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W. W. DEAN.

TELEPHONE TOLL LINE SYSTEM.

APPLICATION FILED JAN. 14, 1902.

NO MODEL.

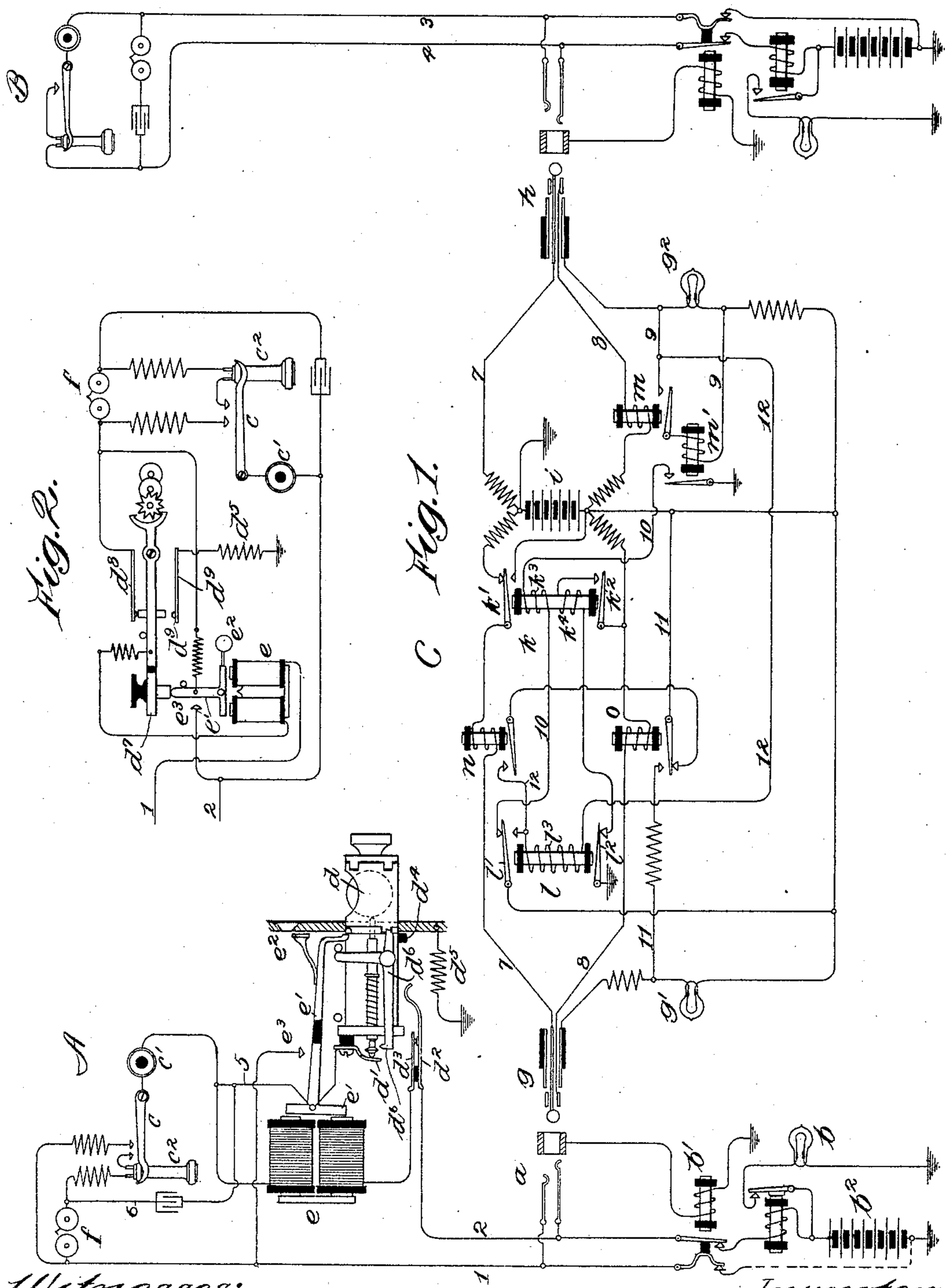

Fig. 1.

Fig. 2.

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No. 771,972. Patented October 11, 1904.

UNITED STATES PATENT OFFICE.

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TELEPHONE TOLL-LINE SYSTEM.

SPECIFICATION forming part of Letters Patent No. 771,972, dated October 11, 1904.

Application filed January 14, 1902. Serial No. 89,666. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM W. DEAN, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Telephone Toll-Line Systems, of which the following is a full, clear, concise, and exact description.

My invention relates to a telephone toll-line system, and may be applied either to a system in which the toll device consists of a coin-receiving box or prepayment device located at the substation in which the subscriber must deposit a coin in order to communicate with the central office or to a system in which the toll device consists of a connection-register or service-meter for the subscriber's line to record each connection therewith.

The object of my invention is to provide means whereby a charge may be made for each use of a subscriber's telephone in originating a connection in which the subscriber is actually placed in communication with the party called for.

More specifically, my object is to compel the user of the telephone to manually operate his toll device, whether it be a prepayment device or a service-meter, or to do any other required act in order to place the telephone or accessory apparatus in operative condition.

My object is, further, to make the necessity for such special act on the part of the telephone user dependent upon the action of apparatus at the central office which is brought under the control of a switch at the substation of the called party, so that the subscriber may be relieved of the special act and the coin returned or no charge registered on the service-meter when the connection called for cannot be made when the called subscriber fails to respond or when the line is used in response to calls from other stations.

Generally speaking, my invention consists of a blocking device for preventing telephonic communication from a toll-line substation, in combination with apparatus at the central office for actuating said blocking device, said apparatus being brought under the control of the called party in the course of establishing connection between the toll-line and another line and mechanism associated with the toll device at the toll-line substation and adapted for manual operation by the usuer of the telephone for counteracting or reversing the blocking mechanism to establish the operative condition of the system. The telephone user at the toll-line substation is thus not compelled to operate his toll device until connection has been actually completed with the line of the called party and the called party has responded. When the called party takes his telephone from its hook to answer the call, the operation of the blocking mechanism on the toll-line is automatically brought about, so that the toll-line subscriber is obliged to operate his toll device in order to converse.

I will describe my invention more particularly by reference to the accompanying drawings, in which—

Figure 1 is a diagram illustrating a telephone toll-line and another line extending from substations to a central office and a pair of plugs and their plug-circuit at the central office for uniting the lines, the system being equipped and operating in accordance with my invention. This figure illustrates a system in which the toll device at the toll-line substation consists of a coin-receiving box or prepayment device; and Fig. 2 is a detail diagram showing a toll-line substation designed for use with the system illustrated in Fig. 1, but having a service-meter or connection-register in place of the coin-receiving box.

Similar characters of reference are used to designate the same parts in both figures.

Referring first to Fig. 1, the telephone-line extends in two limbs or line conductors 1 2 from the toll-line substation A to the central office C. Another telephone-line 3 4 is illustrated extending from a substation B to the central office C. The line conductors 1 2 of the toll-line terminate at the central office in the short and long line-springs, respectively, of the spring-jack *a*. A line-relay which controls a local circuit including a line signal-

lamp b is connected with the limb 2 of the telephone-line by a conductor extending from one of the back contacts of the usual cut-off relay b' to the free pole of the grounded battery b^2. The usual ground-return of limb 1 of the telephone-line at the central office is omitted when the substation is supplied with my toll-collecting device, but has the usual connection, as shown by the dotted lines, when associated with my connection-register. The line signal-lamp will be automatically lighted, therefore, when the line conductor 2 is grounded or in the use of a connection-register when a bridge of the line conductors 1 2 is closed. A circuit for the cut-off relay b' is established in a well-known manner hereinafter to be referred to when the central-office operator makes connection with the telephone-line, the signaling apparatus being thereby removed from the line-circuit.

I will first describe my invention as applied to a telephone system in which the toll-line substation is of the type shown in Fig. 1.

The usual telephone talking and signal-receiving apparatus is provided at the substation, together with a gravity telephone switch-hook c for controlling the circuits through said apparatus. In addition the substation is provided with a toll-box or prepayment device for receiving coins, the toll-box being associated with the telephone-line, so that the deposit of a coin is necessary in order to transmit a signal to the central office. In another application, Serial No. 89,664, filed January 14, 1902, I have described and claimed the mechanical features of a toll-box such as that illustrated diagrammatically in Fig. 1. This toll-box is provided with a coin-receiver d, adapted to slide to and fro in its framework, said coin-receiver being provided upon its outer end with a thumb-piece or button, by which it may be pushed in.

A sliding plunger is mounted in the coin-receiver and is adapted to be engaged by a coin pressed in the receiver, said plunger being pushed against a contact-spring d' to connect the framework of the toll-box with said contact-spring. The framework of the toll-box is grounded through a resistance-coil d^5 of, say, five hundred ohms. A pair of contact-springs d^2 d^3 are provided in the toll-box, normally engaging one another, and the sliding coin-receiver carries an insulated lug d^4, which is adapted when the receiver is pushed in to deposit the coin in the toll-box to engage one of said contact-springs d^2 d^3 and separate them. A polarized electromagnet e is provided in the toll-box, said magnet having a centrally-pivoted tilting armature e'. This armature performs three functions: First, when in its normal position it prevents the coin-receiver from being pushed in; second, it carries a visual signal e^2, which is displayed in an opening of the toll-box when the armature is tilted in a contra-clockwise direction, and, third, when the armature is so tilted it serves as a relay, closing circuit with a contact-anvil e^3. The telephone switch-lever c is connected with the limb 2 of the telephone-line by a conductor which includes serially the transmitter c', the windings of the polarized magnet e, and the contact-springs d^3 d^2, in the order named. A branch conductor 5 is tapped on between the transmitter c' and the magnet e, said conductor 5 being connected with the armature e' of said magnet and with the spring d', associated with the sliding coin-receiver. The contact e^3 is connected directly with the limb 1 of the telephone-line. The telephone-receiver c^2 is included, together with a condenser and one winding of the induction-coil, in a conductor 6, extending from one of the contacts of the switch-hook to a point between the transmitter c' and the magnet e. The other contact of the switch-hook is connected with the limb 1 of the telephone-line through the other winding of the induction-coil. Normally when the telephone is not in use the receiver hangs upon the hook, so that the switch-lever c is out of engagement with its contact-anvils; but when the telephone-receiver c^2 is taken for use the lever rises and engages with both of said contact-anvils. The usual polarized signal-bell f is included, together with the condenser, in a bridge of the line to receive incoming signals. The spring d' is thus connected with the limb 2 of the telephone-line by way of the armature e' and the windings of the magnet e, and when a coin of suitable size is placed in the coin-receiver d the circuit to earth through the resistance d^5 is completed at the contact d'. The armature e' of the electromagnet normally rests in the position shown, so that the arm carried thereby is in the path of a lug carried by the sliding coin-receiver, preventing the coin-receiver from being pushed in. When, however, the magnet e receives current of suitable direction, it will tilt its armature e' to remove the obstruction and permit the coin-receiver to be pushed in to deposit the coin in the cash-box, and at the same time the tilting of the armature will close the contact e^3 and also display the signal e^2. The closing of the contact e^3, it will be observed, short-circuits the telephone apparatus.

Passing now to the apparatus at the central office, the operator is provided with the usual answering and calling plugs g h, respectively united by link conductors 7 8 through the windings of a repeating-coil for connecting telephone-lines together. In accordance with the "central battery system" a central source of current i is connected in a bridge of the link conductors 7 8 between the windings of the repeating-coil in a manner well understood. The side of the battery which is connected with the conductor 7 is grounded, and the other or free pole is connected, through supervisory signal-lamps g' g^2, with the third

contacts of the plugs g and h, respectively. When one of the plugs is inserted in a spring-jack, this third contact registers with the test-ring of the jack, which is grounded through the cut-off relay, so that upon the insertion of a plug in the jack of any line the cut-off relay associated with that line is excited and acts to disconnect the line signal apparatus from circuit. An electromagnetic switch k controls the plug-circuit between the battery i and the answering-plug, said electromagnetic switch having two armatures k' k^2, connected with the conductors 7 8, respectively. The armature k^2 is merely tapped onto the conductor 8; but the armature k' and its back contact are serially included in the conductor 7—that is, the armature k' and its back contact control the connection of the conductor 7 with the grounded pole of the battery i. The front contact of the armature k' is connected to the free pole of battery i, and the front contact of armature k^2 is connected, through one winding k^4 of the magnet of the switch itself to ground by way of the armature l^2 and its back contact of a second electromagnetic switch or relay l. The switch k is thus adapted when energized to transfer the connection of the conductor 7 from the grounded pole of the battery i to the free pole thereof, thus connecting both limbs of the telephone-line in multiple with the grounded battery. The switch k also in drawing up its armature k^2 closes a local circuit, through its retaining-winding k^4, to ground by way of the armature l^2. The electromagnetic switch or relay l has but one winding l^3, but has two armatures l' l^2, similar to the two armatures of the relay k. The armature l^2, as before stated, is grounded, and the armature l' is connected with the free pole of battery i. A supervisory relay m is included in the conductor 8 between the battery i and the calling-plug h. This supervisory relay controls a shunt-circuit 9 about the supervisory signal-lamp g^2 The shunt-circuit 9 includes the winding of a low-resistance relay m' and is normally open at the contact of the supervisory relay m. This latter relay being associated with the calling-plug is dependent for its operation upon the closure of the circuit at the substation of the telephone-line with which the calling-plug may be connected. When the telephone-switch at such a called station is closed, the relay m receives current, as is well understood, and draws up its armature, closing the shunt-circuit 9 about the supervisory lamp g^2, thereby extinguishing the lamp and at the same time causing current to flow through the relay m' included in said local circuit. The armature of the relay m' is grounded, and its front contact is connected by a conductor 10 with the back contact of the armature l' of relay l on the other side of the plug-circuit, said conductor 10 including the magnet-winding k^3 of the relay k. The armature l' being connected with the free pole of the grounded battery i, it will be understood that if the relay l remains inert the closure of the circuit 10 to ground by the relay m' will cause current to flow through the magnet-winding k^3, thus causing the armatures k' k^2 to be drawn up against their front contacts, and armature k^2 in closing against its front contact completes a local circuit through the winding k^4 to ground by way of the armature l^2, whereby the switch k once actuated is rendered independent of the magnet m' and is thereafter dependent only upon the relay l. A relay n is included in the circuit of the conductor 7 between the armature k' and the tip of the answering-plug g, and a similar relay o is included in the cord-strand 8, which leads to the ring-contact of the answering-plug. The armature of the relay o is connected with the free pole of battery i and controls by way of its front contact a shunt-circuit 11 about the supervisory signal-lamp g', associated with the answering-plug. The back contact of the relay o is connected with the armature of relay n. The front contact of relay n and the front contact of armature l' form multiple terminals of a conductor 12, which includes the winding l^3 of magnet l and leads to the third contact of the calling-plug h. It will be seen then that when the supervisory relay n is excited, holding its armature against the front contact connected with the circuit 12, if relay o allows its armature to drop the circuit 11 12 from the grounded battery i will be completed through the winding l^3 of the magnet l. The magnet l being excited will draw up its armatures, thus establishing by way of its front contact a circuit through the winding l^3 independent of the relays n and o and at the same time breaking the circuit through the windings k^3 and k^4 of magnet k.

Station B is illustrated as an ordinary telephone-substation, having the usual telephone apparatus in a bridge of the line and a gravity telephone-switch for controlling the circuit of said bridge.

The operation of the system may be traced as follows: Supposing the subscriber at the toll-line substation A to be desirous of communicating with subscriber B, he first signals the central office by depositing a coin in the coin-receiver d. This closes the circuit of the limb 2 to ground at d' through the magnet e. Current now flows from the grounded-line battery b^2, through the line-relay, out over limb 2 of the line, through the winding of magnet e to the armature thereof, to contact-spring d', to the plunger of the coin-receiver, and thence through the framework of the toll-box to ground. Current flowing in this circuit excites the line-relay at the central office; but the direction of current is such that the armature of the polarized magnet e is not moved. The circuit of the line-lamp b at the central office being completed by the line-relay the

lamp is lighted, indicating to the attendant that a connection is desired. To answer the call thus made, the answering-plug g is inserted in the spring-jack a of the toll-line, thus cutting off the line signal apparatus from the circuit, as heretofore described, and connecting the line with the apparatus in the plug-circuit, including the battery i. It will be understood, of course, that the operator is provided with the usual telephone and calling appliances; but since these are well known in the art I have for clearness omitted them from the drawings. The subscriber at the toll-line substation having removed his telephone from its hook converses with the central-office operator and gives her the number of the subscriber wanted. In taking his telephone from its hook he has closed a bridge of the line including his telephone apparatus in the usual manner, and the contact e^3 being open and the contacts d^2 d^3 closed the circuit is in operative condition. The magnet e is unaffected by the substitution of the battery i in the plug-circuit for the line-battery b^2, since the polarities are the same. In practice one battery is used both for a line signal-battery and for the battery i in the plug-circuit; but for convenience of illustration I have shown these separately. Supervisory relays n and o will both be excited at this time by current flowing out over conductor 7 of the plug-circuit to the limb 1 of the telephone-line, through the telephone apparatus and the magnet e, back over the other limb 2 of the telephone-line and conductor 8 of the plug-circuit, to the negative side or free pole of the battery. Having ascertained the number of the called subscriber, the operator inserts her calling-plug in the spring-jack of the called line and signals over the line in the usual manner. When the subscriber at station B answers the call by removing his telephone from its hook, he closes a bridge of the line conductors 3 4, thereby closing circuit through the supervisory relay m, which, being excited, closes a shunt 9, including the subsidiary relay m'. The relay m' in drawing up its armature closes a circuit to ground from the free pole of the battery i, said circuit including the armature l' and back contact of the relay l, conductor 10, and the magnet-winding k^3 of the electromagnetic switch k. Current flowing in this last-mentioned circuit through the winding k^3 excites the magnet k, so that both armatures k' and k^2 are drawn up, and armature k' transfers the connection of conductor 7 from the grounded pole of the battery i to the free pole thereof. Armature k^2 in closing against its front contact completes a path to ground from the side 8 of the plug-circuit between the pole of the battery and the relay o, said grounded path including the retaining-winding k^4 of the magnet and being controlled by the armature l^2 of the relay l. Current flowing through the winding k^4 keeps the magnet excited independent of current in the winding k^3, so that the magnet, once excited, is rendered independent of further changes in the condition of the circuit of the called line. The operation of the electromagnetic switch k brings about a reversal of current through the magnet e at the toll-line substation and blocks the use of the telephone until the calling subscriber operates his toll device. The conductor 7 being connected with the free pole of the battery i, the circuit of the negative current is traced over limb 1 of the telephone-line through the telephone apparatus at the toll-line substation, through the windings of magnet e to the conductor 2, to the spring-jack at the central office, to the conductor 8, through the supervisory relay o, to the point where the armature k^2 is tapped on, thence through the winding k^4 of the magnet k, to ground by way of the armature l^2. Current may also flow from the battery i, through one winding of the repeating-coil, directly to the armature k^2; but enough current takes the path to the substation to operate the relay e, and it will be noted that the current through the relay e has been reversed. The armature e' will therefore be swung in a contra-clockwise direction and will close the contact e^3, thus establishing a short circuit of the telephone apparatus to prevent its use, at the same time displaying the signal e^2 and removing the obstruction from the coin-receiver d, so that said coin-receiver may be pushed in. The calling subscriber seeing the signal e^2 displayed knows that the called subscriber is waiting and that the coin-receiver d must be pushed in in order that his apparatus may be put in condition for talking. The calling subscriber will then push in on the button which is mounted on the outside of the coin-receiver, and the coin-receiver will slide into the box to deposit the coin therein. As the receiver slides in at the moment the coin is disposed of, the insulating-lug carried by the coin-receiver engages the contact-spring d^2 and separates it from the contact-anvil d^3, whereby the circuit of the limb 2, including the magnet e, is broken. The limb 1 of the telephone-line, however, remains closed to ground through the framework of the box, since I have provided a pivoted stop d^6 in connection with the coin-receiver which when the coin-receiver is pushed in before the coin is released moves up to engage the plunger carried by the coin-receiver and maintain the same in engagement with the spring d'. Circuit of conductor 7, which includes the supervisory relay n, being still completed at the substation, the armature of relay n will remain attracted; but the relay o will be deprived of current, because the limb 2 of the telephone-line is broken at the contact-springs d^2 d^3 when the coin-receiver is pushed in. Relay o will therefore allow its armature to drop against its back contact, thus closing the circuit of battery i to the armature of relay n, and thence by way

of the front contact of the last-mentioned relay, through the winding l^3 of relay l, by conductor 12 to the third contact of the calling-plug h, and thence to ground by way of the cut-off relay of the called line. Relay l being excited by current flowing in the circuit just traced draws up its armatures l' l^2 and establishes a circuit through its winding l^3 independent of the relay n, at the same time breaking the circuit through the windings k^3 k^4 of relay k. The armatures of relay k then fall back and establish the normal connections of the plug-circuit. The relay l will be maintained excited as long as the calling-plug remains in the jack of the called subscriber. The calling subscriber at the toll-line substation having pushed in the coin-receiver as far as it will go and deposited the coin removes the pressure therefrom, whereupon the coin-receiver is returned by a spring to its outer position, and the current through magnet e being reversed by the reëstablishment of the normal circuit conditions at the central office the armature e' of said magnet is tilted to break the short circuit at e^3 and permit the use of the telephone apparatus. When the coin-receiver d returns to its outer position, the stop d^6 is withdrawn from its engagement with the plunger carried by the coin-receiver, so that the contact with the spring d' is broken and the ground removed from the line. The return of the coin-receiver also reëstablishes the circuit at the contact-points d^2 and d^3. The two subscribers are now in communication and no further act on the part of the calling subscriber at the toll-station is necessary, since the releasing device l at the central office maintains the circuit of both windings k^3 k^4 of the blocking-switch broken.

I will now describe briefly the circuits and apparatus shown in Fig. 2, which illustrates a substation adapted to be used with the system of my invention shown in Fig. 1, but in which a connection-register or service-meter is provided instead of a coin-receiving device.

The telephone apparatus and switch are the same in Fig. 2 as in Fig. 1 and are designated by the same reference characters. The service-meter is provided with an actuating-lever d^7, which is adapted to be manually operated by the subscriber to register the connection upon the service-meter. The lever d^7 is connected with the limb 1 of the telephone-line through the windings of the polarized magnet e. Two contact-springs are associated with the lever d^7, with which it is adapted alternatively to engage. Normally the lever d^7 is maintained in contact with the upper spring d^8, which is connected with one of the upper contacts of the telephone-switch c through a winding of the induction-coil and is also connected with the armature-lever of the magnet e. The lower contact-spring d^9, with which the actuating-lever d^7 is adapted to engage when depressed, is connected to ground through a resistance d^5. The armature of magnet e is normally maintained in the position shown and has an arm which forms a stop to prevent the downward movement of the actuating-lever d^7. When the magnet e receives suitably-directed current, however, the armature-lever is tilted in a contra-clockwise direction, removing the stop from the path of the actuating-lever and establishing the contact e^3, whereby the telephone apparatus is short-circuited. The armature of the magnet e also carries the signal e^2. In this modified system the toll-line subscriber signals the central office by merely removing his telephone from its hook, thus closing a bridge of the line. When the operator plugs in at the central office, the battery i of the plug-circuit is substituted for the line-battery and the line-signal apparatus is removed from circuit; but the flow of current through the magnet e is of such direction that the armature thereof is not effected. When, however, the called subscriber responds, the electromagnetic blocking-switch k at the central office is actuated, as previously described, whereby the flow of current through magnet e is reversed. The armature of magnet e is thereupon thrown to the left, establishing the short circuit e^3 and blocking the use of the telephone, at the same time removing the obstruction or stop which prevented the downward movement of the lever d^7. The calling subscriber then by depressing said lever operates his service-meter and at the same time breaks the circuit through the magnet e at the contact d^8 and puts a ground on the limb 1 of the line at contact d^9. The breaking of the circuit of the limb 2 of the telephone-line at the contact d^8 brings about the deënergization of relay o at the central office and the consequent operation of the releasing or counteracting relay l, so that upon the release of the actuating-lever d^7 at the substation the system is again placed in operative condition.

Having thus described my invention, I claim as new, and desire to secure by Letters Patent, the following:

1. The combination with a calling and a called line and a plug-circuit at the central office for uniting the lines, of a toll device at the substation of the calling-line adapted for manual operation by the subscriber, a blocking-switch in the plug-circuit at the central office adapted when actuated to render the apparatus of the calling-line inoperative for telephonic purposes, a supervisory relay associated with the called line in the plug-circuit at the central office and controlled by a switch at the called station, a circuit for the blocking-switch controlled through the agency of said supervisory relay, whereby said blocking-switch is actuated upon the response of the called subscriber, a releasing device l adapted when actuated to counteract the blocking-switch k and restore the apparatus of the calling-line to operative condition, a supervisory

relay *o* associated with the calling-line in the plug-circuit at the central office, a circuit for the releasing device *l* controlled by said supervisory relay *o*, and a switch adapted to be actuated in the operation of said toll device to change the electrical condition of the circuit and bring about the operation of said relay *o* and the consequent operation of the releasing device, as set forth.

2. The combination with a telephone toll-line extending from a substation to a central office, of a source of current, a telephone-switch at the substation controlling the flow of current in the line, a magnet *o* at the central office in the path of current so controlled and mechanism operated by said magnet, a toll device at the substation adapted for manual operation by the subscriber, an electromagnetic switch *e* connected with the line, and means for actuating said switch from the central office, said switch being adapted to establish a shunt of the telephone-switch, said shunt being controlled in switch-contacts which are opened in the operation of the toll device, whereby after the actuation of said electromagnetic switch the magnet *o* at the central office is affected only by the operation of the toll device.

3. The combination with a calling and a called line and means at the central office for uniting them, of a toll device at the substation of the calling-line adapted for manual operation, a polarized magnet *e* associated with the toll device at the substation, an armature for said polarized magnet normally preventing the operation of the toll device, said armature being adapted when moved in a given direction by the magnet to release the toll device and permit the same to operate, means controlled by said armature for rendering the substation telephone apparatus inoperative, a source of current at the central office, a switch *k* controlling the flow of current in the calling-line, and a circuit for said switch *k* controlled through the agency of a telephone-switch at the called substation, whereby upon the response of the called subscriber the magnet *e* at the calling-station is actuated and the calling subscriber compelled to operate his toll device in order to use his telephone, substantially as set forth.

4. The combination with a calling and a called line and means at the central office for uniting them, of a toll device at the substation of the calling-line adapted for manual operation, a polarized magnet *e* associated with said toll device, an armature for said magnet normally preventing the operation of the toll device, switch-contacts controlled by said armature for shunting the telephone apparatus of the calling-line, a source of current at the central office, a blocking-switch at the central office adapted when actuated to apply current to the calling-line in a direction to cause the polarized electromagnet at the substation to release the toll device and shunt the telephone apparatus, a supervisory relay for the called line responsive to the flow of current therein, a switch at the substation of the called line for determining the flow of current in the line, and a circuit for the blocking-switch controlled by said supervisory relay of the called line, substantially as set forth.

5. The combination with a calling and a called line and means at the central office for uniting them, of a toll device at the substation of the calling-line adapted for manual operation, a polarized magnet *e* associated with said toll device, an armature for said magnet normally preventing the operation of the toll device, switch contacts controlled by said armature for shunting the telephone apparatus of the calling-line, a source of current at the central office, a blocking-switch at the central office adapted when actuated to apply current to the calling-line in a direction to cause the polarized electromagnet at the substation to release the toll device and shunt the telephone apparatus, a supervisory relay for the called line responsive to the flow of current therein, a switch at the substation of the called line for determining the flow of current in the line, a circuit for the blocking-switch controlled by said supervisory relay of the called line, an electromagnetic releasing-switch *l* controlling the circuit of the blocking-switch, a switch associated with the toll device at the calling substation, and means, controlled by said switch, for actuating said releasing-switch, substantially as set forth.

In witness whereof I hereunto subscribe my name this 7th day of November, A. D. 1900.

WILLIAM W. DEAN.

Witnesses:
DE WITT C. TANNER,
W. W. LEACH.