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(54) **Self-reciprocating energy recovery device**

Automatische Kolbenvorrichtung zur Energierückgewinnung

Dispositif de récupération d'énergie auto-alternatif

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- **Park, Sang-Jin**
305-340, Daejeon (KR)
- **Kong, Tae-Woo**
305-345, Daejeon (KR)

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(74) Representative: **Jacobson, Claude**
Cabinet Lavoix
2, place d'Estienne d'Orves
75441 Paris Cedex 09 (FR)

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(73) Proprietor: **Korea Institute Of Machinery & Materials**
Daejeon 305-343 (KR)

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(72) Inventors:

- **Ham, Young-Bog**
305-509, Daejeon (KR)

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Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates generally to an energy recovery device for a desalination system and, more particularly, to a self-reciprocating energy recovery device utilized in driving of a seawater pump by self-reciprocating a piston of a power recovery chamber and recovering energy not using an electronic drive unit but using the hydraulic power of concentrated water.

Description of the Related Art

[0002] In general, in order to acquire freshwater from seawater, substances dissolved or floating in seawater need to be removed to satisfy the standards for water and drinking water. Desalination methods mainly include reverse osmosis and electric dialysis using special membranes, and evaporation for changing seawater into vapor to desalinate seawater, and also may use freezing and solar heat.

[0003] A desalination plant using electric dialysis uses semi-permeable membranes that entirely exclude ion materials dissolved in water and pass pure water to filter ionic materials dissolved in seawater.

[0004] A process using high pressure above standard osmosis pressure is needed to separate ionic materials and pure water from seawater is referred to reverse osmosis, and a high pressure of 42 to 70 bars is needed in desalination of seawater.

[0005] The operation of the desalination system using reverse osmosis is as follows.

[0006] First, the seawater introduced from the sea is supplied through a low-pressure pump for reverse osmosis via a pre-treatment process.

[0007] Some of the seawater supplied through the low-pressure pump is supplied to a membrane after being pressurized by a high-pressure pump, and some of the seawater supplied to the membrane is discharged to treated water from which salt is removed by reverse osmosis and the remainder is supplied to an energy recovery device as high-pressure concentrated water.

[0008] The energy recovery device includes a pair of power recovery chambers recovering hydraulic power of concentrated water, a plurality of check valves for interrupting the seawater supplied to the power recovery chambers, and an electric actuator drive spool valve for controlling pistons inside the power recovery chambers to alternately reciprocate.

[0009] In a simple explanation of the operation of such a energy recovery device, some of the high-pressure seawater that has passed through a high-pressure pump is discharged to treated water from which salt is removed through a membrane and the remainder is provided to the energy recovery device as high-pressure concentrat-

ed water.

[0010] High-pressure concentrated water is alternately supplied to the power recovery chambers by interrupting the electric actuator drive spool valve. Then, the pistons are moved by the pressure of the high-pressure concentrated water, whereby high-pressure seawater is supplied to a membrane module and low-pressure seawater is selectively supplied to the power recovery chambers through a boost pump by selective opening/closing of a check valve.

[0011] In the desalination system using reverse osmosis, the energy recovery device can make the capacities of the low-pressure pump and the high-pressure pump smaller and the power of electric motors driving the low-pressure pump and the high-pressure pump less by recovering the hydraulic power of the concentrated water that has been treated in the membranes, saving energy.

[0012] However, such an energy recovery device separately includes a chamber having a cylindrical piston to use hydraulic pressure in reverse osmosis, and a linearly moved spool valve selectively controlling driving of a cylindrical piston in the chamber.

[0013] In other words, since the rotational movement of the electric motor needs to be converted to linear movement and the electric actuator drive spool valve, such as an electric linear motor and a proportional control valve to be provided outside a chamber, the device becomes complex and the size of the device increases.

[0014] In order to overcome the above-mentioned disadvantages, the present applicant has disclosed an energy recovery device in Korean Patent Application No. 2008-0054464.

[0015] The technology enables reduction of the size of the device, precise control of the device, and linear flow of fluid by using a conventional spool valve, selectively supplying concentrated water to a power recovery chamber as a concentrated water control valve block having a fluctuating plate-like concentrated water valve and directly controlling rotation using an electric motor.

[0016] However, since the technology uses a separate electric motor for driving a fluctuating plate-like concentrated water valve, power for driving of an electric motor is consumed and a waterproof structure for interrupting contact with water is needed, making the device complex and larger.

[0017] Documents DE-103 10 662 and US-2003/0017061 disclose an energy recovery device according to the preamble of claim 1.

SUMMARY OF THE INVENTION

[0018] The present invention has been made in views of the above problems, and the present invention provides a self-reciprocating energy recovery device that can reciprocally move pistons in power recovery chambers without using any external electric drive actuator or electronic valve, using a fluctuating actuator integrated plate valve fluctuating by a high pressure of concentrated

water by selectively interrupting high pressure of the concentrated water without using a drive unit by a separate electric drive.

[0019] In order to achieve the object, the present invention provides a self-reciprocating energy recovery device including a pair of power recovery chambers having pistons therein respectively, a high-pressure concentrated supply pipe, a low-pressure concentrated discharge pipe, and a high-pressure seawater discharge pipe to enable the power recovery chambers to recover hydraulic power supplied through the high-pressure concentrated water supply pipe and utilize the hydraulic power in driving of a seawater pump, the energy recovery device comprising: a concentrated water control valve block selectively interrupting introduction and discharge of concentrated water to and from the power recovery chambers through fluctuation of a fluctuating plate-like concentrated water valve having pinion gear teeth on the outer peripheral surface thereof; a rack gear having rack gear teeth enmeshed with the pinion gear teeth and inserted into opposite spools; first and second high-pressure concentrated water pilots branched out from the high-pressure concentrated water supply pipe to pilots and connected to sides of the spools to alternately supply high-pressure concentrated water; first and second high-pressure concentrated water pilot valve interrupting supply of high-pressure concentrated water to the first and second high-pressure concentrated water pilots respectively; first and second low-pressure concentrated water pilots connected to opposite sides of the spools to discharge low-pressure concentrated water; and first and second low-pressure concentrated water pilot valves interrupting discharge of low-pressure concentrated water through the first and second low-pressure concentrated water pilots.

[0020] The concentrated water control valve block includes: a concentrated water chamber cover having chamber ports communicated with the power recovery chambers respectively; a concentrated water inlet/outlet cover having a concentrated water supply hole communicated with the high-pressure concentrated water supply pipe and a concentrated water outlet hole communicated with the low-pressure concentrated water supply pipe; and a fluctuating plate-like concentrated water valve functioning as a hydrostatic bearing by a pressure of supplied water between the concentrated water chamber cover and the concentrated water inlet/outlet cover and having opened holes.

[0021] The self-reciprocating energy recovery device further comprises a fluctuating plate-like check valve block provided on one side of the power recovery chambers and connected to the fluctuating plate-like concentrated water valve, the fluctuating plate-like check valve block being moved in association with the fluctuation of the fluctuating plate-like concentrated valve to selectively interrupt introduction and discharge of seawater to and from the first power recovery chamber and the second-power recovery chamber.

[0022] The fluctuating plate-like check valve block includes: a seawater chamber cover having chamber ports communicated with the power recovery chambers respectively; a seawater inlet/outlet cover having a seawater supply hole connected to the low-pressure seawater supply pipe and a seawater outlet hole connected the high-pressure seawater discharge pipe; and a fluctuating plate-like concentrated water valve functioning as a hydrostatic bearing by a pressure of supply water between the seawater chamber cover and the seawater inlet/outlet cover and having opened holes.

[0023] The first and second high-pressure concentrated water pilot valves and the first and second low-pressure concentrated water pilot valves pass through sides of the power recovery chambers and are connected to resilient members outside the power recovery chambers.

[0024] The present invention also provides a self-reciprocating energy recovery device including a pair of power recovery chambers having pistons therein respectively, a high-pressure concentrated supply pipe, a low-pressure concentrated discharge pipe, and a high-pressure seawater discharge pipe to enable the power recovery chambers to recover hydraulic power supplied through the high-pressure concentrated water supply pipe and utilize the hydraulic power in driving of a seawater pump, the energy recovery device comprising: a fluctuating plate-like concentrated water valve having a fixed vane to selectively interrupt introduction and discharge of concentrated water to and from the first power recovery chamber and the second power recovery chamber through fluctuation thereof; a fluctuating plate-like concentrated water valve block having a space into which the fluctuating plate-like concentrated water valve and in which the fixed vane is accommodated and a first block outlet hole and a first block inlet hole, and a second block outlet hole and a second block inlet hole symmetrically disposed on opposite sides of the space; first and second high-pressure concentrated water pilots branched out from the high-pressure concentrated water supply pipe to pilots and connected to the first and second block inlet holes to alternately supply the high-pressure concentrated water; first and second high-pressure concentrated pilot valves interrupting supply of high-pressure concentrated water to the first and second high-pressure concentrated water pilots; first and second low-pressure concentrated water pilots connected to the first and second block outlet holes to alternately discharge the low-pressure concentrated water; and first and second low-pressure concentrated water pilot valves interrupting discharge of low-pressure concentrated water through the first and second low-pressure concentrated water pilots.

[0025] The fluctuating plate-like concentrated water valve block includes: a concentrated water chamber cover having chamber ports communicated with the power recovery chambers respectively; a concentrated water inlet/outlet cover having a concentrated water supply hole communicated with the high-pressure concentrated water supply pipe and a concentrated water outlet hole

communicated with the low-pressure concentrated water supply pipe; and a fluctuating plate-like concentrated water valve functioning as a hydrostatic bearing by a pressure of supplied water between the concentrated water chamber cover and the concentrated water inlet/outlet cover and having opened holes.

[0026] The self-reciprocating energy recovery device further comprises: a fluctuating plate-like check valve provided on one side of the power recovery chambers and having a fixed vane at the outer periphery thereof to selectively interrupt introduction and discharge of seawater into and from the first power recovery chamber and the second power recovery chamber through fluctuation thereof; a fluctuating plate-like concentrated water valve block having a space into which the fluctuating plate-like concentrated water valve and in which the fixed vane is accommodated and a first block outlet hole and a check valve block having a first block inlet hole, and a second block outlet hole and a second block inlet hole symmetrically disposed on opposite sides of the space; wherein the first and second high-pressure concentrated water pilots alternately supplying high-pressure concentrated water are connected to the first and second check valve inlet holes, and first and second low-pressure concentrated water pilots alternately discharging low-pressure concentrated are connected to the first and second check valve outlet holes.

[0027] The fluctuating plate-like check valve block includes : a seawater chamber cover having chamber ports communicated with the power recovery chambers respectively; a seawater inlet/outlet cover having a seawater supply hole connected to the low-pressure supply pipe and a seawater outlet hole connected to the high-pressure seawater discharge pipe; and a fluctuating plate-like check valve functioning as a hydrostatic bearing by a pressure of supply water between the seawater chamber cover and the seawater inlet/outlet cover and having opened holes.

[0028] The first and second high-pressure concentrated water pilot valves and the first and second low-pressure concentrated water pilot valves pass through sides of the power recovery chambers and are connected to resilient members outside the power recovery chambers.

[0029] The present invention enables self-reciprocating movement of pistons by recovering high-pressure power by hydraulic pressure of concentrated water with no power unit by an electric drive, increasing energy saving efficiency. Furthermore, the present invention does not use an electric drive in an environment in which water is treated, increasing the reliability of operation of a device.

BRIEF DESCRIPTION OF THE DRAWINGS

[0030] The objects, features and advantages of the present invention will be more apparent from the following detailed description in conjunction with the accompanying drawings, in which:

FIGS. 1 and 2 are views illustrating the structure and operation of a self-reciprocating energy recovery device according to the first embodiment of the present invention;

FIGS. 3 and 4 are views illustrating the structure and operation of a self-reciprocating energy recovery device according to the second embodiment of the present invention;

FIGS. 5 and 6 are views illustrating the structure and operation of a self-reciprocating energy recovery device according to the third embodiment of the present invention; and

FIGS. 7 and 8 are views illustrating the structure and operation of a self-reciprocating energy recovery device according to the fourth embodiment of the present invention.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0031] FIGS. 1 and 2 are views illustrating the structure and operation of a self-reciprocating energy recovery device according to the first embodiment of the present invention. The present invention relates to a self-reciprocating energy recovery device utilized in driving of a seawater pump by recovering hydraulic power of high-pressure concentrated water from a power recovery chamber in discharging treated water and concentrated water obtained by removing salt from sea water using reverse osmosis.

[0032] Referring to FIGS. 1 and 2, the self-reciprocating energy recovery device includes a pair of power recovery chambers 1a and 1b, a low-pressure seawater supply pipe 2, a high-pressure seawater discharge pipe 3, a high-pressure concentrated water supply pipe 4, a low-pressure concentrated water discharge pipe 5, a concentrated water control valve block 6, a pair of high-pressure concentrated water pilots 73a and 73b, a pair of high-pressure concentrated water pilot valves 74a and 74b, a pair of low-pressure concentrated water pilots 75a and 75b, and a pair of low-pressure concentrated water pilot valves 76a and 76b.

[0033] The pair of power recovery chambers 1a and 1b are a first power recovery chamber 1a and a second power recovery chamber 1b having pistons 11a and 11b therein respectively, and alternately introduce and discharge concentrated water.

[0034] Then, the pistons 11a and 11b may be floating ball-shaped pistons reciprocating inside the chambers without using piston rods.

[0035] The high-pressure concentrated water treated by a membrane module (not shown) is supplied to the high-pressure concentrated water pipe 4, and the low-pressure concentrated water that has been used in recovery of energy in the power recovery chambers 1a and 1b is discharged through the low-pressure concentrated water discharge pipe 5.

[0036] The low-pressure seawater supplied through a

low-pressure pump (not shown) is supplied to the power recovery chambers 1a and 1b through the low-pressure seawater supply pipe 2, and the high-pressure seawater that has been used in the power recovery chambers 1a and 1b is discharged to the high-pressure seawater discharge pipe 3 through a boost pump (not shown) and is supplied to a membrane (not shown).

[0037] The concentrated water control valve block 6 functions as a valve selectively interrupting introduction and discharge of concentrated water to the first power recovery chamber 1a and the second power recovery chamber 1b through fluctuation of a fluctuating plate-like concentrated water valve 63 having pinion gear teeth 631 on the outer peripheral surface thereof.

[0038] In this case, the concentrated water control valve block 6 includes a concentrated water chamber cover 61 functioning as a hydrostatic bearing using the pressure of supplied water, a concentrated water inlet/outlet cover 62, and a fluctuating plate-like concentrated water valve 63.

[0039] A first concentrated water chamber port 61a communicated with the first power recovery chamber 1a and a second concentrated water chamber port 61b are formed in the concentrated water chamber cover 61. The ports 61a and 61b may be circular or arc shaped.

[0040] A concentrated water supply hole 62a communicated with the high-pressure concentrated water supply pipe 4 and a concentrated water discharge hole 62b communicated with the low-pressure concentrated water discharge pipe 5 are formed in the concentrated water inlet/outlet cover 62. The concentrated water supply hole 62a and the concentrated water discharge hole 62b may be circular or arc shaped.

[0041] The fluctuating plate-like concentrated water valve 63 is provided between the concentrated water chamber cover 61 and the concentrated water inlet/outlet cover 62. Holes 63a and 63b selectively communicating the concentrated water chamber ports 61a and 61b and the concentrated water supply hole 62a, and the concentrated water chamber ports 61a and 61b and the concentrated water discharge hole 62b, by rotating the fluctuating plate-like concentrated water valve 63 are formed in the fluctuating plate-like concentrated water valve 63. For example, the holes 63a and 63b may be circular or arc shaped.

[0042] Then, a plurality of pinion gear teeth 631 are formed on the outer peripheral surface of the fluctuating-plate-like concentrated water valve 63, and a rack gear 72 having rack gear teeth 721 enmeshed with the pinion gear teeth 631 is formed on the fluctuating plate-like concentrated water valve 63.

[0043] In this case, the rack gear 72 is inserted into opposite spools 71 and is linearly reciprocated by the high-pressure concentrated water supplied to opposite ends of the spools 71.

[0044] In other words, the first and second high-pressure concentrated water pilots 73a and 73b branched out from the high-pressure concentrated water supply

pipes 4 are connected to opposite sides of the spools 71, and the rack gear 72 is linearly reciprocated by the pressure of the high-pressure concentrated water alternately supplied through the high-pressure concentrated water pilots 73a and 73b.

[0045] Then, the high-pressure concentrated water supplied to the opposite sides of the spools 71 is selectively interrupted by the first and second high-pressure concentrated water pilot valves 74a and 74b.

[0046] The first and second high-pressure concentrated water pilot valves 74a and 74b pass through the power recovery chambers 1a and 1b lengthwise and are connected to resilient members 741 located outside the power recovery chambers 1a and 1b.

[0047] Due to the above-mentioned structure, the first and second high-pressure concentrated water pilot valves 74a and 74b selectively open the first and second high-pressure concentrated water pilots 73a and 73b by adhesion of pistons in order to alternately supply the concentrated water to the opposite sides of the spools 71.

[0048] The first and second low-pressure concentrated water pilots 75a and 75b for discharging the low-pressure concentrated water are connected to the opposite sides of the spools 71, and the first and second low-pressure concentrated water pilot valves 76a and 76b are provided on the other sides of the power recovery chambers 1a and 1b.

[0049] The first and second low-pressure concentrated water pilot valves 76a and 76b pass through the power recovery chambers 1a and 1b lengthwise and are connected to the resilient members 761 outside the power recovery chambers 1a and 1b respectively, so that the first and second low-pressure concentrated water pilots 75a and 75b are selectively opened by adhesion of the pistons inside the power recovery chambers 1a and 1b whereby the low-pressure concentrated water of the spools 71 is discharged.

[0050] A plurality of ball type check valves 21 for interrupting supply of low-pressure seawater to the first and second power recovery chambers 1a and 1b and supply of high-pressure seawater to the high-pressure seawater discharge pipe 3 are provided at a connection section of the low-pressure seawater supply pipe 2 and the high-pressure seawater discharge pipe 3.

[0051] In this case, the plurality of check valves 21 include a first check valve 21a for supplying low-pressure seawater to the first power recovery chamber 1a, a second check valve 21b for interrupting supply of the high-pressure seawater pressurized by the first power recovery chamber 1a to the high-pressure seawater discharge pipe 3, a third check valve 21c for interrupting supply of the high-pressure seawater pressurized by the second power recovery chamber 1b to the high-pressure seawater discharge pipe 3, and a fourth check valve for supplying the low-pressure seawater to the second power recovery chamber 1b.

[0052] Hereinafter, the operation of the self-reciprocating energy recovery device according to the first embod-

iment of the present invention will be described in detail with reference to FIGS. 1 and 2.

[0053] First, as illustrated in FIG. 1, if the piston 11a in the first power recovery chamber 1a is moved in the direction of A, the first low-pressure concentrated water control valve 76a is opened by adhesion of the piston 11a, and if the piston 11b in the second power recovery chamber 1b is moved in the direction of B, the piston 11b is opened to open the second high-pressure concentrated pilot valve 74b.

[0054] The high-pressure concentrated water is supplied to the spool 71 on one side of the rack gear 72 through the second high-pressure concentrated water pilot 73b when the valves are opened.

[0055] Then, the rack gear 72 is linearly reciprocated due to the high pressure applied to one side of the rack gear 72 by the concentrated water, the pinion gear teeth 631 are enmeshed with the rack gear teeth 721 of the rack gear 72, rotating the fluctuating plate-like concentrated water accommodated on the opposite side of the rack gear 72 is discharged to a drain through the first low-pressure concentrated water pilot 75a.

[0056] In this case, the rack gear 72 may be arbitrarily driven manually by rotation of the fluctuating plate-like concentrated valve 63 during the initial driving of the rack gear 72 or by stopping the rack gear 72.

[0057] Then, the second concentrated water chamber port 61b and the second concentrated chamber port 61b are communicated with each other by rotation of the fluctuating plate-like concentrated water valve 63 whereby the first concentrated water chamber port 61a and the concentrated water discharge hole 62b are communicated with each other.

[0058] The low-pressure seawater supply pipe 2 and the first power recovery chamber 1a are communicated with each other by opening the first check valve 21a and closing the second check valve 21b, and the high-pressure seawater discharge pipe 3 and the second power recovery chamber 1b are communicated with each other by opening the third check valve 21c and closing the fourth check valve 21d.

[0059] Accordingly, the high-pressure concentrated water is introduced into the second power recovery chamber 1b so that if the second piston 11b is moved in the direction of A, the high-pressure seawater is discharged to the high-pressure seawater discharge pipe 3, and the low-pressure seawater is introduced from the low-pressure seawater supply pipe 2 to the first power recovery chamber 1a so that the first piston 11a is moved in the direction of B whereby the low-pressure concentrated water is discharged to the low-pressure concentrated water discharge pipe 5.

[0060] As illustrated in FIG. 2, if the first piston 11a is moved in the direction of B and the second piston 11b is moved in the direction of A, the first high-pressure concentrated water pilot valve 74a and the second low-pressure concentrated water pilot valve 76b are opened so

that the high-pressure concentrated water is supplied to the spool 71 on the opposite side of the rack gear 72.

[0061] Then, since a high pressure is applied to the opposite side of the rack gear 72 by the concentrated water, the rack gear 72 is linearly reciprocated whereby the low-pressure concentrated water accommodated on one side of the rack gear 72 is discharged to a drain through the second low-pressure concentrated water pilot 75b and the pinion gear teeth 631 are enmeshed with the rack gear teeth 721 of the rack gear 72, rotating the fluctuating plate-like concentrated water valve 63.

[0062] The first concentrated water chamber port 61a and the concentrated water supply hole 62a are communicated with each other and the second concentrated water chamber port 61b and the concentrated water discharge hole 62b are communicated with each other, by rotation of the fluctuating plate-like concentrated water valve 63.

[0063] In addition, the high-pressure seawater discharge pipe 3 and the first power recovery chamber 1a are communicated with each other by closing the first check valve 21a and opening the second check valve 21b, and the low-pressure seawater supply pipe 2 and the second power recovery chamber 1b are communicated with each other by closing the third check valve 21c and opening the fourth check valve 21d.

[0064] Accordingly, as illustrated in FIG. 1, the high-pressure concentrated water is introduced into the first power recovery chamber 1a so that the first piston 11a is moved in the direction of A whereby the high-pressure seawater is discharged to the high-pressure seawater discharge pipe 3, and the low-pressure seawater is discharged from the low-pressure seawater supply pipe 2 to the second power recovery chamber 1b so that the second piston 11b is moved in the direction of B whereby the low-pressure concentrated water is discharged to the low-pressure concentrated water discharge pipe 5.

[0065] During repetition of the processes, the concentrated water is alternately introduced and discharged into and from the first power recovery chamber and the second power recovery chamber and the seawater is alternately introduced and discharged, so that the seawater is pressurized and supplied to the high-pressure seawater discharge pipe by self-reciprocating the pistons with any separate electric drive force.

[0066] However, since fluid needs to flow via a ball in the ball type check valve, a pressure resistance due to the flow resistance against the fluid is generated.

[0067] In order to improve the above disadvantage, a self-reciprocating energy recovery device according to the second embodiment of the present invention includes a fluctuating plate-like check valve as illustrated in FIGS. 3 and 4. In this case, detailed descriptions of the same structure and operation as those of the first embodiment of the present invention will be omitted.

[0068] The fluctuating plate-like check block 8 is located on one side of the pair of power recovery chambers 1a and 1b and is connected to the fluctuating plate-like

concentrated water valve 63. Introduction and discharge of seawater into and from the first power recovery chamber 1a and the second power recovery chamber 1b are selectively interrupted by fluctuation of the fluctuating plate-like concentrated water valve 63.

[0069] In this case, the seawater chamber cover 81, the seawater inlet/outlet cover 82, and the fluctuating plate-like check valve block 8 function as a hydrostatic bearing by the pressure of the supplied water.

[0070] A first seawater chamber port 81a communicated with the first power recovery chamber 1a and a second seawater chamber port 81b communicated with the second power recovery chamber 1b are formed in the seawater chamber cover 81. The ports may be circular or arc shaped.

[0071] A seawater supply hole 82a connected to the low-pressure seawater supply pipe 2 and a seawater discharge hole 82b connected to the high-pressure seawater discharge pipe 3 are formed in the seawater inlet/outlet cover 82. The seawater supply hole 82a and the seawater discharge hole 82b may be circular or arc shaped.

[0072] Holes 83a and 83b for selectively communicating the seawater chamber ports 81a and 81b and the seawater supply hole 82a, and the seawater chamber ports 81a and 81b and the seawater discharge hole 82b by rotation of the fluctuating plate-like check valve 83 are formed in the fluctuating plate-like check valve 83. For example, the holes may be circular or arc shaped.

[0073] Then, a plurality of pinion gear teeth 831 are formed on the outer peripheral surface of the fluctuating-plate-like check valve 83 for movement of the fluctuating plate-like check valve 83 that is associated with the fluctuating plate-like concentrated water valve 63, and a rack gear 72 has rack gear teeth 721 enmeshed with the pinion gear teeth 831.

[0074] In this case, the rack gear 72 is inserted into opposite spools 71 and is linearly reciprocated by the high-pressure concentrated water supplied to opposite ends of the spools 71.

[0075] The fluctuating plate-like check valve 83 is moved in association with rotation of the fluctuating plate-like concentrated water valve 63.

[0076] In other words, if the fluctuating plate-like concentrated water valve 63 is rotated in the direction of C, the fluctuating plate-like check valve 83 is simultaneously rotated together with the fluctuating plate-like concentrated water valve 63, so that the low-pressure seawater supply pipe 2 and the first power recovery chamber 1a are communicated with each other and the high-pressure seawater discharge pipe 3 and the second power recovery chamber 1b are communicated with each other.

[0077] In addition, if the fluctuating plate-like concentrated water valve 63 is rotated in the direction of D, the fluctuating plate-like check valve 83 is simultaneously rotated together with the fluctuating plate-like concentrated water valve 63, so that the low-pressure seawater supply pipe 2 and the second power recovery chamber

1b are communicated with each other and the high-pressure seawater discharge pipe 3 and the first power recovery chamber 1a are communicated with each other.

[0078] Accordingly, since a check valve interrupting introduction and discharge of seawater into the power recovery chambers in the second embodiment of the present invention is realized by a fluctuating plate-like check valve, the flow resistance generated by balls of a conventional ball type check valve is prevented, making the flow of fluid linear.

[0079] FIGS. 5 and 6 are views illustrating the structure and operation of a self-reciprocating energy recovery device according to the third embodiment of the present invention. In this case, detailed descriptions of the same structure and operation as those of the first and second embodiments of the present invention will be omitted.

[0080] The self-reciprocating energy recovery device according to the third embodiment of the present invention includes a pair of power recovery chambers 1a and 1b, a low-pressure seawater supply pipe 2, a high-pressure seawater discharge pipe 3, a high-pressure concentrated water supply pipe 4, a low-pressure concentrated water discharge pipe 5, a concentrated water control valve block 6, a rack gear 72, a pair of high-pressure concentrated water pilots 73a and 73b, a pair of high-pressure concentrated water pilot valves 74a and 74b, a pair of low-pressure concentrated water pilots 75a and 75b, and a pair of low-pressure concentrated water pilot valves 76a and 76b.

[0081] The concentrated water control valve block 6 functions as a valve for selectively interrupting introduction and discharge of the concentrated water to the first power recovery chamber 1a and the second power recovery chamber 1b, and includes a fluctuating plate-like concentrated water valve 63 having a fixed vane 632 on the outer periphery thereof to selectively interrupt introduction and discharge of the concentrated water to the first power recovery chamber 1a and the second power recovery chamber 1b by the fluctuation thereof.

[0082] A concentrated water chamber cover 61 and a concentrated water inlet/outlet cover 62 functioning as a hydrostatic bearing by the pressure of supplied water are provided on both sides of the fluctuating plate-like concentrated water valve 63.

[0083] The fluctuating plate-like concentrated water valve 63 is inserted into the fluctuating plate-like valve block 64 having a space in which the fixed vane 632 is accommodated.

[0084] A first block inlet hole 642a and a first block outlet hole 643a, and a second block inlet hole 642b and a second block outlet hole 643b are symmetrically formed on opposite sides of the fluctuating plate-like concentrated water valve block 64.

[0085] First and second high-pressure concentrated water pilots 73a and 73b branched out from the high-pressure concentrated water supply pipe 4 to alternately supply high-pressure concentrated water are connected to the first and second block inlet holes 642a and 642b.

[0086] In addition, first and second low-pressure concentrated water pilots 75a and 75b alternately discharging low-pressure concentrated water are connected to the first and second block outlet holes 643a and 643b.

[0087] First and second high-pressure concentrated water pilot valves 74b pass through the power recovery chambers 1a and 1b lengthwise and are connected to resilient members 741 outside the power recovery chambers 1a and 1b to interrupt supply of high-pressure concentrated water to the first and second high-pressure concentrated water pilots 73a and 73b.

[0088] First and second low-pressure concentrated water pilot valves 76b pass through the power recovery chambers 1a and 1b lengthwise and are connected to resilient members 761 outside the power recovery chambers 1a and 1b to interrupt discharge of low-pressure concentrated water to the first and second low-pressure concentrated water pilots 75a and 75b.

[0089] Hereinafter, the operation of the self-reciprocating energy recovery device according to the third embodiment of the present invention will be described in detail.

[0090] Referring to FIG. 5, if the piston of the first power recovery chamber 1a is moved in the direction of A by the pressure of concentrated water and the piston of the second power recovery chamber 1b is moved in the direction of B, the second high-pressure concentrated water pilot valve 740 and the first low-pressure concentrated water pilot valve 76a are opened so that the high-pressure concentrated water is introduced into a first block inlet hole 642a.

[0091] Then, the fluctuating plate-like concentrated water valve 63 and the fluctuating plate-like check valve 83 are rotated in the direction of C by the high pressure due to the concentrated water introduced into the first block inlet hole 642a whereby the low-pressure concentrated water is discharged through the second block outlet hole 643b and through the first low-pressure concentrated water pilot 75a.

[0092] Then, when the fluctuating plate-like concentrated valve 63 is rotated in the direction of C, the second concentrated water chamber port 61a and the concentrated water supply hole 62a are communicated with each other and the first concentrated water chamber port 61a and the concentrated water outlet hole 62b are communicated with each other.

[0093] The low-pressure seawater supply pipe 2 and the first power recovery chamber 1a are communicated with each other by opening the first check valve 21a and closing the second check valve 21b, and the high pressure seawater discharge pipe 3 and the second power recovery chamber 1b are communicated with each other by opening the third check valve 21c and closing the fourth check valve 21d.

[0094] Accordingly, as illustrated in FIG. 6, when the high-pressure concentrated water is introduced into the second power recovery chamber 1b the second piston 11b is moved in the direction of A whereby the high-pressure seawater is discharged to the high-pressure sea-

water discharge pipe 3, and when the low-pressure seawater is introduced from the low-pressure seawater supply pipe 2 to the first power recovery chamber 1a, the first piston 11a is moved in the direction of B whereby the low-pressure concentrated water is discharged to the low-pressure concentrated water discharge pipe 5.

[0095] If the first piston 11a is moved in the direction of B and the second piston 11b is moved in the direction of A, the first high-pressure concentrated water pilot valve 74a and the second low-pressure concentrated water pilot valve 76b are opened so that the high-pressure concentrated water is introduced into the second block inlet hole 742b.

[0096] Then, the fluctuating plate-like concentrated water valve 63 is rotated in the direction of D by the high pressure of the introduced concentrated water, and the low-pressure concentrated water accommodated in the space 641 is discharged to the second low-pressure concentrated water pilot 75b through the first block outlet hole 643b.

[0097] The first concentrated water chamber port 61a and the concentrated water supply hole 62a are communicated with each other and the second concentrated water chamber port 61b and the concentrated water outlet hole 62b are communicated with each other, by rotation of the fluctuating plate-like concentrated valve 63.

[0098] The high-pressure seawater discharge pipe 3 and the first power recovery chamber 1a are communicated with each other by closing the first check valve 21a and opening the second check valve 21b, and the low-pressure seawater supply pipe 2 and the second power recovery chamber 1b are communicated with each other by closing the third check valve 21c and opening the fourth valve 21d.

[0099] Accordingly, as illustrated in FIG. 5, when the high-pressure concentrated water is introduced into the first power recovery chamber 1a, the first piston 11a is moved in the direction of A whereby the high-pressure seawater is discharged to the high-pressure seawater discharge pipe 3, and when the low-pressure seawater is introduced from the low-pressure seawater supply pipe 2 into the second power recovery chamber 1b, the second piston 11b is moved in the direction of B whereby the low-pressure concentrated water is discharged to the low-pressure concentrated water discharge pipe 5.

[0100] During repetition of the processes, the concentrated water is alternately introduced and discharged into and from the first power recovery chamber and the second power recovery chamber and the seawater is alternately introduced and discharged, so that the seawater is pressurized and supplied to the high-pressure seawater discharge pipe by self-reciprocating the pistons with any separate electric drive force.

[0101] FIGS. 7 and 8 are views illustrating the structure and operation of a self-reciprocating energy recovery device according to the fourth embodiment of the present invention. In this case, detailed descriptions of the same structure and operation as those of the first and second

embodiments of the present invention will be omitted.

[0102] Referring to FIGS. 7 and 8, the self-reciprocating energy recovery device according the fourth embodiment of the present invention includes a fluctuating plate-like check valve block 8. In the fluctuating plate-like check valve block 8, a seawater chamber cover 81, a seawater inlet/outlet cover 82, and a fluctuating plate-like check valve 83 function as a hydrostatic bearing by the pressure of supplied water. The seawater chamber cover 81 and the seawater inlet/outlet cover 82 have been described in detail in the second embodiment of the present invention, and detailed descriptions thereof will be omitted.

[0103] In this case, the fluctuating plate-like check valve 83 is provided on one side of the power recovery chambers 1a and 1b, and a fixed vane 632 is formed at the outer periphery of the fluctuating plate-like check valve 83.

[0104] The fluctuating plate-like check valve 83 is inserted into a check valve block 84 having a space 841 in which the fixed vane 832 is accommodated to selectively interrupt introduction and discharge of the seawater into the first power recovery chamber 1a and the second power recovery chamber 1b through fluctuating thereof.

[0105] A first check valve inlet hole 842a and a first check valve outlet hole 842b, and a second check valve inlet hole 843a and a second check valve outlet hole 843b are symmetrically formed on opposite sides of the space 841 in the check valve block 84.

[0106] Then, the first and second high-pressure concentrated water pilots 73a and 73b alternately supplying the high-pressure concentrated water are connected to the first and second check valve inlet holes 842a and 842b.

[0107] The first and second low-pressure concentrated water pilots 75a and 75b alternately discharging the low-pressure concentrated water are connected to the first and second check valve outlet holes 843a and 843b.

[0108] Hereinafter, the operation of the self-reciprocating energy recovery device according to the fourth embodiment of the present invention will be simply described.

[0109] As illustrated in FIG. 7, if the piston 11a of the first power recovery chamber 1a is moved in the direction of A and the piston 11b of the second power recovery chamber 1b is moved in the direction of B, the second high-pressure concentrated water pilot valve 74b and the first low-pressure concentrated water pilot valve 76a are opened so that the high-pressure concentrated water is introduced into the first block inlet hole 642a and the first check valve inlet hole 842a.

[0110] Then, the fluctuating plate-like concentrated water valve 63 and the fluctuating plate-like check valve 83 are rotated in the direction of C by the high-pressure due to the concentrated water introduced into the first block inlet hole 642a and the first check valve inlet hole 842a whereby the low-pressure concentrated water is discharged through the second block outlet hole 643b and the second check valve outlet hole 843b and through

the first low-pressure concentrated water pilot 75a.

[0111] The second concentrated water chamber port 61b and the concentrated water supply hole 62a are communicated with each other and the first concentrated water chamber port 61a and the concentrated water discharge hole 62b are communicated with each other, by rotation of the fluctuating plate-like concentrated water valve 63.

[0112] Accordingly, as illustrated in FIG. 8, when the high-pressure concentrated water is introduced into the second power recovery chamber 1b, the second piston 11b is moved in the direction of A whereby the high-pressure seawater is discharged to the high-pressure seawater discharge pipe 5, and when the low-pressure seawater is introduced from the low-pressure seawater supply pipe 2 into the first power recovery chamber 1a, the first piston 11a is moved in the direction of B whereby the low-pressure concentrated water is discharged to the low-pressure concentrated water discharge pipe 5.

[0113] If the first piston 11a is moved in the direction of B and the second piston 11b is moved in the direction of A, the first high-pressure concentrated water pilot valve 74a and the second low-pressure concentrated water pilot valve 76b are opened so that the high-pressure concentrated water is introduced into the second block inlet hole 642b and the second check valve inlet hole 842b.

[0114] Then, the fluctuating plate-like concentrated water valve 63 and the fluctuating check valve 83 are rotated in the direction of D by the high pressure of the introduced concentrated water, whereby the low-pressure concentrated water accommodated in the space 841 is discharged to the second low-pressure concentrated water pilot 75b through the first block outlet hole 643a and the first check valve outlet hole 843a.

[0115] The first concentrated water chamber port 61a and the concentrated water supply hole 62a are communicated with each other and the second concentrated water chamber port 61b and the concentrated water outlet hole 62b are communicated with each other by rotation of the fluctuating plate-like concentrated water valve 63.

[0116] Accordingly, as illustrated in FIG. 7, when the high-pressure concentrated water is introduced into the first power recovery chamber 1a, the first piston 11a is moved in the direction of A whereby the high-pressure seawater is discharged to the high-pressure seawater discharge pipe 3, and when the low-pressure seawater is introduced into the second power recovery chamber 1b the second piston 11b is moved in the direction of B whereby the low-pressure concentrated water is discharged to the low-pressure concentrated water discharge pipe 5.

[0117] During repetition of the processes, the concentrated water is alternately introduced and discharged into and from the first power recovery chamber and the second power recovery chamber and the seawater is alternately introduced and discharged, so that the seawater is pressurized and supplied to the high-pressure seawater discharge pipe by self-reciprocating the pistons with

any separate electric drive force.

[0118] While the invention has been shown and described with respect to the exemplary embodiments, it will be understood by those skilled in the art that the system and the method are only examples of the present invention and various changes and modifications may be made without departing from the scope of the invention as defined in the following claims.

Claims

1. A self-reciprocating energy recovery device including a pair of power recovery chambers (1a, 1b) having pistons (11a, 11b) therein respectively, a high-pressure concentrated supply pipe (4), a low-pressure concentrated discharge pipe (5), and a high-pressure seawater discharge pipe (3) to enable the power recovery chambers (1a, 1b) to recover hydraulic power supplied through the high-pressure concentrated water supply pipe (4) and utilize the hydraulic power in driving of a seawater pump, the energy recovery device **characterized in** :

a concentrated water control valve block (6) selectively interrupting introduction and discharge of concentrated water to and from the power recovery chambers (1a, 1b) through fluctuation of a fluctuating plate-like concentrated water valve (63) having pinion gear teeth (631) on the outer peripheral surface thereof;
a rack gear (72) having rack gear teeth (721) enmeshed with the pinion gear teeth (631) and inserted into opposite spools (71) :

first and second high-pressure concentrated water pilots (73a, 73b) branched out from the high-pressure concentrated water supply pipe (4) to pilots and connected to sides of the spools (71) to alternately supply high-pressure concentrated water;

first and second high-pressure concentrated water pilot valve (74a, 74b) interrupting supply of high-pressure concentrated water to the first and second high-pressure concentrated water pilots (73a, 73b) irrespectively;

first and second low-pressure concentrated water pilots (75a, 75b) connected to opposite sides of the spools (71) to discharge low-pressure concentrated water; and

first and second low-pressure concentrated water pilot valves (76a, 76b) interrupting discharge of low-pressure concentrated water through the first and second low-pressure concentrated water pilots (75a, 75b) .

2. The self-reciprocating energy recovery device of

claim 1, wherein the concentrated water control valve block (6) includes:

a concentrated water chamber cover (61) having chamber ports (61a, 61b) communicated with the power recovery chambers (1a, 1b) respectively;

a concentrated water inlet/outlet cover (62) having a concentrated water supply hole (62a) communicated with the high-pressure concentrated water supply pipe (4) and a concentrated water outlet hole (62b) communicated with the low-pressure concentrated water discharge pipe (5); and

a fluctuating plate-like concentrated water valve (63) functioning as a hydrostatic bearing by a pressure of supplied water between the concentrated water chamber cover (61) and the concentrated water inlet/outlet cover (62) and having opened holes.

3. The self-reciprocating energy recovery device of claim 1, further comprising a fluctuating plate-like check valve block (8) provided on one side of the power recovery chambers (1a, 1b) and connected to the fluctuating plate-like concentrated water valve (63) , the fluctuating plate-like check valve block (8) being moved in association with the fluctuation of the fluctuating plate-like concentrated valve (63) to selectively interrupt introduction and discharge of seawater to and from the first power recovery chamber (1a) and the second power recovery chamber (1b).

4. The self-reciprocating energy recovery device of claim 3 , wherein the fluctuating plate-like check valve block (8) includes:

a seawater chamber cover (81) having chamber ports (81a, 81b) communicated with the power recovery chambers (1a, 1b) respectively;

a seawater inlet/outlet cover (82) having a seawater supply hole (82a) connected to the low-pressure seawater supply pipe (2) and a seawater outlet hole (82b) connected the high-pressure seawater discharge pipe (3); and

a fluctuating plate-like concentrated water valve (63) functioning an a hydrostatic bearing by a pressure of supply water between the seawater chamber cover (81) and the seawater inlet/outlet cover (82) and having opened holes (82a, 82b).

5. The self-reciprocating energy recovery device of claim 1, wherein the first and second high-pressure concentrated water pilot valves (74a, 74b) and the first and second low-pressure concentrated water-pilot valves (76a, 76b) pass through sides of the power recovery chambers (1a, 1b) and are connected to

resilient members (741) outside the power recovery chambers (1a, 1b).

6. The self-reciprocating energy recovery device of claim 2, wherein the first and second high-pressure concentrated water pilot valves (74a, 74b) and the first and second low-pressure concentrated water pilot valves (76a, 76b) pass through sides of the power recovery chambers (1a, 1b) and are connected to resilient members (741) outside the power recovery chambers (1a, 1b).
7. The self-reciprocating energy recovery device of claim 3, wherein the first and second high-pressure concentrated water pilot valves (74a, 74b) and the first and second low-pressure concentrated water pilot valves (76a, 76b) pass through sides of the power recovery chambers (1a, 1b) and are connected to resilient members (741) outside the power recovery chambers (1a, 1b).
8. The self-reciprocating energy recovery device of claim 4, wherein the first and second high-pressure concentrated water pilot valves (74a, 74b) and the first and second low-pressure concentrated water pilot valves (76a, 76b) pass through sides of the power recovery chambers (1a, 1b) and are connected to resilient members (741) outside the power recovery chambers (1a, 1b).
9. A self-reciprocating energy recovery device including a pair of power recovery chambers (1a, 1b) having pistons (11a, 11b) therein respectively, a high-pressure concentrated supply pipe (4), a low-pressure concentrated discharge pipe (5), and a high-pressure seawater discharge pipe (3) to enable the power recovery chambers (1a, 1b) to recover hydraulic power supplied through the high-pressure concentrated water supply pipe (4) and utilize the hydraulic power in driving of a seawater pump, the energy recovery device **characterized in** :

a fluctuating plate-like concentrated water valve (63) having a fixed vane (632) to selectively interrupt introduction and discharge of concentrated water to and from the first power recovery chamber (1a) and the second power recovery chamber (1b) through fluctuation thereof;

a fluctuating plate-like concentrated water valve block (64) having a space into which the fluctuating plate-like concentrated water valve (63) and in which the fixed vane (632) is accommodated and a first block outlet hole (643a) and a first block inlet, hole (642a), and a second block outlet hole (643b) and a second block inlet hole (642b) symmetrically disposed on opposite sides of the space (641);

first and second high-pressure concentrated

water pilots (73a, 73b) branched out from the high-pressure concentrated water supply pipe (4) to pilots and connected to the first and second block inlet holes (642a, 642b) to alternately supply the high-pressure concentrated water;

first and second high-pressure concentrated pilot valves (74a, 74b) interrupting supply of high-pressure concentrated water to the first and second high-pressure concentrated water pilots (73a, 73b);

first and second low-pressure concentrated water pilots (75a, 75b) connected to the first and second block outlet holes (643a, 643b) to discharge the low-pressure concentrated water;

and

first and second low-pressure concentrated water pilot valves (76a, 76b) interrupting discharge of low-pressure concentrated water through the first and second low-pressure concentrated water pilots (75a, 75b).

10. The self-reciprocating energy recovery device of claim 9, wherein the fluctuating plate-like concentrated water valve block (64) includes:

a concentrated water chamber cover (61) having chamber ports (61a, 61b) communicated with the power recovery chambers (1a, 1b) respectively;

a concentrated water inlet/outlet cover (62) having a concentrated water supply hole (62a) communicated with the high-pressure concentrated water supply pipe (4) and a concentrated water outlet hole (62b) communicated with the low-pressure concentrated water supply discharge pipe (5); and

a fluctuating plate-like concentrated water valve (63) functioning as a hydrostatic bearing by a pressure of supplied water between the concentrated water chamber cover (61) and the concentrated water inlet/outlet cover (62) and having opened holes.

11. The self-reciprocating energy recovery device of claim 10, further comprising:

a fluctuating plate-like check valve (83) provided on one side of the power recovery chambers (1a, 1b) and having a fixed vane (832) at the outer periphery thereof to selectively interrupt introduction and discharge of seawater into and from the first power recovery chamber (1a) and the second power recovery chamber (1b) through fluctuation thereof;

a fluctuating plate-like check valve block (8) having a space (841) into which the fluctuating plate-like check valve (83) and in which the fixed vane (832) is accommodated and a check valve block

- (84) having a first check valve inlet hole (842a), and a first check valve outlet hole (842b) and a second check valve inlet hole (843a) and a second check valve outlet (843b) hole symmetrically disposed on opposite sides of the space (841);
 wherein the first and second high-pressure concentrated water pilots (73a, 43b) alternately supplying high-pressure concentrated water are connected to the first and second check valve inlet holes (842a, 842b), and first and second low-pressure concentrated water pilots (75a, 75b) alternately discharging low-pressure concentrated are connected to the first and second check valve outlet holes (843a, 843b).
12. The self-reciprocating energy recovery device of claim 11, wherein the fluctuating plate-like check valve block (8) includes:
- a seawater chamber cover (81) having chamber ports (81a, 81b) communicated with the power recovery chambers (1a, 1b) respectively;
 a seawater inlet/outlet cover (82) having a seawater supply hole (82a) connected to the low-pressure supply pipe (2) and a seawater outlet hole (82b) connected to the high-pressure seawater discharge pipe (3); and
 a fluctuating plate-like check valve (83) functioning as a hydrostatic bearing by a pressure of supply water between the seawater chamber cover (81) and the seawater inlet/outlet cover (82) and having opened holes (83a, 83b).
13. The self-reciprocating energy recovery device of claim 9, wherein the first and second high-pressure one of concentrated water pilot valves (74a, 74b) and the first and second low-pressure concentrated water pilot valves (76a, 76b) pass through sides of the power recovery chambers (1a, 1b) and are connected to resilient members (741) outside the power recovery chambers (1a, 1b).
14. The self-reciprocating energy recovery device of claim 10, wherein the first and second high-pressure concentrated water pilot valves (74a, 74b) and the first and second low-pressure concentrated water pilot valves (75a, 76b) pass through sides of the power recovery chambers (1a, 1b) and are connected to resilient members (741) outside the power recovery chambers (1a, 1b).
15. The self-reciprocating energy recovery device of one of claim 11, wherein the first and second high-pressure concentrated water pilot valves (74a, 74b) and the first and second low-pressure concentrated water pilot valves (76a, 76b) pass through sides of the power recovery chambers (1a, 1b) and are connect-

ed to resilient members (741) outside the power recovery chambers (1a, 1b).

16. The self-reciprocating energy recovery device of claim 12, wherein the first and second high-pressure concentrated water pilot valves (74a, 74b) and the first and second low-pressure concentrated water pilot valves (76a, 76b) pass through sides of the power recovery chambers (1a, 1b) and are connected to resilient members (741) outside the power recovery chambers (1a, 1b).

Patentansprüche

1. Eine selbst hin- und hergehende Energierückgewinnungs-Vorrichtung, aufweisend ein Paar von Leistungsrückgewinnungs-Kammern (1a, 1b), die in ihrem Inneren jeweils Kolben (11a, 11b) aufweisen, ein Hochdruckkonzentrations-Zuführrohr (4), ein Niederdruckkonzentrations-Ableitungsrohr (5) und ein Hochdruckmeerwasser-Ableitungsrohr (3), um den Leistungsrückgewinnungs-Kammern (1a, 1b) zu ermöglichen, durch das Hochdruckkonzentrationswasser-Zuführrohr (4) zugeführte Hydraulikleistung zurückzugewinnen und die Hydraulikleistung beim Antreiben einer Meerwasserpumpe zu nutzen, wobei die Energierückgewinnungs-Vorrichtung **gekennzeichnet ist durch:**

einen Konzentrationswasser-Regelventilblock (6), der das Einführen und Ableiten von Konzentrationswasser in die Leistungsrückgewinnungs-Kammern und aus den Leistungsrückgewinnungs-Kammern (1a, 1b) **durch** Fluktuation eines fluktuierenden plattenartigen Konzentrationswasserventils (63), das an seiner Außenumfangsfläche Zahnradzähne (631) aufweist, wahlweise unterbricht,
 eine Zahnstange (72), die Zahnstangenzähne (721) aufweist, die mit den Zahnradzähnen (631) in Eingriff sind, und die in gegenüberliegende Rollen (71) eingesetzt ist,
 eine erste und eine zweite Hochdruckkonzentrations-Wasserleitung (73a, 73b), die von dem Hochdruckkonzentrationswasser-Zuführrohr (4) zu Leitungen abzweigen und an Seiten der Rollen (71) angeschlossen sind, um abwechselnd Hochdruckkonzentrationswasser zuzuführen,
 ein erstes und ein zweites Hochdruckkonzentrationswasser-Vorsteuerventil (74a, 74b), die die Zufuhr von Hochdruckkonzentrationswasser in die erste beziehungsweise in die zweite Hochdruckkonzentrations-Wasserleitung (73a, 73b) unterbrechen,
 eine erste und eine zweite Niederdruckkonzentrations-Wasserleitung (75a, 75b), die an entge-

- gengesetzten Seiten der Rollen (71) angeschlossen sind, um Niederdruckkonzentrationswasser abzuleiten, und ein erstes und ein zweites Niederdruckkonzentrationswasser-Vorsteuerventil (76a, 76b), die das Ableiten von Niederdruckkonzentrationswasser **durch** die erste und die zweite Niederdruckkonzentrations-Wasserleitung (75a, 75b) unterbrechen.
2. Die selbst hin- und hergehende Energierückgewinnungs-Vorrichtung gemäß Anspruch 1, wobei der Konzentrationswasser-Regelventilblock (6) aufweist:
- eine Konzentrationswasser-Kammerabdeckung (61), die Kammeranschlüsse (61a, 61b) aufweist, die jeweils mit den Leistungsrückgewinnungs-Kammern (1a, 1b) kommunizieren, eine Konzentrationswasser-Einlass-/Auslass-Abdeckung (62), die ein mit dem Hochdruckkonzentrationswasser-Zuführrohr (4) kommunizierendes Konzentrationswasser-Zuführloch (62a) und ein mit dem Niederdruckkonzentrationswasser-Ableitungsrohr (5) kommunizierendes Konzentrationswasser-Auslassloch (62b) aufweist, und ein fluktuierendes plattenartiges Konzentrationswasserventil (63), das durch einen Druck von zugeführtem Wasser zwischen der Konzentrationswasser-Kammerabdeckung (61) und der Konzentrationswasser-Einlass-/Auslass-Abdeckung (62) als ein hydrostatisches Lager funktioniert und geöffnete Löcher aufweist.
3. Die selbst hin- und hergehende Energierückgewinnungs-Vorrichtung gemäß Anspruch 1, ferner einen fluktuierenden plattenartigen Absperrventilblock (8) aufweisend, der an einer Seite der Leistungsrückgewinnungs-Kammern (1a, 1b) vorgesehen ist und mit dem fluktuierenden plattenartigen Konzentrationswasserventil (63) verbunden ist, wobei der fluktuierende plattenartige Absperrventilblock (8) in Verbindung mit der Fluktuation des fluktuierenden plattenartigen Konzentrationsventils (63) bewegt wird, um das Einführen und das Ableiten von Meerwasser in die und aus der ersten Leistungsrückgewinnungs-Kammer (1a) und der zweiten Leistungsrückgewinnungs-Kammer (1b) wahlweise zu unterbrechen.
4. Die selbst hin- und hergehende Energierückgewinnungs-Vorrichtung gemäß Anspruch 3, wobei der fluktuierende plattenartige Absperrventilblock (8) aufweist:
- eine Meerwasser-Kammerabdeckung (81), die Kammeranschlüsse (81a, 81b) aufweist, die jeweils mit den Leistungsrückgewinnungs-Kammern (1a, 1b) kommunizieren, eine Meerwasser-Einlass-/Auslass-Abdeckung (82), die ein an das Niederdruckmeerwasser-Zuführrohr (2) angeschlossenes Meerwasser-Zuführloch (82a) und ein an das Hochdruckmeerwasser-Ableitungsrohr (3) angeschlossenes Meerwasser-Auslassloch (82b) aufweist, und ein fluktuierendes plattenartiges Konzentrationswasserventil (63) zwischen der Meerwasser-Kammerabdeckung (81) und der Meerwasser-Einlass-/Auslass-Abdeckung (82), das als ein hydrostatisches Lager durch einen Druck von Zuführwasser funktioniert und geöffnete Löcher (82a, 82b) aufweist.
5. Die selbst hin- und hergehende Energierückgewinnungs-Vorrichtung gemäß Anspruch 1, wobei das erste und das zweite Hochdruckkonzentrationswasser-Vorsteuerventil (74a, 74b) und das erste und das zweite Niederdruckkonzentrationswasser-Vorsteuerventil (76a, 76b) durch Seiten der Leistungsrückgewinnungs-Kammern (1a, 1b) hindurchpassieren und an nachgiebige Elemente (741) außerhalb der Energierückgewinnungs-Kammern (1a, 1b) angeschlossen sind.
6. Die selbst hin- und hergehende Energierückgewinnungs-Vorrichtung gemäß Anspruch 2, wobei das erste und das zweite Hochdruckkonzentrationswasser-Vorsteuerventil (74a, 74b) und das erste und das zweite Niederdruckkonzentrationswasser-Vorsteuerventil (76a, 76b) durch Seiten der Leistungsrückgewinnungs-Kammern (1a, 1b) hindurchpassieren und an nachgiebige Elemente (741) außerhalb der Leistungsrückgewinnungs-Kammern (1a, 1b) angeschlossen sind.
7. Die selbst hin- und hergehende Energierückgewinnungs-Vorrichtung gemäß Anspruch 3, wobei das erste und das zweite Hochdruckkonzentrationswasser-Vorsteuerventil (74a, 74b) und das erste und das zweite Niederdruckkonzentrationswasser-Vorsteuerventil (76a, 76b) durch Seiten der Leistungsrückgewinnungs-Kammern (1a, 1b) hindurchpassieren und an nachgiebige Elemente (741) außerhalb der Leistungsrückgewinnungs-Kammern (1a, 1b) angeschlossen sind.
8. Die selbst hin- und hergehende Energierückgewinnungs-Vorrichtung gemäß Anspruch 4, wobei das erste und das zweite Hochdruckkonzentrationswasser-Vorsteuerventil (74a, 74b) und das erste und das zweite Niederdruckkonzentrationswasser-Vorsteuerventil (76a, 76b) durch Seiten der Leistungsrückgewinnungs-Kammern (1a, 1b) hindurchpassieren und an nachgiebige Elemente (741) außerhalb der Leistungsrückgewinnungs-Kammern (1a, 1b) angeschlossen sind.

geschlossen sind.

9. Eine selbst hin- und hergehende Energierückgewinnungs-Vorrichtung, aufweisend ein Paar von Leistungsrückgewinnungs-Kammern (1a, 1b), die in ihrem Inneren jeweils Kolben (11a, 11b) aufweisen, ein Hochdruckkonzentrations-Zuführrohr (4), ein Niederdruckkonzentrations-Ableitungsrohr (5), und ein Hochdruckmeerwasser-Ableitungsrohr (3), um den Leistungsrückgewinnungs-Kammern (1a, 1b) zu ermöglichen, hydraulische Leistung, die durch das Hochdruckkonzentrationswasser-Zuführrohr (4) zugeführt wird, wiederzugewinnen, und um die hydraulische Leistung beim Antreiben einer Meerwasserpumpe zu nutzen, wobei die Energierückgewinnungs-Vorrichtung **gekennzeichnet ist durch:**

ein fluktuierendes plattenartiges Konzentrationswasserventil (63), aufweisend eine fixierte Schaufel (632), um das Einführen und Ableiten von Konzentrationswasser in die und aus der ersten Leistungsrückgewinnungs-Kammer (1a) und der zweiten Leistungsrückgewinnungs-Kammer (1b) **durch** Fluktuation desselben wahlweise zu unterbrechen,

einen fluktuierenden plattenartigen Konzentrationswasser-Ventilblock (64, aufweisend einen Raum, in dem das fluktuierende plattenartige Konzentrationswasserventil (63) und die fixierte Schaufel (632) aufgenommen sind, und ein erstes Block-Auslassloch (643a) und ein erstes Block-Einlassloch (642a), und ein zweites Block-Auslassloch (643b) und ein zweites Block-Einlassloch (642b), die symmetrisch an entgegengesetzten Seiten des Raumes (641) angeordnet sind,

eine erste und eine zweite Hochdruckkonzentrations-Wasserleitung (73a, 73b), die aus dem Hochdruckkonzentrationswasser-Zuführrohr (4) zu Leitungen abzweigen und an das erste und das zweite Block-Einlassloch (642a, 642b) angeschlossen sind, um das Hochdruckkonzentrationswasser abwechselnd zuzuführen, ein erstes und ein zweites Hochdruckkonzentrations-Vorsteuerventil (74a, 74b), die die Zufuhr von Hochdruckkonzentrationswasser zu der ersten und der zweiten Hochdruckkonzentrations-Wasserleitung (73a, 73b) unterbrechen,

eine erste und eine zweite Niederdruckkonzentrations-Wasserleitung (75a, 75b), die an das erste und das zweite Block-Auslassloch (643a, 643b) angeschlossen sind, um das Niederdruckkonzentrationswasser abwechselnd abzuleiten, und

ein erstes und ein zweites Niederdruckkonzentrationswasser-Vorsteuerventil (76a, 76b), die das Ableiten von Niederdruckkonzentrations-

wasser **durch** die erste und die zweite Niederdruckkonzentrations-Wasserleitung (75a, 75b) unterbrechen.

10. Die selbst hin- und hergehende Energierückgewinnungs-Vorrichtung gemäß Anspruch 9, wobei der fluktuierende plattenartige Konzentrationswasser-Ventilblock (64) aufweist:

eine Konzentrationswasser-Kammerabdeckung (61), die Kammeranschlüsse (61a, 61b) aufweist, die jeweils mit den Energierückgewinnungs-Kammern (1a, 1b) kommunizieren, eine Konzentrationswasser-Einlass-/Auslassabdeckung (62), die ein mit dem Hochdruckkonzentrationswasser-Zuführrohr (4) kommunizierendes Konzentrationswasser-Zuführloch (62a) und ein mit dem Niederdruckkonzentrationswasser-Ableitungsrohr (5) kommunizierendes Konzentrationswasser-Auslassloch (62b) aufweist, und

ein fluktuierendes plattenartiges Konzentrationswasserventil (63) zwischen der Konzentrationswasser-Kammerabdeckung (61) und der Konzentrationswasser-Einlass-/Auslass-Abdeckung (62), das als ein hydrostatisches Lager durch einen Druck von zugeführtem Wasser funktioniert und aufweisend geöffnete Löcher aufweist.

11. Die selbst hin- und hergehende Energierückgewinnungs-Vorrichtung gemäß Anspruch 10, ferner aufweisend:

ein fluktuierendes plattenartiges Absperrventil (83), das an einer Seite der Leistungsrückgewinnungs-Kammern (1a, 1b) vorgesehen ist und an seinem Außenumfang eine fixierte Schaufel (832) aufweist, um das Einführen und Ableiten von Meerwasser in die und aus der ersten Leistungsrückgewinnungs-Kammer (1a) und der zweiten Leistungsrückgewinnungs-Kammer (1b) durch Fluktuation davon wahlweise zu unterbrechen,

einen fluktuierenden plattenartigen Absperrventil-Block (8), der einen Raum (841) aufweist, in dem das fluktuierende plattenartige Absperrventil (83) und die fixierte Schaufel (832) aufgenommen sind, und einen Absperrventil-Block (84), der ein erstes Absperrventil-Einlassloch (842a) und ein erstes Absperrventil-Auslassloch (842b) und ein zweites Absperrventil-Einlassloch (843a) und ein zweites Absperrventil-Auslassloch (843b) aufweist, die symmetrisch an entgegengesetzten Seiten des Raumes (841) angeordnet sind,

wobei die erste und die zweite Hochdruckkonzentrations-Wasserleitung (73a, 43b), die ab-

- wechselnd Hochdruckkonzentrationswasser zuführen, an das erste und das zweite Absperrventil-Einlassloch (842a, 842b) angeschlossen sind, und die erste und die zweite Niederdruckkonzentrations-Wasserleitung (75a, 75b), die abwechselnd Niederdruckkonzentrationswasser ableiten, an das erste und das zweite Absperrventil-Auslassloch (843a, 843b) angeschlossen sind.
12. Die selbst hin- und hergehende Energierückgewinnungs-Vorrichtung gemäß Anspruch 11, wobei der fluktuierende plattenartige Regelventilblock (8) aufweist:
- eine Meerwasser-Kammerabdeckung (81), die Kammeranschlüsse (81a, 81b) aufweist, die jeweils mit den Energierückgewinnungs-Kammern (1a, 1b) kommunizieren,
- eine Meerwasser-Einlass-/Auslass-Abdeckung (82), die ein an das Niederdruck-Zuführrohr (2) angeschlossen Meerwasser-Zuführloch (82a) und ein an das Hochdruckmeerwasser-Auslassrohr (3) angeschlossen Meerwasser-Auslassloch (82b) aufweist, und
- ein fluktuierendes plattenartiges Absperrventil (83), das zwischen der Meerwasser-Kammerabdeckung (81) und der Meerwasser-Einlass-/Auslass-Abdeckung (82) durch einen Druck von Zuführwasser als ein hydrostatisches Lager funktioniert und geöffnete Löcher (83a, 83b) aufweist.
13. Die selbst hin- und hergehende Energierückgewinnungs-Vorrichtung gemäß Anspruch 9, wobei das erste und das zweite Hochdruckkonzentrationswasser-Vorsteuerventil (74a, 74b) und das erste und das zweite Niederdruckkonzentrationswasser-Vorsteuerventil (76a, 76b) durch Seiten der Energierückgewinnungs-Kammern (1a, 1b) hindurchpassieren und an nachgiebige Elemente (741) außerhalb der Leistungsrückgewinnungs-Kammern (1a, 1b) angeschlossen sind.
14. Die selbst hin- und hergehende Energierückgewinnungs-Vorrichtung gemäß Anspruch 10, wobei das erste und das zweite Hochdruckkonzentrationswasser-Vorsteuerventil (74a, 74b) und das erste und das zweite Niederdruckkonzentrationswasser-Vorsteuerventil (76a, 76b) durch Seiten der Leistungsrückgewinnungs-Kammern (1a, 1b) hindurchpassieren und an nachgiebige Elemente (741) außerhalb der Leistungsrückgewinnungs-Kammern (1a, 1b) angeschlossen sind.
15. Die selbst hin- und hergehende Energierückgewinnungs-Vorrichtung gemäß Anspruch 11, wobei das erste und das zweite Hochdruckkonzentrationswas-

ser-Vorsteuerventil (74a, 74b) und das erste und das zweite Niederdruckkonzentrationswasser-Vorsteuerventil (76a, 76b) durch Seiten der Leistungsrückgewinnungs-Kammern (1a, 1b) hindurchpassieren und an nachgiebige Elemente (741) außerhalb der Leistungsrückgewinnungs-Kammern (1a, 1b) angeschlossen sind.

16. Die selbst hin- und hergehende Energierückgewinnungs-Vorrichtung gemäß Anspruch 12, wobei das erste und das zweite Hochdruckkonzentrationswasser-Vorsteuerventil (74a, 74b) und das erste und das zweite Niederdruckkonzentrationswasser-Vorsteuerventil (76a, 76b) durch Seiten der Leistungsrückgewinnungs-Kammern (1a, 1b) hindurchpassieren und an nachgiebige Elemente (741) außerhalb der Leistungsrückgewinnungs-Kammern (1a, 1b) angeschlossen sind.

Revendications

1. Dispositif de récupération d'énergie auto-alternatif comprenant une paire de chambres de récupération d'énergie (1a, 1b) comprenant respectivement des pistons (11a, 11b) à l'intérieur, un tuyau d'alimentation en eau concentrée haute pression (4), un tuyau de décharge d'eau concentrée basse pression (5) et un tuyau de décharge d'eau de mer haute pression (3) pour permettre aux chambres de récupération d'énergie (1a, 1b) de récupérer la puissance hydraulique fournie par le tuyau d'alimentation en eau concentrée haute pression (4) et utiliser la puissance hydraulique pour actionner une pompe à eau de mer, le dispositif de récupération d'énergie étant **caractérisé en ce que** :

un bloc de soupape de réglage d'eau concentrée (6) interrompt de manière sélective l'introduction et la décharge d'eau concentrée vers et depuis les chambres de récupération d'énergie (1a, 1b) par la fluctuation d'une soupape d'eau concentrée (63) en forme de plaque fluctuante ayant des dents d'engrenage à pignon (631) sur sa surface périphérique extérieure ;

un engrenage à crémaillère (72) avec des dents (721) engrenées avec les dents d'engrenage à pignon (631) et insérées dans des tiroirs cylindriques opposés (71) ;

des premiers et seconds pilotes (73a, 73b) d'eau concentrée haute pression sortant du tuyau d'alimentation en eau concentrée haute pression (4) vers les pilotes et reliés aux côtés des tiroirs cylindriques (71) pour alimenter en alternance en eau concentrée haute pression ;

une première et seconde soupape pilote (74a, 74b) d'eau concentrée haute pression interrompt respectivement l'alimentation en eau con-

- centrée haute pression vers des premiers et seconds pilotes d'eau concentrée haute pression (73a, 73b) ;
des premiers et seconds pilotes d'eau concentrée basse pression (75a, 75b) sont reliés aux côtés opposés des tiroirs cylindriques (71) pour évacuer l'eau concentrée basse pression ; et des premières et secondes soupapes pilotes d'eau concentrée basse pression (76a, 76b) interrompent l'évacuation d'eau concentrée basse pression par les premiers et seconds pilotes d'eau concentrée basse pression (75a, 75b).
2. Dispositif de récupération d'énergie auto-alternatif selon la revendication 1, dans lequel le bloc de soupape de réglage d'eau concentrée (6) comprend :
- un couvercle de chambre d'eau concentrée (61) ayant des ouvertures de chambre (61a, 61b) communiquant respectivement avec les chambres de récupération d'énergie (1a, 1b) ;
un couvercle d'entrée/sortie d'eau concentrée (62) ayant un trou d'alimentation en eau concentrée (62a) communiquant avec le tuyau d'alimentation en eau concentrée haute pression (4) et un trou de sortie d'eau concentrée (62b) communiquant avec le tuyau de décharge d'eau concentrée basse pression (5) ; et
une soupape d'eau concentrée en forme de plaque fluctuante (63) fonctionnant comme un palier hydrostatique par une pression d'eau fournie entre le couvercle de chambre d'eau concentrée (61) et le couvercle d'entrée/sortie d'eau concentrée (62) et ayant des trous ouverts.
3. Dispositif de récupération d'énergie auto-alternatif selon la revendication 1, comprenant en outre un bloc de soupape d'arrêt en forme de plaque fluctuante (8) prévu sur un côté des chambres de récupération d'énergie (1a, 1b) et relié à la soupape d'eau concentrée en forme de plaque fluctuante (63), le bloc de soupape d'arrêt en forme de plaque fluctuante (8) étant déplacé en association avec la fluctuation de la soupape concentrée en forme de plaque fluctuante (63) pour interrompre de manière sélective l'introduction et la décharge de l'eau de mer vers et depuis la première chambre de récupération d'énergie (1a) et la seconde chambre de récupération d'énergie (1b).
4. Dispositif de récupération d'énergie auto-alternatif selon la revendication 3, dans lequel le bloc de soupape d'arrêt en forme de plaque fluctuante (8) comprend :
- un couvercle de chambre d'eau de mer (81) ayant des ouvertures de chambre (81a, 81b) communiquant respectivement avec les cham-
- bres de récupération d'énergie (1a, 1b) ;
un couvercle d'entrée/sortie d'eau de mer (82) ayant un trou d'alimentation en eau de mer (82a) relié au tuyau d'alimentation en eau de mer basse pression (2) et un trou de sortie d'eau de mer (82b) relié au tuyau de décharge d'eau de mer haute pression (3) ; et
une soupape d'eau concentrée en forme de plaque fluctuante (63) fonctionnant comme un palier hydrostatique par une pression d'eau d'alimentation entre le couvercle de chambre d'eau de mer (81) et le couvercle d'entrée/sortie d'eau de mer (82) et ayant des trous ouverts (82a, 82b).
5. Dispositif de récupération d'énergie auto-alternatif selon la revendication 1, dans lequel les premières et secondes soupapes pilotes d'eau concentrée haute pression (74a, 74b) et les premières et secondes soupapes pilotes d'eau concentrée basse pression (76a, 76b) passent par des côtés des chambres de récupération d'énergie (1a, 1b) et sont reliées à des éléments élastiques (741) en dehors des chambres de récupération d'énergie (1a, 1b).
6. Dispositif de récupération d'énergie auto-alternatif selon la revendication 2, dans lequel les premières et secondes soupapes pilotes d'eau concentrée haute pression (74a, 74b) et les premières et secondes soupapes pilotes d'eau concentrée basse pression (76a, 76b) passent par des côtés des chambres de récupération d'énergie (1a, 1b) et sont reliées à des éléments élastiques (741) en dehors des chambres de récupération d'énergie (1a, 1b).
7. Dispositif de récupération d'énergie auto-alternatif selon la revendication 3, dans lequel les premières et secondes soupapes pilotes d'eau concentrée haute pression (74a, 74b) et les premières et secondes soupapes pilotes d'eau concentrée basse pression (76a, 76b) passent par des côtés des chambres de récupération d'énergie (1a, 1b) et sont reliées à des éléments élastiques (741) en dehors des chambres de récupération d'énergie (1a, 1b).
8. Dispositif de récupération d'énergie auto-alternatif selon la revendication 4, dans lequel les premières et secondes soupapes pilotes d'eau concentrée haute pression (74a, 74b) et les premières et secondes soupapes pilotes d'eau concentrée basse pression (76a, 76b) passent par des côtés des chambres de récupération d'énergie (1a, 1b) et sont reliées à des éléments élastiques (741) en dehors des chambres de récupération d'énergie (1a, 1b).
9. Dispositif de récupération d'énergie auto-alternatif comprenant une paire de chambres de récupération d'énergie (1a, 1b) comprenant respectivement des

pistons (11a, 11b) à l'intérieur, un tuyau d'alimentation en eau concentrée haute pression (4), un tuyau de décharge d'eau concentrée basse pression (5) et un tuyau de décharge d'eau de mer haute pression (3) pour permettre aux chambres de récupération d'énergie (1a, 1b) de récupérer la puissance hydraulique fournie par le tuyau d'alimentation en eau concentrée haute pression (4) et utiliser la puissance hydraulique pour actionner une pompe à eau de mer, le dispositif de récupération d'énergie étant **caractérisé en ce que** :

une soupape d'eau concentrée en forme de plaque fluctuante (63) a une aube fixée (632) pour interrompre de manière sélective l'introduction et la décharge d'eau concentrée vers et depuis la première chambre de récupération d'énergie (1a) et la seconde chambre de récupération d'énergie (1b) par sa fluctuation ;
 un bloc de soupape d'eau concentrée en forme de plaque fluctuante (64) a un espace, dans lequel la soupape d'eau concentrée en forme de plaque fluctuante (63) et l'aube fixée (632) sont logées et un premier trou de sortie de bloc (643a) et un premier trou d'entrée de bloc (642a) et un second trou de sortie de bloc (643b) et un second trou d'entrée de bloc (642b) sont disposés de manière symétrique sur des côtés opposés de l'espace (641) ;
 des premiers et seconds pilotes (73a, 73b) d'eau concentrée haute pression sortent du tuyau d'alimentation en eau concentrée haute pression (4) vers les pilotes et reliés aux premiers et seconds trous d'entrée de bloc (642a, 642b) pour alimenter en alternance en eau concentrée haute pression ;
 des premières et secondes soupapes pilotes concentrées haute pression (74a, 74b) interrompent l'alimentation en eau concentrée haute pression vers les premiers et seconds pilotes d'eau concentrée haute pression (73a, 73b) ;
 des premiers et seconds pilotes d'eau concentrée basse pression (75a, 75b) sont reliés aux premiers et seconds trous de sortie de bloc (643a, 643b) pour décharger en alternance l'eau concentrée basse pression ; et
 des premières et secondes soupapes pilotes d'eau concentrée basse pression (76a, 76b) interrompent la décharge d'eau concentrée basse pression par les premiers et seconds pilotes d'eau concentrée basse pression (75a, 75b).

10. Dispositif de récupération d'énergie auto-alternatif selon la revendication 9, dans lequel le bloc de soupape d'eau concentrée en forme de plaque fluctuante (64) comprend :

un couvercle de chambre d'eau concentrée (61)

ayant des ouvertures de chambre (61a, 61b) communiquant respectivement avec les chambres de récupération d'énergie (1a, 1b) ;
 un couvercle d'entrée/sortie d'eau concentrée (62) ayant un trou d'alimentation en eau concentrée (62a) communiquant avec le tuyau d'alimentation en eau concentrée haute pression (4) et un trou de sortie d'eau concentrée (62b) communiquant avec le tuyau de décharge d'eau concentrée basse pression (5) ; et
 une soupape d'eau concentrée en forme de plaque fluctuante (63) fonctionnant comme un palier hydrostatique par une pression d'eau fournie entre le couvercle de chambre d'eau concentrée (61) et le couvercle d'entrée/sortie d'eau concentrée (62) et ayant des trous ouverts.

11. Dispositif de récupération d'énergie auto-alternatif selon la revendication 10, comprenant en outre :

une soupape d'arrêt en forme de plaque fluctuante (83) prévue sur un côté des chambres de récupération d'énergie (1a, 1b) et ayant une aube fixée (832) sur sa périphérie extérieure pour interrompre de manière sélective l'introduction et la décharge d'eau de mer dans et depuis la première chambre de récupération d'énergie (1a) et la seconde chambre de récupération d'énergie (1b) par sa fluctuation ;
 un bloc de soupape d'arrêt en forme de plaque fluctuante (8) ayant un espace (841), dans lequel la soupape d'arrêt en forme de plaque fluctuante (83) et l'aube fixée (832) sont logées et un bloc de soupape d'arrêt (84) ayant un premier trou d'entrée de soupape d'arrêt (842a) et un premier trou de sortie de soupape d'arrêt (842b) et un second trou d'entrée de soupape d'arrêt (843a) et un second trou de sortie de soupape d'arrêt (843b) disposés symétriquement sur des côtés opposés de l'espace (841) ;
 dans lequel les premiers et seconds pilotes d'eau concentrée haute pression (73a, 73b) alimentant en alternance en eau concentrée haute pression sont reliés aux premiers et seconds trous d'entrée de soupape d'arrêt (842a, 842b) et des premiers et seconds pilotes d'eau concentrée basse pression (75a, 75b) déchargeant en alternance de l'eau concentrée basse pression sont reliés aux premiers et seconds trous de sortie de soupape d'arrêt (843a, 843b).

12. Dispositif de récupération d'énergie auto-alternatif selon la revendication 11, dans lequel le bloc de soupape d'arrêt en forme de plaque fluctuante (8) comprend :

un couvercle de chambre d'eau de mer (81) ayant des ports de chambre (81a, 81b) commu-

- niquant respectivement avec les chambres de
 récupération d'énergie (1a, 1b) ;
 un couvercle d'entrée/sortie d'eau de mer (82)
 ayant un tuyau d'alimentation en eau de mer
 (82a) relié au tuyau d'alimentation basse pres- 5
 sion (2) et un trou de sortie d'eau de mer (82b)
 relié au tuyau de décharge d'eau de mer haute
 pression (3) ; et
 une soupape d'arrêt en forme de plaque fluc- 10
 tuante (83) fonctionnant comme un palier hy-
 drostatique par une pression d'eau d'alimenta-
 tion entre le couvercle de chambre d'eau de mer
 (81) et le couvercle d'entrée/sortie d'eau de mer
 (82) et ayant des trous ouverts (83a, 83b). 15
- 13.** Dispositif de récupération d'énergie auto-alternatif
 selon la revendication 9, dans lequel les premières
 et secondes soupapes pilotes d'eau concentrée
 haute pression (74a, 74b) et les premières et secon- 20
 des soupapes pilotes d'eau concentrée basse pres-
 sion (76a, 76b) passent par des côtés des chambres
 de récupération d'énergie (1a, 1b) et sont reliées à
 des éléments élastiques (741) en dehors des cham-
 bres de récupération d'énergie (1a, 1b). 25
- 14.** Dispositif de récupération d'énergie auto-alternatif
 selon la revendication 10, dans lequel les premières
 et secondes soupapes pilotes d'eau concentrée
 haute pression (74a, 74b) et les premières et secon- 30
 des soupapes pilotes d'eau concentrée basse pres-
 sion (76a, 76b) passent par des côtés des chambres
 de récupération d'énergie (1a, 1b) et sont reliées à
 des éléments élastiques (741) en dehors des cham-
 bres de récupération d'énergie (1a, 1b). 35
- 15.** Dispositif de récupération d'énergie auto-alternatif
 selon la revendication 11, dans lequel les premières
 et secondes soupapes pilotes d'eau concentrée
 haute pression (74a, 74b) et les premières et secon- 40
 des soupapes pilotes d'eau concentrée basse pres-
 sion (76a, 76b) passent par des côtés des chambres
 de récupération d'énergie (1a, 1b) et sont reliées à
 des éléments élastiques (741) en dehors des cham-
 bres de récupération d'énergie (1a, 1b). 45
- 16.** Dispositif de récupération d'énergie auto-alternatif
 selon la revendication 12, dans lequel les premières
 et secondes soupapes pilotes d'eau concentrée
 haute pression (74a, 74b) et les premières et secon- 50
 des soupapes pilotes d'eau concentrée basse pres-
 sion (76a, 76b) passent par des côtés des chambres
 de récupération d'énergie (1a, 1b) et sont reliées à
 des éléments élastiques (741) en dehors des cham-
 bres de récupération d'énergie (1a, 1b). 55

FIG.1

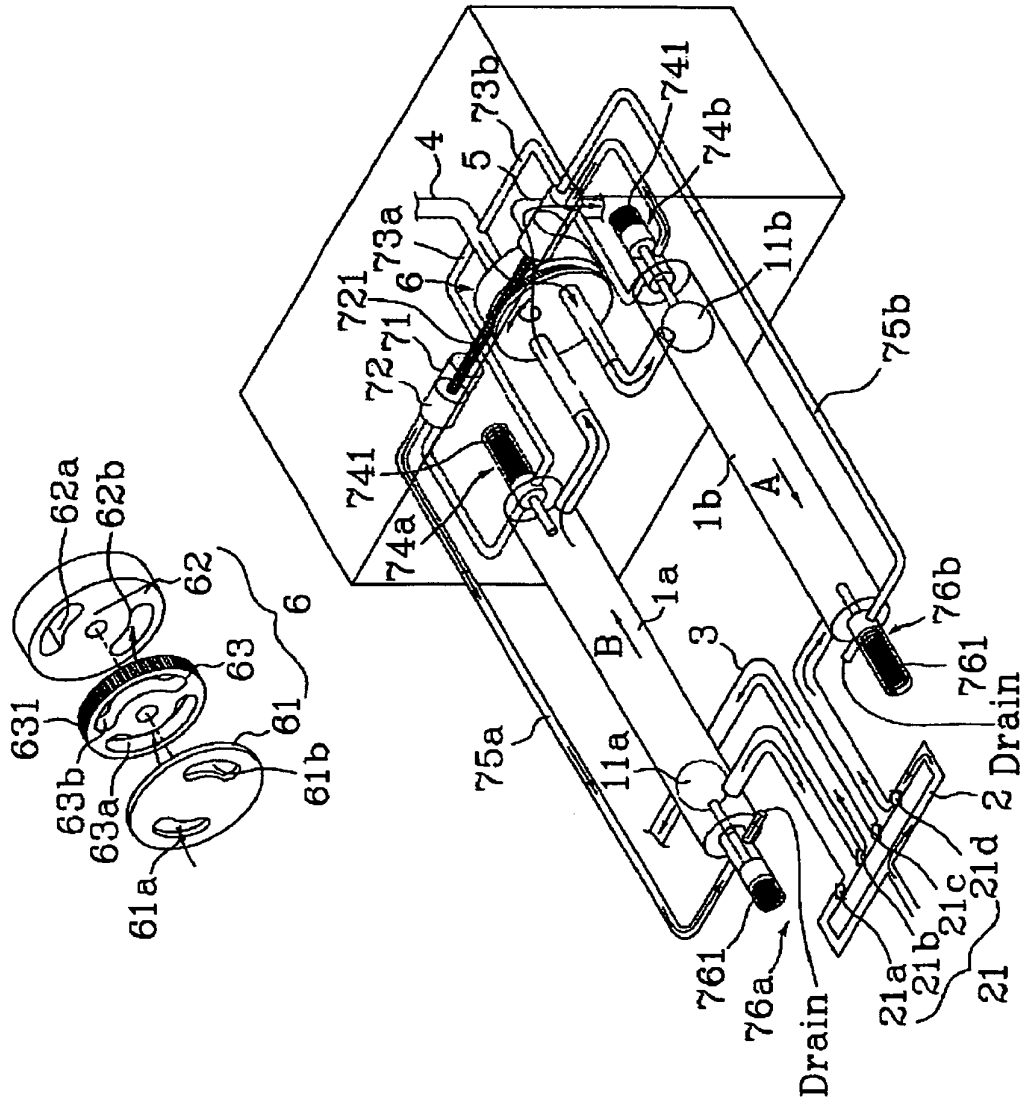


FIG. 2

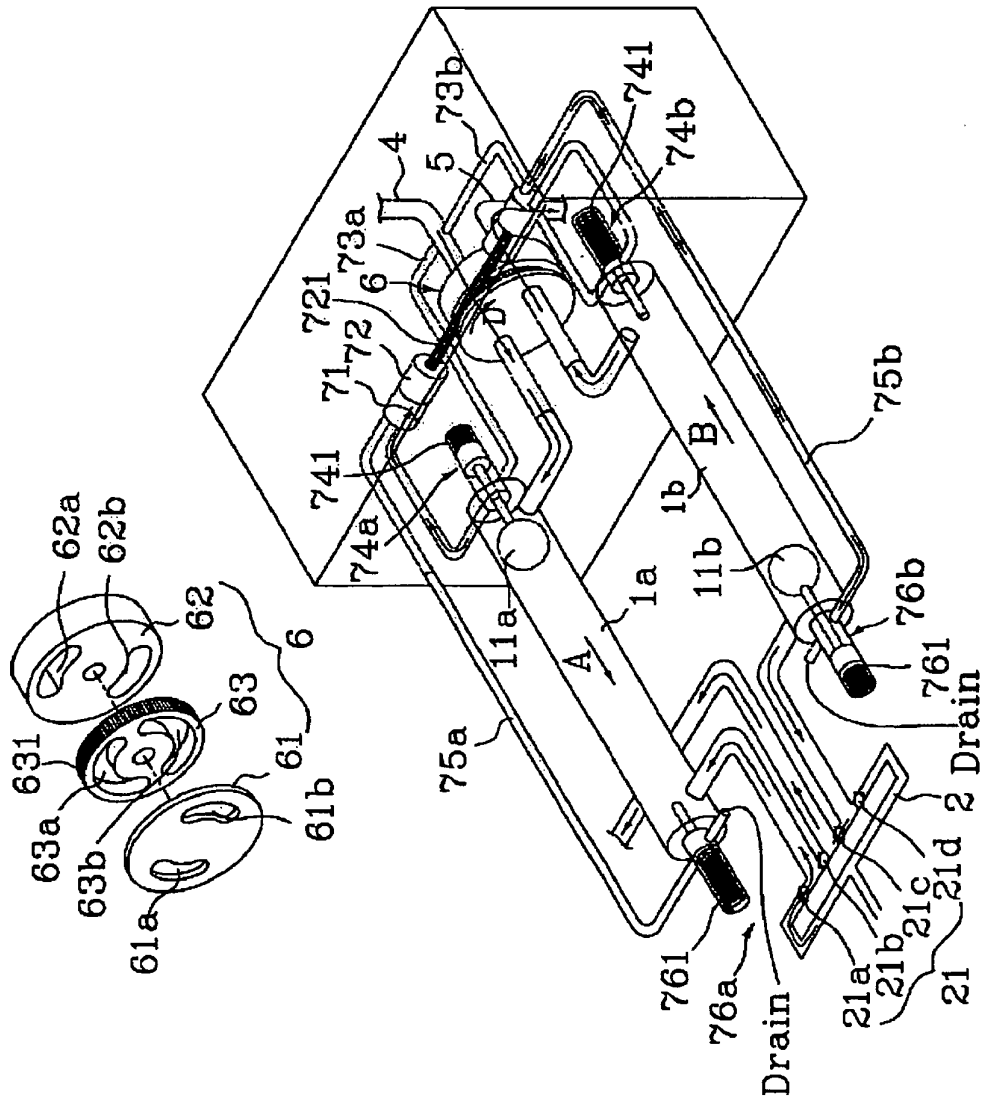


FIG.3

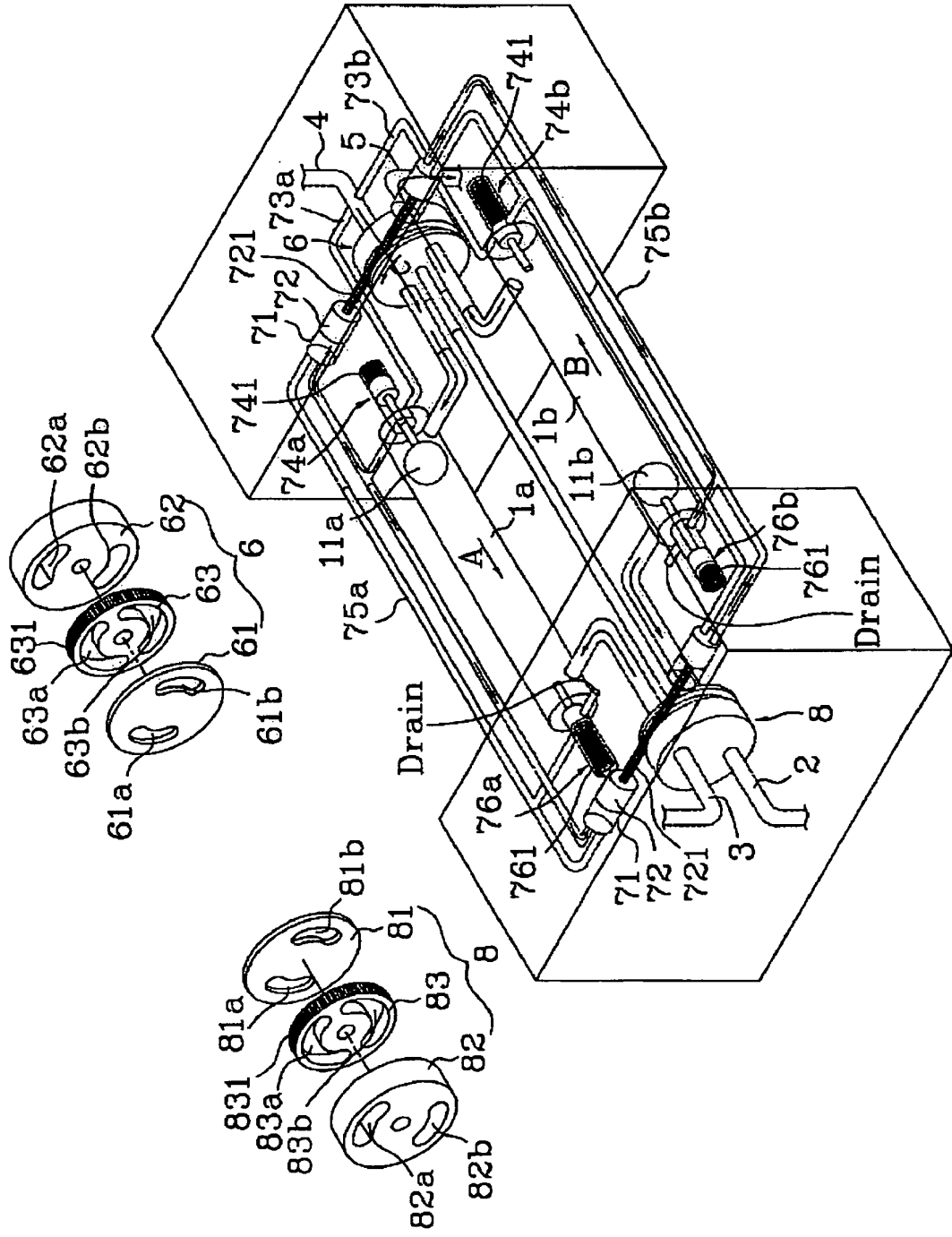


FIG.4

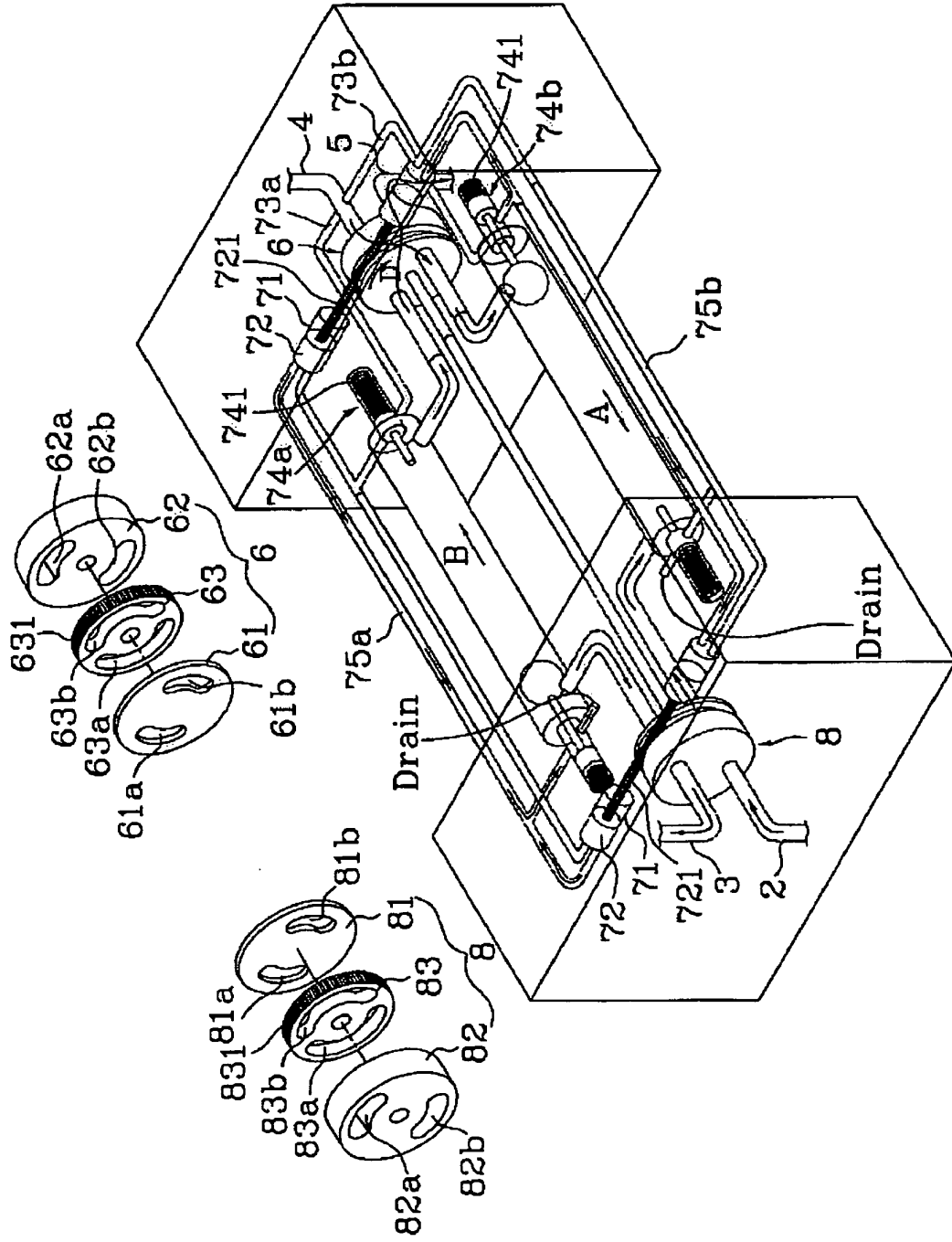


FIG. 5

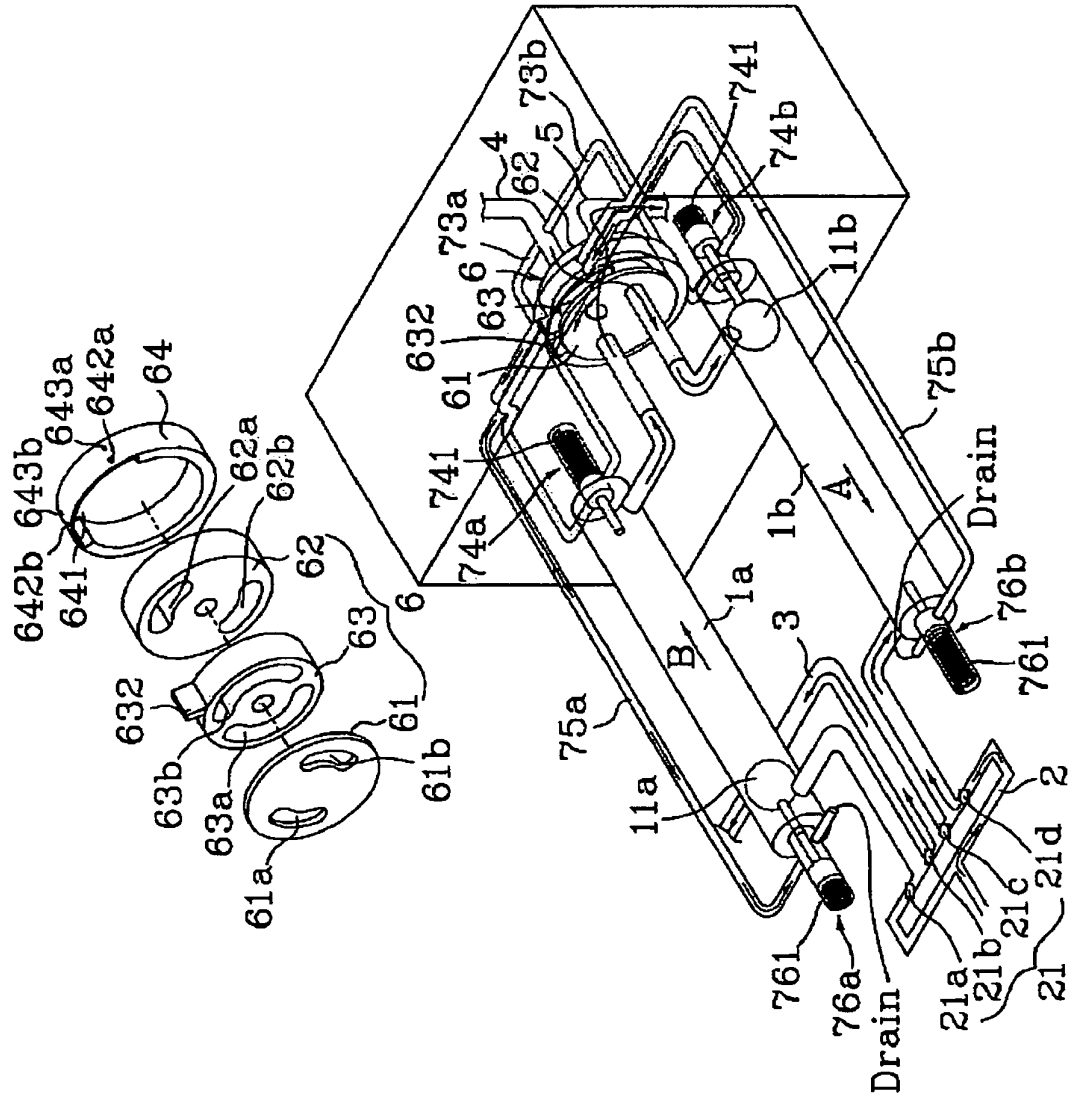


FIG.6

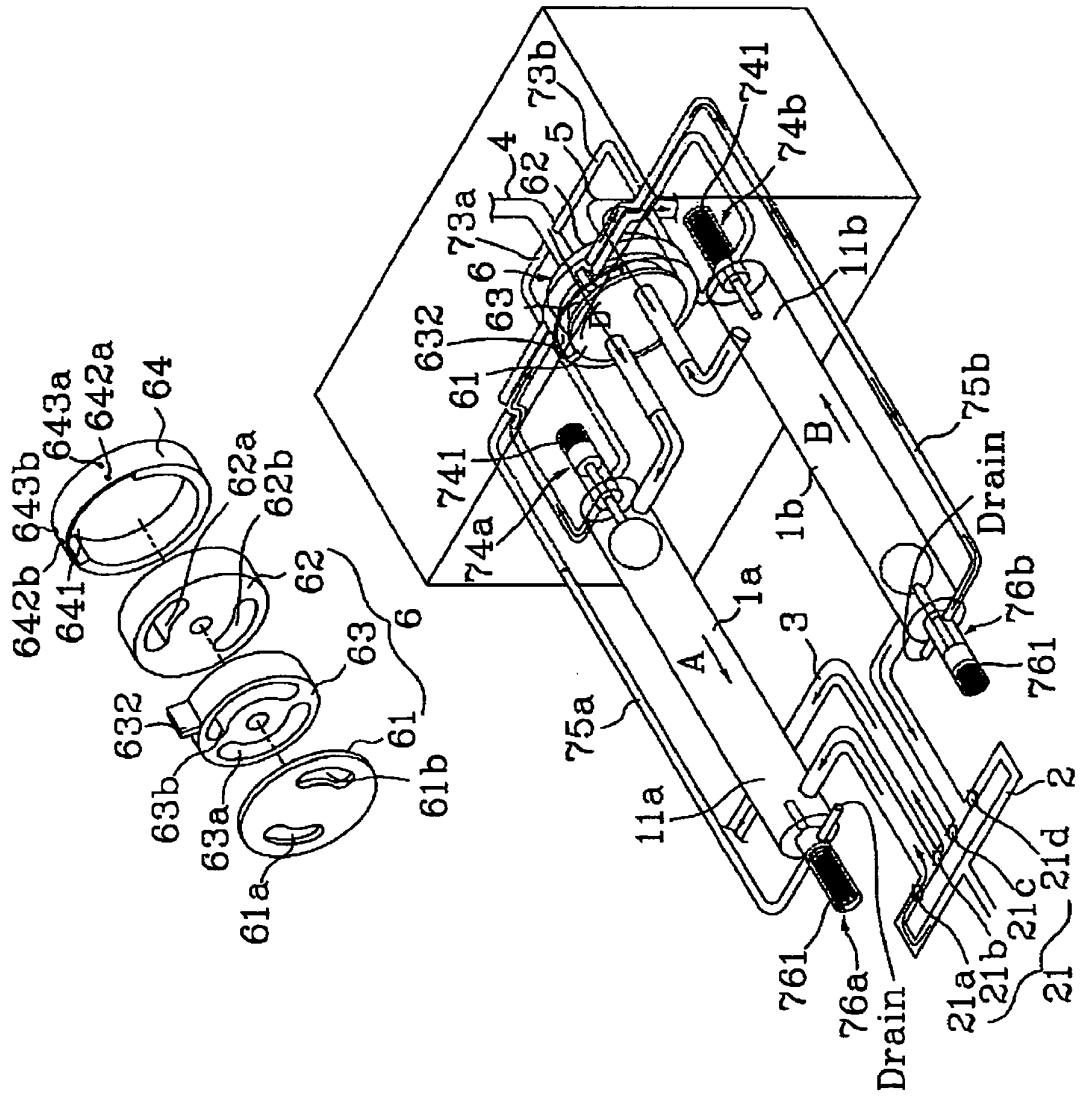


FIG. 7

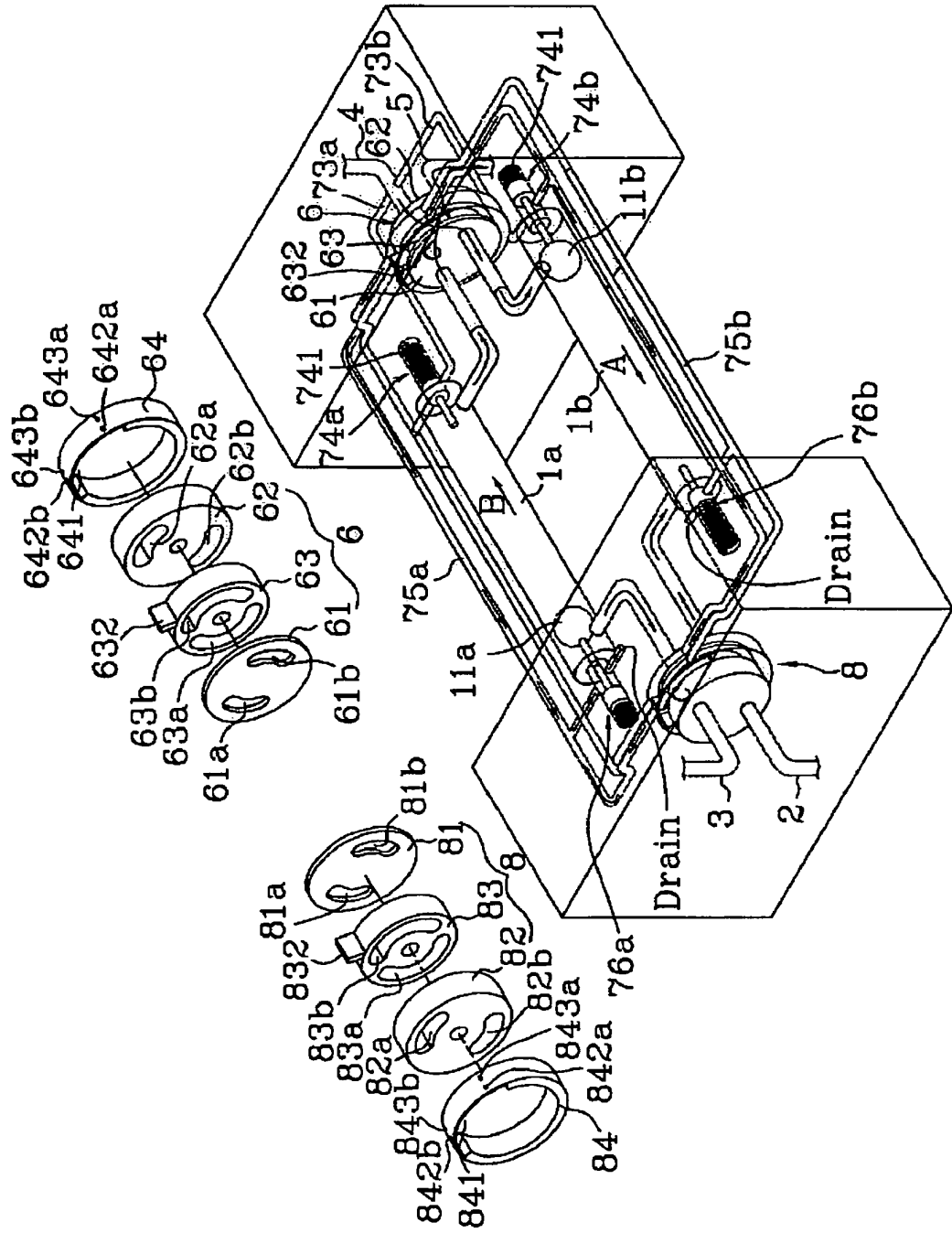
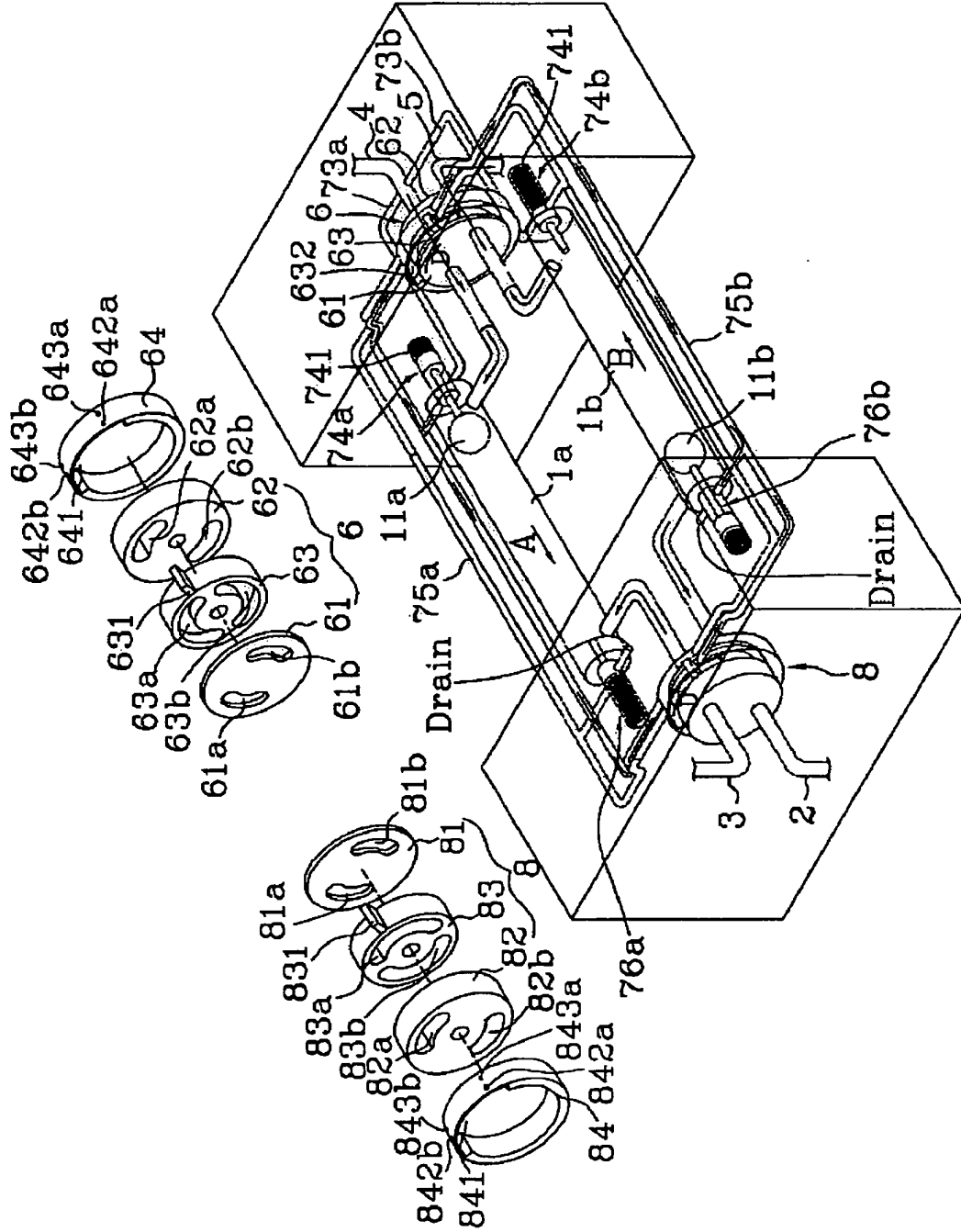


FIG. 8



REFERENCES CITED IN THE DESCRIPTION

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