March 6, 1951 R. B. SARGENT 2,543,941

PROPORTIONING DEVICE

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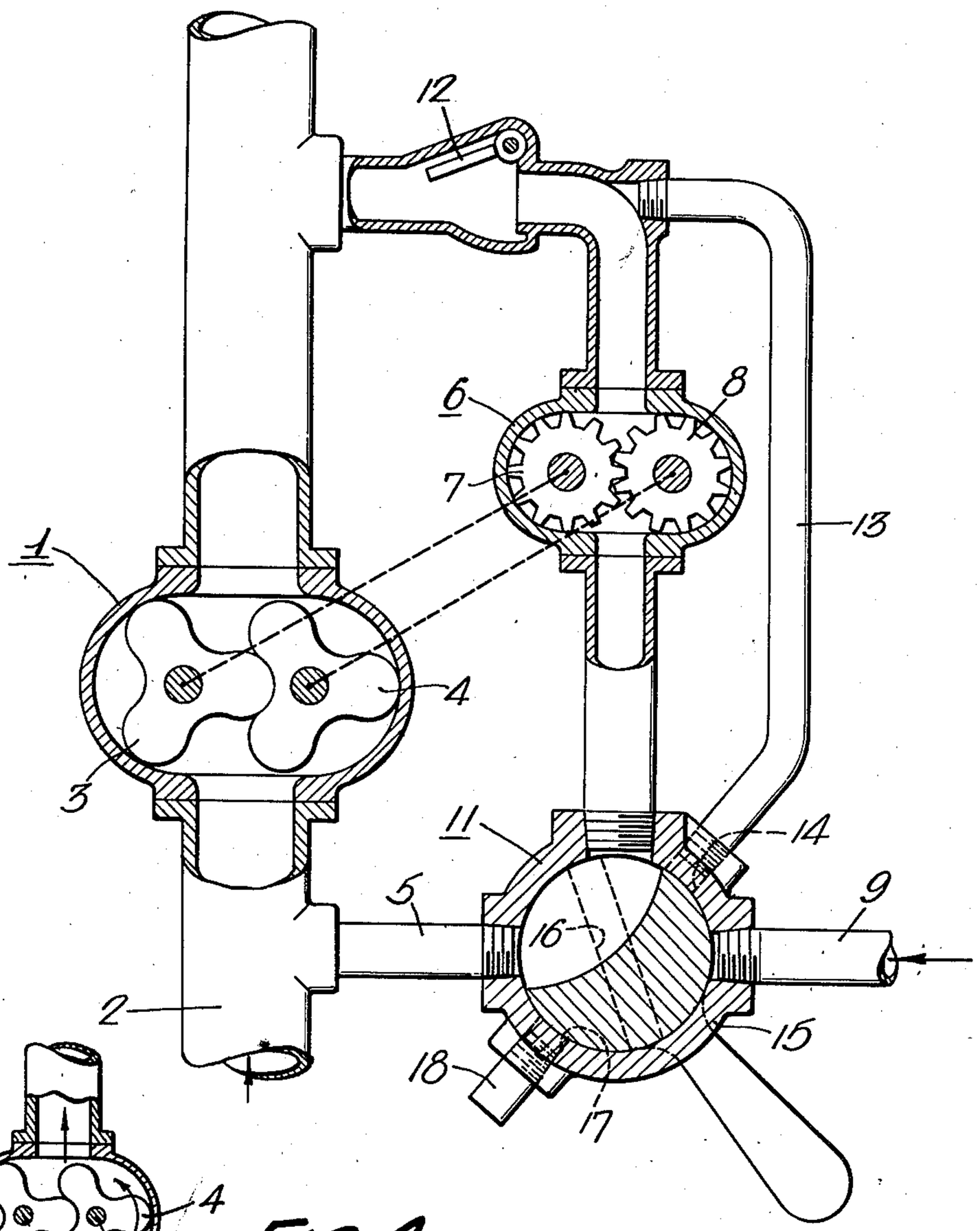
FIG. 1.



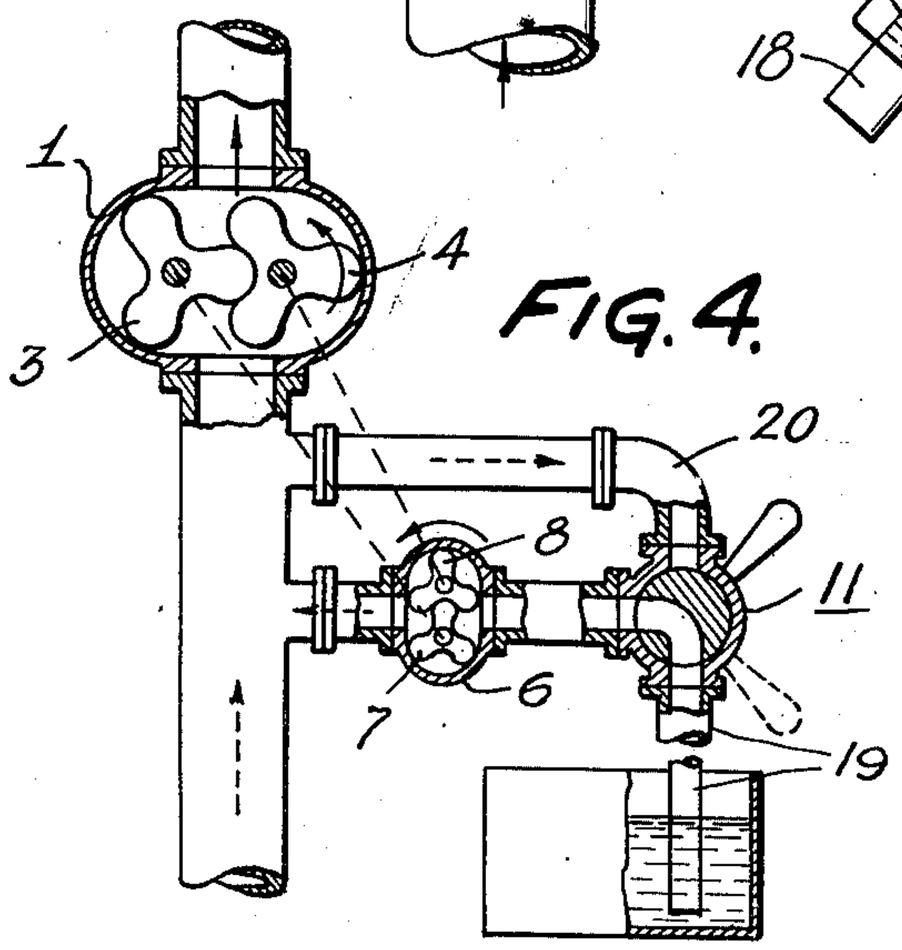


FIG. 4.

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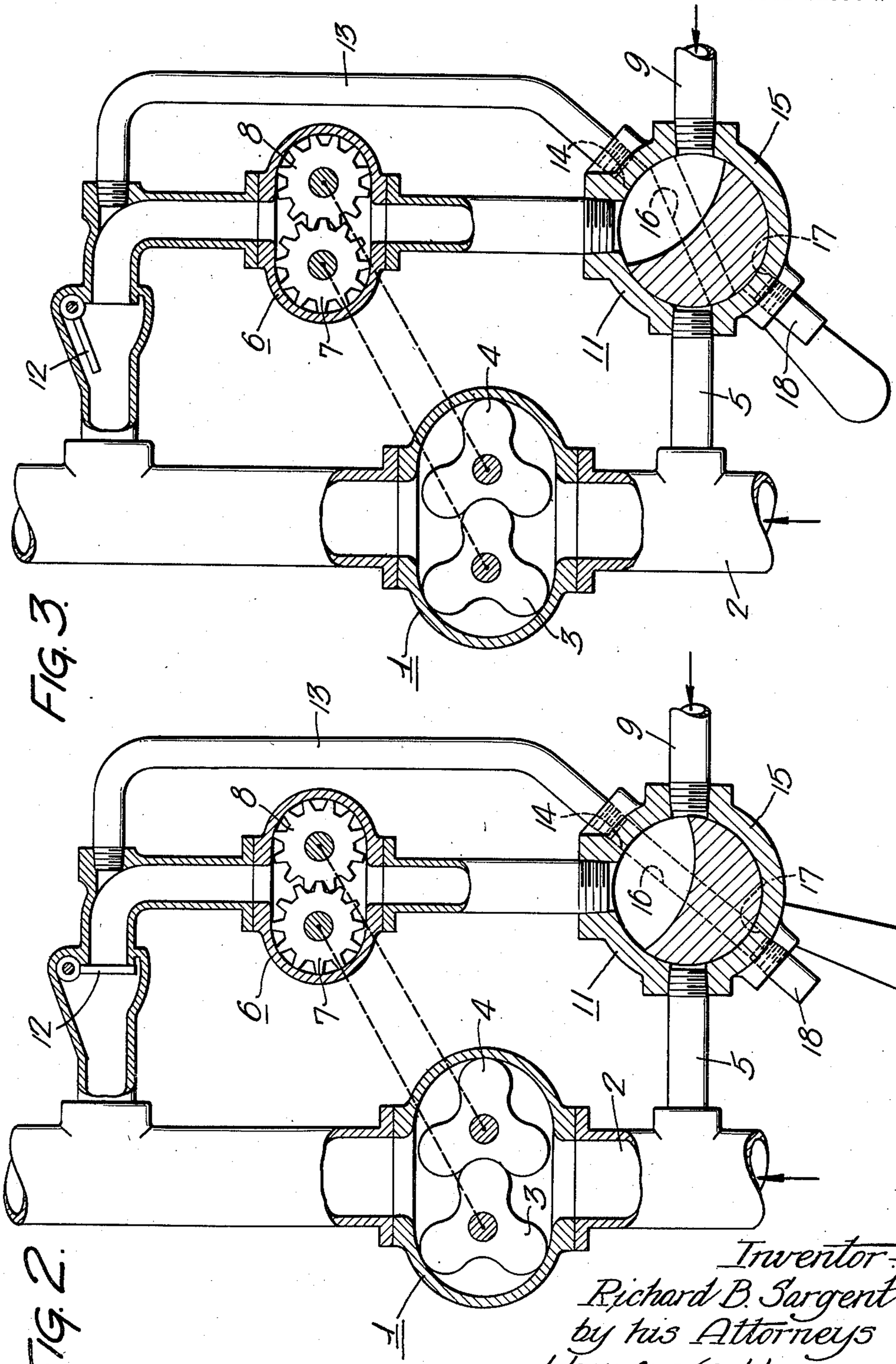

FIG. 3.

FIG. 2.

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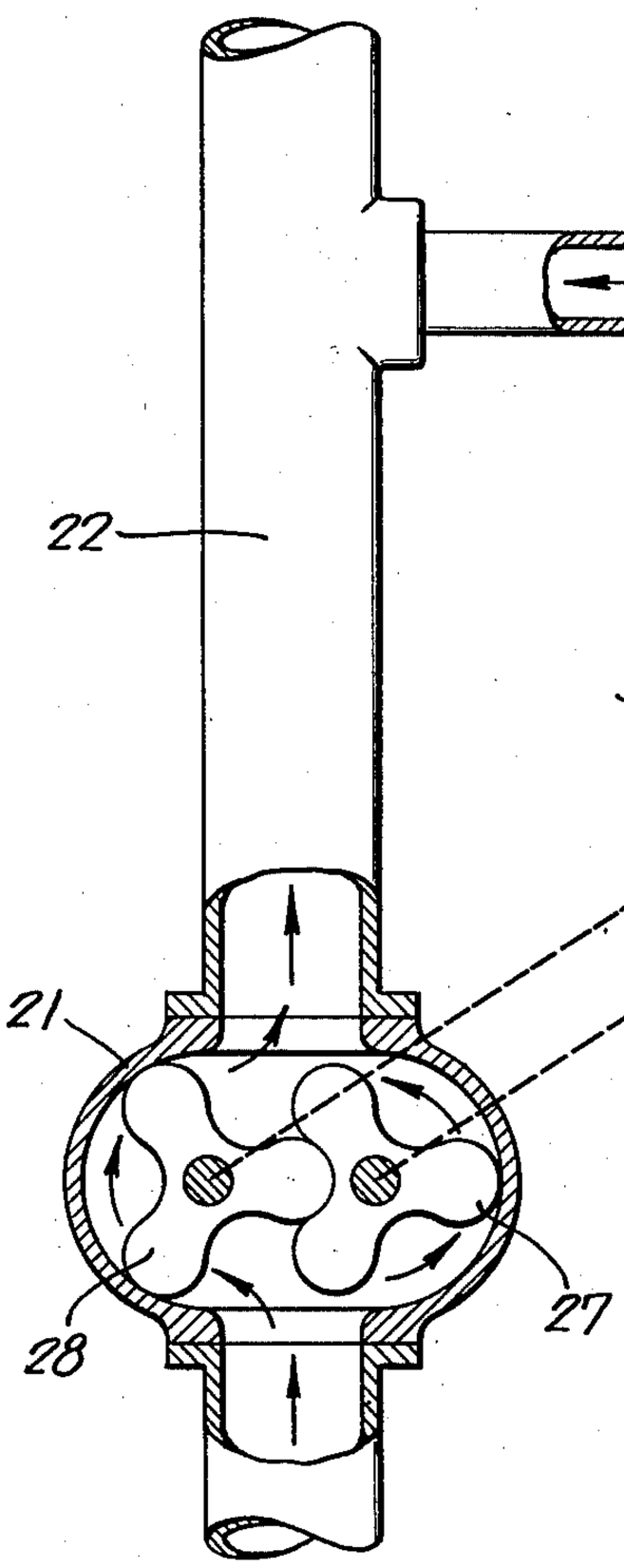
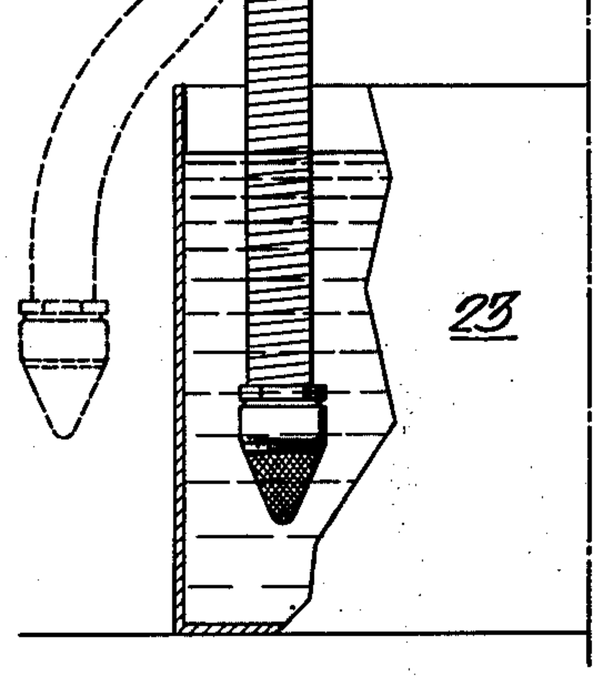


FIG. 5.



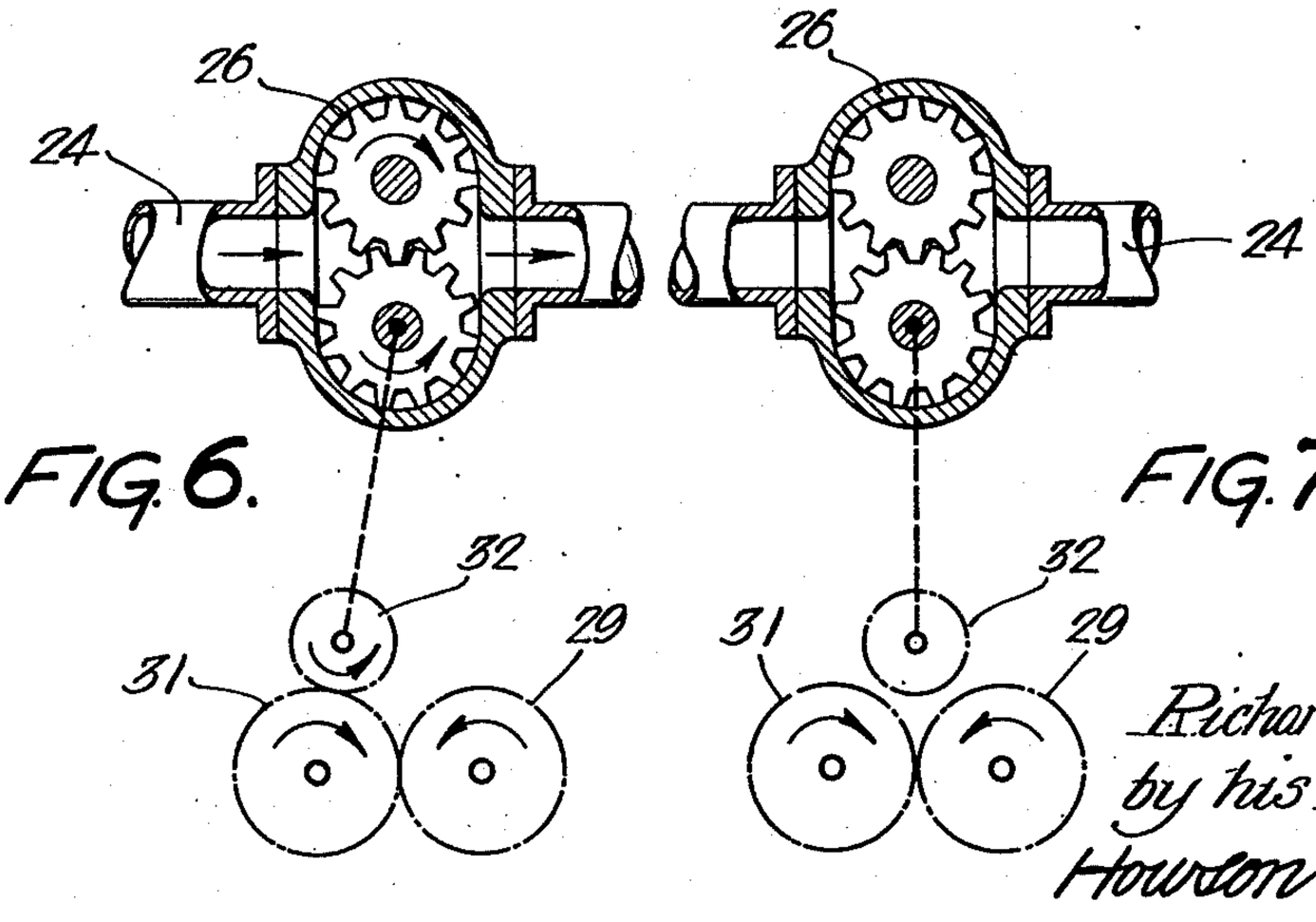


FIG. 6.

FIG. 7.

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UNITED STATES PATENT OFFICE

2,543,941

PROPORTIONING DEVICE

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Application March 6, 1946, Serial No. 652,366

16 Claims. (Cl. 169—15)

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This invention relates to proportioning devices of the type used, for example, in fire-fighting apparatus for introducing foam producing substances into a stream of water flowing from the pumps.

A principal object of the invention is to provide a proportioning device of this class which shall be generally more efficient that the prior devices, shall be highly accurate over a wide range of pressure and volume of flow, and which is susceptible of embodiment in a relatively small and inexpensive unit that may be placed at any convenient spot in the hose line.

Another object of the invention is to provide a device of the stated character, the use of which will involve a relatively small pressure loss in the water conduit.

Still another object of the invention is to provide a proportioner of the stated character which shall exhibit superior priming characteristics.

The invention resides also in certain novel structural and functional details hereinafter described and illustrated in the attached drawings wherein:

Fig. 1 is a schematic view illustrating a proportioning device made in accordance with the invention;

Figs. 2 and 3 are corresponding views illustrating with Fig. 1 the several operating conditions contemplated by the invention;

Fig. 4 is a schematic view illustrating a modification of the apparatus shown in the preceding figures, and

Figs. 5, 6, and 7 are schematic views illustrating a modification within the scope of the invention.

With reference to Figs. 1, 2, and 3 of the drawings, the device consists essentially of a positive displacement water motor 1 which is placed in a conduit 2 through which water is discharged from a pressure source not shown. The motor 1 is of the positive displacement type, and the arrangement is such that all of the water passing through the conduit passes also through the motor. Various types of water motor may be employed and in the present instance the motor is in the form of a three-lobed rotary pump of a conventional form wherein the intermeshing rotors, 3 and 4 respectively, are synchronized by means hereinafter described.

In accordance with the invention, a duct 5 is provided which by-passes the motor 1 and which contains a positive displacement pump 6 which, in the present instance, is of the gear type and consists of two toothed rotors 7 and 8 respectively. These rotors are individually directly connected and are actuated by the rotors 3 and 4 of the motor 1. All liquid passing through the duct 5 passes also through the pump 6.

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Provision is made for introducing the foam-producing substance into the by-pass duct 5 from a suitable source (not shown) by way of a duct 9, and the connection between this duct and the channel 5 is controlled by a three-way valve 11. When the valve is in the position shown in Fig. 1 the duct 9 is disconnected from the duct 5 while the latter duct is open for passage of water therethrough from the duct 2. When the valve 11 is shifted to the position shown in Fig. 3, the source of foam-producing substance is connected directly to the duct 5 for passage of said substance to the conduit 2. In this position of the valve, the duct 5 is disconnected from the conduit 2 at the upper side of the water motor, the foam substance is withdrawn from the source by the pump 6 and is passed through a check valve 12 in the duct 5 into the duct 2 at a point below the water motor. Since the motor and pump are exactly synchronized and since both the motor and the pump are positive displacement units, an exact amount of the foam forming substance will be introduced into the conduit 2 and this amount will be accurately proportioned to the quantity of water flowing through the conduit.

It will be noted that a duct 13 is connected to the duct 5 between the pump 6 and the valve 12. This duct 13 extends to a port 14 in the casing 15 of the valve 11. The valve element 11 has a passage 16 which extends completely through the body of the valve, and one end of this passage will, in a predetermined position of the valve 11, register with the port 14. Diametrically opposite the port 14 is a second port 17 in the casing 15 and to this port is connected a duct 18 which extends to atmosphere or to a suitable point of discharge. When the passage 16 registers with the port 14, it registers also with the port 17 and connects said ports so that the passage 13 is then directly connected with atmosphere.

When the valve 11 is in the position shown in Fig. 2, therefore, the pump is connected through a restricted opening to the duct 9 and to the foam material source. Also, the passage 16 connects the ports 14 and 17. Operation of the pump under these conditions will tend to discharge the foam material withdrawn from the source through the duct 13 to exhaust. In this manner any air in the lines connecting the foam source

with the pump will be discharged through the pipe 18 and the pump will be adequately primed with the foam substance. It will be noted that this position of the valve 11 is an intermediate one between the positions of Fig. 1 and Fig. 3 and that subsequent movement of the valve into the Fig. 3 position will close the duct 13 and permit discharge of the foam substance directly into the duct 2.

In the operation of the device, assuming that water alone is required, the valve 11 will occupy the position shown in Fig. 1. In this case the pump functions as a water motor so that in effect the pump is driven by the water passing through the duct 5 which avoids unnecessary load on the water motor. This materially reduces the pressure loss through the proportioning apparatus. This also provides for a continuous flow of the water through the pump so that the latter is in effect always primed. If foam is required, the valve 11 is first shifted to the position shown in Fig. 2. It has been found that small proportioning pumps are difficult to keep tight enough to pump water and air from the pipe leading from the foam liquid source to the proportion pump. Water having very little viscosity tends to slip by the clearances so that at the slow speed at which the pump is required to run, i. e. in direct drive from the slow-speed low-loss water motor, it will not always pump plain water against the relatively high pressure in the conduit 2. It is of material advantage therefor to get the high viscosity foam material into the proportioning pump before subjecting the pump discharge to the high pressure of the fire hose line. The duct 13 and the valve passage 16 perform this function. As soon as a solid stream of the foam liquid is noted at the discharge duct 18, the valve 11 is shifted to the position shown in Fig. 3 wherein the foam liquid is pumped directly into the duct 2 through the check valve 12.

In the illustrated embodiment wherein the rotors of the motor 1 are connected to the rotors of the pump 6, the latter has in addition to its pumping function, the additional function of synchronizing the rotors 3 and 4 of the motor. This makes for simplification, economy, and compactness in the structure of the proportioning unit. It is apparent, however, that the motor may be provided with separate synchronizing means and that the pump, being relieved of the synchronizing function, may then be made of any form that may be found suitable. Obviously the water motor as well as the pump may be of widely different characters, it being only necessary to a practice of the invention that both of these elements be of a positive displacement type.

It is apparent that the system as described above is susceptible to some modification without departure from the invention. Thus the discharge from the pump 6 may be introduced into the duct 2 at a point upstream from the water motor in which case, when the valve 11 occupies a position corresponding to that shown in Fig. 1, the pump 6 would not function as a motor, but as a circulating pump operating at very low pressure. This would preclude the operation of the pump as a water motor as in the embodiment previously described, but in other respects the apparatus would correspond functionally to that previously described.

Such modification is illustrated in Fig. 4 wherein the corresponding parts are identified by the same reference numerals used in the preceding figures. In this case, however, the pump

6 is established in a duct 19 extending from the source of the foam-producing substance (not shown) to the conduit 2 at a point above the motor 1. A duct 20, also connected to the conduit 2 above the motor 1, connects with the duct 19 at a point intermediate the pump 6 and said source, and a valve 11*a*, corresponding essentially to the valve 11 of the previous embodiment, provides for establishing communication between the pump and the said source while simultaneously shutting off communication between the ducts 19 and 20, or, alternatively, between the pump and the duct 20 to the exclusion of the said source. The different positions of the valve 11*a* affording the above connections are indicated in the drawings.

In the embodiment shown in Figs. 5, 6, and 7, the water motor 21 and conduit 22 are as in the embodiment of Figs. 1 to 3. The foam liquid is introduced into the conduit 22 from a suitable source 23 by way of a duct 24, the latter containing a pump 26 of positive displacement type which feeds the said liquid at a predetermined desired rate. The rotors 27 and 28 of the motor 21 are synchronized by gears 29 and 31, in well known manner, and the pump 26 is operatively connected to the said gears so as to be driven by and in synchronism with the motor. The pump drive is effected through a gear 32 which may be shifted so as to mesh selectively with the gears 29 and 31, and so as to occupy an intermediate or neutral position between said gears, as indicated in the drawing. When the gear 32 is meshed with the gear 29 it will be rotated as indicated by the arrow in Fig. 5 and the pump will draw foam liquid from the source 23 and will force the said liquid into conduit 22. When the gear 32 is meshed with the gear 31 it will be rotated in the opposite direction and the pump will be reversed and will tend to withdraw water from the conduit and force said water through the duct 24. By withdrawing the duct from the source 23, see Fig. 6, the duct and the pump may under these conditions be flushed free from the foam liquid. When the gear 32 is in the neutral position, as shown in Fig. 7, the pump 26 will be inoperative, and plain water may then be discharged through the conduit.

I claim:

1. In combination, a conduit for fluid under pressure, a positive displacement fluid motor in said conduit, a by-pass duct connected at both ends with said conduit, a positive displacement pump in said by-pass, a duct connected to a source of other fluid and extending to the intake side of the pump, valve means for controlling the connections between the intake end of the by-pass and the conduit and between the said duct and the pump, whereby the conduit and the said source may be connected selectively and individually to the intake end of the pump, and means for synchronizing said motor and pump.

2. In combination, a conduit for fluid under pressure, a positive displacement fluid motor in said conduit, a by-pass duct extending around said motor, a positive displacement pump in said by-pass, a duct connected to a source of other fluid and extending to the intake side of the pump, valve means for controlling the connections between the intake end of the by-pass and the conduit and between the said duct and the pump, whereby the conduit and the said source may be connected selectively and individually to the intake end of the pump, and means for synchronizing said motor and pump.

3. The combination defined in claim 1, wherein the said connecting and disconnecting valve means consists of a multiple-way valve.

4. In combination, a conduit for fluid under pressure, a positive displacement fluid motor in said conduit, a by-pass duct connected at both ends with said conduit, a positive displacement pump in said by-pass, a check valve in said by-pass at the discharge side of the pump to preclude flow from the conduit to the by-pass at that end of the latter, a normally closed discharge port in the by-pass intermediate the pump and the check valve, a supply duct connected to the by-pass at the intake side of the pump, valve means for controlling the connections between the intake end of the by-pass and the conduit and between the said supply duct and the pump, whereby the conduit and the said duct may be connected selectively and individually to the intake end of the pump, and means for momentarily opening said discharge port coincidentally with the initial connection of the supply duct with the by-pass.

5. In means for injecting a fluid substance into the stream of fluid in a pressure conduit in amounts proportioned to the quantity of fluid passing through said conduit, a positive-displacement fluid motor in said conduit affording a measure of the quantity of fluid passing therethrough, a supply duct for said fluid substance connected to the conduit and containing a positive displacement pump for effecting said injection, a duct for establishing connection between the conduit and the supply duct at a point intermediate the pump and the source of said fluid substance, valve means for connecting the pump selectively and individually with the conduit by way of said connecting duct and with said source, and transmission means operatively connecting the motor with the pump.

6. In means for injecting a fluid substance into the stream of fluid in a pressure conduit in amounts proportioned to the quantity of fluid passing through said conduit, a positive-displacement fluid motor of the synchronized multiple rotor type in said conduit, a supply duct for said fluid substance connected to the conduit, and synchronizing gears for said motor, said gears being established in said supply duct so as to constitute a positive displacement pump for effecting said injection.

7. In means for injecting a fluid substance into the stream of fluid in a pressure conduit in amounts proportioned to the quantity of fluid passing through said conduit, a positive-displacement fluid motor of the synchronized multiple rotor type in said conduit, a supply duct for said fluid substance connected to the conduit, synchronizing gears for said motor, said gears being established in said supply duct so as to constitute a positive displacement pump for effecting said injection, and valve means for selectively and individually connecting the intake side of said pump with the source of said fluid substance and with the conduit.

8. In means for injecting a fluid substance into the stream of fluid in a pressure conduit in amounts proportioned to the quantity of fluid passing through said conduit, a positive-displacement fluid motor in said conduit affording a measure of the quantity of fluid passing therethrough, a supply duct for said fluid substance connected to the conduit and containing a positive displacement pump for effecting said injection, means for operatively connecting said pump and motor, and valve means for establishing connection between the supply duct and said conduit at two points on opposite sides respectively of said pump and respectively at opposite sides of the motor and for simultaneously disconnecting the source of said fluid substance, whereby the said pump may function as a second motor in parallel with the said motor first named.

9. In means for injecting a fluid substance into the stream of fluid in a pressure conduit in amounts proportioned to the quantity of fluid passing through said conduit, a positive-displacement fluid motor in said conduit affording a measure of the quantity of fluid passing therethrough, a supply duct for said fluid substance connected to the conduit and containing a positive displacement pump for effecting said injection, means for operatively connecting said pump and motor, means for connecting the intake side of the pump with the conduit, and a single valve operative in different positions to connect the intake side of the pump with the conduit and with the source of said fluid substance respectively and individually.

10. In means for injecting a fluid substance into the stream of fluid in a pressure conduit in amounts proportioned to the quantity of fluid passing through said conduit, a positive-displacement fluid motor in said conduit affording a measure of the quantity of fluid passing therethrough, a supply duct for said fluid substance connected to the conduit and containing a positive displacement pump for effecting said injection, means for operatively connecting said pump and motor, means for connecting the intake side of the pump with the conduit, a normally closed vent port in the said supply duct at the discharge side of the pump, and a single valve operative in different positions to connect the intake side of the pump with the conduit and with the source of said fluid substance respectively and individually, and operative while in the latter position to selectively open and close said vent port.

11. In combination, a conduit for fluid under pressure, a fluid motor in said conduit, a source of other fluid, duct means connected with said source and with said conduit, a pump in said duct actuated by the motor, and a two-position selective control assembly for connecting the intake of said pump with said source and said conduit respectively.

12. In combination, a conduit for fluid under pressure, a fluid motor in said conduit, a source of other fluid, duct means for connecting said source with the conduit, a pump in said duct, means for operatively connecting the pump with the motor so as to actuate the pump to withdraw fluid from said source and to inject the fluid so withdrawn into the conduit, and means for interrupting operation of said pump independently of the motor so as to relieve the motor of the pump load.

13. In combination, a conduit for fluid under pressure, a fluid motor in said conduit, a source of other fluid, duct means for connecting said source with the conduit, a pump in said duct having a suction port connected to the said source and having a separate discharge port directed toward the conduit, a valve controlling the connection of said duct with the conduit, a discharge port in said duct intermediate the said valve and the pump, and valve means for controlling said discharge port.

14. In combination, a conduit for fluid under pressure, a fluid motor in said conduit, a source of other fluid, a duct connected to said conduit, means for connecting the duct selectively to said source and to a point of discharge, a pump in said duct, means for operatively connecting the pump with the motor, and means for reversing said pump.

15. In combination, a conduit for fluid under pressure, a positive displacement fluid motor in said conduit, a by-pass duct connected at both ends with said conduit, a positive displacement pump in said by-pass, a control valve in said by-pass at the discharge side of the pump operative when closed to preclude flow from the conduit to the by-pass at that end of the latter, a normally closed discharge port in the by-pass intermediate the pump and the control valve, a supply duct connected to the by-pass at the intake side of the pump, and valve means for disconnecting the intake end of said by-pass duct from the conduit and for connecting the by-pass with said supply duct when the by-pass is so disconnected, said valve means including a device for momentarily opening said discharge port coincidentally with the initial connection of the supply duct with the by-pass.

16. In a device for introducing a fluid agent into a primary stream of fluid in a pressure conduit, a fluid motor in said conduit actuated by said primary stream, a duct system connected to said conduit and to a source of said fluid agent, a pump in said system operatively connected to the motor for actuation by the latter, a two-position selective control assembly operatively associated with the pump and constructed and arranged so that in one position the fluid agent is admitted to the pump from said source and in another position fluid from the said primary stream is admitted to the pump from said conduit, and means for shifting said assembly to the respective positions.

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