

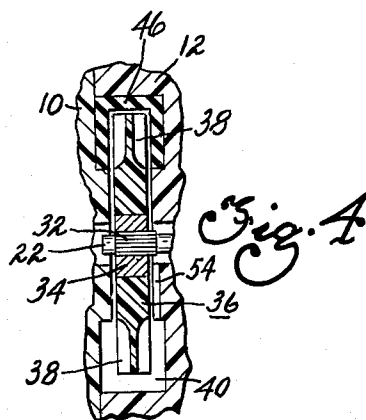
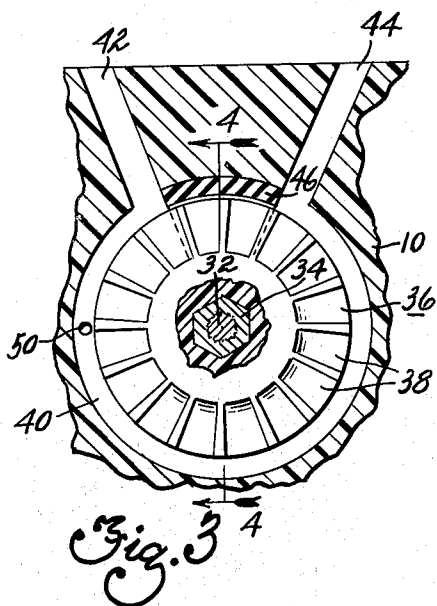
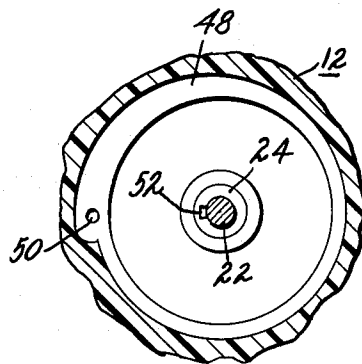
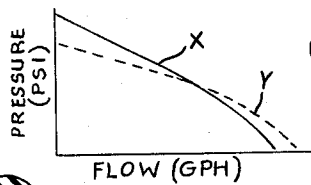
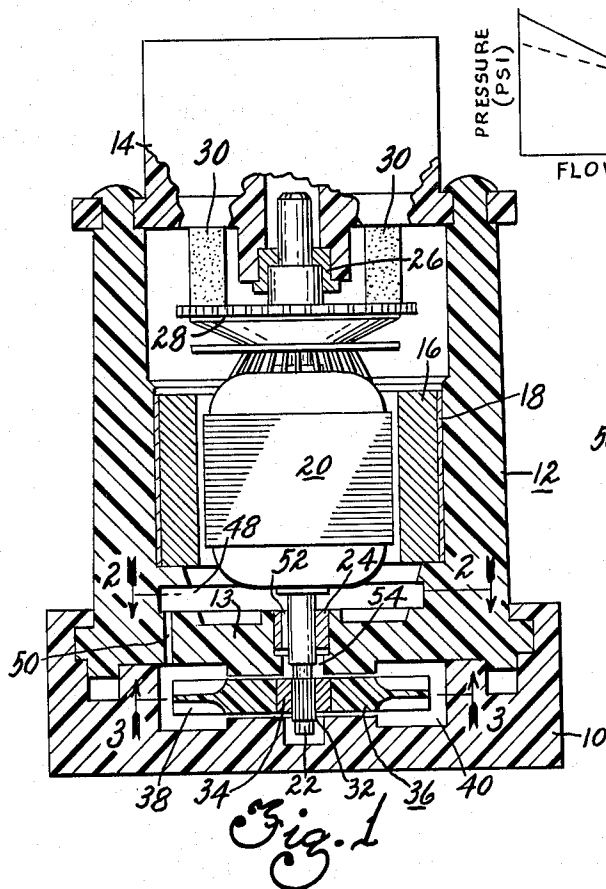
July 5, 1966

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3,259,072

ROTARY FUEL PUMP

Filed Oct. 26, 1964



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3,259,072

ROTARY FUEL PUMP

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Filed Oct. 26, 1964, Ser. No. 406,291

6 Claims. (Cl. 103—87)

This invention pertains to fuel pumps for supplying liquid fuel from a tank to a motor vehicle engine, and particularly to an improved electric motor driven pump structure adapted to be mounted in the fuel tank.

At the present time most motor vehicles are equipped with mechanically driven diaphragm type fuel pumps mounted in the engine compartment of the vehicle and connected by a suction line of considerable length with a fuel tank located in the rear of the vehicle. However, it has been proposed to utilize an electric motor driven pump immersed in the fuel tank and connect the pump output to a conduit connected with the float valve of the carburetor so as to improve the over-all reliability of the fuel supply system. However, in the past the flow vs. pressure characteristics of rotary pumps have not been matched to the requirements of the motor vehicle engine.

The present invention relates to an improved pump structure having flow characteristics compatible with the engine requirements under all engine operating conditions. Accordingly, among my objects are the provision of an improved rotary fuel pump for internal combustion engines; the further provision of an electric motor driven pump of the peripheral type; and the still further provision of a fuel pump of the aforesaid type which utilizes the centrifugal pumping action of the motor armature in combination with pressure taps interconnecting the centrifugal and peripheral pumps to increase the pump capacity and flatten out the pressure-flow characteristic curve of the peripheral pump.

The aforementioned and other objects are accomplished in the present invention by embodying a volute chamber within the motor housing and utilizing the end turns of the armature as a centrifugal impeller, the eye and the output of the centrifugal pump being connected to spaced pressure taps of the peripheral pump so as to cause the centrifugal pump to add to or bleed from the output of the peripheral pump.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawing, wherein a preferred form of the present invention is clearly shown and wherein similar numerals depict similar parts throughout the several views.

In the drawing:

FIGURE 1 is a view, partly in section and partly in elevation, of an electric motor driven fuel pump constructed according to the present invention.

FIGURE 2 is a fragmentary, sectional view taken along line 2—2 of FIGURE 1.

FIGURE 3 is a fragmentary, sectional view taken along line 3—3 of FIGURE 1.

FIGURE 4 is a fragmentary, sectional view taken along line 4—4 of FIGURE 3.

FIGURE 5 is a graph of the flow vs. pressure characteristics of the pump structure.

With reference to the drawing, a submersible rotary fuel pump is shown comprising a plastic pump housing 10 interconnected with a plastic motor housing 12, the upper end of the housing 12 being closed by an end cap 14 adapted to house the brush rigging for the motor. The motor is of the direct current, permanent magnet field type having an annular permanent magnet 16 bonded at 18 to the inner periphery of the motor housing, and a

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wound armature 20 attached to a shaft 22. The shaft 22 is journaled in spaced sleeve bearings 24 and 26 carried respectively by a wall 13 of the motor housing 12 and the end cap 14. The armature carries a disc commutator assembly 28 which is engaged by a pair of diametrically spaced brushes 30 for energizing the field windings of the armature through the commutator. The wall 13 separates the motor chamber from the pump chamber.

As alluded to hereinbefore, the entire motor driven pump is adapted to be submerged in a fuel tank of a motor vehicle. Thus, the entire interior of the motor housing is filled with liquid fuel which serves to lubricate the sleeve bearings 24 and 26 that rotatably support the armature 20. The armature shaft is longitudinally serrated at 32 for driving connection with a hexagonal coupling 34 that fits in a complementary aperture in a peripheral pump impeller 36. The peripheral pump impeller 36 is mounted in the pump housing and has a plurality of radially extending vanes 38 disposed in a pump chamber 40 formed by the pump housing 10 and the motor housing 12. As seen particularly in FIGURE 3, the peripheral pump chamber 40 of the peripheral pump has an inlet, or suction, port 42 and a delivery, or output, port 44 extending laterally therefrom, the ports 42 and 44 being spaced apart by a sealing body, or stripper, 46 of inverted channel-shape as shown in FIGURE 4.

Referring to FIGURE 5, the normal flow vs. pressure characteristics curve of a peripheral pump is shown in the solid line X from which it can be seen that pressure decreases substantially linearly with an increase in flow, but decreases rapidly in the maximum output region of the pump. Moreover, another characteristic of peripheral pumps is that the pressure generated increases uniformly along the ring channel 40 between the intake and the output ports. Thus, in a peripheral pump designed to have a maximum pressure output of 10 p.s.i. at no flow, the pressure potential at the midpoint between the intake and output ports will be 5 p.s.i. and at equal annular distances from the midpoint to both the intake and output ports the pressure varies in direct proportion and therefore can be readily calculated.

The motor housing 12 is formed with a volute chamber 48 surrounding the end turns of the wound armature 20. The end turns of the armature 20 act as a centrifugal pump having its inlet adjacent the armature shaft 22 and its outlet in the volute chamber 40 that connects with a passage 50 at output of the volute, the passage 50 extending axially into the ring chamber 40 of the peripheral pump at a point spaced from the intake port 42, and constituting a pressure tap. The eye of the centrifugal pump is connected through an axial passage 52 in the sleeve bearing 24 and a radially extending passage 54 in the motor housing 12, and the radial passage 54 connects with the ring channel 40 at a point midway between the inlet and outlet ports 42 and 44 of the peripheral pump, thus constituting another pressure tap. Accordingly, the pressure generated by the centrifugal action of the armature in the volute chamber 48 will result in a flow that adds to the output of the peripheral pump under light load conditions, i.e., when the peripheral pump output pressure is low, and bleeds a portion of the peripheral pump output at high peripheral pump pressure.

Thus, when the peripheral pump output pressure is low, the peripheral pump pressure at the pressure tap 50 will be less than the centrifugal pump pressure, and consequently the flow will be from the centrifugal pump volute chamber 48 through the passage 50 into the ring channel 40 of the peripheral pump. On the other hand, when the peripheral pump pressure at the pressure port exceeds the centrifugal output pressure, a certain amount of peripheral pump flow will be bled off through the passage 50

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back to the centrifugal pump thus resulting in a flattening out of the flow vs. pressure curve that is shown in FIGURE 5 by the dotted line Y. The capacity of the pump is thus increased at low pressure and decreased at high pressure so as to flatten out the flow vs. pressure characteristic curve of the peripheral pump. The passage 54 connecting the eye of the centrifugal pump with the midpoint of the ring channel 40 of the peripheral pump prevents cavitation in the centrifugal pump, and also aids in bleeding off output from the peripheral pump under all operating conditions thereof.

From the foregoing it is apparent that the present invention provides an electric motor driven rotary fuel pump having pressure vs. flow characteristics compatible with an internal combustion engine for a motor vehicle, this being achieved through modification of the operation of a conventional peripheral pump by utilizing the rotating armature as a centrifugal pump to produce an output which is either added to or bled from the peripheral pump output depending upon the operating conditions thereof.

While the embodiment of the invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted.

What is claimed is as follows:

1. A fuel pump including, a housing, an electric motor disposed in said housing having an armature, a shaft connected to said armature and journaled in said housing, said housing having a pair of chambers therein separated by a wall with the armature shaft extending therethrough, a peripheral pump impeller disposed in one of said chambers and connected to said armature shaft for rotation therewith, a volute formed in the other chamber of said housing and coacting with said armature to constitute a centrifugal pump, and passage means in said wall interconnecting said volute and said peripheral pump chamber whereby the output of said centrifugal pump modifies the output characteristics of said peripheral pump in accordance with the operating condition thereof.

2. A fuel pump including, a housing having a pair of chambers separated from each other by a wall, an electric motor disposed in one of said chambers including an armature attached to a shaft, said shaft extending through said wall and being rotatably journaled in said housing, a peripheral pump impeller attached to said armature shaft in the other chamber so as to rotate therewith, a volute in said motor chamber coacting with said armature to constitute a centrifugal pump, said peripheral pump chamber having angularly spaced inlet and outlet ports, and passage means extending through said wall between said inlet and outlet ports and interconnecting said volute and said peripheral pump chamber whereby the output of said centrifugal pump will modify the output characteristics of said peripheral pump in accordance with the operating condition thereof.

3. A fuel pump including, a housing having a pair of chambers separated from each other by a wall, an electric motor disposed in one of said chambers including an armature attached to a shaft, said shaft extending through said wall, spaced bearing means rotatably supporting said shaft in said housing, one of said bearing means comprising a sleeve bearing extending through said wall, a peripheral pump impeller attached to said arma-

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ture shaft in the other chamber so as to rotate therewith, a volute in said motor chamber coacting with said armature to constitute a centrifugal pump, first passage means interconnecting the output of said volute with said peripheral pump chamber, and second passage means through said sleeve bearing interconnecting the eye of the centrifugal pump with said peripheral pump chamber at a point angularly spaced from said first passage means whereby a portion of the output of said peripheral pump will be continuously bled through said second passage means to the eye of said centrifugal pump, the direction of flow through said first passage means between the peripheral and centrifugal pumps being determined by the operating conditions of said peripheral pump so as to modify the output characteristics of said peripheral pump in accordance with the operating condition thereof.

4. A fuel pump including, a housing having a pair of chambers separated from each other by a wall, an electric motor disposed in one of said chambers including an armature attached to a shaft, said shaft extending through said wall, a pair of sleeve bearings in said housing for rotatably journaled said armature shaft, one of said sleeve bearings extending through said wall, a peripheral pump impeller attached to the armature shaft in the other chamber so as to rotate therewith, a volute in said motor chamber coacting with said armature to constitute a centrifugal pump, said peripheral pump chamber having angularly spaced, radially extending inlet and outlet ports and a sealing body disposed therebetween, and passage means extending through said wall between said inlet and outlet ports and interconnecting said volute and said peripheral pump chamber whereby the output of the centrifugal pump will modify the output characteristics of said peripheral pump in accordance with the operating condition thereof.

5. The fuel pump set forth in claim 4 wherein said passage means comprises a first passage extending through said wall between the output of said volute and said peripheral pump chamber, and second passage means in the sleeve bearing mounted in said wall and interconnecting the eye of the centrifugal pump with said peripheral pump chamber midway between the inlet and outlet ports.

6. The fuel pump set forth in claim 5 wherein said first passage means is located in said peripheral pump chamber at a point between said second passage means and said peripheral pump intake port whereby under low pressure conditions, said centrifugal pump output will be added to the peripheral pump output and under high pressure conditions the centrifugal pump will bleed a portion of the output from said peripheral pump through said first passage means, a portion of the output of said peripheral pump output being continuously bled to the eye of said centrifugal pump through said second passage means.

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