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TELEPHONE SYSTEM.

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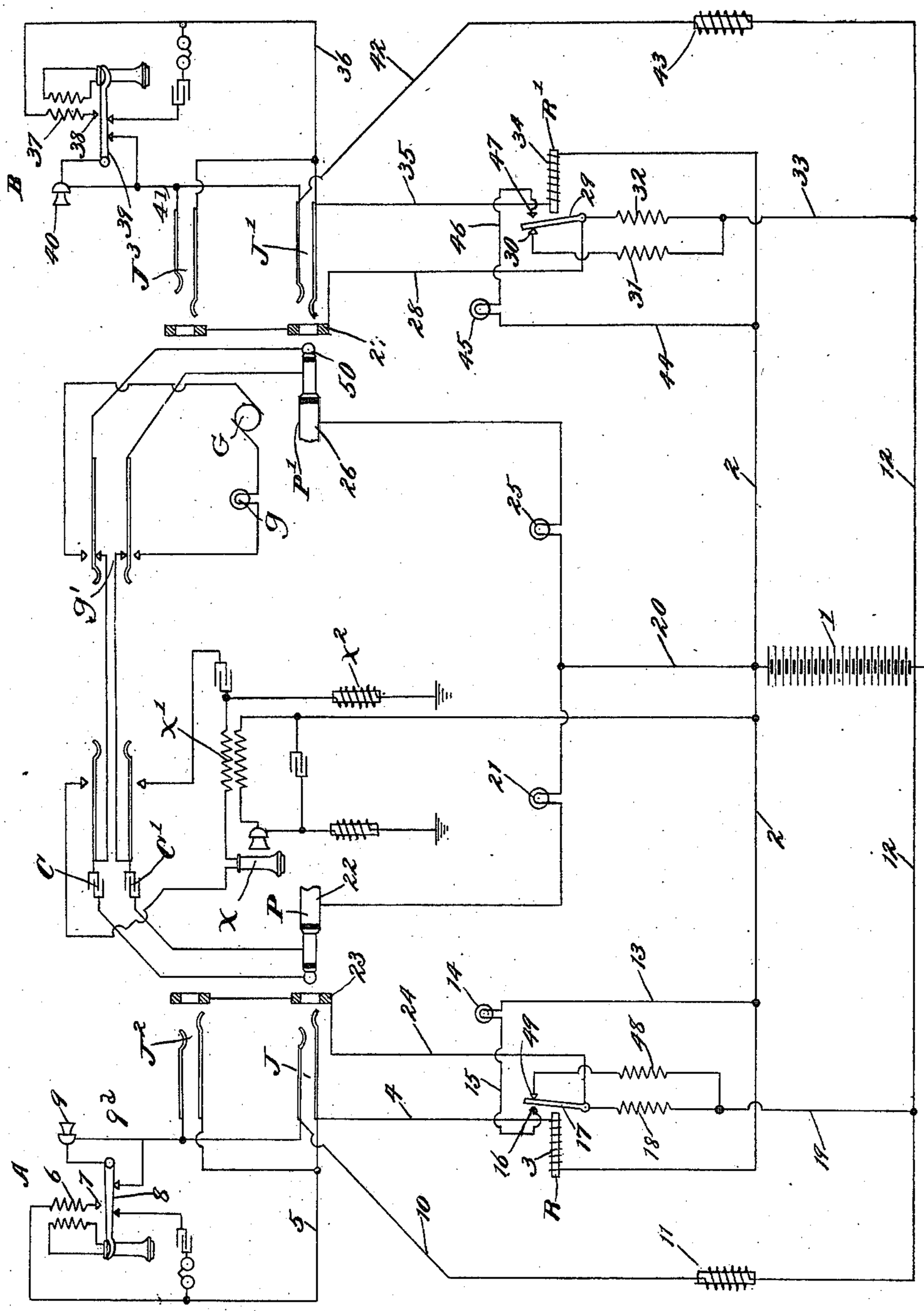
989,768. Patented Apr. 18, 1911.



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UNITED STATES PATENT OFFICE.

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TELEPHONE SYSTEM.

989,768. Specification of Letters Patent. **Patented Apr. 18, 1911.**

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To all whom it may concern:

Be it known that I, ALFRED H. DYSON, a citizen of the United States of America, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Telephone Systems, of which the following is a specification.

My invention relates more particularly to telephone systems of the complete metallic circuit and central energy type. In systems of this character complete metallic circuits are employed between the substations and the central exchange, and the current both for talking and signaling purposes is supplied from a common battery located at the central station. Signaling devices are provided whereby the subscribers may call up the central operator, and also whereby subscribers may signal for a disconnection when through talking. The signals whereby the subscribers call up the central operator are known as line signals. The signals by which the hanging up of the receiver at the substations automatically signals the central operator for a disconnection are known as clearingout or supervisory signals. Preferably, these signals consist of small incandescent lamps arranged on the switchboard in front of the central operator. Suitable relays are employed for automatically closing the circuits of these lamps. In addition to these signaling devices, the central operator is provided with a cord-circuit for establishing connection between the lines of any two subscribers. Each subscriber's line is connected with what is known as a spring-jack, and these jacks are also arranged on the switchboard in front of the operator. The said cord-circuit usually consists of a cord having a number of strands and provided at each end with a plug adapted for insertion in the said jacks. Thus when a subscriber sends in a call, and thereby causes one of the line lamp signals to glow, the central operator then inserts the plug in the jack corresponding to the line of the calling subscriber, and upon receiving the order for connection then inserts the other plug of the cord-circuit in the jack corresponding to the line of the called subscriber. When the called subscriber answers the call, the two substations are then connected up for conversational purposes, the talking circuit consisting of the lines of the substations and the talking strands of the operator's cord-circuit. The current for the microphone transmitters at the substations is supplied over the lines from the common battery at the central exchange. When the subscribers finish talking and hang up their receivers, the supervisory or clearing out signals associated with the operator's cord-circuit are automatically brought into operation and in this way the operator is advised that the subscribers are ready to be disconnected. In this way, the signaling is automatic in character, and, as stated, the current for both signaling and talking purposes is supplied from a common battery located at the central exchange.

Generally stated, it is the object of my invention to provide a highly efficient telephone system of the foregoing character.

A special object is to provide an improved circuit arrangement whereby the number of electrical devices and instruments involved in the switchboard apparatus may be reduced substantially to a minimum.

Another object is to provide an improved and simplified circuit arrangement and apparatus for controlling both the line and supervisory signals.

It is also an object to provide certain details and features of improvement tending to increase the general efficiency and to render the operation of a system of this character satisfactory and reliable.

To the foregoing and other useful ends, my invention consists in matters hereinafter set forth and claimed.

The accompanying drawing is a diagram illustrating a telephone system embodying the principles of my invention. In this diagram only two substations, together with line connections and a central station apparatus are shown. It will be understood that only such instruments and devices are illustrated as are necessary to a full understanding of the invention.

As thus illustrated, and assuming that the subscriber at substation A desires connection with the subscriber at substation B, the circuit connections and operations which then take place are as follows: When the receiver at substation A is removed from the hookswitch, a line circuit is closed from battery 1 at the central station, through the con-

ductor 2, through the coil 3 of the line relay R, through the conductor 4, thence through the limb 5 of the subscriber's line, through the primary 6 of the induction coil, through the hook-switch 8, thence through the transmitter 9, through the other limb 9ª of the subscriber's line, thence through conductor 10 and impedance coil 11 and through conductor 12 to said battery. This energizes the line relay R, causing the latter to attract its armature. The said armature when attracted closes a short local circuit from the battery 1 through conductors 2 and 13, through the line lamp signal 14, through conductor 15 and contact-point 16, thence through said armature 17, through the non-inductive resistance 18, and through conductors 19 and 12 to said battery. The current flowing through this local circuit lights the lamp 14, it being understood that the non-inductive resistance 18 is of such character as to permit the passage of only sufficient current to light the said lamp. The glowing of this lamp attracts the attention of the central operator, and indicates that the subscriber at substation A has sent in a call. Acting on this signal, the central operator then inserts the answering plug P of the cord-circuit in the jack J, it being observed that the latter is connected with the line of the calling subscriber. The insertion of this answering plug completes a local circuit from the battery 1, through conductor 20, through the supervisory lamp 21, through the sleeve 22 of the plug, through the testing ring or thimble 23 of the jack, thence through conductor 24, through the non-inductive resistance 18, and then through the conductors 19 and 12 to said battery. This, it will be seen, puts the lamp 21 in parallel with the lamp 14, but as the current is only sufficient to light the lamp 14, the latter is extinguished and the lamp 21 does not light. At this juncture the operator presses the usual listening key, so as to bridge the operator's talking set across the cord-circuit, and after receiving the order for connection, then inserts the calling plug P′ of the cord-circuit in the jack J′. This jack J′ is connected with the line of the called subscriber. The act of thus inserting the calling plug completes a local circuit from the battery 1, through the conductor 20, through the supervisory lamp 25, through the plug sleeve 26, through the testing ring or thimble 27 of the jack J′, thence through conductor 28, through the armature 29 and contact-point 30, through the non-inductive resistance 31, also through the parallel non-inductive resistance 32, and thence through conductors 33 and 12 to said battery. The resistance of coils 31 and 32 is such that sufficient current flows through this local circuit to light the lamp 25. This lamp remains lighted until the called subscriber answers the call. At this juncture, the operator presses the ringing key, so as to bridge the generator across the cord-circuit in the usual manner, and in this way the operator then projects ringing current on to the line of the called subscriber, so as to ring the bell at the latter's substation. When the called subscriber answers the call by taking down the receiver, a line circuit is completed from batery 1, through conductor 2, through the coil 34 of the line relay R′, thence through the conductor 35, through the limb 36 of the called subscriber's line, through the primary 37 of the induction coil, through the contact-point 38 and the hook-switch 39, thence through the transmitter 40, through the other limb 41 of the called subscriber's line, through the conductor 42, through the impedance or retardation coil 43, and thence back to the battery through conductor 12. This energizes the relay R′, causing the latter to attract its armature. The said armature when attracted completes a short local circuit from said battery through conductors 2 and 44, thence through the line lamp 45, through conductor 46 and contact-point 47, through the armature 29 and the non-inductive resistance 32, and thence through conductors 33 and 12 to said battery. Ordinarily this would light the lamp 45, but inasmuch as the calling plug is in the jack and the lamp 25 in parallel with lamp 45, the current is divided between the two lamps, and the line lamp does not therefore light up or glow. This is for the reason that the resistance 32 is of such character as to permit the passage of only sufficient current to light the lamp 45. Consequently, as stated, when both lamps are in parallel, as in the previous case, the current is not sufficient to light either one. Thus the called subscriber in answering the call automatically extinguishes the supervisory lamp 25, thereby advising the central operator that the call is answered. With both plugs inserted, and with both receivers removed from the hook-switches, the two subscribers are in position to carry on their conversation. The talking circuit, it will be understood, includes the parallel limbs of the two lines, the registering contacts of the plugs and jacks, and the two talking strands of the cord circuit. The condensers C and C′ are preferably located in the tip and sleeve strands of the cord-circuit, so as to permit the passage of the voice currents, but prevent the passage of battery current. During conversation, the current for the microphone transmitters 9 and 40 is supplied over the lines from the battery 1.

When the subscriber at substation A hangs up the receiver, the line circuit is broken and the relay R deënergized. The said relay in releasing its armature causes the latter to break the local circuit in which

the lamp 14 is located, and in this way throws all of the current into the local circuit in which the lamp 21 is located. It will also be seen that when the said armature is released, a non-inductive resistance 48 is placed in parallel with the resistance 18, by reason of the armature 17 making contact with the contact point 49. These two resistance coils thus placed in parallel permit the passage of sufficient current to light the lamp 21. This indicates to the central operator that the subscriber at substation A has hung up the receiver. In a similar manner, when the subscriber at substation B hangs up the receiver, the line circuit is broken, the armature 29 released, and the resistance 31 placed in parallel with the resistance 32. This, as previously explained, permits the passage of sufficient current to light the supervisory lamp 25. Acting on these signals for disconnection, the operator then withdraws the plugs from the jacks.

Thus it will be seen that with the foregoing arrangement, one relay controls both the line and supervisory signals, and also that this relay regulates the current supply of the line condensers and acts as impedance. The line relays, as shown, are preferably connected permanently with the subscribers' lines. The construction and arrangement involve substantially a minimum number of circuits and devices, and tend to materially reduce the cost of installation and maintenance. Thus simplified, the arrangement permits the making of the customary signals, and is characterized by substantially all of the approved methods of operation.

If desired, the central station apparatus can be of the multiple switchboard type, each subscriber's line being connected with a plurality of jacks arranged upon different switchboard sections. With such arrangement the central operator, before establishing connection, makes the usual busy test, which consists in touching the tip of the calling plug to the jack of the called subscriber, so as to ascertain whether or not the line is in use. If the line is busy, a click is produced in the operator's receiver, indicating that the plug of some other cord-circuit is in one of the jacks connected with the line. For example, with a multiple switchboard arrangement, the operator before establishing the previously described connection makes a busy test by touching the tip of the plug P′ to the testing ring 27, and at the same time presses the listening key. If the line of substation B is busy, by reason of the plug of another cord circuit similar to the one shown being already inserted in the jack J^3, and by reason of a plug in the jack, the touching of the plug tip to said testing ring causes a click in the operator's receiver X. This is for the reason that a local circuit is completed from the battery through lamp 45, and through lamp 25 in parallel, through the testing ring 27, through the plug tip 50, thence through the cord-circuit and through the receiver X, through the secondary X′ of the induction coil, and through impedance coil X^2 to the ground, and back to the battery. However, should a plug be inserted in one of the jacks, and the receiver of the substation be on the hook, then a circuit would be derived from the battery, for example, through the supervisory lamp 25 to the jack sleeve or ring, thence through the plug tip and the operator's receiver and the impedance coil to ground and back to the battery. The sudden flow of current through this circuit, as in the previous case, causes a click in the operator's receiver, indicating that the line is busy. Should the subscriber's receiver be on the hook, and should there be no plug in one of the jacks, then there would be no change of potential and no consequent click in the receiver of the operator's talking set. Thus with the line in use, and with a plug inserted, the test circuit includes the line lamp, and also the supervisory lamp in parallel; while with a plug in one of the jacks, and the receiver hung up, the test circuit includes only the supervisory lamp. It will be understood that in the latter case the supervisory lamp is in the other cord-circuit.

With no plugs in any of the jacks, and with the receiver off the hook, the testing circuit includes the line lamp signal, as in the first instance. In each case, the test is noiseless—that is to say, the test is made without producing any sound in the receiver at the substation. In other words, the tests are effected without changing the potential of the line circuit, consequently the subscriber is not annoyed while talking.

It will be readily understood that the resistance of the various lamps, coils and relays can be regulated or adjusted to give the desired results by those skilled in the art, and in accordance with the conditions of any particular case. It will also be understood that the operator's talking set, together with the ringing and listening keys, can be of any suitable form or construction. The substation apparatus can also be of any known or approved form.

The means for ringing out the subscribers may comprise the usual generator G having a resistance lamp g in its circuit, together with a ringing key g^1.

I claim as my invention—

1. In a telephone system, the combination of a subscriber's line, a substation switch for closing the line circuit, a central source of current supply connected with the line, a spring jack connected with the line, a cord

circuit having a plug adapted for insertion in said jack, a relay arranged to be energized when the line circuit is closed, a line lamp having a normally open local circuit including said source of current supply and a suitable resistance, the local circuit for said line lamp being closed when the said relay is energized, the said resistance being adapted to permit the passage of only sufficient current to light the said line lamp, a supervisory lamp located in one of the strands of said cord-circuit, the said supervisory lamp being in parallel with the line lamp when the plug is inserted in the jack, the supervisory lamp thereby operating to shunt out the line lamp when the plug is inserted in the jack, a normally closed shunt around said resistance, said shunt being opened when the line circuit is closed and the relay energized, and said shunt being closed when the line circuit is opened by said switch, and a suitable resistance located in said shunt.

2. A telephone system comprising a subscriber's line, a substation switch for closing the line-circuit, a central source of current supply connected with the line, a spring jack connected with the line, a cord-circuit having a plug adapted for insertion in said jack, a relay connected with the line, a line lamp having a local circuit controlled by said relay and including said source of current supply, the said line lamp signal circuit being closed when the relay is energized by the closing of the line circuit, a non-inductive resistance coil located in the line lamp circuit between the source of current supply and the armature of said relay, a shunt around said resistance coil normally closed by the relay armature when the latter is inert, a non-inductive resistance coil in said shunt, a supervisory lamp located in the sleeve strand of said cord-circuit, the normally open local-circuit of said supervisory lamp including the sleeve of the plug and the testing ring of the jack, and also including the first mentioned non-inductive resistance coil and also the said source of current supply, the said supervisory lamp thus connected and arranged being adapted to shunt out the line lamp when the plug is inserted and the line circuit closed, and the said shunt being adapted to lower the resistance of the supervisory lamp circuit sufficiently to cause the supervisory lamp to light when the plug is inserted and the line circuit closed.

3. In a telephone system, the combination of a substation having a hook-switch adapted to support a receiver, a subscriber's line leading from said substation and adapted to be closed by the removal of the receiver from said hook-switch, a central station having a spring jack connected with the terminal of said subscriber's line, said spring jack being provided with tip and ring contacts and also with a testing ring, a central source of current supply permanently connected with the line, an impedance coil in one of the conductors leading from said source of current supply to the line, a line relay in the other conductor leading from said source of current supply, a line lamp associated with said relay and having a local circuit adapted to be closed when the armature of the relay is attracted, a non-inductive resistance coil located in the local circuit of said line lamp, a normally closed shunt around said resistance, said shunt including the back contact and the armature of said relay, a second non-inductive resistance coil located in said shunt, a three-way cord-circuit having tip, ring and sleeve contacts, a condenser in each talking strand of the cord-circuit, and a supervisory lamp in the third or sleeve strand of said cord-circuit, the local circuit of said supervisory lamp including the sleeve contact of the plug and the testing ring of the jack, and also including both of said non-inductive resistance coils.

4. In a telephone system, the combination of two substations, a hook-switch at each substation adapted to support a receiver, subscribers' lines leading from said substations to a central station, said lines being closed when the receivers are removed from said hook-switches, condensers and bells in normally closed bridges across the lines at the substations, three-way spring jacks connected with the lines at the central station, a three-way cord-circuit having plugs adapted for insertion in said jacks, a condenser in each talking strand of the cord-circuit, a magneto generator at the central station adapted to be connected with the lines for ringing said bells, two supervisory lamps in the third or sleeve strand of said cord-circuit, a common battery at the central exchange permanently connected with the lines, impedance coils between the battery and the lines, relays connected between the battery and the lines, the said relays acting as retardation for one side of the lines, line lamps associated with said relays, and having local-circuits adapted to be closed when the relays are energized and the armatures attracted, noninductive resistance coils located in the local circuits of said line lamps, normally closed shunts around said non-inductive resistance coils, non-inductive resistance in each shunt, each shunt including the back contact and the armature of one of said relays, said shunts being open and the line lamp circuits closed when the line circuits are closed, said shunts being closed and the line lamp circuits open when the line circuits are open, the supervisory lamps operating to shunt out the line lamps when the plugs are inserted and the line circuits closed, and the shunts, when the plugs are inserted and the line circuits open, operating to reduce

the resistance of the supervisory lamp circuits sufficiently to cause the supervisory lamps to light.

5. In a telephone system, the combination of a subscriber's line, means for closing the line circuit, a suitable source of current supply connected with the line, line signal apparatus connected and arranged to be brought into action by the closing of the line circuit, supervisory signal apparatus connected and arranged for shunting the line signal in answering a call, and a resistance serving as a shunt which, when closed by the opening of the line circuit, causes the operation of the supervisory signal.

6. In a telephone system, the combination of a signaling device, a suitable circuit for said device, a source of current in said circuit, a resistance in said circuit sufficient to prevent the operation of said signal, a shunt around said resistance, and a switching device for opening and closing said shunt, said circuit normally closed at said switch, the resistance of said shunt when closed being such that sufficient current may pass through said circuit to operate said signal.

7. In a telephone exchange system, the combination with a telephone line extending from a subscriber's station to an exchange and terminating thereat in a line jack, of cord-connecting apparatus for uniting this telephone line with another for conversation, a relay at the exchange operable from the substation, line and clearing-out lamps, parallel conductors including the lamps, a source of current for the line relay and for the lamps, a resistance interposed between the parallel conductors containing the lamps and their source of current, a second resistance included in a branch parallel to the conductor containing the first resistance, this branch being closed by the armature of the relay when unattracted, and means whereby the cord circuit will include the clearing-out lamp in circuit when connection is being established with the line, the armature of the relay serving to include the line lamp in circuit when attracted.

8. In a telephone exchange system, the combination with a telephone line extending from a subscriber's station to an exchange and terminating thereat in a line jack, of cord-connecting apparatus for uniting this telephone line with another for conversation, a relay at the exchange operable from the substation, line and clearing-out lamps, parallel conductors including the lamps, a source of current for the line relay and for the lamps, a resistance interposed between the parallel conductors containing the lamps and their source of current, a second resistance included in a branch parallel to the conductor containing the first resistance, this branch being closed by the armature of the relay when unattracted, means whereby the cord circuit will include the clearing-out lamp in circuit when connection is being established with the line, the armature of the relay serving to include the line lamp in circuit when attracted, and a busy test circuit in part coincident with the local line signal circuit.

9. In a telephone exchange system, the combination with a telephone line extending from a subscriber's station to an exchange and terminating thereat in a line jack, of cord-connecting apparatus for uniting this telephone line with another for conversation, a relay at the exchange operable from the substation, line and clearing-out lamps, parallel conductors including the lamps, a source of current for the line relay and for the lamps, a resistance interposed between the parallel conductors containing the lamps and their source of current, a second resistance included in a branch parallel to the conductor containing the first resistance, this branch being closed by the armature of the relay when unattracted, means whereby the cord circuit will include the clearing-out lamp in circuit when connection is being established with the line, the armature of the relay serving to include the line lamp in circuit when attracted, and a busy test circuit in part coincident with the local supervisory signal circuit.

10. In a telephone exchange system, a subscriber's line relay, a line signal lamp and a resistance in a local circuit adapted to be closed by said relay when excited, a supervisory lamp, an operator's connecting apparatus adapted to bring the same into shunt of said line lamp to extinguish the latter, said supervisory lamp being adapted to remain unlighted because of said resistance in the circuit, and a second resistance arranged to be connected in parallel with the first resistance by said line relay when its armature is retracted, whereby the supervisory lamp is illuminated by the increased current through said parallel resistances.

Signed by me at Chicago, Cook county, Illinois, this 15th day of February, 1902.

ALFRED H. DYSON.

Witnesses:
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