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SIGNAL FOR TRUNK-LINES.

SPECIFICATION forming part of Letters Patent No. 667,448, dated February 5, 1901.

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To all whom it may concern:

Be it known that we, FRANK R. McBERTY, residing at Downer's Grove, in the county of Du Page, and JAMES L. McQUARRIE, residing at Chicago, in the county of Cook, State of Illinois, citizens of the United States, have invented a certain new and useful Improvement in Signals for Trunk-Lines, (Case No. 51,) of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawing, forming a part of this specification.

Our invention refers to trunk-lines between different switchboards of a telephone-exchange; and it consists in certain signals to apprise each of the operators of acts performed by the other and by the subscriber and means for operating the signals automatically in the process of making connection between stations.

The invention is particularly useful in connection with trunk-lines extending between a switchboard whereon subscribers' lines terminate and another whereon special toll-lines or other similar circuits terminate. It is further designed for association with subscribers' lines fitted with signals responding automatically to movements of the telephone at the substation in its use or disuse.

The following steps are commonly followed in establishing connection between the terminal of a subscriber's line in the subscriber's switchboard and that of a toll-line in the toll-switchboard: Upon a call from the toll-line the operator at the toll-switchboard inserts one plug of a pair into the terminal socket of the toll-line and the other into the terminal socket of a trunk-line ending in a plug before an operator, to whom the terminal of the required subscriber's line is accessible, at the same time instructing the latter operator to complete the connection between the trunk-line and the required subscriber's line. This act having been performed, the two lines are united in a complete circuit. When the conversation has been completed, a suitably-operated signal indicates this fact to the toll operator, who thereupon removes the connection between the toll-line and the trunk-line, after which the subscriber's operator must remove

the connection between the trunk-line and the subscriber's line. Our invention provides means for automatically operating the signals to instruct the operators when to perform these latter acts. The signals comprise a lamp before the toll operator, which is controlled by a relay responsive to currents in the subscriber's line, determined by the position of the telephone-switch at the subscriber's station, and a lamp before the subscriber's operator, displayed consequent upon the act of withdrawing the plug from the terminal socket of the trunk-line at the toll-board.

The invention further provides a repeating-coil to sever the conductive connection between the subscriber's line and the toll-line, a switch for removing the repeating-coil from the circuit in special cases, and a device operated by that switch to prevent the display of the signal controlled by the relay when the latter is thus rendered inoperative.

The invention involves also certain details of construction whereby the system is simplified, which will be pointed out particularly in the claims.

Our new system of signals is illustrated in the accompanying drawing. Therein two substations, one of which may be a subscriber's station, are represented with lines terminating in suitable appliances in different switchboards, a trunk-line extending between the switchboards, and the usual connecting-plugs at one of them.

The apparatus at the subscriber's station A comprises a transmitting-telephone b and a receiving-telephone b' , a signal-bell b^2 , and a switch b^3 for bringing the appliances into connection with the line-circuit when the receiving-telephone is removed from the switch-hook. The line conductors are led to a spring-jack c in the subscriber's switchboard and thence through the magnet-windings of a signal-controlling relay d to a source of signaling-current e . The subscriber's signaling appliances in the switchboard are not shown in full, since they do not enter into the operation of the present invention. The spring-jack is arranged to sever the line-circuit from these appliances when a plug is inserted into the jack. The apparatus at station A' may be of

different character, being adapted for magneto-call service. In addition to the telephone and the switch-hook before described the station is furnished with a generator b^4 of alternating current for calling the central station. This line also is connected with a spring-jack (designated f) in the switchboard and with an annunciator g , which is disconnected from the line when a plug is inserted into the spring-jack. The spring-jack c and signaling instrument d of the subscriber's line A may be located in a subscriber's switchboard h . The corresponding appliances of the line A', which may be a toll-line, are located in a toll-switchboard h' . Between these switchboards extends a trunk-line 5 6, which terminates in a spring-jack i near the toll-switchboard and in a plug i' in the subscriber's switchboard. The operator at the toll-board is provided with the usual pairs of plugs k and k' , with their plug-circuit for uniting the toll-line and the trunk-line. Associated with the conductors of the trunk-line is a signaling-conductor 9, forming part of a signaling-circuit between the switchboards h and h' . This conductor terminates at spring-jack i in a thimble l and in the plug i' in a sleeve l' , adapted to make connection with the thimble of a subscriber's jack, into which it may be inserted. This thimble of the subscriber's jack (designated l^2) is connected to earth through a conductor 10, including a resistance-coil m . This earth branch from the thimble of the jack of the subscriber's line may form a portion of the signaling-circuits pertaining to the subscriber's line. The plug k' at the toll-board h is also furnished with a sleeve l^3 , which is adapted to register with the sleeve l of spring-jack i when the plug is inserted into the spring-jack. The sleeve l^3 of plug k' is connected by a conductor 11 with the free pole of a grounded battery n . This conductor includes a signal-lamp o and another battery p of similar polarity in the circuit to that of battery n . A shunt 13 is arranged about the lamp-signal o , controlled by a relay q , connected with the circuit of plugs k k' in a way which will be presently be described. This shunt includes a small resistance-coil r . The sleeve l' of plug i' is connected with the free pole of the same battery n by a conductor 12, which includes a signal-lamp o' , associated with the plug i' in the switchboard h' .

The resistance m should be so adjusted with relation to the resistances of lamps o and o' and the electromotive force of battery n that when the circuit through both lamps is closed neither shall receive current sufficient to illuminate it, the effect of battery p in the conductor 11 being for the present disregarded. Under such a condition the interruption of conductor 11 or its disjunction from the conductor 9 of the trunk-line signaling-circuit will cause the diversion of the entire current from battery n through the lamp o' , whereby this lamp will become lighted. Then in this

circuit, the circuit 9 11 being closed, the battery p should have such an electromotive force as to cause the illumination of lamp o , while assisting in the extinction of lamp o' . The resistance r should be sufficient to permit the extinction of lamp o when the conductor 13 is closed at the switch-contacts of the relay. It may have a resistance approximately equal to that of the lamp. Suitable electrical dimensions for these different appliances may be as follows: The battery n may be of twenty volts, the battery p of four volts, the lamps o and o' may be four-volt lamps, taking two-tenths ampere each, the resistance m may be forty ohms, and resistance r twenty ohms.

The operator's plugs at the toll-board h are connected together inductively through the medium of a repeating-coil s , the line-contacts of plug k being connected together by conductors 14 and 15 through one windings s' of the repeating-coil and the similar contact-pieces of plug k' being connected together by other conductors 16 and 17 through a divided winding s^2 , between whose portions a source of current t is interposed. The usual calling-key u is provided for connecting a generator of calling-current with key k' and also a listening-key v for connecting the operator's telephone with the circuit. In addition to these usual keys is a special key w , whose switch-contacts are interposed in the conductors 14 15 16 17. These switch-contacts are so arranged that in the normal position of the key the circuits are as before traced, while in the alternate or occasional position of the key conductors 14 and 16 and conductors 15 and 17 are brought into conductive connection, respectively, the windings s' s^2 of the repeating-coil being disconnected from the circuit. This key is designed for use only when it is desired that the connection made through the plugs shall be free from local grounds and unnecessary appliances, as in long-distance connections or in circuits subject to disturbances which makes conversation difficult. The magnet of relay q is connected in parallel with one of the windings s^2 of the repeating-coil, so as to share with it any current which may flow from battery t through the plug k' and the line with which it may be temporarily associated. The key w carries two switch-contacts w' and w^2 , which become closed together when the key is thrown into position to disconnect the windings of the repeating-coil from the plugs. One of these contact-points is connected with one pole of battery t and the other with one terminal of the relay q in such a way that a path for current from battery t is provided through relay q when the key is thrown into position to disconnect the repeating-coil from the plugs. This is for the purpose of preventing the continuous display of the supervisory signal o at such times, as will be explained at length presently.

The operators at switchboards h and h' may

have the usual instruction or order circuit 16 between their telephones to permit them to communicate orders orally.

In tracing the operation of this system of signals assume that a connection is required from station A' to station A. The operation of the station-generator at the former station causes the display of the line-annunciator *g*, whereupon the operator at the toll-board *h'* inserts plug *k* into spring-jack *f*, brings her telephone into connection with the plug-circuit 14 16 15 17 by means of key *v*, and learns the order for the required connection. She then requests the operator at board *h* by means of the order-wire to connect the trunk-line 5 6 with the required subscriber's line before the latter operator. At the time of giving this instruction to the operator at board *h* the operator at toll-board *h'* inserts plug *k'* into the spring-jack *i* of the trunk-line. Subsequently the operator at board *h*, complying with the instruction, inserts plug *i'* into the spring-jack *c* of the required line. This completes a circuit from battery *t* at the toll-board through conductors 16 and 17 of the plug-circuit, conductors 5 and 6 of the trunk-circuit, and line-wires 1 and 2 of the line to the substation. At the same time it completes a circuit from battery *n* through wires 11, 9, and 10, including battery *p*, in which current circulates sufficient to illuminate the supervisory lamp *o* at the toll-board. As before stated, the electrical conditions of the circuit formed are such that the difference of potential between the terminals of lamp *o'* is insufficient to cause the lighting of that lamp. Since the circuit of the line at the called substation is practically open to a current from battery *t*, the relay *q* remains inert and permits the illumination of supervisory lamp *o*. Hence the displayed condition of this lamp indicates to the toll-operator the condition of the telephones at the substation A. The lighting of the lamp also signifies the completion of the local circuit traced, and hence assures her that the operator at board *h* has completed the connection with the subscriber's line. The operator at the toll-board now sends a calling-current to the station A by means of calling-key *u*. The response of the called subscriber is signaled by the extinction of supervisory lamp *o*, this being accomplished through the excitement of relay *q* by current from battery *t* in the line. As before mentioned, if the connection between stations A and A' be of high resistance or peculiarly subject to disturbances the operator at board *h'* may now withdraw the repeating-coil *s* from the circuit, supervising the connection by means of her listening-key *v* only. The interruption of current from battery *t* through relay *q* to the station A by the severance of connection between the plug-circuit and the repeating-coil would tend to permit the display of supervisory signal *o*; but the local closed circuit which is formed through the relay *q* would prevent such condition. Or-

dinarily, however, the operator leaves the repeating-coil in connection with the plug-circuit. Hence when the telephone at station A is replaced upon its switch at the termination of conversation supervisory signal *o* becomes displayed. This constitutes a signal for disconnection. Accordingly the operator at board *h'* withdraws plugs *k* and *k'* from the spring-jacks into which they are inserted. The act of withdrawing plug *k'* from spring-jack *i* breaks the connection between conductors 11 and 9, and thus removes the cause of the slight difference of potential between the terminals of lamp *o'*. This lamp therefore receives the full current from battery *n* through conductors 12 and 10, whereby the lamp is lighted. Its illumination constitutes a signal to the operator at board *h* to remove the connection, and she accordingly replaces the apparatus in its normal condition.

We claim as new—

1. The combination with two telephone-lines and spring-jacks thereof, plugs in the spring-jacks and a plug-circuit uniting the lines, of a source of current included in the circuit and means for closing the line-circuit at the substation during the use of the telephone, a magnet interposed in the circuit to respond to current therein, and a supervisory signal controlled by the magnet, adapted to be displayed when the magnet is inert, a key constructed to disconnect the said source of current from the plug-circuit when in one position, and switch-contacts associated with the key adapted to alter the circuit determining the display of the supervisory signal to prevent the display thereof, as described.

2. The combination with two telephone-lines, one of which is provided with a switch to close the line-circuit during the use of the telephone, spring-jacks for the lines, plugs in the spring-jacks, and a plug-circuit uniting the plugs, of a repeating-coil having its windings normally interposed in the plug-circuit, a source of current in a bridge of the plug-circuit between said windings, a relay connected with the plug-circuit to respond to current therein from the said source, a local circuit including a supervisory signal-lamp, and a shunt of the lamp adapted to be closed by the switch-contacts of the relay when the relay is inert, a key constructed to disconnect the repeating-coil from the plug-circuit and to complete the connection between the plugs directly, and switch-contacts adapted to close a local circuit through a winding of the relay when the said key is brought into position to cut out the repeating-coil, as described.

3. The combination with a telephone-line extending in two limbs from a substation to a central office, of a spring-jack for the line at the central office, a plug adapted for insertion in the spring-jack to make connection with the line, a plug-circuit having a pair of conductors adapted to be connected with the two limbs of the telephone-line by way of the

plug and spring-jack, a source of current in a bridge of the plug-circuit conductors, a relay in the plug-circuit responsive to current therein, and a switch at the substation for
 5 controlling the flow of current from said source through the plug-circuit and telephone-line, a supervisory signal associated with the plug-circuit, a local circuit including said supervisory signal, closed in registering contacts of the plug and spring-jack,
 10 and a shunt about said supervisory signal controlled by the relay, substantially as described.

4. The combination with a telephone-line
 15 having a switch at the substation adapted to close the line during the use of the telephone, a spring-jack therefor, a plug in the spring-jack, and a plug-circuit therefor, a source of current in a bridge of the plug-circuit and
 20 a relay connected with the plug-circuit to respond to current therein, of a local circuit including a supervisory signal, a shunt about the said supervisory signal including a resistance-coil, said shunt being interrupted at the
 25 switch-contacts of the relay when the relay is inert, as described.

5. The combination in a circuit divided into two parallel branches, a source of current and a resistance-coil in the undivided portion of
 30 the circuit, a signal-lamp in each of said parallel branches, a source of current in one of the branches, and a switch controlling one of said branches, whereby one of the lamps may be extinguished, as described.

6. In combination in a circuit divided into two parallel branches, a source of current and a resistance-coil in the undivided portion of
 40 the circuit, a signal-lamp in each of the branches, a source of current and a switch in one of the branches, a shunt about the signal-lamp in the said branch and a switch controlling the shunt, as described.

7. The combination with a trunk-line and means for making connection between each
 45 end thereof and a subscriber's line, of a signal-circuit including a resistance-coil and a source of current, a signal in the circuit at one terminal of said switchboard, a shunt-circuit about the signal, and switch-contacts
 50 closing the shunt in the act of making connection with the other terminal of the trunk-line, substantially as described.

8. The combination with a trunk-line and means for making connection therewith at
 55 each terminal, of a signal-circuit, a source of current and a resistance-coil included therein, said signal-circuit being divided into parallel branches, a supervisory signal in each of said branches, the supervisory signals be-

ing located at the different ends of the trunk-
 line, switch-contacts adapted to close the signal-circuit when connection is made with one
 60 end of the trunk-line, and other switch-contacts closed together in the act of making connection with the other terminal of the trunk-
 65 line, said last-mentioned switch-contacts being included in the circuit with the signal at the same terminal, and a source of current in the branch with said last-mentioned signal,
 70 substantially as described.

9. The combination with telephone-lines provided with means for creating current in the lines during the use of the station-tele-
 phones, of a trunk-line for uniting the lines, a signal-circuit associated with the trunk-
 75 line including a source of current and a resistance-coil and divided into two parallel branches, a supervisory signal in each of the branches, the signals being located at different
 80 terminals of the trunk-line, switch-contacts adapted to close the signal-circuit through registering contacts brought into connection in uniting the trunk-line with the
 subscriber's line at one terminal, other switch-
 85 contacts closed together in making connection with the other terminal of the trunk-line controlling the branch including the supervisory signal at the same terminal, a
 source of current in the last-mentioned
 90 branch, a shunt about the signal in the same branch, and a relay responsive to the currents determined by the display of the sub-
 station apparatus of the telephone-line, substantially as described.

10. The combination with a telephone-line
 95 and means for making connection therewith at two or more points, of a local conductor forming part of a circuit including a source of current together with a resistance-coil,
 said local circuit being divided at one point
 100 into parallel branches, one of said branches being normally open, a signal-lamp in each of the branches, registering contacts of a
 plug and spring-jack in the normally open
 105 branch, and a source of current in one of the branches, whereby the insertion of the said plug in the spring-jack changes the current in the signal-lamp connected with the local
 conductor at the distant point, as described.

In witness whereof we hereunto subscribe
 110 our names this 21st day of November, A. D. 1896.

FRANK R. McBERTY.
 JAMES L. McQUARRIE.

Witnesses:

ELLA EDLER,
 DUNCAN E. WILLET.