Aug. 20, 1929. F. H. GRAHAM 1,724,924

TELEPHONE SYSTEM

Filed March 26, 1926

Fig.1.

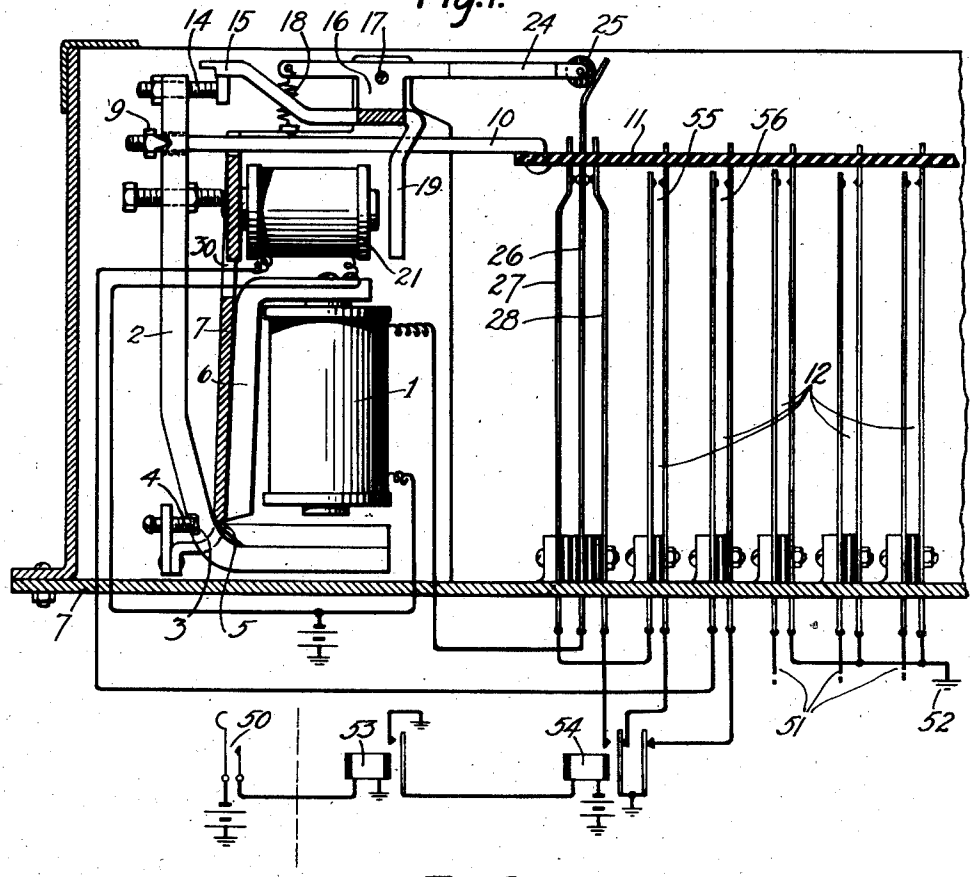
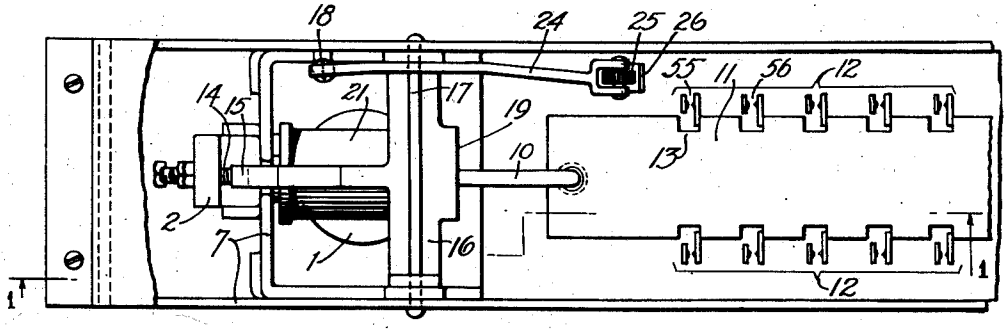


Fig.2.



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UNITED STATES PATENT OFFICE.

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TELEPHONE SYSTEM.

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This invention relates to telephone systems and apparatus and more particularly to improvements in mechanically locking relays and associated circuit arrangements.

Multi-contact relays and similar devices for actuating a plurality of contacts simultaneously are well known in the art. Such devices are commonly used for making a plurality of telephone circuits busy and in many instances this busy condition is controlled from a distance. For example it is often desirable to make the lines terminating in automatic switches busy by means controlled over a line incoming from a manual exchange. That is, by operating a key in the manual exchange a single application of current over a line leading to an automatic exchange is all that is required to control multi-contact devices to apply a ground potential on the busy terminals of a plurality of lines terminating in automatic switching devices at said automatic exchange.

The multi-contact relay and circuit arrangement that form the subject matter of this invention may be used for the above mentioned purposes, and it is an object of this invention to provide a relay of this type that is particularly efficient in all its functions, that is, in its actuation, in the maintenance of its actuated condition and in its release.

Another object of the invention is to provide a multi-contact relay and a circuit arrangement therefor whereby considerable saving in operating current is effected. That is, the relay and its circuit are so arranged that the actuating current is only applied for a short interval to cause the relay to become mechanically locked and again applied for a short interval when it is decided to cause its release.

To attain these and other objects of the invention there is provided in accordance with one feature thereof a mechanically locking multi-contact relay having a coil or magnet structure for the actuation of a plurality of contacts; a locking device therefor that holds the contacts actuated and operates other contacts to open the energized circuit for this coil to save the operating current during the period of actuated condition of the relay; a release coil or magnet operating on the locking device, and a circuit arrangement for these magnets including a relay whereby the operation and release of the multi-contact relays may be obtained. The operation is obtained by the temporary operation of the contact actuating magnet which is then locked in its operated position by the locking device and the release is obtained by again temporarily operating the contact actuating magnet and by operating the release magnet. The release of the multi-contact relay is thereby made comparatively easy as the second operation of the contact actuating magnet permits the locking device to be lifted out of its locking position under the influence of the release magnet without interference.

Another feature of the invention is the provision in the circuit arrangement of a series of contact springs under control of the multi-contact relay itself whereby the above noted sequence of operations is always performed with the same accuracy and speed.

The invention is illustrated in the accompanying drawings in which Fig. 1 shows a side view of a mechanically locking multi-contact relay and an associated circuit arrangement embodying the features of this invention. This figure shows certain portions of the relay in section to bring out the detail construction thereof. Fig. 2 shows a top or plan view of the multi-contact relay shown in Fig. 1 to illustrate the relative proportions and positions of various parts thereof and particularly the positions of the locking device and the multi-contact springs.

Referring now to the drawing more in detail, a description will be made of the construction of the multi-contact relay shown followed by a description of the sequence of operations under control of the circuit arrangement actuated from a distance. It is to be understood that the particular structure of this mechanically locking multi-contact relay and the accompanying circuit arrangement shown are merely illustrative of

the invention and that any other similar structures and circuit arrangements may be employed without departing from the spirit thereof.

The relay consists primarily of a contact actuating coil or magnet 1 having an armature 2 movably mounted at 3 between the end of the adjustable screw 4 and the sharp edge 5 of the frame 7 to which the magnet 1 is secured through the pole piece 6. To this armature 2 is movably secured, by means of an adjustable screw 9 resting in a slot in the upper end of the armature, a link member 10, the opposite end of which is linked to a contact actuating plate 11 of insulating material. This plate controls a plurality of pairs of contact springs 12. One spring of each pair rests in a corresponding slot 13 in the plate so that when the armature is moved by the energization of the magnet, by being attracted at its lower end to the core of the coil, the upper end of the armature will move the plate 11 in a longitudinal direction towards the left to cause a contact to be made between the springs of each pair.

Attached to the extreme upper end of the armature is an adjustable screw 14 of non-magnetic material and having a flat round head cooperating with one end or arm 15 of the locking and release lever, 16. This lever is pivoted at 17 and arranged so that the end 15 is normally pressed against the upper surface of the head of screw 14 by means of a coiled spring 18, secured at one end to a projection on the lever 16 and at the other end to the frame 7. This lever 16 is also provided with an armature portion 19 extending in a substantially vertical direction to cooperate electro-magnetically with one end of the core of release magnet 21. This magnet is mounted on the frame 7 by having the opposite end of its core secured to the frame. The third portion of arm 24 of the lever 16 is provided at its end with a member 25 of insulating material cooperating with the contact spring 26 which normally makes contact with springs 27 and 28. The cooperation of this arm 24 and member 25 with spring 26 is such that when the member 25 is moved downward from the position shown in the drawing, spring 26 is separated from contact with spring 27 and when the roller is moved upward from its normal position, spring 26 is separated from contact with spring 28. The cooperation between the armature 2 and the lever 16 is such that when the armature 2 is moved by the energization of magnet 1, the arm 15 is moved downwardly off the head of the screw 14 due to the tension of spring 18, while the arm 24 and roller 25 are moved upwardly so that the contact between springs 26 and 28 is opened. The cut-in portion of arm 15 will therefore now rest or butt against the top of the head of the screw 14 and with the arm 15 in this position the armature 2 is prevented from returning to normal position and locked in the actuated position independent of the fact that magnet 1 becomes deenergized at this time as will be hereinafter more fully described. To release the armature 2, the magnet 21 may be energized to attract its armature 19 and thus cause the arm 15 to be moved upwardly away from the top of the head of screw 14 and permit the armature 2 to return to normal position.

It will be noted that the part of the frame-work 7 to which the two magnets 1 and 21 are secured is so constructed as to prevent a direct path for electromagnetic lines between these two magnets. That is, a portion of the frame-work 7 between the two magnets is cut away as shown at 30. The contact springs 26, 27 and 28 and the pairs of contact springs 12 may be secured at the base of the frame 7 as shown and suitably insulated from each other in any manner well known in the art.

A description will now be made of the functioning of the multi-contact relay and its associated circuit arrangement when employed, for example, in a telephone system where the relay is controlled from a distant exchange to apply ground potential to a plurality of busy test leads. It may be assumed that the key 50 is located at a manual exchange and the remainder of the apparatus and circuits shown in Fig. 1 are located at an automatic exchange. It may also be assumed that the conductors 51 and others (not shown) connected to spring contacts such as 12 are associated with the busy test terminals of automatic switches. Consequently, when the spring contacts 12 are closed as will hereinafter be described, ground at 52 will be applied to these terminals so that the corresponding lines will test busy when attempts are made to establish connections therewith as is well known in the art.

Therefore, to establish these busy conditions, key 50 may be depressed and held operated as long as it is desired to maintain the busy condition. On the operation of key 50, an obvious circuit is closed for the operation of relay 53 and on the operation of this relay, an obvious local circuit is closed for the operation of relay 54. This latter relay, in operating, closes an energizing circuit for magnet 1 as follows: battery, winding of magnet 1, spring contacts 26 and 28, inner armature and front contact of relay 54 to ground. Magnet 1 in operating attracts its armature 2 and thus causes the contact operating plate 11 to be moved towards the left to close a contact between the individual springs of each pair of spring contacts 12

for the purpose hereinbefore described. The armature 2 also in operating moves the adjusting screw 14 from under the end of arm 15 of lever 16 so that the cut-in portion of this arm will now butt against the head of the screw 14 and thus lock the armature 2 in the operated position. The lever 16 in moving in the direction indicated under tension of spring 18 will cause the arm 24 with its member 25 to be moved upward and thus cause the contact between the springs 26 and 28 to be opened. The relative strength and tension of springs 26 and 27 are such that spring 26 moves towards the left against the tension of spring 27. The magnet 1 is thereby deenergized, although armature 2 will be maintained in operated position and hold the contacts 12 actuated as long as key 50 is maintained depressed. It will be noted therefore that the only relays that are operated during the maintaining of the busy condition on the conductors 51 will be relays 53 and 54. The energy consumption for these relays is small as compared with the energy consumption by magnet 1 and consequently a considerable saving is made by locking the multi-contact relay mechanically and maintaining the magnet 1 deenergized during the time it is desired to continue the busy condition.

When it is decided to discontinue the busy condition key 50 is released. The release of this key causes the release of relays 53 and 54. On the release of relay 54 it will be noted that a circuit will be completed for the reenergization of magnet 1 as follows: battery, winding of magnet 1, spring contacts 26 and 27, contacts 55 of the spring contacts 12, inner armature and back contact of relay 54 to ground. Another circuit is also closed through the release of relay 54 for the energization of release magnet 21 as follows: battery, winding of release magnet 21, contacts 56 of the spring contacts 12, outer armature and back contact of relay 54 to ground. The operation of magnet 1 causes the armature 2 to be operated to a slight degree so that the head of screw 14 will not press against the end of arm 15. Consequently, the energization of release magnet 21 in attracting its armature 19 will be free to lift the arm 15 from in front of the head of screw 14 without interference from the armature 2. In other words, the energization of magnet 1 will assist in the proper release of the mechanically locking relay by the release magnet 21. The release magnet 21 in attracting armature 19 also causes arm 24 and member 25 to be moved downward. In doing this, the contact between spring contacts 26 and 27 is opened and the energizing circuit through these contacts for magnet 1 is therefore now opened so that the magnet 1 will release and cause the return of the spring contacts 12 to normal condition and consequently discontinue the busy condition established through the conductors 51. Contact springs 55 and 56 are so arranged when opened through the return of the contact operating plate 11 to normal position that the connection through contacts 55 is opened before the connection through contacts 56. Consequently the magnet 1 cannot be reenergized and accidently locked by the lever 16 on the release of release magnet 21.

What is claimed is:

1. In a multi-contact operating system, a plurality of contacts, a single wound relay for actuating said contacts, means for actuating said relay, mechanically operating means for locking said relay in actuated position and for disabling the actuating means in response to the actuation of the relay, means for restoring the relay to normal position to release the contacts comprising means for temporarily actuating the relay to free the locking means from control by the relay, and means for disabling the locking means.

2. A multi-contact control device comprising a plurality of contacts, a single wound relay for actuating said contacts, means for actuating said relay, means controlled by the actuation of said relay for automatically locking the relay in actuated position and for disabling the relay actuating means, and means including a control relay for temporarily actuating the first mentioned relay to free the automatic locking means from control by said relay and for actuating a second single wound relay to disable the locking means.

3. In a multi-contact operating system, a plurality of contacts, a magnet for operating said contacts, a separate release magnet therefor energizing circuits for said magnets, means responsive to the operation of said first magnet through an energizing circuit therefor for locking said magnet in operated position and to open said energizing circuit and to prepare a second energizing circuit therefor and to prepare an energizing circuit for the release magnet, means responsive to the actuation of said first magnet through the second energizing circuit therefor and the actuation of said release magnet through the energizing circuit therefor for opening the second energizing circuit for the first magnet, and means responsive to the release of the first magnet for releasing the plurality of contacts actuated by the original energization of said magnet and for disabling the energizing circuit for the release magnet.

4. In a multi-contact operating system, a plurality of contacts, a magnet for operating said contacts, a release magnet therefor, energizing circuits for said magnets, a relay for controlling said energizing circuits, means responsive to the operation of said re-

lay for closing an energizing circuit for said first magnet, means responsive to the actuation of said first magnet for automatically locking said magnet in actuated position and partially preparing energizing circuits for said two magnets, and means responsive to the release of said relay for completing said energizing circuits to actuate the first magnet to free the locking means from control by said first magnet and for actuating the release magnet to control the locking means to cause the energizing circuits for said magnets to open.

5. In a multi-contact operating system, a plurality of contacts, a magnet for actuating said contacts, a magnet for releasing said contacts, energizing circuits for both of said magnets, a relay for controlling said energizing circuits, means including said control relay for closing the energizing circuit for said actuating magnet, mechanically operated means responsive to the operation of said actuating magnet for locking said magnet in operative position for disabling said energizing circuit and for partially preparing an energizing circuit for said release magnet, and means responsive to the release of said control relay for completing the energizing circuit to actuate said release magnet to restore the contacts to a non-operative position.

6. In a multi-contact operating system, a plurality of contacts, a magnet for operating said contacts, a release magnet therefor, energizing circuits for said magnets, a relay for controlling both of said energizing circuits, means responsive to the operation of said relay for closing the energizing circuit for said first magnet, means controlled by the actuation of said first magnet for automatically locking said magnet in actuated position for disabling the actuating means and for partially preparing the energizing circuit for said release magnet, and means including said relay for temporarily actuating said first magnet to free the automatic locking means from control by said first magnet and for completing the energizing circuit for said release magnet to restore the contacts to a non-operative position.

In witness whereof, I hereunto subscribe my name this 25th day of March, A. D. 1926.

FRANK H. GRAHAM.