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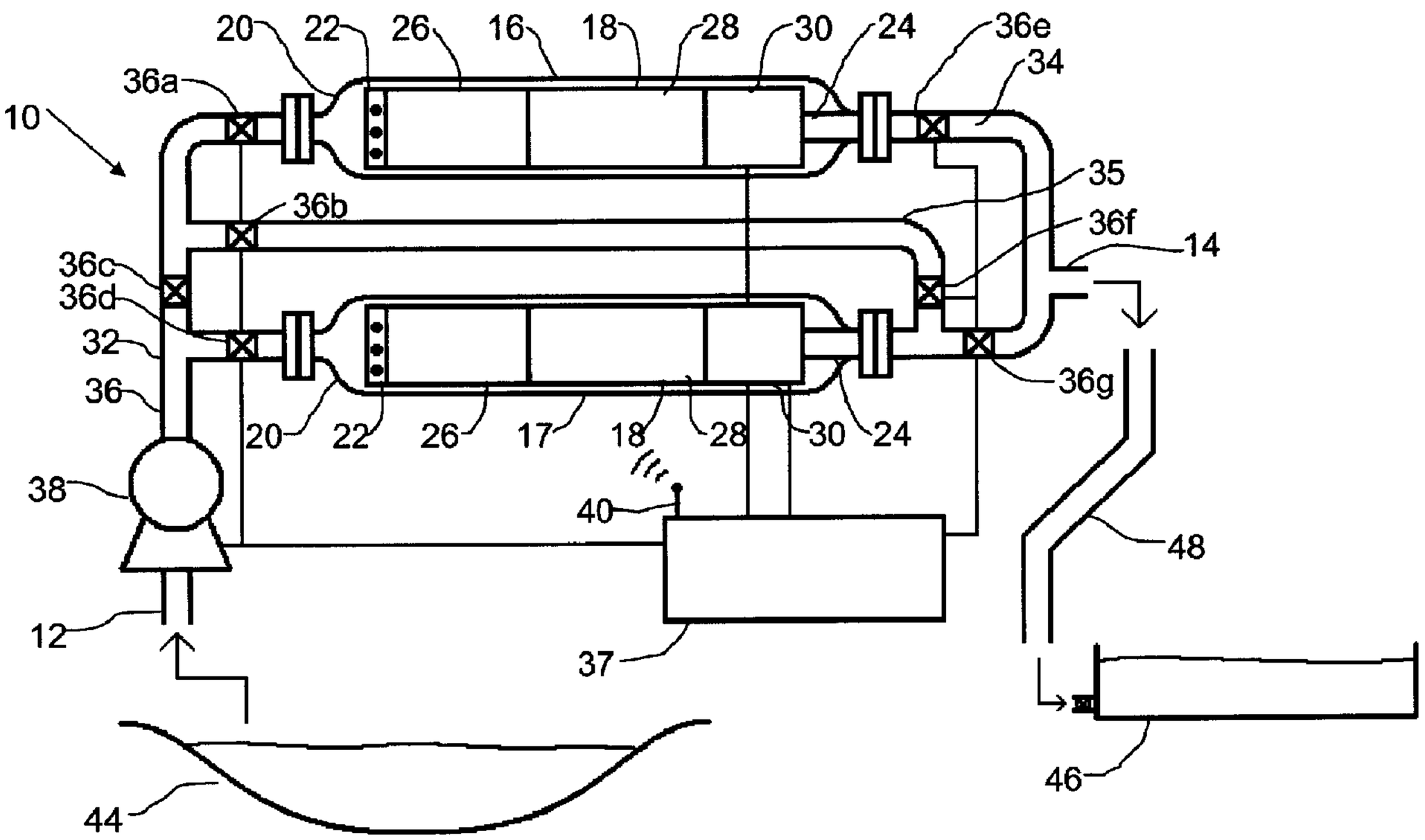
(54) Titre : POMPE DE TRANSFERT DE LIQUIDE
(54) Title: LIQUID TRANSFER PUMP



(57) Abrégé/Abstract:
A liquid transfer pump has an inlet and an outlet. Two or more pump assemblies are connected in parallel between the inlet and the outlet. Each pump assembly comprises an electric submersible pump in a pump housing. An inlet manifold connects the inlet to the two or more pump assemblies. One or more feed pumps fill the pump housing with liquid.

ABSTRACT OF THE DISCLOSURE

A liquid transfer pump has an inlet and an outlet. Two or more pump assemblies are connected in parallel between the inlet and the outlet. Each pump assembly comprises an electric submersible pump in a pump housing. An inlet manifold connects the inlet to the two or more pump assemblies. One or more feed pumps fill the pump housing with liquid.

TITLE

[0001] Liquid transfer pump

FIELD

[0002] This relates to a liquid transfer pump for transferring large volumes of liquid.

BACKGROUND

[0003] Fracing operations are used to stimulate a well and increase production flow. These types of operations involve pumping down fluid, often water, at sufficient pressure to fracture the hydrocarbon-producing formation. Often, large amounts of fluid are required in a short amount of time. This is particularly the case when a multi-well pad is being fraced. In order to supply the necessary amount of fluid, large reservoirs, referred to as frac tanks, are often erected on site and filled as necessary.

SUMMARY

[0004] There is provided a liquid transfer pump, comprising an inlet and an outlet, and two or more pump assemblies connected in parallel between the inlet and the outlet. Each pump assembly comprises an electric submersible pump in a pump housing. An inlet manifold connects the inlet to the two or more pump assemblies. One or more feed pumps fill the pump housing with liquid.

[0005] According to another aspect, the inlet manifold may comprise valves. There may be an outlet manifold connecting the two or more pump assemblies to the outlet. The outlet manifold may comprise valves.

[0006] According to another aspect, there may be a control system for controlling at least one of the two or more pump assemblies, the feed pump, and valves in the manifolds.

[0007] According to another aspect, the liquid transfer pump may be mounted on a movable platform.

[0008] According to an aspect, there is provided a method of filling a liquid reservoir with liquid from a source of liquid, comprising the steps of: providing a liquid transfer pump in communication with the source of liquid, the liquid transfer pump comprising two or more

pump assemblies, each pump assembly comprising an electric submersible pump in a pump housing; connecting at least one feed pump to the pump assemblies via an inlet manifold; operating the at least one feed pump to draw liquid from the source of liquid and submerge the electric submersible pump in the pump housing; and operating the electric submersible pump to expel the liquid through the outlet.

[0009] According to another aspect, the inlet manifold may comprise valves. The pump assemblies may be connected to the outlet via an outlet manifold, and the outlet manifold may comprise valves.

[0010] According to another aspect, the method may further comprise the step of sending instructions to at least one of the pump assemblies, the feed pump and the valves of the manifolds via a control system.

[0011] According to another aspect, the method may further comprise the step of mounting the liquid transfer pump on a movable platform and transporting the liquid transfer pump.

[0012] According to another aspect, the liquid may be drawn from a natural body of water. The outlet may be connected to a pipeline that fills a liquid reservoir on a wellsite.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] These and other features will become more apparent from the following description in which reference is made to the appended drawings, the drawings are for the purpose of illustration only and are not intended to be in any way limiting, wherein:

FIG. 1 is a schematic view of a liquid transfer pump.

FIG. 2 is a side elevation view of an example of a liquid transfer pump.

FIG. 3 is a top plan view of the example shown in **FIG. 2**.

FIG. 4 is a perspective view of another example of a liquid transfer pump.

DETAILED DESCRIPTION

[0014] A liquid transfer pump, generally identified by reference numeral 10, will now be

described with reference to **FIG. 1** through **4**.

[0015] Referring to **FIG. 1,** liquid transfer pump 10 has an inlet 12 and an outlet 14. There are pump assemblies 16 connected between inlet 12 and outlet 14. As shown, two pump assemblies 16 and 17 are connected together. As will be described below, pump assemblies 16 and 17 are connected by a series of valves and conduits that allow them to be operated in series, in parallel, or on its own. As will be understood, while there are two pump assemblies 16 and 17 shown in parallel, additional pump assemblies may be connected in series or in parallel to one or both of pump assemblies 16 and 17. Each pump assembly 16 and 17 has an electric submersible pump (ESP) 18 in a pump housing 20, operating horizontally. The depicted ESPs 18 are examples only, with the major components shown, including an intake section 22, an output section 24, a pump section 26, a motor 28 and a power section 30. ESPs are commonly used to produce fluid from a well, and it will be understood that other designs may also be used for ESP 18.

[0016] As shown in **FIG. 1,** an inlet manifold 32 connects inlet 12 to pump assemblies 16, while an outlet manifold 34 connects pump assemblies 16 to outlet 14. A bypass conduit 35 connects the inlet of pump assembly 16 to the outlet of pump assembly 17. A series of valves 36a – 36f are provided on manifolds 32 and 34 and bypass conduit 35 to control the flow of liquid. By controlling valves 36a – 36g, pump assemblies 16 may be operated in parallel. For example, by opening only valves 36a and 36e, or only opening valves 36d and 36g, pump assembly 16 or pump assembly 17 may be used in isolation. This may be useful in situations where a single pump assembly is capable of supplying the necessary pressure and volume. In another example, valves 36d, 36f, 36b, 36a and 36e may be opened and valves 36c and 36g may be closed such that bypass line 35 is open and transfers the output from pump assembly 17 to the input of pump assembly 16. This allows pump assemblies 16 and 17 to operate in series, which may be used when a higher pressure output is desired. In another example, valves 36a, 36c, 36d, 36e and 36g may be opened and valves 36b and 36f on the bypass line are closed, which allows pump assemblies 16 and 17 to be operated in parallel. This may be useful when a higher volume output is desired.

[0017] As shown, a feed pump 38 may be used to ensure ESPs 18 are kept submerged within housing 20 and able to operate. Feed pump 38 may be a dry prime pump with a relatively low output pressure. However, feed pump 38 will be sufficient to move liquid over the short distance required between the source of liquid and the ESPs 18, which are able to provide sufficient pressure to move the liquid the long distances required.

[0018] Feed pump 38 shown in **FIG. 1** is representative of a source of pressurized liquid, and may be replaced by other sources. For example, instead of generating pressure using feed pump 38, a gravity feed may be used, such as by connecting inlet 12 to an outlet of an elevated source of liquid (not shown). As long as pump assemblies 16 and 17 are below the level of the source of liquid, the outlet of the source of water will constitute a pressurized source of liquid. As will be discussed below, this is reflected in **FIG. 4**, which may have alternate inputs for sources of externally pressurized liquid.

[0019] It will be understood that manifolds 32 and 34 that are depicted in **FIG. 1** are merely representative of what is to be accomplished. **FIG. 2** and **4** depict other examples of manifolds 32 and 34 that may be used to redirect liquid between pump assemblies 16 and 17 as desired, such that one or both pump assemblies are used to pump liquid, depending on the demands and preferences of the user. Referring to **FIG. 4**, manifolds 32 and 34 may not be located at one end or the other end of liquid transfer pump 10 as suggested by **FIG. 1**. In this example, pump assembly 17 is reversed relative to pump assembly 16, such that the inlet and outlet of each pump assembly 16 and 17 are adjacent. In this case, bypass line 35 may play a role as part of one or both manifold 32 or 34, depending on the arrangement of valves 36.

[0020] The flow of liquid through manifolds 32 and 34 is controlled by the position of valves 36, which may be manually controlled, or automatically controlled by a control unit 37, as shown in **FIG. 1**. In the embodiment shown in **FIG. 4**, both manual valves 36h – 36m and automatic valves 36n – 36s are included. Both types of valves are preferably included in preferred embodiments as will be recognized by those skilled in the art. For example, manual valves 36h – 36m may be used to define the operation of liquid transfer pump 10 or for increased safety. It will also be understood that the number of valves, their position and

designation is for illustrative purposes only, and may be modified depending on the preferences of the user and the specific design used for liquid transfer pump 10. The depicted embodiment has been provided with multiple connections and valves between tubing to provide more versatility during use. As with **FIG. 1**, the configuration of valves may be modified in order to allow pump assemblies 16 and 17 to be used in parallel, in series or in isolation.

[0021] Referring to **FIG. 4**, liquid transfer pump 10 may have multiple inlets 12a – 12d and may have outlets 14a, 14b and 14c. Some inlets, such as inlets 12a and 12d may be used as suction inlets, i.e. inlets that supply liquid to feed pump 38, while inlets 12c and 12d may be preferably used as gravity fed inlets, i.e. to be fed by an externally pressurized source of liquid. Additional inlets 12a and 12d and outlets 14a and 14b provided at various points around liquid transfer pump 10 also increases its versatility when installed on a site by providing the installer more options for making connections to the source of liquid or to the intended destination. Obviously, depending on the valve configurations, those ports labelled as inlets or outlets may also be used as outlets or inlets. In **FIG. 4**, feed pump 38 is connected to draw fluid from inlet manifold 32, and pumps it into line 39, which may be opened at either end or both ends by valves 36i and 36m to feed the inlet of one or both pump assembly 16 and 17. Preferably, feed pump 38 is connected using flexible tubing to allow for some movement and differences in sizes

[0022] Referring to **FIG. 1,** control unit 37 may also control the operation of feed pump 38 and ESPs 18. Control unit 37 may also be designed to allow a user to remotely monitor the operation of liquid pump 10 as well as remotely control its operation. This may be by a wireless link 40 as shown, or by a wired link. Additionally, while control unit 37 is shown as being wired to the various components, control signals may also be transmitted wirelessly, or by other known methods of communication. Flow and pressure sensors (not shown) may also be included at various points in liquid transfer pump 10 to allow the operator to monitor operation.

[0023] Liquid transfer pump 10 is preferably mounted on a movable platform, such as a

skid 42 as shown in **FIG. 4**, or in a container 43, as shown in **FIG. 2** and **3**. This allows liquid transfer pump 10 to be moved to and removed from a desired location more easily.

[0024] Referring to **FIG. 1**, liquid transfer pump 10 is preferably located adjacent to a source of liquid, such as a natural body of water 44, or other reservoir. Valves 36 are set to the desired arrangement, and feed pump 44 draws liquid through inlet 12 and pumps it into one or both housings 20, where the liquid is pumped by ESPs 18 out outlet 14 at a desired pressure to reach a desired location, such as a reservoir 46 at a well site. Preferably, outlet 14 is connected to a pipeline 48 that is connected between the source of liquid 44 and the well site (not shown). There may be a network of pipelines that carry liquid to various well sites. Alternatively, the pipeline may end at a central location that is used to fill truck, which may then transport the liquid wherever it is needed. The actual distribution of the liquid, as well as the source of liquid, is immaterial to the liquid transfer pump 10, and may vary depending on the needs and preferences of the user. The liquid transfer pump 10 may be used to create sufficient pressure to pump high volumes of liquid long distances, without requiring booster stations, or with fewer booster stations. It will be understood that other liquid transfer pumps 10 may be used as booster stations if the distances require it.

[0025] In this patent document, the word "comprising" is used in its non-limiting sense to mean that items following the word are included, but items not specifically mentioned are not excluded. A reference to an element by the indefinite article "a" does not exclude the possibility that more than one of the element is present, unless the context clearly requires that there be one and only one of the elements.

[0026] The following claims are to be understood to include what is specifically illustrated and described above, what is conceptually equivalent, and what can be obviously substituted. Those skilled in the art will appreciate that various adaptations and modifications of the described embodiments can be configured without departing from the scope of the claims. The illustrated embodiments have been set forth only as examples and should not be taken as limiting the invention. It is to be understood that, within the scope of the following claims, the invention may be practiced other than as specifically illustrated and described.

What is Claimed is:

1. A liquid transfer pump, comprising:

an inlet and an outlet;

two or more pump assemblies, each pump assembly comprising an electric submersible pump in a pump housing;

a plurality of valves that selectively connects selected pump assemblies in parallel, in series or in isolation between the inlet and the outlet;

one or more sources of pressurized liquid that submerges the electric submersible pumps of the selected pump assemblies with liquid.

2. The liquid transfer pump of claim 1, wherein a manifold comprises the plurality of valves and a bypass line that connects an outlet of a first pump assembly to an inlet of a second pump assembly.

3. The liquid transfer pump of claim 2, further comprising a control system for controlling at least one of the two or more pump assemblies, the feed pump, and the valves of the inlet manifold.

4. The liquid transfer pump of claim 1 mounted on a movable platform.

5. A method of filling a liquid reservoir, comprising the steps of:

providing a liquid transfer pump comprising an inlet, an outlet, and two or more pump assemblies, each pump assembly comprising an electric submersible pump in a pump housing, the liquid transfer pump further comprising a plurality of valves that selectively connect the two or more pump assemblies in parallel, in series or in isolation between the inlet and the outlet;

configuring the valves to connect selected pump assemblies in parallel, in series or in isolation between the inlet and the outlet;

connecting the inlet to a source of pressurized liquid to submerge the electric submersible pumps of the selected pump assemblies; and

operating the electric submersible pump to expel the liquid through the outlet.

6. The method of claim 5, wherein the connecting the inlet to a source of pressurized liquid comprises connecting at least one feed pump to the pump assemblies via an inlet manifold, and the method further comprises the step of operating the at least one feed pump to draw liquid from the source of liquid and submerge the electric submersible pump in the pump housing.

7. The method of claim 5, wherein the liquid transfer pump comprises a manifold comprising the plurality of valves and a bypass line connecting the outlet of a first pump assembly to an inlet of a second pump assembly.

8. The method of claim 6, further comprising the step of sending instructions to at least one of the pump assemblies, the feed pump and the valves of the inlet manifold via a control system.

9. The method of claim 5, further comprising the step of mounting the liquid transfer pump on a movable platform and transporting the liquid transfer pump.

10. The method of claim 7, wherein liquid is drawn from a natural body of water.

11. The method of claim 5, wherein the outlet is connected to a pipeline that fills a liquid reservoir on a wellsite.

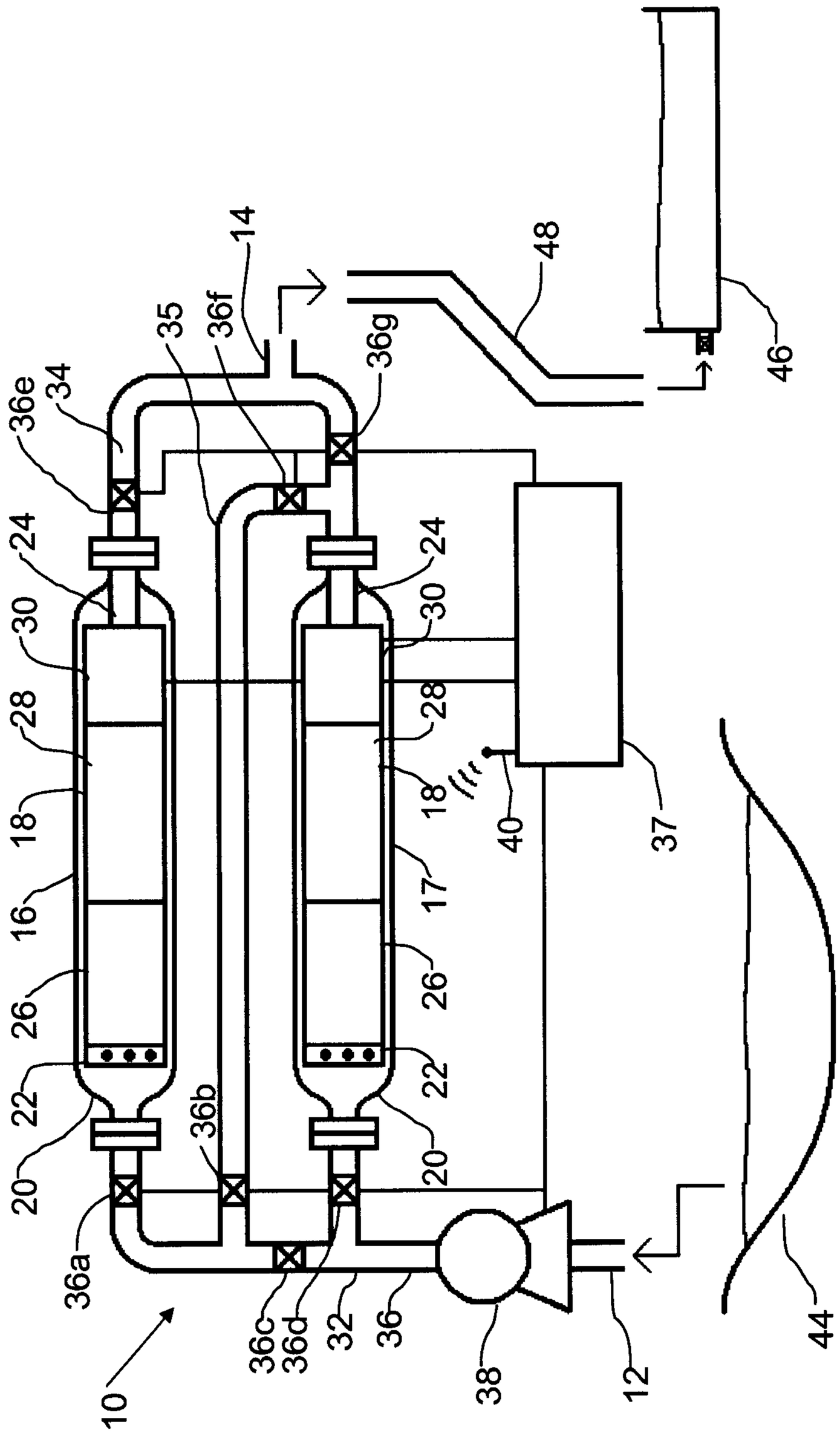

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FIG. 1

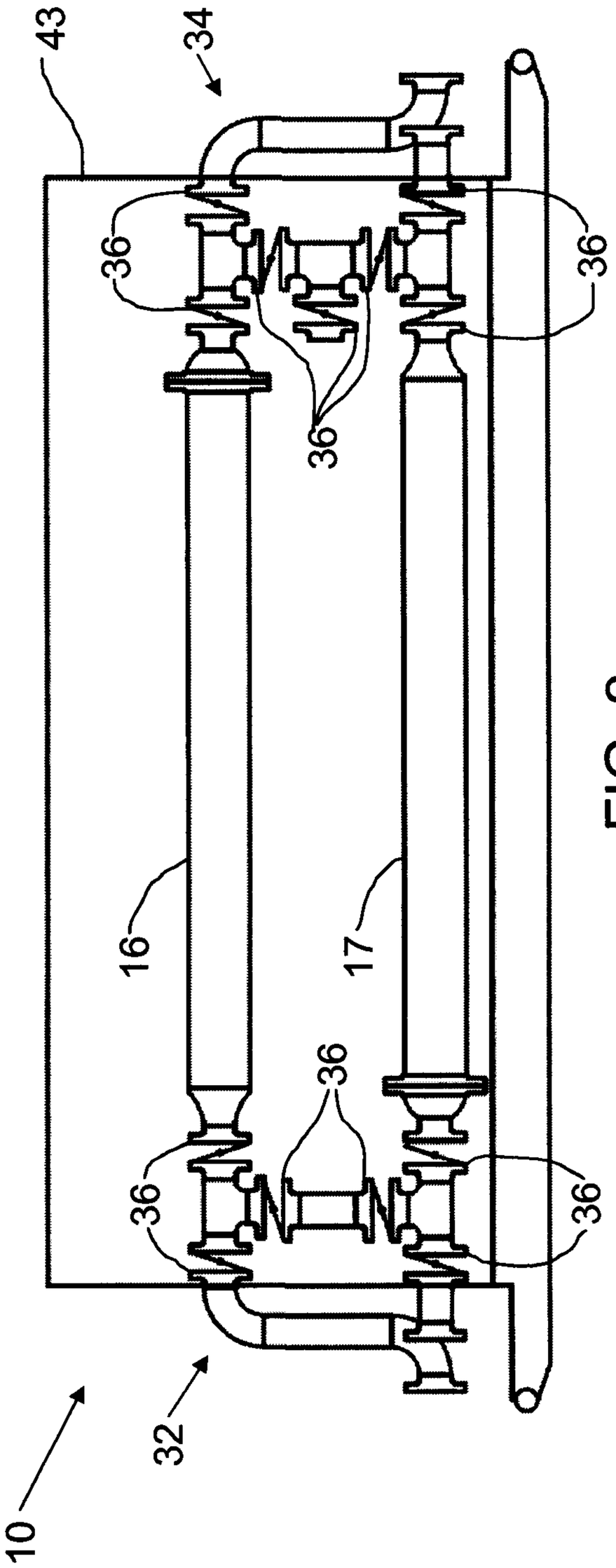
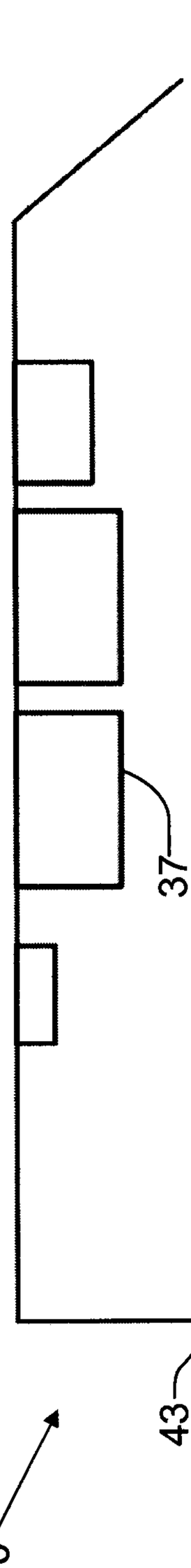


FIG. 2



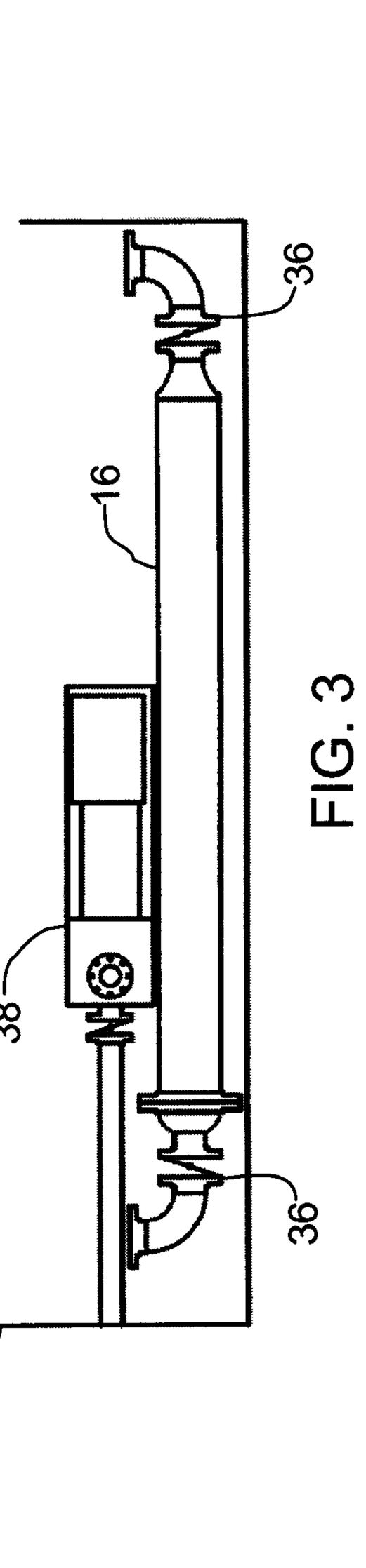


FIG. 3

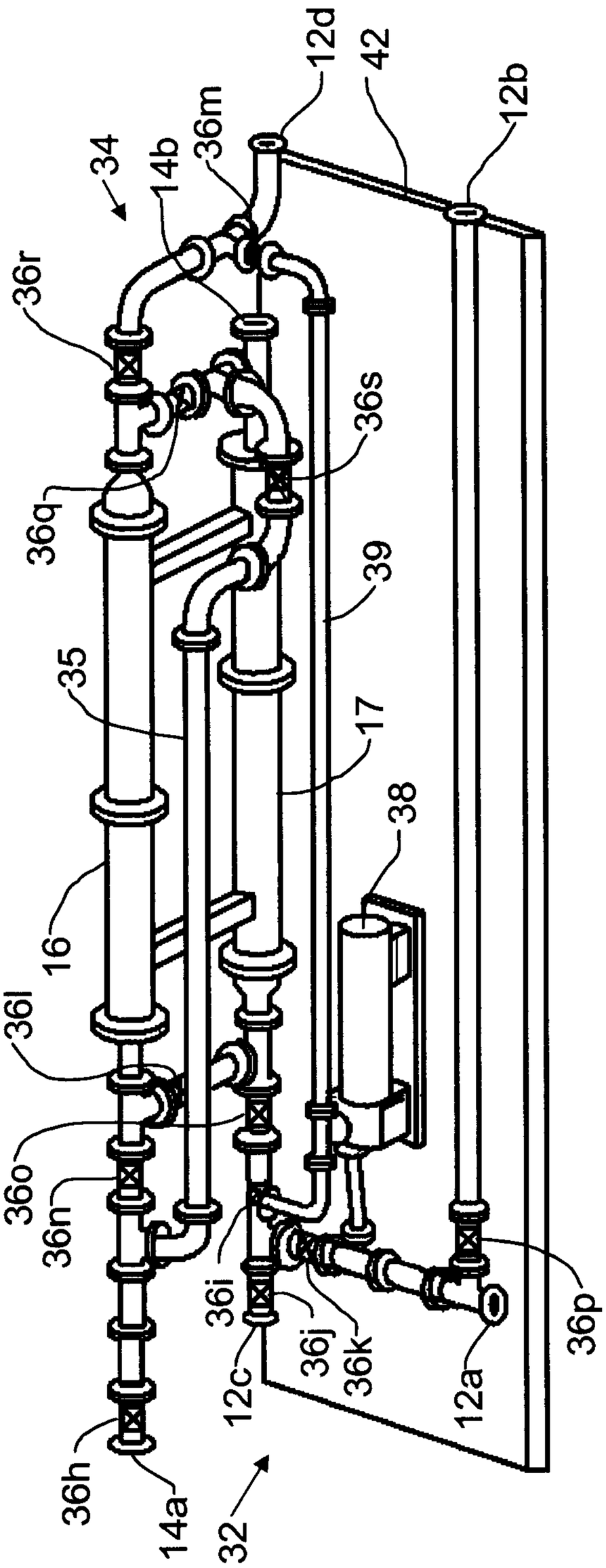

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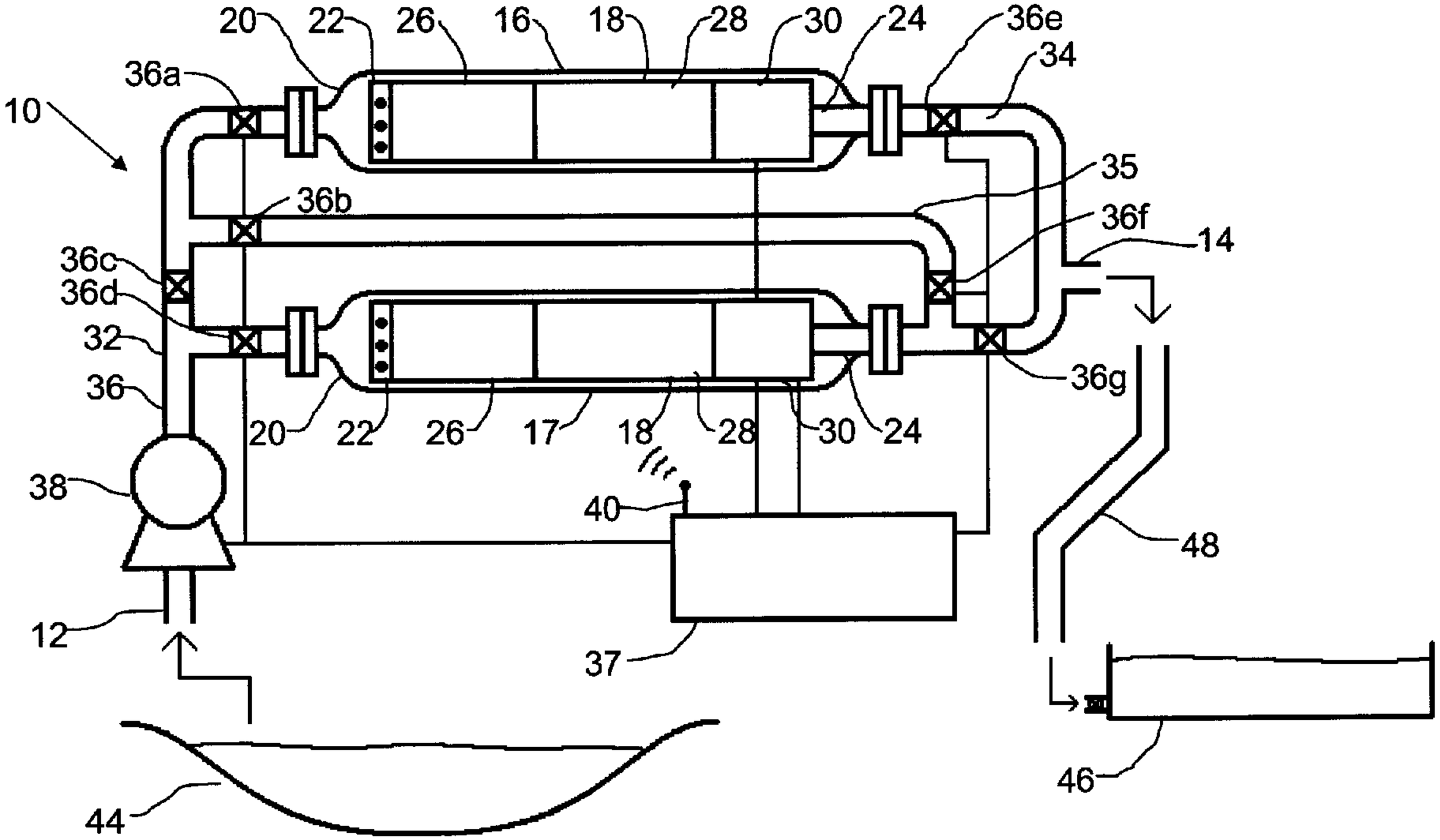
FIG. 4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