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[54] **AUTOMATIC-FUNCTIONING BREATHER DEVICE**

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[51] **Int. Cl.** **F04b 49/08**

[58] **Field of Search** 417/299, 286, 285, 435, 417/211.5

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[57] **ABSTRACT**

An automatically-functioning breather system for one or more pumps in which a variable volume chamber communicates, in series, with a restrictor and with the atmosphere through a normally open control valve having a valving element normally urged to an "open" position and in which the control valve communicates with the pump output to which the valving element is subjected to close off communication with the atmosphere during predetermined pressure output conditions of said pump.

6 Claims, 3 Drawing Figures

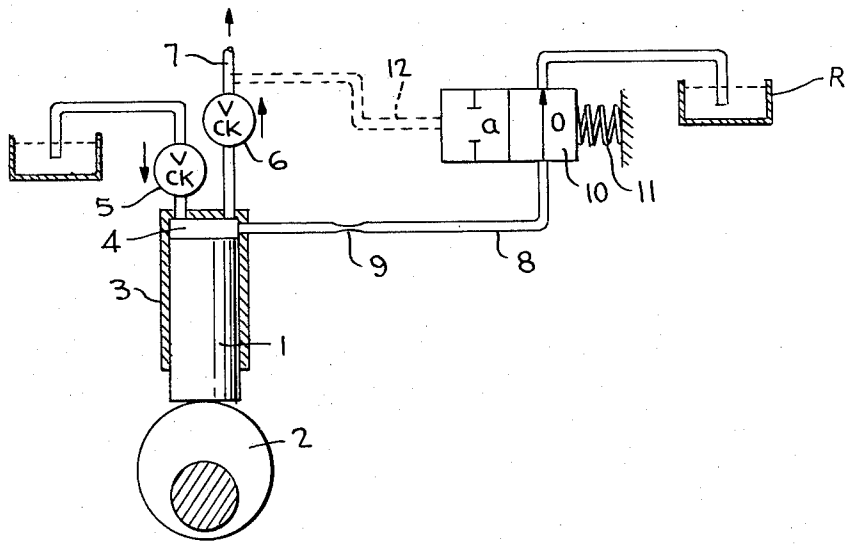


FIG. 1

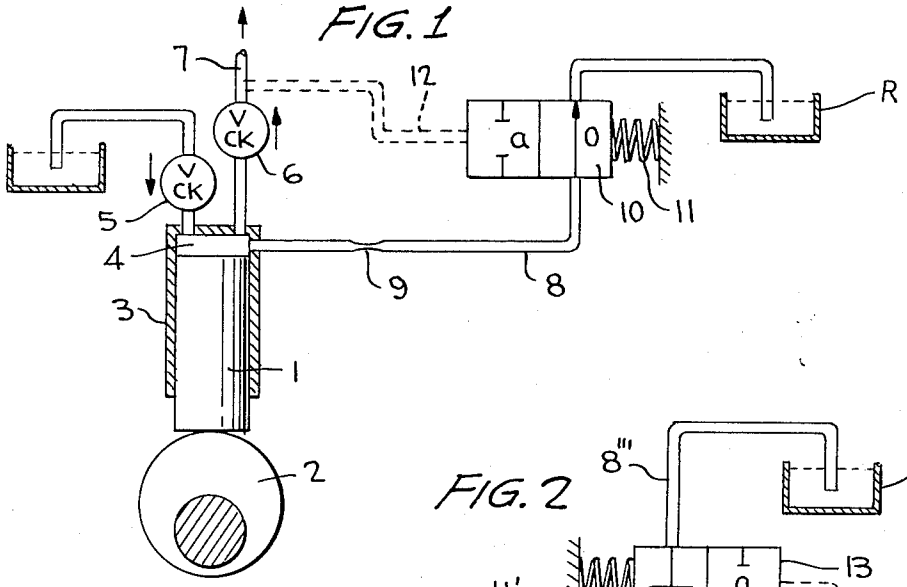


FIG. 2

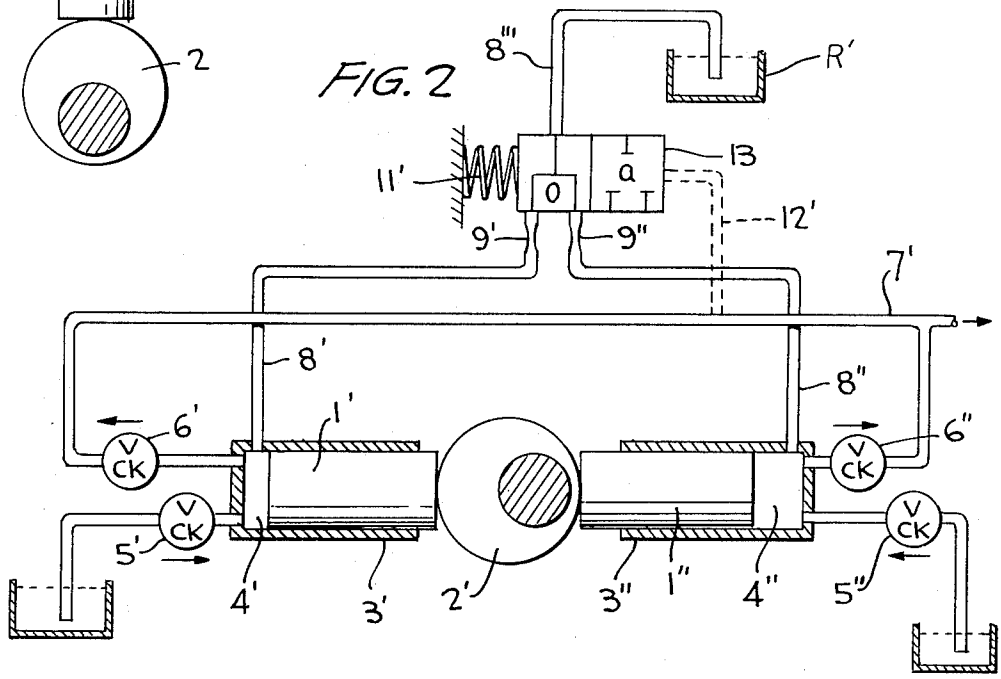
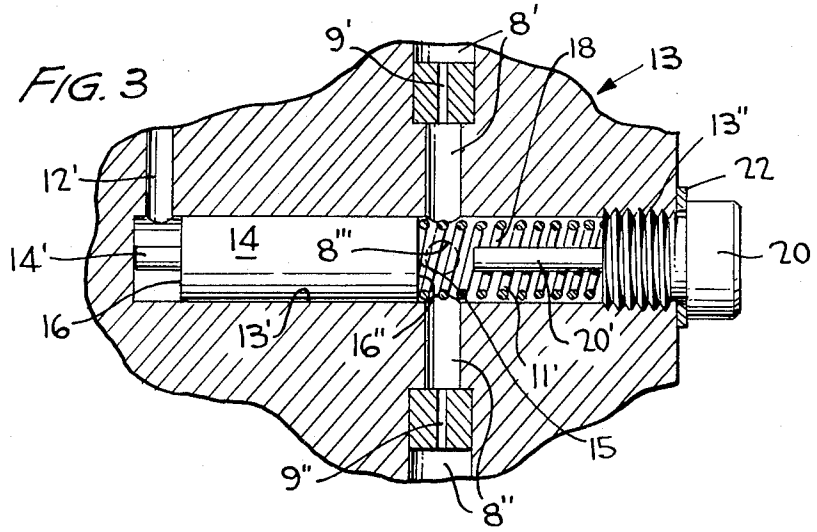


FIG. 3



AUTOMATIC-FUNCTIONING BREATHER DEVICE

BACKGROUND OF THE INVENTION

The instant invention concerns an automatically-functioning breather device for distribution chambers of piston-pumps which are provided with pressure-controlled exhaust-members, whereby a restrictor and an ON/OFF (open/closed) valve are mounted in series in a by-pass pipe leading to a system which is under atmospheric pressure, and whereby the closing-member of the ON/OFF valve is stressed by means of a permanently-functioning force, preferably a spring, in the direction of the "ON" switch-position, while in opposite direction, the closing-member may be switched by means of pressure into the "OFF" switch-position.

PRIOR ART GENERALLY

Such an ON/OFF valve is known in prior art and is provided with a control piston which affords, in the "ON" switch-position, a flow-passage over a narrow annular clearance between two connections, to which a by-pass pipe is connected. The annular clearance represents the throttle point. Due to the low dynamic viscosity, the air can pass without any nominal rise in pressure. During the passage of liquids, however, there results a dynamic pressure which is utilized for switching to the "OFF" position. The connecting of such an exhaust-valve to the distribution chamber of a piston pump results in difficulties as the pressure upstream of the throttle point alternates between positive and negative pressure values according to the cycle of the piston arranged in the distribution chamber. Also, as wear occurs on the control piston as it operates in accordance with the change of pressure; this results in undesirable volumetric losses and a reduction of the work life.

SUMMARY OF THE INVENTION

It is the scope of the instant invention to eliminate these disadvantages and to provide for an exhaust-mechanism of the above-mentioned type which permits a safe ventilating of the distribution chamber, and whereby said chamber remains in an "OFF" switch-position after exhaust is made, without the influence of dynamic pressure-variations in the distribution chamber.

The solution of this problem is inventively obtained in that a by-pass pipe is connected to the distribution chamber, while the pressure-load on a control member is effected by means of a control passage or a control pipe operated by a pressure of a system connected to the exhaust member.

The advantage of such a system resides in that the system itself has a storage-effect or accumulator-effect with the exhaust-member, and therefore functions to equalize pulsations, or, this effect is obtained by means of installation of accumulators, pressure-storages, etc. This means that the liquid pressure in the system itself is always positive when using a single-piston pump or fluid motor, and, in so far as once it has exceeded a certain pressure, it retains the control valve positively in an "OFF" switch-position.

Other objects and advantages will become apparent from the following description of examples when taken with the drawing forming a part thereof.

The disclosure is made by means of embodiments which are schematically illustrated with the aid of symbols, wherein:

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 shows the invention relative to a single-piston pump;

FIG. 2 shows an arrangement utilizing a plurality of pumps and a single "ON/OFF" valve; and

FIG. 3 is an enlarged section illustrating the "ON/-OFF" valve of FIG. 2 in detail.

DESCRIPTION OF PREFERRED EMBODIMENTS

A piston **1** is actuated by means of a suitable powered rotary eccentric cam **2** and forms, in cooperation with a cylinder **3**, a variable-volume distribution chamber **4**. During outward-movement of the stroke of the piston **1**, suction in the distribution chamber **4** is effected by means of a one-way suction valve **5**. During inward-lift of the pressure stroke of the piston **1**, however, pressurized fluid is pushed out into a system (not shown) through pressure pipe **7**, past a one-way outlet or relief valve **6** which serves as a pressure-controlled exhaust member. A by-pass pipe **8** is connected to the distribution chamber **4** said by-pass pipe **8** being provided with an intermediate restrictor **9** and an ON/OFF valve **10**. The ON/OFF valve **10** is provided with two switch-positions "**0**" and "*a*." Switch-position "**0**" is produced by means of a return-spring **11** and complies with the ON-switch position, i.e., normally maintains the valve "open." The ON/OFF valve **10** can also be loaded with pressure generated by means of a control pipe **12** which communicates with the pressure pipe **7** and will be switched into a second switch-position "*a*," i.e., "off" where pressure is blocked.

Similarly functional parts are identified in FIG. **2** by numerals **1'**, **2'** . . . or **1''**, **3''**, etc. Only the ON/OFF valve **13** has a different function since it has three connections; both by-pass pipes **9'** and **9''** and restrictors are connected to an ON/OFF valve **13** and in the switch position **0** = "ON," both pump pressure chambers are vented. An overflow between distribution chambers **4'** and **4''** is generally prevented by means of throttle points or restrictors **9'** and **9''**, after switching, a complete separation is obtained.

FIG. **3** shows details of the control piston **14** of the "ON/OFF" valve **13** of FIG. **2** which serves as a valving member. It is stressed on its one side **15** by means of a compression spring **11'** which is the illustrated switch-position "**0**" = "ON;" in this attitude, communication is made between the by-pass pipes **8'** and **8''** and a continuing by-pass port **8'''**. The control piston **14** is switched into the switch-position "a" = "OFF," against the force of the return-spring **11'** by means of the control pipe **12'** which communicate with liquid pressure generated, so that the by-pass pipes **8'**, **8''** and **8'''** are isolated from each other. The piston **14** includes at the end adjacent communication with conduit **12'** an axial pin **14'** (which could be integral with the end of passage **13'**) so that end **16** of the valving piston **14** does not prevent communication of passage **13'** with port **12'** to be subjected to pressure entering thereat. The passage **13'** includes therein a compression spring engageable at one end with piston **14** and normally maintaining conduits **8'**, **8''** and **8'''** in communication with each other (so that the breathing function can be accomplished). The control valve **13** which includes the

passage 13' has in the passage a tapped portion 13'', a sealing cap 20 engaging a washer or gasket element 22. The sealing element includes an axial pin 20' which extends through the spring 18 and is engagable with end 16'' of the piston (constituting the valving edge relative to ports 8', 8'' and 8''') for properly orienting the valving piston and preventing excessive reciprocation of the piston. The restricting portions 9, 9', and 9'' of FIGS. 1 and 2, can be integrated into a valve body and may comprise separate elements staked in the valve body as shown in FIG. 3.

OPERATION

In order to describe the operation of a hydraulic system equipped with the automatically functioning breather (or air bleed) system, it should be assumed that the hydraulic system downstream of the outlet valve 6 is pressureless and the distribution chamber 4 and the suction line are filled with air. During a suction stroke of the piston 1, air from the suction line enters the distribution chamber 4 via the suction valve 6. Because the spring 11 keeps the ON/OFF valve 10 in its switch-position 0, a small amount of air may enter the distribution chamber via the ON/OFF-valve 10, the by-pass pipe 8 and the restrictor 9. It is to be noted that the pressure drop between the ON/OFF-valve 10 and the distribution chamber 4 cannot exceed the value of 1 atmosphere during the suction stroke. Therefore, in spite of the very low viscosity, the amount of air passing the restrictor 9 is very small. The outlet valve 6 will remain closed. After the suction stroke, a pressure stroke of the piston 1 follows: suction valve 5 closes, air is discharged through the restrictor 9, the by-pass pipe 8 and the ON/OFF-valve 10 into a reservoir R below the liquid level so that air discharges through the liquid. On the next suction stroke liquid from reservoir R might be drawn into pipe 8, but due to the liquid's higher viscosity only a substantially small amount will pass through restrictor 9. Because of the low viscosity of air, the pressure generated in the distribution chamber 4 is not able to open the outlet valve 6, which is held in its closed position by certain force, e.g., by a spring. Therefore, after some cycles a substantial volume of air is discharged via the restrictor 9 and liquid will enter the distribution chamber 4 via the suction valve 5. When the air or a mixture of air and liquid has been discharged, the much more viscous liquid will build up a hydraulic pressure at the restrictor 9 sufficient to open the outlet valve 6. The loss of volume via the restrictor 9 is not important, the efficiency of the pump will be reduced only by a small amount. The discharge of liquid via the outlet valve 6 will cause a rising pressure in the pressure pipe 7 and simultaneously in the control pipe 12. If the pressure exceeds a certain predetermined value, the ON/OFF-valve 10 is urged into its switch-position "*a*" against the force of the spring 11. When this happens, the connection between the by-pass line 8 and the reservoir is blocked. Liquid can no longer be discharged via the by-pass line 8. The ON/OFF-valve 10 remains in its switch-position "*a*" until the pressure in the pressure pipe 7 and in the control line 12 drops far enough to enable the spring 11 to switch the ON/OFF-valve into "0"-position. However, this occurs only if the pump stops or air enters the distribution chamber 4. Normally, however, the ON/OFF-valve 10 keeps its position without any motions caused by pressure changes inside the distribution chamber 4 or the pressure line 7.

The operation of the embodiment shown in FIG. 2 becomes more apparent if it is assumed that the device of FIG. 1 is duplicated and the ON/OFF-valves are combined to the ON/OFF-valve 13. As long as air enters the distribution chambers 4' and 4'' the air will be discharged or bled off via the by-pass lines 8' and 8'' the restrictors 9' and 9'', the ON/OFF-valve 13 and the common bypass line 8''' into a reservoir. During this time, the spring 11' urges the ON/OFF-valve 13 into its switching position "0." The low pressure in the distribution chambers 4' and 4'' cannot open the outlet valves 6' and 6''. Only after filling the distribution chambers 4' and 4'' with liquid, the hydraulic pressure in consequence of the higher viscosity of the liquid, will rise enough to open the outlet valves 6' and 6'' against a certain closing force. Discharge of liquid takes place in the common pressure line 7', there too causing a rising of pressure. The loss of volume by discharging via the ON/OFF-valve 13 or by overflowing from one distribution chamber to the other one via the by-pass lines 8' and 8'' and the restrictors 9' and 9'' is negligable. The pressure in the pressure line 7' acts through the control line 12' upon the ON/OFF-valve 13 with the tendency to switch it into the switch-position "*a*." Switching takes place if the hydraulic pressure exceeds the force of the spring 11' and the by-pass lines become blocked. All the liquid entering the distribution chambers 4' and 4'' is discharged via the pressure line 7'.

Also in the embodiment shown in FIG. 2, the ON/OFF-valve 13 is only switched in response to the hydraulic pressure generated in the pressure line 7' and never in response to the pressure generated in the distribution chambers 4' and 4''. Therefore, it can remain in the switch-position "a" during most of the running time of the pump. Noise and wear are avoided and duration of like of the air bleed device is prolonged. Air will not enter the hydraulic system and there cause malfunction.

What is claimed is:

1. In a hydraulic pressure-system comprising at least one pump having means for periodically generating hydraulic pressure, said pump means including a variable-volume pressure-chamber having fluid control inlet and outlet means, an automatically-functioning air-exhaust means operatively connected to said variable-volume chamber by throttle means connected in series with said variable-volume chamber and including valving means having a portion normally communicating with liquid at atmospheric pressure, said air exhaust means including means normally biasing said valving means to a "valve-open" condition whereby air relief is provided for said variable-volume chamber prior to hydraulic pressure build-up, said variable-volume chamber outlet means communicating with said valving means and subjecting it to hydraulic pressures generated therein and subjecting said valving means to said hydraulic pressure in opposition to said means normally biasing the valving means to the "valve-open" condition or urging the valving means to a "valve-closed" position at predetermined hydraulic pressures.

2. The system as claimed in claim 1 in which said fluid control inlet and outlet means comprise one-way valves, said throttle means being connected to said variable-volume chamber downstream of the outlet one-way valve.

3. The system as claimed in claim 2 in which said valving means of said air-exhaust means comprises a piston element, said biasing means comprising a spring means engaging said piston element, said piston being subject at one end to hydraulic pressure generated in said variable-volume chamber in opposition to said spring means and being subject to the throttle pressure at the other end for reacting on said piston in conjunction with said spring means.

4. In the system as claimed in claim 1, a second pump having a variable-volume chamber operatively connected in series through throttling means to said air-exhaust means and substantially duplicating the function of said first-mentioned pump, said pump having means communicating hydraulic pressure generated to said air-exhaust means for urging the valving means to a "valve-closed" position after hydraulic pressure is built up.

5. In the system as claimed in claim 4 in which pumps are of the piston-and-cylinder type and said variable-volume chambers are defined by movement of a piston in a cylinder, said throttle means comprising individual conduits having intermediate integral throttle portions for limiting pressurized liquid passing therethrough, said valve means comprising a reciprocable piston element disposed in a passage portion of said valve means, spring means normally acting on said piston element and urging it in one direction, an inlet communicating with the pressure generated in the pumps and connected to the passage portion of said piston in opposition to said spring means, said individual conduits being connected to said piston passage for normally communicating through a body of liquid to the atmosphere at one end of said piston element, said passage portion having an atmosphere port in substantial alignment with the connection of the individual conduits at the one end of the piston element whereby the piston element controls air-exhaust communication between said individual conduits and said atmosphere port.

6. In the system as claimed in claim 5, in which said passage portion includes stop portions therein in the path of travel of said piston element for positively orienting the piston relative to the inlet, atmosphere port and connections of the individual conduits with the passage portion.

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