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SUCTION PUMP

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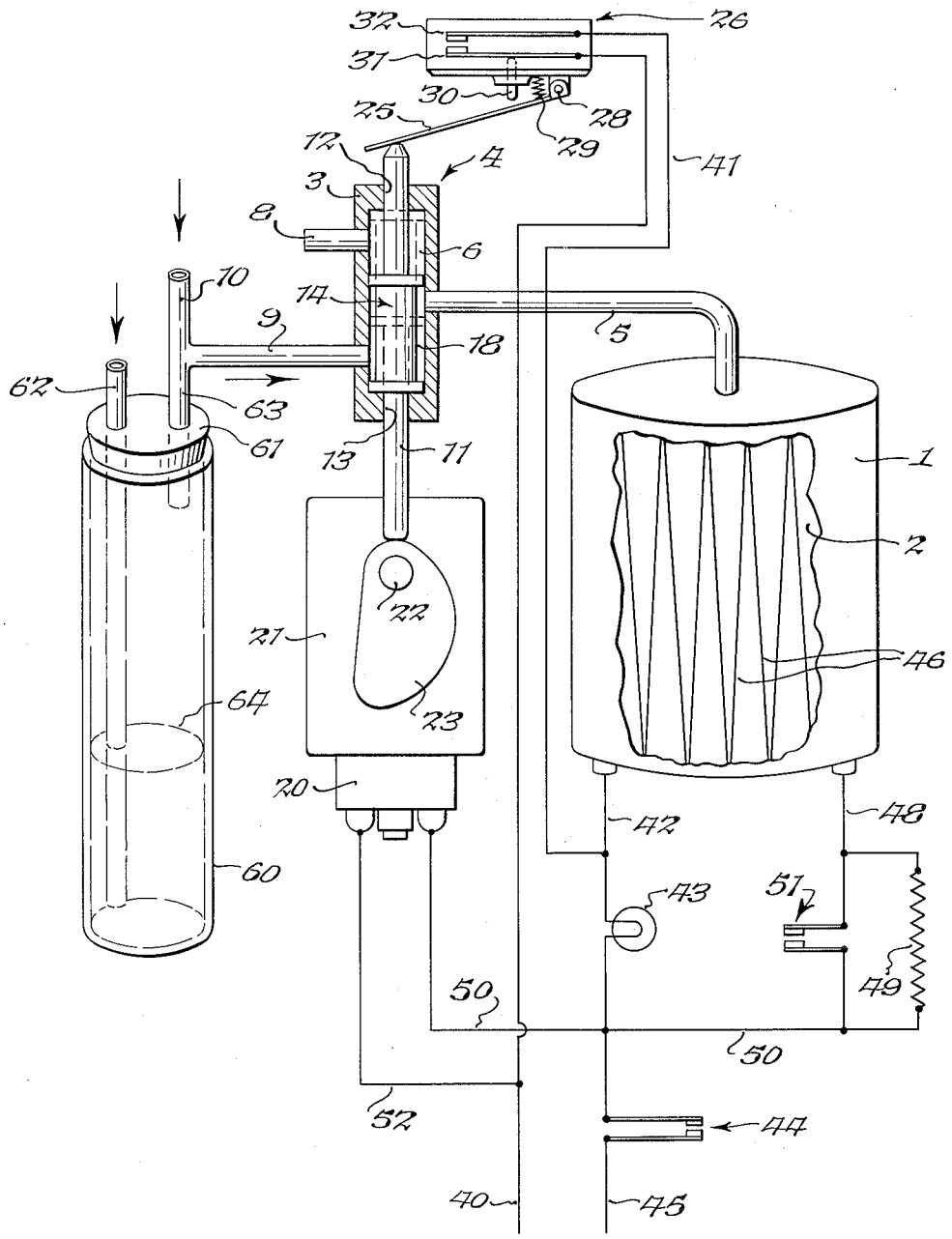

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SUCTION PUMP

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This invention relates to thermotic suction pumps and more particularly to a pump such as is shown in my prior Patent No. 2,465,685, granted March 29, 1949, and which pump is actuated by the expansion and contraction of air as a function of alternately heating and cooling the air in a working chamber and which pump has a device for adjustably controlling the maximum suction effect of the pump.

Such pumps have been found to be particularly useful for draining patients in many fields of surgery, particularly in urology. Such pumps are characterized by having a low value suction and on and off periods of short duration, thereby to effect, when used in the surgical field, a gentle drainage and a release of the flesh drawn against the catheter following each suction period so as to render the catheter operative for drainage during the next succeeding period.

The principal object of the present invention is to provide a simple, reliable and highly accurate device which positively limits the maximum suction value of the pump and which also permits this suction value to be regulated with a high degree of accuracy.

Another object is to provide such regulating device which cannot interfere with the functioning of the pump as a drainage unit and which is easily kept in a clean and sanitary condition.

Another object of the invention is to provide such a control device which is easily adjusted to insure the desired maximum value of the pump suction.

Other objects and advantages will be apparent from the following description and drawing which is a diagrammatical representation of the invention as including a pump actuated by the expansion and contraction of alternately heated and cooled air and having a device for controlling the maximum suction value of the pump.

The pump embodying the present invention is shown as including an enclosed cylinder 1 having end heads forming a cylindrical working chamber 2. The enclosed cylinder 1 is preferably made of aluminum so as to be light in weight and so as to readily dissipate the heat generated in its working chamber 2. However, it is not essential for a surgical pump that this cylinder be made of metal and it could be made of glass, plastic or other material.

The cylinder 1 is shown as connected with the housing 3 of a suction valve indicated generally at 4 by a tube 5, this tube providing communication between the working chamber 2 of the cylinder 1 and the internal cylindrical chamber 6 of the suction valve 4. The tube 5 is shown as connected with the center of the suction valve chamber 6 and one end of this suction valve chamber 6 is vented to the atmosphere as indicated at 8 and its other end is connected through a suction tube 9 with a tube 10 which forms the suction line for draining the patient. This suction line normally connects with a drainage bottle as shown in my said Patent No. 2,465,685 and the fluids draining from the patient are sucked into and collected in this drainage bottle.

A valve stem 11 is shown as arranged coaxially in the valve housing 3 in slideways 12 and 13 provided at opposite ends of this housing. Within the housing, this valve stem is provided with a valve plug 14 forming a piston closely fitting the cylindrical valve chamber 6. The valve plug is of reduced diameter at its center to provide a cylindrical groove 18. In one extreme position of the valve plug as shown by full lines, this groove 18 establishes communication between the tubes 5 and 9 while in the other extreme position of the valve plug 14 shown by dotted lines, this groove establishes communication between the line 5 and the vent 8.

The valve stem 11 is reciprocated by an electric valve motor 20 having a gear reducer 21 driving a shaft 22 carrying a cam 23. This cam engages the lower end of the valve stem 11 so that upon each rotation of the cam, it lifts the valve stem 11 so as to break communication between the tubes 5 and 9 and to establish communication between the tube 5 and the vent 8. The valve stem 11 and its valve plug 14 drops by gravity as the cam passes beyond its maximum salient contact with the valve stem 11.

The upper end of the valve stem 11 engages the actuating arm 25 of a microswitch 26. This arm is shown as pivoted at 28 to the casing for the microswitch 26 and as being urged downwardly by a helical compression spring 29. This arm 25 is adapted to be pushed into engagement with a vertically sliding pin 30 carried by the casing of the microswitch 26 and engaging the movable contact 31 of the switch. This contact 31 is moved into engagement with a fixed contact 32 each time the valve stem 11 is elevated and the movable contact 32 raised through the arm 25 and pin 30.

The movable contact 31 is shown as being connected to the side 40 of a main power line while the other contact 32 is shown as connected through a wire 41, pilot lamp bulb 43, and on-off switch 44 with the other side 45 of the main power line. A line 42 also connects the line 41 with one end of an electrical resistance filament 46 arranged within the working chamber 2 and preferably supported within this working chamber in the manner shown in my said Patent No. 2,465,685. The opposite end of the filament 46 connects with a line 48 connected through a resistor 49 with a line 50 connected with one terminal of the valve motor 20. A manual high-low switch 51 is arranged parallel with the resistor 49, and the other terminal of the valve motor 20 is connected through a line 52 with the other side 40 of the main power line.

In the operation of the pump as above described, closing the manual on-off switch 44 establishes a circuit from the side 40 of the main power line through the line 52, valve motor 20, line 50 and through the on-off switch to the other side of the main power line. Energization of the valve motor 20 causes rotation of its cam 23 to lift the valve rod 11. This causes the sliding valve plug to rise and its groove 18 to move out of register with the suction line 9. This also causes the arm 25 of the microswitch 26 to raise and, through the pin 30, to close the contacts 31 and 32 of this microswitch.

Closing the microswitch 26 closes a circuit from the side 40 of the main power line through the closed contacts 31 and 32 and lines 41 and 42 through the resistance heating filament, the circuit being completed through the line 48, resistor 49, line 50 and on-off switch 44 to the other side 45 of the main power line. Closing the microswitch 26 also lights the pilot lamp 43 which is in parallel with the resistance heating filament 46 and if heating of the air in the working chamber 2 to a higher temperature is required (to produce a higher value of suction) the high-low switch 51 is closed to short circuit the resistor 49.

With the high-low switch **51** either open or closed, energization of the resistance heating filament in the working chamber **2** causes this filament to rise in temperature and heat the air in this chamber. This causes the air in the working chamber **2** to expand and when the groove **18** of the valve plug **14** comes into register with the vent **8**, the air in the working chamber **2** so expanded by heat escapes through the pipe **5**, groove **18** and vent **8** to the atmosphere.

As the salient part of the cam **22** passes beyond the valve stem **11**, the valve stem falls by gravity so as to break communication between the vent **8** and the groove **18** in the valve plug **14**. At the same time, the arm **25** is lowered so as to lower the plunger **30** and permit the contacts **31** and **32** of the microswitch **26** to open. This opens the circuit through the resistance heating filament **46** so that the air in the working chamber **2** cools, its heat being dissipated through the walls of the cylinder **1**. As a result of this cooling of the air, it contracts with a resultant pressure drop. Accordingly, when the groove **18** of the valve plug **14** reaches the pipe **9**, air is sucked from the catheter and suction bottle (not shown) and through the pipes **10** and **9** and valve **4** into the working chamber. The pumping cycle is then repeated.

The present invention is directed to maintaining an adjustable maximum value of the suction of such a pump and consists of an enclosed receptacle such as a glass bottle **60** having an apertured cork or plug **61** in its upper end. An equalizing tube **62** extends through and is tightly fitted in this plug or cork **61** with its lower end terminating near the bottom of the bottle and its upper end open to the atmosphere. A regulating pipe **63** extends through and is tightly fitted in the cork or plug **61**, the lower end of which is close to the underside of the cork or plug in communication with the interior of the enclosed receptacle and the upper end of which connects with the pipe **10** to the patient and hence with the suction line **9**. The device is rendered effective by a body of water **64** in the bottle **60**, the level of which determines the maximum effective suction value of the pump.

In use, when the suction in the suction line **9** from the pump exceeds the value determined by the head of water **64**, atmospheric air is drawn in through the balancing tube **62** and bubbles through the liquid body **64** to join the air drawn in from the patient through the pipe **10**. If a high suction value is desired, more water is placed in the bottle **60** so that the suction works against a higher head. If a lower suction value is desired, a part of the water **64** is poured out of the bottle **60** to provide a lower effective head. The bottle could, of course, be graduated.

It will be seen that for the suction values under consideration, the present invention provides an extremely simple, accurate and reliable device for not only insuring a maximum suction value, but also one which is conveniently adjustable to provide any desired value.

I claim:

1. In a pump having means forming a working chamber, a suction line, means for alternately heating and cooling a body of air in said working chamber, and means connecting said chamber with said suction line during the cooling phase of the air therein and disconnecting said chamber from said suction line during the heating phase therein; the combination therewith of means for adjustably controlling the maximum suction value of said pump comprising an enclosed receptacle containing a body of liquid, a balancing tube having its lower open end immersed in said body of liquid and its other end open to the atmosphere, and a regulating tube having one end in communication with the interior of said receptacle above said body of liquid and its other end in communication with said suction line.

2. The combination set forth in claim 1 wherein said liquid is water.

3. The combination set forth in claim 1 wherein said enclosed receptacle comprises a bottle having a mouth closed by a plug having a pair of apertures therethrough and wherein said equalizing tube and regulating tube are tightly fitted in the apertures of said plug.

References Cited in the file of this patent

UNITED STATES PATENTS

2,346,841 Henderson ---------- Apr. 18, 1944