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PUMP

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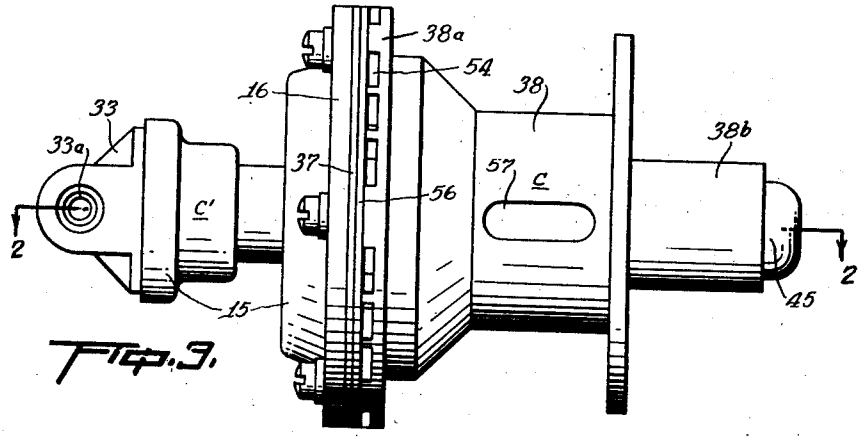


Fig. 3.

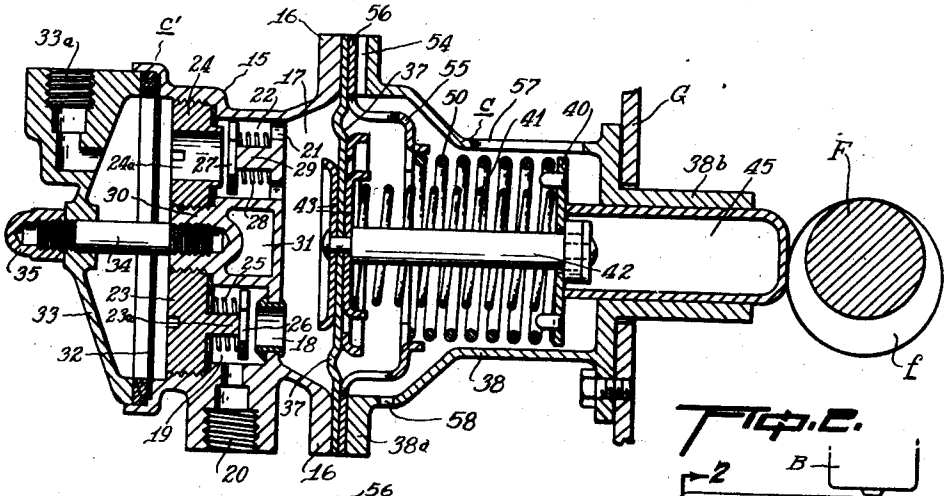


Fig. 2.

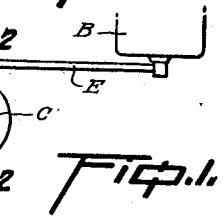


Fig. 1.

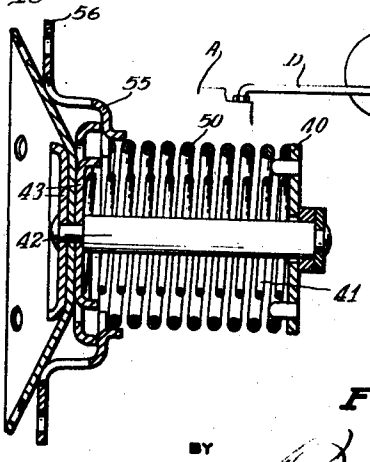


Fig. 4.

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PUMP

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3 Claims. (Cl. 103—38)

This invention relates to improvements in pumps for motor vehicle fuel systems in which the pump is connected directly to a source of fuel supply and to the carbureter of the engine and is actuated by direct connection with the engine.

Pumps used in this manner are therefore subject to variable speed conditions and variable demands in fuel consumption. My present invention is designed to meet the problem of providing a continuous supply of fuel from the fuel supply source to the carbureter with means to prevent excessive pressure being exerted on the carbureter and to prevent either overloading or under supply of fuel to the carbureter.

The present invention is of the pumping type, but is arranged with a view to being very sensitive to changes in conditions with respect to pump operation, and at the same time adapted to produce pump operations at the changed speed with a minimum of lag in responsiveness. By this means it is possible to provide for a substantial balance between the demand and supply. This is obtained through several features. For instance, the pumping is made immediately responsive to the differences in speed of operation of the engine and thereby immediately responsive to the differences in demand in the consumption of fuel, so that the change in demand is instantly detected, and the pump automatically responds thereto. Another feature lies in the fact that the pumping stroke produced by the cam action is utilized in the delivery of the fuel to the carbureter line, thus obtaining the benefit of the uniformity of the cam operation; the opposite stroke is provided by a spring, thus making possible the conditions of a slight lag with high speed conditions, but the latter does not affect the stroke length; any pulsation effect which might result is ineffective to vary the carbureter supply, since the spring-imparted stroke is active with respect to the supply to the pump, the quantity supplied being similar to that which would be obtained by the cam operation, although the pumping movement may vary from the uniform timing of the cam.

A problem present in fuel feed pumps is provided by the condition generally referred to as "vapor lock". Heating of the gasoline within the fuel path tends to vaporization, thus reducing the liquid content and providing a gaseous increment which is compressible and expansible. When the gaseous content is present within such path to a material extent, the pumping element will expend its stroke in compressing the gas, thus affecting the pumping of the fuel itself, the opposite stroke permitting the gas to expand and hence not drawing the proper amount, the result being that the carbureter becomes starved for fuel.

Provision is also made for eliminating this "vapor lock" by positive mechanical means and by forming the pump and locating it in such manner as to largely reduce the vaporization effect, so that, if present at all, it is of no material detriment.

The pump, structurally, utilizes but a single diaphragm as the pumping and control element, and the assembly is such as to provide for simplicity, rapid assembly and servicing, the arrangement being such as to provide for a relatively low cost of manufacture, and for low service cost, including the ability to service by unskilled labor. In addition, the invention contemplates the use of a power unit which, in itself, becomes the main servicing factor of the pump, and which can be sold independent of the pump and capable of providing a spare for the vehicle owner capable of bodily replacement when needed.

To these and other ends, therefore, the nature of which will be readily understood as the invention is hereinafter disclosed, said invention consists in the improved construction and combinations of parts, hereinafter more particularly described in detail, illustrated in the accompanying drawing, and more particularly pointed out in the appended claims.

In the accompanying drawing, in which similar reference characters indicate similar parts in each of the views,—

Figure 1 is a view illustrating diagrammatically a fuel pump of the type of the present invention, located relative to a fuel supply tank and the carbureter to be supplied, the pump being shown in end elevation;

Fig. 2 is a sectional view, taken on line 2—2 of Fig. 1, and illustrating one of the forms which the present invention may have, the parts being shown in the position assumed at medial position of the pumping cycle;

Fig. 3 is a view in elevation (looking downward in Fig. 2) of the present invention; and

Fig. 4 is a sectional view of the power unit of Fig. 2, the view illustrating the unit as removed from the pump assembly.

The general conditions under which the invention is utilized are indicated in Fig. 1 in which A indicates a fuel tank and B indicates the carbureter of a power plant such as is usable in motor vehicle service. In the particular condi-

tions referred to, the tank A is normally on a level below that of the carbureter, so that feed of the fuel by gravity from tank to carbureter is out of the question. To meet the conditions the fuel pump C is interposed within the connections between tank and carbureter, the connections being indicated as a conduit D between the tank and pump, and a conduit E between the pump and carbureter. The present invention relates more particularly to the pump C, and the detailed description is given of the pump unit, Fig. 1 showing the pump in end elevation.

In such arrangement, the structure may be considered as formed of two general features, one of these being the power section *c*, the other as a controlled fuel path section *c'*, the movement of the fuel through the latter being controlled generally by the needle valve of the carbureter which serves to determine the fuel consumption per unit of time, the arrangement being such that the supply passing through the pump is determined by the fuel consumption of the engine admitted to the carbureter through the usual needle valve control.

The fuel path section is made up of a casting 15 having the general arrangement shown in these views, the line of section being indicated in Fig. 3, the general contour of the casting being more or less oblong, as in Fig. 1, the inner end of the casting, however, being in the form of a circular flange 16 which is designed to be secured to the power section as presently described. The inner end of the casting is recessed, as at 17 to provide, in the assembly, the pumping chamber, one end of this chamber having a port 18 leading to a cavity 19 which is in communication with the thread connection 20 for conduit E. At the opposite end of the chamber, a small port 21 opens into a second cavity 22. Cavities 19 and 22 are completed respectively by threaded members 23 and 24, inserted from the outer side of the casting. Member 23 is a closure for cavity 19, and carries a post 23*a* for positioning a light coil spring 25 designed to urge a valve 26 to its seat at the outlet end of port 18. Member 24, however, is provided with a port 24*a* leading to cavity 22, the inner end of the member forming a valve seat for a valve 27 normally urged to such seat by a light coil spring 28 surrounding a post 29 of the casting.

Cavities 19 and 22 are separated by a wide web structure 30 which is preferably formed with a through opening or channel 31 to permit of the free passage of air therethrough, the opening being designed as a part of the general arrangement for retaining the pump cool in order to obviate the conditions of "vapor lock".

The outer end of the casting is recessed and arranged with a seat to receive a filtering screen 32, held in place by a cap 33 formed to constitute a sump, the cap being secured in position by suitable securing means, this being shown as a bolt 34 threaded to the web structure 30 and projecting through the cap, the outer end of the bolt being threaded to receive a nut 35. The inturned flange of the cap thus provides a recess on the outer side of screen 32, the recesses on opposite sides of the screen thus providing ample space for the movement of the fuel through the filtering structure. Cap 33 is provided with the threaded opening 33*a* to which the conduit D is secured.

As will be understood, the fuel enters through opening 33*a*, passes the screen 32, and then through port 24*a* into cavity 22 from where it passes through port 21 into the pump chamber 17. When pumped from the latter the fuel passes through port 18 into cavity 19 and then onward to the carbureter. Valve 27 controls the admission of fuel to cavity 22, while valve 26 controls the discharge of fuel from chamber 17, these valves being of suitable structure and generally of thin sheet metal so as to provide for light weight and aid in the sensitive operation of the apparatus.

The pumping chamber 17 is completed by a flexible diaphragm 37 of suitable material, this diaphragm being peripherally secured between flange 16 and a similar flange 38*a* carried by cylindrical housing 38, the diaphragm thus forming a movable inner wall of the chamber, and being considered as a part of the power section *c*.

The movements of the cam *f* of the cam shaft F are made active upon a disk or follower 40 located within housing 38, through an actuator, the disk being operatively connected with the diaphragm 37 by a coil spring 41 of suitable small power value—two or three pounds, for instance. To take care of wear conditions and to provide true movement of the diaphragm, the latter, at its center, carries a pair of clamping members 43 mounted on opposite sides of the diaphragm, spring 41 contacting with the inner member 43. Stem 42 secured to the diaphragm clamping members extends through a central opening in the disk 40, and carries a stop structure in the form of a collar. There is no connection between the stem and either the disk or the actuator, so that relative movement between the stem and disk is possible at all times.

The actuator may differ somewhat in its form as shown in the present embodiment of my invention. In Fig. 2, the housing 38 carries a tubular extension 38*b* within which is located a tubular member 45, closed at its inner end, the opposite end contacting with disk 40. Member 45 has its closed end contacting with cam *f* and thus serves as an actuator for positively moving the disk 40 in the direction of the diaphragm. The actuator member 45 receives the projecting end of the stem 42 freely, thus permitting relative movement therebetween. In this form, the pump is designed to be secured to the side wall G of the crank case of an internal combustion engine, with the extension 38*b* extending into the crank case in proximity to the cam shaft, so that the cam *f* acts directly on the actuator without any open communication between the pump and the crank case.

To move disk 40 in the opposite direction to maintain the piston on the cam and to provide the suction stroke to the diaphragm, there is a spring 50 of sufficient power to provide the desired action, and necessarily of greater power than spring 41. Spring 50 lies between the disk and a suitable abutment structure, and surrounds spring 41, so that both springs 41 and 50 are located on the same side of the disk—the side opposite the actuator.

The abutment is in the form of a spider 55 having an annular securing flange 56 which is adapted to be clamped, with the diaphragm, between the flanges 16 and 38*a*. This arrangement makes possible the production of what may be termed a power unit—shown as removed, in Fig. 4—capable of bodily insertion and removal from the power section, by simply separating the housing and casing. Since the parts which form this unit comprise practically all of the parts which are likely to deteriorate in use, it can be readily

understood that the arrangement is of especial value as a servicing feature for the pump, since a change from one unit to another does not require the services of an expert, so that service costs are greatly reduced. The drain opening **58** is provided to allow the oil that may seep into the pump from the crankcase to escape.

The operation of the pump will be readily understood. Movement of the diaphragm towards and away from the pumping chamber serves to contract and expand the pumping chamber and thereby set up a pumping action therein to draw fuel from the fuel source and expel it from the pump to the carbureter. However, there are certain characteristics present, due to the arrangement of the power section by which the supply and demand are accurately balanced.

The disk **40**, in effect, provides the power source for the movement of the diaphragm. The disk, however, is connected with the diaphragm only on its compression stroke through the coil spring **41** which, as pointed out above, is of but a few pounds pressure. The engine actuated stroke of the diaphragm, therefore, is a cushioned stroke. On the suction stroke, the disk is connected with the diaphragm only through the power spring **50** and the collar **44** and the stem **42**, leaving the lighter spring **41** to follow the disk by the force of its own expansion. At idling speeds, the pressure exerted on the liquid fuel will be approximately that of the spring **41** and, that pressure together with the reduced speed of the engine and, of necessity, the consequent reduction in frequency of the pumping impulses, will be found to be sufficient to supply the carbureter of the engine with an adequate amount of fuel. With the increase in the speed of operation of the engine, there will be an increased demand for fuel that must be supplied without an increase in the effective pressure on the carbureter. This is accomplished by the resultant of several factors. One is the reduction in the effective pressure of the actuating mechanism on the diaphragm by reason of the loss of energy in the spring **41** due to its inability to follow the disk as the speed of operation increases or, in other words, the time interval required for the spring to expand and follow the disk is greater than the time interval between the compression impulses imparted to the disk by the actuator. Another is the increase in the frequency of the pumping impulses due to the increased speed of the actuating mechanism.

By providing disk **40** as the active power member for the diaphragm, several advantages are present. The opposing power sources—the actuator and spring **50**—operate directly upon the same element, so that the disk **40** is thus moved positively in both strokes. In addition, it permits spring **50** to be located on the opposite side of the member from the actuator, and on the same side as the idling spring **41**, thus not only providing for a compact arrangement as well as the production of a power unit such as indicated in Fig. 4, but in addition, permits of an advantageous use of the direct actuator stroke.

The diaphragm movements in the direction of pumping into cavity **19**, should be as uniform as it is possible to provide them. This can be done by utilizing the cam and actuator as the power source during this stroke, thus utilizing the regularity of the cam *f* for the purpose, so that a sameness in stroke as well as a certainty in the timing of the stroke is assured, since there is no possibility of lag present. Spring **50**, being a power source only, and effective on disk **40**, can be given a desired power value, sufficient for instance, to maintain the actuator in contact with the cam. It is possible, however, that conditions may be present, during motor operation, when changes in speed, etc., might create a tendency to a slight lag—of no material effect in maintaining substantial contact of actuator and cam, since the power would immediately compensate—a condition which might become effective on the diaphragm movements to vary slightly from a regularity such as is provided by the cam. The final result would not be changed, since the increased rapidity of movement of the disk on the return stroke would be effective to decrease the pressure of the pumping chamber sufficiently to cause the flow of fuel into the pumping chamber in the proper amount even though in a shorter period. Such variations in diaphragm action are immaterial on the suction stroke, since the time of supply does not affect the operation, whereas a variation in the timing during the pumping stroke could tend to set up a somewhat pulsating action in the supply line to the carbureter.

The strokes of the disk **40** will be equal in length in each case, but the timing factor may differ because of the use of a spring as the power source for one of the strokes. Because of this condition, it is obviously advantageous that the actuator power stroke be utilized for the pumping stroke to avoid, as far as possible, the production of pulsating activities in conduit E, any pulsating effect in conduit D due to this source, being unimportant.

The arrangement thus provides for two independent power sources of similar stroke length characteristic and which are in opposition relative to the disk **40**, so that the strokes of the latter are of equal length, with the timing of the strokes provided by the cam movements. The power sources co-operate in producing the stroke length, since spring **50** is effective in substantially retaining the actuator in contact with the cam, and at the same time provides the resistance which restrains the actuator from an excessive stroke length at high speeds. And by utilizing the regularity of movement provided by the cam as the basis for the pumping stroke, the possibility of any lag effects on the part of the spring **50** is made ineffective upon the supply for the carbureter, and at the same time ensures that a proper quantity of fuel will be delivered to the pumping chamber from the supply.

And by utilizing spring **41** as the connection between the disk **40** and the diaphragm, it is possible to utilize the difference in pressure between the diaphragm and the disk at low speeds and at high speeds to determine the effective pressure on the discharge line without affecting the stroke-length of the disk, and at the same time meet the conditions due to the sudden changes in the demand for fuel, should that demand occur when the disk **40** is out of its position at the inner end of its stroke. Consequently, the pump is exceedingly sensitive in action and at the same time is sturdy and capable of sustaining the service conditions required, regardless of the speed of operation.

The structure disclosed herein is so formed as to permit ready servicing by the customer himself, so that the repair can be made at any place. If the difficulty is with the springs of the power section or the diaphragm, the casting and housing are separated by removal of the securing screws, and, with the unit of Fig. 4 employed, a

spare unit placed in position and the sections united. If either of the valve springs are affected, a removal of nut 35 permits the pump to be removed and affords access to the removable members 23 and 24. The cost of the unit of Fig. 4 is small as compared with the cost of the pump, so that not only is the cost of expert assistance avoided, but the cost of the substitution is itself relatively small.

The present structure in addition to providing a novel and effective fuel pump is designed to effectively meet the problem of "vapor lock" both by positive mechanical means and by structural design. The movable disk 40 is reciprocated back and forth rapidly and acts as an air agitator in close proximity to the fuel path and in combination with the housing 38 and the openings 54 in the securing flange 38a constitutes an air impeller that will draw in and expel air to and from the housing and thereby maintain a low temperature at the point in the fuel path where "vapor lock" is most likely to occur. Without the use of the housing 38 the movable disk 40 will agitate the air in proximity to the diaphragm so that the excessive heat developed in operation will not effect the fuel in the pump and will adequately prevent the formation of "vapor lock". If desired openings 58 may be provided in the housing.

The present structure is designed so that, where it is in contact with the crank case, communication between the interior of the pump and the interior of the crank case is closed and the heated gases therein are prevented from ready access to the interior of the pump and this is accomplished by the use of the tubular piston 45 as the pumping actuator. Hence, the heat condition of the motor is reduced to this extent. By reason of the particular mechanical structure employed in the power unit, it is also made possible to space the valve casing through which the fuel passes away from the crank case, the distance of the space occupied by the actuating mechanism and the power unit and this distance will be found to position the valve casing out from the crank case of the engine to where it will be in a current of air passing through the hood of the automobile. Provision is also made in the valve casing 15 between the fuel passages for free access to external air by the open channel 31 which ventilates and keeps this particular section cool and thus eliminates heating of the valve casing as a source of "vapor lock". To enable this to be done, the web 30 is provided in the casting 15 and in order to screen the fuel and have the web 30 the fuel inlet port is placed in the cap 33, instead of in the side wall of the valve casing.

As will be understood, the general arrangement is relatively simple and of comparatively low cost of manufacture and of maintenance. The arrangement is such that the pump can be installed to meet various types of motor vehicle structures, the fuel section being substantially the same in each case, the cap structure permitting of a top or side supply connection, while the power section can be actuated in any suitable manner. Consequently, the production costs for supplying various types are retained at a minimum, while providing for the general similarity in action and for efficient service.

What I claim is:—

1. An actuating means for a diaphragm type fuel pump comprising an engine operated cam, a rigid actuator in contact with said cam, a spring positioned between the diaphragm and said actuator and in direct contact with said diaphragm for actuation of said diaphragm on its compression stroke under the influence of said cam, a pull rod secured to said diaphragm and extending axially of said spring, said pull rod terminating in an enlarged head which resides internally of said actuator, a fixed abutment immediately adjacent the diaphragm and comprising a spider through which the diaphragm actuating spring is positioned and an annular flange by which the diaphragm is secured to the pump, a second spring reacting against the spider of the fixed abutment at one end and against said actuator at its other end, and a lost motion connection between said second spring and the enlarged head of said pull rod through which said diaphragm is actuated on its rarefaction stroke.

2. An operating unit for diaphragm pumps having a fuel path casing and pump operating mechanism comprising: a diaphragm adapted to form a closure for the fuel path casing, a rod rigidly secured at one end to the diaphragm and having an enlarged head at its other end, a plate rigidly secured to the rod at the end which is attached to the diaphragm, a supporting member and a plate loosely surrounding said rod, the inner diameter of the supporting member being less than the outer diameter of the fixed plate, a relatively strong spring surrounding the rod and reacting between said supporting member and said loose plate and urging said supporting member against the fixed plate and the loose plate into contact with the rod head, a relatively weak spring surrounding the rod and reacting at one end against the fixed plate and at its other end against the loose plate, and a power actuator for said loose plate.

3. An operating unit as in claim 2, the supporting member and the diaphragm being in peripheral contact when the unit is attached to the fuel path casing.

FLOYD F. FLINT.