R. H. MANSON.

TELEPHONE EXCHANGE SYSTEM.

APPLICATION FILED MAY 22, 1906.

1,038,617.

Patented Sept. 17, 1912.

2 SHEETS—SHEET 1.

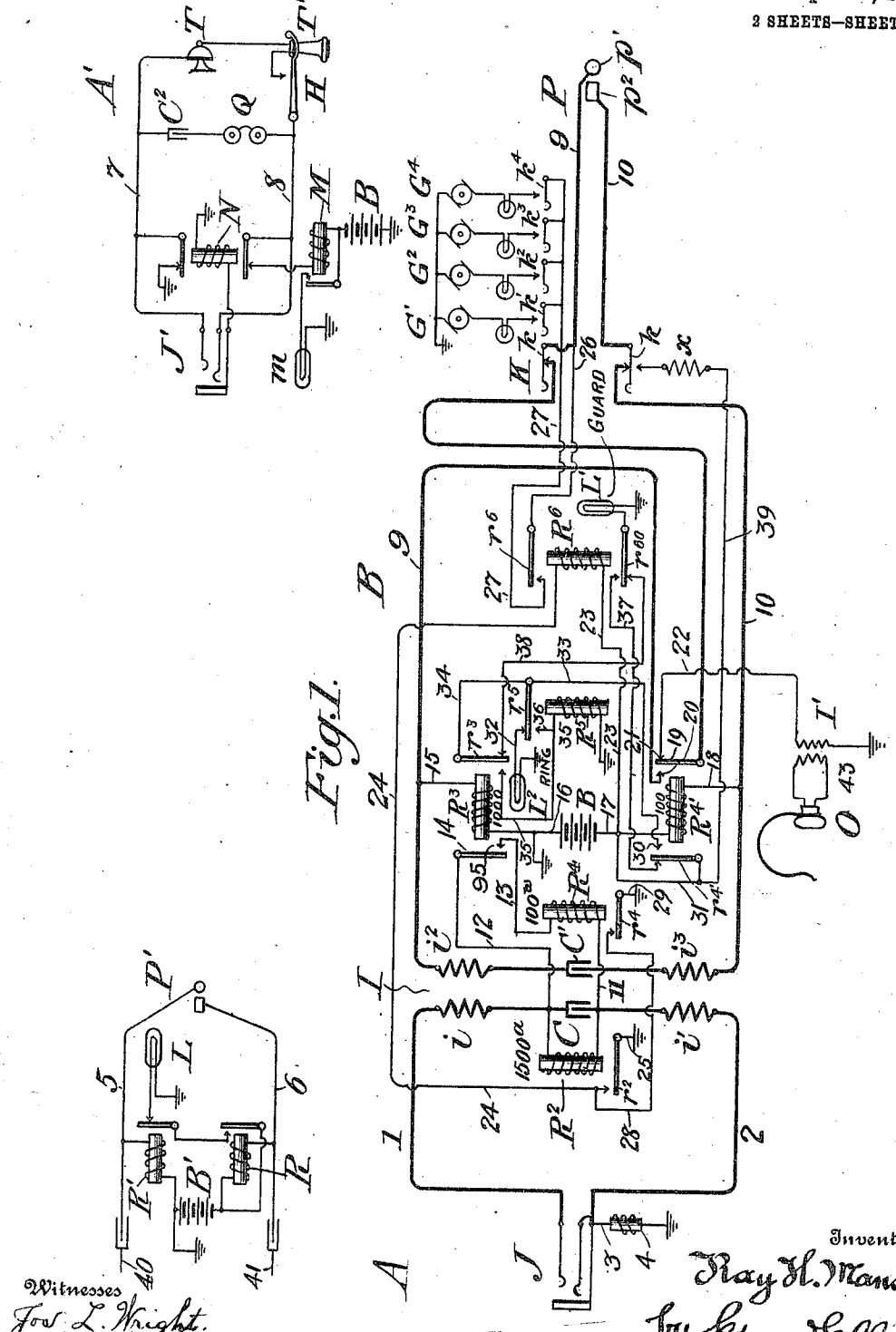

Fig. 1.

Witnesses

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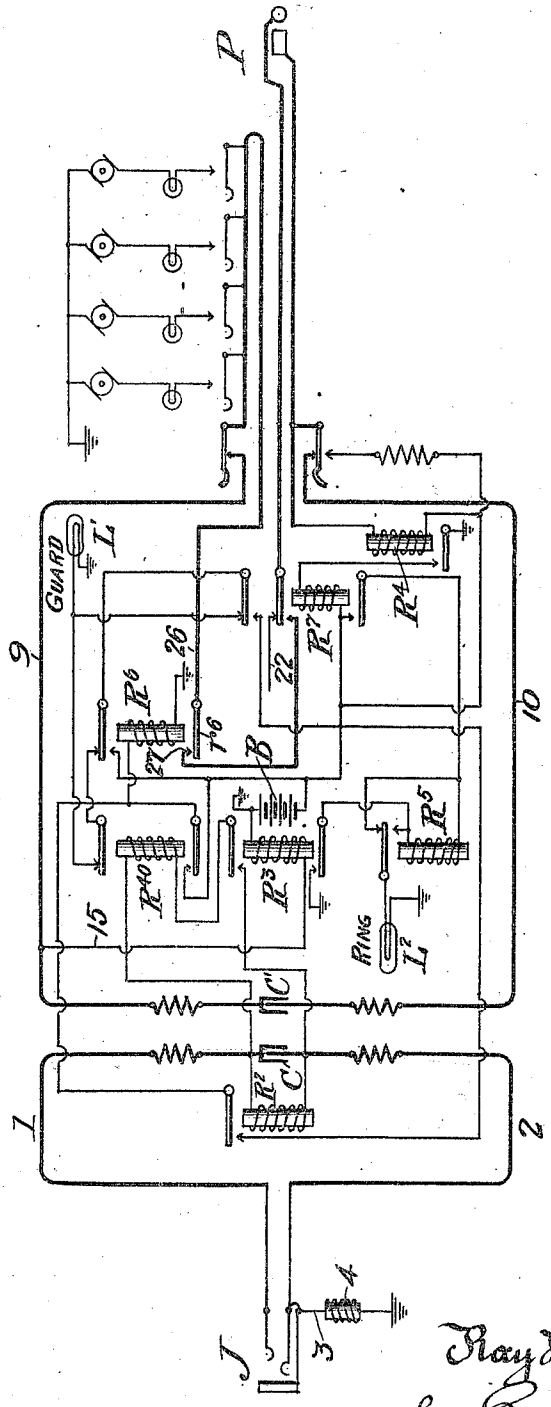
2 SHEETS—SHEET 2.

Fig. 2.



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UNITED STATES PATENT OFFICE.

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TELEPHONE-EXCHANGE SYSTEM.

1,038,617. Specification of Letters Patent. Patented Sept. 17, 1912.

Application filed May 22, 1906. Serial No. 318,250.

To all whom it may concern:

Be it known that I, RAY H. MANSON, a citizen of the United States, residing at Elyria, in the county of Lorain and State of Ohio, have invented certain new and useful Improvements in Telephone-Exchange Systems, of which the following is a specification, reference being had therein to the accompanying drawing.

My invention relates to telephone exchange systems, and has for its object the provision of improved means for signaling subscribers, and particularly for trunk ringing, that is to say signaling a subscriber whose line terminates in a central office different or distant from that in which the call originated.

In handling trunk calls, the best practice at present gives the supervision of all connections to the "A" operator, that is the subscriber's operator who originally answers the call and initiates the desired connection.

The actual ringing, however, is not always possible to be done directly by this "A" operator, for the reason that many trunks have complicated arrangements of relays, etc., and in addition have a resistance which taken with that of the line called and considering losses from intermediate bridges and the like, would very perceptibly diminish the effect finally produced at the called station. The ringing is therefore usually done by the "B" or trunk operator, as directed by the "A" operator. Where selective ringing is practised, in party-line calls, the "B" operator also sets up the proper selective key or keys.

It is my purpose in the present case to give the "A" operator absolute control of the ringing. A circuit of this type, however, must fulfil the following conditions.

First—The trunk must terminate in multiple jacks at the "A" board and in plugs and supervisory lamps at the "B" board of the distant office.

Second—The "B" end of the trunk must have a normal connection from the tip of the plug to the operator's busy test. This connection must be controlled by a relay so that the insertion of the plug will automatically disconnect the test circuit and connect the talking circuit through to the "A" switchboard.

Third—The disconnect lamp at the "B" board must be controlled by the insertion and removal of a plug at the "A" board. If the "A" operator inserts the plug before the "B" operator makes the desired connection, the disconnect lamp will light; in other words, serving as a guard.

Fourth—The ringing lamp must be located at the "B" position in conjunction with each one of these trunks, which will light on inserting the plug at the "B" board and extinguish when the subscriber responds, and then stay locked out until the connection is pulled down. When automatic ringing is provided this ringing lamp is not essential, but can be used as a guard if desired.

Fifth—The supervisory lamp in the "A" switchboard cord-circuit which is connected to one of these trunks, must be controlled by the distant subscriber connected to the "B" end of the same trunk; thus, the disconnect signal is first received by the "A" operator, and when she pulls down her connecting cord the disconnect lamp located at the "B" end of the trunk, will light.

Sixth—The current for supplying the subscriber's instrument must be furnished from the "B" end of the trunk and come from the "B" exchange storage battery.

Seventh—The "B" operator must do all the ringing, either individual or party-line ringing, and she will not be able to throw generator current out to line until the "A" operator inserts a plug into the other end of the trunk used.

My present system is designed to meet these conditions, and briefly stated it operates as follows: In initiating the connection, the "A" operator gets on the order wire to the "B" office, and orders up a trunk in the usual manner, the "B" operator responding by designating the trunk to be used, and proceeding at once to test the jack of the line wanted. The "A" operator plugs in on the trunk designated, thereby energizing certain relays at the "B" end, which connect the ringing circuit and light a guard lamp. When the "B" operator finally plugs in on the wanted subscriber's line she extinguishes the guard lamp and lights a "ringing" lamp. She then rings in the usual way, and when the subscriber answers the ringing lamp is cut out and the controlling relay therefor is locked so the lamp will remain extinguished. At the same time sufficient current is permitted to pass through the

trunk to operate the supervisory relay at the "A" operator's position and show her that the call is answered. When the operator pulls down her connection battery is disconnected from the "A" end of the trunk, and a disconnect lamp is lighted before the "B" operator, who pulls down her part of the connection. The gist of the present invention lies in the control of the "B" ringing circuit by the "A" operator.

My invention is illustrated in the accompanying drawings, in which—

Figure 1 is a diagram showing a trunk-line extending between two city exchange offices, with a portion of the "A" operator's cord-circuit at the first office, and a subscriber's line at the second office. Fig. 2 is a diagram of a modification of Fig. 1.

Referring to the drawings, and particularly to Fig. 1, J represents the terminal jack of an outgoing trunk from one city office to another, or it may be the terminal of a trunk between divisions of the same office. At the other end this trunk terminates in a plug P. The jack J is at what is called the "A" end of the trunk, and the plug P at the "B" end. Two different classes of operators are employed at each exchange, "A" operators and "B" operators. The first are also called "subscribers'" operators, and the second "trunk" operators. The main portion of the trunk-line extending between these operators is shown at 1—2, and the continuity of the trunk for direct currents is broken at the "B" office where the repeating coil I and the condensers C are interposed. The trunk-jack J has spring-contacts and a so-called thimble or test contact, but in my present diagrams a two-wire circuit is shown, so the long spring and the test contact are tied together and to ground through wire 3 and the choke-coil 4. Coöperating with the jack J is an operator's plug P′, whose tip and sleeve contacts form the terminals of cord-conductors 5—6, which are supposed to be matched with other cord-conductors leading to the answering plug with which the operator may respond to calling subscribers. This answering plug and its conductors are not shown, since they form no part of the present invention. The conductors 5—6 have bridged across them the main battery B′ and a sleeve and a tip relay R and R′, respectively, which control the battery supply to the supervisory lamp L. On the right-hand side of Fig. 1 I have shown a subscriber's line having a central office terminal or spring-jack J′ with three contacts like the jack J, a cut-off relay N, a line-relay M, a line-signal lamp m, line-wires 7 and 8, a substation set comprising a transmitter T, receiver T′, ringer Q, switch-hook H, condenser C^2, and at the central office a normal connection from wire 7 to ground and from wire 8 through the line-relay M to the main battery B. Both the cord-circuit and the line-circuit shown are of standard type, and their mode of operation is well understood and obvious from the diagrams. When a plug such as P′ is inserted in a jack, such as J′, current will flow from the battery B′ through the cord-relay R and conductor 6 to the relay N and ground. This relay then pulls up its armature, cutting off the line-signal relay; and the relay R pulls up its armature putting battery on the lamp L if the relay R′ is at the same time deënergized. If the line is calling, so that the subscriber's receiver is off the hook, relay R′ will also be energized, and hence the lamp L will be deprived of current; but if the line is being called, the relay R′ will remain inactive until the subscriber answers.

Having thus stated very briefly the direct operation of the cord and line-circuits, I will return to the trunk. The sleeve side of the trunk-jack J is provided with the choke-coil 4 in order to furnish a path to ground similar to that through the cut-off relay N of a subscriber's line-circuit. This is necessary in order that the relay R should supply current for the supervisory lamp L. Except for the foregoing, the peculiar and characteristic features of my trunk-circuit are all located at the "B" end, or in the "B" office. The trunk-wires 1—2 pass respectively to the windings i, i' of the repeating coil, and thence to the two sides of the condenser C. The twin windings i^2, i^3 of the repeating coil are connected intermediately to the opposite sides of condenser C′, and at their outer ends to the extension wires 9, 10, which lead to the trunk plug P through suitable flexible conductors.

Bridged across the terminals of the condenser C is a relay R^2 of very high resistance, which may be 15,000 ohms. I provide a shunt 11, 12, 13 about the relay R^2, normally open at contacts 14, 95 of the relay R^3, and containing a relatively low resistance relay R^4, whose windings may well be of 100 ohms resistance. The relay R^3 is the tip relay of the trunk, which corresponds to the tip relay R′ of the "A" operator's cord-circuit. Similarly, the relay $R^{4'}$ is the sleeve relay of the trunk and corresponds to the sleeve relay R of the "A" operator's cord-circuit. These two relays R^3, $R^{4'}$ are connected across the trunk-conductors 9—10 by means of the wires 15, 16, 17, 18, with the main battery B connected between them. This battery therefore supplies current through the contacts of the trunk-plug to the called subscriber's line, in the same manner that the battery B′ in the "A" operator's cord-circuit. When a trunk-plug P is inserted in any line-jack J′, the relay $R^{4'}$ will be at once energized by current flow through the following circuit: ground, 16, B, 17, $R^{4'}$,

10, p^2, J', N, ground and back to battery. The relay $R^{4'}$ when energized completes the normally open tip side 9 by closing the contact 19, 20. At the same time, it cuts off the operator's test set O, by opening the contacts 19 and 21. The latter contact is connected by wire 22 through coil I' to ground. This coil is shown as the primary of an induction coil whose secondary is connected to the operator's head telephone, but it may equally well be the coil of a special testing relay, or the winding of the receiver itself. It will thus be perceived that as long as the plug P is idle the tip side of the trunk is open and the tip of the plug P connected to the test set. Two other relays are provided, marked R^5 and R^6. The latter is controlled by the relay R^2, and itself controls the guard and disconnect lamp L'. The former is under the control of the relay R^3 and itself controls the ringing lamp L^2. The operation of these relays and the lamps will be clear from the general statement of operation hereinafter. The relay R^6 also controls the ringing circuit, responding to the act of the "A" operator, in the following manner: When the relay R^2 is energized it closes the following circuit: from battery B by wire 17, 23, R^6, 24, r^2, 25 and ground back to battery by wire 16. This energizes relay R^6, as already stated, which pulls up both its armatures r^6 and r^{60}. The former closes the following circuit: p', 9, 26, r^6, 27, to the ringing keys, thence to the generator, and ground. The continuity of the ringing circuit from the generator to the plug tip is thus determined by the presence of the "A" operator's calling-plug P' in the trunk-jack J, while the continuity of the tip side of the trunk 9, at its incoming or "B" end, is determined by the presence of the trunk-plug P in the jack J' of the called line. Another point should be noted in passing, viz., that the low resistance relay R^4, when energized, maintains the circuit of relay R^6 closed through the branch 28, r^4, 29. That is to say either of the relays R^2 or R^4 will close the circuit of relay R^6, and the reason for this is apparent when it is considered that the low relay R^4 shunts the high relay R^2, so that the latter becomes deënergized when the called subscriber answers. The purpose of having two relays R^2 and R^4 arranged as they are, is that the called subscriber may control the supervisory lamp L in the "A" operator's cord-circuit. The relay R^2, by reason of its high resistance, will not pass sufficient current to effectively energize the tip relay R' of the "A" operator (this relay usually having a resistance of about 100 ohms), but when the relay R^4 is cut in across the terminals of relay R^2, sufficient current will immediately pass from the "A" operator's battery B' through the cord-conductors 5—6, the trunk-wires 1—2, coils i, i', a circuit 11, 12, 13, R^4, to energize the relay R' in the cord-circuit, so that the lamp L which has previously been burning will become extinguished and will thereby indicate to the "A" operator that the called subscriber has answered. The relay R^3 it will be observed responds directly to the act of the called subscriber, becoming energized only when he takes down his receiver T' and closes the circuit at the hook H'.

The ringing key K is set by the "B" operator who continues to ring at the proper intervals as long as the ringing lamp continues to burn. This lamp L^2 is normally connected to the front contact 30 of the relay $R^{4'}$, and thence to battery through the wire 31, this connection being by way of the following circuit: 32, r^5, 33, 30, $r^{4'}$, 31, 17, B, 16 and ground back to the lamp. When the sleeve relay $R^{4'}$ becomes energized upon the insertion of the plug P, therefore, the lamp will light. It can be extinguished only by the energization of relay R^5, which depends upon the energization of relay R^3, when the called subscriber answers. R^5 locks itself, however, after being once energized, and remains locked until the trunk plug is finally removed from the subscriber's line-jack. The energizing circuit is as follows: B, 17, 31, $r^{4'}$, 30, 33, 34, r^3, 35, R^5, and ground back to battery by wire 16. The locking circuit is as follows: B, 17, 31, $r^{4'}$, 30, 33, r^5, 36, 35, R^5 and ground back to battery by wire 16. This locking circuit is of course broken at the contact 30 when the plug P is finally pulled out of the jack. The lamp L^2 is thus lighted only from the time the plug is inserted until the called subscriber answers, confusion of signals being thus avoided. The lamp L' is first lighted when the "A" operator's plug is inserted in the jack J, this being brought about by the energization of the relays R^2 and R^6 in sequence. The lamp circuit is then as follows: 16, B, 17, 31, $r^{4'}$, 37, r^{60}, L' and ground back to battery. As soon as the plug P is inserted in the wanted line-jack, the relay $R^{4'}$ pulls up and breaks this circuit by separating the armature $r^{4'}$ from its back contact. The lamp then goes out, and it should be observed that if the "B" operator follows the proper sequence of steps, she will not attempt to insert the plug P or ring until this lamp lights. When the subscriber, having answered, finally hangs up his receiver and thereby breaks his line-circuit, the relay R^3 will become deënergized and when the "A" operator pulls the plug P' from the jack J, a relay R^6 thereby becomes deënergized, the lamp L' will again light, upon the following circuit: 16, B, 17, 31, $r^{4'}$, 30, 33, 34, r^3, 38, r^{60}, L' and ground back to battery. Should the operator insert the plug P in the wanted line-jack without waiting for the lamp L' to light, both lamps L' and L^2 will thereupon light simultane-

ously. This is normal for the lamp L^2, which is controlled by the relay $R^{4'}$ particularly, but is due in the case of L′ to the closure of the circuit: B, 31, 33, 34, 38, etc., as last traced. The lighting of both lamps simultaneously serves as a guard signal to the operator that she is not yet to ring. Since the "A" operator has inserted the plug P′ in the trunk-jack the relays R^2 and R^6 will become energized, and the lamp L′ will become extinguished, while the lamp L^2 will continue to burn, thereby advising the "B" operator that she may proceed to ring. Should she proceed previously, however, in defiance of the guard signal, her manipulation of the key K will be idle, since the ringing circuit remains open at the contacts of the armature r^6 controlled by the relay R^6. Thus in case of a mistake, or for any other reason, the "A" operator may prevent the "B" operator from sending out ringing current on the wanted line.

I have shown at K a four-party selective ringing key. This has two master key springs k, playing against anvil contacts forming terminals for the trunk conductors 9—10, so that when these springs are open the continuity of the trunk is interrupted in the usual manner for secondary ringing. I also show four selective keys k', k^2, k^3, k^4, each of which when actuated connects one of the selective generators G′, G^2, G^3 or G^4 to the wire 27, and thence through wire 26 to the tip of the plug p'. The sleeve of the plug is connected through wire 10, and a master key spring k, when the key is in use, through the resistance x and wire 39 to the battery and ground. The purpose of this is to supply the battery current to the cutoff relay N of the line while ringing. The spring k and the wire 10 may however be grounded direct without going to the battery, if desired, without altering the invention. This arrangement of manual ringing is illustrated herein as a matter of convenience only. I contemplate practising my invention with automatic ringing of any sort, the characteristic feature of the invention being that the ringing is absolutely controlled by the "A" operator. Thus, the key K may be fitted with any desired form of latch, to be tripped when the called subscriber answers. Such a latch is shown for example in Letters Patent No. 634,575, issued to Edwin W. Ham, October 10, 1899. Other methods of automatic ringing are very well known to those skilled in the art, and can be substituted for the method herein illustrated without the slightest invention. It is unnecessary to illustrate them therefore, and it will be understood that I include them within the scope of my present claims.

I will now state briefly the following operation of effecting connection from the "A" operator's position after answering a call, through the mechanism and circuits shown in Fig. 1 to the subscriber's station A′. We will assume the calling subscriber to have been answered by the "A" operator, her answering plug, which forms the terminal of her conductors 40, 41 having been inserted in the calling line-jack, and the number wanted ascertained. We will assume that this number is of a station A′ connected to a different central office B. It therefore becomes necessary for the "A" operator to trunk the connection. She then proceeds as follows: Depressing an order button, she connects her telephone to an order circuit leading from the "A" to the "B" switchboards. This order circuit is not shown in the drawings, but being common and perfectly well known to all engineers, its illustration is thought unnecessary. The "B" operator is already on the order circuit, or if desired she may have a signal for each circuit, and come in on the one calling. The "A" operator then communicates to her the number of the line wanted, and in turn the "B" operator designates the trunk to be used. We will assume this to be the trunk as shown in the Fig. 1. The "A" operator inserts plug P′ in the jack J, current flows from battery B′ through the trunk-conductors 1—2 and the relay R^2, this relay energizes the relay R^6, and the lamp L′ lights before the "B" operator. The "B" operator at this time takes up the plug P and tests the multiple-jack of the line wanted, by touching the tip p' of the plug to the thimble of the jack J′. If the plug is already in another multiple-jack of this line, the potential of this thimble will be raised through the following circuit from the battery: B, 17, $R^{4'}$, 18, 10, p^2. In this case the testing operator will receive a click, through the following circuit: p', 9, 19, 21, 22, I′ and ground (secondary), 43, primary to the receiver O. The line will then be reported busy either by word of mouth, or by the "B" operator inserting the plug P in a "busy jack" connected to a suitable tone producing device. Assuming the line wanted to be idle, the operator receiving no click inserts the plug P in the jack J′, and thereby connects the trunk extensions 9—10 to the line-wires 7—8. The relay $R^{4'}$ immediately pulls up, the lamp L′ immediately goes out, and the lamp L^2 immediately lights. The "B" operator now manipulates the ringing key, and continues to do so at intervals until the lamp L^2 is extinguished, which occurs when the called subscriber answers, his line-circuit then being closed, and current flowing to the relay R^3 over the following path: B, 17, $R^{4'}$, 18, 10, 8, H, T′, T, 7, 9, 15, R^3, 16. The relay R^5 immediately pulls up and locks itself, so that the lamp L^2 is locked out. The relay R^4 also

pulls up, due to the closure of circuit 11, 12, 13, 14, 95, the relay R^2 becomes deënergized, and effective current reaches the "A" operator's relay R′ through the following circuit: B′, R, 6, 2, i', R^4, 13, 14, 95, 12, i, 1, 5, R′. Relay R′ thereupon pulls up and extinguishes the "A" operator's supervisory lamp L, informing her that the called subscriber has answered. When the subscribers have finished their conversation, and hang up their receivers, they thereby sever their line-circuits, the answering supervisory signal of the "A" operator lights as usual, and the calling supervisory lamp L also lights, owing to the following operations in the trunk: The breaking of the called line-circuit 7—8 at the switch H, causes the relay R^3 to become deënergized. The circuit 11, 12, 13, 14, 95 is thereupon broken, and the relay R^4 is replaced in the shunt around the condenser C by the relay R^2, the effect of this being the same upon the supervisory relay R′ as if the circuit had been broken. The "A" operator therefore gets the clearing-out signal. It will be observed, however, that the relay R^2 maintains the circuit 28, 24, 23, etc., of the relay R^6 in a closed condition. The "A" operator now pulls down her plugs. The removal of the plug P′ from the trunk-jack J results in the deënergization of the relay R^2, which breaks the circuit of the relay R^6, and that in turn closes the circuit of the lamp L′ as follows: 16, B, 17, 31, r^1, 33, 34, r^3, 38, r^{60}, L′ and ground back to battery. This is the clearing-out signal for the "B" operator, and she immediately pulls out the plug P, whereupon the relay $R^{4'}$ loses current, and becoming deënergized breaks the circuit of the lamp L′ at the contact 30, and at the same point cuts off the locking current from the relay R^5. The lamp L′ thereupon becomes dark, and all the parts are restored to normal condition ready for another operation.

In Fig. 2 I have shown a modification of the trunk-circuits in which an intermediate relay R^7 is employed to cut off the test circuit 22 and to complete the talking circuit, there being thus two contacts in the talking-circuit, since the ringing contacts r^6, 26, 27 are directly in the talking-circuit instead of in a branch. The arrangement of the relays in the diagram is somewhat shifted from that in Fig. 1, but the invention and the general operation are the same.

Having thus described my invention what I claim and desire to secure by Letters Patent is:—

1. In a telephone exchange system, the combination of a central exchange, a cord circuit at the exchange, a sub-exchange, a trunk circuit connecting the central exchange with the subexchange, a supervisory relay for the cord circuit, a high resistance relay in the trunk circuit connected in circuit with the supervisory relay upon connection of the cord circuit with the trunk circuit, said high resistance relay preventing operation of the supervisory relay, a telephone line leading from the subexchange and terminating in substations, ringing mechanisms at the subexchange, automatic relay mechanism for controlling the connection of the ringing mechanism with the trunk circuit and telephone line connected therewith, a low resistance relay, and a controlling relay automatically operated upon the response of the called subscriber for closing the circuit of the low resistance relay, said high resistance relay being normally effective to control the circuit for the automatic ringing relay, and said low resistance relay being connected in shunt of the high resistance relay upon operation of the controlling relay to destroy the control of the automatic relay by the high resistance relay and to assume the control of said automatic relay circuit.

2. In a telephone exchange system, the combination of a main exchange, a cord circuit at the main exchange, a subexchange, a trunk circuit for connecting the main exchange with the subexchange, a telephone line leading from the subexchange and terminating in substations, a supervisory relay for the cord circuit, a high resistance and a low resistance relay for the trunk circuit, a controlling relay for controlling the circuit of the low resistance relay, connection of the cord circuit with the trunk circuit causing closure of a circuit including the supervisory relay and the high resistance relay, said high resistance relay preventing operation of the supervisory connection of the trunk circuit with the telephone line and operation of telephone apparatus at the connected substation causing closure of a circuit through the controlling relay whereby the low resistance relay is bridged about the high resistance relay and the supervisory relay rendered operative, ringing mechanism associated with the trunk circuit, automatic relay mechanism for controlling the connection of the ringing mechanism with the trunk circuit, said automatic ringing mechanism circuit being first controlled by the high resistance relay and then by the low resistance relay.

3. In a telephone exchange system, the combination of a cord circuit, a trunk circuit, normally closed master key springs in said trunk, a ringing circuit extending through a normally open operator's key and normally open also at a second point independent of said master key springs, and relay mechanism for closing the ringing circuit at such second point, such relay mechanism being controlled by the connection of the cord circuit with the trunk circuit.

4. In a telephone system, the combination of

a central exchange, connecting conductors thereat, a subexchange, a trunk circuit for connecting the central exchange with the subexchange, a telephone line leading from the subexchange and terminating at a substation, a source of ringing current at the subexchange in a circuit normally disconnected from the trunk circuit, an operator's key at the subexchange, relay mechanism under the control of the central exchange operator for placing the ringing circuit under the control of such operator's key, said ringing circuit being completed through to said key when said sub and central exchanges are connected and a source of current connected to said central exchange connecting conductors for controlling said relay mechanism.

5. In a telephone exchange system, the combination of a central exchange, a subexchange, a trunk circuit for connecting the central exchange with the subexchange, a telephone line leading from the subexchange and terminating at a substation, a source of ringing current at the subexchange in a circuit normally disconnected from the trunk circuit, a normally open operator's key in the ringing circuit, a source of current at the central exchange normally connected to the central exchange circuit, and means under the control of the central exchange operator for preventing the closure of the ringing circuit by such operator's key, said means being controlled by said source and when operated completing the ringing circuit through to the operator's key.

6. In a telephone exchange system, a central exchange, a subexchange, a trunk connecting the exchanges, a source of ringing current at the subexchange normally disconnected from the trunk, a master key in said trunk, a circuit for said ringing current independent of said master key and normally interrupted at two points, and means controlling one of the interruptions under the influence of the central operator.

7. In a central telephone system, a central exchange, a source of current thereat, a cord circuit thereat, a subexchange, a trunk circuit between said two exchanges, switch means for connecting the cord and trunk circuits, a subscriber's line terminating at each exchange, a source of ringing current at the subexchange normally disconnected from said trunk circuit, a relay controlling the connection of said source to said trunk, and operated by current from said central exchange source, a circuit for said relay closed as long as said cord circuit is connected to said trunk.

8. In a central telephone system, a central exchange, a cord circuit thereat, a source of current thereat, a subexchange, a trunk circuit connecting the said two exchanges, switch means for connecting the cord and trunk circuits, subscribers' lines terminating at each exchange and adapted to be connected by the cord and trunk circuits, a source of signaling current normally disconnected from the connecting circuits, a circuit for said signaling source, a relay controlling said circuit, a circuit for said relay including the central exchange current source, means in the trunk for controlling said relay circuit, said last named means operated to control said circuit as long as the cord circuit is connected to the trunk circuit.

9. In a telephone exchange system, a central exchange, a cord circuit thereat, a supervisory relay thereat, a subexchange, a trunk circuit connecting said subexchange and said central exchange, a source of signaling current normally disconnecting from subexchange, a telephone line leading from circuit controlling both the signaling current and the supervisory relay.

10. In a telephone exchange system, a main exchange, a cord circuit, a subexchange, a trunk circuit adapted to be connected to the cord circuit, subscribers' lines adapted to be interconnected by said cord and trunk circuits, a source of signaling current, a circuit for said signaling source normally interrupted to disconnect said signaling source from said main circuit, and operator's ringing key in said circuit; a supervisory relay, a relay in said trunk circuit controlling said relay, and said circuit for said signaling source, said controlling relay adapted, when operated, to connect said ringing circuit through to the operator's key.

In testimony whereof I affix my signature in presence of two witnesses.

RAY H. MANSON.

Witnesses:
A. J. ROBERTS,
WM. C. STRONG.