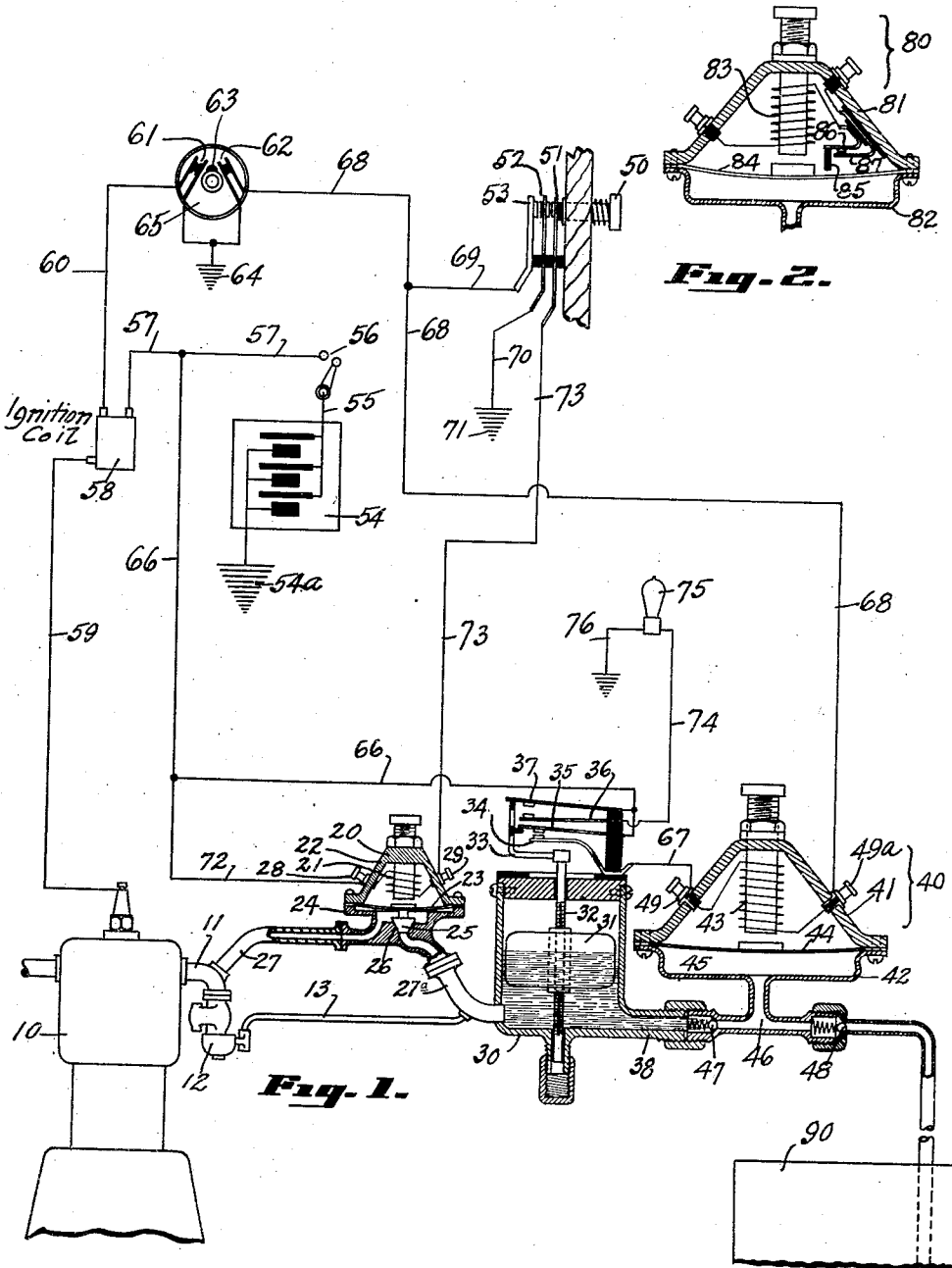


C. F. KETTERING.
FUEL SUPPLY SYSTEM.
APPLICATION FILED AUG. 5, 1918.

1,404,152.

Patented Jan. 17, 1922.



Witnesses
Walter Riedel
Emory E. Freed

By

Inventor
Charles F. Kettering
Hens, Page, Cooper & Hayward
Attorneys.

UNITED STATES PATENT OFFICE.

CHARLES F. KETTERING, OF DAYTON, OHIO, ASSIGNOR, BY MESNE ASSIGNMENTS, TO
DELCO-LIGHT COMPANY, OF DAYTON, OHIO, A CORPORATION OF DELAWARE.

FUEL-SUPPLY SYSTEM.

1,404,152.

Specification of Letters Patent. Patented Jan. 17, 1922.

Application filed August 5, 1918. Serial No. 248,272.

To all whom it may concern:

Be it known that I, CHARLES F. KETTERING, citizen of the United States of America, residing at Dayton, county of Montgomery, State of Ohio, have invented certain new and useful Improvements in Fuel-Supply Systems, of which the following is a full, clear, and exact description.

This invention relates to improvements in fuel supply systems, and particularly that type of fuel supply system used in connection with internal combustion engines.

One of the objects of the invention is to provide a fuel supply system which includes an electrically operated priming device, which can be controlled by a manually operable member located to suit the convenience of the operator.

Another object of the invention is to provide a fuel supply system including a supplemental fuel tank located between the source of fuel and the carburetor of the engine in which a substantially constant head of fuel may be maintained, and to provide an electrically operated fuel pump for pumping fuel from the source of supply to the supplemental tank.

Another object of the invention is to provide a fuel supply system in which the pump for supplying the supplemental fuel tank is controlled manually or by the operation of the engine, said system including provisions whereby the pump will be automatically disabled when the level of fuel in the supplemental tank reaches a predetermined high point.

Another object of the invention is to provide a fuel supply system including a signal device which will indicate to the operator that the level of fuel in the supplemental tank is below normal.

Another object of the invention is to provide a common manually operable member for effecting the operation of the primer and the operation of the pump, so that if the level of the fuel in the supplemental tank is insufficient for priming, the pump may be set into operation at the same time that the primer is rendered effective to permit the engine to draw raw fuel from the supplemental tank for priming purposes.

Further objects and advantages will be apparent from the following description, reference being had to the accompanying drawings wherein forms of embodiments of the present invention are clearly shown.

Referring to the drawings:

Fig. 1 is a diagrammatic view showing the relative position of the different elements included in the present invention and their respective circuit connections.

Fig. 2 is a modified form of the electrically operated pump element.

In Fig. 1 there is shown an internal combustion engine 10, having an intake manifold 11, and a carburetor 12. The carburetor 12 is connected to a supplemental fuel tank 30 by means of pipes 13 and 27^a. The pipe 27^a also connects the inlet of a priming device 20 with the supplemental fuel tank 30 while the outlet of the priming device is connected with the intake manifold 11 by means of the pipe 27.

Included in this priming device 20 is an electro-magnet 21, adjustably secured to the upper housing 22, thereof. A diaphragm 23, securely held in position between the housing 22 and the lower housing 24 of the priming device, is provided with a valve 25, adapted to fit within a seat 26 formed in the housing 24. As will be described hereinafter, this valve 25 is electrically operated to permit the passage of fuel from the tank 30, directly to the intake manifold 11 of the engine via the pipes 27 and 27^a.

The supplemental fuel tank 30, is provided with a float element 31, adjustably secured to a stem 32. The stem 32 is provided with screw threads which permit the float 31 to be screwed up or down on the stem, thereby permitting the float to be adjusted to any suitable height for purposes hereinafter set forth. On the upper portion of the tank 30, there are secured two sets of contacts including two stationary contacts 34 and 36, and two movable contacts 35 and 37. A projecting arm 33, secured to the stem 32, is so formed that when the float 31 is raised or lowered by the fuel level in the tank 30, this arm 33 will tend to shift the movable contacts 35 and 37 out of or permit them to return into engagement with their respective stationary contacts 34 and 36.

Any suitable signalling device 75, shown in the drawing as being an electric light, is associated with the contacts 36 and 37 in such a manner that the status of the fuel level in the tank 30 is automatically shown.

Adjacent to the bottom of the tank 30 and formed integral therewith is a pipe 38 which is adapted to be secured to the electric fuel pump 40.

The electric fuel pump 40 includes an upper housing 41 and a lower housing 42. An electro-magnet 43 is adjustably secured to the housing 41 while a diaphragm 44 is held in position between the housings 41 and 42. The lower housing 42 of the electric fuel pump 40 provides a chamber 45 into and out of which the fuel is pumped when the diaphragm 44 is operated by the electro-magnet 43. The housing 42 is provided with passage 46 in which are located ball checked valves 47 and 48 which operate to permit fuel to be drawn up from a main fuel supply tank 90, and to be forced into the supplemental chamber 30.

A manually operable push button 50 is provided for closing the contacts 51 and 52, and 52 and 53. These contacts are adapted to complete circuit connections between the storage battery 54 and the electric priming device 20 and fuel pump 40, as will be described later.

An engine operated timer 65, is provided with two pairs of contacts 61 and 62 and a common contact closing element 63. The contacts 61 are adapted to close the circuit between the battery 54 and ignition coil 58, while the contacts 62 are adapted to intermittently open and close the circuit between the battery 54 and the pump 40.

The operation of the invention is as follows:

To start the engine 10, the ignition switch 56 is closed, thereby establishing a circuit through battery 54, wire 55, switch 56, wire 57, coil 58, wire 60, timer 65, ground connections 64 and 54^a to battery. The ignition system is operative to deliver sparking impulses to the spark plug of the engine through wire 59. To prime the engine, the button 50 is pressed thereby completing a circuit through battery 54, wire 57, wire 66, wire 72, terminal 28, magnet 21, terminal 29, wire 73, contacts 51 and 52, wire 70, and ground connections 71 and 54^a to battery 54. This circuit having been completed, the electro-magnet 21 will attract the diaphragm 23, thereby causing the valve 25 to move away from the seat 26, and thus permit the engine 10, to draw the raw fuel from the supplemental fuel tank 30 through pipes 27^a and 27 into the intake manifold of the engine to prime the same.

However, due to evaporation, or some other cause, the fuel in the tank 30 may have become exhausted and the operator would then find it necessary to replenish same. In order that the operator will not attempt to start the engine when the tank 30 is empty the signal light 75 is provided. When the float element 31, located within the supplemental fuel supply tank is down, due to the absence of fuel in this tank, the contacts 36 and 37 are in engaged position, permitting current to flow from the battery 54

by wires 57 and 66 to the contact 37, contact 36, wire 74, light 75 and back to the battery via ground connections 76 and 54^a, thus lighting this light which signifies to the operator that the fuel is exhausted in the supplemental fuel tank 30. In order to replenish this fuel supply, the operator intermittently depresses the button 50 which will permit current to flow from the battery 54 by wire 57, wire 66, contacts 35 and 34, to the pump terminal 49. Thence the current will flow through the electro-magnet 43, to terminal 49^a, and through wire 68, wire 69, contacts 53 and 52 and back to the battery via ground connections 71 and 54^a.

Current passing through the electro-magnet 43 will attract the diaphragm 44 which will tend to draw fuel from the main fuel supply tank 90 into the chamber 45 of the pump, due to the operation of the ball check valves 47 and 48 into closed and open positions, respectively. As soon as the current through the electro-magnet is discontinued due to the release of the button 50 by the operator, the diaphragm will by virtue of its elasticity flex back to normal position, thereby tending to force the fuel in the chamber 45 into the supplemental fuel tank 30 due to the operation of the check valves 47 and 48 into open and closed positions, respectively. This pumping operation will be repeated with each intermittent operation of the button 50, resulting in raising the fuel level in tank 30.

When the fuel in said tank 30 reaches a predetermined high level, the float element 31 rising with the fuel will cause the contacts 36 and 37 to become disengaged thereby breaking the circuit connection through the signal light 75, thus indicating that sufficient fuel has been pumped into the tank 30 to permit the engine to be primed.

As soon as the engine becomes self actuating, the button 50 is released and the primer thereby thrown out of operation. Fuel will then pass to the carburetor 12 from the supplemental fuel tank 30 through pipe 13.

The operation of the engine 10 will also cause the intermittent closing of contacts in order that the electrically operated fuel pump 40 may be operated at any time that the engine lowers the fuel level to a predetermined point in the tank 30. If this happens the float element 31 will cause the contacts 34 and 35 to close, permitting current to pass from the battery 54, through switch 56, wire 57, wire 66, contacts 34 and 35, terminal 49, electro-magnet 43, terminal 49^a, wire 68, contacts 62, and back to the battery 54 via the ground connections 64 and 54^a. Due to the shape of the common operating element 63, the above circuit will be intermittently opened and closed with each rotation of the engine driven timer 65

to replenish the fuel supply in tank 30. Thus a substantially constant fuel head will be maintained in the tank 30.

The contact elements 34 and 35 are so arranged relatively to the contacts 36 and 37 that the downward movement of the float 31 will permit the pump controlling contacts 34 and 35 to be closed, but the signal light contacts 36 and 37 will be held open until a relatively lower fuel level is reached. Thus the signal lamp 75 will burn only when the fuel level in tank 30 is below normal.

In Fig. 2 there is disclosed a modified form 80 of the electrically operated pump. In this modification a pair of contact elements 86 and 87 are connected in series with the electro-magnet windings 83. A lug 85 is secured to the upper contact element 86 and so positioned relative to the diaphragm 84 that when said diaphragm is attracted out of its normal position by the electro-magnet, it will contact with the lug 85 and tend to open the electro-magnet circuit by breaking the contacts 86 and 87, thereby destroying the magnetic attraction of the diaphragm 84 by the magnet 83 and causing the former to assume its normal position due to its elasticity and completing the electro-magnet circuit. By using a pump of this type, the intermittent operation of the push button 50 to obtain intermittent operation of the pump is eliminated as this modified form 80 will continue to operate as long as the push button 50 is held in depressed position.

It is apparent from the foregoing description that a fuel supply system has been provided which includes a priming device which can be controlled by an electric button placed within convenient reach of the operator. There has been provided a supplemental fuel tank located between the source of fuel supply and the carburetor of the engine in which a substantially constant head of fuel may be maintained so that the carburetor will be supplied with a correct amount of fuel, whether the automobile in which this system may be included is running on the level or up and down hill. There has been provided an electrically operated pump for supplying the tank with fuel, said pump being controlled either manually or by the operation of the engine, and said system including provisions whereby the pump is automatically disabled when the level of the fuel reaches a predetermined high point. There is provided a common manually operable controlling device which will render the primer operative to permit raw fuel to be drawn into the engine for priming purposes, and which will at the same time render the pump operative to supply the supplement fuel tank when level in said tank is below the level normally required for priming purposes.

There has been provided a signalling de-

vice which will indicate to the operator when the fuel supply system is below the normal. The fuel supply system embodied in the present invention is combined with the ignition system of the engine in such a way that the timer cam performs the double function of operating the timer and controlling the pump. Therefor when the engine stops and fuel is no longer needed, the pump will cease to operate until the engine is started again, or until manually operated when the supply of fuel in the tank is below normal.

The term "fuel supply tank" used in the claims which follow refers to the supplemental fuel tank 30 and not to the large tank 90 which constitutes the source of fuel supply, nor to the small float chamber which is generally provided in the carburetor. In fact, where the fuel supply system included in the present invention is used the carburetor float chamber may be unnecessary.

While the form of mechanism herein shown and described constitutes a preferred form of embodiment of the invention, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow:

1. In a fuel supply device, the combination with an engine having a carburetor, a fuel supply tank, and a by-pass from the tank to the engine; of an electrically operated priming device, including an electro-magnet and a diaphragm valve, controlled thereby to open the valve and by-pass fuel from the fuel supply tank, around the carburetor, to the engine for priming purposes.

2. In a fuel supply system, the combination with an engine and a fuel supply tank therefor; of a priming device associated with the tank and engine; a fuel pump for supplying the tank; and common means for effecting the operation of the primer and pump.

3. In a fuel supply system the combination with an engine and a fuel supply tank therefor; of a priming device associated with the tank and engine; a fuel pump adapted to be rendered operative by the action of the engine for supplying the tank; and common manually operable means for effecting the operation of the primer and pump.

4. In a fuel supply device, the combination with an engine and a fuel supply tank therefor; of a source of current; an electrically operated priming device; an electrically operated fuel pump; and a common operating element for closing the circuit between the source of current and the priming and pumping devices for bringing both the latter into operation for purposes set forth.

5. In a fuel supply device, the combination with an engine and a fuel supply tank therefor; a source of current; of an electrically operated priming device; an elec-

trically operated fuel pump; and a common manually operable element for closing the circuit between the source of current and the priming and pumping devices for bringing both the latter into operation for purposes set forth.

6. In a fuel supply device, the combination with an engine and a fuel supply tank therefor; of an ignition system for said engine including an ignition coil, an electrically operated fuel pump; a priming device; a source of current; a common engine driven element for intermittently connecting the source of current with the ignition coil and with the fuel pump; and manual means for effecting the operation of the primer and the pump.

7. In a fuel supply device, the combination with an engine; of a fuel supply tank connected with the engine; a pump connected with the tank; and means to cause the pump to operate when the fuel in the tank reaches a predetermined low level irrespective of the state of operation of the engine.

8. In a fuel supply device, the combination with an engine; of a fuel supply tank including a float element; a source of current; an electrically operated fuel pump; and means associated with the float element in the fuel tank whereby the circuit between the source of current and the pump will be automatically completed when the fuel in said tank has reached a predetermined low level.

9. In a fuel supply system, the combination with an engine; of a fuel tank associated with the engine; a source of current; an electrically operated pump for supplying fuel to said tank; circuit connections between the source of current and the pump; a float element associated with said fuel tank; and means associated with the aforementioned float element whereby the circuit connections between the source of current and the pump will be broken when the fuel in the tank has reached a certain predetermined high level.

10. In a fuel supply system, the combination with an engine; of a fuel supply tank connected with the engine; a pump adapted to be operated to fill the fuel tank; a signal device; and means controlled by the level of fuel in the tank for bringing the pump into operation at a certain level and for causing the signal device to be automatically brought into operation when the fuel in the tank reaches a predetermined lower level.

11. In a fuel supply system, the combination with an engine; of a fuel supply tank connected with the engine; a source of electric current; an electrically operated pump for filling the fuel tank; a signal device; circuit connections between the source of current and the pump and signal device; a

float element in the tank; and means associated with said float element whereby the circuit connections between the source of current and the pump will be made when the fuel reaches a predetermined low level, and the circuit connections between the source of energy and the signal device will be made when the fuel in the tank reaches a level relatively lower than that controlling the pump.

12. In a fuel supply system, the combination with an engine; of a fuel supply tank connected with the engine; a pump for filling the fuel tank; a signal device; and means controlled by the level of fuel in the tank for causing the signal device to operate at a predetermined low level and for rendering the pump inoperative at a predetermined high level.

13. In a fuel supply system, the combination with an engine; of a fuel supply tank connected with the engine; a source of electrical current; a pump adapted to be operated to fill the fuel tank; signal device; and means controlled by the level of fuel in the tank for making connections between the source of current and the pump and signal device whereby the signal device will be automatically operated when the fuel in the tank reaches a predetermined low level, and the pump will be stopped when the fuel reaches a predetermined high level.

14. In a fuel supply system, the combination with an engine; of a fuel supply tank connected with the engine; a fuel pump for filling the tank; a signal device; and means controlled by the fuel level in the tank for rendering the signal device inoperative at a predetermined high level, and for rendering the pump inoperative at a still higher level.

15. In a fuel supply system, the combination with an engine; of a fuel supply tank connected with the engine; a source of electric current; an electrically operated pump for filling the fuel tank; a signal device; circuit connections between the source of current and the pump and signal device; and means controlled by the fuel level in the tank for controlling said circuit connections whereby the signal device will be inoperative when the fuel reaches a predetermined high level, and the pump will be inoperative when the fuel in the tank reaches a relatively higher level.

16. In a fuel supply system, the combination with an engine of a fuel supply tank; an ignition system for said engine; a source of electric current; a signal device, circuit connections between the source of current and the signal device and ignition system; a switch in the circuit connections controlled by the fuel level in the tank and adapted to be closed at a predetermined low level to permit the signal device to be operated; and a manually controlled switch for rendering

the ignition system operative and for causing the signal device to operate when the fuel in the tank is at a predetermined low level, whereby to indicate the lack of fuel in the tank before attempting to start the engine.

17. In a fuel supply system, the combination with an engine; of a fuel supply tank; an electrically operated fuel pump for filling said tank; a signal light; a source of electric current; means controlled by the level of the fuel in the tank for making and breaking circuit connections between the source of current and the signal device and pump, said means being adjustable whereby the predetermined level at which said connections are made or broken may be altered.

18. In a fuel supply system, the combination with an engine of a fuel supply tank; an electrically operated fuel pump for filling said tank; a float element in said tank; a signal device; a source of electric current; means controlled by the level of the float element for making and breaking circuit connections between the source of current and the signal device and pump, said means being adjustable relatively to the float, whereby the predetermined level at which said connections are made or broken may be altered.

19. In a fuel supply system, the combination with an engine; of a fuel supply tank; an electrically operated fuel pump for filling said tank; a source of electric current; means controlled by the level of the fuel in the tank for making and breaking circuit connections between the source of current and the pump, said means being adjustable whereby the predetermined level at which said connections are made or broken may be altered.

20. In a fuel supply system, the combination with an engine; of a fuel supply tank; a signal light; a source of electric current; means controlled by the level of the fuel in the tank for making and breaking circuit connections between the source of current and the signal device, said means being adjustable whereby the predetermined level at which said connections are made or broken may be altered.

21. In a fuel supply system, the combination with an engine and a fuel supply tank therefor; of a battery type ignition system for the engine including a current source, an ignition coil and a timer including a pair of cooperating contacts for connecting the coil and current source and a timer cam for operating the contacts; an electrically operated fuel pump; and circuit connections between the fuel pump and current source including a switch arranged to be intermittently operated by said timer cam.

22. In a fuel supply system, the combina-

tion with an engine and a fuel supply tank therefor; of a main fuel reservoir; a fuel pump connected between the reservoir and tank; a carburetor connected between the tank and engine intake; a primer connected between the tank and engine intake; and a manually operable device for controlling the operation of the primer alone or of the primer and pump together.

23. In a fuel supply system, the combination with an engine and a fuel supply tank therefor; of a main fuel reservoir; an electric fuel pump connected between the reservoir and tank; a carburetor connected between the tank and engine intake; a primer connected between the tank and engine intake; a current source; and a manually operable device for connecting the current source with the primer alone, or with both the primer and pump.

24. In a fuel supply system, the combination with an engine having an intake and a carburetor; of a main fuel reservoir located below the carburetor; a fuel supply tank located above the carburetor; a priming device connected between the engine intake and said tank; a pump connected between the reservoir and tank; engine controlled means for effecting the operation of the pump; and manual means for effecting the operation of the primer or of both the primer and pump.

25. In a fuel supply system, the combination with an engine; of a fuel supply tank connected with the engine; a source of electric current; an electrically operated pump for filling the fuel tank; a signal device; circuit connections between the source of current and the pump and signal device; a float element in the tank; and means associated with said float element whereby the circuit connections between the source of current and the pump will be made when the fuel reaches a predetermined low level, and the circuit connections between the source of energy and the signal device will be made when the fuel in the tank reaches a level relatively lower than that controlling the pump.

26. In a fuel supply device, the combination with an engine; of a fuel supply tank; a source of current; an electrically operated fuel pump; and means responsive to the head of fuel within the fuel tank whereby the circuit between the source of current and the pump will be automatically completed when the fuel in said tank has reached a predetermined low level.

In testimony whereof I affix my signature.

CHARLES F. KETTERING.

Witnesses:

J. W. McDONALD,

H. E. SOLLENBERGER.