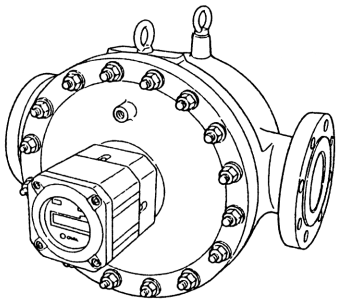
OVAL INSTRUCTIONS

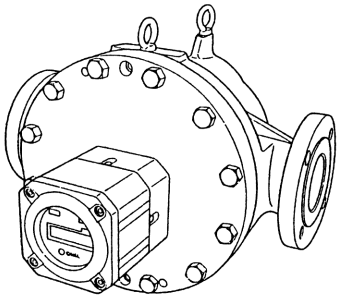
Ins. No. B-317-13-E

ULTRA OVAL

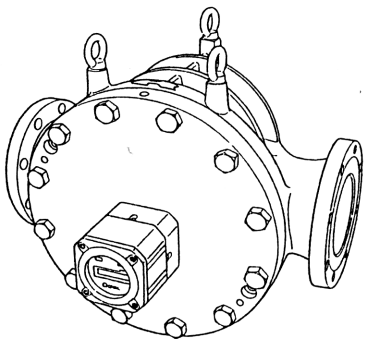
Meter Sizes 28, 29, 60 & 31
32, 33 & 34
Register type UA



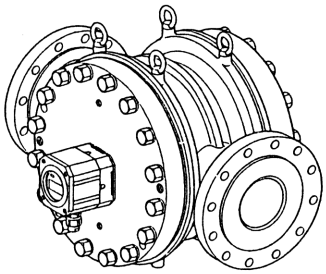
Meter sizes 28, 29, 60 and 31
double-case construction



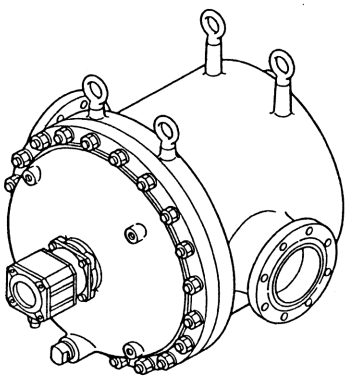
Meter size 29
single-case construction



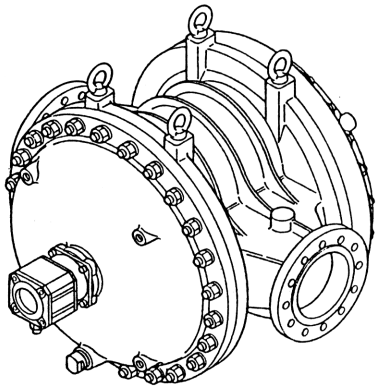
Meter sizes 60 and 31
single-case construction



Meter sizes 32 and 33
single-case construction



Meter sizes 32 and 33
double-case construction



Meter size 34
single-case construction

Every 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 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 OVAL product is thoroughly inspected and tested before it leaves the factory. When received, carefully inspect it for any indication of shipping damage. Necessary handling precautions are described in this section; read the instructions carefully.

As for other information, find the respective section from “CONTENSTS” on pages 2 and 3.

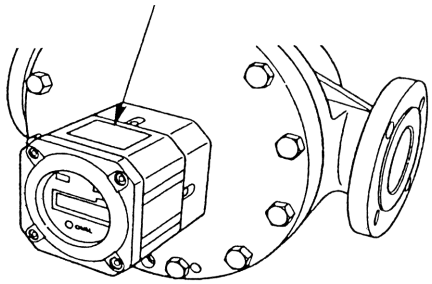
For any inquiries, call the sales office from which you purchased the product, or contact the nearest OVAL representative in our customer service network.

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

1.1 Confirming the Nameplate

Every OVAL flowmeter is assembled and adjusted according to individual specifications. Product code and ratings are stated on the nameplate of the register housing. Make sure that, by referring to the GENERAL SPECIFICATIONS, the product you received is fully in compliance with your order.

Nameplate (Ratings shown)



1.2 Transportation Considerations

(1) To prevent unexpected problems, transport the flowmeter to the installation site using the original manufacturer’s packing for shipment 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

Storing the OVAL flowmeter for long periods of time upon receipt before installation can result in unexpected and undesirable conditions. When long-term storage is anticipated, take the following precautions:

(1) Your OVAL flowmeter can best be stored in the manufacturer’s original packing used for shipping if possible.
(2) Place of storage should conform to the following requirements:
★ Location free from rain and water.
★ Location free from vibration and impact shocks.
★ At room temperature with minimal temperature and humidity variation (around 25°C and 65% R.H.).
(3) Purge the OVAL flowmeter that has once been placed in service with clean air, N2 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 Structural Considerations

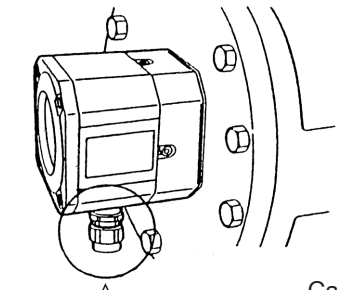
(1) The register is designed for outdoor use with waterproof configuration.
(2) Do not install substitute parts or perform any unauthorized modification to the instrument, or it will nullify the warranty.
(3) The cable lead-in supplied with the explosionproof type forms part of the flameproof configuration. Do not attempt to use any substitute lead-in other than those supplied. Also tighten the union of pressuretight packing firmly upon completion of wiring connections.
- Output provided: Other than 00 in the last two digits of product code ..... Pressuretight packing is supplied .
- Output not provided: 00 in the last two digits of product code ..... Close-up plug is supplied.

(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

⚠ CAUTION:
Moisture intrusion into the register will present a fogging-up display window and performance problem.

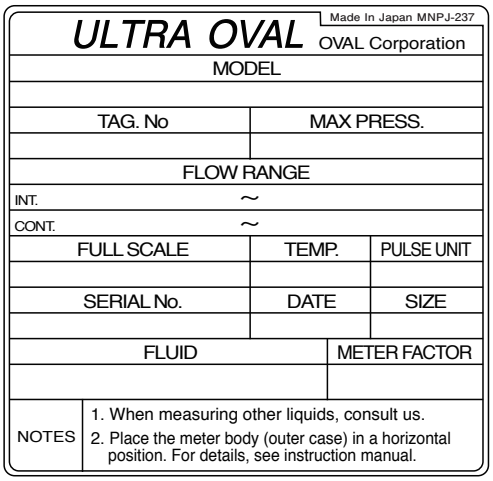


➡ NOTE: Cable gland is not supplied with non-explosionproof type models. The customer is to prepare a watertight gland (thread size: G1/2). In such a case, provide means to preclude moisture from the register.

2. OPERATING CONDITIONS

To maintain the stated high accuracy and long service life of 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.
(3) This flowmeter is not provided with subtract function. If pulsation in the flow (where the fluid moves back and forth in the pipeline under the influence of pressure) or reversal of flow exists, the total counter may show erratic reading, accumulating all incoming pulses irrespective of flow direction.



⚠ CAUTION: Uncertified flowmeters need to be certified by a certifying agency before use for commercial purposes or in certifying transactions under the measurement law. (A certificate label appears on top of the flowmeter register.)

2.1 Operating Conditions for Explosionproof Model

This product is approved as explosionproof. Failure to comply with the following conditions will automatically nullify this rating.

(1) Do not perform any unauthorized modification to this product.
(2) Before opening the enclosure, if necessary for some reason, ensure safety against hazards associated with flammable gases present in the atmosphere.
(3) In case of TIIS explosionproof type used under the ambient temperature of 45°C or higher, use a cable resistant to the temperature of 75°C or higher.
(4) Intrinsically safe rating remains valid only when no external circuit is connected to this equipment. To use it rated intrinsically safe, do not connect it to any external circuitry.
(5) Use under ambient temperature conditions below 60℃ .
(6) Metered fluid temperature must be held within the allowed temperature range.

Specification (1): Output provided (Product code ends with a code other than 00.)

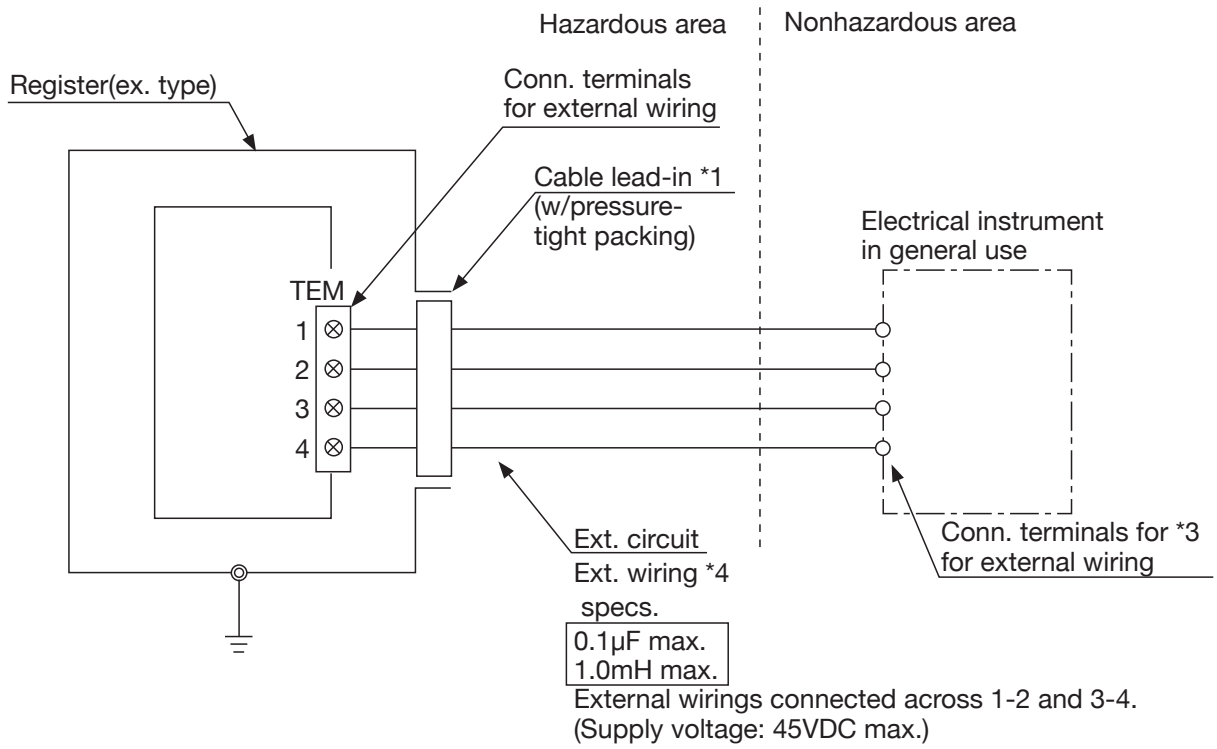


Fig. 2.1

Specification (2): Output not provided (Product code ends in 00.)

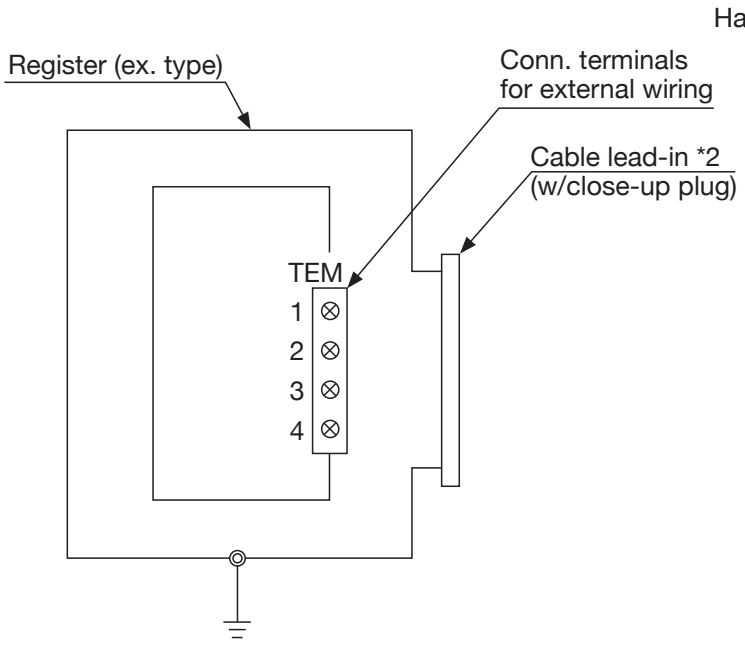


Fig. 2.2

➡ NOTE: Detailed explanation of asterisks *1 through *4 in Figs. 2.1 and 2.2.

*1 *3 *4	Explosionproof enclosure of the ex. type equipment is represented by a code Exd IIB T4/Exia IIB T4. For models with the provision of output (product code ends with a code other than 00), a pressuretight packing *1 for cable entry is supplied as standard accessory. Flameproof rating (Exd IIB T4) remains valid as long as it is used in place. However, because of a built-in battery pack, if supply power is removed from this state and an external circuitry *3 is disconnected at the external circuit wiring connection terminals end, then intrinsic safety rating (Exd IIB T4) applies.
*2	For models with no provision of output (product code ends with 00), close-up plugs *2 (manufactured by Shimada Electric, Model SBP-16) for cable entry are supplied as standard accessories. Intrinsically safe rating (Exia IIB T4) remains valid as long as these are used in place.
*4	In working with models with provision of output (product code ends with a code other than 00), use cables that link this product with an electrical instrument in general use (receiving instrument, etc.) which meet the following requirements: • Temperature rating: In case of TIIS explosionproof type used under the ambient temperature of 45°C or higher, • use a cable resistant to the temperature of 75°C or higher. • Electrical ratings: Allowable cable capacitance 0.1μF max. Allowable cable inductance 1.0mH max.

3. GENERAL DESCRIPTION

ULTRA OVAL has been developed to meet the needs of accurate flowrate measurement.
The local direct-reading total counter is an all-electronic register built around a single-chip CPU. With latest electronic technologies used throughout, this versatile register displays accumulated total flow, instant 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

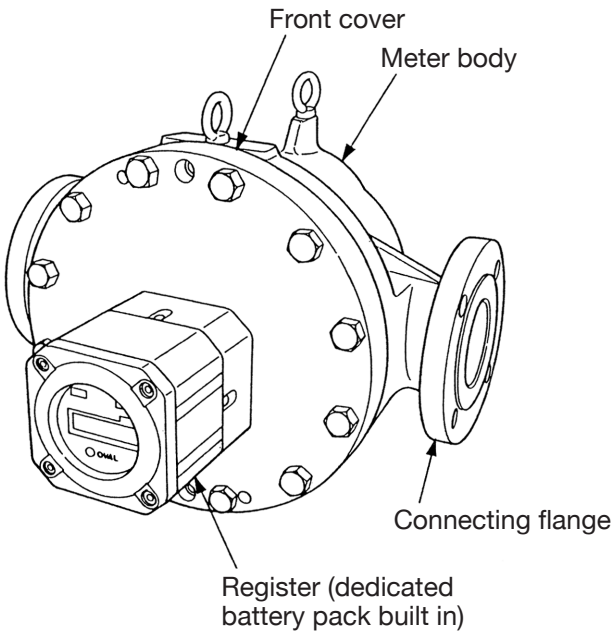
(1) Absence of any mechanically sliding components except for oval rotors contributes to long service life.
(2) The fewest possible number of wetted parts and pocketless design make this meter ideally suited for flow measurement of chemical liquids.
(3) You can monitor accumulated total flow and instant flowrate locally on the digital display.
(4) When coupled with a remotely located receiving instrument, output signals can readily and simply be used for control, adjustment, recording applications, etc.
(5) Explosionproof configuration offers increased safety.
(6) A nonvolatile memory retains variables in cases of power cycling and power failure.
(7) Features an alarm indicator, including low battery alarm.

➡ NOTE: See Section 9.4 on page 19.

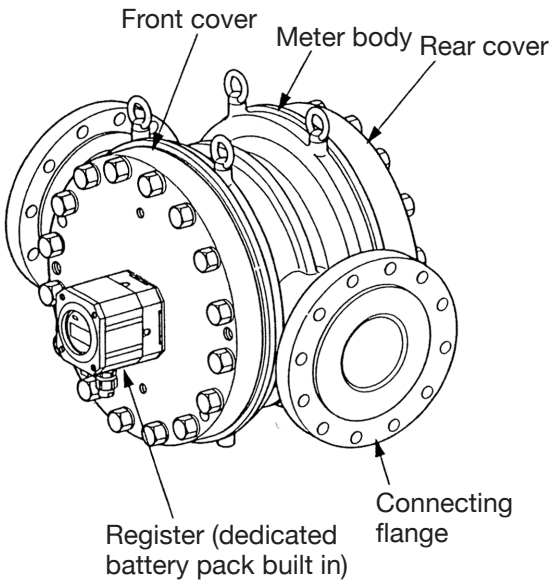
⇒**NOTE: With the use over an extended period of time, meter error will deviate more or less from the initial point. Upon request, we may conduct an instrumental error testing once again and establish a "new meter factor" in the scaler when your Ultra Oval is returned to the factory for periodic inspection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

4. PART NAMES

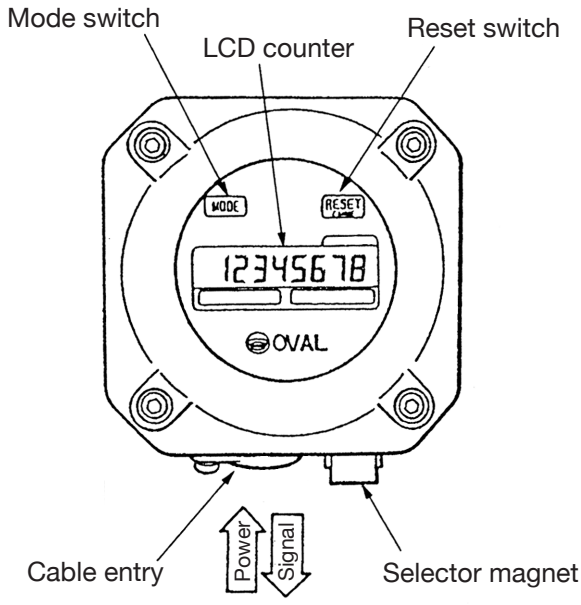
Meter sizes 28, 29, 60 and 31

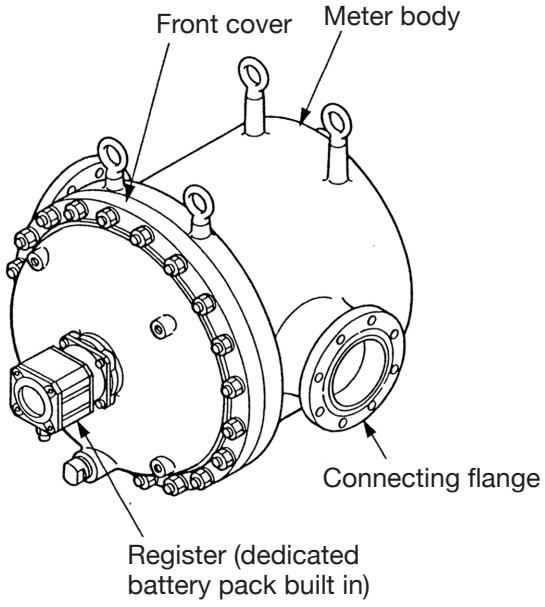


Meter sizes 32, 33 and 34 single-case construction



Meter sizes 32 and 33 double-case construction





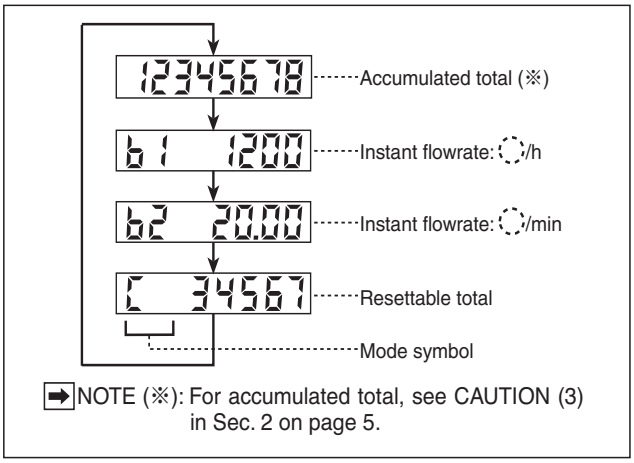
Cable gland for
explosionproof type (option)

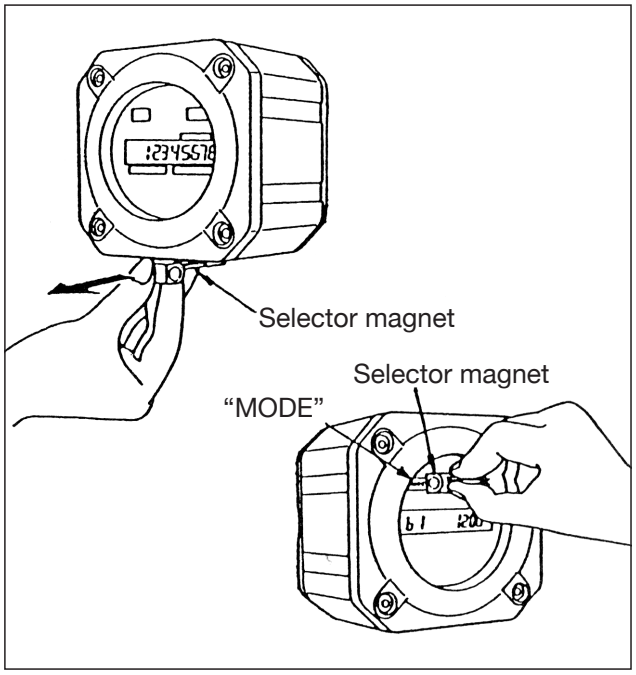
Fig. 4.1

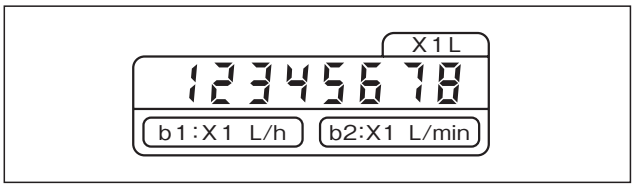
5. LCD COUNTER DISPLAY

5.1 “MODE” Switch

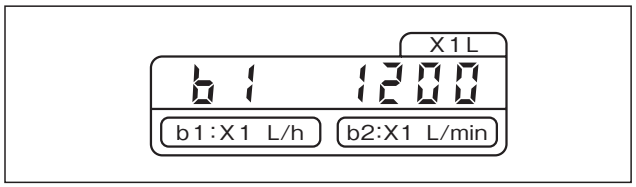
Removing the selector magnet housed at the bottom of the register, hold it close to the area labeled “MODE” or “RESET” on the LCD counter face and the display will scroll forward through available variables as shown.



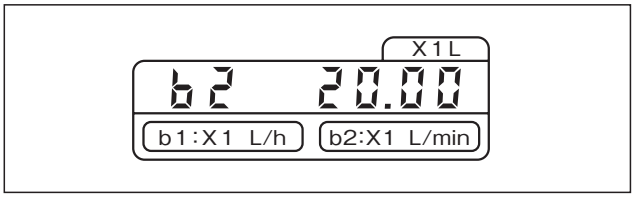




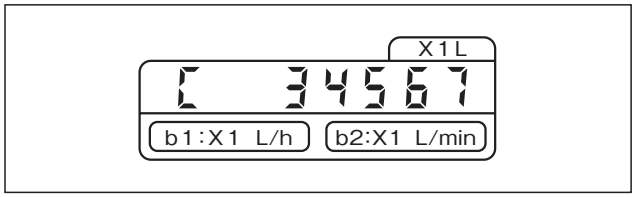
① **Accumulated Total Flow**
An accumulated total of 12345678 L is shown here.



② **Instant Flowrate (b1)**
An instant flowrate of 1200 L/h is shown here.



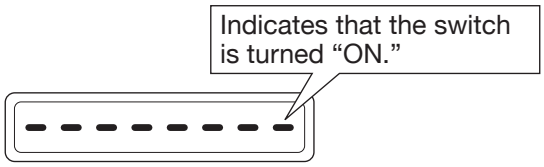
③ **Instant Flowrate (b2)**
An instant flowrate of 20.00 L/min. is shown here.



④ **Resettable Total Flow**
A resettble total of 34567 L is shown here.

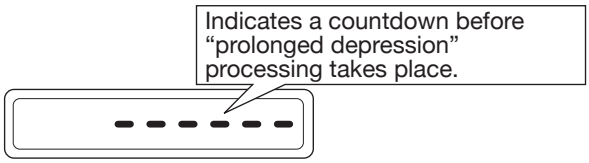
5.2 Displayed Messages during Operation

① Ordinary operation
"MODE" switch is turned "ON"
(selector magnet held close to it.)
⇒ 8 bars appear.



⇒ Immediately turning "OFF" moves the window to the next one.

② Prolonged operation
Held turned ON without turning "OFF" immediately by removing the fingers.
⇒ Bars begin to disappear from the leftmost one.



⇒ Holding turned ON until the last bar disappears results in "prolonged depression" processing (※). The same behavior appears (※) to takes place. (Turning OFF before the last bar disppears results in the same behavior as in ① to take place.)

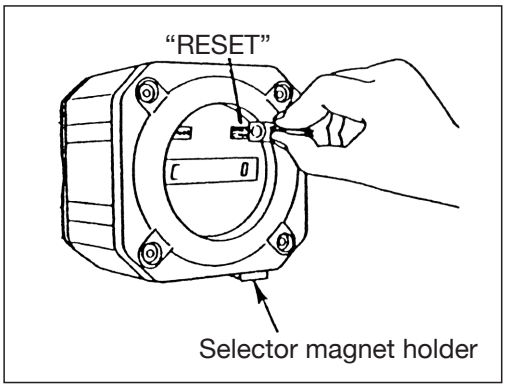
※ Prolonged operation: An operation required for Normal mode ⇔ Parameter review mode selection or finalizing the parameter setting, etc.

➡ NOTE: While RESET switch is in a valid mode (resettable total mode, etc.), the same message as stated above appears in response to RESET switch operation.
(There is no distinction between ordinary depression and prolonged depression, however.)

5.3 "RESET" Switch

Only in the resettable mode, or in "Mode Symbol: C ", the accumulated total is resettable.

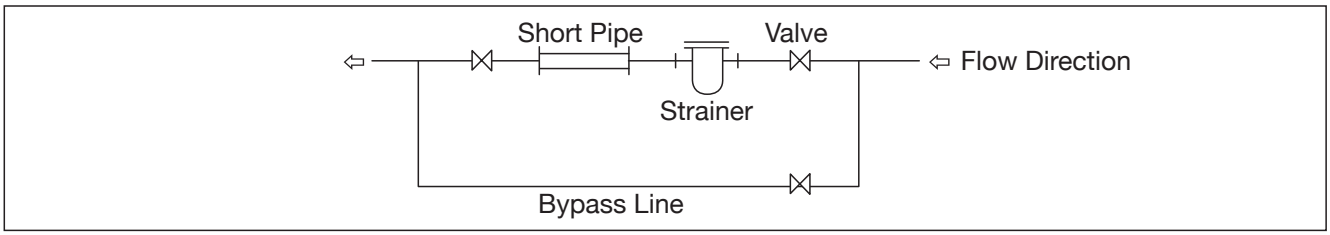
⚠ **CAUTION: Do not fail to install the selector magnet in its holder after use, and please be careful not to lose it. It uses an intensive magnet; never hold it close to floppy disks or other magnetic storage items.**



6. INSTALLATION

6.1 Considerations at Installation

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

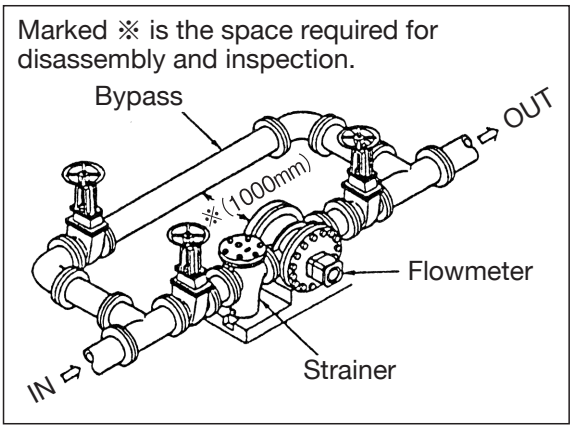


(2) Upon completion of flushing, install the meter in the piping assembly carefully in a way that willl not distort the piping.
(3) The meter must be installed on the outlet side of the pump.
(4) If the meter is to be used under tank head, give a head pressure larger than the total pressure loss of the piping system, strainer, meter, etc.
⇒ NOTE: Pressure losses of OVAL flowmeter and strainer are shown on the product general specifications.
(5) Meter installation is correct if the flow direction conforms to the arrow mark on the meter body.
(6) The strainer is to be located upstream of, and as close to, the meter as possible.
(7) Since the sensing element of the OVAL flowmeter detects the change of magnetic flux density, it must be isolated from the influence of any external magnetic flux. In order to prevent the possible influence of external magnetic flux, the meter should be located at least 5 meters 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 the register and its adapter.

● Shown below are standard installations for this meter

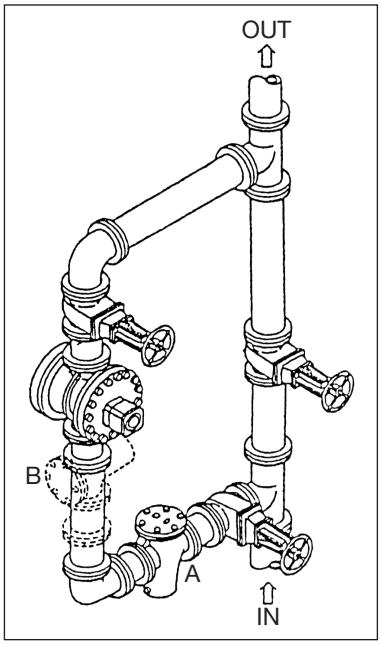
6.2 Standard Installation, Horizontal Line

(1) If the flow direction is from right to left, change places of meter and strainer.
(2) Arrange piping so as to facilitate drainage.
(3) Strainer should be inspected regularly.



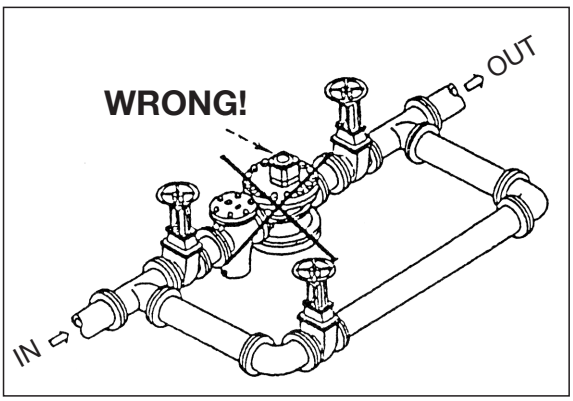
6.3 Standard Installation, Vertical Line

(1) If the flow direction is from top to bottom, change places of meter and strainer.
(2) Locating the strainer at position B makes servicing the net difficult; locating it at position A is therefore suggested.



6.4 Example of Incorrect Installation

Do not install the meter in a position like this.



NOTE: For outline dimensions and connecting pipe dimensions, refer to the approval drawing.

⚠ **CAUTION**

6.5 Piping Instructions and Operating Precautions of Jacketed Meters

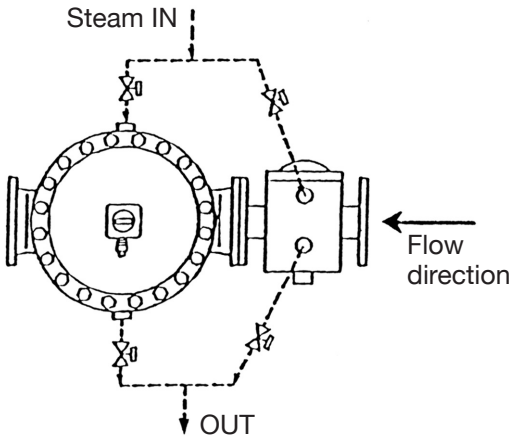
◆ **Hot water or steam jacketed meters require piping work in the following manner:**

(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

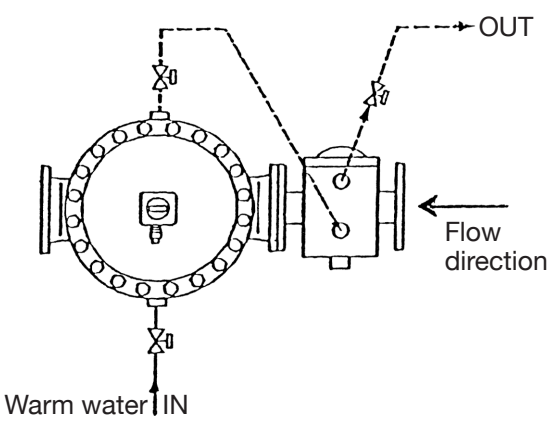
Basically, the piping should be so arranged that steam flows from the top and leaves from the bottom. Provide steam traps at outlet ports (see figure below).



◊ **Steam Jacketed, Horizontal Line** ◊

Hot-water Jacketed

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



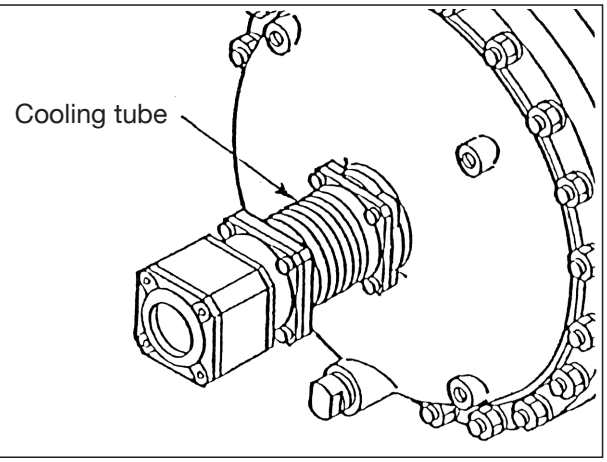
◊ **Hot-water Jacketed, Horizontal Line** ◊

(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 strains. 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 for removal. 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, leading to costly downtime.

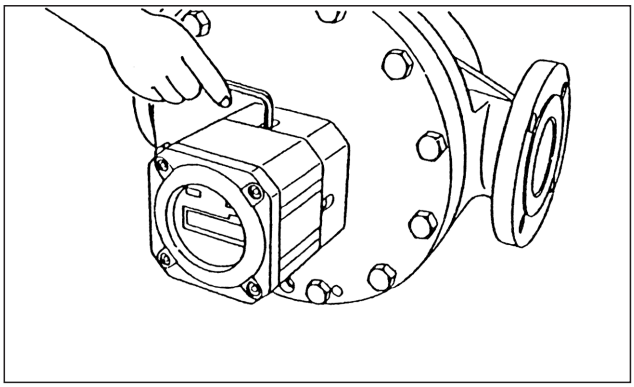


NOTE: As for outline dimensions and tube connection dimensions, see approval drawing.

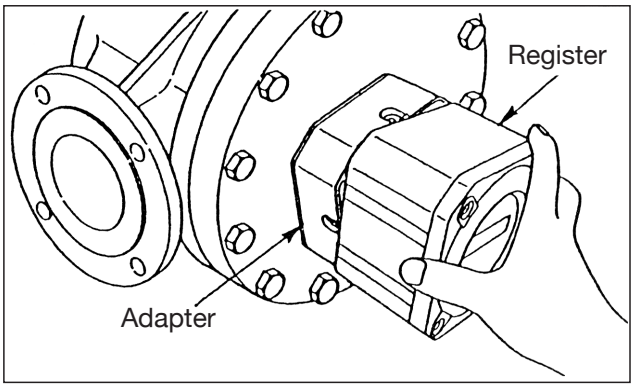
7. REVERSING THE FLOW DIRECTION

⚠ **WARNING: Do not fail to remove power to the meter before beginning work.**

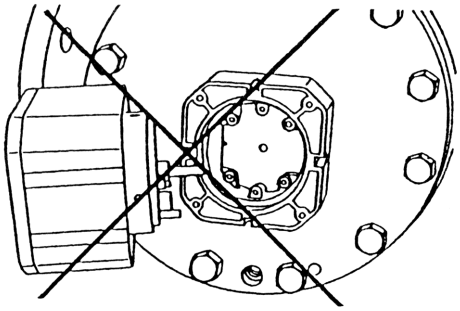
To reverse the flow direction, change the orientation of both the register and flowmeter body to the new flow direction.



① Take off 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.



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 has once been separated, restore the register's original orientation before changing flow directions and then change flow directions in the manner described in ② above (without separating the register) once again.

8. WIRING INSTRUCTIONS **(Refer also to the wiring instructions in the instruction manual of the companion receiving instrument.)**

8.1 Wiring Guidelines

(1) Cables for field wiring

The following cables should be used unless otherwise specified:

Cables 1.25mm^2 in conductor area and 8.5 to 11 mm in finished O.D. As to the number of conductors, select 2 to 4 according to your particular 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 45°C or higher, use a cable resistant to the temperature of 75°C or higher.**

(2) Transmission length

The maximum transmission length is typically one kilometer.

➡ NOTE: If it exceeds one kilometer, consult the factory.

(3) Inductive interference prevention

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

⚠ (4) Considerations on wiring connections

① M3.5 terminal posts are used on the terminal block. Use crimp-style terminals that fit the conductors at the cable end.

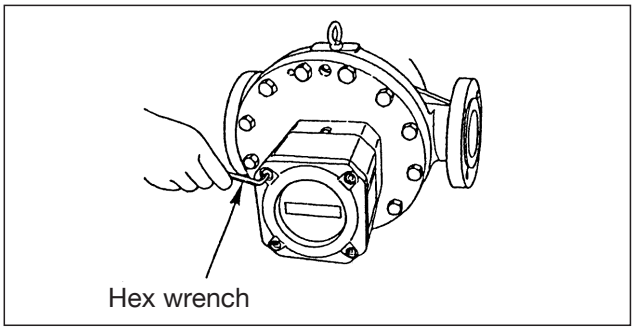
② Be sure to earth ground the transmitter's ground terminal.

③ Pitch down the cable from the cable entry so that rainwater will not have a chance to enter the equipment through the cable.

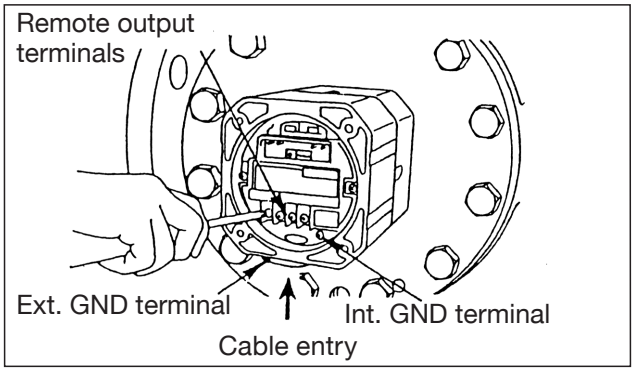
④ In areas where lightning strokes are expected, provide a lightning arrestor for protection.

⚠ **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.**

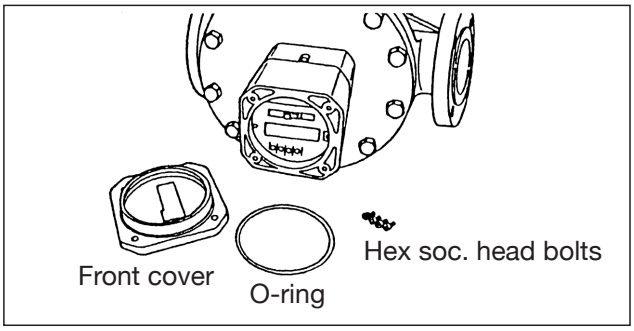
8.2 Terminal Connections



① Take off four hex socket head bolts on the front of register assembly and remove the front cover.



③ Using crimp-style terminals, ensure good electrical connections



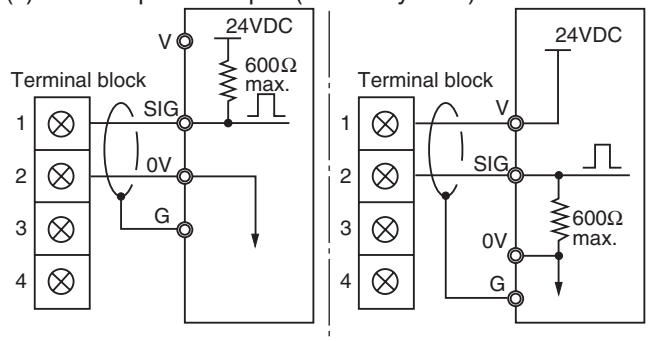
② Removing the front cover provides access to a 4-post terminal block. (Terminal identification label is found on the back of front cover. When you separate the front cover, pull it out straight toward you without rotating it.)

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

➡ **NOTE: Pressuretight packing are not furnished with non-explosionproof models and those without the provision of output signal (see page 4).**

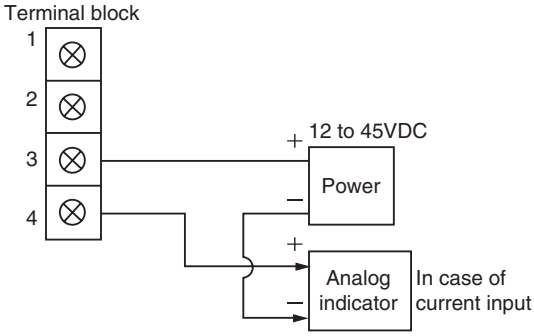
8.3 Method of Connections

(1) Current pulse output (2-wire system)



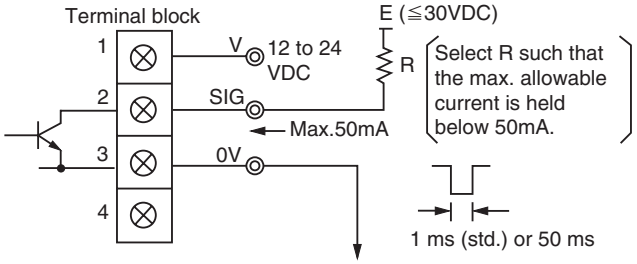
➡ NOTE: The OVAL circuit to accept current pulses comes in two configurations as shown above. Refer to the receiving instrument instruction manual before making connections.

(2) Analog output (2-wire system)



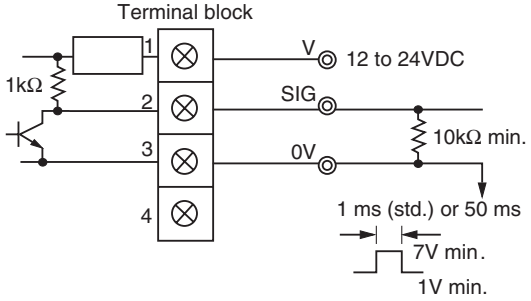
➡ NOTE: In case of voltage input, couple an external load resistor (see the acceptable load resistance range in Section 8.4).

(3) Open collector output (3-wire system)

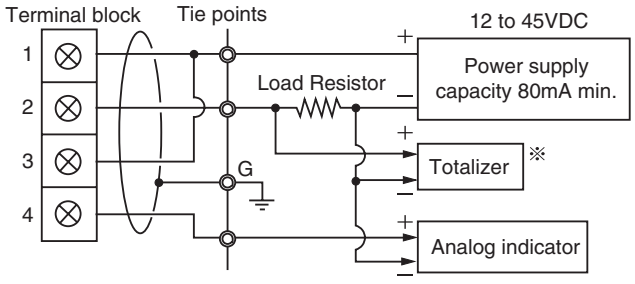


➡ NOTE: Select load resistance R such that the current flowing into the transistor is held within 50mA in relation with source voltage E.

(4) Voltage pulse output (3-wire system)



(5) Current pulse + analog output (4-wire system)



* Select the voltage input for the totalizer.
Make sure of the trigger level of voltage input and determine the supply voltage and load resistance. value.

➡ NOTE:

1. In an OVAL receiving instrument, signal conversion takes place with an internal load resistor. If you build a system like the one shown here with a commercially available third party totalizer, verify that the signal level to the totalizer matches since the signal conversion from current pulses into voltage pulses takes place according to the law 4/20mA × load resistance.
2. If you use an OVAL receiving instrument in the configuration shown here, make sure of the current carrying capacity of receiving instrument's power supply. If it has a problem in current carrying capacity, a separate power supply should be provided for the analog indicator.

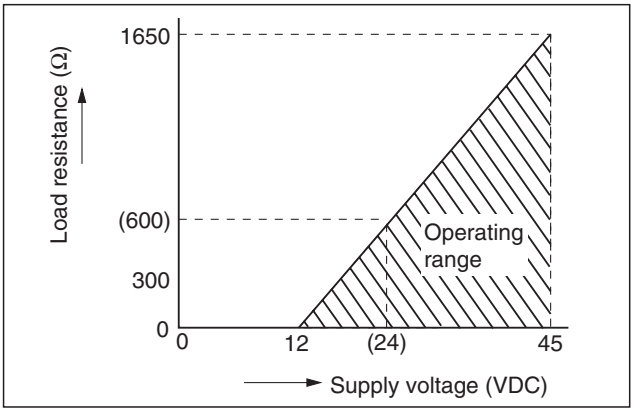
8.4 Acceptable Load Resistance Range (with current pulse and analog output)

In the specification of two-wire transmission system for analog and pulse signals, the power lines also serve as signal lines.

The transmission loop requires a DC power supply. If it is desired to connect an instrument in a loop, the load resistance of both the instrument and conductors must fall within the operating range as shown in the graph at right.

Standard: Power supply voltage = 24VDC

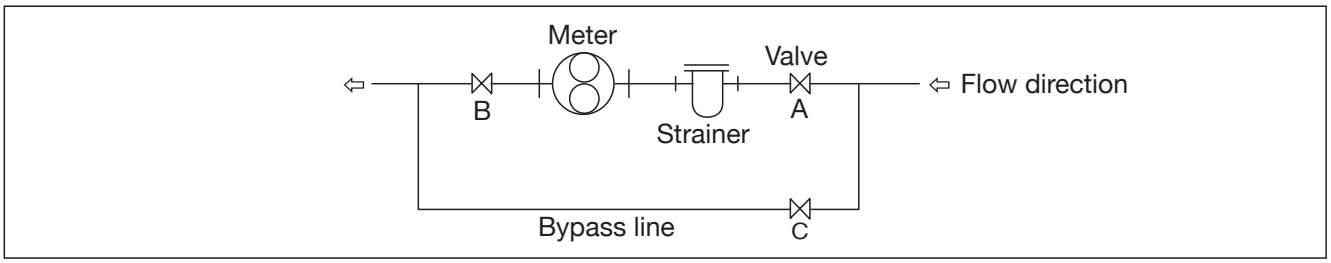
Load resistance = 250Ω



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 valve (A) on the inlet side and valve (B) on the outlet side and then open 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 for a newly installed piping assembly.**

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

(3) Slowly close 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 instant 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 meter 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 bypass line valve (C) completely and open upstream valve (A) progressively until fully open and slowly open downstream valve (B) until the rated flow is obtained.

(5) Flowrate should be regulated with 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 newly installed piping assembly, in particular, inspect daily at first and, according to the condition of the net being observed for clogging, inspection intervals may be reduced progressively to, say, once a week thereafter.

9.2 Operating Precautions

(1) When changing the 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.

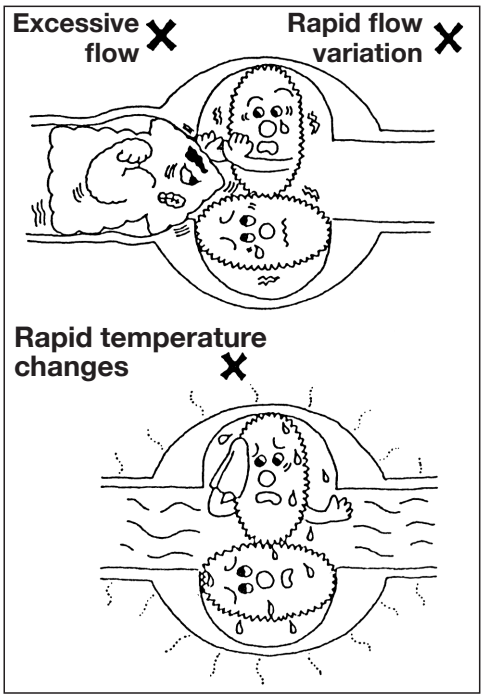
Operating the meter at flowrates in excess of the maximum allowable flowrate will nullify the guaranteed accuracy, reduce the meter life and may result in faulty conditions, such as the seizure of bearings or the rotor-to-measuring chamber contact.

(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.

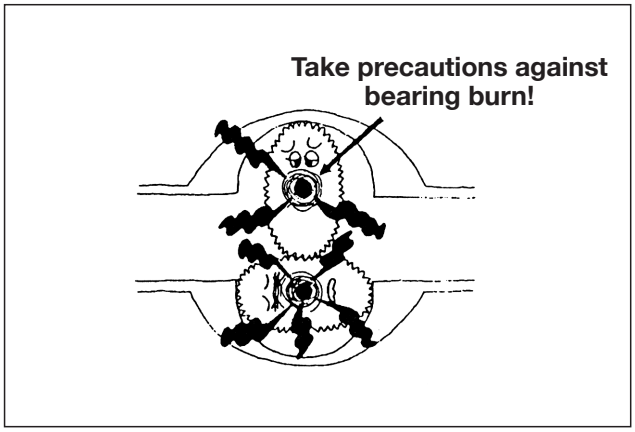
If rapid temperature changes are anticipated, heat trace the piping assembly as well as the meter.



(3) Liquids of low steam pressure

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

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



(4) Corrosive liquids

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

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 a damage to the meter.

(2) Precautions against pressure buildup on closure

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

(3) Liquids ready to adhere or gel

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 precaution can lead to a locked rotor condition and you will find difficulty in restarting meter operation.

9.4 Register Life

(1) The electronic module in the register requires replacement every 10 years or so due to the life expectancy of LCD and other electronic component parts.

The electronic module life depends on operating conditions. Under such environmental conditions as listed below, it is suggested to replace the entire register assembly in 5 to 6 years.

- u High temperature environment
- u High temperature process fluid measurement
- u Field installation with widely varying temperatures
- u Register LCD display exposed to the sun (ultraviolet rays)
- u Frequent start / stop in process fluid operation

(2) The battery pack has a storage life of 10 years after shipment, whether the battery is consumed or not. In other words, even in applications where the register is powered from an external source for most of the time and the battery current drain is considered negligibly small, battery replacement is yet required due to its storage life.
Storage life may be reduced even more under such adverse environmental conditions as:
- u High temperature environment
- u High temperature process material measurement
- u Cold region

9.5 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 measurement law, Japanese Industrial Instruments Federation, JIS standards, etc.

• **How to Determine a New Meter Factor**

New Meter Factor = (Current meter factor) × $(1\frac{E}{100})$ (mL/P)
where current meter factor: Stated in the test report or on the nameplate of the product.
E: Instrumental error determined in the test (%)

⚠**CAUTION: The new meter factor should be recorded for later reference.**

➡ NOTE: For the information about meter factor display and modification procedure, see Section 11.5 “Parameter Setup Procedure” on page 32.

10. DISASSEMBLY AND INSPECTION

• Although the frequency of servicing depends upon individual operating conditions, periodic disassembly should be performed once a year under normally encountered conditions.

⚠CAUTION: Because this 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 completely, drain the piping assembly and then place a suitable fluid receptacle directly below the flowmeter. Please be careful not to get any dust or sand on the disassambled parts.

⚠CAUTION: Be sure to remove power before you disassemble.

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

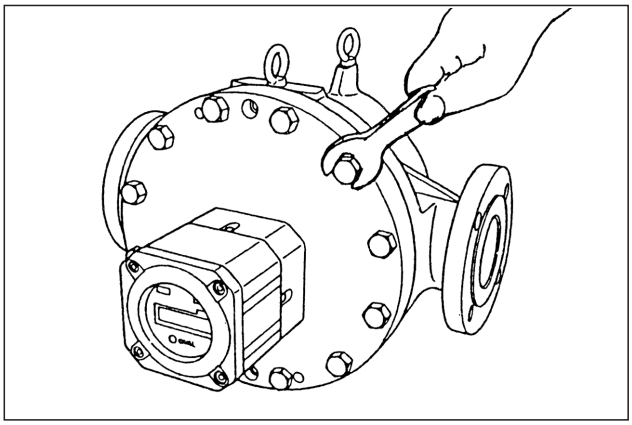
SUBINDEX

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

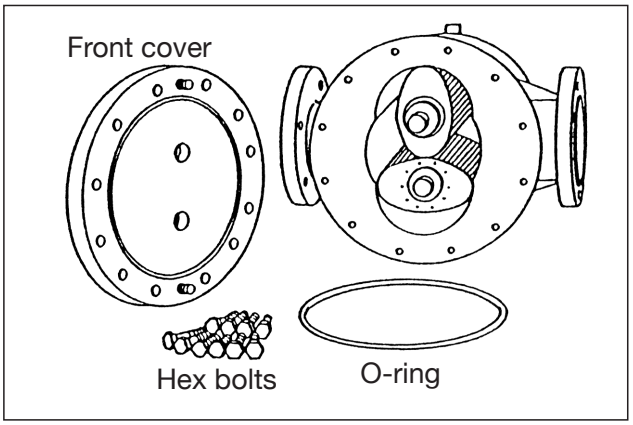
10.1.1 Oval Rotor Inspection

⚠**CAUTION: Be sure to follow the steps given below, referring to "Exploded Views" on pages 44, 46 and 48.**

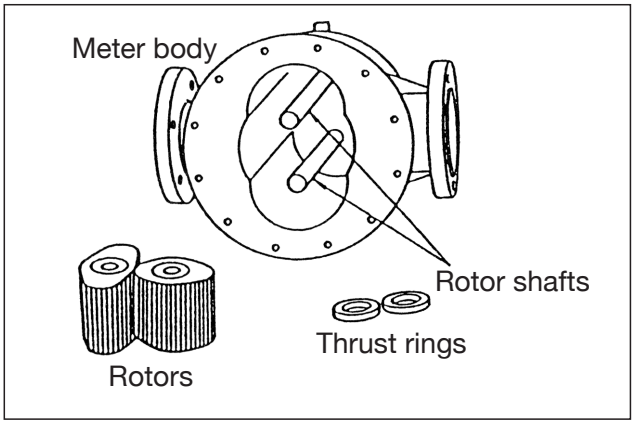
➡ NOTE: Meter size 29 single-case construction meter body is shown here. The same procedure applies to meters of other sizes.



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

(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 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.

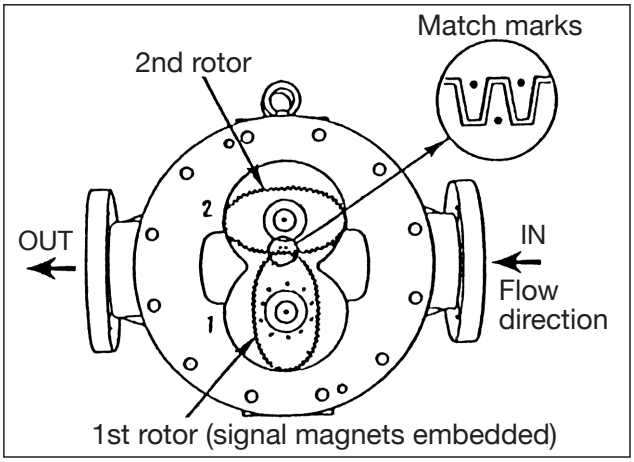
⚠**CAUTION:**

(1) Score marks, scratches, surface irregularities due to impressions, or other flaws should be smoothed out with oilstone or similar tool.

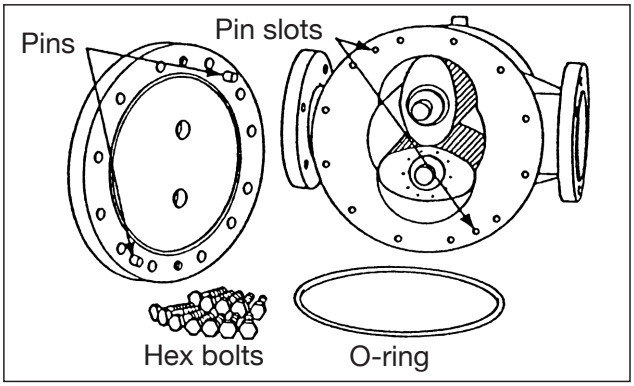
(2) If the areas which have been forced into contact with front cover jacking bolts are distorted outwardly, forming burrs or ridges, smooth the affected surfaces with oilstone.

10.1.2 Assembly Procedure

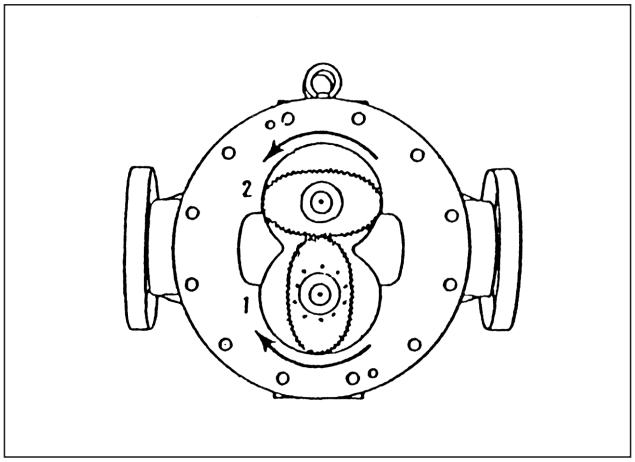
⚠ **CAUTION: Service note before assembly**
Oval rotors, inner walls of the rotor shafts, inner wall of the measuring chamber, inlet and outlet ports, and inner surface of the front cover should be thoroughly washed clean, completely removing dust, grime and other foreign matter.



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 - the 1st rotor (match mark "•") on one shaft with "1" stamped on the outside of measuring chamber and the 2nd rotor (match mark "• •") on the other shaft with "2" stamped. Ensure that the match marks are aligned 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 mating pin slots in the meter body and, installing 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 smooth rotation**
With air or water, make sure to see that the rotors move smoothly.

⚠ **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.

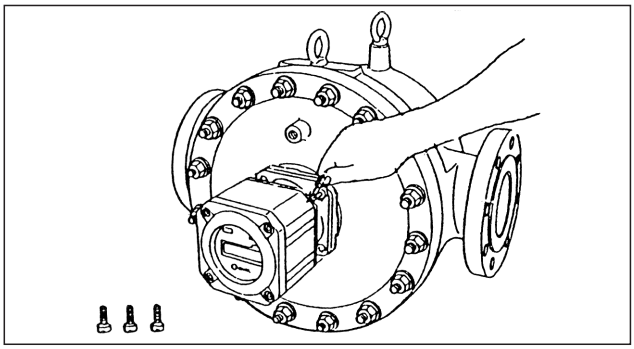
⚠ **CAUTION: This meter is NOT compatible with any other registers. Never attempt to replace it.**

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

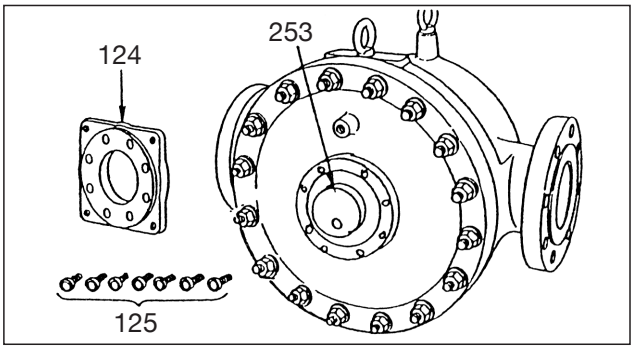
10.2.1 Oval Rotor Inspection

⚠ **CAUTION: Be sure to follow the steps given below, referring to "Exploded Views" on pages 50, 52, 54 and 56.**

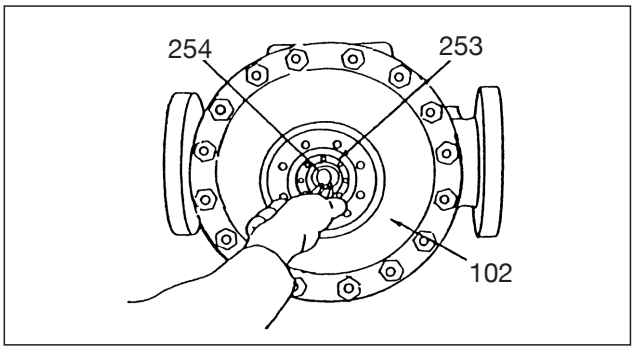
➡ NOTE: Meter size 60 single-case construction meter body is shown here. The same procedure applies to meters of other sizes.



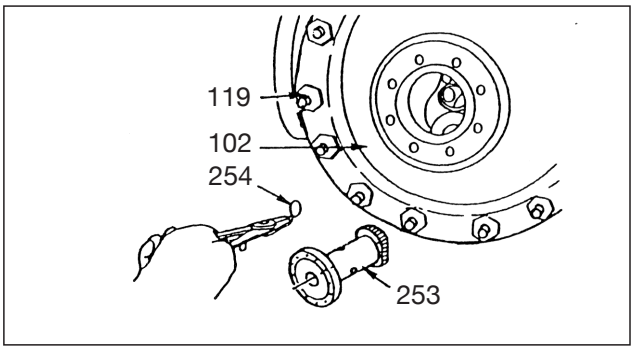
① Using hex key, take off four bolts (115). Holding the register assembly in both hands, carefully separate it from the meter body.



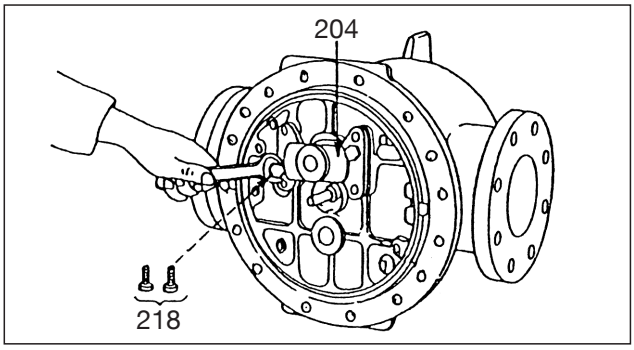
② Using hex key, take off eight bolts (125) and remove sealing flange (124).



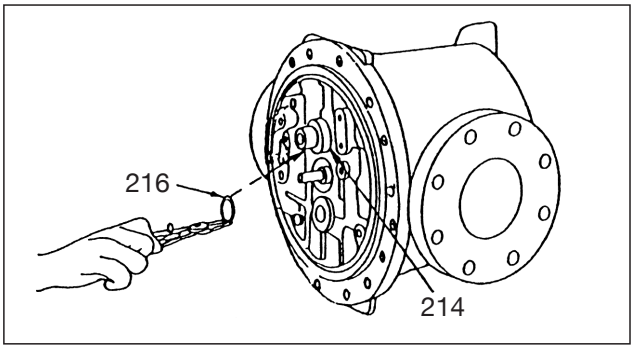
③ Using stop ring pliers, remove stop ring (254). At assembly, install part (253) (in case of the 30K type) and then tighten front cover (102).



④ Remove the signal generating magnet assembly. Take off 16 stud bolt nuts (119) (on 30K type) and the front cover is ready to be separated.

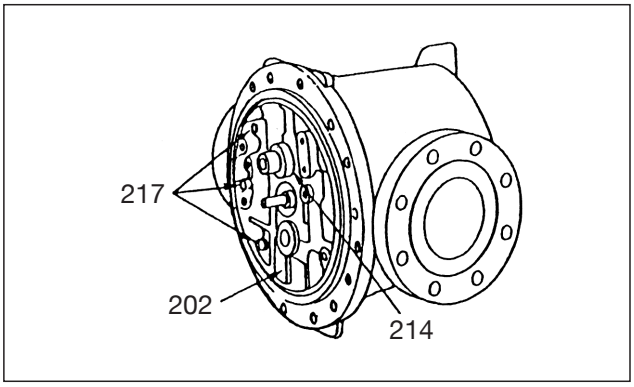


⑤ Take off four hex bolts (218) and use two of them in the threaded jack screw holes in the longer shaft holder (204) to jack the longer shaft holder by tightening them alternately as shown until the longer shaft holder comes off.

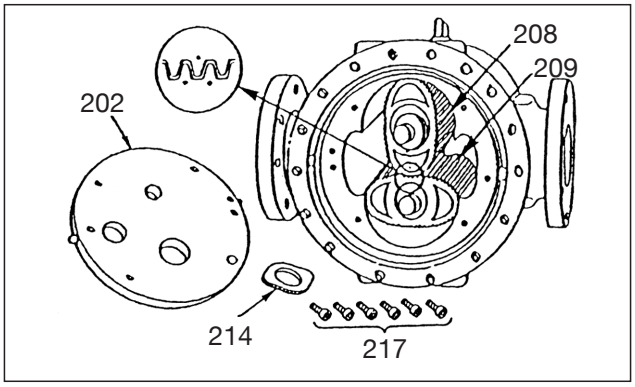


⑥ Using stop ring pliers, remove stop ring (216) and remove uniform-motion drive gear (214). At assembly, install in line with the locating pins of uniform-motion gears.

Continued on next page.



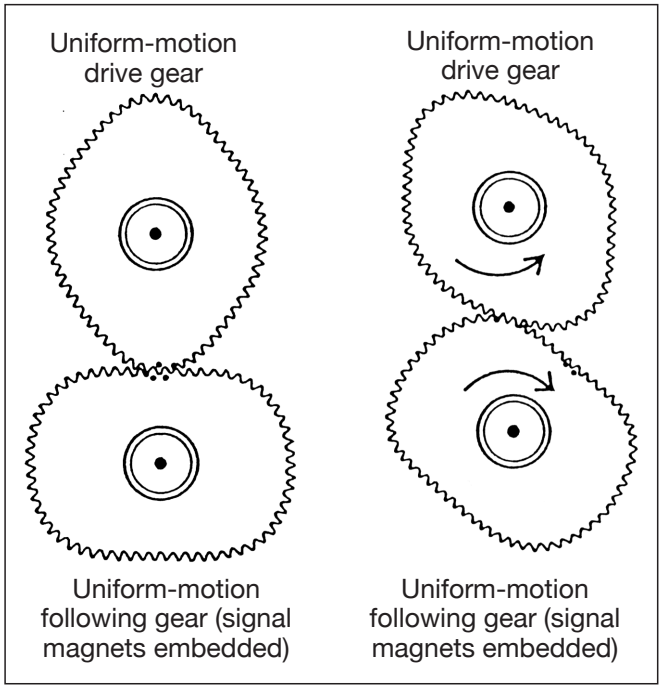
⑦ Using hex key, take off six bolts (217) and use two of them in the threaded jack screw holes in the inner case top cover (202) to jack the inner case top cover by tightening them alternately.



⑧ Now the measuring chamber is accessible 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 in the inset and make sure of smooth rotor rotation.

10.2.2 Assembly Procedure

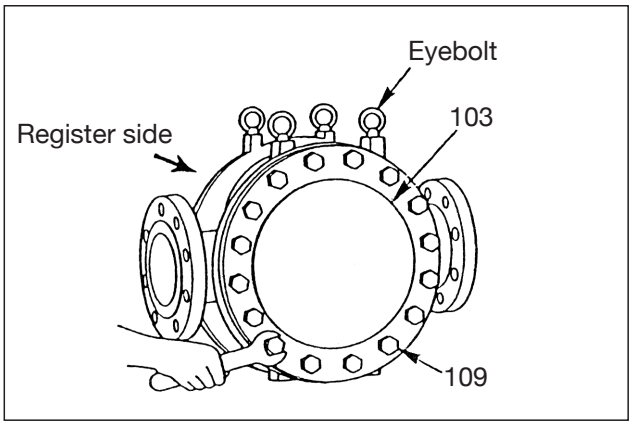
Assembly is the reverse of the removal procedure, but observe the following instructions.
Illustrated at right is the way the uniform-motion gears are assembled.
At assembly, careful attention must be paid to the proper engagement of uniform-motion gears.
With match marks aligned, slide the gears in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



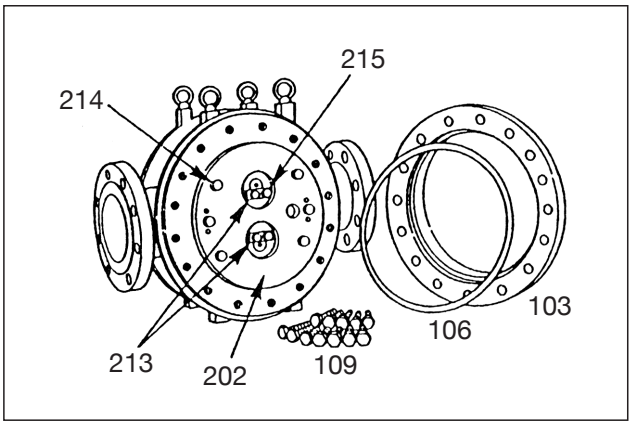
10.3 Meter Sizes 32 and 33 Single-case Construction

10.3.1 Oval Rotor Inspection

⚠ **CAUTION: Be sure to follow the exploded view on page 58.**

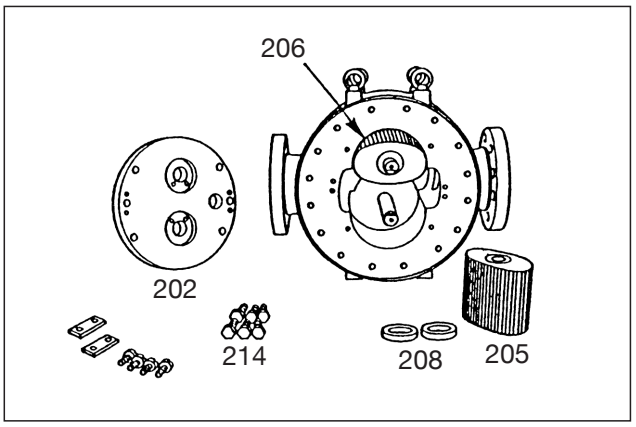


① Take off hex bolts (109) holding the rear cover (103) and remove the rear cover. To do this, screw eyebolts into screw hole in the rear cover and draw the cover horizontally. Pay attention to the possibility of a seized O-ring.
Residual process fluid may run from the measuring chamber. Receive it with 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 scales adhering to the inner wall of measuring changer.
Use care not to damage thrust rings (208).
It is good practice to put identification marks for correct installation.

⚠ **CAUTION:**

(1) Score marks, scratches, surface irregularities due to impressions, or other flaws should be smoothed out with oilstone or similar tool.

(2) If the areas which have been forced into contact with front cover jacking bolts are distorted outwardly, forming burrs or ridges, smooth the affected surfaces with oilstone.

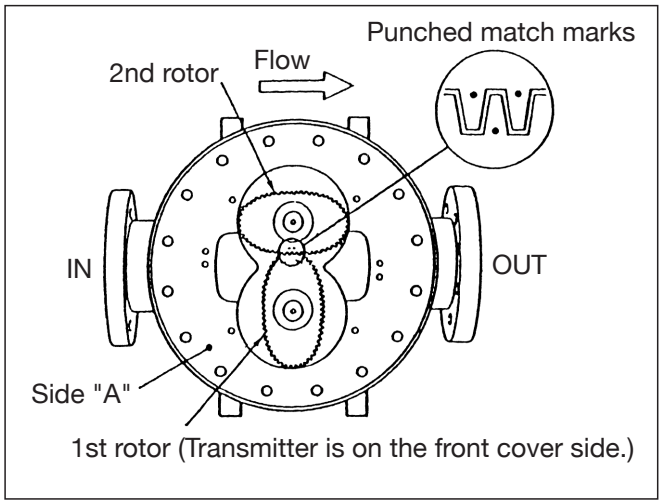
(3) Remember that excessive correction may result in a loss of meter accuracy.

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.

➡ NOTES:

1. If the flow direction is from left to right as shown in the figure at right (right → 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, smooth out with oilstone or similar tool.



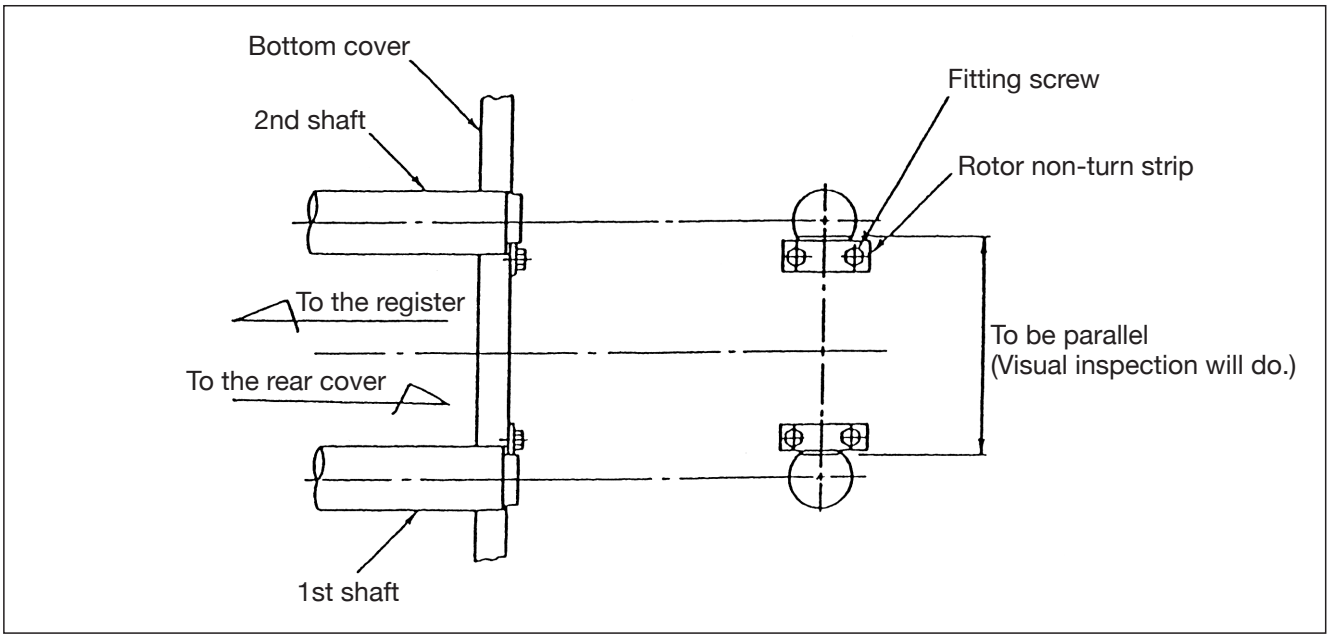
⚠ **NOTE: In this case, the flow direction is as viewed from the register side.**

⚠ **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).



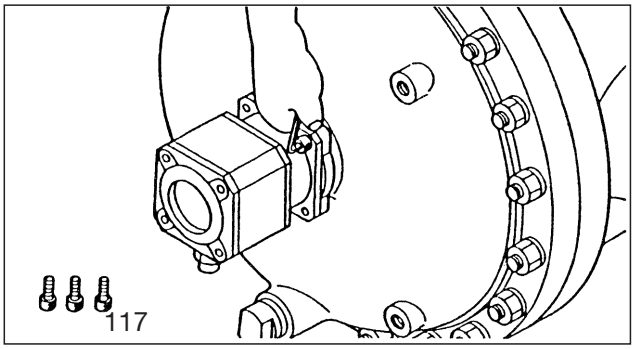
⚠ **CAUTION: Incompatible with any other register. Do not attempt to replace it.**

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

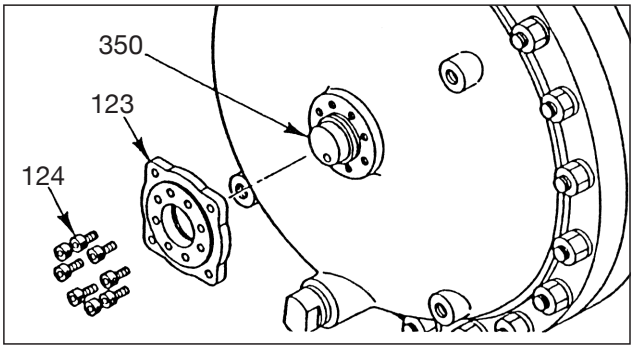
10.4.1 Oval Rotor Inspection

⚠ **CAUTION: Be sure to follow the procedure given here, referring to the "Exploded Views" on pages 60, 62, 64 and 66.**

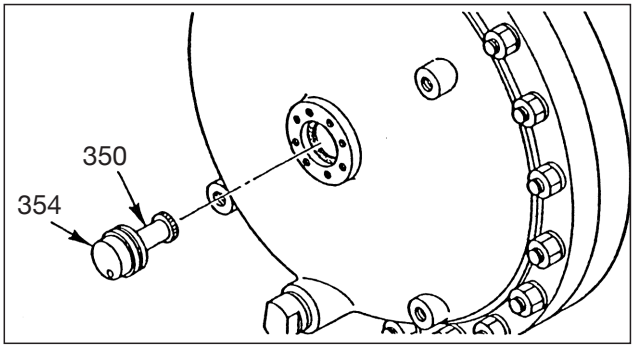
➡ NOTE: Size 33 double-case construction meter body is shown here. The same procedure applies to other models.



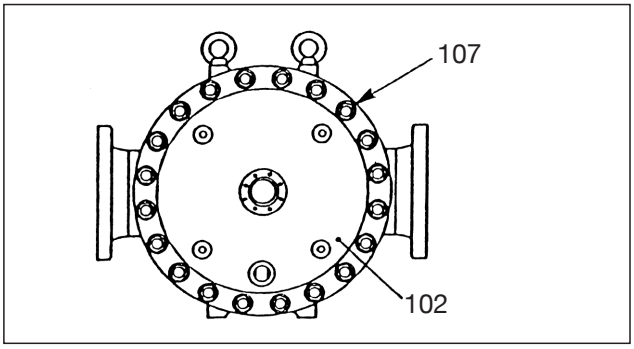
① Using hex key, take off four bolts (117). Holding the register assembly in both hands, carefully separate it from the meter body.



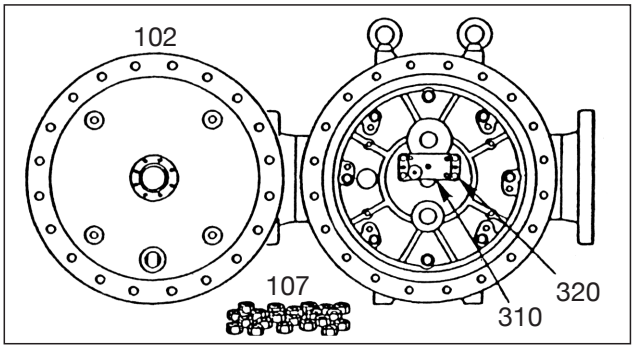
② Using hex key, take off eight bolts (124) and remove sealing flange (123).



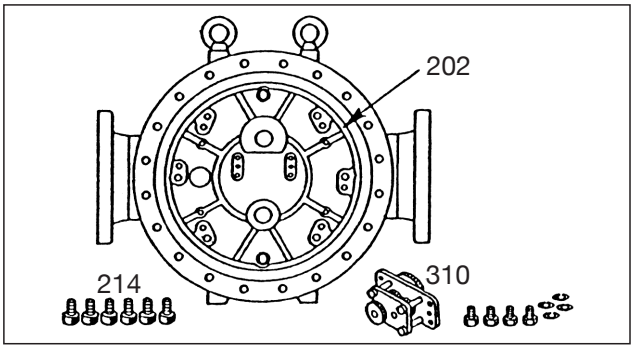
③ Uniformly draw pressuretight sealing plate (354) out and remove signal generating magnet assembly (350).



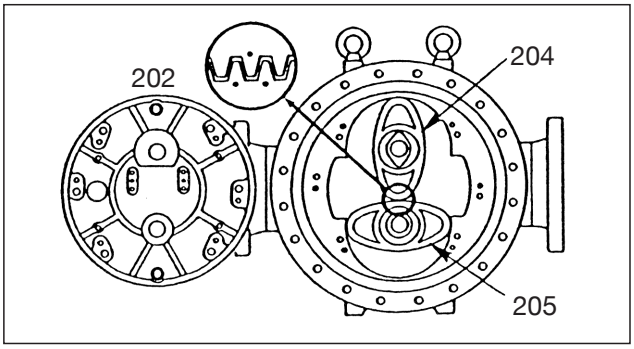
④ Take off a total of 20 nuts (107) of stud bolts holding the front cover. The front cover (102) is now ready to be separated.



⑤ Take off four hex bolts (320) and, using two of them in the threaded jack screw holes in the transmission gear train (310) and tightening them alternately until the transmission gear train comes off.



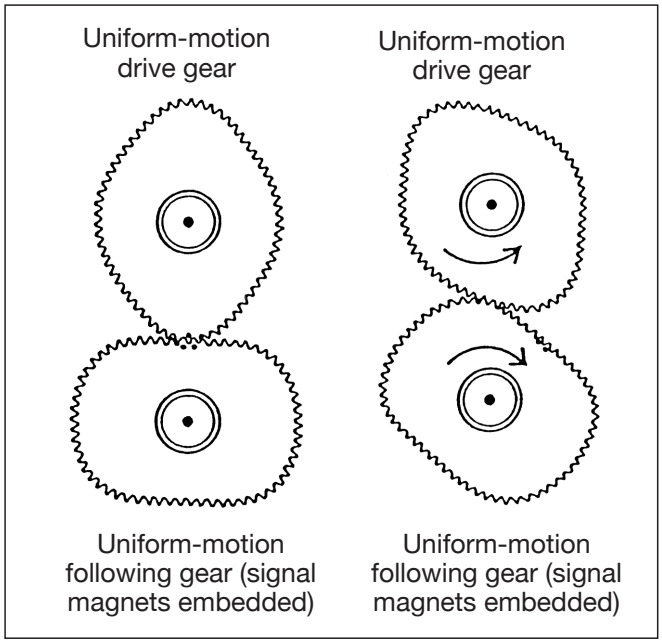
⑥ Using hex key, take off six bolts (214) and use two of them in the threaded jack screw holes in the inner case top cover (202) to jack the top cover of inner case by progressively tightening them alternately until the inner case top cover comes off.



⑦ Now the measuring chamber is accessible 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 in the inset and make sure of smooth rotor rotation.

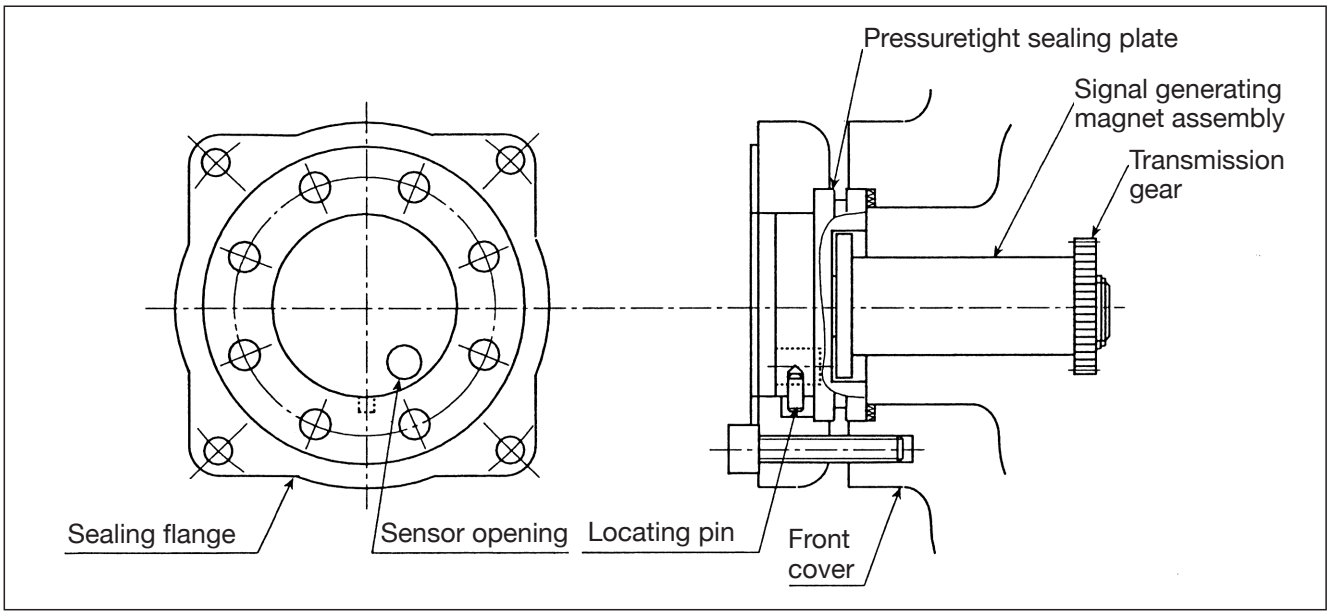
10.4.2 Assembly Procedure

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.
With match marks aligned, slide the gears in the direction of arrow marks as shown. Following the gear engagement, be sure to make one complete revolution to ensure smooth rotation.

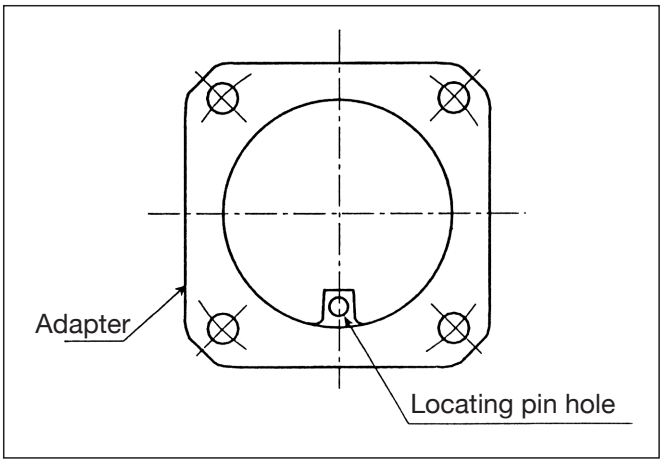


10.4.3 Precautions at Signal Magnet Disassembly and Reassembly

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 with the locating pin pointed downward when the flow direction is from right to left or pointed upward when flow direction is from left to right.

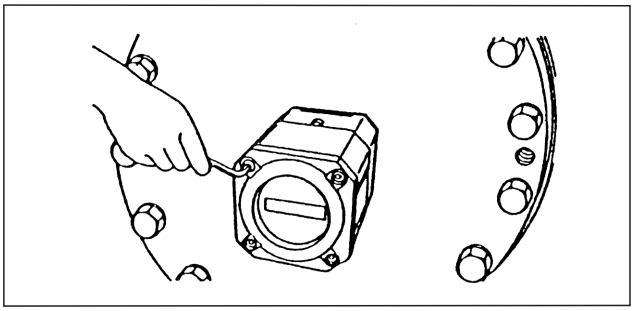


➡ NOTE: Install the adapter such that the locating pin hole comes on the same side as the locating pin of signal generating magnet assembly.

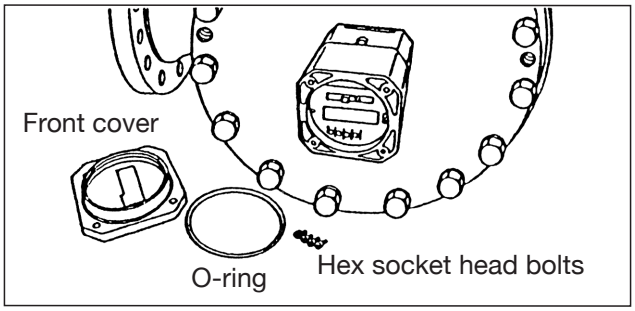


11. REGISTER SWITCH FUNCTIONS AND PARAMETER SETTING

11.1 Switch Names and Functions



① Using hex key, remove four hex socket head bolts securing the front cover.



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

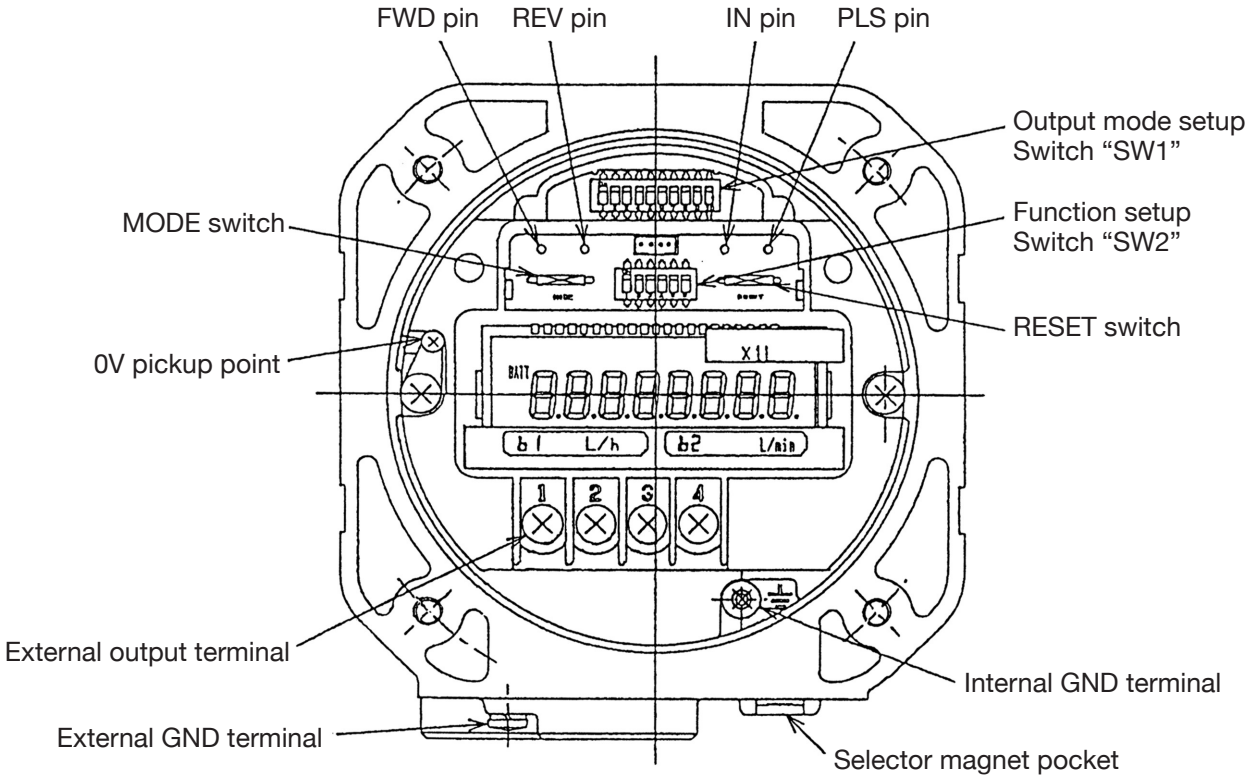


Fig. 11.1 Part Names of Electronics Unit

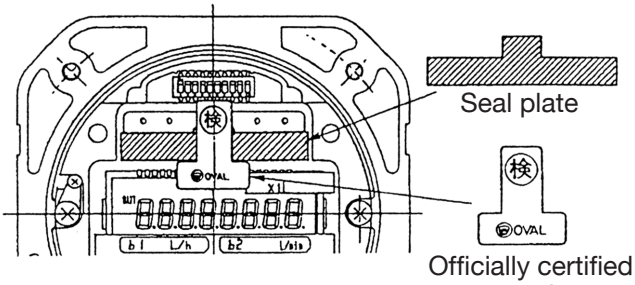


Fig. 11.2

11.1.1 Function Setup Switch “SW2”

DIP switch No.	Description of functions
SW2-1	Parameter write-protect [OFF: Rewritable “Default”] ON: Write protect ※ To seal, set to ON before attaching the seal.
SW2-2	Factored/unfactored pulse select OFF: Factored pulse ON: Unfactored pulse
SW2-3	Inhibit to reset the resettabie total [OFF: Resettable “Default”] ON: Nonresettable
SW2-4	Accumulated total reset ON → OFF resets the accumulated total. [※ Set to OFF in normal use.]
SW2-5	Unused [※ Always OFF]
SW2-6	Battery power switch OFF: Battery power OFF [ON: Battery power ON “Default”]

➡ NOTE: [ ] shows default setting.

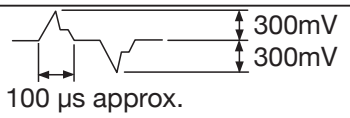
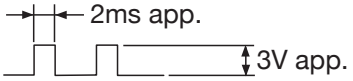
11.1.2 Output Mode Setup Switch “SW1”

Output mode / DIP switch No.	Current pulse/ analog	Open collector pulse	Voltage pulse	Remarks
SW2-1	OFF	OFF	ON	ON for voltage pulse only. All else OFF.
SW2-2	OFF	OFF	ON	
SW2-3	ON	OFF	OFF	ON for current pulse/analog output only. All else OFF.
SW2-4	ON	OFF	OFF	
SW2-5	ON	OFF	OFF	
SW2-6	ON	OFF	OFF	
SW2-7	OFF	ON	ON	ON for open collector output and voltage pulse output only. All else OFF.
SW2-8	OFF	ON	ON	
SW2-9	OFF	ON	ON	
SW2-10	OFF	ON	ON	

⚠ **CAUTION: To change SW1 settings, place all switches in OFF and then place only the requied switch in the ON.**

11.2 Individual Test Pin Functions

➡ NOTE: Connect the 0V end to the L.H. side fitting screw in the electronics unit (see Fig. 11.1).

Pin name	Function	Waveform
FWD	Monitors the amplified output waveform from magnetic sensor for flow metering.	
REV	Monitors the amplified output waveform from magnetic sensor for discriminating between FWD and REV flow. (Only when the double sensor is used.)	Same as above
PLS	Monitors the rectangular waveform after FWD pulse wave-shaping. Timing remains the same as that of FWD and its waveform is one before unfactored output amplification	
IN	Accepts a simulated pulse train from OVAL pulse checker Model PC2201 or other signal source. Input mode is PG30 mode of Model PC2201. It also accepts pulses with levels “0”: 1V max. and “1”: 7 to 12V min. or open collector.	

11.3 Total Flow and Instantaneous Flowrate Calculation

(1) Total flow ····· Both accumulated total and resettable total

$Q = P \times F \times H$

where P: Number of incoming pulses
F: Meter factor
H: Conversion factor

(2) Instant flowrate ····· Valid only for input pulses of small periodic variation

The period of incoming pulses for the sample cycle number is measured in units of 30 µsec and substituted in the following formulas for readout:

$$\text{Hourly Flowrate} = b1 = \frac{3600 \times F \times H \times A}{T\ (\text{sec})}$$

$$\text{Per-min. Flowrate} = b2 = \frac{b1}{60}$$

➡ NOTE: where A: Sample cycle number
F: Meter factor
H: Conversion factor

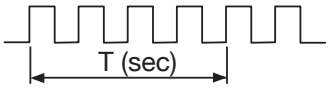
(3) Sample cycle number

It shows the number of sampling pulses in instant flowrate computation. If indicated reading on the display fluctuates, an average reading may be obtained by selecting a larger number.

If the fluctuation of indicated reading is excessive, pulsation of the flow is suspected among possible causes and the pipeline should be inspected for condition.

➡ NOTE: Sample cycle number

Input pulses



If a setting A=4 is chosen, the time is measured for 4 cycles of incoming pulses and, based on the formulas above, calculation is made. Resolution of measurement is 30µsec.

If the number of incoming pulses falls below the sample cycle number (A: Default 4) in the sampling time (At: Default 5 sec), the instant flowrate reads 0.

Accordingly, if it is desired to read the instant flowrate in small flows, select a smaller sample cycle number.

11.4 Parameter List

Parameter	Code	Default setting	Description	Remarks
Meter factor	F	Depends on the customer specification. [Indicated on the params label.]	• Meter factor (Unit [□/Pulse]) • Setting range: 0.9999-9 to 9.9999E7	Ex.: Given meter factor 9.918mL/P. To change the indicated flowrate to read in [L] → 9.918 [mL/P]=9.918×10^{-3} L/P] Therefore, set to "**9.9180^{-3}**" (L/P).
Conversion factor	H	1.0000E0	• Unit conversion factor (Unit: [△/L]) △: Unit after conversion (without conversion, △ = □) • Setting range: 0.9999-9 to 9.9999E7	Changes units of total flow and instant flowrate to any unit desired. (Without conversion, H1.0000E0) Ex.: At 1.5kg per 1L, change the flowrate to read in kg → Conversion factor is 1.5 [kg/L] (=1.5000 ×10^{-0} [kg/L]. Therefore, set to "**H1.5000E0**" (kg/L). (Note 1)
Pulse weight	Pu	Depends on the customer specification. [Indicated on the params label.]	• Weight of factored pulse output (Unit: [△/Pulse]) • Setting range: 0.99-9 to 9.99E7	Ex.: To change the weight of factored pulse from 1 L/P to 10 L/P (=1.00×10+1 [L/P]) → Set to "**Pu 1.00E1**" (L/P). (Note 2)
Reading unit	Un	—	—	This parameter is unused. (Do not set it up.)
Decimal point position in instant flowrate	bP	Depends on the customer specification.	• Decimal point position in instant flowrate b1 • Setting range: 0, 1, 2	Ex.: To change the resolution of reading in instant flowrate from 1 L/h to 0.1 L/h (=one place below decimal point) → Set to "**bP .1**".
Decimal point position in total flow	SP	Depends on the customer specification.	• Decimal point position in accumulated total and resettable total • Setting range: 0, 1, 2, 3	Ex.: To change the resolution of reading in total flow from 1L to 0.01 L (= 2 places below decimal point) → Set to "**bP .2**".
Sampling duration	At	5	Upper limit in instant flowrate sampling (Unit: [sec]) • Setting range: 1 to 999	If flow pulses fail to arrive for a duration At [sec], the instant flowrate reads 0.
Sample cycle number	A	Depends on the customer specification. [Indicated on the params label.]	• Sampling frequency • Setting range: 1 to 999	Instant flowrate is determined by measuring the time required for counting incoming flow pulses for A times. If the spread of instant flowrate measured is too great, select a larger A to reduce the variation.
Analog full scale (Note 3)	AF	Depends on the customer specification. [Indicated on the params label.]	• Analog full scale flowrate (Unit: [△/h]) • Setting range: 0.01 to 99999	Ex.: To change the analog output full scale flowrate (flowrate to produce a 20mA output) from 3600L/h to 1800L/h → Set to "**AF 1800**" (L/h).
Analog damping (Note 3)	AdAn	2.5	• Analog time constant (software) (Unit: [sec]) • Setting range: 0.01 to 99999	If the ripple in analog output is too great, select a larger AdAn to reduce fluctuation and stabilize the reading. Ex.: To change the analog output time const, from 2.5 [sec] to [5 sec] → Set to "**AdAn 5.0**".
4mA trim (Note 3)	A04	—	Analog output 4mA trim	See "Parameter Setup Procedure" for detail.
20mA trim (Note 3)	A20	—	Analog output 20mA trim	See "Parameter Setup Procedure" for detail.
Pulse width	Pon	1 or 50 [Indicated on the params label.]	"ON" duration of factored pulse output (Unit: [msec])	Ex.: To change the pulse width from 1ms to 50ms → Set to "**Pon 50**" (msec) (Note 4).

Parameter	Code	Default setting	Description	Remarks
Dummy pulse output 1	Pd1	Not a parameter to be set up	Furnishes a 1 Hz simulated factored pulse output irrespective of flowmetering.	• This function is useful in loop check, etc. • For operation in practice, see "Dummy Output Functions (special features)."
Dummy pulse output 2	Pd2	Not a parameter to be set up	Furnishes a 10 Hz simulated factored pulse output irrespective of flowmetering.	

NOTES 1. When conversion factor (H) is set, change pulse weight (Pu), reading unit (Un) and the like must also be modified relative to the affected units after conversion.

2. Be sure to set up a value such that $\frac{F \times H}{2} < Pu < F \times H \times 10000$.

3. Not shown on the LCD if the meter operates on the battery alone.

4. Be sure to set a value such that factored pulse OFF width > 1 ms.

※ To see the factory-default setting parameters upon delivery, please refer to the "Parameter Settings Table" that is shipped with the product.

11.5 Parameter Setup Procedure

11.5.1 Procedure to Modify a Parameter

Given below is the parameter setup procedure:

① In “Measure Mode (normal mode)”, turn MODE switch ON for 5 seconds to go into “Review Mode”.

⬇

② Using MODE and RESET switches, show the parameter you want to modify.

⬇

③ Turn MODE switch for 2 seconds to go into “Parameter Setup Mode”.

⬇

④ Using MODE and RESET switches, set up a new parameter. (See Sec. 11.5.2 below for the procedure.)

⬇

⑤ Following the parameter entry, press MODE switch for 2 seconds to go back to “Review Mode”.

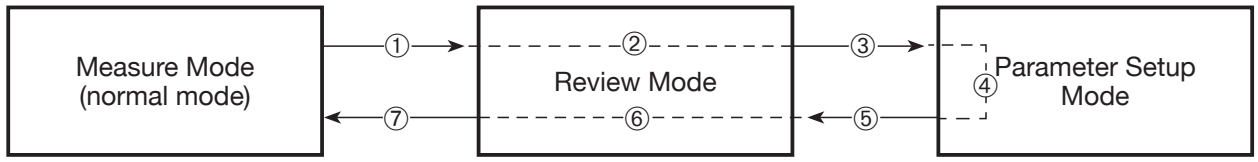
⬇

⑥ Using MODE and RESET switches, display the title (= any of bdAtA, AnA, PuLSE and CorrEctCo.).

⬇

⑦ Turn MODE switch ON for 5 seconds to go back to “Measure Mode”.

A diagram to show parameter setup flow



➡ NOTE: For complete detail of MODE and RESET switch operation in steps ①, ②, ⑥ and ⑦, see “Table 11.2: Screen Transition Chart of Parameter Change” on page 40.

11.5.2 Procedure to Enter a Parameter

The procedure to enter a parameter (switch operation sequence in “Parameter Setup Mode”) comes in three ways (numerical value setup, decimal point position setup and analog 4/20mA trim) that follow:

[Kind 1] Numerical value setup parameters (F, H, Pu, At, A, AF, AdAn, and Pon)

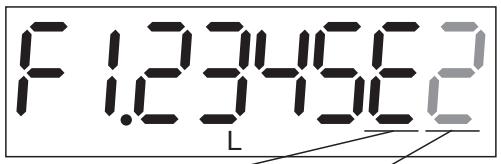
The blinking digit in the parameter setup mode is the place of interest.

MODE ····· Each time the switch is turned on, the place of interest moves one place to the left.

RESET ····· Each time the switch is turned on, the figure in the place of interest increases by one. Or exponential sign toggles (“E,”, “-”, etc.).

→ Following the parameter setup, hold the MODE switch turned ON for 2 seconds (the new setting is established and the screen returns to the review mode).

Example: parameter “F” (meter factor)



Exponential sign (E: 10^{+n}, “–”: 10^{-n})
(the screen above reads
F=1.2345×10^{+2} L.)

Digit of interest (blinking)

- Turning MODE “ON” moves the blinking digit one place to the left (“E”).
- Turning RESET “ON” increases the figure by one (“2” → “3”).

[Kind 2] Decimal point setup parameters (bP and SP)

In the parameter setup mode, a figure representing the decimal places of interest blinks.

MODE ····· Unused in the setup process.

RESET ····· Each time the switch is turned ON, the decimal point moves one place to the left and the figure increases by one.

→ When the decimal point appears at the desired position, hold MODE turned ON for 2 seconds. (This establishes the setting and the window returns to the review mode.

Example: Parameter "bP" (decimal point position in instant flowrate)

Decimal point (according to the figure at right of decimal point, this point moves.)

If a setting above (bP = 2) is selected, the instant flowrate reads [b1□□□.□□].

A figure representing the decimal places of interest (blinking)

• Turning RESET switch ON, the figure increases by one ("0"→"1"→"2").

[Kind 3] Analog output 4/20mA trim

• During the analog trim, keep on monitoring the analog output with a milliammeter or voltmeter.

Given below is the 4mA trim procedure (the same holds true with 20mA trim).

(1) At "A04 4.000", hold "MODE" turned ON for 2 seconds to go into the parameter setup mode; the least significant digit "0" at the rightmost place blinks on and off and a 4mA simulated output from the register appears.

(2) Set the milliammeter reading in the procedure below.

Example: Parameter "A04" (4mA trim)

MODE ····· Each time the switch is turned ON, the digit of interest moves one place to the left.

RESET ····· Each time the switch is turned ON, the figure of interest increases by one.

Digit of interest (blinking)

• Turning MODE "ON", the blinking digit moves to the left.

• Turning RESET "ON", the figure increases by one ("0"→"1").

(If the milliammeter reads 3.988mA, set to "A04 3.988".)

Following the entry of setting, hold MODE turned ON for 2 seconds to establish the setting.

(3) Analog output is trimmed; make sure of the milliammeter reading once again. (The indicated reading returns to "A04 4.000" (the least significant digit at the rightmost place is blinking) now).

- If the reading is within the tolerance with respect to 4mA, by holding MODE turned ON for 2 seconds the second time, you can exit the setup mode. → Adjustment is complete. Returns to the review mode.
- If the reading is still outside the tolerance, repeat step (2) above.

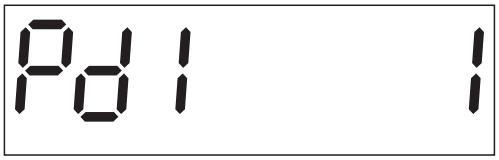
11.5.3 Dummy Output Features (special functions)

By the following steps, a 1 Hz or 10 Hz simulated factored pulse train can be furnished irrespective of flowmeter measurement.

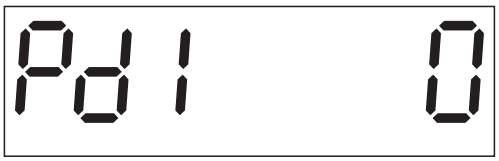
➡ NOTE: This feature is not available with the unfactored pulse output specification.

- **1Hz simulated output mode (dummy output 1 mode** Code: Pd1)

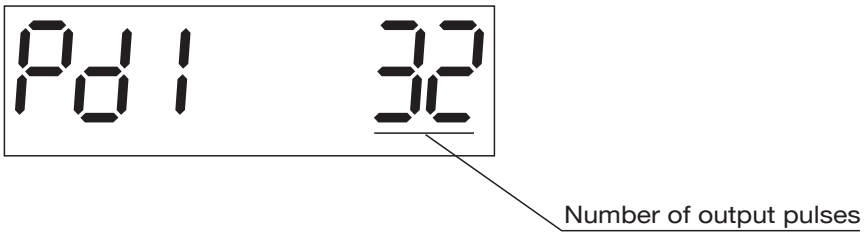
① According to Table 11.2 “Screen Transition Chart of Parameter Change” (page 40), show the dummy output 1 (“Pd1 1”) on the LCD.



② Turn MODE button ON for 2 seconds to go to the dummy output run mode.
(The display shows “Pd1 0”.)



③ Operation within the dummy output run mode
- Turn RESET button ON → Dummy output appears and the counter counts in sync with the pulse output produced.
- Turn MODE button ON → Dummy output stops.
- Hold MODE button turned ON for 2 seconds → Dummy output run mode is terminated, returning to the state ①.



➡ NOTES: (1) The procedure above also applies to the 10Hz simulated output mode (dummy output 2 mode, Code: Pd2).
(2) Pulse width is set by parameter Pon.

11.5.4 Parameter Initialization

(1) Remove the external power source.
(2) Holding the selector magnet close to the MODE switch, turn the battery switch (SW2-6) from OFF to ON.
(3) The LCD lights up in all figure places. (The selector magnet is held in proximity.)
(4) When the screen shows “PA. rESEt”, move the selector magnet away to turn the switch OFF → Initialization is complete.
(Holding the magnet in proximity while “PA. rESEt” stays on causes the modes to go to the measure mode without initialization.)

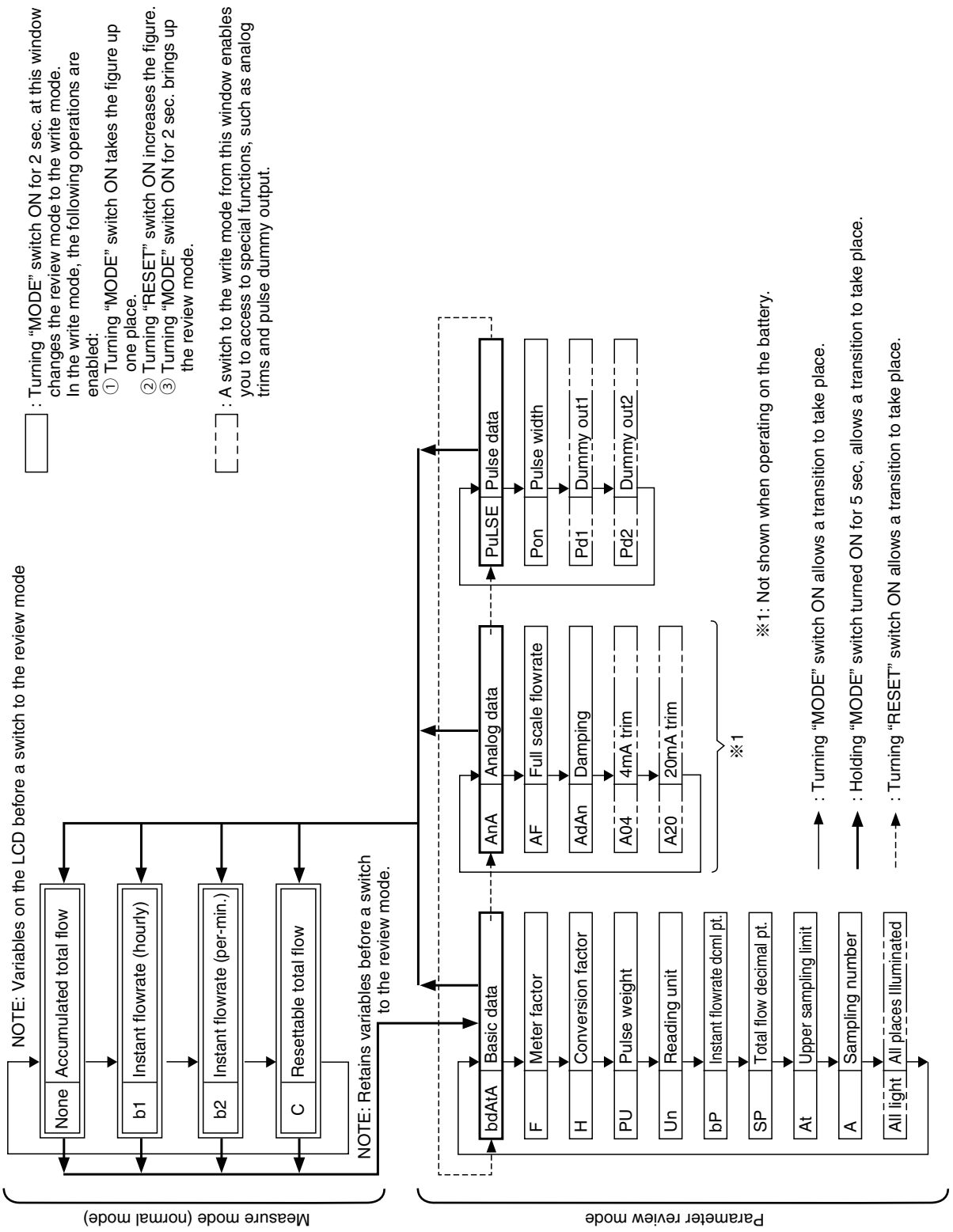
➡ NOTE: Parameter initialization is the step to be taken upon detection of a parameter error “PA. Err 1” or other erratic condition. Do not take this step unless absolutely necessary.

11.5.5 Error Messages

The electronics unit can be reconfigured for new parameters at your option. However, if some parameters you set up conflict, or when an erratic condition arises, the LCD display will tell you with an error message from Table 11.1 below.

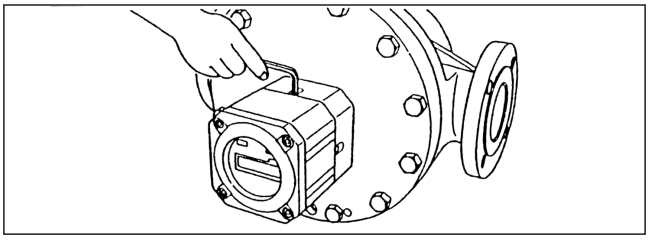
Error message	Error name	Description	Action
PA. Err.	Parameter setup error	An attempt is made to rewrite a parameter while parameters are write-protected. (In the standard model, write-protect feature is set in OFF and will not appear.)	Can be reset by placing No. 1 of display board SW2 in the OFF. (This enables you to change parameters.)
PA. Err. 1	Parameter error 1	Backup data retained for parameters has been damaged.	Following a CPU initialization, parameter reconfiguration is required.
PA. Err. 2	Parameter error 2	Some of the backup data retained for the display mode, accumulated total flow reading, and resettable total flow reading have been damaged.	Measure mode can be restored with MODE switch, but the accumulated total flow and resettable total reading will be reset to 0.
PA. Err. Pu	Pulse weight error	Pulse weight “Pu” setting is too small with respect to meter factor “F” and conversion factor “H”.	Change the setting to an appropriate value such that the relationship between F, H, and Pu satisfies the following formula: $\frac{F \times H}{2} \leqq Pu \leqq F \times H \times 10000$
AnA. Err	Analog output error	Analog output reading has exceeded 120% of full scale for one of the reasons below: ① Flowrate is excessive. ② Analog full scale setting is too large.	In case ①: Reduce the flowrate. In case ②: Select an appropriate analog full scale FS setting with respect to the flowmeter specification.
Out. Err	Pulse output error	Pulse “OFF” width in the factored pulse output falls short of 1 msec for one of the reasons below: ① Flowrate is excessive. ② Factored pulse width setting is too large.	In case ①: Reduce the flowrate. In case ②: Select an appropriate factored pulse width Pon setting with respect to the flowmeter specification.
BATT	Battery life	Supply voltage has dropped.	Replace the battery with a new one.

Table 11.2 Screen Transition Chart of Parameter Change

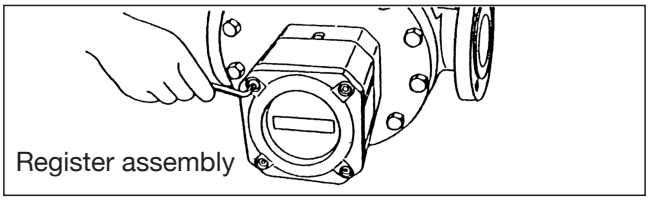


12. SENSOR REPLACEMENT

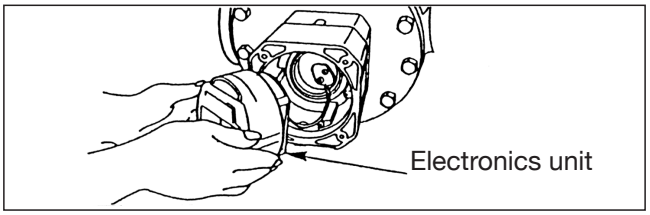
➡ **NOTE: Size 29 meter body is shown here. The same procedure applies to other size models.**



① Take off four hex socket head bolts on the register.

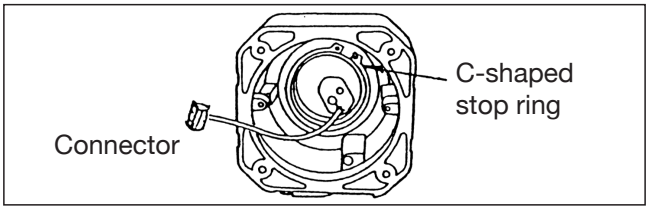


③ Take off four hex socket head bolts and separate the cover.

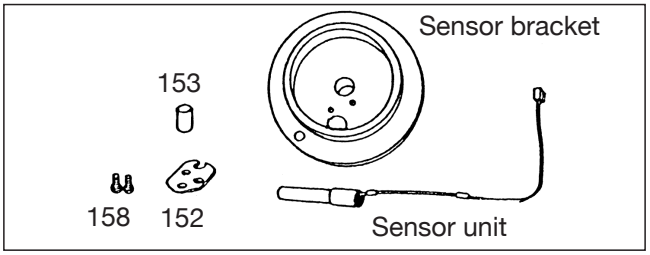


⑤ Holding the electronics unit in both hands, carefully draw it out.

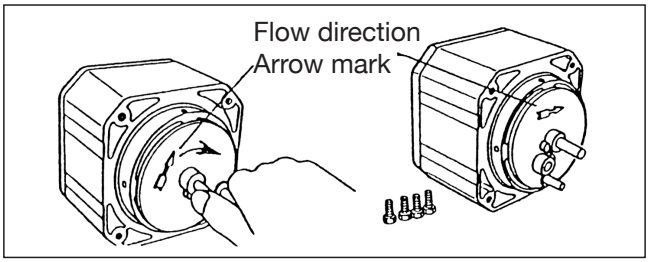
⚠**CAUTION: Use extra care not to damage the leads by forcing the sensor bracket.**

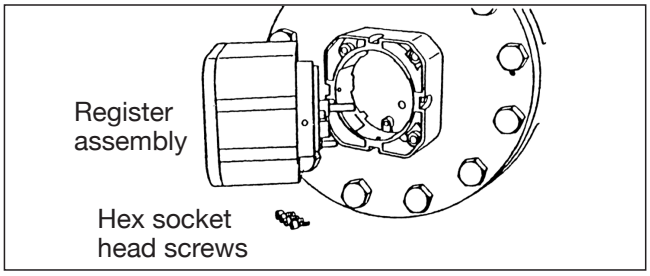


⑦ Using C-shaped stop ring pliers, remove the C-shaped stop ring for the shaft. The sensor unit is now separable from the register housing.

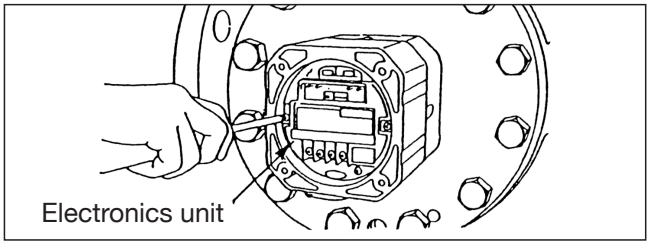


⑨ Install a new sensor unit through the opening through which the old sensor unit was removed and assemble in the reverse order of disassembly.

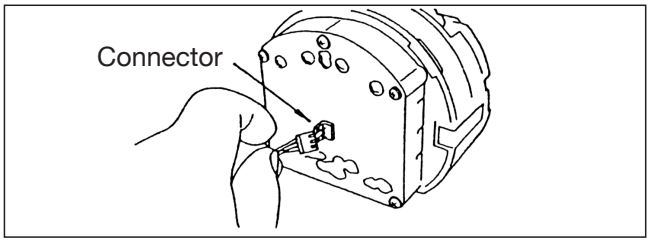




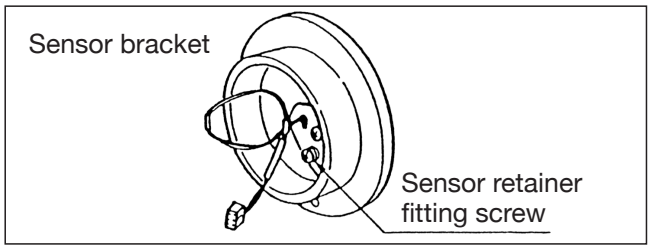
② Carefully draw the register assembly out. Be careful not to bump the sensor against adjacent components, draw it out in the horizontal direction.



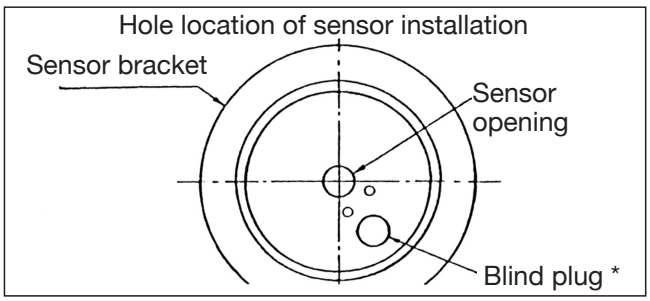
④ With screwdriver, take off two fitting screws holding the electronics unit.



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



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



➡ NOTE: Sensor location varies with model. Sizes 28, 29, 31 and 60 double-case construction, and sizes 32 and 33 double-case construction as well as size 34 single-case construction meters have the sensor opening marked *.

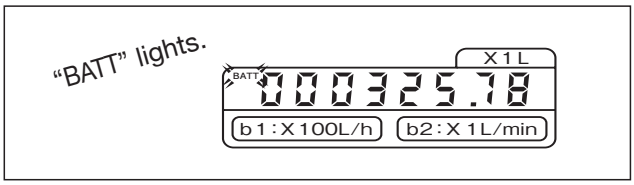
⑩ At register installation on meter body, match the flow direction arrow of meter body with that of sensor bracket.

13. BATTERY REPLACEMENT

13.1 Battery Pack

(1) When the battery has depleted, a low battery alarm “BATT” appears on the register display. This alarm tells you it’s time to replace the battery within a week.

(2) This dedicated battery pack is provided with a connector. Other commercially available batteries cannot be used. Be sure to use the battery pack dedicated to this register.

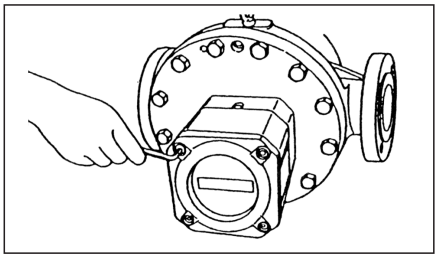


➡ NOTE

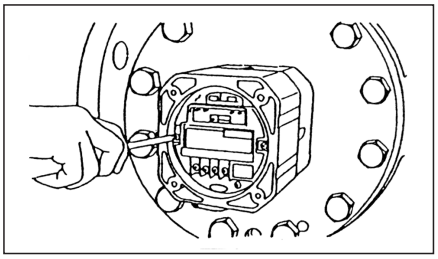
(※) Battery life is 8 years approx. on a continuous run basis without external power supply. (It varies with operating and environmental conditions, however.)

13.2 Battery Pack Replacement

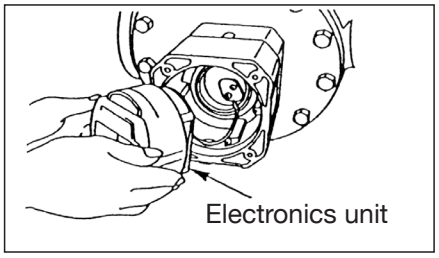
⚠ **CAUTION: If your meter is of externally powered type, turn off power first.**



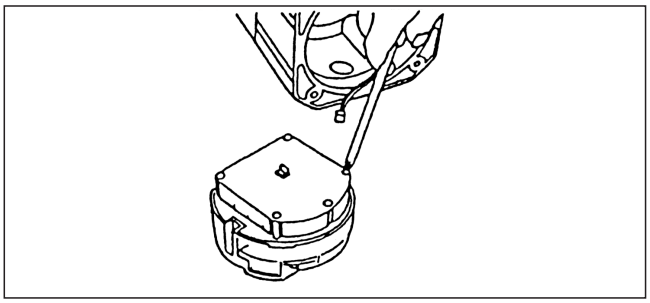
① Take off four hex socket head bolts on the front face of the register and remove the cover.



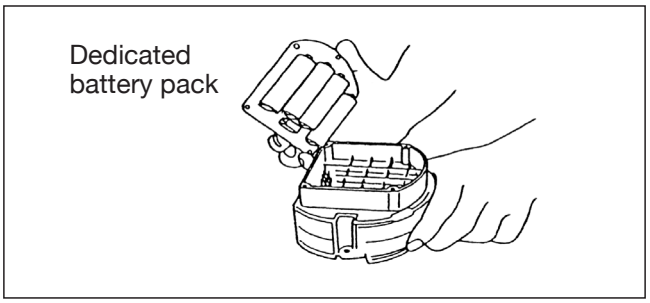
② Using screwdriver, take off two fitting screws holding the electronics unit.



③ Holding the electronics unit in both hands, carefully draw it out. Be careful not to damage the sensor leads connected.



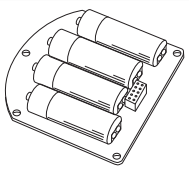
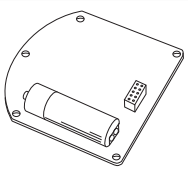
④ Uncouple the connector from the sensor unit at back of the electronics unit and take off five screws as shown.



⑤ Carefully draw the dedicated battery pack out.

⑥ Install a new battery pack. Make sure of the connector location. Forcing the battery pack into position may damage the connector or cause poor electrical contact.

◎ **Two types of dedicated battery packs are available.**

	Battery pack without external output (4 batteries)	Battery pack with external output (1 battery)
Appearance		
Life (with battery operated)	Approx. 8 years	Approx. 2 years
Applicable range	Applicable to the battery pack without external output (Usable for the battery pack with external output)	Applicable to the battery pack with external output (Not usable for the battery pack without external output)

IMPORTANT

When you replace batteries, contact your nearest OVAL designated service station and use dedicated battery packs.

⚠WARNING

This dedicated battery pack is of intrinsic safety explosionproof configuration. Never attempt to disassemble it.

14. TROUBLESHOOTING

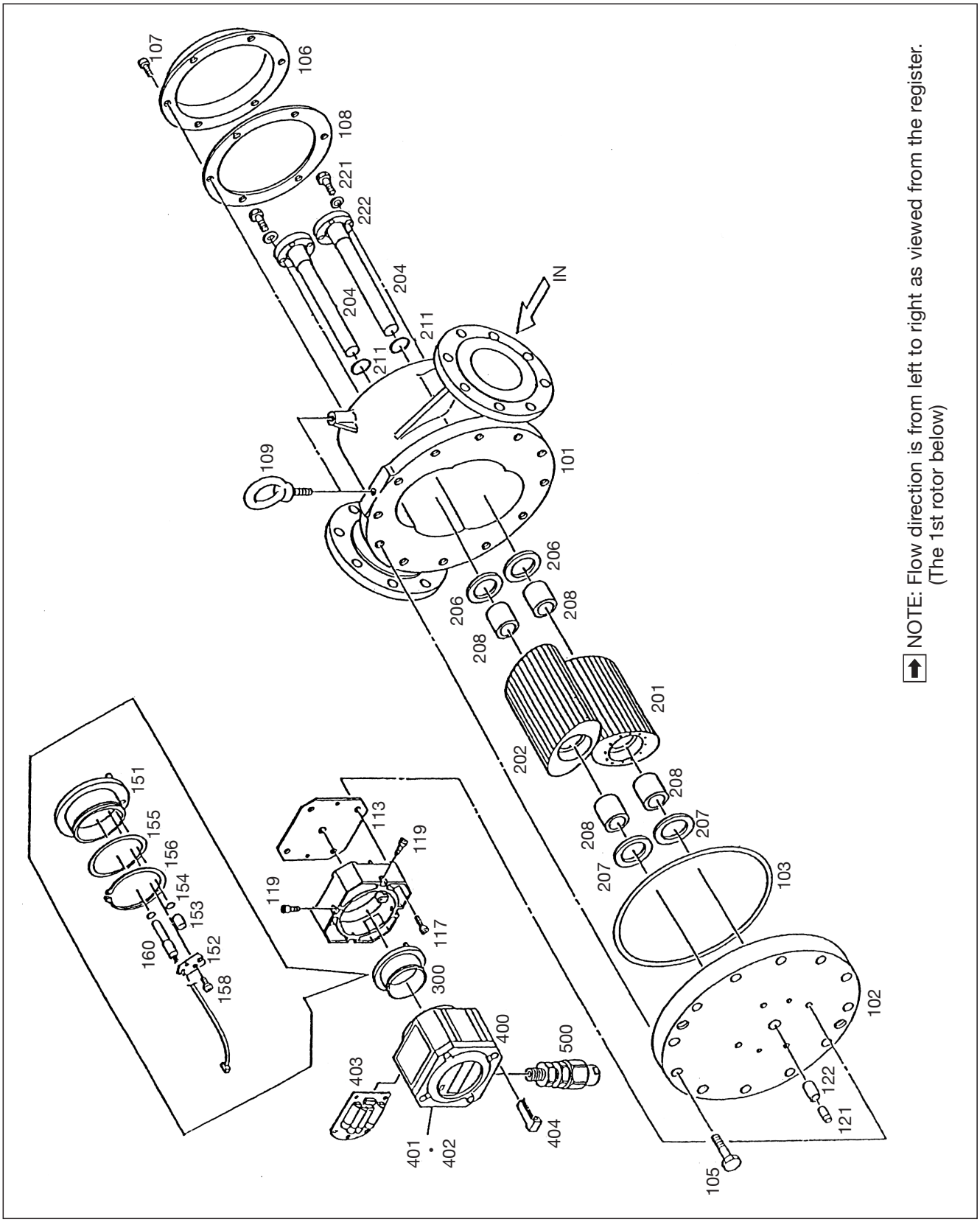
Problem	Possible cause	Handling
1. Totalizer is inoperative.	1. Flowrate is low.	1. Open valves progressively.
	2. Insufficient pump pressure or head pressure.	2. Taking pressure loss of the entire piping assembly into consideration, correct pump pressure or head pressure.
	3. Power line voltage is out of specification or current carrying capacity of power source is inadequate.	3. Provide a 12 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 option, 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 (page 21), disassemble meter body and wash clean the rotors and other components thoroughly.
	5. Oval rotors installed upside down.	5. Referring to Disassembly and Inspection Procedure (page 21), install the rotors in their correct position.
	6. Sensor installed out of position.	6. Referring to “Reversing the Flow Direction” (page 14), install the sensor in the correct position.
2. Unusual noise.	1. Air is entrapped.	1. Reduce the flowrate and eliminate air in the piping assembly completely.
	2. Vaporized metered liquid in the piping assembly.	2. Reduce the flowrate and control metered fluid temperature and pressure to prevent vaporization.
	3. Oval rotors revolving in contact with measuring chamber.	3. Referring to Disassembly and Inspection Procedure (page 21), disassemble and inspect for condition. Correct as necessary.
3. “BATT” lights up.	1. Battery voltage is low.	1. Referring to page 42, replace the battery pack.
4. Liquid leaks.	1. Incomplete seal of the pipeline.	1. Retighten bolts at pipeline connections and replace O-rings and gaskets as necessary.
	2. Incomplete seal of the cover of meter body.	2. Inspect cover fitting bolts for tightness and replace O-rings (or gaskets) as necessary.
5. Counts while valves remain closed.	1. Valve and pipeline leak.	1. Inspect valves and piping assembly.
	2. Air pockets between valve and oval flowmeter; rotors turn 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.
6. Analog output unusual.	1. Load resistance too high	1. Referring to “Load Resistance Range” on page 17, check load resistance to power supply voltage relationship. Adjust the load resistance within the specified range.
7. 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 (Meter sensor picks up external magnetic fields created by a motor, generator, etc.)	2. Keep external magnetic fields away.
	3. Air entrapped.	3. Provide an air vent.
8. Accumulated total too low.	1. Influenced by external magnetic fields.	1. Keep external magnetic fields away.

15. EXPLODED VIEWS AND PARTS LIST

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

15.1 Meter Size 29 Single-case Construction

15.1.1 Meter Size 29 Single-case Construction - Exploded View



NOTE: Parts list appears on the next page.

15.1.2 Meter Size 29 Single-case Construction - Parts List

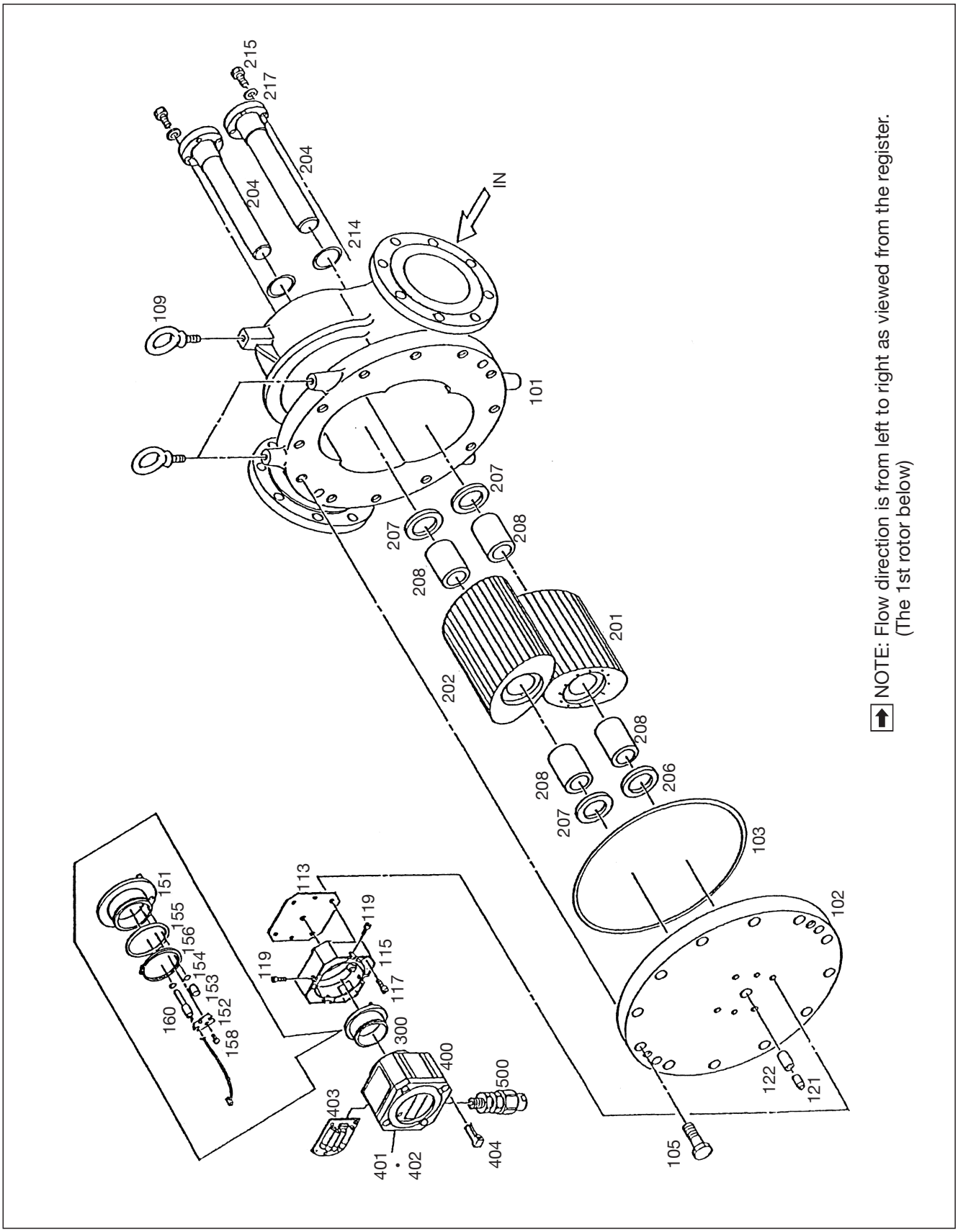
Symbol No.	Part Name	Q'ty	Remarks
100	Meter body assembly	1 set	
101	Meter body	1	
102	Front cover	1	
▲103	O-ring	1	
105	Front cover fitting bolt	12	M16×60
106	Rear cover	1	
107	Rear cover fitting bolt	6	M8×20
108	Rear cover gasket	1	
109	Eyebolt	2	M10×18
113	Gasket	1	
115	Adapter	1	
117	Adapter fitting bolt	4	M10×35
119	Register fitting bolt	4	M6×15
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
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 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 (with washer)
403	Battery pack	1	Option
404	Selector magnet	1	
405	Internal assembly	1 set	
500	Pressuretight packing	1 set	Option

※: Rotors and rotor bearings are supplied as matched pairs.

▲: Recommended spare parts.

15.2 Meter Size 60 Single-case Construction

15.2.1 Meter Size 60 Single-case Construction - Exploded View



➡ NOTE: Parts list appears on the next page.

15.2.2 Meter Size 60 Single-case Construction - Parts List

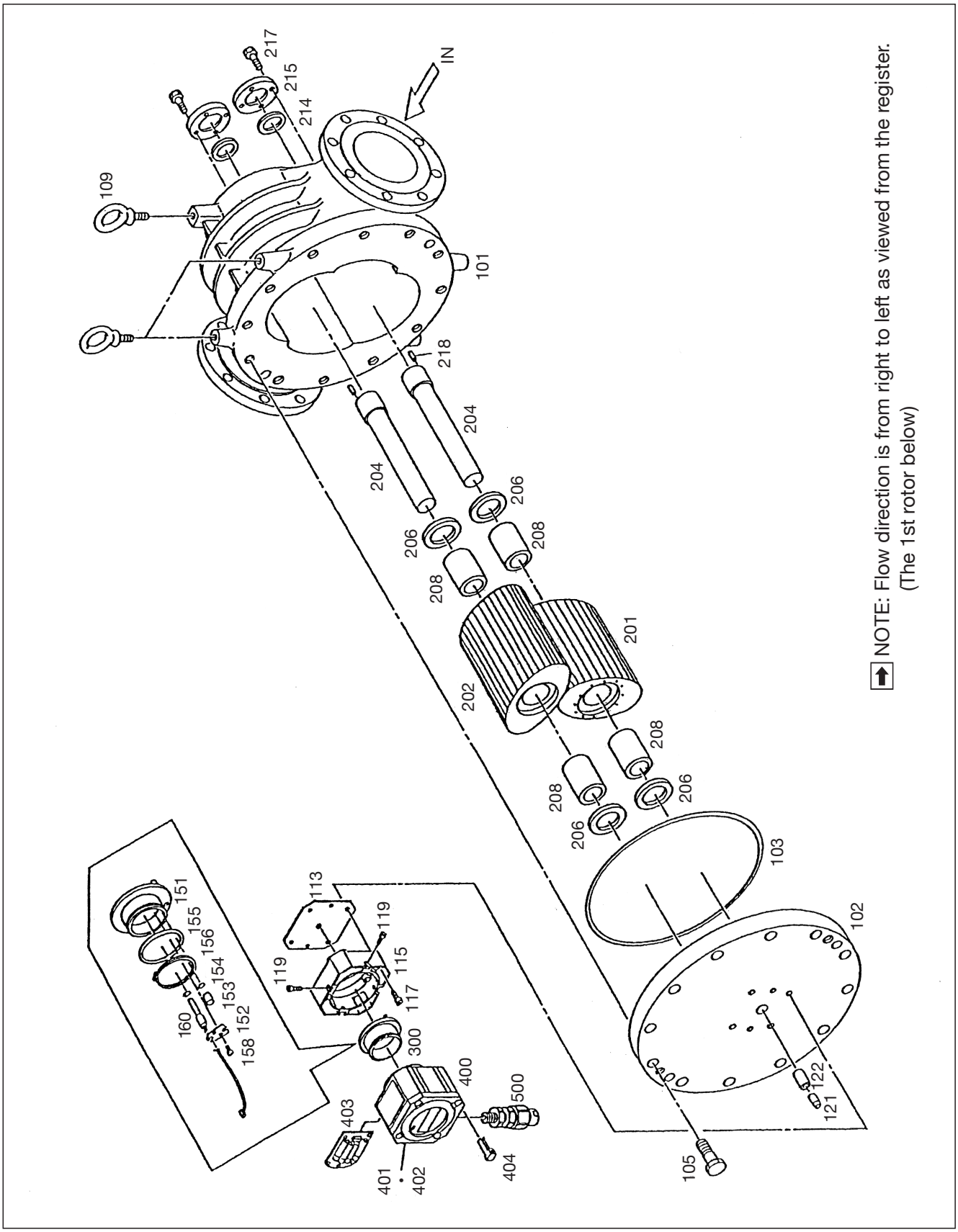
Symbol No.	Part Name	Q'ty	Remarks
100	Meter body assembly	1 set	
101	Meter body	1	
102	Front cover	1	
▲103	O-ring	1	JIS P-320
105	Front cover fitting bolt	12	M16×60
109	Eyebolt	2	M12
113	Gasket	1	
115	Adapter	1	
117	Adapter fitting bolt	4	M10×35
119	Register fitting bolt	4	M6×15
121	Iron slug	1	
122	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	1	
207	Thrust ring B	3	
※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
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 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 (with washer)
403	Battery pack	1	Option
404	Selector magnet	1	
405	Internal assembly	1 set	
500	Pressuretight packing	1 set	Option

※: Rotors and rotor bearings are supplied as matched pairs.

▲: Recommended spare parts.

15.3 Meter Size 31 Single-case Construction

15.3.1 Meter Size 31 Single-case Construction - Exploded View



➡ NOTE: Parts list appears on the next page.

15.3.2 Meter Size 31 Single-case Construction - Parts List

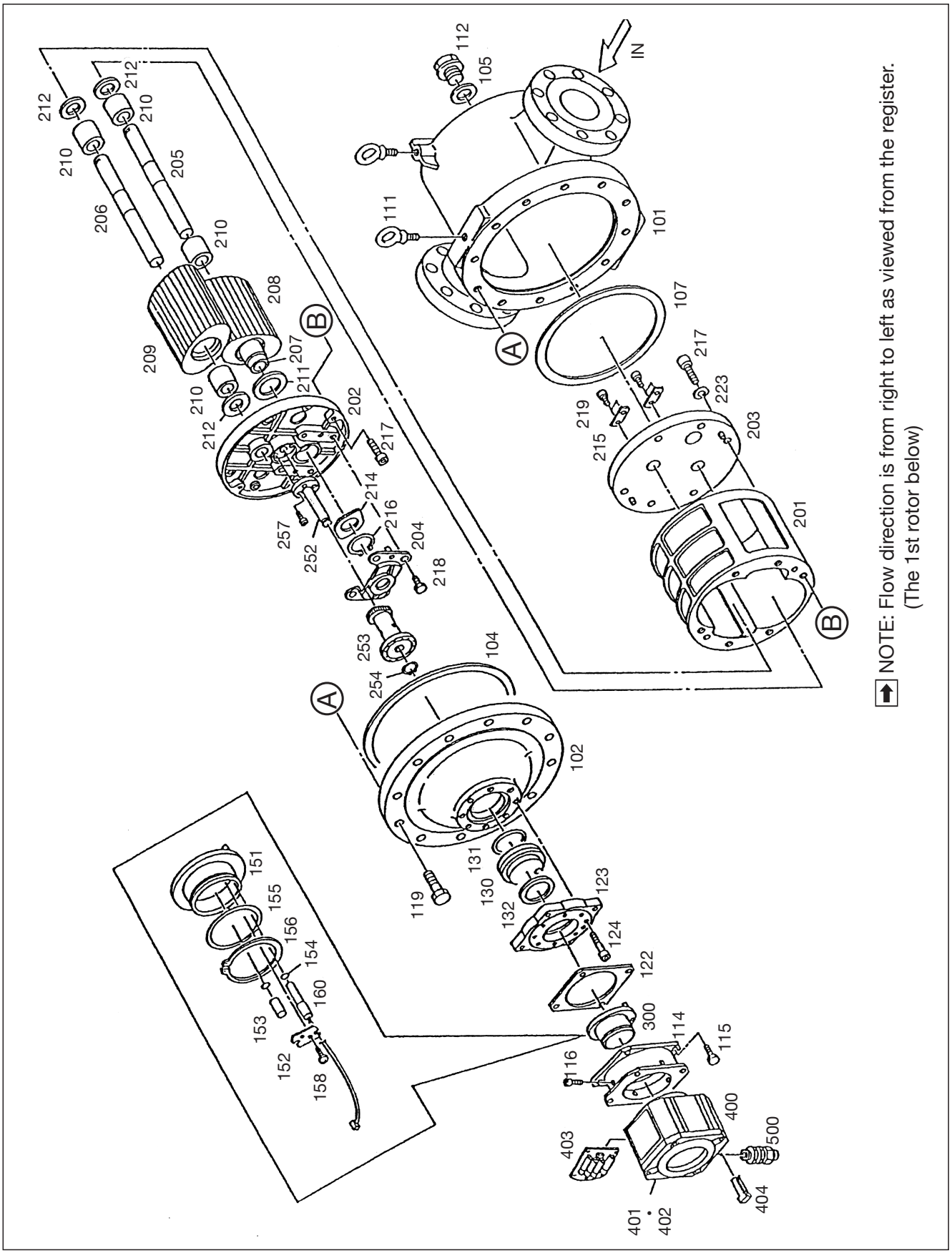
Symbol No.	Part Name	Q'ty	Remarks
100	Meter body assembly	1 set	
101	Meter body	1	
102	Front cover	1	
▲103	O-ring	1	JIS P-400
105	Front cover fitting bolt	12	M24×75
109	Eyebolt	2	M12
113	Gasket	1	
115	Adapter	1	
117	Adapter fitting bolt	4	M10×35
119	Register fitting bolt	4	M6×15
121	Iron slug	1	
122	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	4	
※208	Rotor bearing	4	
214	Keystone ring	2	
215	Blind cover	2	
217	Blind cover fitting bolt	8	M10×35
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 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 (with washer)
403	Battery pack	1	Option
404	Selector magnet	1	
405	Internal assembly	1 set	
500	Pressuretight packing	1 set	Option

※: Rotors and rotor bearings are supplied as matched pairs.

▲: Recommended spare parts.

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

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



NOTE: Parts list appears on the next page.

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

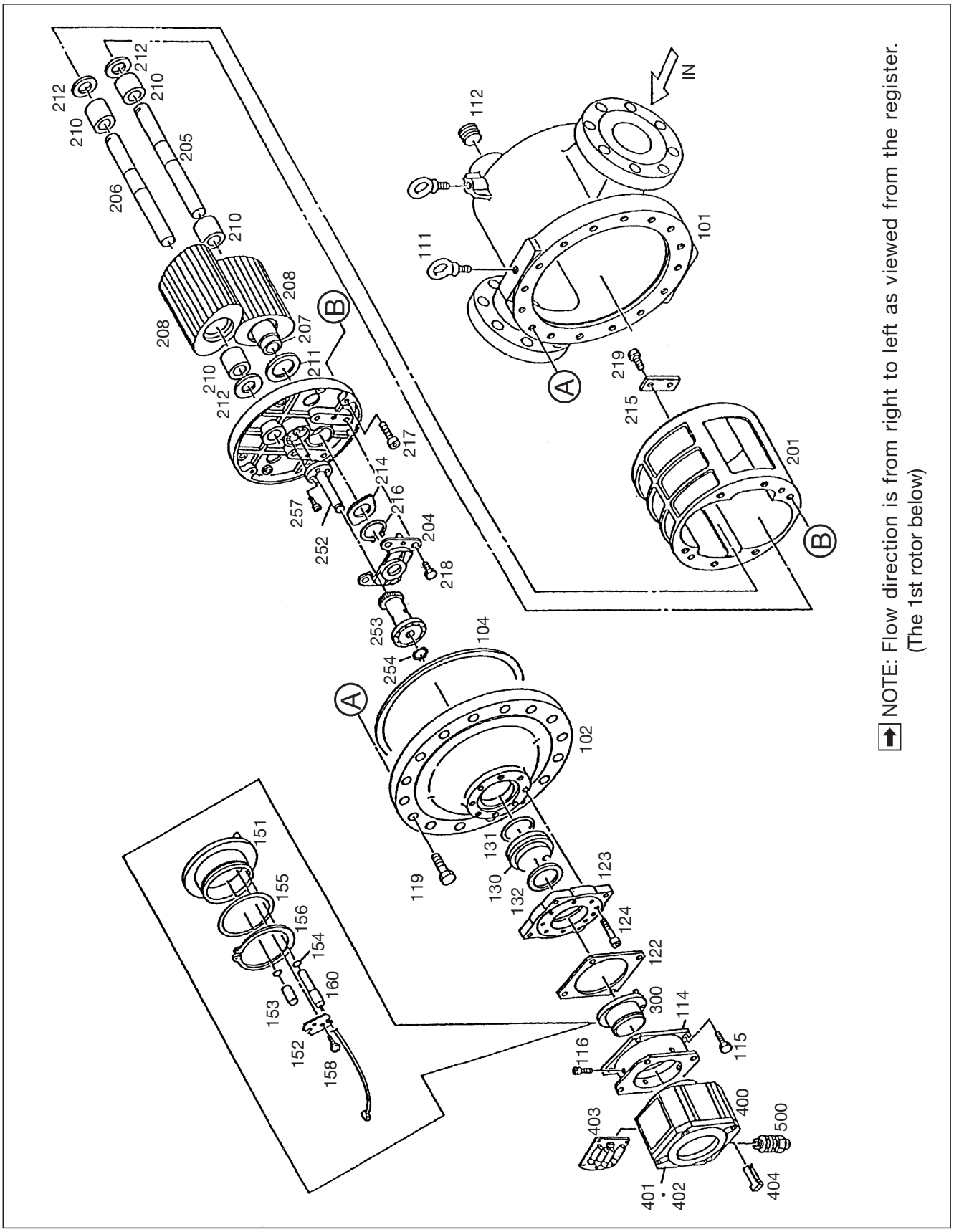
Symbol No.	Part Name	Meter size 28		Meter size 29		Meter size 31	
		Q'ty	Remarks	Q'ty	Remarks	Q'ty	Remarks
100	Outer case assembly	1 set		1		1 set	
101	Outer case	1		1		1	
102	Front cover	1		1		1	
▲104	Gasket, Outer case top cover	1		1		1	
105	Blind plug gasket	1		1		1	
107	Gasket, Inner case bottom 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	M6×15	4	M6×15	4	M6×15
119	Outer case top cover fitting bolt	12	M16×65	12	M16×65	12	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	(151-158,160)				
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				
403	Battery pack	1	Option				
404	Selector magnet	1					
405	Internal assembly	1 set					
500	Pressuretight packing	1 set	Option				

※: Rotors, rotor bearings and uniform-motion gear bosses are supplied as matched pairs.

▲: Recommended spare parts.

15.5 Meter Size 60 Double-case Construction 10K Type

15.5.1 Meter Size 60 Double-case Construction 10K Type - Exploded View



➡ NOTE: Parts list appears on the next page.

15.5.2 Meter Size 60 Double-case Construction 10K Type - Parts List

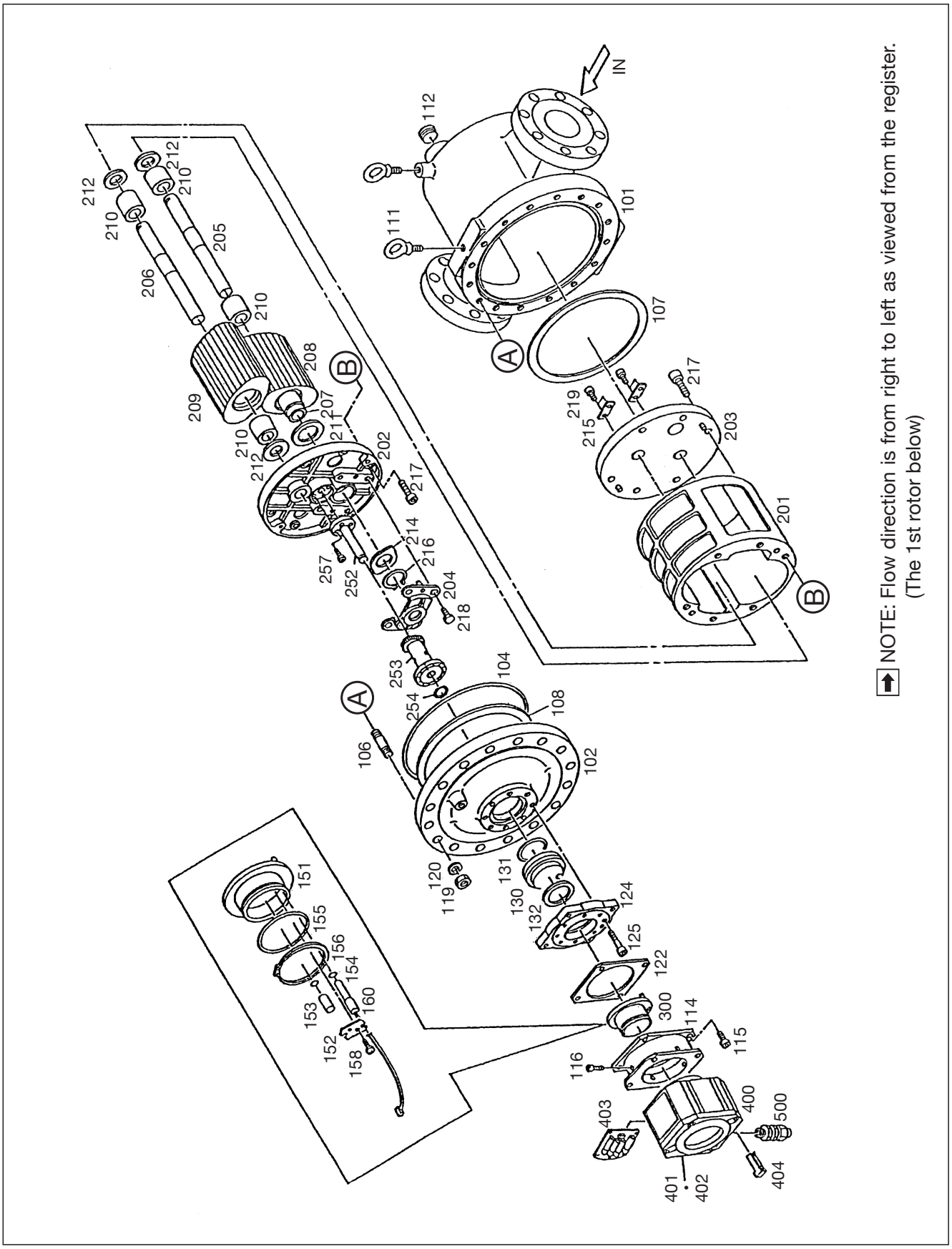
Symbol No.	Part Name	Q'ty	Remarks
100	Outer case assembly	1 set	
101	Outer case	1	
102	Front cover	1	
▲104	Gasket	1	
111	Eyebolt	2	
112	Blind plug	2	R1
114	Adapter	1	
115	Adapter fitting bolt	4	M10×20
116	Register fitting bolt	4	M6×15
119	Front cover fitting bolt	16	M16×65
122	Gasket	1	
123	Sealing plate	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	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	End plate 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 generating magnet shaft	1	
253	Signal generating magnet assembly	1 set	
254	Stop ring	1	
257	Signal generating magnet shaft fitting bolt	4	M5
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 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
403	Battery pack	1	Option
404	Selector magnet	1	
405	Internal assembly	1 set	
500	Pressuretight packing	1 set	Option

※: Rotors, rotor bearings and uniform-motion gear bosses are supplied as matched pairs.

▲: Recommended spare parts.

15.6 Meter Sizes 28, 29 and 31 Double-case Construction 30K Type (F3)

15.6.1 Meter Sizes 28, 29 and 31 Double-case Construction 30K Type (F3) - Exploded View



NOTE: Parts list appears on the next page.

15.6.2 Meter Sizes 28, 29 and 31 Double-case Construction 30K Type (F3) – Parts List

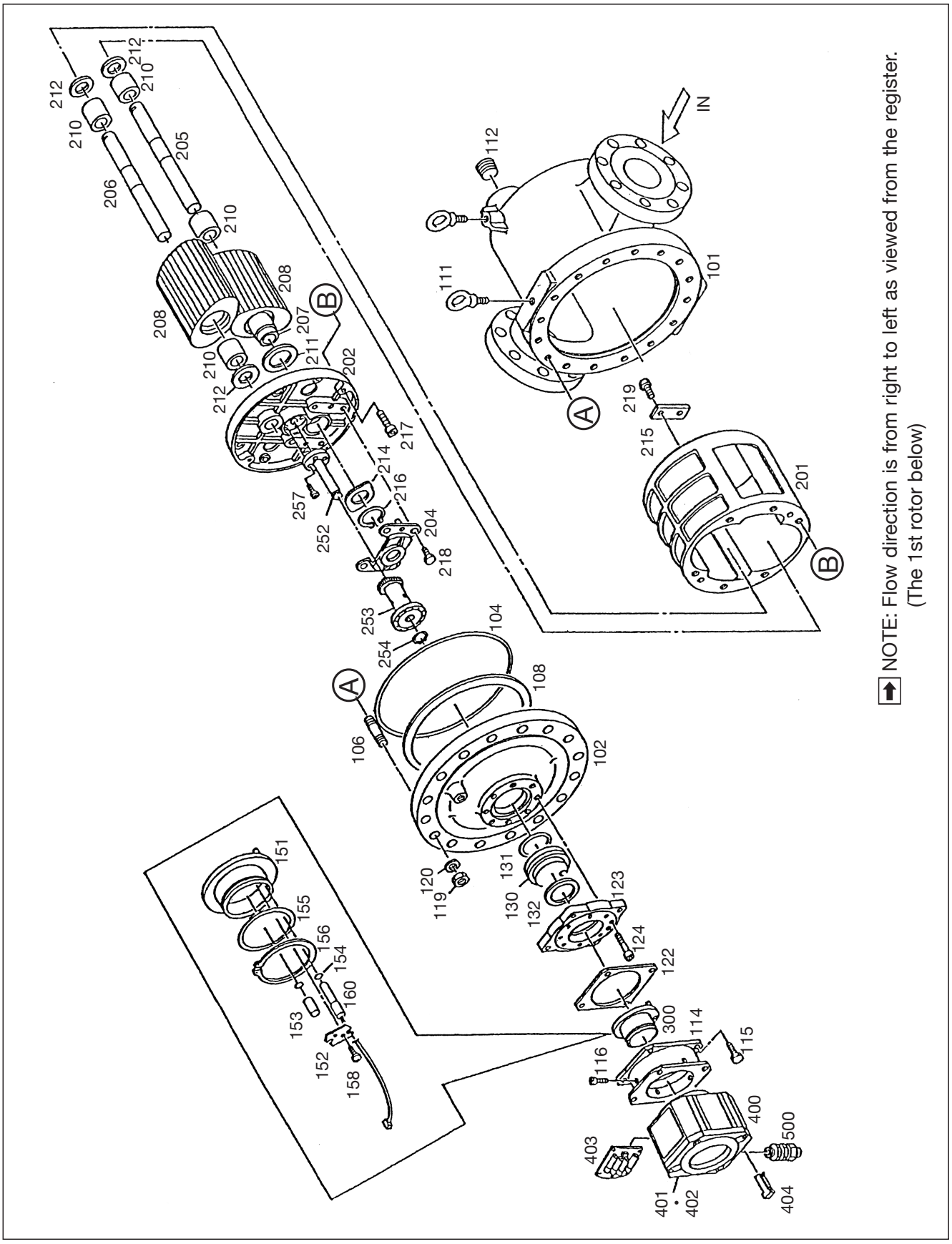
Symbol No.	Part Name	Q'ty	Remarks
100	Outer case assembly	1 set	
101	Outer case	1	
102	Front cover	1	
▲104	O-ring	1	
106	Stud bolt	16	
107	Gasket, inner case bottom	1	
108	Gasket, inner case top	1	
111	Eyebolt	2	
112	Blind plug	2	R1
114	Adapter	1	
115	Adapter fitting bolt	4	
116	Register fitting bolt	4	M6
119	Nut	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 generating magnet shaft	1	
253	Signal generating magnet assembly	1 set	
254	Stop ring	1	
257	Signal generating magnet shaft fitting bolt	4	M5
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 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
403	Battery pack	1	Option
404	Selector magnet	1	
405	Internal assembly	1 set	
500	Pressuretight packing	1 set	Option

※: Rotors, rotor bearings and uniform-motion gear bosses are supplied as matched pairs.

▲: Recommended spare parts.

15.7 Meter Size 60 Double-case-construction 30K Type (F3)

15.7.1 Meter Size 60 Double-case Construction 30K Type (F3) - Exploded View



➡ NOTE: Parts list appears on the next page.

15.7.2 Meter Size 60 Double-case Construction 30K Type (F3) - Part List

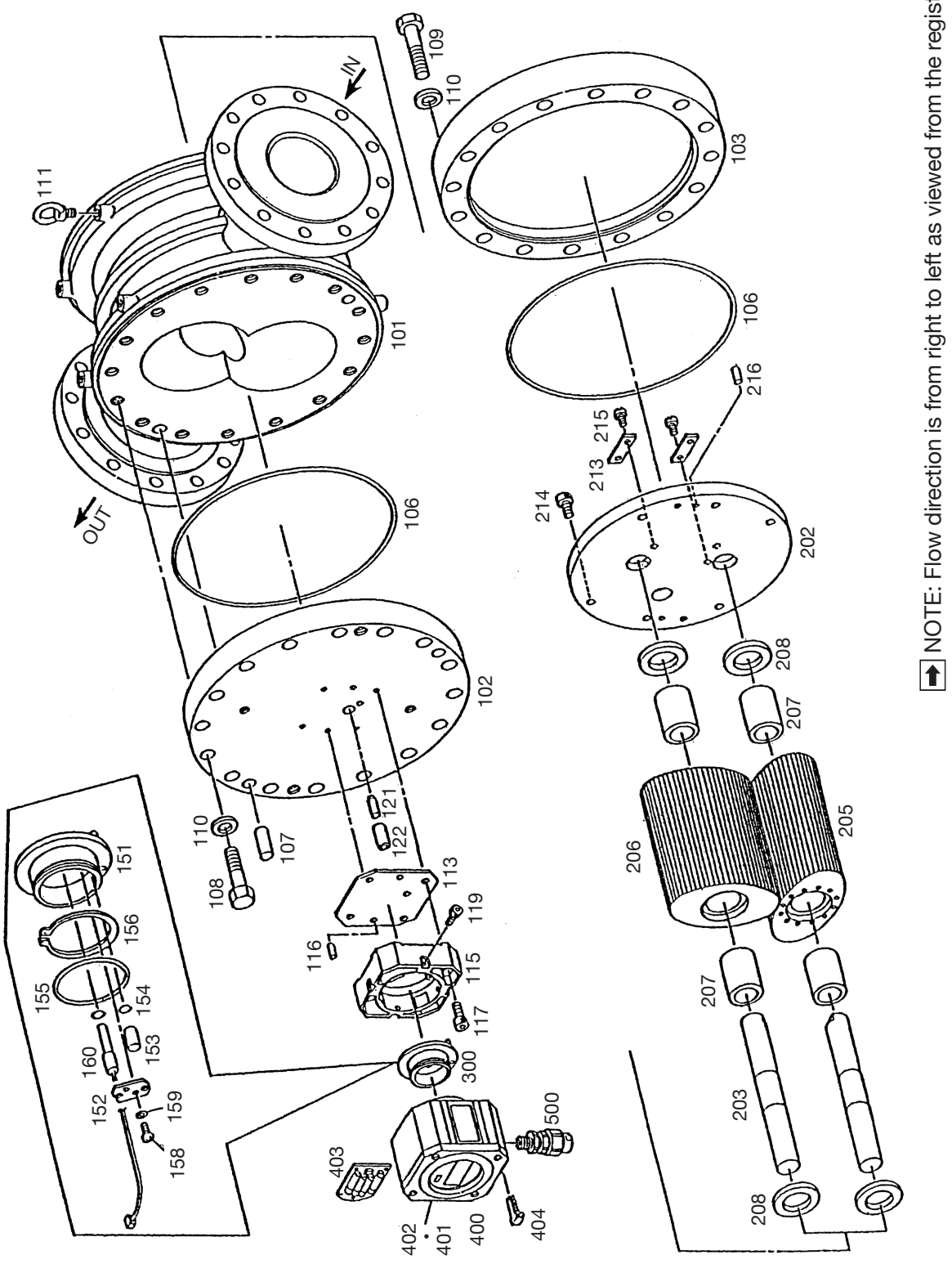
Symbol No.	Part Name	Q'ty	Remarks
100	Outer case assembly	1 set	
101	Outer case	1	
102	Front cover	1	
▲104	O-ring	1	P320
106	Stud bolt	16	M20×95
108	Gasket, inner case top	1	
111	Eyebolt	2	M12×22
112	Blind plug	2	R1
114	Adapter	1	
115	Adapter fitting bolt	4	M10×20
116	Register fitting bolt	4	M6×15
119	Nut	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	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	End plate 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 generating magnet shaft fitting bolt	4	M5
300	Sensor assembly	1 set	(151-158, 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
403	Battery pack	1	Option
404	Selector magnet	1	
405	Internal assembly	1 set	
500	Pressuretight packing	1 set	Option

※: Rotors, rotor bearings and uniform-motion gear bosses are supplied as matched pairs.

▲: Recommended spare parts.

15.8 Meter Sizes 32 and 33 Single-case Construction

15.8.1 Meter Sizes 32 and 33 Single-case Construction - Exploded View



NOTE: Flow direction is from right to left as viewed from the register. (The 1st rotor below)

NOTE: Parts list appears on the next page.

15.8.2 Meter Sizes 32 and 33 Single-case Construction - Parts List

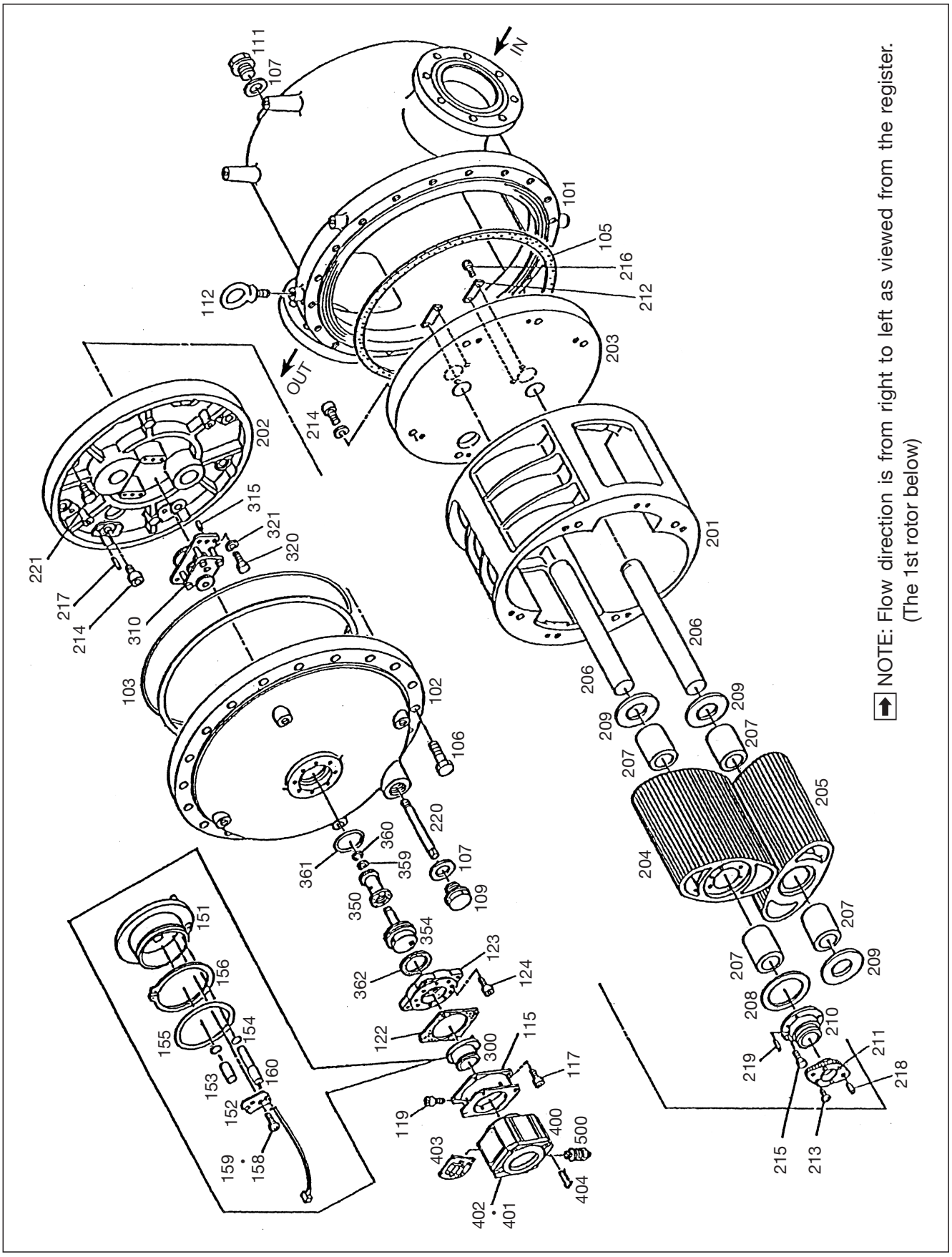
Symbol No.	Part Name	Q'ty	Remarks
100	Meter body assembly	1 set	
101	Meter body	1	
102	Front cover	1	
103	Rear cover	1	
▲106	O-ring	2	Size 32: ϕ460×ϕ8.4 Size 33: ϕ535×ϕ8.4
107	Locating pin	2	
108	Front cover fitting bolt	16	M24
109	Rear cover fitting bolt	16	M24
110	Washer	32	M24
111	Eyebolt	4	M16
113	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 generating magnets
※206	2nd rotor	1	
※207	Rotor bearing	4	
208	Thrust ring	4	
213	Rotor non-turn strip	2	
214	Bottom cover fitting bolt	6	M20
215	Flat fillister head screw	4	M8
216	Locating pin	2	
300	Sensor assembly	1 set	(151-160)
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	
400	Register assembly	1 set	
401	Front cover	1	
402	Cover fitting bolt	4	M6
403	Battery pack	1	Option
404	Selector magnet	1	
405	Internal assembly	1 set	
500	Pressuretight packing	1 set	Option

※: Rotors, rotor bearings and uniform-motion gear bosses are supplied as matched pairs.

▲: Recommended spare parts.

15.9 Meter Sizes 32 and 33 Double-case Construction 10K Type

15.9.1 Meter Sizes 32 and 33 Double-case Construction 10K Type - Exploded View



NOTE: Parts list appears on the next page.

15.9.2 Meter Sizes 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	
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	M6×15
122	Gasket	1	
123	Sealing flange	1	
124	Sealing flange 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	First rotor	1	
※205	Second 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 strip	2	
213	Unif. motion gear screw	4	
214	Top/bottom cover fitting bolt	12	W3/4
215	Bolt, unif. motion gear	4	M10
216	Non-turn strip fitting bolt	4	
217	Inr. case cover locating pin	4	
218	Pin, unif. motion drive gear	2	
219	Pin, unif. motion gear boss	2	
220	Blind hole bolt plug A	1	
221	Blind plug	1	

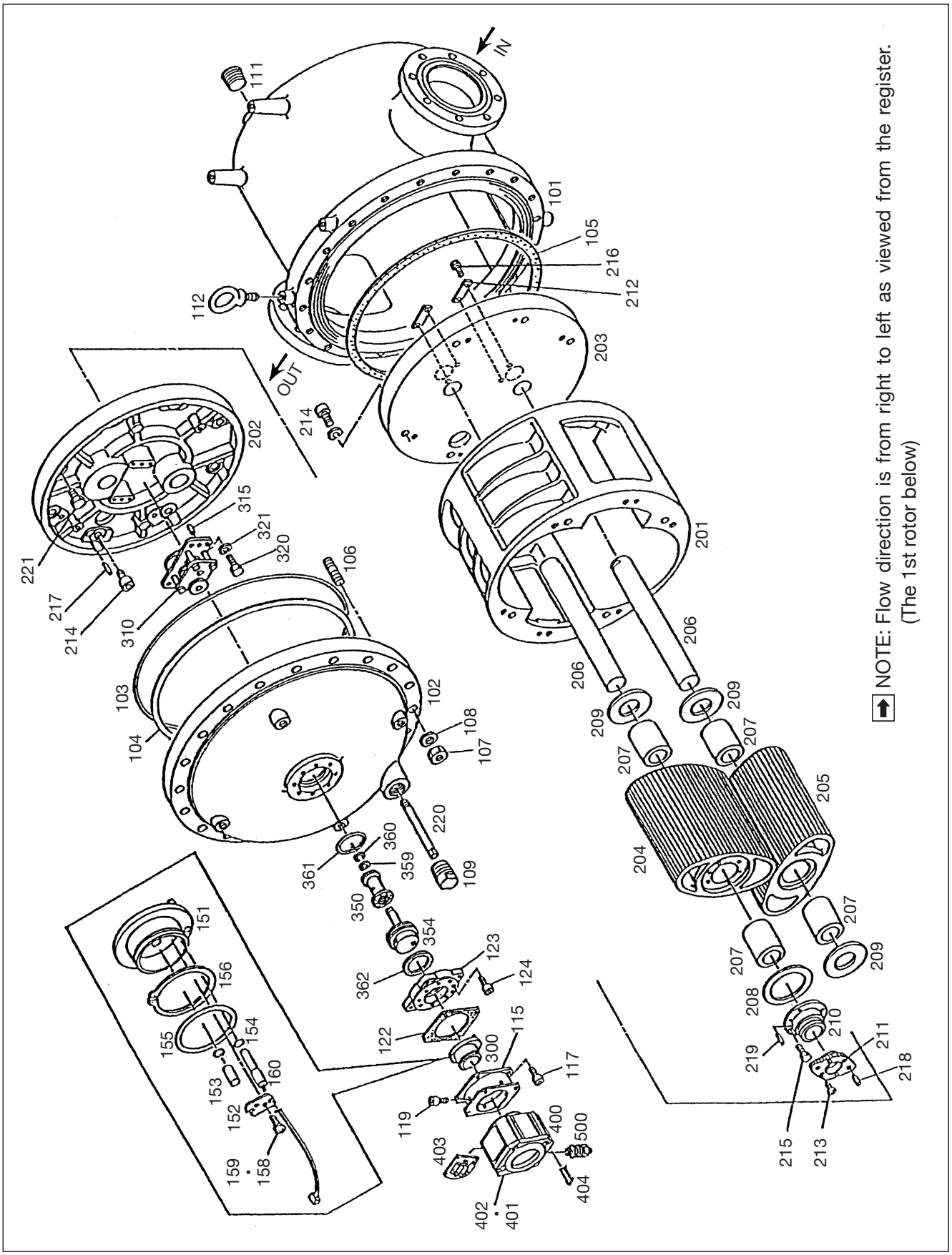
Symbol No.	Part Name	Q'ty	Remarks
300	Sensor assembly	1 set	(151 – 160)
151	Sensor fitting disc	1	
152	Sensor retainer	1	
153	Blind plug	1	
154	O-ring B	2	S10
155	O-ring C	1	G65
156	C-shaped stop ring	1	
158	Pan head screw	2	M4
159	Washer	2	M4
160	Sensor unit	1	
310	Transmission gear train	1 set	
315	Pin	2	
320	Hex bolt	4	
321	Spring washer	4	
350	Signal magnet assembly	1 set	w/signal magnet and transmission gear
354	Pressuretight sealing plate	1	
359	Thrust spacer	1	
360	C-ring	1	
▲361	O-ring	1	
362	Sealing plate gasket	1	t 0.4
400	Register assembly	1 set	
401	Register cover	1	
402	Cover fitting bolt	4	M6
403	Battery pack	1	Option
404	Selector magnet	1	
405	Internal assembly	1 set	
500	Pressuretight packing	1 set	Option

※: Rotors, rotor bearings are supplied as matched pairs.

▲: Recommended spare parts.

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

15.10.1 Meter Sizes 32 and 33 Double-case Construction 30K Type (F3) - Exploded View



NOTE: Parts list appears on the next page.

15.10.2 Meter Sizes 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 plug	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	Sealing flange 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 strip	2	
213	Unif. motion gear screw	4	
214	Top/bottom cover fitting bolt	12	W3/4
215	Bolt, unif. motion gear boss	4	M10
216	Non-turn strip fitting bolt	4	
217	Ine. case cover locating pin	4	
218	Pin, unif. motion drive gear	2	
219	Pin, unif. motion gear boss	2	
220	Blind hole bolt plug A	1	
221	Blind plug	1	

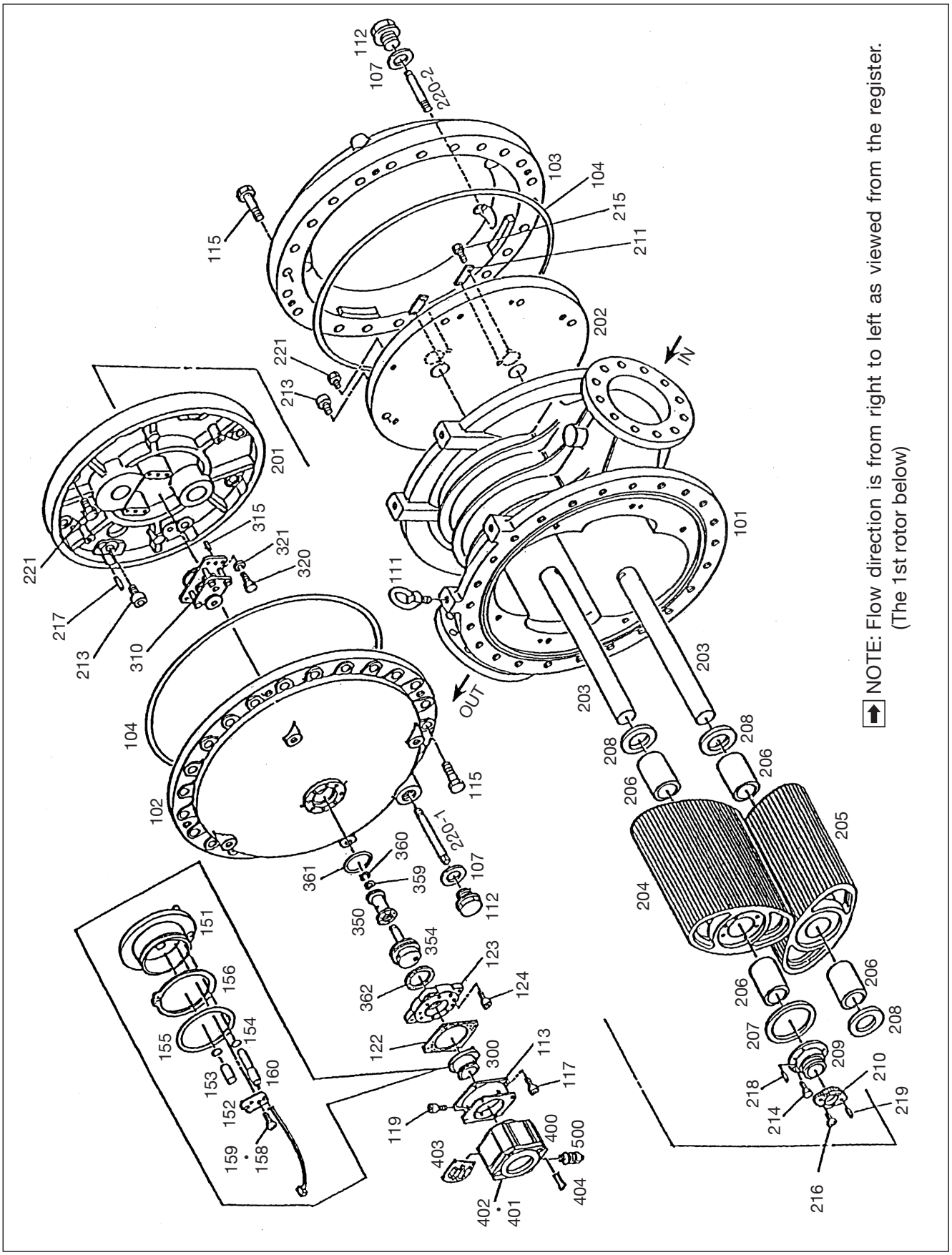
Symbol No.	Part Name	Q'ty	Remarks
300	Sensor assembly	1 set	(151–160)
151	Sensor fitting disc	1	
152	Sensor retainer	1	
153	Blind plug	1	
154	O-ring B	2	S10
155	O-ring C	1	G65
156	C-shaped stop ring	1	
158	Pan head screw	2	M4
159	Washer	2	M4
160	Sensor unit	1	
310	Transmission gear train	1 set	
315	Pin	2	
320	Hex bolt	4	
321	Spring washer	4	
350	Signal magnet assembly	1 set	w/signal magnet and transmission gear
354	Pressuretight sealing plate	1	
359	Thrust spacer	1	
360	C-ring	1	
▲361	O-ring	1	
362	Sealing plate gasket	1	t 0.4
400	Register assembly	1 set	
401	Register cover	1	
402	Cover fitting bolt	4	M6
403	Battery pack	1	Option
404	Selector magnet	1	
405	Internal assembly	1 set	
500	Pressuretight packing	1 set	Option

※: Rotors, rotor bearings are supplied as matched pairs.

▲: Recommended spare parts.

15.11 Meter Size 34 Single-case Construction 10K Type

15.11.1 Meter Size 34 Single-case Construction 10K Type - Exploded View



NOTE: Parts list appears on the next page.

15.11.2 Meter 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	Sealing flange fitting bolt	8	M10
200	Inner case assembly	1 set	
201	Top cover	1	
202	Bottom cover	1	
203	Rotor shaft	2	
※204	First rotor	1	
※205	Second 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 strip	2	
213	Top/bottom cover fitting bolt	4	
214	Unif. motion gear boss bolt	4	
215	Shaft non-turn strip fitting bolt	4	
216	Unif. motion gear fitting 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	

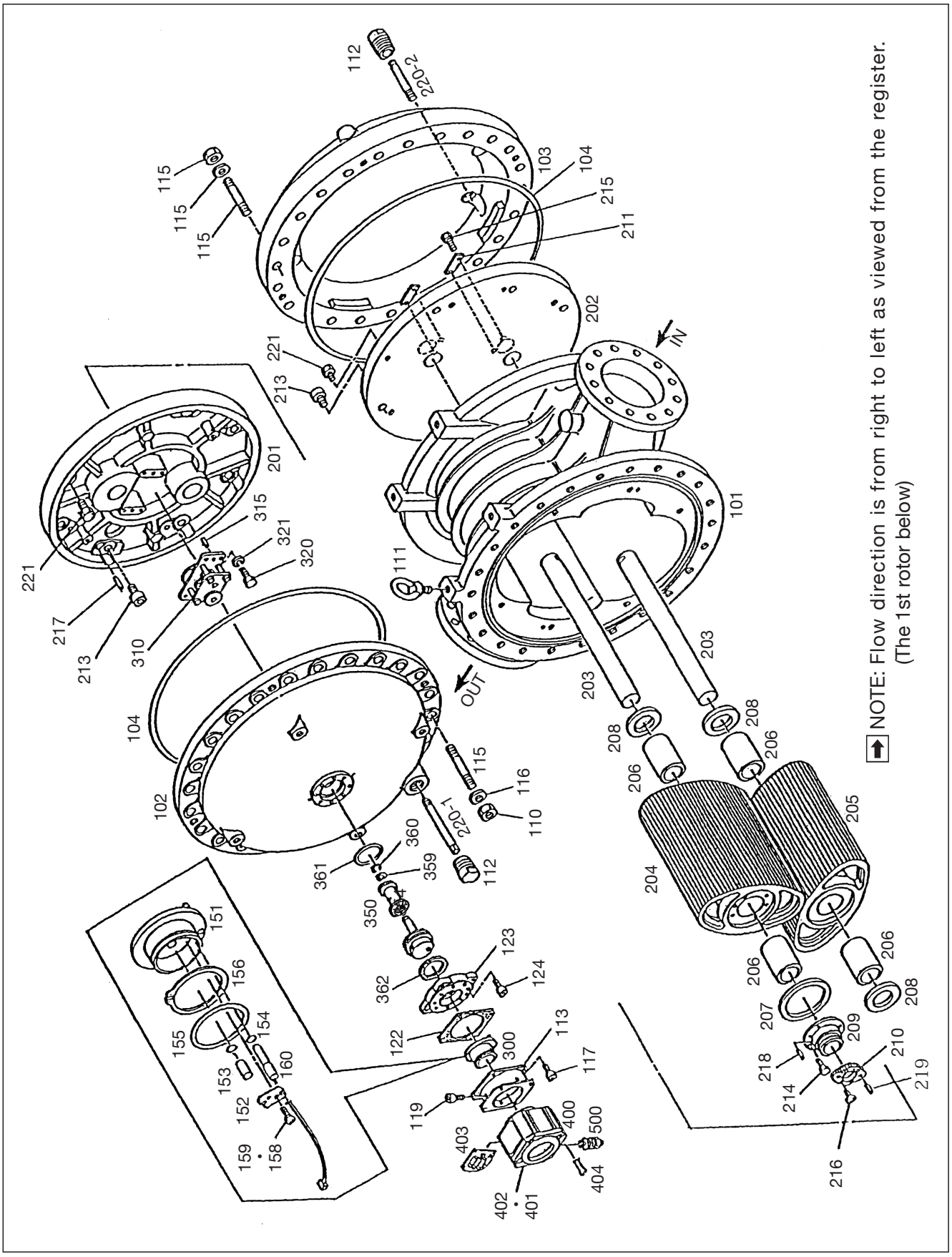
Symbol No.	Part Name	Q'ty	Remarks
300	Sensor assembly	1 set	(151–160)
151	Sensor fitting disc	1	
152	Sensor retainer	1	
153	Blind plug	1	
154	O-ring B	2	S10
155	O-ring C	1	G65
156	C-shaped stop ring	1	
158	Pan head screw	2	M4
159	Washer	2	M4
160	Sensor unit	1	
310	Transmission gear train	1 set	
315	Pin	2	
320	Hex bolt	4	
321	Spring washer	4	
350	Signal magnet assembly	1 set	w/signal magnet and transmission gear
354	Pressuretight sealing plate	1	
359	Thrust spacer	1	
360	C-ring	1	
▲361	O-ring	1	
362	Sealing plate gasket	1	t 0.4
400	Register assembly	1 set	
401	Front Cover	1	
402	Cover fitting bolt	4	M6
403	Battery pack	1	Option
404	Selector magnet	1	
405	Internal assembly	1 set	
500	Pressuretight packing	1 set	Option

※: Rotors, rotor bearings are supplied as matched pairs.

▲: Recommended spare parts.

15.12 Meter Size 34 Single-case Construction 30K Type (F3)

15.12.1 Meter Size 34 Single-case Construction 30K Type (F3) - Exploded View



➡ NOTE: Parts list appears on the next page.

15.12.2 Meter Size 34 Single-case Construction 30K Type (F3) - 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, fr./rr. cover stud bolt	48	
111	Eyebolt	4	
112	Blind hole bolt	2	
113	Adapter	1	
115	Fr./rr. 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	Sealing flange fitting bolt	8	M10
200	Inner case assembly	1 set	
201	Top cover	1	
202	Bottom cover	1	
203	Rotor shaft	2	
※204	First rotor	1	
※205	Second 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 strip	2	
213	Top/bottom cover fitting bolt	12	
214	Bolt, Unif. motion gear boss	4	
215	Shaft non-turn strip fitting bolt	4	
216	Unif. motion gear fitting 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	

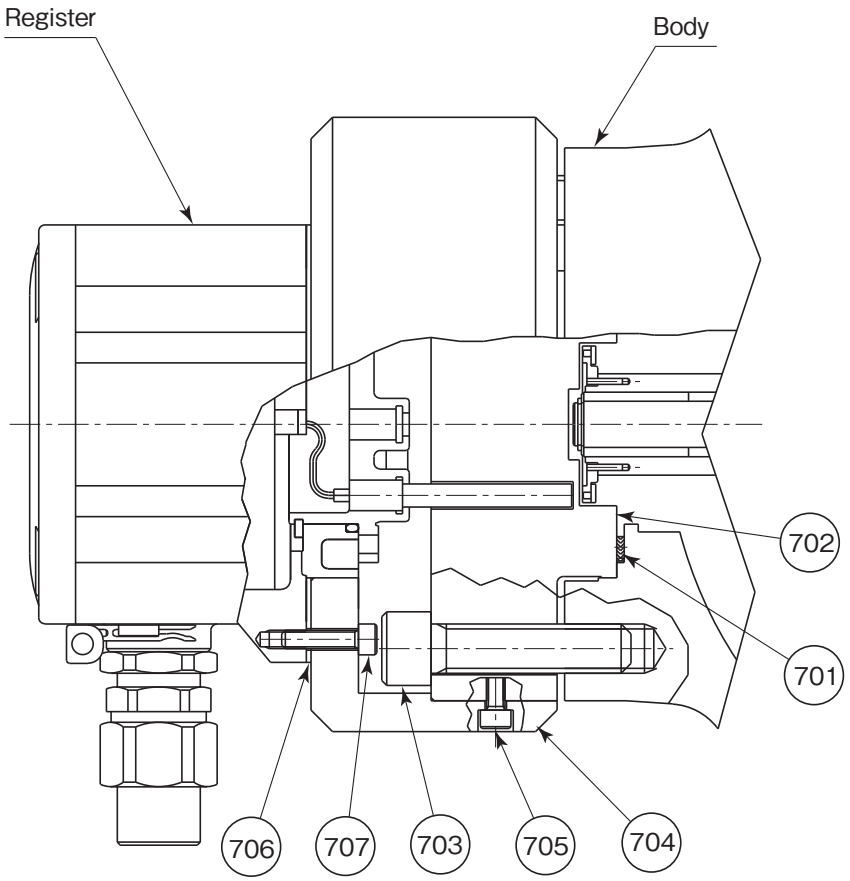
Symbol No.	Part Name	Q'ty	Remarks
300	Sensor assembly	1 set	(151–160)
151	Sensor fitting disc	1	
152	Sensor retainer	1	
153	Blind plug	1	
154	O-ring B	2	S10
155	O-ring C	1	G65
156	C-shaped stop ring	1	
158	Pan head screw	2	M4
159	Washer	2	M4
160	Sensor unit	1	
310	Transmission gear train	1 set	
315	Pin	2	
320	Hex bolt	4	
321	Spring washer	4	
350	Signal magnet assembly	1 set	w/signal magnet and transmission gear
354	Pressuretight sealing plate	1	
359	Thrust spacer	1	
360	C-ring	1	
▲361	O-ring	1	
362	Sealing plate gasket	1	t 0.4
400	Register Assembly	1 set	
401	Register cover	1	
402	Cover fitting bolt	4	M6
403	Battery pack	1	Option
404	Selector magnet	1	
405	Internal assembly	1 set	
500	Pressuretight packing	1 set	Option

※: Rotors, rotor bearings are supplied as matched pairs.

▲: Recommended spare parts.

15.13 Register Double-case Construction 60K Type (F6)

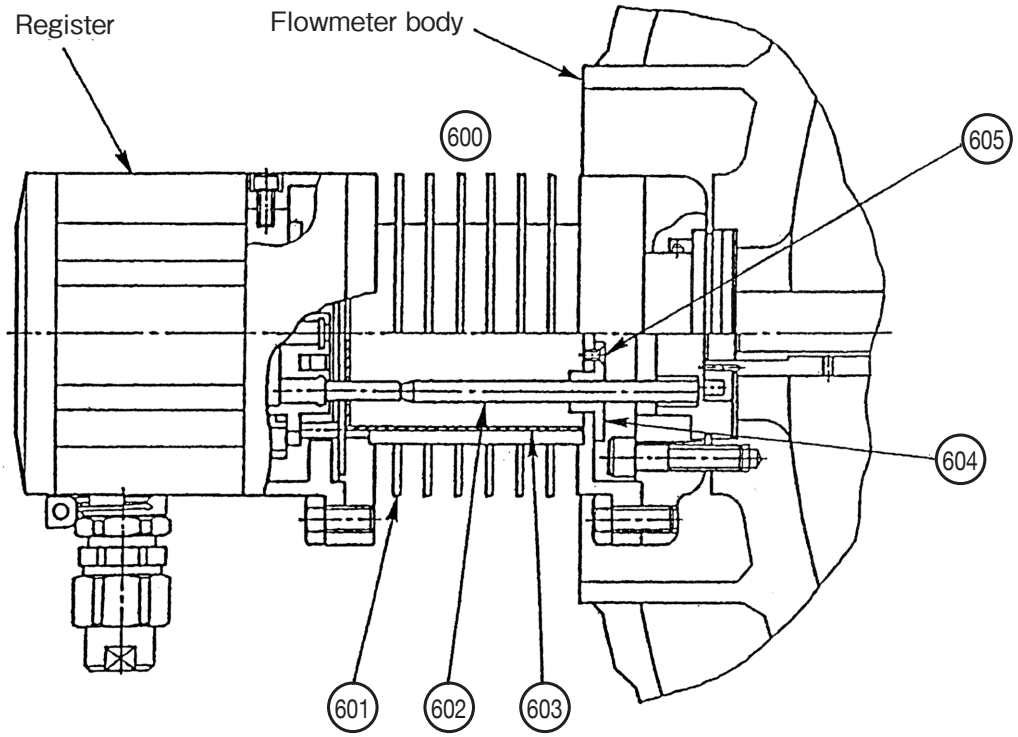
Exploded View



Parts List

Symbol No.	Part name	Quantity	Remarks
701	Gasket	1	Spiral wound type
702	Pressuretight sealing plate	1	
703	Sealing plate fitting bolt	8	M16
704	Adapter	1	
705	Adapter fitting bolt	2	M6
706	Register fitting bolt	4	M6
707	Gasket	1	t=1.5

16. COOLING TUBE (Fits the double-case construction meter body.)



Symbol No.	Part name	Quantity	Remarks
600	Cooling tube assembly	1 set	(601-605)
601	Cooling tube	1	
602	Iron slug	1	
603	Screen	1	
604	Iron slug holder	1	
605	Screw, iron slug holder	3	M4

17. GENERAL SPECIFICATIONS

Figures in brackets [ ] apply to high/low service meters.

Item				Description				
Meter size				28	29	60 and 31	32 and 33	34
Local Display (LCD) (Note 1)		Total count (8-diait)	—	※ 0.1L (standard) 1L, 0.01m³ [1 L (standard)] [0.01m³, 0.1m³]	0.001m³ (standard) 0.01m³, 0.1m³ [0.001m³ (standard)] [0.01m³, 0.1m³]	0.001m³ (standard) 0.01m³, 0.1m³ ※ [0.001m³ (standard)] [0.01m³, 0.1m³]	※ 0.001m³ (standard) 0.01m³, 0.1m³ [0.01m³ (standard)] [0.1m³, 1m³]	0.01m³ (standard) 0.1m³, 1 m³
			C mode					
		Resettable total (7-digit)	b1 mode	1L/h (standard) [1 L/h (standard)]	0.01m³/h (standard) [0.01m³/h (standard)]	0.1m³/h (standard) [0.01m³/h (standard)]	0.1m³/h (standard) [1m³/h (standard)]	0.1m³/h (standard)
		Instant flowrate (4-digit)	b2 mode	0.01L/min (standard) [0.01 L/min (standard)]	0.0001 m³/min (standard) [0.0001 m³/min (standard)]	0.001 m³/min (standard) [0.0001 m³/min (standard)]	0.001 m³/min standard) [0.01 m³/min (standard)]	0.001m³/min (standard)
Output	—	None		Local display only				
	Current	Analog		4 to 20mA DC See the acceptable load resistance range on page 17.				
		Pulse (Notes 2 and 3)	Type	Factored or unfactored: 0/1 = 4/20mA DC				
			Pulse width	Factored: 1 ms (default), 50ms Unfactored: 2 ms				
			Voltage pulse unit	Same as the reading unit				
	Open collector	Pulse (Notes 2 and 3)	Type	Factored or unfactored: Max. voltage impression 30V DC, Allowable current 50mA				
			Pulse width	Factored: 1 ms (default), 50ms Unfactored: 2 ms				
			Voltage pulse unit	Same as the reading unit				
	Voltage	Pulse (Notes 2 and 3)	Type	Factored or unfactored: 0/1 - 1 V DC max. / 7V DC min.				
			Pulse width	Factored: 1 ms (standard), 50 ms Unfactored: 2 ms				
			Voltage pulse unit	Same as the reading unit				
Power Source		Output not provided		Built-in dedicated lithium battery pack good for 8 years approx. (Depends on operating conditions.)				
		Output provided		External power source 12 to 45V DC (analog, current pulse) 12 to 24V DC (open collector pulse, voltage pulse) 12 to 45V DC (analog and current pulse combined) Current drain: 30mA DC max. See the acceptable load resistance range on page 17. (Note 1)				
Signal Transmission Cable				Externally shielded cabtyre cable (VCTF 1.25mm²) Finished O.D. 8.5 to 12 mm (Note 4)				
Transmission Length				One kilometer max.				
Transmission Lines			2-wire system	Analog or current pulse				
			3-wire system	Open collector pulse or voltage pulse				
			4-wire system	Analog + current pulse				
Ambient Temperature				-10 to + 60°C				
Explosionproof Configuration				Select either one of the following: ① Non-explosionproof type ② TIIS：Exd ⅡB T4/Exia ⅡB T4 ③ NEPSI：Exd ⅡB T4 ④ KOSHA：Exd ⅡB T4 ⑤ ITRI：Exd ⅡB T4 Gb				
Applicable EU Directives				RoHS：2011/65/EU EMC ：2014/30/EU				
Applicable EN standard				RoHS：EN50581：2012 EMC ：EN61326-1：2013 Class A				
Protection rating of Enclosure				IP66 (dusttight / watertight) IEC / EN60529, JIS 0920				
Housing Material				Aluminum die casting				
Finish				Munsell 2.5PB 5/8 (finished with baked melamine)				

➡ NOTE: 1. Battery powered models feature local display only. Remote signal output is not available.
2. If pulse width in excess of 1ms is desired with minimum factored pulse unit, the max. flowrate may possibly be restricted; consult the factory.
3. With factored pulse unit marked ※, pulse width other than 1ms is unacceptable if the minimum factored pulse unit is selected.
4. 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 45℃ or higher, use a cable resistant to the temperature of 75℃ or higher.

● **Nominal Meter Factors Figures in brackets [ ] apply to high/low service meters**

Meter size	Nominal meter factor, mL/P	Max. frequency, Hz	Max. flowrate, m^3/h	Number of pulses, P/rev
28	135.16 (270.3)	102.8 (51.3)	50	12 (6)
29	198.62 (397.3)	125.9 (62.9)	90	12 (6)
60	338.9 (677.8)	120.3 (61.5)	150	12 (6)
31	629.5 (1259.0)	101.4 (50.7)	230	12 (6)
32	992.7 (1985.3)	89.6 (44.8)	320	12 (6)
33	1490.7 (2981.3)	83.8 (41.9)	450	12 (6)
34	3250.0	59.6	700	12

NOTE: For outline dimensions and pipe connection dimensions, see the approval drawing (or specifications for shipment).

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