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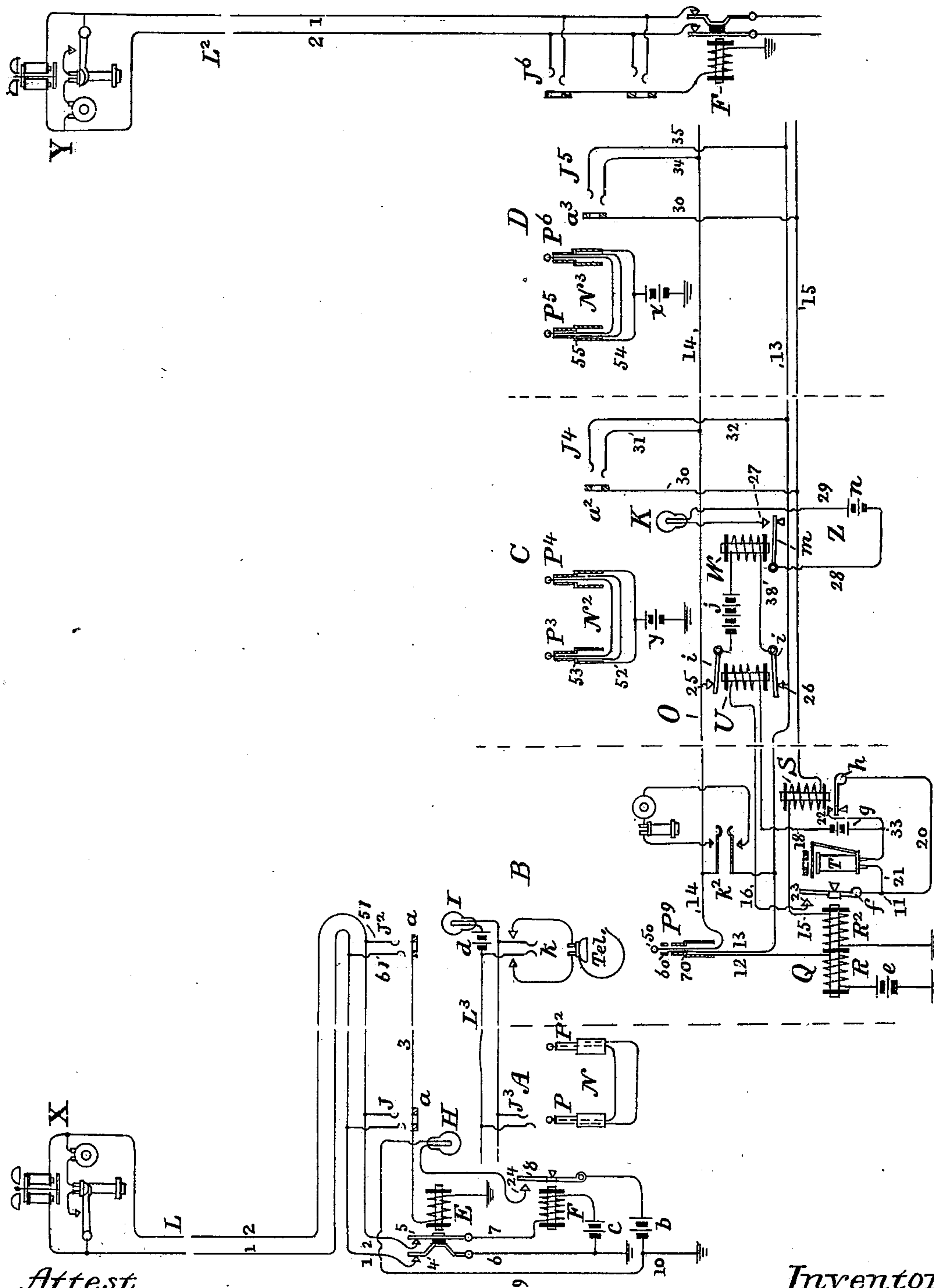
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TELEPHONE TOLL CIRCUIT.

(Application filed May 25, 1898.)

(No Model.)



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TELEPHONE TOLL-CIRCUIT.

SPECIFICATION forming part of Letters Patent No. 626,146, dated May 30, 1899.

Application filed May 25, 1898. Serial No. 681,724. (No model.)

To all whom it may concern:

Be it known that we, HENRY M. CRANE, residing at Boston, in the county of Suffolk, and THOMAS C. WALES, Jr., residing at Newton, in the county of Middlesex, State of Massachusetts, have invented certain Improvements in Telephone Toll-Circuits, of which the following is a specification.

The present invention relates to toll trunking-circuits which extend between operators in the same central station or between two telephone central stations, whereby the substation-circuits associated with the said station or stations may be placed in electrical connection with each other.

The invention is described in connection with the type of substation-circuits known as "relay-circuits," in which the current-supply for the substation calling apparatus and telephone-transmitters is located at the central office and wherein the signals between the different stations and operators are automatically operated. In such trunking-circuits the mode of operation is as follows: The subscriber wishing a toll connection removes his telephone from its switch, which, automatically actuated, closes the circuit, causing the line lamp-signal at the central station to be lighted. The subscriber's operator takes the call in the usual manner by inserting the answering-plug of a cord-circuit into the jack of the circuit and then inserts the other plug of the cord-circuit in the jack of an order-circuit extending to the switching operator's table, thereby causing a signal-lamp to be lighted at said table. The latter operator, listening at the order-circuit, takes the details of the call from the subscriber and then inserts the terminal plug of the toll trunk-circuit in the jack of the subscriber's circuit, which is multiplied to her table, after which the connections with the order-circuit are taken down. The toll operator is now informed by a ticket or otherwise of the number of the called substation and of the number of the trunk plugged to the calling-circuit, and it is her duty to make the connection with a cord-circuit. Now if for any reason the toll operator fails or delays in making

the connection the calling subscriber meanwhile has no means for attracting the attention of any operator and must wait until the connections so far made are taken down and his circuit restored to its normal condition before he can again signal an operator.

The object of the present invention is to provide means for overcoming this defect in the operation of the circuits and to render it at all times possible for the subscriber to signal to an operator and have the trouble rectified.

The invention also provides means whereby any substation-circuit will test "busy" at all of the operators' tables to which it is multiplied when a toll-circuit has been plugged thereto whether the called-for-substation circuit has been completely connected or not.

The means whereby the invention is carried out will now be fully described, and pointed out in the appended claims.

The drawing, to which reference is made, is a diagram illustrative of the invention and shows two substation-circuits X and Y, terminating at a central station. Each circuit consists of the conductors 1 and 2, provided with jacks J² and J, multiplied at the tables of the operators, the conductors at the latter jack normally continuing by armature-levers 4 and 5 and wires 6 and 7, which are closed to one another and form a grounded loop, which includes the relay F and battery c. The armature 8 of relay F and its front contact 24 are connected by the conductor 9, which includes battery b and the line lamp-signal H, while a branch 10 connects wire 9 to ground. Wire 3 connects the test-rings a a to ground through the relay E. Both substation-circuits are alike; but only a portion of L² is shown.

O represents a toll trunk-circuit terminating at the end where the call is initiated in the plug P⁹, from whose tip and sleeve contacts extend, respectively, the wires 14, 13, and 12. The wires 13 and 14 constitute (when the trunk is connected up) the talking-circuit, and between them are bridged the listening-key k² and the branches 31 and 32 and 34 and 35, leading to the jacks J⁴ and J⁵. The

wire 12 extends to ground through helix R of relay Q and battery *e*, while the helix R² of said relay is connected to ground on one side and to wire 15 on the other side. The said wire includes the relay S and has branches 30 to the test-rings of the jacks J⁴ and J⁵. The armature *f* of relay Q is connected by wire 20 with the armature *h*, and from point 11 on wire 20 a wire 21 extends to the front contact 22 of armature *h*, including in its circuit the signal T. A wire 18 connects with wire 21 at point 33 and also with one side of the relay U, from whose other side wire 16 extends to the front contact 23 of armature *f*. The wire 18 includes battery *g*.

The relay U has two armatures *i i*, or armature-contacts normally retracted to their back contacts 25 and 26, which are connected, respectively, with the conductors 14 and 13. A wire 38 unites the two armatures *i i* and includes serially the battery *j* and relay W. The armature *m* of relay W is connected by the wire 28 with the grounded wire 29, having in its circuit battery *n* and lamp-signal K, controlled by the armature *m*.

L³ is an order-circuit between the subscriber's operator and the switching operator and is provided at the former table with jack J³ and at the latter section with lamp-signal I, battery *d*, listening-key *k*, and telephone.

We have designated the different operators' tables or sections as A B C D and have spaced off the apparatus and circuits by dotted lines.

In the operation of the invention, supposing that the subscriber at X wishes a toll connection, he removes his telephone from its hook-switch, which rises, closes the circuit through the battery *c*, and energizes the relay-magnet F, which by attracting the armature S to its contact 24 closes the local circuit 9 and lights the lamp-signal II. The operator at A inserts plug P of cord-circuit N into the jack J of the substation-circuit and receives the call and then inserts the other plug P² into jack J³ of the order-circuit L³, closing the same and lighting the lamp-signal at the table B of a switching operator, who depresses the listening-key *k* in the order-circuit and takes the call from the subscriber. The number of the substation wanted, together with the number of the trunk O, may be noted upon a ticket and transferred to the toll operator at section D, who accordingly completes the connection. This information may be conveyed to the toll operator by an order-circuit or by any other suitable means. The switching operator at B also inserts plug P⁹ into jack J² of the calling-substation circuit, and its tip 50 makes connection with the jack-spring 51, the sleeve-contact 60 makes connection with the spring 61, and the sleeve-contact 70 connects with the test-ring *a*, and a current of, say, one-tenth of an ampere flows from battery *e* through winding R of relay Q, wire 12, sleeve-contact 70, test-ring *a*, and cut-off relay E to ground. This flow of current is insufficient to cause the relay Q to attract its armature *f*,

but serves to charge the busy-test wire 3 of the substation-circuit throughout the switch-board and to attract armature-levers 4 and 5, thus breaking the circuit from conductors 1 and 2 through battery *e*. The switching operator after receiving the subscriber's call asks him to replace his telephone upon its hook, stating that he will be called when the connection is ready. Now if the instruction-ticket mentioned should be lost or for any reason the toll operator delays in making or fails to make the connection the waiting subscriber may call the attention of the operator at the C section to such neglect in the following manner: After waiting a due time without being called he lifts the telephone from the hook, and current flows from the battery *j*, conductor 38, upper armature *i* of relay U, conductor 14, tip 50 of plug P⁹, line-spring 51, conductor 2 of circuit L, and back by conductor 1, line-spring 61, sleeve-contact 60 of the plug, conductor 13, lower armature *i* of relay U, wire 38, and relay W. This current causes the relay W to attract its armature *m* to its contact 27, closing the local circuit Z and lighting the lamp guard-signal K. To answer the signal, the operator at C, who may be the chief operator, inserts plug P³ of the cord-circuit N² into the trunk-jack J⁴, and current flows from battery *y* in said cord-circuit via conductor 52, sleeve-contact 53, test-ring *a*², wires 30 and 15, relay S, and winding R² of relay Q to ground. The resistances of this circuit are so proportioned that two-tenths of an ampere will flow through it, causing the armature *f* of relay Q to be drawn up to the contact 23 and the armature *h* of relay S to be drawn up to its contact 22. When the armatures *f* and *h* are thus drawn up, current flows from battery *g* through wire 18, cut-off relay U, wire 16, armature *f*, wire 21, and signal T to battery; but as the signal T is shunted by the wire 20, connecting point 11 with armature *h* and point 33, the signal T is not operated, the current from battery *g* energizes relay U, and the armatures *i* are drawn thereto and away from their contacts 25 and 26, whereupon the armature *m* falls away from contact 27, and the lamp-signal K is extinguished. The relay U by drawing armatures *i i* away from contacts 25 and 26 removes the bridge connection between conductors 13 and 14 by way of said armatures, battery *j*, relay W, and wire 38. Said bridge connection, if not moved or rectified, would constitute an obstruction in the talking-circuit between the operator D and the subscriber X. The chief operator can now communicate with the subscriber and remedy the trouble. If the said ticket has not been destroyed or lost while on its way from the switching to the toll operator or if the call is attended to in due course, the toll operator inserts plug P⁵ of cord-circuit N³ into the jack J⁵ of the designated truck-circuit, and current from battery *x* flows via cord 54, plug-contact 55, test-ring *a*³, wires 30 and 15, relay S, and winding R² of relay Q. The

armatures *f* and *h* of relays Q and S are drawn up, and current from battery *g* operates relay U, but does not operate signal T, the results being the same as described of the act of inserting plug P³ into the jack J⁴. The relay U by drawing its armatures *i i* away from contacts 25 and 26 removes the bridge connection between conductors 13 and 14 by way of said armatures, battery *j*, relay W, and wire 38. Said bridge connection, if not removed or rectified, would constitute an obstruction in the talking-circuit finally established between the subscribers. The toll operator now inserts the second plug P⁶ of the cord-circuit into jack J⁶ of the called-for line and proceeds to complete the connection in a well-known manner. The disconnecting-signal for the circuit thus made up is in the cord-circuit N³ of the toll operator, and when this is operated by either subscriber hanging his telephone on its hook the said operator withdraws the plug P⁶ from the jack J⁶ and plug P⁵ from jack J⁵. Current then ceases to flow through relay S and winding R² of relay Q, and armature *h* of the former relay falls back; but the armature *f* of relay Q remains attracted, for while the current from battery *e* is not strong enough to attract armature *f* it is sufficient to hold it up. When the armature *h* fell away from contact 22, the portion of current from battery *g* which flowed in the shunt 20 was united to that flowing through the signal T, which caused the signal to operate and indicate to the switching operator at B that the circuit is to be disconnected. She therefore withdraws the plug P⁹ from the jack J², and thereupon the armature *f* of relay Q falls away and opens the circuit, including the signal T and the relay U, which then resume their normal positions.

The invention has been described in association with a toll-circuit O, by means of which the substation-circuits L and L² are directly connected with each other; but it will be understood that if the circuit O should be connected to an outgoing toll-line terminating at a distant point, which line should then be connected with a substation-circuit, such an extension would be within the scope of the invention and it is indeed our purpose to thus employ it.

We claim as our invention—

1. The combination with a toll trunking-circuit, multiplied to a plurality of switchboard-sections, provided with means for connecting two substation-circuits together and to energize their test-circuits and also its own; of an automatic disconnecting-signal at the first of said sections; and means at the second section, whereby when a calling-substation circuit has been connected to the trunking-circuit the subscriber at the substation is enabled to signal the operator at said section, substantially as and for the purpose set forth.

2. The combination in a toll trunking-circuit multiplied to a plurality of switchboard-sections, provided with means for connecting

two substation-circuits together, and to energize their test-circuits and also its own; of an automatic disconnecting-signal at the first of said sections; with means at the second section, whereby when a calling-substation circuit has been connected to the trunking-circuit the subscriber at the substation is enabled to signal the operator at the said section, said means consisting of a normally-closed shunt between the main conductors of the trunk-circuit including a battery and a relay, the latter adapted to close a local circuit and operate a signal, substantially as specified herein.

3. The combination in a toll trunking-circuit multiplied to a plurality of sections at which sections three distinct operative functions are performed; of means at the first section for receiving a call from a substation and for switching the trunk-circuit thereto, means at the second section for rectifying obstructions in the circuit so made up, and means at the third section for connecting the trunk-circuit to the called-for circuit; with an automatic disconnecting-signal at the first section, as set forth.

4. The combination in a toll trunking-circuit multiplied to a plurality of switchboard-sections at which sections three distinct operative functions are performed; of means at the first section for receiving a call from a substation, for switching the trunk-circuit thereto, and for energizing its test-circuit, means at the second section for rectifying obstructions in the circuit so made up consisting of a signal adapted to be operated by the calling-substation, and an operators' telephone outfit, and of means at the third station for connecting the trunk-circuit to the called-for-substation circuit and for energizing its own and the said substation-circuits test-circuit, substantially as set forth.

5. The combination with a toll trunking-circuit multiplied to a plurality of switchboard-sections provided with means for connecting two substations together consisting of a plug-terminal at one section, and a spring-jack and cord-circuit at another section, and with means at both sections to energize the several test-circuits concerned; of means for operating a disconnecting-signal at the first section, the said means consisting of a double-wound relay, one winding of which is connected from ground through a battery to the testing contact of the said plug, the second winding being connected through an auxiliary relay to the test-conductor of the trunk, said relay being adapted to render the disconnecting-signal inoperative when the called-substation circuit is connected to the trunk, and to cause it to become operative when the said circuit is disconnected therefrom.

6. The combination in a toll trunking-circuit multiplied to a plurality of switchboard-sections, of means at the first section for receiving a call from a substation, and for switching the trunk-circuit thereto, and for

energizing the test-circuit thereof, and also for receiving a disconnecting-signal, the same consisting of a three-contact plug-terminal, and a double-wound relay, one winding of
5 which is connected from ground through a battery to the test-ring contact of the plug, the other winding being connected through an auxiliary relay to the test-conductor of the trunk and adapted to operate a disconnect-
10 ing-signal; means at the second section for rectifying obstructions in the circuit so made up, and means at the third section for connecting the trunk-circuit to the called-for-substation circuit; for rendering the said dis-
15 connecting-signal inoperative and for causing it to become operative when the said circuit is disconnected, as set forth.

7. The combination in an organized telephone-circuit, of a substation-circuit multiplied to a plurality of switchboard-sections
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and provided with an automatic line-signal; a toll trunking-circuit having a plug-terminal at its call-receiving section, terminal switches at a plurality of switchboard-sections, and means for connection with a called- 25 for substation; with means at an intermediate switchboard-section, whereby when a calling-substation circuit has been connected to the trunking-circuit, the subscriber at the substation can signal the operator at said section; as set forth. 30

In testimony whereof we have signed our names to this specification, in the presence of two subscribing witnesses, this 12th day of May, 1898.

HENRY M. CRANE.
THOMAS C. WALES, JR.

Witnesses:

GEO. WILLIS PIERCE,
FRANK C. LOCKWOOD.