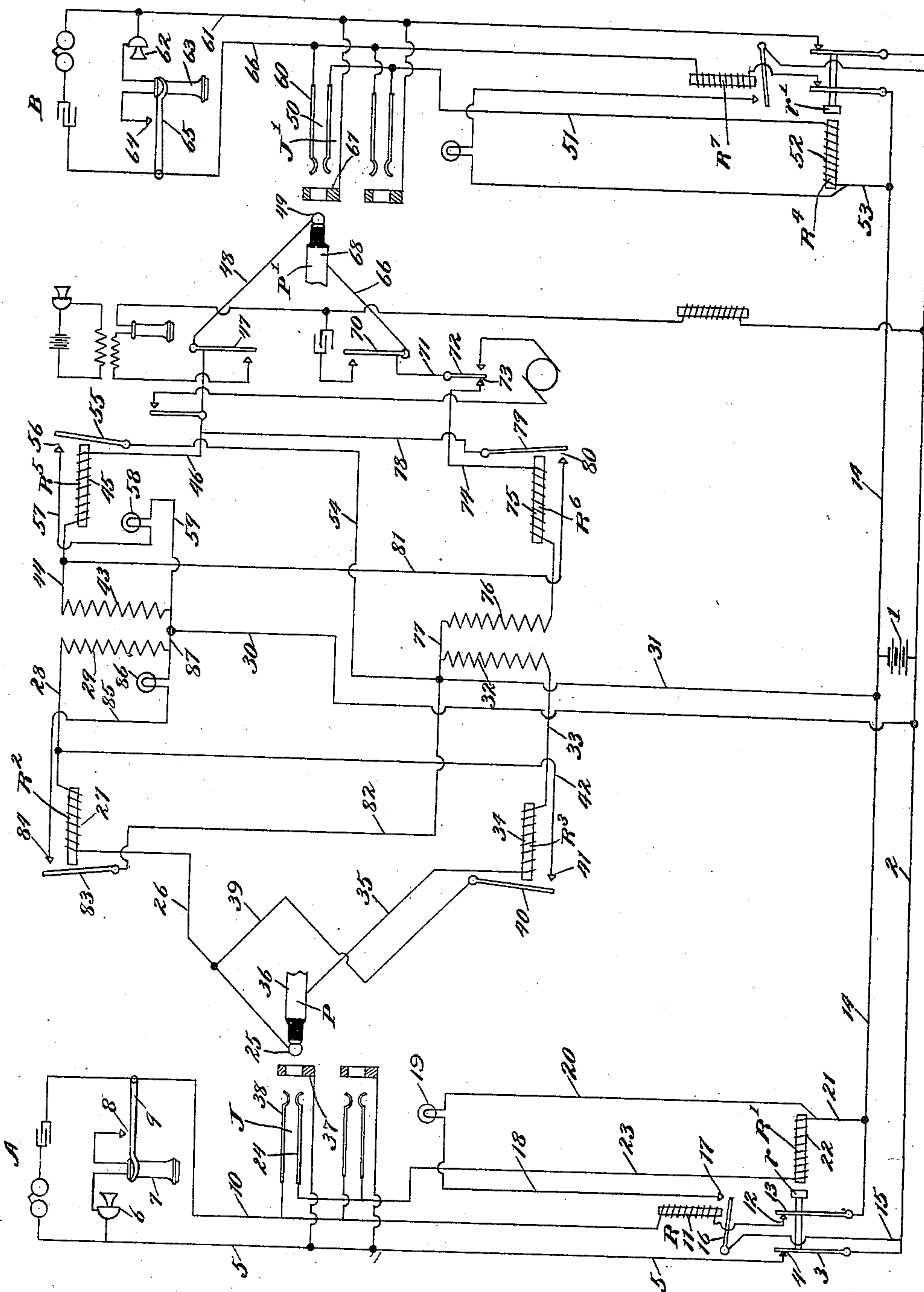


C. L. GOODRUM.
TELEPHONE SYSTEM.
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Witnesses:

Chas. D. Perry
J. B. Weir

Inventor:

Charles L. Goodrum
By Chas. C. Bulkeley

UNITED STATES PATENT OFFICE.

CHARLES L. GOODRUM, OF ATLANTIC CITY, NEW JERSEY, ASSIGNOR, BY MESNE ASSIGNMENTS, TO STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, OF ROCHESTER, NEW YORK, A CORPORATION OF NEW YORK.

TELEPHONE SYSTEM.

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To all whom it may concern:

Be it known that I, CHARLES L. GOODRUM, a citizen of the United States, residing at Atlantic City, county of Atlantic, and State of New Jersey, have invented certain new and useful Improvements in Telephone Systems, of which the following is a specification.

My invention relates to telephone systems of the complete metallic circuit and central energy type. In systems of this character it is usual to provide complete metallic circuits between sub-stations and a central exchange. It is also the practice to operate the various signals, as for example, the line and supervisory signals at a central exchange, and also the bells at the subscribers' stations, by current from suitable sources of supply located at the central station. At the central exchange the switch-board is provided with what are commonly known as jacks, each jack being connected with a subscriber's line. The central operator is usually provided with a connecting medium, preferably in the form of a cord having two or more strands provided at each end with a plug. These plugs are adapted for insertion in the jacks, so as to establish connection between the lines of any two subscribers. Ordinarily the operator is provided with a generator for ringing the bells at the sub-stations. The line and supervisory signals are operated by current supplied from the common battery at the central station. When the subscriber sends in a call the line signal is operated, so as to attract the attention of the central operator, and the latter, after learning the number of the subscriber desired, makes the connection with the plugs and cord circuit. When the subscribers at the sub-station hang up the receivers the supervisory signals are brought into operation and the central operator is, in this way, advised that the subscribers are through talking. The common battery at the central exchange is so arranged as to supply current over the lines to the microphone transmitters at the sub-stations. In this way, as stated, the current, both for talking and calling purposes, is supplied entirely from one or more batteries or generators located at the central exchange. The line and supervisory signals are usually in the form of small incandescent lamps, arranged in position to be easily

observed by the central operator. The circuits for these lamps are automatically closed by relays, which are energized or de-energized, as the arrangement may require, by the closing or opening of the line circuits.

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

A special object is to provide a simplified and improved arrangement of circuits and apparatus for operating the line signals.

It is also an object to provide certain details and features of improvement tending to increase the general efficiency, and to render a system of this character more serviceable and satisfactory in use.

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 it will be observed that only two substations together with a cord circuit and line connections are shown, and it will be understood that only such instruments and apparatus are illustrated as are necessary to a full understanding of the invention.

As far as the construction of the system is concerned, it will be readily understood that the system comprises any suitable number of sub-stations equipped with subscribers' apparatus of any suitable or approved character. For example, the subscribers' apparatus may be substantially of the character shown at sub-stations A and B, these sub-stations being connected with the exchange or central station in any suitable manner. Preferably, however, complete metallic line connection is employed between the sub-stations and the switch-board apparatus at the exchange or central station. Also, it will be readily understood that the battery shown at the central station or exchange is adapted to furnish current for both talking and signaling purposes—that is to say, this battery furnishes the current for both operating the line and supervisory signaling apparatus, and for charging the transmitters at the sub-stations. As illustrated, the subscribers' lines terminate in spring jacks of a character hereinafter more particularly de-

scribed, these spring jacks being mounted in any suitable manner on the switchboard at the central station. Also, as shown, the switch-board apparatus includes any suitable number of cords or operators' cord circuits, each cord being provided with plugs adapted for insertion in the said jacks; and it will also be seen that the line relays and the line signals are associated with the lines, while the supervisory signals and supervisory relays are associated with the cord circuits. The different circuit arrangements, and the functions of the different devices, will, however, be more clearly understood by considering the various connections and operations which take place in connecting up one subscriber with another. Therefore as thus illustrated, and assuming that the subscriber at sub-station A desires connection with a subscriber at sub-station B, the operation and circuit connections which take place are as follows: When the receiver is removed from the hook-switch at sub-station A, a circuit is closed from battery 1 through conductor 2, through the switch-spring 3 and contact point 4, thence through conductor 5, through the transmitter 6, through the receiver 7, thence through the contact point 8, and the hook-switch 9, through the line conductor 10, through the coil 11 of the line relay R, thence through contact point 12 and switch-spring 13, and through conductor 14 to said battery. The current flowing through this closed line circuit energizes the relay R, causing the latter to attract its armature. The said armature when attracted closes a short local circuit from battery 1 through conductors 2 and 15 through the armature 16, the contact point 17, thence through conductor 18, through the line lamp signal 19, conductors 20 and 21, and through conductor 14 to said battery. This lights the line lamp signal 19, thereby advising the central operator that the subscriber at sub-station A has sent in a call. The central operator then inserts the answering plug P of the cord circuit in the jack J, so as to establish connection between the calling subscriber's line and the operator's talking set in the cord circuit. The insertion of the answering plug in the jack in this manner completes a short local circuit from the battery 1 through the conductors 14 and 21, through the coil 22 of the cut-out relay R¹, through conductor 23, through the tip spring 24 of the jack, thence through the tip contact 25 of the plug, through the cord strand 26, through the coil 27 of the supervisory relay R², thence through conductor 28 and the winding 29 of the repeating coil, and thence through conductors 30 and 2 to said battery. This energizes both the cut-out relay R¹ and the supervisory relay R². The relay R¹ attracts its armature r, thereby opening the two

switch-points controlled by the switch-springs 3 and 13, and in this way severing the direct connection between the battery and the line. This, it will be observed, serves to deenergize the relay R, and the latter in releasing its armature opens the switch-point in the circuit of the lamp 19. In this way the insertion of the answering plug operates to automatically extinguish or restore the line signal. It will also be seen that when the answering plug is thus inserted, a line circuit is closed from the battery 1 through the conductor 31, through the winding 32 of the other repeating coil, through the conductor 33, thence through the coil 34 of the supervisory relay R³, through the cord strand 35, the sleeve 36 of the plug, thence through the thimble or ring 37 of the jack, through the line conductor 5, through the transmitter 6 and receiver 7, through the contact point 8 and hook-switch 9, thence through the line conductor 10, through the contact spring 38 of the jack, through the tip contact 25 of the plug, through the cord strand 26, through the relay R², through the conductor 28 and the repeating coil winding 29, thence through the conductors 30 and 2 to said battery. The energization of the relay R³ by the closing of the line circuit closes a normally open shunt connection around the relay R², consisting of the conductor 39, the armature 40, contact point 41 and the conductor 42. This deenergizes the relay R², and prevents the latter from attracting its armature and thereby closing the circuit of the supervisory lamp. In this way, when the answering plug is inserted, the relay R³ is made a part of the line circuit and the relay R² is made a part of such line circuit and also a part of a local circuit. At this juncture, it will be understood that the operator communicates with the calling subscriber in any suitable manner as, for example, by pressing an ordinary listening key, so as to bridge the operator's talking set across the cord circuit, in the usual manner. After learning the number of the sub-station desired, the operator then inserts the calling plug P¹ in the jack J¹. The operator also then presses the ringing key, so as to bridge the generator across the cord circuit, and then by operating the generator ringing current is projected onto the line of the called for subscriber, for the purpose of ringing the bell at the latter's sub-station. At this juncture, it will be seen that the line has been put into proper condition to permit the operation of the generator by the severing of the connection between the battery and the line, due to the energization of the cut-off relay R⁴.

When the calling plug P¹ is inserted a local circuit is completed from the battery through the conductors 2 and 30, through the winding 43 of the repeating coil, through

conductor 44, through coil 45 of the supervisory relay R^5 , through the conductor 46, through the spring 47 of the listening key, through the cord strand 48, through the plug tip 49, through the tip spring 50 of the jack, thence through the conductor 51, through the coil 52 of the cut-out relay R^4 , thence through the conductors 53 and 14 to said battery. This energizes the supervisory relay R^5 and, as stated, also energizes the cut-out relay R^4 . The latter in attracting its armature a^1 opens the normally closed switch-points in the connection between the battery and the line, thereby giving a free circuit for the projection of the ringing current. The energization of the supervisory relay R^5 causes its armature to close a local circuit from the battery through the conductors 31 and 54, through the armature 55, contact point 56 and the conductor 57, through the lamp 58, through conductors 59 and 30, and through conductor 2 to said battery. This lights the supervisory lamp 58, and the said lamp remains lighted until the called for subscriber answers the call. When the subscriber at sub-station B removes the receiver from the hook-switch, a line circuit is completed from the battery through conductors 2 and 30, through the winding 43 of the repeating coil, through conductor 44, through the coil 45 of the relay R^5 , through the conductor 46, through the key spring 47 and the cord strand 48, thence through the plug tip 49 and the jack spring 60, through the line conductor 66, through the hook-switch 65 and the contact point 64, thence through the receiver 63 and the transmitter 62, through the line conductor 61 and the ring or thimble 67 of the jack, through sleeve contact 68 of the plug, through cord strand 66, through key-spring 70 and conductor 71 and key-spring 72, through contact point 73 and conductor 74, thence through the coil 75 of the supervisory relay R^6 , through the winding 76 of the repeating coil, through conductors 77, 31 and 14 to the said battery. This, it will be seen, energizes the relay R^6 , causing the latter to attract its armature and close a normally open shunt around the relay R^5 . This shunt, it will be seen, consists of a conductor 78, armature 79, contact point 80 and conductor 81. The closing of this shunt causes the relay R^5 to release its armature, thereby opening the switch-point in the circuit of the lamp 58, and thus extinguishing the latter and advising the operator that the called for subscriber has answered the call. The answering of the call at the sub-station B does not energize the line relay R^7 , inasmuch as the connection between the battery and the line has already been severed in the manner described. With both plugs inserted, and with both receivers removed from the hooks at the substations,

the subscribers can communicate with each other, the talking circuit consisting of the lines and the strands of the cord circuit. While the subscribers are talking, the current is furnished to the lines through repeating coils in the cord circuit. When the subscribers hang up the receivers at the sub-stations, relays R^3 and R^6 are deenergized, and release their armatures. Said armatures when released open the normally open shunts around relays R^2 and R^5 , thereby allowing the latter to become energized. The said supervisory relays R^2 and R^5 when energized, close the normally open switch-points in the circuits of the supervisory lamps and cause the latter to glow and attract the attention of the central operator. Acting upon these signals, the central operator then withdraws the plugs of the cord circuit, and the system is then in its normal or disconnected condition, as shown in the drawing. Thus it will be seen that the circuit arrangement for operating the lines of the supervisory signals is simple and efficient. At the same time, the arrangement is characterized by substantially all of the approved methods of operation. It will be readily understood that the resistance of the various coils and relays can be readily adjusted or regulated by those skilled in the art, and in accordance with the conditions of any particular case.

The cut-out relays are, it will be observed, advantageously energized through derived circuits including different portions of the cord circuit connections. In this way each derived circuit operates to hold the cut-out relay in operation as long as the plug is in the jack.

What I claim as my invention is:

1. In a telephone system, the combination of a subscriber's line, a battery connected with the line through a normally closed switch, a line lamp signal, a line relay for controlling the circuit of said line lamp signal, a cut-out relay arranged to operate said switch, a jack connected with the line, a plug and a cord circuit, a supervisory lamp and a supervisory relay associated with the cord circuit, one terminal of said cut-out relay being permanently connected with the battery, the other terminal of said relay being permanently connected with a tip contact of said jack, and the local circuit for said cut-out relay being closed by the insertion of the plug in the jack and including said supervisory relay.

2. In a telephone system, the combination of a subscriber's line, a central source of current supply connected with the line through a normally closed switch, a line lamp signal, a line relay for controlling the circuit of said line lamp signal, a cut-out relay arranged to control said switch, a jack having tip and sleeve contacts connected

with the subscriber's line, said jack also having a second tip contact connected with one terminal of said cut-out relay, the other terminal of the cut-out relay being permanently connected with said source of current supply, a plug and a cord circuit, and a supervisory lamp and supervisory relay associated with said cord circuit, the local circuit of said cut-out relay being closed by the insertion of the plug in the jack, and said local circuit including said supervisory relay.

3. In a telephone system, the combination of a subscriber's line, a central source of current supply connected with the line, a jack connected with the line, a plug and a cord circuit, suitable connections for supplying current from the central source of supply through the strands of the cord circuits and the registering contacts of the plug and jack to said line, a supervisory relay in each strand of the cord circuit, a supervisory lamp having a circuit controlled by one of said supervisory relays, a normally open shunt around the relay arranged to control the circuit of the supervisory lamp, said shunt being controlled by the other supervisory relay, a line lamp signal, a line relay for controlling the circuit of said line lamp signal, and a cut-out relay for severing the connection between said source of current supply and the said line, the circuit for said cut-out relay including tip contacts of a jack and plug, and also including the supervisory relay which controls the circuit of the supervisory lamp.

4. A telephone system comprising a line signal and a line relay for operating the same, a cut-out relay for deenergizing said line relay, a supervisory relay, a source of current supply with suitable connection for energizing all of the said relays, and a plug switch for closing the circuit of said cut-out relay, said switch having a plurality of tip contacts in the jack, so as to restore the line signal, the circuit of said cut-out relay including tip contacts of said switch.

5. In a telephone exchange system, telephone lines, a cord circuit, a pair of supervisory relays included in said circuit, one at each side thereof, a shunt or short circuit extending around one relay, controlled by the other relay, and a supervisory signal controlled by the one relay.

6. In a telephone exchange system, telephone lines, a cord circuit, a pair of supervisory relays included in said circuit, one at each side thereof, a shunt or short circuit extending around one relay, controlled by the other relay, and a supervisory signal controlled by the one relay, together with repeating coils included in the talking circuit, and energizing circuits for said relays, each energizing circuit including a repeating coil winding.

7. In a telephone exchange system, a cut-off relay for a telephone line, a supervisory relay, an energizing circuit including the two relays in series, a short circuit around said supervisory relay also included in said circuit, and a jack permanently connected with the line, said relays all energized over circuits including portions of the talking circuit.

8. The combination with a switchboard having terminal plugs provided with a plurality of switch contacts, and containing two conductors electrically uniting corresponding contacts of said plugs, a source of current in a bridge between said conductors, and two signal devices associated with said plugs respectively, of relay mechanism in the circuits of said conductors and source of current controlling the current supplied to said signaling devices, and two relays in circuit with the said cord conductors one on either side of the said bridge, of shunt circuits controlling said signals and controlled by said two relays, thereby determining the display or withdrawal of said signals, substantially as set forth.

9. In a telephone system, a line, a relay, a normally open short circuit around said relay, a second relay for closing said shunt, a line circuit for energizing the said second relay, a local circuit for energizing the first mentioned relay, when connection is made to said line, and means for supplying battery current to the windings of both the said relays and to the said line.

10. In a telephone system, a line, a relay, a normally open short circuit around said relay, a second relay for closing said shunt, a line circuit for energizing the said second relay, means for supplying battery current to the windings of both the said relays and to the said line, a line signal, and a cut off relay having its winding included in said local circuit.

11. In a telephone system, the combination of calling and called telephone lines, an operator's cord circuit for connecting said lines, a pair of relays for each end of said cord circuit, one member of each pair of relays having a normally open shunt controlled by the other relay thereof, and a supervisory lamp for each pair of relays, said relays all energized over circuits including portions of the talking circuit.

12. In a telephone system, a line, a pair of relays, a normally open shunt around one relay controlled by the other relay, a local circuit for energizing the one relay, and a line circuit for the other or shunt controlling relay, said line circuit including the windings of the shunt controlling relay and the shunt around the other relay in series.

13. In a telephone system, a pair of relays, a line signal, a shunt around one relay controlled by the other relay, a cut-off relay

for retiring the line signal, and a local circuit for energizing said cut-off relay in series with the winding of the shunted relay, said relays all energized over circuits including portions of the talking circuit.

14. A telephone system comprising a telephone line, a source of current and a relay between the two limbs of said line, the source of current in bridge of the talking circuit, a second relay and means for energizing it, a switch at the substation and a switch at the central station for controlling the circuit through said relays, a signal controlled by the conjoint action of said relays, and a line signal cut-off relay for each line energized in series with one of said relays.

15. A telephone system comprising a telephone line, of a source of current and a relay between the two limbs of said line, whereby the source of current is in bridge of the talking circuit, a second relay and means for energizing it, a switch at the substation for controlling said bridged relay and a switch at the central office for controlling said other relay, a signal controlled by the conjoint action of said relays, and a line signal cut-off relay for each line energized in series with one of said relays.

16. A telephone system comprising a telephone line, of a source of current and an electro-magnet between the two limbs of said line, whereby the source of current is in bridge of the talking circuit, a second electro-magnet and means for energizing it, a switch at the substation and a switch at the central station for controlling the circuit through said electro-magnets, a supervisory signal controlled by the joint action of said electro-magnets, and a line signal cut-off relay for each line energized in series with one of said relays.

17. A telephone line, a source of electricity and a pair of relays between the limbs of said line, whereby the source of current is in bridge of the talking circuit, a switch at the substation and a switch at the central station for controlling the circuit through said relays, a signal adapted to be controlled by the conjoint action of said relays, and a line signal cut-off relay for each line energized in series with one of said relays.

18. A telephone system comprising a pair of telephone lines, an inductive device through which the same are adapted to be united for conversation, a charging source of electricity and two pairs of relays between the two limbs of said lines, whereby the source of current is in bridge of the talking circuit, one pair of relays being individual to one of said lines and the other pair being individual to the other line, switches at the substations and at the central station for controlling the circuit through said relays, a signal controlled by the conjoint action of each pair of relays, and a line signal

cut-off relay for each line energized in series with one of said relays.

19. In a telephone system, a metallic telephone line, an operator's plug and a cord circuit, a source of current and a pair of relays placed by the cord circuit between the terminals of said line, a third conductor connected with one pole of said source, one of said relays being adapted to be operated over the metallic line when the subscriber's telephone is in use, and the other to be operated over a part of the line and said third conductor when the subscriber's telephone is not in use and the operator's plug is connected with the line, and a line signal cut-off relay for each line energized in series with one of said relays.

20. In a telephone system, a telephone line, a source of current and a relay inserted between the two limbs of said line, to bridge the source of current across the talking circuit, a second relay at the central office and connected with one side of the talking circuit and means for energizing it, a switch at the substation and a switch at the central station for controlling the circuit through said relays, a signal controlled by the conjoint action of said relays, and a line signal cut-off relay for each line energized in series with one of said relays.

21. In a telephone system, a telephone line, a source of electricity at the central office, an operator's plug and a pair of relays associated therewith, one of said relays being energized from the said source of electricity while the plug is connected with the said line and over a path having a part coincident with the talking circuit, and the other relay being energized while the plug is connected with the said line and the subscriber's telephone is in use, a signal associated with said pair of relays, the circuit of said signal being established by the operation of the first of said relays and said signal being rendered inoperative by the operation of the second of said relays, and a line signal cut-off relay for each line energized in series with one of said relays.

22. In a telephone exchange system, telephone lines extending from substations to an exchange, each of said substations being provided with a telephone switch hook for supporting the receiver thereat, a common battery at the exchange, supervisory signals located at the exchange, corresponding to calling and called subscribers' stations, supervisory relays at the exchange, one for each of the supervisory signals, means whereby the switch hooks at the subscribers' stations are adapted to operate each of said relays independently of the other to actuate the corresponding indicator, a second supervisory relay associated with each supervisory signal adapted through the agency of the switch hooks to restore the super-

visory signals each independently of the other, means whereby the latter relays are both actuated independently of each other by the said switch hooks, and a line signal cut-off relay for each line energized in series with one of said relays, said relays all energized over circuits including portions of the talking circuit.

23. In a telephone system, telephone lines extending from subscribers' stations to an exchange, a cord circuit at the exchange provided with two strands for forming connections between two telephone lines, a pair of relays corresponding to each end of the cord circuit, a source of current for inclusion in circuit with each of said pairs of relays, connected in bridge of the talking circuit, a supervisory signal for each pair of relays and jointly controlled thereby through the agency of the substation apparatus, a local circuit for each telephone line to include the said source of current in a local circuit, one relay of each pair that is controlled by a subscriber's station apparatus being included in the corresponding local circuit, whereby one relay of each pair may place the supervisory signal in one condition of use, and both relays coöperating place the supervisory signal in another condition of use, and a line signal cut-off relay for each line energized in series with one of said relays.

24. In a telephone system, telephone lines extending from subscribers' stations to an exchange, a cord circuit at the exchange provided with two strands for forming connections between two telephone lines, a pair of relays corresponding to each end of the cord circuit, a source of current for inclusion in circuit with each of said pairs of relays, connected in bridge of the talking circuit, a supervisory signal for each pair of relays and jointly controlled thereby, switching apparatus for controlling the operation of the relays, a reactive device included in each cord strand between the connections of the relays therewith, and a line signal cut-off relay for each line energized in series with one of said relays.

25. In a telephone system, telephone lines extending from subscribers' stations to an exchange, a cord circuit at the exchange provided with two strands for forming connections between two telephone lines, a pair of relays corresponding to each end of the cord circuit, a source of current for inclusion in circuit with each of said pairs of relays, connected in bridge of the talking circuit, a supervisory signal for each pair of relays and jointly controlled thereby, a local circuit for each telephone line to include the said source of current in a local circuit, one relay of each pair being included in the corresponding local circuit, whereby one relay of each pair may place the supervisory

signal in one condition of use, and both relays coöperating place the supervisory signal in another condition of use, and a line signal cut-off relay for each line energized in series with one of said relays.

26. In a telephone system, telephone lines extending from substations to jacks at an exchange, a cord circuit at the exchange provided with two strands for forming connections between subscribers' lines, a pair of relays corresponding to each end of the cord circuit, a source of current for energizing the said relays, connected in bridge of the talking circuit, a supervisory signal for each pair of relays and jointly controlled thereby, switching mechanism at the substations for controlling the operation of one of each pair of relays, means including a jack and a cord circuit plug inserted in the jack, whereby a closed circuit is established through the remaining relay of each pair which is independent of the operative position of the substation apparatus, a reactive device included in each cord strand between the connections of the relays therewith, and a line signal cut-off relay for each line energized in series with one of said relays.

27. A telephone system comprising a telephone line, a source of current and a relay inserted between the two limbs of said line, a second relay and means for energizing it over a circuit including part of the talking circuit, a switch at the substation and a switch at the central station for controlling the circuit through said relays, a signal controlled by the conjoint action of said relays, a line signal, and means whereby the flow of current in one of said relays serves to retire the said line signal.

28. A telephone system comprising a telephone line, a source of current and a relay inserted between the terminals of the two limbs of said line, a second relay and means for energizing it over a circuit including part of the talking circuit, a switch at the substation for controlling said bridged relay and a switch at the central office for controlling said other relay, a signal controlled by the conjoint action of said relays, a line signal, and means whereby the flow of current in one of said relays serves to retire the said line signal.

29. A telephone system comprising a telephone line, a source of current and an electromagnet inserted between the terminals of the two limbs of said line, a second electromagnet and means for energizing it over a circuit including part of the talking circuit, a switch at the substation and a switch at the central station for controlling the circuit through said electro-magnets, a supervisory signal controlled by the joint action of said electro-magnets, a line signal, and means whereby the flow of current in one of

said relays serves to retire the said line signal.

30. A telephone line comprising a source of electricity and a pair of relays adapted to be inserted between the limbs of said line, to place the source of current in bridge of the talking circuit, a switch at the substation and a switch at the central station for controlling the circuit through said relays, a signal adapted to be controlled by the conjoint action of said relays, a line signal, and means whereby the flow of current in one of said relays serves to retire the said line signal.

31. A telephone system comprising a pair of telephone lines, an inductive device through which the same are adapted to be united for conversation, a charging source of electricity and a pair of relays adapted to be inserted between the two limbs of each of said lines, to place the source of current in bridge of the talking circuit, one pair of relays being individual to one of said lines and the other pair being individual to the other line, switches at the substations and at the central station for controlling the circuit through said relays, a signal controlled by the conjoint action of each pair of relays, a line signal, and means whereby the flow of current in one of said relays serves to retire the said line signal.

32. In a telephone system, a metallic telephone line, an operator's plug and a cord circuit, a source of current and a pair of relays bridged by the cord circuit between the limbs of said line, a third conductor connected with one pole of said source, one of said relays being adapted to be operated over the metallic line when the subscriber's telephone is in use, and the other to be operated over a part of the line and said third conductor when the subscriber's telephone is not in use and the operator's plug is connected with the line, a line signal, and means whereby the flow of current in one of said relays serves to retire the said line signal.

33. In a telephone system, a telephone line, a source of current and a relay bridged between the terminals of the two limbs of said line, a second relay at the central office and connected with one side of the talking circuit and means for energizing it, a switch at the substation and a switch at the central station for controlling the circuit through said relays, a signal controlled by the conjoint action of said relays, a line signal, and means whereby the flow of current in one of said relays serves to retire the said line signal.

34. In a telephone system, a telephone line, a source of electricity at the central office, an operator's plug and a pair of relays associated therewith, one of said relays being energized from the said source of electricity while the plug is connected with the

said line and over a path having a part coincident with the talking circuit, and the other relay being energized while the plug is connected with the said line and the subscriber's telephone is in use, a signal associated with said pair of relays, the circuit of said signal being established by the operation of the first of said relays and said signal being rendered inoperative by the operation of the second of said relays, a line signal, and means whereby the flow of current in one of said relays serves to retire the said line signal.

35. In a telephone exchange system, telephone lines extending from substations to an exchange, each of said substations being provided with a telephone switch hook for supporting the receiver thereat, a common battery at the exchange, supervisory signals located at the exchange, corresponding to calling and called subscribers' stations, supervisory relays at the exchange, one for each of the supervisory signals, means whereby the switch hooks at the subscribers' stations are adapted to operate each of said relays independently of the other to actuate the corresponding indicator, a second supervisory relay associated with each supervisory signal adapted through the agency of the switch hooks to restore the supervisory signals each independently of the other, means whereby the latter relays are both actuated independently of each other by the said switch hooks, a line signal, and means whereby the flow of current in one of said relays serves to retire the said line signal, said relays all energized over circuits including portions of the talking circuit.

36. In a telephone system, telephone lines extending from subscribers' stations to an exchange, a cord circuit at the exchange provided with two strands for forming connections between two telephone lines, a pair of relays corresponding to each end of the cord circuit, a source of current for inclusion in circuit with each of said pairs of relays, connected in bridge of the talking circuit, a supervisory signal for each pair of relays and jointly controlled thereby through the agency of the substation apparatus, a local circuit for each telephone line to include the said source of current in a local circuit, one relay of each pair that is controlled by a subscriber's station apparatus being included in the corresponding local circuit, whereby one relay of each pair may place the supervisory signal in one condition of use, and both relays cooperating place the supervisory signal in another condition of use, a line signal, and means whereby the flow of current in one of said relays serves to retire the said line signal.

37. In a telephone system, telephone lines extending from subscribers' stations to an exchange, a cord circuit at the exchange pro-

vided with two strands for forming connections between two telephone lines, a pair of relays corresponding to each end of the cord circuit, a source of current for inclusion in circuit with each of said pairs of relays, connected in bridge of the talking circuit, a supervisory signal for each pair of relays and jointly controlled thereby, switching apparatus for controlling the operation of the relays, a reactive device included in each cord strand between the connections of the relays therewith, a line signal, and means whereby the flow of current in one of said relays serves to retire the said line signal.

38. In a telephone system, telephone lines extending from subscribers' stations to an exchange, a cord circuit at the exchange provided with two strands for forming connections between two telephone lines, a pair of relays corresponding to each end of the cord circuit, a source of current for inclusion in circuit with each of said pairs of relays, connected in bridge of the talking circuit, a supervisory signal for each pair of relays and jointly controlled thereby, a local circuit for each telephone line to include the said source of current in a local circuit, one relay of each pair being included in the corresponding local circuit, whereby one relay of each pair may place the supervisory signal in one condition of use, and both relays cooperating place the supervisory signal in another condition of use, a line signal, and means whereby the flow of current in one of said relays serves to retire the said line signal.

39. In a telephone system, telephone lines extending from substations to jacks at an exchange, a cord circuit at the exchange provided with two strands for forming connections between subscribers' lines, a pair of relays corresponding to each end of the cord circuit, a source of current for energizing the said relays, connected in bridge of the talking circuit, a supervisory signal for each pair of relays and jointly controlled thereby, switching mechanism at the substations for controlling the operation of one of each pair of relays, means including a jack and a cord circuit plug inserted in the jack, whereby a closed circuit is established through the remaining relay of each pair which is independent of the operative position of the substation apparatus, a reactive device included in each cord strand between the connections of the relays therewith, a line signal, and means whereby the flow of current in one of said relays serves to retire the said line signal.

40. A telephone system comprising a telephone line, a source of current and a relay inserted between the terminals of the two limbs of said line, a second relay and means for energizing it over a circuit including part of the talking circuit, a switch at the

substation and a switch at the central station for controlling the circuit through said relays, a signal controlled by the conjoint action of said relays, and means for ringing over the two sides of the called line in series.

41. A telephone system comprising a telephone line, a source of current and a relay inserted between the terminals of the two limbs of said line, a second relay and means for energizing it over a circuit including part of the talking circuit, a switch at the substation for controlling said bridged relay and a switch at the central office for controlling said other relay, a signal controlled by the conjoint action of said relays, and means for ringing over the two sides of the called line in series.

42. A telephone system comprising a telephone line, a source of current and an electro-magnet inserted between the terminals of the two limbs of said line, a second electro-magnet and means for energizing it over a circuit including part of the talking circuit, a switch at the substation and a switch at the central station for controlling the circuit through said electro-magnets, a supervisory signal controlled by the joint action of said electro-magnets, and means for ringing over the two sides of the called line in series.

43. A telephone line comprising a source of electricity and a pair of relays adapted to be placed between the terminals of the two limbs of said line, a switch at the substation and a switch at the central station for controlling the circuit through said relays, a signal adapted to be controlled by the conjoint action of said relays, and means for ringing over the two sides of the called line in series.

44. A telephone system comprising a pair of telephone lines, an inductive device through which the same are adapted to be united for conversation, a charging source of electricity and two pairs of relays adapted to be placed between the terminals of the two limbs of each of said lines, one pair of relays being individual to one of said lines and the other pair being individual to the other line, switches at the substations and at the central station for controlling the circuit through said relays, a signal controlled by the conjoint action of each pair of relays, and means for ringing over the two sides of the called line in series.

45. In a telephone system, a metallic telephone line, an operator's plug and a cord circuit, a source of current and a pair of relays bridged by the cord circuit across the terminal of said line, a third conductor connected with one pole of said source, one of said relays being adapted to be operated over the metallic line when the subscriber's telephone is in use, and the other to be oper-

ated over a part of the line and said third conductor when the subscriber's telephone is not in use and the operator's plug is connected with the line, and means for ringing over the two sides of the called line in series.

5 46. In a telephone system, a telephone line, a source of current and a relay bridged between the two terminals of the two limbs of said line, a second relay at the central office and connected with one side of the talking circuit and means for energizing it, a switch at the substation and a switch at the central station for controlling the circuit through said relays, a signal controlled by the conjoint action of said relays, and means for ringing over the two sides of the called line in series.

10 47. In a telephone system, a telephone line, a source of electricity at the central office, an operator's plug and a pair of relays associated therewith, one of said relays being energized from the said source of electricity while the plug is connected with the said line and over a path having a part coincident with the talking circuit, and the other relay being energized while the plug is connected with the said line and the subscriber's telephone is in use, a signal associated with said pair of relays, the circuit of said signal being established by the operation of the first of said relays and said signal being rendered inoperative by the operation of the second of said relays, and means for ringing over the two sides of the called line in series.

20 48. In a telephone exchange system, telephone lines extending from substations to an exchange, each of said substations being provided with a telephone switch hook for supporting the receiver thereat, a common battery at the exchange, supervisory signals located at the exchange, corresponding to calling and called subscribers' stations, supervisory relays at the exchange, one for each of the supervisory signals, means whereby the switch hooks at the subscribers' stations are adapted to operate each of said relays independently of the other to actuate the corresponding indicator, a second supervisory relay associated with each supervisory signal adapted through the agency of the switch hooks to restore the supervisory signals each independently of the other, means whereby the latter relays are both actuated independently of each other by the said switch hooks, and means for ringing over the two sides of the called line in series, said relays all energized over circuits including portions of the talking circuit.

30 49. In a telephone system, telephone lines extending from subscribers' stations to an exchange, a cord circuit at the exchange provided with two strands for forming connections between two telephone lines, a pair

of relays corresponding to each end of the cord circuit, a source of current for inclusion in circuit with each of said pairs of relays, connected in bridge of the talking circuit, a supervisory signal for each pair of relays and jointly controlled thereby controlled by a subscriber's station apparatus, a local circuit for each telephone line to include the said source of current in a local circuit, one relay of each pair that is controlled by a subscribers' station apparatus being included in the corresponding local circuit, whereby one relay of each pair may place the supervisory signal in one condition of use, and both relays cooperating place the supervisory signal in another condition of use, and means for ringing over the two sides of the called line in series.

50. In a telephone system, telephone lines extending from subscribers' stations to an exchange, a cord circuit at the exchange provided with two strands for forming connections between two telephone lines, a pair of relays corresponding to each end of the cord circuit, a source of current for inclusion in circuit with each of said pairs of relays, connected in bridge of the talking circuit, a supervisory signal for each pair of relays and jointly controlled thereby, switching apparatus for controlling the operation of the relays, a reactive device included in each cord strand between the connections of the relays therewith, and means for ringing over the two sides of the called line in series.

51. In a telephone system, telephone lines extending from subscribers' stations to an exchange, a cord circuit at the exchange provided with two strands for forming connections between two telephone lines, a pair of relays corresponding to each end of the cord circuit, a source of current for inclusion in circuit with each of said pairs of relays, connected in bridge of the talking circuit, a supervisory signal for each pair of relays and jointly controlled thereby, a local circuit for each telephone line to include the said source of current in a local circuit, one relay of each pair being included in the corresponding local circuit, whereby one relay of each pair may place the supervisory signal in one condition of use, and both relays cooperating place the supervisory signal in another condition of use, and means for ringing over the two sides of the called line in series.

52. In a telephone system, telephone lines extending from substations to jacks at an exchange, a cord circuit at the exchange provided with two strands for forming connections between subscribers' lines, a pair of relays corresponding to each end of the cord circuit, a source of current for energizing the said relays, connected in bridge of the talking circuit, a supervisory signal for each pair of relays and jointly controlled

thereby, switching mechanism at the substations for controlling the operation of one of each pair of relays, means including a jack and a cord circuit plug inserted in the jack, whereby a closed circuit is established through the remaining relay of each pair which is independent of the operative position of the substation apparatus, a reactive device included in each cord strand between the connections of the relays therewith, and means for ringing over the two sides of the called line in series.

53. A telephone system comprising a telephone line, a source of current and a relay connecting together the two limbs of said line, so that the battery is in bridge of the talking circuit, a second relay and means for energizing it over a circuit including part of the talking circuit, a switch at the substation and a switch at the central station for controlling the circuit through said relays, a signal controlled by the conjoint action of said relays, and a busy test circuit including one of said relays.

54. A telephone system comprising a telephone line, a source of current and a relay connecting together the two limbs of said line, so that the battery is in bridge of the talking circuit, a second relay and means for energizing it over a circuit including part of the talking circuit, a switch at the substation for controlling said bridged relay and a switch at the central office for controlling said other relay, a signal controlled by the conjoint action of said relays, and a busy test circuit including one of said relays.

55. A telephone system comprising a telephone line, a source of current and an electro-magnet connecting together the two limbs of said line, a second electro-magnet and means for energizing it over a circuit including part of the talking circuit, a switch at the substation and a switch at the central station for controlling the circuit through said electro-magnets, a supervisory signal controlled by the joint action of said electro-magnets, and a busy test circuit including one of said relays.

56. A telephone system comprising a line, a source of electricity and a pair of relays adapted to be placed between the limbs of said line, a switch at the substation and a switch at the central station for controlling the circuit through said relays, a signal adapted to be controlled by the conjoint action of said relays, and a busy test circuit including one of said relays.

57. A telephone system comprising a pair of telephone lines, an inductive device through which the same are adapted to be united for conversation, a charging source of electricity and a pair of relays adapted to be placed between the two limbs of each of said lines, one pair of relays being for one of said lines and the other pair being for the

other line, switches at the substations and at the central station for controlling the circuit through said relays, a signal controlled by the conjoint action of each pair of relays, and a busy test circuit including one of said relays.

58. In a telephone system, a metallic telephone line, an operator's plug and a cord circuit, a source of current and a pair of relays placed by the cord circuit between the terminals of said line, a third conductor connected with one pole of said source, one of said relays being adapted to be operated over the metallic line when the subscriber's telephone is in use, and the other to be operated over a part of the line and said third conductor when the subscriber's telephone is not in use and the operator's plug is connected with the line, and a busy test circuit including one of said relays.

59. In a telephone system, a telephone line, a source of current and a relay placed between the two limbs of said line, a second relay at the central office and connected with one side of the talking circuit and means for energizing it, a switch at the substation and a switch at the central station for controlling the circuit through said relays, a signal controlled by the conjoint action of said relays, and a busy test circuit including one of said relays.

60. In a telephone system, a telephone line, a source of electricity at the central office, an operator's plug and a pair of relays associated therewith, one of said relays being energized from the said source of electricity while the plug is connected with the said line and over a path having a part coincident with the talking circuit, and the other relay being energized while the plug is connected with the said line and the subscribers' telephone is in use, a signal associated with said pair of relays, the circuit of said signal being established by the operation of the first of said relays and said signal being rendered inoperative by the operation of the second of said relays, and a busy test circuit including one of said relays.

61. In a telephone system, telephone lines extending from substations to an exchange, each of said substations being provided with a telephone switch hook for supporting the receiver thereat, a common battery at the exchange, supervisory signals located at the exchange, corresponding to calling and called subscribers' stations, supervisory relays at the exchange, one for each of the supervisory signals, means whereby the switch hooks at the subscriber's stations are adapted to operate each of said relays independently of the other to actuate the corresponding indicator, a second supervisory relay associated with each supervisory signal adapted through the agency of the switch hooks to restore the supervisory signals each

independently of the other, means whereby the latter relays are both actuated independently of each other by the said switch hooks, and a busy test circuit including one of said relays.

62. In a telephone system, telephone lines extending from subscribers' stations to an exchange, a cord circuit at the exchange provided with two strands for forming connections between two telephone lines, a pair of relays corresponding to each end of the cord circuit, a source of current for inclusion in circuit with each of said pairs of relays, connected by the relays in bridge of the talking circuit, a supervisory signal for each pair of relays and jointly controlled thereby through the agency of the substation apparatus, a local circuit for each telephone line to include the said source of current in a local circuit, one relay of each pair that is controlled by a subscriber's station apparatus being included in the corresponding local circuit, whereby one relay of each pair may place the supervisory signal in one condition of use, and both relays coöperating place the supervisory signal in another condition of use, and a busy test circuit including one of said relays.

63. In a telephone system, telephone lines extending from subscribers' stations to an exchange, a cord circuit at the exchange provided with two strands for forming connections between two telephone lines, a pair of relays corresponding to each end of the cord circuit, a source of current for inclusion in circuit with each of said pairs of relays, connected in bridge of the talking circuit, a supervisory signal for each pair of relays and jointly controlled thereby, switching apparatus for controlling the operation of the relays, a reactive device included in each cord strand between the connections of the relays therewith, and a busy test circuit including one of said relays.

64. In a telephone system, telephone lines extending from subscribers' stations to an exchange, a cord circuit at the exchange provided with two strands for forming connections between two telephone lines, a pair of relays corresponding to each end of the cord circuit, a source of current for inclusion in circuit with each of said pairs of relays, connected in bridge of the talking circuit, a supervisory signal for each pair of relays and jointly controlled thereby, a local circuit for each telephone line to include the said source of current in a local circuit, one relay of each pair being included in the corresponding local circuit, whereby one relay of each pair may place the supervisory signal in one condition of use, and both relays coöperating place the supervisory signal in another condition of use, and a busy test circuit including one of said relays.

65. In a telephone system, telephone lines extending from substations to jacks at an exchange, a cord circuit at the exchange provided with two strands for forming connections between subscribers' lines, a pair of relays corresponding to each end of the cord circuit, a source of current for energizing the said relays, connected in bridge of the talking circuit, a supervisory signal for each pair of relays and jointly controlled thereby, switching mechanism at the substations for controlling the operation of one of each pair of relays, means including a jack and a cord circuit plug inserted in the jack, whereby a closed circuit is established through the remaining relay of each pair which is independent of the operative position of the substation apparatus, a reactive device included in each cord strand between the connections of the relays therewith, and a busy test circuit including one of said relays.

66. A telephone system comprising a telephone line, a source of current and a relay bridged between the two line terminals of the limbs of said line, a second relay and means for energizing it over a circuit including part of the talking circuit, a switch at the substation for controlling said bridged relay and a switch at the central office for controlling said other relay, and a signal controlled by the conjoint action of said relays.

67. In a telephone system, telephone lines extending from subscribers' stations to an exchange, a cord circuit at the exchange provided with two strands for forming connections between two telephone lines, a pair of relays corresponding to each end of the cord circuit, a source of current for inclusion in circuit with each of said pairs of relays, connected in bridge of the talking circuit, a supervisory signal for each pair of relays and jointly controlled thereby, and a local circuit for each telephone line to include the said source of current in a local circuit, one relay of each pair being included in the corresponding local circuit, whereby one relay of each pair may place the supervisory signal in one condition of use, and both relays coöperating place the supervisory signal in another condition of use.

68. In a telephone system, the combination with a pair of telephone lines, of a cord circuit to connect said lines for conversation, calling and answering supervisory signals for said cord circuit, four relays, one located in each end of each talking strand of the cord circuit, the circuit of each of said signals being completed through contacts controlled by two of said relays, switches under the control of the operator in the circuit of two of said relays, the actuation of said relays being adapted to close the circuits of said supervisory signals, switches

under the control of the subscribers in the circuits of the other two of said relays, said relays being adapted when actuated to open the circuits of said supervisory signals, substantially as described.

69. In a telephone system, the combination with a pair of telephone lines, of a cord circuit to connect said lines for conversation, calling and answering supervisory signals for said cord circuit, four relays, one located in each end of each talking strand of the cord circuit, switches under the control of the operator in the circuit of two of said relays, the actuation of said relays being

adapted to cause the display of said supervisory signals, switches under the control of the subscribers in the circuits of the other two of said relays, the actuation of said relays being adapted to efface said signals, substantially as described.

Signed by me at Atlantic City, Atlantic county, New Jersey, this 1st day of March 1902.

CHARLES L. GOODRUM.

Witnesses:

ARTHUR WRIGHT,
J. S. CARRINTH.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."