Dec. 16, 1941. C. H. BOUVY 2,266,585

FUEL PUMP

Filed April 6, 1939 2 Sheets-Sheet 1

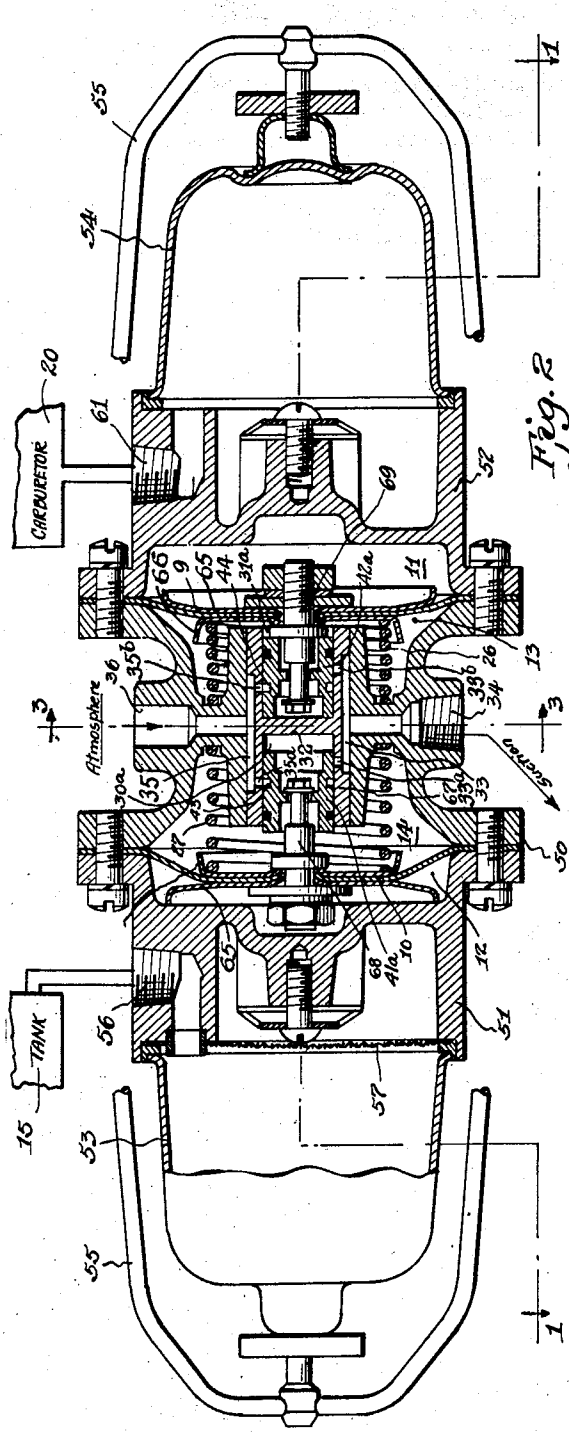


Fig. 2

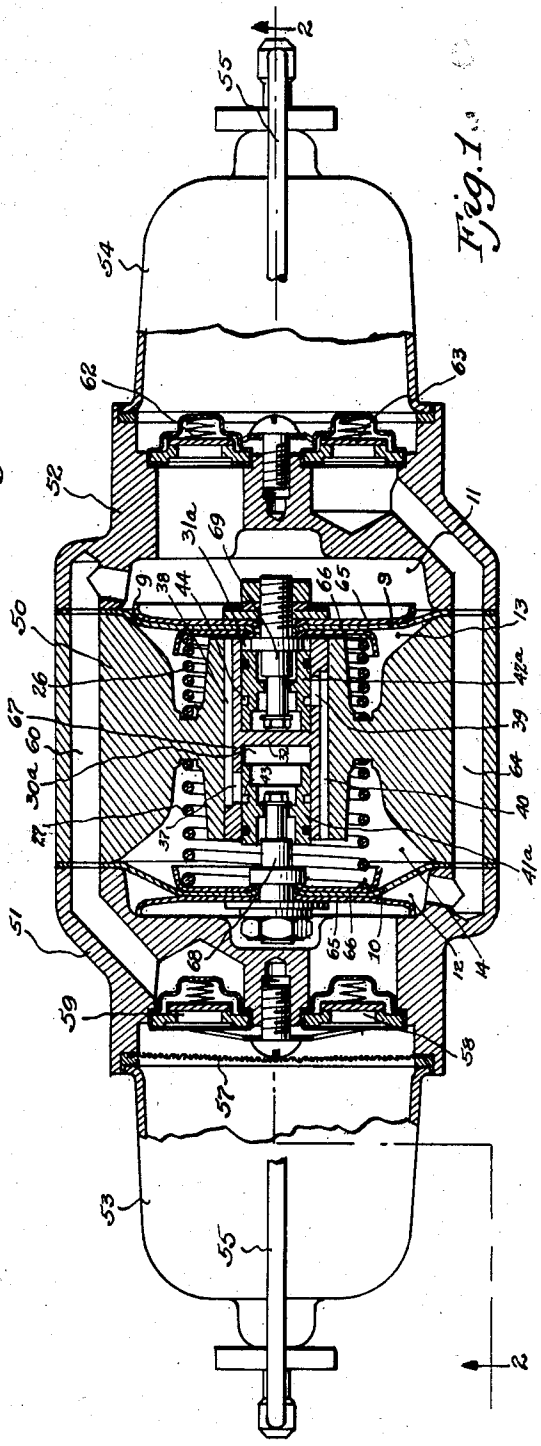


Fig. 1

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Filed April 6, 1939 2 Sheets-Sheet 2

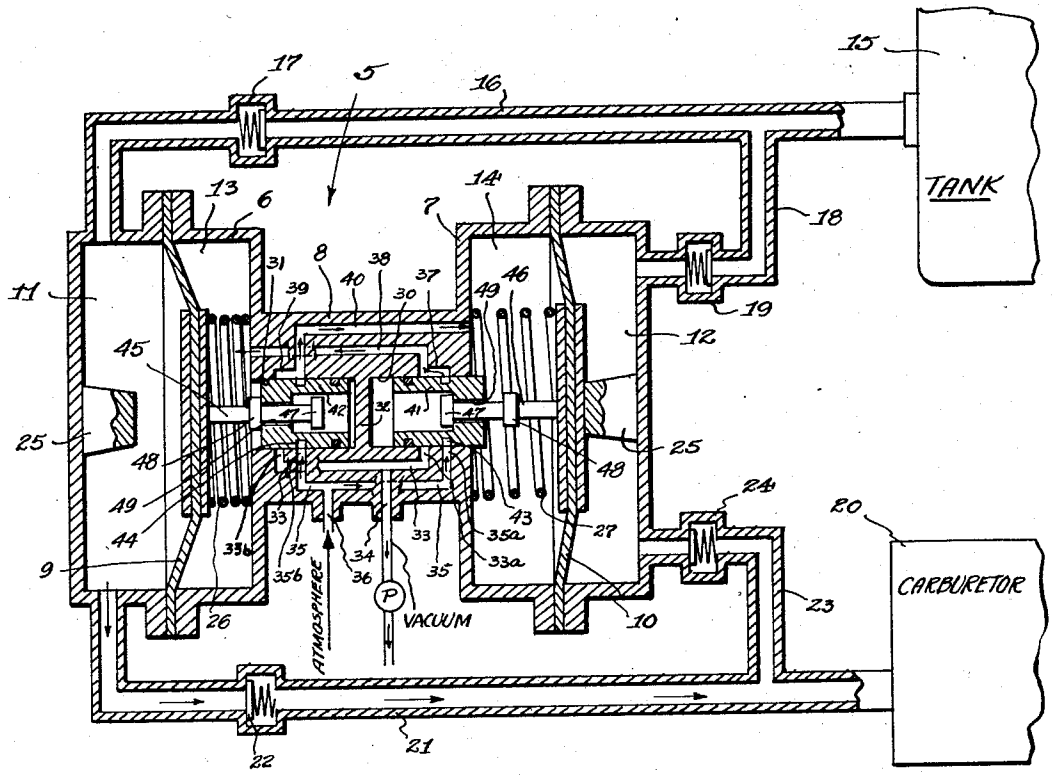


Fig. 4

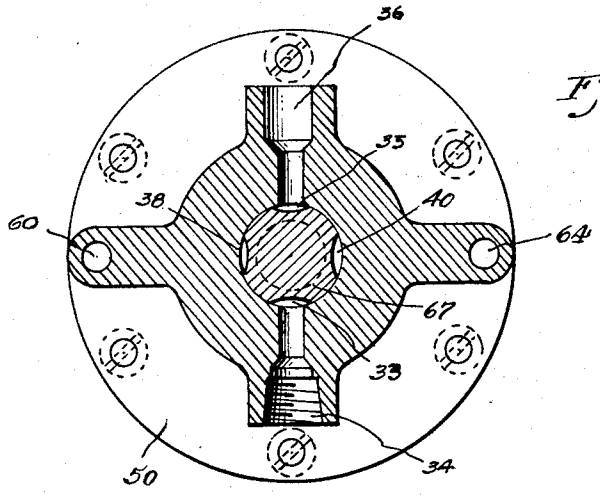


Fig. 3

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2,266,585

FUEL PUMP

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6 Claims. (Cl. 103—152)

This invention relates to a fuel pump and has particularly to do with a fuel pump for internal combustion engines.

In the past it has been common to provide vacuum operated fuel pumps in which two pumping members are interconnected and it has been common to provide snap action connections between the control valves and the pumping members to control pressure or vacuum to the pumping members. The present invention contemplates a fuel pump which is self-contained in that no mechanical connection is necessary between the pump and an operating part of the engine. The pump of the present invention is to be operated by differential pressures, one of the pressures being atmospheric and the other being sub-atmospheric. However, if found desirable the range of the pressure differential can be changed, one pressure being atmospheric and the other above atmospheric.

A further object of the invention has to do with provision of a pump which will furnish a supply of fuel to an engine, as required at a limited maximum pressure. An additional object has to do with the provision of a fuel pump in which the two pumping elements operate independently of each other as far as mechanical connection is concerned.

It is a further object of the invention to provide a fluid-operated fuel pump with a simplified valve structure. The vacuum operated pump has the advantage that it can be mounted outside of the engine compartment in a cool location so as to avoid trouble from vapor locking. Also, the feed line to the fuel pump, which is under sub-atmospheric pressure, is not exposed to the heat in the engine compartment, as is the case with a mechanical operated pump mounted on the engine.

Other features and objects of the invention having to do with details of construction and operation, as, for example, the arrangement of ports in the valve-cylinder structure, will be further brought out in the following description and claims.

In the drawings:

Fig. 1 is a horizontal longitudinal section taken through a fuel pump constructed in accordance with the present invention.

Fig. 2 is a vertical section of the invention taken on lines 2—2 of Fig. 1. Section lines 1—1 of Fig. 2 refers to the section of Fig. 1.

Fig. 3 is a transverse section taken on the lines 3—3 of Fig. 2.

Fig. 4 is a diagrammatic presentation of the pump for purposes of illustration, each of the passageways shown in the plane of the section.

Referring to Fig. 4, a fuel pump is shown generally at 5 and consists of two housings 6 and 7 connected by a valve housing 8. Each of the housings 6 and 7 is divided into two compartments by diaphragms 9 and 10, respectively. To the left of the diaphragm 9 and to the right of the diaphragm 10 are fuel pumping chambers 11 and 12, respectively. To the right of the diaphragm 9 and to the left of diaphragm 10 are actuating or vacuum chambers 13 and 14.

A fuel tank 15 is connected to pumping chamber 11 through pipe 16 and check valve 17 and to pumping chamber 12 through pipe 18 and check valve 19. A carburetor 20 is connected to pumping chamber 11 through pipe 21 and check valve 22 and to chamber 12 through pipe 23 and check valve 24. Stops 25 are provided in chambers 11 and 12 to limit the outward movement of the diaphragms. Springs 26 and 27 are provided in chambers 13 and 14, respectively, and these springs tend to urge the diaphragms 9 and 10 toward the stops 25.

The valve housing 8 is provided with axial cylinder openings 30 and 31, these cylinders being separated by a wall 32. Port openings 33*a* and 33*b* in cylinders 30 and 31, respectively, open into a passageway 33 connected via passageway 34 to a source of vacuum. Port openings 35*a* and 35*b* in cylinders 30 and 31, respectively, open into a passageway 35 connected via passageway 36 to the atmosphere. Fig. 4 shows that vacuum port 33*b* in cylinder 31 is located to the left of the atmospheric port 35*b* in cylinder 31, while vacuum port 33*a* in cylinder 30 is also located to the left of atmospheric port 35*a* in cylinder 30. This non-symmetrical arrangement of ports is necessary for proper operation.

A port 37 is formed in the wall of cylinder 30 and is connected by a passageway 38 to chamber 13. A similar port 39 is formed in the wall of the cylinder 31 and is connected to the chamber 14 by a passageway 40. The axial width of ports 37 and 39 is equal to the axial distance between the inner edge of vacuum port 33*a* and the outer edge of atmospheric port 35*a*, and also equal to the axial distance between the outer edge of vacuum port 33*b* and the inner edge of atmospheric port 35*b*. The total travel of the valves later to be described, is equal to this axial distance minus the axial width of the annular grooves in the valves.

Within the cylinders 30 and 31 are slidable piston valves 41 and 42. These piston valves are

each provided with annular grooves 43 and 44. A suitable groove is also provided in the piston for packing to provide for frictional contact between piston and cylinder. Connected to each diaphragm 9 and 10 are rods 45 and 46, respectively. Each of these rods is provided with spaced collars 47 and 48. The portion of the rods 45 and 46 between the collars 47 and 48 is passed through an axial opening 49 in each of the pistons 30 and 31, this opening being smaller than the collars 47 and 48. The inner ends of the pistons 30 and 31 are also provided with recesses in which the collars 47 may slide. It will be seen that the space between the collars 47 and 48 is greater than the length of the opening 49 so that there will be a lost motion between movement of the rods and the pistons.

Referring now to the operation of the pump as shown in Fig. 4 the diaphragm 10 has just completed a discharge pumping stroke and is connected to the atmosphere through passageways 36 and 35, port 35*b*, groove 44, port 39 and passageway 40. The diaphragm 9 has just completed an intake pumping stroke to the right and is now connected to the atmosphere through passageways 36 and 35, port 35*a*, groove 43, port 37 and passageway 38. With the diaphragms in these positions, the fuel pumping chamber 12 has been ensmalled and the fuel pumping chamber 11 has been enlarged and filled with fuel from the tank 15. The spring 26, operating on the diaphragm 9, will tend to ensmall the pumping chamber 11, forcing the fuel through the check valve 22 and to the carburetor 20 through the pipe 21. During the first stages of the movement of the diaphragm 9 to the left, the piston 42 will remain in the position shown. When the collar 47 on rod 45 contacts the shoulder at the end of the opening 49 of piston 42, the piston will start moving to the left with the diaphragm 9. When the piston 42 is moved to the left a predetermined amount, the groove 44 in the piston will first be cut off from port 35*b* and atmospheric passageway 35 and then be connected to port 33*b* and to the passageway 33 in the valve housing. The passageway 33 is connected to sub-atmospheric pressure conduit 34 and consequently the actuating chamber 14 will be connected to sub-atmospheric pressure through passageway 34, passageway 33, port 33*b*, groove 44, port 39 and passageway 40. At this time the diaphragm 10 will start to move to the left in its intake stroke. Because of the lost motion between the collar 48 on rod 46 and the piston 41 there will be no movement of the piston 41 during the first stages of the movement of the diaphragm 10. After about half the stroke of the diaphragm is completed, the collar 48 will contact the piston 41 and move the same to the left thereby cutting off the chamber 13 from atmospheric port 35*a* and passageway 35, and as the piston 41 reaches the end of its leftward movement, the chamber 13 will be connected to sub-atmospheric pressure through passageways 34 and 33, vacuum port 33*a*, groove 43, port 37, and passageway 38. This will initiate the intake stroke of diaphragm 9. Chamber 11 will again be filled with fuel through pipe 16 and check valve 17 and the diaphragm 10 will then move to the right by the action of the spring 27 and will discharge fuel through the valve 24 to the carburetor. It will be seen that if the need for fuel to the carburetor is discontinued, the pump will cease its operation until demand is re-established, in which case, either spring 26 or 27 may force its respective diaphragm outward against the reduced fuel pressure in the discharge line feeding the carburetor. At this time the pump will again start to operate.

It is at the end of the discharge pumping stroke of diaphragm 9 that the actuating chamber 14 is connected to sub-atmospheric pressure and it is at the end of the intake stroke of diaphragm 10 that actuating chamber 13 is connected to sub-atmospheric pressure. Similarly, at the end of the intake stroke of diaphragm 9, the chamber 14 is connected to atmospheric pressure and at the end of the discharge pumping stroke of diaphragm 10 the chamber 13 is connected to atmospheric pressure.

Referring now to the embodiment of the invention shown in Figs. 1, 2 and 3, reference characters from Fig. 4 have been applied to Figs. 1, 2 and 3 where they identify similar parts. The housing for the fuel pump in Figs. 1 and 2 is made up of a central housing 50 and two end housings 51 and 52 bolted appropriately to the center housing with diaphragms 9 and 10 interposed. Each of the housings 51 and 52 are provided with end chambers 53 and 54 respectively with suitable bail means 55 for holding the same in position. The end housing 51 is provided with an entrance port 56 leading to the housing 53. A filter screen 57 separates the end chamber 53 from entrance valves 58 and 59, and chamber 53 serves as sediment chamber. These valves are check valves of common construction. The valve 58 gives one way connection to chamber 12 and the valve 59 gives one way connection to chamber 11 through passageway 60 in the housings 51, 50 and 52. The chamber 54 which serves as an airdome to reduce pressure fluctuations, is connected to the carburetor through a port 61. A check valve 62 gives a one way connection from the chamber 11 to the chamber 54 and the check valve 63 gives a one way connection from chamber 12 to chamber 54 through a passageway 64 in housings 52, 50 and 51. The embodiment of the pump shown in Figs. 1 and 2 is mounted in operation so that the sediment chamber 53 is at the bottom and the airdome chamber 54 is at the top. Diaphragms 9 and 10 are clamped between reinforcing discs 65 and 66 which can serve also as stop members by contacting the housings at the ends of the stroke of the diaphragm.

The central housing 50 is provided with an axial cylindrical hole which receives a sleeve 67. This sleeve 67 has two cylinders 30*a* and 31*a* formed in each end and separated by the wall 32. These cylinders which correspond to cylinders 30 and 31 of Fig. 4, are connected by the ports 33*a* and 33*b* and passageway 33 which is open to the suction or sub-atmospheric passage 34. Passageway 35 also connects the atmospheric ports 35*a* and 35*b* in the cylinder walls and is open to the atmospheric passage 36. Passageways 33 and 35, each in the form of an axial groove on the outside of the sleeve 67, are diametrically positioned, as shown particularly in Figs. 2 and 3. In Fig. 1 the ports 37 and 39 and the passageways 38 and 40, formed as axial grooves in sleeve 67, are shown diametrically positioned in the sleeve 67, the passageway 38 leading to chamber 13 and the passageway 40 leading to chamber 14. Within the cylinders of sleeve 67 are pistons 41*a* and 42*a* each provided with grooves 43 and 44 respectively, as described in connection with Fig. 4. Rods 68 and 69 are attached to the diaphragms 9 and 10 respectively, which are clamped between the

discs 65 and 66, and each rod is provided with a portion having a reduced diameter at its inner end to be received within an opening of the pistons 41a and 42a. There is a lost motion connection between the pistons and rods as previously described. The operation of the embodiment of the invention shown in Figs. 1, 2 and 3 is identical with that described in Fig. 4 and will not be repeated in detail.

As shown in Figs. 1 and 2, the chambers 13 and 14 are connected to atmosphere and the diaphragm 9 is ready to start a discharge pumping stroke by reason of the action of spring 26. The diaphragm 10 has just completed a discharge pumping stroke and is connected to atmosphere. Upon movement of the diaphragm 9 a certain distance to the right, as viewed in the drawings, the groove 44 will be disconnected from port 35b and upon further movement, connected to port 33b so that the source of sub-atmospheric pressure will be connected to chamber 14 through pasasgeway 40, port 39, groove 44, port 33b and passageway 33. Similarly, when the diaphragm 10 has been moved to the right by differential pressures a predetermined distance, the piston 41a will then be shifted to the right to disconnect the chamber 13 from the atmospheric port and later be connected to the sub-atmospheric pressure through the passageway 38, port 37, groove 43, port 33a and pasasgeway 33. This will cause movement of the diaphragm 9 to the left and the chamber 14 will then be again connected to atmosphere as shown.

It is, of course, within the contemplation of the invention that a pressure above atmospheric be used in actuating chambers 13 and 14. In such cases, a means equivalent to springs 26 and 27 should be provided to urge the diaphragms in a direction opposite to that in which they are now urged by the springs.

What I claim is:

1. In a liquid fuel pump, opposed coaxial chambers, pumping elements in said chambers to divide each chamber into a fuel pumping chamber and an actuating chamber, means urging said pumping elements in a direction to ensmall said fuel pumping chambers, a central valve housing positioned between said pumping chambers, coaxial cylindrical recesses in said valve housing, valve members in said recesses, means connecting said valve members respectively to said pumping elements, an atmospheric passageway connecting said valve recesses, a sub-atmospheric passageway connecting said valve recesses, passageways connecting each of said actuating chambers with one of said valve recesses, said valve members being arranged to be shifted to connect respectively said atmospheric and sub-atmospheric passageways with said actuating chambers, the valve member connected to one pumping element being adapted to control the connection of pressure to the actuating chamber of the other pumping element.

2. In a liquid fuel pump, opposed coaxial chambers, pumping elements in said chambers to divide each chamber into a fuel pumping chamber and an actuating chamber, means urging said pumping elements in a direction to ensmall said fuel pumping chambers, a central valve housing positioned between said pumping chambers, coaxial cylindrical recesses in said valve housing, valve members in said recesses, means forming a lost motion connection between said valve members respectively and said pumping elements, an atmospheric passageway connecting said valve recesses, a sub-atmospheric passageway connecting said valve recesses, passageways connecting each of said actuating chambers with one of said valve recesses, said valve members being arranged to be shifted to connect respectively said atmospheric and sub-atmospheric passageways with said actuating chambers, the valve member connected to one pumping element being adapted to control the connection of pressure to the actuating chamber of the other pumping element.

3. In a liquid fuel pump, a central housing having inlet and outlet openings for fluid operation, a bore extending longitudinally of said housing, end pieces attached at each end of said housing forming operating chambers at each end of said housing, diaphragms in each of said chambers dividing the same into pumping chambers and actuating chambers, a wall centrally of said bore dividing the same into aligned valve chambers, valve members slidable in each of said valve chambers, means operably connecting each of said valve members with the diaphragm at its respective end of the housing, and passageways connecting said valve chambers with said fluid inlet and outlet openings, the valve member connected to one diaphragm being adapted to control the connection of pressure to the other diaphragm and vice versa.

4. In a liquid fuel pump, a housing having two spaced, coaxial pumping chambers, inlet and outlet openings for actuating fluid, and coaxial bores between said chambers, valves in said bores, diaphragms dividing said chambers into actuating and pumping sides, means connecting each of said valves with a diaphragm whereby movement of a diaphragm actuates the valve connected therewith, and passageways formed in said housing between said openings and the actuating sides of said diaphragms whereby movement of one valve by one diaphragm controls the connection of actuating fluid to the other diaphragm and vice versa.

5. In a liquid fuel pump, a housing having two spaced, coaxial pumping chambers, inlet and outlet openings for actuating fluid, and bores arranged on an axis parallel with the axis of said spaced chambers, diaphragms dividing said chambers into actuating and pumping sides, means connecting each of said valves with a diaphragm whereby movement of a diaphragm actuates the valve connected therewith, and passageways formed in said housing between said openings and the actuating sides of said diaphragms whereby movement of one valve by one diaphragm controls the connection of actuating fluid to the other diaphragm and vice versa.

6. In a liquid fuel pump, a housing having two spaced coaxial pumping chambers, inlet and outlet openings for actuating fluid, and central bore connecting said chambers, diaphragms dividing said chambers into actuating and pumping sides, the actuating sides facing the central bore, a sleeve in said bore having surface openings therein to connect the inlet and outlet openings of said housing with the actuating sides of said chambers, valves in each end of said sleeve, means connecting each of said valves with a diaphragm whereby movement of a diaphragm actuates the valve connected therewith, said valves having surface openings arranged to cooperate with the openings of said sleeve whereby the movement of a valve connected to one diaphragm controls the connection of actuating fluid to the other diaphragm and vice versa.

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