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T. F. PETERS
FLUID ACTUATED PUMP

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4 Sheets-Sheet 1

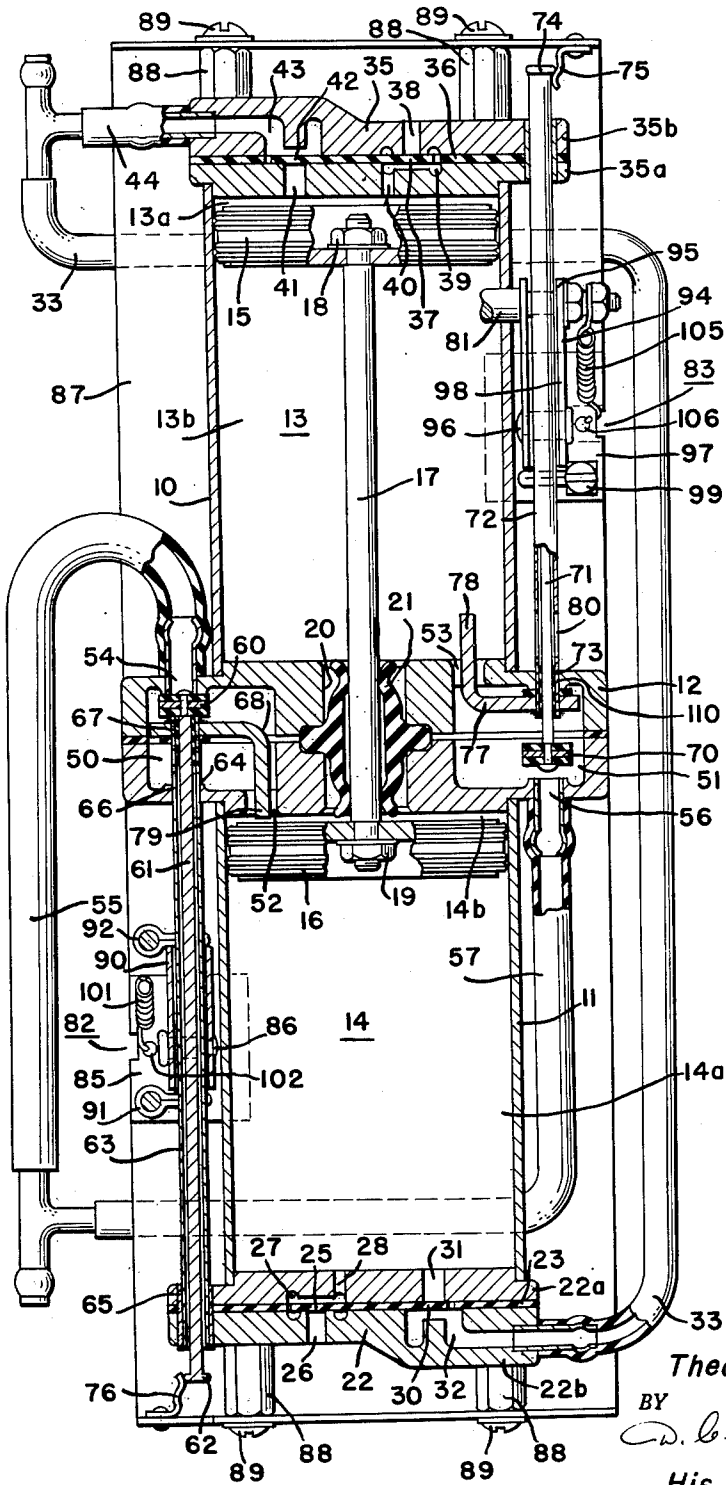


Fig. 1

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This diagram provides a detailed side view of the mechanical assembly. It shows the internal mechanism where the lever 90 pivots at point 91. The lever has two sets of contacts or pins, 84 and 85 at its upper end, and 86 and 87 at its lower end. Springs 97 and 98 are connected to the lever's pivot area. Other components include a spring 99, a pin 92, and a screw 93. The entire assembly is mounted between vertical guides 81 and 82, which are secured by screws 35 and 59. A central shaft 62 passes through the assembly, with a nut 63 and a washer 64 visible. The bottom of the assembly features a base plate 22 and a foot 58.

Fig. 2

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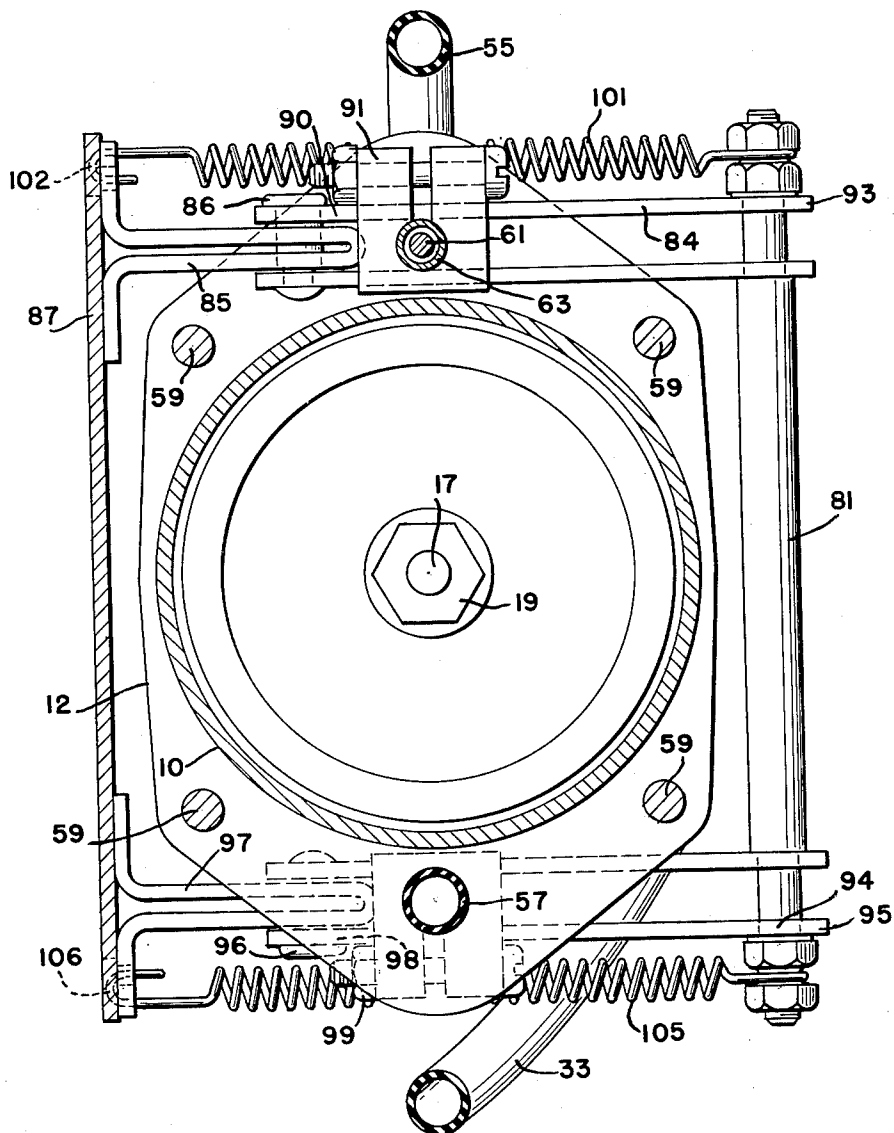


Fig. 4

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FLUID ACTUATED PUMP

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This invention relates to a fluid actuated fluid pump and particularly to a fluid pump that is operated by a source of vacuum or subatmospheric pressure.

An object of the invention is to provide an improved vacuum or subatmospheric operated fluid pump in which the pistons of the pump effect operation of control valves that control the admission of vacuum or subatmospheric pressure to the pump for reciprocation of the pistons of the pump, the pistons of the pump operating a resiliently acting overcenter throw mechanism which operates the control valves with a snap action to avoid having the pump arrive at a dead center position, or the control valves thereof arriving at a dead center position, under any conditions of operation of the pump.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein preferred embodiments of the present invention are clearly shown.

In the drawings:

FIGURE 1 is a longitudinal cross-sectional view of the fluid actuated fluid pump of this invention.

FIGURE 2 is a side elevational view of the pump.

FIGURE 3 is a side elevational view of the pump taken 90° from that of FIGURE 2.

FIGURE 4 is a transverse cross-sectional view taken along line 4-4 of FIGURE 2.

In this invention the pump consists of a pair of cylinders 10 and 11 that are separated by a central partition block 12 thereby forming two separate and independent cylinder chambers 13 and 14.

Piston 15 is slidably disposed in cylinder chamber 13 and piston 16 is slidably disposed in cylinder chamber 14. The pistons 15 and 16 are connected together for concurrent reciprocation by a rod 17 having its opposite ends connected to the respective pistons by the nuts 18 and 19.

The rod 17 extends through a passage 20 in the central partition block 12, passage 20 having the seal member 21 therein disposed between the rod 17 and the wall of the passage 20 to prevent interchange of fluid pressure between the cylinder chambers 13 and 14 respectively.

Piston 15 divides the cylinder chamber 13 into a pressure chamber 13a and a power chamber 13b. Similarly, piston 16 divides the cylinder chamber 14 into the pressure chamber 14a and a power chamber 14b. The power chambers 13b and 14b are adapted to receive vacuum or subatmospheric pressure for reciprocating the pistons in a manner hereinafter described.

The cylinder 11 extends between the central partition block 12 and a closure wall 22 at the opposite end of the cylinder 11. The closure wall 22 is formed of two wall members 22a and 22b that retain a rubber diaphragm 23 therebetween. The diaphragm 23 has a cut portion forming a valve 25 that closes the atmosphere inlet port 26, the valve 25 being located in a valve chamber 27 formed between the wall parts 22a and 22b, the valve chamber 27 having a port 28 that communicates with the cylinder chamber 14.

The diaphragm 23 has a second cut portions forming a valve 30 that closes a fluid pressure exhaust port 31 through which fluid compressed by the piston 16 is discharged into the discharge or exhaust chamber 32 of the

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wall part 22b for delivery into the fluid pressure outlet conduit 33.

Similarly, cylinder 10 extends between the central partition block 12 and a closure wall 35 formed of the two wall parts 35a and 35b.

The wall parts 35a and 35b retain a diaphragm member 36 therebetween. The diaphragm member 36 has a cut portion forming an inlet valve 37 that closes the atmosphere inlet port 38, valve 37 being retained in a valve chamber 39 between the wall parts 35a and 35b. Valve chamber 39 communicates by a port 40 with the cylinder chamber 13.

A fluid pressure exhaust port 41 is closed by a cut portion in the diaphragm 36 forming a valve 42, fluid under pressure being exhausted or discharged into the exhaust chamber 43 that connects with a conduit 44 which, in turn, connects with the conduit 33 for a common exhaust of fluid under pressure from opposite ends of the fluid pump.

It will be apparent from the foregoing description that reciprocation of the pistons 15 and 16 in their respective cylinder chambers 13 and 14 will cause air to be drawn into the respective cylinder chambers through the inlet valves 26 and 38 for the pressure chambers 14a and 13a respectively, the air being compressed in the pressure chambers and exhausted through the respective exhaust ports 31 and 41.

The pistons 15 and 16 are reciprocated in their respective cylinders by admission of vacuum or a subatmospheric pressure into the power chambers 13b and 14b respectively alternately under control of suitable control valves hereinafter described.

The central partition block 12 has two separate and independent valve receiving chambers 50 and 51 positioned at opposite sides of the rod 17 that connects the pistons 15 and 16. Valve receiving chamber 50 is connected with the power chamber 14b by a port 52 continuously so that whatever pressure exists in valve receiving chamber 50 will also be supplied into the power chamber 14b between the piston 16 and the central partition block 12. Similarly, valve receiving chamber 51 is connected with the power chamber 13b by means of the port 53 for the same purpose.

Valve receiving chamber 50 also has a port 54 for the admission of vacuum or subatmospheric pressure into the valve receiving chamber 50, port 54 being connected with the conduit 55 which is adapted to be connected to a suitable source of vacuum or subatmospheric pressure. Similarly, valve receiving chamber 51 has a port 56 for admission of vacuum or subatmospheric pressure into the valve receiving chamber 51. This port 56 is connected by a conduit 57 with the conduit 55 so that both conduits can be connected to a common source of vacuum or subatmospheric pressure.

The cylinders 10 and 11, the central partition block and the end closure walls 22 and 35 are held together in assembled relation by the through bolts 59.

The vacuum port 54 is controlled by a valve element 60 carried on a valve rod 61 that has its opposite end 62 extending beyond the closure wall 22. The valve rod 61 is movable in a valve sleeve 63 which slides in a port opening 64 in the wall of the valve receiving chamber 50 and has its opposite end sliding in a guide sleeve 65 provided in the closure wall 22 for the cylinder 11.

The valve sleeve 63 has vent ports 66 which bridge the port 64 in the wall of the valve receiving chamber 50 when the valve sleeve and valve rod are in the position shown in FIGURE 1 whereby atmosphere pressure is admitted into the valve receiving chamber 50, valve element 60 closing the vacuum port 54 at this time. With atmosphere pressure present in valve receiving chamber 50, the same pressure is present in the power chamber 14b

between the piston 16 and the central partition block 12.

The valve sleeve 63 carries a seal member 67 at the end received within the chamber 50 and positioned between the sleeve 63 and the valve rod 61 to prevent entry of air into the chamber 50 when the vacuum port 54 is open.

A strike member 68 is secured to the valve sleeve 63 and is positioned within the chamber 50, one end of the strike member extending through the port 52 for engagement by the piston 16 to operate the valve 60 and the ported valve formed by the valve sleeve 63 with its port 66 in a manner hereinafter described.

Vacuum port 56 is adapted to be closed by a valve element 70 carried on a valve rod 71 that moves within a valve sleeve 72 in the same manner as heretofore described with reference to valve rod 61 and valve sleeve 63. A seal member 73 is placed between the valve sleeve 72 and the valve rod 71 to prevent admission of atmosphere pressure when the valve element 70 opens the port 56, as shown in FIGURE 1. The valve rod 71 extends through the end of the valve sleeve 72 and terminates in an enlarged head 74 that is engaged by a light spring 75 to hold the valve rod 71 in the position shown in FIGURE 1 when there is initial relative movement between the valve sleeve 72 and the valve rod 71, and thereby overcome the friction between the seal 73 and the valve rod 71 during the initial movement of the valve sleeve 72 in a manner hereinafter described. Similarly, a light spring 76 is adapted to engage the enlarged head 72 on the end of the valve rod 61 that extends through the valve sleeve 63.

The strike member 77 is secured to the valve sleeve 72 and has its end 78 extending into the power chamber 13b between the piston 15 and the central partition block 12 in the same manner that the end 79 of the strike member 68 extends into the power chamber 14b.

The valve sleeves 63 and 72 working in cooperation with the valve rods 61 and 71 respectively provide a lost motion connection between the valve element 60 and the valve port 66 and between the valve element 70 and the valve port 80 provided in the valve sleeve 72 so that there can be relative movement between the valve members during a part of the stroke of movement of the valve devices and can also have concurrent movement in a manner hereinafter described.

The valve sleeves 63 and 72 are mechanically interconnected by a rod 81 that extends between the overcenter throw mechanisms 82 and 83 operably associated with the valve sleeves 63 and 72 respectively.

The overcenter mechanism 82 consists of a lever 84 pivotally supported on a bracket 85 by means of a pivot pin 86. The bracket 85 is secured to a support plate 87 that is attached to a pair of the through bolts 59 by the extended nuts 88 and screws 89 threadedly extending into the extended nuts 88. The lever 84 has a circular portion 90 adjacent the pivot pin 86, opposite sides of which portion 90 are engaged by the clamp members 91 and 92 secured on the valve sleeve 63 so that oscillating movement of the lever 84 about its pivot 86 will cause reciprocal movement of the sleeve 63.

The lever 84 has a free end 93 that is connected by means of the rod 81 with a similar lever 94 at its free end 95. Lever 94 is carried on the pivot pin 96 supported on the bracket 97 that is secured to the support plate 87 in the same manner as the bracket 85. The enlarged circular portion 98 of lever 94 is engaged by the clamps 99 and 100 secured to the valve sleeve 72 so that oscillation of the lever 94 about its pivot axis 95 will cause reciprocation of the valve sleeve 72 in a manner hereinafter described.

From the foregoing description it will be apparent that when either of the levers 84 or 94 is operated that both levers will be operated concurrently by the interconnecting rod 81.

The tension spring 101 extends between the free end 93 of lever 84 and a connecting point 102 on the bracket 85, the tension spring 101 being on one side of the pivot pin 86 for the lever 84 when it is in the position shown in FIGURE 2. The spring 101 is an overcenter throw spring so that when the free end 93 of the lever 84 aligns between the point 102 on the bracket 85 and the center of the pivot pin 86, further movement of the lever 84 will cause the spring 101 to move the lever throughout the remaining portion of its stroke. Obviously this action will occur in either direction of movement of the lever 84.

Similarly, an overcenter throw spring 105 extends between the free end 95 of the lever 94 and a point 106 on the bracket 97 so that the lever 94 will be operated by the overcenter throw spring 105 in the same manner as lever 84, and in fact concurrently therewith.

In operation, with the mechanisms of the pump in the positions shown in the drawings, the pistons 15 and 16 are ready to make a reciprocal stroke with piston 16 moving toward wall 22 and with piston 15 moving toward the central partition block 12. Under the conditions of the position of the mechanism shown in the drawing, piston 16 on its previous stroke away from the closure wall drew in atmospheric air through the inlet port 26, 28 so that on its next stroke toward wall 22 the air drawn into the pressure chamber 14a can be compressed for exhausting through the pressure exhaust port 31, 32. Also, valve 70 has opened the vacuum or subatmospheric port 56 so that vacuum or subatmosphere pressure is now admitted to the power chamber 13b of the cylinder chamber 13. At this time the vent port 66 in the valve sleeve 63 bridges the port 64 in the wall of the valve receiving chamber 50 so that atmosphere pressure is admitted into the chamber 50 for admission into the chamber 14b of the cylinder chamber 14. Thus with vacuum or subatmosphere pressure admitted into power chamber 13b, and with atmosphere pressure admitted into power chamber 14b, the pistons 15 and 16 will be moved in a manner heretofore just mentioned.

As piston 15 approaches the central partition block 12 it will engage the end 78 of the strike member 77 that is secured to the valve sleeve 72 and will move the strike member further into the valve receiving chamber 51. This movement of the strike member 77 causes valve sleeve 72 to move concurrently with the strike member 77 so that the atmosphere port 80 of sleeve 72 begins to enter the port 110 in the wall of the valve receiving chamber 51. Concurrently, valve sleeve 63 is moved with valve sleeve 72 by means of the interconnecting rod 81. At this time also valve rod 71 will be retained in the position shown in FIGURE 1 by the light detent spring 75 so that the friction of the seal 73 will not cause the rod to move and close the vacuum port 56. Thus vacuum port 56 will remain open during this initial movement of the valve sleeve 72 with the end of the valve sleeve approaching the valve element 70.

At this time also valve sleeve 63 is moving away from the valve element 60 that closes vacuum port 54, valve element 60 being held on its seat by the pressure differential at opposite sides of the valve element, atmosphere pressure being present in chamber 50 while vacuum or subatmosphere pressure is present in the port 54. Thus, during the initial movement of the valve sleeves 72 and 63 there is relative movement between these sleeves and the valve members 60 and 70 so that the overcenter throw mechanisms 82 and 83 can move to position the overcenter springs 101 and 105 in position to ready the springs for moving the levers 84 and 94 in the remaining part of the stroke as soon as the axis of the springs 101 and 105 passes over the pivot centers 86 and 96 for the levers 84 and 94 respectively.

When the overcenter springs 101 and 105 pass over the respective centers 86 and 96 for the levers 84 and 94 the valve sleeves 63 and 72 will then be driven by the

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springs 101 and 105 so that the end of the valve sleeve 72 will engage the valve element 70 while the end of the valve sleeve 63 engages the enlarged head 62 on the valve rod 61, thereby driving the valve element 70 against its seat to close port 56 and positively forcing valve 60 off its seat to open port 54. Also, this action causes the vent port 66 in valve sleeve 63 to move out of the port 64 to close the atmosphere connection to the chamber 50 and vent port 80 in the valve sleeve 72 will move inwardly to bridge the port 101 and provide for admission of atmosphere pressure into the valve receiving chamber 51.

With the pressure conditions in the valve chambers 50 and 51 now being reversed to that initially described, the chamber 14b will be open to vacuum or subatmosphere pressure and the chamber 13b will be open to atmosphere pressure so that the pistons 15 and 16 can then be driven to the position shown in the drawing causing the piston 15 to compress the air admitted into the chamber 13a on the inward stroke of the piston for exhaust into the exhaust conduit 44.

While the embodiments of the present invention as herein disclosed constitute preferred forms, it is to be understood that other forms might be adopted.

What is claimed is as follows:

1. In a fluid pump, a cylinder having a central partition block dividing the cylinder into two cylinder chambers, a piston in each of said cylinder chambers connected and carried by a single rod extending through said partition block so as to be coacting, a fluid seal between said rod and block, each cylinder chamber having a fluid inlet and a pressure fluid outlet, said partition block having two separate valve receiving chambers therein each ported to one of said cylinder chambers, separate first valve means in each of said valve receiving chambers oppositely acting to control admission of subatmosphere pressure to said cylinder chambers alternately including separate second valve means oppositely acting to control admission of atmosphere pressure to said cylinder chambers alternately, said first and second valve means of each of said valve receiving chambers having lost motion connecting therebetween with said second valve means actuating said first valve means, a snap action mechanism linking together said second valve means for positively and alternately opening and closing both said valve means, said second valve means in one of said valve receiving

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chambers having actuation initiated by one of the pistons and the other of said second valve means in the other of said valve receiving chambers having actuation initiated by the other of said pistons, both said second valve means being actuated concurrently and oppositely with delayed action of said first valve means by said second valve means respectively on alternate strokes of said pistons during reciprocation thereof.

2. In a fluid pump, a cylinder having a central partition block dividing the cylinder into two cylinder chambers, a piston in each of said cylinder chambers connected and carried by a single rod extending through said partition block so as to be coacting, a fluid seal between said rod and block, each cylinder chamber having a fluid inlet and a pressure fluid outlet, said partition block having two separate valve receiving chambers therein each ported to one of said cylinder chambers alternately including separate sleeve valve means in each of said valve receiving chambers oppositely acting to control admission of atmosphere pressure to said cylinder chambers alternately, said first valve means including rod means movable axially in said sleeve valve means and providing therewith a lost motion connection between said first valve means and said sleeve valve means with said sleeve valve means actuating said first valve means, a snap action mechanism linking together said sleeve valve means for positively and alternately opening and closing both said valve means, said sleeve valve means in one of said valve receiving chambers having actuation initiated by one of the pistons and the other of the sleeve valve means in the other of said valve receiving chambers having actuation initiated by the other of said pistons, both said sleeve valve means being actuated concurrently and oppositely by said snap action mechanism with said sleeve valve means delaying movement of said first valve means through a part of the stroke of said sleeve valve means on alternate strokes of said pistons during reciprocation thereof.

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