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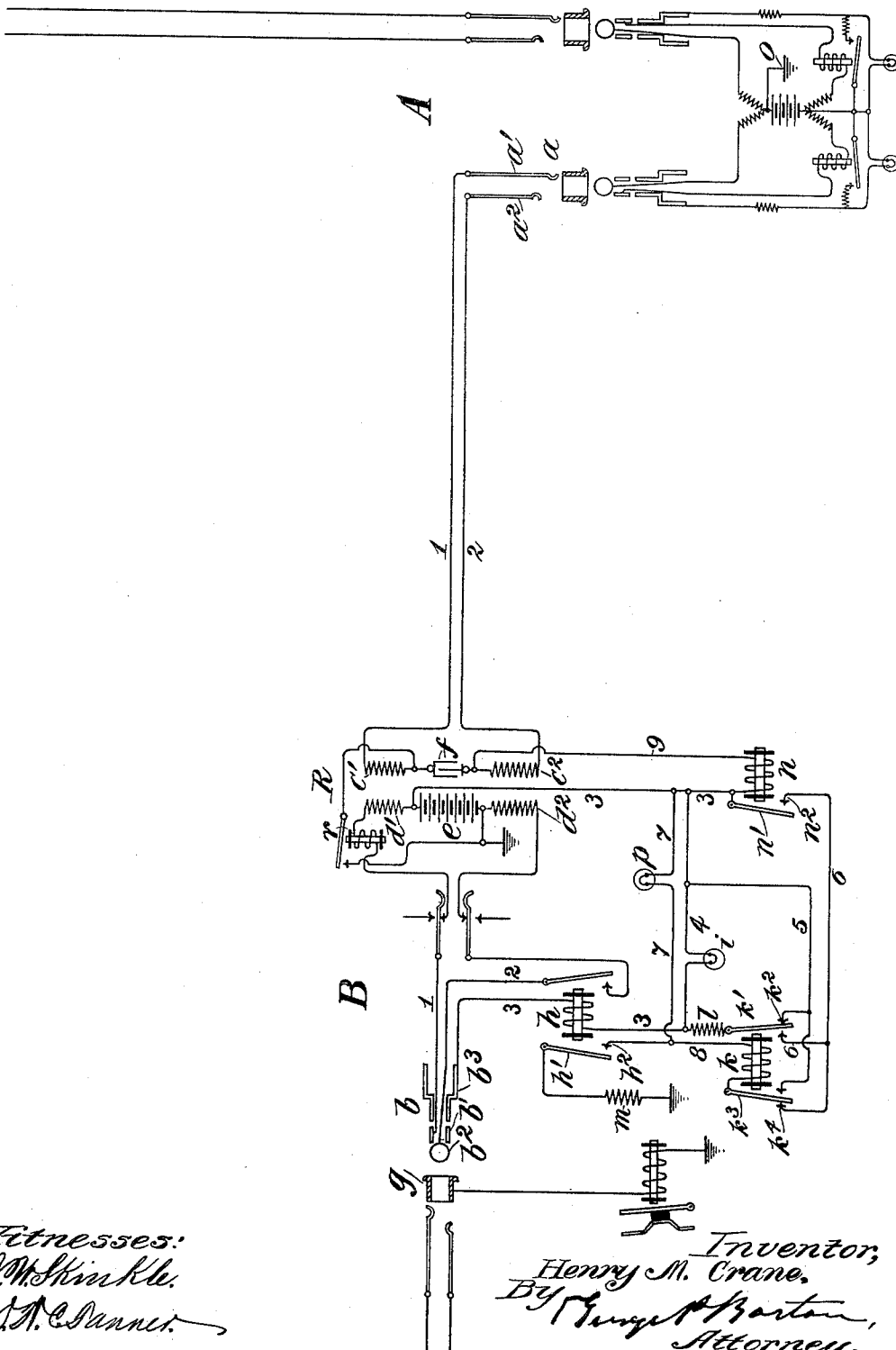
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SIGNAL FOR TELEPHONE TRUNK LINES.

(Application filed Jan. 10, 1900.)

(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. 659,789, dated October 16, 1900.

Application filed January 10, 1900. Serial No. 920. (No model.)

To all whom it may concern.

Be it known that I, HENRY MIDDLEBROOK 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. 1,) of which the following is a full, clear, concise, and exact description.

My invention relates to signals for telephone trunk-lines, and has for its object to provide means whereby the receiving operator or "B operator," as she is called, may be kept informed as to the condition of the trunk-line at the switch of the answering operator or "A operator."

Heretofore it has been usual to provide a clearing-out signal at the board of the receiving operator to notify the receiving operator when the connection has been taken down at the answering-board, so that she may remove the trunk-line plug from its connection. On most of the trunk-circuits ordinarily in use the clearing-out signal is displayed at all times when the terminal plug at the receiving end of the trunk-line is out of its seat in the switchboard or inserted in a spring-jack, while no plug is in a jack of the trunk-line at the outgoing terminal, so that the clearing-out signal is displayed when a trunk connection is ordered over an order-wire from the moment the B operator connects the trunk-line with the called-subscriber's line until the A operator makes connection from the calling-subscriber's line to the trunk-line and again from the time the latter connection is removed until the former is removed, the last-stated period being the proper time for the display of the clearing-out signal.

By my invention the display of the clearing-out signal during the first-described period is prevented, so that the display of the signal is never ambiguous, but always means one thing—*i. e.*, a notice for disconnection. For this purpose I provide shunts for the clearing-out signal, the signal being shunted when connection is made from the trunk-line to the called line at the receiving-switchboard and being again shunted when connection is made with the trunk-line at the answering-switchboard, the removal of the latter con-

nection, however, causing the shunts of the signal to be removed, whereby its display is effected. I further provide a guard-lamp at the receiving end of the trunk-line, which remains lighted from the time the trunk-plug is connected with the called-subscriber's line until the A operator has connected the calling-line with the trunk-line by inserting her connecting-plug into the trunk-line spring-jack. While this guard-lamp remains lighted, it therefore indicates to the B operator that the connected trunk-line has not yet been made use of, thus obviating the possibility that an A operator could order a trunk-line connected with a called subscriber and then fail to make the connection at her end, leaving the called subscriber helplessly connected with the trunk-line to the A office.

My invention will be particularly described by reference to the accompanying drawing, which is a diagram illustrating, with the aid of conventional symbols, a trunk-line extending from an answering-board to a receiving-board, the said trunk-line being equipped with signaling apparatus and circuits of my invention.

The trunk-line is composed of two limbs 1 2, terminating at the answering-switchboard in the line-springs a' a^2 , respectively, of the trunk-line spring-jack a and terminating at the receiving-switchboard in the sleeve-contact b' and tip-contact b^2 , respectively, of the trunk-line plug b .

As is a matter of common knowledge among telephone engineers it is usual for the receiving operator to make connections with the trunk-line plugs at the order of the answering operator received over a separate order-wire telephone-circuit. The ordinary circuits and the operation of such a trunk-line are well known in the art, and I have therefore shown in the drawing only the apparatus directly involved in my invention, so that the drawing will not be uselessly obscured. While I have spoken of the trunk-line as a "continuous line" and have applied the numerals 1 2 to the conductors which constitute the same, it is shown as divided into two parts at the receiving-switchboard B by a repeating-coil R, one side of which repeating-coil—that is, the portions c' c^2 —being included in

that part of the trunk-line which extends to the spring-jack at the answering-board and the other portions d' d^2 of the repeating-coil being included in that part of the trunk-line which extends to the plug b . A battery e is connected between the windings d' d^2 of the repeating-coil, and a condenser f is included between the windings c' c^2 thereof. The third contact or shank b^3 of the plug, which engages with the grounded test-ring g of the spring-jack of the called-subscriber's line, is connected by a conductor 3 through the winding of the relay h with the battery e , whereby the relay h is energized as soon as the plug is inserted in any spring-jack. The conductor 3 is divided into three paths between the battery e and the winding of relay h , one of said paths 4 including the clearing-out signal, while the other two paths 5 6 are shunts for the clearing-out lamp. Thus the path 5 leads from battery by way of the armature-lever k' and back contact k^2 of a relay k and includes the resistance-coil l , which may be of, say, forty ohms resistance. The other path 6 leads from the front contact of the armature-lever k' to the battery, and the continuity of this path is further controlled by a relay n , the armature n' of which, with its front contact n^2 , forms a part of this conductor. The relay h has two armature-levers with their associated switch-contacts, one of which armature-levers controls the continuity of the tip-strand 2 of the plug-circuit, while the other armature-lever h' is connected to ground through resistance m of, say, one hundred and twenty ohms. The front contact h^2 for the armature-lever h' is connected with the battery e by three paths, one of which, the conductor 7, includes the guard-lamp p , while the other two paths 8 5 and 8 6 include the winding of relay k and the armature k^3 thereof. Thus the two paths 8 5 and 8 6 constitute shunts for the guard-lamp p , one of said shunts 8 5 being by way of the front contact of the armature-lever k^3 and including the winding of this relay. The other path 8 6 includes the winding of the relay and the armature k^3 and back contact k^4 thereof and is also controlled by the relay n . It will be evident then that when the relay h is energized current will flow through the conductor 7, including the guard-lamp p , until relay n is energized and that when the relay n is energized the closing of conductor 6 by the armature n' of such relay will complete the circuit 8 6, which includes the winding of the relay k . Thereupon the armature k^3 being attracted an independent shunt-circuit 8 5 will be established by way of the front contact of armature k^3 , including the winding of the relay k , so that the guard-lamp will thus be permanently shunted independently of relay n and controlled only by the armature h' of relay h . The energization of the relay n will permanently shunt the guard-lamp, and at the same time the armature k' of the relay k will break

the shunt 5 about the clearing-out signal i , substituting for this shunt another one by way of the front contact of the armature-lever k' over conductor 6, and since the armature k' will now remain attracted independently of the relay n it will be apparent that the clearing-out signal is now shunted only by way of conductor 6 and that this shunt will be opened when the relay n is deenergized. The relay n then is the factor which at different times determines the display of both the guard-signal and the clearing-out signal, and to provide means whereby the relay n may be controlled from the answering-switchboard, the winding of the relay is included in a conductor 9, which extends from the battery-wire 3 to the limb 2 of the trunk-line extending to the answering-board. An ordinary pair of plugs and their cord-circuit are shown at the answering-board A, and a repeating-coil is included in the usual manner in the strands of this cord-circuit, together with the talking-battery, the side of the battery which is connected with the tip-strand being grounded at o . It will be apparent, therefore, that the insertion of the operator's connecting-plug in the trunk-line spring-jack at the board A will complete the circuit from battery e , which includes the relay n , by way of conductor 9, winding c^2 of the repeating-coil R, limb 2 of the telephone-line, a shorter line-spring a^2 of the trunk-line jack at the answering-board to the tip of the plug, and thence to ground at o .

In order that the usual supervisory apparatus in the operator's cord-circuit at the board A may be responsive to changes in the condition of the called line, means are provided for grounding the side 1 of the trunk-line when the called subscriber responds. This is accomplished through the agency of a supervisory relay r , included in the side 1 of the trunk-line between the plug b and the battery e . This relay is operated in the usual manner of supervisory relays—that is to say, it remains inert until the called subscriber responds; but when he does a path is provided from one side of battery e through a winding of the repeating-coil, out over the line to the subscriber's station, through his telephone apparatus, and back over the other side of the line to the other pole of the battery. The armature of the relay r is connected with the side 1 of that portion of the trunk-line which extends to battery A between the winding c' of the repeating-coil and the condenser f , and the front contact of the relay is grounded. It will be understood, therefore, that when the called subscriber responds current from the battery included between the cord-strands of the plug-circuit at the A board will flow from ground o through the supervisory relay, which is included in the sleeve-strand of the connecting-plug, to the sleeve of the plug, the long spring a' of the trunk-jack a , limb 1 of the trunk-line, winding c of the repeating-coil, and armature and front contact of the

relay *r* to ground. The relay *r* thus controls this circuit through the supervisory relay of the plug-circuit at board A, rendering that supervisory relay responsive to the flow of current in the called line, to which the trunk-line may be connected at board B.

The operation of the apparatus and circuits above described is as follows: Upon receiving an order from the A operator to connect the trunk-line with the line of a called subscriber the B operator inserts the plug *b* into the spring-jack of the called-subscriber's line. Making this connection completes the circuit of the battery *e* from ground through the winding of relay *h* by way of the shank *b*³ of the plug and to the grounded test-ring *g* of the called subscriber, current passing through the branch 5 of the conductor 3 by way of the back contact *k*³ and armature-lever *k'* and through the resistance *l*. The clearing-out signal-lamp *i* being thus shunted remains dark. The current passing through the winding of relay *h* energizes the core of the relay and causes the armature-levers to be attracted, one of said armatures completing the continuity of the limb 2 of the cord-circuit and the other armature *h'* completing a circuit from battery *e* through the conductor 7, which includes the guard-lamp *p*, to ground. The guard-lamp is thus lighted and remains lighted until a connection is made with the spring-jack *a* of the trunk-line at the answering-board. When such connection is made, the relay *n* will be energized by current from the grounded battery *e* through the winding of the relay to the limb 2 of the trunk-line by way of the conductor 9, thence to the line-spring *a*² of the trunk-line jack, through the tip of the connecting-plug, and to ground at *o*. The energization of this relay *n* thus completes the circuit of conductor 8 through the armature-lever *n'* and front contact *n*² of the relay, so that the guard-lamp *p* is shunted by conductor 8, which includes the winding of the relay *k*. This relay, it should be stated, is of comparatively-low resistance—say forty ohms—so that most of the current passing through the conductor 6 will take the path 8 through the relay in preference to the path 7 through the guard-lamp *p*, in consequence of which the guard-lamp will be darkened. As soon as circuit is completed through the relay *k* by way of the path 8 6, however, the armatures *k'* *k*³ will be attracted, the latter of which will close the independent circuit 8 5 through the winding of the relay by way of conductor 5, the guard-lamp *p* being thus permanently shunted over conductor 5 by the low-resistance winding of the relay. The attraction of the armature *k'*, moreover, changes the shunt about the clearing-out signal-lamp *i*, so that instead of being shunted by conductor 5 by way of the back contact of the armature *k'* it will now be shunted by conductor 6 and the front contact of said armature, the continuity of this shunt being controlled by the armature *n'* of the relay *n*.

This condition—that is, with the guard-lamp *p* and clearing-out signal-lamp *i* both dark—will continue to exist until the connection is removed at the answering-switchboard—that is, until the circuit through the relay *n* is broken by the removal of the ground *o* from the limb 2 at the answering-board. When this connection is removed, the consequent deenergization of relay *n* breaks the shunt 8 of the lamp *i*, which thereupon becomes lighted, indicating to the B operator that the trunk-line is no longer in use at board A and notifying her to remove the trunk-plug *b* from its connection. Thus the clearing-out signal-lamp is dark while the B terminal of the lamp is connected, the A terminal not being connected, because of the inert condition of relay *k*, and is still dark after connection at the A terminal, because both of the relays *k* and *n* are excited, but becomes lighted while the trunk-line is still connected at the A terminal, because of the excited condition of relay *k* and the inert condition of relay *n*.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The combination with a telephone trunk-line extending from a spring-jack at an answering-board to a terminal plug at a receiving-board, of a clearing-out signal *i* and a circuit 3 including the same with a source of current, said circuit being closed in registering contacts of the terminal plug and the spring-jack of the called-subscriber's line, two relays *k* *n* controlling said clearing-out signal, a circuit through relay *k* controlled by the relay *n* and forming a shunt for the clearing-out signal, a circuit 5 adapted to be closed by the relay *k* when the same is energized, said circuit 5 including the winding of relay *k* to establish an independent circuit through said relay, the circuit 5 being in shunt with the clearing-out signal, and a circuit for the relay *n* completed by connection with the trunk-line spring-jack at the answering-board, whereby the clearing-out signal is continuously shunted while the terminal plug of the trunk-line is connected, the shunt about said clearing-out signal being removed and the signal displayed when the connection with the trunk-line is removed at the answering-board, substantially as set forth.

2. In a system of trunk-circuits between two switchboards of a telephone-exchange, a guard lamp or signal *p* and a clearing-out lamp or signal *i* combined with circuits which said signals are connected, electrical apparatus, said apparatus including shunting apparatus or circuit-controllers, and a source of current brought into action by the plug and switch connections of the trunk-line, whereby on making connection with the called line the guard-signal is displayed, said display of the guard-signal being caused to cease on inserting the connecting-plug in the

trunk-line switch at the answering-board by a shunt-circuit controlled through the agency of said plug, the clearing-out signal being at this time also shunted, said shunt being adapted to be removed from about the clearing-out signal to display the clearing-out signal by the removal of the said plug from its switch at the said answering-switchboard, substantially as described.

10 3. The combination with a telephone trunk-line extending from an answering-board to a receiving-board, of a signaling system for the trunk-line comprising a clearing-out signal i and a guard-signal p , and circuits and a source of current associated therewith for
15 operating said signals, means for effecting the display of the guard-signal when connection is made at the receiving-board from the trunk-line to the called-subscriber's line, a relay n and switching mechanism operated
20 thereby for effecting the concealment of the guard-signal, means, controlled by said relay, for bringing the clearing-out signal into action, the said clearing-out signal being controlled by said relay, and a circuit 9 for
25 controlling said relay, said circuit 9 being controlled by connection with the trunk-line at the answering-board, whereby the guard-signal is displayed when connection is made
30 between the trunk-line and the called-subscriber's line at the receiving-board and is concealed when connection is made with the line at the answering-board, and whereby the clearing-out signal-circuit is brought into action
35 when connection is made with the trunk-line at the answering-board, the clearing-out signal being displayed when such connection is removed, substantially as set forth.

4. The combination with a telephone trunk-line extending from an answering-board to a receiving-board, of a guard-signal p and a clearing-out signal i at the receiving-board, a source of current e , a circuit 3, 4 including
40 the clearing-out signal and a circuit 7 including the guard-signal, said circuits being closed when connection is made from the trunk-line to the called-subscriber's line at the receiving-board, shunt-circuits about said signals, relay mechanism controlling said
45 shunt-circuits, and a circuit 9 controlling said relay mechanism, said circuit 9 being closed by connection with the trunk-line at the answering-board, whereby the guard-signal and clearing-out signal are shunted when the last-mentioned connection is made, and whereby
50 the shunt about the clearing-out signal is removed when such connection is taken down, substantially as set forth.

5. The combination with a telephone trunk-line extending between an answering-board A and a receiving-board B, of a clearing-out signal i at the board B for indicating the condition of the trunk-line at the answering-board, a circuit 3 including the signal with a
60 source of current, said circuit being closed by connection from the trunk-line to the called-

subscriber's line at board B, a relay k and a circuit including the same with a source of current, said last-mentioned circuit being adapted to be completed by connection with
70 the trunk-line at the board A, two shunt-circuits for the clearing-out signal controlled by said relay, one of said shunts 5 being closed by the relay when the same is inert, and the other of said shunts 6 being closed by the
75 relay when it is excited, a circuit, including the winding of the relay, closed when the relay is excited, whereby said relay is rendered independent of the apparatus at board A, and means controlled by the removal of the
80 connection with the trunk-line at board A, for opening the shunt 6, substantially as set forth.

6. The combination with a telephone trunk-line, of a clearing-out signal therefor at the
85 receiving-terminal of the line and a circuit including the signal, a relay k and means controlled by connection with the trunk-line at both terminals thereof for exciting said relay, two shunts 5 6 for the clearing-out signal, one
90 of said shunts 5 being normally closed by the relay, and a relay n controlled by connection with the trunk-line at the distant terminal thereof, the shunt 6 about the clearing-out signal being controlled at switch-contacts of
95 both relays and being closed at the contacts of relay k when the same is excited, whereby the clearing-out signal is continuously shunted until connection with the trunk-line has been made and removed at the distant terminal,
100 the signal being displayed on the removal of such connection, substantially as described.

7. The combination with a telephone trunk-line, of a clearing-out signal therefor at the
105 receiving-terminal of the line and a circuit including the signal, a relay k and means controlled by connection with the trunk-line at both terminals thereof, for exciting said relay, two shunts 5, 6 for the clearing-out signal, one
110 of said shunts 5 being normally closed by the relay, a relay n controlled by connection with the trunk-line at the distant terminal thereof, the shunt 6 about the clearing-out signal being controlled at switch-contacts of both
115 relays and being closed at the contacts of relay k when the same is excited, whereby the clearing-out signal is continuously shunted until connection with the trunk-line has been made and removed at the distant terminal, the clearing-out
120 signal being displayed on the removal of such connection, and a guard-signal p controlled by connection with the trunk-line at both terminals thereof, said guard-signal being displayed when connection is made with
125 the trunk-line at the same switchboard and being shunted by a circuit controlled by the relay n when connection is made with the trunk-line at the distant terminal, substantially as described.

8. The combination with a telephone trunk-line, of a clearing-out signal at one terminal
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thereof, and a circuit for exciting the signal, two relays k n controlled by connection with the trunk-line at the distant terminal, an independent circuit through relay k closed when the same is excited, a shunt for the signal normally closed by relay k and opened when the same is excited, and a second shunt for the signal controlled by the relay n , whereby the signal is displayed only when the con-

nection is removed at the distant terminal of the trunk-line, substantially as described. 10

In witness whereof I hereunto subscribe my name this 5th day of August, A. D. 1899.

HENRY MIDDLEBROOK CRANE.

Witnesses:

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