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(54) Constant output pump.

(57) A volumetric pump (12) for a filtering system for dispensing into the system a predetermined constant amount of the liquid slurry over a period of time despite pressure variations at the pump outlet is disclosed. The pump (12) comprises an inlet (26) connected to a supply tank and a pair of pump housings (34, 36), each having a flexible diaphragm (40, 42) forming first and second chambers on opposite sides thereof within a housing. A link (44) extending between said housings interconnects the diaphragms (40, 42) so that they move together. A first check valve (50, 52) connected to one side of each housing (34, 36) and to said inlet (26) allows liquid to move into a first chamber of one of said housings (34, 36) when its diaphragm (40, 42) is moved in one direction and allows liquid into the first chamber of the other said housing (34, 36) when its diaphragm (40, 42) is moved in the opposite direction. A second check valve (56, 60) is connected on one side to the pump outlet (32) and on the other side to the first check valve (50, 52) and thus also to said one side of the diaphragm for each housing (34, 36). A valve (70) controls the supply of air pressure first to one side of one housing (34, 36) and then to one side of the other housing (34, 36) in alternating cycles for moving the diaphragms (40, 42) within their respective housings (34, 36) at a preselected periodic rate. A timer (78) controls the frequency of the alternating air pressure cycles so that the pump (12) will operate to meter a precise predetermined amount of liquid at its outlet (32) from the liquid supply tank over a period of time despite any variations in outlet back pressure.

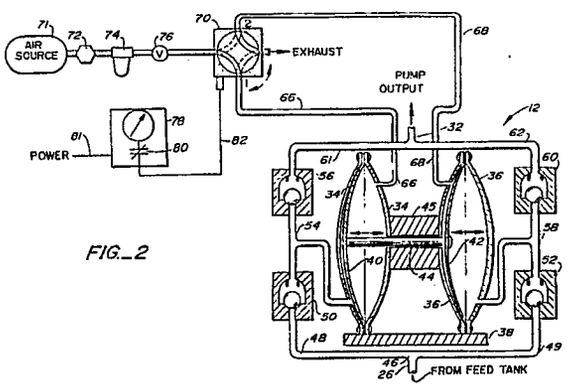

FIG_2

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CONSTANT OUTPUT PUMP

Specification

This application is a divisional application of parent application Serial No. 07/320,227, filed on March 7, 1989. This invention relates to pumping systems and more particularly to a volumetric pump that will always pump at a preselected constant output rate of liquid or slurry regardless of the amount of head pressure it must pump against.

Background of the Invention

In conventional air operated or liquid operated diaphragm pumps available heretofore, the output volume was set by the quantity and pressure of the fluid driving source, either liquid or air. Once this output volume was set, it remained relatively steady as long as the head pressure that the pump was discharging against remained the same. However, if or when the head pressure changed, either increasing or decreasing, the output volume of the pump also changed. This inherent characteristic of diaphragm pumps previously available presented a serious disadvantage for systems or applications wherein a constant output volume from the dispensing pump per unit time was required.

It is therefore a general object of the present invention to solve this problem by providing a diaphragm or a double piston pump system that makes it possible to pump a constant output volume regardless of the head pressure changes the pump must discharge against.

Another object of the invention is to provide a volumetric or metering pump that can continuously pump a predetermined constant amount of particulate material in slurry form without being damaged or excessively worn internally by the slurry and without any internal pump slippage.

Summary of the Invention

In accordance with the principles of the invention a volumetric pump is provided which will provide a constant output despite the resistance head which it has to pump against. The pump comprises a pair of pump housings each having a piston or a flexible diaphragm situated within its housing. The two pistons or diaphragms are connected by a rigid shaft or link supported by a bearing means between the housings. The two pump housings have an inlet conduit and an outlet conduit. The inlet conduit is connected to a liquid or slurry supply vessel at one end and to one of each of a pair of check valves at its other end. The outlet conduit is connected at one end to another pair of check valves and to a using receiver of fluid or slurry (e.g. a filter or elevated tank) at its other end. One of each pair of check valves is connected together by an intermediate conduit and each intermediate conduit is connected to one housing on one side of the internal diaphragm. The two pump housings are also connected to an air pressure source through a control valve which is connected and controlled by a timer or programmable controller.

When in use, for example, in a filter system, the air pressure source can be regulated to move the diaphragms within both housings first in one direction and then in another direction. On movement in one direction, a charge of liquid or slurry is drawn into one pump housing and is ejected from the other pump housing. Under control by the timer and the control valve, the action is reversed for the two pump housings upon movement of the shaft and its connected diagrams in the opposite direction. Thus, with each linear stroke, that is, a full travel of the connecting shaft in one direction, a predetermined charge of fluid or slurry is ejected through the pump outlet, and this occurs despite the level of back pressure at its outlet. Thus, when used for a filter system, the volumetric pump according to the invention enables a predetermined amount of filter aid to be supplied to a plate type filter despite the level of pressure buildup due to dirt within the filter chambers. By varying the setting on the timer control, the precise amount of filter aid dispensed by the volumetric pump per unit time can be preselected and maintained continuously during each filter run or cycle.

The steady output volume of my pump is so accurate and remains so constant that this pump can be referred to as a zero slip, constant-output, volumetric positive displacement pump.

Other objects, advantages and features of the invention will become apparent from the following detailed description of one embodiment thereof presented in conjunction with the accompanying drawings.

Brief Description of the Drawing

Fig. 1 is a diagrammatic view of a filter system utilizing a volumetric pump embodying principles of the present invention.

Fig. 2 is a more detailed and partially diagrammatic view in section of the diaphragm type of volumetric pump shown in Fig. 1 using a single

timer.

Fig. 3 is a diagrammatic view of an alternate piston form of volumetric pump according to the invention.

Detailed Description of Embodiment

With reference to the drawing, Fig. 1 is a diagrammatic layout of a typical filtering system 10 which utilizes a volumetric pump 12 embodying principles of the present invention. In the filtering system shown, which may be used, for example, for cleaning oil in a can-forming plant, or coolant used in an aluminum or steel rolling mill, or for any of several other industrial uses, the oil or liquid to be filtered is pumped from a holding tank 11 by a positive displacement pump 13 through a valve 14 in an inlet line 16 to a filter 18 which as shown, may be of the horizontal plate type. In such a filter, as described in my U.S. Patent No. 3,608,734, the filter plates 20 are arranged in a vertical stack and when pressed together they form a receiving chamber between each pair of plates for the liquid to be filtered and a collecting chamber on the opposite side of each plate for the clean, filtered liquid. The collecting chambers are connected in parallel to an outlet manifold 22 that is connected through a valve 24 to a clean liquid tank 25. A layer of filter media (e.g. paper) is provided at the bottom of each receiving chamber through which the liquid to be filtered must pass during the filtering process. In order to build up a filtering cake covering the filter media, which is necessary to provide adequate filtering efficiency, a so-called "body feed" of particulate filtering material such as diatomaceous earth must be supplied to the flow of liquid filtrate in the inlet line 16. Moreover, the body feed material must be supplied at a constant rate despite back pressure buildup within the filter, so that the filter cake builds up evenly on the filter media. In the present invention, this body feed flow is controlled with precision by the volumetric pump 12.

While the present invention may be applied for use with other types of filters, such as tube filters or screen filters which use a body feed or filter aid to build an internal cake, the plate type filter 18 is shown for purposes of illustration. The volumetric pump 12 may also be used for other applications where a preselected constant output quantity for each stroke must be maintained during pump operation.

As shown in Fig. 1, the pump 12 has an inlet line 26 connected through a valve 28 to a body feed tank 30 that contains a supply of body feed material in slurry form. An outlet conduit 32 from the pump 12 is connected directly to the inlet line 16 to the filter. The pump 12 operates, as described below, to dispense, at a constant flow rate, a desired or predetermined amount of body feed to the filter 18 despite any pressure variations that occur within the filter due to a buildup of dirt therein during a typical filter cycle.

Turning to Fig. 2, the volumetric pump 12 according to the invention comprises a pair of housings 34 and 36 each having the same size and shape and mounted on a suitable frame support base 38. Each housing is generally circular and formed by a pair of convex wall members that are connected together at their adjoining circular edges. Within the housings, between the opposite wall members of each, are movable members such as flexible diaphragms 40 and 42, respectively. These diaphragms are connected together at their centers by a straight, rigid link 44 so that the diaphragms move together from side to side, and are always in the same relative positions within their respective housings. The link 44 is supported within a bearing housing 45 that interconnects and supports the pump housings 34 and 36.

The inlet feed line 26 from the body feed slurry supply tank 30 is connected to a "tee" connection 46 that furnishes body feed slurry equally through a pair of pipes 48, 49 to a pair of inlet ball check valves 50 and 52. The valve 50 is connected by a fluid line 54 to an outlet ball check valve 56, and the valve 52 is connected by a fluid line 58 to an outlet ball check valve 60. The outlet check valves 56 and 60 are connected by outlet lines 61, 62 to the main outlet conduit 32 which supplies body feed slurry to the filter 18.

A first air line 66 is connected to the pump housing 34 on one air-only side of its diaphragm 40, and a second air line 68 is connected to the other pump housing 36 at the air-only side of its diaphragm. These air lines 66 and 68 are connected to two outlet ports "1" and "2" respectively of a 4-way solenoid valve 70. This valve is supplied with plant air from a suitable source (not shown) at a constant pressure that is always well above that of the filter back pressure (e.g. 80 psi) through a standard air filter-regulator 72, a lubricator 74 and a needle valve 76 in a conduit 77.

As shown in Fig. 2, the four-way solenoid valve 70 has outlet ports "1" and "2", an inlet port "3" connected to the air pressure supply conduit and an exhaust port "x". Within the valve is a two-position rotor that is moved by a solenoid. In one position, the cylinder provides a passage between the inlet port and outlet port "1" while outlet port "2" is connected to the exhaust port. In this position, air flows in line 66 to pump housing 34 to force its diaphragm to eject slurry through conduit 61, and simultaneously air flows from pump housing 36 through line 68 to port "2" and through the internal valve cylinder to the exhaust port of the

valve. When the solenoid moves the valve cylinder to its alternate or second position, the inlet port is connected to outlet port "2" while outlet port "1" is now connected to the exhaust port. Thus, the flow of air is now furnished through port "2" of the valve to pump housing 36 through line 68 and simultaneously through line 66 to valve port "1" and then out the exhaust port "x".

The solenoid valve 70 may be actuated back and forth between its first and second positions in a preselected manner or rate by a simple single pole timer 78 which is of the type which is commercially available. This timer has an on-off switch 80 connected by a lead 81 to a suitable power source so that its time of operation can be set to any preselected time period.

In a typical operation of the volumetric pump 12, as used with the filter system of Fig. 1, for example, the body feed slurry from the supply tank 30 flows through line 26 through the open check valves 50 and 52 and into one side of each of the pump housings 34 and 36 as shown in Fig. 2. The timer 78 controls the solenoid valve 70 so that fluid or air pressure for driving the pump is supplied first to one pump housing and then to the other pump housing. The pressure of the driving fluid is always considerable higher than the head pressure which the pump must work against. For example, when used for a filter system wherein the filter back pressure may be around 80 psi, air pressure at a level of around 100 psi is adequate for operating the pump on a constant output basis. As pressurized air enters each housing on one side of the diaphragm therein, the latter is forced from one side of the housing to the other side. Since the diaphragms 40 and 42 for the two housings are connected by link 44, both diaphragms move together. One diaphragm always moves against a portion of the housing chamber which contains the charge of slurry that was supplied from the slurry supply tank 30 on the previous stroke. Now, as the diaphragm moves against the housing chamber containing slurry, the slurry is forced out of the pump through a ball check valve 56 or 60 and through the common outlet line 32 to the main inlet feed conduit 16 to the filter 18. Simultaneously a charge of slurry is drawn into the other pump housing from the supply tank and is ready to be expelled during the reverse movement of the diaphragm on the next cycle. The air pressure supplied to the pump is always sufficient to complete a pump stroke in one direction within the time period set for the timer.

Thus, depending on the timing of the strokes for the pump 12, as controlled by the body feed timer 78, it will always take in and pump out an equal amount of liquid or slurry on each stroke or cycle regardless of the head pressure of the back pressure or head that it must pump against. In a filter system such as shown in Fig. 1, this is highly important because it assures a positive and continually equal ratio of slurry and thus of filter media such as diatomaceous earth to the dirt load within the filter chambers. The cake buildup within the filter chambers will thus be more uniform and will remain porous and unplugged for a longer time, and therefore the filter runs between cleaning periods can be longer. This enables filter operation to be more efficient both in labor costs and filter media consumption.

In a somewhat modified form shown diagrammatically in Fig. 3, a pump 12A may be provided wherein, in lieu of the diaphragms 40 and 42 of pump 12, the movable members are provided in the form of rigid piston heads 40A and 42A connected by a link 44A. The piston heads are movable within a cylindrical housing 84 having an internal barrier 86 which forms a pair of chambers 34A and 36A. In an arrangement similar to the pump 12, the pump 12A has an inlet line 26A from a liquid supply to a first pair of check valves 50A and 52A connected to the chambers 34A and 36A on one side of the piston heads. Similarly, a second pair of chech valves 56A and 60A from the air source 71 are connected to pump chambers but on the other side of the piston heads. Air lines from the pump housing are connected to the parts designated "1" and "2" on a 4-way solenoid valve 70 which is the same as used with the diaphragm version of the pump 12. As previously described, the solenoid valve 70 is controlled in its operation by a timer 78 and the mode of operation is the same as for the diaphragm pump 12.

Although the structure described for either embodiment of my volumetric pump according to the invention is relatively simple, its performance in providing a preselected output flow of liquid despite varying back pressure or output head can be maintained with precision and reliability, a feature that is highly desireable for many applications.

To those skilled in the art to which this invention relates, many changes in construction and widely differing embodiments and applications of the invention will suggest themselves without departing from the spirit and scope of the invention. The disclosures and the description herein are purely illustrative and are not intended to be in any sense limiting.

Claims

1. A volumetric pump having an inlet connected to a liquid supply tank and an outlet for dispensing a predetermined constant amount of the liquid per unit of time despite pressure variations at

the outlet, said pump comprising:
- a pair of pump housings;
- a movable member within each housing forming first and second chambers on opposite sides thereof;
- link means extending between said housings and connecting said movable members together;
- a first check valve means connected to one side of each housing and to said inlet for allowing liquid into a first chamber of one of said housings when its member is moved in one direction and for allowing liquid into the first chamber of the other said housing when its member is moved in the opposite direction;
- a second check valve means connected on one side to said outlet and on their other side to said first check valve means and thus also to said one side of the diaphragm for each housing:
- a source of air pressure at a pressure level substantially higher than the pressure at said pump outlet;
- a valve means for supplying air pressure from said source first to one side of one said housing and then to one side of the other said housing in alternating cycles for moving said movable members within their respective housings at a preselected periodic rate; and
means for controlling the timing of said alternating cycles;
- whereby said pump operates on a preselected timed basis to meter a predetermined amount of liquid at its outlet from said liquid supply tank despite any variation in pressure at its outlet.

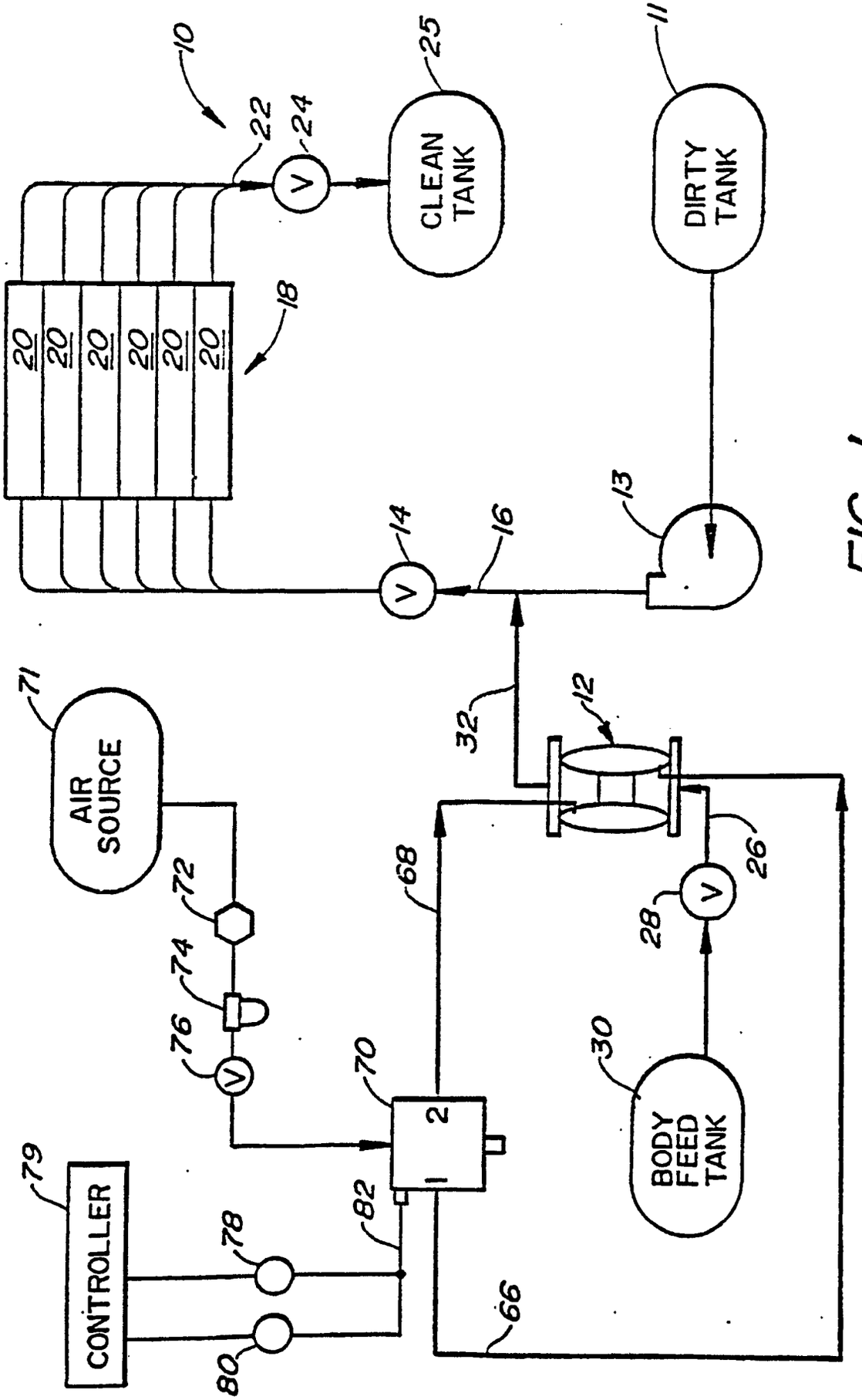
2. The volumetric pump as described in claim 1 wherein said means for supplying air pressure comprises a four-way valve connected to said air pressure source and timer control means for controlling said four-way valve to provide air pressure alternately to said pump housings at preselected intervals, thereby moving said link means and said movable members back and forth and maintaining a constant predetermined output of liquid from said pump.

3. The volumetric pump as described in claim 1 wherein said four-way valve is a solenoid valve controlled by said timer control means.

4. The volumetric pump as described in claim 1 wherein said movable members are flexible diaphragms.

5. The volumetric pump as described in claim 1 wherein said movable members are fixed piston heads connected to a common shaft, said housings surrounding said shaft and forming a pair of chambers including one for each said piston head.

6. The volumetric pump as described in claim 1 wherein the pressure at said air pressure source is at least 100 pounds per square inch.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DIRTY TANK
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AIR SOURCE
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12
72
74
76
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70
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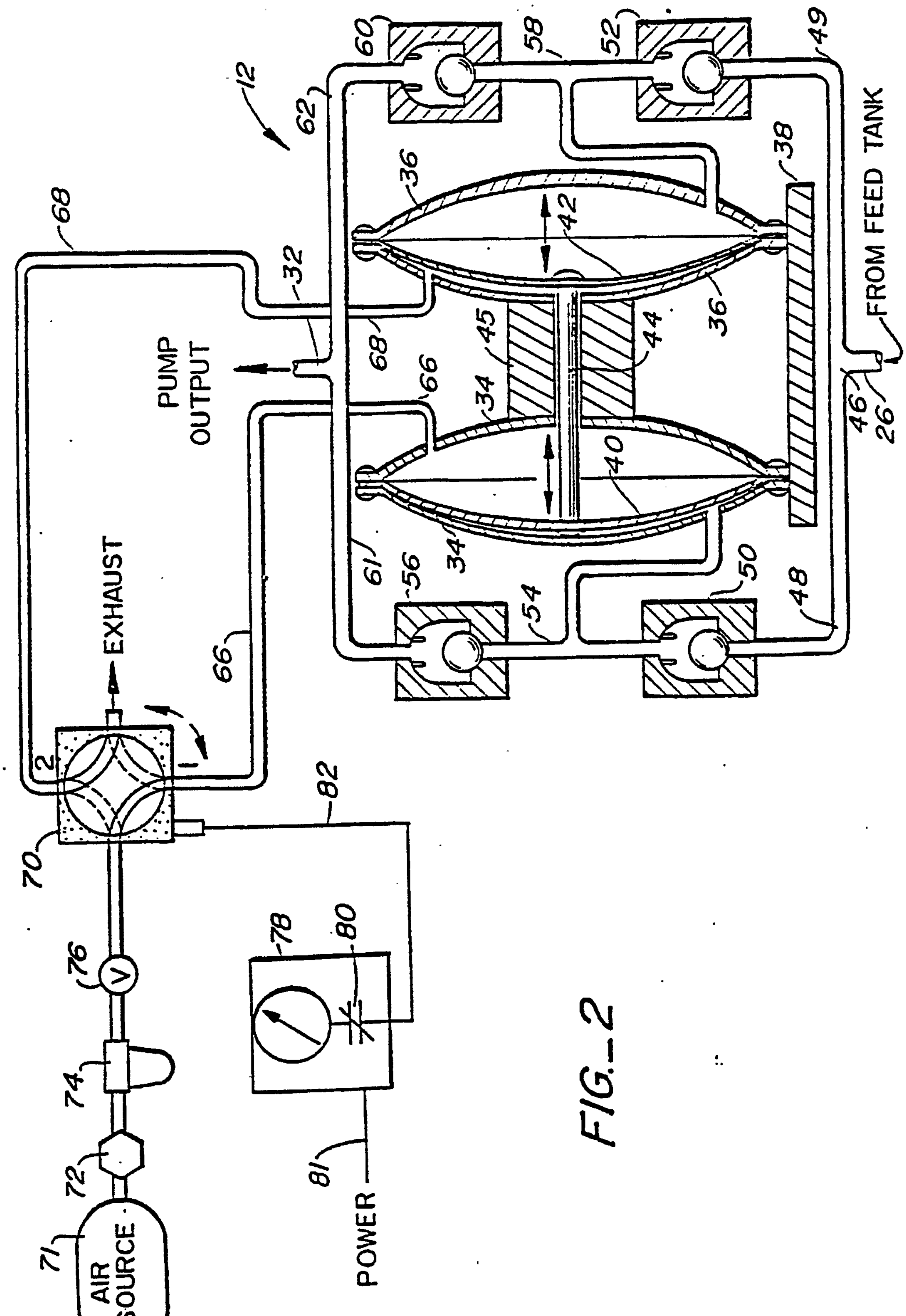
BODY FEED TANK
79
CONTROLLER
78
82
80
66

FIG._1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FROM FEED TANK
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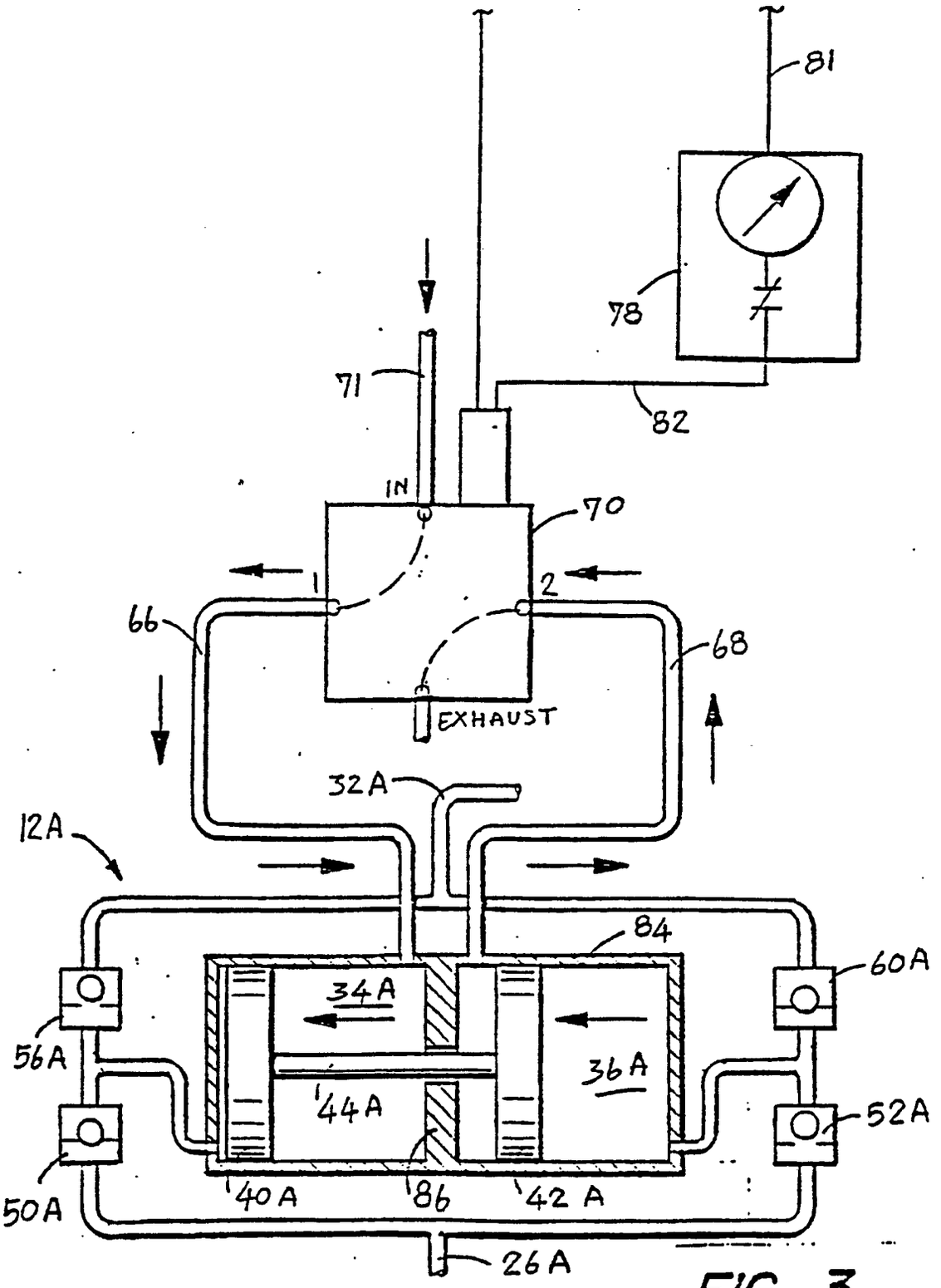
FIG._2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26A

FIG._3

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EUROPEAN SEARCH REPORT

Application Number

EP 90 10 3929

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
Y	DE-A-3326268 (BORSDORF) * page 5, paragraph 2 - page 6, paragraph 4; claims 5, 6; figures 1, 2 *	1-6	F04B43/06 F04B9/12
Y	DE-A-2542392 (FLEISNER) * page 10, paragraph 2 - page 12, last paragraph; figure 1 *	1-6	
A	FR-A-2394694 (DRAGERWERK) * page 4, line 4 - page 5, line 1; figures 1, 2 *	1, 4	
A	US-A-4135496 (CHAZOV) * column 3, lines 17 - 49; figure 1 *	1-3	
A	US-A-4068641 (JOHNSON) * column 3, lines 11 - 45; figure 1 *	1-3	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5) F04B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	14 MAY 1990	BERTRAND G.

CATEGORY OF CITED DOCUMENTS

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