E. E. CLEMENT.

ELECTRICAL RELAY OR ELECTROMAGNET.

APPLICATION FILED DEC. 16, 1905.

946,489. Patented Jan. 11, 1910.

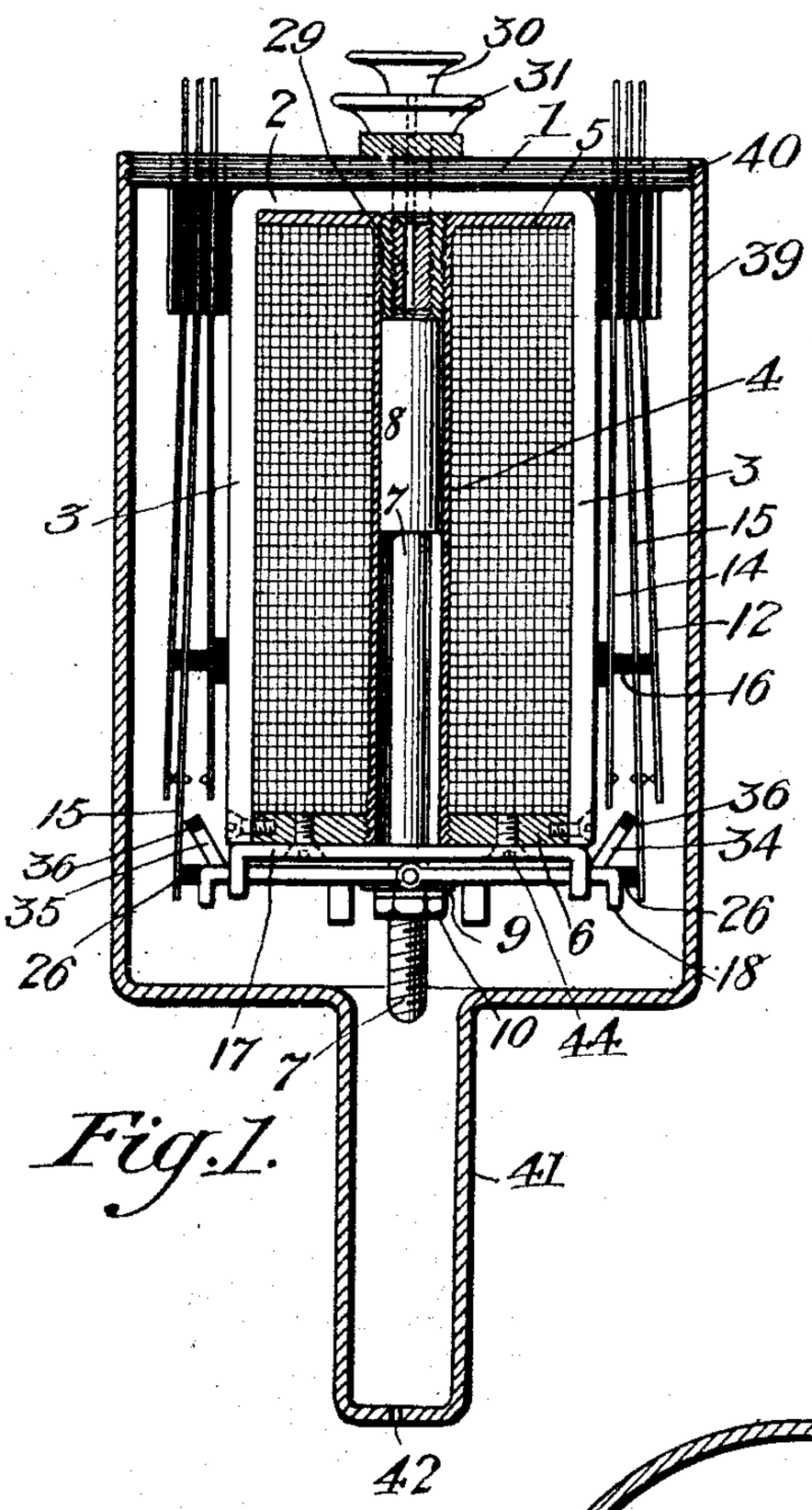

Fig. 1.

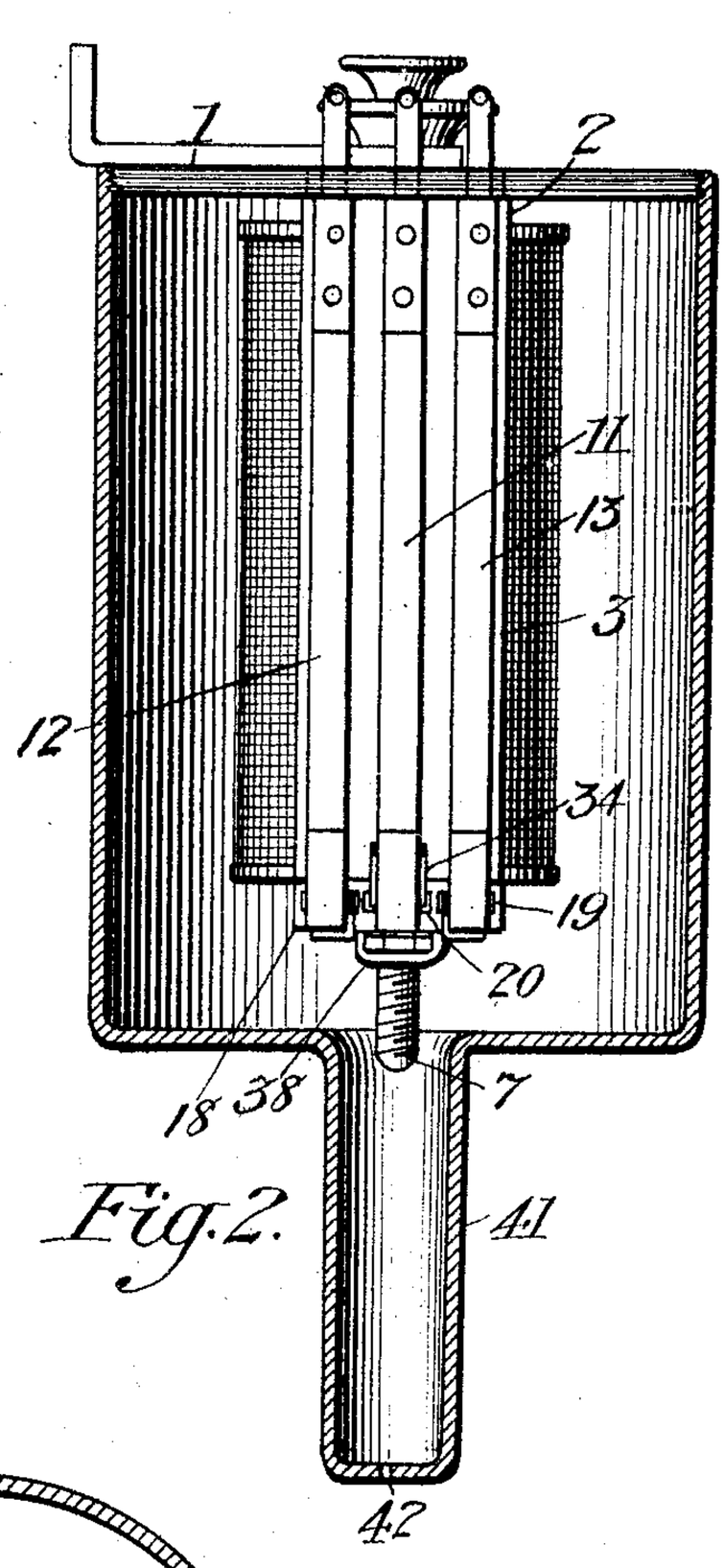

Fig. 2.

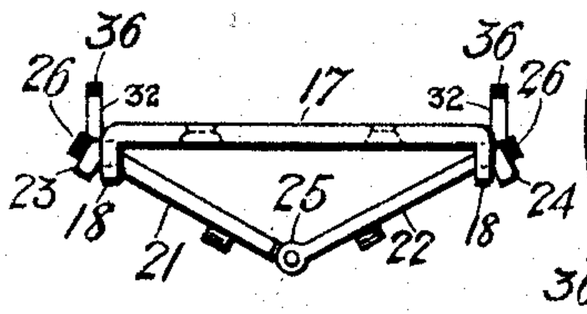

Fig. 4.

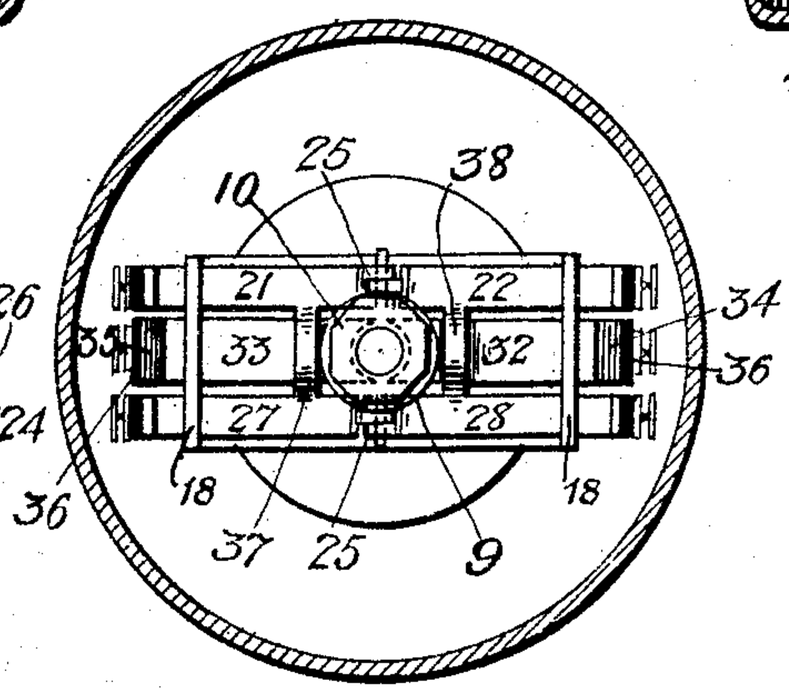

Fig. 3.

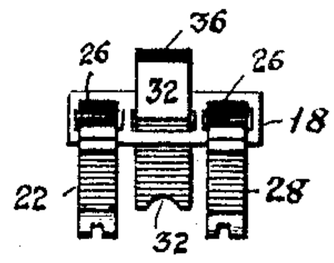

Fig. 5.

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ELECTRICAL RELAY OR ELECTROMAGNET.

946,489. Specification of Letters Patent. Patented Jan. 11, 1910.

Application filed December 16, 1905. Serial No. 292,080.

To all whom it may concern:

Be it known that I, EDWARD E. CLEMENT, a citizen of the United States, residing at Washington, in the District of Columbia, have invented certain new and useful Improvements in Electrical Relays or Electromagnets, of which the following is a specification, reference being had therein to the accompanying drawing.

My invention relates to electrical relays or circuit changing devices, and has for its object the production of a relay which will satisfy the following requirements: Its time of operation must be regulable by simple means, so that it can be caused to act quickly and recover slowly, or vice versa, or both act and recover either quickly or slowly. The contacts must be of standard form, preferably of platinum carried by German silver springs mounted on the frame of the device. The operation must be positive and sharp, without margins and not liable to change through depreciation or deterioration. The entire device must be adapted to be mounted with others upon a frame or rack, and must be covered and protected by a shell or casing preferably of metal, so as to exclude dust and moisture.

I attain my object, as above stated, together with subsidiary objects which will sufficiently appear from the detail description hereinafter, by the following construction and arrangement: I employ as the actuating means a solenoid having a plunger core, the central tube of the magnet spool constituting a dash-pot with a valve or valves by which the movement of the core may be determined and regulated. I mount this solenoid preferably in a vertical position, so that the core will be drawn down by gravity; and in order to give it certainty of action I provide a return magnetic circuit in the shape of a soft iron frame with side pieces parallel to the core and one end piece carrying the valve or valves, while the other is perforated to permit the passage of the core. Upon the side pieces of the frame I mount the contact-springs after a fashion now well understood and practiced in other types of relays. In order to move these springs and produce different effects in or among their contacts, I provide bell-crank levers or toggle levers, or both, at the lower end of the solenoid, these being moved by the core when it is drawn up and retracted.

The structure is supported from the upper part of the frame, where it is provided with a cap, upon which I secure, preferably by screw-threads, the upper end of a spun or drawn metal shell or casing.

My invention is illustrated in the accompanying drawings, in which—

Figure 1 is a sectional view of one embodiment of my invention. Fig. 2 is a side view looking in a direction at right angles to that of Fig. 1, the shell only being in section. Fig. 3 is a bottom plan view of the device. Figs. 4 and 5 are detail views of the operating levers.

Referring to the drawings, 1 is a cap, preferably of insulating material such as hard fiber. Upon this cap is secured the soft iron frame 2, having the side pieces 3 which are parallel to each other and also to the central tube 4 of the solenoid spool, which is fitted with one fiber or rubber head 5 and one soft iron head 6, the latter to complete the magnetic circuit. The central tube 4 I prefer to make of brass, although it may also be made of paper, hard fiber or the like, or it may even be made of soft iron, provided it is suitably proportioned. Fitted to slide within this tube 4 is the plunger core 7, having an enlarged head 8, which fits the tube rather snugly. At its lower end the core is threaded to receive the nuts 9 and 10, the former being preferably circular or carrying a circular washer, and the latter of indifferent shape, serving as a lock nut. Mounted upon the side piece 3 of the frame are sets of contact springs 11, 12, 13, etc. Each set of these may consist of two or more springs. The number of sets may be varied as will presently appear.

In Fig. 2 I have shown three sets of springs on one side frame, and there may be three more sets on the other side frames, making a total of six sets. Each set may act to make a circuit by closing together when actuated, to break a circuit by opening when actuated, or to make and break, thus both opening and closing when actuated. In the drawings herewith I have shown the last named arrangement.

By reference to Fig. 1 it will be seen that the spring, 15, plays between the two springs 12 and 14. In its normal position it rests against and makes contact with the spring 14, but when raised up as shown it leaves spring, 14, and comes into contact with

spring 12. In order to produce certainty of action among these springs I provide an insulating stud 16 for each set, the spring 14 resting upon a shoulder formed on the stud, and forcing the latter thereby against the side piece 3. The spring 12 rests upon the end of a reduced portion of the stud, while the spring 15 moves freely upon it, both springs 14 and 15 being perforated to take the reduced portion of the stud.

The springs are mounted with interposed strips of insulation, upon the upper portions of the side frames 3, and have their extremities projecting through openings in the cap 1.

At the lower end of the solenoid I secure a yoke 17, shown as screwed fast to the lower head 6, and provided with downwardly turned extremities 18, which have openings 19 and 20 (best shown in Fig. 2).

In the form of relay I have here chosen to illustrate, the outer sets of springs on both sides are operated simultaneously at opposite ends of the stroke of the solenoid core; that is to say, when the core is drawn all the way up as in Figs. 1 and 2, the spring 15 of each set is forced out. These springs then remain set in the position so taken until upon a lengthy break in the circuit the core has dropped all the way down and the head 8 reached its lowermost position, when the springs are tripped and again thrown inward. To accomplish this I employ a double pair of toggle levers, one pair for each double set of springs. These levers are best shown in Figs. 1 and 3, with detail views in Figs. 4 and 5. Referring first to Fig. 4, it will be seen that the frame 17 has projecting through the openings in its end portions 18 a pair of levers 21 and 22 with hook ends 23 and 24, and their middle points pivoted together at 25. On the outer end of each lever is a button of insulation 26, which takes against the operating spring 15 in order to actuate the same. When the core is drawn all the way up, the nut 9 or its washer rising beneath the pivot points 25 lifts the toggle levers 21 and 22, so that their ends slide in the openings in the yokes 17, and the insulating buttons 26 are thrown outwardly in opposite directions. The pivot ends 25 of the levers are drawn up so as to be on center or preferably a little past center, so that the inward pressure of the springs 15 will hold them in position and prevent their dropping down without some positive force to move them again past the center. The stem of the core 7 passing freely through the central opening between the toggle levers (21, 22 and 27, 28) produces no effect thereon until it has reached its lowermost position, whereupon the head 8 engages the pivot ends on the upper side, and the weight of the core carries them down until they are below a straight line joining the points of impact on the springs, when the inward pressure of the latter will force them down the rest of the way, until they again assume the position shown in Fig. 4.

The arrangement thus described contemplates the actuation of the contact-springs in one direction when the solenoid core is pulled all the way up, and in the contrary direction when it is dropped all the way down. In order to regulate the time of these movements I provide the tube 4 at its upper end with a check valve comprising a weighted cap 30, resting on a perforated cap 31, secured upon the outer end of the stud 29, which has a central channel or air passage, and being of soft iron forms a part of the magnetic circuit. I have not found it necessary to use any packing around the head 8, nor indeed to have any special adjustment of the valve; but if the same be required in order to produce an especially long movement of the core, I consider it within the scope of my invention. With this check valve set as shown the core 7 will pull up very quickly, throwing out the springs 15 sharply upon the first make in the solenoid circuit. When so attracted and drawn up, the core head 8 expels the air in the tube through the channel or opening in the stud 29 and the cap 31; but when the core starts to fall, this channel is closed, hence air is admitted to the tube very slowly, leaking under the valve a little, and also around the head 8. The time of descent of the core may be regulated quite well with this simple arrangement, so as to reach two seconds or more if required, while the upward motion can be made practically instantaneous.

In addition to the outer sets of springs, I have shown two middle sets, one of these appearing in Fig. 2 at 11. These sets of springs are precisely like the others, but their mode of operation is different. I wish the condition of these to be changed only when the core is fully drawn up, and to remain changed only until it starts down, the original condition being then immediately restored, without waiting for the completion of its travel. For this purpose I provide a pair of intermediate bell-crank levers 32 and 33, passing through the central openings in the end pieces 18 of the yoke 17, and lying between the opposite pairs of toggle levers 21, 22, 27 and 28. The outer ends of these levers are turned up to form bell-cranks, as shown at 34—35, and carry insulating studs or buttons 36 to bear against the operating springs of the sets 11. These bell-cranks are maintained in the bracket ends of the yoke 17 by the pressure of the springs against them, as best shown in Fig. 2. Their direction of operation, that is the determination of whether they will operate on the up stroke or on the down stroke of

the core, depends upon the direction in which the ends 34—35 are turned. Turned up, as shown in the figure, they will operate when the core is drawn all the way up; but if reversed, so that the ends 34 are turned down, they will obviously be actuated to operate the springs when the core is all the way down only. Since these two bell-cranks on opposite sides are not connected together. I may combine these effects by turning one up and the other down, whereby one of their sets of springs will be operated when the solenoid core goes up, released when it starts down; the other set will be operated when it is all the way down, and released when it starts up.

The toggle levers 21, 22 and 27, 28 are preferably kept in parallelism for the most efficient operation, although this is not absolutely essential. They may be connected as shown in Fig. 3, by bridge pieces 37 and 38, the former connecting the two side levers 21 and 27, and the latter the side levers 22 and 28. These bridge pieces are bent down so as to project below the bell-crank levers 32 and 33, as best shown in Fig. 2.

In order to secure my relay against deterioration or loss of efficiency due to dust and moisture, I provide a metal shell 39, which is fastened to the cap 1, preferably by screw-threads 40. This shell has a reduced lower portion 41 extending down from its body to receive the core 7 when retracted. A small air vent 42 may be produced in the end of this reduced portion, if required, or for that matter in any other part of the shell. I very much prefer not to have it, but to make the shell as nearly as possible dust and moisture proof.

It is to be understood that my invention is not limited to the specific form illustrated and described herein. I find this relay to be especially useful in certain types of telephone exchange systems which I have designed, and in its continued use changes and improvements are certain to occur, but such changes and improvements I consider within the scope of my present invention, without altering its character, and I wish my present claims to be so construed. I would point out particularly that the combination of bell-cranks and toggle levers is not invariable, since there are other and equivalent mechanical means which may be substituted therefor; and I also point out that instead of having the toggle levers on the outside and the bell-cranks on the inside, the reverse may be advantageously arranged in some cases. Such changes involve only mechanical skill, and I reserve the right to make them. It will be observed that the yoke 17 is secured to the head 6 of the magnet by screws. The head 6 is preferably screwed on the tube 4 at its lower end, the upper end being suitably attached to the stud 29, which furnishes the means not only for securing the cap 1 and the frame 2 to the magnet, but also for suspending the entire structure for the rack or frame, as shown in Figs. 1 and 2, the frame being marked 43, and being clamped between the cap 1 and the cap-nut 31.

By taking out the screws 44, the yoke 17 and all of its attached parts may be removed, as shown in Fig. 4, together with the core 7, which will then drop out of the solenoid.

The arrangement of the studs or insulating buttons 26 and 36 may be such that all the contacts will be visible at the lower end of the relay. Such an arrangement is not specifically described, but is contemplated herein, and may be claimed.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:—

1. An electrical relay comprising the following instrumentalities: a magnetic frame, a winding supported in said frame, a plunger core within the winding, contact springs mounted on the frame parallel to the core, and levers associated with said springs and adapted to be rocked by said core to actuate the springs, substantially as described.

2. An electrical relay comprising the following instrumentalities: a magnetic frame, a winding supported therein, a plunger core adapted to reciprocate in the winding, contact springs supported upon members of the frame lying parallel to the core, actuating means for the springs mounted to rock on the frame, and connections such that the said means will be engaged and actuated by the core in its movement, substantially as described.

3. An electrical relay comprising the following instrumentalities: a magnetic frame and a central tube, a winding on the tube and a plunger core moving within it, spring-contacts mounted on the frame, substantially parallel to the core, and a yoke associated therewith, together with means carried in said yoke adapted to transmit motion from the plunger core to said contact springs, substantially as described.

4. An electrical relay comprising the following instrumentalities: a solenoid having a plunger core, means for regulating the rate of movement of said core in the solenoid, a frame piece secured upon the solenoid, contacts mounted thereon parallel to the core, and operating means associated therewith adapted to be actuated by the core at different points in its travel, substantially as described.

5. An electrical relay comprising the following instrumentalities: an electromagnet structure, an armature therefor, means for retarding the movements of said armature, contacts controlled thereby mounted on said

magnet structure, and means for directly operating said contacts, said means being engaged by the armature at the end of each movement only, substantially as described.

6. An electrical relay comprising the following instrumentalities: an electromagnet, a plurality of contact springs mounted thereon, a moving magnetic part controlled by the electromagnet, a yoke secured upon the magnet, and a toggle lever carried upon said yoke, moved by said magnetic part, and when so moved engaging the contact springs to change their relations, substantially as described.

7. An electrical relay comprising the following instrumentalities: an electromagnet having a retarded armature, contact springs associated therewith, and a toggle lever set and unset to operate and restore the contact-springs, at opposite ends of the travel of the armature, substantially as described.

8. An electrical relay comprising the following instrumentalities: A solenoid provided with a magnetic frame 2, a central tube 4, heads 5 and 6, a yoke 17, toggle levers carried in said yoke, contact springs secured upon the frame and adapted to be engaged by said toggle levers, and a core for the solenoid reciprocating therein and fitted with means to engage the toggle levers on opposite sides at opposite ends of its travel, whereby the springs may be set in one position by the travel of the solenoid core in one direction and unset when its travel is completed in the opposite direction, substantially as described.

9. An electrical relay comprising the following instrumentalities: an electromagnet having a movable magnetic core, contact springs associated with said magnet, a bell-crank lever having one edge engaging said springs, and means whereby the moving magnetic core may engage the other end of said bell-crank to work the springs, substantially as described.

10. An electrical relay comprising the following instrumentalities: a solenoid depending from a support or cap and fitted with a plunger core, a magnetic frame for said solenoid and contact-springs mounted thereon, a yoke secured upon and at the lower end of the frame, and a bell-crank lever mounted in said yoke, so that one arm will engage the springs and the other arm will be engaged by the core of the solenoid, substantially as described.

11. An electrical relay comprising the following instrumentalities: a solenoid carrying contact-springs and having a plunger core, and intermediate operating means also carried on the solenoid, engaging the springs and normally disengaged from the core and adapted to be engaged by the core to operate the same, substantially as described.

12. An electrical relay comprising the following instrumentalities: a solenoid carrying contact-springs and having a plunger core, and intermediate pivoted operating means also carried by the solenoid engaging the springs and normally disengaged from the core and adapted to be engaged by the core to operate the same, together with means to regulate the rate of movement of the core, substantially as described.

13. An electrical relay comprising the following instrumentalities: a solenoid having a magnetic frame carrying contact-springs and having a plunger core, and intermediate operating means carried on said frame, engaging the springs and engaged by the core, to operate the same, said intermediate operating means adapted to be moved by the core only at the end of its travel in either direction and to remain set when so operated until positively reset or restored, substantially as described.

14. An electrical relay comprising the following instrumentalities: a solenoid carrying contact springs and having a plunger core, and intermediate operating means engaging the springs and engaged by the core to operate the same, said intermediate means comprising toggle levers adapted to be engaged by the core at opposite ends of its travel, and remaining set after being so engaged during the return excursion of the core, substantially as described.

15. An electrical relay comprising the following instrumentalities: a solenoid carrying contact springs and having a plunger core, and intermediate operating means engaging the springs and engaged by the core to operate the same, said intermediate means comprising bell-crank levers engaged by the core at the end of its travel, substantially as described.

16. An electrical relay comprising the following instrumentalities: a solenoid comprising contact springs and having a plunger core, and intermediate operating means engaging the springs and engaged by the core to operate the same, said intermediate means comprising bell-crank and toggle levers engaged by the core at the end of its travel, said toggle levers remaining set when so engaged until positively unset, but said bell crank being self-restoring, whereby the contact springs controlled by the toggle levers may be set and unset at stated intervals, and the other contact springs may be moved intermittently or momentarily, substantially as described.

17. An electrical relay comprising an operating magnet, a plurality of sets of contact-springs, a moving magnetic part controlled by said electromagnet, and means normally out of engagement with but adapted to be engaged by said part whereby said part may close and open said sets of springs at different intervals or in dissimultaneous

order during its travel, substantially as described.

18. An electrical relay comprising an operating magnet and separately insulated contact springs, together with means normally out of engagement with but adapted to be controlled by the magnet to actuate said springs in dissimultaneous order and with asynchronous intervals, substantially as described.

19. An electrical relay comprising a solenoid, insulated contact springs, a plunger core with means to operate said springs asynchronously, and means on the solenoid to regulate the rate of movement of said core, substantially as described.

20. An electrical relay comprising a solenoid having a central tube, a plunger core therein, means fitted to said tube whereby the motion of said plunger core in one direction is made slower than in the reverse direction, and contact springs adapted to be actuated by the core at definite points in its direct and reversed travel, substantially as described.

21. An electrical relay comprising a solenoid having contact springs and a plunger core for operating the same, means for effecting a quicker movement of said plunger in one direction than in the reverse direction and a shell or casting inclosing the relay and tightly secured thereto, and provided with an extension chamber of reduced diameter to provide for the movement of the core, substantially as described.

22. An electrical relay comprising a solenoid, contact springs therefor, a moving magnetic core and intermediate operating means between said core and the springs, and an inclosing shell for the entire relay to protect the same from dust and moisture, said springs, core, operating means and shell, all being supported upon the relay frame, substantially as described.

23. An electrical relay comprising a solenoid with its axis vertical, and having a central tube, a plunger core adapted to be magnetically drawn up therein and to fall by gravity, and a gravity actuated valve fitted upon said tube, so as to relieve the air pressure upon the upward movement of the plunger but to cause the formation of a partial vacuum upon the downward movement thereof, whereby the action of the solenoid when energized is rendered quick, and when deënergized is retarded, together with contact devices adapted to be actuated at different points in the opposite travel of the plunger, substantially as described.

24. An electrical relay comprising a solenoid having a central tube, a plunger core therein, means adapted to be engaged by the plunger core at the end of its movement for effecting the closure of contacts and means for regulating the time constant for the relay, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

EDWARD E. CLEMENT.

Witnesses:

E. EDMONSTON, Jr.,

JAMES H. MARR.