

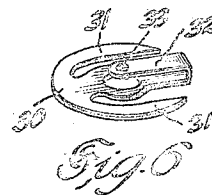
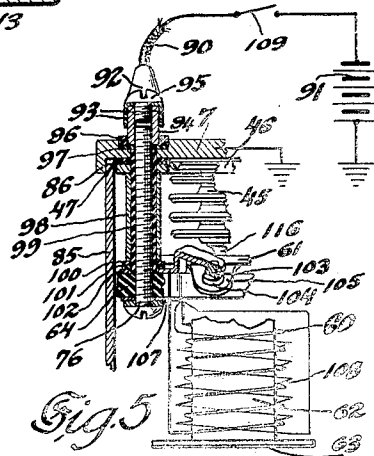
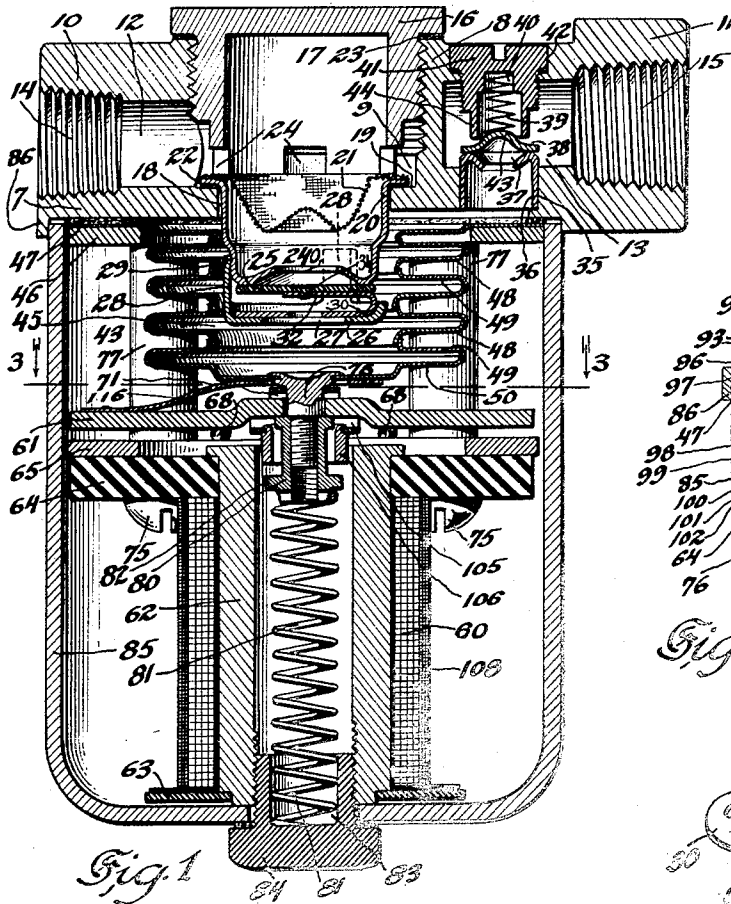
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ELECTRIC MOTOR MECHANISM

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ELECTRIC MOTOR MECHANISM

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The invention relates to electric motor mechanism of the type in which an electromagnet is utilized to effect reciprocating movement of a member to be actuated. Preferably, the electromagnetic means is arranged to effect the movement of the member in one direction only, the return movement being produced by a spring or springs in which energy is stored during the active or working stroke of the electromagnet. While in some respects of more general application, the invention has been found of particular utility in connection with, and will be herein described as embodied in, the actuating mechanism of a pumping device adapted to supply liquid fuel to the carbureter of an internal combustion engine.

The pump herein disclosed includes an expansible chamber, preferably of the metallic bellows type, in which one end wall of the bellows is movable to cause expansion or contraction of the chamber. In supplying fuel to a reservoir, such as the float chamber of a carbureter, it is desirable that the fuel should be delivered by the pump approximately continuously while the engine is in operation and at approximately a constant pressure. I have therefore so arranged the motor mechanism of the pump that the delivery stroke is effected by spring means while the suction or intake stroke is effected directly by the electromagnet.

The object of the invention is to improve the construction and operation of devices of the class referred to and to this end it includes various features of the electromagnet and its control devices and of the parts related thereto, all as hereinafter described in detail and set forth in the appended claims.

In the accompanying drawings, illustrating one embodiment of the invention, Figure 1 is a vertical sectional view showing the invention as applied to a fuel pump for an internal combustion engine of an automobile, the scale being greatly enlarged in order to show the parts more clearly;

Figure 2 is a top plan view of the structure shown in Figure 1 but on a reduced scale;

Figure 3 is a horizontal section on line 3—3 of Figure 1;

Figure 4 is a vertical section on line 4—4 of Figure 3 showing a part of the structure also on an enlarged scale;

Figure 5 is a section on line 5—5 of Figure 3, showing part of the structure and also a wiring diagram; and

Figure 6 is a perspective view of a valve spring forming a detail of the pump mechanism.

Referring to the drawings, 7 indicates a head or top plate formed, on its upper side, with a central boss 8 having within it the internally screw-threaded recess 9. Extending laterally from the boss 8 are enlargements 10, 11, in which are formed respectively the inlet passage 12 and outlet passage 13. These passages are provided with screw threads, as at 14, 15, to adapt them for the attachment of suitable pipe fittings. The upper end of the recess 9 is closed by a screw cap 16 adapted to engage the screw threads on the interior of the recess. The cap is hollow to provide an air chamber 17. An orifice 18 extends through the lower face of the plate 7 communicating with the recess 9 but of somewhat smaller diameter thus providing a shoulder above the orifice.

Between the shoulder around the orifice 18 and the lower end of the screw cap 16 is positioned a flange 19 of a valve casing member 20. If desired, a screen 21 may be positioned at the inlet end of the valve casing, the periphery of the screen being formed to rest upon the flange 19 and beneath the lower end of the screw cap 16.

It will be seen therefore that the valve casing 20 and screen 21 are insertable and removable through the recess 9 from the upper or outer side of plate 7 and are retained in assembled relation by the screw cap 16. The soft gasket 22, positioned beneath the flange 19, and harder gasket 23, between the screw cap 16 and the top of the boss 8, serve both to seal the respective joints and to permit some tolerance in the dimensions of the parts. Openings 24 in the lower edge of the screw cap 16 permit flow of liquid from the inlet passage 12 to the chamber 17 and the interior of the valve casing 20.

The lower end of the valve casing 20 is bent

inwardly or upwardly and centrally apertured at 240. The lower or outer face of the casing is suitably ground or polished to provide a seat with which a disk valve 25 engages when in closed position. The valve is housed within a retaining cap 26 centrally apertured at 27 and having spring arms 28 engageable in indentations 29 in the side walls of the valve casing 20. A valve spring 30, shown in perspective in Figure 6, is formed with wings 31 adapted to rest on the retainer 26 around the aperture 27 and with a U-shaped arm 32 the free end of which engages the valve 25. A small hole 33 is formed in the end of the arm 32 in which engages a projection 34 centrally located on the lower side of the valve disk, thus retaining the valve in position to seat properly. The spring arm 32 tends to maintain the valve normally in closed position. In the assembly of the parts the valve spring is placed in the retainer with the valve in position thereon. The retainer is then pushed over the lower end of the valve casing 20 until the spring arms or clips 28 seat in the indentations 29. Thus the structure permits of assembly or of removal for inspection or repair with the greatest facility.

Communicating with the outlet passage 13 and extending to the lower face of the plate 7 is an opening 35 in which is secured in any suitable manner as by a pressed fit, a sleeve 36. This sleeve is formed at the upper end with the inwardly directed flange 37 which provides a valve seat on its upper face for the disk valve 38. A valve spring 39 fits closely in a recess 40 in the screw cap 41 inserted in an opening 42 in the upper side of the enlargement 11. The lower end of the spring 39 seats over a boss 43 centrally located on the valve disk 38. The opening movement of the valve is limited and its lateral displacement prevented by engagement with the downwardly extending sleeve 44 of the screw cap 41.

Secured to the lower face of the top plate 7 and extending over both the inlet opening 18 and the discharge opening 35 is a bellows member 45. The upper end section of the bellows member may be fixed to the plate in any suitable manner as by the ring 46, a gasket 47 being positioned between the upper face of the section and the lower face of the plate. The body portion of the bellows member is formed of a series of rings 48, 49, which may be stamped from thin sheet metal, with outwardly directed flanges at their outer and inner edges. The flange at the inner edge of ring 48 fits inside the flange at the inner edge of ring 49, and similarly the flange at the outer edge of ring 48 fits within the flange at the outer edge of ring 49. The flanges may be secured in assembled relation as by soldering, and the bellows member thus constituted is not only very simple in structure and easily manufactured and assembled but is of very

great durability. The last or end section of the bellows is constituted by a plate 50 which, of course, closes the end of the bellows and forms an end wall by the actuation of which the expansible chamber within the bellows may be caused to expand or contract.

The actuating mechanism for the bellows comprises a solenoid 60 and an armature 61. The solenoid is wound upon the core 62 between the washer 63 at the lower end and the head plate 64 of insulating material, such as fiber. Upon the upper face of plate 64 is positioned a field plate 65 of magnetic material. This plate is formed, as shown in Figures 3 and 4, with wings 66 which lie under the armature 61 and constitute a part of the magnetic circuit of the solenoid. The plate 65 also carries an L-shaped extension 67 between which and the body of the plate the armature 61 is pivotally supported.

The supporting means comprises two balls 68 seated in holes 69 in the plate 65 and upon which the lower face of the armature rests. A single ball 70 positioned between the upper face of the armature and the lower face of the extension 67 provides a third point of support. The ball 70 is held in position by a spring retainer 71 having a depression 72 in which the ball is seated. The retainer is prevented from lateral displacement by the engagement of the end remote from the ball around the stud 78 and by an intermediate point of support constituted by a projection 73 seated in a depression 74 in the upper face of the armature. The bearing means described provides a very simple form of anti-friction support for the armature whereby it is permitted to reciprocate with minimum loss of energy due to bearing friction. It is particularly effective in resisting side strains on the armature and thus preventing any displacement laterally of the plane of reciprocation.

The field plate 65 and the insulating plate 64 are secured to the top plate 7 by screws 75 and 76, the latter being utilized also as a part of the electric circuit as hereafter described. Spacing sleeves 77 surround the screws 75 and rest at their ends respectively against the ring 46 and the plate 65. The electromagnet and the parts connected therewith are thus supported fixedly from the top plate 7.

The armature 61 is connected to the end wall 50 of the bellows member by means of the stud 78 which is secured to the end wall in any suitable manner as by riveting. This pin extends loosely through a hole 79 in the armature and is screw-threaded at its lower end to receive a nut 80. The armature rests upon the upper end of this nut and, when attracted by the solenoid, acts to pull the pin downwardly and thereby expand the bellows. The force necessary to return the bellows to its original position may be supplied in

part by the initial set given the bellows itself. It is preferred however to utilize the additional energy supplied by a coiled spring 81 housed within the core 62 and engaging at its upper end a flange 82 on the lower end of the nut 78. The lower end of the spring is seated tightly in a recess 83 in the screw 84 engaging the screw threaded interior of the core 62. By the tight fit of the spring 81 within the recess 83, and similarly of the spring 39 within the recess 40, the springs are automatically retained in proper position for assembly which operation is thereby materially facilitated, and loss or misplacement is obviated.

The pump and its actuating mechanism are wholly enclosed by the casing 85 which is cup-shaped with an aperture in the bottom through which the screw 84 extends. The casing seats directly on the end of the core 62 and is clamped in that position by the screw 84. The upper edge of the casing fits within a peripheral flange 86 on the top plate 7 and is thereby held from lateral displacement relatively to the top plate and the parts supported thereon. The casing, which is of magnetic material, forms part of the external metallic circuit for the lines of force generated by the electromagnet. For this reason it is very close to the peripheral edge of the plate 65, also of magnetic material, and which also forms part of the external circuit. The armature 61, which is a substantially flat plate pivoted near one edge, bridges the end of the core 62 and the plate 65 with its wings 66. It is therefore so positioned as to utilize most efficiently the magnetic energy in effecting the slight movement toward the core necessary for the actuation of the pump.

The supply of electric energy to the winding 60 of the electromagnet may be effected by the means shown in part in section and in part diagrammatically in Figure 5. In the arrangement illustrated, a conductor 90, leading from a suitable source of electricity as the storage battery 91 of the automobile, terminates in a connector 92. This connector is provided with depending flanges 93 which engage the sides of a square nut 94 to which the connector is clamped by a screw 95. The nut is seated at its lower end in a square block of insulating material 96, positioned in a square depression in the top plate 7, and rests upon an insulating washer 97 whereby it is insulated from the top plate. The flanges 93 prevent rotation of the connector on the nut and the block 96 prevents rotation of the nut on the top plate. A sleeve of insulating material such as a piece of rubber tubing, may be placed over the connector 92 and nut 94 to prevent external objects from contacting with the bare conducting parts. The screw 76, which also serves as one of the screws for securing the insulating plate 64 and the parts carried thereby to the top plate 7, engages

in the lower end of the nut 94 and is therefore in electrical connection with the source 91. The spacing sleeve 98 is insulated from the screw by the sleeve 99 and rests at its lower end upon the metal washer 100 which serves to support the spacing sleeve upon the insulating washer 101.

A fixed contact support 102 is clamped between the washer 101 and the end plate 64 of the electromagnet. This contact support is connected to one end of the winding 60 and carries a relatively fixed contact member 103. The relatively movable contact member 104 which is adapted to engage the fixed contact 103 is mounted upon a support 105 of spring material which extends entirely across the armature 61, lying in a slight indentation therein, and is secured at its extreme end to the lower face of the armature as by riveting and soldering. Adjacent to its mid point the contact support 105 is apertured to provide for the passage therethrough of the nut 80 and to the edge of the aperture is secured a sleeve 106 of magnetic material. This sleeve loosely surrounds the nut 80 and extends at its lower end slightly within the upper end of the core 62. Owing to the position of the magnetic sleeve 106 with reference to the core and to the armature the flow of current through the winding of the electromagnet causes the sleeve to be drawn toward the armature thereby flexing the spring support 105 and causing the contact 104 to be held in engagement with the contact 103 during a predetermined interval until the armature in its downward movement engages with the support and forces the contacts to separate. Since the end of the spring support 105 is secured to the armature it will be seen that the downward movement of the armature will flex the spring in such manner as to give it a tendency to move downwardly in opposition to the attraction exerted upon the sleeve 106. When, therefore, the movement of the armature brings it into engagement with the sleeve and thereby causes separation of the contacts or when the flexing of the spring becomes sufficient to cause it to overcome the magnetic attraction exerted upon the sleeve 106 the tension in the spring support will be such as to effect a quick break or snap action in the separation of the contacts. It will be noted that the contacts are set at a slight angle with reference to the direction of relative movement, thereby providing for a slight wiping engagement.

The contact support 105 is grounded through the armature 61 and the bellows member, which latter is in electrical connection through the ring 46 and fastening screw therefor with the top plate 7. The latter, when used on an automobile, is grounded through the pipe connections to the machine frame. To increase the efficiency of the connections I prefer to join the armature di-

rectly to the pump bellows, as by the spring leaf 116 suitably attached, as by soldering, to the armature at one end and to the bellows end wall at the other.

5 The end of the winding 60 opposite to that which is connected to the support 102 is joined to a plate 107. This plate is clamped beneath the head of the screw 76 and in electrical connection therewith. The energizing
10 circuit can be traced from the source 91 through conductor 90, connector 92, nut 94, screw 76, and plate 107 to the winding 60, thence through support 102, contacts 103, 104, support 105, and intervening parts to the
15 top plate 7.

In order to prevent undesirable sparking upon separation of the contacts 103, 104, by reason of the self-induction of the winding 60, I have devised a means to counteract the
20 building up of potential in the winding at the moment of breaking the circuit. Such means is particularly desirable in devices where a low-resistance coil is arranged to receive a comparatively heavy current, and
25 where such devices are used in a circuit supplied for example, by a storage battery, and in which there are no other inductive devices, in which case the power factor is controlled by said device. It comprises a conductor ar-
30 ranged preferably in a series of turns and adjacent to the winding 60, the counter-inductive effect varying with the resistance of the conductor and the number of turns. In order to reduce the loss of electrical energy
35 in the device to a negligible amount and still reduce the sparking to a point where it is not objectionable, I have found it preferable to use for the conductor a coil of wire considerably finer than that of the winding 60 and of substantially the same number of turns. This counter-inductive winding is represented
40 on the drawing at 108 and may be wound directly under or over the winding 60. Its ends may be connected to each other in any suitable manner but, for convenience, I have
45 used the outside winding and connected the ends to plate 107 to which the one end of the winding 60 is also connected. This closed or short circuit coil takes the place of or renders
50 unnecessary the usual form of commercial condenser and is much cheaper and more effective as well as simpler and more convenient for manufacture and assembly. It will
55 be understood that the make and break device may be located as shown or at any other point in the circuit without affecting the operation of the counter-induction coil and that it may be operated mechanically or otherwise, including, for example, such devices as
60 ignition coils for internal combustion engines and like constructions.

Operation.—When the pump chamber is empty and supply of current to the electro-
65 magnet is interrupted, the armature will be

held by spring action in its upper position, the pump chamber being thereby contracted and the contacts 103, 104, in engagement. If
now current is supplied to the electromagnet
70 as by closing the switch 109, which may be the engine ignition switch, the magnetic body 106 will be attracted toward the armature and the latter simultaneously drawn toward the coil, thereby expanding the pump chamber. This movement constitutes the intake stroke
75 of the pump during which liquid may flow through the passage 12 and openings 24 and 240 past the valve 25 into the interior of the pump chamber. Air trapped within the chamber 17 will be somewhat rarified during
80 the intake or suction stroke and will therefore operate to continue the suction effect after the closure of the valve 25 thereby rendering the flow to the pump from the source
85 of supply, as the main fuel tank, approximately continuous. Furthermore, the expansion of the air permits the armature to complete its stroke quickly irrespective of any resistance that might ensue as a result
90 of the inertia or friction incident to the setting in motion of a long column of liquid.

Upon separation of the contacts 103, 104, by the movement of the armature the pump chamber will be placed under spring influence
95 tending to cause its contraction and forcing the contents out through the valve passage 37 past the valve 38 into the discharge passage 13. During this movement which constitutes the discharge stroke of the pump,
100 the pressure upon the material being discharged will be determined solely by the tension given to the actuating spring or springs. The discharge pressure therefore remains approximately constant irrespective
105 of height of lift or other conditions on the intake side. Furthermore, the rate of discharge depends upon the rate of utilization in the system to which the liquid is supplied and may be determined, for example, by the
110 opening of the float valve of a carbureter with which the pump may be associated. The discharge stroke may therefore continue over an indeterminate period, the electromagnet remaining entirely inactive until the contraction
115 of the pump chamber permits the contacts 103, 104, to again engage whereupon the cycle of operations will be repeated.

While I have herein described the mechanism in detail, it will be understood that
120 many changes may be made in features of construction without departing from the principles and scope of the invention and therefore I do not wish to be restricted to the specific
125 structure herein disclosed except as may be required by the language of the appended claims in view of the prior art.

I claim:

1. In an electromagnetic actuating device, a solenoid, an armature therefor, a circuit for
130 supplying current to said solenoid, a fixed

contract, a movable contact, a support for the movable contact actuable to break the circuit upon movement of said armature, a magnetic body connected to said support and influenced by the magnetic field of said solenoid to re-
 5 tain the contacts in engagement for a predetermined period and a short circuited coil surrounding said solenoid to reduce the E. M. F. therein upon separation of the contacts.

10 2. In an electromagnetic actuating device, a member to be actuated, a solenoid, an armature therefor connected to said member, a circuit for supplying current to said solenoid, a fixed contact and a movable contact
 15 in said circuit, a resilient support for said movable contact mounted upon said armature, means for tensioning said support upon closing the circuit in the direction to retain the contacts in engagement, and means for
 20 moving the support in the opposite direction to separate the contacts.

3. In electromagnetic actuating means, a solenoid, a member to be actuated, an armature connected thereto, a circuit for supplying
 25 current to said solenoid, a fixed and a movable contact in said circuit, a spring fixed to said armature at one end and carrying said movable contact at the other end, and a magnetic body fixed to said spring intermediate
 30 its ends and so positioned with reference to said solenoid and armature that upon passage of current through said solenoid said body will tend to move toward said armature.

4. In electromagnetic actuating mechanism,
 35 a solenoid, an armature therefor arranged for pivotal movement toward and from said solenoid, and a bearing support for said armature comprising anti-friction bearing members engaging opposite sides of the armature.

40 5. Reciprocating mechanism comprising an electromagnet, an armature therefor, and means for pivotally supporting the armature comprising a plurality of balls partially embedded in the armature.

45 6. An armature support comprising a fixed yoke having recesses in the inner face of one arm, the armature having corresponding recesses in one face, balls seated in corresponding pairs of recesses to provide thereby a pivot
 50 about an axis passing through the balls, and a ball between the other arm of the yoke and the opposed face of the armature.

7. In an electromagnetically actuated pump, the combination of a reciprocating
 55 member, an electromagnet, an armature therefor operative to actuate said member, contacts for controlling said electromagnet one of which is arranged to be moved to circuit opening position by said armature, and
 60 magnetically actuated means for maintaining said contacts in engagement during a predetermined movement of said armature.

8. In electromagnetic pumping mechanism,
 65 a reciprocating member, an electromagnet, an armature therefor pivotally supported and

arranged to actuate said member, a pair of contacts adapted to control said electromagnet, a spring mounted in proximity to said armature and supporting one of said contacts, a magnetic body mounted upon said spring
 70 and arranged to cause movement thereof toward said armature and in a direction to retain said contacts closed upon passage of current through said magnet.

9. In electromagnetic actuating means, the
 75 combination of an electromagnet, a movable armature connected to the member to be actuated, contacts adapted to control flow of current to said electromagnet, one of said con-
 80 tacts arranged to be actuated by said armature in such manner as to separate the contacts after a predetermined travel of the armature toward the electromagnet, means for
 85 moving the armature away from the magnet, a spring tending to move said movable contact toward circuit-opening position, and a magnetic body in proximity to said armature
 90 and associated with said spring, the parts being so constructed and arranged that the magnetic body is moved toward the armature upon the passage of current through the electro-
 95 magnet thereby stressing the spring and retaining the contacts in engagement during a predetermined travel of the armature.

10. In a device for pumping fluids, a re-
 95 ciprocating member, a second reciprocating member carrying electrical contact means adapted to control the action of said first member, and means for producing a magnetic
 100 field, both of said members arranged to be actuated magnetically in said field, the parts being so constructed and arranged that the magnetic flux tends to cause movement of
 105 said reciprocating members in opposite directions.

11. An electromagnetic actuating device
 110 comprising an electromagnet, an armature therefor arranged to be moved by the electromagnet in one direction, a spring adapted to move the armature in the opposite direc-
 115 tion and to have energy stored therein during the movement of the armature by the electromagnet, contacts for determining the action of the electromagnet, and means for controlling said contacts including a magnetic
 120 body located within and controlled by the magnetic field of the electromagnet and arranged to hold said contacts in engagement during a predetermined travel of the armature, said armature arranged to move the said
 125 body during the final portion of its travel and thereby cause separation of the contacts.

12. Structure as set forth in claim 11, the
 125 magnetic body and armature being arranged to move in opposite directions under the influence of the magnetic field and in the same direction when the body is actuated by the armature to separate the contacts.

13. An electromagnetic actuating device
 130 comprising an electromagnet, an armature

therefor, a circuit for said electromagnet, contacts in said circuit, means for controlling actuation of said contacts, including a magnetic body and a spring, said body and armature both located in the magnetic field of said electromagnet and arranged to be moved toward each other and in opposite directions by the magnetic stresses, said spring means arranged to be tensioned by such movement and the magnetic stresses acting to hold the contacts together for a predetermined period of the travel of the armature.

14. Structure as set forth in claim 13, said magnetic body being positioned to be engaged and moved by said armature after a predetermined travel to thereby separate the contacts.

15. An electromagnetic actuating device comprising an electromagnet, a circuit for supplying current thereto, contacts in said circuit, an armature mounted to reciprocate toward and from said electromagnet, and a magnetic member arranged to control the actuation of said contacts, said member positioned concentrically with said electromagnet and in part within the core thereof, and having a part projecting from said core toward the said armature and separated from the core and armature.

16. Structure as set forth in claim 15, said magnetic member being tubular in form and the armature having a portion extending through said member.

17. In an electromagnetic actuating device, a solenoid, an armature therefor, a circuit for supplying current to said solenoid, contacts for controlling said circuit one of which is movable relatively to the other, means for actuating said movable contact to break said circuit, magnetic means acting upon said contact to retain same in circuit-closing position during a predetermined travel of said armature, and a short-circuited coil arranged in inductive relation to said solenoid to reduce sparking at said contacts upon breaking the circuit.

In testimony whereof I affix my signature.

JOHN M. LEA.

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