Aug. 2, 1927. 1,637,425

A. NAGEL

SWITCH FOR ELECTRICAL FUEL FEEDING APPARATUS

Filed Aug. 4, 1925 4 Sheets-Sheet 1.

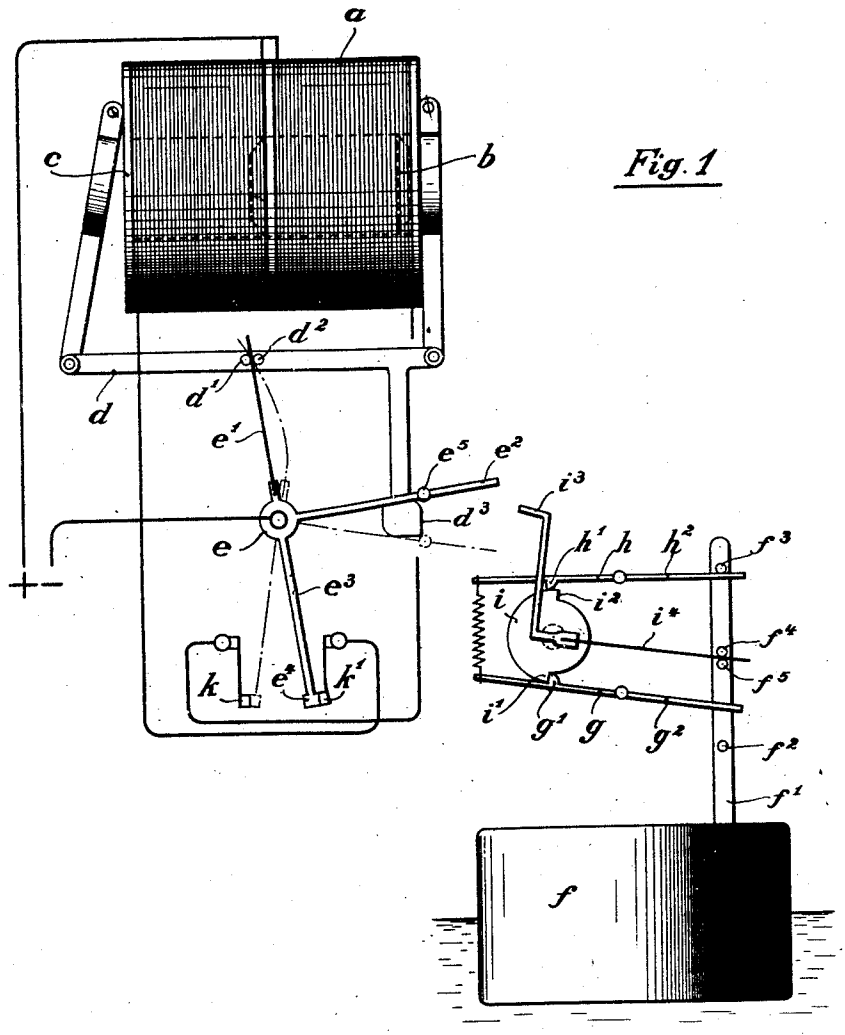



Fig. 1

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Aug. 2, 1927. 1,637,425

A. NAGEL

SWITCH FOR ELECTRICAL FUEL FEEDING APPARATUS

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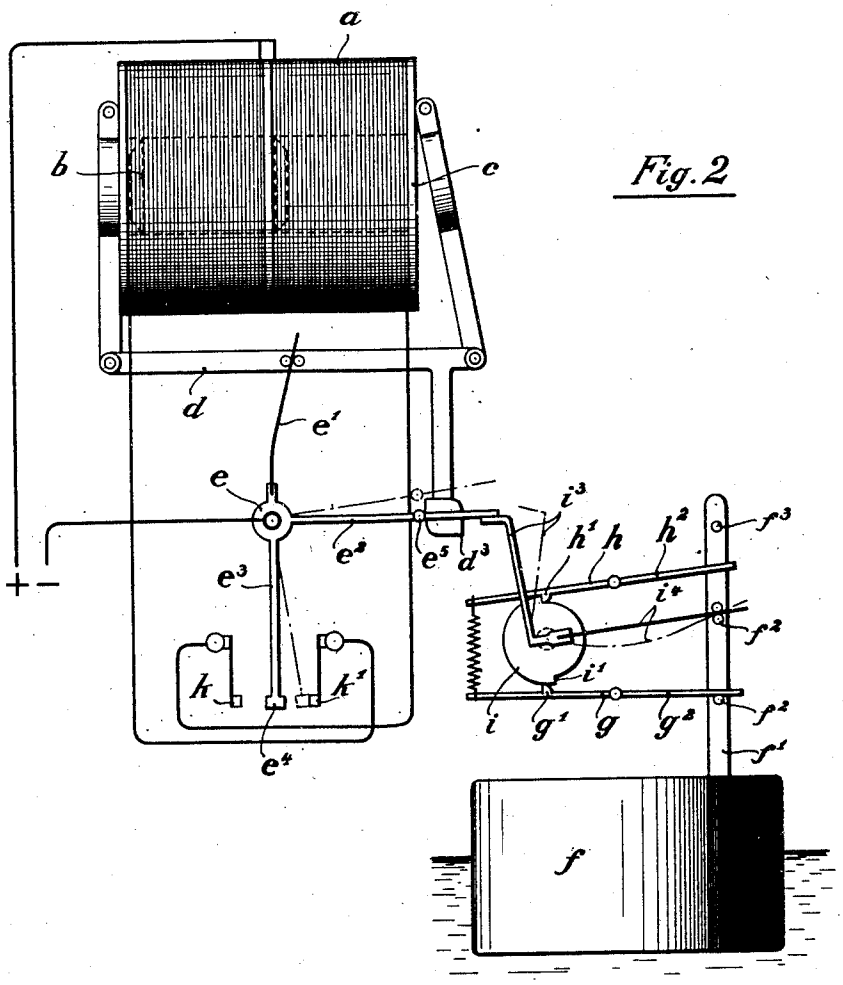



Fig. 2

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SWITCH FOR ELECTRICAL FUEL FEEDING APPARATUS

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Fig. 3.

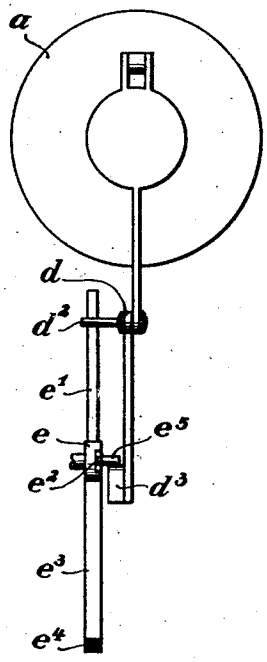



Fig. 4

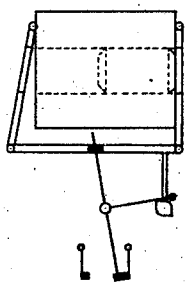


Fig. 5

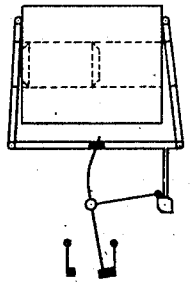


Fig. 6

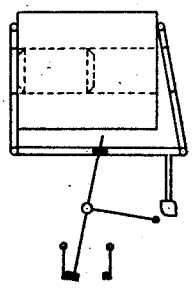
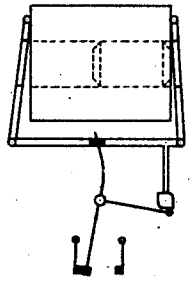


Fig. 7



A. Nagel
INVENTOR

By: Marks & Clark
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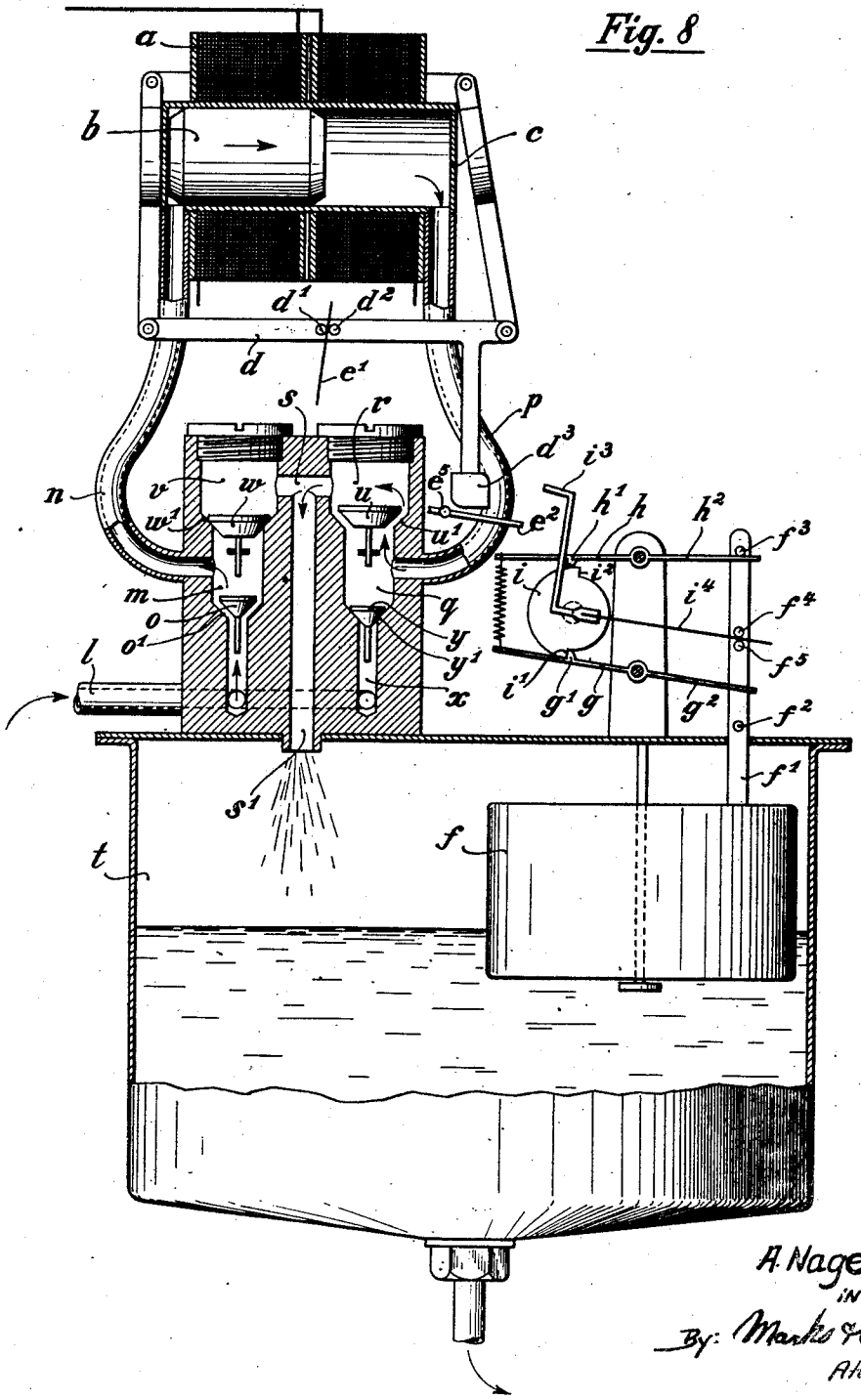
Aug. 2, 1927. 1,637,425

A. NAGEL

SWITCH FOR ELECTRICAL FUEL FEEDING APPARATUS

Filed Aug. 4, 1925 4 Sheets-Sheet 4

Fig. 8




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Patented Aug. 2, 1927. 1,637,425

# UNITED STATES PATENT OFFICE.

AUGUST NAGEL, OF STUTTGART, GERMANY.

## SWITCH FOR ELECTRICAL FUEL-FEEDING APPARATUS.

Application filed August 4, 1925, Serial No. 48,180, and in Germany August 26, 1924.

In electric pumps for the delivery of fuel or the like for the feeding of carburettors or the like, such for example as is described in United States Patent No. 496,331 granted on the 25th April, 1893, it is important that an absolutely reliable method of working be attained. In order to attain this, a switching device has been provided for electrical fuel-delivering pumps the piston of which does not extend through the pump casing and is reciprocated by the alternate excitation of solenoid windings arranged round the pump chamber, and at the ends of its strokes gives rise to a strengthening of the lines of force on the end surfaces of the pump chamber, as in my application Serial No. 751,937, filed Nov. 24, 1924. This strengthening of the lines of force attracts members which are located outside the pump chamber opposite to the end faces of the pump and which are adapted to act in the manner of a magnetic hammer break. The switching device is characterized by the feature that the aforesaid members acting like a magnetic hammer break consist of double-armed levers rockable about stationary fulcra and are connected with one another by a connecting rod. This rod has an attachment which is so shaped that during the moving to and fro of the connecting rod it serves as a sliding support and an abutment with its upper and under surfaces alternately, for one arm of a three-armed switch lever, that is to say, it acts like a link motion or sliding guide. This result is attained owing to the fact that a second arm of the switch lever is constructed as a blade spring. The latter slides with its outer end between guides provided on the connecting rod of the pump members acting in the manner of a magnetic hammer break. Since the other arm of the switch is held fast, by means of a pin, by the slide-guide acting as an abutment, until the reciprocating movement of the connecting rod has reached its end in one direction or the other a stress is imparted to the switch spring, which suddenly straightens it as soon as the effect of the sliding guide on the switch arm which co-operates therewith ceases. By this means there also results the reversal of the pin of the switch lever, from one sliding surface of the cam-like sliding guide to the other. The third arm of the switch lever, which is directed oppositely to the blade spring, is provided at its end with a double-sided contact. It is simultaneously rocked in common with the other arms, thereby removing its contact from the co-acting contact of one solenoid circuit, while the contact located on the other side of the switch-lever arm comes at the next instant into contact with the corresponding contact of the circuit of the other solenoid.

Since the liquid delivered by the electric solenoid pump flows to a measuring tank, and any overflowing thereof must be prevented, a float is provided in the measuring tank. This float, by a suitable arrangement of controlling and locking means puts the pump switch and consequently the pump itself out of operation when the measuring tank is filled.

The float is provided for this purpose with a rod. This rod carries, outside the measuring chamber, two pins. One or other of these pins, shortly before the termination of the upward or downward movement of the float, comes into contact with one end of one or other of two double-armed levers. The levers are connected with one another by a helical spring at the ends of the levers remote from these co-acting points. On each of the lever arms connected by the spring is provided a stop which is adapted to engage in front of a projection on a rotatable disc. This disc serves to support at its centre a bent lever. The upper bent end of this lever is adapted to lock the end of the switch arm that bears against the surfaces of the cam-like sliding and abutment member moving to and fro with the connecting rod of the pump members that operate in the manner of a magnetic hammer break. By this means it prevents the said arm and consequently also the other arms of the switch lever from continuing their rocking or reversing movements. After the emptying of the measuring chamber has been effected the said locking lever suddenly releases this switch lever arm. This latter result is obtained by the fact that the bent locking lever or its carrying disc is equipped with a blade spring, which slides through a guide consisting of two pins located on the float rod between the aforementioned lever-actuating pins. During the upward or downward movement of the float, that is, during the

filling or emptying of the measuring tank, one of these guide pins acts upon the said blade spring and subjects it to a bending stress until the blade spring is released. This occurs as soon as either the upper or the lower lever-actuating pin on the float rod bears against the upper or lower toothed lever, rocks the latter, and thereby brings it out of engagement with the disc carrying the switch-arm locking lever. At the moment of release the blade spring straightens itself and rocks the bent locking lever. When the latter has thereby passed out of reach of the end of the switch arm the latter is released for reversal and the other pump solenoid circuit closed, as previously described. The operation of the pump can then recommence and the fuel be again delivered to the measuring tank and so forth.

In order to attain this the new construction hereinafter described in detail is provided.

The same is illustrated in one constructional example in the accompanying drawings.

Figure 1 shows the switching apparatus which is fitted to an electric pump, in the position in which the magnet core or piston of the pump is about to be moved from right to left in the pump chamber.

Figure 2 shows the same apparatus in a locked position, that is to say, out of operation.

Figure 3 is a partial side elevation of the switching apparatus.

Figures 4 to 7 are diagrammatic views showing the various switching positions in the order in which they are assumed during the operation of the pump.

Figure 8 shows in part sectional elevation the switching apparatus and a solenoid pump controlled thereby.

The method of working of the apparatus is as follows:—

As the switch position in Figure 1 shows, the current flows through the left-hand solenoid coil $a$, and consequently the piston $b$ located in the pump cylinder is moved towards this side. At the close of its movement it comes to the end wall $c$ of the pump, brings the lines of force up to their maximum value, and causes the reversing rod gear $d$ to move to the right. The blade spring $e^1$ slidably supported between pins $d^1$ and $d^2$ on the rod gear is bent in the opposite direction, as indicated in dot-and-dash lines. This bending of the blade spring $e^1$ is only possible owing to the fact that the T-shaped carrying member thereof is guided with its limb $e^2$, by the pin $e^5$ or the like located thereon, upon the upper surface of a guide or link $d^3$, which moves to the right with the reversing rod, and may be integral with it (see Figures 4 and 5). During this guiding and blade-spring stressing the contact stud $e^4$ provided on the third limb $e^3$ has remained in connection with the contact stud $k^1$ of the circuit of the left-hand solenoid $a$. When the reversing rod gear $d$ in moving to the right has reached its end position, the pin $e^5$ slides off its guide (see Figure 6), the blade spring $e^1$ straightens itself into alignment with the limb $e^3$ shown in dot-and-dash lines in Figure 1, and the circuit of the right-hand solenoid is closed, as the contact $e^4$ now bears upon the associated circuit contact $k$. The position of the T-shaped member $e$ illustrated in Figure 7 shows its configuration and position at the last instant before reversal into the position shown in full lines, that is, when the reversing rod gear $d$ has just moved to the left.

Now since the liquid delivered by the electrically operated solenoid pump flows to a measuring tank, and any overflowing thereof must be prevented, there is provided in the measuring tank a float $f$, which, through the medium of suitable connections, by means of a controlling and locking member, puts the pump switch, and with it the pump itself, out of operation, as soon as the measuring tank is filled.

For this purpose the float $f$ is provided with a vertical rod $f^1$. The latter has, outside the measuring vessel, two pins $f^2$, $f^3$. These co-operate alternately, shortly before the termination of the upward and downward movements of the float, with two double-armed levers $g$, $h$ respectively. The said levers are connected with one another by a helical spring. The lever arms which are coupled together in this manner have each a tooth $g^1$, $h^1$ respectively, and these teeth alternately take up positions in front of the projections $i^1$, $i^2$ respectively upon a disc $i$, which is rotatable about a pivot. This disc serves at its centre as a support for a bent lever $i^3$.

Now while the pump is working owing to the excitation of the solenoids $a$ alternating in rapid succession, fuel is supplied from the pump chamber by the piston $b$ to the measuring tank, as shown in Figure 8.

From this figure it will be seen that when the piston $b$ is moving from left to right in the pump chamber, on the left-hand side of the pump chamber liquid is drawn by suction out of the main tank, which is not shown in the drawings, through the piping $l$ into the valve chamber $m$, and from there through the pipe $n$, the valve cone $o$ being lifted off its seat $o^1$.

During this suction of the liquid a pressure is exerted by the piston $b$ upon the liquid on the right hand side of the pump chamber and that in the pipe $p$ connected therewith, and also in the valve chamber $r$, and the liquid is supplied through the piping $s$, $s^1$ to the measuring tank $t$, Figure 8. During this

action the valve cone $u$ has been lifted off its seat $u^1$, while the valve cone $w$, which bears upon its valve seat in the neighbouring valve chamber $v$, owing to the pressure of the liquid that passes into the latter through the pipe $s$, and also in consequence of its own weight, assisted if desired by a light spring, prevents this liquid from flowing through to the valve chamber $m$.

When the movement of the piston $b$ is reversed, that is, when it is moving from right to left in the pump chamber, a change-over of the liquid occurs, the liquid passing through the piping $l$ to the valve chamber $x$, by lifting the valve cone $y$ from the seat $y^1$, into the valve chamber $q$, and from there through the pipe $p$ to the right hand pump chamber, but passing out of the left hand pump chamber through the pipe $n$ to the valve chamber $m$, and by lifting the valve cone $w$ off its seat $w^1$ into the chambers $v$ and $r$ and through the pipes $s$ and $s^1$ to the measuring tank $t$.

Owing to the constant supply of liquid to the measuring tank $t$, as previously described, the float $f$ rises in the measuring chamber, and with it the rod $f^1$ is also raised, and a blade spring $i^4$, which extends from the shaft of the disc $i$ carrying the bent lever $i^3$ as far as the rod $f^1$, is bent upwards by a pin $f^5$ located on the rod $f^1$ and thereby stressed, as the disc $i$ is prevented from rotating by the tooth $g^1$, which engages in front of the projection $i^1$. The stress to which the blade spring is subjected increases until the pin $f^2$ presses against the end of the arm $g^2$ of the locking lever $g$, so that the lever rocks, and the tooth $g^1$ is moved out of engagement with the projection $i^1$. This takes place at the moment when the column of liquid in the measuring chamber has reached its highest level.

There then follows the straightening of the blade spring $i^4$, with the rotating of the disc $i$ thereby, so that the bent lever $i^3$ moves into its locking position in relation to the switch arm $e^2$, as shown in Figure 2.

Since in the instance illustrated the aforementioned switch arm $e^2$ shown resting above the upper bend of the lever $i^3$, the contact arm $e^3$, with its contact $e^4$, was evidently on its way to the circuit contact $k$ of the right-hand solenoid $a$ of the pump.

The contact arm $e^3$ now remains in an idle position between the circuit contacts $k$, $k^1$ until sufficient fuel has been removed from the measuring tank.

At the time when the rocking of the bent lever $i^3$ is accomplished by the straightening of the blade spring $i^4$, as previously indicated, the tooth $h^1$ on the lever $h$ takes up a position during this rotary movement in front of the projection $i^2$ on the disc $i$.

Now as the fuel escapes from the measuring vessel, during the sinking of the float $f$, the latter now presses with a pin $f^4$ on its rod $f^1$ against the blade spring $i^4$ and consequently subjects it to a stress. Finally the pin $f^3$ located at the upper end of the float rod $f^1$ comes against the arm $h^2$ of the lever $h$, bringing the tooth $h^1$ out of engagement with the projection $i^2$ on the disc $i$, and thereby releases the stressed blade spring $i^4$. Under these circumstances a rotation of the disc $i$ takes place in a clockwise direction. The bent lever $i^3$ is moved away from the rocking switch arm $e^2$, and the switch spring $e^1$, which, as will be seen from Figure 2, is still partially stressed, straightens itself out, and thereby brings the contact $e^4$ up to the circuit contact $k$. The deliver of liquid by the pump is then resumed, and the disc $i$ carrying the bent lever $i^3$ is again locked against rotation by means of the tooth $g^1$ and the projection $i^1$.

What I claim is:—

1. Switching apparatus for electrical fuel-delivering apparatus and the like, comprising a magnetizable reciprocating member, two solenoids for reciprocating said member, and means for energizing said solenoids alternately, said means comprising a movable switch member, a reversing rod, magnetic means for displacing said reversing rod upon the magnetizable reciprocating member reaching either end of its stroke, an abutment on said reversing rod, the movable switch member being adapted to engage with said abutment during displacement of the reversing rod and to be released thereby at the end of said displacement, and resilient means for changing the position of the movable switch member as soon as said switch member is released by the abutment, said resilient means being stressed by the displacement of the reversing rod.

2. Switching apparatus for electrical fuel-delivering apparatus and the like, comprising a magnetizable reciprocating member, two solenoids for reciprocating said member, and means for energizing said solenoids alternately, said means comprising a pivoted three-armed reversing switch member, one of the arms of said switch member being a spring and the other two being rigid, a reversing rod, magnetic means for displacing said reversing rod upon the magnetizable reciprocating member reaching each end of its stroke, guiding means on said rod between which the said spring arm can slide, an abutment on the reversing rod, a circuit changing contact stud on one rigid arm of the switch member, a projecting member on the other rigid arm of the switch member, said projecting member being adapted to engage with said abutment during displacement of the reversing rod and to be released thereby at the end of said displacement, the spring arm of the switch member being bent by the guiding means

during the displacement of the reversing rod and being thereby adapted to change the position of the switch member as soon as said switch member is released by the abutment.

3. Switching apparatus for electrical fuel-delivering apparatus and the like, comprising a magnetizable reciprocating member, two solenoids for reciprocating said member, and means for energizing said solenoids alternately, said means comprising a movable switch member, a reversing rod, magnetic means for displacing said reversing rod upon the magnetizable reciprocating member reaching either end of its stroke, an abutment on said reversing rod, the movable switch member being adapted to engage with said abutment during displacement of the reversing rod and to be released thereby at the end of said displacement, resilient means for changing the position of the movable switch member as soon as said switch member is released by the abutment, said resilient means being stressed by the displacement of the reversing rod, means for locking the movable switch member in an intermediate position in which neither of the solenoids is energized, and means for bringing said locking means into action automatically as soon as the surface level of the fuel reaches a predetermined height and keeping it operative until said level sinks again.

4. Switching apparatus for electrical fuel-delivering apparatus and the like, comprising a magnetizable reciprocating member, two solenoids for reciprocating said member, and means for energizing said solenoids alternately, said means comprising a movable switch member, a reversing rod, magnetic means for displacing said reversing rod upon the magnetizable reciprocating member reaching either end of its stroke, an abutment on said reversing rod, the movable switch member being adapted to engage with said abutment during displacement of the reversing rod and to be released thereby at the end of said displacement, resilient means for changing the position of the movable switch member as soon as said switch member is released by the abutment, said resilient means being stressed by the displacement of the reversing rod, a rotatable locking member, a locking arm secured thereto, said locking arm being adapted in one position of said rotatable member to move into the path of the movable switch member and prevent it from energizing either of the solenoids, a spring secured at one end to said rotatable member, a float in the liquid, a float rod secured to said float, guiding means on said float rod between which said spring can slide, said guiding means tending to rotate the rotatable member through the medium of the spring as the surface level of the liquid rises and falls, a pawl capable of engaging with the rotatable member to prevent it from rotating in one direction, a second pawl capable of engaging with said rotatable member to prevent it from rotating in the opposite direction, means provided on the float rod for disengaging one of the pawls when the float has risen to a predetermined level to enable the rotatable body to move the locking arm into its operative position, and means provided on the float rod for disengaging the other pawl when the float has sunk a predetermined distance below the said level to enable the rotatable body to move the locking arm out of its operative position.

In testimony whereof I have signed my name to this specification.

AUGUST NAGEL.