(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 495 306 A2**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **91311605.9**

(51) Int. Cl.5: **F04D 9/02**

(22) Date of filing: **11.12.91**

(30) Priority: **16.01.91 GB 9100986**
31.10.91 GB 9123087

(43) Date of publication of application:
22.07.92 Bulletin 92/30

(84) Designated Contracting States:
DE FR IT

(71) Applicant: **Comerford, Hugh**
21 Carew Road, Ealing
London W13 9OL(GB)

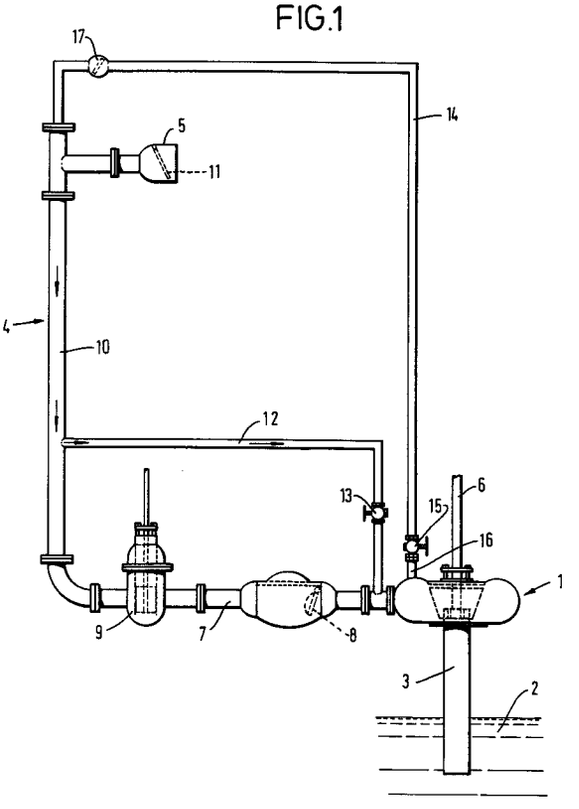
(72) Inventor: **Comerford, Hugh**
21 Carew Road, Ealing
London W13 9OL(GB)

(74) Representative: **Prentice, Raymond Roy**
R.R. Prentice & Co. The Hop Exchange 24
Southwark Street
London SE1 1TY(GB)

(54) Pump priming apparatus.

(57) Apparatus for priming a centrifugal pump (1) comprises a closed circuit connected to the casing of the pump and consisting of a priming pipe (12) connected to a vertical section (10) of an outlet pipe (4) from the pump downstream of a non-return valve (8) in the outlet and to the pump outlet upstream of the non-return valve (8). A valve (13) is provided in the priming pipe (12). A second part of the closed circuit consists of an air displacement pipe (14) which is connected to an upper part of the pump casing (1) and to the upper end of the outlet section (10). A non-return valve (17) is provided in the pipe (14) and a further valve (15) is provided in the pipe (14) adjacent the pump casing. The valves (13, 15) are closed during normal operation of the pump. When the pump is stopped, liquid is retained in the outlet pipe and in the priming pipe (12). The pump can be primed by opening the valves (13, 15). Liquid flows along the pipe (12) and into the pump casing (1) and air displaced from the casing can pass along the air-displacement pipe (14). In this manner the pump can be primed, i.e. filled with liquid, without recourse to secondary priming means.

FIG.1



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This invention relates to the priming of centrifugal pumps.

It is well known that, upon start-up, a centrifugal pump needs to be primed, i.e. filled with water or other liquid to be pumped, because the pump cannot create sufficient suction to draw in liquid. Previous methods of priming centrifugal pumps include locating the pump at a position below the level of the liquid to be pumped so that the liquid can flow into the pump under the action of gravity or drawing liquid into the pump by means of one or more secondary suction pumps, such as a vacuum pump. If liquid is to be pumped from ground level then setting the pump below the level of the liquid involves sinking a well in the ground at a position near the water supply so that the pump can be located within the well. This is a costly exercise. The use of a secondary pump is also costly since this further pump will require its own power supply.

The present invention seeks to provide an improved method of and apparatus for priming a centrifugal pump.

According to one aspect of the present invention there is provided an apparatus for priming a centrifugal pump which comprises a closed circuit adapted to be connected to the casing of a centrifugal pump at a low point in the circuit, means for retaining a predetermined head of liquid in a first part of the circuit above the level of the pump and means for releasing the head of liquid such that the liquid flows into the pump and displaces any air present in the pump casing into a second part of the circuit.

Preferably, said first part of the circuit includes a discharge pipe connected to the pump outlet. Conveniently, the pump outlet includes a non-return valve and the discharge pipe is connected to the pump outlet upstream of the non-return valve to by-pass said valve so as to permit a flow of liquid back into the pump casing, a valve being provided in said discharge pipe to trap or release the head of liquid in the first part of the circuit.

Alternatively, the first part of the circuit may comprise a substantially vertical outlet pipe adapted to be connected to a pump casing and closable at its lower end by a non-return valve, a priming pipe leading from the outlet pipe adjacent to the lower end thereof but downstream of the non-return valve and adapted to be connected to a lower part of the pump casing, and a further valve in the priming pipe to control the flow of liquid through said priming pipe.

Advantageously, means are provided to prevent the flow of liquid from the first part of the circuit into the second part of the circuit, said means preferably taking the form of a non-return valve.

The second part of the circuit may comprise an air purging pipe adapted to be connected, at one end, to an upper part of a pump casing and connected, at its other end, to the outlet pipe substantially at the upper end thereof.

Preferably, the second part of the circuit incorporates a sight glass, which may be provided at the highest point on the casing, to indicate when all air has been displaced from the pump casing into the second part of the circuit, a valve preferably being provided downstream of the sight glass to close off the second part of the circuit from the pump casing.

The invention also extend to a centrifugal pump equipped with the priming apparatus above described.

A second aspect of the present invention provides a pumping installation comprising at least one centrifugal pump, having an inlet and an outlet provided with a non-return valve, and means for priming the or each pump, the priming means comprising a priming tank located above the level of the pump(s), a priming pipe leading from a lower part of the tank to a lower part of the casing of the or each pump, an air purging pipe leading from the upper part of the casing of the or each pump to an upper part of the tank, and valves in each of the priming and purging pipes, the tank being sealed from atmosphere and providing, with said priming and purging pipes, a closed priming circuit for the pump(s).

According to a third aspect of the invention, there is provided a method of priming a centrifugal pump, the method comprising the steps of connecting the casing of a centrifugal pump to a closed circuit at a low point in the circuit, trapping a predetermined head of liquid in a first part of the circuit above the level of the pump and releasing the trapped head of liquid such that the liquid flows into the pump and displaces any air present in the pump casing into a second part of the circuit.

The invention will now be further described, by way of example, with reference to the drawings, in which:-

Fig. 1 is a schematic illustration of one embodiment of a centrifugal pump and priming apparatus according to the invention;

Fig. 2 is a schematic illustration of a second embodiment of a priming apparatus for a centrifugal pump according to the invention;

Fig. 3 is a schematic front elevation of a pumping installation having a plurality of pumps each equipped with a priming apparatus according to another embodiment of the invention; and

Fig. 4 is a schematic illustration of an embodiment of a priming apparatus according to the invention for priming a pump for use in pumping mains water.

Reference will first be made to Fig. 1 of the drawings in which a centrifugal pump 1 is used to pump sewage 2 which passes along a pump inlet pipe 3, through the pump and then along an outlet pipe 4 to an outlet 5 connected to the atmosphere. The pump is connected to an appropriate drive unit by means of a shaft 6.

The pump outlet pipe 4 has a first section 7 which extends at substantially the same level as the pump 1 and which incorporates a non-return valve 8 and a gate-type valve 9. The non-return valve 8 prevents material which has been pumped into the outlet pipe from passing back through the pump.

The first section of the outlet pipe 4 extends into a second section 10 which extends upwardly to the outlet 5 which is disposed at a position well above the level of the pump 1. The outlet 5 is provided with a non-return valve 11 which prevents air from entering the outlet pipe 4.

A priming pipe 12 extends from a position on the outlet pipe adjacent the casing of the pump 1 to a position part way up the second section 10 of the outlet pipe. A shut off valve 13 is provided in the priming pipe relatively close to its connection with the outlet pipe adjacent the pump casing.

An 'air displacement' pipe 14 extends from the casing of the pump 1 to the uppermost end of the section 10 of the pump outlet pipe 4 adjacent the outlet 5. A shut off valve 15 is located in the air displacement pipe 14 at a position adjacent the pump casing. A sight glass 16 is provided in the air displacement pipe 14 between the shut off valve 15 and the casing of the pump 1. A non-return valve 17 is provided in the uppermost portion of the air displacement pipe 14 at a position relatively close to the outlet 5, this valve permitting flow in a direction towards the outlet 5 but preventing the flow of sewage along the air displacement pipe.

When the pump 1 is operational the gate valve 9 is open and sewage, or other liquid or semi-liquid material to be pumped, is drawn in through the inlet pipe 3 and pumped along the outlet pipe 4 and out through the outlet 5. The valves 13 and 15 are closed.

In an initial condition, the pump 1 is stationary, the non-return valves 8 and 11 are closed and a predetermined volume of liquid is trapped in the outlet pipe 4 between the non-return valve 8 and the outlet 5 and within the priming pipe 12 above the valve 13. Air is trapped in the air displacement pipe between the valve 15 and the uppermost level of the liquid within the outlet pipe 4. The liquid present in the casing of the pump 1 and in the short length of piping from the pump to the valves 8, 13 and 15 slowly drains back through the pump into the main body of sewage 2 as air leaks into the pump casing over a prolonged period of time.

Before the pump can then pump effectively it must be primed. This can be simply effected, without the need for any auxiliary power supply, by opening the valves 15 and 13. The liquid present in the priming pipe and in the outlet pipe 4 above the level of the priming pipe will flow into the pump casing and the pump inlet pipe, displacing air upwardly along the air displacement pipe 14. The air is simultaneously drawn along the air displacement pipe by the pressure drop created adjacent the outlet 5 as liquid drains down the outlet pipe 4.

The volume of liquid trapped in the outlet pipe and the priming pipe when the pump is switched off is sufficient to fill the pump inlet pipe and the pump casing. As the liquid fills the pump inlet pipe and the pump casing the sight glass 16 is observed until such time as liquid appears within the sight glass, which is upstream relative to the valve taking into account the direction of flow, whereupon the valve 15 is closed. All air has now been displaced from the pump casing which is now filled with liquid. The valve 13 is closed and the pump is ready to be started. The air previously present in the pump casing and the pump inlet pipe is now trapped in the air displacement pipe 14 above the level of the valve 15. The air which passes along the air displacement pipe 14 and past the non-return valve 17 during priming of the pump may escape to atmosphere via the outlet 5.

The pump may now be started and, because it is primed, it will pump effectively. When operation of the pump is to be terminated, the drive unit is switched off. The non-return valve 8 will then close maintaining a head in the outlet pipe 4. The pump is then again in the initial condition described above.

It will be appreciated that the arrangement described above allows for the priming of the pump by providing a closed circuit system i.e. a circuit into which atmospheric pressure cannot gain entry, the circuit incorporating a trapped head of liquid which can be selectively released to displace air present in the pump casing.

Fig. 2 shows a similar priming apparatus to the apparatus shown in Fig. 1 except that, in this case, a centrifugal pump 21 has an outlet 22 at the upper part of the pump casing. The outlet 22 is provided with a non-return valve 23 and leads to a substantially vertical outlet pipe 24 which in turn leads to a substantially horizontal section 25 terminating at an outlet 26 which is capable of being closed by an anti-atmospheric non-return valve 27. A priming pipe 28 leads from the outlet pipe 24 just above the outlet 22 and is led back to the lower part of the pump casing. A valve 29 is provided in the priming pipe 28. An air purging pipe 31 also leads from the upper part of the pump casing to the horizontal section 25 of the outlet pipe 24 adjacent

to the outlet 26 and a pair of valves 32 and 33 are provided in the pipe 31. An inlet pipe 34 to the pump is immersed in raw sewage or other effluent (not shown) as with the embodiment shown in Fig. 1 and a gate valve (not shown) is desirably provided in the outlet pipe 24 downstream of the non-return valve 23 to prevent solids from sinking down onto the valve 23 when the pump is not in operation. A sight glass (likewise not shown) is preferably provided in the upper part of the pump casing or at the lower end of the air purging pipe 31 upstream of the valve 32.

The non-return valve 27 at the outlet 26 will prevent atmospheric pressure from affecting the water level in the outlet pipe 24 when the pump is stopped. If when it is desired to re-start the pump, the pump requires priming because of air in the pump casing, the valve 29 in the priming pipe 28 is opened to allow water to drain from the outlet pipe 24 through the pipe 28 and into the pump casing. The valves 32 and 33 in the air purging pipe 31 are opened to allow air in the pump casing displaced by the water to evacuate into the vacuum caused in the horizontal section 25 of the outlet pipe 24 by water draining from the pipe. The anti-atmospheric non-return valve 27 prevents air at atmospheric pressure from entering the system so that a closed circuit is formed and the water level cannot be affected by atmospheric pressure. With the absence of atmospheric pressure on the outlet pipe water levels, the displacement of the limited air in the pump by the outlet water enables the pump to be primed without the requirement of either a separate vacuum pump or the pump being lowered to below the level of water or effluent to be pumped. Once the pump has been primed, the valves 29, 31 and 33 can be closed and the pump started.

One disadvantage with the embodiments shown in Figs. 1 and 2 is that, if the pumps are used for pumping solids, such as sewage, there is a chance of the priming pipes being blocked. In order to overcome this problem, the installation shown in Fig. 3 was devised.

Fig. 3 shows a pumping installation comprising a series of pumps 41 each having a respective drive shaft 40 and a respective inlet pipe 42 the lower end of which is immersed in effluent 43 to be pumped. Each pump 41 has a non-return valve 44 within its casing which leads to an outlet pipe 45. A gate valve 46 is provided in each outlet pipe 45 adjacent the pump casing to prevent solid matter from interfering with the operation of the associated non-return valve 44. In this case, no further non-return valves are provided in the outlet pipes 45 and pumped effluent is simply discharged from the outlet ends 47 of the pipes 45.

Priming of the pumps is achieved by mounting a priming tank 48 on a firm base 49 above the level of the pumps 41. A priming pipe 51 provided with a valve 52 leads from the lower region of the priming tank 48 to a second priming pipe 53. Branch pipes 54 lead off from the priming pipe 53 to each of the pumps 41 and lead into the casings of said pumps. A respective valve 55 is provided in each of said branch pipes 54.

An air purging pipe 56 leads from the upper portion of the tank 48 to a second air purging pipe 57 from which branch pipes 58 lead, respectively, into the upper parts of the casings of each of the pumps 41. A respective valve 59 is provided in each of the branch pipes 58. The priming tank 48 is substantially filled with water drawn off from effluent through a pipe 61. The level of water in the tank is controlled by means of a conventional ball valve 62. The tank is preferably also provided with an inspection plate 63 to which a non-return valve 64, having a fresh air vent 65 and a ball float member 66, may be fitted. Sight glasses (not shown) may be provided in the upper part of each of the pump casings or in the branch pipes 58 upstream of the valves 59.

By means of the arrangement shown in Fig. 3 of the drawings, each pump may be primed individually with relatively clean water, or at least water which is free of solids, in order to ensure efficient operation. When a pump is stopped, water will drain from its casing down the inlet pipe 42. Pumped effluent will remain in the outlet pipe 45 because of the non-return valve 44 but this has no effect on the priming operation. In order to prime a pump, the normally closed valves 52, 55 and 59 associated with that pump are opened and liquid is allowed to drain from the tank 48 down the pipes 51, 53 and 54 into the pump casing. At the same time, air is displaced from the said pump casing and flows up the air displacement pipes 58, 57 and 56 into the upper part of the tank 48. Once the pump casing has been filled with liquid, the valves 52, 55 and 59 can be closed and the pump started as with the previous embodiments above described. The other pumps of the installation can be primed in the same way.

It will be seen that, with this arrangement, each pump can be started or stopped individually to provide means for controlling the rate of discharge of effluent from the installation. Further, each pump can be primed with relatively clean water and there is no fear of solids blocking the priming pipes.

The priming tank 48 is sealed from the atmosphere and if the pressure of air in the tank should exceed atmospheric pressure, the excess pressure will vent through the valve 64. When the level of water in the tank drops because of priming one or more of the pumps, the ball valve 62 will drop to the open position to allow the tank to be replenished via the pipe 61 until the water level in

the tank is again effective to close the ball valve 62.

Fig. 4 illustrates an apparatus for use in priming a pump 81 for use in pumping clean fresh water into a ring-main 80 of a water system. An inlet 82 for the water leads into the casing of the pump 81 from which leads an outlet 83 provided with a non-return valve 84. The outlet 83 is connected to a vertical reservoir 85 which is closed at the top by a non-return valve 86. The reservoir is connected to the ring-main 80. A priming pipe 87 leads off from the reservoir 85 adjacent the bottom thereof and is connected via a valve 88 to the pump casing 81. An air displacement pipe 91 leads off from the upper part of the pump casing 81 and is connected via a valve 92 and a non-return valve 93 to the upper region of the reservoir 85. A sight glass (not shown) may be provided in an upper part of the pump casing 41 or in the air displacement pipe 91 upstream of the valve 92.

With the pump stopped and the valves 88 and 92 opened, water can drain from the reservoir 85 into the pump casing 81, the air displaced from the pump casing passing up the purge pipe 91 through the non-return valve 93 into the reservoir. The displaced air will not, however, be at sufficient pressure to open the non-return valve 86. This arrangement ensures that the pump is primed ready for use. Prior to starting the pump, the valves 88 and 92 are closed. The pump can then be started and water is pumped into the reservoir. The non-return valve 93 prevents the water from being pumped down the air displacement or purge pipe 91 and the increased pressure in the reservoir 85 forces the non-return valve 86 off its seat.

Initially, air will pass through the valve 86 and, in order to prevent this air from being carried along the ring main, a vent valve is provided which comprises a valve casing 94 containing a float valve member 95 movable between a pair of valve seats 96 and 97. Air entering the valve casing 94 under pressure will force the float valve 95 off the lower seating 97 and permit the air to escape to atmosphere via a vent 98. When all of the air has been expelled, the following water will cause the float valve 95 to float upwards and seat on the upper valve seat 96 thereby closing the valve and preventing the flow of water out of said valve. Should the pressure of water in the ring main subsequently fall, the float valve can drop down to the lower valve seat 97 so that the valve is still closed and the ingress of atmospheric air into the ring main is prevented.

It will be appreciated that each of the above-described embodiments enables a pump to be primed without resource to digging a pit or well for the pump and without recourse to a separate priming system involving the use of a secondary pump.

The invention is not restricted to the above-described embodiments but modifications and variations may be made without departing from the scope of the invention.

Claims

1. Apparatus for priming a centrifugal pump comprising a closed circuit adapted to be connected to the casing of a pump and a low point in the circuit, means for retaining a predetermined head of liquid in a first part of the circuit above the level of the pump and means for releasing the head of liquid such that the liquid flows into the pump and displaces any air present in the pump casing into a second part of the circuit.

2. Apparatus according to claim 1, wherein the said first part of the circuit includes a discharge pipe connected to the pump outlet.

3. Apparatus according to claim 2, wherein the pump outlet includes a non-return valve and the discharge pipe is connected to the pump outlet upstream of the non-return valve to bypass said valve so as to permit a flow of liquid back into the pump casing, a valve being provided in said discharge pipe to trap or release the head of liquid in the first part of the circuit.

4. Apparatus according to claim 1, wherein the first part of the circuit comprises a substantially vertical outlet pipe adapted to be connected to a pump casing and closable at its lower end by a non-return valve, a priming pipe leading from the outlet pipe adjacent to the lower end thereof but downstream of the non-return valve and adapted to be connected to a lower part of the pump casing, and a further valve in the priming pipe to control the flow of liquid through said priming pipe.

5. Apparatus according to claim 3 or claim 4, wherein a second non-return valve is provided to prevent the ingress of atmospheric air into the pump outlet when the pump is not in operation.

6. Apparatus according to any preceding claim, wherein means are provided to prevent the flow of liquid from the first part of the circuit into the second part of the circuit, said flow preventing means preferably comprising a non-return valve.

7. Apparatus according to claim 4 and claim 6, wherein the second part of the circuit com-

prises an air purging pipe adapted to be connected, at one end, to an upper part of a pump casing and connected, at its other end, to the outlet pipe substantially at the upper end thereof.

8. Apparatus according to claim 6 or claim 7, wherein the second part of the circuit includes a sight glass to indicate when all air has been dispelled from the pump casing into the said second part of the circuit, a valve desirably being provided downstream of the sight glass to close off the second part of the circuit from the pump casing.

9. A centrifugal pump equipped with the priming apparatus claimed in any one of the preceding claims.

10. A pumping installation comprising at least one centrifugal pump, having an inlet and an outlet provided with a non-return valve, and means for priming the or each pump, the priming means comprising a priming tank located above the level of the pump(s), a priming pipe leading from a lower part of the tank to a lower part of the casing of the or each pump, an air purging pipe leading from the upper part of the casing of the or each pump to an upper part of the tank, and valves in each of the priming and purging pipes, the tank being sealed from atmosphere and providing, with said priming and purging pipes, a closed priming circuit for the pump(s).

11. A method of priming a centrifugal pump, the method comprising the steps of connecting the casing of a centrifugal pump to a closed circuit at a low point in the circuit, retaining a predetermined head of liquid in a first part of the circuit above the level of the pump and releasing the retained liquid such that the liquid flows into the pump and displaces any air present in the pump casing into a second part of the circuit.

FIG.1

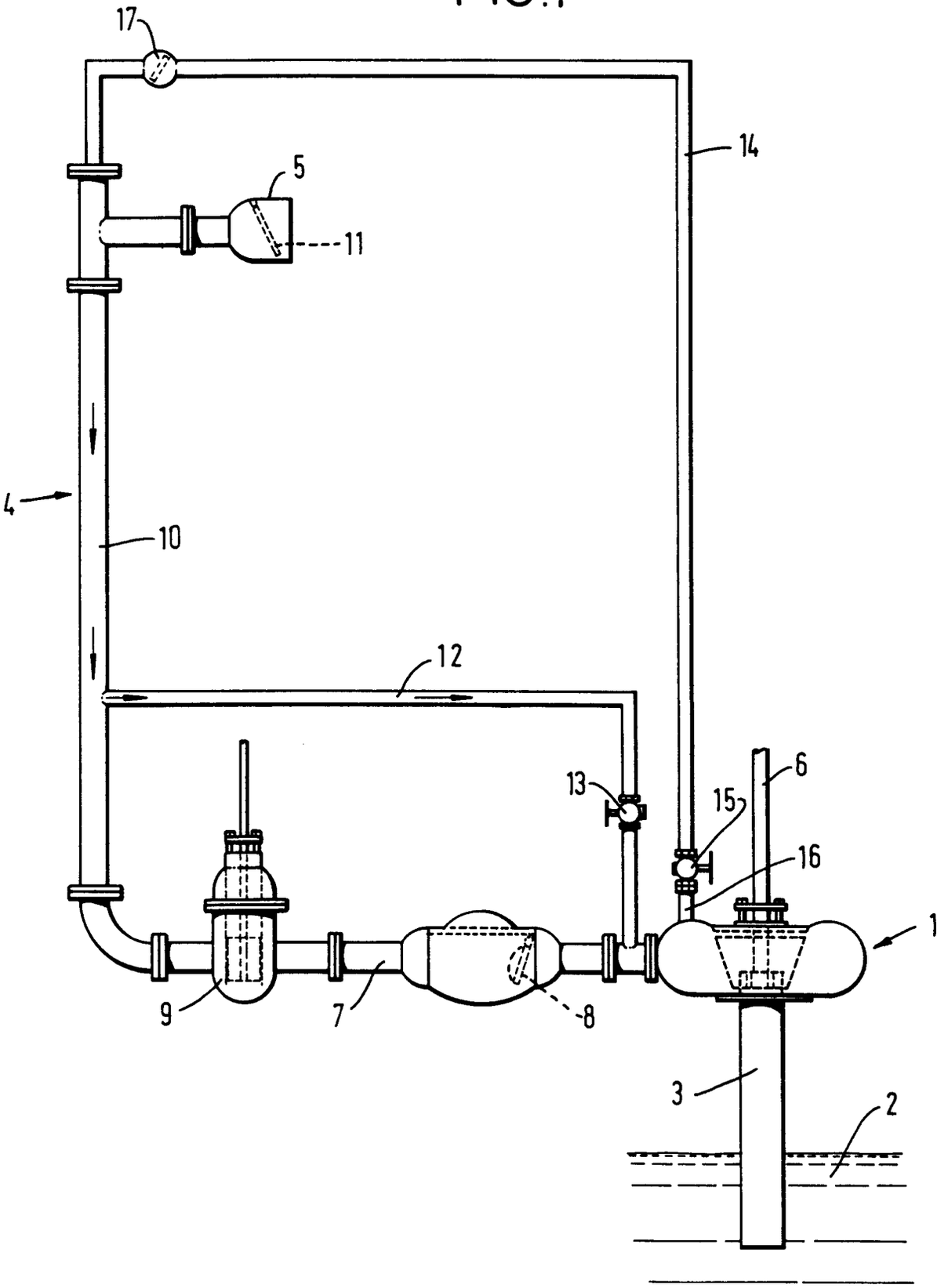
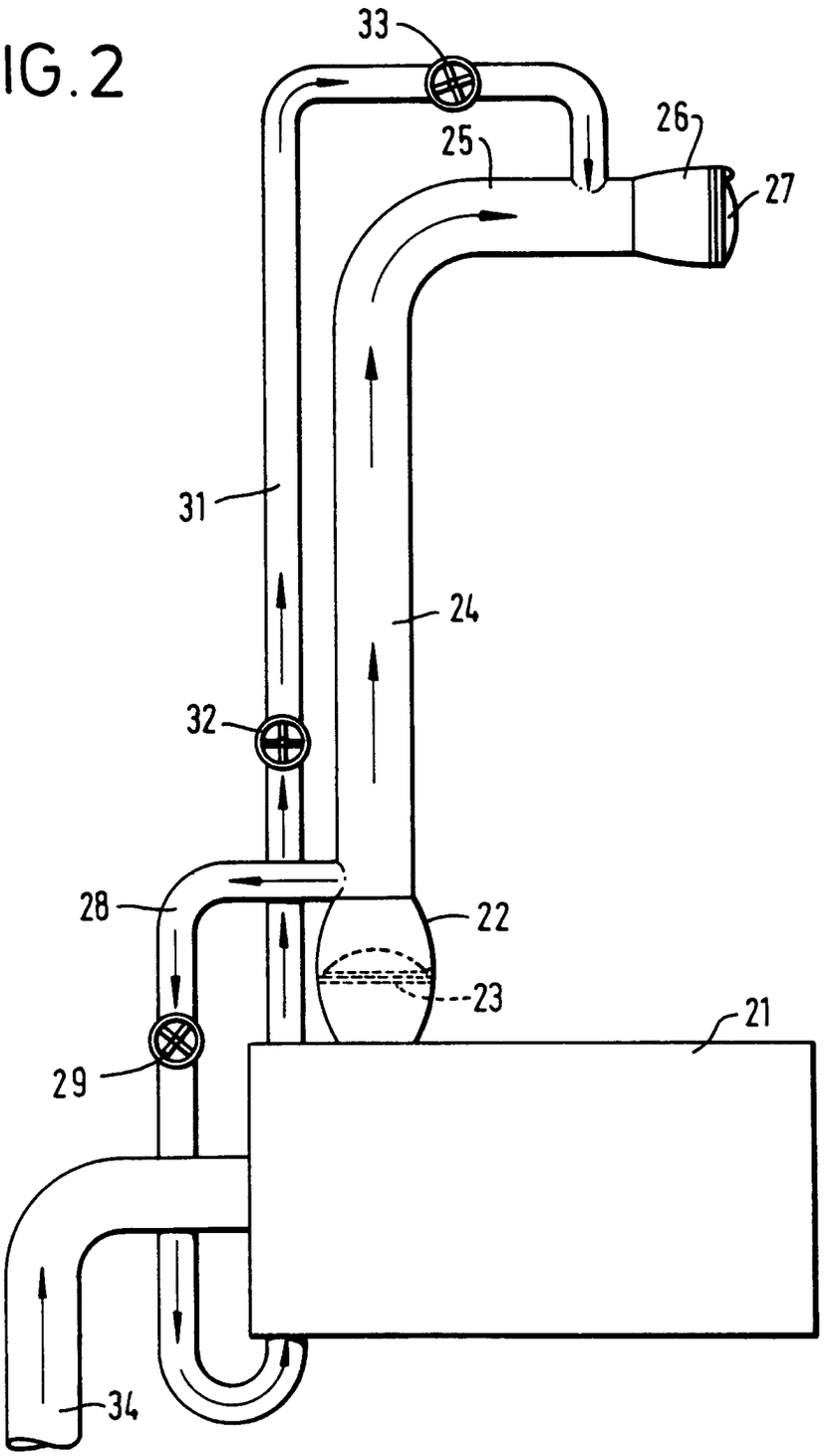


FIG. 2



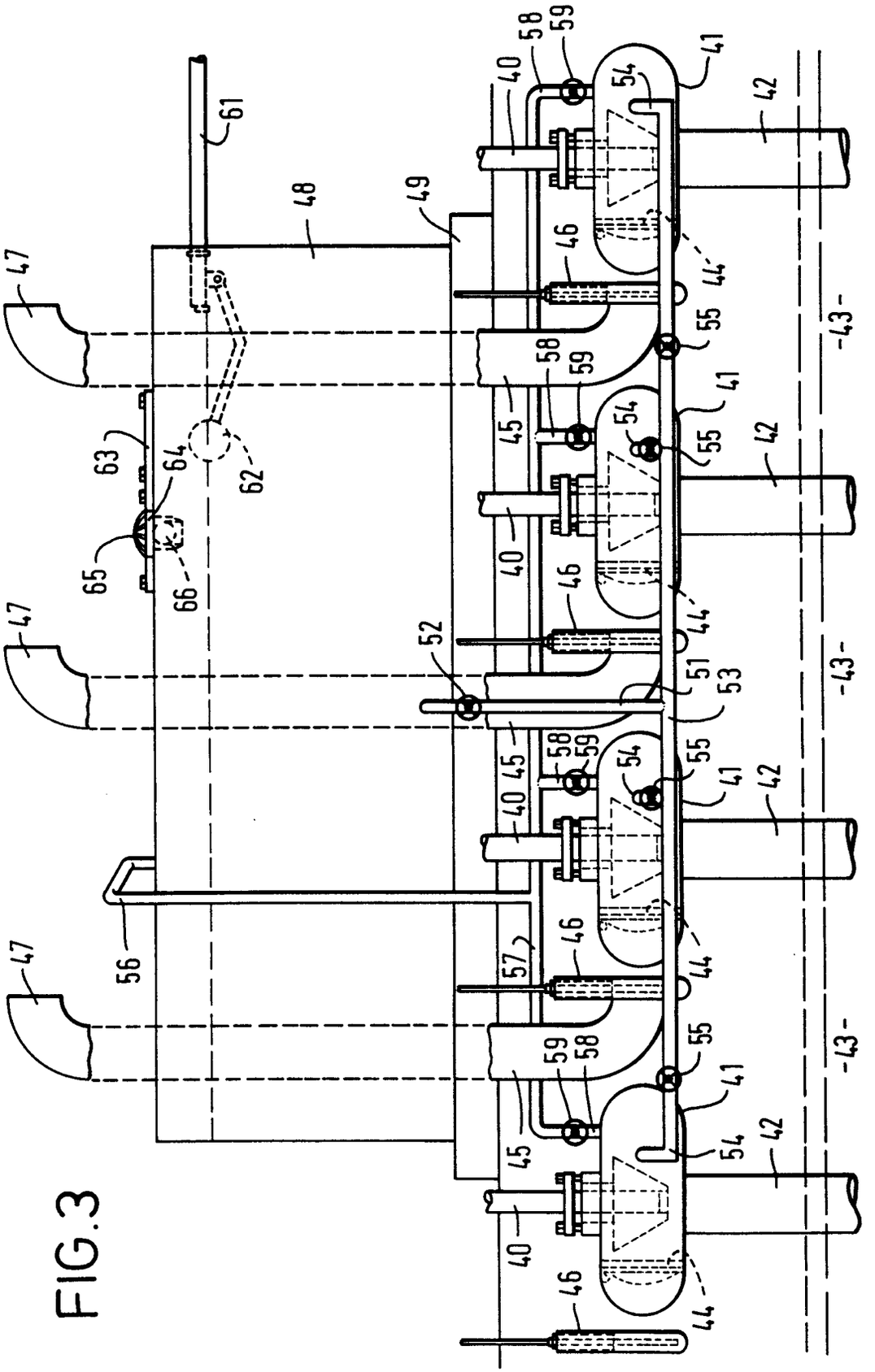

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FIG.3

FIG. 4