

[72] Inventor **Tomoichi Kaneko**
4-3, Momoi 1-Chome, Suginami-ku,
Tokyo, Japan

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Primary Examiner—Robert M. Walker
Attorney—Michael S. Striker

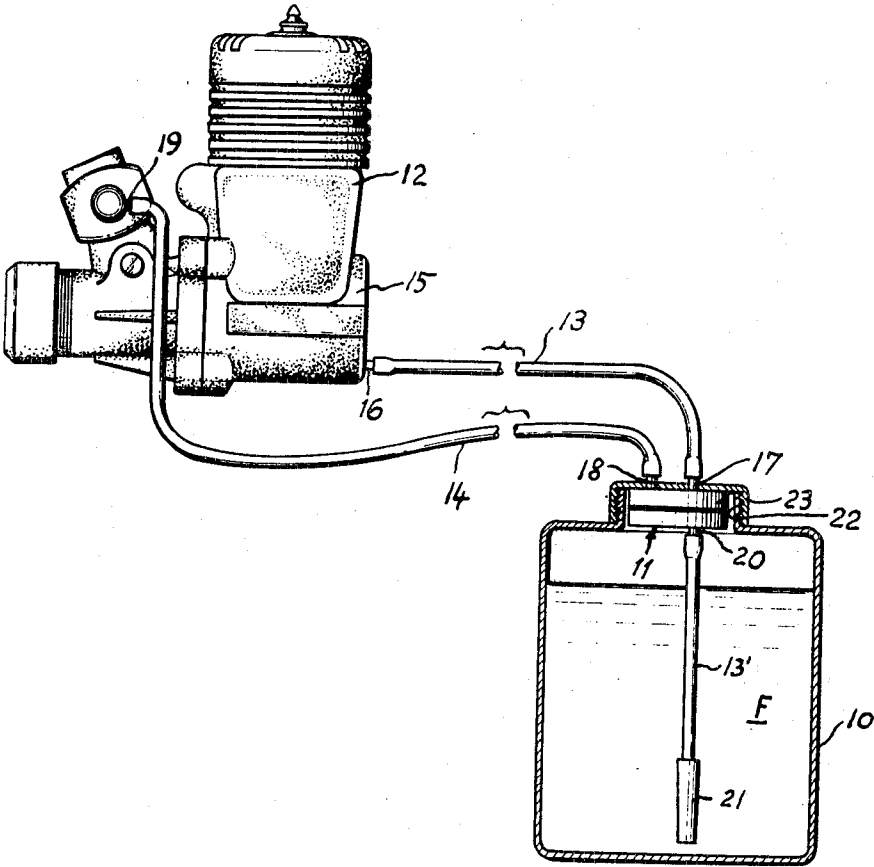
[54] **FUEL PUMP FOR MINIATURE INTERNAL COMBUSTION ENGINES OR THE LIKE**
9 Claims, 4 Drawing Figs.

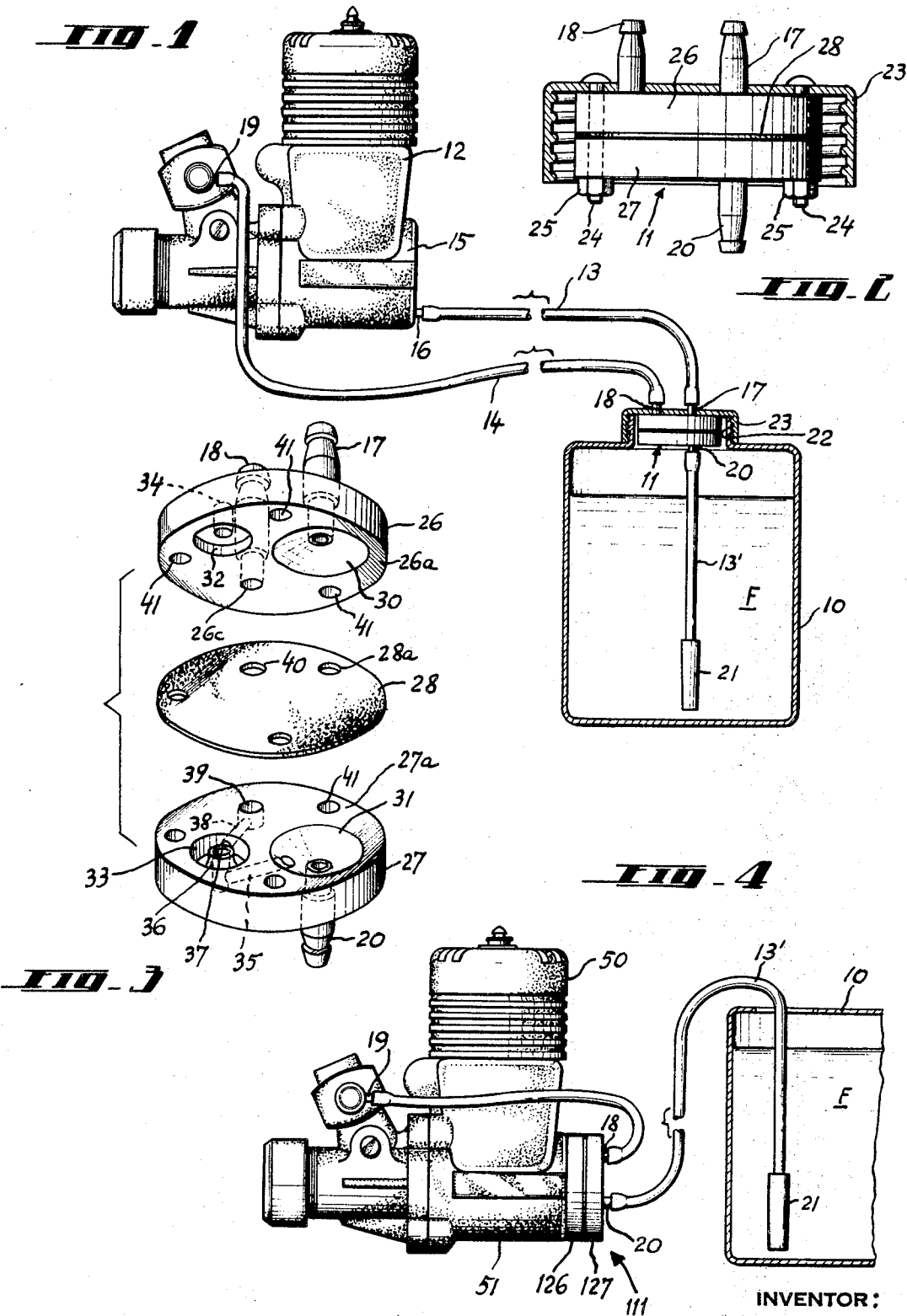
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ABSTRACT: A fuel pump wherein a diaphragm is clamped between registering chambers provided in the surfaces of two disks and draws fuel from a tank into one of the chambers in response to changes in fluid pressure in the other chamber. The other chamber is connected with the crank case of an internal combustion engine and the one chamber is connected with the fuel admitting nozzle of the engine by way of a passage provided in one or both disks. Two portions of the passage can be sealed from each other by the diaphragm.





INVENTOR:
TOMOICHI KANEKO
BY *Michael S. Straker*
his ATTORNEY

FUEL PUMP FOR MINIATURE INTERNAL COMBUSTION ENGINES OR THE LIKE

BACKGROUND OF THE INVENTION

The present invention relates to pumps in general, and more particularly to improvements in diaphragm pumps. Still more particularly, the invention relates to improvements in pumps which can be utilized to deliver fuel from the tank to the internal combustion engine of a toy device or model, for example, to the engine of a miniature aircraft, watercraft, road vehicle or the like. Such engines normally utilize so-called "glow" fuel, i.e., a mixture which can contain castor oil and nitromethane in addition to alcohol as a basic ingredient. The delivery of fuel from the tank to the engine is such that the fuel is forcibly sucked into the engine by way of a nozzle simultaneously with aspiration of air by way of an air inlet which is adjacent to the nozzle. Suction is produced in response to reciprocation of the piston in the engine.

It was already proposed to forcibly inject fuel in order to increase the RPM and the torque of the engine. For this purpose, compressed air is admitted from the crank case into the fuel tank in order to raise the pressure in the interior of the tank and to bring about forced flow of fuel from the tank into the engine. A drawback of such proposal is that the pressure in the tank fluctuates, for example, due to changes in the level of fuel in the tank, and such fluctuations interfere with the operation of the engine by causing undesirable changes in rotational speed. When the engine is built into a miniature airplane which is used to perform various stunts in flight, the engine is likely to become defective or to cease its operation altogether if the forcible injection of fuel depends on the condition prevailing in the fuel tank and/or on the position of the injection nozzle with reference to the tank.

SUMMARY OF THE INVENTION

It is an object of my invention to provide a fuel pump which insures that the engine receiving fuel therefrom can operate in a desired way and that the operation of such engine is not dependent on the condition and/or position of the fuel tank.

Another object of the invention is to provide a pump of the just outlined character which insures controlled injection of fuel into a miniature internal combustion engine irrespective of the position of the injection nozzle with reference to the fuel tank.

A further object of the invention is to provide a compact, simple and inexpensive fuel pump which is small enough to be installed in the fuel tank or directly on the crank case of a miniature internal combustion engine.

An ancillary object of the invention is to provide a novel housing for the improved fuel pump.

A concomitant object of the instant invention is to provide a fuel pump which can be readily installed in a space that is available in a miniature aircraft, watercraft or road vehicle.

A further object of the invention is to provide a pump which can be readily taken apart and reassembled by resorting to simple tools.

The improved pump comprises a housing including first and second sections which may resemble disks and have adjacent surfaces respectively provided with first and second chambers located opposite each other and respectively connected with a fuel tank and with a source of varying fluid pressure in an internal combustion engine (preferably with the crank case), a diaphragm having a flexible portion extending between the chambers so as to be flexed in response to variations in fluid pressure in the second chamber and to thereby draw fuel from the tank into the first chamber, a passage provided in the first section or in both sections and in the diaphragm and communicating with the first chamber, and a supply conduit connecting the passage with the injection nozzle of the engine.

In accordance with a preferred embodiment of my pump, the passage has two parts which can be separated from each other by a second portion of the diaphragm when the pressure in the second chamber drops whereby the second portion of

the diaphragm pumps fuel from the second part of the passage into the nozzle.

The housing of the pump may be mounted in the fuel tank, on the fuel tank, on the crank case of the engine, or elsewhere to occupy a space which is readily available in the conveyance which embodies the engine and the tank.

It is further preferred to provide the pump with a feed conduit which is connected with the first chamber and dips into the supply of fuel in the tank. The feed conduit accommodates a check valve which prevents return flow of fuel from the first chamber into the tank when the pressure in the second chamber increases. In this way, the fuel is forced to flow from the first chamber into the aforementioned passage.

The novel features which are considered as characteristic of the invention are set forth in particular in the appended claims. The improved pump itself, however, both as to its construction and its mode of operation, together with additional features and advantages thereof, will be best understood upon perusal of the following detailed description of certain specific embodiments with reference to the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a schematic elevational view of an arrangement comprising a fuel pump which embodies one form of my invention, the fuel tank being shown in vertical section;

FIG. 2 is an enlarged view of a detail in the arrangement shown in FIG. 1;

FIG. 3 is an exploded perspective view of the fuel pump; and

FIG. 4 is a fragmentary partly elevational and partly sectional view of a second arrangement which comprises a modified fuel pump.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 illustrates a fuel pump 11 which embodies my invention. This pump is mounted in a fuel tank 10 and serves to deliver liquid fuel to the injection nozzle 19 of an internal combustion engine 12, for example, an engine which can be used in miniature aircraft. The engine 12 comprises a crank case 15 which constitutes a source of varying fluid pressure. As is well known, pressure in the crank case of a two-cycle engine alternately increases and decreases during each revolution of the crankshaft.

The pump 11 comprises a housing composed of two matching disk-shaped sections 27, 26 having adjacent surfaces 27a, 26a (FIG. 3) which are respectively provided with chambers 31, 30 of circular outline. Each of these chambers is bounded by a conical portion of the respective surface and the chambers are located opposite each other when the housing is assembled in a manner as shown in FIG. 1 or 2. The surfaces 27a, 26a are further provided with circular recesses 33, 32 which are also located opposite each other when the housing is assembled. A flexible circular diaphragm 28 is clamped between the surfaces 26a, 27a and is provided with holes 28a registering with holes 41 provided in the sections 26, 27 to receive bolts 24 shown in FIG. 2. The bolts 24 can take nuts 25 and serve to connect the housing including the sections 26, 27 to an internally threaded cap 23 which normally seals the opening 22 in the top of the tank 10 so as to prevent escape of liquid fuel F even if the tank is turned upside down. The chamber 31 of the section 27 communicates with a nipple 20 which is connected to the discharge end of a feed conduit 13' dipping into the tank 10 and carrying at its lower end a one-way valve 21 which permits inflow of fuel F into the feed conduit 13' but not the other way around. The valve 21 may be a simple check valve of any known design wherein a ball is biased against a seat by a suitable spring.

The chamber 30 in the section 26 is in communication with a nipple 17 which is connected with one end of a pressure transmitting conduit 13. The other end of the conduit 13 is connected with a nipple 16 communicating with the interior of the crank case 15. Thus, when the engine 12 is running and

the pressure in the crank case 15 increases and decreases, that portion of the diaphragm 28 which extends between the chambers 30, 31 is flexed and draws fuel F from the tank 10. Such fuel flows through the valve 21, feed conduit 13', nipple 20 and into the chamber 31.

The sections 26, 27 define with the diaphragm 28 a composite passage or channel whose inlet is in communication with the chamber 31 and whose outlet is provided in the section 26. This passage includes first bores 35, 37 machined into the section 27 and communicating with the chamber 31, the recess 33 in the surface 27a, second bores 38, 39 which communicate with the recess 33, an aperture or hole 40 provided in the diaphragm 28 and registering with the bore 39, and a third bore 26c in the section 26. The bore 26c communicates with the aperture 40 and its outlet accommodates a portion of a nipple 18 which is connected with the nozzle 19 by a supply conduit 14. The section 27 is further provided with an annular seat 36 which is concentric with the recess 33 and normally abuts against that portion of the diaphragm 28 which extends between the recesses 33, 32 to thereby seal the recess 33 from the bore 37.

The operation is as follows:

When the engine 12 is started, the pressure in the crank case 15 increases and decreases at a rate which is a function of the speed of the engine. The changes in pressure are communicated to the chamber 30 by way of the nipples 16, 17 and conduit 13 whereby the diaphragm 28 pumps liquid fuel F from the tank 10 by way of the valve 21, feed conduit 13' and nipple 20. The valve 21 prevents return flow of fuel into the tank 10 so that the fuel flows from the chamber 31 into the first bores 35, 37 to deform the diaphragm 28 in the region of the seat 36 and to overflow into the recess 33, bores 38, 39, aperture 40 and bore 26c whence it enters the nipple 17 to be conveyed to the nozzle 19 by way of the supply conduit 14.

The pressure of fuel in the bore 37 of the section 27 causes deformation of that portion of the diaphragm 28 which extends between the recesses 32, 33 whereby such portion of the diaphragm yields and penetrates into the recess 33 to permit overflow of fuel from the bore 37 into the recess 33. The diaphragm 28 may consist of rubber or other elastomeric material. The thickness of the section 26 may but need not be the same as that of the section 27. The recess 32 is provided with a vent 34 to permit flexing of the diaphragm 28 away from the seat 36.

An important advantage of my pump is that the nozzle 19 of the engine 12 receives fuel at a constant pressure. This is due to the action of that portion of the diaphragm 28 which extends between the recesses 32, 33 and which forces fuel into the supply conduit 14 when it is permitted to return against the seat 36 in response to a pressure drop in the chamber 30. The nozzle 19 injects fuel into the carburetor of the engine 12. The amounts and the pressure of fuel which enters the nozzle 19 are not dependent on the liquid level in the tank 10. Thus, once the nozzle 19 is properly adjusted, it delivers predetermined amounts of fuel to the engine 12. This is important in miniature aircraft, particularly when the craft performs a stunt.

FIG. 4 illustrates a portion of a modified arrangement wherein the housing of the fuel pump 111 is mounted directly on the rear portion of the crank case 51 in an internal combustion engine 50. The disk-shaped sections of the housing in the pump 111 are denoted by the numerals 126, 127. The numerals 13' and 18—21 denote parts which are identical with those described in connection with FIGS. 1 to 3. The nipple 17 is not seen because it is concealed between the rear portion of the crank case 51 and the section 126. The nozzle 18 is connected directly to the bore 38 or 39 in the section 127, i.e., the diaphragm in the pump 111 of FIG. 4 need not have an aperture 40 and the bore 26c shown in FIG. 3 can be dispensed with.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features which fairly constitute essential characteristics of the generic and specific aspects of my contribution to the art and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the claims.

I claim:

1. A pump, particularly for forcibly feeding liquid fuel from a tank to the nozzle of a miniature internal combustion engine of the type including a source of varying fluid pressure, comprising a housing including first and second sections having adjacent surfaces and being respectively provided with first and second chambers located opposite each other and extending from said surfaces respectively into said sections and with first and second recesses located transversely spaced from said chambers opposite each other and also extending from said surfaces respectively into said sections, said second chamber being connected with the source of varying fluid pressure; a single diaphragm clamped between said surfaces with the exception of flexible and continuous uninterrupted portions thereof, one of which is located between said chambers and the other between said recesses, said flexible portions of said single diaphragm being the only movable parts in said housing; first passage means connecting the chamber of said first section with the recess of said first section and forming in said recess an annular seat normally in engagement with said other flexible portion of said diaphragm in undeformed condition of said other flexible portion; second passage means communicating at one end with said recess in said first section and connected at the other end thereof to said nozzle; and fuel supply means connecting the chamber in said first section to the tank for permitting flow of fuel from the tank in said chamber while preventing reverse flow of fuel, whereby during decrease of the varying fluid pressure fuel is sucked from the tank through said fuel supply means into the chamber of said first section, while during increase of said pressure fuel is pressed from said chamber through said first passage means deflecting thereby said other flexible portion of said diaphragm so that such fuel may pass into the recess in the first section and subsequently thereto through said second passage means into said nozzle.

2. A pump as defined in claim 1 wherein said second passage means comprises first bore means formed in said first section and having one end in said recess in said first section and a second end at the surface thereof, an aperture in said diaphragm aligned with said second end, and second bore means in said second section and communicating with said aperture.

3. A pump as defined in claim 1 and including vent means communicating with the recess in said second section.

4. A pump as defined in claim 1, said fuel supply means comprising feed conduit means connecting said first chamber with the tank and one-way valve means provided in said feed conduit means to admit liquid from the tank into said first chamber.

5. A pump as defined in claim 1, wherein said housing is mounted on the tank.

6. A pump as defined in claim 1, wherein said source is the crank case of the engine and wherein said housing is mounted on the crank case.

7. A pump as defined in claim 1, wherein said sections are disks and wherein said diaphragm is sealingly clamped between the surfaces of said disks.

8. A pump as defined in claim 1, wherein said chambers are bounded by conical portions.

9. A pump as defined in claim 1, wherein said chamber are of circular outline.