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FLUID DELIVERY SYSTEM

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A fluid delivery system is revealed. A double diaphragm pump (1) provided with two inlets (13, 16) and two outlets (14, 17) is mounted in the fluid delivery system. An introducing pipeline (2) of the fluid delivery system is connected to one set of inlet and outlet (13, 14) while a return pipeline (3) of the fluid delivery system is connected to the other set of inlet and outlet (16, 17). Thereby a pneumatic mechanism (10) in the double diaphragm pump (1) drives two diaphragms (11, 12) there-

in to draw in and expel fluid in the system so that the fluid flows in and out through the two sets of inlets and outlets. Thus the pressure remains constant and the volume flow rate is uniform during delivery and returning of the fluid. A drain-back tube (6) provided with a control valve (61) is arranged between the introducing pipeline (2) and the return pipeline (3). The fluid is returned and delivered under control of the control valve (61) while changing fluids or cleaning pipelines of the system.

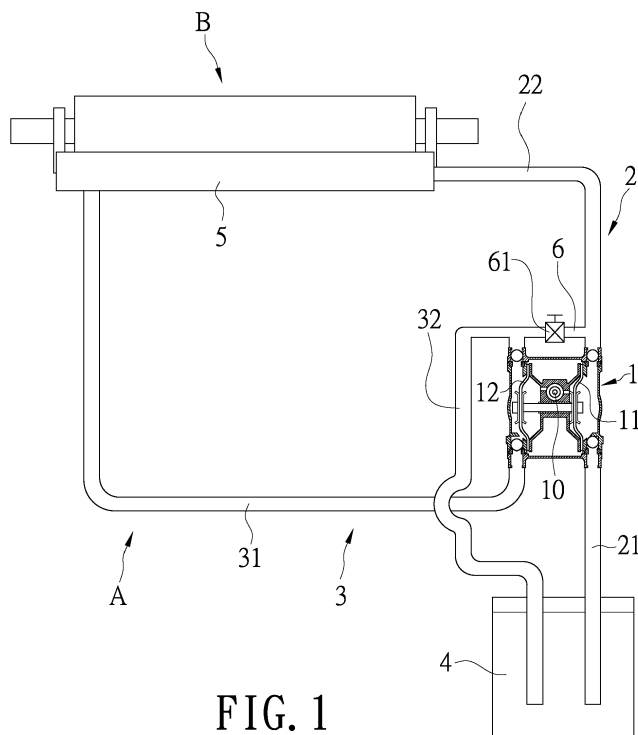


FIG. 1

Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a fluid delivery system, especially to a fluid delivery system in which fluid is delivered and recycled uniformly under constant pressure and uniform volume flow rate.

Description of Related Art

[0002] Generally, fluid is pressurized by the pump to be delivered to the desired location through pipelines. The pump is driven by an external engine for drawing and expelling the fluid continuously. Yet most of the engines are bulky and fuel consumption is required. Thus the engine is suitable for outdoor use where no power is provided. For indoor use or places easy to access to the power, the pump is usually driven by motors or electromagnetic means.

[0003] The pump available now is only suitable for quick delivery and liquids with lower requirements for delivery quality, unable to be applied to machines with viscous fluids delivered at low speed such as printing machine. An air pump is widely used for ink delivery in ink printing machines. A diaphragm mounted in the pump is driven by the alternating air pressure for ink delivery to an ink fountain and use in printing. As shown in Fig. 5, one end of an air pump 7 is connected to an ink fountain 71 and the other end thereof is connected to an ink tube 81 of an ink printing machine 8 while two ink fountain rollers 82 are disposed under the ink tube 81 and the sections of the two ink fountain rollers 82 are tangent to each other (in close contact with each other). The ink tube 81 is located just above the position where the surfaces of the two ink fountain rollers 82 are in close contact and the two ink fountain rollers 82 are rotated from the lower to the upper in opposite directions respectively so that ink from the ink tube 81 will not fall through a gap between the contact surfaces of the two ink fountain rollers 82. Instead of flowing down, the ink from the ink tube 81 flows into a trough formed above the contact surfaces of the two ink fountain rollers 82 for being attached to the surface of each of the rotating ink fountain rollers 82. At the same time, redundant ink passes through two ends of the trough and flows into an ink-collecting groove 83 set on each of the two ends of the slot and the ink-collecting groove 83 is connected to a return tube 84 for sending the ink back to the ink fountain 71 and recycling. The ink in the ink-collecting groove 83 is dropped into the return tube 84. Then the ink is returned to the ink fountain 71 by height difference defined in fluid statics (gravity-driven flow) or capillary effect/penetration. Thus the ink delivery in the printing machine available now has the following shortcomings:

1. The pipe diameter of the return tube should be increased. The larger the diameter/size, the easier the flow of viscous fluids being delivered/returned. Thus the cost is increased.

2. The more viscous the fluid is, the slower the flow rate is. Thus the solvent is evaporated easily and the ink is dried.

3. During the delivery process, the fluid is drawn in at a higher speed but returned at a lower speed. Thus the delivered amount is not balanced over time.

4. The pipelines are difficult to be cleaned. A lot of water is required for cleaning the return tube owing to the dried ink attached to the tube wall.

SUMMARY OF THE INVENTION

[0004] Therefore it is a primary object of the present invention to provide a fluid delivery system that includes a double diaphragm pump used for driving two diaphragms to draw in and expel fluid alternately and then the fluid flows in and out through two sets of inlets and outlets of the double diaphragm pump. Thus the pressure remains constant and the volume flow rate is uniform during the delivery and returning of the fluid. Therefore the fluid is delivered smoothly and uniformly.

[0005] It is another object of the present invention to provide a fluid delivery system in which only a little amount of water is required to clean pipelines thereof owing to constant pressure and uniform flow rate during delivery. Thus water used for cleaning is saved. Moreover, quick cleaning and replacement is achieved by a drain-back tube.

[0006] It is a further object of the present invention to provide a fluid delivery system that features on no evaporation, no leakage and stable fluid supply during fluid delivery process.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] The structure and the technical means adopted by the present invention to achieve the above and other objects can be best understood by referring to the following detailed description of the preferred embodiments and the accompanying drawings, wherein:

Fig. 1 is a schematic drawing showing structure (closed) of an embodiment according of the present invention;

Fig. 2 is a schematic drawing showing an enlarged view of a pump in action of an embodiment according of the present invention;

Fig. 3 is another schematic drawing showing an enlarged view of a pump in action of an embodiment according of the present invention;

Fig. 4 is a schematic drawing showing structure (non-

hermetic) of another embodiment according of the present invention;

Fig. 5 is a schematic drawing showing structure of a prior art.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0008] Refer to Fig. 1, a schematic drawing showing structure of a fluid delivery system of the present invention is revealed. The fluid in the system is delivered by the following steps.

- (a) providing a fluid delivery system. A fluid delivery system A is used for supplying fluid to a machine B and composed of an introducing pipeline 2 connected to a fluid storage unit 4 for delivering fluid in the fluid storage unit 4 to a fluid supply portion 5. The fluid supply portion 5 is connected to a return pipeline 3 for returning the fluid back to the fluid storage unit 4.
- (b) providing a double diaphragm pump. The double diaphragm pump 1 is mounted in the system A and the introducing pipeline 2 is connected to an action path of a first diaphragm 11 thereof while the return pipeline 3 is connected to an action path of a second diaphragm 12 thereof;
- (c) applying a pressure to the first diaphragm. The double diaphragm pump 1 applies a pressure to the first diaphragm 11 so that fluid in the fluid storage unit 4 is passed through the introducing pipeline 2 and the action path of the first diaphragm 11, and delivered into the fluid supply portion 5 for being used by the machine B.
- (d) applying a pressure to the second diaphragm. The double diaphragm pump 1 applies a pressure to the second diaphragm 12 so that fluid in the fluid supply portion 5 is passed through the return pipeline 3 and the action path of the second diaphragm 12, and returned to the fluid storage unit 4.

[0009] The above fluid delivery steps are carried out by a liquid delivery system A according to the present invention and the liquid delivery system A includes a double diaphragm pump 1, an introducing pipeline 2, a return pipeline 3, a fluid storage unit 4, and a fluid supply portion 5.

[0010] As shown in Fig. 2, the double diaphragm pump 1 consists of a pneumatic mechanism 10 mounted therein, a first diaphragm 11, a second diaphragm 12, a first inlet 13, a first outlet 14, a first fluid chamber 15, a second inlet 16, a second outlet 17, a second fluid chamber 18 and a plurality of check valves 19. The first diaphragm 11 and the second diaphragm 12 are disposed on the pneumatic mechanism 10 that is provided with a lever 102 and an air-intake portion 101 that brings air therein for driving the first and the second diaphragms 11, 12 to move and act. The first inlet 13 and the first outlet 14 are arranged at one end of the pneumatic mechanism 10

with the first diaphragm 11 while the first fluid chamber 15 is formed between the first diaphragm 11, the first inlet 13 and the first outlet 14. The second inlet 16 and the second outlet 17 are disposed on another end of the pneumatic mechanism 10 with the second diaphragm 12 while the second fluid chamber 18 is formed between the second diaphragm 12, the second inlet 16 and the second outlet 17. Each inlet and each outlet are provided with one of the check valves 19 correspondingly.

[0011] The introducing pipeline 2 is composed of a first guiding tube 21 and a second guiding tube 22. One end of the first guiding tube 21 and one end of the second guiding tube 22 are connected to the first inlet 13 and the first outlet 14 of the double diaphragm pump 1 respectively.

[0012] The return pipeline 3 includes a first return tube 31 and a second return tube 32, being connected to the second inlet 16 and the second outlet 17 of the double diaphragm pump 1 respectively. The pipe diameter of the introducing pipeline 2 is the same as that of the return pipeline 3.

[0013] The fluid storage unit 4 used for supplying fluid required and receiving fluid returned is connected to the first guiding tube 21 and the second return tube 32.

[0014] The fluid supply portion 5 is used for supplying fluid required to the machine B and connected to the second guiding tube 22 and the first return tube 31.

[0015] While in use, the present invention can be applied to various machines used for transporting viscous liquids (such as oil, ink, liquid glucose, slurry, etc.). The above system A is used in combination with the delivery steps. Refer to Fig. 1 and Fig. 2, this embodiment is used in fluid (ink) transportation in the printing machine.

[0016] Refer to Fig. 1-3, the machine B receiving fluid from the system A in this embodiment is a printing machine and the system A is responsible for ink delivery in the printing machine. That means ink supply in the printing machine is performed by the fluid delivery system A. The system in the printing machine can be a closed fluid delivery system, a doctor blade chamber system, a conventional liquid delivery system, etc. As shown in Fig. 1, the present system is applied to a closed fluid delivery system and composed of a fluid storage unit 4 filled with ink therein, an introducing pipeline 2 for sending fluid, a return pipeline 3 for recycling fluid, a double diaphragm pump 1 that connects the introducing pipeline 2 and the return pipeline 3, and a fluid supply portion 5 for supplying fluid to a machine B. Thus a closed delivery path is formed. The introducing pipeline 2 and the return pipeline 3 have the same pipe diameter. Then run the steps (a) and (b): providing a double diaphragm pump 1 with two sets of inlets and outlets. A pneumatic mechanism 10 is mounted in the double diaphragm pump 1 and provided with a first diaphragm 11 and a second diaphragm 12 on two ends thereof, respectively. Just like the general pump, the pneumatic mechanism 10 is provided with an air-intake portion 101 that brings air for driving the first and the second diaphragms 11, 12 to move and act. A

first inlet 13 and a first outlet 14 are arranged at one end of the pneumatic mechanism 10 with the first diaphragm 11 and a first fluid chamber 15 is formed between the first diaphragm 11, the first inlet 13 and the first outlet 14 (that's an action path of the first diaphragm 11). The end of the pneumatic mechanism 10 with the second diaphragm 12 is provided with a second inlet 16 and a second outlet 17 while a second fluid chamber 18 is formed between the second diaphragm 12, the second inlet 16 and the second outlet 17 (that's an action path of the second diaphragm 12). Each of the inlets as well as the outlets is provided with a check valve 19. The first inlet 13 and the first outlet 14 are connected to the introducing pipeline 2 composed of a first guiding tube 21 and a second guiding tube 22. One end of the first guiding tube 21 is connected to the first inlet 13 while the other end thereof is connected to a fluid storage unit 4 filled with ink therein. One end of the second guiding tube 22 is connected to the first outlet 14 and the other end thereof is connected to a fluid supply portion 5 that is corresponding to an anilox roller of a printing machine (a machine). A return pipeline 3 connects the fluid supply portion 5 with the double diaphragm pump 1 and the fluid storage unit 4. The return pipeline 3 includes a first return tube 31 and a second return tube 32. One end of the first return tube 31 is connected to the fluid supply portion 5 while the other end thereof is connected to the second inlet 16. One end of the second return tube 32 is connected to the second outlet 17 and the other end thereof is connected to the fluid storage unit 4.

[0017] The fluid supply portion 5 not only provides ink required to the anilox roller of the printing machine but also removes redundant ink attached to the anilox roller. Then the ink removed is turned back to the fluid storage unit 4 by the return pipeline 3. Take the step (c) when the pneumatic mechanism 10 of the double diaphragm pump 1 drives the first diaphragm 11 and the second diaphragm 12 to act. The lever 102 drives the first diaphragm 11 to move toward the first fluid chamber 15 and cause ink in the first fluid chamber 15 moving toward the first outlet 14 and pushing the check valve 19. Thus the ink is flowing into the second guiding tube 22 to be delivered to the fluid supply portion 5. The ink being pushed by the first diaphragm 11 makes the check valve 19 of the first inlet 13 close. At the same time, the second diaphragm 12 is moved away from the second fluid chamber 18 owing to the movement of the first diaphragm 11 toward the first fluid chamber 15 by the lever 102 so that a negative pressure is created in the second fluid chamber 18 and the check valve 19 of the second outlet 17 is drawn back to close the second outlet 17. At the same time, the check valve 19 of the second inlet 16 is pushed away from the hole, allowing ink in the first return tube 31 (intend to be recycled) to flow into the second fluid chamber 18.

[0018] Next run the step (d). Refer to Fig. 3, ink in the second fluid chamber 18 is moved toward the second outlet 17 to push the check valve 19 of the second outlet

17 when the lever 102 drives the second diaphragm 12 to move toward the second fluid chamber 18. Thus the ink is flowing into the second return tube 32 to be delivered to the fluid storage unit 4. The ink being squeezed pushes the check valve 19 of the second inlet 16 to close the second inlet 16 for blocking ink in the first return tube 31 to flow in. At the same time, the first diaphragm 11 is moved away from the first fluid chamber 15 owing to the movement of the second diaphragm 12 toward the second fluid chamber 18 by the lever 102 so that a negative pressure is created in the first fluid chamber 15 and the check valve 19 of the first outlet 14 is drawn back to close the first outlet 14. Simultaneously the check valve 19 of the first inlet 13 is pushed off to open the first inlet 13, causing ink in the first guiding tube 21 from the fluid storage unit 4 to flow into the first fluid chamber 15. By alternately drawing and expelling mentioned above, the pressure remains constant and the volume flow rate (the volume of fluid delivered per unit time) is uniform during the delivery and returning of the ink/fluid. Thus the fluid is delivered uniformly.

[0019] Refer to Fig. 1, Fig. 2 and Fig. 3, when the printing machine is stopped for changing colors or cleaning, fluid in the system A should be cleaned out. A drain-back tube 6 is arranged between the second guiding tube 22 and the second return tube 32 and provided with a control valve 61. For changing colors or cleaning, firstly the first guiding tube 21 is released from the fluid storage unit 4. Then the control valve 61 is open so that the second guiding tube 22 and the second return tube 32 communicate with each other. Thus ink in the second guiding tube 22 flows into the second return tube 32 through the drain-back tube 6. Next ink originally inside the system pipelines is pushed out by the double diaphragm pump 1 and returned to the fluid storage unit 4, without the waste of ink. Then fluid in the fluid storage unit 4 is replaced by cleaning solution or ink in different colors. Lastly the system A is turned on after the control valve 61 being closed and the fluid is delivered into the system pipelines by the alternately drawing and expelling mentioned above for cleaning pipelines or color changing during printing.

[0020] Furthermore, as shown in Fig. 4, the present system is applied to a non-hermetic fluid delivery system. The system A is composed of a fluid storage unit 4 filled with ink therein, an introducing pipeline 2 for delivering fluid, a return pipeline 3 for recycling fluid, a double diaphragm pump 1 that connects the introducing pipeline 2 and the return pipeline 3, and a fluid supply portion 5 for supplying fluid to a machine B. Thus a non-hermetic fluid delivery system is formed. The steps in the operation process are the same as those mentioned above.

[0021] The present invention has the following advantages compared with the structure available now.

1. The pneumatic mechanism in the double diaphragm pump draws in and expels the fluid alternately so that the fluid flow in and out through the

two sets of inlets and outlets. Thus the pressure remains constant and the volume flow rate is uniform during the delivery and returning of the fluid. Therefore the fluid is delivered smoothly and uniformly.

2. The pipe diameter of the introducing pipe and that of the return pipeline are the same so that the cost-saving is achieved.

3. Owing to constant pressure and uniform flow rate during delivery, only a little amount of water is required to clean the pipelines of the system so that the water is saved.

4. No matter applied to the closed fluid delivery system or the general fluid delivery system, the present system features on no evaporation, no leakage and stable fluid supply.

5. By arrangement of the drain-back tube, not only fluid in the system will not be wasted during cleaning or liquid changing, quick cleaning and liquid changing can also be achieved.

[0022] Additional advantages and modifications will readily occur to those skilled in the art. Therefore, the invention in its broader aspects is not limited to the specific details, and representative devices shown and described herein. Accordingly, various modifications may be made without departing from the spirit or scope of the general inventive concept as defined by the appended claims and their equivalent.

Claims

1. A fluid delivery system used for supplying fluid to a machine comprising:

a double diaphragm pump (1) that includes a pneumatic mechanism (10) mounted therein and provided with a first diaphragm (11), a second diaphragm (12), and an air-intake portion (101) that brings air therein for driving the first and the second diaphragms (11, 12) to move and act through action paths, a first inlet (13) and a first outlet (14) that are disposed on one end of the pneumatic mechanism (10) with the first diaphragm (11), a first fluid chamber (15) formed between the first diaphragm (11), the first inlet (13) and the first outlet (14), a second inlet (16) and a second outlet (17) that are disposed on another end of the pneumatic mechanism (10) with the second diaphragm (12), a second fluid chamber (18) formed between the second diaphragm (12), the second inlet (16) and the second outlet (17), a plurality of check valves (19) each of which disposed on the first inlet (13), the first outlet (14), the second inlet (16) and the second outlet (17) correspondingly;
an introducing pipeline (2) composed of a first guiding tube (21) with one end thereof connect-

ed to the first inlet (13) of the double diaphragm pump (1), and a second guiding tube (22) with one end thereof connected to the first outlet (14) of the double diaphragm pump (1);

a return pipeline (3) that includes a first return tube (31) connected to the second inlet (16) of the double diaphragm pump (1), and a second return tube (32) connected to the second outlet (17) of the double diaphragm pump (1);

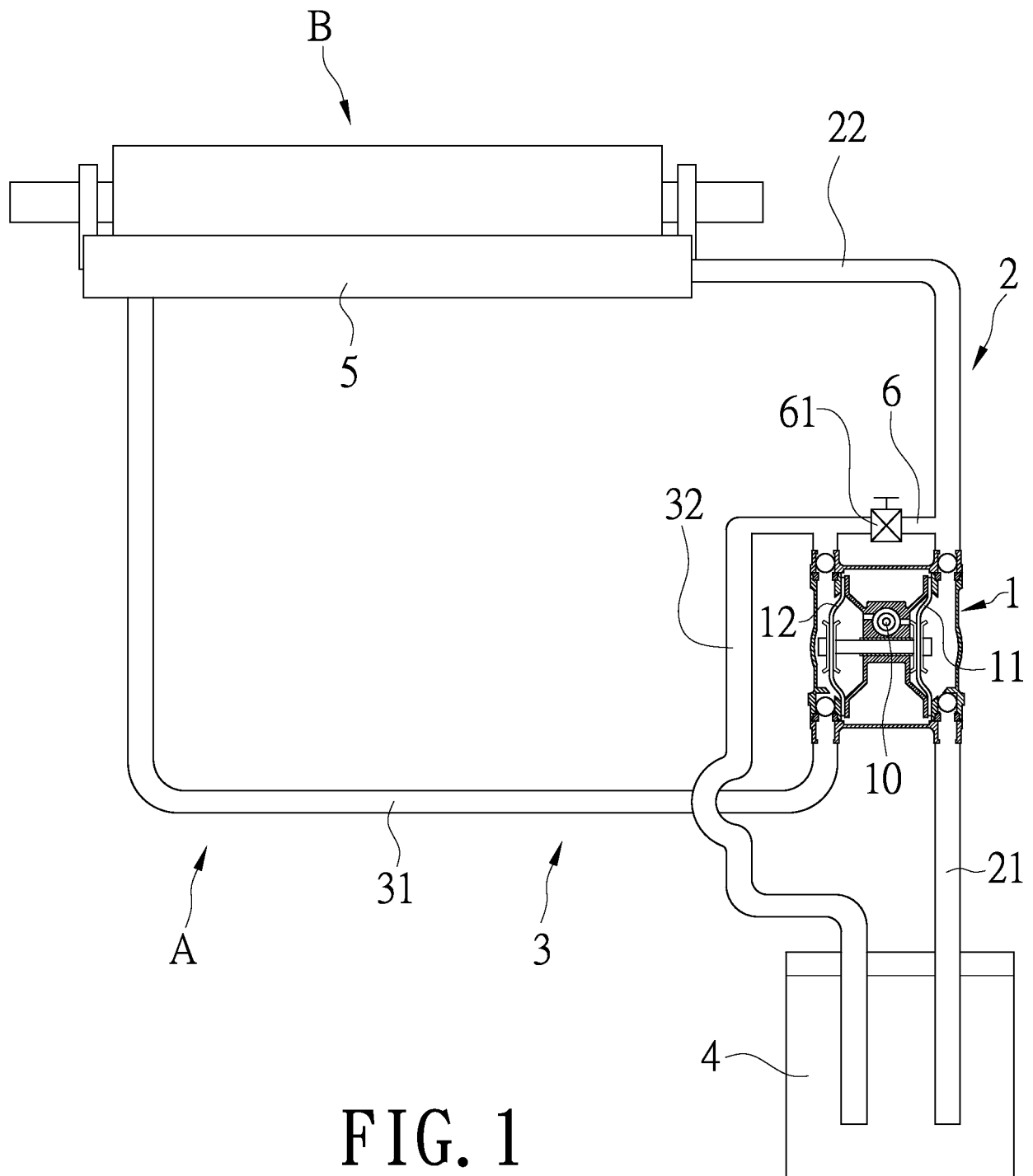
a fluid storage unit (4) used for supplying fluid required and receiving fluid returned and connected to the first guiding tube (21) and the second return tube (32);

a fluid supply portion (5) that supplies fluid required to the machine and connected to the second guiding tube (22) and the first return tube (31); and

a drain-back tube (6) arranged between the second guiding tube (22) and the second return tube (32) and provided with a control valve (61);

wherein fluid in the fluid storage unit (4) is passed through the introducing pipeline (2) and the action path of the first diaphragm (11) and delivered into the fluid supply portion (5) to be used by the machine when the double diaphragm pump (1) applies a pressure to the first diaphragm (11); fluid in the fluid supply portion (5) is passed through the return pipeline (3) and the action path of the second diaphragm (12), and returned to the fluid storage unit (4) when the double diaphragm pump (1) applies a pressure to the second diaphragm (12); fluid in the introducing pipeline (2) is sent back to the return pipeline (3) and then returned to the fluid storage unit (4) when the second guiding tube (22) and the second return tube (32) communicate with each other by the drain-back tube (6).

2. The fluid delivery system as claimed in claim 1, wherein the introducing pipeline (2) and the return pipeline (3) have the same pipe diameter.
3. The fluid delivery system as claimed in claim 1, wherein the fluid delivery system is a closed fluid delivery system.



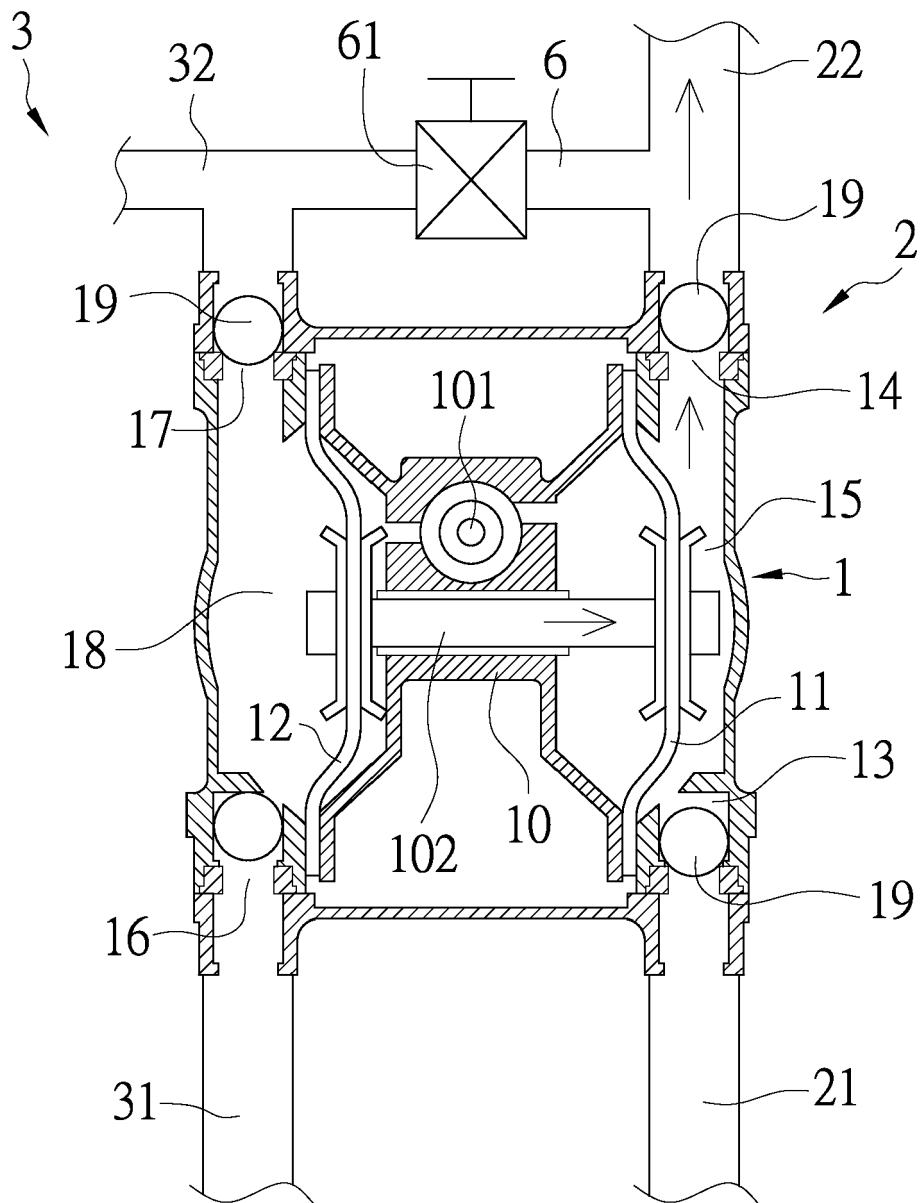


FIG. 2

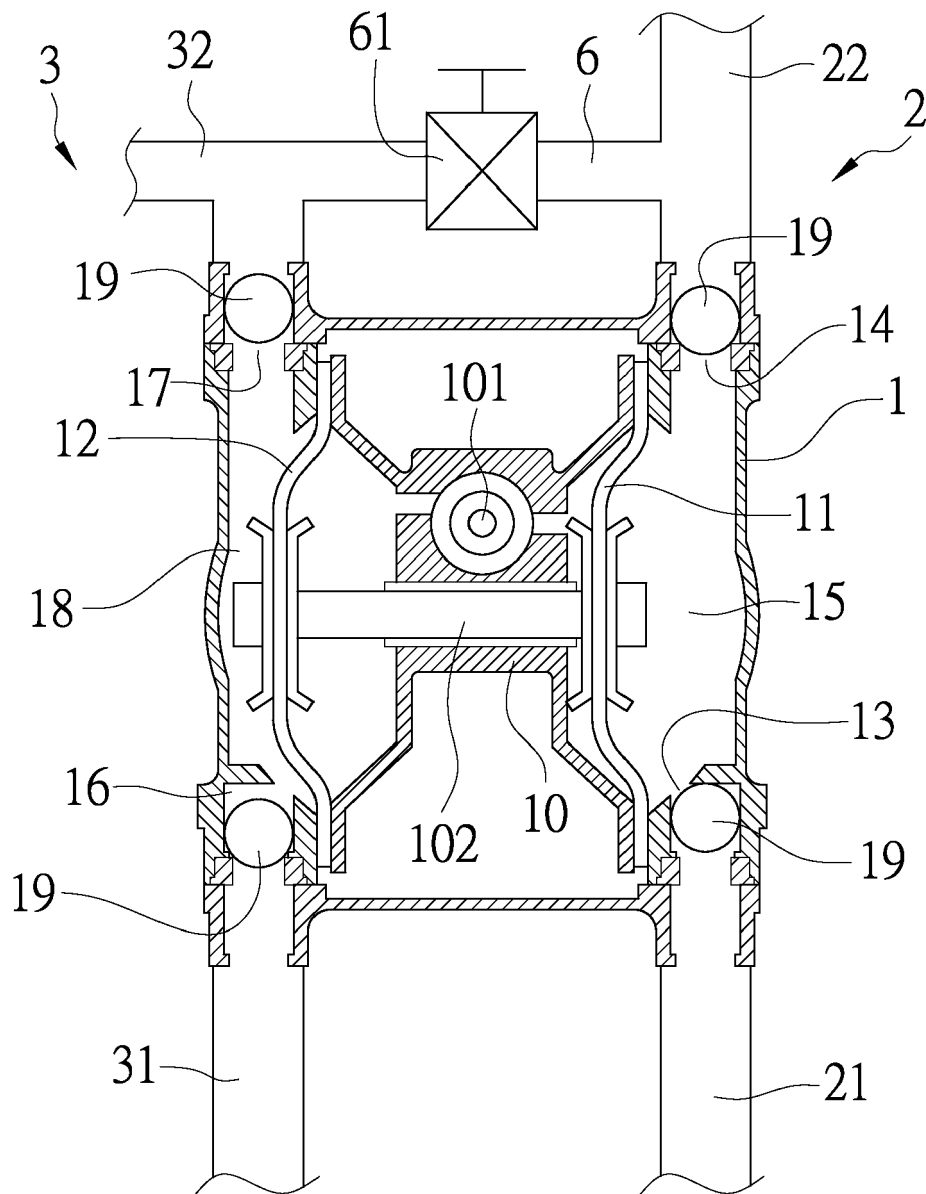
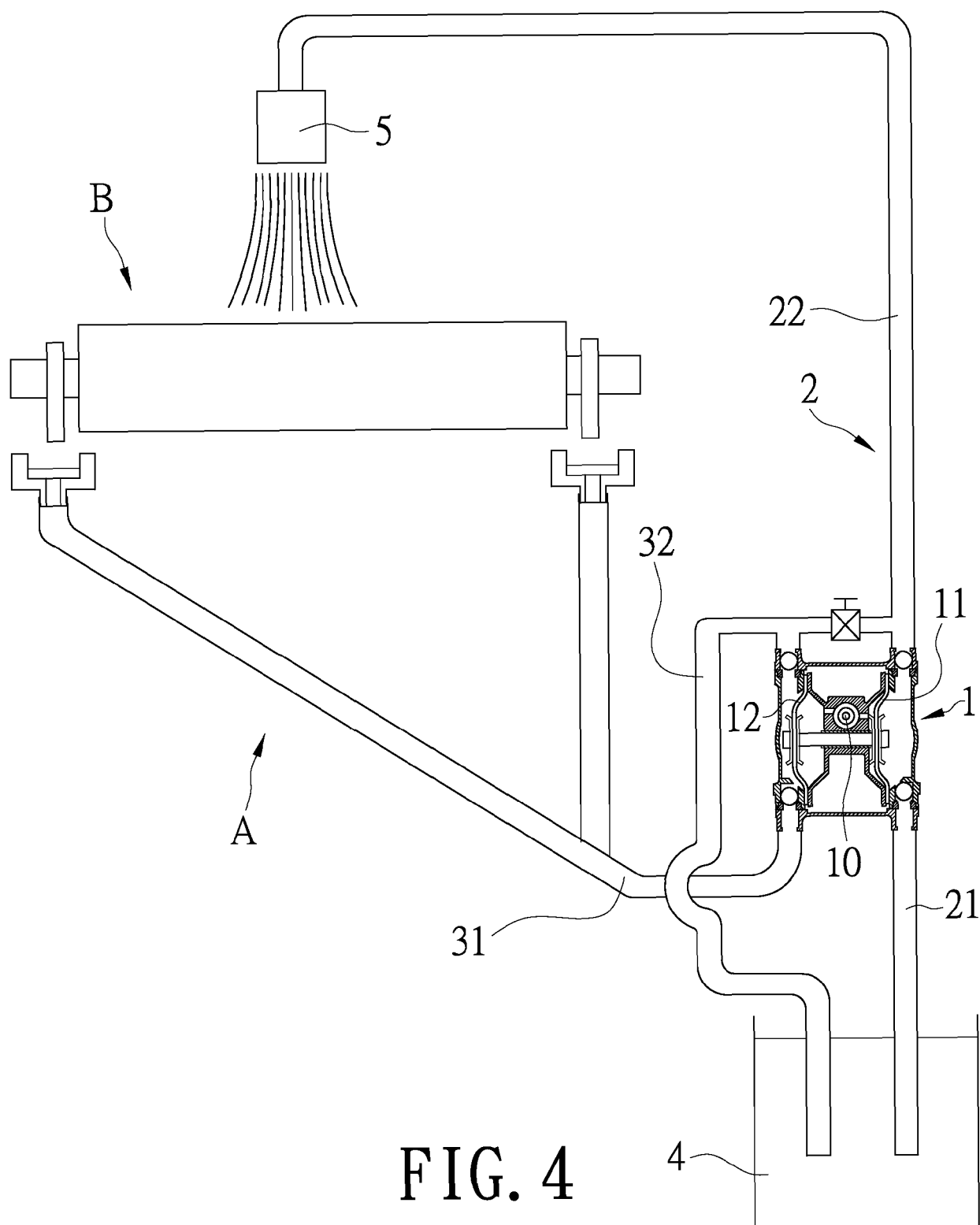


FIG. 3



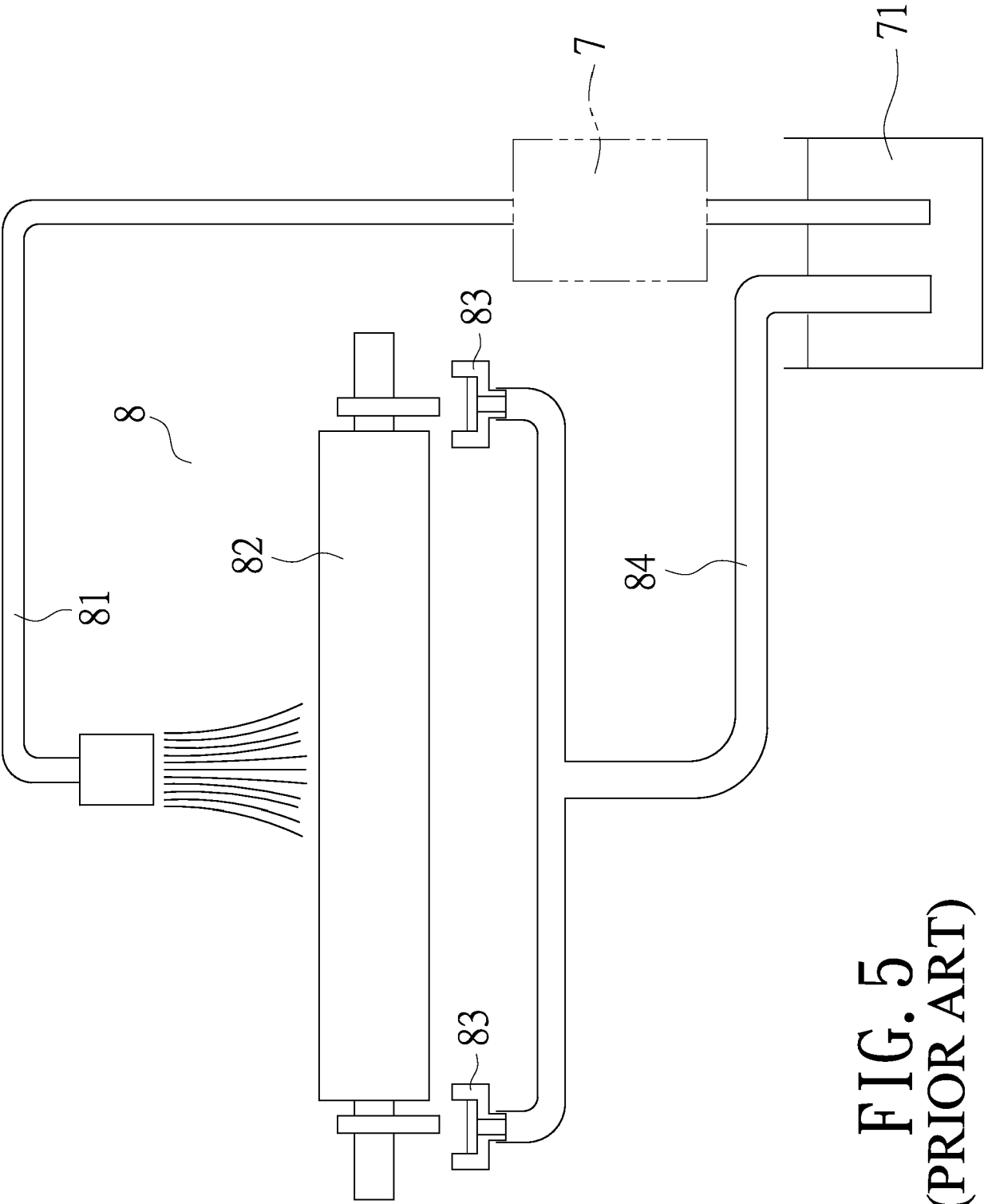


FIG. 5
(PRIOR ART)



EUROPEAN SEARCH REPORT

Application Number
EP 19 17 0390

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 4 643 124 A (SWITALL THOMAS G [US]) 17 February 1987 (1987-02-17)	1-3	INV. B41F31/08 B41F31/20 B41F35/00 F04F1/00
Y	* figure 1 * * column 2, line 50 - column 4, line 31 *	1-3	
X	DE 102 25 681 A1 (WINDMOELLER & HOELSCHER [DE]) 8 January 2004 (2004-01-08)	1-3	
Y	* figures 1,2 * * paragraphs [0016] - [0023] *	1-3	
A	US 5 003 876 A (HARRISON JOHN R [US] ET AL) 2 April 1991 (1991-04-02) * the whole document *	1-3	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
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Place of search		Date of completion of the search	Examiner
Munich		20 August 2019	Hajji, Mohamed-Karim
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03.02 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 19 17 0390

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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20-08-2019

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