E. H. JACOBS.

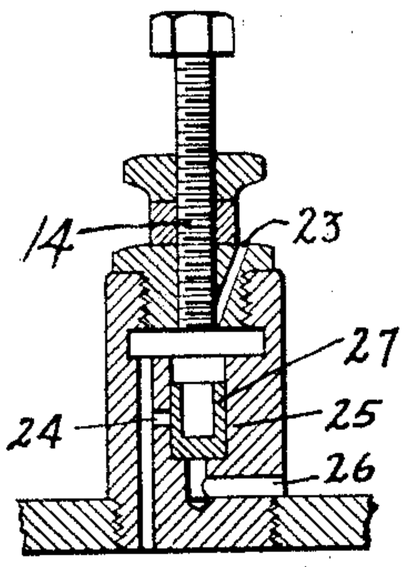
TIME LIMIT RELAY.

APPLICATION FILED FEB. 23, 1909.

963,897.

Patented July 12, 1910.

Fig. 4



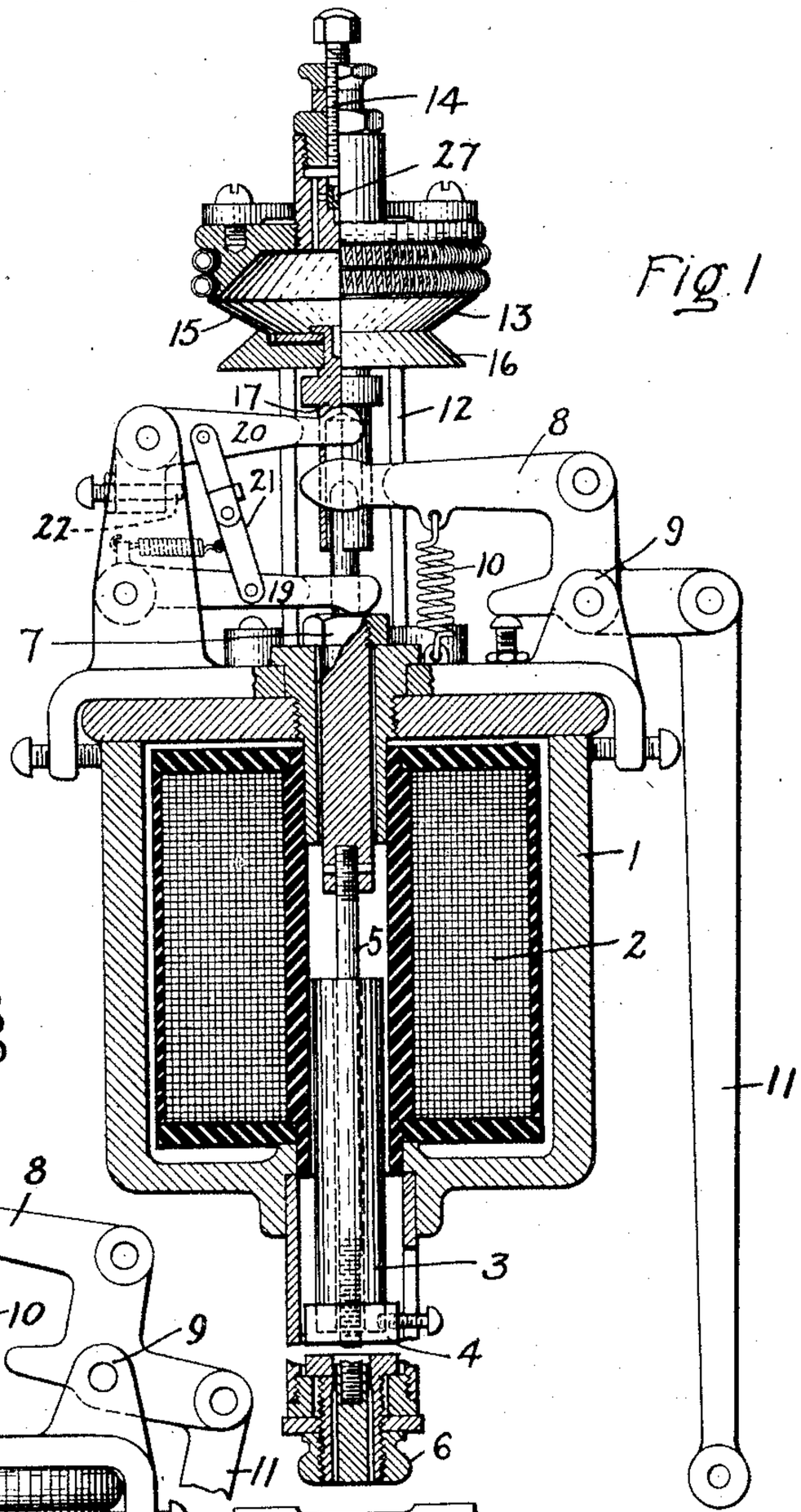
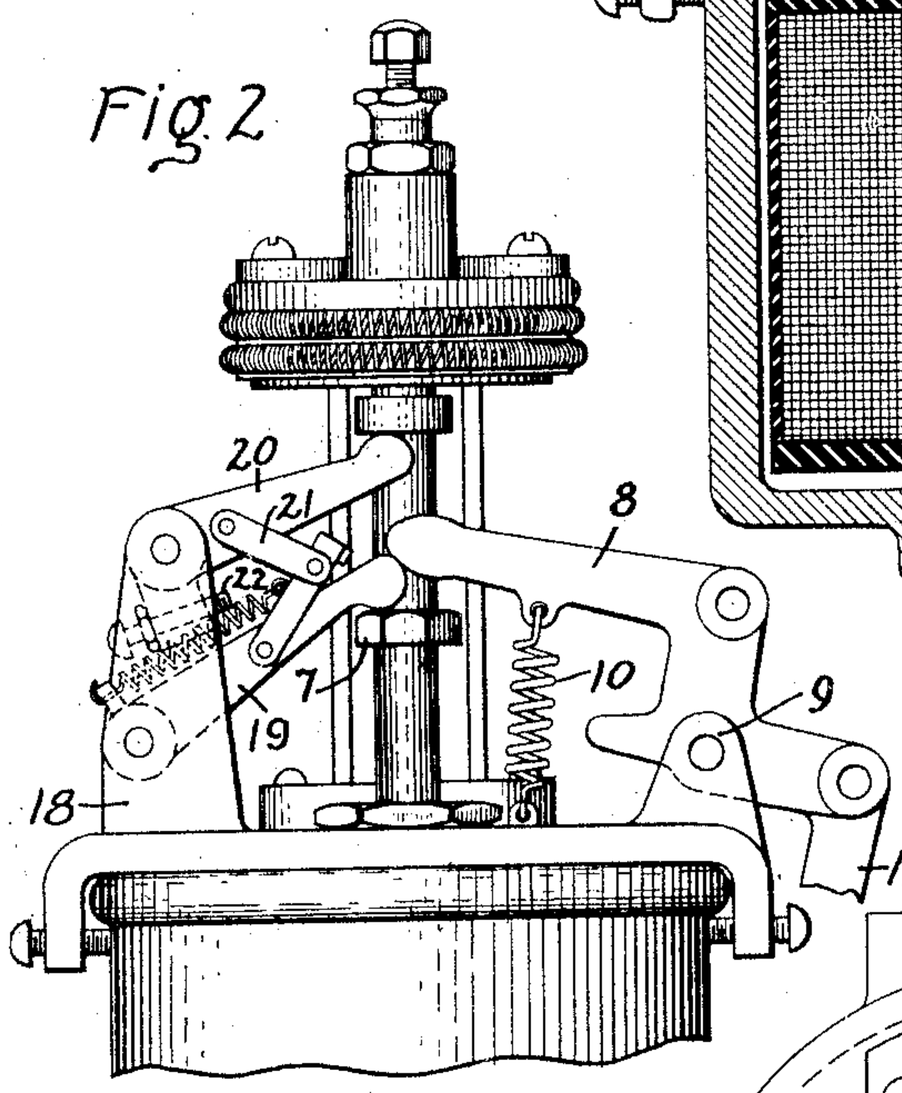


Fig. 1

Fig. 2



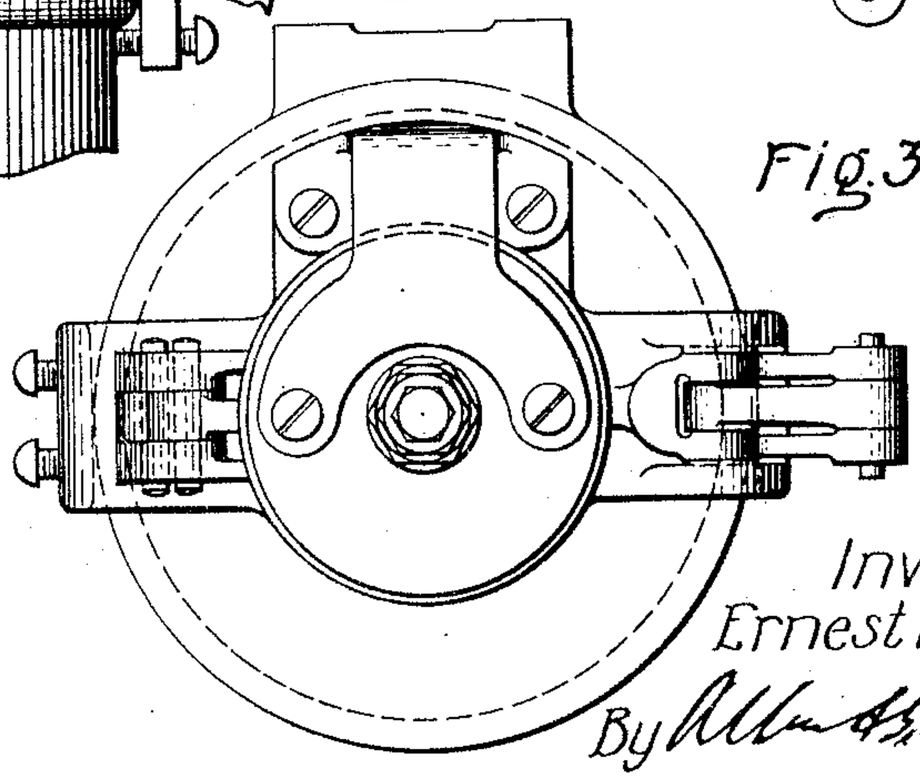


Fig. 3

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UNITED STATES PATENT OFFICE.

ERNEST H. JACOBS, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

TIME-LIMIT RELAY.

963,897. Specification of Letters Patent. **Patented July 12, 1910.**

Application filed February 23, 1909. Serial No. 479,407.

To all whom it may concern:

Be it known that I, ERNEST H. JACOBS, a citizen of the United States, residing at Schenectady, in the county of Schenectady, State of New York, have invented certain new and useful Improvements in Time-Limit Relays, of which the following is a specification.

My invention relates to tripping coils and relays in which a time limit is secured by some suitable form of retarding device and more particularly to devices of this character in which a time limit is secured by means of some collapsible vessel, such as a bellows, which has an outlet for determining the rate of collapse of the vessel and an inlet port controlled by some form of check valve for admitting air to the vessel.

In many electromagnetic time limit tripping devices heretofore used, a movable armature actuated by a coil was rigidly connected to some form of retarding device, and near the end of its travel must operate against not only the restraint of the retarding device, but also the friction of the latch of a circuit breaker or of the contacts of a relay. In such a device the requisite certainty of action can only be secured by making the actuating coil considerably larger than is necessary where the time limit feature is omitted and the armature or core of the actuating coil can move freely and is arranged to strike a hammer blow. It has also been found that a retarding device of the bellows type with a light check valve on the inlet port is subject to variations when used in connection with a coil energized by alternating current, because the periodic variations in pressure in the bellows due to the periodic variations in excitation of a coil through which alternating current is flowing are sufficient to actuate the inlet valve and set up a kind of pumping action which varies the amount of air in the bellows and changes the time limit of the device.

The object of my invention is to provide a tripping mechanism in which the overload coil can be of the same size as though the retarding device were not present, in which all the power exerted by the coil is available for moving the armature and delivering a hammer blow to the latch of the circuit breaker or to the contacts of a relay, and in which the objectionable pumping action of the bellows type time limit device is eliminated.

In carrying out my invention, the tripping member, which may be the latch of a circuit breaker or the movable contact of a relay, is mounted in a position where it will be struck a hammer blow by the armature or core of the overload coil as the core reaches the limit of its movement. The time limit effect is secured by means of any suitable retarding device which will restrain the movement of the armature or core during the first part of its travel and an overset toggle is provided for rigidly connecting the armature to the retarding device during the first part of the travel of the armature, but before the armature reaches the tripping member the toggle is automatically collapsed and the armature or core, which is then free from the retarding device, is lifted by all the power of the coil and delivers a hammer blow against the tripping member. The pumping action observed in the bellows type of time limit relay is overcome by providing the bellows with an inlet valve which is not affected by the periodic variations in pressure set up by the alternating current, but which will respond freely to a long continued decrease in pressure and will permit the bellows to fill freely as the core drops back to its normal position.

My invention will best be understood in connection with the accompanying drawings, which illustrate one form in which it may be embodied and in which—

Figure 1 is a view partly in section of a relay embodying one form of the invention, the parts being shown in normal position with the calibrating tube shortened by having a portion broken away; Fig. 2 a view in elevation showing the relation of the parts after the coil has been energized and the core has been moved to tripping position; Fig. 3 a plan view of the relay shown in Fig. 1; and Fig. 4 a detail view of the inlet valve of the bellows retarding device which is shown in Figs. 1 and 2.

In the drawings the invention is shown as applied to a relay of a well known type, in which an iron casing 1 contains a coil or solenoid 2, provided with an armature 3

having at the lower end a nut 4, which is immovably secured to the core and is kept from turning by means of a set screw which fastens the nut to the lower end of the core and projects through a slot in a stationary calibrating tube carried by the casing 1. The nut 4 is threaded on a rotatable rod 5 squared at the lower end and loosely fitted into any suitable rotatable member, such as the thumb piece 6, which is rotatably mounted on the lower end of the calibrating tube and by means of which the rod 5 may be rotated to move the nut 4 up or down and thereby vary the relation of the core 3 and the coil 2. The upper end of the rod 5 is rigidly secured to a sliding pin, which in the specific form of device shown in the drawing, is provided with a shoulder formed by a nut 7 threaded on the upper end of the sliding pin. The armature 3, rod 5 and sliding pin are normally in rigid relation to each other and form a core which is movable longitudinally of the coil and is lifted when a current of predetermined amount flows through the coil 2. The calibrating tube is longer than shown in Fig. 1, in which part of the tube between the nut 4 and the bottom of the tube has been broken away for convenience of illustration.

In the specific form of device shown in the drawings, in which the relay actuates the latch of a circuit breaker or similar automatic switch through a system of links, the armature actuates a tripping member 8 made in the form of a bell crank pivoted on a bracket 9, with one end in the path of the shoulder 7 of the core and normally yieldingly held in the position shown in Fig. 1 by means of a spring 10. An arm 11, forming part of the tripping member, is connected by means of suitable links to the latch or other restraining means of the circuit breaker or switch controlled by the relay and when the tripping member is moved to the position shown in Fig. 2, the switch or circuit breaker controlled by it is opened automatically.

In order to secure a time limit for the action of the relay any suitable retarding device may be connected to the core, but the preferred form of retarding device is of the bellows type as shown in the drawings, in which a bracket 12, secured to the top of the casing 1, carries a suitable collapsible vessel, such as a bellows 13, in alinement with the core 3. The bellows 13 has an outlet controlled by a regulating valve 14, and has one wall 15 formed of some flexible material, such as leather. The flexible wall carries a metal plate 16 provided with a sleeve 17 fitting loosely over and acting as a guide for the upper end of the core or armature 3 when the parts are in normal position. Owing to the space between the upper end of the core and the bottom of the guide or sleeve 17, as shown in Fig. 1, the core can move a short distance before its upper end reaches the bottom of the sleeve, and during this movement it is not restrained by the bellows.

In order to secure the restraining effect of the bellows or similar retarding device during the first part of the movement of the core or armature, the core is rigidly connected to the bellows during a predetermined portion of its movement and at a certain point in its movement is automatically disconnected, whereupon the core, unrestrained by the retarding device, is suddenly raised with all the power of the overload coil 2 and delivers a hammer blow to the tripping member 8. The preferred arrangement for locking the core to the retarding device during a definite portion of the movement of the core consists of a locking toggle between the retarding device and the core, and normally overset to rigidly connect the core to the retarding device, the toggle being automatically collapsed at a definite point in the movement of the core to permit the core to move freely. In the specific arrangement shown in the drawings for connecting to core and the bellows the bracket 18, mounted on the casing 1, carries one pivoted lever 19 with its free end in engagement with the shoulder 7 of the core or armature, and also carries on a pivot parallel to the pivot of the lever 19 a second pivoted lever 20 with its free end in engagement with the sleeve 17 of the bellows. The two levers are normally rigidly connected through a locking toggle 21, which is normally overset, as shown in the drawings, and compels the two levers to move together. As best shown in Fig. 1, the locking toggle 21 is connected to the two levers at different distances from their pivots and is automatically collapsed by engaging a stop at a definite point in the movement of the core 3, the preferred arrangement being that shown in which the second pivoted lever 20, made in the form of a bell crank, carries on one arm a stop 22, preferably threaded through the arm to be adjustable and arranged to engage the locking toggle 21 as the lever 20 is moved about its pivot, whereby the locking toggle is collapsed. Owing to the different distances from the pivots at which the toggle is connected to the levers the upward movement of the levers gives the toggle 21 a lateral motion toward the stop 22 and by varying the position of the stop 22 the point at which the toggle is engaged by the stop and thereby collapsed can be varied. As the core moves upward in response to overload from the position shown in Fig. 1, the levers swing about their pivots and the toggle, which acts as a rigid connection between the levers and enables the bellows to restrain the movement of the core, is carried toward the stop 22 until at a definite point in the move-

ment of the core the toggle encounters the stop and is collapsed, whereupon the core is freed from the retarding device, since the two levers are free to move toward each other into the position shown in Fig. 2 except for the light tension of the toggle setting spring, while the core, no longer restrained by the retarding device, is suddenly lifted with all the force of the overload coil and through the shoulder 7 carries the end of the lever 19, as best shown in Fig. 2, against the end of the tripping member 8, thereby striking the end of the tripping member 8 a hammer blow which quickly and positively unlatches the circuit breaker or switch.

The pumping of the bellows is overcome by means of the arrangement best shown in Fig. 4, in which the upper wall of the bellows 13 is provided with an outlet port 23 controlled by an adjusting screw, and with an inlet port 24 opening into one side of a vertical cylindrical valve seat 25 formed in the upper wall of the bellows and open to the atmosphere at the lower end through the port 26. The cylindrical valve 27, which fits in the cylindrical valve seat and has its upper end exposed to the pressure in the interior of the bellows, is normally in the position shown in Fig. 4, in which the lower edge projects below the inlet port a sufficient distance to give the valve enough lap to allow it to lift slightly in response to periodic fluctuations in the bellows without uncovering the inlet port. As a result of this construction, the variations due to the alternating current cause a slight vibration of the valve, but do not move it far enough to uncover the inlet port, while the long continued decrease of pressure due to the core dropping back to normal position will lift the inlet valve and permit air to flow in through the inlet port.

My invention may be embodied in many other forms than that above described and I, therefore, do not desire to limit myself to the precise arrangement disclosed, but aim in the appended claims to cover all changes and modifications which are within the spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States, is—

1. In an automatic tripping mechanism, the combination with a tripping member and an electroresponsive device having an armature arranged to actuate said tripping member when moved, of a retarding device for retarding the movement of said armature, a toggle normally overset to form a rigid connection between said armature and said retarding device, and means whereby said toggle is collapsed at a predetermined point in the travel of said armature and said armature is thereby freed from restraint.

2. In an automatic tripping mechanism, the combination with a tripping member, an electroresponsive device having a movable armature, and a tripping member mounted in the path of said armature, of a retarding device for restraining the movement of said armature, a normally overset toggle which forms a rigid connection between said armature and said retarding device, and means actuated by the movement of said armature for collapsing said toggle and freeing said armature from restraint before said armature encounters said tripping member, whereby said tripping member is actuated by a hammer blow from said armature.

3. In an automatic tripping mechanism, the combination with an electroresponsive device having a movable armature, a tripping member mounted in the path of said armature to be actuated thereby, and a retarding device for restraining the movement of said armature, of a pivoted lever having one end in engagement with said retarding device, a toggle between said lever and said armature normally overset to form a rigid connection, and a stop on said lever cooperating with said toggle to collapse it as said lever moves about its pivot.

4. In an automatic tripping mechanism, the combination with an electroresponsive device having a movable armature, a tripping member mounted in the path of said armature to be actuated thereby, and a retarding device for restraining the movement of said armature, of a pivoted lever having its free end in engagement with said retarding device, a second pivoted lever having its other end in engagement with said armature, a normally overset toggle connected to said levers at different distances from the pivots thereof and forming a rigid connection between them, and a stop engaged by said toggle as said levers move about their pivots to collapse said toggle and thereby free said armature from said retarding device.

5. In an automatic tripping mechanism, the combination with an electroresponsive device having a movable armature, a tripping member mounted in the path of said armature and actuated thereby, and a retarding device for restraining the movement of said armature, of a normally overset toggle forming a rigid connection between said retarding device and said armature, means actuated by the movement of said armature for imparting a lateral movement to said toggle, and a stop mounted in the path of lateral movement of said toggle to collapse said toggle and thereby free said member from restraint at a predetermined point in the travel of said armature.

6. In an automatic tripping mechanism, the combination with a solenoid having a movable core, a tripping member mounted in the path of said core to be actuated thereby, and a retarding device comprising a

sleeve in which the end of said core is loosely guided, of two levers mounted on parallel pivots with their free ends in engagement with said sleeve and with said core, a normally overset toggle connected to said levers at different distances from their pivots, and a stop mounted on one of said levers to engage said toggle and collapse it as said levers are moved about their pivots by said core, whereby said core is freed from restraint at a predetermined point in its path to engage said tripping member with a hammer blow.

7. The combination with an electroresponsive device having a movable armature, and a collapsible vessel with one wall connected to said armature to resist the movement thereof, said vessel being provided with an outlet port and an inlet port, of an inlet valve unaffected by variations of pressure in said vessel which persist less than a fixed period and lifted to uncover said inlet port in response to a decrease of pressure which persists beyond a predetermined length of time.

8. The combination with an electroresponsive device having a movable armature, and a collapsible vessel with one wall connected to said armature to resist the movement thereof, said vessel being provided with an inlet port and an outlet port, of an inlet valve normally closing said inlet port and movable in response to variations in pressure in said vessel, said valve being arranged to cover said inlet port during a predetermined fraction of its travel from normal position.

9. The combination with an electroresponsive device having a movable armature, and a collapsible vessel with one wall connected to said armature to resist the movement thereof, said vessel being provided with an outlet port and an inlet port opening through one side of a cylindrical valve seat in the wall of said vessel, of a piston valve fitting said seat and movable in response to variations of pressure in said vessel, said valve having sufficient lap to keep said inlet port covered during pressure variations which persist less than a predetermined length of time.

10. The combination with an electroresponsive device having a movable armature, and a collapsible vessel with one wall connected to said armature to resist the movement thereof, said vessel being provided with an outlet port and an inlet port through one side of a vertical cylindrical valve seat formed in the wall of said vessel, said valve seat being open to the atmosphere at the bottom and to the interior of said vessel at the top, of a piston valve fitting in said seat with its lower edge normally at a predetermined distance below said inlet port.

In witness whereof, I have hereunto set my hand this 20th day of February, 1909.

ERNEST H. JACOBS.

Witnesses:

BENJAMIN B. HULL,

HELEN ORFORD.