

April 28, 1964

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3,130,741

LIQUID PURGING SYSTEMS

Filed Nov. 25, 1960

2 Sheets-Sheet 1

**Fig. 1**

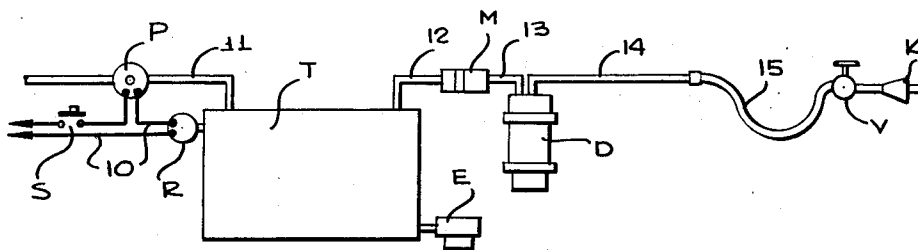


**Fig. 2**

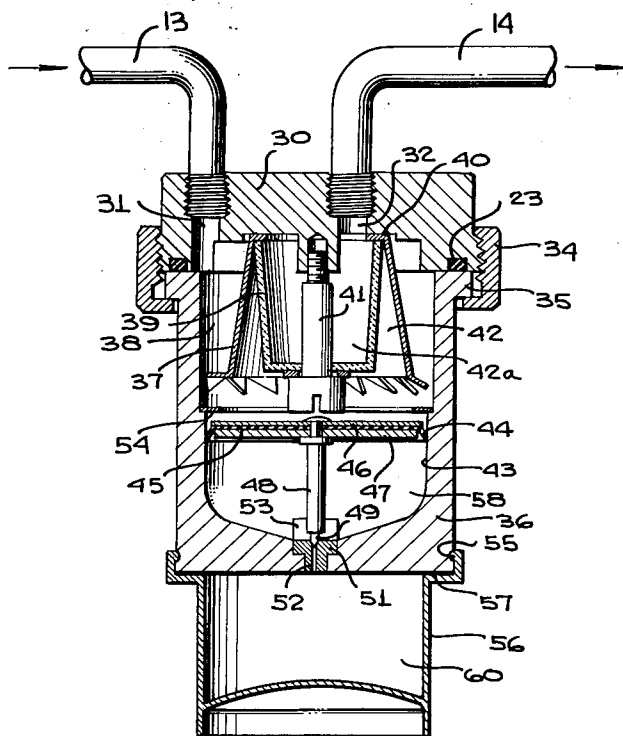
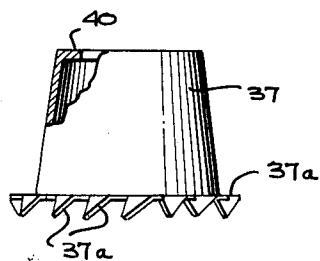


**Fig. 3**



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**FIG. 4**

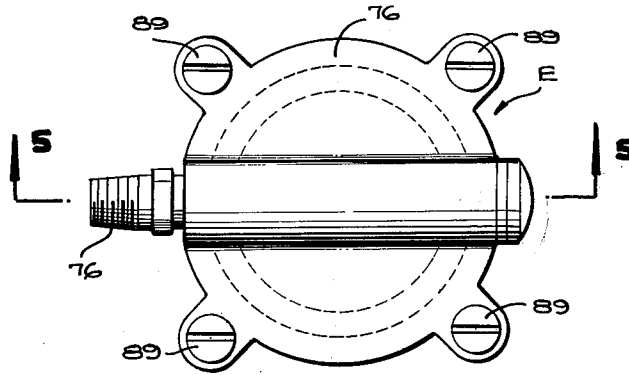


**FIG. 5**

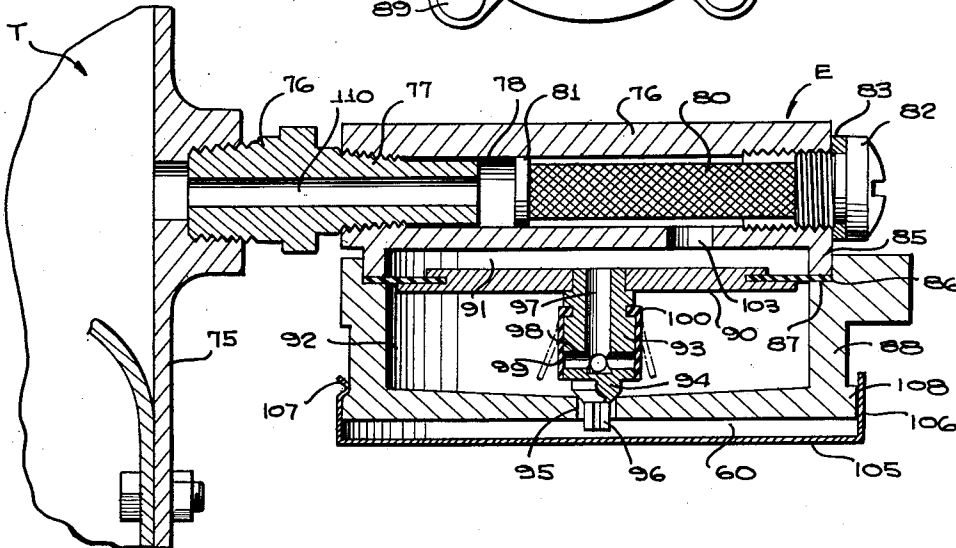
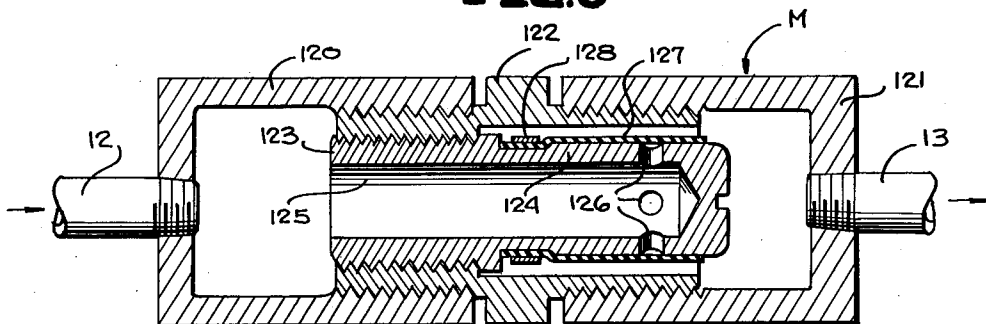


**FIG. 6**



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## LIQUID PURGING SYSTEMS

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This invention relates to drainage devices for removing liquids from gas pressure systems.

An object of the invention is the provision of a drainage device which can be connected to a gas pressure system having varying pressure conditions therein, and which responds to change of the pressure condition by actuating a valve whereby liquid may be discharged.

Another object is the provision of a drainage device having two chambers separated by a piston-like element which responds to pressure differential between the chambers for opening and closing a valve from one of the chambers to the atmosphere, and including a passage between the chambers and a closing device for the passage which responds to a pressure in the other of said chambers for permitting liquid flow from the said other chamber to the said one chamber.

A further object is the provision of a gas pressure system including an intermittently acting pressure producing means, a drainage device body having upper and lower chambers separated by a piston movable in response to the pressure differential of the chambers, the pressure producing means being connected to the upper chamber for producing downward movement of the piston, a valve effective between the lower chamber and the atmosphere and closed by said downward movement of the piston and opened by an upward movement thereof, and a device responsive to a greater pressure in the upper chamber than in the lower chamber for effecting delivery of liquid from the upper chamber into the lower chamber.

With these and other objects as purposes in view, illustrative embodiments of the invention are shown on the accompanying drawings, in which:

FIGURE 1 is a conventionalized diagram of an air pressure system with drainage devices of the present invention included therein;

FIGURE 2 is an upright sectional view of a drainage device included in the air pressure line of FIGURE 1;

FIGURE 3 is a side elevational of a baffle member in FIGURE 2;

FIGURE 4 is a top view of a drainage device connected to the pressure tank of FIGURE 1;

FIGURE 5 is an upright section substantially on line 5-5 of FIGURE 4;

FIGURE 6 is an axial section through an auxiliary pressure-dropping device.

In FIGURE 1, a compressed air system is shown conventionally as including a pressure tank T, a motor-driven compressor pump assembly P, a switch R responsive to the tank pressure, and a tool K to be driven by air when the valve V is opened. The switch R is connected by conductors 10 and the main switch S for energizing the pump P when the tank pressure has fallen below a preset minimum and for de-energizing the pump when the tank pressure has thereafter been raised to a preset maximum. An air line 11 connects the pump P and the tank T. An air supply line 12, 13, from the tank T leads to an automatic drain device D, from which the outlet conduit 14 with a flexible portion 15 leads to the tool K. A tank drain device E is connected to the tank T at a low level, to receive liquid by gravity flow therefrom. A flow control valve M, as described hereinafter, may be included in the line 12, 13 between the tank T and the drain device D.

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The body structure of the drain device D (FIGURE 2) comprises an upper member 30 having an inlet passage 31 leading from the conduit 13, an outlet passage 32 leading to the conduit 14, a groove in its lower surface to receive a sealing ring 33, and an external threading to receive a threaded clamp ring 34 which engages beneath the outwardly projecting flange 35 of a central member 36 and serves to clamp the members 30, 36 together with the sealing ring 33 between them. An annular deflector baffle 37 (FIGURES 2 and 3) engages the lower face of the upper member 30 and extends downward into the central member 36 for providing an outer annular chamber 38 in communication with the inlet passage 31, and a central chamber 42 which receives a cup-like filter element 39 whose upper edge bears against the inward top flange 40 of the baffle 37. The baffle 37 can be of sheet metal, and have outwardly turned projections 37a at its lower edge, FIGURE 3, with downwardly angled portions for producing a whirling movement of the passing gases; these projections assist in locating the parts during assembly. The filter element 39 establishes a pressure drop, e.g., of 2 or 3 pounds per square inch when air is flowing from the tank T at the maximum rate required for the tool K: thus, it may be a fine-meshed screen assembly or a porous structure. A screw 41 is threaded into a boss at the lower face of the member 30, with the screw head effective to press the filter cup 39 upward and thereby hold it and the baffle 37 solidly to the upper member 30. The outlet passage 32 communicates with the space 42a within the filter cup 39.

A lower part 43 of the inner surface of the central member 36 is cylindrical, to receive the downwardly turned edge 44 of a piston packing washer 45 held between plates 46, 47 of a piston having a downwardly projecting rod 48 whose lower end has a valve portion 49. The bottom of the inner surface of the member 36 converges downwardly toward the axis of the rod 48, and has a valve seat member 51 fixed and sealed therein. This seat member 51 has a passage 52 extending through the bottom of the member 36, and peripherally spaced upwardly extending fingers 53 for guiding the rod 48. It is preferred to seat a deflector ring 54 against a shoulder of the central member 36, above the positions of the piston 46, 47; with this deflector extending inward to divert the gas flow from chamber 38 so that it does not kinetically displace liquid which may be lying above the seal 44 of this piston. Also, preferably the lower surface of the screw 41 is so located that it can act as a stop for the piston structure before the piston engages the ring 54 and before the valve 49 leaves its guides 53. The cylinder wall 43, the piston 45, 46, 47 and the bottom of the member 36 provide a chamber 58 which can be closed from the passage 52 by the valve 49.

A peripheral external groove near the lower end of the central member 36 receives an internal annular bead 55 near the upper end of the cup or sump member 56, which illustratively has an internal ledge 57 for engaging the lower face of the member 36 when the bead 55 has entered the groove. This cup member 56 may be made of a transparent resilient plastic such as polyethylene, nylon, or the like: and its engagement with the member 36 is not airtight, so that atmospheric pressure prevails within its chamber 60.

In operation of this structure, the pressure in the chamber 38 is caused to vary; for examples at the starting and stopping of the air pump connected to the inlet passage 31, or by the starting and stopping of an air tool K driven by the air passing from the outlet passage 32. Assuming that the air pump is started, with the chamber 60 of the sump member 56 and the chambers 38, 42, 42a, 58 being at atmospheric pressure, the increase of pressure at the inlet passage 31 and in chamber 38 causes the air to flow

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downward along the outside of the baffle 37, upward within the baffle in chamber 42 and through the filter 39 to chamber 42a and thus to the outlet passage 32. Assuming that this outlet is blocked, for example by a valve V controlling an air tool K, the pressure in chamber 38 is exerted upon the upper surface of the piston 45, 46, 47 and acts to hold the valve 49 seated so that there is no communication between the chamber 58 beneath the piston, and the sump chamber 60. Therewith, also, the greater pressure in chamber 38, compared to chamber 58, causes air to deflect the packing edge 44 and to pass into chamber 58, carrying with it any water which has entered through the inlet, or has been condensed upon the walls of member 36, the baffle 37 and the filter 39. When the pump attains a determined pressure, and is stopped, the system has the air line at such pressure, along with chambers 38, 58, while the sump chamber 60 is at atmospheric pressure. Assuming that the valve V is then opened, so that air flows from the outlet passage 32, the pressure in chambers 38, 42, 42a drops, while the pressure in chamber 58 is momentarily retained: and therewith a pressure differential exists by which the piston 45, 46, 47 is raised, and the valve 49 leaves its seat. The pressure in chamber 58 is still above atmospheric, and any water which has collected in chamber 58 adjacent the valve is now expelled downwardly through the passage 52 into the sump chamber 60. Therewith, the pressure in the chamber 58 drops, both by escape of fluid into the sump chamber 60, and by the increase of chamber volume by the raising of the piston: and the system resets itself, for a further action at each drop of pressure in the chamber 38 relative to that in chamber 58.

When the amount of condensate liquid is small and it is volatile, the collection in the sump cup 56 may evaporate and pass to the atmosphere. If the collection increases, the attendant can note the level in the cup 56; the cup can be removed by pulling it downward so its bead 55 slips from the body member groove, the cup dumped, and then the cup returned by engaging its lip around the lower end of the central member 36 and pressing it upward until its bead is re-engaged.

In the form shown in FIGURES 4 and 5 for the drain device E, an air pressure tank T has an end wall 75 into which is sealed the threaded connector 76 which has also a threaded outer end 77 which has a sealed engagement at one end of the diametrical bore 78 in the upper body member 79. A cylindrical screen 80 is located in the bore 78 and has an enlarged inner end 81 closing the cross-section of the bore. The screen 80 can be fixed to a screw plug 82, engaged in the other end of the bore 78 and sealed by a gasket 83. A lower annular flange 85 on the body member 79 presses the outer margin of a flexible annular gasket 86 against a shoulder seat 87 of a lower body member 88: screws 89, FIGURE 4, being engaged with the body members 79, 88 to maintain the clamping and sealing pressure upon the gasket 86. A piston head 90 has a peripheral groove to receive the inner edge of the gasket 86 for sealing a first chamber space 91 above the piston from a second chamber space 92 below the piston and within the lower body member 88. A piston rod 93 is tightly fitted and sealed to the piston head 90 so that the parts move together: and has a valve portion 94 thereon for engaging the edge of a drain hole 95 in the bottom wall of the lower body member 88, and a projection 96 extending into the hole for piloting the lower end of the piston rod. The piston rod 93 has a passage 97 leading from the chamber 91 and having lateral ports 98 through the piston rod wall above the valve portion 95. An elastic sleeve 99, e.g., of rubber, has an inward flange 100 received in an external groove of the piston rod, and when contracted closely fits the external surface of the piston rod for sealing the outer ends of the openings 98.

An opening 103 is provided in the upper body 79, between the chamber 91 and the annular space in the bore 78 around the screen 80. A collection or sump cup 105

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has a skirt 106 and peripherally spaced spring portions 107 for engaging the radially projecting lower bead 108 of the lower body member 88; noting that free atmospheric access is permitted to the cup space 60.

The operation of the device of FIGURES 4 and 5 is in response to pressure changes in the tank T. Assuming all parts, including the tank T, at atmospheric pressure, and that the compressor pump P is started, the air pressure in the tank T is raised. Air, with liquid, can flow from the tank T through the passage 110 in the connection 76, 77 into the bore 78 and thence into the screen 80: after passing through the screen 80 and the opening 103, the air and liquid enter chamber 91 and pass into the piston rod passage 97; thence move out through the ports 98; distending the elastic sleeve 99, as indicated by the dotted lines, and enter the chamber 92 with the liquid collecting adjacent the valve portion 94, noting the sloping inner surface of the bottom of the lower body member 88. Due to the flow restriction by the sleeve 99, the pressure in chamber 91 is always slightly above that in chamber 92, and the piston head 90 is held down by this pressure differential, and by gravity; and the valve portion 94 seals upon its seat.

Assume that the compressor is stopped automatically or by hand, the pressure in the tank T, the passages 110, 78, 103 and chamber 91 are the same; with the pressure in chamber 92 below that in chamber 91 by an amount depending upon the force required to dilate the sleeve 99 away from the valve stem 93. The piston and its rod remain down, and the valve 94 remains sealed.

If air is drawn from the tank T, its pressure drops. Therewith, the pressure in passages 110, 78, 103 and chamber 91 drops. The sleeve 99 seals the ports 98, so that the chamber 92 momentarily remains at the prior super-atmospheric pressure. The piston 90 remains in its lower position, until the reversed pressure differential of chambers 91 and 92 acts upon the piston head to lift it and therewith the rod 93 opens the valve portion 94 so that the super-atmospheric pressure in chamber 92 can now be vented past the valve 94 into the cup 105, carrying the liquid with it. Shortly thereafter, the drop of pressure in chamber 92, due to the venting, brings this pressure below that in chamber 91 and tank T, so that the piston 90 is forced down by the restored pressure differential, and the valve is closed again. It will be noted that such opening and reclosing of the valve can be effected with a drop of, say, two pounds pressure per square inch in the tank T, from an automatic shut-off pressure of 60 pounds per square inch: and that the opening and reclosing is repeated with each like drop of pressure until the tank T returns to atmospheric pressure or until the compressor is started again by hand or automatically.

The structure can be connected at a low point of the tank T, or other part of a gas pressure system, so that collected liquid will flow by gravity to and through the filter screen 80 and thence into chamber 91; being assisted by air movement in the passages each time the pressure in chamber 92 drops below that in chamber 91 by an amount sufficient to provoke dilation of the sleeve 99 away from the ports 98.

When it is desired to operate a drainage device such as that of FIGURES 2 and 3 at lower rates of flow there-through on some occasions, but without disturbing its operation at a higher rate of flow, the device M may be employed, FIGURES 1 and 6 to attain a momentary pulsation for effecting the operation, e.g., a pulsation of two pounds per square inch in the above example. This is a desirable result, when the demand for supply by conduit 14 may vary from a low rate of flow at which the element 39 does not cause the illustrative differential of 2 pounds per square inch to become established between chambers 38 and 58: to a high rate at which the element 39 by its normal strainer or filter function causes such differential. For example, the valve V may be opened wide, with a maximum delivery to the tool K, when the

valve V is partly opened, to procure a lesser delivery to element 39 is effective to procure the purging. When the tool K, the pressure upstreamward of the valve V is higher and may be close to the pressure in the supply conduit 13 and chambers 38, 42, so that the pressure drop between chambers 38 and 58 of FIG. 2 may not have the illustrated value of 2 pounds per square inch for inducing the automatic purging action each time the tool K is operated at this low rate.

As shown in FIGURE 6, the device M comprises two end caps 120, 121 which are sealed to the supply and delivery portions of the air line 12, 13 of FIGURE 1. These end caps are treadedly sealed to the connection piece 122 which is hollow and is threaded internally near one end to receive the sleeve 123 which has a reduced portion 124 spaced from the inner surface of the piece 122. The sleeve 123 has a bore 125 in free communication with the supply conduit 12, and closed at the end within the cap 121; and having lateral ports 126 in the wall of the portion 124. An elastic sleeve 127 is fitted around the portion 124 to close the ports 126 when there is no pressure differential between the chambers in the caps 120, 121; but being dilated when such pressure differential is, say, 2 pounds per square inch, so that the air can flow from the supply portion to the delivery conduit 13, and being contracted again to close the ports when the pressure differential falls below this value. A clamping ring 128 holds the sleeve 127 in place.

In operation, if the valve V of FIGURE 1 is opened so that the flow is, say, 0.05 cubic feet per minute, the pressure at the valve falls slightly, and the slow flow through the device D is not enough of itself to establish immediately a pressure in chamber 38 which is the above-assumed 2 pounds per square inch below that in chamber 58. However, the conduit 13 between the devices M and D holds only a limited amount of air at the high pressure, so that the pressure in chamber 38 drops rapidly while the sleeve 127 seals the ports 126 and procures a piston movement to discharge liquid at the valve 49, before the pressure differential at the device M is effective to dilate the sleeve, noting that the energy necessary to dilate the sleeve is attained by the pressure differential effect, at the expense of the air pressure downstreamward. After dilation, the sleeve 127 permits air flow as demanded by the tool K and the opening of the valve V, with a pressure drop in the conduit 12, 13 of about 2 or 3 pounds per square inch. Thus, a minor opening of the valve V produces a liquid-expelling action in the device D. When the flow past the dilated sleeve 127 acts to restore pressure in the system downstreamward thereof, the sleeve 127 tends to close as the pressure differential drops; and thus a succession of expelling actions can occur. When the valve V is given a greater opening, the flow causes the pressure differential between chambers 38 and 58 to increase rapidly, and also the demand on conduit 13 causes the sleeve 127 to open quickly. Under this condition, the pressure drop caused by the element 39 acts, as above, to procure liquid expulsion; and the device M acts as a pressure reducing device.

The illustrative embodiments are not restrictive and the invention may be practiced in many ways within the scope of the appended claims.

What is claimed is:

1. A liquid discharging system comprising a pressure gas supply, a conduit between said pressure gas supply and a drain device, a restricting device in said conduit between said pressure gas supply and said drain device, said drain device comprising a structure having a plurality of chambers, a first of said chambers being in direct communication with said conduit, an outlet conduit in communication with said first chamber, a member in said drain device responsive to pressure differential between said first chamber and a second chamber of said plurality of chambers, a valve connected to said pressure responsive member to open and close communication between said

second chamber and the atmosphere, means for effecting fluid flow from the first chamber to the second chamber when the pressure in the first chamber is greater than that in the second chamber and for preventing flow from the second chamber to the first chamber when the pressure in the second chamber is greater than in said first chamber, said restricting device comprising a restrictive valve, said restrictive valve including an internal cavity separated by a dilatable barrier between inlet and outlet communication at spaced points thereof connected respectively to said supply and to said first chamber, whereby said barrier is dilated when the pressure at the inlet connection exceeds that at the outlet connection by a predetermined value.

2. The liquid discharging system of claim 1 wherein said dilatable member includes a projection having a bore for receiving gas from said supply and an elastic sleeve secured to said projection and normally closing said bore.

3. The liquid discharging system of claim 1 wherein said dilatable member includes a projection within said cavity, said projection having a bore for receiving gas from said supply and having a plurality of peripheral openings, and a dilatable sleeve surrounding said projection and normally closing said openings.

4. A liquid discharging structure for a system having varying gas pressure in a part thereof, comprising a body connected to said part, said body having a plurality of chambers including an inlet first chamber, an outlet chamber, an outlet conduit in communication with said outlet chamber, a flow restricting element positioned between said first and outlet chambers, a piston positioned between said first chamber and a second said chamber in said body and responsive to the pressure differential of said first and second chambers, a packing on the piston for permitting flow past the piston from said first chamber to said second chamber and for preventing reverse flow, said body including a passage from said second chamber to a third said chamber, and a valve connected to the piston and actuated thereby for sealing said passage when the pressure in the first chamber exceeds that in the second chamber and for opening said passage when the pressure in the second chamber exceeds that in the first chamber, and a deflector provided in said body, said deflector preventing the flowing gas from acting by its kinetic energy upon said piston whereby said piston is actuated solely by pressure differential.

5. A structure as defined in claim 4 wherein a baffle is provided in said body for deflecting gas entering said first chamber away from said flow restricting element and toward said piston, said baffle having angularly directed portions in the path of gas flow to cause the gas to whirl as it passes from the first chamber toward said flow restricting element.

6. A structure as defined in claim 5 wherein the body has a cavity, an annular baffle in said cavity defining said first chamber between itself and the cavity wall, said baffle having an inwardly directed flange bearing against the body, said flow restricting element having an annular portion located within the baffle, and a screw engaging said element and said body and thereby effective for holding the element and baffle fixed to the body.

7. A structure as defined in claim 6 wherein the piston is positioned opposite said screw, said screw thereby providing a stop for limiting the piston movement when the pressure in the second chamber exceeds that in said first chamber.

#### References Cited in the file of this patent

##### UNITED STATES PATENTS

|           |           |               |
|-----------|-----------|---------------|
| 2,100,485 | Lindemann | Nov. 30, 1937 |
| 2,125,144 | Aikman    | July 26, 1938 |
| 2,232,899 | Aikman    | Feb. 25, 1941 |

(Other references on following page)

3,130,741

7

UNITED STATES PATENTS

|           |               |               |           |
|-----------|---------------|---------------|-----------|
| 2,535,760 | Sherman ----- | Dec. 26, 1950 | 2,677,386 |
| 2,580,455 | Myers -----   | Jan. 1, 1952  | 2,726,732 |
| 2,651,322 | Hendry -----  | Sept. 8, 1953 | 2,822,887 |
| 2,662,544 | Hall -----    | Dec. 15, 1953 | 2,886,128 |
|           |               |               | 2,918,075 |

5

8

|                 |               |
|-----------------|---------------|
| Wilkerson ----- | May 4, 1954   |
| Faust -----     | Dec. 13, 1955 |
| Engman -----    | Feb. 11, 1958 |
| Ralys -----     | May 12, 1959  |
| Wilson -----    | Dec. 22, 1959 |