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FUEL PUMP

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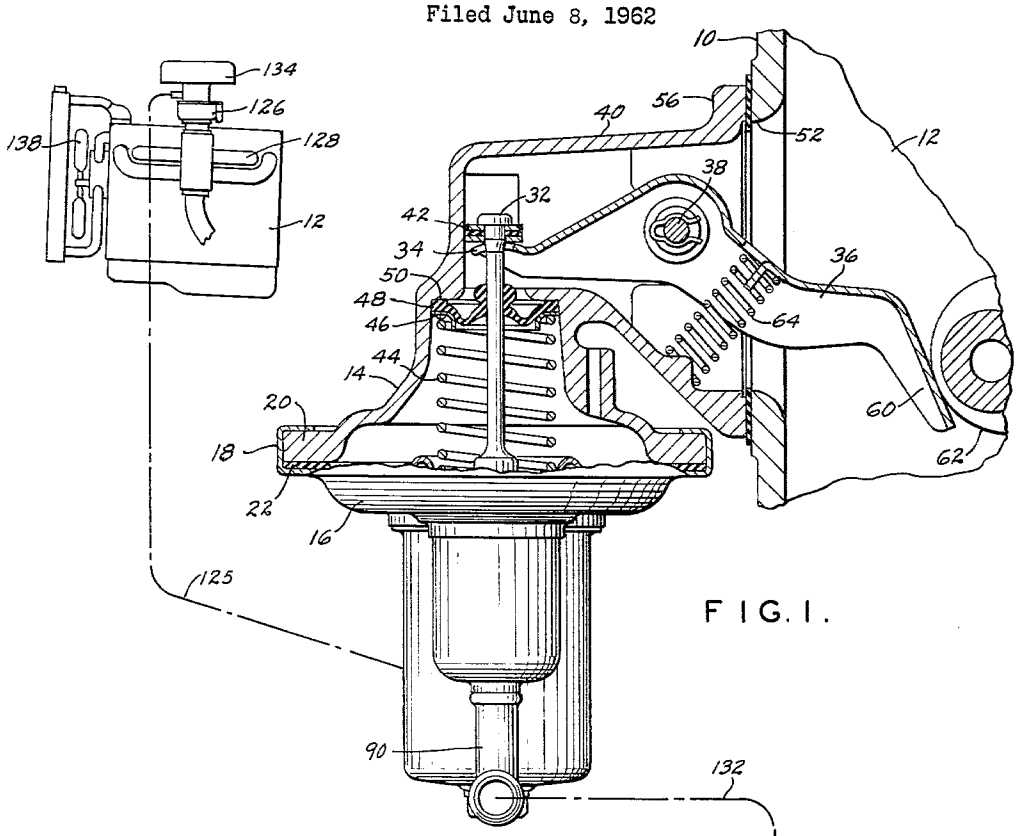


FIG. 1.

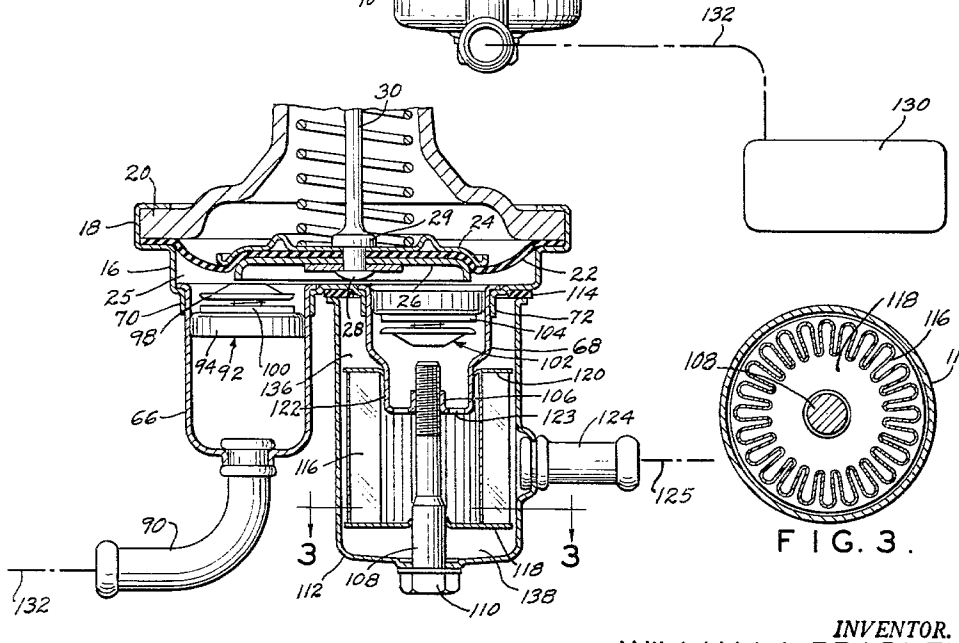


FIG. 2.

FIG. 3.

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FUEL PUMP

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This invention relates to a mechanical fuel pump and particularly to a fuel pump design, in which the basic considerations are heat dissipation and cost reduction.

Mechanical fuel pumps made of cast metal housings use an excessive amount of metal alloy and require considerable machining operations. In considering the problem of reducing the cost of fabrication of such pumps, it has been found that sheet metal construction lends itself advantageously for this purpose.

An object of this invention is to provide a novel design of a fuel pump and filter assembly for the fuel system of an automotive vehicle, which is formed easily of sheet metal to provide a cost reduction in pump fabrication.

Another object of this invention is to provide a novel construction of a fuel pump and filter assembly for the fuel system of an internal combustion engine, in which the integral parts are easily formed of sheet metal and adapted to utilize a folded paper filter.

This invention is directed to a novel design of a mechanical fuel pump and filter assembly in which heat dissipation is greatly increased by the use of thin walled metal housing structures and in which cost reduction is achieved by the use of shaped sheet metal parts. The fuel filter chamber is detachably joined with the pump housing structure to form a housing for a replaceable folded paper filter.

FIGURE 1 is a partial sectional view in elevation of the novel pump and filter assembly, in accordance with this invention, and schematically showing the assembly attached to a portion of an internal combustion engine and with the fuel system of the engine indicated.

FIGURE 2 is a sectional view in elevation of a portion of the fuel pump of FIGURE 1, and rotated 90° from the position of FIGURE 1.

FIGURE 3 is a cross section along section line 3—3 of FIGURE 2.

FIGURE 1 discloses this invention in a sectional view, in elevation, of the pump and filter assembly connected to the crankcase 10 of an internal combustion engine 12. The pump portion of the pump and filter assembly includes a pump spring housing 14 attached to a pump housing portion 16. The pump housing portion 16 is a sheet metal dished plate construction, of iron, or steel, for example, and having a thickness in the order of 0.030". The dished plate 16 has a rim 18 bent up and inwardly over a flange 20 of the spring housing 14. The fastening of the rim 18 over flange 20 is done with sufficient pressure so that the peripheral edge of a circular flexible rubber-coated fabric pump diaphragm 22 (FIGURE 2) is tightly gripped between rim 18 and flange 20. This seals, in a fuel-tight manner, the diaphragm to rim 18. This method of attaching rim 18 to flange 20 eliminates the necessity of using screws through flange 20 which would require a large flange area. Thus, flange 20 is kept to a minimum size permitting the positioning of the pump within a smaller space.

The central portion of the pumping diaphragm 22 is made sufficiently rigid by a pair of backing plates 24 and 26 on opposite sides of the diaphragm 22. Backing plates 24 and 26 are tightly fixed together with the pumping diaphragm 22 in between by flattening the end 28 of a pump rod 30 extending through the several parts. This holds the plates and diaphragm between a shoulder portion 29 abutting the surface of plate 24 and the end

portion 28. The other end of rod 30 is formed with a nail head 32, which is fitted into the forked end 34 of an actuating lever 36, which in turn is mounted for pivotal movement on a bearing pin 38 journaled in an extension 40 of the spring housing 14. A flexible noise-suppression wear pad 42 is positioned between the rod head 32 and the forked end 34 of the actuating lever 36. A pump driving spring 44 is positioned between the upper surface of backing plate 24 and a support eyelet 46, which is forced by the spring 44 to tightly seal the peripheral edge of a sealing ring 48 against a shoulder 50 of the spring housing 14. The actuating rod 30 passes through the center of sealing ring 48, which permits reciprocating motion of the rod but fits the rod with sufficient tightness to provide a wiping action. This prevents oil from the crankcase from penetrating into the portion of housing 14 enclosing the spring 44.

Spring housing 14 is fixed across an opening 52 through the wall of the crankcase 10 of the engine 12 and may be attached to the crankcase 10 by fastening the housing to studs extending through the flange portion 56 of housing 14 from the crankcase 10. The operating lever 36 has an end 60 extending through the opening 52 into the crankcase of engine 12 and into contact with an engine driven eccentric cam 62, as indicated in FIGURE 1. A spring 64 is tensioned between a portion of the housing extension 40 and the lever arm 36 to hold lever end 60 against cam 62.

During engine operation, the eccentric cam 62 is rotated and causes the pump operating lever 36 to oscillate back and forth. As viewed in FIGURE 1, the upward motion of the rocker arm end 34 pulls the pump rod 30 upwardly and tensions spring 44. Movement of operating lever 36 in a counterclockwise direction permits the spring 44 to press the pump rod and diaphragm 22 downwardly. The space between the housing plate wall 16 and the pump diaphragm 22 forms a pumping chamber 25.

To the bottom of the cup-shaped plate 16 there is attached a pair of axially parallel tubular cup members 66 and 68 (FIGURE 2) formed of sheet metal such as iron, or steel, in the order of 0.030" thick. The bottom wall of housing plate 16 is formed with a pair of apertures, which are formed with collars 70 and 72 drawn from the metal of the plate 16. Tubular cups 66 and 68 have upper rim portions, as shown in FIGURE 2, which are tightly fitted into the collars 70 and 72, respectively. In this position, the cups 66 and 68 are welded or soldered to the respective collars 70 and 72 to rigidly fix the cups 66 and 68 to the pump housing plate 16.

A tubular inlet fitting 90 is fixed through the bottom wall of cup 66 leading to inside of the cup. An inlet valve assembly 92 is press-fitted or spot welded across the inside of cup 66 leading to the pumping chamber 25. The structure of valve assembly 92 is more fully described and is the subject of the copending application Serial Number 169,012, filed January 26, 1962, of Russel F. Smith. As shown in FIGURE 2, the valve unit is formed with a supporting cup 94 having a flat bottom with inlet apertures therethrough and supporting a valve stop member 98. A valve washer 100 is positioned between the valve stop 98 and the upper surface of the valve support plate 94. The valve washer 100 extends over the inlet apertures to prevent fuel flow downwardly through the apertures from the pumping chamber 25. A light spring between the under surface of stop member 98 and the upper surface of washer 100 biases the washer in position on plate 94. An identical outlet valve assembly 102 is fixed across the inside of cup 68 in a turned-over

position from that of valve assembly 92 to provide an outlet valve to the pumping chamber 25. The outlet valve assembly consists of similar parts shown for the inlet valve assembly 92 and includes an outlet valve washer 104. The closed end of cup 68 is apertured and drawn into an inturned collar 106 which is internally threaded to receive one end of a bolt 108, the other end 110 of which passes throught the bottom of a filter support cup 112.

The end 110 of bolt 108 is headed to support the filter support cup 112 and to press the open end portion of cup 112 against a rubber gasket 114 to prevent the escape of fuel from cup 112. Within cup 112 there is supported a cylindrical shaped folded paper filter element 116 which has its free ends sealed respectively to fiber board annular end plates 118 and 120. The filter is assembled to cup 68 by fitting the central aperture of plate 120 over the tapered lower end 122 of the outlet cup 68. Thus, the filter is telescoped over the cup end 122 until the inner periphery plate 120 tightly fits the outer surface of cup 68 and forms a fuel-tight seal. Cup 112 is then attached by threading bolt 108 into cup portion 106. An enlarged portion of bolt 108 adjacent to the headed end 110 extends into the central aperture of filter plate 118 with a tight fit to seal the interior of filter 116 from cup 112.

Sealed through the side of the support cup 112 at one end is an outlet nipple or connector 124, to which an outlet conduit 125 may be fastened leading from the pump to the carburetor 126, as indicated in FIGURE 1.

In operation, the upward stroke of diaphragm 22, as viewed in FIGURE 2, causes a low pressure to be formed in the pumping chamber 25. This is reflected in the cup 66 and fuel will be pressed by the atmospheric pressure from a tank 130 through an intake line 132 into the intake nipple 90 leading into cup 66. Fuel is sucked out of the cup 66 through the inlet valve assembly 92 and into the pumping chamber 25. On the downward stroke of rod 30, spring 44 presses the diaphragm downwardly and forces the fuel through the outlet valve assembly 102 into the cup 68. Fuel then passes through apertures 123 in the bottom of cup 68 into the center of filter 116. Additional fuel will fill the filter and will force the fuel under pressure through the paper folds of filter 116 and into the cup 112. Fuel then flows through the outlet connector 124 into the outlet fuel line 125 to the carburetor 126.

FIGURE 1 shows the carburetor 126 mounted on the manifold 128 of engine 12. The construction and operation of carburetor 126 is not a part of this invention and thus is not described in detail. However, it may be assumed that the carburetor is of a conventional design and one in which air is pumped through an air filter 134 to mix with the fuel from line 125 within the carburetor 126.

Air and vapor passing through the pump become trapped in the upper region 136 between the tops of the coaxially nested cups 68 and 112. This trapped air and vapor provides a pulsation dampening airdome which absorbs the pulsations of the pump and prevents the necessity of the pump on each stroke to move the accumulated quantities of fuel between the outlet valve structure 102 and the carburetor mounted at some distance from the pump. Without such a dampening or pulse absorbing accumulation of vapor, an undue burden is put upon the pump and diaphragm 22 because of the more solid resistance of the fuel in the line between the outlet valve 102 and the carburetor. The presence of an airdome or air and vapor accumulation provides an air space into which fuel is forced under pressure on the pumping stroke and which forces the fuel along the line 125 to the carburetor on the suction stroke. The space 136 within the filter cup 112 eliminates the necessity of providing within the pump outlet cup 68 additional structure for trapping air to provide a pulse dampening chamber. If the pump assembly is used in an upsidedown position from that shown in FIGURE 2, the space 138 at the opposite end of cup 112 will trap air from pump dampening.

Carburetor 126 has an inlet valve which, when the carburetor fuel bowl is filled, closes off the inlet line 125 to the carburetor. Since the engine continues to run, the rocker arm 36 will actuate the pumping diaphragm upwardly in an intake stroke. The downward stroke of the diaphragm under the urging of spring 44 will take place only as far as the fuel pressure within the line between the carburetor and fuel pump will permit. That is, on a downward stroke of diaphragm 22, the inlet valve 100 will close off the inlet line 132 and since fuel is also blocked in its flow to the carburetor, fuel pressure within the pumping chamber 25 will retain the diaphragm in an upward position, as viewed in FIGURE 2, and keep the spring 44 under tension. The forked end 34 of the lever 36 permits the oscillating movement of lever 36 to continue without affecting the pump until the carburetor inlet valve opens and the fuel pressure in the pump chamber released.

The fuel pump and filter assembly described is one which is made from easily formed and fabricated metal parts. These parts are those which are assembled by soldering, brazing, welding, or any desired and well known procedure. The thinness of the metal allows the fuel passing through both the pump and the filter portions of the assembly to be exposed to the cooling effect of ambient air. During the operation of the motor vehicle, air will flow around the engine and the pump assembly to provide this cooling effect to the fuel in this pump and filter assembly.

Heat transfer through the sheet metal housing 16 and cups 66 and 112 is much greater than if these parts were formed of cast metal several times thicker, even though the cast metal were an aluminum alloy having a greater heat conductivity. The pump housing 16, cups 66 and 112 are all exposed to the cooling effect of ambient air moving over the surfaces of these parts due to the movement of the vehicle or the fan 138 of the engine. Thus, the fuel pump is maintained at a lower temperature which minimizes vapor lock conditions. Such conditions exist when the engine is shut off for a period of time for a hot run. The heat of the engine builds up and by conduction and radiation heats the fuel in the fuel lines and the pump. Upon starting the engine, however, the flow of air past the pump quickly cools the pump parts to a lower temperature and reduces the vapor conditions in this part of the fuel system.

The thickness of the sheet metal pump and filter structures have been given above as being in the order of 0.030". However, the thickness need only be sufficient to provide the required structural strength and rigidity for proper pump and filter operation. Such a thickness with sheet steel, for example, may range from 0.010" to 0.0625". Sheet metal of this thickness provides a greater cooling effect and pumps fabricated in the manner described operate at lower temperatures than those made from thicker castings and with the described advantages. It would also be within the scope of this invention to form the pump spring housing 14 of sheet metal.

The sheet metal construction lends itself well to the filter housing of the invention. The telescoped cups 68 and 112 connected together with the axially positioned bolt 108 provide a filter housing which can be easily disassembled for replacing the filter element 116. Cup 112 has 360° of adjustability about its axis so that outlet fitting 124 can be positioned to accommodate line 125. In a like manner, inlet fitting 90 has a universal adjustment about the axis of cup 66 to accommodate inlet line 132.

We claim:

1. A fuel pump comprising a sheet metal pump hous-

ing, a flexible diaphragm sealed across said housing to form a pumping chamber therewith, means for actuating said diaphragm for pumping fuel through said pumping chamber, a plurality of apertures in said housing, a first cup-shaped sheet metal member having an open end, said open end being sealed around one of said apertures in said housing, an inlet valve assembly fitted across said first cup-shaped member, an inlet fitting in fluid communication with said first cup-shaped member upstream of said inlet valve assembly, a second sheet metal cup-shaped member having an open end, said open end being sealed around another of said apertures in said housing, an outlet valve assembly fitted across said second cup-shaped member, a third sheet metal cup-shaped member coaxially enclosing said second cup-shaped member and extending in side-by-side generally parallel relation to said first cup-shaped member, a filter element within said third member and telescoped in sealing engagement over the end opposite said open end of said second cup-shaped member, said opposite end of said second member being apertured for fuel flow into said filter element, and releasable means joining said second and third cup-shaped members together with said filter in between.

2. A fuel pump comprising a sheet metal pump housing, a flexible diaphragm sealed across said housing to form a pumping chamber therewith, means for actuating said diaphragm, for pumping fuel through said pumping chamber, a plurality of apertures in said housing, a first cup-shaped sheet metal member having an open end, said open end being sealed around one of said apertures in said pump housing, a normally closed inlet valve assembly fitted across said first cup-shaped member, a fuel inlet fitting in fluid communication with said first cup-shaped member upstream of said inlet valve assembly, a second sheet metal cup-shaped member extending generally axially parallel to said first cup-shaped member and having an open end, said open end being sealed around another of said apertures in said housing, a normally closed fuel outlet valve assembly fitted across said second cup-shaped member, said second cup-shaped member having its end opposite said open end closed and tapered, a third sheet metal cup-shaped member coaxially enclosing said second cup-shaped member and extending in side-by-side generally parallel relation to said first cup-shaped member, a filter element telescoped in sealing engagement over said closed tapered end of said second cup-shaped member, said closed end of said second member being apertured for fuel flow into said filter element, and releasable means joining said second and third cup-shaped members together with said filter inbetween.

3. A fuel pump comprising a sheet metal pump housing, a flexible diaphragm sealed across said housing to form a pumping chamber therewith, means for actuating said diaphragm for pumping fuel through said pumping chamber, a plurality of apertures in said housing, a first cup-shaped sheet metal member having an open end, said open end being sealed around one of said apertures in said pump housing, a normally closed inlet valve assembly fitted across said first cup-shaped member, a fuel inlet fitting in fluid communication with said first cup-shaped member upstream of said inlet valve

assembly, a second sheet metal cup-shaped member extending axially parallel to said first cup-shaped member and having an open end, said open end being sealed around another of said apertures in said housing, a normally closed fuel outlet valve assembly fitted across said second cup-shaped member, said second cup-shaped member having its end opposite said open end closed and tapered, a third sheet metal cup-shaped member coaxially enclosing said second cup-shaped member and extending in side-by-side generally parallel relation to said first cup-shaped member, a filter element telescoped in sealing engagement over said closed tapered end of said second cup-shaped member, said closed end of said second member being apertured for fuel flow into said filter element, and releasable means joining said second and third cup-shaped members together with said filter inbetween, said releasable means including a bolt having one end threaded into the tapered end of said second cup-shaped member and having a headed end abutting the closed end of said third cup-shaped member, said bolt having an intermediate portion extending axially of the filter and in sealed relation therewith for maintaining proper filtering action of the filter element.

4. A fuel pump comprising a sheet metal pump housing, a flexible diaphragm sealed across said housing to form a pumping chamber therewith, means for actuating said diaphragm for pumping fuel through said pumping chamber, a first cup-shaped sheet metal member extending from said pump housing, a normally closed inlet valve assembly fitted across said first cup-shaped member, an inlet fitting in fluid communicating with said first cup-shaped member, upstream of said inlet valve assembly, a second sheet metal cup-shaped member extending axially parallel to said first cup-shaped member from said pump housing, a normally closed outlet valve assembly fitted across said second cup-shaped member, said second cup-shaped member having its end opposite the pump housing end closed and tapered, a third sheet metal cup-shaped member coaxially enclosing said second cup-shaped member, a filter element telescoped in sealing engagement over said closed tapered end of said second cup-shaped member, said closed end of said second member being apertured for fuel flow into said filter element, and releasable means joining said second and third members cup-shaped together with said filter inbetween, said releasable means including a bolt having one end threaded into the tapered end of said second cup-shaped member and having a headed end abutting the closed end of said third cup-shaped member, said bolt having an intermediate portion extending axially of the filter and in sealed relation therewith for maintaining proper filtering action of the filter element.

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