W. W. DEAN.

MAGNETIC DEVICE FOR TELEPHONE SYSTEMS.

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917,017. Patented Apr. 6, 1909.

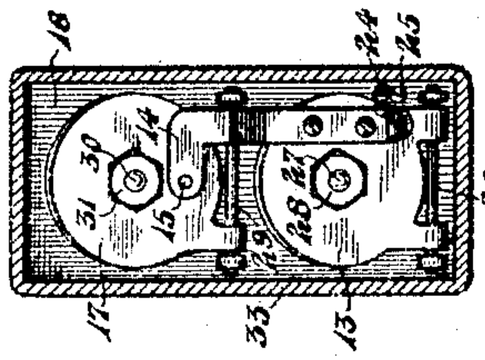

Fig. 3.

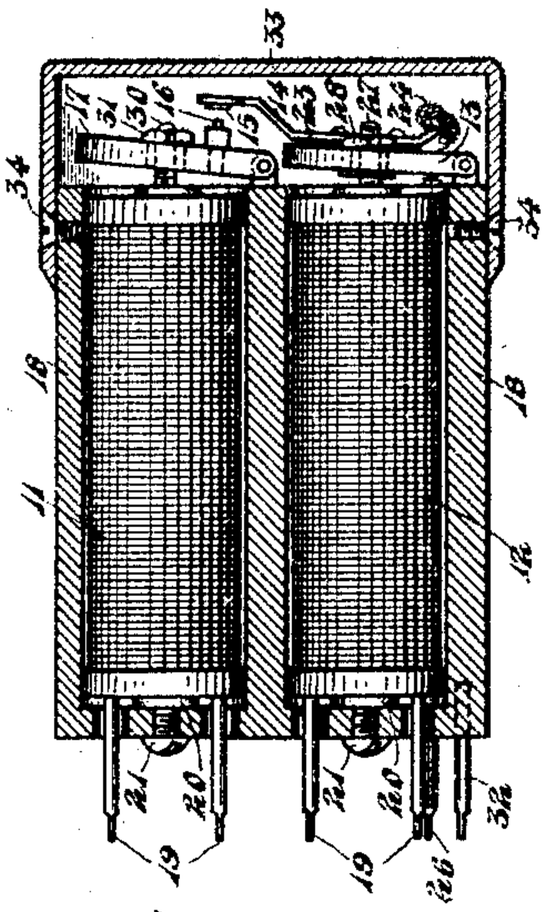

Fig. 2.

Fig. 1.

Witnesses.

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UNITED STATES PATENT OFFICE.

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MAGNETIC DEVICE FOR TELEPHONE SYSTEMS.

No. 917,017. Specification of Letters Patent. Patented April 6, 1909.

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To all whom it may concern:

Be it known that I, WILLIAM W. DEAN, a citizen of the United States of America, and resident of Chicago, in the county of Cook and State of Illinois, have invented a new and useful Improvement in Magnetic Devices for Telephone Systems, of which the following is a specification.

My invention relates to supervisory apparatus for telephone lines.

It has heretofore been common, in connection with supervisory systems for telephone lines, particularly in such systems as required only two strands in the cord circuit, to provide a pair of relays for each end of the cord circuit, one of said relays being adapted to normally open the circuit of the supervisory signal to prevent the same from lighting when the cord circuits are not in use and to close the circuit of said signal when the corresponding plug is connected with the subscriber's line. The second relay is ordinarily arranged to open the circuit of the supervisory signal whenever current is flowing over the telephone line so that said signal is lighted only during the time that the plug is connected with the telephone line and the subscriber's telephone is not in use. The provision of a pair of relays of this type requires a set of contacts for each relay, as well as the individual relays themselves. Such contacts are made of platinum, which is expensive, and each set of contacts is liable to get out of order through the collection of dust or through the constant sparking that occurs at them.

The object of my present invention is to reduce not only the number of the individual apparatuses but to reduce the number of contacts required for each set of relays or magnets, and more particularly to reduce the number of contacts to only one set. This is accomplished in my present invention by including the magnets of the heretofore separate relays in a single integral structure and to provide a single set of contacts for the armatures of said magnets, whereby when the one magnet is energized a circuit is completed through the set of contacts and when the other magnet is energized the said contacts are opened to thus open the said circuit. Under normal conditions also when both magnets are deënergized, the said set of contacts is open. This arrangement results in a considerable saving in apparatus and contacts with a consequent saving in initial cost and in the cost of maintenance.

Another feature of this invention is that the magnet which separates the contacts can do so without extra effort on account of the energization of the first magnet.

My invention is illustrated in the accompanying drawing in which the same reference characters are used throughout, and in which:

Figure 1 is a diagram of a telephone system showing a cord circuit provided with supervisory apparatus embodying my invention; Fig. 2 is a sectional view of the supervisory relay, and Fig. 3 is a front view of the same with the cover in section.

Referring first to Fig. 1, L and L^2 indicate two telephone lines extending in two limbs 2 and 3 from their respective substations to the central office where they are fitted with the usual line signal S and a plurality of multiple jacks J, J^2 and J^3 in any desired number, according to the size of the switchboard. A line relay R controlling through its normally open contacts the local circuit of the line signal S is included in the normal connection of the line conductor 3 with the battery lead 4 extending to the live pole of the central common battery B, while the other line conductor 2 is normally grounded. A cut-off relay R^2 is legged to ground from the sleeve side of the jack section of the line and is adapted when energized to disconnect said line conductors 2 and 3 from their normal connections and connect them with corresponding sides of the jack section of the telephone line.

At the substation a signaling bell 5 and a condenser 6 are included in a bridge of the line conductors that is normally closed by the switch-hook 7, while a transmitter 8, a receiver 9 and a retardation coil 10 are adapted to be suitably connected in circuit with said condenser, 6, when the receiver 9 is lifted from the switch-hook 7. This apparatus, however, is intended merely to typify any usual or desired common battery subscriber's outfit.

At the central office each operator is provided with a plurality of cord circuits, usually 10 or 12 in number, each having an answering plug P and a calling plug P^2 provided with tip and sleeve contacts adapted to register with the corresponding contacts of the spring jacks when inserted therein. The tip contacts of the plugs are united

through the flexible strands t and t^2 and the interposed condenser c, while their sleeve contacts are similarly joined by the strands s and s^2 and the interposed condenser c^2. The supervisory apparatus associated with each plug is only diagrammatically indicated in this figure, and consists of magnets 11 and 12, connected respectively between the tip and sleeve strands of the cord circuit and the adjacent poles of the batteries B or B^2. The magnet 12 is provided with an armature 13 carrying a spring contact 14, which is provided at its end with a platinum contact 15 adapted to be normally out of contact with a similar platinum contact 16 carried upon the armature 17 of the magnet 11, but when the magnet 12 is energized the said contact 15 is brought into engagement with the contact 16 of the armature 17. The adjustment of these parts is such that when the magnet 12 is energized, contact 15 moves forwardly and engages contact 16 but such contact 15 is limited in its forward movement so that when the magnet 11 is energized the contact 16 is drawn away from the contact 15 and the contacts are again separated. An apparatus of this type is provided for each end of the cord circuit, that associated with the answering plug P serving to control the local circuit of the supervisory signal S^2, while that associated with the calling plug P^2 similarly controls the local circuit of the supervisory signal S^3 assigned to said plug. The mechanical construction of this supervisory relay is shown in Figs. 2 and 3, and consists preferably of a cast iron block or bar 18 provided with two holes, in one of which the magnet 12 is placed and in the other of which the magnet 11 is located. These magnets have suitable terminals 19 projecting through the rear of the shell 18. The core 20 of each magnet is secured in place by the set screw 21 and together with the shell 18 form the stationary parts of the magnetic circuit of the magnets. The armature 13 of the magnet 12 is pivoted upon the pin 22 at its lower end and the contact spring 14 is secured thereto but is insulated therefrom by a suitable insulating strip 23. The spring 14 is connected by means of a flexible wire 24 with a terminal wire 25 extending back through the shell 18 to the rear of the casing where it is provided with a suitable terminal 26 to which to connect the conductor of the electrical circuit; said wire 25 is insulated from the material of the casing 18. A threaded stud 27 projecting from the forward end of the core 20 of the magnet 12 passes through an enlarged aperture in the armature 13 and is provided with a nut 28 upon the outer side of the armature 13 which acts as a stop for said armature in its normal position. The contact 15 is carried upon the end of the contact spring 14, which spring is preferably turned at right angles as indicated in Fig. 3. Contact 16 is mounted in a suitable manner upon the armature 17 of the magnet 11, which armature is pivoted upon a suitable pin 29 secured to the shell 18. A threaded stud 30 projecting from the end of the core 20 together with a nut 31 upon the outer side of the armature 17 serves as a stop for said latter armature. The contact 16 and the armature 17 are not insulated from the shell 18 and to complete the circuit of the instrument said shell may be provided with a suitable terminal such as 32 to which the conductor of the circuit may be readily connected. With this arrangement it is evident that when the magnet 12 is energized its armature 13 will be attracted and the contact 15 upon the spring 14 will engage the contact 16 of armature 17. The movement of the armature 13 is so adjusted in any desired way that it cannot close the armature 17 of the magnet 11, which consequently may be drawn away by the energization of the magnet 11 so as to again separate the contact 16 from the contact 15, even though the magnet 12 remains energized.

A suitable cover 33 may be provided for the forward end of the relay to inclose the armatures and their contacts and may be secured in place by set screws 34. While only one relay is shown in Figs. 2 and 3, it is apparent that the bar 18 may be of considerable length and that rows of holes may be provided therein to accommodate a plurality of such apparatus in which case the cover 33 would be enlarged to cover the forward ends of all of the relays in the bar.

The operation of the apparatus will now be readily understood. Assuming that the subscriber upon the line L takes up his receiver to call the central office, current flows from the battery B through the line relay R, over the line conductor 3 and with return through the grounded conductor 2, thus operating the line relay R and consequently the line signal S. Upon observing the signal, the operator inserts the answering plug P^2 of the cord circuit in the answering jack J of the telephone line, and depresses her listening key to connect her head telephone 35 together with the secondary of her induction 36 and a suitable condenser c^3 in a bridge of the calling end of the said cord circuit. The insertion of this plug completes a path for current from the live pole of the battery B through the winding of the magnet 12, strand s of the cord circuit and over the sleeve side of the jack section of the telephone line, through the winding of the cut-off relay R^2 to ground. Current in this path actuates said cut-off relay thereby rendering the line signal inoperative and to complete connection between the external and switchboard sections of the said line. At the same time the magnet 12 is energized to close the local

circuit of the supervisory signal S^2, but owing to the fact that the subscriber has his telephone off the hook current from the battery B now circulates over the metallic line and through the magnet 11 as well, to thereby energize said magnet and attract the armature 17 of the same and separating the contact 16 from contact 15 to open the circuit of said supervisory signal and prevent its operation. Upon learning the order of the subscriber, which we will assume to be the line L^2, the said line is tested by touching the tip of the calling plug to the test ring of the jack of that line in the usual manner. If the line is idle, no flow of current results since both the test rings and the tip of the testing plug are at the same potential, but if the line is connected for use, said test rings are at a different potential due to their connection with the live pole of either the battery B or B^2 through the medium of the sleeve strand of the inserted plug, and consequently a flow of current takes place over the strand t^2 of the cord circuit, thus causing a surge of current through the operator's receiver to indicate to her that the line is busy. Assuming that the line is found idle the calling plug P^2 is inserted in one of the multiple jacks and the ringing key 38 is depressed. The operation of this key connects the ringing generator 39 with the tip strand of the cord circuit which sends ringing current out over the telephone line and through the call bell 5 of the wanted station, while at the same time current from the battery B^2 flows out over the battery lead 4^a and through the branch conductor 40 and the sleeve spring of said ringing key 38, through the cut-off relay R^2 of the called line to maintain the same actuated during ringing. After the subscriber has been called but before his response current from the battery B^2 is flowing through the magnet 12 of the supervisory relay associated with the calling plug P^2 and through the cut-off relay R^2 to ground. Current in this path suffices to actuate the magnet 12 and to cause its contact 15 to engage contact 16 of the magnet 11 and since the latter magnet is not yet energized the local circuit of the supervisory signal S^3 is now closed and said signal is lighted to indicate the fact of the non-response of the called subscriber to the operator. When the subscriber responds to his call, current is permitted to flow from the battery B^2, through the metallic line with return through said magnet 11 thereby attracting its armature 17 and withdrawing its contact 16 from contact 15, thus opening the local circuit of the signal S^3 and retiring the same.

At the termination of the conversation when the subscribers return their receivers to the hooks current is no longer permitted to flow over the telephone lines so that the magnets 11 are deënergized and the contacts 16 are again brought into engagement with contacts 15 thereby lighting the supervisory signals S^2 and S^3. Upon observing these signals the operator withdraws the plugs P and P^2, thereby cutting off current from the magnets 12 of the supervisory relays which permit the contacts 15 to separate from contact 16 and return to normal position, thus again opening the circuit of the supervisory signals S^2 and S^3 which are accordingly retired when the cord circuit is not in use.

With this apparatus, but one contact is required for the supervisory device at each end of the cord circuit, and magnet 11 is not required to over-power the attractive force of magnet 12 before the circuit of the signal can be opened.

While I have thus described a particular telephone system with which my invention is adapted to operate, it is to be understood that I do not wish to be limited thereto nor do I wish to be unduly limited to the details of the magnetic device itself, many modifications of which would be possible without departing from the spirit or scope of my invention.

I claim—

1. In a relay, the combination with a pair of parallel coils, of a pair of armatures, one for each of said coils mounted at the end thereof, a contact carried upon one of said armatures, an extension carried upon the other of said armatures having a contact thereon adapted to register with the first contact, said contacts being adapted to be closed when one of the relays is actuated and open when both of said relays are actuated, substantially as described,

2. In a relay, the combination with an integral inclosing shell having a pair of parallel openings therein, a pair of electromagnets, one within each of said openings, a pair of armatures hinged to said inclosing shell and respectively held in positions, one before the end of each of said electromagnets, a contact carried by one of said armatures, an extension upon the other of said armatures, a contact carried by said extension, said pair of contacts being adapted to be closed by the actuation of the latter armature and again opened by the actuation of the former armature, substantially as described.

3. In a relay, the combination with an integral inclosing shell having a pair of parallel openings therein, a pair of electromagnets, one within each of said openings, a pair of armatures hinged to said inclosing shell and respectively held in positions, one before the end of each of said electromagnets, a contact carried directly upon one of said armatures, an extension carried by the other armature and insulated therefrom, a contact carried upon said extension, said pair of contacts being adapted to be closed by the actuation

of the latter armature and again opened by the actuation of the former armature, substantially as described.

4. In a relay, the combination with an inclosing shell, of a pair of parallel electromagnets within said shell, a pair of armatures for said magnets respectively pivoted before the end of each of said electromagnets, coöperating contacts carried, one upon each of said armatures, said contacts being adapted to be closed by the energization of one of said electromagnets and opened by the energization of both of said electromagnets, a dust cap adapted to inclose the armatures and contacts, substantially as described.

5. In a relay, the combination with a pair of parallel electro-magnets, of armatures located opposite one end of each of said magnets, coöperating contacts carried by said armatures, the contact of one armature being adapted to be drawn against the contact of the other when the first armature is actuated, and the contact of the second armature being adapted to be drawn away from the first when the second armature is actuated, substantially as described.

6. In a relay, the combination with a pair of parallel electro-magnets, of a shell inclosing said magnets and forming a portion of the magnetic circuit thereof, a pair of armatures supported by the shell, one before each of said electro-magnets, contacts carried by said armatures adapted to connect with each other upon the actuation of one of the armatures and to be again disconnected upon the actuation of both of the armatures, substantially as described.

7. In a relay, the combination with a pair of parallel electro-magnets, of an armature located at the end of each of said magnets, said armatures carrying contacts, said contacts being in their normal condition when both armatures are unactuated, in their abnormal condition when only one armature is actuated and again in their normal condition when both armatures are actuated, substantially as described.

Signed by me at Chicago, county of Cook, State of Illinois, this 31st day of December 1903.

WILLIAM W. DEAN.

Witnesses:
E. A. GARLACK,
ROBERT LEWIS AURES.