No. 833,907. PATENTED OCT. 23, 1906.

J. G. WRAY, H. T. GARDNER & W. G. KINTON.

SIGNALING APPARATUS FOR TELEPHONE TOLL LINES.

APPLICATION FILED JULY 3, 1905.

2 SHEETS—SHEET 1.

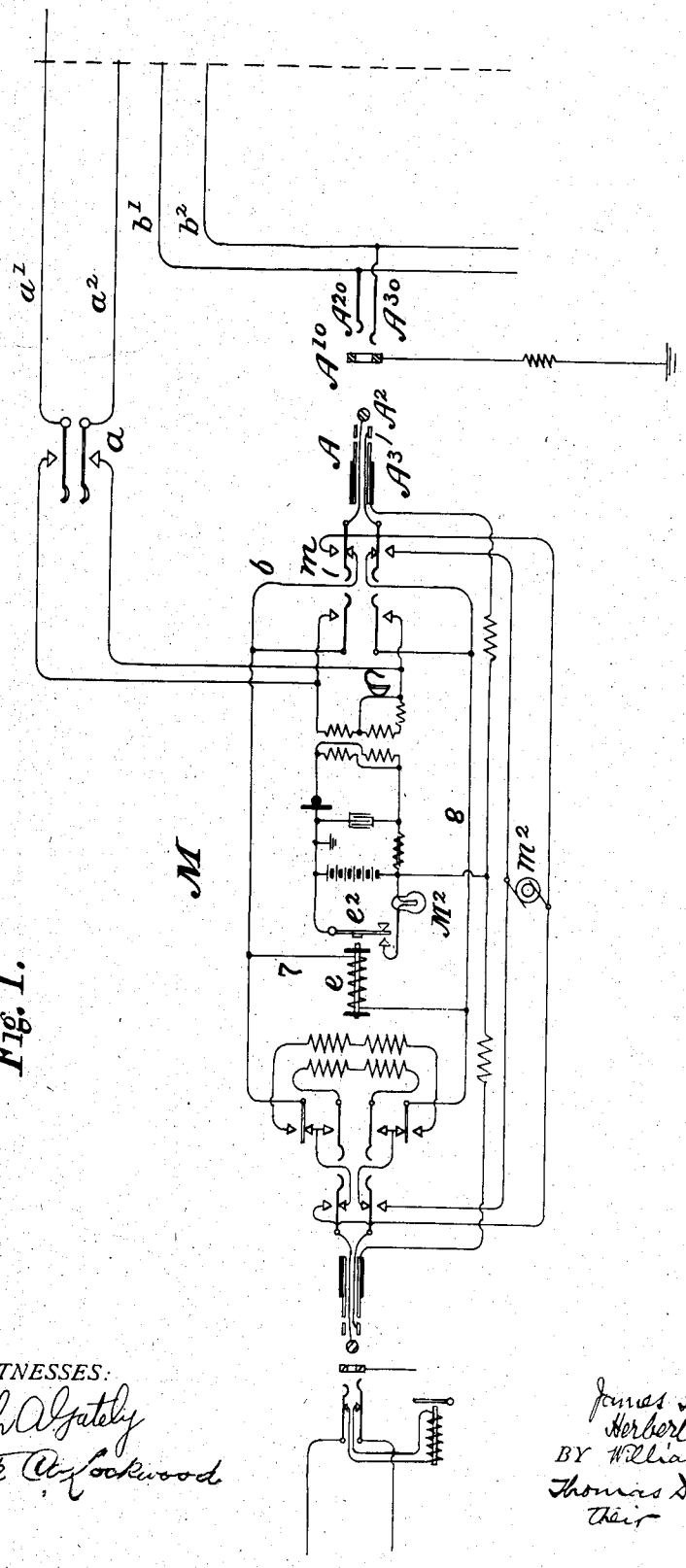

Fig. 1.

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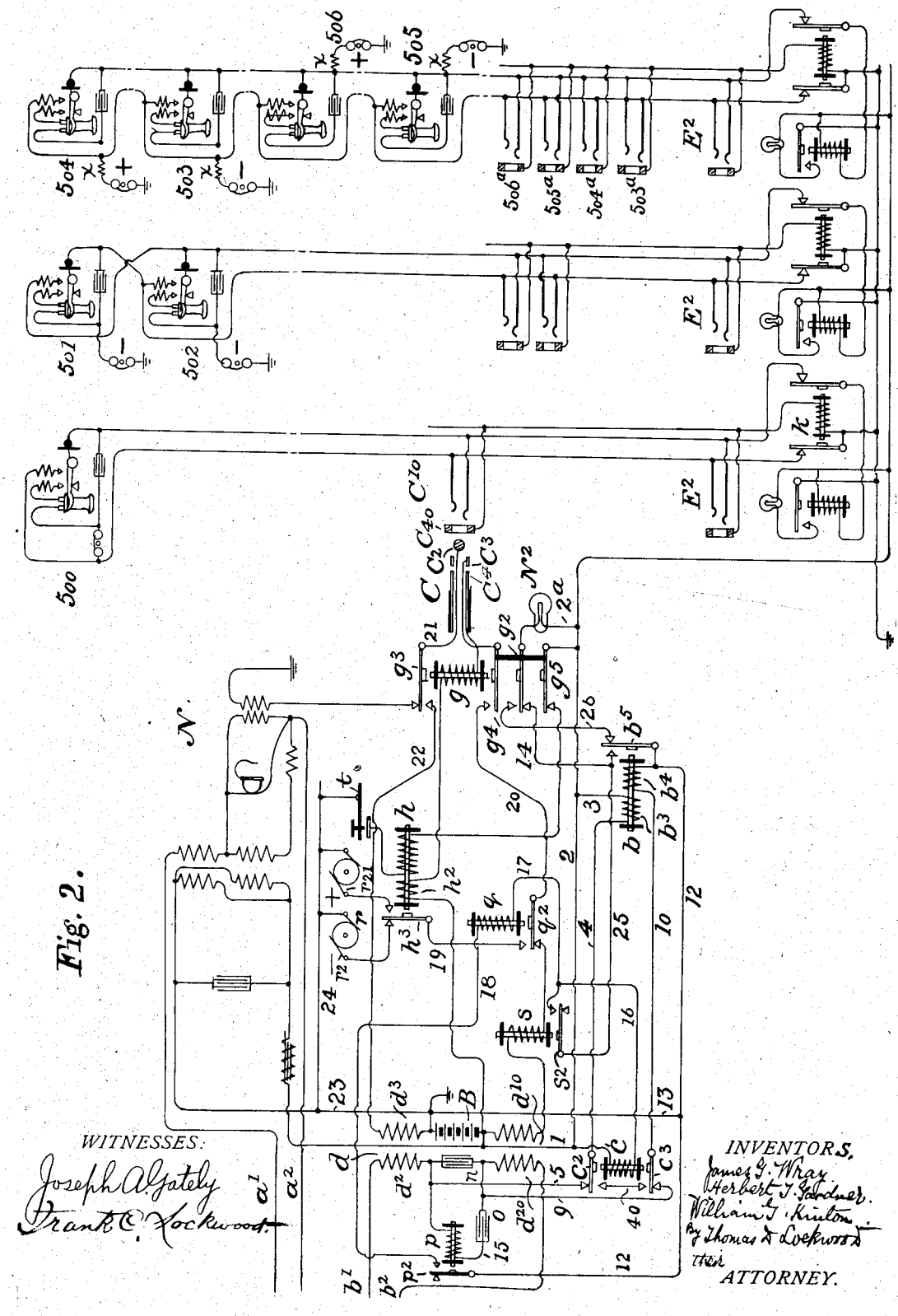

Fig. 2.

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SIGNALING APPARATUS FOR TELEPHONE TOLL-LINES.

No. 833,907. Specification of Letters Patent. Patented Oct. 23, 1906.

Application filed July 3, 1905. Serial No. 268,216.

To all whom it may concern:

Be it known that we, JAMES G. WRAY, residing at Chicago, HERBERT T. GARDNER, residing at Maywood, and WILLIAM G. KINTON, residing at Chicago, in the county of Cook and State of Illinois, have invented certain Improvements in Signaling Apparatus for Telephone Toll-Lines, of which the following is a specification.

The present invention relates to a telephone-exchange system, and is mainly embodied in the call signaling and supervisory signaling devices used in connection with toll-lines.

In accordance with the invention the call signaling system for the station wanted is adapted for use with one, two, or four party lines, the selection of the station on a party-line being under control of the operator at the called central station, while the actual operation of sending out the signal is under the control of the operator at the calling central station.

The selective signaling system shown is that in which multiple jacks are employed on the party-lines and the signals branched from opposite sides of the line to a third conductor or ground connection, while the spring-jack connections are reversed, so that in two-party lines no change of direction in the signaling-current is required.

In connection with four-party lines the two signals which are branched from the same side of the line are arranged to respond to pulsating currents flowing in opposite directions, and an electromagnetic pole-changing switch is employed at the called central station, which is under the control of a key at said station.

The supervisory signals are so arranged as to cause the signal at the calling central station to be displayed when the connection is made with the called station and to be retired when the called subscriber takes down his receiver. At the called central station the supervisory signal is displayed upon the insertion of the plug in the jack at the calling-station and retired upon the insertion of the plug in the jack of the called subscriber's line. When conversation has been finished and the called subscriber has hung up his receiver, the supervisory signal is displayed at the calling central station, and upon the removal of the plug at that station the signal at the called central station is displayed and is finally retired upon the removal of the plug at the latter station.

Figure 1 is a diagram of the cord-circuit at the calling central station or toll operator's station, and Fig. 2 is a diagram of the cord-circuit at the called central station where the wanted subscriber's line is connected. It is to be understood in tracing the circuits, in connection with the following description, that the conductors a' and a^2 and b' and b^2 in Fig. 2 are continuations, respectively, of the conductors similarly characterized in Fig. 1.

In describing the apparatus and its operation the successive acts of the central-station operators and the subscribers will be followed, beginning with the part performed by the toll operator after receiving a call for connection with a substation at another central station.

The toll operator's station, which will be hereinafter designated as station M, is shown in Fig. 1. Upon receiving a call for a subscriber whose line is connected with another central station, such as that shown in Fig. 2 and hereinafter referred to as station N, the operator at station M first presses the key a, connecting her telephone, through the conductors a' and a^2, with the operator's telephone at station N, and asks for the assignment of a trunk. Assuming that the trunk represented by the conductors b' and b^2 and the cord set shown in Fig. 2 is the one assigned, the operator at station M places the plug A in the jack A^{10}, thereby connecting her cord set with the cord set at station N. This establishes a circuit supplied with current from the battery B at station N, which circuit passes through conductors 1, 2, and 3 to the coil b^3 of relay b, conductor 4, armature c^2 of relay c, conductor 5, winding d^2 of induction-coil d, conductor b', short spring A^{20} of jack A^{10}, tip-terminal A^2 of the plug A, conductors 6 and 7, winding of relay e, conductor 8, ring A^3 of plug A, spring A^{30} of jack A^{10}, conductor b^2, winding c^{20} of induction-coil d^{10}, conductor 9, armature c^3 of relay c, conductor 10, winding b^4 of relay b, and conductors 12 and 13 back to the battery. This attracts the armature e^2 of relay e at the sta-

tion M, thus closing the circuit through the supervisory signal M^2 at station M. It also causes the attraction of the armature b^5 of the relay b, thereby closing a circuit through conductors 1, 2, and 2^a, armature g^2 of relay g, conductor 14, armature b^5, and conductors 12 and 13 back to the battery B, thus lighting the supervisory lamp N^2 at station N. The lighting of the lamp N^2 notifies the operator at station N that connection has been made with the proper trunk, and she then tests to ascertain if the line wanted is busy, the ordinary busy-test arrangement being shown as connected with the tip of the plug C through the armature g^3 of the relay g. If the line wanted is not busy, the plug C is then inserted in the proper jack—for example, the jack C^{10} on the single-party line, which is represented as leading to station 500. Upon the insertion of the plug in the jack the usual local circuit is closed through the sleeve C^4 and frame C^{40}, this circuit including a winding h^2 upon a relay h, the winding of the relay g, and the winding of the cut-off relay k. This energizes the cut-off relay k and the relay g, but does not cause the operation of the armature h^3 of relay h, since the coil h^2 is merely a retaining-coil, the purpose of which will be hereinafter described in connection with the selective signaling of a four-party line. The energization of the relay g causes the armatures g^2, g^3, g^4, and g^5 to be attracted, the attraction of the armature g^2 breaking the circuit through the supervisory lamp N^2 and retiring this signal. At the same time the armature g^2 establishes a circuit through the lamp N^2, which is under the control of relays b and c, as will be hereinafter described.

The signal to the called subscriber is under the control of the operator at station M, the selection of the signal, however, in connection with party-lines being under the control of the operator at station N, as will be hereinafter described. In signaling the called subscriber the operator at station M presses the key m, thereby connecting the terminals of a generator m^2 to the conductors b' and b^2, respectively, the generator-current in this case, however, being utilized not for direct signaling, but for controlling circuits at station N, whereby a signal is sent to the proper subscriber from the generator at the latter station. It is to be understood, of course, that the signaling-generator at station M is merely used for convenience in this connection, so that the same key can be used for direct signaling, if desired. So far as relates to the operations at station N any other source of current under the control of the operator at station M would answer the purpose equally well. Starting with the conductor b^2, the circuit from the source of current or generator m^2 may be traced to the winding d^{20} of the induction-coil d^{10}, after passing through which it divides, one branch leading directly through the condenser n and winding d^2 back to the generator through the conductor b', another branch leading through condenser o, conductor 15, and relay p, through the coil d^2 to conductor b', &c., while still a third path for the current is afforded through conductor 9, armature c^3, conductor 10, winding b^4, conductor 12, conductor 13, battery B, conductors 1, 2, and 3, winding b^3, conductor 4, armature c^2, conductor 5, winding d^2 of the induction-coil d, and conductor b'. The latter or third circuit is, however, only momentarily closed and is at once superseded by a circuit through battery B, which includes conductors 1 2 3, winding b^3, conductor 4, armature c^2, conductor 40, armature c^3, conductor 10, winding b^4, conductors 12 and 13 to battery B. The second of the above-described circuits energizes relay p, thus maintaining the attraction of the armature p^2, while the last-named circuit through battery B maintains the attraction of the armature b^5. The attraction of the armature p^2 closes a circuit through the relay q, which passes through conductor 1, relay c, conductor 16, conductor 17, winding of relay q, conductor 18, armature p^2, and conductors 12 and 13 back to the battery B. The closing of this circuit causes the attraction of the armature q^2, thereby causing current to flow from the generator r over conductors 19 and 20 to the ring C^3 of the plug C and thence over the line and through the signal at station 500 and back to the tip C^2 of said plug, the conductors 21 and 22, winding d^3 of induction-coil d, and conductors 23 and 24 to the generator.

Upon the release of the key m at station M the relay p becomes deënergized, thus breaking the circuit through the relay q and releasing the armature q^2, so that the signaling-circuit to the called substation is broken, the release of the said armature also completing the talking-circuit through the induction-coil windings and battery. When the subscriber at the substation takes down the receiver, thereby short-circuiting the associated condenser and signal, the current in the talking-circuit flows through the relay s, thus causing the attraction of the armature s^2, which completes a circuit from battery B through conductor 1, relay c, conductor 16, armature s^2, conductor 25, armature b^5, and conductors 12 and 13 back to the said battery. The consequent attraction of the armatures c^2 and c^3 breaks the circuit previously traced through the relay e at station M, so that the supervisory signal M^2 is retired, thus notifying the operator at said station that the proper connection has been made and the receiver taken down. In order to maintain the armature b^5 of the relay b attracted for the purpose of controlling the signal N^2, the armatures c^2 and c^3 are arranged to close a circuit from the battery B,

including the windings of the relay *b*, this circuit being through the conductors 1, 2, 3, and 4, armatures c^2 and c^3, connected together when attracted by the conductor 40, conductor 10, winding b^4, conductors 12 and 13 back to the battery. The maintenance of the armature b^5 is necessary for the purpose of closing a circuit through the supervisory signal N^2, which circuit is controlled, as will be hereinafter described, from the station M prior to the removal of the plug C from the jack at station N.

When the subscriber at the called substation hangs up the receiver, thereby cutting out the conductive connection between the two lines, the relay *s* becomes deënergized, and the armature s^2 thereof falls back, thus breaking the circuit through the relay *c*, so that the armatures c^2 and c^3 are released and return to their back contacts. This reëstablishes the circuit through the conductors 1, 2, 3, 4, and 5, *b'*, 6, 7, relay *e*, &c., previously traced, and causes the attraction of the armature e^2, so that the supervisory signal M^2 is established. The operator at station M is thus informed that conversation has been finished and removes the plug A from the jack A^{10}. This breaks the circuit through the relay *b*, which circuit was originally established at the first insertion of the plug and which has been restored to its first closed circuit connections by the deënergizing of the relay *c* due to the hanging up of the receiver at the called substation, as described. The relay *b* is thus finally deënergized, and the armature b^5 returns to its back contact, as shown in the drawings, thus connecting the conductor 12 with a conductor 26, which completes a circuit through the supervisory lamp N^2, including the conductors 1 2, armature g^2, conductor 26, armature b^5, and conductors 12 and 13. The supervisory signal N^2 is thus displayed, informing the operator at station N that the operator at the other station has disconnected the line, and the plug C is then removed, deënergizing the relay *g* and breaking the circuit through the supervisory lamp N^2 by the action of the armature g^2. This restores everything to normal condition at both stations ready for a new connection.

It will be seen from the foregoing description that the relays *b* and *c* cooperate to control the supervisory signals at the two central stations, the relay *c* when operating to control the signal M^2 also serving to control a circuit through the relay *b*, so as to maintain the armature thereof in such position as to control the signal N^2, so that the said signal will be responsive to the operation of withdrawing the plug from the jack at station M. Relay *b* is energized when the plug A is first inserted at the calling central station, thus closing a circuit which depends for its continuity upon the deënergization of relay *c*. Relay *c* then becomes energized, but in so doing closes another circuit through relay *b*. Under these conditions while relay *b* is still in condition to control the signal N^2 the relay *c* has been placed in condition to control the signal M^2 in response to the hanging up or the receiver at the called substation. After the operation of the relay *c*, due to the hanging up of the receiver, the circuit through the relay *b* is the same as that originally established upon the insertion of the plug A at station M and the plug C at station N, so that upon the removal of the plug A the said relay will be deënergized, causing the signal N^2 to be displayed.

The calling and supervisory signaling systems above described may be utilized in connection with two and four party lines at the same central office, as well as with single-party lines, the multiple-jack, or jack per station system, being herein shown as employed for the purpose. In the case of a two-party line—for example, the line shown as having the stations 501 and 502 located thereon—spring-jacks having reversed connections are employed, and the signals branched to ground from the opposite sides of the line. In this case the operator at station N has nothing to do except place the plug in the right jack of the two-party line in order to select the substation to be called. In the four-party line the bells bridged to ground on the same side of the line are arranged to respond to current flowing in opposite directions, and in connection with the jacks of the four-party line a key *t* is employed, which controls a local circuit through the relay *h*, said relay constituting an electromagnetic pole-changing switch.

In the position shown in Fig. 2 the signaling-current, the circuit for which was previously traced in describing the signaling of station 500, is assumed to pass from the negative brush r^2 of the generator *r* and consists of negative impulses. If the station required has a signal which will respond to current flowing in the opposite direction, as is the case with stations 504 and 506, the key *t* is employed and manipulated prior to the insertion of the plug C in the proper jack, thus closing a local circuit through the main coil of the relay *h* and causing the armature h^3 thereof to be attracted. Starting from the positive brush or generator-pole—r^{21} in this case—the path of the positive signaling-current may be traced through armature h^3 of relay *h*, conductor 19, armature q^2 of relay *q*, conductor 20, armature g^4, ring contact C^3 of the switch-plug C, the long contact-spring of jacks 504^a or 506^a, as the case may be, and their corresponding main conductors to the call-bell at the wanted substation, appropriately adjusted to respond to plus currents transmitted over one or the other of said main conductors, the said bell, with its asso-

ciated resistance x, being connected in an earth branch of its main conductor, thence by earth return and central-station conductors 23 and 24 to the opposite brush or pole of the generator. The circuit through the main coil of the relay h is broken upon the attraction of the armature g^5 when the plug C is inserted; but the supplemental coil h^2 is capable of creating sufficient magnetism to maintain the armature h^3 attracted, so that it is necessary, therefore, for the operator to depress the key t prior to the insertion of the plug C in the jack, releasing the said key as soon as the said plug has been inserted. This selective signaling system forms no part of the present invention, and it is believed, therefore, that no further description is required.

It is to be understood, of course, that the drawing is a conventional illustration of the system, the relays being shown where the control of two or more circuits is involved as provided with two or more armatures. In practice each relay may be and usually is provided with a single armature adapted to actuate such contacts as may be necessary for the control of the several circuits.

In order to avoid any possibility of misunderstanding, it may be stated that the lowermost jack E^2 of each set of jacks shown in the drawings is the answering-jack for the line to which it belongs, the operation of said answering-jacks not being referred to, since no novelty is involved, the jacks being shown simply to complete the illustration of the system in general.

What we claim is—

1. In a telephone system, a calling central station; a called central station; a supervisory signal at the calling central station; a relay controlling the operation of said signal; a circuit-controller for said relay located at the called central station; a relay for said circuit-controller; a circuit for said relay including the substation line-circuit; a supervisory signal at the called central station; a circuit-controlling relay therefor; a circuit for said relay including the calling central-station line-circuit, and a branch circuit thereof for said supervisory signal at the called station, the energization of said circuit-controlling relay being maintained until the plug and jack at the calling-station have been separated.

2. In a telephone-exchange system, a calling central station; a source of current at said calling central station; a called central station; a source of signaling-current at said called central station; a circuit for said source of signaling-current; a relay controlling the circuit for said source of signaling-current; a circuit for energizing said relay; a circuit-controlling relay for said circuit; means for closing a circuit from the source of current at the calling central station through said relay; a supervisory-signal relay, the coils of which are included in the same circuit, and a supervisory signal in a branch of said circuit and controlled by said relay.

3. In a telephone-exchange system, a calling central station; a source of current at said calling central station; a called central station; a source of signaling-current at said called central station; a circuit for said source of signaling-current; a relay controlling the circuit for said source of signaling-current; a circuit for energizing said relay; a circuit-controlling relay for said circuit; means for closing a circuit from the source of current at the calling central station through said relay; a supervisory-signal relay, the coils of which are included in said circuit; a supervisory signal in a branch of said circuit and controlled by said relay a supervisory-signal relay at the calling central station; a circuit-controller for said relay located at the called central station and in operative relation with the called-substation line-circuit; said first-named supervisory-signal relay and said controller cooperating to control the supervisory signals at the two central stations.

4. In a telephone system, a calling central station; a called central station; a supervisory signal at the calling central station; a relay controlling the operation of said signal; a circuit-controller for said relay located at the called central station; a relay for said circuit-controller; a circuit for said relay including the substation line-circuit; a supervisory signal at the called central station; a circuit-controlling relay therefor; a circuit for said relay including the calling central-station line-circuit, and a branch circuit thereof for said supervisory signal at the called station; the energization of said circuit-controlling relay being maintained until the plug and jack at the calling-station have been separated; and means for retiring said last-named signal upon the insertion of the plug in the jack of the called subscriber's line.

In testimony whereof we have signed our names to this specification, in the presence of two subscribing witnesses, this 28th day of June, 1905.

JAMES G. WRAY.
HERBERT T. GARDNER.
WILLIAM G. KINTON.

Witnesses:
MARION A. REEVE,
GEORGE E. CHIPMAN.