F. M. SLOUGH.

SELF RESTORING DROP RELAY.

APPLICATION FILED MAY 29, 1907.

900,435.

Patented Oct. 6, 1908.

3 SHEETS—SHEET 1.

Fig. 1.

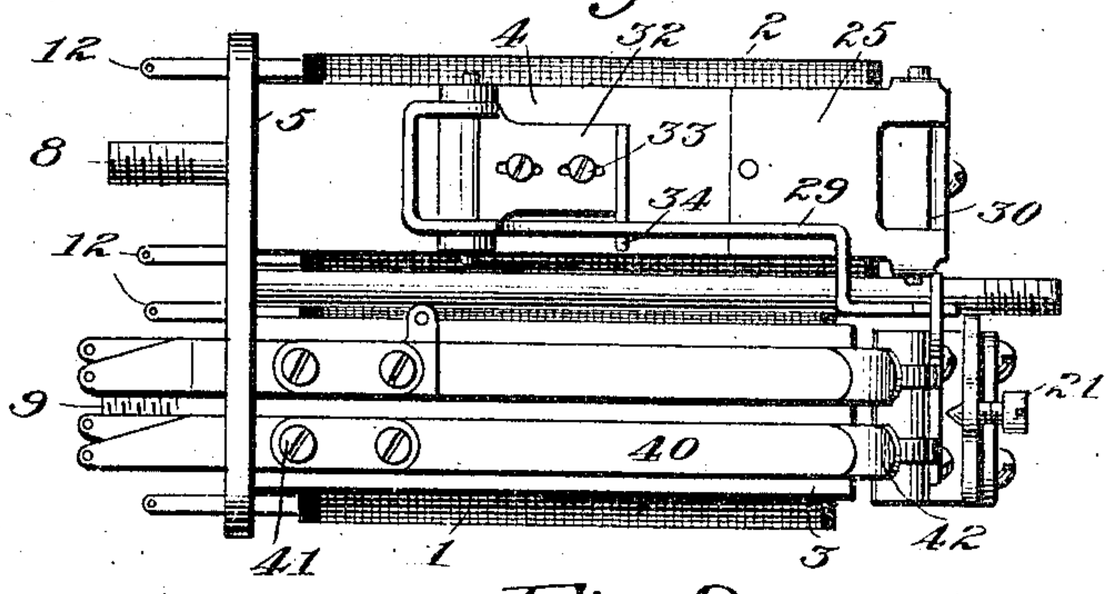


Fig. 2.

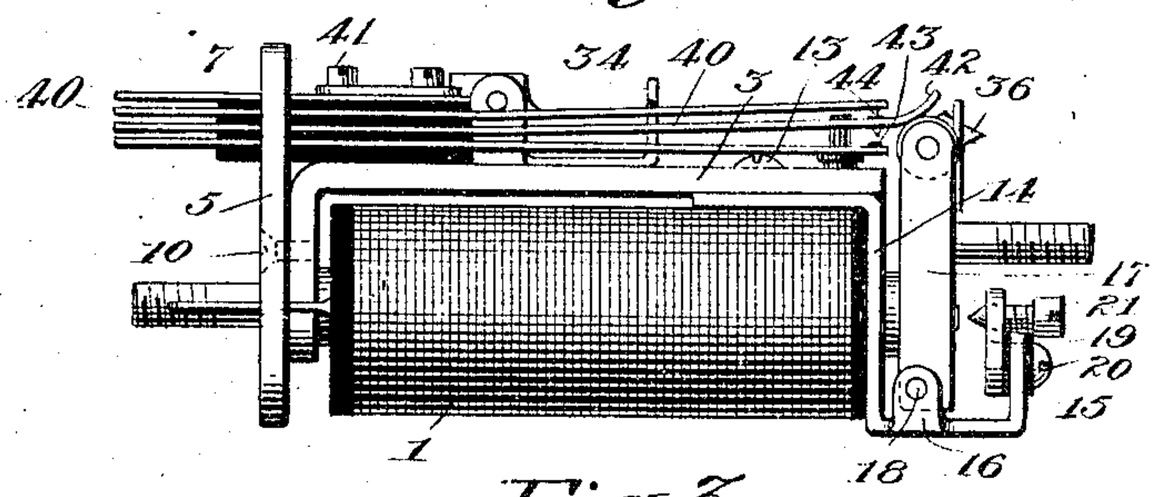


Fig. 3.

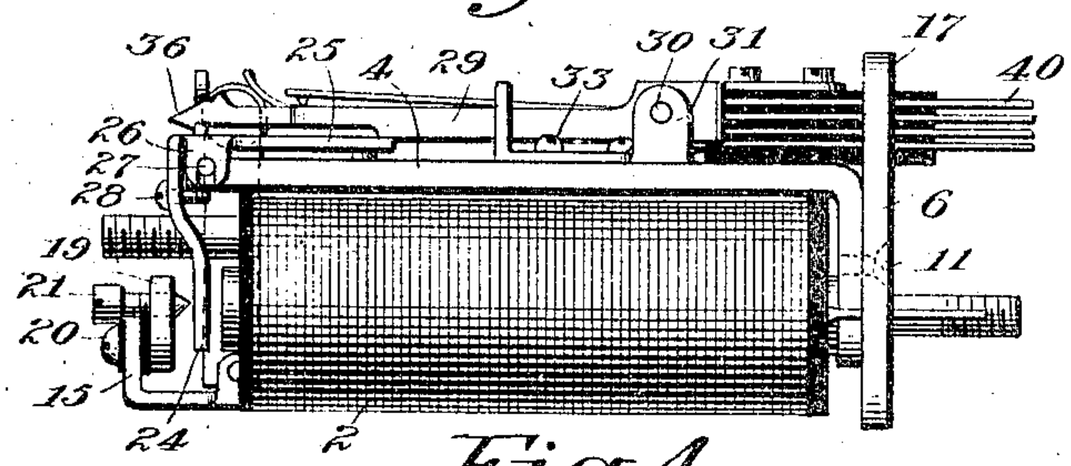
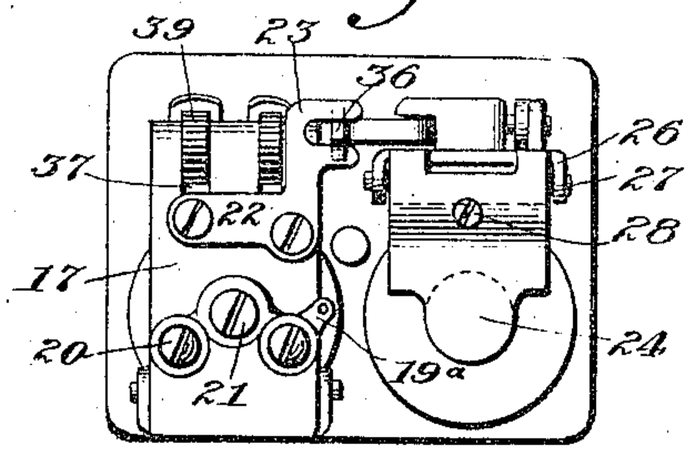


Fig. 4.



Witnesses

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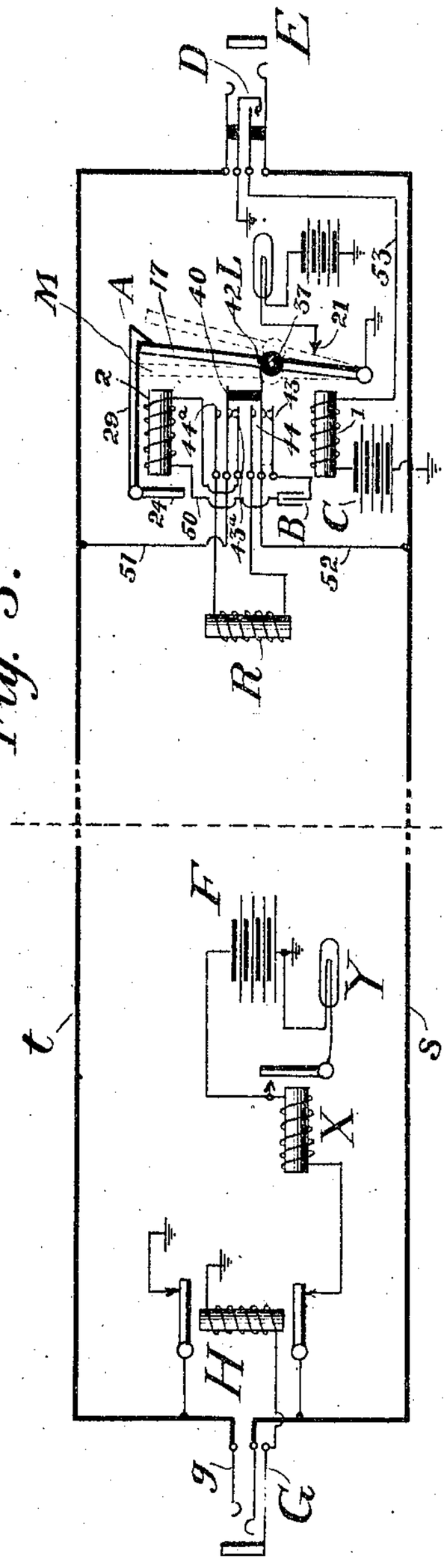
3 SHEETS—SHEET 2.

Fig. 5.



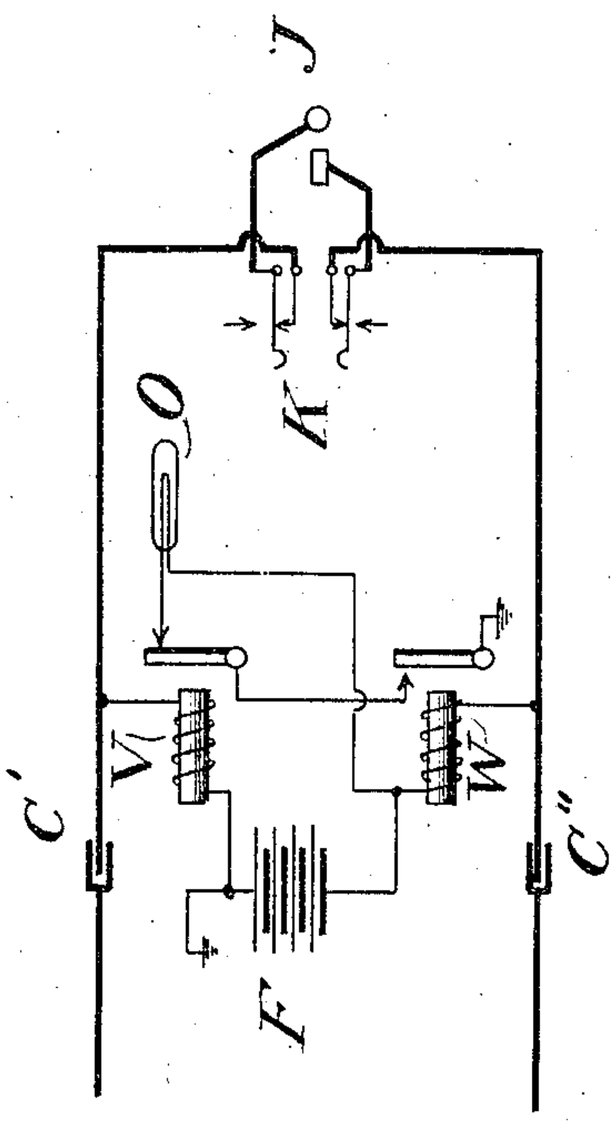


Fig. 6.

Witnesses

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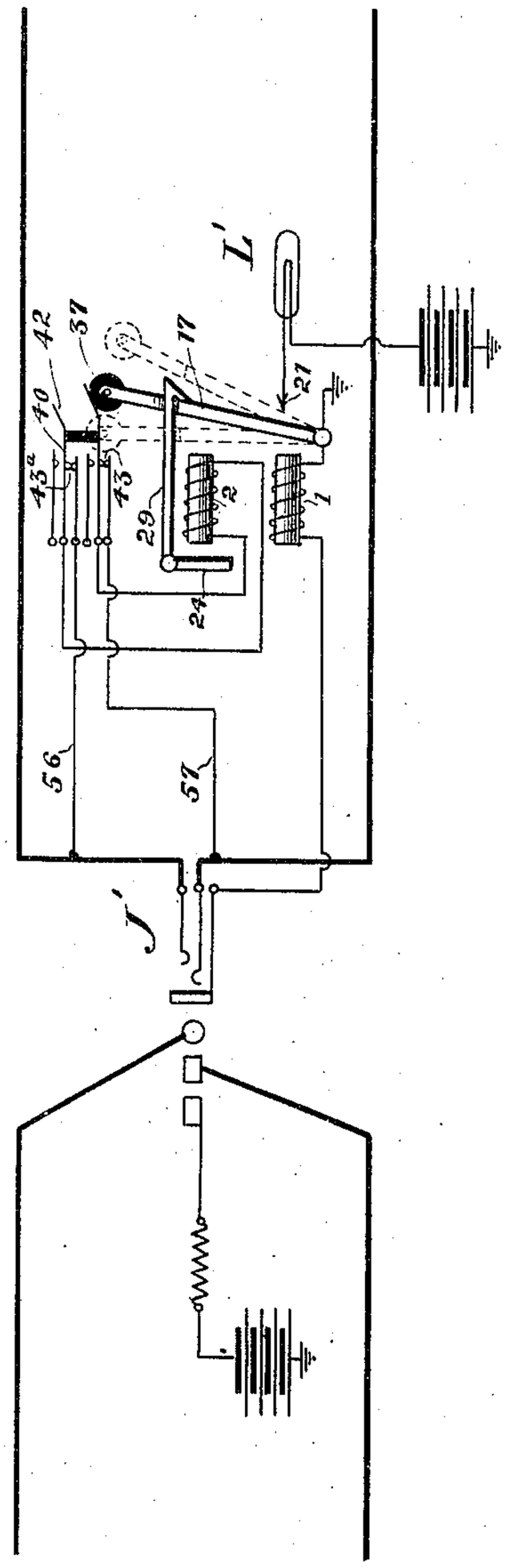
3 SHEETS—SHEET 3.

Fig. 7.



Witnesses

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SELF-RESTORING DROP-RELAY.

No. 900,435. Specification of Letters Patent. Patented Oct. 6, 1908.

Application filed May 29, 1907. Serial No. 376,435.

To all whom it may concern:

Be it known that I, FRANK M. SLOUGH, a citizen of the United States, residing at Elyria, in the county of Lorain and State of Ohio, have invented certain new and useful Improvements in Self-Restoring Drop-Relays, of which the following is a specification, reference being had therein to the accompanying drawing.

My invention relates to improvements in self-restoring drop relays for use in toll line circuits or for private branch exchange trunk circuits, and it consists in the constructions, combinations and arrangements hereinafter described and claimed.

An object of my invention is to provide a drop relay in which the armature is operated by gravity supplemented by the action of a positive releasing device which operates to force the armature away from the core if it should be retained by residual magnetism and in which the action of the armature itself is made use of to open and close circuits after the manner of the ordinary individual relays.

A further object of my invention is to provide a self-restoring drop relay which combines in one structure the necessary mechanism for operating the various circuits common to private branch exchange work and which does away with the necessity of the more complicated arrangement of relays usually necessary for the advantageous working of the system.

My improved relay is designed to operate the usual lamp signal armature in the ring down trunk. Other circuits making use of the lamp signal in the ring down trunk generally employ three or more relays, one of which requires rather a sensitive adjustment in order to operate. This adjustment has to be made for different lengths of line, as a current which will operate properly through, say 1000 ohms, would be too strong to give positive operation on a short line of only a few ohms resistance. In the latter case the alternating current would tend to vibrate the armature violently and the locking winding would be overpowered so that the armature would be virtually kicked off. It would appear that with any design of alternating current relay which must be located in its operative position, special means must be provided for a variation in the line resistance and the locking winding, in order to be positive, must be compensating in character.

My improved relay is designed to obviate the objections due to the use of the relays of the ordinary type in that it provides a device in which the making and breaking of the circuits is accomplished in a simple and positive manner and which can be operated in line circuits of varying resistance, thus doing away with the necessity of employing devices requiring sensitive adjustment for the successful operation of the system.

In the accompanying drawings, forming part of this application and in which similar reference symbols indicate corresponding parts in the several views: Figure 1 is a plan view of my improved relay. Fig. 2 is a side elevation. Fig. 3 is an elevational view of the side opposite that shown in Fig. 2. Fig. 4 is an end elevation showing the working parts. Fig. 5 is a diagrammatic view showing the use of my invention in a private branch exchange trunk circuit. Fig. 6 is a diagrammatic view showing a typical arrangement on one end of a main exchange cord circuit. Fig. 7 is a diagrammatic view showing the terminus of a toll line circuit and the arrangement of my improved relay therein, and a portion of an operator's cord circuit.

Referring to the drawings, 1 and 2 indicate electromagnets disposed in parallel arrangement. Extending longitudinally of the electromagnets and immediately above them are the metal frame plates 3 and 4, which are bent at right angles at one end to form downwardly projecting arms 5 and 6. These arms abut against the ends of the electromagnets and are secured to a mounting plate 7, having openings for the passage of the threaded bolts 8 and 9, by the screws 10 and 11. The mounting plate 7 is perforated at other suitable places to provide outlets for the terminals 12 of the magnet coils.

Secured to the forward end of plate 3 by means of screws 13 is a perforated Z-shaped member 14 provided with an upturned flange 15 at its forward lower end. Arms 16 are bent upward from the sides of the member 14 to provide bearings for the armature 17 which is pivoted on said arms at 18 in such a manner that its center of gravity lies forward of its pivot. The armature 17, therefore, tends to

tilt forward and is kept from doing so only when held by the attraction of the core of the electromagnet 1, which projects through the perforations in the Z-shaped member 14 in close proximity to said armature, or by other means hereinafter described.

A plate 19 having an extension 19ª to which a conducting wire may be soldered is secured to the upright flange 15 by means of screws 20 and is suitably insulated therefrom. Carried by the plate 19 is an adjustable contact screw 21 adapted to form an electrical contact with the armature 17 in its tilted position. An L-shaped plate 22 having a laterally extending yoke 23 on one of the arms thereof, is secured to the upper end of the armature for a purpose hereinafter explained.

Adjacent the forward end of the electromagnet 2 is an armature 24 having a lateral extension 25 at its upper end, said extension being provided with downwardly extending slotted arms 26 adapted to pivotally support said armature on pivot pins 27 carried by the plate 4. A retaining screw 28 passing through the armature and underneath the plate 4 prevents displacement of the armature while permitting its ready removal without interfering with the free pivotal operation of the armature and its lateral extension 25. It will be noted that the armature 24 and its lateral extension 25 form a bell crank lever.

A retaining hook 29 is pivoted on a pintle 30 held on the upper arms 31 of a slotted plate 32 which is adjustably secured to the plate 4 by the screws 33. At one end of the plate 32 there is provided an upturned flange having an extension 34 adapted to limit the upward movement of the pivoted hook. At its forward end the retaining hook is provided with a lower cam surface 35 and an upper cam surface 36 adapted to engage the lower and upper arms respectively of the yoke 23.

When the magnet 2 is energized the armature 24 is attracted and the lateral extension 25 at the top of the latter, and which forms with it a bell crank lever, lifts the retaining hook allowing the armature 17 to drop against the contact screw 21. It will be noted that owing to the construction of the hook, there is a camming action on the upper arm of the yoke 23 and the armature is forced away from the coil against any tendency of residual magnetism to retain it.

When a circuit is closed through the restoring coil 1 the armature 17 is drawn toward the core and the retaining hook keeps it from dropping back against the contact screw when the current is broken. Moreover, the armature 17 on being drawn toward the magnet acts through the medium of the hook 29 to force the armature 24 away from the magnet 2.

The armature 17 is provided at its top with two downwardly extending slots 37. Journaled in said slots on pins 38 is a pair of cam rollers 39 of insulating material. Disposed above the plate 3 and suitably insulated from one another are the contact springs 40. These contact springs are held in place by means of the screws 41 which extend through the springs and the insulating material and terminate in the plate 3. The central spring, it will be noted, is longer than the other two, and the forward end is curved upwardly, as shown in Fig. 2, to form a cam surface 42. When the armature 17 is attracted toward the magnet 1 the cam rollers 39 engage the cam surface 42 to open the contacts at 43 and 43ª with the lower spring and to close the contacts at 44 and 44ª with the upper spring. It will be noted that the opening and closing of the contacts 44 and 43 are only effected when the armature is in close proximity to the magnet, for it is only when the armature has been fully drawn up that the cam rollers 39 engage the spring to control these contacts. When the coil 1 is deënergized the armature is free to assume an intermediate position, the lower contacts 43 and 43ª are then closed and the upper contacts 44 and 44ª are open.

The utility of my invention is well illustrated in Figs. 5, 6 and 7. Fig. 5 shows my improved relay connected up for private branch exchange work. In this figure is shown the main exchange end of a regular exchange line circuit, the trunk lines, and the private branch exchange end. In the figure, A designates in general the restoring drop relay, the magnet 2 of which is bridged directly across the trunk circuit with the condenser B in series with the same and being connected therewith through the conductor 50, the use of the condenser being to prevent the flow of direct current which would otherwise cause the operation of the line signal at the main exchange end. The three positions of the armature 17 of the restoring coil 2 are readily seen from the figure. The restoring coil 1 is connected with a local battery C and the other terminal of the winding is connected with a contact D on the jack E and adapted to be put into electrical connection with the sleeve side of said jack. The calling lamp L is arranged in the local circuit and is adapted to be operated when the contact 21 is closed, *i. e.*, when the armature 17 has been released by the hook 29. A retardation coil R is connected to the upper contacts 44 and 44ª of the spring contact member 40 for a purpose hereinafter explained. The main exchange end is provided with the usual jack G, the cut-off relay H, the line lamp Y and the line relay X, in circuit with the local battery F.

The trunk end of the cord circuit is shown in Fig. 6 and is typical. It includes the usual plug J, the ringing key K, the con-

densers C′ and C², the battery F, bridged across the tip and sleeve sides of the cord circuit through the windings of the supervisory control relays V and W, jointly controlling the circuit of the supervisory lamp O.

The operation of the above circuits is as follows: The main exchange operator upon receiving a call for the private branch exchange inserts the calling plug J of one of the regular pairs of cords into the multiple jack G of the line extending to the private branch exchange. This line is usually taken as a regular exchange circuit, which is, of course, multipled through the switchboard and it also terminates in one of the operator's positions in the answering jack and line lamp. The operator handles the call in the usual way, by projecting ringing current on the line by pressing the key H. The ringing current then finds a path through the tip side of cord *g*, *t*, 51, the upper contact 43, winding of the magnet 2, condenser B, lower contact 43, 52 and back over the sleeve side of the line to the cord circuit and generator. This releases the drop armature 17, the latter establishing a local battery circuit through the calling lamp L. The private branch exchange operator inserts one of her answering plugs in the jack E, thereby closing the contact D. Current then flows through the restoring coil from the battery C through the winding of the coil 53, D, ground, and back to battery. The magnet in the restoring coil not only restores the armature 17 but draws it up into the position M, shown in the figure. The cam rollers 39 engaging the cam surface 42 of the springs 40 cause the relay contacts 44 and 43 to change position, opening up the connection to the drop winding 1 and substituting in its place a circuit through the retardation coil R. This latter coil serves to provide a path for the main exchange battery current so as to operate the supervisory relay V in the connected cord circuit and which extinguishes the calling supervisory lamp O. Thus the regular sequence of signaling is maintained at the central exchange. The retardation coil R not only serves as a path for the main exchange battery current but is also of high enough impedance to prevent a short circuiting of the voice currents.

It will be noted that when the subscribers are through talking and the private branch exchange operator pulls down the circuit, that the drop relay armature 17 will return to its normal position (its intermediate position) and the relay contacts 43 and 44 will be changed so as to disconnect the retardation coil R and establish the circuit through the drop winding 1 and the condenser B. The current from the main exchange battery will then cease to flow and the cord supervisory relay V will become deënergized, thereby lighting the disconnect lamp O.

The same method of operation is used in putting the calls through in the reverse direction from a private branch exchange and the main exchange subscriber. The private branch exchange operator inserts the calling plug in the jack E of the trunk line, but in this case it is not necessary to ring, as the armature 17 is fully drawn up, thereby working the retardation coil R across the line circuit in the manner already described. This establishes a path for the main exchange battery through the line relay X, thereby lighting the line lamp Y which is in circuit with the local battery F. The main exchange operator responds in the usual way and the presence of the retardation coil R across the trunk line causes the answering supervisory relay to be energized and its associated lamp signal to remain extinguished.

Fig. 7 shows the use of my relay in toll line circuits. With the parts in their position, as shown in this figure, ringing current coming over the toll line would pass by means of the conductor 56, upper contact 43ª, winding of magnet 1, lower contact 43, conductor 57. This would energize the magnet 1, and attract the armature 24, operating the hook 29, and release the armature 17. The local circuit would be complete through the line lamp L by means of the closing of the contact 21. Now when the operator plugs into the toll line jack J′, the current in the third strand flows through the restoring winding of the coil 2, attracting the armature 17 and causing the cam rollers 39 to engage the springs 40 so as to open up the cut off contacts 43 and 43ª thus disconnecting the drop winding 1 from the toll line. The line lamp L′ is thereby extinguished and the toll line is relieved of all bridged coils.

The circuits described above furnish an illustration of some of the uses to which my improved self restoring drop relay can be put. It will be readily seen that my invention provides a relay which is positive in its action, simple in construction and which is calculated to obviate the objections in the use of the more complicated system of relays usually necessary in circuits of this kind.

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

1. In a drop relay, a pair of electromagnets disposed in parallel arrangement, a pair of pivotally mounted armatures at one end thereof, a contact adapted to establish a local circuit through one of said armatures, means actuated by the second armature to drop the first armature against its contact, and contact springs arranged in proximity to said first armature and adapted to be actuated by said first armature when its magnet is energized.

2. In a drop relay, a pair of electromag-

nets, a pair of pivotally mounted armatures therefor, one of said armatures being provided with insulating cam rollers, contact springs arranged in proximity to said cam rollers and adapted to be engaged by said rollers when the armature has been drawn up by its magnet, a contact screw adapted to contact with said armature, and means controlled by the second armature to drop the first armature against its contact, said means acting to normally detain said first armature in inoperative condition.

3. In a drop relay, a pair of electromagnets, a pair of pivotally mounted armatures therefor, one of said armatures having a laterally extending yoke and being provided with cam rollers, contact springs adapted to be engaged by said cam rollers when said armature has been drawn up by its magnet, a pivoted retaining hook adapted to be actuated by the second armature and arranged to engage the arms of said yoke to forcibly release the first armature and drop it against its contact.

4. In a drop relay, a pair of electromagnets, disposed in parallel arrangement, common mounting means for said electromagnets at one end thereof, a separate pivoted armature for each magnet arranged at the other end, one of said armatures being provided with insulating cam rollers, contact springs arranged in proximity to said first armature and adapted to be engaged by said rollers, and means actuated by the second armature for forcibly releasing the first armature.

5. In a magneto relay, a pair of electromagnets, a pair of armatures therefor, one of said armatures having three positions, a signal controlled by said armature when in its lowest position, circuits controlled by said armature when in its highest position, means for normally detaining said armature in its intermediate inoperative position, and means controlled by the second armature to release the first armature and set the signal.

6. In a drop relay, the combination of a mounting plate, a pair of frame plates, a pair of electromagnets disposed in parallel arrangement and secured at one end of said frame plates, a Z-shaped member attached to one frame plate, an armature pivotally mounted on said Z-shaped member and having a longitudinally extending yoke, said armature being provided with cam rollers, contact springs arranged in proximity to said armature and adapted to be engaged by said cam rollers, a second armature having a lateral extension pivotally mounted on the other of said frame plates, a contact screw, a hook mounted on one of said frame plates and arranged to be actuated by said second armature to engage the arms of the yoke on said first armature to forcibly release said armature and to drop it against said contact screw.

7. In a signal system, a main line circuit, a local lamp circuit, a circuit provided with a retardation coil, a drop relay having a line coil normally bridged across said main circuit and adapted to be actuated when said circuit is closed, a pivotally mounted armature for the line coil, a restoring coil, adapted to be connected with said main circuit provided with a pivoted armature adapted to assume three positions, means controlled by the line coil armature for retaining said restoring coil armature in its inoperative position, said restoring coil armature being provided with cam rollers, contact springs arranged in proximity to said cam rollers and adapted to be actuated thereby when the restoring coil is energized to cut off the line coil and to put the retardation coil in circuit, and a contact in the local lamp circuit adapted to be closed when said restoring coil armature has been released by the armature of said line coil.

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

FRANK M. SLOUGH.

Witnesses:
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A. J. ROBERTS.