Aug. 5, 1952 M. F. HALL 2,605,752

HUMIDIFIER AND AIR CLEANER

Filed Aug. 23, 1946 2 SHEETS—SHEET 1

Fig. 1

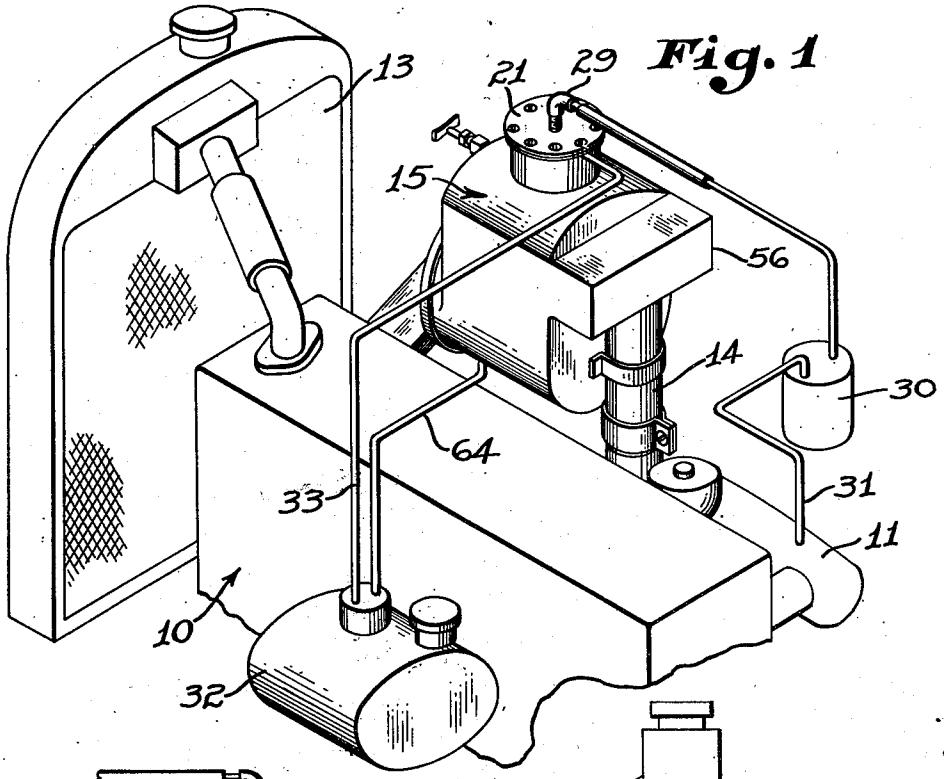

Fig. 2

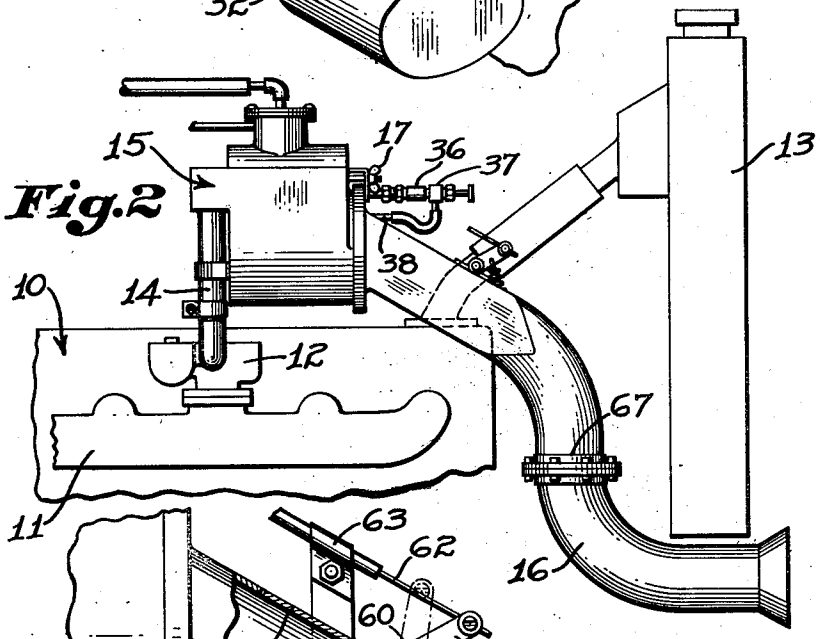

Fig. 3

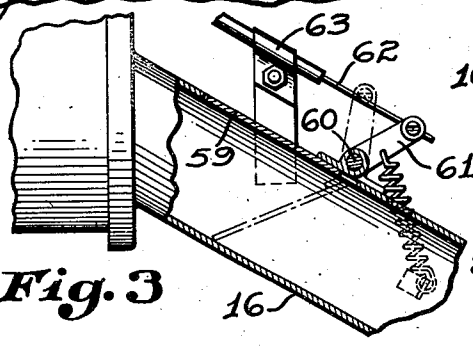

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Fig. 4

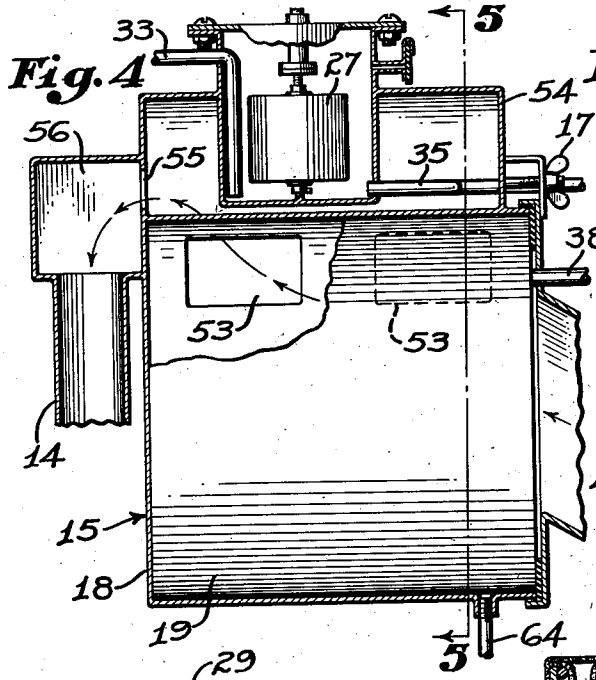


Fig. 5

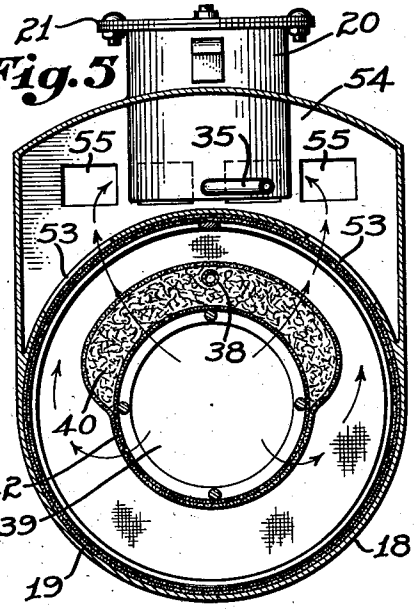


Fig. 6

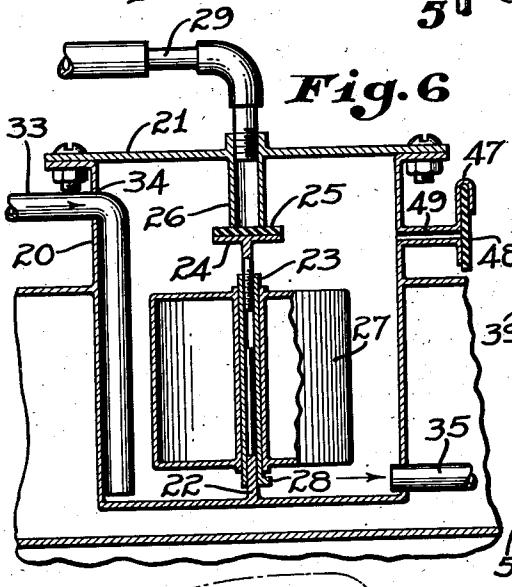
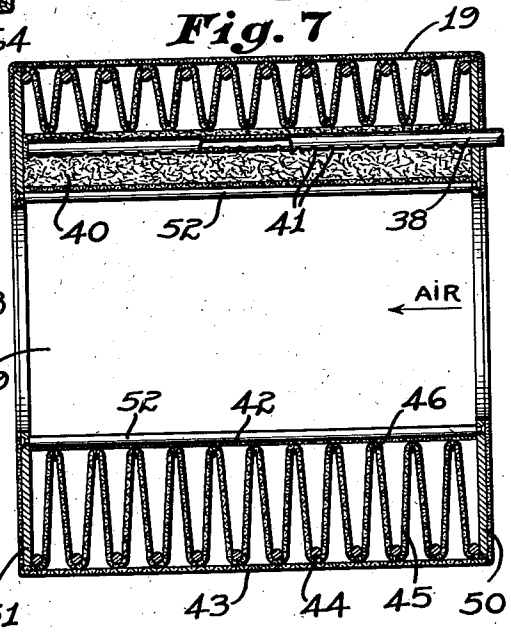


Fig. 7



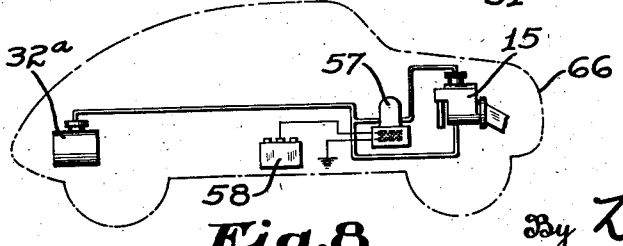


Fig. 8

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HUMIDIFIER AND AIR CLEANER

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11 Claims. (Cl. 123—25)

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This invention relates to internal combustion engines and is particularly directed to a humidifier and air cleaner for use with the fuel intake system of such engines.

It is known that injection of water into the air stream entering the carburetor or into the combustible fuel mixture within the intake manifold of an internal combustion engine has certain beneficial effects and that among these are increased power, suppression of detonation and decreased fuel consumption.

The principal object of this invention is to provide an improved form of humidifier and air cleaner through which passes substantially all of the air entering the carburetor of an internal combustion engine, in order that the density of the air may be increased prior to carburetion with consequent increase in volumetric efficiency. Another object is to humidify to the point of near saturation substantially all of the air drawn into the carburetor, thereby cooling of the air to increase its density, and hence providing a supercharging effect by increasing the amount of oxygen admitted with each cubic foot of combustible mixture entering the intake manifold. Another object is to provide a supercharging effect without corresponding increase in temperature, such as is ordinarily obtained when employing mechanical type supercharger apparatus. Another object is to provide humidifier apparatus of this type which offers minimum resistance to air flow. Another object is to effect automatic thermodynamic control on the amount of moisture added to the air mixture entering the carburetor. A further object is to provide an apparatus for accomplishing these purposes together with novel means for collecting impurities in a readily removable element. A further object of my invention is to provide means whereby the apparatus normally used for humidification may be operated in subfreezing temperatures as an air cleaner. Other objects and advantages will appear hereinafter.

In the drawings:

Figure 1 is a perspective view, partly broken away, showing a preferred embodiment of my invention associated with a conventional form of automotive engine of the internal combustion type.

Figure 2 is a side elevation, partly broken away.

Figure 3 is a fragmentary view on an enlarged scale, partly in section, showing details of an air valve employed in connection with the air inlet pipe.

Figure 4 is a side elevation, partly in section,

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of the humidifying unit employed in connection with my invention.

Figure 5 is a sectional elevation taken substantially on the line 5—5 as shown in Figure 4.

Figure 6 is a sectional elevation on an enlarged scale showing details of construction of the float chamber associated with my invention.

Figure 7 is a transverse sectional view of the humidifier cartridge employed in connection with my invention.

Figure 8 is a diagrammatic illustration showing a device embodying my invention as applied to an automobile and illustrating preferred locations of various associated parts.

Referring to the drawings, an automotive engine of the internal combustion type generally designated 10 is provided with an intake manifold 11 and a carburetor 12, of any conventional design. A radiator 13, of the usual type, is provided for cooling water circulated through the engine 10 by a pump (not shown).

Secured to the carburetor inlet 14 is an air cleaner and humidifier unit generally designated 14. An air scoop or inlet pipe 16 extending to the front of the engine in advance of the radiator 13 also leads to the unit 15 and is secured thereto by means of wing nut 17. The entire volume of air which passes into the carburetor 12 enters the unit 15 via the scoop 16 and is cleaned, humidified and cooled within the unit 15 before passing downwardly into the carburetor air inlet 14.

As shown in the preferred embodiment illustrated in Figures 4 to 7, the air cleaner and humidifier unit 15 comprises a casing 18 having an annular removable element 19 mounted thereon.

A water supply chamber 20 is secured to the casing 18 and is formed in the shape of a cup provided with a removable closure 12. A stationary post 22 attached to the bottom of the chamber 20 extends upwardly therein and forms a guide for the sleeve 23 which is slidably mounted on the post. The upper end of the sleeve is threaded to receive the depending shank of a valve element 24 having a sealing disk 25 secured thereto.

A downwardly extending tube 26 formed integrally with the closure 21 is adapted for cooperation with the sealing disk 25 to close off the lower end of the tube 26. A hollow float 27 is mounted within the chamber 20 and is arranged to slide vertically on the sleeve 23. A lug 28 is provided on the lower end of the sleeve for engagement with the float 27 so that the float 27 may move the sleeve 23 downwardly and thereby

separate the valve disk 25 from the lower end of the tube 26.

Suction is applied to the interior of the chamber 20 by means of the suction line 29 which is threaded into the tube 26. The suction line 29 communicates with a water trap 30, of any preferred construction, which in turn is connected to the intake manifold 11 by connecting conduit 31. A water tank 32 of any preferred construction may be located adjacent the engine 10, or may be located elsewhere on the vehicle (see Figure 8).

The inlet line 33 from the water tank 32 enters the chamber 20 at a sealed port 34 and extends downwardly to a point adjacent the bottom of the chamber 20. The discharge line 35 communicates with the interior of the chamber 20 at a point near the lower end thereof and extends upwardly for connection with a check valve 36, which permits flow through the line 35 only in the direction of discharge from the chamber 20.

A control valve 37 communicates with the check valve 36 and also connects with the water tube 38 which projects into the humidifier element 19.

Above the central opening 39 in the humidifier unit 19 and extending almost one-half of the way around the opening is an absorbent pad 40 which may be formed of any desirable material, such as excelsior. The water injector tube 38 extends into the pad 40 as shown in Figure 7 and is provided with a plurality of outlets 41 for distributing water in to the absorbent pad 40.

The annular element 19 containing the pad 40 includes a central tube 42. A spirally wound wire 44 encircles the wire mesh tube 42 in coaxial relation and a layer of cloth, such as open weave cloth 45, is wrapped around the spirally wound wire 44. A cord 46 is then spirally wound over the cloth 45 between the coils of the wire 44 and is drawn inwardly on diameter until the cloth 45 touches the wire mesh tube 42. On that portion of the periphery of the central wire mesh tube 42, which is adjacent the pad 40, the cloth 45 is drawn inwardly until it rests on the outer surface of the pad 40 rather than on the tube 42. This arrangement has been found to produce an inexpensive yet efficient form of bellows which act as a strainer and humidifier for air passing through it. A cloth cover 43, which also may be absorbent cloth encircles the entire element 19. The ends of the annular element 19 comprise annular metallic disks 50 and 51 retained in position by axially extending rods 52.

In operation, vacuum from the intake manifold 11 is transmitted by the line 31 to the water trap 30. Vacuum pressure is then applied via the line 29 and inlet 26 into the water supply chamber 20. The reduced pressure within the chamber 20 induces a flow of water into the chamber through the inlet pipe 33. As the water level in the chamber rises, the float 27 moves upwardly on the sleeve 28. When the top of the float strikes the underside of the valve 24, the valve disk 25 is brought into contact with the lower end of the tube 26, thereby closing off the vacuum line 29.

A flapper valve 47 having a flexible flap 48 adapted to close off a line 49 leading from the chamber 20 may be provided if desired.

The valve 47 is closed when suction within the chamber 20 draws the flexible flap 48 into sealing position at the outer end of the tube 49.

Water within the supply chamber 20 passes outwardly by gravity through the discharge line 35 and through the check valve 36, the rate of flow being governed by the set of manually adjustable control valves 37. The water then passes inwardly through the distributor pipe 38 and outwardly through the lateral ports 41 to saturate the absorbent material of the pad 40. Water passes by capillary attraction from the pad 40 to the cloth bellows 45 and closure 43 so that the entire element 19 is normally saturated with water.

Motion of the vehicle in which the engine 10 is mounted serves to ram air into the scoop tube 16 and into the central opening 39 within the element 19. The air then passes radially outwardly through the wire mesh tube 47, cloth bellows 45 and cover 43 and through the ports 53 provided in the casing 18. The bellows construction provides maximum area for humidifying the air yet offers only minimum restriction to flow of air therethrough. The ports 53 communicate with the interior of the enclosure 54, and air passes from the enclosure 54 through lateral ports 55 into the header 56 which is in communication with the carburetor air intake 14. It will be observed that the entire volume of air passing into the carburetor intake 14 is humidified upon passing through the saturated element 19. The amount of moisture absorbed by the air depends, of course, on the relative humidity of the air entering the scoop 16 and upon its temperature. It should be noted, however, that in general higher temperatures of incoming air automatically result in higher moisture content of air entering the inlet 14 and thus automatically thermodynamic control is obtained for injecting relatively larger amounts of moisture into the air as the temperature increases and thereby detonation within the combustion chamber is minimized.

The increase in air density and the addition of moisture permits satisfactory use of a leaner mixture, thus resulting in a better power mixture strength for obtaining maximum performance of the engine. The element 19 may be conveniently withdrawn as a unit from the casing 18 by removal of the wing nuts 17 and separation of the connection 67. A flexible tube 65 forms a convenient means for disconnecting the water tube 38 from the control valve 37, for purposes of removal of the element 19. Cleaning of the element 19 is then easily accomplished. The casing 18 is provided with a drain 64 for returning excess water to the tank 32.

While I have shown and described a water supply chamber 20 for supplying water to the absorbent pad 40, my invention is not limited to this arrangement and may instead utilize an electric pump 57 operated from the battery 58 of the vehicle as shown in Figure 8. If desired, the pump 57 may be electrically connected with the ignition circuit so that it operates only when the ignition key is turned on. The pump 57 may discharge water directly into the line 35 leading to the check valve 36 and control valve 37. As shown in Figure 8, the water tank 32a may be mounted in the rear of the vehicle if desired.

Under certain conditions of operation, such as operation at low temperatures, it may be desirable to draw air from within the enclosure 66 in which the engine 10 is mounted. Accordingly, a valve 59 may be mounted within the air inlet tube 16 and arranged for pivotal movement about the axis of its supporting shaft 60. A crank 61 secured to the shaft may be operated by a Bowden cable 62 carried on the bracket 63. When the valve 59 is turned to the position il-

lustrated by the dotted lines in Figure 3 air is no longer drawn from a location in advance of the radiator **13**, but enters through the opening normally closed by the valve **59**. In subfreezing weather oil may be substituted for water in the tank **32** or **32a** in order that the unit may continue efficient operation as an air cleaner.

While I have described my invention in connection with an engine employing a carburetor, it is to be understood that many of its principal advantages are useful with an engine of the diesel type using solid injection instead of carburetion.

Having fully described my invention, it is to be understood that I do not wish to be limited to the details herein set forth, but my invention is of the full scope of the appended claims.

I claim:

1. In a device for humidifying air for subsequent combustion with a fuel, the combination of a casing having a removable element therein, a central opening in said element closed at one end by the casing, absorbent mesh material encircling said opening, an absorbent pad adjacent said opening confined within said mesh material, means imbedded in said pad for injecting water into said pad, means for conveying atmospheric air axially into the central opening whereby it may pass radially outwardly through the mesh of said absorbent material, and means associated with the casing for discharging moist air.

2. In a deivce for humidifying air for subsequent combustion with a fuel, the combination of a casing having a removable element therein, a central opening in said element closed at one end by the casing, a pad of absorbent material adjacent said opening, a perforated pipe imbedded in the pad for injecting water into said pad, a bellows of absorbent mesh material encircling said opening and said absorbent pad, and adapted to become saturated from said pad, duct means for conveying atmospheric air axially into the central opening whereby it may pass radially outwardly through the material of the bellows and absorb moisture therefrom, and duct means associated with the casing for discharging moist air.

3. In a device for humidifying air for subsequent combustion with a fuel, the combination of a casing, an annular removable element in the casing and provided with a central horizontal opening closed at one end by the casing, a pad for absorbent material adjacent said opening, a perforated pipe imbedded in the pad for injecting water into said pad, said annular element including a bellows of absorbent mesh material encircling said opening and said absorbent pad, and adapted to become saturated with moisture from said pad, duct means for conveying atmospheric air into the central opening whereby it may pass radially outwardly through the mesh material of the bellows and absorb moisture therefrom, and duct means associated with the casing for discharging moist air.

4. In a device for humidifying air for subsequent combustion with a fuel, the combination of a casing, an annular removable element in the casing and provided with a central horizontal opening closed at one end by the casing, a pad of absorbent material extending axially of the element above said opening and extending around the opening in an arc less than 180°, a perforated pipe imbedded in the pad for injecting water into said pad, said annular element including a bellows of absorbent mesh material encircling said opening and said absorbent pad, and adapted to become saturated with moisture from said pad, duct means for conveying atmospheric air into the central opening whereby it may pass radially outwardly through the mesh material of the bellows and absorb moisture therefrom, and duct means associated with the casing for discharging moist air.

5. In a device for humidifying air for subsequent combustion with a fuel, the combination of a casing, an annular removable element in the casing and provided with a central horizontal opening closed at one end by the casing, a pad of absorbent material extending axially of the element above said opening and extending around the opening in an arc less than 180°, a perforated pipe imbedded in the pad for injecting water into said pad, said annular element including a bellows of absorbent mesh material encircling said opening and said absorbent pad, and adapted to become saturated with moisture from said pad, duct means for conveying atmospheric air into the central opening whereby it may pass radially outwardly through the mesh material of the bellows and absorb moisture therefrom, and ports in the upper portion of the casing for discharging moist air.

6. In a device for humidifying air for operation of an internal combustion engine, the combination of a casing, a replaceable corrugated element in the casing formed of water absorbent mesh material, means including a pump driven independently of the engine for injecting water into the casing to saturate the absorbent material, and means for passing through the mesh of said saturated material substantially the entire flow of air required for combustion in the engine.

7. In a device for humidifying air admitted to the carburetor of an internal combustion engine, the combination of a casing, a replaceable corrugated element in the casing formed of water absorbent mesh material, means for injecting water into the casing to saturate the absorbent mesh material, and means for passing through the mesh of said saturated material substantially the entire flow of air required for operation of the engine, whereby the density of the air may be increased prior to carburetion.

8. A device for increasing the density of air supplied to an internal combustion engine, comprising an air inlet conduit, a casing connected to the conduit, a replaceable corrugated element in the casing formed of water absorbent mesh material, means for injecting water into the absorbent mesh material to saturate the same, and means for passing through the mesh of said saturated material substantially the entire flow of air required for operation of the engine.

9. In a device for suppressing detonation in an internal combustion engine, the combination of means for humidifying an absorbent mesh material, said absorbent mesh material being corrugated to provide maximum area and minimum resistance to flow of air therethrough and means for passing through the mesh of said saturated material substantially the entire flow of air required for operation of the engine, whereby the air may be humidified, cooled and its density increased.

10. In a device for humidifying air to be used in combustion with a fuel in an engine, the combination of a casing; a replaceable humidifier

cartridge adapted to be received within the casing; a central axial opening in said cartridge closed at one end by the casing, the cartridge including a spirally wound element positioned axially of the central opening; a cloth fabric water absorbent material encircling the spirally wound element; a second spirally wound element positioned exteriorally of the cloth fabric and between the coils of said first spirally wound element, said elements cooperating to hold the cloth fabric in the shape of a bellows; means for saturating the cloth fabric with water; means for conveying atmospheric air axially into the central opening whereby it may pass radially outwardly through the mesh of said absorbent cloth fabric; and means associated with the casing for discharging moist air.

11. As an article of manufacture, a replaceable cartridge for a humidifier unit comprising in combination a spirally wound element extending axially of the cartridge; means in the cartridge defining an axially extending central opening therein; a cloth fabric water absorbent material

encircling the spirally wound element; and a second spirally wound element positioned exteriorally of the cloth fabric and between the coils of said first spirally wound element, said elements cooperating to hold the cloth fabric in the shape of a bellows.

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