

[54] **PUMPING TRAP FOR CONDENSATE** 1,439,691 12/1922 Chase 417/128
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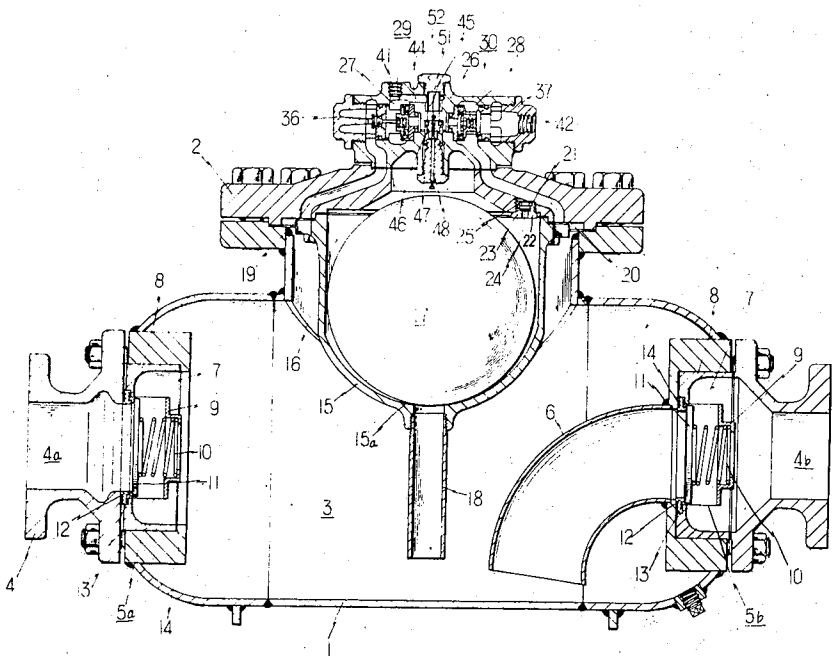
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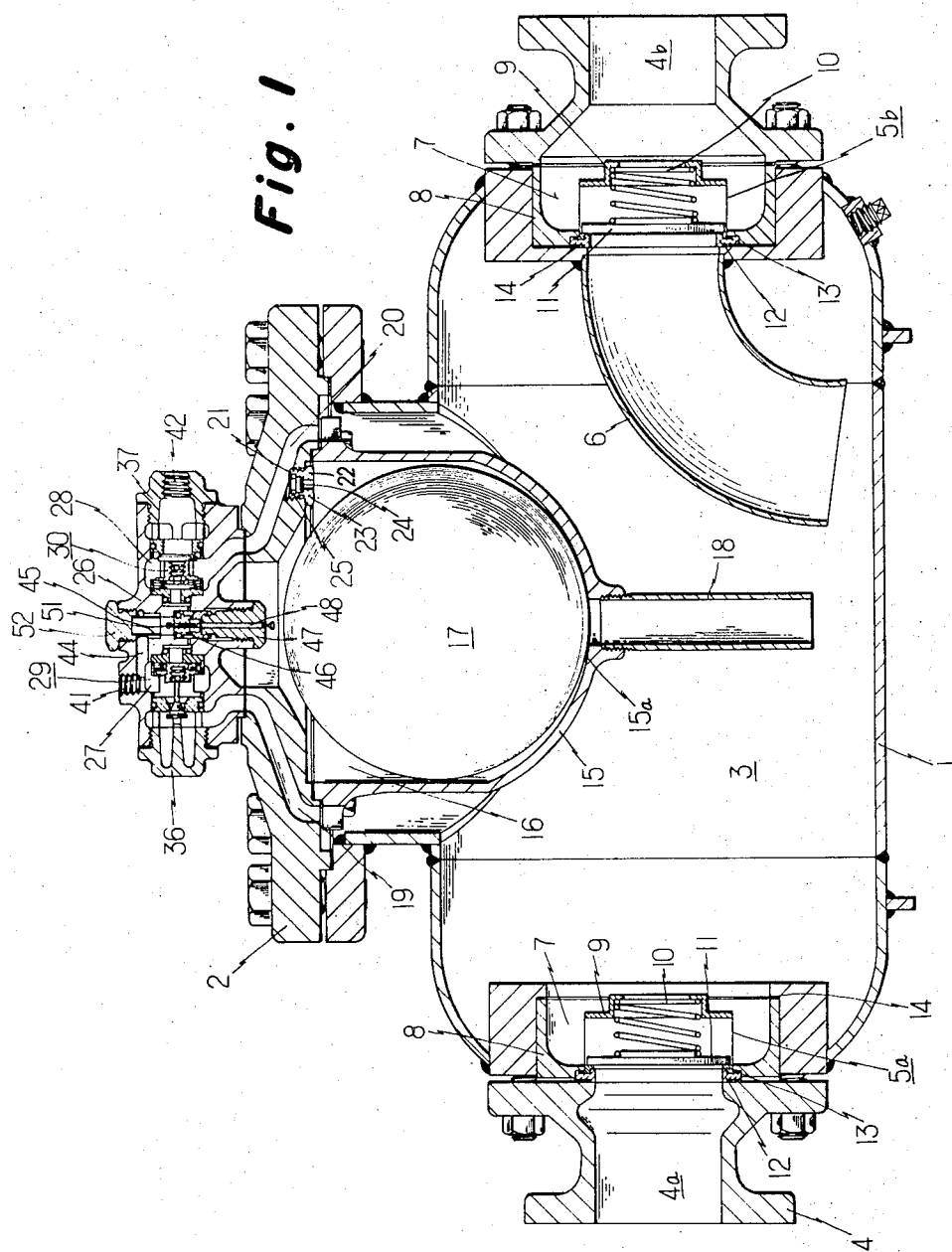
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[57] **ABSTRACT**
A pumping trap for returning high temperature condensate under lower presure directly to a boiler under higher pressure. This trap comprises in combination a condensate sump having an inlet and an outlet respectively provided with a check valve, supply and exhaust passages for higher pressure air, gas or the like, a float accomodated in said condensate sump, inlet and outlet check valves as well as pressure operated supply and exhaust valves provided on said passages, and a pilot valve which opens and closes according to rise and fall of said float.

6 Claims, 6 Drawing Figures





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Fig. 3

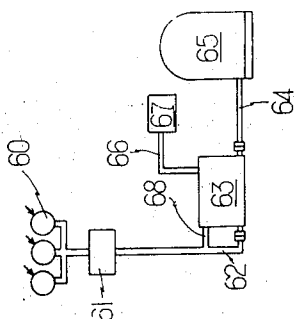
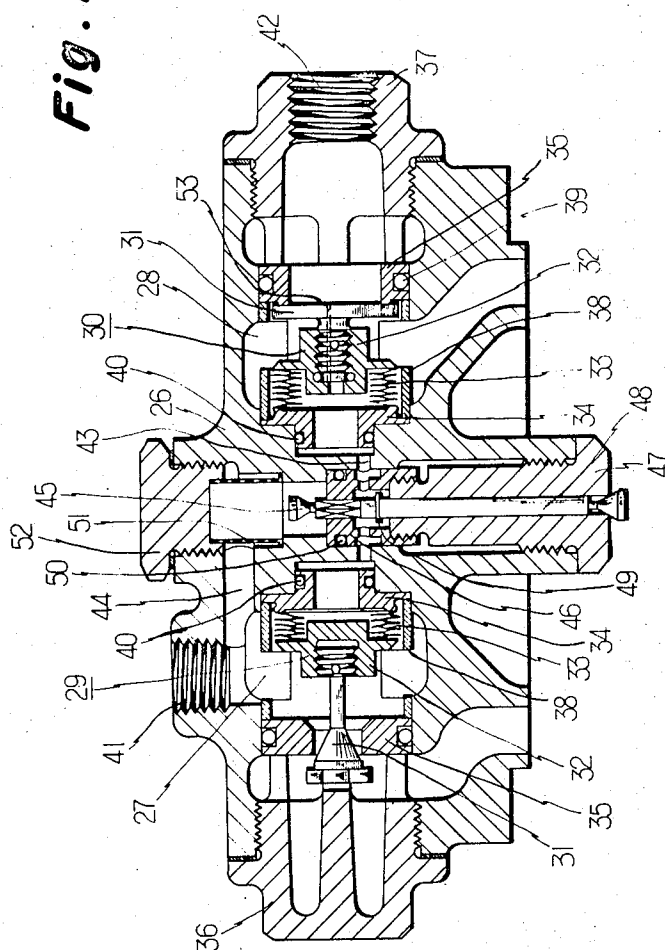


Fig. 2



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Fig. 5

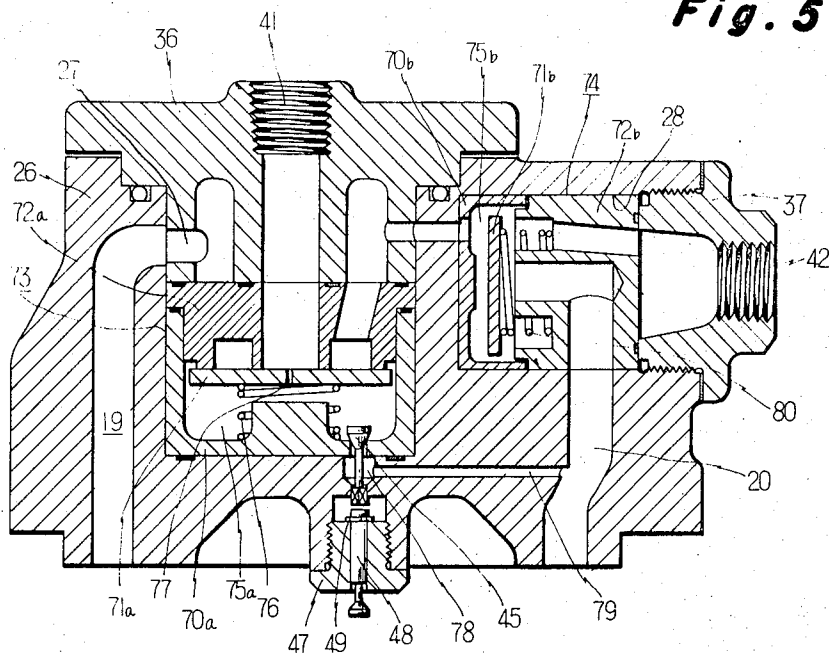
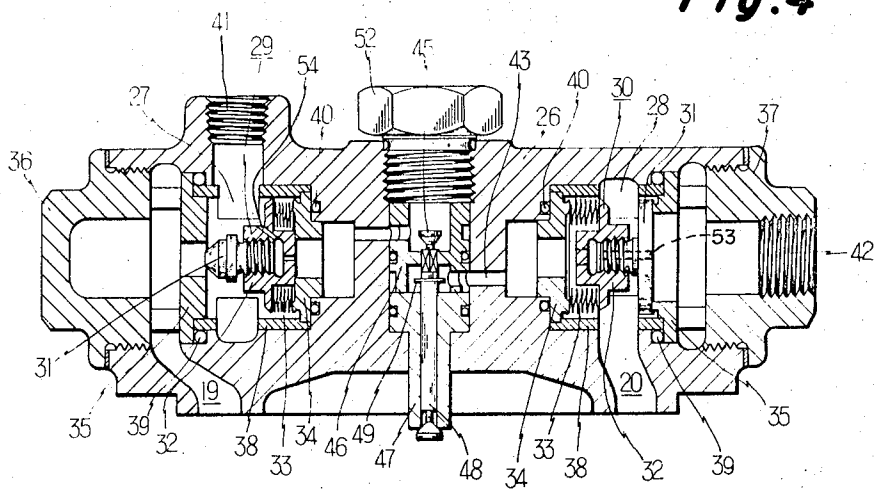


Fig. 4



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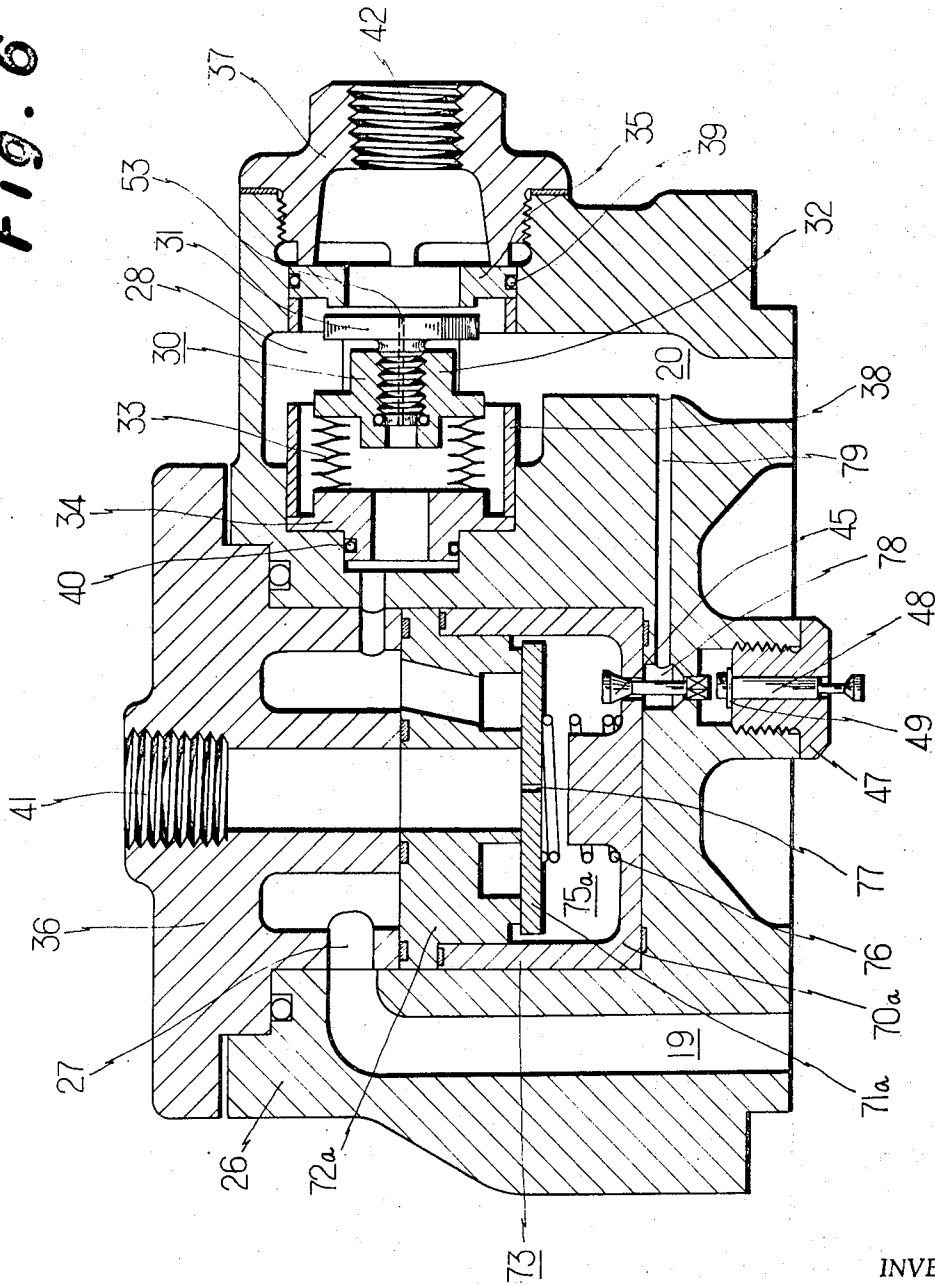
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Fig. 6



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PUMPING TRAP FOR CONDENSATE

BACKGROUND OF THE INVENTION

This invention relates to pumping traps, which are used for returning condensate from one system under lower pressure, to another system under higher pressure.

In a steam system, condensate discharged by means of steam traps is wasted as it is, or utilized in some waste heat systems. Particularly, it is most desirable to return high temperature condensate directly to a boiler, because the waste heat is recovered not only 100 percent, but also it has pertinent quality as a supply water for a boiler. Then, as a means for returning the condensate to a boiler, a pumping trap is generally used.

Usually, this type of pumping trap comprises two valves which communicate with supply and exhaust passages respectively, a float effecting said two valves through a lever connected directly therewith, and two check valves arranged on inlet and outlet passages respectively and co-operating with said two valves, and thus an opening and closing of said two valves are effected inversely of each other according to rise and fall of said float.

In such a structure, it is very difficult to assure perfect action of the opening and closing of said two valves. And since said two valves are connected with the float through a lever mechanism, the opening and closing of the valves are frequently affected by a slight tremble of the water surface or a slight falling of the water level. Thus, the discharge capacity returned per one cycle of operation is very little, and a large quantity of condensate remains in the pumping trap body, and further, because of having lever mechanism, the structure is very complex, and the shape of whole trap becomes larger and also its maintenance is very difficult.

SUMMARY OF THE INVENTION

The present invention relates to a pumping trap, comprising a condensate sump having an inlet passage for the inflow of condensate, an outlet passage for the discharge of condensate, supply and exhaust passages for the higher pressure air, gas and the like, and a float accommodated in said condensate sump, with inlet and outlet check valves incorporated in said inlet and outlet passages, and pressure operated supply and exhaust valves incorporated in said supply and exhaust passages, and also a pilot valve, of which opening and closing is effected by rise and fall of said float, whereby the opening and closing of said two pressure operated valves is effected inversely of each other by the pressure variation in the pressure chambers according to the opening and closing of said pilot valve.

Accordingly, an object of this invention is to obtain a pumping trap which is simple in construction and very reliable in the operation thereof.

The various features of novelty which characterize the invention are pointed out with particularity in the claims annexed to and forming a part of this disclosure. For a better understanding of the invention, its operating advantages and specific objects attained by its use, reference should be had to the accompanying drawings and descriptive matter in which there are illustrated and described preferred embodiments of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS:

FIG. 1 is a longitudinal section showing an embodiment of the present invention. FIG. 2 is an enlarged longitudinal section of main part in FIG. 1. FIG. 3 is a piping diagram of an embodiment of the pumping trap according to the present invention. FIG. 4, FIG. 5 and FIG. 6 are longitudinal sections similar to FIG. 2 showing other embodiments of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS:

In FIG. 1 and 2, 1 denotes a main body of a pumping trap according to the present invention, 2 a cover member thereof and a condensate sump 3 formed by said two parts. On an inlet passage 4a and an outlet passage 4b communicating with said condensate sump 3, check valve units 5a, 5b are incorporated, and said check valve units are fixed by flanges 4 attached with said main body 1, and with the outlet check valve unit 5b, a water collecting pipe 6 is connected. Said check valve units 5a, 5b respectively comprise a main body 8 being provided with guide walls 7 on the inner wall thereof, a spring retainer 9, a coil spring 10, a disk valve 11, and a valve seat 12, which is covered with a plastic member 13 such as Teflon for assuring better airtight seal, 14 are packings.

Further, a float cover 15 is fitted with said cover member 2 constituting said condensate sump 3 to form a float chamber 16, in which a float 17 is housed in a free state. Further, a water collecting pipe 18 is connected with said float cover 15, and said float chamber 16 is communicated with said condensate sump 3 through said water collecting pipe 18, and on an inner wall of said float cover 15 around the connecting port of the water collecting pipe 18, protrusions 15a are provided so as to prevent said float 17 from blocking said connecting port of the water collecting pipe 18 when the float 17 falls.

The cover member 2 is provided with two passages 19, 20 communicating with said condensate sump 3, one of which passages is a supply passage 19, and another of which is an exhaust passage 20 for a high pressure fluid, and on a through hole 21 communicating said exhaust passage 20 with said float chamber 16, a vent valve 22 is provided so as to discharge the air within the float chamber 16.

Said vent valve 22 comprises a main body 23, in which a valve body 24 is arranged, and a snap ring 25 is attached for preventing said valve body 24 from slipping out of the main body 23, thus said vent valve 22 opens according to a pressure rise within the float chamber 16.

And further, on said upper cover member 2, a main body 26 of a change-over valve unit is provided, having hollow chambers 27, 28 communicating with said supply and exhaust passages, and in each said hollow chambers 27, 28, bellows mechanisms 29, 30 are arranged. Said bellows mechanisms 29, 30 respectively comprise a valve body 31, a valve holder 32, a bellows 33, a bellows holder 34 and a valve seat 35, and these are fixed by union ends 36, 37.

Said bellows mechanism 29 on the side of the supply passage 19 is opened with the expansion of a bellows 33 according to the increase of pressure within a bellows chamber, while another bellows mechanism 30 on the side of the exhaust passage 20 is closed. 38 denotes

a sleeve, 39, 40 denote O-rings, and 41, 42 supply and exhaust ports.

Said two bellows chambers are mutually communicated through a passage 43, and said passage 43 is communicated with said supply port 41 through a passage 44. On said passage 44, a pilot valve 45 and a pilot valve seat 46 are arranged. Said pilot valve seat 46 is fixed by screwing upwardly a float valve seat 47 from the side of float chamber 16. On said float valve seat 47, an operating rod 48 having a valve member on its lower end is arranged. According to rise and fall of the float 17, said pilot valve 45 is opened and closed through said operating rod 48, thus said two bellows chambers are connected or disconnected with said supply port 41, and opening and closing of said two bellows mechanisms is effected inversely of each other. When the float 17 rises, the valve member on the lower end of said operating rod 48 will be pressed on the float valve seat 47 to disconnect the float chamber 16 and the supply port 41. Further, on said operating rod 48, there is arranged a snap ring 49 attached for preventing said operating rod 48 from slipping out of the float valve seat 47. 50 is an O-ring, and on said passage 44, a screen 51 is arranged, and kept in place by plug 52.

Hereinafter, the working of said pumping trap will be explained with an embodiment according to FIG. 3. 60 are steam traps, and 61 is a water collecting tank, while 62 is an inlet pipe to a pumping trap 63, which is connected with said flange 4 on the inlet passage 4a. 64 is an outlet pipe to a boiler 65 and is connected with said flange 4 on the outlet passage 4b. And, 66 is a supply pipe, which supplies compressed air from a compressor 67, and is connected with said supply port 41. Further, 68 is an exhaust pipe connected with said exhaust port 42.

Firstly, when the amount of condensate is little within the condensate sump 3, the float 17 will fall and the pilot valve 45 will close as seen in FIG. 1, while the bellows chambers of two bellows mechanisms 29, 30 are entirely disconnected from the high pressure side of said supply port 41. Therefore, the bellows mechanism 29 on the side of supply passage 19 will be contracted and closed by high supply pressure air operating from outside, and conversely the bellows mechanism 30 on the side of exhaust passage 20 will be contracted and opened by a spring action of the bellows, because the pressure within the bellows chamber becomes equal to the outside pressure.

Hereupon, if the valve body 31 of the bellows mechanism 30 on the side of exhaust passage 20 is provided with a small orifice 53 so as to make the pressure in the said bellows chamber escape to the side of exhaust port 42, said valve opening may be effected more accurately and quickly.

In this condition, the check valve 5a on the side of inlet passage 4a is opened by the pressure of the water level of the condensate, and conversely, the check valve 5b on the side of outlet passage 4b is closed by the boiler pressure, and the condensate flows into the condensate sump 3 through the check valve 5a. Simultaneously with the inflow of the condensate into the condensate sump 3, the air within the float chamber 16 opens the vent valve 22 and escapes through the exhaust passage 20 and port 42, so that water level in said float chamber 16 rises at the same time, and the float 17 begins to rise and pushes up the pilot valve 45 through the operating rod 48 to open the valve.

Consequently, said two bellows chambers are communicated with the high pressure side of the supply port 41, and at the same time, the valve member of said operating rod 48 is pressed on the float valve seat 47 to close the valve. The two bellows are expanded, so that the bellows mechanism 29 on the side of supply passage 19 is opened, while the bellows mechanism 30 on the side of exhaust passage 30 is closed. (FIG. 2) Therefore, the high pressure air on the side of supply port 41 flows into the condensate sump 3 from the supply passage 19 through the bellows mechanism 29, and causes the pressure within said sump 3 to rise, the check valve 5a on the side of inlet passage 4a is closed, while the check valve 5b on the side of outlet passage 4b is opened, and thus the condensate is returned to the boiler 65. Hereupon, it is necessary to make the pressure of air on the side of supply port 41 higher than the pressure on the side of boiler 65.

As the condensate is returned, the condensate level in the sump 3 falls. However, the vent valve 22 is closed by the weight of the valve body 24 and the pressure difference acting on both sides of said valve body 24, so that the condensate level within the float chamber 16 does not fall, and the pilot valve 45 is kept in a opened state. When the condensate level within the sump 3 falls below the lower end of the water collecting pipe 18, the condensate within the float chamber 16 falls into the condensate sump 3, thus the float 17 and the operating rod 48 fall, and the pilot valve 45 is closed at the same time.

Therefore, both of the bellows chambers are disconnected again with the high pressure side of said supply port 41, and the pressure within said bellows chambers will become equal to the pressure within the condensate sump 3, so that the bellows mechanism 29 on the supply side will be closed, while the bellows mechanism 30 on the exhaust side will be opened. Thus, the pressure within the condensate sump 3 will become lower because of its escape to the inlet side through the exhaust port 42, while the check valve 5a on the side of inlet passage 4a will be opened, and the check valve 5b on the side of outlet passage 4b will be closed, so that the condensate will flow into the condensate sump 3 through said inlet check valve 5a, and thereafter the same operations are repeated to return the condensate.

The construction of said embodiment is such that the two bellows chambers of said bellows mechanisms (29, 30) are communicated mutually, and on the passage communicating with said supply port, the pilot valve (45) is arranged, whereby the opening and closing of the two bellows mechanisms are effected inversely of each other according to the pressure variation within the pressure chambers by the opening and closing of said pilot valve. However, when the pilot valve is arranged on the passage communicating with the two bellows chambers mutually, and the bellows mechanism 29 on the supply side is provided with an orifice 54 so as to communicate the supply port 41 with said bellows chamber, as shown in FIG. 4, a similar effect may be obtained.

Namely, in FIG. 4, when the float 17 falls, the pilot valve 45 closes, and the bellows mechanism 29 on the supply side is closed because the pressure within the bellows chamber is high, while the bellows mechanism 30 on the exhaust side is opened, because the supply pressure to the bellows chamber is cut off. And when the float 17 rises, and the pilot valve 45 is opened

through the operating rod 48, the pressure within the bellows chamber on the supply side will escape to the bellows chamber on the exhaust side, thus the bellows mechanism 29 will be opened and the bellows mechanism 30 will be closed.

Further, FIG. 5 is a longitudinal section of the change-over means, showing another embodiment, wherein the disk type operating valves are used instead of the bellows mechanisms in said embodiments. Hereby, the parts corresponding to those of said embodiments are marked with the same reference numbers.

In each said hollow chamber 27, 28 communicating with said supply and exhaust passages 19, 20, a disk type operating valve 73 comprising a cap member 70a, a disk valve 71a and a valve seat 72a, and a disk type operating valve 74 comprising a cap member 70b, a disk valve 71b and a valve seat 72b are arranged and fixed with union ends 36, 37, which are provided with supply and exhaust ports 41, 42 respectively.

Said disk valves 71a, 71b are respectively arranged within pressure chamber 75a, 75b which are formed by said cap members 70a, 70b and said valve seats 72a, 72b and the disk valve 71a on the supply side is energized by a spring 76 in the direction of valve closing and the disk valve 71a is provided with an orifice 77 communicating said pressure chamber 75a with said supply port 41 when the disk valve 71a closes. Further, said pressure chamber 75a is communicated with the float chamber 16 through a passage 78, on which a pilot valve 45 is arranged and which is communicated with the exhaust passage 20 through a passage 79. The opening and closing of said pilot valve 45 is effected by rise and fall of said float 17 through the operating rod 48, thus the pressure chamber 75a is connected or disconnected with said passage 78. On the other hand, the pressure chamber 75b of the disk type operating valve 74 on the exhaust side is communicated with the supply passage 19, and the disk valve 71b is energized by a spring 80 in the direction of valve opening.

The working of this embodiment will be explained, as follows. Firstly, when the float 17 falls and the pilot valve 45 closes, the pressure chamber 75a of the disk type operating valve 73 is communicated with the supply port 41 through the orifice 77, so that the disk valve 71a will close, while the disk valve 71b on the exhaust side will open by the spring 80. And, when the float 17 rises and the pilot valve 45 opens through the operating rod 48, the pressure within the pressure chamber 75a of the disk type operating valve 73 will escape to the inlet side through the passage 78, 79, the exhaust passage 20 and the port 42, so that said disk valve 71a compresses the spring 76 for opening the valve. Hereupon, it is necessary to make the orifice 77 of the disk valve 71a smaller than the passage 78.

As soon as the high pressure air flows into the condensate sump 3 through the supply passage 19, the disk valve 71b compresses the spring 80 for closing the valve. Thereafter, when the condensate is returned and the float 17 falls again, the pilot valve 45 will be closed, and the pressure within the pressure chamber 75a will be raised, thus the disk valve 71a is closed, and conversely, the pressure within the pressure chamber 75b will be lowered, and the disk valve 71b is opened by the spring 80.

Further, as shown in FIG. 6, a combination of a bellows mechanism and a disk type operating valve may also result in a similar effect.

In this manner, the opening and closing of the pilot valve is effected by rise and fall of the float according to the condensate level within the condensate sump, for controlling the pressure within the pressure chambers of the pressure operated valves provided on the supply and exhaust passages respectively, and moreover the opening and closing of said pressure operated valves is effected alternately and inversely, co-operating with the check valves provided on the inlet and outlet passages respectively, whereby this pumping trap returns the condensate co-operating with the opening and closing of said pressure operating valves and said check valves, having valves which are opened and closed by pressure variation, without a lever mechanism such as a conventional pumping trap, so that the operation thereof is reliable and reasonable, thus a pumping trap having very high performance may be obtained.

This pumping trap is used not only for returning condensate to a boiler, but also for discharging from one system under lower pressure to another system under higher pressure, namely, for a vacuum trap discharging condensate under vacuum to the atmosphere, and it has many uses.

While specific embodiments of the invention have been shown and described in detail to illustrate the application of the inventive principles, it will be understood that the invention may be embodied otherwise without departing from such principles.

What is claimed is:

1. A pumping trap comprising, in combination, a main body defining a condensate sump, inlet and outlet passages and supply and exhaust passages communicating with said condensate sump, a float cover fitted to form part of an enclosure constituting said condensate sump, a float accommodated to be freely movable within said float cover, said cover including means defining a float chamber in which said float is housed, an open water collecting pipe connected with said float cover at the lower portion thereof and extending downwardly to communicate said float chamber with said condensate sump, orifice means communicating said exhaust passage with said float chamber, a first check valve provided in said orifice means to discharge air from within said float chamber, a second and a third check valve unit each provided, respectively, on said inlet and outlet passages, said second and third check valve units being detachably mounted directly within said main body, two pressure operated valves each including a pressure chamber provided on said supply and exhaust passages respectively, and a pilot valve operatively associated with said float whereby opening and closing of said pilot valve is effected by rise and fall of said float, and whereby opening and closing of said two pressure operated valves is effected inversely of each other by pressure variation in the pressure chambers of said valves in accordance with opening and closing of said pilot valves.

2. A pumping trap according to claim 1, wherein each of said pressure operated valves comprise bellows mechanisms each having a bellows chamber respectively arranged on said supply and exhaust passages, with opening and closing of said passages being effected inversely of each other by pressure variation in the bellows chambers, passage means communicating

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said bellows chambers with said supply passage, said pilot valve being arranged within said passage means.

3. A pumping trap according to claim 2, including passage means enabling communication between said bellows chambers, said pilot valve being arranged within said passage means, with said supply port bellows mechanism being provided with an orifice whereby its bellows chamber is placed in direct communication with said supply passage.

4. A pumping trap according to claim 1, wherein said pressure operated valves comprise a pair of disk valves each including a cap member, a valve disk and a valve seat, pressure chambers for each of said valves formed by said cap members and said valve seats, with operation of said valves being controlled by pressure within said chambers, orifice means formed in the valve disk of said supply passage valve for communicating its pressure chamber with said supply passage when said supply passage valve is closed, passage means having said pilot valve located therein for communicating the pressure chamber of said supply passage valve with said exhaust passage to control pressure in said pressure chamber by operation of said pilot valve in accordance with rise and fall of said float, and means for placing the pressure chamber of said exhaust passage valve in com-

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munication with said condensate sump through said supply passage.

5. A pumping trap according to claim 1, wherein said pressure operated valves comprise, respectively, a disk valve including a pressure chamber arranged on said supply passage and a valve including a bellows mechanism having a bellows chamber arranged on said exhaust passage, said disk valve including orifice means communicating said pressure chamber with said supply passage when said disk valve is closed, said pilot valve being operatively arranged to effect communication between said pressure chamber and said exhaust passage whereby the pressure within said pressure chamber may be controlled by opening and closing of said pilot valve in accordance with rise and fall of said float, and means communicating said bellows chamber of said bellows mechanism with said condensate sump through said supply passage.

6. A pumping trap according to claim 1, wherein each of said check valve units includes a main body, guide walls provided on the inner wall of said main body, a spring retainer, a coil spring, a disk valve, and a valve seat, said disk valve being energized by said coil spring in the direction of valve closing.

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