May 13, 1969 J. M. WHITE 3,443,519

FUEL PUMP WITH COLLECTOR CHAMBER

Filed Dec. 11, 1967

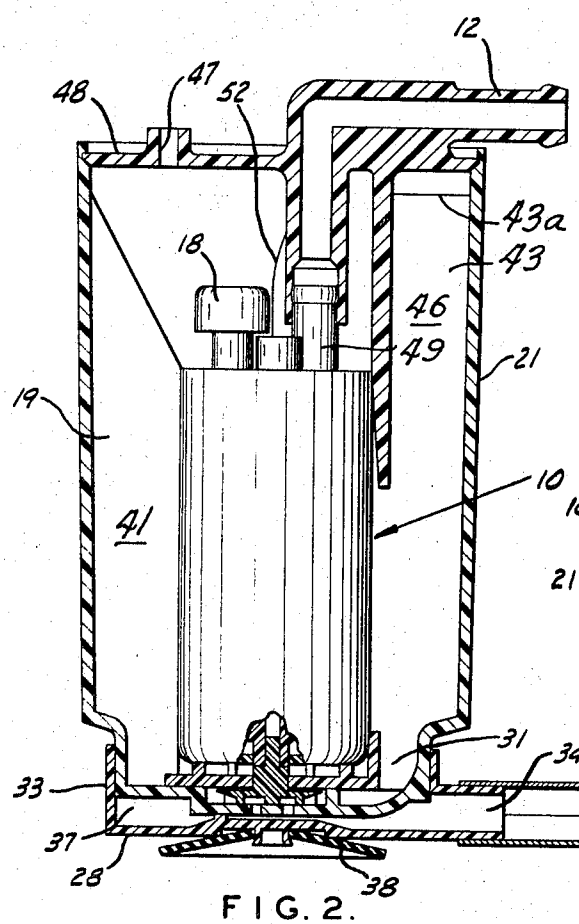


FIG. 2.

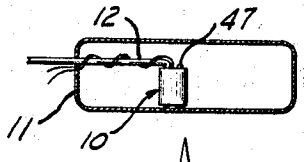


FIG. 1.

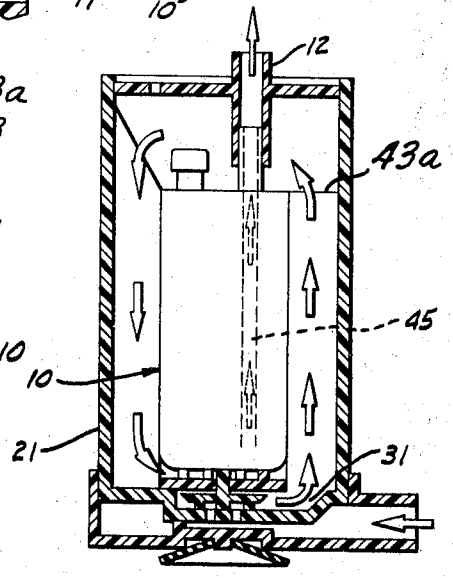


FIG. 5.

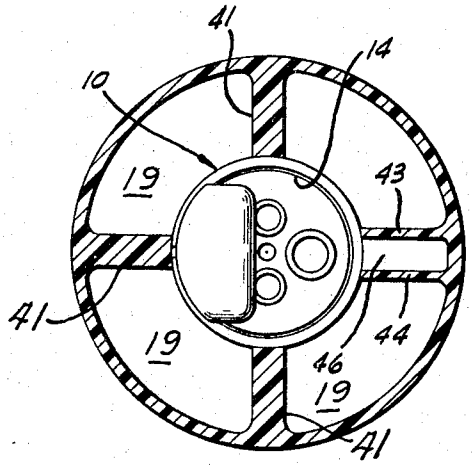


FIG. 3.

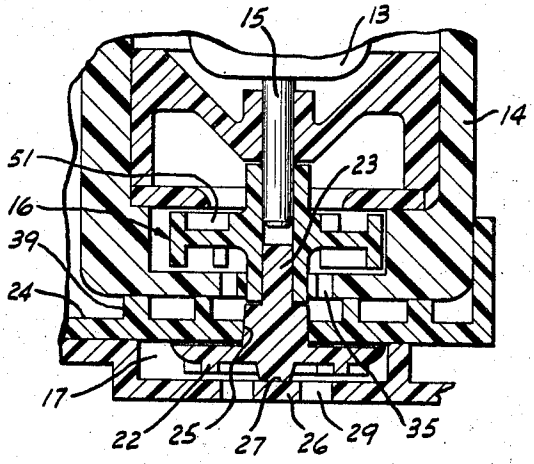


FIG. 4.

INVENTOR
JACK M. WHITE

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FUEL PUMP WITH COLLECTOR CHAMBER

Jack M. White, Florissant, Mo., assignor to ACF Industries, Incorporated, New York, N.Y., a corporation of New York

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ABSTRACT OF THE DISCLOSURE

The invention relates to a novel fuel pump for use in a relatively flat tank. The pumping arrangement includes a pair of motor driven centrifugal pumps, at least one pump being positioned to discharge into a collector chamber associated with the drive motor. The second pump receives liquid from the collector chamber and discharges to a point of use. The device thereby maintains a substantially constant head of liquid on said second pump suction regardless of the quantity of liquid held in the fuel tank and concurrently cools the drive motor with pumped liquid.

Background of the invention

Fuel pumps of the type presently contemplated are designed primarily to be submerged within a fuel containing tank. In the instance of automotive practice, the tank in conforming to the structure of a vehicle and to space requirements, is usually rather expansive but flat. When such a tank holds a reasonable amount of fuel, the submerged pump is at least partially immersed in liquid and consequently operates satisfactorily.

As the amount of fuel in the tank decreases, movement of the liquid in response to movement of the vehicle will become more pronounced. For example, with the tank only partially filled, any sustained turning motion of the vehicle at a high or even normal speed will tend to urge the entire mass of fuel to one side of the tank. It is easily perceivable then how the fuel pump suction might become separated from the fuel source and within a matter of seconds the engine will be starved to the point of stalling.

The stalling condition is aggravated and prompted in highway driving wherein the usual sweeping type cloverleaf complex provides the only access to the highway. It is not difficult to imagine a situation as above noted when, with up to as much as a quarter of a tankful of gas, the vehicle could stall while attempting to merge from a cloverleaf turn into a fast moving traffic flow.

Until now the problem has been approached, and to a degree successfully overcome, by providing baffles and walls within a fuel tank to minimize liquid movement. This, however, requires that fuel tanks be specially constructed and braced, both of which factors add to the weight as well as to the cost of the unit. Further, fuel tank baffling by itself is not considered to be the most effective fuel sloshing deterent although it does minimize such undesired movement.

Among the objects of the disclosed arrangement is to provide an apparatus for maintaining a constant fuel feed to an engine under adverse operating conditions and with a partially full gas tank. A further object is to provide a liquid cooled immersible pump which might be maintained with its suction under a substantially constant head of liquid.

Summary

The inventive concept presently disclosed, embodies an immersible fuel pump in which at least two centrifugal pumps are mounted in tandem and driven by a common electric motor. The motor and pumps are mutually enclosed within an elongated cylindrical housing which forms with the motor, an annular fuel holding reservoir. The suction and discharge openings of the respective pumps are so connected that the reservoir will be maintained at a maximum flow level regardless of the fuel level in the surrounding tank. Further, one of the pumps discharges fuel to the engine carburetor and will operate at a suction head at least equal to the height of the fuel reservoir. In that the driving motor will at all times be completely immersed so long as there is any fuel in the tank, the motor will be substantially cooled under all operating conditions.

Brief description of the drawing

FIGURE 1 shows a fuel tank having the fuel pump of the invention installed therein,

FIGURE 2 is an elevation, partly in section, of the fuel pump and collector chamber,

FIGURE 3 is a plan view, partly in section, of the fuel pump and collector chamber,

FIGURE 4 is an enlarged sectional view of the pumping section, and

FIGURE 5 is a partially sectioned view showing the circulation of fluid through the pump and collector chamber.

Description of the invention

The present arrangement comprises basically an electric drive motor adapted for connection to a source of electric current. At least two centrifugal type pumps preferably arranged in tandem, are drivingly connected to the motor, and an elongated housing encloses all of the units. A preferred overall construction of the unit is that the housing be relatively long and narrow to facilitate inserting through a limited access port of an automobile fuel tank. Further, the present description discloses the motor and pumps as being in a substantially upright position with relation to the enclosing fuel tank. This of course is a desirable, although not necessary condition in that the unit may be suitably disposed horizontally with respect to the fuel tank and still achieve to some extent the objectives toward which the device is directed.

It has been determined in the present arrangement that the connection of the respective centrifugal pumps to one end of the drive motor is a preferred arrangement. It should be appreciated, however, that such an arrangement can be modified by connecting the pumps to opposed ends of the drive motor and thereby achieve the objectives of the invention.

FIGURE 1 illustrates the fuel pump unit **10** supported within a fuel tank **11** by a suitable bracketing arrangement. The pump suction is disposed close to the floor of the tank and preferably rests against the latter thereby serving as a tank rigidizing member. A discharge conduit **12** passes through the tank wall for carrying a stream of fuel to the engine carburetor or other fuel distribution facility.

Pump unit **10** comprises an electric motor **13** supportably mounted within a relatively elongated enclosing housing **14**. One end of motor **13** is provided with a protruding shaft **15** which drivingly engages the first of two centrifugal pumps **16**. Separated from the first pump **16** is a second pump **17** which is drivingly connected to pump **16** or to the motor shaft **15** so that both pumps may be driven at substantially the same shaft speed.

Motor **13** is supported in casing **21** and adapted to operate with a normal automotive ignition voltage such as a 6 or 12 volt direct current. Electric current is carried to the motor through one or more insulated leads to resist deterioration by exposure to fuel.

The structure of drive motor **13** will not be explored here in detail except to note that said motor is lodged

within housing **14** which extends the length of the motor and encloses pump **16** adjacent thereto. Housing **14** is vented through a tube **18** to carry accumulated vapors into the fuel reservoir **19** defined between housing **14** and casing **21**.

Centrifugal pumps **16** and **17** are substantially identical in mechanical structure with the essential significant differences being in the volume which might be pumped at a particular motor speed, and the positioning of the suction and discharge openings. For example, pump **17** includes an impeller **22** having a plurality of peripheral blades, which impeller fits within a recess in casing **21** defining the pumping chamber or mating member to said impeller **22**. The impeller also includes a hub **23** slideably registered in opening **25** in panel **24** to be coupled to the impeller of pump **16**.

The lower side of impeller **22** is shaped to provide a formed bearing surface **26** which may be suitably contoured to be received on a bearing surface **27** for journalling the impeller. Lower wall **28** of casing **21** is normally disposed adjacent to the floor of fuel tank **11**. A plurality of apertures **29** in said wall form the suction for admitting fuel into the lower impeller chamber. Said chamber is further provided with a discharge port **31** carrying a pressurized stream of pumped liquid.

A cap **33** forms the lower end of casing **21**, having an inlet port **34** to which a filter **36** is fitted. Said cap defines with the lower wall of casing **21**, a primary chamber **37** which communicates by way of opening **29** with the pumping chamber of pump **17**.

A support member **38** depending from cap **33** normally rests on the tank floor to at least partially support the pumping unit. Panel **24** forms not only a closure and end wall to pump **17**, but also provides support for housing **14**. Said panel **24** includes a plurality of circularly arranged and separated spacers **39** upon which said housing **14** rests. Peripherally spaced openings in said spacer **39** permit a flow of fuel into the suction of pump **16**.

Housing **14** surrounding the pump and motor unit **10**, is spaced outwardly from pump casing **21** by a plurality of radial ribs **41** extending longitudinally of the casing defining the substantially annual reservoir **19**. A pair of parallel ribs **43** and **44** also extending longitudinally of casing **21** define channel **46** and terminate at the lower end thereof adjacent to housing **14**. Said channel **46** communicates with discharge opening **31** of pump **17** whereby fuel is urged upwardly from the discharge of pump **17** through elongated channel **46** and permitted to overflow across weir **43***a* into reservoir **19**.

Fuel fed from reservoir **19** to pump **16**, passes through a plurality of peripheral aperatures in spacer **39** to enter suction opening **35** and enter impeller chamber **51** of pump **16**. Thereafter the fuel is discharged from pump **16** into an elongated conduit **45** or directly into motor **13** for cooling the latter, from which it is passed from the fuel tank by way of fitting **49** and discharge conduit **12**.

The upper end of casing **21** is provided with a cover **48** in which an overflow port **47** is formed. Said cover further positions discharge conduit **12** and electric leads **52** which pass through reservoir **19**.

Operationally, fuel will tend to accumulate in reservoir **19** until overflowing by way of port **47** into tank **11**. Under ordinary operating conditions the liquid fuel level in reservoir **19** will be maintained to the overflow point by both the action of pump **16** and by the level of fuel in tank **11**. However, as the tank becomes more depleted and the fuel level drops below the top edge of casing **21**, reservoir **19** will be maintained in a full condition only by pump **17**. Under the latter circumstances, should movement of the vehicle cause fuel to be sloshed away from filter **36**, fuel fed to pump **17**, and consequently to reservoir **19** will stop immediately. However, the fuel in reservoir **19** will maintain a pressure head of at least several inches on the suction of pump **16** such that the latter will continue to function. The interval of time through which

pump **16** will remain operative is of course dependent on the capacity of reservoir **19** and the severity of the fuel shortage at filter **36**.

For a relatively short period as would ordinarily be encountered, fuel will return to filter **36** prior to the level in reservoir **19** descending to the inlet of pump **16**. It will be appreciated, of course, that should pump **17** remain starved of fuel for an extended period, eventually all flow will stop from pump **16** as well.

I claim:

1. A liquid handling pump for delivering a stream of liquid from a source thereof to a point of use and including;

(a) rotary electric drive means,

(b) a first rotary pump drivingly connected to said drive means and including suction and discharge ports, the suction of said first pump being normally communicated with said source of liquid, and subject to being out of communication therewith for limited periods of time,

(c) means forming a reservoir for holding a quantity of said pumped liquid and being communicated with the discharge of said first pump,

(d) a second rotary pump drivingly connected to said drive means and having a suction communicated with said means forming a reservoir to receive liquid from the latter,

(1) said second pump having a discharge communicated with said point of use for delivering a stream of liquid to the latter during said limited period of time when said first pump suction is out of communication with said source of liquid.

2. In a liquid handling pump as defined in claim **1** wherein said means forming a reservoir is disposed in heat exchange relation with said drive means for cooling the latter by heat exchange with said pumped liquid.

3. In a liquid handling pump as defined in claim **1** wherein said drive means includes at least one electric powered motor having a casing, said reservoir is formed by a container having walls spaced outwardly of said casing and defining a liquid holding chamber therebetween whereby said liquid is in cooling contact with said casing.

4. In a liquid holding pump as defined in claim **1** wherein said drive means includes an electric powered motor having a drive shaft, said first pump having an impeller coupled to said drive shaft and said second pump having an impeller coupled to said first impeller.

5. In a liquid handling pump as defined in claim **1** having a conduit communicated with the discharge of said first pump, said reservoir including a container having walls spaced from said motor and defining a liquid holding compartment, said conduit opening into said reservoir for passing pumped liquid thereto.

6. In a liquid handling pump as defined in claim **3** wherein said casing includes a cover at the uppermost end thereof, and vent means carried in said cover for directing vapors from said casing.

7. In a liquid handling device as defined in claim **6** wherein, said vent means opens into said means forming a reservoir for directing liquid vapor thereto.

8. In a liquid handling device as defined in claim **3** wherein said casing includes a cover having a port therethrough, at least one passage means extending longitudinally through said casing and communicating said second pump discharge with said port.

9. In a liquid handling device as defined in claim **8** including a plurality of passages extending longitudinally through said casing.

10. A submergible pump for a fuel tank unit including;

(a) a housing having an end wall, and a cover disposed at opposed ends thereof defining a subsubstantially closed chamber,

(b) a panel having an opening therein, and being

spaced in said housing from said end wall thereby forming a first pump chamber therebetween having suction and discharge openings,

(c) an impeller journalled for rotation in said pump chamber and including a hub,

(d) a closed casing supportably positioned in said housing and having side walls spaced from walls of said housing to define an annular chamber therebetween,

(e) said casing including a second pump at one end thereof having an impeller,

(f) a drive motor coupled to said second impeller,

(g) means coupling said second pump impeller to said first pump impeller for driving both of said pumps,

(h) said first pump chamber being communicated with said fuel tank and said annular chamber respectively to pass a stream of fuel to the latter, and said second pump having a suction communicated with said annular chamber and having a discharge for passing a stream of fuel from said pump.

11. In a submergible pump as defined in claim **10** wherein said housing includes a cover forming a substantial closure and disposed in opposite relation to said panel, and an overflow port in said cover to pass fuel from said annular chamber to said fuel tank.

12. In a submergible pump as defined in claim **10** including passage means communicating with said pump chamber discharge, said passage means extending substantially the length of said annular chamber and opening into the latter at a point opposite to said tank.

13. In a submergible pump as defined in claim **10** including passage means extending longitudinally of said casing, said second pump discharge communicating with said passage means to carry a stream of liquid therethrough for cooling contact with said motor.

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ROBERT M. WALKER, *Primary Examiner.*

WARREN J. KRAUSS, *Assistant Examiner.*

U.S. Cl. X.R.

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