Feb. 11, 1958 G. ENGMAN 2,822,887

MOISTURE SEPARATOR FOR AIR PRESSURE LINES

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Fig.1.

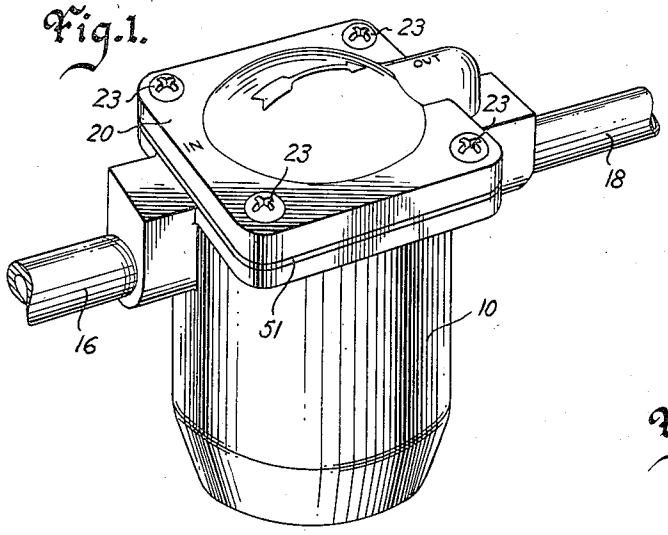


Fig.3.

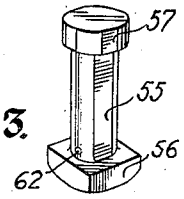


Fig.2.

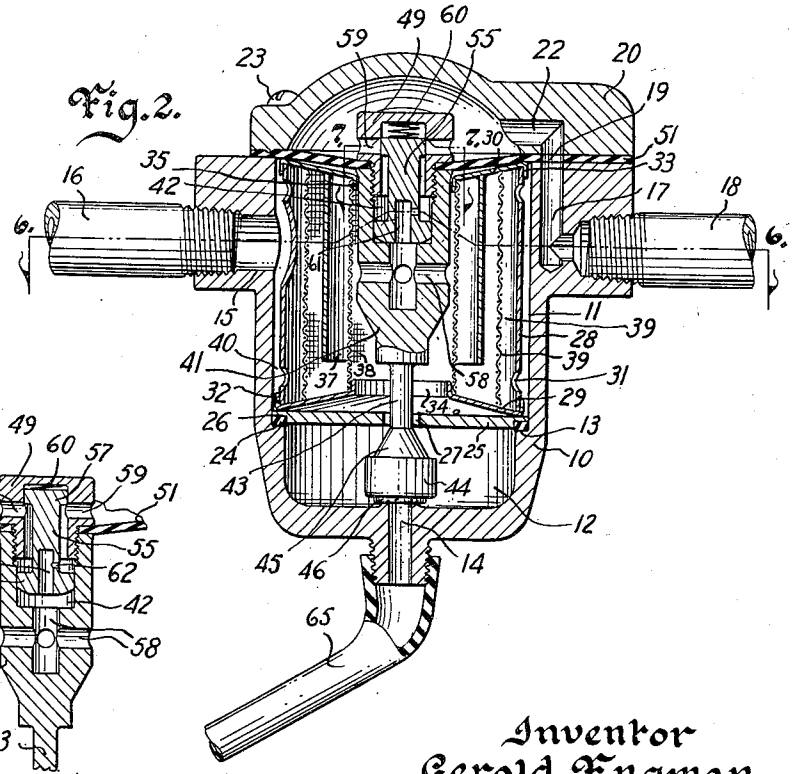


Fig.4.

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Fig. 5.

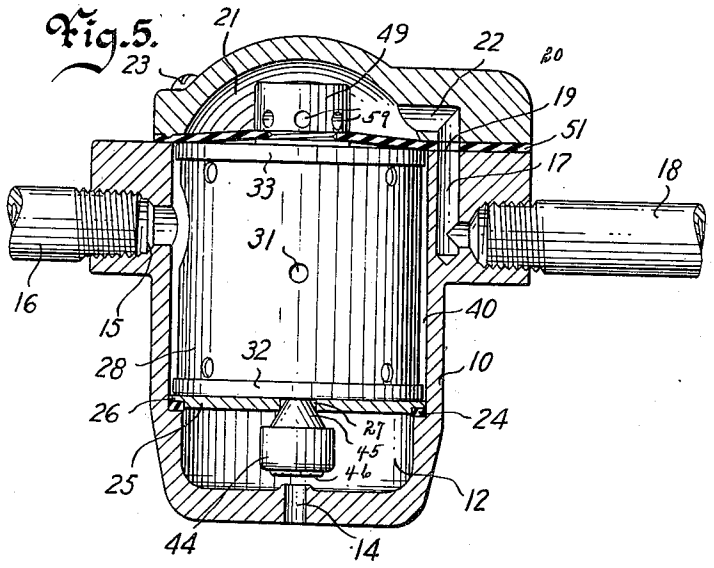


Fig. 7.

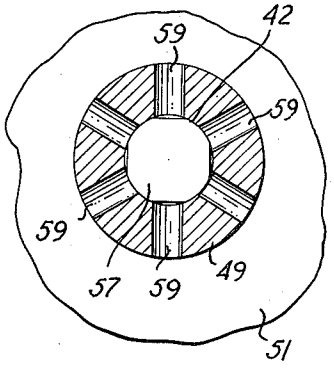
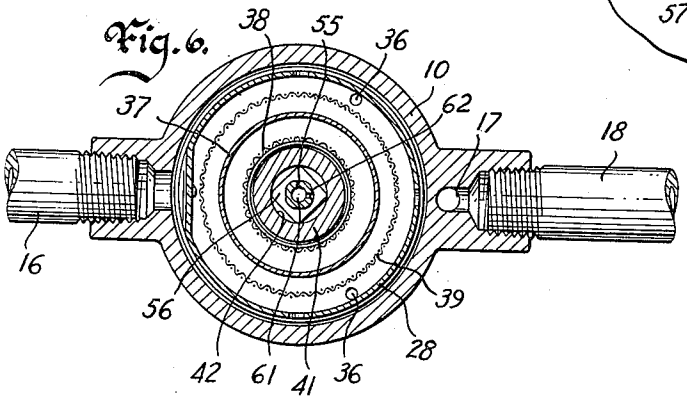


Fig. 6.



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MOISTURE SEPARATOR FOR AIR PRESSURE LINES

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9 Claims. (Cl. 183—41)

This invention relates to a device for separating water from air pressure lines and more particularly to a separator that will automatically compensate for variations in pressure lines and/or the sizes of exit orifices at point of use.

Compressed air as a source of power has many uses today such as operating spark plug cleaners, paint spray guns, powered hand tools, grease guns and the like and in these uses it is highly essential that the air at the point of use be free of moisture, grit, sludge, rust or the like. It is well known that moisture will condense out of compressed air and the amount of condensation will vary in proportion to the distance the air must travel to the point of use, changes of temperature along the air line and other causes. Consequently, if moisture is permitted to be discharged with the air at the point of use, serious damage and inefficient results can and will frequently occur.

The use of water removal means in air pressure conduits is not new. An example of such means is found in Churchman Patent No. 2,636,571, issued April 28, 1953, on a combination filter and trap. While the Churchman device worked quite successfully with a given air pressure, a given line capacity, and a given orifice size, it was not successful when such factors varied. The Shaw Patent Number 2,669,320, issued February 16, 1954, on a water separator and filter for air pressure lines, attempted to cure this objection found in the Churchman structure. The Shaw compensating means utilized an adjustable valve manually operated outside the separator housing. To obtain the desired results, however, was by the trial and error method. Also the average workman had no idea what he was doing when he rotated the valve stem. In fact it usually required the services of an expert to properly adjust the device and even when properly adjusted, users were constantly getting the mechanism out of proper adjustment.

Therefore, one of the principal objects of my invention is to provide a moisture separator for air pressure conduits that will automatically compensate and adjust for varying conditions of the line, the pressure and the size of the orifice at point of use.

A further object of this invention is to provide a combination water separator and filter through which air under pressure flows from a source of supply to a point of use and wherein any moisture, sludge, grid, rust or the like is filtered from the compressed air and automatically discharged from the air flow line at times.

It is still another object of the invention to provide a combination filter and trap through which air under pressure flows in passing to a point of use wherein any moisture in the compressed air is filtered from the compressed air and collected in a trap with said trap opened automatically by the differential of pressure existing between the inlet and outlet of the combination filter and trap when compressed air is withdrawn from the pipe line at the point of use.

A still further object of this invention is to provide a

combination water separator and filter through which air under pressure flows from a source of supply to a point of use and wherein any moisture, sludge or the like is filtered from the compressed air and collected in a trap from which point it is automatically discharged and which separator and filter is designed to permit a bleeding or slight leakage of the moisture from the tray to a collecting chamber during any prolonged operation of the device at the point of use and from which chamber it will not only drain by gravity during such prolonged operation but will be discharged by air pressure when the device at the point of use is started or stopped.

Still further objects of this invention are to provide a combination water separator and filter for drying and filtering compressed air in an air pressure line and automatically discharging the moisture therefrom which is economical in manufacture, simple in construction, easily and quickly installed, efficient in operation, easy and economical to repair, and design for long usage.

These and other objects will be apparent to those skilled in the art.

My invention consists in the construction, arrangement, and combination of the various parts of the device, whereby the objects contemplated are attained as hereinafter more fully set forth, pointed out in my claims, and illustrated in the accompanying drawings, in which:

Fig. 1 is a perspective view of my device installed in an air pressure line.

Fig. 2 is a vertical sectional view of my moisture separator and more fully illustrates its construction,

Fig. 3 is an enlarged perspective view of the flutter valve head means,

Fig. 4 is a side sectional view of the flutter valve means in a raised position,

Fig. 5 is a side view of the device with its housing broken away to expose certain interior parts,

Fig. 6 is a cross sectional view of the device taken on line 6—6 of Fig. 2, and

Fig. 7 is an enlarged cross sectional view taken on line 7—7 of Fig. 2.

Referring to the drawings, I have used the numeral 10 to designate a housing provided with the chamber 11 and a reduced chamber portion 12 below chamber 11 which results from the circumscribing ledge 13 that is machined in the lower inner portion of the housing 10, as shown in Fig. 2. The numeral 14 designates a centrally located opening provided in the bottom of the housing 10.

One side of the upper portion of the housing 10 is provided with the inlet 15 that is designed to communicate with a hose or pipe 16 conducting air under pressure from a source of supply. The other side of the housing 10, at a point substantially diametrically opposite to the inlet 15, is provided with the outlet 17 that is designed to communicate at one end with a hose or pipe or the like 18 conducting compressed air to a point of use and extends at its other end upwardly through the top of the housing 10 at the point 19 as shown in Fig. 2.

The numeral 20 designates a housing provided with the chamber 21 and the outlet 22. The housing 20 is designed to be detachably secured to the top of the housing 10 by any suitable means such as the stud screws 23. When the housing 20 is so arranged the outlet 22 in the housing 20 will be in line and communicate with the outlet 17 at the point 19, as shown in Fig. 2.

The numeral 24 designates a rubber washer resting on the ledge 13 and the numeral 25 designates a circular metal plate member provided with an inverted lip portion 26 about the underside of the periphery thereof and designed to snugly fit within the housing 10 with the lip ledge 26 resting on the rubber washer 24, as shown in

Fig. 2. The plate 25 is provided with the centrally located opening 27.

A cylindrical filter housing 28 provided with a detachable bottom member 29 and cover member 30 is positioned within the chamber 11 and rests on the plate 25. The filter housing 28 is further provided with a plurality of spaced apart holes 31 in its side wall.

Peripheral flanges 32 and 33 are formed on the bottom 29 and cover 30 respectively, to frictionally engage the top and bottom rim portion of the filter housing 28. This filter housing 28 is formed from a wide resilient metal band that has its free ends in spaced relation. When the base 29 and cover 30 are placed in their respective positions on the filter housing 28 the free ends of the housing are pushed together and the tendency of the band to expand thereby increases the frictional relation between the housing and the base and cover respectively.

The bottom 29 extends radially inwardly and upwardly to a center opening circumscribed by the upwardly extending circular collar flange 34. The cover 30 extends radially inwardly and downwardly to a centrally located opening circumscribed by the downwardly extending circular collar flange 35.

The numeral 36 designates a plurality of holes arranged near the periphery of the bottom 29 and inside and closely adjacent the flange 32. The numeral 37 designates a cylindrical shaped baffle member secured at one end to the inside of the cover 30 between and spaced apart from the flange 33 and flange 35 and extending vertically downwardly towards but short of the bottom member 29, as shown in Fig. 2.

The numeral 38 designates a cylindrical shaped mesh screen filter member that is vertically positioned within the filter housing 28 so that one end embraces the flange 34 on the bottom 29 and the other end embraces the flange 35 on the cover 30. A portion of the screen filter 38 is thus inside the baffle 37.

A second cylindrical shaped mesh screen filter member 39, larger in diameter than filter 38 is also vertically positioned within the filter housing 28 so that one end rests on the inside of the bottom 29 and the other end engages the inside of the cover 30. In this position the baffle 37 will be spaced apart and inside of the filter 39.

When the filter element is arranged and positioned as herein described there will be a space 40 in the chamber 11, between the inside of the housing 10 and the outside of the filter housing 28, as shown in Fig. 2 and Fig. 4.

The numeral 41 designates a valve stem having a reduced lower stem portion 43. A valve head 44 on the bottom of the valve stem 41 is provided with a conical shaped valve top portion 45 and a resilient valve seat portion 46 on the bottom thereof. The numeral 42 designates a well in the top of the valve stem 41. Threaded into this well is the hollow nut member 49. The numeral 51 designates a flexible resilient diaphragm between the cap 20 and housing 10 to divide the same into an upper chamber 21 and the intermediate chamber 40. The numeral 12 designates the lower chamber. The hollow nut 49 extends through the central area of the resilient gasket diaphragm or flexible wall 51 and is connected thereto as shown in Fig. 2, by the diaphragm being clamped between the valve stem unit and nut 49. Slidably mounted in the well 42 and the nut 49 is the flutter valve unit or piston 55 having an enlarged rectangular head 56 inside the well and an enlarged irregular head 57 inside the hollow nut 49. The numeral 58 designates air passageways in the valve stem communicating with the inside bottom of the well 42 and the inside of the chamber 40. In the upper portion of the nut 49 are lateral air passageways 59 communicating with its inside and the chamber 21. When the head 57 is in lowered position, the passageways 59 are closed and when in a raised position the passageways are open as shown in Fig. 4. The numeral 60 designates a coil spring having one end bearing on the inside bottom of the nut 49 and its other end

bearing on top of the head 57, for yieldingly holding the flutter valve downwardly in its vertical sliding movement. The numeral 61 designates an air passageway extending vertically through the head portion 56. This hole 61 connects with an air passageway 62 laterally extending through the side of the flutter valve stem above the head 56. This hole 62 is small in diameter relative to the air passageways 58.

The practical operation of the device is as follows: It is first arranged in an air pressure line so that the inlet 15 is in communication with a source of air under pressure that is conducted through the hose or pipe or the like 16 and the outlet 17 is in communication with a hose, pipe or the like 18 that conducts the compressed air to a point of use, such as a paint spray gun, powered hand tools or the like. Thus, the compressed air will pass through my separator and filter before it reaches the point of use. Preferably, this device should be placed in the air line as close as possible to the point of use so that the air after leaving the separator will have no great distance to flow before being used and thereby reducing the possibility of additional moisture forming in the air line between the separator and point of use.

The position of the valve seat 46 in the chamber 12 when no air is flowing is illustrated in Fig. 2. The reason for this is that the air pressure within the chambers 11, 12 and 21 respectively is equal, and consequently the pressure on both sides of the diaphragm 51 is the same.

Air will enter through inlet 15 into the space 40. From the space 40 it will pass through the holes 31 in the filter housing 21, and thence through the larger mesh screen filter 39. After passing through the filter 39, the air will be directed downwardly by the baffle plate 37 and under this baffle to pass through the smaller mesh screen filter 38. As the air passes through the filter 38 it will be in position to be released through the passageways 58, as will later be described in detail.

The path of the air flow through the filter element just described will cause the moisture, sludge, grit, rust or the like to be separated and filtered therefrom and to collect on the inside of the bottom 29 of the filter housing 28. The bottom 29 slopes from the center openig therein downwardly to the periphery thereof where the holes 36 are located. These holes 36 provide an outlet path for the moisture from the bottom 29 in addition to the central opening in the bottom 29.

When air is released at the point of use the position of the valve seat 46 is illustrated in Fig. 5. As this air is released through the outlet 17, the pressure above the diaphragm 51 in the chamber 21 becomes less than the pressure below the diaphragm, thereby causing the valve assembly to travel to its upwardly position. As this occurs, the conical portion 45 on the valve head 44 will seat in the underside of the opening 27 in the metal plate 25. This will move the valve seat 46 off of the opening 14 in the housing 10 and will expose the chamber 12 to the atmosphere. When this occurs there will be a distinct snap or sharp report due to a momentary rush of air from the chamber 12 to the outside atmosphere because while the valve assembly is in its upwardly position the chamber 11 will be substantially sealed off from the chamber 12 by the seating of the conical portion 45 in the opening 27 so that the pressure in the chamber 12 will be reduced to substantially that of the atmosphere. In this initial rush of air from the chamber 12, moisture that has collected therein will be blown out through the opening 14.

The valve assembly will remain in its upwardly position as long as air is released at the point of use. The reason for this is that the air is continually entering the filter as described and passing out through the passageways 58 and 59 into the chamber 21 and thence through the outlet 22 into the outlet 17, and during this time the pressure above the diaphragm 51 will be sufficiently less than that below it to hold the valve assembly up.

When the release of air at the point of use is stopped, a momentarily high pressure, due to inertia, will be built up in the chamber **21**. This pressure being above the diaphragm and considerably greater than the pressure below, it will blast the valve assembly downwardly to its lower position. As this occurs and during the time interval that it takes the valve seat **46** to be seated in the opening **14** the moisture or the like collected on the bottom **29** will be blown through the holes **36**, the center opening of the bottom **29**, thence through the opening **27** in the washer **25** and discharged through the opening **14**. The distance of travel of the valve seat **46** is short but the concentrated pressure built up when the air flow is stopped is sufficient to produce the discharge just described.

In order to obtain a satisfactory discharge of moisture or the like when the air flow is stopped, as just described, it is essential that this device be positioned within a very few feet from the point of use. The reason for this is to insure the proper pressure in chamber **21** due to inertia when the flow of air at the point of use is stopped. If the point of use is too far from this device, pressure in the flow line will build up slowly when the air flow is stopped, and instead of the valve seat **46** being blown downwardly it will merely slowly flutter to its closed position. However, this will not impair the operation of my invention because when the air flow is again started, any moisture collected in this device will be blown out as previously described. But since this device is capable of discharging moisture both at the stopping and starting of the flow air, it is preferably located near the point of use to obtain the full advantages of which it is capable. Likewise, the location of this separator and filter close to the point of use serves the additional useful purpose, previously described, of reducing the possibility of moisture condensing in the air line between this device and the point of use.

After the valve seat **46** is seated the pressure within the separator will equalize and when air is again released at the point of use, the operation just described is repeated. After a prolonged operation, or for any other reason, if it is believed that all of the moisture has not been discharged, it is merely necessary to start and stop the flow of air one or more times and this will discharge any moisture or the like that might still be inside the device.

The fact that the distance of the device from point of use affects its operation is indicative that there are also other factors that must be considered. They may well be the size of the air conduit, the normal maintained pressure at source, and certainly the size of the exit orifice. Obviously, the major portion of the air flow will always be able to pass through the air passageways **58**, thence into the valve stem well **42**, thence up along the side of the flutter valve stem **55**, and thence through the passageways **59** into the chamber **21**. However, the flutter valve has a great equalizing or stabilizing function to automatically take care of such above variations and thus eliminate manual adjustments. The spring bearing downwardly on the flutter valve head member **57** will tend to yieldingly close the passageways **59**. Also this yielding action will tend to hold the head portion **56** of the flutter valve in closed position over the outlet of the merging air passageways **58**. However, even with the flutter valve in such lowered position a small amount of air can pass from the passageways **58**, through the air passageways in the flutter valve and into the well **42** and nut **49** and around the central area of the flutter valve. This air under pressure will lift the flutter valve accordingly, elevating the head **57** to expose the air passageway **59**. By the head **56** being rectangular the major portion of the air will pass around it when it is raised from its valve seat as shown in Fig. 4. Thus the flutter valve unit will reciprocate to iron out the extreme variations encountered. The result is a valve

mounted within a valve and when the main valve, i. e., the member **41**, reciprocates, it will accordingly carry the valve **55**.

If it is desired to convey the water to a distance away from the device a conduit **65** may be secured over the opening **14**. To facilitate the entrance of air in volume into the chamber space **40** the member **28** may be indented adjacent the opening **15**.

Some changes may be made in the construction and arrangement of my moisture separator for air pressure lines without departing from the rear spirit and purpose of my invention, and it is my intention to cover by my claims, any modified forms of structure or use of mechanical equivalents which may be reasonably included within their scope.

I claim:

1. In a device of the class described, a housing having an air inlet opening, an air outlet opening and a water outlet opening, a flexible wall inside said housing dividing said housing into two compartments one of which communicates with said air inlet opening and the other with said air outlet opening, a pressure differential operated valve for controlling flow through said water outlet opening, means for connecting said valve to said flexible wall for movement therewith, said means having a passageway therein providing communication between said first and second compartments, a pressure responsive reciprocating valve in said passageway for opening said passage in response to pressure in said first compartment, and a spring means for yieldingly holding said reciprocating valve in a closed position.

2. In a device of the class described, a housing having a detachable lid cover, an inlet opening, an air outlet opening and a water outlet opening provided in said housing, a flexible wall inside said housing intermediate said cover and said housing to form an upper and lower compartment therein; said lower compartment in communication with said air inlet opening and said upper compartment in communication with said air outlet opening, a filter means arranged within said lower compartment intermediate said air inlet opening and said air outlet opening, a plate member arranged in said lower compartment to form an upper and lower chamber therein; said plate member provided with an opening to permit communication between said chambers, a pressure differential operated valve assembly in said housing, said assembly including a first valve in said lower chamber for controlling flow through said water outlet and between said upper and lower chambers, a stem extending through said plate and said filter means connecting said valve to said flexible wall for movement therewith, said stem having a passageway therein providing communication between said upper and lower compartments, a pressure responsive reciprocating valve in said passageway for opening said passage in response to pressure in said lower compartment, and a spring means for yieldably holding said reciprocating valve in a closed position.

3. In a device of the class described, a housing having an air inlet opening, an air outlet opening and a water outlet opening, a flexible wall inside said housing dividing said housing into two compartments one of which communicates with said air inlet opening and the other with said air outlet opening, a pressure differential operated valve assembly, said assembly including a valve for controlling flow through said water outlet opening, a bore connecting said valve to said flexible wall for movement therewith, an air passageway connecting its bore with the compartment that communicates with said air outlet, an air passageway connecting its bore with the compartment that communicates with said air inlet, a pressure responsive reciprocating piston valve in said bore for opening said passage in response to pressure in said first compartment, and a spring means for yieldingly holding said reciprocating valve in a closed position.

4. The structure of claim 3, wherein said second men-

tioned air passageway connects the bottom of its bore with the compartment that communicates with said air inlet.

5. In a device of the class described, a housing having an air inlet opening, an air outlet opening and a water outlet opening, a flexible wall inside said housing dividing said housing into two compartments one of which communicates with said air inlet opening and the other with said air outlet opening, a pressure differential operated valve assembly, said assembly including a valve for controlling flow through said water outlet opening, a bore connecting said valve to said flexible wall for movement therewith, an air passageway connecting its bore with the compartment that communicates with said air outlet, an air passageway connecting the bottom of its bore with the compartment that communicates with said air inlet, a pressure responsive reciprocating double-headed piston valve slidably mounted in said bore having one head adapted to close said first air passageway and its other head adapted to close said second air passageway in response to pressure in said first compartment, and a spring means for yieldingly holding said piston valve in one direction of its sliding movement.

6. The structure of claim 5, wherein said piston valve has an air passageway extending through one of its heads.

7. The structure of claim 5, wherein said piston valve has an air passageway extending through one of its heads and said passageway communicates with said second mentioned air passageway.

8. The structure of claim 5, wherein said piston valve has an air passageway extending through one of its heads and communicates with said second mentioned air passageway, said air passageway in said piston valve having a capacity substantially less than the capacity of said second air passageway.

9. The structure of claim 5, and perforated filtering members embraced in said first mentioned compartment.

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