H. KOCOUREK.

SOLENOID OPERATED LIQUID FUEL SUPPLY MAINTAINING DEVICE FOR INTERNAL COMBUSTION ENGINES.

APPLICATION FILED JAN. 25, 1917.

1,257,613.

Patented Feb. 26, 1918.

2 SHEETS—SHEET 1.

Fig. 1.

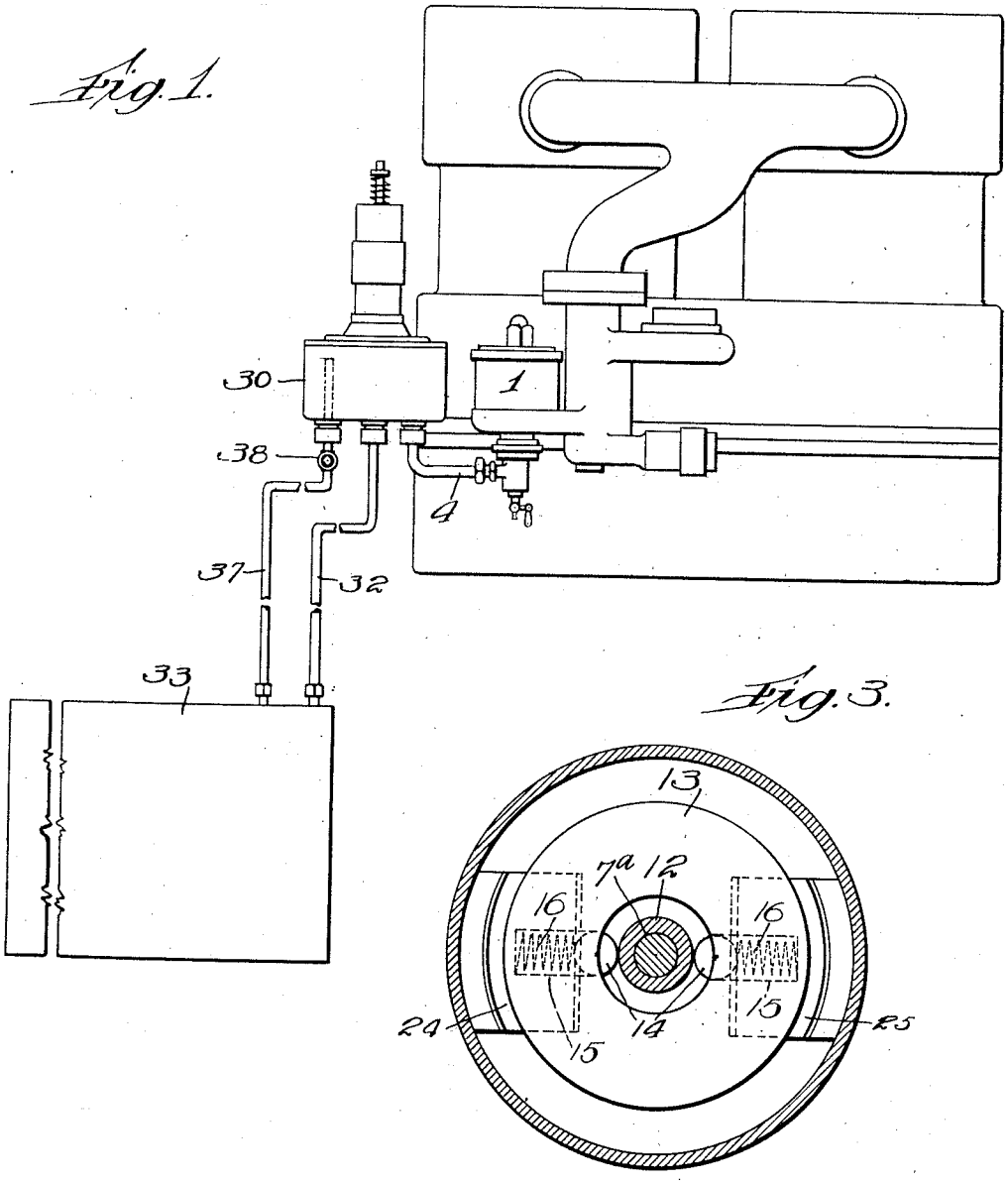


Fig. 3.

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2 SHEETS—SHEET 2.

Fig. 2.

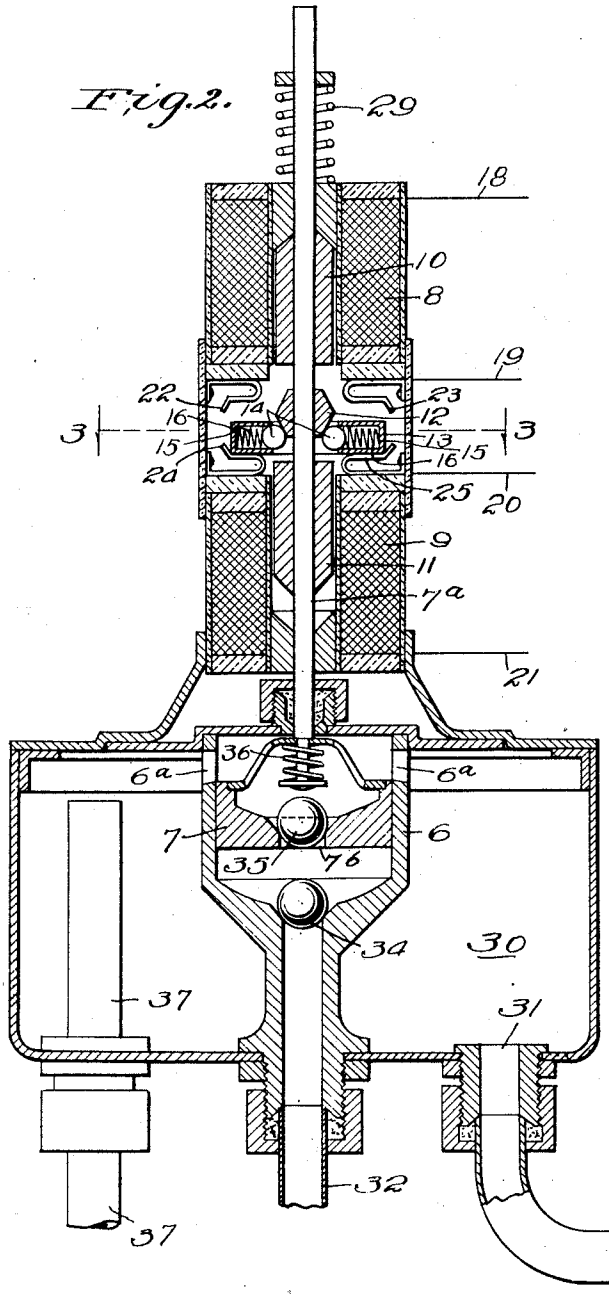
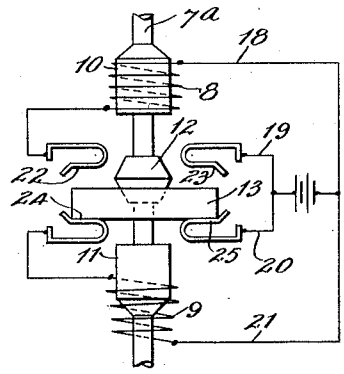
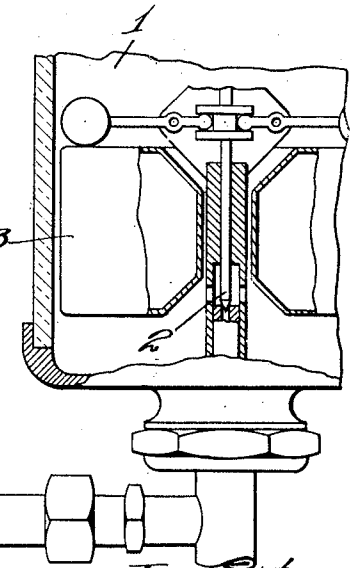


Fig. 4.





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UNITED STATES PATENT OFFICE.

HENRY KOCOUREK, OF JERSEY CITY, NEW JERSEY, ASSIGNOR TO JULIA B. STEWART, EXECUTRIX OF JOHN K. STEWART, DECEASED.

SOLENOID-OPERATED LIQUID-FUEL-SUPPLY-MAINTAINING DEVICE FOR INTERNAL-COMBUSTION ENGINES.

1,257,613. Specification of Letters Patent. Patented Feb. 26, 1918.

Application filed January 25, 1917. Serial No. 144,565.

To all whom it may concern:

Be it known that I, HENRY KOCOUREK, a citizen of the United States, residing at Jersey City, in the county of Hudson and State of New Jersey, have invented new and useful Improvements in Solenoid-Operated Liquid-Fuel-Supply-Maintaining Devices for Internal-Combustion Engines, of which the following is a specification, reference being had to the accompanying drawings, forming a part thereof.

The purpose of this invention is to provide an improved electrically-operated pumping device for maintaining a supply of liquid fuel for an internal combustion engine. It consists in the elements and features of construction shown and described, as indicated in the claims.

In the drawings:

Figure 1 is a diagrammatic view showing a portion of an internal combustion engine with its carbureter and the device constituting this invention in connection with the carbureter..

Fig. 2 is an axial section of the device constituting this invention and the carbureter float chamber with the connecting pipe from one to the other.

Fig. 3 is a detail section at the line, 3—3, on Fig. 2.

Fig. 4 is a diagram of the wiring of the electric circuit.

In the structure shown in the drawings the device constituting this invention is represented in the relation which it is designed to sustain to the carbureter of an engine, of which the float chamber is shown at 1, having an inlet valve, 2, controlled by a float, 3, in the chamber so as to be closed when the liquid in the chamber reaches a predetermined height, according to the usual well understood manner of operation of such devices. 4 is a pipe leading from the chamber of the pumping device to the carbureter inlet. The pumping device comprises a variable-capacity chamber which in the form shown is a pump cylinder, 6, and its piston, 7, the piston being connected to the stem, 7^a, of the armatures of solenoids coaxially arranged, as seen at 8 and 9, one above the other, the stem 7^a, having mounted upon it the armatures, 10 and 11, of the two solenoids, and having fixed upon it between the two solenoids a double conoidal cam, 12, which coöperates with a collar, 13, comprising spring-pressed balls, 14, in radial pockets, 15, and actuated by springs, 16, thrusting the balls inward radially against the conoidal cam, to constitute a snap switch device, as more particularly hereinafter explained. The wires of the circuit for energizing the solenoid are connected as indicated at 18 and 19, for the upper solenoid, and at 20 and 21 for the lower solenoid, so as to constitute gaps in said energizing circuits between contact terminals, 22 and 23, upon the lower end of the upper solenoid, and 24 and 25 upon the upper end of the lower solenoid, said collar, 13, being positioned on the stem between said terminals of the upper and lower solenoids respectively, with a range of play between them so that it may rest in contact either with the lower terminals or with the upper terminals, but not in contact with both. The stem, 7^a, extends through the upper solenoid and above the same it is provided with a coiled spring, 29, reacting upon it for upholding it and uplifting it to uplift the piston, 7, of the pumping device,—that is, to expand the variable-capacity chamber consisting of the cylinder, 6 and piston, 7, said piston being the movable wall of said variable-capacity chamber. The cylinder, 6, is contained within a chamber, 30, which is closed at the top and has an outlet, 31, at the bottom at which the pipe, 4, is connected which leads to the carbureter float chamber, 1. The inlet pipe, 32, entering the lower end of the pump cylinder, 6, leads from a lower level supply tank, 33, and said inlet is provided with a check valve, 34, to retain the liquid lifted by the uplifting of the piston. The piston has formed through it a fluid way, 7^b, which is controlled by a check valve, 35, at the upper end thereof, the liquid passing up through said piston as the latter is depressed in the cylinder, and being lifted for discharge from the cylinder, 6, to the ports, 6^a, at the upper end thereof into the closed chamber, 30, within which said cylinder is contained.

The mode of operation of this device will be obvious from the above description, but it may be indicated briefly as follows:

The spring, 29, tends normally to hold the piston, 7, uplifted,—that is, to expand the variable-capacity chamber. When it is at

this position the conoidal cam, 12, stands above the snap switch collar, 13, and said collar is lodged upon the contacts, 24 and 25, of the lower solenoid, and the electric circuit is thereby closed for energizing said lower solenoid, causing its armature, 11, to be pulled down against the resistance of the spring, 29, with the effect of depressing the piston, 7, that is, contracting the variable capacity chamber and passing the liquid therein up through the piston to the upper side thereof, so that it will be discharged in the next lifting movement of the piston over into the chamber, 30. Such down-stroke of the stem, 7^a, and piston, 7, draws the conoidal cam down through the central aperture of the snap switch collar, 13, forcing the balls, 14, back in their radial sockets against the resisting springs until the apex of the cam passes the plane of the centers of the balls, whereupon the reaction of the springs pressing the balls toward the cam resting upon the upper slope thereof causes the collar, 13, to fly upward against the contacts, 22 and 23, of the upper solenoid, breaking the energizing circuit of the lower solenoid, and causing the upper solenoid to be energized; whereupon its armature, 10, will be pulled upward, the stored up energy in the spring, 29, assisting such movement for lifting the piston, 7, and simultaneously drawing up the new charge of liquid through the inlet pipe, 32, and discharging the previously drawn supply over into the chamber, 30. It will be observed that in this action, the lower solenoid when energized, performs no work of lifting or discharging liquid, but only the work of compressing the spring, 29, and that the energy thus stored up has become available in the second step of the action when the upper solenoid was energized, the spring operating together with the upper solenoid, so that the energy of both solenoids is ultimately operative for lifting and discharging the liquid.

It will be observed that if at any time the lifting and discharging stroke of the piston should occur at a time when the valve, 2, of the carbureter float chamber is closed so that no liquid can be passed from the chamber, 30, into the carbureter float chamber, said action of the piston, 7,—that is, the action of expanding the variable-capacity chamber,—would have the effect of compressing the air trapped in the chamber, 30, above the liquid which might be therein, or trapped in said chamber and the pipe, 4, connecting it with the carbureter float chamber if said pipe, 4, were not full; and it will be observed that such action of compressing the air would be repeated at every subsequent up-stroke of the piston, 7, and that this action would continue until the resistance of the compressed air was equal to the energy of the solenoid and spring operating upon the piston for lifting it. It is contemplated that this would be the usual condition,—that is to say, that the device would originally be operated before the engine which it served was started, so that the carbureter float chamber would be filled and its inlet valve closed, and liquid fuel pumped over into the chamber, 30, and pipe, 4, until a condition of compression of the trapped air equal to the power of the lifting devices was produced. Assuming the capacity of the device adequate for the purpose of maintaining the maximum supply at any time necessary for the engine, this condition of things would be maintained after the engine started and the fuel began to be withdrawn from the carbureter float chamber, each withdrawal having the effect to cause the pumping device to start and discharge over into the chamber, 30, a quantity of liquid equal to that withdrawn from the carbureter float chamber. The result would be that the carbureter float chamber would at all times be fed by the pressure of the compressed air in the chamber, 30, and said pumping device comprising said chamber, 30, may therefore be located at any convenient point below the level of the carbureter not greater than the distance to which the liquid can be lifted by the pressure of the air compressed to the extent of the capacity of the device as above described. The device, therefore, has the especial advantage of being adapted to maintain liquid fuel supply for a carbureter without being elevated above the same and without danger of flooding it by reason of undue pressure.

It will be noticed that in the operation of the device as thus far described, it has been assumed that when a degree of compression is produced in the air compressed in the chamber, 30, the operation of the pumping device will cease until the compression is relieved by a discharge of some of the liquid pumped. If this should in fact happen, there would be a tendency to heat the solenoid coil which was at the time energized (which would of course always be the upper coil). This would necessitate constructing the solenoid enough larger than necessary for the work to be done in order that the overload upon it when it was blockaded as above described might not overheat it. To avoid this necessity, it is desirable to provide an elastically-yielding connection between the stem, 7^a, and the piston, 7, adapted to yield when the resistance to the lifting of the piston begins to exceed a predetermined pressure which it is desired to maintain in the chamber, 30. Such elastically-yielding connection is shown in the drawings, consisting of the spring, 36, which may be interposed at any point in the length of the stem, 7^a, between two sections thereof, or

directly between the piston and said stem as illustrated in Fig. 2. When such elastically-yielding connection is employed, the effect is that the solenoid device continues operating, reversing the movement at the end of each stroke, but without moving the piston, until the pressure in the chamber, 30, is relieved by the discharge of some of the liquid into the carbureter float chamber.

If it is not desired to cause the device to operate by the compression of the air in the chamber, 30, but instead to locate the device with this chamber at a sufficient level above the carbureter float chamber so as to discharge it into the latter by gravity, oversupply may be prevented by providing an overflow pipe, 37, leading back to the main fuel supply tank, 33. When this overflow pipe is provided, the spring, 36, will be out of service,—that is, it will have no necessary function, but its presence will not at all interfere with the operation of the device with such overflow. The overflow pipe, 37, if employed, should preferably be provided with a valve, 38, for shutting it off so that the device may be operated in the manner previously described,—that is, by producing a condition of compressed air in the chamber, 30, bringing into effect the spring, 36, for preventing over-working the solenoid.

I claim:—

A fuel supply maintaining device comprising a variable-capacity chamber; a solenoid for moving a wall thereof to vary its capacity; inlet and outlet connections for said variable-capacity chamber, and check valves in said connections respectively; an electric circuit in which the solenoid is energized; a discharge chamber into which the variable-capacity chamber discharges; an outlet connection from said discharge chamber, and means for alternately opening and closing said connection, and an overflow connection from said discharge chamber, and circuit-making and breaking means operated by the solenoid at the limit of the strokes of its armature for enlarging and reducing the variable-capacity chamber.

In testimony whereof, I have hereunto set my hand at Jersey City, this 15th day of January, 1917.

HENRY KOCOUREK.