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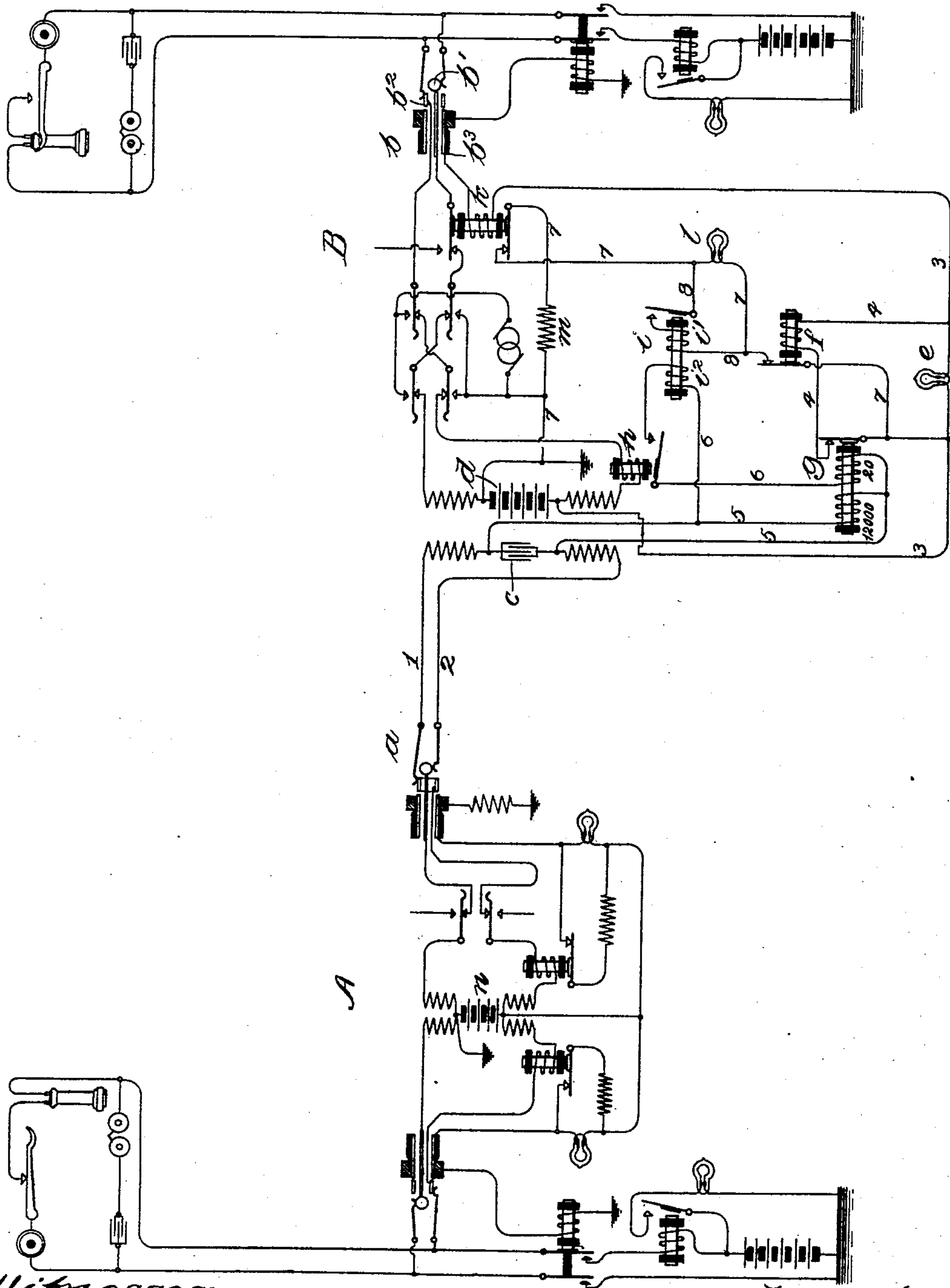
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H. M. CRANE.

SIGNAL FOR TELEPHONE TRUNK LINES.

(Application filed Feb. 25, 1901.)

(No Model.)



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UNITED STATES PATENT OFFICE.

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SIGNAL FOR TELEPHONE TRUNK-LINES.

SPECIFICATION forming part of Letters Patent No. 684,194, dated October 8, 1901.

Application filed February 25, 1901. Serial No. 48,649. (No model.)

To all whom it may concern:

Be it known that I, HENRY M. CRANE, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented a certain new and useful Improvement in Signals for Telephone Trunk-Lines, (Case No. 3,) of which the following is a full, clear, concise, and exact description.

My invention relates to telephone trunk-lines for extending connections from one switchboard of a telephone-exchange system to another; and its object is, in general, to provide a ringing-signal at the "trunking" or "receiving" end of a trunk-line by which the operator at that end may automatically be informed that the called party requires to be signaled.

In extending connection from one line to another through a trunk-line it is usual for the operator who completes the connection with the line wanted to transmit a call in this line; but the necessity often arises for transmitting a second and subsequent calls in the same line, even after the effacement of the ringing-signal has apparently indicated the response of the called party to the initial call. The necessity for such subsequent ringing of the called party's bell may arise from a variety of causes, among which the chief is the need for recalling the wanted party to his telephone.

In trunking circuits so far designed which have been equipped with ringing-signals—i.e., signals indicating to the trunking operator that the called party has not answered and should be signaled—the ringing-signal remains displayed until the called subscriber answers, and then is permanently locked out, so that it is no longer responsive to the switch at the called station which before controlled it. With such trunking-circuits if it is desired to ring the called subscriber a second time it is necessary for the line operator or "supervising" operator at the answering-board to communicate by telephone with the trunking operator at the other end of the line from an order-wire or in some other way and tell her orally to ring again.

The present invention comprises means whereby the supervising operator at the A board by manipulating certain apparatus—

as for example, by withdrawing the calling-plug or depressing one of the ringing-keys—may reset the ringing-signal to order the incoming trunk operator to ring again without increasing the load on the order-wire by taking the time and trouble to converse by telephone with the trunking operator.

Generally speaking, my invention consists of a ringing-signal at the trunking-board and means controlled by connection with the trunk-line at the answering-board for displaying said signal, electromagnetic mechanism controlled through the agency of the telephone-switch at the called station for rendering the ringing-signal inert, and electromagnetic switching mechanism controlled from the answering-board for reestablishing the original conditions and so resetting the signal. The ringing-signal is preferably included with a source of current in a circuit which is established at the trunking-board in making connection with the called line. A shunt is provided for the ringing-signal, controlled through the agency of the telephone-switch at the called station, and a retaining relay-magnet in said shunt is adapted when the shunt has once been closed to hold it closed, so that the signal will be locked against further control from the called station. A relay-magnet is provided for opening the circuit of the ringing-signal to reset the signal, said relay-magnet being controlled through the agency of a switch at the answering-board. This relay-magnet is preferably included in a shunt of the usual disconnect-signal at the trunking-board, which shunt is controlled by the contacts of a relay included in the circuit of the trunk-line, receiving current from the battery in the operator's plug-circuit at the answering-board.

The accompanying drawing illustrates diagrammatically a telephone trunk-line extending from an answering-switchboard to a trunk-board and there connected with a called-subscriber's line, the system being equipped with the ringing-signal of my invention.

The telephone-exchange system which is illustrated is of a type well known in the art and will require but little description, the trunk-line extending in two limbs 1 2 from a

spring-jack *a* at the answering-switchboard to the tip and ring-contacts *b'* *b''* of the terminal-plug *b* at the trunking-board. The trunk-line is, however, divided at the trunking-board by an inductive appliance, such as a repeating-coil, in the usual manner, the limbs of the line leading to the answering-board being united through two windings of the repeating-coil and a condenser *c* bridged between them, and the other two ends leading to the terminal-plug being similarly united through the other two windings of the coil with a battery *d*, bridged between said windings. The trunk-line circuit is therefore continuous as to telephonic currents, but is divided into two sections as to direct currents.

The subscribers' lines which center at the trunking-board are provided with terminal spring-jacks into which the trunk-plug may be inserted, whereby connection between the trunk-line and any subscriber's line may be made. I have illustrated one subscriber's line, into the spring-jack whereof the terminal-plug *b* of the trunk-line has been inserted to make connection therewith.

The board A is the answering-switchboard, where the operator is located who supervises the connections, the trunking operator at the board B being required only to connect the several trunk-lines with the subscribers' lines centering at her board upon the order of the supervising operator and to ring the called party. For this purpose the B operator is provided with suitable ringing-keys, which when depressed connect a source of ringing-current with the called line. It is understood, of course, that the usual order-wire circuits are provided between the two switchboards, whereby the operators may communicate directly with one another.

A disconnect-signal *e* is provided at the trunking-board, included serially in a conductor 3, which extends from the free pole of the battery *d* to the shank *b''* of the trunk-plug, the circuit of this conductor being completed to ground in the usual way when a trunk-plug is inserted in the spring-jack of the subscriber's line, as shown. A shunt 4 is provided about the disconnect-signal lamp *e*, said shunt including a low-resistance relay *f* and being controlled by the armature of a relay *g*. The relay *g* has two windings. One, of very high resistance—say twelve thousand ohms—is included in the circuit of the limbs 1 2 of the trunk-line leading to the answering-board in a conductor 5, shunting the condenser *c*. The other winding of said relay *g* is of low resistance—say twenty ohms—and is included in a parallel or shunt circuit 6 about the high-resistance winding, this conductor 6 being controlled by the armature and front contact of the supervisory relay *h*. This supervisory relay is connected in the circuit of the trunk-line between the battery *d* and the plug *b*, thus being under the control of the telephone-switch at the substation of the line with which the trunking-plug may

be connected. The conductor 6, besides including the low-resistance winding of relay *g*, includes one winding of, say, sixty ohms resistance of a relay *i*, which has two windings.

The conductor 3 includes the helix of a magnet *k*, which may have a resistance of, say, eighty-three ohms. This relay, besides controlling the connection of the operator's telephone set with the trunk-plug in accordance with a well-known system, also controls by its armature and front contact the circuit of a conductor 7, in which circuit the battery *d* and the ringing-signal lamp *l* are included. The conductor 7 is also controlled by the armature and front contact of the relay *f*, which is placed in the shunt-circuit 4 about the disconnect-signal. The resistance *m*, of about one hundred and twenty ohms, is included in the conductor 7 between the contacts of relay *k* and the ground-pole of the battery. A conductor 8 shunts the ringing-signal, which conductor is controlled by the armature and front contact of the relay *i* and includes the retaining-winding *i'* of said relay.

At the answering-switchboard the operator is provided with the usual pairs of plugs and their plug-circuits for connecting different telephone-lines together and supervising the connections made. One of these plug-circuits is shown in the drawing uniting the spring-jack of a telephone-line with the spring-jack of the trunk-line. The two plugs are united by link conductors, which include the windings of a repeating-coil in the usual manner, and the battery *n* is connected in a bridge of the plug-circuit between the windings of a repeating-coil. The usual supervisory signaling apparatus is shown. The plug-circuit is also provided with a ringing-key for severing the link conductors and connecting the ends leading to the calling-plug with the source of ringing-current.

The operation of the system is as follows: Supposing that the answering operator at the A board receives a call for a subscriber whose line terminates at the switchboard B, she connects by her cord-circuit the spring-jacks of the calling subscriber with the spring-jack of a trunk-line, first inquiring of the B operator which of the several trunks between the two boards may be used for this purpose and giving the B operator the number of the subscriber wanted. The B operator then takes up the plug of the trunk-line which has been used and inserts it in the spring-jack of the subscriber wanted. Then, unless the system be provided with means for automatically ringing the called party by the mere act of inserting the plug, the B operator depresses her ringing-key to connect a source of ringing-current with the line of the subscriber wanted. When the answering operator connects her plug-circuit with the trunk-line, circuit is thus established for the battery *n* through the conductor 5 at the B switchboard, which includes the high-resistance winding

of relay *g*. This relay instantly draws up its armature, establishing the shunt-circuit 4 about the disconnect-signal, so that the signal is not lighted. The closure of the shunt 5 4 supplies relay *f* with current, which in drawing up its armature closes the conductor 7. Conductor 7 being also closed at the contacts of relay *k* when the trunk-plug is inserted in the spring-jack of the called line 10 has current flowing therein from battery *d*, which lights the ringing-signal lamp *l*.

In practice the ringing-lamp is usually red and the disconnect-lamp white. The lighting of the red lamp always means that the 15 subscriber with whom the trunk-line of that lamp is connected has not answered the call and that he should be signaled. The white light always means a signal to disconnect. When the called party answers, the removal 20 of his telephone from its switch-hook closes a bridge of the line in the usual manner, whereupon the relay *h*, receiving current from battery *d*, draws up its armature and closes the shunt-circuit 6, which includes the winding 25 *i*² of relay *i* and the low-resistance winding of relay *g*. The substitution of the low-resistance shunt 6 for the high-resistance winding of the magnet *g* in the circuit of the battery *n* brings about the extinction of the 30 supervisory lamp at the answering-board in a well-known way, thus informing the supervising operator that the called party has responded. At the same time the relay *i* at the trunking-board being excited draws up its 35 armature and closes the shunt 8 about the red lamp *l*, so that this lamp is extinguished. The shunt 8, as before explained, includes a retaining-winding *i*' of the relay, so that the armature of said relay is held up independently of any further flow of current in the 40 conductor 6—that is to say, without regard to the position of the telephone-hook at the called station. When the conversation is finished and both subscribers hang up their 45 telephones, the supervisory lamps at the answering-board are lighted in the usual way and the supervising operator takes down the connection. This removes the battery from the trunk-line, so that the relay *g* is deprived 50 of current and, allowing its armature to fall back, opens the shunt 4 about the disconnect-lamp, so that this lamp is lighted. The B operator in this manner receives her signal to disconnect. If, however, after the called 55 party has hung up his telephone the calling party wishes further conversation with him and having attracted the attention of the supervising operator requests her to signal the called party again the supervisory operator 60 instead of being required to call up the B operator over the order-wire, as has heretofore been necessary, merely withdraws for a moment her calling-plug from the trunk-line jack and then puts it back again, or, what 65 may accomplish the same thing, depresses her ringing-key. The effect of such action

on her part is to momentarily disconnect the battery *n* from the trunk-line circuit and so momentarily to deprive the relay *g* of current. Relay *g* having allowed its armature 70 to fall back for a moment has interrupted the flow of current through the relay *f*, which in turn allowing its armature to fall back interrupts the flow of current in conductor 7, thus 75 allowing the armature of relay *i* to fall back and break the shunt which it has heretofore made about the red ringing-signal. Then when the battery *n* is again thrown in the trunk-line, the circuit of the conductor 7 is 80 established at the relay *f* and the red lamp is lighted, thus informing the B operator that she is desired to ring over the trunk-line again. The red lamp will stay lighted until the called party by removing his telephone 85 from its hook again brings about the excitation of relay *i*.

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

1. The combination with a telephone trunk- 90 line extending from an answering-switch-board to a trunking-board, and means for there connecting the same to a subscriber's line, of a ringing-signal at the trunking-board and means controlled by connection with the 95 trunk-line at the answering-board, for displaying said signal, electromagnetic mechanism controlled through the agency of the telephone-switch at the subscriber's station, for rendering said signal inert; and electromag- 100 netic switching mechanism controlled from the answering-board, for reestablishing the original conditions and resetting the signal, substantially as set forth.

2. The combination with a telephone trunk- 105 line extending from an answering-switch-board to a trunking-switchboard, of a ringing-signal for the trunk-line at the trunking-board and a circuit for the same, a shunt for said signal, a relay, controlled through the 110 agency of the telephone-switch at the called station, controlling said shunt, a retaining-magnet energized by the flow of current in the shunt, for maintaining said shunt closed independently of the called line, and a relay 115 controlled through the agency of a switch at the answering-board, controlling the circuit of said ringing-signal, whereby the signal may be reset from the answering-board, substantially as set forth. 120

3. The combination with a telephone trunk- line extending from an answering-switch- 125 board to a trunking-board, of a ringing-signal for the trunk-line and a circuit therefor, a shunt for said signal, a relay responsive to the flow of current in the called line, controlling said shunt, a device responsive to the flow of current in the called line adapted when once actuated to maintain said shunt 130 irrespective to the flow of current in the called line, and electromagnetic switching mechanism controlled through the agency of a switch

at the answering-board, for breaking the shunt and resetting the signal, substantially as set forth.

4. The combination with a telephone trunk-line extending from an answering-switch-board to a trunking-board, and means at the trunking-board for connecting said trunk-line through an inductive appliance to a called-subscriber's line, of a ringing-signal for the trunk-line, at the trunking-board, a circuit for said ringing-signal, a relay controlling said signal-circuit responsive to the flow of current in the called line, means at the substation of the called line for determining the flow of current therein, a second relay also controlling the signal-circuit, responsive to the flow of current in the trunk-line, and means at the answering end of the trunk-line for determining the flow of current therein.

5. The combination with a telephone trunk-line extending from an answering-switch-board to a trunking-board, and means at the trunking-board for connecting said trunk-line to a called-subscriber's line, of a signal at the trunking-board, means for exciting said signal, brought into action in connecting the trunk-line to the called line, a magnet controlled through the agency of the telephone-switch at the called station, and mechanism operated by said magnet for controlling said signal, a locking device actuated thereby for maintaining the signal inert irrespective of further operation of the switch at the called station, an electromagnetic mechanism controlled through the agency of a switch at the answering-switchboard for reversing said locking device, to reset the signal, substantially as set forth.

6. The combination with a telephone trunk-line extending from an answering-switch-board to a trunking-switchboard, and means at the trunking-board for connecting the

trunk-line to a called-subscriber's line, of a ringing-signal for the trunk-line at the trunking-board, a circuit for said ringing-signal, a disconnect-signal and a circuit for the same, a shunt for the disconnect-signal controlled through the agency of a switch at the answering-board, a shunt for the ringing-signal controlled through the agency of a switch at the called station, a retaining relay-magnet in said last-mentioned shunt, adapted to hold the shunt closed when the same has once been closed, and a relay-magnet in the shunt of the disconnect-signal, controlling the circuit of the ringing-signal, substantially as described.

7. The combination with a telephone trunk-line extending from an answering-switch-board to a trunking-board, and means at the trunking-board for connecting the trunk-line to a called-subscriber's line, of a ringing-signal for the trunk-line at the trunking-board, a circuit for said ringing-signal including a source of current, established in making connection with the called line, a disconnect-signal and a circuit for the same including a source of current, a shunt for the disconnect-signal, controlled through the agency of a switch at the answering-board, a shunt for the ringing-signal controlled through the agency of a switch at the called station, a retaining relay-magnet in said last-mentioned shunt, adapted, when the shunt has once been closed, to hold the same closed, and a relay-magnet in the aforesaid shunt of the disconnect-signal, controlling the circuit of the ringing-signal, whereby the ringing-signal may be reset from the answering-board, as set forth.

In witness whereof I hereunto subscribe my name this 11th day of January, A. D. 1901.

HENRY M. CRANE.

Witnesses:

HENRY F. WHITE,
JOHN C. ENDERS.