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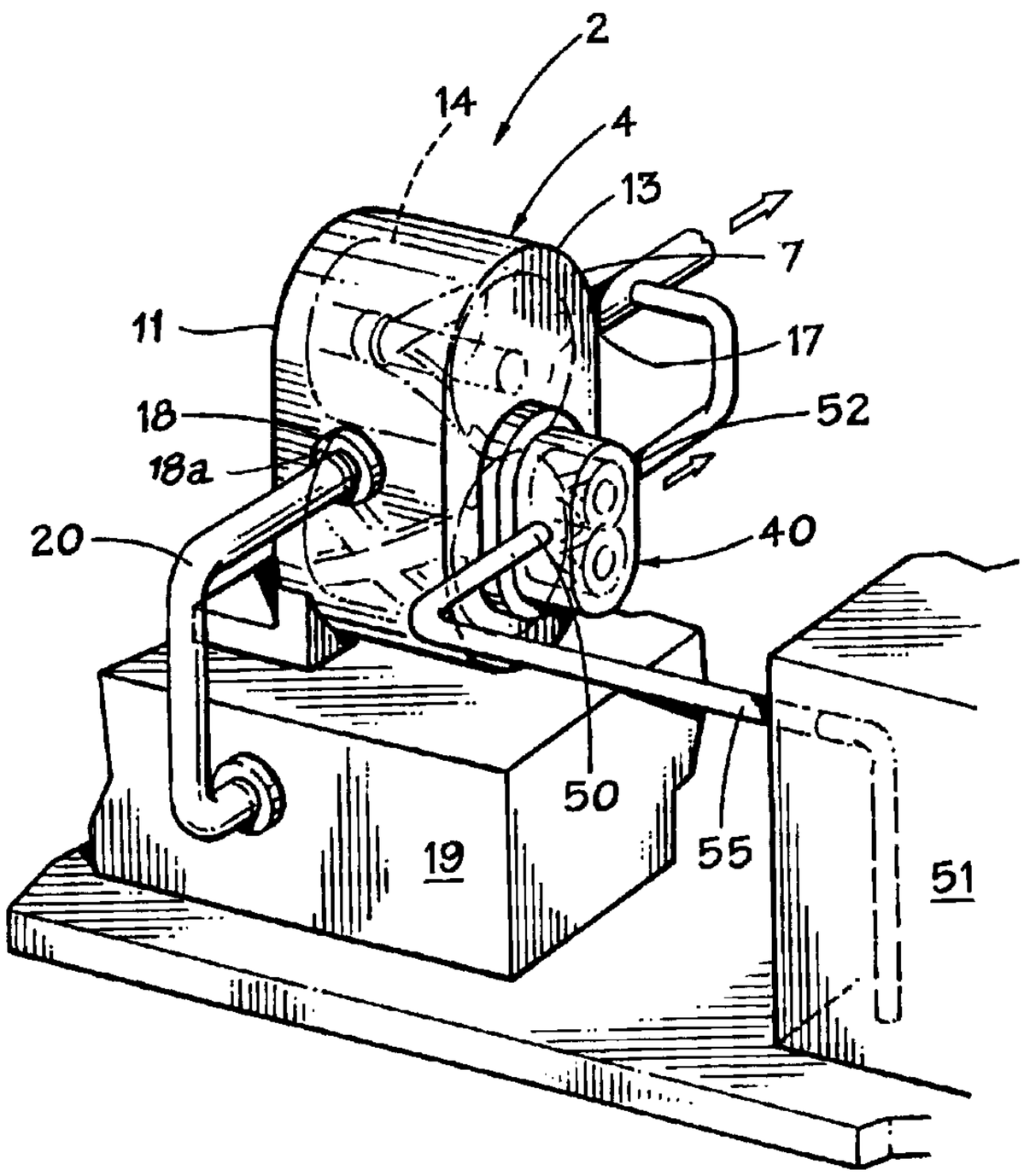
(54) Titre : SYSTEME DE POMPAGE SERVANT A INJECTER DES QUANTITES MESUREES DE FLUIDE DANS UN FLUX LIQUIDE

(54) Title: PUMPING SYSTEM FOR THE INJECTION OF MEASURED QUANTITIES OF FLUID INTO A FLUID STREAM



(57) Abrégé/Abstract:
A pump system for the selected injection of one or more fluids is disclosed where the system generally includes a flow meter including a means to translate the flow rate through the meter to one or more pumps coupled to the meter such that upon a selected introduction of fluid flow through the meter a selected amount of fluid is pumped through the one or more pumps.

ABSTRACT OF THE DISCLOSURE

A pump system for the selected injection of one or more fluids is disclosed where the system generally includes a flow meter including a means to translate the flow rate through the meter to one or more pumps coupled to the meter such that upon a selected introduction of fluid flow through the meter a selected amount of fluid is pumped through the one or more pumps.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention is directed to an apparatus and method for metering fluid. More particularly, the present invention is directed to an apparatus to injected a predetermined amount of a liquid into a fluid stream and methods for its use.

2. Description of the Prior Art

Several devices have been developed for injecting predetermined quantities of liquid additives into a liquid flow stream for such applications as adding medication to drinking water with additives such as chlorine or iodine and adding fertilizer concentrate to irrigation water. An exemplary device which is powered by the liquid stream to which the additive is being injected is described in U.S. Pat. Nos. 3,937,241 and 4,060,351 as issued to Philippe Cloup. In the apparatus described in the Cloup patents, the additive or adjuvant is injected into the main fluid stream within a piston chamber of a hydraulic motor which drives the additive injection pump.

The architecture for this metering pump, however, is disadvantageous when the additive is a corrosive fluid such as chlorine, fertilizer or other chemically active substance. Accordingly, it is desirable to be able to inject the additive into the liquid stream at a point downstream of the motor which is powering the additive pump to avoid problems associated with the corrosive action of the additive.

To accomplish this objective, a number of fluid pumps have been designed which inject the additive into the primary fluid stream where the primary fluid provides the motive fluid for activating the additive injection pump. Such a device is described for example in applicants' U.S. Patent No. 4,558,715 as issued to Walton.

While overcoming many of the disadvantages of prior fluid injection system, the apparatus described in the Walton patent involves a number of components which are subject to wear and subsequent failure. Elastic or elastomeric biasing components necessary in a piston drive pump are particularly prone to fatigue and failure. Moreover, the use of a piston and its auxiliary components enhance production and manufacturing costs.

SUMMARY OF THE INVENTION

The present invention addresses the above and other disadvantages of prior art metering pumps by providing a system which includes a minimum of moving components in a robust design to selectively inject a second and/or a third fluid in a fluid stream, where the second and third fluid constitute a predetermined percentage of the total mixture.

Generally speaking the present invention may be considered as providing an apparatus to inject selected quantities of a second fluid into a fluid stream comprising: a metering apparatus to monitor the flow of a first fluid introduced through a meter inlet to a meter outlet where the apparatus generates a selective rotation of a shaft based on the quantity of the first fluid passing through the metering apparatus; and a fluid pump coupled to the shaft and positioned between a source of a second fluid and a pump outlet where a predetermined amount of the second fluid is directed through the pump outlet based on the flow of the first fluid through the metering apparatus.

Furthermore, the invention may be considered as providing an apparatus for injecting a predetermined quantity of a fluid additive into a fluid stream to produce an ultimate fluid mixture wherein the fluid additive constitutes a predetermined percentage of the ultimate fluid mixture, the apparatus comprising: a flow meter having at least one rotatable metering element disposed in a first housing between a flow meter inlet for a first fluid stream and a flow meter outlet for said first fluid stream, the at least one rotatable metering element becoming rotational at a rate of rotation dependent upon a rate of flow of the first fluid stream between the flow meter inlet and the flow meter outlet; a first shaft coupled to one of the at least one rotatable metering element to rotate therewith and extending through a wall of the first housing; a first metering pump mounted to the wall of the first housing, the first metering pump having at least one rotatable pumping element disposed in a second housing between a first metering pump inlet and a first metering pump outlet, the first metering pump outlet being coupled to the flow meter outlet to inject a second fluid into the first fluid stream, at a point downstream of the flow meter; and one of the at least one rotatable pumping element being coupled to the first shaft to rotate therewith to induce a flow of the second fluid through the first metering pump outlet for injection into the first fluid steam to form a fluid mixture having a predetermined percentage of the second fluid.

Additionally, the present invention contemplates a dosing apparatus for mixing a first and other fluids in a predetermined, volumetric relationship comprising: a flow measuring component having a meter inlet in fluid communication with the first fluid and a meter outlet, where the flow measuring component further includes a translation means which rotates at a selected number of revolutions when a predetermined amount of fluid is directed from the meter inlet to the meter outlet; and a fluid pump which includes a housing defining a pump inlet and a pump outlet, where the pump is coupled to the translation means, and further wherein the fluid pump and the flow measuring component are linked to a common drive shaft, such that the rotation of the translation means causes the pump to move a second fluid from the pump inlet towards the pump outlet.

In other aspect the present invention provides a method for establishing a mixture of a first fluid and a second fluid where the first fluid constitutes a volumetric portion of the mixture, the method comprising: (a) providing a flow meter having a rotatable metering member in fluid communication with the first fluid and disposed between a meter inlet and a meter outlet; (b) providing a pump having at least one rotatable pumping member disposed between a pump inlet and a pump outlet where the pump inlet is disposed in fluid communication with the second fluid; (c) directly coupling the rotatable metering member to the rotatable pumping member of the pump using a common drive shaft; (d) directing the first fluid through the meter inlet and the meter outlet to induce a predetermined amount of rotation in the rotatable metering member for each unit of the first fluid to thereby cause the rotatable pumping member to rotate and thereby pump a predetermined amount of the second fluid from the pump inlet to the pump outlet; and (e) mixing the second fluid that has been directed through the pump with the first fluid that has been directed through the meter outlet.

The present invention offers a number of advantages over prior art metering pumps. One such advantage is a robust design which requires a minimum of moving components. In such a fashion, the apparatus is relatively inexpensive to manufacture and maintain.

Another advantage of the present invention is its lack of dependance on elastic biasing components to accomplish the metering process.

Another advantage is the ability to avoid contamination of the fresh water supply by introducing the metered additive concurrently with the metered water into the treatment pool. In such a fashion, inadvertent backflow will not result in a contamination of the water supply.

Yet other advantages include quiet operation, a compact size when compared to competitive devices and a low pressure loss across the inlet and outlet of the pump.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 illustrates a perspective, partially phantom view of one embodiment of the present invention operative for the injection of a metered, second fluid.

Figure 1A illustrates a detail, perspective view of the embodiment illustrated in Figure 1.

Figure 2 illustrates a side, cross sectional view of the embodiment illustrated in Figure 1.

Figure 3 illustrates a perspective view of a second embodiment of the present invention operative for the injection of a second and a fluid.

Figure 4 illustrates a top view of the embodiment illustrated in Figure 3.

Figure 5 illustrates a side, cross sectional view of a third embodiment of the present invention.

Figure 6 illustrates a side, cross sectional view of a helical gear pump.

Figure 7 illustrates an exploded view of the helical pump illustrated in Figure 6.

Figure 8 illustrates a perspective, assembly view of a fourth embodiment of the invention utilizing an impeller.

Figure 9 illustrates a cross section of an impeller as it may be used with the embodiment of Figure 8.

Figure 10 illustrates yet another embodiment of the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

One embodiment of the pumping system of the present invention may be seen reference to Figures 1 and 1A.

As illustrated, the pumping system 2 includes a flow meter 4 to which is mounted a metering pump 40 where flow meter 4 includes a housing 13, a fluid inlet port 18 and a fluid outlet 17. As intended by the present invention, flow meter broadly means a device which has at least one movable element, and the movable element can be moved when fluid is directed through the device. In the

embodiment shown in Figures 1 - 1A, the flow meter 4 is a gear-type flow meter, as more fully described below.

In the illustrated embodiment, the fluid inlet port 18 of the flow meter 4 is connected to a fluid conduit 20. More specifically, in one presently preferred embodiment, conduit 20 includes an annular threaded connector 18a which can rotate relative to said conduit, and the connector can be engaged with threads that are formed on inlet port 18. In turn, conduit 20 is situated in fluid communication with a water supply or other source of fluid 19. It is to be understood that conduit 20 can be connected to a water supply by any suitable means known in the art, e.g., by connecting conduit 20 to a fitting or nozzle that is in turn in fluid communication with a water supply.

The housing 13 of flow meter 4 comprises a top wall 7, a bottom wall 11 and a side wall 14 where each of the aforereferenced elements are adapted to be combined to form a substantially fluid tight unit. Typically, housing 13 includes some sort of access means, e.g., an access plate (not shown), to allow for inspection, repair and replacement of the internal components of flow meter 4.

In accordance with the present invention, flow meter 4 includes one or more rotational elements which, in the embodiment shown in Figures 1 - 2, include a first gear 24 and second gear 25 which rotate when the pressurized first fluid passes from the inlet 18 port to the outlet port 17.

By reference to Figure 2, gears 24 and 25 are disposed within an internal cavity 23 defined by housing 13. In some embodiments, gears 24 and 25 may be provided with magnetic inserts (not shown). The introduction of fluid through inlet 18 rotates gears 24 and 25, thereby moving inserts past a point on the housing 13, which contains means to detect the rotation of said insert. The frequency of this rotation may then be monitored to determine a flow rate.

In the embodiment illustrated in Figures 1 - 2, metering pump 40 includes a housing 41 defining an internal cavity 49 in which are disposed a pair of intermeshing, counter rotating rotors 44 and 46. Housing 41 includes a sidewall 43, a bottom wall 45 and a top wall 47, the combination adapted to be sealed to form a fluid tight compartment defining an inlet 50 and an outlet 52, where inlet 50 is disposed in fluid communication with a reservoir 51 of a second fluid via conduit 55.

In some embodiments, the bottom wall 45 of pump 40 may compromise the top wall 17 of flow meter 4. In such a fashion, economy of construction may be observed.

By reference to Figures 1A, 6 and 7, it is desired that rotors 44 and 46 define a tooth pattern which promotes a maximum amount of fluid flow from inlet 50 to outlet 52. In may be desirable to utilize a helical tooth pattern such as that disclosed in U.S. Patent No. 5,415,041. Other tooth patterns, however, are also contemplated within the spirit of the invention. For example, it may also be desirable to adopt a herringbone or straight tooth pattern to advance the objects of the invention.

By reference to Figures 6 and 7, rotors 44 and 46 are preferably provided with a system of bearings to enhance smoother and low drag operation. Top wall 47 preferably comprises a cover to close the cavity 49 by fitting on a machined face of said housing 41 which is bolted in place with bolts 42 which extend through openings 63 of cover 48 into aligned receivers 65 in housing 41.

The buildup of deposits, e.g., calcium and precipitants from the additive solution, is a major cause for premature failure of cavity gear pumping systems. In some applications therefore, it may be desirable to utilize a metering pump housing which defines a close tolerance between rotors 44 and 46 and the pump outlet 52, the walls defining cavity 49 and the pump inlet 50. In such a fashion, any deposits collecting about the inlet 50 or outlet 52 are continuously sheered off by rotors 44 and 46 during the operation of pump 40.

In the embodiment illustrated in Figures 1 and 2, a connecting element 30, e.g., a spline, is coupled to first rotor 25 of flow meter 4 and extends through flow meter housing 13 into operative engagement with the rotor 44 of pump 40. In such a fashion, the rotation of gear 24 as induced by the flow of the first fluid from the inlet 18 to outlet 17 rotates the first rotor 44 and hence second rotor 46. The counter rotation of rotors 44 and 46 create a partial vacuum in housing 41, thereby inducing fluid flow of the second fluid from reservoir 51 through conduit 55 into inlet 50 and ultimately through outlet 52.

The coupling of rotor 24 to rotor 44 of pump 40 allows for the metered input of the additive second fluid based on the flow valve of the fluid as dictated by the rotation of rotors 24 and 25. The proportions of the additive fluid may be varied based upon the ratio of the size of rotors 24 and 25 vis-a-vis rotors 44 and 46. Alternatively, spline 30 may be formed to include a manually adjustable gear down assembly (not shown) to allow the ratio of the additive fluid to be altered.

By reference to Figure 1A and 2, in one aspect of the invention, pump 40 may be provided with priming means which comprises a piston 86 slidably situated in a bore 89 which is disposed in fluid communication with cavity 23 of flow meter 4 via access bore 95. Reciprocation of piston 86 in bore 89 allows the first fluid, e.g. water, to pass through bore 89 into cavity 23, thereby priming pump 40.

It is contemplated that it may be desirable in some situations to introduce the additive fluid downstream of flow meter 4. In other applications, however, the pump outlet 52 may be disposed upstream of meter 4 or concomitant with flow meter outlet 17.

A second embodiment of the present invention may been seen by reference to Figures 3 - 4 in which is illustrated a flow meter 100 of the general configuration as described above in relation to the embodiment of Figures 1 and 2, where such flow meter 100 includes a first 102 and second 104 rotational element rotatingly disposed within an internal cavity 106 defined within a housing 105 which also includes an inlet 108 and an outlet 110. Inlet 108 is disposed in fluid communication with a first source of fluid, e.g., water, through a conventional conduit 113 or other similar fluid flow member. Outlet 110 is likewise coupled to a conduit 115, as illustrated.

A first metering pump 140 and a second metering pump 160 are joined to flow meter 100 in a similar manner to that described in relation to the embodiment of Figures 1 and 2. In this connection, one or both of first 140 and second pumps 160 may share a common wall with flow meter 100. Alternatively, either or both of first and second pumps may be formed integrally with flow meter in a common housing with means provided for the separation of fluid flow. Still alternatively, first or second pumps may be raised or separated from flow meter 100 as long as means are provided for the translation of the rotation of the rotational element(s) of flow meter 100 to said first and second pumps. This later arrangement may be helpful, for example, where it is desirable to remove one or more metering pumps from exposure from the heat of the primary fluid passing through flow meter 100. Such an arrangement, may also be helpful when there exists space and design concerns. This design also provides an air gap to separate the source of drive water and the chemical being pumped.

Each of metering pumps 140 and 160 include, in the example of the first pump 140, a housing 122 defining an internal cavity 123 and an inlet 125 and an outlet 126, where said inlet 125 is coupled to a second source of fluid 137 by a conduit 129. In this embodiment, at least one rotational element

131 is rotatably disposed in cavity 123 such that the rotation of said element 131 induces fluid flow through inlet 125 and outlet 126.

A connecting element 120, e.g, a spline, is coupled to one or both of rotational elements 102 and 104 and to at least one of the rotor elements disposed in both first and second pumps 140 and 160, respectively. In such a fashion, the flow of fluid from inlet 108 to outlet 110 of the flow meter 100 rotates first and second rotational elements 102 and 104 and at least one of the rotors disposed in each of first and second pumps 140 and 160. As described above in relation to prior embodiments, the rotation of rotors in pumps 140 and 160 induces fluid flow from each of reservoirs 137 and 143 through respective fluid inlets 148 and 129 and through outlets 126 and 132 and ultimately through valve 91 and common flow passage 80. In the embodiment illustrated in Figure 4, additive second and third fluids are introduced to the fluid stream through housing 105. Alternatively, one or more of the additive fluids may be introduced in the outflow conduit 115 as illustrated in Figure 3.

In some applications, it may be desirable to include means to divert at least a portion of an additive fluid back to the fluid reservoir. Such reticulation may be important, for example, when the additive fluid is prone to settling. By reference to Figure 4, a valve 91 may be disposed in outlet conduit 80 such that upon partial opening of valve 91 a portion of the additive fluid is diverted back to the fluid reservoir.

Yet another embodiment of the present invention may be seen by reference to Figure 5 in which is illustrated a flow meter 150, a first pump 170 and a second pump 190. Flow meter 150 is configured in much the same fashion as described above in relation to other embodiments and may adopt a variety of configurations. It is desired, however, that meter 150 include a fluid tight housing defining an inlet and an outlet, where at least one rotor element 155 is disposed therebetween. Similarly, pumps 170 and 190 may also adopt a number on configurations involving the use of at least rotational element which is coupled to element 155. In this connection, it is contemplated that one or both of pumps 170 and 190 may incorporate counter rotating helical gears of the type illustrated in Figures 6 and 7 or may alternatively utilize a single rotor formed in a cavity disposed in a housing. In each case, however, it is desirable that the rotor element of pumps 170 and 190 be rotationally coupled to at least one of the rotational elements of the flow meter 150.

In the illustrated embodiment, pumps 170 and 190 are arranged in a vertical or "stacked" relationship with respect to one another as to share a common interconnecting element or spline 175. In such a fashion, the rotation of the rotational element of flow member 150 results in the rotation of rotors in each of pumps 170 and 190 to include the metered flow of second or third fluids as described above. As set forth above, the ratio of the injection of the second and first fluids may be determined as a function of the ratio of the respective gear size between each of pumps 170 and 190 to flow meter 150. Alternatively, a compound spline 175 may be employed which allows for the selective adjustment of the rotation of one or both of pumps 170 and 190 vis-a-vis metering pump 150.

The immediately aforedescribed embodiment may be desirable due to space constraints or design limitations.

Yet another embodiment of the invention may be seen by reference to Figs. 8 and 9 in which is illustrated a flow meter 200 which includes a housing 202, a fluid inlet port 204 and a fluid outlet 206, as described previously in relation to other embodiments. Housing 202 itself comprises a top wall 211, a bottom wall 209 and a side wall 202. Consistent with prior embodiments, the flow meter includes one or more rotational elements 214 (as shown in phantom) which rotate about shafts and include an extended spline 215 which extends outside housing 202. In the illustrated embodiment, spline 215 includes a flat 216 to aid in engaging pump 230, as will be described below.

By reference to Figures 8-9, pump 230 includes a housing which is generally circular in configuration and which defines a substantially circular bore 239, a fluid inlet 240 and an outlet 242. Bore 239 is receivable to an impeller 234 which is adapted to rotate about a hub 239. It is contemplated that hub 239 includes a fixed shaft engageable with spline 215 so as to transfer the rotation of spline to impeller 234 so as to pull fluid from inlet 240 through outlet 242.

As illustrated, impeller 234 is eccentrically disposed in bore 239, which eccentricity is adjustable depending on desired flow rates. The housing includes an adjustment flange 260 which includes a pivot aperture 262 about which the housing may be pivoted in a plane coplanar with the plane described by housing top 211. The pivot of the housing serves to distort the shape of impeller 234 so as to increase or decrease the quantity of fluid moved through said pump 230. In this connection, impeller 234 is preferably made from a pliable compound, e.g. rubber, which allows

resilient deformation. Impeller 234 itself defines a number of fins which will be familiar to those skilled in the art.

It is contemplated that the aforedescribed adjustment to impeller 234 may be made manually and gauged about gradations scored on top 207. Alternately, a flow gauge (not shown) may be situated in the outflow line (not shown) and manual adjustments made from this flow gauge. Still alternately, pump 230 may be remotely adjusted, e.g. by a stepper motor, to achieve a desired and preprogrammed flow rate. In the instance of manual adjustment, pump housing 232 may be secured to meter housing 202 about a particular orientation by a screw 250, as illustrated.

Fluid metered through pump 230 need not be necessarily introduced into flow meter 200, to outlet 206 or outlet line 213 immediately downstream from outlet 206. Instead, the metered additive may be carried in a separate line 243 which may parallel water outlet line 209, where lines 209 and 243 coterminate at a given point, e.g., the mixing pool. In such a fashion, inadvertent backflow will not result in a contamination of the water supply.

Still another embodiment of the invention may be seen by reference to Figure 10 in which is illustrated a flow meter 300 defining a housing 302 and at least one interior metering element which is rotated about the introduction of fluid through meter 300 in a manner consistent with that described above. In the illustrated embodiment, at least one of the rotatable elements includes a spline 304 which extends beyond housing 302 and is coupled to a cam wheel 307 which in turn is coupled to a crank 309 in a manner familiar to those skilled in the art. Crank 309 is in turn coupled to a metering pump 312 of a design generally disclosed and claimed in U.S. Patent No. 4,558,715.

In such a fashion, the introduction of water into meter 300 turns at least one rotatable element which in turn acts upon crank 309 and pump 312 to induce a metered flow of fluid, e.g. medication or chemicals. The amount of fluid introduced through pump 312 may be adjusted in a conventional fashion as disclosed in Applicant's prior patents, Patent Nos. 4,809,731 and 4,558,715.

Although particular detailed embodiments of the apparatus and method have been described herein, it should be understood that the invention is not restricted to the details of the preferred embodiment. Many changes in design, composition, configuration and dimensions are possible without departing from the spirit and scope of the instant invention.

CLAIMS:

1. An apparatus for injecting a predetermined quantity of a fluid additive into a fluid stream to produce an ultimate fluid mixture wherein the fluid additive constitutes a predetermined percentage of the ultimate fluid mixture, said apparatus comprising:

a flow meter having at least one rotatable metering element disposed in a first housing between a flow meter inlet for a first fluid stream and a flow meter outlet for said first fluid stream, said at least one rotatable metering element becoming rotational at a rate of rotation dependent upon a rate of flow of the first fluid stream between the flow meter inlet and the flow meter outlet;

a rotatable first shaft coupled directly to one of said at least one rotatable metering element to rotate therewith and extending through a wall of the first housing;

a first metering pump mounted to said wall of the first housing, said first metering pump having at least one but no more than two rotatable pumping elements disposed in a second housing between a first metering pump inlet and a first metering pump outlet, said first metering pump outlet being coupled to the flow meter outlet to inject a second fluid into the first fluid stream, at a point downstream of the flow meter; and

one of said at least one but no more than two rotatable pumping elements being mechanically coupled to said rotatable first shaft to rotate therewith to induce a flow of said second fluid through the first metering pump outlet for injection into the first fluid stream to form a fluid mixture having a predetermined percentage of the second fluid.

2. The apparatus of claim 1 where said second housing defines top, bottom and side walls where said bottom wall is common to the top wall of the first housing.

3. The apparatus of claim 1 where the first metering pump includes a first gear and a second gear mounted in a co-meshing relationship in said second housing.

4. The apparatus of claim 3 where the teeth of said first gear and said second gear of said first metering pump define a double helical configuration.

5. An apparatus for injecting a predetermined quantity of a fluid additive into a fluid stream to produce an ultimate fluid mixture wherein the fluid additive constitutes a predetermined percentage of the ultimate fluid mixture, said apparatus comprising:

a flow meter having at least one rotatable metering element disposed in a first housing between a flow meter inlet for a first fluid stream and a flow meter outlet for said first fluid stream, said at least one rotatable metering element becoming rotational at a rate of rotation dependent upon a rate of flow of the first fluid stream between the flow meter inlet and the flow meter outlet;

a rotatable first shaft coupled directly to one of said at least one rotatable metering element to rotate therewith and extending through a wall of the first housing;

a first metering pump mounted to said wall of the first housing, said first metering pump having at least one but no more than two rotatable pumping elements disposed in a second housing between a first metering pump inlet and a first metering pump outlet, said first metering pump outlet being coupled to the flow meter outlet to inject a second fluid into the first fluid stream, at a point downstream of the flow meter; and

one of said at least one but no more than two rotatable pumping elements being mechanically coupled to said rotatable first shaft to rotate therewith to induce a flow of said second fluid through the first metering pump outlet for injection into the first fluid stream to form a fluid mixture having a predetermined percentage of the second fluid;

wherein the first metering pump includes a first gear and a second gear mounted in a co-meshing relationship in said second housing;

further wherein said apparatus further comprises a second metering pump mounted to said wall of the first housing, said second metering pump having a third gear and a fourth gear disposed in a third housing between a second pump inlet and a second pump outlet, wherein the second gear of the flow meter and the third gear disposed in the third housing are both coupled to a second shaft such that a predetermined amount of a third fluid is pumped through the second pump outlet a predetermined amount of the first fluid is directed through the flow meter inlet to the flow meter outlet.

6. The apparatus of claim 1 further including means to prime the first metering pump.

7. The apparatus of claim 1 where said first metering pump comprises an impeller eccentrically disposed in said second housing.

8. The apparatus of claim 7 where the second housing is pivotally disposed about said first housing such that the eccentricity of said impeller may be altered when said second housing is pivoted vis-a-vis said first housing.

9. The apparatus of claim 1 where said first metering pump outlet is concomitant with the flow meter outlet.

10. A dosing apparatus for mixing a first and other fluids in a predetermined, volumetric relationship comprising:

a flow measuring component having a meter inlet in fluid communication with the first fluid and a meter outlet, where said flow measuring component further includes a translation means which rotates at a selected number of revolutions when a predetermined amount of fluid is directed from the meter inlet to the meter outlet; and

a fluid pump which includes a housing defining a pump inlet and a pump outlet, where said pump is coupled to said translation means, and further wherein said fluid pump and said flow measuring component are attached directly to a common drive shaft, such that the rotation of the translation means causes the pump to move a second fluid from the pump inlet towards the pump outlet.

11. The dosing apparatus of claim 10 where said pump outlet is disposed in fluid communication with the meter outlet of said flow measuring component.

12. The dosing apparatus of claim 10 where said pump includes a first rotatable element and a second rotatable element situated in a comeshing relationship.

13. The dosing apparatus of claim 10 further including a means to selectively divert a portion of the second fluid pumped through the pump outlet back to a second fluid reservoir.

14. The dosing apparatus of claim 12 further including means to continuously remove deposits from the first rotatable element and the second rotatable element.

15. The dosing apparatus of claim 12 where said rotatable elements include helical gears.

16. The dosing apparatus of claim 10 further including a second pump comprising a first gear and a second gear mounted between a second pump inlet disposed in fluid communication with a third fluid and a second pump outlet such that at least one of said first gear and said second gear are also coupled to said translation means such that the rotation of the rotational means urges a predetermined amount of the third fluid from said second pump inlet to said second pump outlet.

17. The dosing apparatus of claim 16 where the second pump outlet is coupled in fluid communication with the meter outlet through a valve to allow for selective diversion of at least a portion of the third fluid pumped through said second outlet to a third fluid reservoir.

18. The dosing apparatus of claim 10 where the pump includes a piston disposed in a said housing between the pump outlet and the pump inlet and where the translation means is coupled to said piston such that rotation of said rotational means actuates reciprocation of said piston in said housing so as to pump said second fluid through said pump outlet.

19. The dosing apparatus of claim 10 where said pump includes an impeller eccentrically disposed in said housing.

20. The dosing apparatus of claim 19 where the eccentricity of said impeller may be modified.

21. The dosing apparatus of claim 16 where the second pump includes double helical rotors.

22. The dosing apparatus of claim 16 further including means to pressurize the second pump.

23. An apparatus to inject selected quantities of a second fluid into a fluid stream comprising:

a metering apparatus to monitor the flow of a first fluid introduced through a meter inlet to a meter outlet where said apparatus generates a selective rotation of a shaft based on the quantity of the first fluid passing through said metering apparatus; and

a fluid pump coupled directly to said shaft and positioned between a source of a second fluid and a pump outlet where a predetermined amount of said second fluid is directed through the pump outlet based on the flow of the first fluid through the metering apparatus.

24. The apparatus of claim 23 where said second fluid is contained within a reservoir which is disposed in fluid communication with a pump inlet.

25. The apparatus of claim 23 wherein the fluid pump includes a pair of counter rotating helical gears.

26. The apparatus of claim 23 where the fluid pump comprises a piston disposed in a housing between a first and a second position where such piston is coupled to a crank which in turn is operably coupled to said shaft such that rotation of said shaft induces reciprocation of said piston in said housing so as to pump fluid from said pump inlet to said pump outlet.

27. A method for establishing a mixture of a first fluid and a second fluid where the first fluid constitutes a volumetric portion of the mixture, the method comprising:

(a) providing a flow meter having a rotatable metering member in fluid communication with the first fluid and disposed between a meter inlet and a meter outlet;

(b) providing a pump having at least one rotatable pumping member disposed between a pump inlet and a pump outlet where said pump inlet is disposed in fluid communication with the second fluid;

(c) directly coupling the rotatable metering member to the rotatable pumping member of the pump using a common drive shaft;

(d) directing the first fluid through the meter inlet and the meter outlet to induce a predetermined amount of rotation in the rotatable metering member for each unit of the first fluid

to thereby cause the rotatable pumping member to rotate and thereby pump a predetermined amount of said second fluid from said pump inlet to said pump outlet; and

(e) mixing the second fluid that has been directed through the pump with the first fluid that has been directed through the meter outlet.

28. A method for establishing a mixture of a first fluid and a second fluid where the first fluid constitutes a volumetric portion of the mixture, the method comprising:

(a) providing a flow meter having a rotatable metering member in fluid communication with the first fluid and disposed between a meter inlet and a meter outlet;

(b) providing a pump having at least one rotatable pumping member disposed between a pump inlet and a pump outlet where said pump inlet is disposed in fluid communication with the second fluid;

(c) directly coupling the rotatable metering member to the rotatable pumping member of the pump using a common drive shaft;

(d) directing the first fluid through the meter inlet and the meter outlet to induce a predetermined amount of rotation in the rotatable metering member for each unit of the first fluid to thereby cause the rotatable pumping member to rotate and thereby pump a predetermined amount of said second fluid from said pump inlet to said pump outlet; and

(e) mixing the second fluid that has been directed through the pump with the first fluid that has been directed through the meter outlet;

said method further including the steps of providing a second pump having at least one rotatable member disposed between an inlet and an outlet where said inlet is disposed in fluid communication with a third source of fluid, and further where said rotatable member of said second pump is operably coupled to the rotatable member of the flow meter such that fluid flow through said meter induces fluid flow through said second pump.

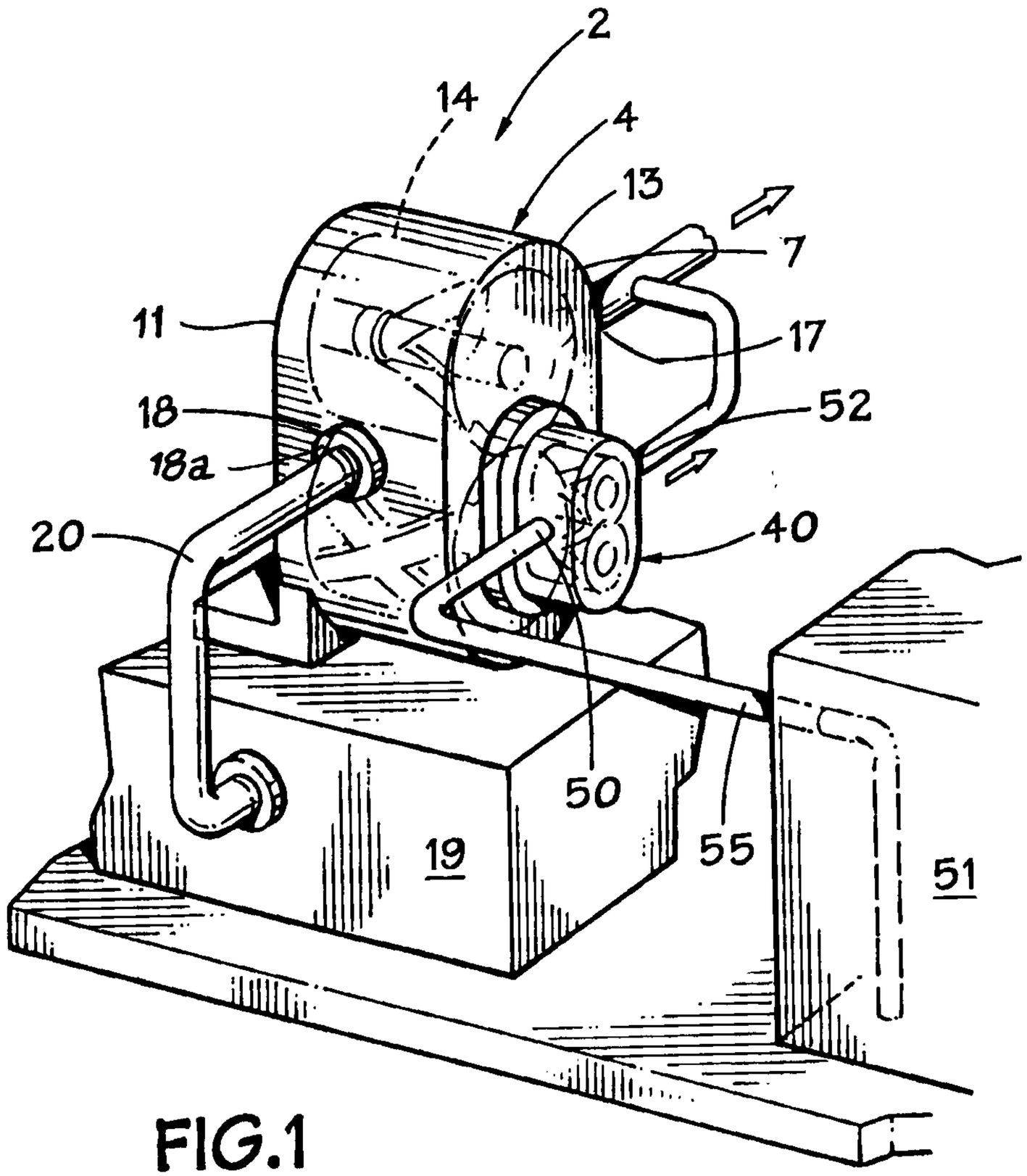


FIG.1

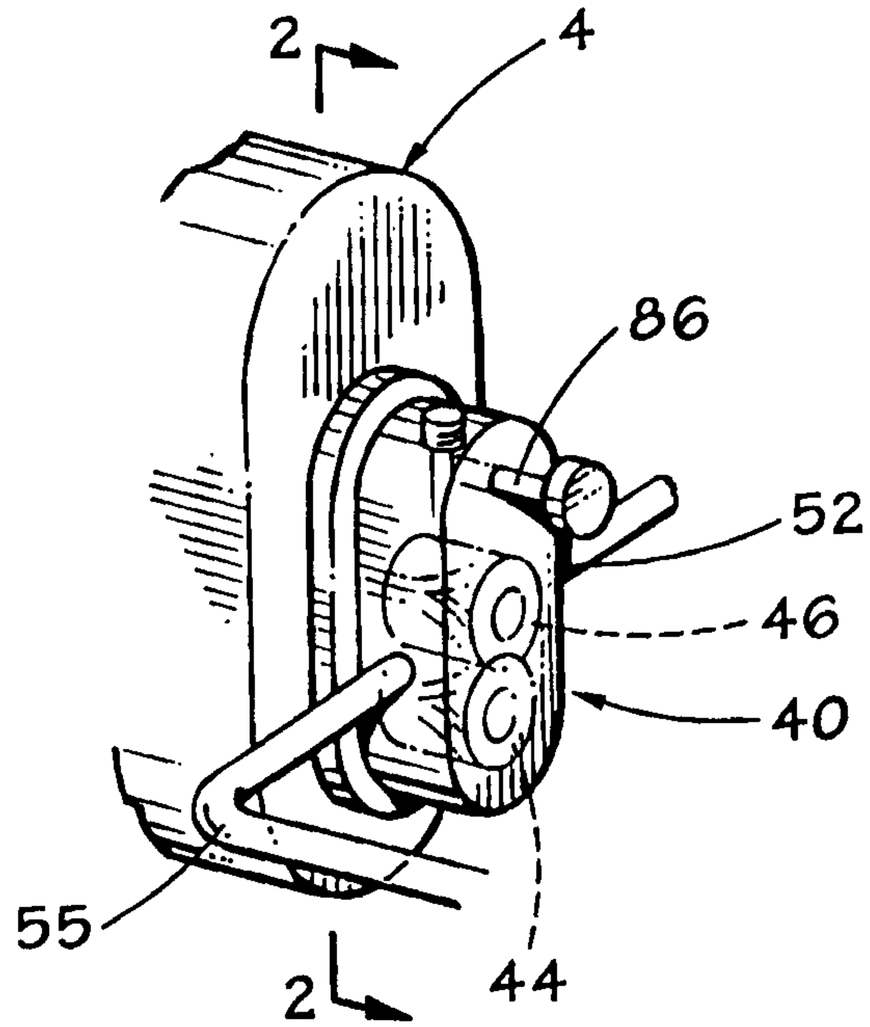


FIG.1A

CA 02311098 2004-04-08

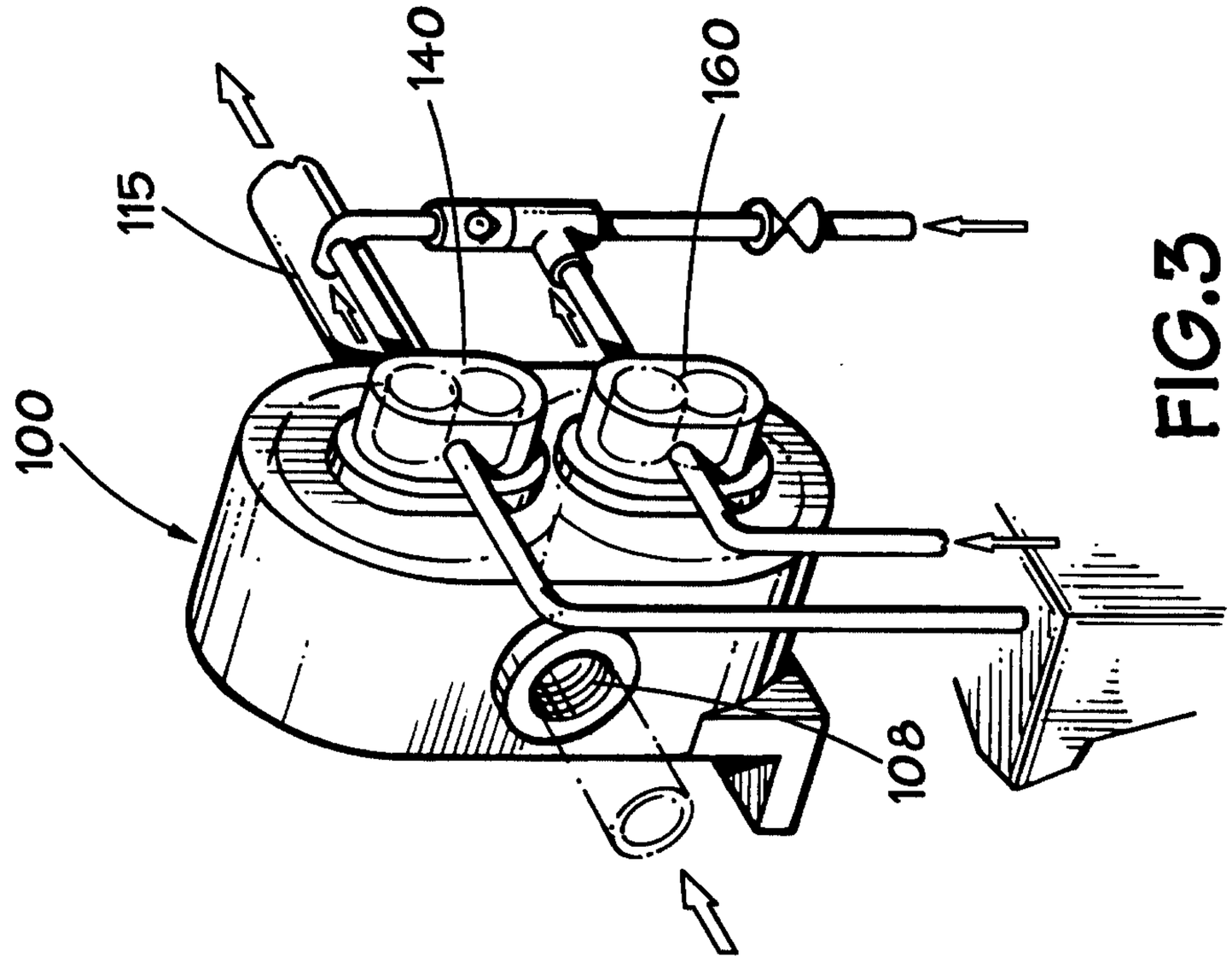

140
160
115
100
108

FIG.3

89
86
46
49
47
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FIG.2

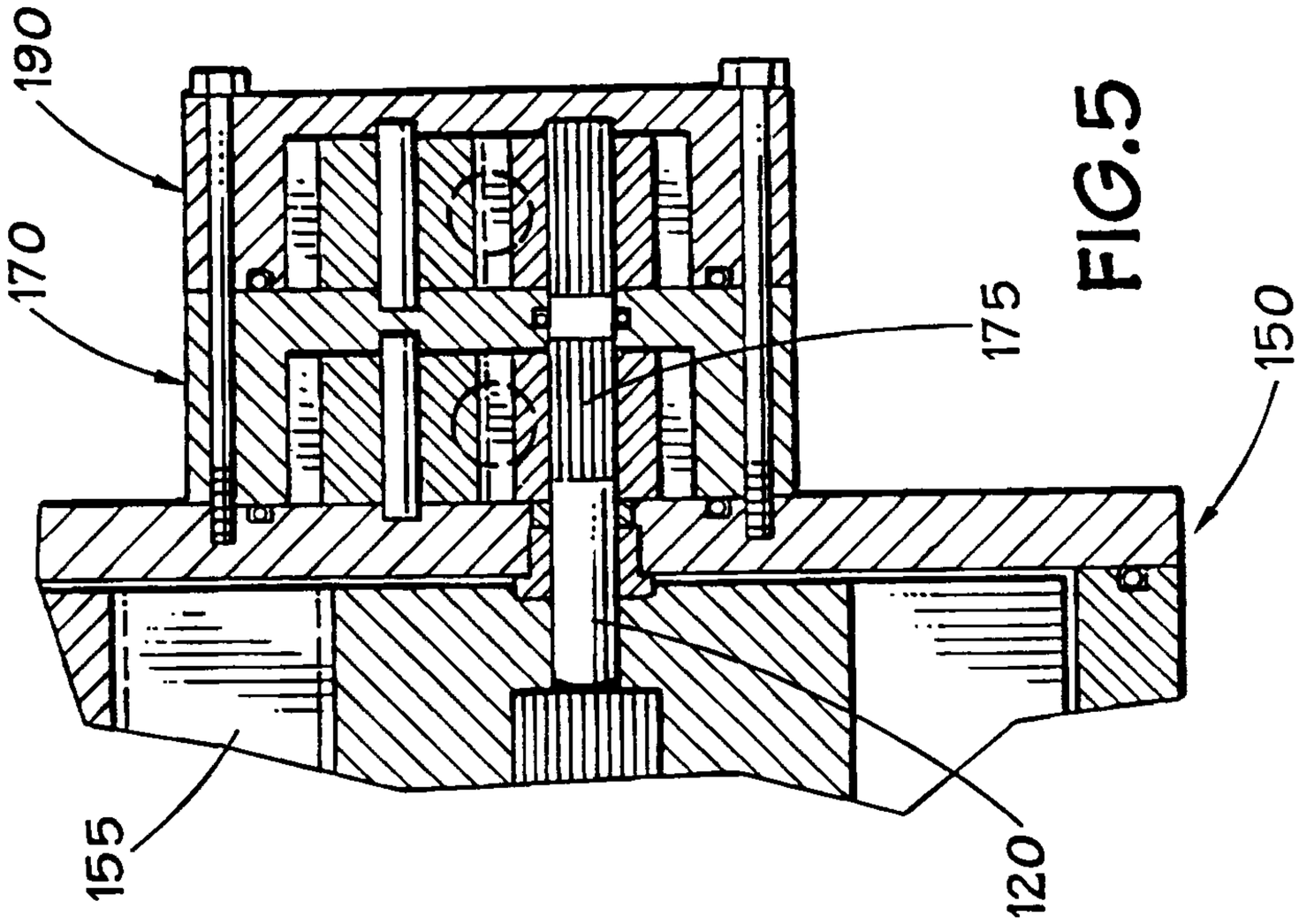
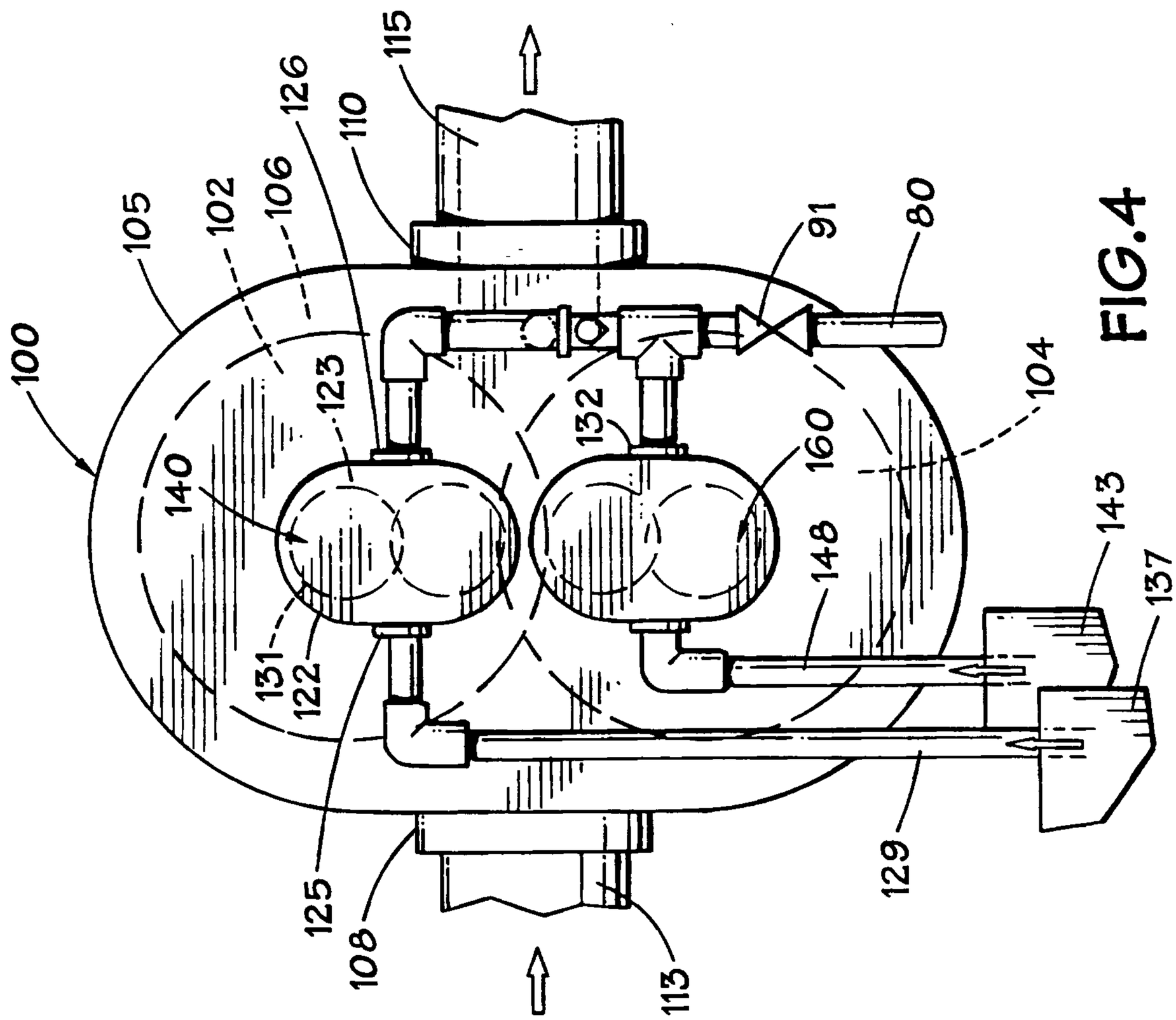

190
170
175
150
155
120

FIG.5


115
126
110
105
102
106
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132
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129
113

FIG.4

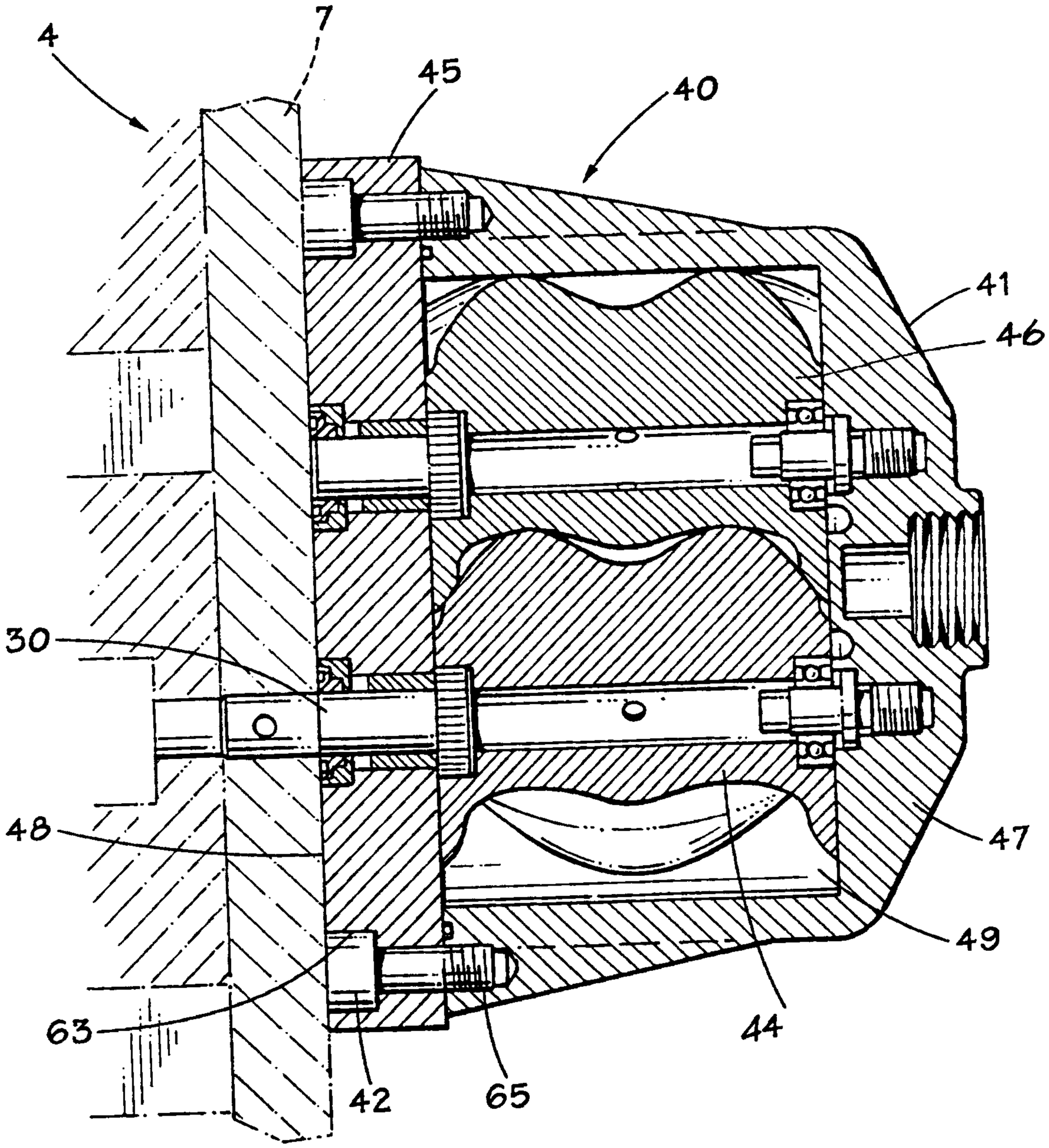


FIG.6

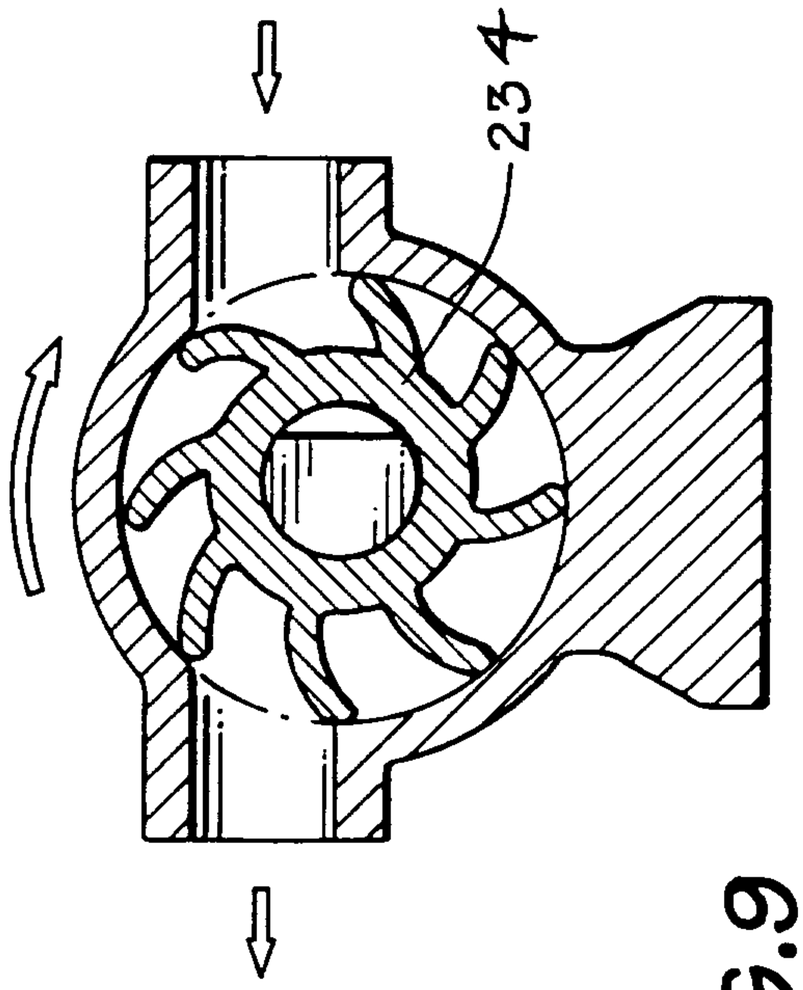


FIG.9

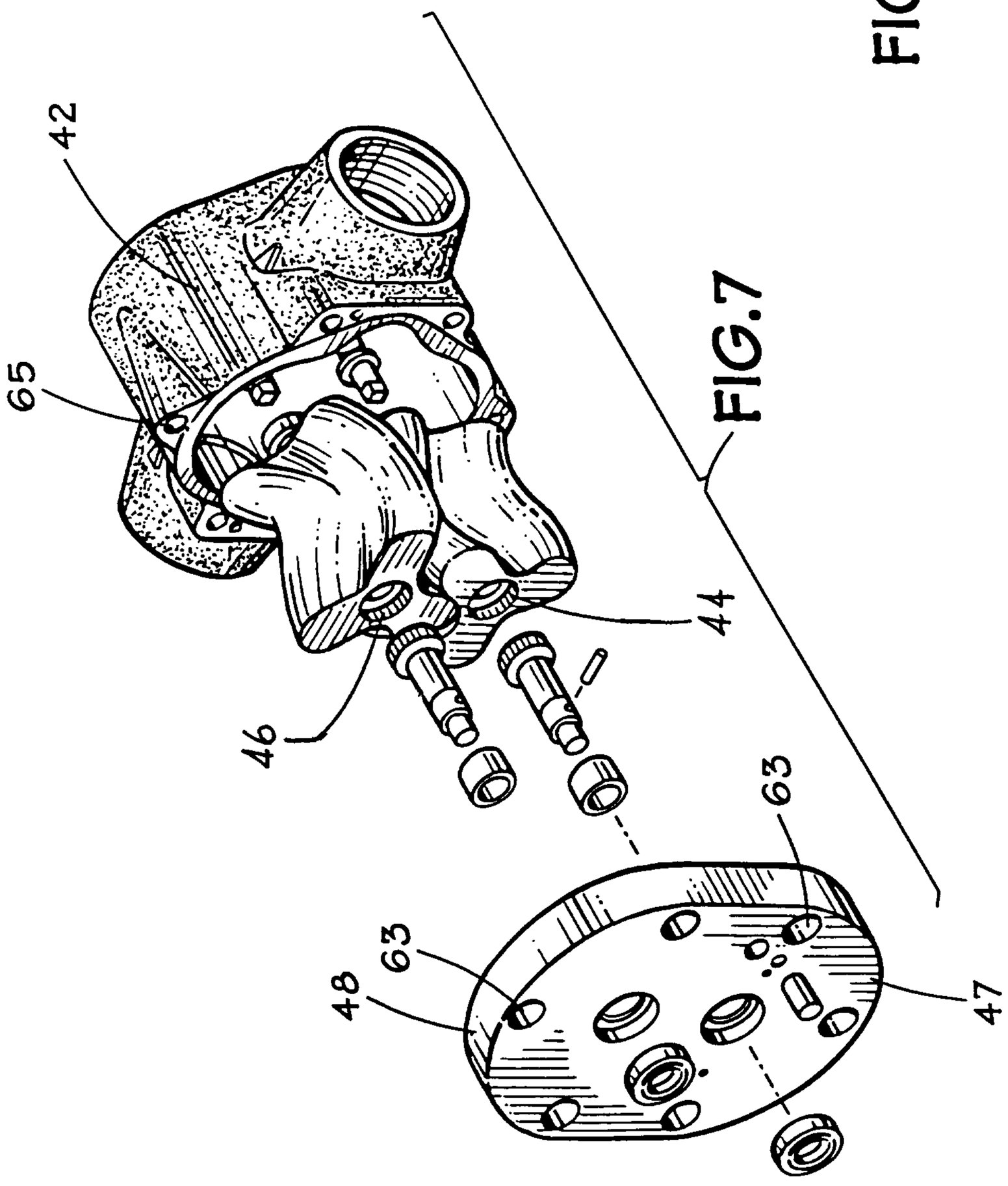


FIG.7

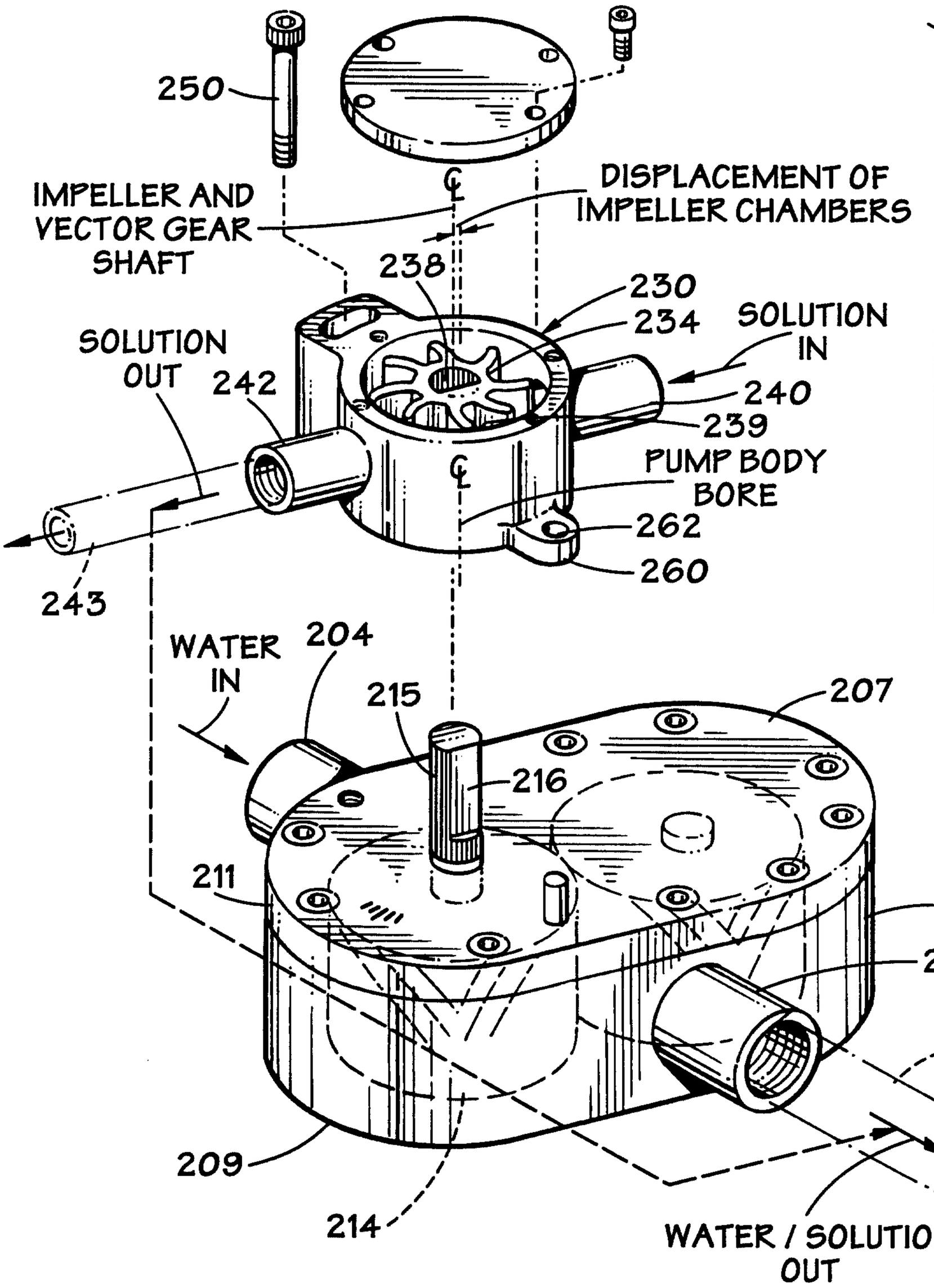

250
IMPELLER AND VECTOR GEAR SHAFT
DISPLACEMENT OF IMPELLER CHAMBERS
238
230
234
SOLUTION IN
240
239
SOLUTION OUT
242
PUMP BODY BORE
262
260
243
WATER IN
204
215
207
216
211
202
206
213
209
214
WATER / SOLUTION OUT

FIG.8

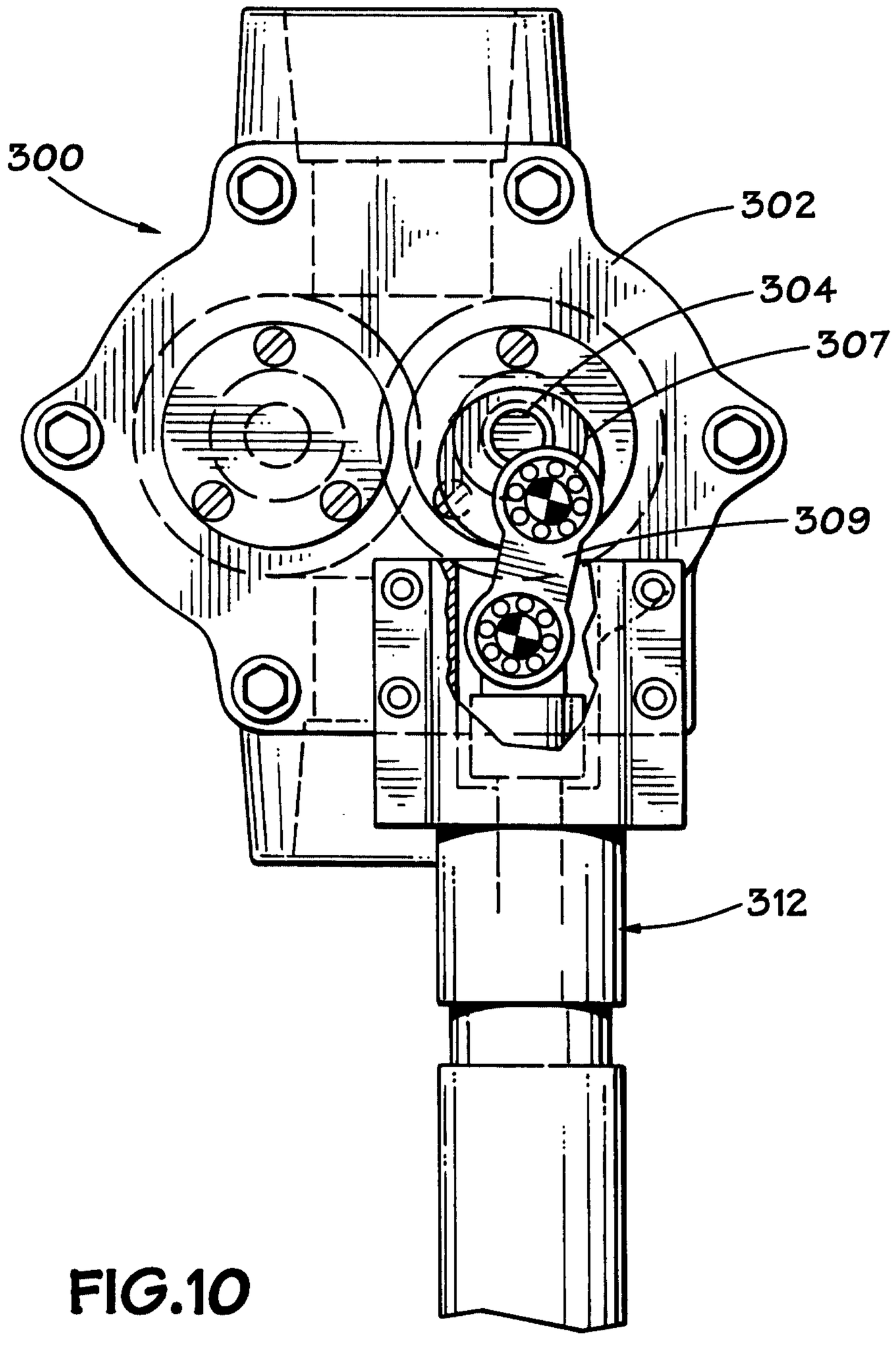
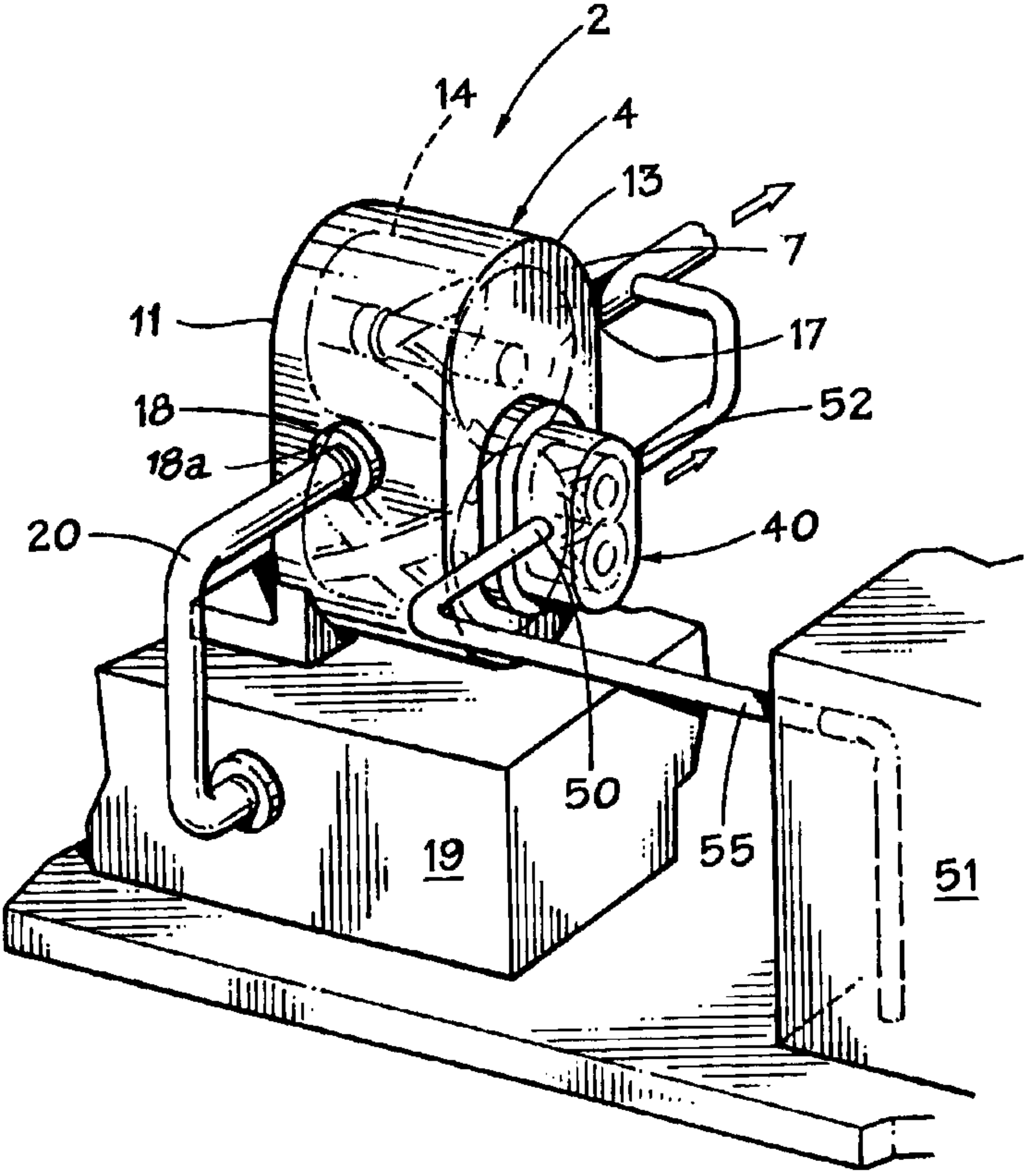


FIG.10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