C. A. SIMPSON.

RELAY.

APPLICATION FILED JUNE 2, 1910.

1,141,982.

Patented June 8, 1915.

2 SHEETS—SHEET 1.

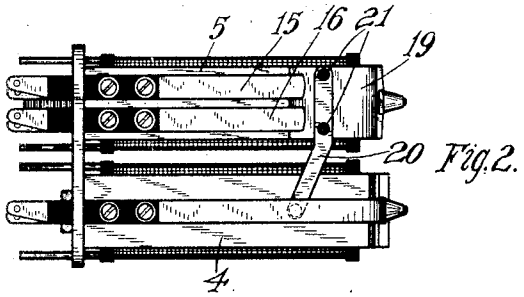


Fig.2.

Fig.1

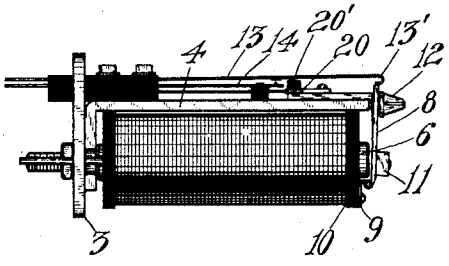


Fig.3.

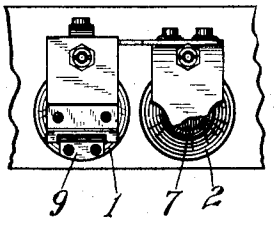


Fig.6.

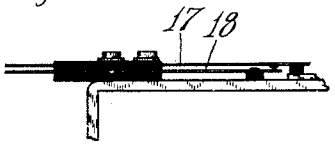


Fig.4.

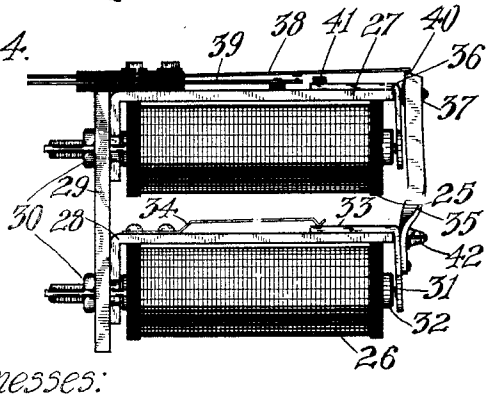
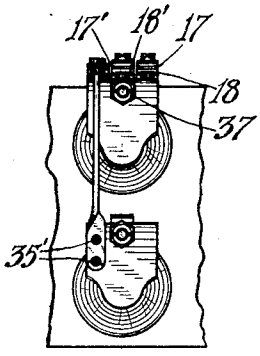


Fig.5.



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Atty.

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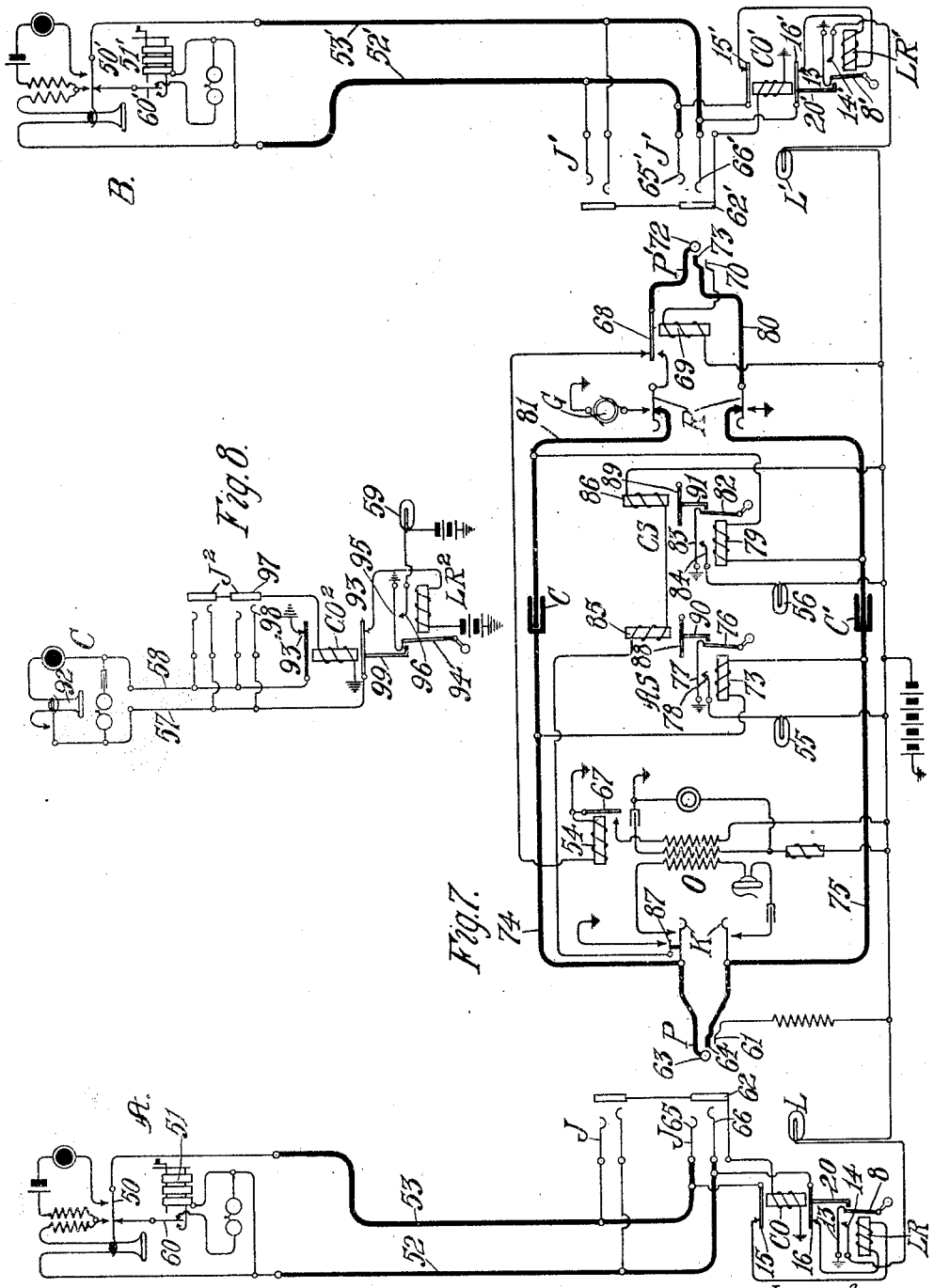

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UNITED STATES PATENT OFFICE.

CHARLES A. SIMPSON, OF CHICAGO, ILLINOIS, ASSIGNOR TO KELLOGG SWITCHBOARD AND SUPPLY COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

RELAY.

1,141,982. Specification of Letters Patent. Patented June 8, 1915.

Application filed June 2, 1910. Serial No. 564,563.

To all whom it may concern:

Be it known that I, CHARLES A. SIMPSON, a citizen of the United States of America, residing in Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Relays, of which the following is a specification.

My invention relates to relays and more particularly to relays used in telephone systems and arranged in pairs, whereby one relay of a pair is actuated to display a signal and thereafter the other relay of the pair is actuated to efface the signal, or if the signal-effacing relay is actuated first, the signal is not displayed even though the signal-displaying relay is thereafter actuated. Where such a pair of relays are used as line and cut-off relays, it is necessary for the line relay which usually controls the display of the signal to operate through the resistance of the line, and I have found the relay of my invention to be very sensitive so as to operate over lines of thirty-four thousand ohms which is especially desirable when used in connection with long lines such as toll lines, while the cut-off relay which controls the effacement of the signal is usually operated over a local circuit.

The object of my invention is to provide such a pair of relays mechanically and electrically coöperating to perform the functions stated above, the said relays being simple of construction, and very efficient in operation.

Referring to the accompanying drawings in which like reference characters refer to like parts, Figure 1 is a side elevation of the relay of my invention; Fig. 2 is a plan view of the structure shown in Fig. 1, and Fig. 3 is an end view of the same; Fig. 4 is a modification of the structure shown in Figs. 1, 2 and 3; Fig. 5 is an end view of the structure of Fig. 4, and Fig. 6 shows the spring combination of the two sets of springs mounted at the right in Fig. 5. Fig. 7 is a local battery telephone system using the relay of my invention; Fig. 8 is a line circuit for a common battery telephone system using the relay of my invention.

Referring now to the relay shown in Figs. 1, 2 and 3, a pair of electromagnets 1 and 2 are shown secured to the mounting plate 3. The pole-pieces 4 and 5 are secured to their respective cores 6 and 7 and mounting plate 3. The armature 8 is pivotally connected to the bracket 9 below the core 6, the said bracket being screwed to the spool head 10 of the electromagnet 1. The block 11 is fastened to the armature 8, the said block 11 being adapted to retract the armature 8 by gravity. The adjustable stop-nut 12 limits the retraction of the armature 8. Secured to the top of the pole piece 4 are the contact springs 13 and 14, the spring 13 resting under tension and engaging the upper free edge of the armature 8 by means of the catch 13′. Secured to the pole piece 5 are two sets of contact springs 15 and 16, the said sets each comprising two springs 17 and 18 as shown in Fig. 6. The said contacts which are normally closed are adapted to be opened, the upper springs being moved to their alternate position by the armature 19, the said armature 19 being adapted to rock on the upper edge of the pole piece 5. The arm 20 is secured to the armature 19 by the screws 21, the said member extending below the contact spring 13 and being adapted to lift the said spring 13 to return said spring to its normal position after the armature 8 has been attracted.

The operation of the relay shown in Figs. 1, 2 and 3 is as follows: The armature 8 is attracted, allowing the spring 13 to move to its alternate position, contacting with the spring 14, the catch 13′ dropping and engaging the armature 8 to hold it in its attracted position. To again open the contacts of the springs 13 and 14 the armature 19 is attracted, moving the arm 20 upward, the buffer 20′ thereby engaging the spring 13, opening the contacts of springs 13 and 14 and lifting the catch 13′ free of the upper edge of the armature 8, allowing the said armature 8 to retract. When the armature 19 is now retracted the arm 20 moves downward, allowing the catch 13′ of the spring 13 to again engage the upper edge of the armature 8, as shown in Fig. 1. The attraction of the said armature 19 also moves the contact springs 15 and 16 to their alternate position holding them thus while the said armature 19 remains attracted.

It is obvious that if the armature 19 is first actuated, the arm 20 moves upward, engaging the contact spring 13 and holding the said spring 13 in its normal position

even though the armature 8 be attracted while the said armature 19 remains attracted.

Referring now to the relay shown in Figs. 4, 5 and 6, the electromagnets 25 and 26 with their respective pole-pieces 27 and 28 are secured to the mounting plate 29 by the nuts 30. The armature 31 rocks at the upper edge of the pole piece 28 and when attracted to the core 32, moves the extension 33 upward against the tension of the spring 34. The said armature 31 is held close to the pole piece 28 by the adjustable nut 42. The arm 35 is secured to the armature 31 by means of the screws 35', the part of the arm 35 extending above the rocking edge, moving toward the right when the armature 31 is attracted. The armature 36 rocks on the upper edge of the pole piece 27 in a manner similar to that of armatures 31 and 19, the said armature 36 being held close to the pole piece 27 by the adjustable nut 37. Mounted on top of the pole piece 27 are the springs 17, 18 and 17', 18', these two sets being similar to the springs shown in Fig. 6. The contact springs 38 and 39 are also mounted on the pole piece 27, the spring 38 normally resting under tension in engagement with the catch end 40 of the arm 35, the said spring 38 being held in its normal position by this engagement.

The operation of the relay of Figs. 4, 5 and 6 is as follows: The armature 31 is attracted by the electromagnet 26, moving the catch 40 of the arm 35 out of engagement with the contact spring 38, allowing the said spring 38 to move to its alternate position to contact with the spring 39, and locking the armature 31 in its attracted position. To restore the contact spring 38, the electromagnet 25 is now energized, attracting the armature 36 and the buffer 41 engages the contact spring 38, moving it upward to its normal position out of engagement with the contact spring 39. This allows the armature 31 to retract, the catch 40 thereby again moving to a point below the contact spring 38 and when the armature 36 retracts the said catch 40 holds the said spring 38 in its normal position, out of engagement with the contact spring 39, as shown in Fig. 4. By the attraction of the armature 36, the contact springs 17 and 17' are moved to their alternate position, being held out of engagement with their respective contact springs 18 and 18' until the armature 36 is again retracted. Should the armature 36 be first attracted, the spring 38 will be held in its normal position, while the said armature 36 remains attracted, so that even if the armature 31 is attracted while the armature 36 is held attracted, the contact springs 38 and 39 will fail to close.

Referring now to Fig. 7, A is a well-known form of local battery subscriber's telephone set having a switch-hook 50, the hand-generator 51 and customary receiver, induction coil, transmitter, local battery and call bell. The said telephone at A is connected to the exchange by the line limbs 52 and 53 terminating in the spring jacks J. Associated with the line of subscriber at A is the magnet LR, magnet CO and the lamp signal L, the magnets being a diagrammatic representation of the relay of my invention. The subscriber's telephone at B includes the same apparatus as that shown in connection with the subscriber at A, being connected in the exchange to apparatus similar to that shown in connection with the line of the subscriber at A and having the same reference characters, but having the exponent "'" thereafter. The cord circuit of Fig. 7 includes the usual answering plug P, calling plug P', and the operator's set O with the test relay 54. The answering supervisory lamp 55 and calling supervisory lamp 56 are respectively controlled by the relays AS and CS, each of the said relays including two electromagnets, mechanically cooperating as shown in the relay of Figs. 1, 2 and 3 or the relays shown in Figs. 4, 5 and 6. Fig. 8 which is a common battery telephone line, includes the subscriber's station C connected to the jacks J^2 by the line limbs 57 and 58. Associated with the said line is the line lamp 59, the magnet LR^2 and CO^2, the said magnets being a diagrammatic representation of the relay of Figs. 1, 2, and 3 or of Figs. 4, 5 and 6.

Referring now to Fig. 7, the operation of the system shown therein is as follows: The subscriber at A operates the hand generator 51, closing a circuit through the relay LR from one pole of the said generator, through alternate contact 60, normal contact of switch-hook 50, line limb 53, normal contact 15 of relay CO, the winding of relay LR, normal contact 16, line limb 52 to the other pole of the said hand generator 51. This circuit energizes magnet LR attracting the armature 8 and thereby allowing the spring 13 to contact with the spring 14, closing the circuit from ground through contacts 13, 14, line lamp L to battery, lighting the said lamp and attracting the attention of the operator. The armature 8 is now held in its attracted position due to the spring 13 dropping down and engaging the said armature 8. After operating the hand generator the subscriber at A removes his receiver from its switch-hook which moves upward closing the upper contacts and the switch-hook. The operator now inserts the plug P in the jack J closing a circuit from battery through plug sleeve 61, jack sleeve 62, the winding of relay CO to ground, energizing the said relay and opening the contacts 15 and 16, also lifting the arm 20 which engages the spring 13 and lifting the said

spring out of contact with the spring 14 and effacing the line lamp L. The spring 13 in rising is disengaged from the armature 8 which retracts. The contacts 63 and 64 of the plug P engage respectively the contacts 65 and 66 of the jack J extending the conductors of the cord circuit to the telephone of the calling subscriber at A. The operator now momentarily closes the contacts of the listening key K to ascertain the number of the subscriber desired.

Assuming that the subscriber at A desires connection with the subscriber at B, the operator touches the tip 72 of the plug P′ to the sleeve 62′ of one of the multiple jacks J′ and if the line of the telephone B is busy, there will be a potential above that of ground, on the said sleeve 62′ and a circuit will be traced from ground at the said sleeve, through tip 72, normal contact 68, the winding of relay 54 to ground, energizing the said relay and closing a circuit through the tertiary winding of the operator's induction coil from ground at alternate contact 67, through the said winding to battery. This causes a click in the operator's receiver and notifies the operator that the line of the desired subscriber is busy. Assuming that the said called for line is idle, there will be no potential above that of ground on the sleeve 62′ and therefore the relay 54 will fail to energize when the tip 72 of the plug P′ is touched against the sleeve 62′ of the jack J′. The operator now inserts the plug P′ into a jack J′ energizing the relays 69 and CO′ over a path traced from battery through the winding of the said relay 69, the plug sleeve 70, jack sleeve 62′, the winding of magnet CO′ to ground, energizing said relays 69 and CO′. The energization of the magnet CO′ disconnects the magnet LR′ from the line of the called subscriber at B and the energization of the relay 69 disconnects the test relay 54 from the tip 72 of the plug P′ and connecting the said tip 72 to the upper talking strand of the cord circuit and extending the connection from the subscriber at A to the subscriber at B. The operator now closes the contacts of the ringing key R closing a circuit from one pole of the alternating generator G, alternate contact 68, plug tip contact 72, jack contact 65′, line limb 52′, the call bell of the subscriber at B, normal contact 60′, switch hook 50′, line limb 53′, jack contact 66′, plug contact 73, to ground at the ringing key R. The subscriber at B in response to the said signal, removes his receiver from its switch hook, disconnecting the bell and hand generator from the line and closing the upper contacts of the switch hook, thereby closing the circuit through the transmitter, battery and primary winding of the induction coil and closing the line limbs through the secondary of the induction coil. The subscribers at A and B are now connected in a conversational circuit, the said circuit being traced over the heavily marked conductors and through the condensers C and C′. The subscribers having finished their conversation, now replace their receivers upon their respective switch hooks, and thereafter operate the hand generators for disconnection. The operation of the hand generator 51 of the subscriber at A closes a circuit of alternating current through the coil 73 of the cord circuit traced over the following path: from one pole of the hand generator 51, alternate contact 60, normal contact of the switch-hook 50, line limb 53, contact 65, 63, conductor 74, through the winding of the said magnet 73, conductor 75, contact 64, 66, line limb 52 to the other pole of the generator 51. This current energizes the magnet 73 attracting the armature 76, and allowing the spring 77 to move to its alternate position and contact with the spring 78. This closes a circuit through the supervisory lamp signal 55 from ground through contact 77, 78, the said lamp signal 55 to battery, lighting the said lamp 55. The armature 76 is held in its attracted position due to the spring 77 moving downward and engaging the said armature.

The operation of the hand generator 51′ of the called subscriber at B actuates the magnet 79 by current traced over the following path: from one pole of the alternating generator 51′, alternate contact 60′, normal contact of the switch-hook 50′, line limb 53′, contact 66′, 73, conductor 80, through the winding of the said magnet 79, conductor 81, alternate contact 68, contact 72, 65′, line limb 52′, to the other pole of the generator 51′. This current energizes the magnet 79 attracting the armature 82 and allowing the spring 83 to move downward to its alternate position, contacting with the spring 84 and closing a circuit through the supervisory lamp signal 56 from ground through contact 83, 84, the said supervisory lamp signal 56 to battery, lighting the said lamp. The armature 82 is held in its attracted position by the engagement of the spring 83, in a manner similar to that of the armature 76 of magnet 73. The two lamps 55 and 56 now being lighted, the operator is notified that disconnection is desired. The operator now actuates the key K to efface the two lamp signals 55 and 56 by closing a series circuit through the magnets 85 and 86 from ground through contact 87, through the windings of the said magnets 85 and 86 to battery, energizing the said magnets and attracting their respective armatures 88 and 89. The attraction of the armature 88 moves the arm 90 to engage the spring 77 which is in its alternate position, and continuing in its upward movement, lifts the spring 77

out of engagement with the armature 76, opening the circuit through the lamp 55 at contact 77, 78, effacing the said lamp signal and also allowing the armature 76 to retract. The energization of the magnet 86 attracts the armature 89, thereby moving the arm 91 into engagement with the spring 83 and the armature 89 continuing upward, the said spring 83 is moved out of contact with the spring 84, opening the circuit for the lamp 56 and effacing the said lamp signal. The upward movement of the spring 83 also allows the armature 82 to retract. The operator now restores the key K, opening the contact 87, thereby opening the circuit through the magnets 85 and 86 and the said magnets are now deënergized, retracting their armatures 88 and 89, allowing the springs 77 and 83 to again rest upon the upper edge of their respective armatures 76 and 82. The relays AS and CS are now at normal and the lamp signals 55 and 56 are effaced. The operator now withdraws the plug P from the jack J, opening the circuit through the relay CO, deënergizing the said relay which restores its contacts 15 and 16 to normal and allowing the spring 13 to rest in engagement with the armature 8. The magnets LR and CO are now at normal. The plug P′ is now withdrawn opening the circuit for the relays 69 and CO′, deënergizing the said relays and the relay 69 retracting its armature 68. The deënergization of the relay CO′ restores the contacts 15′ and 16′ to their normal position, also allowing the spring 13′ to again rest in engagement with the upper edge of the armature 8′. The two subscribers' lines and the cord circuit having now been restored to normal, are available for another connection.

Referring now to Fig. 8, a well-known form of common battery telephone line is here illustrated, but using the relay of my invention in place of the ordinary cut-off and line relays. While I have shown no cord circuit for connection with the line circuit of Fig. 8, the well-known Kellogg four-relay common battery cord circuit is adapted to be used in connection with the said line.

The operation of the system of Fig. 8 is as follows: The subscriber at C removes the receiver 92 from its switch-hook, closing a circuit through the magnet LR^2 from battery, through the winding of the said magnet, normal contact 93, line limb 57, the telephone of subscriber at C, line limb 58, normal contact 93′ to ground, energizing the said magnet LR^2, and attracting the armature 94. The attraction of the said armature 94 allows the spring 95 to move to its alternate position, contacting with the spring 96 and closing a circuit through the line lamp 59 from ground through contact 95, 96 and the said lamp signal 59 to battery, lighting the said lamp. The operator responds to the display of the said signal by inserting a plug of the cord circuit referred to, into one of the jacks J^2, the sleeve of the plug contacting with the sleeve 97, and spring 98 of the jack J^2, closing a circuit through the magnet CO^2 from battery at the sleeve contact of the plug, through sleeve contact 97 of jack J^2, the winding of the said magnet CO^2, energizing the said magnet, opening the contacts 94, 93 and disconnecting the magnet LR^2 from the line of the subscriber at C. The energization of the said magnet CO^2 moves the arm 99 upward, engaging the spring 95 and restoring it to its normal position, opening the circuit for the lamp 59, and also allowing the armature 94 to retract. The operator now ascertains the wants of the calling subscriber at C and should a connection be desired with another subscriber, the operator completes the connection in a well-known manner. After the subscriber at C has finished conversation, a disconnect signal is received by the operator in a well-known manner and the operator withdraws the answering plug of the cord circuit from the jack J^2 opening the circuit for the relay CO^2. The said relay is now deënergized restoring the contacts 93, 94 to normal and the arm 99 moving downward allows the spring 95 to again rest in engagement with the upper edge of the armature 94. The line of the subscriber at C with its associated magnets CO^2 and LR^2 is now restored to normal and is available for another connection.

It is to be understood that I do not wish to be unduly limited to the particular structure of the relays shown or to any particular application of the relays or circuit arrangement, many changes being possible without departing from the spirit or scope of my invention.

What I claim as new and desire to secure by Letters Patent is:

1. In a pair of electromagnets, the combination with a contact spring, of a normally retracted armature for one of the magnets, means operated by the other magnet to move and lock said contact to an alternate position, and means actuated by said armature to unlock and restore said contact to a normal position, substantially as described.

2. In a pair of electromagnets, the combination with a contact spring, of an armature and contact springs for one of the magnets, means operated by the other magnet to move the first said contact to an alternate position, and means actuated by said armature to restore said contact to a normal position and move the other contacts to an alternate position, substantially as described.

3. In a pair of electromagnets, the com-

bination with a contact, of means adapted to be actuated by one of the magnets, whereby said contact is moved to and locked in an alternate position, and means controlled by the other magnet to prevent said first magnet from moving said contact to an alternate position if said magnet has not previously operated or to unlock and restore said contact if said first magnet has already operated, substantially as described.

4. In a pair of electromagnets, the combination with a contact spring, of a catch for one of said magnets adapted to hold said spring in a normal position, an armature for the other magnet having a member secured thereto, means controlled by said first magnet to operate said catch, whereby said spring is moved to an alternate position, and means controlled by said second magnet to operate its armature, whereby said member moves said spring to its normal position.

5. In a pair of electromagnets, the combination with a contact spring, of a catch for holding said spring in a normal position, means for operating said catch by one of said magnets whereby said spring is adapted to move to an alternate position, and means operated by the other magnet to prevent said spring from moving to an alternate position when said catch is actuated.

6. In a relay, the combination with a pair of electromagnets, an armature for one of said magnets, a contact spring normally engaging said armature, means whereby the actuation of said armature will lock said spring and armature in an alternate position, and means controlled by the other magnet for restoring said spring to normal to unlock said armature to permit its restoration.

7. In a relay, the combination with an electromagnet, of an armature for said magnet, a contact spring engaging said armature, said spring being held in its normal position by said engagement, means whereby when said armature is attracted said spring moves to and is locked in an alternate position, a second electromagnet and armature therefor having a member secured thereto for engaging said spring to unlock it when said second armature is attracted.

8. A relay comprising a pair of electromagnets, an armature for one of said magnets pivoted below the core of said magnet, a contact spring mounted parallel to and on the opposite side of the core and engaging a free edge of said armature, said spring being adapted to move to an alternate position when said armature is attracted and lock said armature in said attracted position, an armature and contact springs for restoring it on the other magnet, a member extending from said second armature, the said member engaging said first contact spring to restore same when the said second armature is attracted.

9. In a device of the character described, the combination with a pair of electromagnets, of normally retracted armatures for said magnets, a contact spring, a device operated by one of said armatures to permit said contact spring to move and lock itself and the armature in a definite position, and means actuated by the other armature to unlock and restore said contact to its first position whereby said first armature is restored.

Signed by me at Chicago, county of Cook, and State of Illinois, in the presence of two witnesses.

CHARLES A. SIMPSON.

Witnesses:
GEORGE E. MUELLER,
MARJORIE E. GRIER.