Nov. 1, 1932. L. N. HAMPTON 1,885,436

FLUID TRANSFER DEVICE

Filed Aug. 18, 1928 2 Sheets-Sheet 1

Fig. 1,

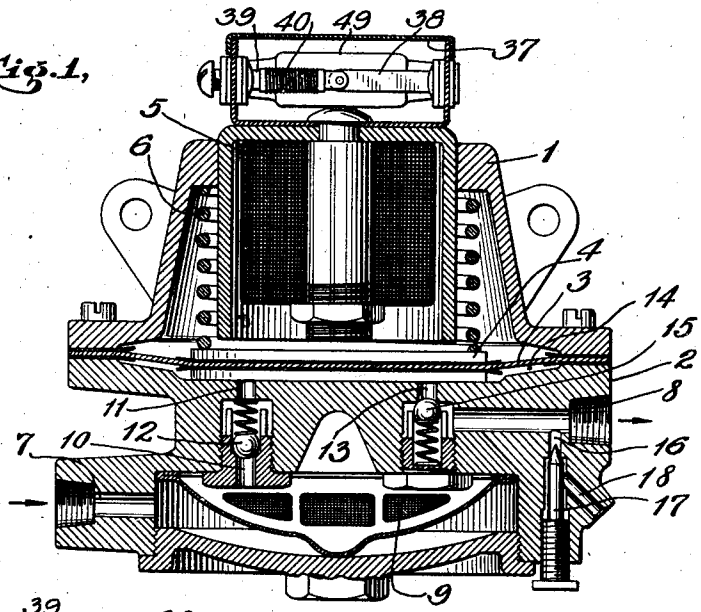


Fig. 2,

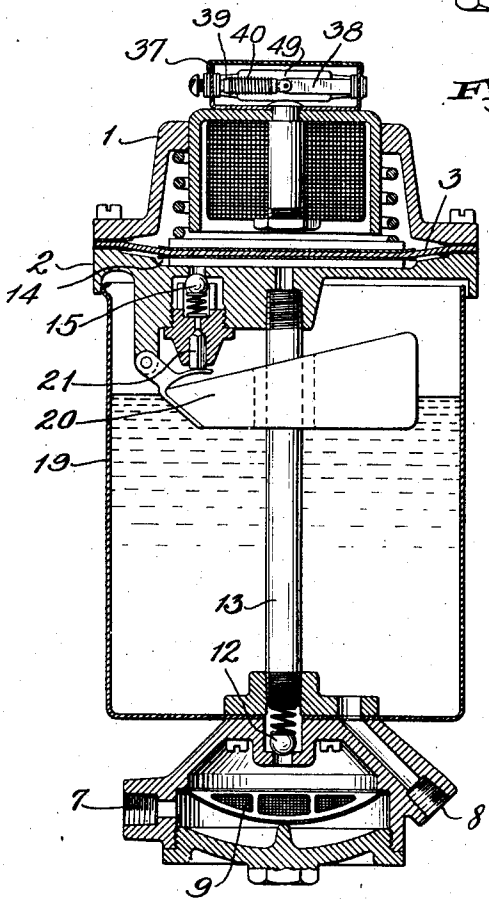


Fig. 3,

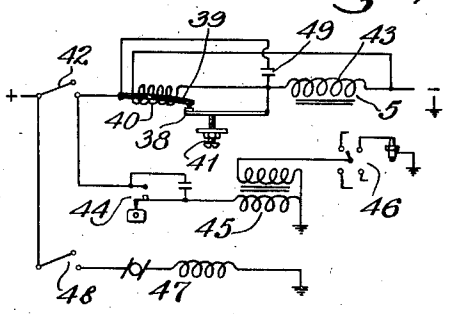
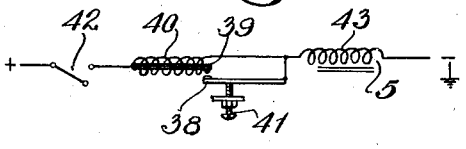


Fig. 4,



INVENTOR.
Leon N. Hampton

BY
Riddle Margeson and Hornidge.
ATTORNEYS.

Nov. 1, 1932. L. N. HAMPTON 1,885,436

FLUID TRANSFER DEVICE

Filed Aug. 18, 1928 2 Sheets-Sheet 2

Fig. 5.

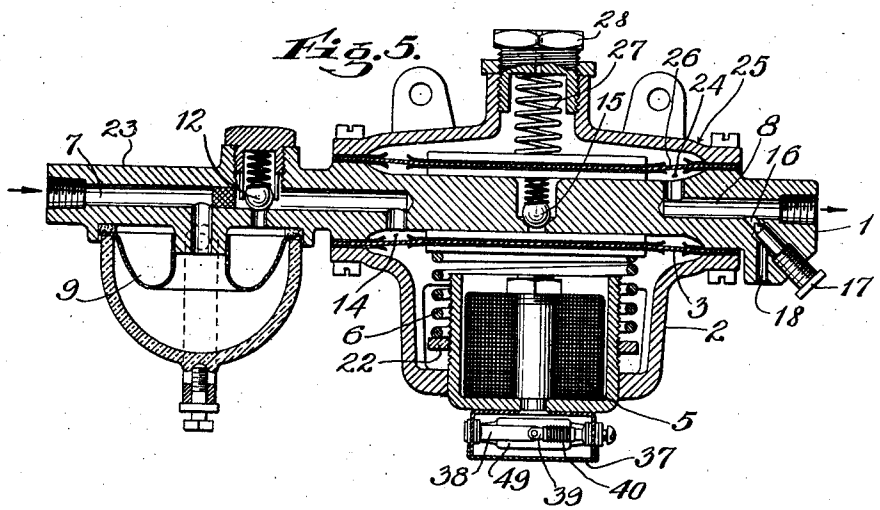


Fig. 6.

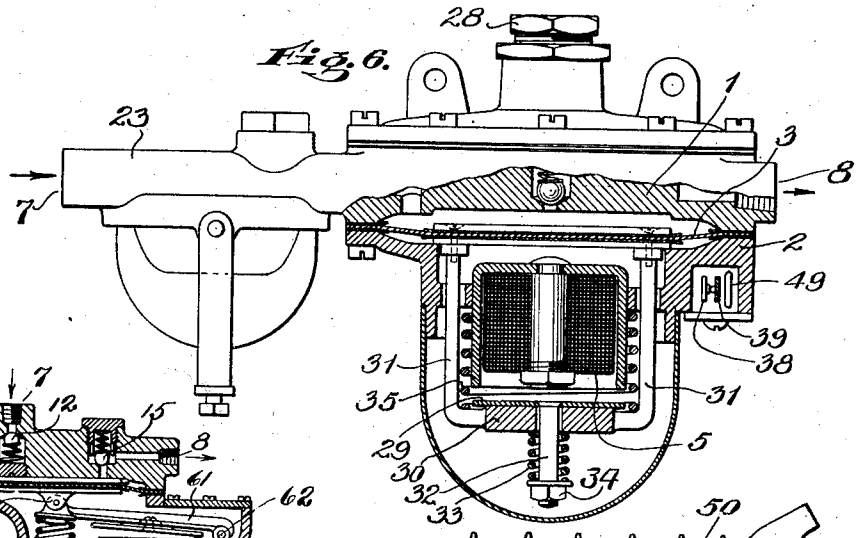


Fig. 8.

Fig. 7.

INVENTOR.

BY Leon N. Hampton.

Riddle, Margeson and Hornidge. ATTORNEYS.

Patented Nov. 1, 1932 1,885,436

UNITED STATES PATENT OFFICE

LEON N. HAMPTON, OF NEW YORK, N. Y., ASSIGNOR TO A C SPARK PLUG COMPANY, A CORPORATION OF MICHIGAN

FLUID TRANSFER DEVICE

Application filed August 18, 1928. Serial No. 300,567.

My invention relates to improvements in fluid transfer devices.

In fluid transfer devices employing flexible pumping members such as diaphragms, bellows, etc. it is good practice to limit the stroke or displacement of the pumping member so as to keep the maximum developed unit stress well within the elastic limit. In instances where the capacity requirements of the installation served vary it is advisable to vary the stroke of the pumping member proportionately so that the developed stress will never be any higher than necessary. It is also desirable to keep the number of operations during the expected life of the apparatus as low as possible but it is far more important to keep the stress low as there is no sensible relation between the developed stress and the number of operations required to cause rupture, the number of operations decreasing out of all proportion to increase in stress.

There are many ways in which slow speed variable stroke operation may be obtained but a combination which will be efficient, positive, inexpensive and require a minimum of maintenance may not be apparent. The problem resides primarily in the timing unit and applicable units will be discussed later.

Considering internal combustion engine installations for the moment it is not the best practice to time the operation of the transfer device from the engine because if this is done relatively high operating speeds will at times be encountered unless expensive speed reducing means are provided. Even though speed reduction means are resorted to it remains that the operating speed of the transfer device will be proportional to that of the engine and this, in some instances, is undesirable. The highest pumping rate is required when the engine is operating at full speed under full load but at such times the transfer device operating at correspondingly high speed will be least efficient due to valve slippage, etc. This undesirable condition applies to all valved transfer devices whether a piston or a flexible pumping member is used. It also applies to that class of transfer devices wherein timing is independent of engine speed but is controlled by the pumping rate, as is the case with constant stroke variable speed solenoid pumps wherein the solenoid circuit is changed at the extremes of the pumping member stroke.

My improved fluid transfer device comprises essentially a pumping member, as for example a flexible pumping member such as a disc diaphragm, a bellows, etc. although a piston might be used satisfactorily under certain conditions, a solenoid for moving the pumping member in one direction with means for causing movement in the opposite direction together with a relatively slow speed periodic control for the solenoid circuit.

The periodic control may be in the form of a slow acting relay, an escapement or the like but preferably in the form of a thermal contact consisting of dissimilar metals suitably secured to each other and heated by a battery fed coil for example wrapped about the thermal device. The energizing of this coil will cause the dissimilar metals to heat and the device will be deflected from its original shape due to unequal expansion of its components. The thermal contact when so deflected may either open the circuit to the heating coil in the case of a closed circuit or short circuit the coil in the case of an open circuit to effect a cyclic operation of the thermal contact and thus institute a periodic control for the solenoid circuit. Both types of circuits are shown herein.

In the case of the closed circuit, heating of the thermal contact of the periodic thermal control will cause the solenoid of the pump to be deenergized, whereas in the case of the open circuit heating of the thermal contact will cause the solenoid current to be increased to the operating point. In both cases, however, the solenoid circuit is periodically changed, that is to say is changed at substantially constant speed so as to impart a pumping action to the pumping member.

The make and break characteristics of the periodic thermal control may be varied by design. In most cases, however, it is probably preferable to design these parts so that the intake period of the transfer device will

be short as compared to the output period, as in this way the output will be fairly steady. Further adjustment or regulation of the time characteristics of the contact of the periodic control may be attained by adjustment of the contact pressure and follow.

Such adjustment will also change the operating speed making it practical to manufacture but a single size pump for many difference services, adjusting the operating speed in proportion to the maximum capacity requirements of the particular installation served.

When a diaphragm pumping member is used it is of course advantageous to keep the displacement minimum as will be understood. Naturally when the stroke is decreased the device must operate more quickly but this is preferable to increasing the stroke. When the diaphragm is operated by a solenoid a small displacement has another advantage. The tractile effort of a solenoid is inversely proportional to the square of armature separation and therefore a small displacement materially decreases the necessary solenoid current and this tends to prolong the life of the associated contacts. Of course this latter observation applies even though a piston might be used and also in general the diameter should be as large as practicable as then the operating speed will be slower. Although a small stroke is desirable the stroke nevertheless must be sufficient to assure ready priming. This however will be accomplished even with a very small stroke if a disc diaphragm pumping member is used and the pump casing is made to conform to the diaphragm.

When employed in connection with an internal combustion engine for example for supplying fuel thereto a solenoid transfer device of the class described will start functioning as soon as the controlling switch therefor is closed and even before the engine starter is operated. This of course insures that the carbureter of the engine will contain fuel when the engine is first turned over, thereby facilitating starting and also conserving the starting battery.

My improved device also provides an additional advantageous feature in that it may be operated independently of the apparatus it serves and because of this gasoline or other fluid may be pumped for emergency purposes or for any other reason aside from supplying the apparatus to which the device is applied.

Where an extremely uniform flow to the carbureter or other apparatus is required, as for example in an oil burner installation, it is desirable to provide a double acting pump or pressure head or both. While a pressure head will ordinarily suffice the conventional air chamber pressure head is not entirely satisfactory in this service as the air may be absorbed by the fuel or otherwise displaced and then the effectiveness of the head is destroyed.

The present apparatus provides a pressure head having a flexible wall and more specifically my improved apparatus provides an auxiliary flexible member such as a diaphragm or a bellows, etc. so mounted as to be subjected on one side to the output of the pumping member and on the other side to the action of a spring. This auxiliary flexible member which constitutes a flexible wall for the pressure head will flex under the discharge pressure of the pumping apparatus on its output stroke, absorbing some of the output and will deliver some or all of the output thus absorbed to the consumer during the intake stroke of the pumping member, thus tending to smooth out the delivery pressure. In other words, the delivery of the fluid being transferred will be a constant or nearly constant flow as distinguished from a pulsating delivery.

In the accompanying drawings, Fig. 1 is a sectional elevational view of an embodiment of my invention;

Fig. 2 is a view of another embodiment of my invention showing the same applied to a gravity feed tank;

Figs. 3 and 4 are wiring diagrams;

Fig. 5 is a further modification showing my improved device provided with a flexible wall pressure head;

Fig. 6 is a view similar to Fig. 5 of a still further modified form of my invention;

Fig. 7 shows my apparatus installed in connection with an internal combustion engine; and

Fig. 8 is a sectional elevational view of a still further modification of my invention.

As above stated the apparatus of this invention is for the purpose of transferring fluids and may be used for supplying fuel for example to an oil burner, to internal combustion engines, either directly or indirectly, and is capable of other and further uses. It is to be understood therefore that the term fluid transfer device is to be interpreted in a broad sense.

Except when an auxiliary gravity feed tank is used the device illustrated may of course be mounted in any desired relation to the supply or receiving means or both and without regard to their normal position.

Referring first of all to the embodiment of my invention illustrated in Fig. 1: The same comprises a casing composed of two sections which for convenience will be termed an upper section 1 and a lower section 2. Clamped between the two sections 1 and 2 of the casing is a pumping member, the pumping member as illustrated comprising a disc diaphragm 3 of metal, fabric or other suitable material. It is to be understood, however, that other types of pumping member may be employed if desired, a pumping

member of the disc diaphragm type alhough possessing certain inherent advantages, having been shown merely for purposes of illustration and not by way of definition. The upper face of the diaphragm 3 is provided with a plate 4 of magnetizable material such as magnetic iron for instance.

Immediately above the pumping member 3 and plate 4 I mount a solenoid 5 secured to the upper section 1 of the casing of the device in any suitable manner, it being understood that the solenoid is mounted within the casing section. Surrounding the solenoid is a coil spring 6 which in this instance is a delivery spring. The upper end of this spring bears against a shoulder formed on the inside of the casing section 1, the lower end of the spring bearing against the plate 4 which as above mentioned is secured to the pumping member 3. Obviously energizing of the solenoid 5 up to the operating point will cause the same to attract the plate 4, moving the pumping member 3 upwardly, as viewed in the drawings, at the same time placing the delivery spring 6 under compression. Obviously deenergizing the solenoid below the operating point will permit the delivery spring 6 to move the diaphragm in the opposite direction, thereby effecting a vibration of the pumping member.

The lower section 2 of the casing of the device is provided with an intake port 7 and delivery port 8. The intake port 7 is in communication with a strainer or filter 9, the fluid being transferred by the device, as to be hereinafter explained. after passing through the filter 9, passing through ports 10 and 11 to the chamber beneath the pumping member 3 between the pumping member and the upper face of the lower casing section 2. The port 10 is provided with a spring loaded intake valve 12.

The lower casing section 2 is also provided with a delivery port 13 opening directly into the chamber 14 which is below the pumping member and controlled by spring loaded delivery valve 15 adapted to place the port 13 and delivery port 8, above referred to, in communication with each other at the proper time.

The operation of the device is exceedingly simple, it being obvious that movement of the pumping member 3 upwardly, as viewed in Fig. 1, will deliver fluid from any source of supply through the intake port 7, strainer 9, past the intake valve 12, which opens of course when the pumping member moves upwardly and through port 11 to the chamber 14. On the reverse movement of the pumping member 3 under the action of the delivery spring 6 the intake valve 12 will seat, delivery valve 15 will be unseated and the fluid in the chamber 14 will be discharged to any receiving means from or through delivery ports 13 and 8.

The lower casing section 2 of the device is also provided with a valve-controlled drain or auxiliary discharge in the form of a port 16 communicating with the discharge port or outlet 8, hand operated valve 17 and drain or auxiliary port 18. As to be hereinafter explained by opening the valve 17 fluid may be discharged to the exterior of the device through the port 18 in the case of an emergency or when it is desired for some reason to take fluid from the device instead of passing it to the receiving means to which the fluid is normally discharged through the port 8.

Inasmuch as the control of the circuit of the solenoid 5 is the same in the various modifications shown herein, this feature of my invention will be described in detail after the detail description of the mechanical side of the invention.

Referring now to Fig. 2, it will be seen that I have here provided a fluid transfer device as applied to a gravity feed tank, the gravity feed tank being designated 19. I might say that this tank is analogous to the gravity tank section of so-called vacuum tanks now used as standard equipment on many makes of automobiles wherein fuel is drawn into the vacuum tank by cylinder depression and flows therefrom by gravity to the carbureter. Inasmuch as the particular construction of the mechanism of the gravity feed tank itself constitutes no part of the present invention the same will not be described in any detail.

The transfer device is mounted as will be seen at the top of the tank 19 and is or may be exactly the same so far as construction is concerned as the transfer device already described in connection with Fig. 1. It will be seen that in this figure fluid is taken from any suitable source through the intake port 7, through the filter 9 and is drawn up due to upward movement of the pumping member 3, past the intake valve 12, tube or conduit 13 to the chamber 14 beneath the pumping member 3 and when the pumping member moves on its discharge stroke which as illustrated is downward the intake valve 12 will seat and discharge valve 15 will be unseated, permitting the fuel to be discharged into the tank 19 from whence as understood it will flow by gravity to a carbureter or other suitable receiving means, the level of the fluid in the tank 19 as is usual being controlled by a float 20 adapted when the maximum level in the tank has been reached to close a controlling valve 21 which will prevent the admission of any more fuel to the tank until after the level shall have been lowered.

In Fig. 5 which as above explained is a further modification of my invention I have inverted the solenoid 5, the same now being placed below the pumping member 3 instead of above it. In this instance I have provided

for adjusting the tension of the delivery spring 6, this adjustment consisting of an adjusting ring 22 which screws upon the outside of the casing of the solenoid and against which the lower end of the spring will rest. Obviously by adjustment of this ring the tension of the delivery spring may be adjusted.

The upper section 1 of the casing of the device in this instance is provided with a lateral extension 23 and this extension carries the filter 9. In this form of my invention movement of the pumping member 3 downwardly under action of the solenoid 5 will draw the fluid to be transferred through the intake port 7, filter 9 and past the spring loaded intake valve 12 to the chamber 14 above the diaphragm. When the solenoid is deenergized below the operating point the discharge spring 6 will move the pumping member in the opposite direction, the intake valve 12 seating and the fluid flowing past the discharge valve 15 to a chamber 24.

The upper section 1 of the casing of the device is provided with a cap or third section 25 and clamped between this section 25 and the upper face of the casing section 1 is the flexible wall 26 of the pressure head comprising chamber 24.

Above this flexible wall, which also functions as a pumping member in a sense to be brought out later, and always in contact therewith is a spring 27, the adjustment of which may be effected by a screw plug 28 screwed into the top of the section 25 and bearing against the upper end of the spring.

The flexible wall or pumping member 26 and the upper face of the section 1 of the casing constitutes what I shall term a flexible wall pressure head, chamber 24 thus formed being in communication with the output valve 15 through which the chamber is charged and the port 8 through which the chamber is discharged.

It will be obvious that with this device in operation there will be a substantially constant discharge of the fluid from the chamber 24 by way of discharge port 8 to any device to be supplied, as distinguished from a pulsating or intermittent discharge.

This construction, therefore, provides a fluid transfer device capable of delivering fluid at a uniform rate as distinguished from a pulsating or intermittent delivery.

This apparatus is provided as in the case of Fig. 1 with an auxiliary discharge outlet whereby fluid in an emergency or for any other reason may be discharged from the device instead of delivering fluid to the normal receiving means whatever it may be.

In Fig. 6, I have illustrated a still further modification of my invention, this figure illustrating primarily a modification of the apparatus of Fig. 5. In this figure the solenoid 5 is rigidly mounted in the lower section 2 of the casing of the device but instead of operating directly on the pumping member as in the other forms of my invention above described is adapted to attract, that is to say move a metallic plate 29 which is mounted upon a portion of a bridge member 30 below the solenoid 5. This bridge member is attached by suitable members 31 to the pumping member 3.

The plate 29 is attached to the bridge 30 by a stud 32 secured to the plate in any suitable fashion and projecting some distance below the lower face of the bridge piece 30. This stud is provided with a spring 33, the upper end of which bears against the underside of the bridge 30 and the lower end of which bears against the upper side or face of a nut 34 screwed upon the stud 32. By adjustment of the nut 34 obviously an adjustment may be effected of the spring 33.

It will be apparent that energization of the solenoid 5 up to the operating point will draw the plate 29 upwardly and, depending upon the tension in the spring 33, will also effect through the bridge 30 and supports 31 an upward or discharge movement of the pumping member 3, deenergizing of the solenoid below the operating point permitting the intake spring 35 to move the pumping member 3 downwardly on its intake stroke. This embodiment of my invention, therefore, differs from that of Fig. 5 structurally and in a sense in an operating way by employing the solenoid to move the pumping member on the discharge stroke and a spring for moving the pumping member on its intake stroke as distinguished from Fig. 5 and the other figures above described wherein the solenoid moves the pumping member on its intake stroke and the spring moves the pumping member on its discharge stroke.

In all of the forms of my invention above described it will be apparent, therefore, that I have provided a fluid transfer device comprising a pumping member which is adapted to be actuated in one direction electrically as by a solenoid and in the opposite direction by a spring. It will be apparent also that in the embodiments of my invention illustrated in Figs. 5 and 6, I have provided in addition to these features a pressure head having a flexible wall whereby the device or apparatus will deliver fluid at a constant rate as distinguished from the more or less intermittent or pulsating delivery of the forms illustrated in Figs. 1 and 2 for instance.

As I have mentioned above the solenoid of all of the forms of my invention described is controlled by similar apparatus or mechanism. This apparatus I have termed herein a periodic thermal control, and a wiring diagram of the same is illustrated in Fig. 3 as well as in Fig. 4. The construction of the same which is very simple is best illustrated in Fig. 1 or in Fig. 2 for instance. Returning to these two figures of the drawing it

will be seen that attached to the casing of the device is a box or enclosure designated 37. This box or enclosure contains a fixed contact 38, a thermal movable contact 39 and a heating coil 40. The contact 38 may be adjusted to vary its position with respect to the thermal contact 39 by an adjusting screw 41 which as will be presently explained will vary the operating periods of the control.

Referring to the wiring diagram of Fig. 3 which illustrates a closed circuit control, it will be seen that closure of a switch 42, with the thermal contact 39 in the position illustrated which is its initial position, will close a circuit, to the coil 43 of the solenoid 5, and also to the heating coil 40. The winding 43 of the solenoid under these conditions will cause the solenoid to move the pumping member 3 on its intake stroke in Figs. 1, 2, 5 and 8 and on its delivery stroke in the case of Fig. 6.

The heating coil 40 will eventually heat the thermal contact 39 sufficiently to cause the same to move away from the contact 38 and when this occurs the circuit to the solenoid 43 will be opened and the pumping member 3 will be moved under the action of the discharge or intake spring as the case may be on its discharge or on its intake stroke. Obviously this arrangement will operate at regular intervals and hence I have defined this control as a periodic thermal control. It will be obvious also that by adjusting the screw 41 the time intervals between the closing and opening of the contacts 39 and 38 may be varied so that the device may be set to suit various installations.

On a motor vehicle installation it is convenient to have this control arranged so that it will become operative when the ignition switch is closed and hence supply fluid to the carbureter of the engine of the motor vehicle at once and before the closure of the circuit for the starter motor. I have illustrated such an arrangement in Fig. 3 more or less diagrammatically in which figure the switch 42 already referred to may be considered to be the ignition switch of an automobile, 44 the interrupter of the ignition system of the automobile, 45 the ignition coil, 46 the distributor, 47 the starter motor and 48 the starter switch. This will provide an arrangement whereby so far as motor vehicles are concerned closure of the ignition switch 42 will permit the solenoid winding 43 to be energized up to the operating point and the fluid transfer device to be set into operation to supply fuel to the carbureter of the motor of the vehicle and upon operation of the starter switch 48 the starter motor 47 will receive current in the usual way, the motor will be turned over and fire in the usual way, the carbureter, however, already being supplied with the desired quantity of fuel by the transfer device.

In the diagram of Fig. 4 in which diagram I have not shown the ignition circuit and starter circuit as I have done in Fig. 3, I have provided an open circuit system as distinguished from a closed circuit system such as illustrated in Fig. 3. In this diagram closure of the switch 42 will close a circuit to the winding 43 of the solenoid 5 and also to the heating coil 40, the windings being in series and the current in the solenoid coil 43 being too low to move the pumping member 3. Upon heating of the coil 40 the thermal contact 39 will move into engagement with the fixed contact 38 thereby short circuiting the heater coil 40 and thus permitting sufficient current to flow to the solenoid coil 43 to cause it to move the pumping member. The heater coil being short circuited will cool and the thermal contact will again open and the cycle will be repeated.

In the closed circuit a condenser 49, which may be conveniently mounted in the thermal contact mounting box, may be shunted across the contacts 38 and 39 to act as a spark quench. In the open circuit the heater coil will act to a measure in this capacity.

In Fig. 7 I have shown the application or installation of my apparatus on an internal combustion engine 50 in which the apparatus of Fig. 5 is illustrated. In this figure 51 designates a fuel tank, 52 a carburetor, the apparatus or device as a whole of Fig. 5 being designated 53. The pipe 54 connects the intake side of the device to the fuel tank 51, the pipe 55 connects the delivery side of the device to the carbureter 52.

In Fig. 8, I have shown a modification of my invention which is particularly well adapted for use in installations of my apparatus on oil burners for instance, or other installations where a relatively high delivery pressure may be desirable. In this embodiment of my invention the pumping member 3 is actuated by a solenoid 5, as in the embodiments of the invention above described, but instead of actuating the pumping member 3 directly, the same is operated so to speak indirectly through power multiplying mechanism. To this end, therefore, the pumping member 3 is provided with a lug 60 of any suitable form to which is pivotally attached one end of a lever 61 fulcrumed at 62, the lever intermediate its fulcrum and the lug 60 being provided with a plate 63 of magnetizable material such as magnetic iron for instance and adapted to be pulled downwardly as viewed in the drawings by the action of the solenoid 5 as will be understood. The delivery spring 6 is interposed between the pumping member and the bottom of the casing of the device and by reason of the provision of the lever 61 and the plate 63, it will be obvious that the delivery pressure of the device may be materially increased as compared with the devices of the other embodiments of my invention above described without in any way

varying the dimensions of the solenoid 5. In this form of the invention, the intake valve is designated 12 and the delivery valve 15, each of these valves being spring loaded. The tension of the spring 6 may be adjusted by the adjusting device 64. It will be understood that the box 37 contains periodic thermal control mechanism for the solenoid 5 similar to that above described.

This form of my invention provides, therefore, a fluid transfer device which is similar in operation to the devices above described in that the same comprises a pumping member operated in one direction by a solenoid and in the other direction by a spring, the circuit of the solenoid being controlled by a periodic thermal control apparatus.

It is to be understood that if desired the device of Fig. 8 may be provided with a pressure head of suitable construction, as for example a flexible wall pressure head similar to that shown and described in connection with Fig. 5.

In all the forms of my invention herein illustrated and described, therefore, it will be seen that I have provided a fluid transfer device in which the operation of the pumping member, whether the same be a disc diaphragm, as illustrated, a bellows, a piston, or other form of pumping member, is controlled by periodic thermal control mechanism, whereby the speed of operation of the pumping member is independent of the speed of the apparatus being served. As an illustration, it will be evident that the speed of operation of the pumping member 3 in all instances is independent of the speed of the crank shaft of the motor 50 of Fig. 7 being supplied with fuel by the device or of the load under which the motor is working.

It will be evident also that in all cases the pumping member is actuated in one direction electrically and in the opposite direction by a spring opposed to the electrically actuated movement of the pumping member, this spring being adjustable so that the delivery pressure may be correspondingly adjusted or regulated.

It will be obvious also that my device may be so constructed as to deliver fluid uniformly although the pumping member is of the vibrating or of the reciprocating type.

It will be apparent also that I have provided an electrically operated transfer device controlled by periodic thermal control mechanism in which the device is operable in any position and also operable regardless of the relative positions of the supply and receiving means and regardless of the position of the device with respect to these two elements.

It will be seen furthermore that I have provided an electrically operated fluid transfer device having the above mentioned characteristics in which the periodicity of the periodic thermal control mechanism may be adjusted to vary the speed of operation to suit different or variable conditions.

It will be further observed that when used for the transfer of fuel from a supply to a consumer my device is exceedingly useful in that the same by reason of its construction and mode of operation will always insure a supply of fuel to the consumer not only in running which is essential but in starting. For example the advantage of the application as described to an internal combustion engine insures a properly charged carbureter before the motor is turned over by the starter.

I wish it to be understood that many changes may be made in the construction of my fluid transfer device without departing from the spirit of the invention and accordingly the invention is not to be limited to the precise forms as herein shown and described.

What I claim is:—

1. In a fuel pump, a pumping member, a magnetizable plate secured thereto, a solenoid adjacent said plate to actuate the same in one direction, and a spring surrounding said solenoid and engaging said plate to actuate the same in the opposite direction.

2. In a fuel pump, a solenoid, a pumping member above said solenoid, a bridge member secured to said pumping member and extending below said solenoid, a magnetizable plate attached to said bridge member beneath said solenoid to be moved thereby to actuate said pumping member upwardly, and a spring vertically engaging said bridge member to actuate said pumping member downwardly.

3. In a fuel pump, a pumping member, a solenoid adjacent said pumping member to actuate the same towards said solenoid, a cylindrical housing about said solenoid, a spring surrounding said housing and engaging said pumping member to actuate the same away from said solenoid, and means to vary the tension of said spring comprising a spring abutment ring adjustably mounted on said solenoid housing.

4. In a fuel pump, a pump housing, a pumping member and operating means including a solenoid within said housing, and a self-contained periodic control unit for said solenoid carried within a separate housing attached to but removable from said pump housing.

5. In a fuel pump, a pump housing, a pumping member, and operating means including a solenoid secured to said housing, and a self contained periodic thermal control unit for said solenoid attached to but removable from said pump housing.

This specification signed this 16th day of August, 1928.

LEON N. HAMPTON.