

Oct. 8, 1963

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FUEL TREATMENT DEVICE

3,106,527

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2 Sheets-Sheet 1

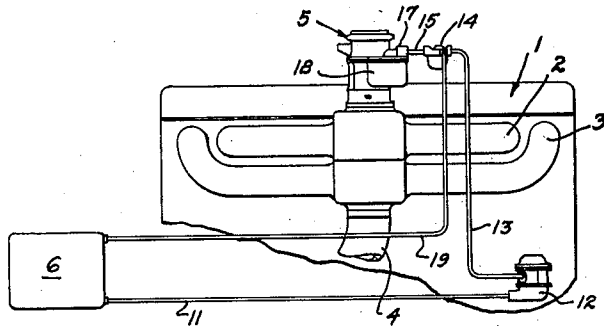


FIG. 1.

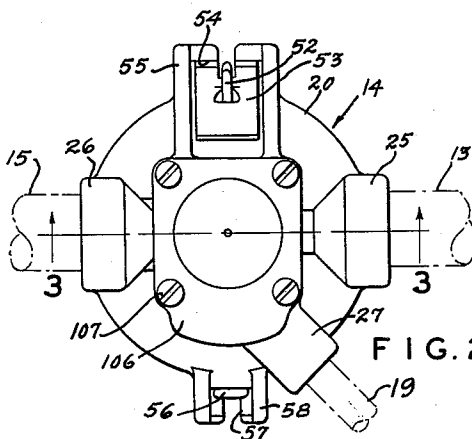


FIG. 2.

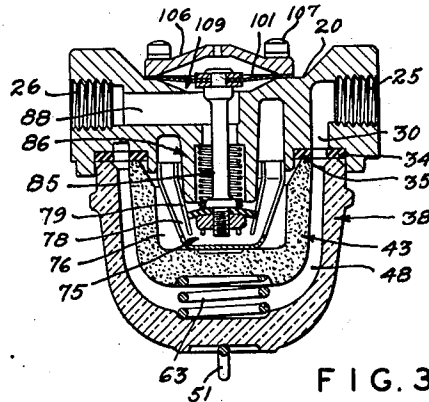


FIG. 3.

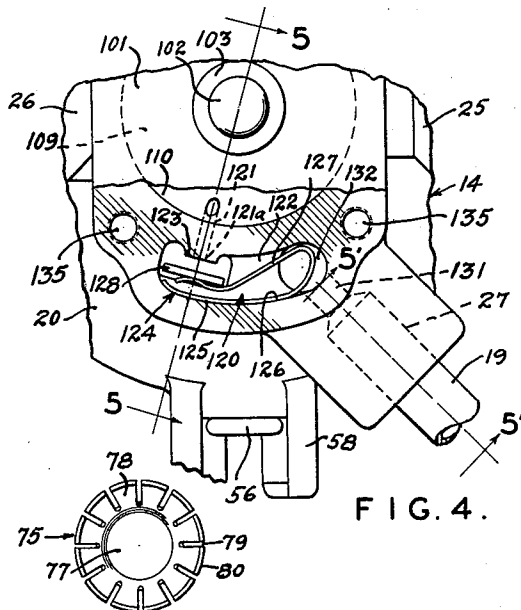


FIG. 4.

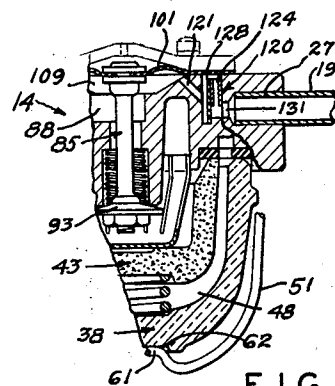


FIG. 5.

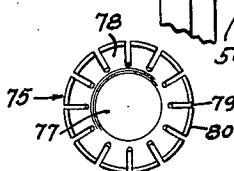


FIG. 6.

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2 Sheets-Sheet 2

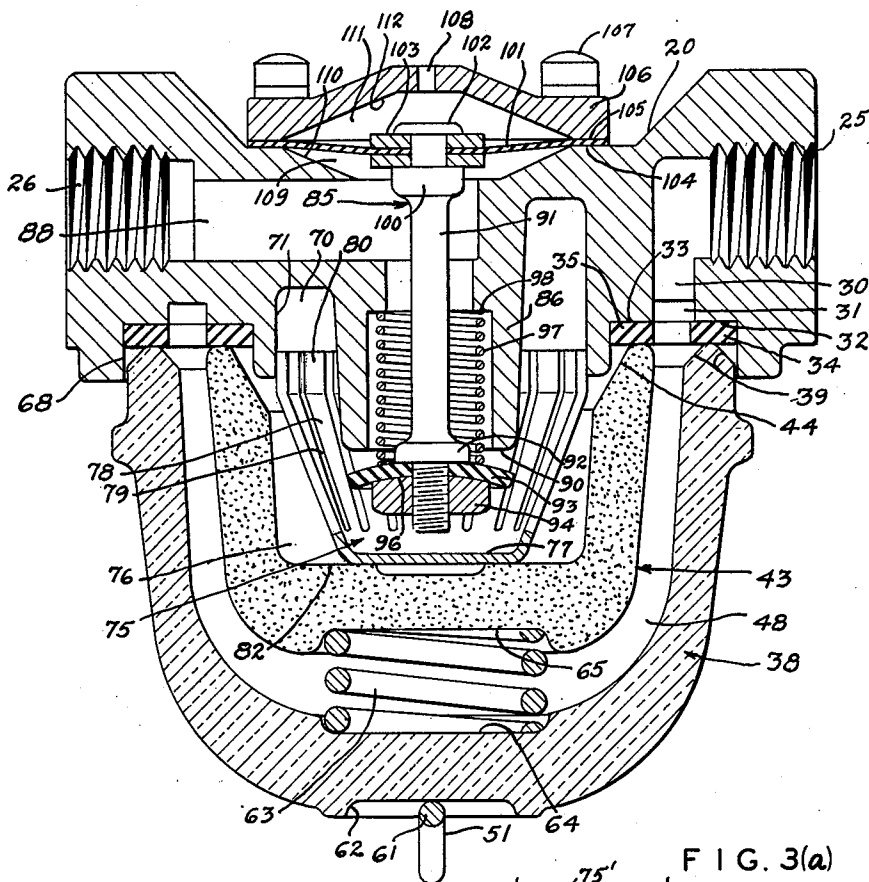


FIG. 3(a)

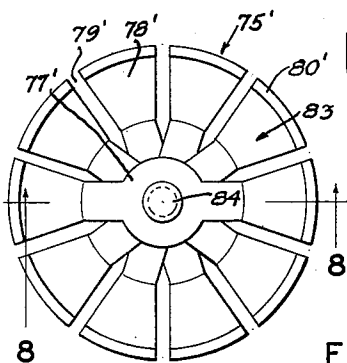


FIG. 7.

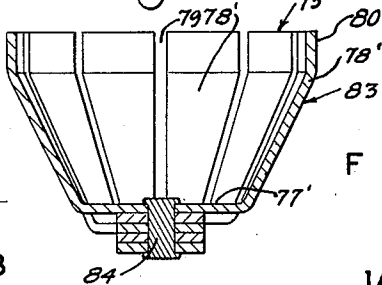


FIG. 8.

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3,106,527

## FUEL TREATMENT DEVICE

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Filed Aug. 28, 1958, Ser. No. 757,849  
6 Claims. (Cl. 210-223)

This invention relates to an improved fluid handling device especially suitable for use in internal combustion engine fuel supply systems, and particularly to an improved pressure control and filter device.

The fluid handling device of this invention is of the type which may advantageously be used in conjunction with the fuel supply system of an internal combustion engine. Prior to entering a carbureting apparatus and being charged into an engine combustion chamber, fuel should be filtered to remove foreign matter, water, grit, such as sand, metallic particles, and the like. Such filters are often equipped with mechanical filter elements such as a ceramic filtering element, or the like, which is usually constructed as finely as possible without overly retarding the flow of fuel through the filter. Some of the metallic particles to be filtered from the fuel are magnetizable, such as iron and steel, and a portion of these particles are usually sufficiently fine to pass through the mechanical filter element. In many present day fuel filters, magnets are so located as to affect only a small portion of the fuel, and some are difficult to remove. When the magnet is installed in an obscure location in the device, or is difficult to remove, it is likely that it will be retained in service until it is so loaded with magnetizable material as to become relatively ineffective.

Should the fuel become hot before reaching the engine's carbureting device, as when the engine has been in operation, especially on a hot day, or when the engine has been stopped and no fuel is flowing from the tank to the carbureting device, thereby exposing a small quantity of fuel to hot conduits, or a hot fuel pump, filter, and the like, for an extended period of time, the fuel may be sufficiently heated that its pressure is substantially increased. Such excessive pressure may result in erratic performance of the carbureting device, and is likely to damage the carbureting device, or to flood the engine. For example, in a conventional carburetor having a float actuated needle valve for admitting fuel to the carburetor, an excessive pressure in the line leading to the needle valve may force the valve open, even to the extent of bending the actuating mechanism, and the pressure of the fuel may force it through the carburetor and into the intake manifold, flooding the engine.

Furthermore, under hot conditions, certain fuels may vaporize, reducing the actual quantity of fuel reaching the engine, and thereby reducing the engine output, or a vapor lock may occur in the fuel system.

It is, therefore, an object of this invention to provide an improved fluid handling device which acts as a regulator.

Another object of this invention is to provide an improved and compact fluid handling device which may be easily serviced.

Still another object of this invention is to provide an improved pressure regulation, vapor elimination, and filter

A further object of this invention is to provide an improved filtering device. Other objects are to provide an device.

improved mounting assembly for filters, an improved filtering device incorporating an improved magnetic filtering element, and an improved magnetic filtering element.

Additional objects and advantages of this invention will

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be apparent from the following description and drawings, in which:

FIG. 1 is a side view of an internal combustion engine illustrating an operative environment of an embodiment of the improved fluid handling device.

FIG. 2 is a top view of the improved fluid handling device illustrated in FIG. 1.

FIG. 3 is a sectional elevation view taken on the line 3-3 in FIG. 2, and FIG. 3(a) is to an enlarged scale.

FIG. 4 is a fragmentary top view of a portion of the improved fluid handling device with parts removed and broken away, and to an enlarged scale.

FIG. 5 is a sectional elevation view taken primarily on the line 5-5 in FIG. 4, and in part on the line 5'-5' in FIG. 4.

FIG. 6 is a top view of an embodiment of an improved magnetic filtering element incorporated in the fluid handling device.

FIG. 7 is a top view of another embodiment of an improved magnetic filtering element incorporated in the fluid handling device.

FIG. 8 is a sectional elevation view taken on the line 8-8 in FIG. 7.

Briefly, the invention relates to a fluid handling device incorporating a magnetic filtering element which may be maintained in position in the device by a ceramic filtering element, or the like, and in which the entire mass of fluid passing through the device must pass through both filtering elements, and in close proximity to the poles of the magnetic filtering element. Of particular interest is the magnetic filtering element which is generally cup-shaped, with the walls of the cup having narrow gaps defining fingers, each of the fingers being magnetized with an opposite polarity. The device further incorporates a pressure regulating assembly arranged concentrically with the filtering elements and actuated by a diaphragm type pressure responsive motor responsive to pressure of the fluid in the outlet passage of the fluid handling device. In addition to regulating the pressure of the fluid in the outlet passage, the valve also shuts off the flow of fluid into the outlet passage if the pressure therein becomes excessively high. The outlet system of the device is provided with a vent incorporating a resilient temperature and pressure responsive element for opening the vent should the temperature of the device become excessive, and for permitting the escape of fluid from the outlet system should the pressure of the fluid become excessive.

When the fluid handling device is used in conjunction with a vaporizing fuel, the vent inlet is so arranged that fluid vapors tend to escape through the vent and fluid liquid tends to remain in the passage leading to the outlet of the device. Should the pressure regulating system become inoperative, and in the event of an extremely high pressure on the outlet side of the filters, the vent may open to prevent backflow through the filter.

The fluid handling device of this invention may be used in conjunction with numerous fluid handling systems, such as liquid lubricant systems, refrigeration systems, fuel systems utilizing a fluid fuel, and the system is particularly useful with liquid fluids which could vaporize within the range of temperatures which may be encountered by the fluid handling system. For purposes of illustration and description, and without so limiting the invention, the device will be described in conjunction with an internal combustion heat engine utilizing a fluid liquid fuel subject to vaporization, such as gasoline.

Referring to FIG. 1 of the drawings, a conventional internal combustion engine 1 has an intake manifold 2, and an exhaust manifold 3 which discharges into an exhaust pipe 4. A carburetor 5 is secured to the intake manifold 2 in a conventional manner, and is supplied with

fuel which is drawn from a tank 6 through the conduit 11 by a fuel pump 12. The fuel then passes through a conduit 13 to the improved fluid handling device 14, to be more fully described hereinafter. During normal operation fuel passes from the fluid handling device 14 through a conduit 15 and into a conventional float bowl 18 of the carburetor 5 through a carburetor fuel inlet 17. Conduit 19 is a return line from the fluid handling device 14 to the fuel tank 6, and is operative under certain conditions which will be fully described hereinafter.

FIG. 2 illustrates a top view of the fluid handling device 14 with the inlet conduit 13, the outlet conduit 15, and the return conduit 19, illustrated in phantom lines. A body member 20, preferably of non-magnetic material, receives the conduits in any conventional manner. The inlet conduit 13 is screwed into an inlet connection 25, the outlet conduit 15 is screwed into an outlet connection 26, and the return conduit 19 is sweated into, or otherwise connected to, a return connection 27.

Referring now to FIG. 3, and more particularly to enlarged FIG. 3(a), the inlet 25 in the body member 20 connects with an inlet passage 30 which, in turn, opens into a circumferential groove 31 and chamber 48. Immediately adjacent the groove 31 are a pair of offsets 32 and 33, each receiving a resilient sealing washer 34 and 35, respectively. An imperforate closure or fuel bowl 38, which may be fabricated of any appropriate material, such as glass, plastic, metal, or the like, has an upper, tapered sealing edge 39 which engages the sealing washer 34. A mechanical filter element 43 of ceramic material, or the like, is concentric with the bowl 38 and has a tapered upper sealing edge 44 which engages the sealing washer 35. A chamber 48 is defined by the inner surface of the bowl 38 and the outer surface of the ceramic filter element 43, and is in communication with the circumferential groove 31 in the body member 20. If desired, the resilient sealing washers 34 and 35 may be a single unit with appropriate openings for the passage of fluid from the circumferential groove 31 into the chamber 48. The fuel bowl 38 is clamped tightly against its sealing washer 34 by a U-shaped bale 51. The bale 51 is pivotally attached to the body member 20 by a hook or eye 52 on one end of the bale which engages through a hole in a plate 53, the plate 53 being freely received against a shoulder 54 on an attaching fixture 55 formed integrally with the body member 20. The other end of the bale 51 has a loop 56, or other appropriate transverse projection, which is received in a slot 57 in a second attaching fixture 58 formed integrally with the body member 20. The bight portion of the U-shaped bale 51 has an inwardly offset portion 61 engaging in a socket 62 in the bottom of the outer wall of the bowl 38. A compression spring 63 has one end received in a socket 64 formed in the inner wall of the bowl 38, and its other end is received in a socket 65 formed in the outer wall of the ceramic filter 43. Spring 63 urges the sealing edge 44 of the ceramic filter into tight sealing engagement with the resilient washer 35. The offset 32 in the body member 20 is provided with a vertical wall 68 which conforms to the size of the bowl 38 and provides lateral support for the bowl.

Referring to FIG. 6, in addition to FIG. 3, and FIG. 3(a), a magnetic filter element 75 is received in a cup-shaped cavity 76 in the ceramic filter element 43, and in a socket 70 having vertical side walls 71 in the body member 20. The magnetic filter element 75 is of generally frusto-conical, cup-shaped configuration, and preferably has a solid base or bottom wall 77 to retain any magnetic particles which may fall thereon, and side wall gaps or slots 79 to form a plurality of fingers 78. The top of the fingers 78 are bent to form a cylindrical rim portion 80. The fingers 78 preferably have sufficient resiliency, and the cylindrical rim portion 80 is of such size that the fingers grip around the wall 71 of the socket 70 with

a sealing fit and to temporarily retain it in the socket during assembly.

FIGS. 7 and 8 illustrate another embodiment of a magnetic filter element 75', again of generally frusto-conical cup-shaped configuration having a hollow and a solid base or bottom wall 77', a plurality of generally U-shaped magnetized bars or strips 83 having opposite polarities at opposite ends. The bars or strips are joined together at their bight portions as by a rivet 84. The resilient strips 83 are shaped to provide fingers 78' and gaps 79'. The free ends of the legs of the strip are bent to form a cylindrical portion 80', and, as shown, the bight portion of the U-shaped members are shaped to provide a solid base 77'.

The magnetic filter elements are preferably formed of a material such as that known in the trade as "Cunico," which is an alloy containing about 50 percent copper, 21 percent nickel, and 29 percent cobalt, although other materials such as that known in the trade as "Alnico," an alloy containing, basically, aluminum, nickel, cobalt, and iron, may also be used. When fabricated from "Cunico," the metal is preferably about .020 inch thick and the gaps 79 are about .040 inch wide.

In both embodiments, the magnetic filter element is magnetized in such a manner that adjacent fingers have opposite polarities. A magnetic flux field is therefore provided between opposite edge faces of the fingers and through the gaps between the fingers. The gaps 79 or 79' should project toward the bases 77 or 77' only to the extent that an adequate magnetic flux field exists in the gaps. As the free ends of the fingers 78 or 78' are in sealing engagement with the socket wall 71, the entire mass of fuel flowing through the filter must pass through the magnetic flux fields in the gaps 79 or 79'. By fabricating the body member 20 of a non-magnetic material, the portions of the fluid handling device adjacent the magnetic filter will not be coated with magnetized particles, and it is therefore merely necessary to remove the magnetic filters to remove all of the magnetized particles.

The magnetic filter 75, or 75', can be used without the ceramic filter 43, but it is positively retained in the socket 70 through engagement of the outer face of its bottom 77 with the inner face 82 of the bottom of the cup-shaped socket 76 in the ceramic filter 43, which also maintains proper spacing between the filters. It should be noted that the cylindrical portion 80 of the magnetic element 75 is free to slide vertically into socket 70 in the body member 20 so that a precision fit between the magnetic filter element 75, the ceramic filter element 43, and the resilient washer 34, is not necessary.

Still referring to FIGS. 3 and 3(a), a pressure regulating and shut-off valve assembly 85 is mounted in the body member 20 and is concentric with the bowl 38, ceramic filter 43, and magnetic filter 75. Valve assembly 85 is received inside a cylindrical boss 86 formed integrally with, and projecting outwardly from, the body member 20. The cylindrical boss 86 is concentric with the socket 70 and groove 31 in the body member or head 20. The hollow boss 86 opens at its top end into an outlet passage 88 which, in turn, opens into and forms a part of the outlet connection 26. The bottom of the cylindrical boss 86 provides a valve seat 90, and opens into the hollow in the cup of the magnetic filter element 75 or 75'.

The outer surface of the boss 86 acts as a baffle in causing the fuel entering through the top of gaps 79 to flow into intimate contact with the magnetic poles, and causes the fuel to flow along the poles to the valve seat 90, thus providing more efficient filtration of any magnetizable particles remaining in the fuel after the fuel has passed through the gaps 79.

A valve stem 91 is concentric with the cylindrical boss 86, and passes therethrough. The bottom portion of the valve stem 91 has a flange 92 and receives a resilient valve washer 93, which may be fabricated of synthetic rubber,

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leather, or the like. The washer 93 is clamped between the flange 92 and a nut 94 threaded onto the bottom end of the valve stem 91. The nut 94 is larger than the flange 92, and the upper face of the nut has a convex, arcuate, generally spherical surface 96. The resilient valve washer 93 is therefore arched to provide an improved sealing engagement with the valve seat 90 formed by the inner edge of the bottom of the cylindrical member 86. The arching of the valve washer 93 is aided by a compression spring 97 which engages the valve washer 93 and a shoulder 98 formed in the cylindrical member 86. The spring 97 is of greater diameter than the flange 92, but smaller than the nut 94. The upper end of the valve stem 91 is provided with a flange 100. A diaphragm 101 is clamped on the upper end of the valve stem 91 between the flange 100 and a peened-over clamping portion 102. A pair of rigid disks or washers 103 embrace opposite faces of the diaphragm 101 between the shoulder 100 and the peened-over portion 102. The periphery of the diaphragm 101 is clamped between the top face 104 of the body member 20 and a flat face 105 on a cap 106. The cap is tightly clamped to the body member 20 by bolts 107. A vent 108 is provided in the crown of the cap. The outlet passage 88 opens into a chamber 109 formed by the bottom face of the diaphragm 101 and a substantially frusto-conical face 110 in the body member 20. A second chamber 111 is formed between the upper face of the diaphragm 101 and the inner generally frusto-conical face 112 of the cover 106. The upper chamber 111, being vented through vent 108, offers no substantial resistance to the movement of the diaphragm 101, although the vent 108 may, if desired, be calibrated to a sufficiently small size that the upper chamber 111 would act to dampen movement of the diaphragm 101. Pressure regulation in the outlet passage 88 is normally determined by calibration of the spring 97 and the effective area of the diaphragm 101. It should be noted that the valve, valve stem, and diaphragm form a rigid assembly with no relatively moving parts such as pivots or sliding links and, therefore, this assembly will give satisfactory service for a prolonged period of operation.

FIGS. 4 and 5 illustrate a valved vent assembly 120, which is responsive to ambient temperature as well as the pressure in the outlet passage 88 and, more particularly, in the diaphragm chamber 109. FIG. 4 shows the top of the fluid handling device with the diaphragm cover 106 removed and a portion of the diaphragm 101 broken away. In FIG. 5, the cover 106 and bolts 107 are shown in phantom lines. FIG. 4 is to an enlarged scale, and it should be noted that in FIG. 5 the section is taken principally on the line 5—5 in FIG. 4 and that the passage 131, connecting portion 27, and return conduit 19 are sectioned on the line 5'—5' in FIG. 4, with this section including the wall 126 of the chamber 122. The leg 125 of the generally U-shaped thermostatic spring member 124 is shown in the major plane 5—5. It should also be noted that in FIG. 3 the valve assembly 85 is shown in an open position, whereas, in FIG. 5 the valve assembly 85 is shown in the closed position. A passage 121 preferably opens through the upper region of the frusto-conical wall 110 and connects the diaphragm chamber 109 with a chamber 122 in the body member 20. Therefore, liquid, or any vapors which inherently tend to collect in the upper reaches of the outlet system 26, 88 or 109, are removed by the vent, thereby tending to prevent vapor lock. The passage 121 is preferably about 10 percent to 15 percent of the area of the seat of the float controlled needle to cause the majority of the liquid to flow to the carburetor 5. The needle valve seat is normally the smallest restriction in the passage system from the chamber 109 to the float bowl 18. The passage 121 could open into other portions of the outlet system, or into the inlet side of the valve 90, 96, but it is preferable that the vent system remove vapor and excess pressure in the outlet system, as in the above-described pre-

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ferred arrangement. Adjacent either end of the chamber 122 are threaded sockets 135 which receive bolts 107. The passage 121 has a valve seat 123 at the end opening into the chamber 122. The valve mechanism includes a temperature responsive, bimetallic, resilient strip 124 of general U-shape, having a leg 125 conforming to and closely engaging a wall 126 of the chamber 122. The other leg 127 is provided at its free end with a resilient valve member 128 of synthetic rubber, leather, or the like. As shown in FIG. 4, the valve is open. The return conduit 19 is received in the body member connecting portion 27 by a fluid-tight sweat fit, although it may be connected therein in any appropriate manner. The connecting portion 27 opens into a passageway 131 which, in turn, opens into the chamber 122. The bottom wall of the chamber 122 adjacent the passage 131 is provided with a sump 132 to facilitate the free flow of fluid from the chamber 122 into the passageway 131.

When used in a gasoline system, the bimetallic spring 124 is calibrated to open between about 80° F. and 110° F., and to be tightly closed at about 60° F., when the passageway 121 is exposed to substantially normal operating pressures in the chamber 109 and outlet passage 88. Whether or not the valve assembly 120 is open or closed is of no particular significance for normal outlet pressures when the thermostatic spring 124 is at temperatures between about 60° F. and 100° F.

The valve assembly 120 also opens responsive to fluid pressure in the outlet system, and particularly in passage 121. As illustrated in FIG. 4, the pressure in chamber 109 which will open the valve 128 may be adjusted by varying the size of the mouth 121a of the passage, without disturbing the balance between the carburetor needle valve seat and metering restriction 131. The thermostatic spring 124 should be so calibrated that a pressure slightly above the normal desired outlet pressure will open the valve member 128 when the ambient temperature of the thermostatic spring is below the calibrated opening temperature, as previously described. Both temperature and pressure act together to open and close the valve, and therefore a slightly higher pressure is required to open the valve when the ambient temperature is relatively low, which may be desirable, as there is less likelihood of vapor lock under these conditions.

#### Operation

Under normal operating conditions, fuel is drawn from the fuel tank 6 through line 11 and into the fuel pump 12, from which it is discharged into the conduit 13 at a pressure of between approximately 2½ and 4 pounds. The fuel is pumped through the conduit 13, into the fluid handling device inlet connection 25 and passage 30, then into groove 31, past gaskets 34 and 35, and into chamber 48. The fuel then passes through the ceramic filter element 43 and into the chamber 76. All of the fuel then passes through the slots 79 of the magnetic filter element 75. In passing through the slots 79, substantially the entire mass of fuel passes through the magnetic fields between the opposite poles of each adjacent arm 78, and thus, any fine, magnetizable particles which may pass through the ceramic filter 43 are removed from the fuel. Under normal operating conditions, the valve 85 is open and fuel passes through the inside of cylindrical boss 86 and into the outlet passage 88, from which it is discharged through the outlet connection 26 into conduit 15, and then into the carburetor fuel bowl through the carburetor inlet 17. The diaphragm 101 is exposed to the fuel pressure in the outlet system 26, 88, and 109, and accurately limits the pressure of the fuel delivered to the carburetor fuel inlet 17, irrespective of the resistance to fluid flow of the valve 96 and valve seat 90, or the resistance to fluid flow of the filters 43 and 75, which may vary with different filters, or after continued use, because of clogging of the filters, and the like. Should the

pressure of the fuel in the outlet system of the fluid handling device begin to rise, the pressure on diaphragm 101 will be increased, moving the diaphragm 101 and valve washer 96 upwardly from the position shown in FIG. 3 toward the position shown in FIG. 5. Such a rise in pressure is particularly likely to occur when the engine speed is decreased very rapidly, so that the inertia of the fuel in conduit 13 forces the fuel into the fluid handling device at a relatively high pressure after the engine's demand for fuel has diminished and the float controlled needle valve in the carburetor has closed. The pressure is also likely to increase when the engine has been run hot, particularly on a hot day, and then has been stopped, resulting in a small quantity of fuel in the conduits 13 and 15, and in the fluid handling device 14, being exposed for an extended period of time to a high temperature, during a so called "hot soak." Whatever the cause of the increased pressure, the valve assembly 85 will be at least partially closed, reducing the pressure in the outlet system 26, 88, and 109. When the engine is stopped, the outlet pressure may become so high that the valve will close entirely, although this could occur during operation of the engine.

When the temperature and pressure responsive vent valve assembly 120 is closed, that is, when the valve member 128 tightly engages seat 123, the bimetallic spring element 124 is exposed to the ambient temperature in the chamber 122 and the wall 126. The bimetallic element 124, as mentioned previously, is calibrated to open at a temperature of between 80° and 110° F. under substantially normal pressure conditions in the outlet system of the fluid handling device, this pressure being controlled and maintained normally constant at about 3½ to 4 p.s.i. by valve assembly 85, irrespective of the action of the vent, and for a fuel having a vaporizing temperature of about 95° to 100° F. at normal operating pressures. When the valve assembly 120 opens, the bimetallic spring element 124 is then also exposed to the temperature of the fuel, or vapor, or both, passing from the chamber 109 through the passage 121 into chamber 122 and out passage 131 into return conduit 19. As passage 121 opens into the upper portion of the outlet system, through wall 110 of diaphragm chamber 109, fuel vapors which inherently rise from the liquid fuel will tend to be removed from the outlet system through the vent, rather than liquid fuel. As illustrated in FIG. 1, the return conduit 19 discharges into tank 6, although it could, alternatively, discharge into fuel supply conduit 11, but then excessive pressure in conduit 11 would be reflected in chamber 122. Normally, the valve assembly 85 controls the pressure in the outlet system 26, 88, and 109 of the fluid handling device, but when the valve assembly 85 is shut, that is, when valve washer 93 tightly engages valve seat 90 and, particularly, when the engine is stopped and not using fuel, the pressure in conduit 50, passage 88 and chamber 109, may become so excessive as to tend to force the float control needle valve in the carburetor open and flood the engine 1. Should the pressure become this high, say, 15 to 20 pounds, as an example only, with the temperature responsive valve assembly 120 closed, the pressure applied through passage 121 will open the valve, permitting the excessive pressure to escape back to the tank 6 through the conduit 19.

#### Disassembly and Reassembly

The fluid handling device of this invention is extremely simple to service in the field, and merely requires removing the offset portion 61 of the resilient bale 51 from the socket 62, whereupon the bale will pivot out of the way, permitting the bowl 38 to be removed along with the ceramic filter element 43. The magnetic filter element 75 may then be withdrawn manually by the fingers from socket 70. The magnetic filter element 75 may be cleaned by wiping off the magnetized particles adhering thereto and removing any deposits. The ceramic filter element

may be cleaned in a manner which is well understood in the art, or, preferably, it may be replaced. In reassembling the device during field service, the magnetic filter element 75 is lightly inserted into the socket 70, and will be temporarily retained therein by the resiliency of the arms 78. With the bowl 38 in an upright position, the spring 63 is inserted in the bowl socket 64, and the ceramic filter element 43 is inserted into the bowl 43 with the top of the spring 63 received in the filter socket 65. This assembly is then inserted into the filter body member 20 with the top of the outer wall of the bowl 38 engaging the vertical wall 68 in the body member 20. The resilient bale 51 is then pivoted around the bowl 38, and the eye 56 is again engaged in the slot 57, completing the assembly. It should be noted that the bale has an offset portion 61 received in socket 62 in the bottom of the bowl to prevent accidental disengagement.

Should it be desired to completely disassemble the fluid handling device, it should preferably be removed from the engine, although the disassembly may be effected while the device is installed on an engine. Following the routine for the field service disassembly, the bolts 107 are removed, and the diaphragm cover 106 may then be removed. The nut 94 retaining the valve washer 93 on the stem 91 is next removed, and to facilitate this operation, the head 102, or the end of the threaded portion of the valve stem 91 may be provided with a slot or other means to receive a tool for holding the stem stationary. The valve washer 93 and spring 97 may then be removed, and the diaphragm and stem 91 may be withdrawn through the top of the body member 20. Should disassembly to this extent be desirable, it would be desirable to replace the diaphragm 101 and the stem 91, in which event, care would not have to be taken to protect the diaphragm when removing the nut 94. The thermostatic element 124 and valve 128 may be removed after removal of the diaphragm by merely withdrawing the parts from the chamber 122, being careful not to damage the face of the valve 128.

The fluid handling device is reassembled by inserting the thermostatic element 124 into the chamber 122, replacing the valve stem 91 through the cylindrical portion 86, inserting the spring 97, and then placing the valve washer 93 on the stem 91, and tightening down the nut 94. Care should be taken to align the holes in the diaphragm with the holes 135 in the body member 20. The cover 106 is then replaced and clamped to the body member 20 by bolts 107. The sealing washers 34 and 35 may be replaced, if desired, and the remainder of the fluid supply control is assembled as previously described.

Although this invention has been described with particular reference to certain embodiments, particular features, materials, and functional relationships, the disclosed embodiments are intended only to facilitate a clear and concise description. Various changes, and other embodiments and modifications, will be apparent to one skilled in the art, and the invention is, therefore, not to be limited to the particularly described embodiments, features, materials, or functional relationships, except as set forth in the appended claims.

We claim:

1. In a fuel system, a fuel filtering device comprising, a non-magnetic base including an outwardly projecting boss, a passage having an inlet in said boss, a socket defined by a wall in said base and encircling said boss and said inlet, a plurality of nested cup-shaped members having end walls and spaced apart side walls with free ends, means maintaining said free ends in sealed relationship with said base, said boss being received within a first one of said cup-shaped members, said first cup-shaped member having side walls thereof defined by a plurality of magnetized resilient fingers having free ends retained in said socket by resilient engagement with said socket wall, a second one of said cup-shaped members being a mechanical filter and receiving said first member, a third

one of said cup-shaped members being an impermeable closure and receiving said second member, and means securing said closure to said base.

2. In a fuel system, a fuel filtering device including a magnetic filter comprising, a cup-shaped member having an end wall and resilient side wall means extending from said end wall, a plurality of spaced gaps in said side wall means for the passage of a filterable medium there-through, said gaps defining therebetween a plurality of fingers extending upwardly from said end wall, said fingers having free ends forming a lip of said cup-shaped member, means at the free ends of said fingers for mounting said filter, opposite portions of adjacent fingers having opposite polarities providing a magnetic flux field between said fingers and through said gaps, said end wall being substantially imperforate to retain thereon magnetizable particles which may fall from said fingers.

3. A fuel filter comprising a body structure formed with an inlet opening and an outlet opening and a fuel passage connecting said openings, and a magnetic filter element positioned within said fuel passage, said filter element including a base and a plurality of spaced resilient magnetized strips extending from said base and across said fuel passage, said strips forming with said base a cup-like configuration having a lip portion tightly biased around the inner wall portion of said fuel passage.

4. A fuel filter comprising a body structure formed with an inlet opening and an outlet opening and a fuel passage connecting said openings, a magnetic filter element positioned within said fuel passage, said filter element including a base and a plurality of spaced resilient magnetized strips extending from said base and across said fuel passage, said strips forming with said base a cup-like configuration having a lip portion tightly biased around the inner wall portion of said fuel passage, and a ceramic filter having a cup-like shape and mounted coaxially with and adjacent to said magnetic filter with the lip of said cup-like ceramic filter sealed across said fuel passage.

5. A fuel filter comprising a body structure formed with an inlet opening and an outlet opening and a fuel passage connecting said openings, a magnetic filter element positioned within said fuel passage, said filter element including a base and a plurality of spaced resilient

magnetized strips extending from said base and across said fuel passage, said strips forming with said base a cup-like configuration having a lip portion tightly biased against an inner wall portion of said fuel passage, a cup-like ceramic filter coaxially enclosing said magnetic filter with said magnetic filter base in contact with the inner bottom surface of said cup-like ceramic filter, and means sealing the lip of said cup-like ceramic filter around the periphery of the inner surface of said fuel passage.

6. A fuel filter comprising a body structure formed with an inlet opening and an outlet opening and a fuel passage connecting said openings, a magnetic filter element positioned within said fuel passage, said filter element including a base and a plurality of resilient magnetized strips extending from said base and across said fuel passage, and a tubular conduit forming a portion of said fuel passage, said strips forming with said filter element base a cup-like configuration enclosing one end of said tubular conduit, said cup-like magnetic filter having a lip portion tightly biased against and around the inner wall portion of said fuel passage.

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