAUTION: When you make inquiries, include the product name, model number, serial number, ratings and other necessary information.

1.1 Confirming the Nameplate

Every Ultra OVAL flowmeter is assembled and adjusted according to individual specifications. Product code and ratings are stated on the register nameplate. Make sure that, by referring to the GENERAL SPECIFICATIONS, the ratings shown conform to your particular specification.



1.2 Transportation Considerations

(1) To safeguard against damage during transit, transport the Ultra OVAL flowmeter to the installation site in the same container used for transportation from the factory if circumstances permit.

(2) OVAL flowmeter is adjusted and inspected as an assembly consisting of the meter body, sensor and register. It should therefore be handled as an integral assembly.

(3) The register is accurately set up and adjusted. Do not attempt to remove the front cover to gain access to its internal assembly.

1.3 Storage Considerations

If the Ultra OVAL flowmeter is stored for long periods of time upon receipt before installation, unexpected faulty conditions could result. If a long-term storage is anticipated, take the following precautions:

(1) Keep your Ultra OVAL flowmeter in store in the same shipping container used for transportation from OVAL if possible.

(2) Place of storage should conform to the following requirements:
- Free from rain and water.
- Free from vibration and impact shocks.
- Temperature and relative humidity in the storage place are at or near room temperature and humidity (around 25°C and 65%).

(3) Purge the Ultra OVAL flowmeter that has once been placed in service with clean air, N, gas, etc. to prevent the metered fluid from adhering to the meter connections, piping inner walls, housing, etc. before storage. (Wash clean with suitable detergent if necessary.)

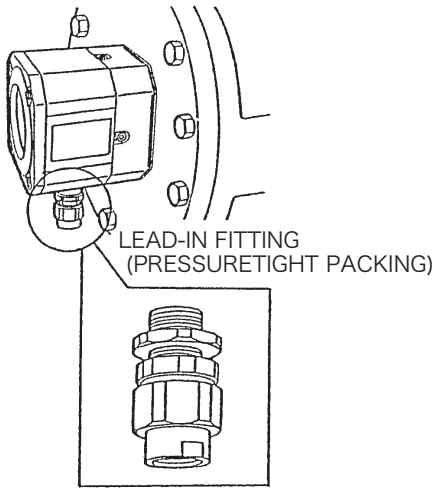
(4) In case of storage for extended periods of time, good practice is to keep in store in the same containers used for shipment from the factory.

1.4 Considerations of Construction

(1) The register is of waterproof construction for outdoor service.
(2) Do not attempt to replace component parts with others or make any circuit modification.
(3) The pressuretight packing furnished constitutes part of the flameproof construction. Do not attempt to use any pressuretight packing other than those furnished. The pressuretight packing union should be tightened securely upon completion of connections.
(4) Of the four different pressuretight packings (ϕ9, ϕ10, ϕ11 and ϕ12) furnished as standard accessories, a ϕ11 packing is tentatively installed in place.
Select from these and install the one that best fits the finished outside diameter of your particular cable.

Table 1.1 Applicable Cable Outside Dia. Unit in mm

Packing Code	Packing I.D.	Cable O.D.
9	9.0	8.5 to 9.0
10	10.0	9.1 to 10.0
11	11.0	10.1 to 11.0
12	12.0	11.1 to 12.0



➡ NOTE: Pressuretight packings are not supplied with nonexplosionproof models.

⚠ CAUTION: Moisture allowed into the register will cause blurred display glass and functional trouble.

Precautions on cable lead-in fitting (pressuretight packing), both explosionproof and nonexplosionproof models:
- Use a pressuretight packing that fits the finished cable O.D.
- Tighten up positively to allow no clearance between the pressuretight packing and the cable.
- If a pressuretight packing is not used, apply some waterproof treatment to preclude any chance of moisture getting into the equipment.

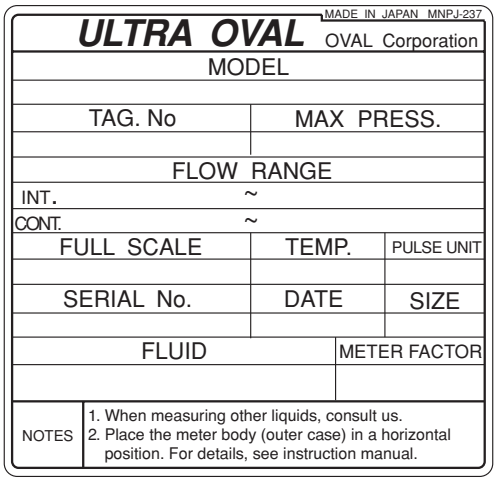
2. OPERATING CONDITIONS

To maintain the stated high accuracy and long service life of ULTRA OVAL flowmeter, make sure that flowrate, pressure, temperature and viscosity are within the ratings as stamped on the meter register nameplate. Do not fail to confirm these ratings before placing it in service.

⚠ CAUTION:

1) Although allowable ambient temperature is up to +60 °C for explosionproof units, it is desirable that the meter be used at room temperature and humidity.

2) In cases where the register is exposed to elevated temperatures due to exposure to direct rays of the sun or to radiant heat, ensure, by providing a sunshade or similar protection, that the meter is used within the operating temperature range.



⚠ CAUTION: The Weights and Measures law requires meters certified by an authorized agency for use in transactions and certification. (OVAL certified label appears on the flowmeter register.)

3. GENERAL DESCRIPTION

ULTRA OVAL has been developed to meet the needs of precise flowrate measurement. The local direct-reading total counter is an all-electronic register built around a single-chip CPU. With the latest electronic technologies used throughout, this versatile register displays accumulated total flow, instantaneous flowrate (digital readout) and provides, by option, a pulse and analog output proportional to the rate of flow.
In this meter, fluid flow is detected by sensing with an amorphous sensor the magnetic fields of permanent magnets embedded in the oval rotors. As a result, high reliability is achieved.

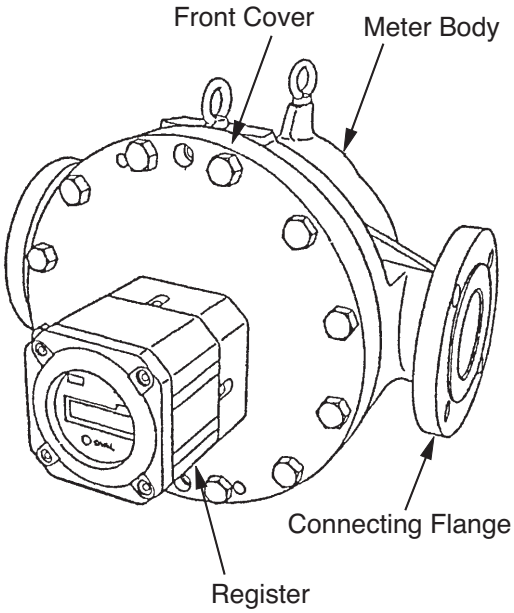
Features

(1) Absence of any mechanically sliding components except for oval rotors contributes to long service life.
(2) Small wetted parts count and pocketless design makes this meter ideally suited for flow measurement of chemical liquids.
(3) You can monitor accumulated total flow and instantaneous flowrate locally on the digital display.
(4) When coupled with a remotely located receiving instrument, output signals can readily and simply be used for applications including control, adjustment and recording.
(5) IEC explosionproof construction offers increased safety and the design is compact.
(6) A nonvolatile memory retains variables in cases of power failure or when de-energized.

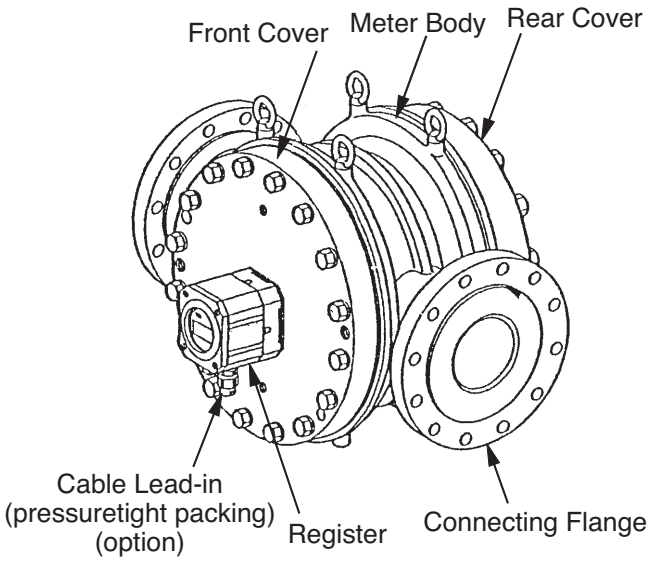
➡ NOTE: With the use over an extended period of time, meter error will deviate more or less from the initial point. Upon request, we may conduct an instrumental error testing once again and establish a "new meter factor" in the scaler when your Ultra OVAL is returned to the factory for periodic inspection or for other reasons.

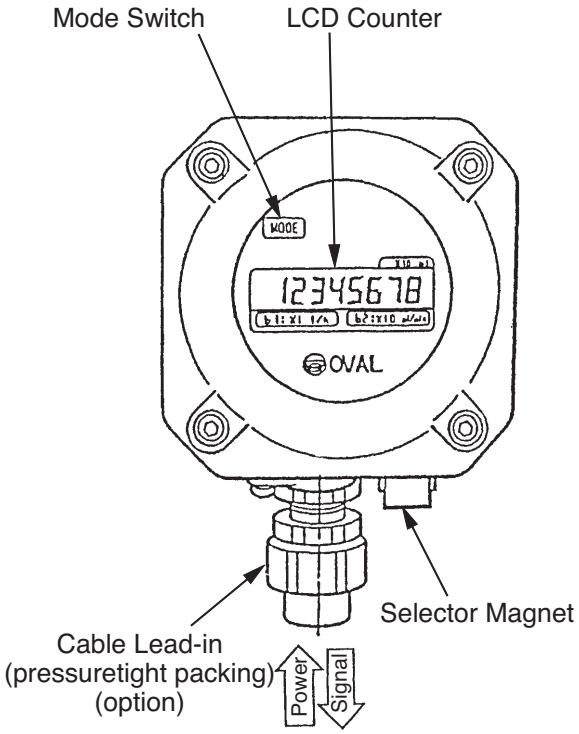
4. PART NAMES

Meter Sizes 28, 29, 31 and 60



Meter Sizes 32, 33, 34 Single-case Construction





Meter Sizes 32 and 33 Double-case Construction

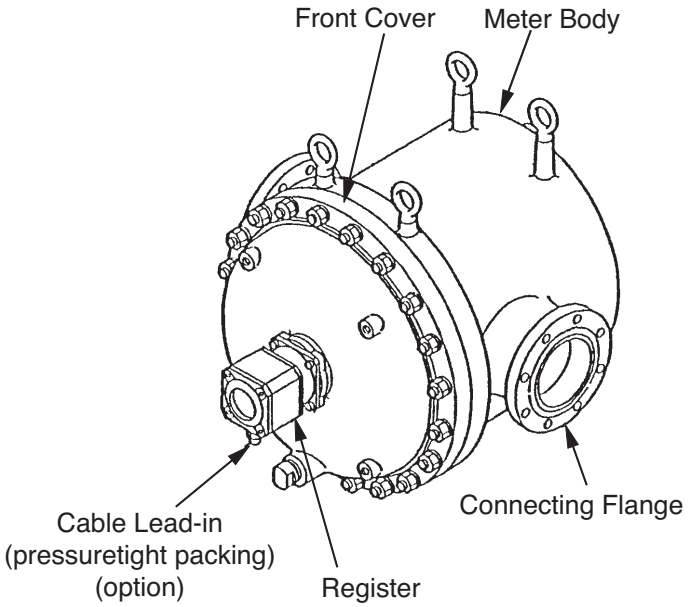
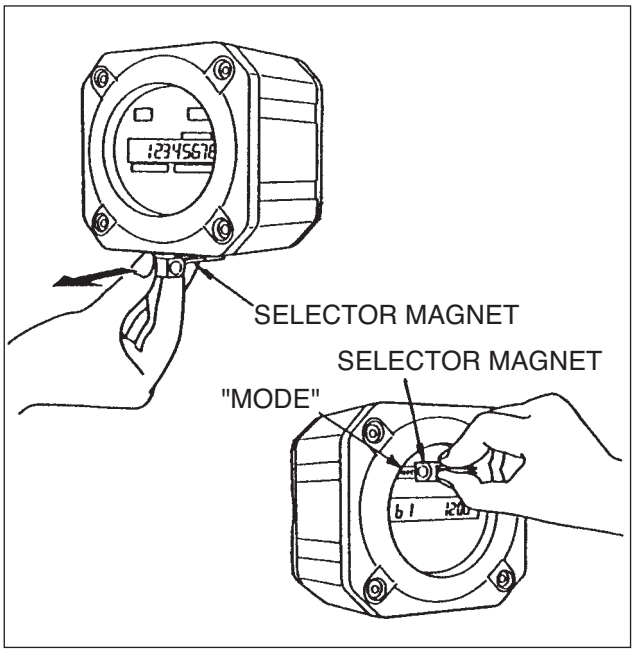


Fig. 4.1

5. LCD COUNTER DISPLAY

5.1 About "MODE" Switch

Removing the selector magnet inserted at the bottom of the register, apply it to the label "MODE" on the LCD counter face and the display will scroll forward through the available readings.



⚠ CAUTION

Do not fail to install the selector magnet in its holder after use lest you will not lose it. It uses an intensive magnet; never hold it close to floppy disks or other magnetic storage media.

5.2 Display Functions

The display can show four different kinds of flow information - total flow, instantaneous actual flowrate, percent instantaneous flowrate, and 8-division percent bar graph.

It also shows the following error messages:

Full scale exceeded: **ErrorFS**
Upper-limit flowrate exceeded: **ErrorOF**

➡ NOTE: Multiple errors will be indicated in priority order below:
ErrorOF > ErrorFS

5.3 Display Selection

Two ways are available to select displays - with a display select switch inside the register, or through communications with the Smart Communication Unit Model EL2310.

If your option is through communications, follow the instructions outlined in the Smart Communication Unit EL2310 instruction manual.

➡ NOTE: Show "Transmitter Info." window at "Configure" menu on the PC screen.

Selection with display select switch requires access to the display select switch SW1 by opening the register cover facing its internal assembly and pressing this switch (see page 26). The display scrolls forward through available information each time you press this switch as shown in Fig. 5.1.

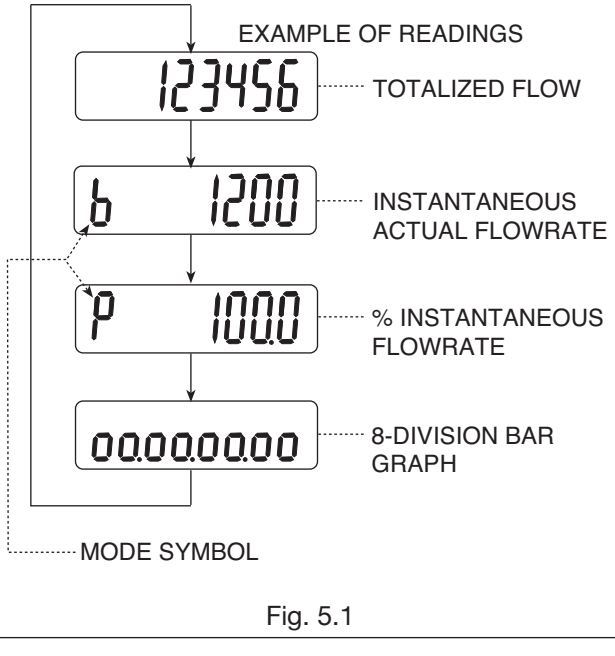


Fig. 5.1

5.4 Total Flow Reset

Displayed total flow can be reset either by the display select switch SW1 (see Fig. 11.1 on page 26) or through communications with the Smart Communication Unit. It your option is through communications, follow the instructions outlined in the Smart Communication Unit EL2310 instruction manual.

➡ NOTE: Show "Measure" window at "View" menu on the PC screen.

With the display select switch, then, you can reset the totalizer by holding the display select switch SW1 depressed for more than 3 seconds while the total flow is shown.

5.5 Precautions with Pulse Output Type

(1) If your model is of pulse output type, the pulse output and total counter remain inoperative for 15 seconds approx. after power on and while communications with the Smart Communication Unit continue. For 15 seconds approx. after termination of communications, the pulse output and total counter also remain inoperative.

(2) Requirements for validating communications
Communications is valid only when the following requirements are met:
- Flowrate at zero (There is no pulse output.)
- Within 15 seconds after power turn-on

➡ NOTE: The period of 15 seconds immediately after power on is called "Communication standby mode." (The built-in indicator, if so equipped, will display as shown in ① in the figure below.)
If communications are started during this time period, a switchover to "Communication mode" takes place, permitting you to communicate until power is turned off the next time. (The built-in indicator will display as shown in ② in the figure below.)
To start flow measurement routine, turn power on again. (After power cycling, the pulse output and total counter will also remain inoperative for 15 seconds.)

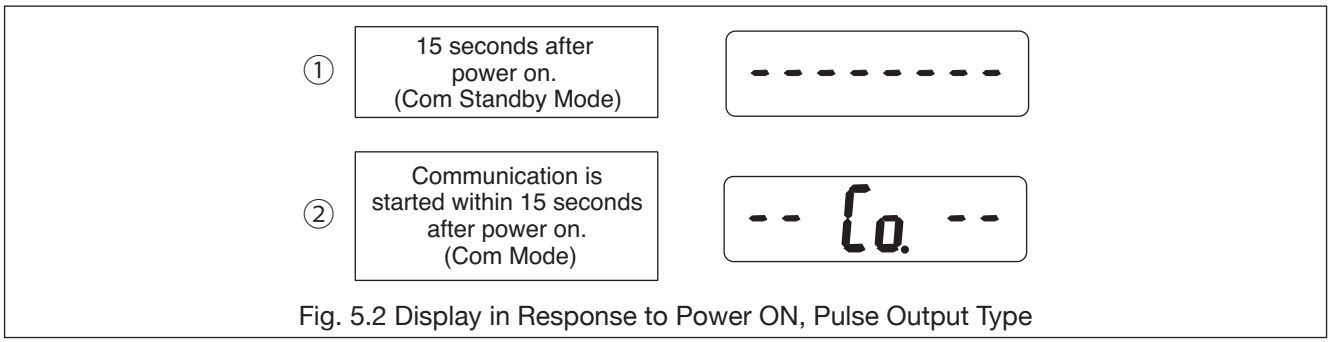


Fig. 5.2 Display in Response to Power ON, Pulse Output Type

(3) While communications continue, the receiving instrument (total counter, etc.) may overcount under certain circumstances. To eliminate the possibility of such erratic extra counting, precautions should be taken by either disconnecting the receiving instrument before starting communications, or recording the most recent total reading and other important data on paper.

(4) Except for the purpose of communications, do not attempt to connect the probe of Smart Communication Unit with the signal lines. If the probe remains connected, the influence of capacitive impedance the interface has could go to the point of producing distorted signals in waveform and, as a result, the receiving instrument would fail to receive pulse signals accurately.

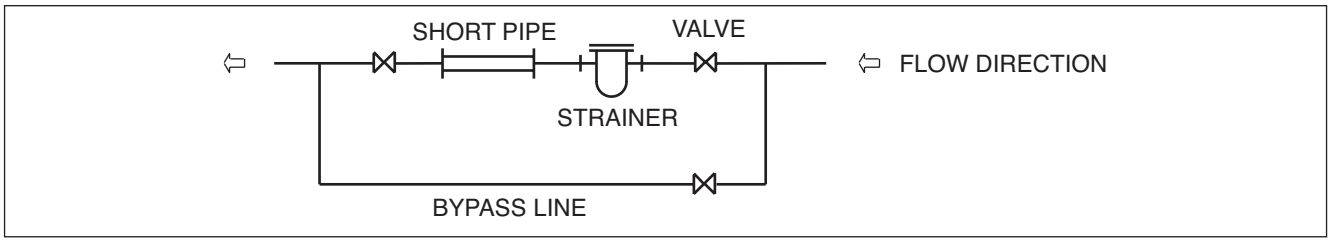
⚠ CAUTION: PRECAUTIONS with ANALOG OUTPUT TYPE

The analog type permits communications with the Smart Communication Unit at any time. However, if, in an attempt to alter current parameters, the meter is configured by mistake such that the new parameters are incompatible with the specification, resultant sharp changes in output may disturb the behavior of the receiving instrument. It is good practice, therefore, to make parameter changes while the fluid flow is at zero.

6. INSTALLATION

6.1 Considerations Installation

(1) Flush the piping assembly.
Flushing must be performed before meter installation. Install a short pipe in place of the meter at this time (see diagram below).



(2) Install the meter free from pipe strains.
(3) The meter must be installed on the discharge side of the pump.
(4) If the meter is to be used under tank head, give a head pressure greater than the losses with the piping system, strainer, meter, etc.

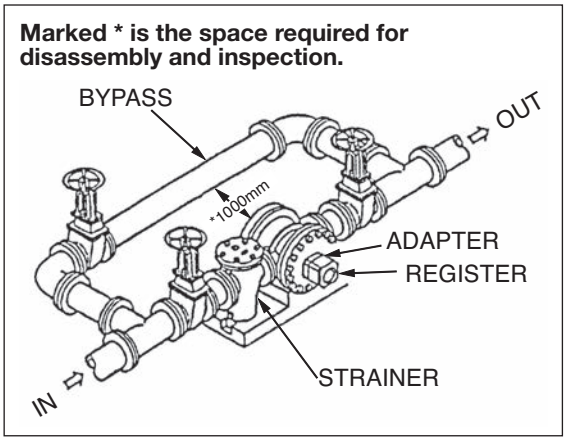
➡ NOTE: Pressure losses of OVAL flowmeter and strainers are stated in the GENERAL SPECIFICATIONS.

(5) The meter installation is correct if the flow direction conforms to the arrow mark on the meter body.
(6) The strainer should be located upstream of, and as close to the meter as possible.
(7) Since the sensor in the Smart Ultra OVAL operates on the principle of sensing changes in magnetic flux density, it must be isolated from the influence of any external magnetic flux. In order to minimize the influence of external magnetic flux, select an installation location at least 5 meters away from existing power equipment and conductors - potential sources of creating large magnetic and electric fields, such as motors and generators.
(8) In case electric heating is desired, consult the factory.
(9) Lagging material, if used, must not cover up the adapter and register.

- Typical OVAL flowmeter Installations

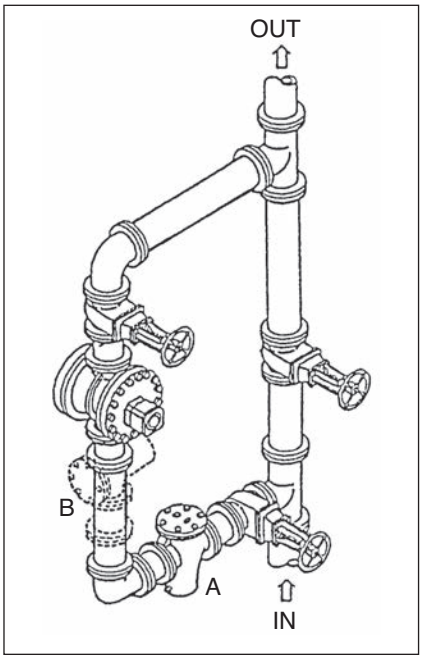
6.2 Standard Installation, Horizontal Line

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



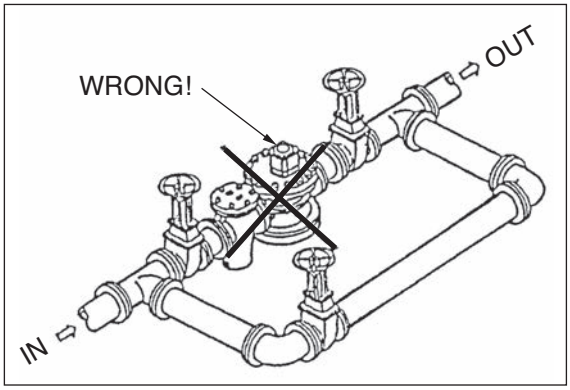
6.3 Standard Installation, Vertical Line

(1) Install on the bypass side to prevent scales falling from top of the piping assembly.
(2) If the flow direction is from top to bottom, switch the places of meter and strainer.



6.4 Example of Faulty Piping

(1) Do not install the meter in a position like this.



➡ NOTE: For outline dimensions and pipe connection dims. see approval drawing.

⚠ CAUTION

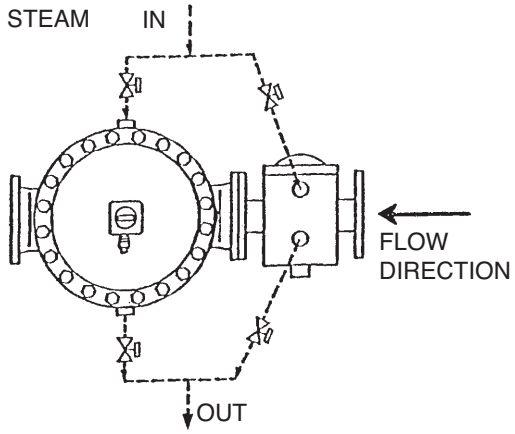
6.5 Piping Instructions and Operating Precautions of Jacketed Meters

◆Hot water or steam jacketed meters require piping work in the following manner:

(1) Piping to the meter body remains the same as that of standard meters (meters not jacketed).
(2) Adhere to the following instructions for the piping to the jacket:

Steam Jacketed

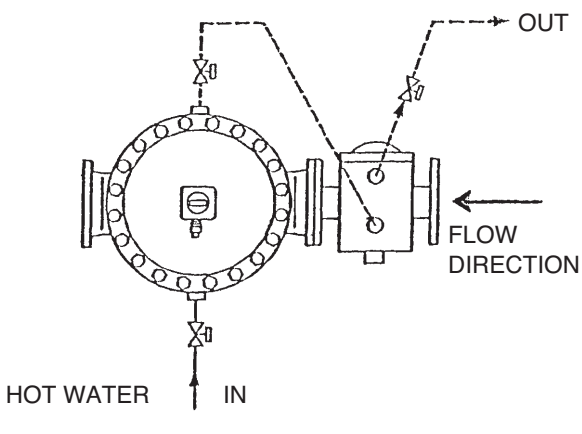
Basically, the piping should be so arranged that steam flows in from the top and out from the bottom. Provide steam traps at outlet ports (see figure below).



Steam Jacketed Type, Horizontal Run

Hot-water Jacketed

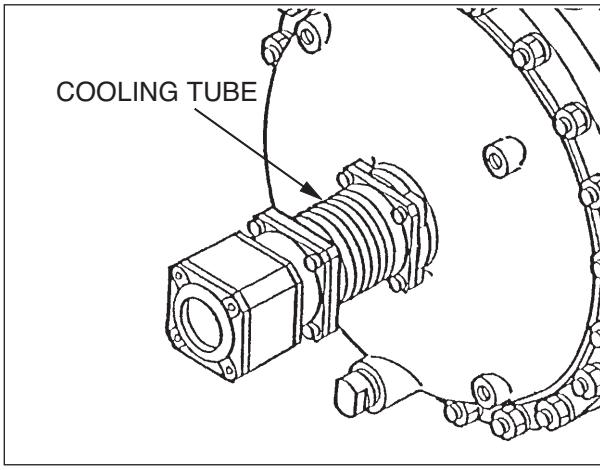
Basically, the piping should be so arranged that hot water flows in from the bottom and out from the top (see figure below).



Hot Water Jacketed Type, Horizontal Run

(3) Although the measuring chamber is heat treated, due consideration should be taken to avoid piping elongation and contraction by sharp temperature changes or by pipe strain. Progressive heating is suggested at least four hours before commencing service operation.
(4) If heat tracing is desired, considerations should be taken to facilitate maintenance and servicing. Make sure, if it is the case, that there is no liquid leaks when related components are covered with lagging material.
(5) Lagging should be so provided that the top cover of strainer is easily accessible. Also it is necessary that the strainer net be cleaned on a regular basis.

(6) Never attempt to lag radiator fins.
Lagging them will cause excessive heat buildup in the register and pulse generator, possibly leading to costly downtime.

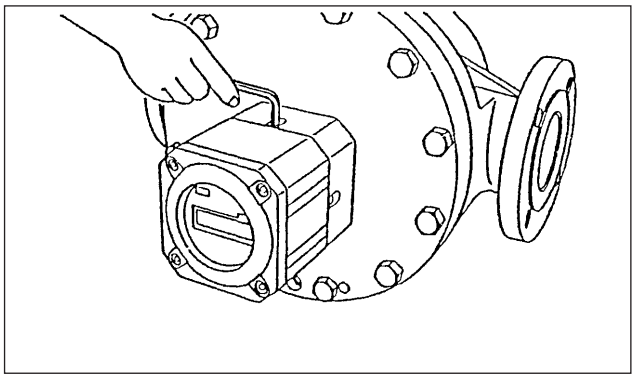


NOTE: As for outline dimensions and tube connection dimensions, see approval drawing.

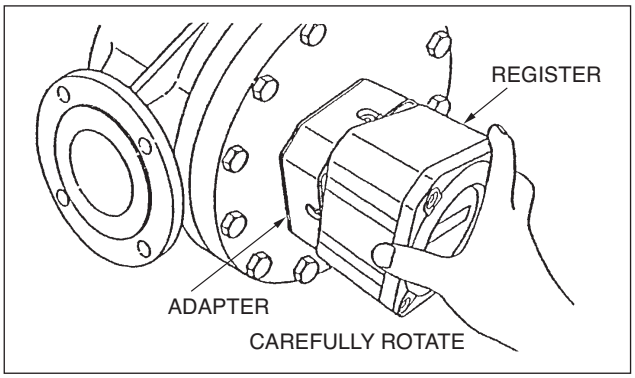
7. HOW TO CHANGE FLOW DIRECTIONS

⚠ CAUTION: Do not fail to remove power to the meter.

To change flow directions, change the orientation of both the register and the flowmeter body to the new flow direction.

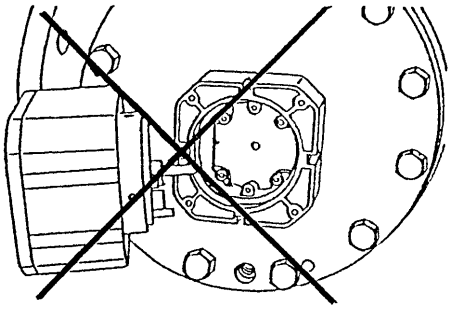


(1) Take four hex socket head bolts (M6) with hex wrench.



(2) Holding the register assembly in both hands, carefully rotate it and then secure it with hex socket head bolts in line with the new direction of flow.

DON'T DO THIS!



Do not attempt to separate the register like this to change flow directions.

⚠ CAUTION

- **Rotate the register without separating from the adapter.**
- **Do not attempt to rotate the register more than one complete revolution.**

➡ NOTE: If the register assembly has been separated, restore the conditions of the register before changing flow directions and start the flow direction changing procedure given in (2) above (without separating the register) all over again.

8. WIRING INSTRUCTIONS

(Refer also to the wiring instructions of respective receiving instrument instruction manual.)

8.1 Wiring Guidelines

(1) Cables for field wiring

The following cables should be used unless otherwise specified:

Use cables of conductor area 1.25mm^2 and finished O.D. 12mm, selecting from 2 to 4pcs. according to your application. It is recommended that their shield be grounded at the receiving instrument.

⚠ CAUTION: In case of TIIS explosionproof type used under the ambient temperature of 50°C or higher, use a cable resistant to the temperature of 70°C or higher.

(2) Transmission length

The maximum transmission length is typically one kilometer.

➡ NOTE: If it exceeds one kilometer, consult OVAL.

(3) Inductive interference prevention

To minimize the possibility of stray current pickup, the field wiring should be routed sufficiently away from existing power cables or power circuits.

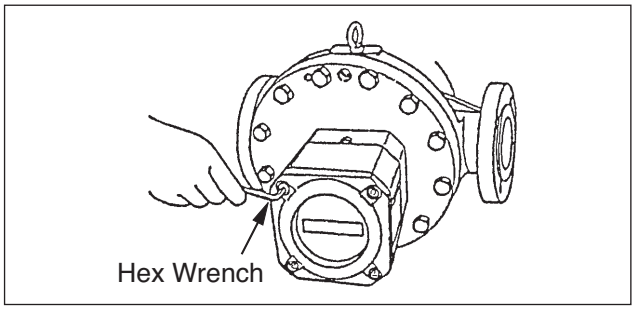
(4) Considerations on connections

1) M3.5 terminal posts are used on the terminal block. Use crimp-style terminals that fit the conductors at the cable end.
2) Be sure to earth ground the preamplifier's ground terminal.
3) Pitch down the cable from the cable entry so that rainwater will not have a chance to enter the equipment through the cable.
4) In areas where lightning strokes are expected, provide a lightning arrestor for protection.

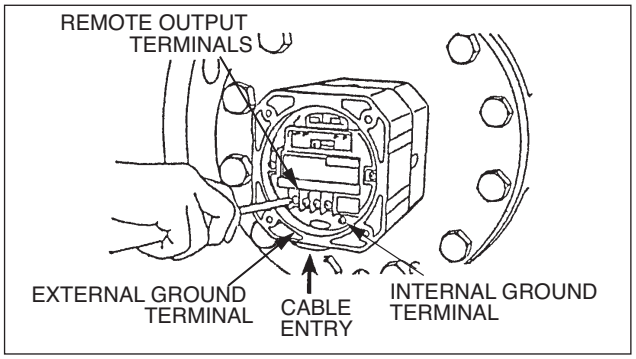
⚠ CAUTION

Make sure of the validity of meter (register) and receiving instrument combination by referring to their model numbers, serial numbers, etc. before you make electrical connections.

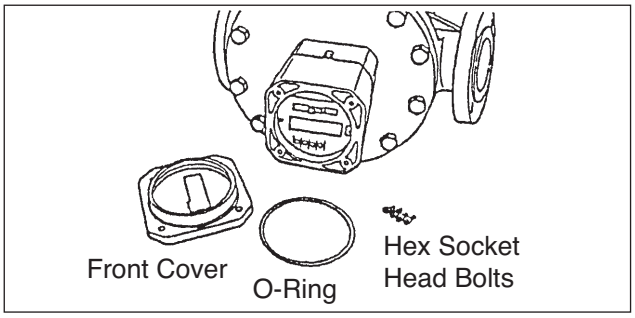
8.2 Terminal Connections



(1) Take off four hex socket head bolts on the front face of register.



(3) Using crimp-style terminals, ensure good electrical connections.



(2) Remove the front cover to gain access to a 4-post terminal block. Terminal identification label is found on the back of front cover.

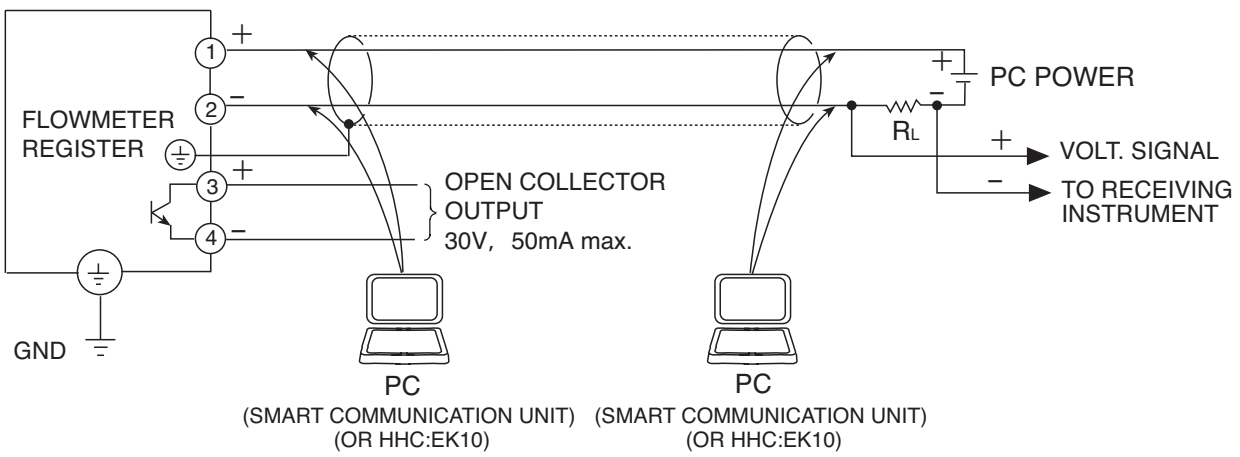
➡ NOTE: Connect the external earth ground terminal to instrumentation earth ground before use.

➡ NOTE: Pressuretight packings are not furnished for nonexplosionproof models (page 5).

8.3 Preamplifier-to-Receiving Instrument Hookup

The 2-wire signal transmission system used in this flowmeter furnishes DC power to the meter. It serves as the power line and signal line as well with pulse or analog current output.
An OVAL receiving instrument can be coupled directly, but instruments in general which are designed to accept a voltage signal input require a load resistor R_L connected in series for voltage conversion. Since the voltage signal level varies with the load resistance value, determine the load resistance value by referring to the receiving instrument specifications and the acceptable load resistance range shown below.
Communications with a PC (Smart Communication Unit) requires a 250 to 1000Ω load.

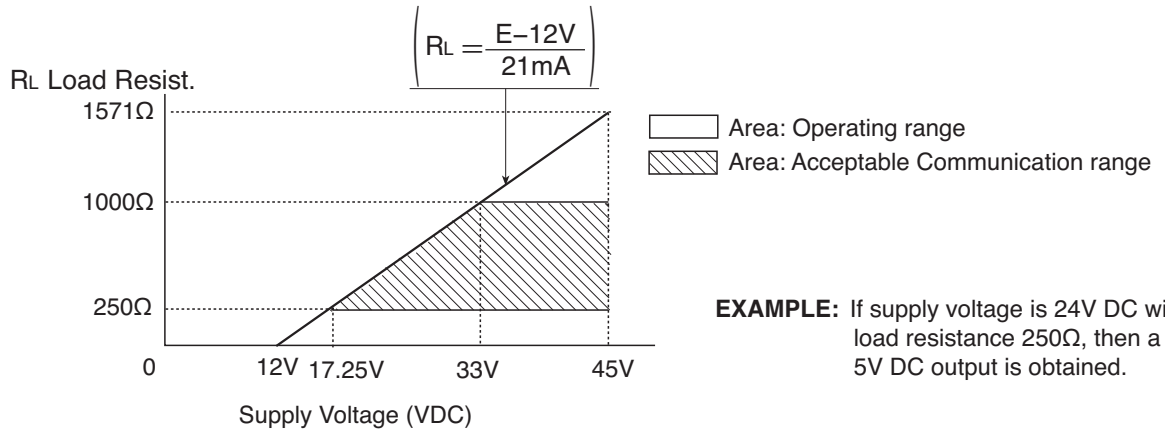
- In case a voltage input is fed to the receiving instrument



Output	Voltage Signal (V)
Pulse Output	ON/OFF = (20mA × R_L) / (4mA × R_L)
Analog Output	(4mA × R_L) – (20mA × R_L) at 0 to FS

➡ NOTE: With the relationship with supply voltage E, select the load resistance value R_L so that the current flowing into the transistor is held below 50mA.

Fig. 8.1



EXAMPLE: If supply voltage is 24V DC with load resistance 250Ω, then a 1 to 5V DC output is obtained.

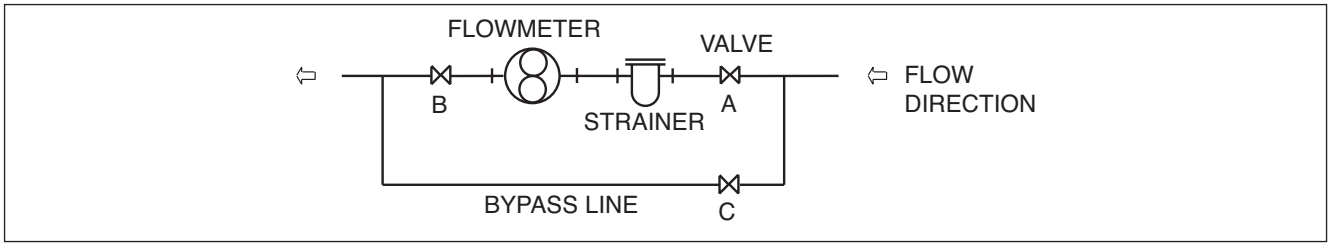
Acceptable Load Resistance Range.

Fig. 8.2

9. OPERATING INSTRUCTIONS

9.1 Operation

At first-time operation, carefully operate in the following sequence, allowing the flow within the flow range specified. (Refer to the piping diagram below.)



(1) Shut off the valve (A) on the inlet side and the valve (B) on the outlet side and then open the bypass line valve (C) to allow the fluid in the bypass line, thereby removing weld chips, scales and other foreign matter left in the piping assembly.

⚠ CAUTION: This is particularly important on new installations.

(2) Carefully and slightly at first, open the valve (A) upstream of the meter progressively and then, slightly at first, open the valve (B) downstream progressively.

(3) Slowly close the bypass line valve (C) and make sure that the total counter in the register advances in response. Maintain a flowrate 10 to 20% of the maximum flowrate (confirm it in the instantaneous flowrate display mode) at this time, allow the flow for more than 15 minutes and make sure that air in the piping assembly has totally escaped.
In applications where temperature exceeds 60°C, run the system at least for 30 minutes in this state to ensure uniform heat distribution in the measuring chamber.

(4) Following the break-in operation (preheating), shut off the bypass line valve (C) completely and open the upstream valve (A) progressively until fully open and slowly open the downstream valve (B) until the rated flow is obtained.

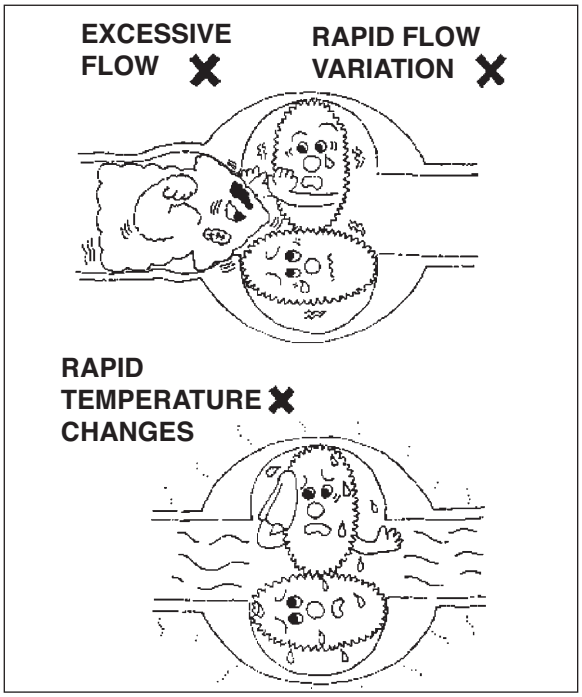
(5) Flowrate should be regulated with the valve (B) downstream of the meter and should be held within the specified rate.

(6) 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 a week.

9.2 Operating Precautions

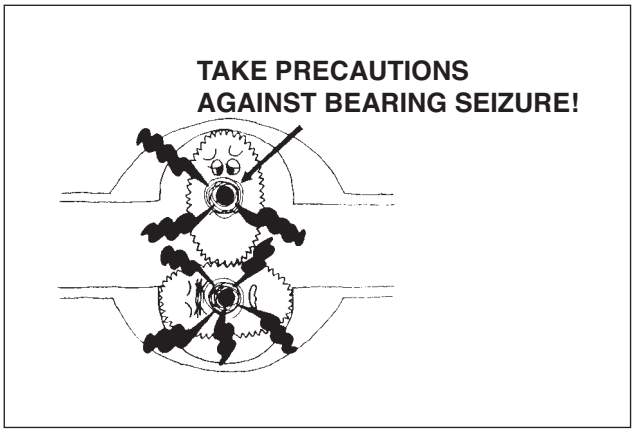
(1) When changing flowrates
In applications where the flowrate varies or where shutoff valve opening and closure takes place in batch operation, avoid rapid changes in flowrate across the meter.
Operating the meter at flowrates in excess of the maximum allowable flowrate will nullify the guaranteed accuracy, 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.



(3) Liquids of low steam pressure
Temperature and pressure of LPG, polyvinyl chloride monomers or other volatile liquids with low viscosity and low steam pressure 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 measure 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 dissolved 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.



9.3 Precautions at Operation Shutdown

(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 could cause a rise of internal pressure due to a rise of atmospheric temperature, resulting in 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 by 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.

9.4 About Register Life

Due to the life expectancy of components incorporated, such as the LCD and non-volatile memory, the internal electronics are designed to be replaced in about 10 years. The electronics life depends on the environment in which they are used; if any of the following operating conditions applies, we recommend you to replace them as an assembly in five to six years:

- High temperature environment.
- High temperature process fluid measurement.
- Field installation with widely varying temperatures.
- LCD counter display is exposed to the direct rays of the sun.
- Frequent process fluid flow interruptions.

10. DISASSEMBLY AND INSPECTION

◎ **Although it depends on individual operating conditions, periodic disassembly and inspection should be performed at least once a year.**

⚠ **CAUTION: Because the oval gear flowmeter is a precision industrial instrument, disassembly and inspection should be performed indoors as a rule. If it is desired to disassemble and inspect it as installed in the field, an important precaution to remember is to reduce the internal pressure of the piping assembly to a safe level, shut off valves upstream and downstream of the meter fully, drain the piping assembly and then place a suitable fluid receptacle directly below the flowmeter. Exercise care to keep individual components disassembled free from grit and dust.**

⚠ **CAUTION: Be sure to deenergize before you disassemble.**

◆ **Meter Body Inspection** ◆ **Complaint and possible cause: Process fluid will not run. Jammed with scales, the oval rotors fail to rotate, resulting in an interrupted fluid flow.**

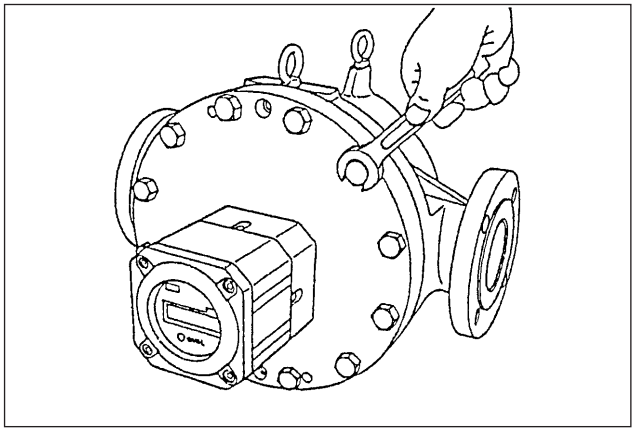
CONTENTS

10.1 Sizes 29, 31, and 60 Single-case Construction

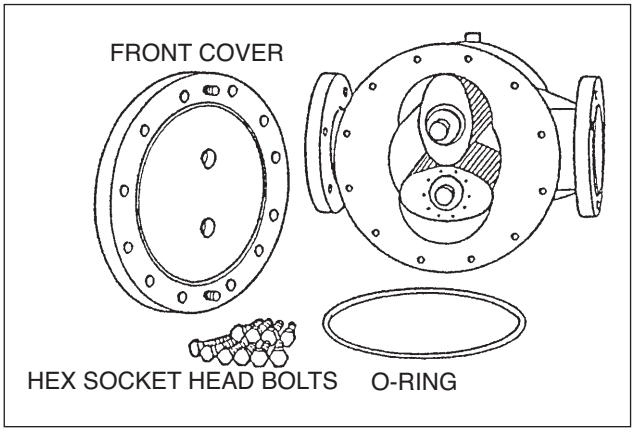
10.1.1 Oval Rotor Inspection

⚠ CAUTION: Be sure to follow the steps given below, referring to "Exploded View" on pages 30, 32 and 34.

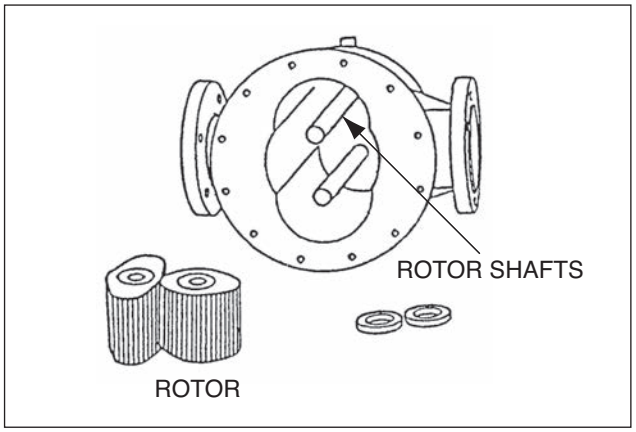
➡ NOTE: Size 29 single-case construction meter body is shown here. The same procedure applies to other size meters.



(1) Take off all the twelve hex bolts (105), using wrench.



(2) With the front cover removed, the measuring chamber with oval rotors and other components are accessible.



(3) Remove oval rotors from the measuring chamber and inspect them for condition.
(Rotor shafts should be drawn out straight forward.)
   (a) Inspect the oval rotors to see if they are jammed with foreign solids.
   (b) Check the rotors, shafts and other members for wear.
   (c) Inspect the measuring chamber and the inner wall of front cover for damage or any other sign of unusual condition.

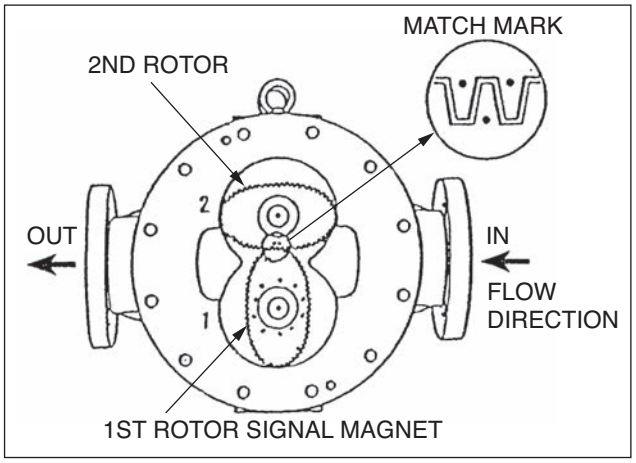
Upon completion of these inspections, clean the oval rotors, rotor shafts, measuring chamber and front cover with clean water or suitable solvent thoroughly.

⚠ 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.**

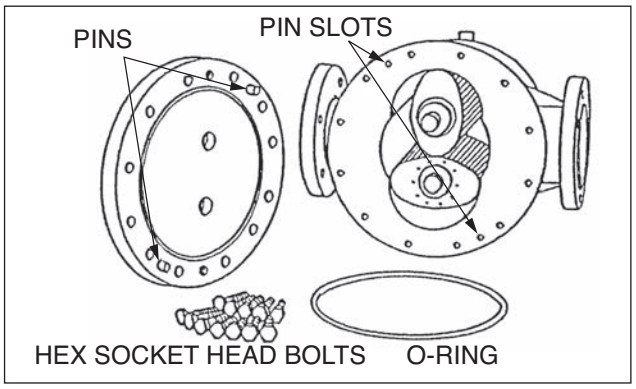
10.1.2 Assembly Procedure

⚠ **SERVICE NOTE BEFORE ASSEMBLY:**
Oval rotors, inner walls of the rotor shafts, inner wall of the measuring chamber, inlet and outlet ports, and inner surface of the front cover should be thoroughly washed clean, completely removing dust, grime and other foreign matter.



(1) Rotor Installation

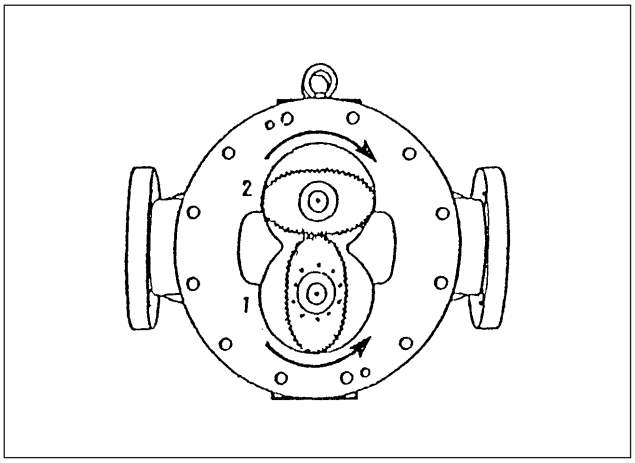
Rotor installation is correct if the side where signal generating magnets are embedded faces the register (top of the measuring chamber) and the side with match marks (•) (• •) faces the front cover. Carefully install the rotors with the 1st rotor (match mark " • ") on the shaft with "1" stamped on the outside of measuring chamber and the 2nd rotor (match mark " •• ") on the shaft with "2" stamped. Ensure that the match marks are as shown in the inset.



(3) Front Cover Installation

Firstly install O-ring (103) on the front cover. If the O-ring is damaged or swollen with metered liquid, it will not fit in the groove. If such is the case, replace with a new one.

Align the locating pins of front cover with its pin slots in the meter body and, fitting the rotor shafts into rotor shaft sockets in the front cover, force the meter body until the locating pins fit firmly into the pin slots in the meter body without slanting the front cover. Install 12 hex bolts (M16) and tighten them evenly until the front cover is closely in contact with the meter body.



(2) Confirming the Rotor Gear Engagement

Hand rotate the rotors to make sure of correct gear mesh.

(4) Confirming Freely Rotation

With air or water, make sure to see that the rotors move freely.

⚠ **CAUTION: Rotation check should be performed at low rotor r.p.m. Violent rotor spinning may cause a damage to the components, such as bearing seizure.**

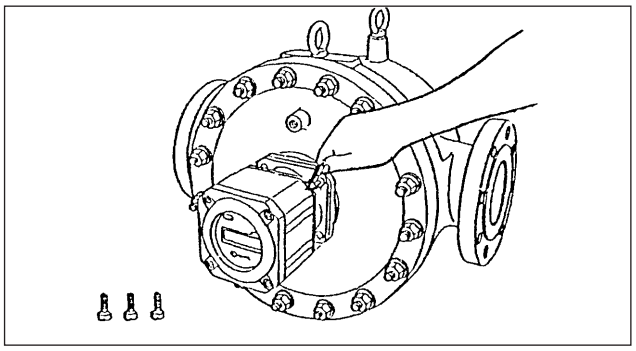
⚠ **CAUTION: Since the registers are not compatible each other, do not replace one register with that of other meter.**

10.2 Sizes 28, 29, 31, and 60 Double-case Construction

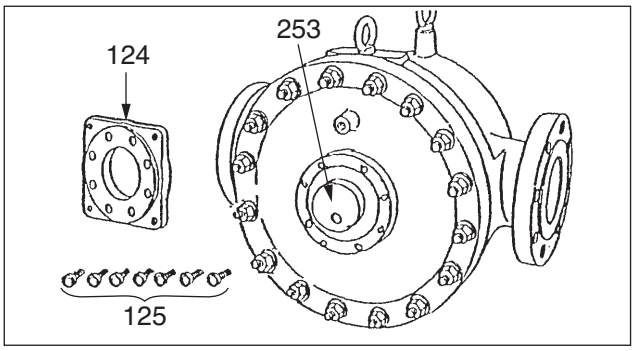
10.2.1 Oval Rotor Inspection

⚠ CAUTION: Be sure to follow the steps given below, referring to "Exploded View" on pages 36, 38, 40, and 42.

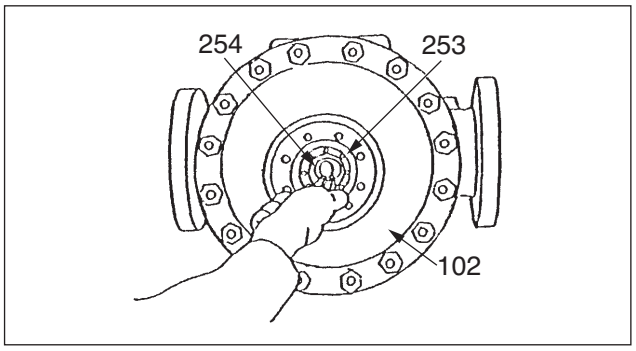
➡ NOTE: Size 60 single-case construction meter body is shown here. The same procedure applies to other size meters.



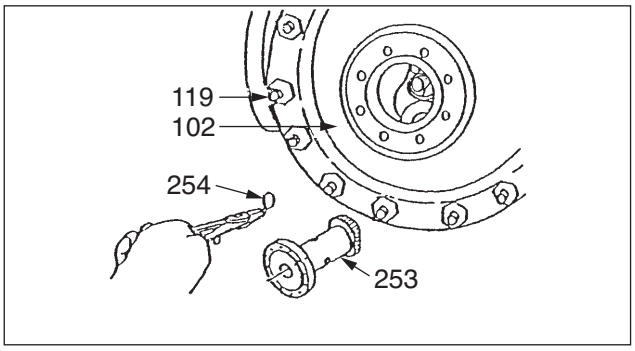
(1) Using hex key, take off four bolts (115). Holding the register assembly in both hands, carefully separate it from the meter body.



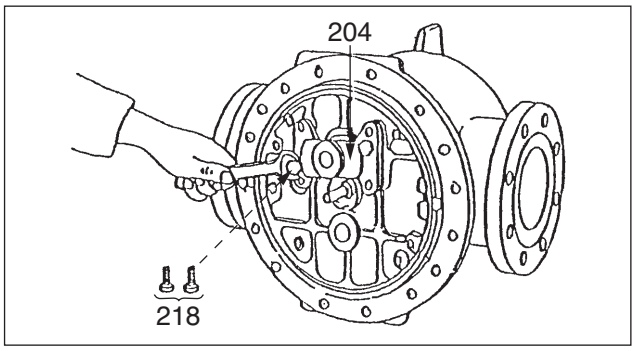
(2) Using hex key, take off eight bolts (125) and remove sealing flange (124).



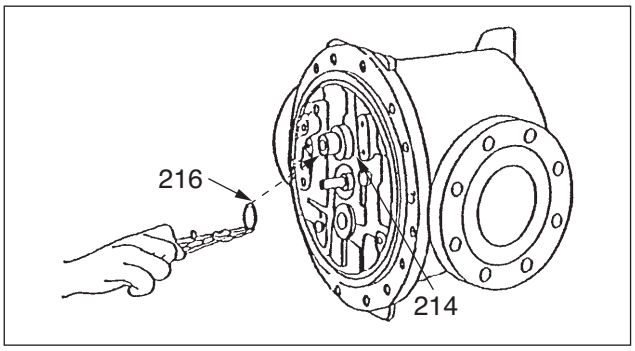
(3) Using stop ring pliers, remove stop ring (254). At assembly, install part (253) (in case of the 30K type) and then tighten front cover (102).



(4) Remove the signal generating magnet assembly. Take off 16 stud bolt nuts (119) and the front cover is ready to be separated.

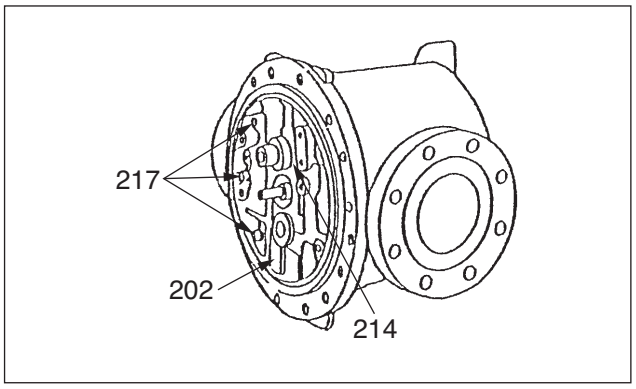


(5) Take off four hex bolts (218) and use two of them in the threaded jack screw holes in the longer shaft holder (204) to jack the longer shaft holder by tightening them alternately as shown.

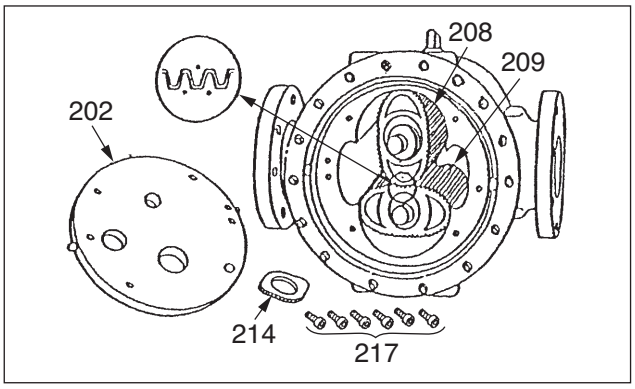


(6) Using stop ring pliers, remove stop ring (216) and remove uniform-motion drive gear (214). At assembly, install in line with the locating pins of uniform-motion gears.

⇨Continued on next page.



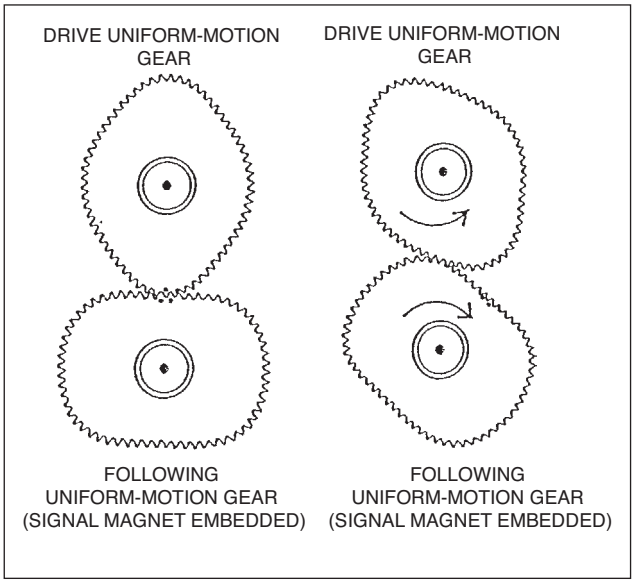
(7) Using hex key, take off six bolts (217) and use two of them in the threaded jack screw holes in the inner case top cover (202) to jack the inner case top cover by tightening them alternately.



(8) Now the measuring chamber is ready for inspection.
Wash clean the oval rotors, measuring chamber, and inner case top cover with suitable cleaning oil. Reassemble them exercising care to keep grit and dust from entering.
At assembly, align match marks as shown and make sure of freely rotor rotation.

10.2.2 Assembly Procedure

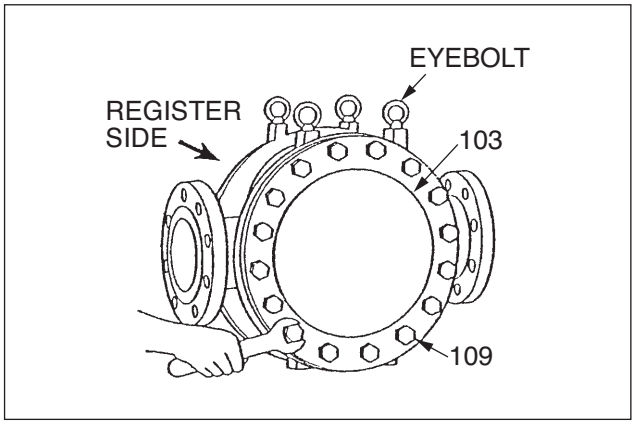
Assembly is the reverse of the removal procedure, but observe the following instructions.
Illustrated at right is the way the uniform-motion gears are assembled.
At assembly, careful attention must be paid to the proper engagement of uniform-motion gears. Lining up with match marks, slide the arrow marks as shown. Following gear engagement, be sure to make one complete revolution to ensure freely rotation.



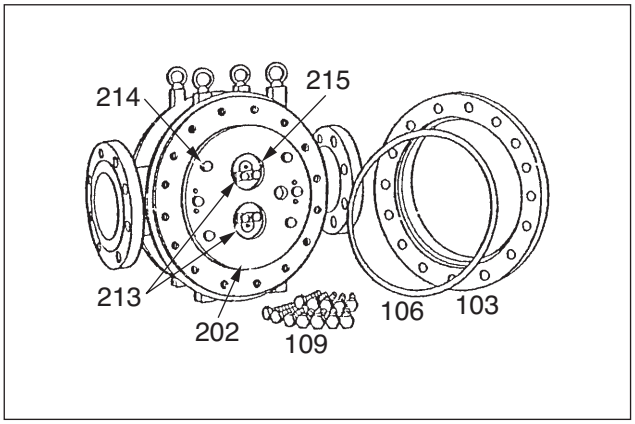
10.3 Sizes 32 and 33 Single-case Construction

10.3.1 Oval Rotor Inspection

⚠ IMPORTANT: Be sure to follow the procedure given here, referring to the exploded view on page 44.

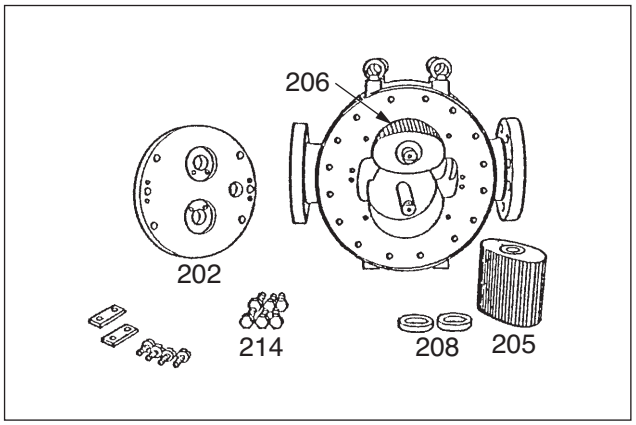


(1) Take off a total of sixteen hex bolts (109) holding the rear cover (103) and remove the rear cover. To do this, screw eyebolts into screw hole in the rear cover and draw the cover horizontally. Pay attention to the possibility of a seized O-ring. Residual process fluid may run from the measuring chamber. Receive it with a suitable receptacle.



(2) Take off four screws (215) and remove non-turn strips (213) of the shafts.

(3) Take off six hex socket head bolts (214) with hex wrench and screw two of the bolts which have just been removed into two threaded holes in the bottom cover (202). Then, holding these bolts, separate the bottom cover horizontally.
If it is hard to separate, try again while lightly tapping its flanged area with plastic mallet.



(4) Remove rotors Nos. 1 and 2 (205, 206) and remove scale adhering to the inner wall of measuring changer. Use care not to damage the thrust ring (208).
It is good practice to put identification marks for correct installation.

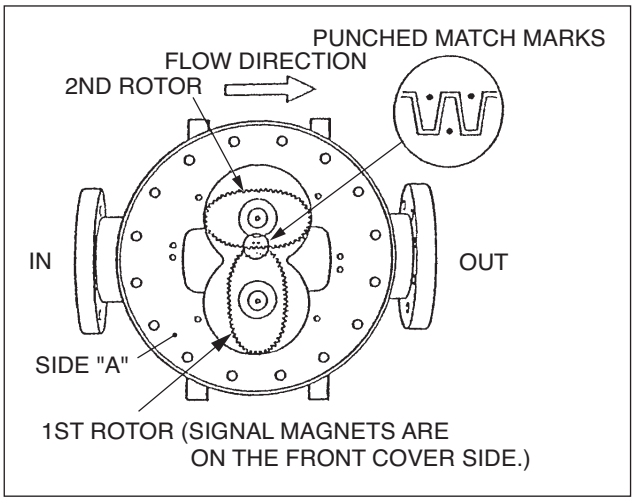
⚠ CAUTION

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 in contact with rear cover jacking bolts are distorted outwardly, recondition it flat with oil stone.**
3. **Excessive correction may result in a loss of flowmeter accuracy.**

10.3.2 Assembly Procedure

The rotor installation procedure is reverse of the removal procedure. But careful attention must be paid to the following instructions:

Install the rotors with their match marks correctly aligned as shown in the inset of the figure at right. Installing the 1st and 2nd rotors the wrong way will result in a dead register.



➡ NOTE: 1. If the flow direction is from left to right as shown in the figure at right (right to left as viewed from the register), the 1st rotor installs below the 2nd.

2. If the flow direction is otherwise (from right to left), the 1st rotor installs above the 2nd.

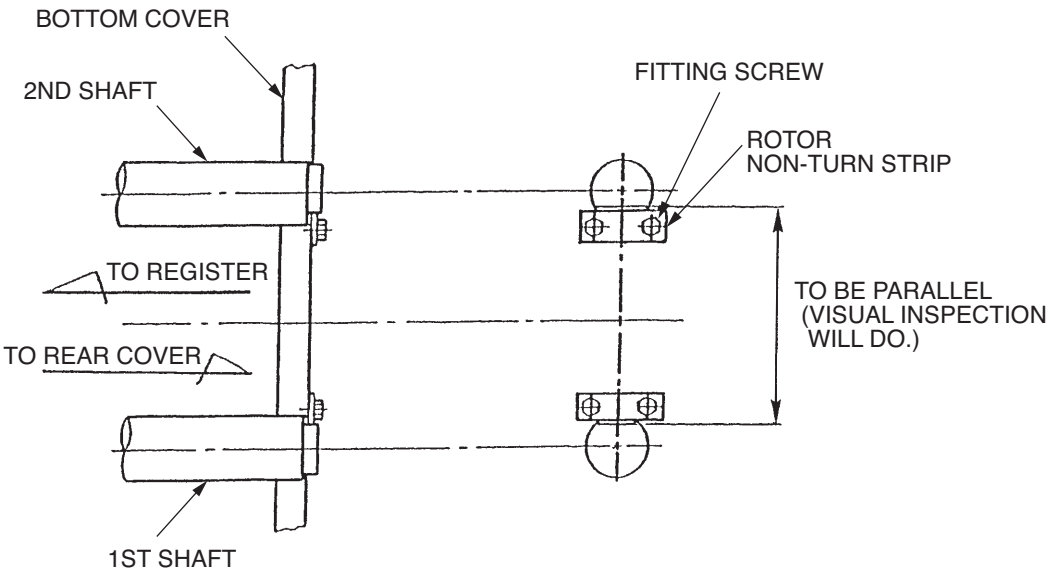
3. If high spots are found on surface A of the mete body, recondition flat with oil stone or similar tool.

⚠ CAUTION: In this case, the flow direction is as viewed from the rear cover.

⚠ Precautions at Assembly

(1) The assembly procedure is reverse of the removal procedure, but observe the following precautions:
   1) Be careful not to install the 1st rotor and the 2nd rotor the wrong way.
   2) At installation of non-turn strips, install them in close contact with notches in the rotor shafts and then tighten screws.

(2) This flowmeter is designed to hold the rotor shafts with non-turn strips on the rear cover side as shown below. At assembly, therefore, ensure parallel shaft installation with respect to shaft notches (visual inspection will do).



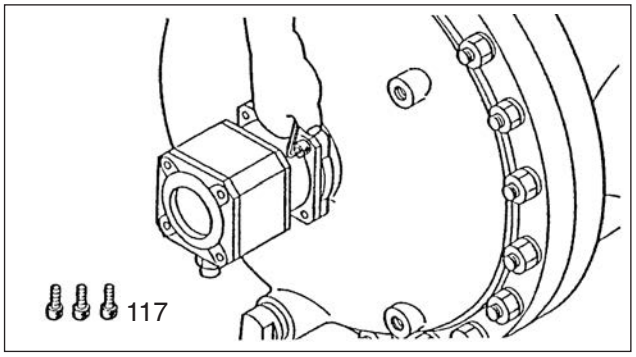
⚠ CAUTION: Since the registers are not compatible each other, do not replace one with that of other meter.

NOTE: Procedure for meter size 33, double case construction, is shown here. The same procedure applies to other meter.

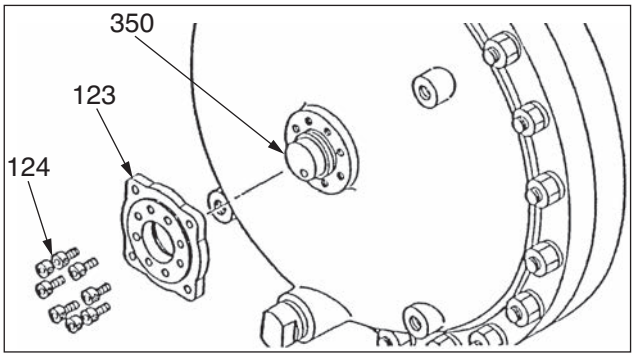
10.4 Sizes 32 and 33 Double-case Construction and Size 34 Single-case Construction

10.4.1 Oval Rotor Inspection

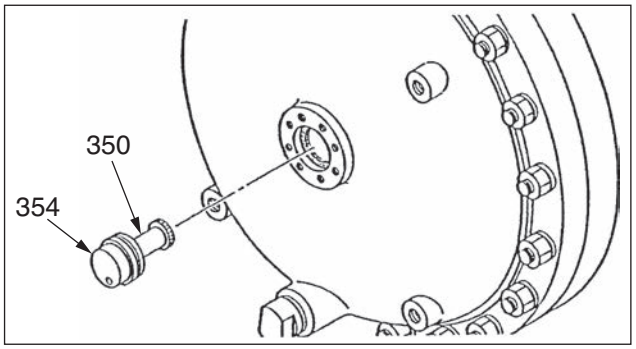
⚠ CAUTION: Be sure to follow the procedure given here, referring to the exploded view on pages 46 and 48.



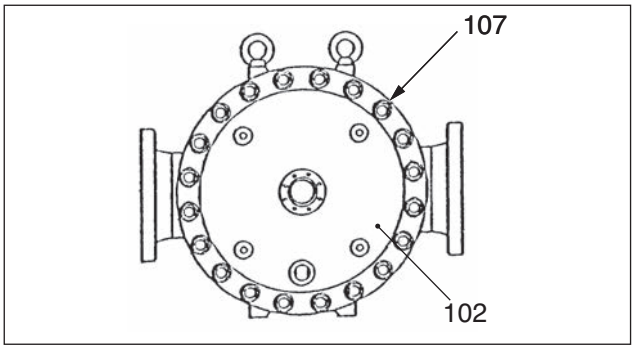
(1) Using hex key, take off four bolts (117). Holding the register assembly in both hands, carefully separate it from the meter body.



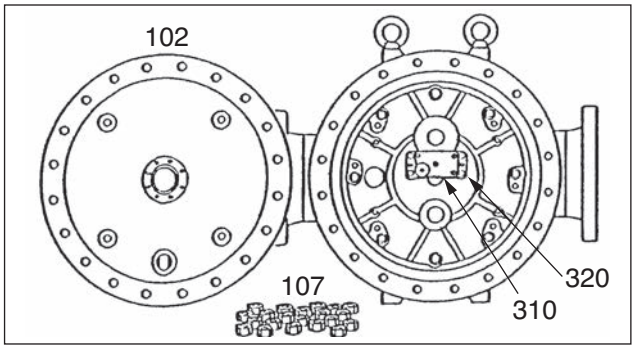
(2) Using hex key, take off eight bolts (124) and remove sealing flange (123).



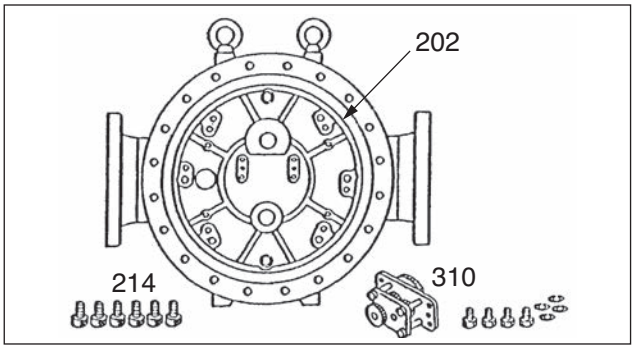
(3) Uniformly draw pressuretight sealing plate (354) out and remove signal generating magnet assembly (350).



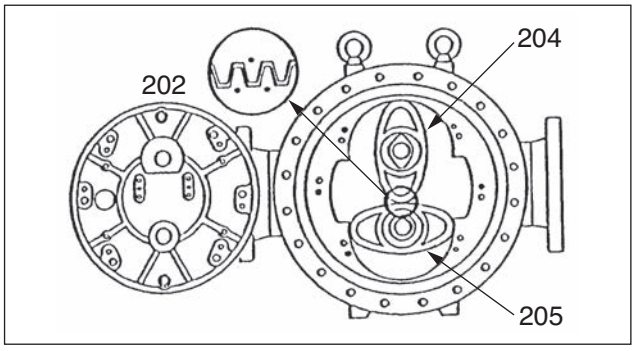
(4) Take off a total of 20 nuts (107) of stud bolts holding the front cover. The front cover (102) is now ready to be separated.



(5) Take off four hex bolts (320) and, using two of them in the threaded jack screw holes in the transmission gear train (310) as shown, jack the transmission gear train by tightening them alternately - one at a time.



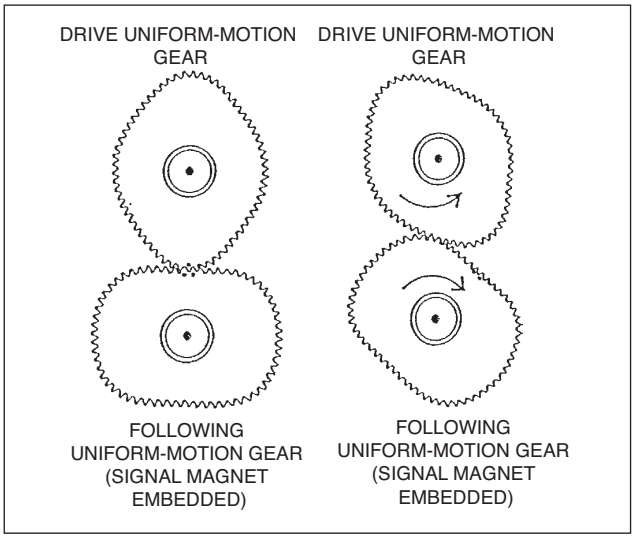
(6) Using hex key, take off six bolts (214) and use two of them in the threaded jack screw holes in the top cover (202) of inner case to jack the top cover of inner case by progressively tightening them alternately.



(7) Now the measuring chamber is ready for inspection.
Wash clean the oval rotors, measuring chamber, and top cover of the inner case with suitable cleaning oil. Reassemble them exercising care to keep grit and dust from entering.
At assembly, align match marks as shown and make sure of freely rotor rotation.

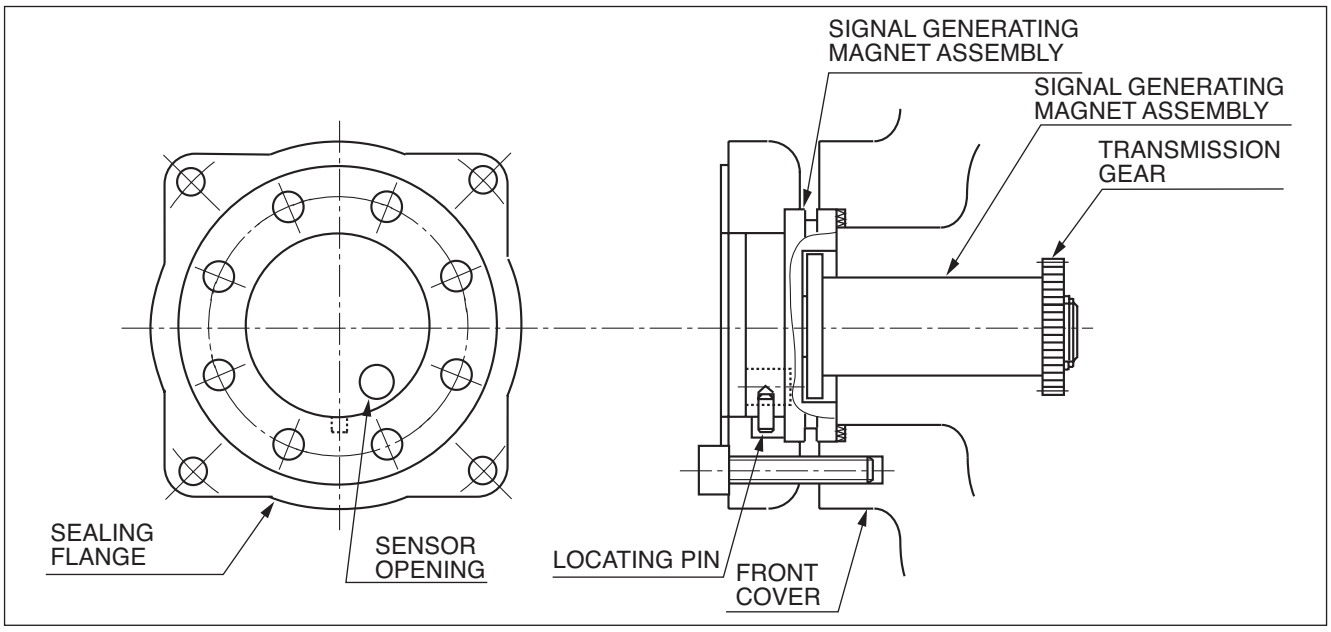
10.4.2 Assembly Procedure

Assembly is the reverse of the removal procedure, but observe the following instructions.
Illustrated at right is the way the uniform-motion gears are assembled.
At assembly, careful attention must be paid to the proper engagement of uniform-motion gears. Lining up with match marks, slide the arrow marks as shown. Following gear engagement, be sure to make one complete revolution to ensure freely rotation.

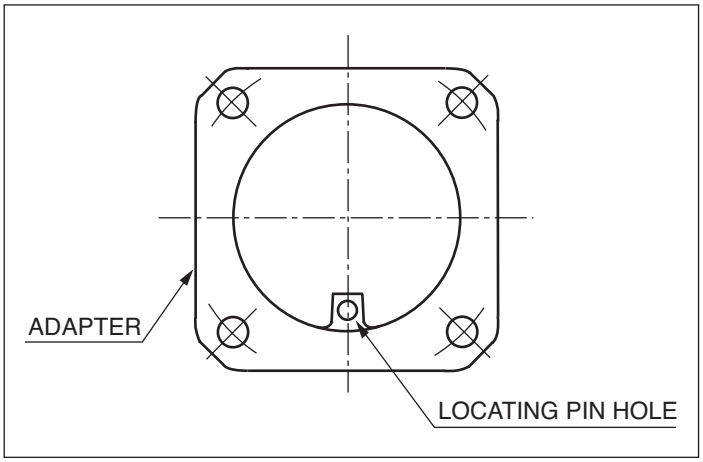


10.4.3 Precautions at Signal Magnet Disassembly and Reassembly

Phase observation is required for the signal generating magnet assembly. If installed out of phase at assembly, the total counter will not count. Install the generating magnet assembly such that the locating pin always points in a downward direction.

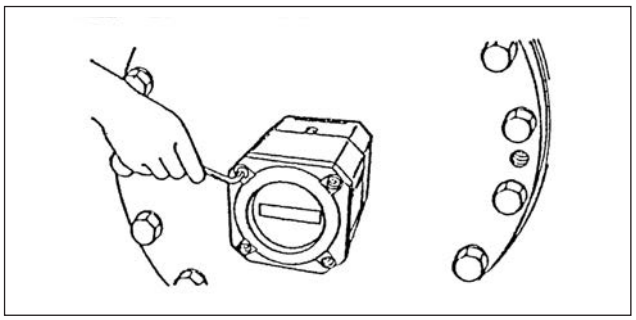


➡ NOTE: The adapter is installed correctly as shown at right (pin hole in right under).

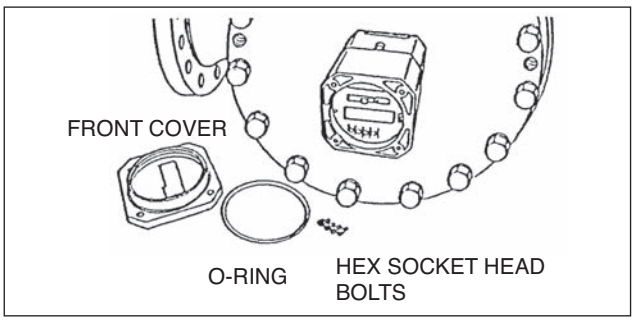


11. REGISTER SWITCH FUNCTIONS AND PARAMETER SETUP

11.1 Switch Names and Functions



(1) Using a hex key, take off four hex socket head bolts securing the front cover.



(2) Removing the front cover provides access to the electronics unit.

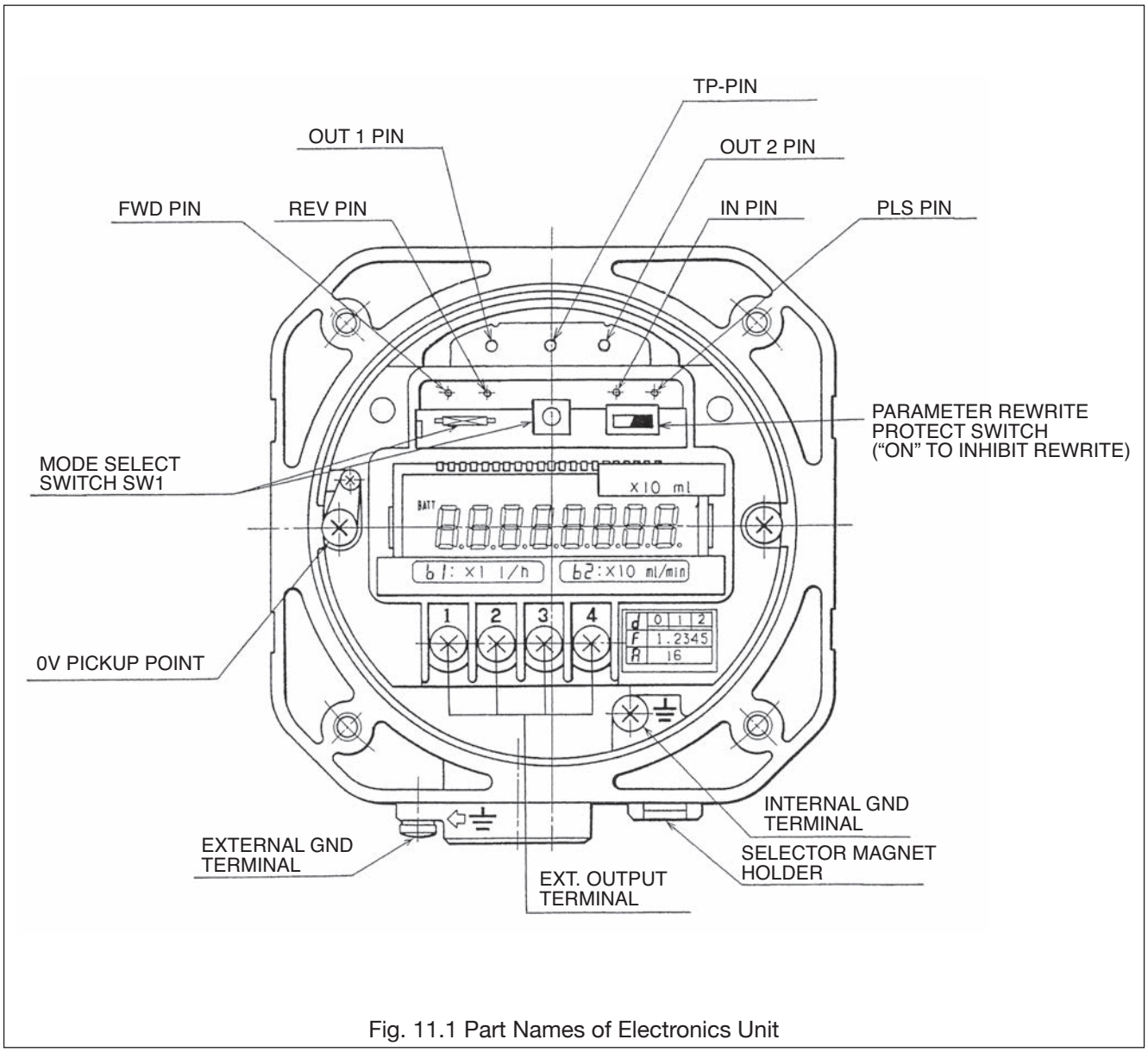
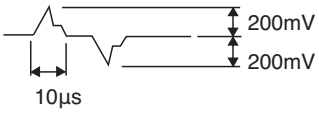
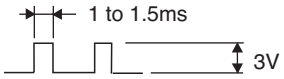
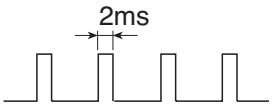
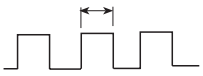
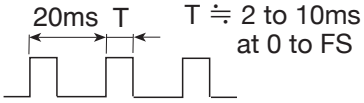


Fig. 11.1 Part Names of Electronics Unit

11.2 Individual Test Pin Functions

➡ NOTE: Connect the 0V end to the L.H. side fixed screw of the electronics unit.

PIN NAME	FUNCTION	WAVEFORM
FWD	An output of No. 1 amorphous sensor waveform appears.	
REV	An output of No. 2 amorphous sensor waveform appears. While the flowmeter is making forward revolutions, pulses are produced slightly behind the FWD pulses.	Same as above.
PLS	A rectangular waveform after FWD pulse waveshaping appears. Timing remains the same as that of FWD and its waveform is one before unfactored output amplification.	
IN	Accepts a square-wave pulse train from the pulse checker (OVAL Model PC2201, for example). Used for analog full scale adjustment, loop check, or other servicing. Input mode is Model PC2201's PG30 mode. Also accepts pulses with levels "0": 1V max. and "1": 7 to 12V min., or open collector.	
OUT1	Provides a waveform corresponding to the power signal which appears across remote output signal terminals 1 and 2.	(1) Unfactored pulse  (2) Factored pulse Depends on "Pulse width" set  (3) Analog output 
OUT2	Produces a waveform corresponding to the open collector output which appears across remote output terminals 3 and 4.	

11.3 About Meter Factor

If it is desired to change meter factors in an instrumental error testing, for example, you may establish a new meter factor by the following procedure.
Instrumental error testing must be conducted with proper facilities and procedures specified in the Weights and Measures Law, Japanese Industrial Instruments Federation, JIS standards, or other established standards.

- How to Determine a New Meter Factor

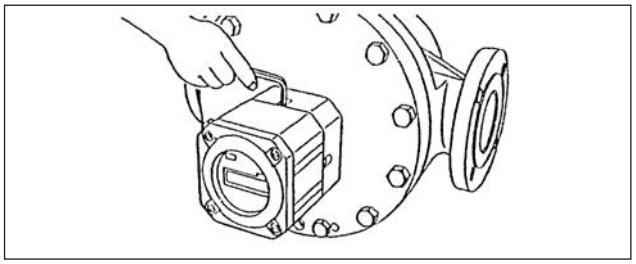
$$\text{New Meter Factor} = (\text{Current meter factor}) \times \left(1 - \frac{E}{100}\right) (\text{mL/P})$$

E: Instrumental error determined by the test (%)

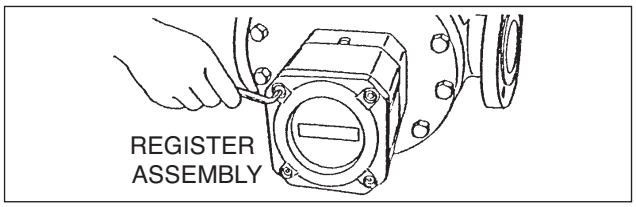
⚠ CAUTION: The new meter factor should be put on paper for later reference.

12. SENSOR REPLACEMENT PROCEDURE

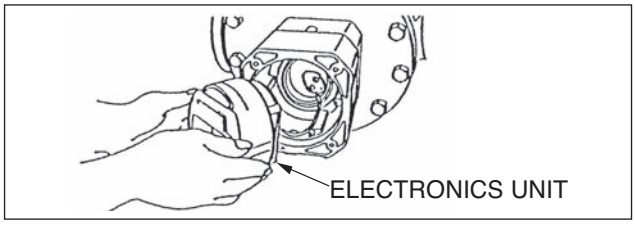
➡ NOTE: Size 29 single-case is shown here. The same procedure applies to other size models.



(1) Take off four hex socket head screws on the register.

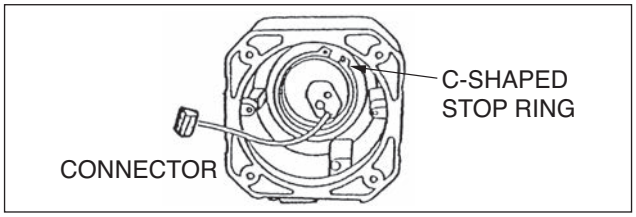


(3) Take off four hex socket head bolts and separate the cover.

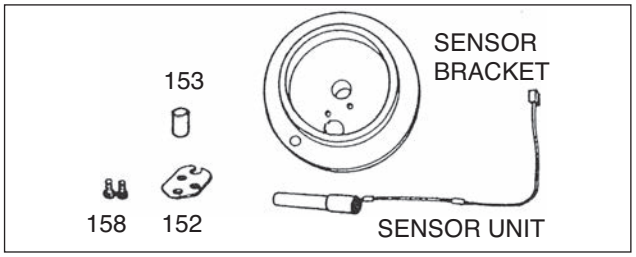


(5) Holding the electronics unit in both hands, carefully draw it out.

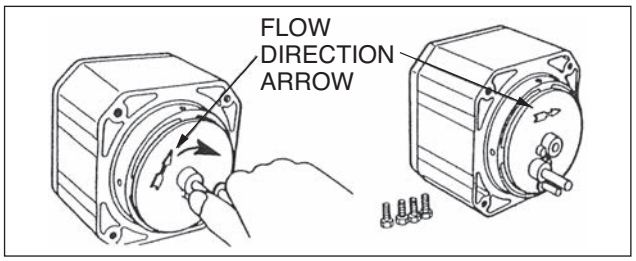
⚠ **CAUTION: Use extra care not to damage the leads by forcing the sensor bracket.**

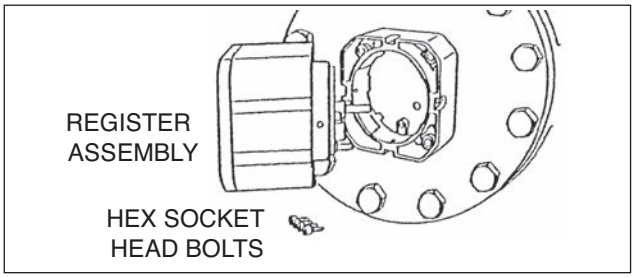


(7) Using C-shaped stop ring pliers, remove the C-shaped stop ring for the shaft. The sensor unit is now separable from the register housing.

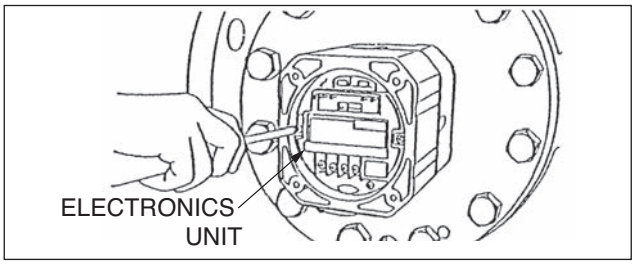


(9) Install a new sensor unit through the opening through which the old sensor unit was removed and assemble in the reverse order of disassembly.

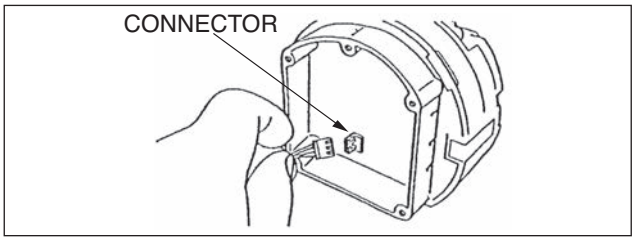




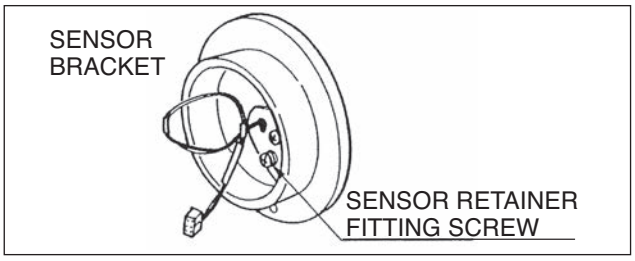
(2) Carefully draw the register assembly out. Exercising care not to bump the sensor against adjacent components, draw it out in the horizontal direction.



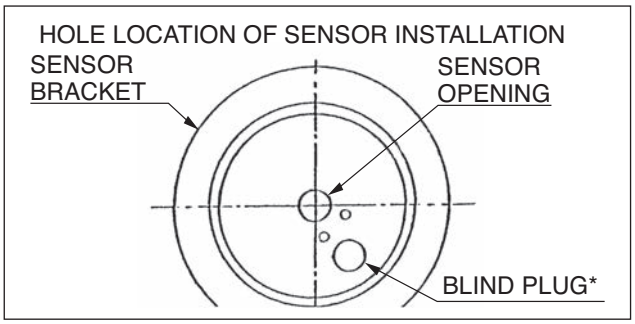
(4) With cross slot screwdriver, take off two fitting screws holding the electronics unit



(6) Uncouple the connector from the sensor unit at back of the electronics unit.



(8) Loosen the sensor retainer fitting screws (M4) with cross slot screwdriver, remove the sensor retainer and draw out the sensor unit.



➡ NOTE: Sensor location differs by model
Sizes 28, 29, 31, 60 double-case construction and sizes 32, 33, double-case construction, as well as size 34 single-case types have the sensor opening shown with an asterisk*.

⇦ (10) At register installation in the meter body, match the flow direction of the meter body with the arrow on the sensor bracket.

13. TROUBLESHOOTING

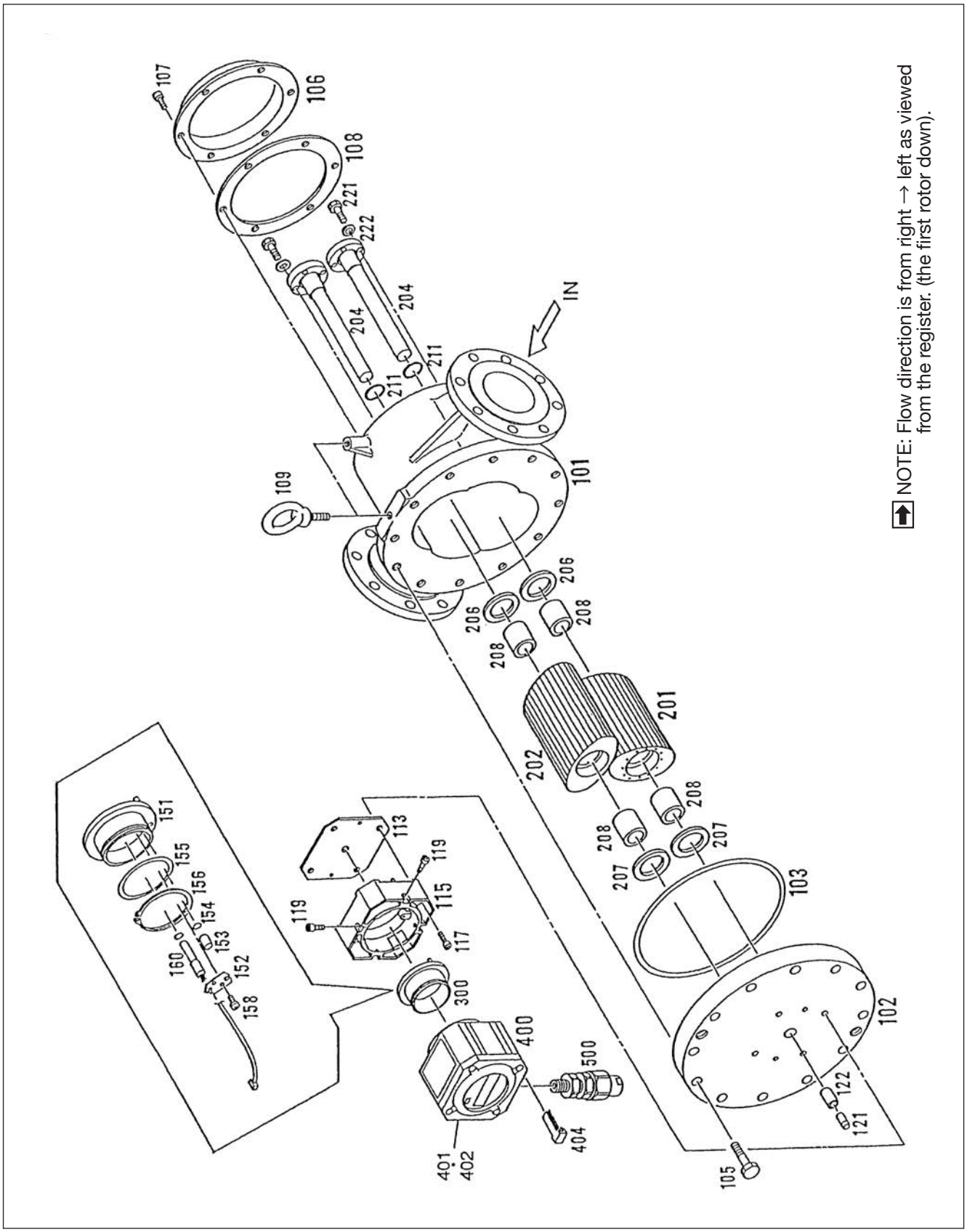
PROBLEM	PROBABLE CAUSE	COPING ACTION
1. Totalizer will not count.	1. Flowrate is low.	1. Open valves progressively.
	2. Insufficient pump pressure or head pressure.	2. Taking pressure loss of entire piping assembly into consideration, correct pump pressure or head pressure.
	3. Power line voltage is out of specification or current carrying capacity of power source is inadequate.	3. Provide a 14 to 45VDC power to the register. (12 to 24VDC for open collector or voltage pulse output.) Current carrying capacity 30mA min. is required for power. (With analog output, 24VDC, 60mA min. is required.)
	4. Oval rotors jammed with foreign matter; rotors locked; metered liquid fails to run.	4. Referring to Disassembly and Inspection Procedure (Sec. 10), disassemble the meter body and clean the rotors thoroughly.
	5. Oval rotors installed upside down.	5. Refer to Sec. 10.3 Assembly in Section 10, Disassembly and Inspection and reassemble correctly.
	6. Sensor installed out of position.	6. Refer to "How to Change Flow Directions" (Sec. 7) and reinstall the sensor.
2. Unusual noise.	1. Air is entrapped.	1. Decrease flowrate and eliminate air in the piping assembly.
	2. Vaporized metered liquid in the piping assembly.	2. Decrease flowrate and control metered fluid temperature and pressure to prevent vaporization.
	3. Oval rotors revolving in contact with measuring chamber.	3. Refer to Disassembly and Inspection Procedure (Sec. 10) and disassemble and inspect for condition
3. Liquid leaks.	1. Incomplete seal of the pipeline connections.	1. Inspect rear cover fitting bolts for tightness or replace gaskets.
	2. Incomplete seal on front/rear cover of meter body.	2. Retighten bolts at pipeline connections and replace O-ring or gasket with new one.
4. Counts while valve remain closed.	1. Valve and pipeline leaks.	1. Inspect valves and pipeline.
	2. Air pockets between valve and the meter: rotors in rocking motion in response to pump's pulsating pressure.	2. Vent air. Provide a check valve and accumulator.
	3. Supply power voltage fluctuates.	3. Eliminate voltage fluctuation.
5. Analog output unusual.	1. Load resistance too great.	1. Referring to "Load Resistance Range" on page 14, check load resistance to power supply voltage relationship and keep them within the specified range.
6. Accumulated total too high.	1. Rotors in rocking motion in response to a pulsating flow.	1. Add a check valve and accumulator.
	2. Influenced by external magnetic fields (the meter sensor picks up external magnetic fields created by a motor, generator, etc.)	2. Keep out external magnetic fields.
	3. Air entrapped.	3. Provide an air vent.
7. Accumulated total too low.	1. Influenced by external magnetic fields.	1. Keep out external magnetic fields.

14. EXPLODED VIEWS AND PARTS LIST

- When you order replacement parts, specify the stock No., flowmeter model, instruction manual No., symbol No., part name and the quantity desired.

14.1 Size 29 Single-case Constructing

14.1.1 Size 29 Single-case Constructing Exploded View



NOTE: Parts list appears on the next page.

14.1.2 Size 29 Single-case Construction Parts List

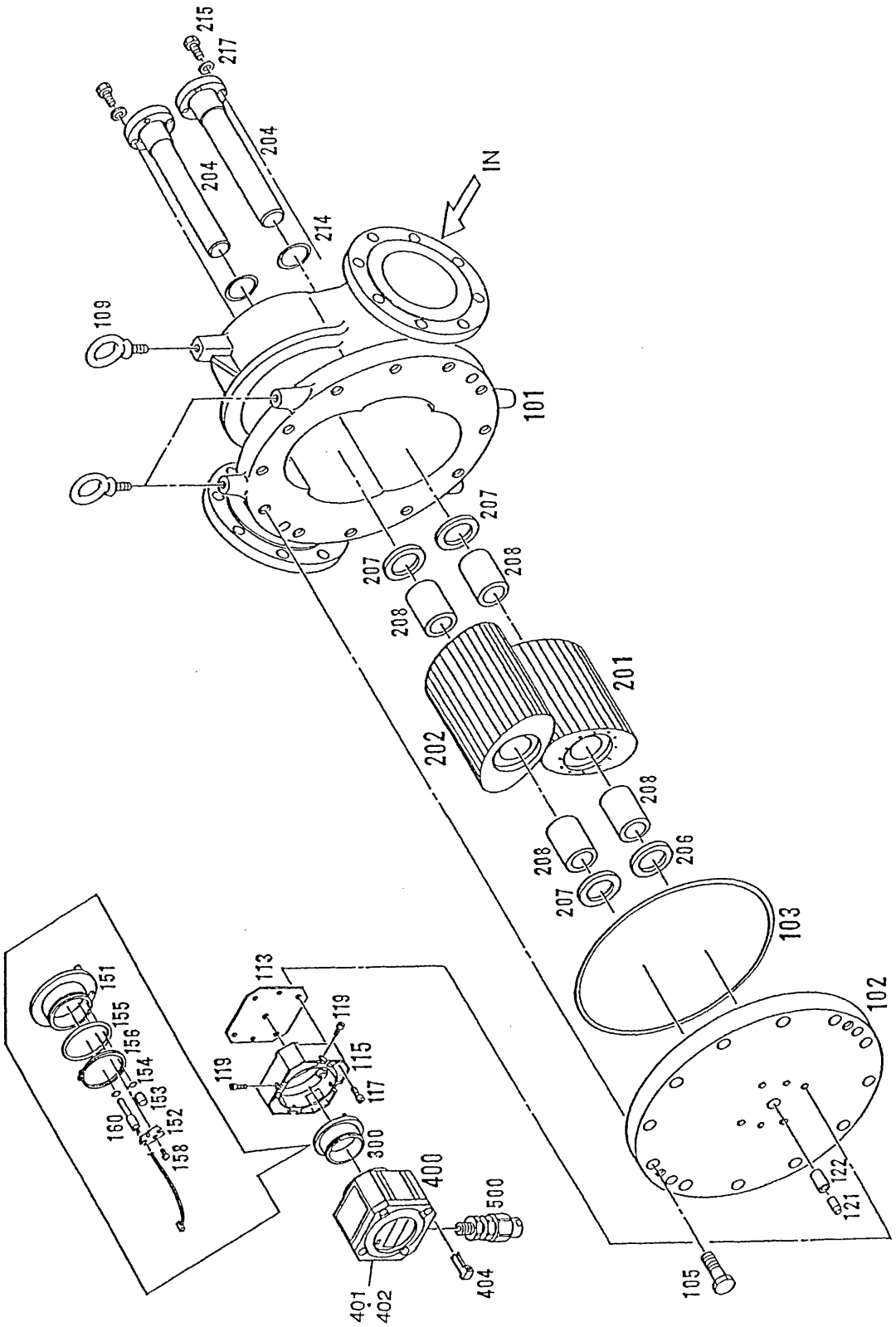
Symbol No.	Part Name	Q'ty	Remarks
100	Meter Body Assembly	1 set	
101	Meter Body	1	
102	Front Cover	1	
▲103	O-Ring	1	
105	Front Cover Fitting Bolt	12	M16 × 60
106	Rear Cover	1	
107	Rear Cover Fitting Bolt	6	M8 × 20
108	Rear Cover Gasket	1	
109	Eyebolt	2	M10 × 18
113	Gasket	1	
115	Adapter	1	
117	Adapter Fitting Bolt	4	M10 × 35
119	Register Fitting Bolt	4	M6 × 12
121	Iron Slug	1	
122	Spacer	1	
200	Inner Case Assembly	1 set	
※201	First Rotor	1	Signal magnet embedded
※202	Second Rotor	1	
204	Rotor Shaft	2	
206	Thrust Ring A	2	
207	Thrust Ring B	2	
※208	Rotor Bearing	4	
211	O-Ring	2	
221	Shaft Fitting Bolt	8	M8 × 25
222	Shaft Fitting Bolt Washer	8	M8

Symbol No.	Part Name	Q'ty	Remarks
300	Sensor Assembly	1 set	(151 to 158, 160)
151	Sensor Fitting Disc	1	
152	Sensor Retainer	1	
153	Blind Plug	1	
154	O-Ring B	2	S10
155	O-Ring C	1	G65
156	C-shaped Stop Ring	1	
158	Cross Recess Pand Head Screw	2	M4 x 8 (with washer)
160	Sensor Unit	1	
400	Register Assembly	1 set	
401	Register Cover	1	
402	Cover Fitting Bolt	4	M6 (with washer)
404	Selector Magnet	1	
405	Internal Assembly	1 set	
500	Pressuretight Packing	1 set	Option

※: Rotors and rotor bearings are matched pairs and are available as an assembly.
▲: Recommended spare parts.

14.2 Size 60 Single-case Constructing

14.2.1 Size 60 Single-case Constructing Exploded View



NOTE: Flow direction is from right → left as viewed from the register. (the first rotor down).

NOTE: Parts list appears on the next page.

14.1.2 Size 60 Single-case Construction Parts List

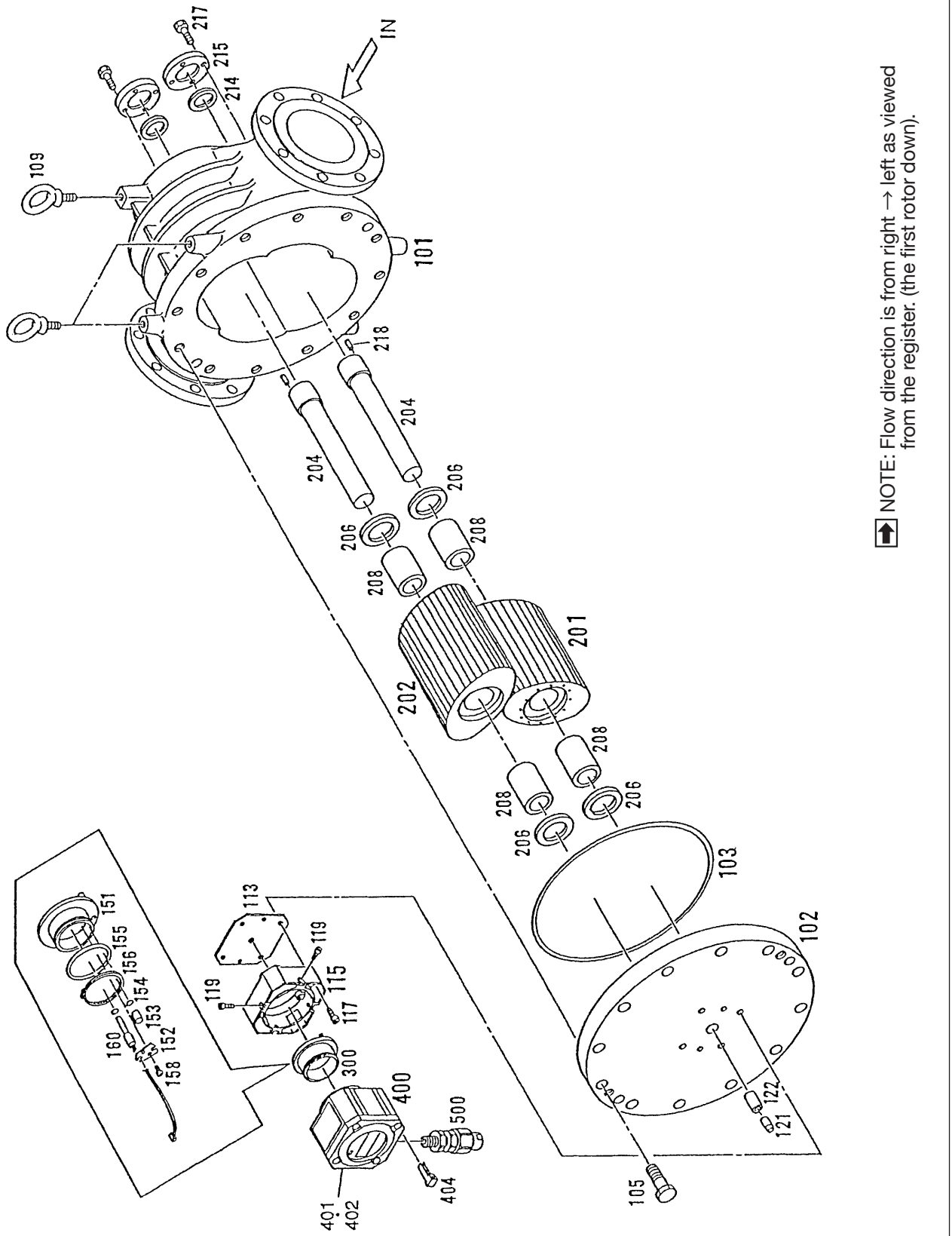
Symbol No.	Part Name	Q'ty	Remarks
100	Meter Body Assembly	1 set	
101	Meter Body	1	
102	Front Cover	1	
▲103	O-Ring	1	JIS P-320
105	Front Cover Fitting Bolt	12	M16 × 60
109	Eyebolt	2	M12
113	Gasket	1	
115	Adapter	1	
117	Adapter Fitting Bolt	4	M10 × 35
119	Register Fitting Bolt	4	M6 × 12
121	Iron Slug	1	
122	Spacer	1	
200	Inner Case Assembly	1 set	
※201	First Rotor	1	Signal magnet embedded
※202	Second Rotor	1	
204	Rotor Shaft	2	
206	Thrust Ring A	2	
207	Thrust Ring B	2	
※208	Rotor Bearing	4	
214	O-Ring	2	JIS S-42
215	Shaft Fitting Bolt	8	M10 × 35
217	Shaft Fitting Bolt Washer	8	M10

Symbol No.	Part Name	Q'ty	Remarks
300	Sensor Assembly	1 set	(151 to 158, 160)
151	Sensor Fitting Disc	1	
152	Sensor Retainer	1	
153	Blind Plug	1	
154	O-Ring B	2	S10
155	O-Ring C	1	G65
156	C-shaped Stop Ring	1	
158	Cross Recess Pand Head Screw	2	M4 x 8 (with washer)
160	Sensor Unit	1	
400	Register Assembly	1 set	
401	Register Cover	1	
402	Cover Fitting Bolt	4	M6 (with washer)
404	Selector Magnet	1	
405	Internal Assembly	1 set	
500	Pressuretight Packing	1 set	Option

※: Rotors and rotor bearings are matched pairs and are available as an assembly.
▲: Recommended spare parts.

14.3 Size 31 Single-case Constructing

14.3.1 Size 31 Single-case Constructing Exploded View



NOTE: Parts list appears on the next page.

14.3.2 Size 31 Single-case construction Parts List

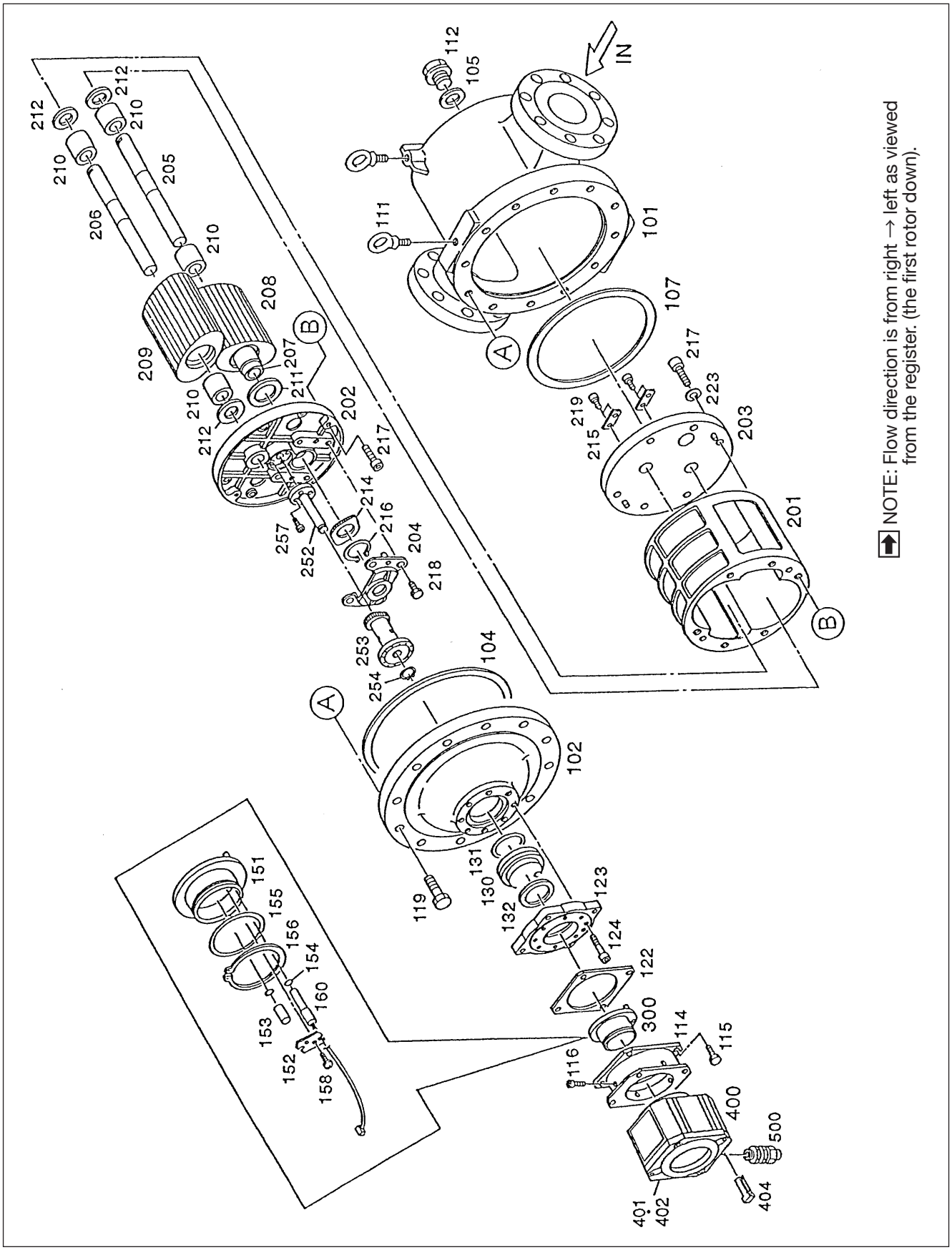
Symbol No.	Part Name	Q'ty	Remarks
100	Meter Body Assembly	1 set	
101	Meter Body	1	
102	Front Cover	1	
▲103	O-Ring	1	JIS P-400
105	Front Cover Fitting Bolt	12	M24 × 75
109	Eyebolt	2	M12
113	Gasket	1	
115	Adapter	1	
117	Adapter Fitting Bolt	4	M10 × 35
119	Register Fitting Bolt	4	M6 × 12
121	Iron Slug	1	
122	Spacer	1	
200	Inner Case Assembly	1 set	
※201	First Rotor	1	Signal magnet embedded
※202	Second Rotor	1	
204	Rotor Shaft	2	
206	Thrust Ring	2	
※208	Rotor Bearing	4	
214	O-Ring	2	
215	Shaft Fitting Bolt	2	
217	Shaft Fitting Bolt Washer	8	M10 × 35

※: Rotors and rotor bearings are matched pairs and are available as an assembly.
▲: Recommended spare parts.

Symbol No.	Part Name	Q'ty	Remarks
300	Sensor Assembly	1 set	(151, 158, 160)
151	Sensor Fitting Disc	1	
152	Sensor Retainer	1	
153	Blind Plug	1	
154	O-Ring B	2	S10
155	O-Ring C	1	G65
156	C-shaped Stop Ring	1	
158	Cross Recess Pand Head Screw	2	M4 x 8 (with washer)
160	Sensor Unit	1	
400	Register Assembly	1 set	
401	Register Cover	1	
402	Cover Fitting Bolt	4	M6 (with washer)
404	Selector Magnet	1	
405	Internal Assembly	1 set	
500	Pressuretight Packing	1 set	Option

14.4 Sizes 28, 29 and 31 Double-case Construction, 10K Type

14.4.1 Sizes 28, 29 and 31 Double-case Construction, 10K Type Exploded View



NOTE: Parts list appears on the next page.

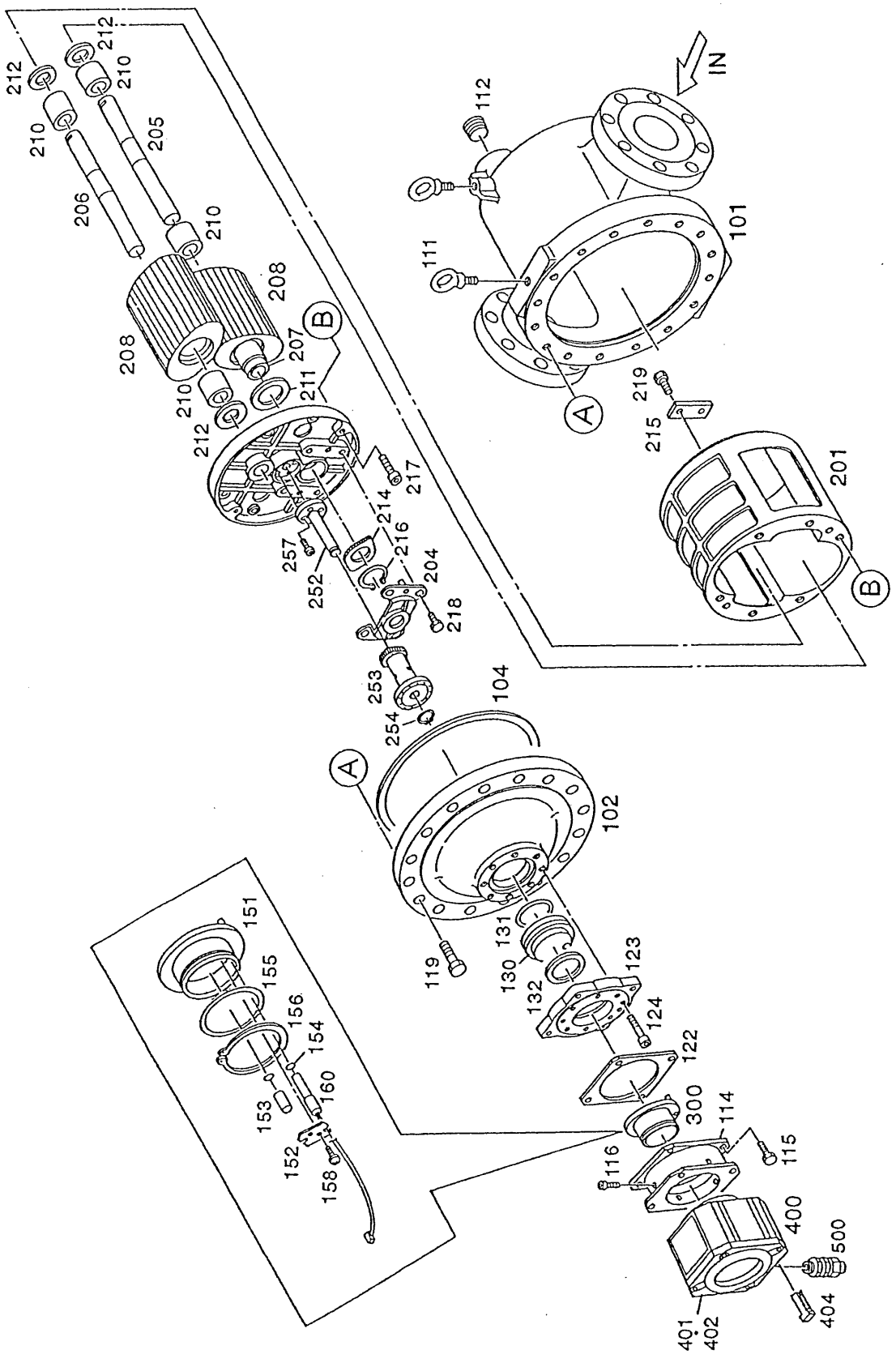
14.4.2 Sizes 28, 29 and 31 Double-case Construction, 10K Type Parts List

Symbol No.	Part Name	Size 28		Size 29		Size 31	
		Q'ty	Remarks	Q'ty	Remarks	Q'ty	Remarks
100	Outer Case Assembly	1 set		1 set		1 set	
101	Outer Case	1		1		1	
102	Front Cover	1		1		1	
▲104	Gasket, Outer Case Top Cover	1		1		1	
105	Blind Hole Gasket	1		1		1	
107	Gasket, Inner Case Bottom Cover	1		1		1	
111	Eyebolt	2	M10	1	M10	1	M10
112	Blind Plug	1		1		1	G1
114	Adapter	1		1		1	
115	Adapter Fitting Bolt	4	M10 × 20	4	M10 × 20	4	M10 × 20
116	Register Fitting Bolt	4	M6 × 12	4	M6 × 12	4	M6 × 12
119	Outer Case Top Cover Fitting Bolt	12	M16 × 65	12	M16 × 65	16	M16 × 60
122	Gasket	1		1		1	
123	Sealing Flange	1		1		1	
124	Hex Socket Head Bolt	8	M10 × 45	8	M10 × 45	8	M10 × 45
130	Sealing Plate	1		1		1	
▲131	O-Ring	1		1		1	
132	Sealing Plate Gasket	1		1		1	
200	Inner Case Assembly	1 set		1 set		1 set	
201	Inner Case	1		1		1	
202	Inner Case Top Cover	1		1		1	
203	Inner Case Bottom Cover	1		1		1	
204	Longer Shaft Holder	1		1		1	
205	First Rotor Shaft	1		1		1	
206	Second Rotor Shaft	1		1		1	
207	Uniform-motion Gear Boss	1		1		1	
※208	First Rotor	1		1		2	
※209	Second Rotor	1		1		-	-
※210	Rotor Bearing	4		4		4	
211	Thrust Ring A	1		1		1	
212	Thrust Ring B	3		3		3	
214	Uniform-motion Drive Gear	1		1		1	
215	Shaft Non-turn Strip	2		2		2	
216	Stop Ring	1		1		1	
217	Inner Case Top/Bottom Cover Fitting Bolt	12	M12 × 35	12	M12 × 35	12	M12 × 35
218	Longer Shaft Holder Fitting Bolt	4		4		4	M10 × 25
219	Shaft Non-turn Strip Fitting Screw	4		4		4	
223	Spring Washer	6	M12	6	M12	6	M12
252	Signal Magnet Shaft	1		1		1	
253	Signal Generating Magnet Assembly	1 set		1 set		1 set	
254	Stop Ring	1	C14	1	C14	1	C14
257	Signal Magnet Shaft Fitting Bolt	4	M5	4	M5	4	M5
300	Sensor Assembly	1 set	(151 to158, 160)				
151	Sensor Fitting Bracket	1					
152	Sensor Retainer	1					
153	Blind Plug	1					
154	O-Ring B	2	S10				
155	O-Ring C	1	G65				
156	C-shaped Stop Ring	1					
158	Cross Recess Pan Head Screw	2	M4 × 8 (with washer)				
160	Sensor Unit	1					
400	Register Assembly	1 set					
401	Register Cover	1					
402	Cover Fitting Bolt	4	M6				
404	Selector Magnet	1					
405	Internal Assembly	1 set					
500	Pressuretight Packing	1 set	Option				

※: Rotors and rotor bearings are matched pairs and are available as an assembly.
▲: Recommended spare parts.

14.5 Size 60 Double-case Construction 10K Type

14.3.1 Size 60 Single-case Construction, 10K Type, Exploded View



NOTE: Parts list appears on the next page.

14.5.2 Size 60 Double-case Construction 10K Type Parts List

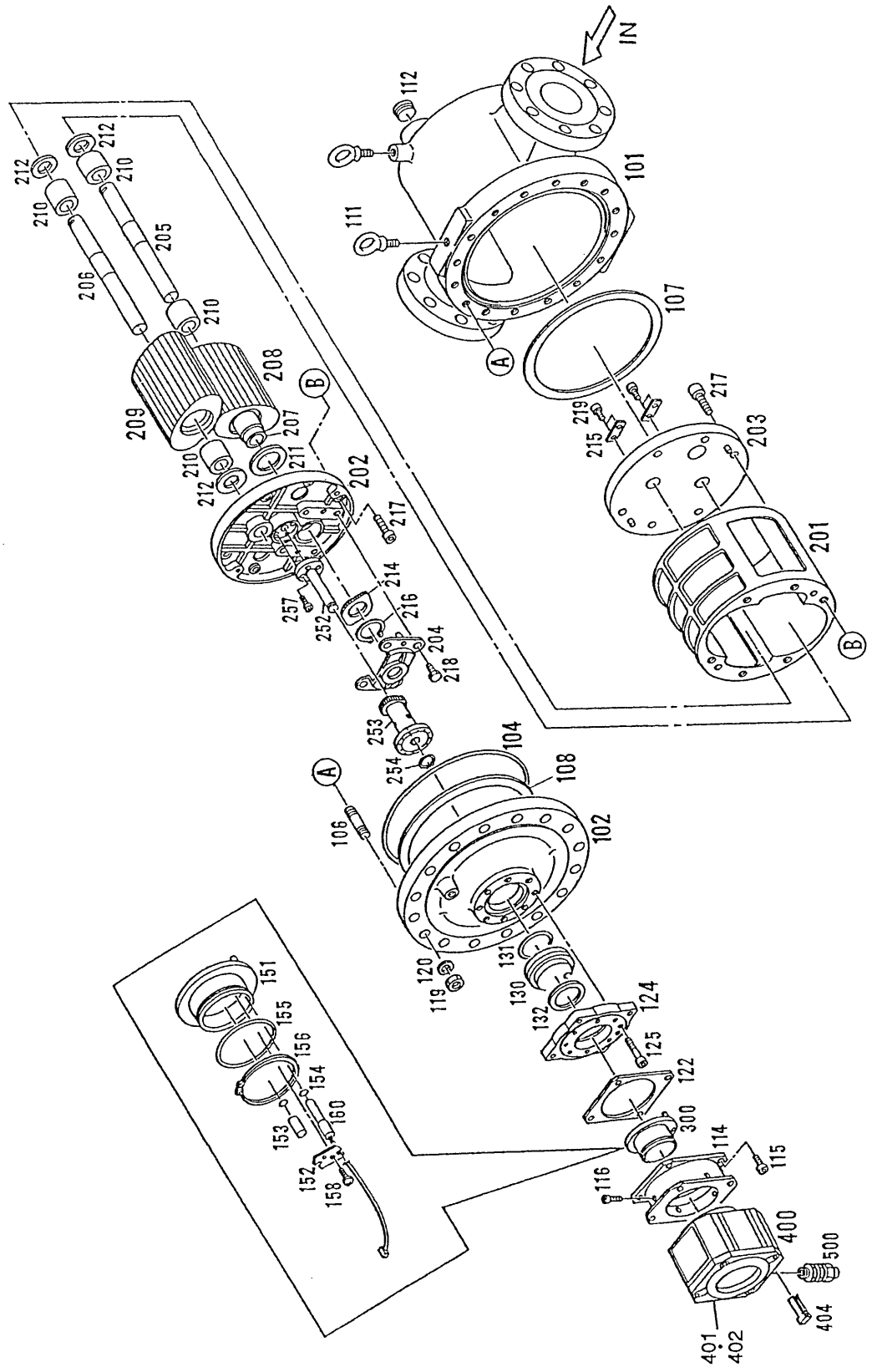
Symbol No.	Part Name	Q'ty	Remarks
100	Outer Case Assembly	1 set	
101	Outer Case	1	
102	Front Cover	1	
▲104	Gasket	1	
111	Eyebolt	2	
112	Blind Plug	2	R1
114	Adapter	1	
115	Adapter Fitting Bolt	4	M10 × 20
116	Register Fitting Bolt	4	M6 × 12
119	Outer Case Top Cover Fitting Bolt	16	M16 × 65
122	Gasket	1	
123	Sealing Flange	1	
124	Hex Socket Head Bolt	8	M10
130	Sealing Plate	1	
▲131	O-Ring	1	
132	Sealing Plate Gasket	1	
200	Inner Case Assembly	1 set	
201	Inner Case	1	
202	Inner Case Top Cover	1	
204	Longer Shaft Holder	1	
205	First Rotor Shaft	1	
206	Second Rotor Shaft	1	
207	Uniform-motion Gear Boss	1	
※208	Rotors	2	
※210	Rotor Bearing	4	
211	Thrust Ring A	1	
212	Thrust Ring B	3	
214	Uniform-motion Drive Gear	1	
215	Shaft Non-turn Strip	1	
216	Stop Ring	1	C42
217	Inner Case Top/Bottom Cover Fitting Bolt	4	M12 × 45
218	Longer Shaft Holder Fitting Bolt	4	M10 × 20
219	Shaft Non-turn Strip Fitting Screw	2	M10 × 15
252	Signal Magnet Shaft	1	
253	Signal Generating Magnet Assembly	1 set	
254	Stop Ring	1	
257	Signal Magnet Shaft Fitting Bolt	4	M5

Symbol No.	Part Name	Q'ty	Remarks
300	Sensor Assembly	1 set	(151 to 158, 160)
151	Sensor Fitting Bracket	1	
152	Sensor Retainer	1	
153	Blind Plug	1	
154	O-Ring B	2	S10
155	O-Ring C	1	G65
156	C-shaped Stop Ring	1	
158	Cross Recess Pan Head Screw	2	M4 × 8 (with washer)
160	Sensor Unit	1	
400	Register Assembly	1 set	
401	Register Cover	1	
402	Cover Fitting Bolt	4	M6
404	Selector Magnet	1	
405	Internal Assembly	1 set	
500	Pressuretight Packing	1 set	Option

※: Rotors and rotor bearings are matched pairs and are available as an assembly.
▲: Recommended spare parts.

14.6 Size 28, 29 and 31 Double-case Construction 30K Type (F3)

14.6.1 Size 28, 29 and 31 Double-case Construction, 30K Type (F3), Exploded View



NOTE: Parts list appears on the next page.

14.6.2 Size 28, 29 and 31 Double-case Const. 30K Type (F3) Parts List

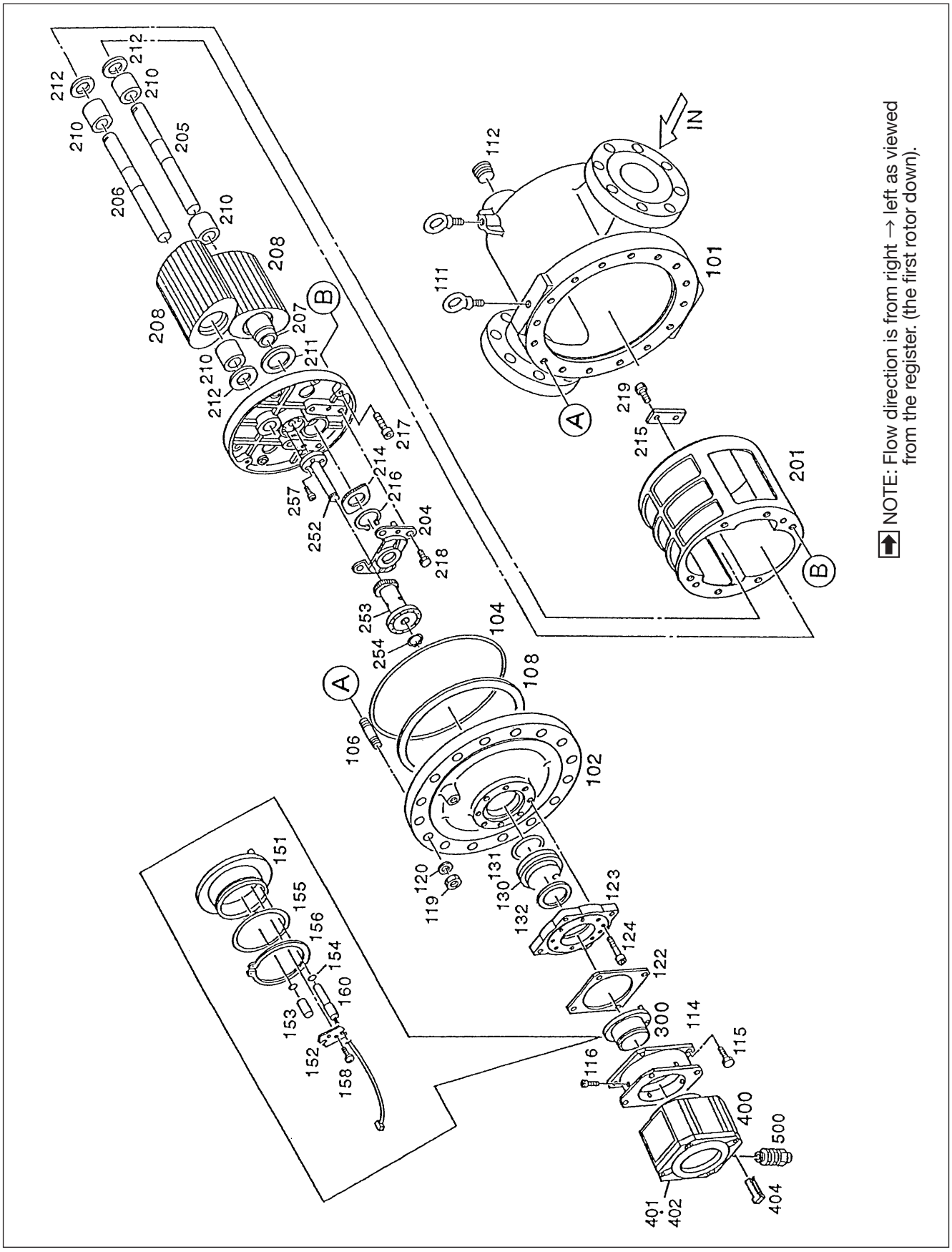
Symbol No.	Part Name	Q'ty	Remarks
100	Outer Case Assembly	1 set	
101	Outer Case	1	
102	Front Cover	1	
▲104	O-Ring	1	
106	Stud Bolt	16	
107	Gasket, Inner Case Bottom	1	
108	Gasket, Inner Case Top	1	
111	Eyebolt	2	
112	Blind Plug	2	R1
114	Adapter	1	
115	Adapter Fitting Bolt	4	
116	Register Fitting Bolt	4	M6
119	Outer Case Top Cover Fitting Bolt	16	
120	Washer	16	
122	Gasket	1	
124	Sealing Flange	1	
125	Hex Socket Head Bolt	8	M10
130	Sealing Plate	1	
▲131	O-Ring	1	
132	Sealing Plate Gasket	1	
200	Inner Case Assembly	1 set	
201	Inner Case	1	
202	Inner Case Top Cover	1	
203	Inner Case Bottom Cover	1	
204	Longer Shaft Holder	1	
205	First Rotor Shaft	1	
206	Second Rotor Shaft	1	
207	Uniform-motion Gear Boss	1	
※208	First Rotor	1	
※209	Second Rotor	1	
※210	Rotor Bearing	4	
211	Thrust Ring A	1	
212	Thrust Ring B	3	
214	Uniform-motion Drive Gear	1	
215	Shaft Non-turn Strip	2	
216	Stop Ring	1	C35
217	Inner Case Top/Bottom Cover Fitting Bolt	12	
218	Longer Shaft Holder Fitting Bolt	4	
219	Shaft Non-turn Strip Fitting Screw	4	M4
252	Signal Magnet Shaft	1	
253	Signal Generating Magnet Assembly	1 set	
254	Stop Ring	1	
257	Signal Magnet Shaft Fitting Bolt	4	M5

Symbol No.	Part Name	Q'ty	Remarks
300	Sensor Assembly	1 set	(151 to 158, 160)
151	Sensor Fitting Bracket	1	
152	Sensor Retainer	1	
153	Blind Plug	1	
154	O-Ring B	2	S10
155	O-Ring C	1	G65
156	C-shaped Stop Ring	1	
158	Cross Recess Pan Head Screw	2	M4 × 8 (with washer)
160	Sensor Unit	1	
400	Register Assembly	1 set	
401	Register Cover	1	
402	Cover Fitting Bolt	4	M6
404	Selector Magnet	1	
405	Internal Assembly	1 set	
500	Pressuretight Packing	1 set	Option

※: Rotors and rotor bearings are matched pairs and are available as an assembly.
▲: Recommended spare parts.

14.7 Size 60 Double-case Construction 30K Type (F3)

14.7.1 Size 60 Double-case Construction, 30K Type (F3), Exploded View



NOTE: Parts list appears on the next page.

14.7.2 Size 60 Double-case Construction 30K Type (F3) Parts List

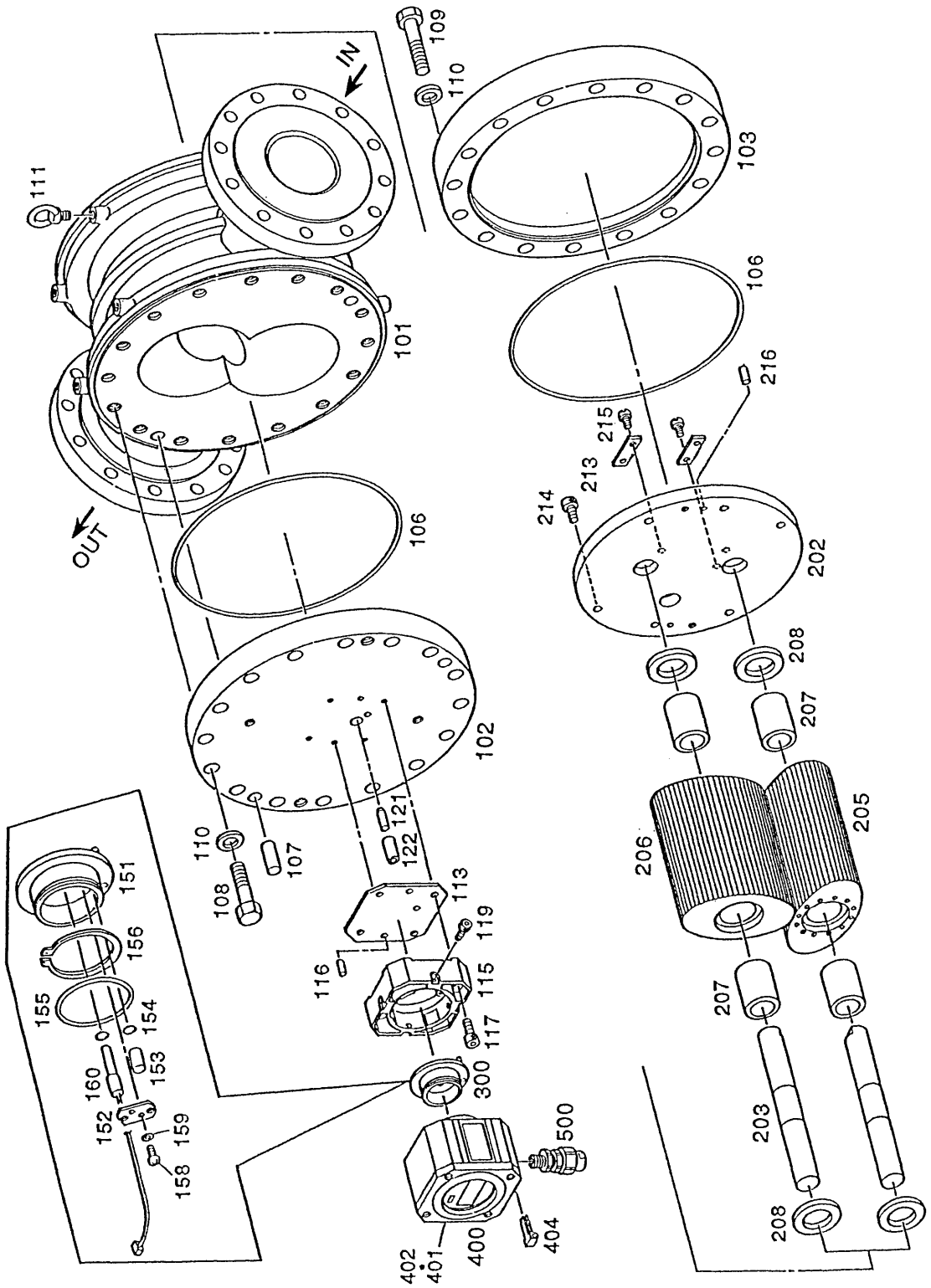
Symbol No.	Part Name	Q'ty	Remarks
100	Outer Case Assembly	1 set	
101	Outer Case	1	
102	Front Cover	1	
▲104	O-Ring	1	P320
106	Stud Bolt	16	M20 × 95
108	Gasket, Inner Case Top	1	
111	Eyebolt	2	M12 × 22
112	Blind Plug	2	R1
114	Adapter	1	
115	Adapter Fitting Bolt	4	M10 × 20
116	Register Fitting Bolt	4	M6 × 12
119	Outer Case Top Cover Fitting Bolt	16	M20
120	Washer	16	M20
122	Gasket	1	
123	Sealing Flange	1	
124	Hex Socket Head Bolt	8	M10
130	Sealing Plate	1	
▲131	O-Ring	1	
132	Sealing Plate Gasket	1	
200	Inner Case Assembly	1 set	
201	Inner Case	1	
202	End Plate	1	
204	Longer Shaft Holder	1	
205	First Rotor Shaft	1	
206	Second Rotor Shaft	1	
207	Uniform-motion Gear Boss	1	
※208	First Rotor	2	
※210	Rotor Bearing	4	
211	Thrust Ring A	1	
212	Thrust Ring B	3	
214	Uniform-motion Drive Gear	1	
215	Shaft Non-turn Strip	1	
216	Stop Ring	1	C42
217	Inner Case Top/Bottom Cover Fitting Bolt	4	M12 × 45
218	Longer Shaft Holder Fitting Bolt	4	M10 × 20
219	Shaft Non-turn Strip Fitting Screw	2	M10 × 15
252	Signal Magnet Shaft	1	
253	Signal Generating Magnet Assembly	1 set	
254	Stop Ring	1	
257	Signal Magnet Shaft Fitting Bolt	4	M5

Symbol No.	Part Name	Q'ty	Remarks
300	Sensor Assembly	1 set	(151 to 158, 160)
151	Sensor Fitting Bracket	1	
152	Sensor Retainer	1	
153	Blind Plug	1	
154	O-Ring B	2	S10
155	O-Ring C	1	G65
156	C-shaped Stop Ring	1	
158	Cross Recess Pan Head Screw	2	M4 × 8 (with washer)
160	Sensor Unit	1	
400	Register Assembly	1 set	
401	Register Cover	1	
402	Cover Fitting Bolt	4	M6
404	Selector Magnet	1	
405	Internal Assembly	1 set	
500	Pressuretight Packing	1 set	Option

※: Rotors and rotor bearings are matched pairs and are available as an assembly.
▲: Recommended spare parts.

14.8 Sizes 32 and 33 Single-case Construction

14.8.1 Size 32 and 33, Single-case Construction, Exploded View



NOTE: Flow direction is shown from right to left as Viewed from the register end.

NOTE: Parts list appears on the next page.

14.8.2 Sizes 32 and 33 Single-case Construction Parts List

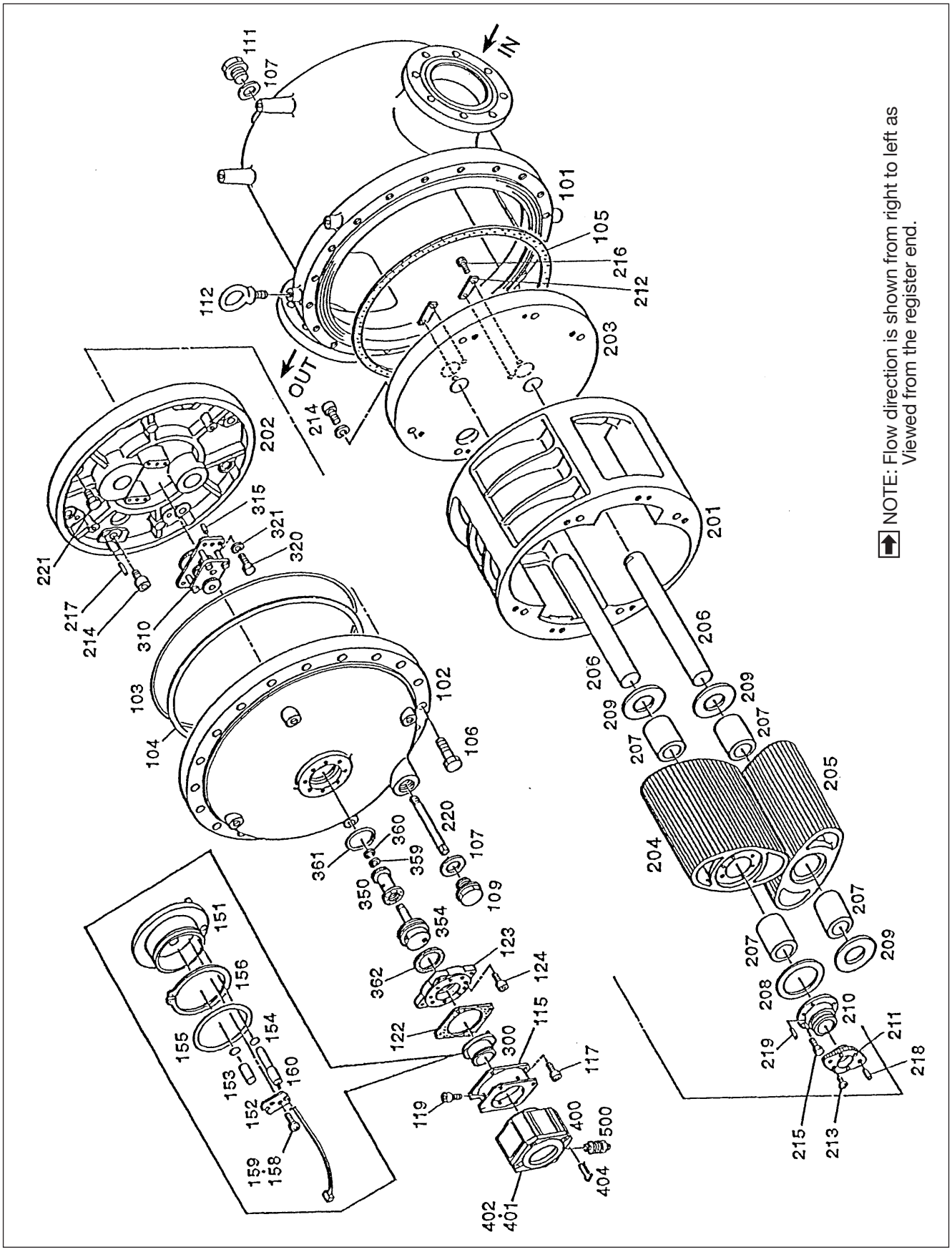
Symbol No.	Part Name	Q'ty	Remarks
100	Meter Body Assembly	1 set	
101	Meter Body	1	
102	Front Cover	1	
103	Rear Cover	1	
▲106	O-Ring	2	Size 32: 460 × ϕ8.4 Size 33: 535 × ϕ8.4
107	Locating Pin	2	
108	Front Cover Fitting Bolt	16	M24
109	Rear Cover Fitting Bolt	16	M24
110	Washer	32	M24
111	Eyebolt	4	M16
113	Gasket	1	
115	Adapter	1	
116	Adapter Locating Pin	2	
117	Adapter Fitting Bolt	4	M10
119	Register Fitting Bolt	4	M6
121	Iron Slug	1	
122	Spacer	1	
200	Inner Case Assembly	1 set	
202	Bottom Cover	1	
203	Rotor Shaft	2	
※205	1st Rotor	1	w/Signal magnets
※206	2nd Rotor	1	
※207	Rotor Bearing	4	
208	Thrust Ring	4	
213	Rotor Non-turn Piece	2	
214	Bottom Cover Fitting Bolt	6	M20
215	Flat Fillister Head Screw	4	M8
216	Locating Pin	2	

Symbol No.	Part Name	Q'ty	Remarks
300	Sensor Assembly	1 set	(151 to 160)
151	Sensor Fitting Disc	1	
152	Sensor Retainer	1	
153	Blind Plug	1	
154	O-Ring B	2	S10
155	O-Ring C	1	G65
156	C-shaped Stop Ring	1	
158	Pan Head Screw	2	M4
159	Washer	2	M4
160	Sensor Unit	1	
400	Register Assembly	1 set	
401	Register Cover	1	
402	Cover Fitting Bolt	4	M6
404	Selector Magnet	1	
405	Internal Assembly	1 set	
500	Pressuretight Packing	1 set	Option

※: Rotors and rotor bearings are matched pairs and are available as an assembly.
▲: Recommended spare parts.

14.9 Sizes 32 and 33 Double-case Construction 10K Type

14.9.1 Size 32 and 33 Double-case Construction 10K Type Exploded View



NOTE: Parts list appears on the next page.

14.9.2 Size 32 and 33 Double-case Construction 10K Type Parts List

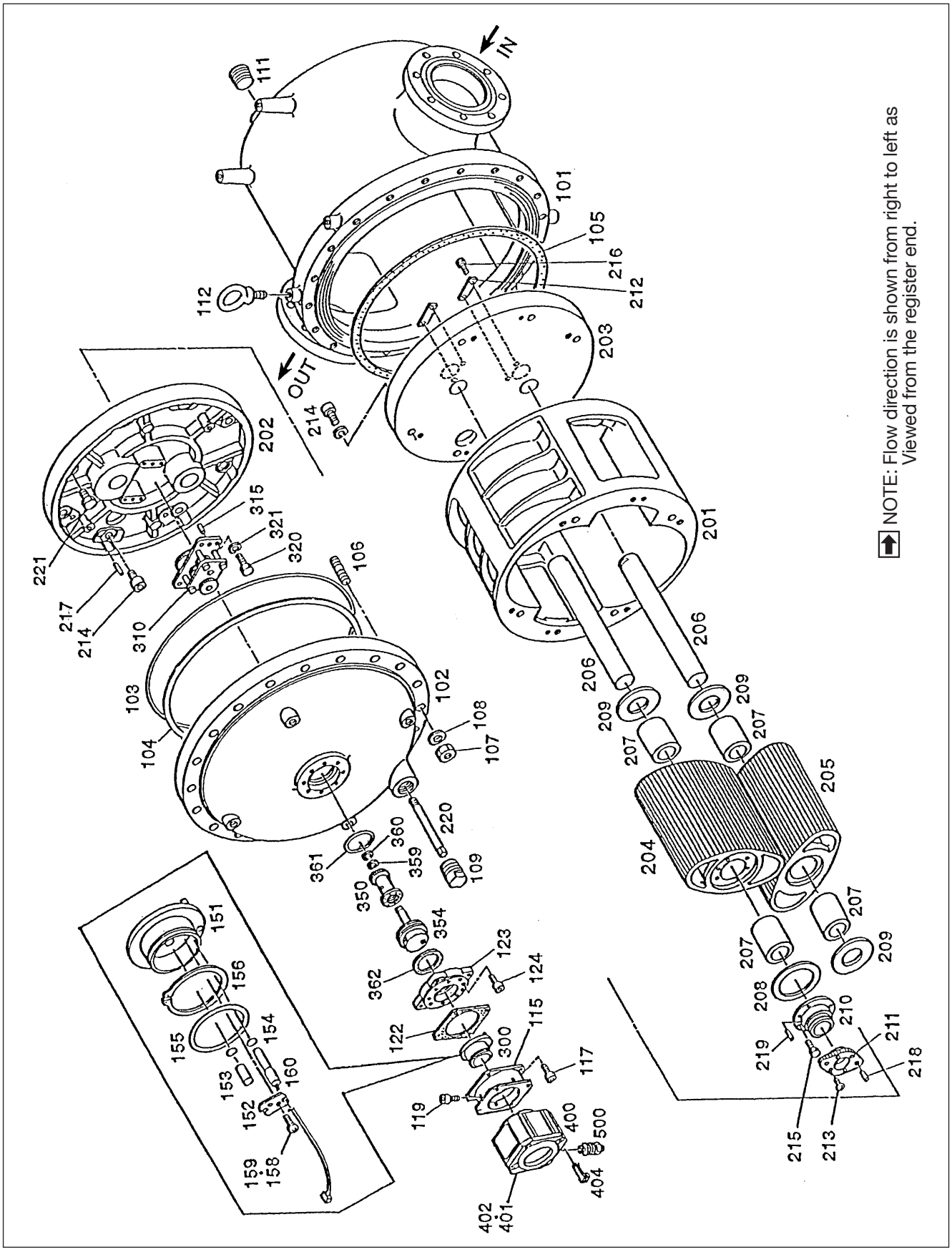
Symbol No.	Part Name	Q'ty	Remarks
100	Outer Case Assembly	1 set	
101	Outer Case	1	
102	Front Cover	1	
▲103	Front Cover Gasket	1	
104	Upr. Gasket, Inner Case	1	
105	Lwr. Gasket, Inner Case	1	
106	Hex Bolt	20	M20
▲107	Gasket	3	
109	Blind Hole Bolt	1	
111	Blind Hole Bolt	2	
112	Eyebolt	4	M16
115	Adapter	1	
117	Adapter Fitting Bolt	4	M10
119	Register Fitting Bolt	4	M6
122	Gasket	1	
123	Sealing Flange	1	
124	Fitting Bolt	8	M10
200	Inner Case Assembly	1 set	
201	Inner Case	1	
202	Top Cover, Inner Case	1	
203	Bottom Cover, Inner Case	1	
※204	1st Rotor	1	
※205	2nd Rotor	1	
206	Rotor Shaft	2	
※207	Rotor Bearing	4	
208	Thrust Ring A	1	
209	Thrust Ring B	3	
210	Unif. Motion Gear Boss	1	
211	Unif. Motion Drive Gear	1	
212	Shaft Non-turn Piece	2	
213	Unif. Motion Gear Screw	4	
214	Cover Fitting Bolt	12	W3/4
215	Bolt, Unif. Motion Gear	4	M10
216	Non-turn Piece Bolt	4	
217	Inner Case Locating Pin	4	
218	Pin, Unif. Motion Drive Gear	2	
219	Pin, Unif. Motion Gear	2	
220	Blind Hole Bolt Plug A	1	
221	Blind Plug	1	

Symbol No.	Part Name	Q'ty	Remarks
300	Sensor Assembly	1 set	(151 to 160)
151	Sensor Fitting Disc	1	
152	Sensor Retainer	1	
153	Blind Plug	1	
154	O-Ring B	2	S10
155	O-Ring C	1	G65
156	C-shaped Stop Ring	1	
158	Pan Head Screw	2	M4
159	Washer	2	M4
160	Sensor Unit	1	
310	Transmission Gear Train	1 set	
315	Pin	2	
320	Hex Bolt	4	
321	Spring Washer	4	
350	Signal Magnet Assembly	1 set	w/Signal magnet and transmission gear
354	Pressure Sealing Plate	1	
359	Thrust Spacer	1	
360	C-Ring	1	
▲361	O-Ring	1	
362	Sealing Plate Gasket	1	t0.4
400	Register Assembly	1 set	
401	Front Cover	1	
402	Cover Fitting Bolt	4	M6
404	Selector Magnet	1	
405	Internal Assembly	1 set	
500	Pressuretight Packing	1 set	Option

※: Rotors and rotor bearings are matched pairs and are available as an assembly.
▲: Recommended spare parts.

14.10 Sizes 32 and 33 Double-case Construction 30K (F3) Type

14.10.1 Size 32 and 33 Double-case Construct. 30K (F3) Type Exploded View



NOTE: Parts list appears on the next page.

14.10.2 Size 32 and 33 Double-case Construction 30K Type (F3) Parts List

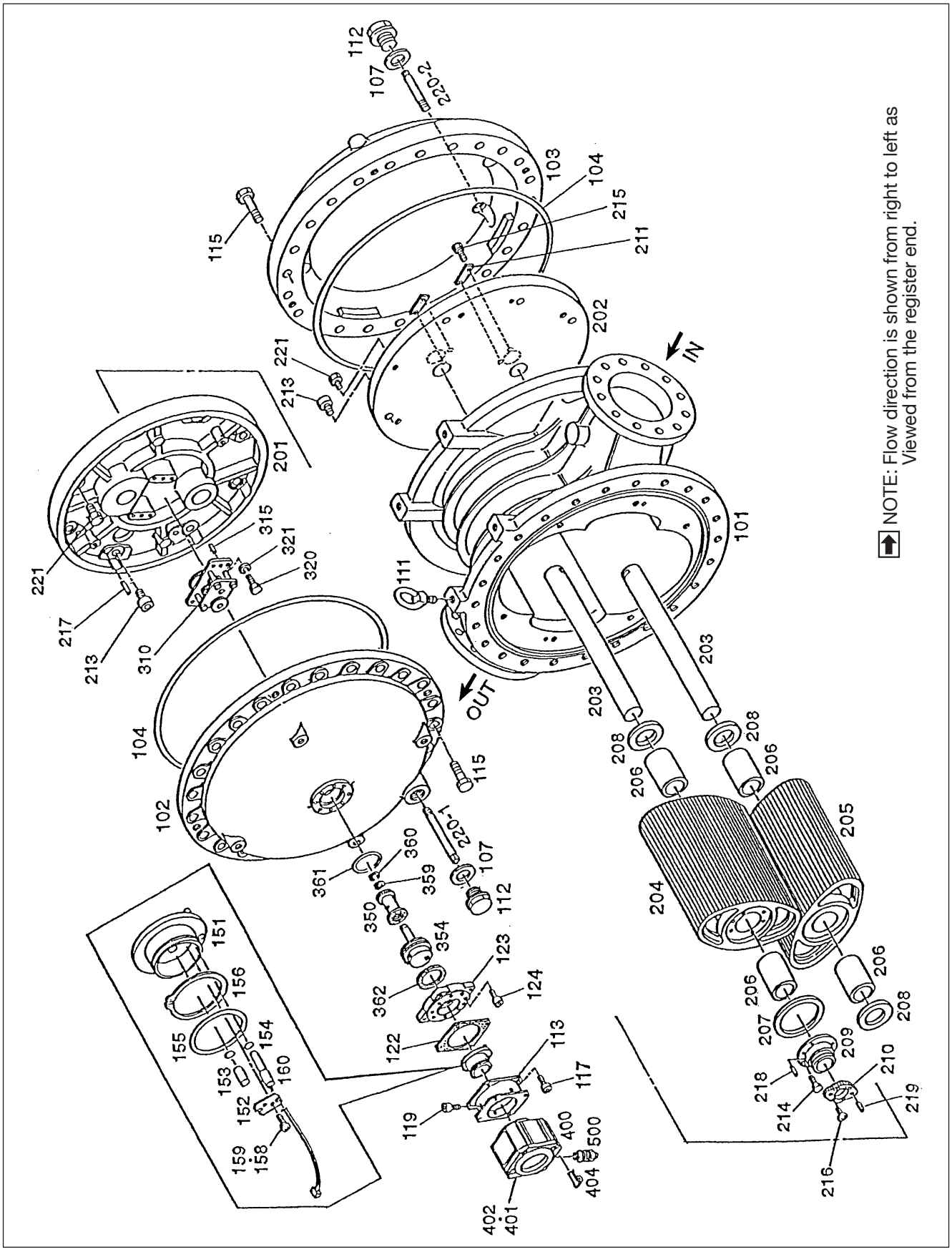
Symbol No.	Part Name	Q'ty	Remarks
100	Outer Case Assembly	1 set	
101	Outer Case	1	
102	Front Cover	1	
▲103	O-Ring	1	
104	Upr. Gasket, Inner Case	1	
105	Lwr. Gasket, Inner Case	1	
106	Front Cover Stud Bolt	20	M30
107	Nut, Stud Bolt	20	M30
108	Washer, Stud Bolt	20	M30
109	Blind Hole Bolt	1	
111	Blind Hole Bolt	2	
112	Eyebolt	4	M20
115	Adapter	1	
117	Adapter Fitting Bolt	4	M10
119	Register Fitting Bolt	4	M6
122	Gasket	1	
123	Sealing Flange	1	
124	Fitting Bolt	8	M10
200	Inner Case Assembly	1 set	
201	Inner Case	1	
202	Top Cover, Inner Case	1	
203	Bottom Cover, Inner Case	1	
※204	1st Rotor	1	
※205	2nd Rotor	1	
206	Rotor Shaft	2	
※207	Rotor Bearing	4	
208	Thrust Ring A	1	
209	Thrust Ring B	3	
210	Unif. Motion Gear Boss	1	
211	Unif. Motion Drive Gear	1	
212	Shaft Non-turn Piece	2	
213	Unif. Motion Gear Screw	4	
214	Cover Fitting Bolt	12	W3/4
215	Bolt, Unif. Motion Gear	4	M10
216	Non-turn Piece Bolt	4	
217	Inner Case Locating Pin	4	
218	Pin, Unif. Motion Drive Gear	2	
219	Pin, Unif. Motion Gear	2	
220	Blind Hole Bolt Plug A	1	
221	Blind Plug	1	

Symbol No.	Part Name	Q'ty	Remarks
300	Sensor Assembly	1 set	(151 to 160)
151	Sensor Fitting Disc	1	
152	Sensor Retainer	1	
153	Blind Plug	1	
154	O-Ring B	2	S10
155	O-Ring C	1	G65
156	C-shaped Stop Ring	1	
158	Cross Recess Pan Head Screw	2	M4
159	Washer	2	M4
160	Sensor Unit	1	
310	Transmission Gear Train	1 set	
315	Pin	2	
320	Hex Bolt	4	
321	Spring Washer	4	
350	Signal Magnet Assembly	1 set	w/Signal magnet and transmission gear
354	Pressure Sealing Plate	1	
359	Thrust Spacer	1	
360	C-Ring	1	
▲361	O-Ring	1	
362	Sealing Plate Gasket	1	t0.4
400	Register Assembly	1 set	
401	Front Cover	1	
402	Cover Fitting Bolt	4	M6
404	Selector Magnet	1	
405	Internal Assembly	1 set	
500	Pressuretight Packing	1 set	Option

※: Rotors and rotor bearings are matched pairs and are available as an assembly.
▲: Recommended spare parts.

14.11 Size 34 Single-case Construction 10K Type

14.11.1 Size 34 Single-case Construction, 10K Type Exploded View



NOTE: Parts list appears on the next page.

14.11.2 Size 34 Single-case Construction, 10K Type Parts List

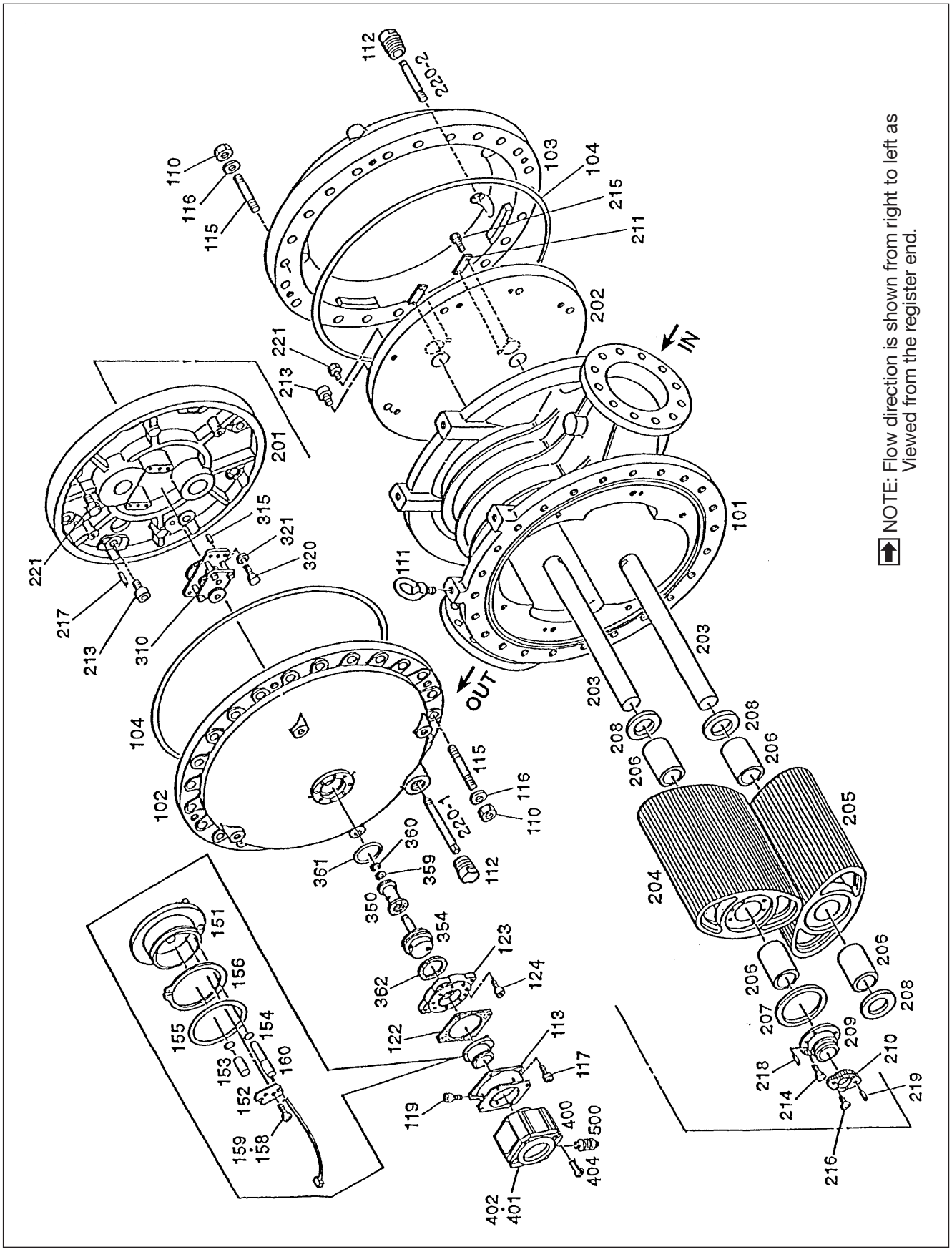
Symbol No.	Part Name	Q'ty	Remarks
100	Meter Body Assembly	1 set	
101	Meter Body	1	
102	Front Cover	1	
103	Rear Cover	1	
▲104	O-Ring	2	
▲107	Gasket	2	
111	Eyebolt	4	
112	Blind Hole Bolt	2	
113	Adapter	1	
115	Hex Bolt	48	
117	Adapter Fitting Bolt	4	M10
119	Register Fitting Bolt	4	M6
122	Gasket	1	
123	Sealing Flange	1	
124	Fitting Bolt	8	M10
200	Inner Case Assembly	1 set	
201	Top Cover	1	
202	Bottom Cover	1	
203	Rotor Shaft	2	
※204	1st Rotor	1	
※205	2nd Rotor	1	
※206	Rotor Bearing	4	
207	Thrust Ring A	1	
208	Thrust Ring B	3	
209	Unif. Motion Gear Boss	1	
210	Unif. Motion Drive Gear	1	
211	Shaft Non-turn Piece	2	
213	Cover Fitting Bolt	12	
214	Unif. Motion Gear Boss Bolt	4	
215	Shaft Non-turn Piece Bolt	4	
216	Unif. Motion Gear Screw	4	
217	Locating Pin	4	
218	Pin, Unif. Motion Gear Boss	2	
219	Pin, Unif. Motion Gear	2	
220-1	Blind Hole Bolt Plug A	1	
220-2	Blind Hole Bolt Plug B	1	
221	Blind Plug	2	

Symbol No.	Part Name	Q'ty	Remarks
300	Sensor Assembly	1 set	(151 to 160)
151	Sensor Fitting Disc	1	
152	Sensor Retainer	1	
153	Blind Plug	1	
154	O-Ring B	2	S10
155	O-Ring C	1	G65
156	C-shaped Stop Ring	1	
158	Cross Recess Pan Head Screw	2	M4
159	Washer	2	M4
160	Sensor Unit	1	
310	Transmission Gear Train	1 set	
315	Pin	2	
320	Hex Bolt	4	
321	Spring Washer	4	
350	Signal Magnet Assembly	1 set	w/Signal magnet and transmission gear
354	Pressure Sealing Plate	1	
359	Thrust Spacer	1	
360	C-Ring	1	
▲361	O-Ring	1	
362	Sealing Plate Gasket	1	t0.4
400	Register Assembly	1 set	
401	Front Cover	1	
402	Cover Fitting Bolt	4	M6
404	Selector Magnet	1	
405	Internal Assembly	1 set	
500	Pressuretight Packing	1 set	Option

※: Rotors and rotor bearings are matched pairs and are available as an assembly.
▲: Recommended spare parts.

14.12 Sizes 34 Single-case Construction 30K (3F) Type

14.12.1 Size 34 Single-case Construct. 30K (3F) Type Exploded View



NOTE: Parts list appears on the next page.

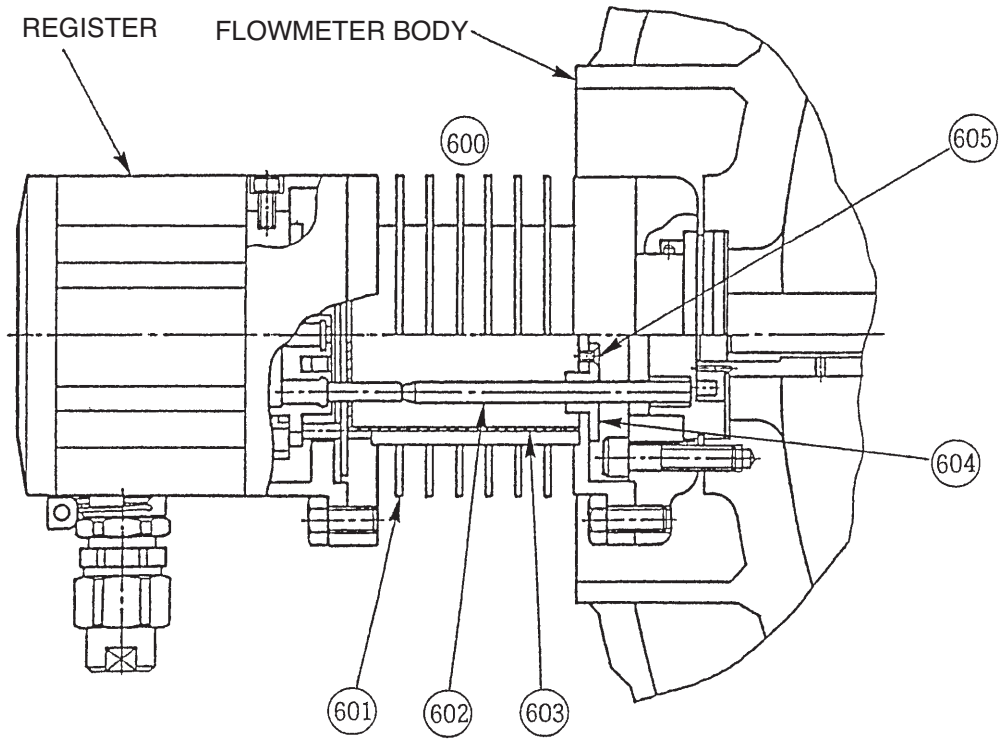
14.12.2 Size 34 Single-case Construction, 30K Type (3F) Parts List

Symbol No.	Part Name	Q'ty	Remarks
100	Meter Body Assembly	1 set	
101	Meter Body	1	
102	Front Cover	1	
103	Rear Cover	1	
▲104	O-Ring	2	
110	Nut, Cover Stud Bolt	48	
111	Eyebolt	4	
112	Blind Hole Bolt	2	
113	Adapter	1	
115	Cover Stud Bolt	48	
116	Washer, Cover Stud Bolt	48	
117	Adapter Fitting Bolt	4	M10
119	Register Fitting Bolt	4	M6
122	Gasket	1	
123	Sealing Flange	1	
124	Fitting Bolt	8	M10
200	Inner Case Assembly	1 set	
201	Top Cover	1	
202	Bottom Cover	1	
203	Rotor Shaft	2	
※204	1st Rotor	1	
※205	2nd Rotor	1	
※206	Rotor Bearing	4	
207	Thrust Ring A	1	
208	Thrust Ring B	3	
209	Unif. Motion Gear Boss	1	
210	Unif. Motion Drive Gear	1	
211	Shaft Non-turn Piece	2	
213	Cover Fitting Bolt	12	
214	Bolt, Unif. Motion Gear Boss	4	
215	Non-turn Piece Bolt	4	
216	Unif. Motion Gear Screw	4	
217	Locating Pin	4	
218	Pin, Unif. Motion Gear Boss	2	
219	Pin, Unif. Motion Gear	2	
220-1	Blind Hole Bolt Plug A	1	
220-2	Blind Hole Bolt Plug B	1	
221	Blind Plug	2	

Symbol No.	Part Name	Q'ty	Remarks
300	Sensor Assembly	1 set	(151 to 160)
151	Sensor Fitting Disc	1	
152	Sensor Retainer	1	
153	Blind Plug	1	
154	O-Ring B	2	S10
155	O-Ring C	1	G65
156	C-shaped Stop Ring	1	
158	Cross Recess Pan Head Screw	2	M4
159	Washer	2	M4
160	Sensor Unit	1	
310	Transmission Gear Train	1 set	
315	Pin	2	
320	Hex Bolt	4	
321	Spring Washer	4	
350	Signal Magnet Assembly	1 set	w/Signal magnet and transmission gear
354	Pressure Sealing Plate	1	
359	Thrust Spacer	1	
360	C-Ring	1	
▲361	O-Ring	1	
362	Sealing Plate Gasket	1	t0.4
400	Register Assembly	1 set	
401	Front Cover	1	
402	Cover Fitting Bolt	4	M6
404	Selector Magnet	1	
405	Internal Assembly	1 set	
500	Pressuretight Packing	1 set	Option

※: Rotors and rotor bearings are matched pairs and are available as an assembly.
▲: Recommended spare parts.

15. COOLING TUBE (double-case construction meter)



Symbol No.	Part Name	Quantity	Remarks
600	Cooling Tube Assembly	1 set	(601 to 605)
601	Cooling Tube	1	
602	Iron Slug	1	
603	Screen	1	
604	Iron Slug Holder	1	
605	Screw, Iron Slug Holder	3	M4

16. GENERAL SPECIFICATIONS

Meter Size		28*	29, 31, 60	32*, 33*	34
Local Indicator (LCD) Mode Select	Accumulated total, 8-digit units of measurement	×0.1L (standard)	× 1L (standard)	× 1L (standard)	× 10L (standard)
	Instantaneous flowrate (b mode)	× 1L/h, ×10 L/h	×10L/h, ×100 L/h	×10L/h, ×100 L/h	×100L/h, ×1000 L/h
	% instantaneous flowrate (P mode)	0 to 100%			
	Bargraph mode	8-segment bargraph			
Output	Analog	0 to FS, : 4 to 20mA		➡ NOTE: One of them is chosen.	
	Current pulse (scaled)	0/1: 4/20mA			
	Current pulse (unscaled)	0/1: 4/20mA			
	Open collector scaled pulse	Open collector Max. allowable voltage: 30V DC Allowable current: 50mA		➡ NOTE: One of them is chosen.	
	Open collector unsealed pulse				
	Open collector alarm output				
	Open collector FWD/ REV flow discrimination				
Output Pulse Width (ON duration)		1 ms (standard) 1 ms to 1000 ms (resolution 1 ms) (Notes 2 and 3)			
Power Supply		12 to 45 VDC Acceptable load resistance range appears on page 14.			
Signal Transmission Cable		Shielded cable 1.25 mm^2 Transmission length one kilometer (cable O.D. 8.5 to 12 mm) (Notes 1)			
Operating Temperature Range		-10 to +50 °C (Register alone -10 to +60 °C)			
Construction		Explosionproof TIIS: Exd II BT4 Explosionproof KOSHA: Exd II BT4			
		Non-explosionproof construction			
Housing Material		Aluminum die casting			
Finish		Munsell 2.5PB 5/8, baked			

➡ NOTE: 1. For wiring of explosionproof type (output available models), do not fail to use the ancillary pressure-resistant packing. Also, in case of TIIS explosionproof type used under the ambient temperature of 50°C or higher, use a cable resistant to the temperature of 70°C or higher.
2. If pulse width in excess of 1ms is desired for minimum factored pulse unit, the max. flowrate can possibly be restricted; consult the factory.
3. With meter size marked *, if standard factored pulse unit is selected, pulse width other than 1ms is unacceptable.

•Nominal Meter Factors

Meter Size	Number of pulses, P/r	Nominal Meter Factor, L/P	Cycle Sample Number
28	12	0.13516	24
29	12	0.19863	
60	12	0.3389	
31	12	0.6295	
32	12	0.9927	24
33	12	1.4907	
34	12	3.260	

NOTE: For outline dimensions and pipeline connection dimensions, see approval drawing.

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