

Jan. 29, 1924.

1,482,374

A. J. SEYMOUR

CORD CIRCUIT

Original Filed Jan. 13, 1919 2 Sheets-Sheet 1

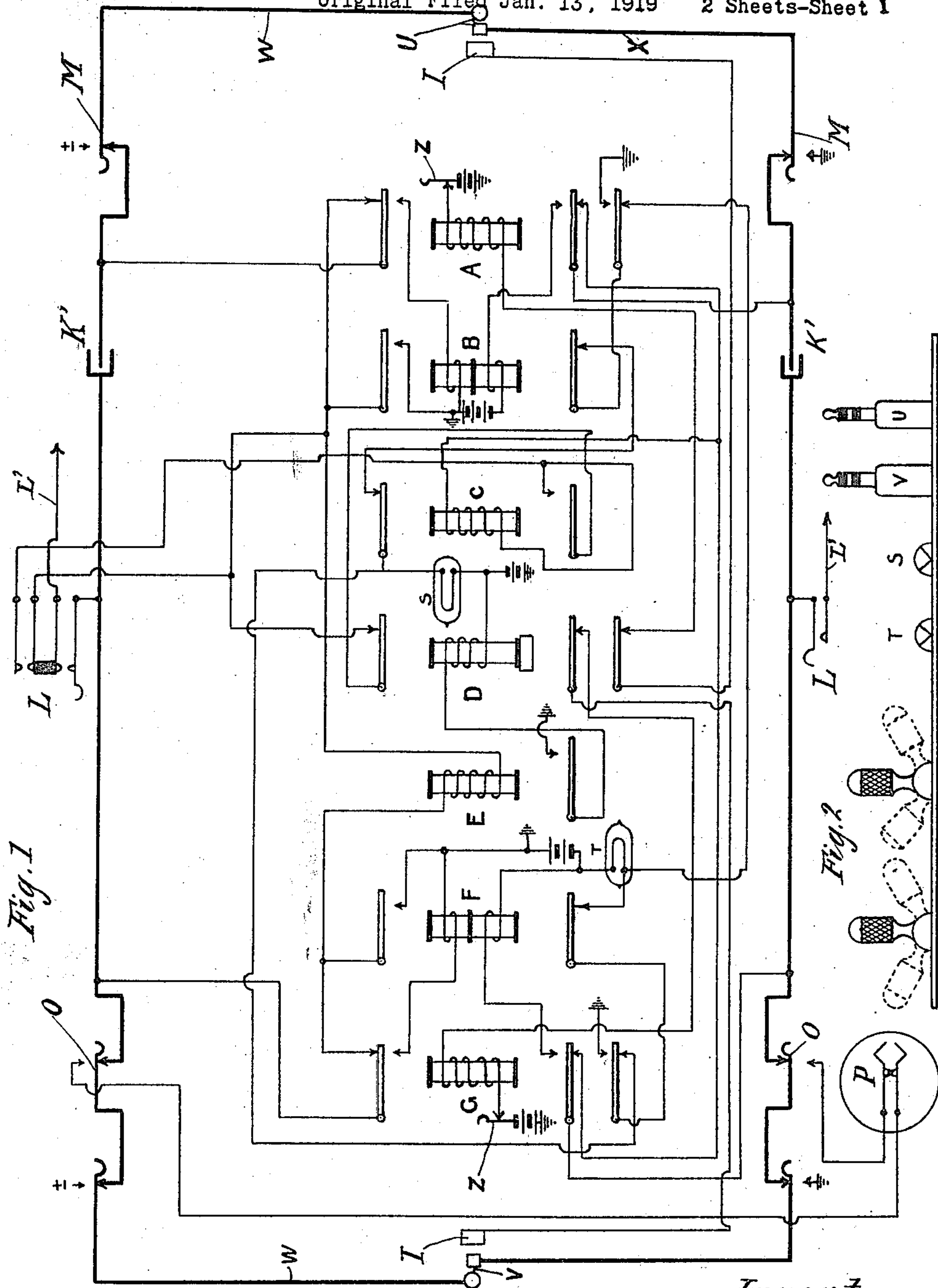


Fig. 2

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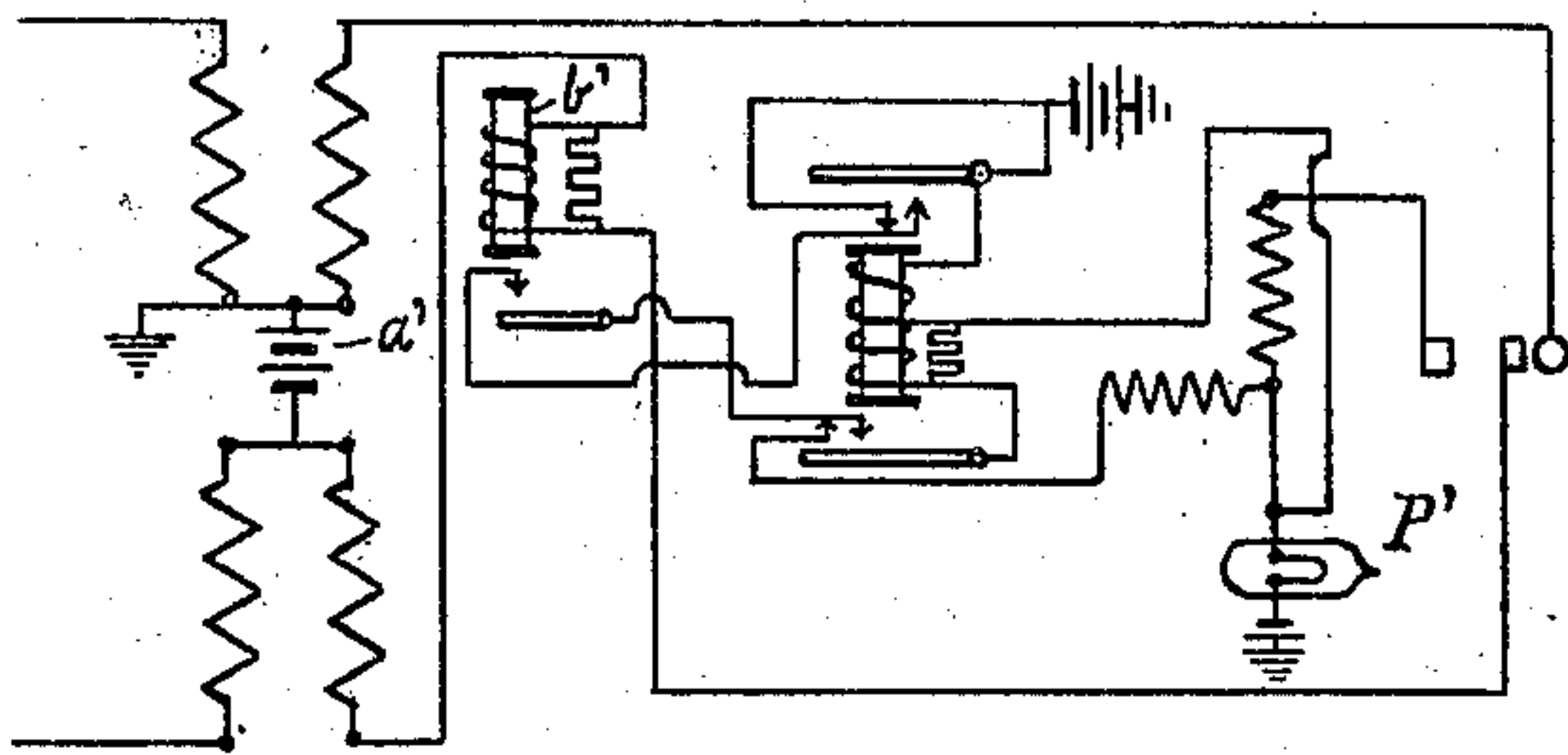
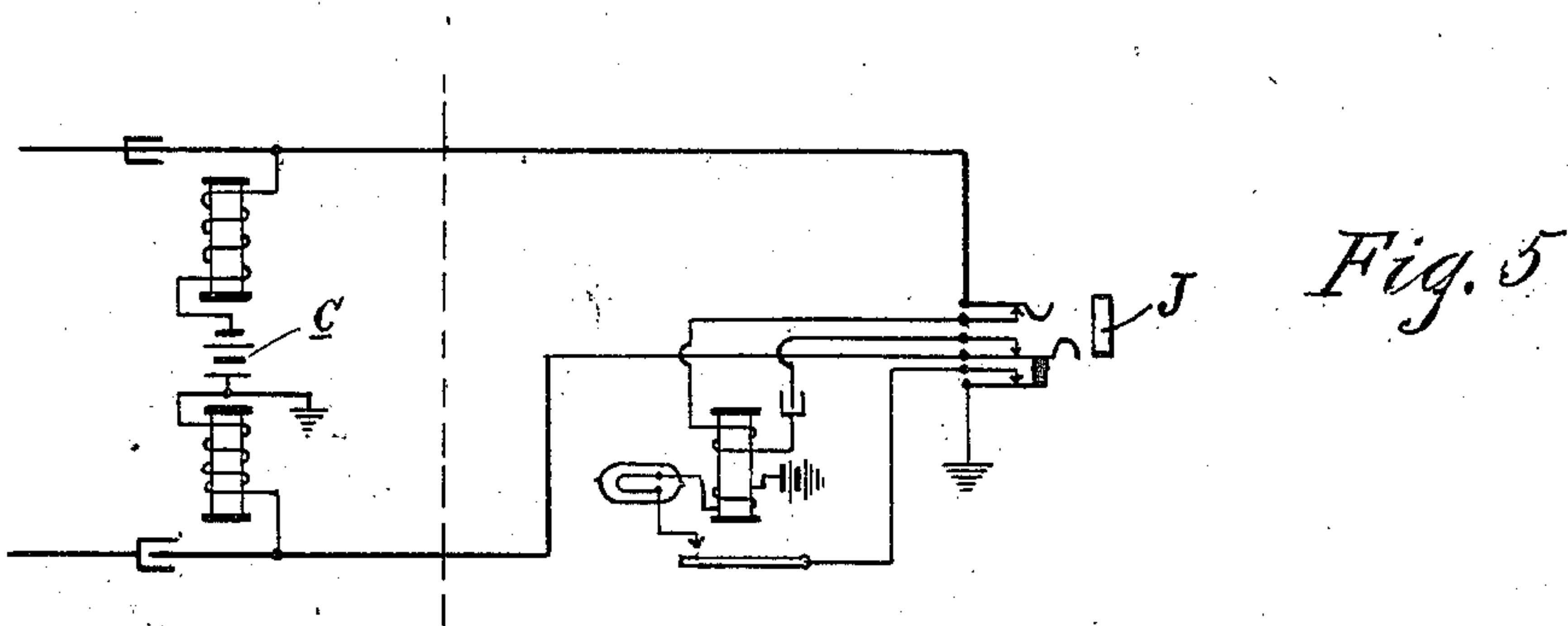
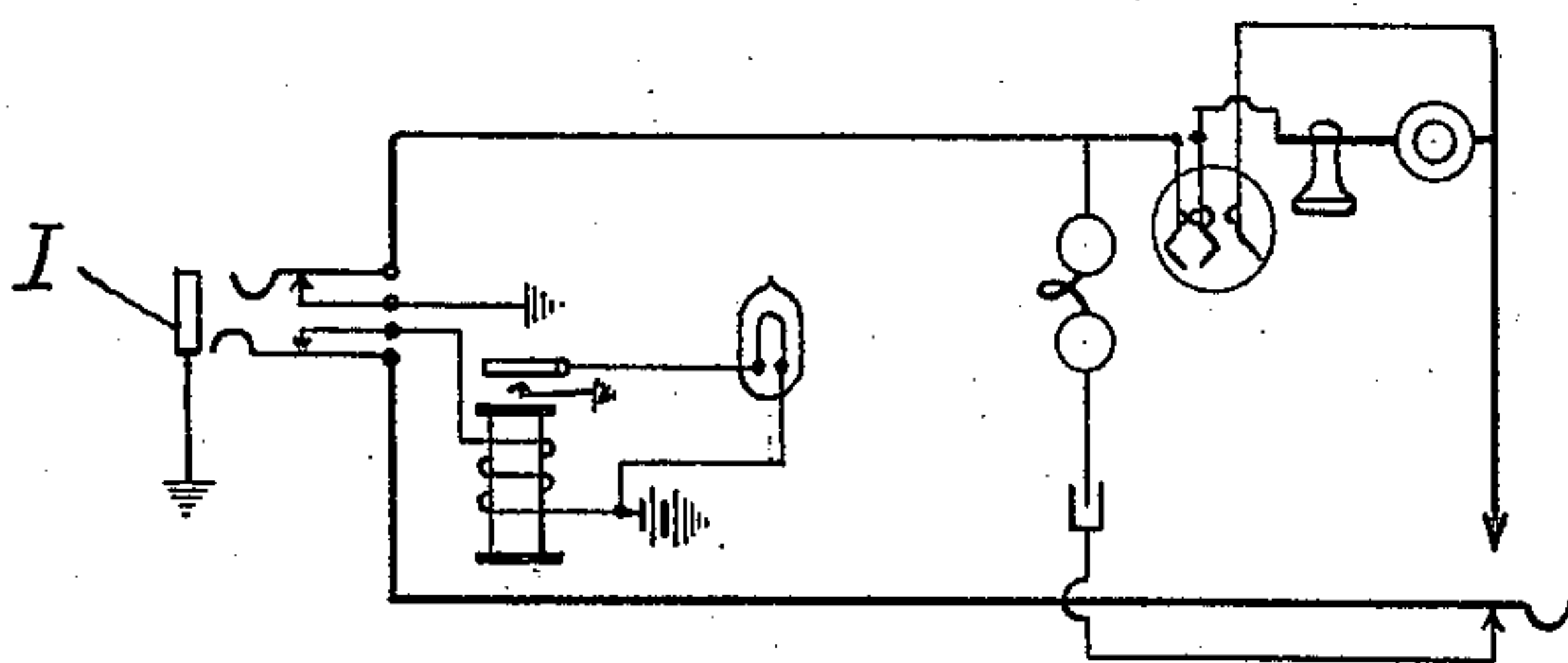
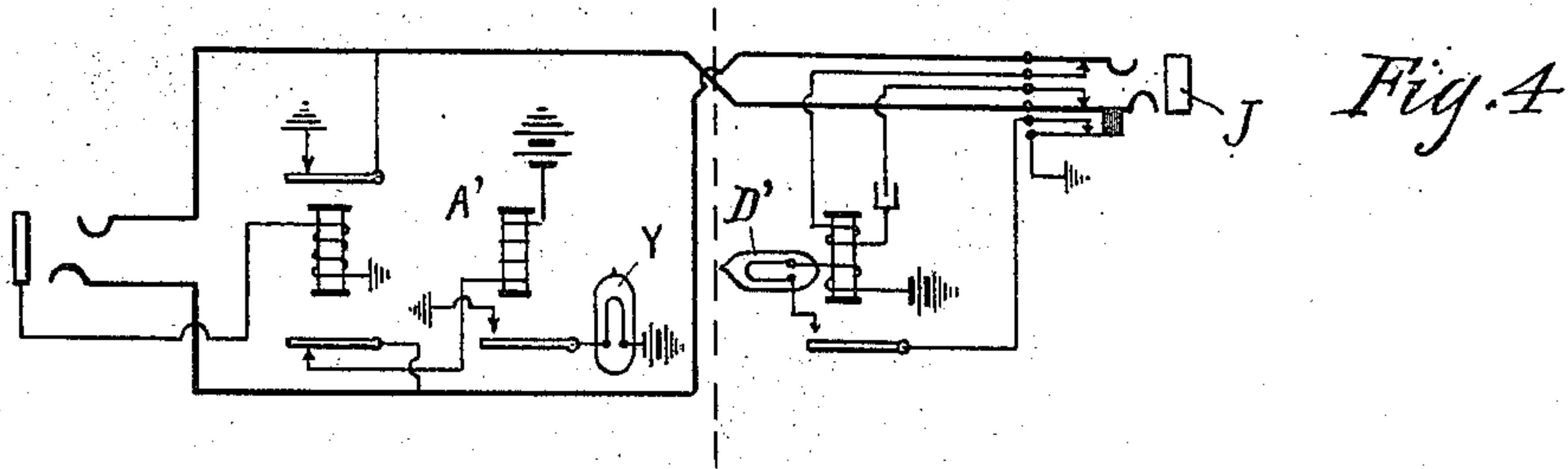
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Original Filed Jan. 13, 1919, 2 Sheets-Sheet 2



Inventor,
Arthur J. Seymour
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UNITED STATES PATENT OFFICE.

ARTHUR J. SEYMOUR, OF ST. PAUL, MINNESOTA, ASSIGNOR TO STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, OF ROCHESTER, NEW YORK, A CORPORATION OF NEW YORK.

CORD CIRCUIT.

Application filed January 13, 1919, Serial No. 270,799. Renewed November 4, 1922. Serial No. 599,150.

To all whom it may concern:

Be it known that I, ARTHUR J. SEYMOUR, a citizen of the United States, residing at St. Paul, in the county of Ramsey and State of Minnesota, residing at 1938 Terrace Park Avenue, have invented certain new and useful Improvements in Cord Circuits, of which the following is a specification.

My invention relates to telephone systems and more particularly to that part of the common battery manually operated switchboards known to the art as connecting cord circuits.

In private branch exchange switchboards at which a variety of local stations and trunk lines from common battery manually operated or automatic exchanges terminate, it is common practice to equip the switchboard with different types of cord circuits with which to establish the various combinations of connections. For instance, a board may comprise pairs of cords designed for setting up local to local connections only; or pairs of cords designed for establishing either local to local, local to exchange, or exchange to local connections. There are also cord circuits termed plug ended, for establishing exchange connections only. To have a variety of cord circuits on a switchboard is objectionable in that it complicates the process of establishing connections resulting in a low standard of efficiency, and complicates the switchboard both from a traffic or maintenance point of view.

The principal object of my invention is to provide improved telephone line connecting means, employing a connecting pair of cords terminating in plugs of a single type, and with which, for conversation and signalling, connections may be effected between two similar or two dissimilar private branch exchange stations, or between either type of private branch exchange stations, (by means of a two-way trunk) with a common battery manually operated exchange subscriber or with an automatic exchange subscriber; also for connecting either a common battery exchange subscriber or automatic subscriber by means of a two way trunk with either type of private branch exchange station.

A further object of my invention is to provide, in a cord circuit, certain novel circuit arrangements and connections whereby different kinds of lines or trunks may be

inter-connected by the same operation; the operator perceiving no difference whatever in establishing such connections as:—

Local to local;

Local to common battery manual exchange;

Local to automatic exchange;

Common battery manual exchange to local;

Automatic exchange to local.

A still further object is to provide a cord circuit whereby may be connected any local station with either type of exchanges for incoming or outgoing night, Sunday or holiday calls, and wherein the circuit arrangement is such that the act of replacing the receiver at the local station, after completion of a conversation on a trunk or central office connection, causes both supervisory lamps at the private branch exchange and the supervisory lamp at the central office to light, which is to be regarded by the operators as a peremptory disconnect signal, thereby affording standard through supervision.

Referring to the accompanying drawings Figure 1, shows, diagrammatically, a cord circuit employing my invention.

Figure 2 is a side elevation of a portion of the operator's key shelf showing the key levers, plugs and lamps.

Figure 3 illustrates diagrammatically, an ordinary private branch exchange circuit showing the signalling lamp and line jack forming part of the usual line terminal equipment in the switchboard.

Figure 4 shows diagrammatically, a well known type of manual exchange line circuit and a well known private branch trunk in connection therewith, showing the trunk jack and lamp forming a part of the line terminal equipment in the switchboard.

Figure 5 shows diagrammatically a well known automatic exchange line circuit in connection with an ordinary private branch exchange trunk showing the line jack and lamp forming part of the line terminal equipment in the switchboard.

Fig. 6 illustrates diagrammatically the calling end of the well known Western Electric cord circuit.

Before describing, in detail, the circuit operation, and the switching and the signalling features of the invention, I will give a brief outline of the mode of operation in

establishing each of the various combinations of connections recited in the foregoing.

The mode of operation in setting up a talking connection, between two stations of a private branch exchange is as follows:—

At the station desiring a connection the receiver is removed from the hookswitch of the telephone, which lights the usual lamp, forming part of the line terminal equipment in the switchboard. The operator in response to the signal inserts the answering plug of an idle pair in the line jack of the calling station which extinguishes the lamp. She then moves the lever of the operator's usual telephone set key and ascertains the number of the station with which a connection is desired. Having obtained the number of the station she inserts the calling cord in the line jack of the called station and rings.

A supervisory lamp is associated with the answering cord and also one with the calling cord, the lamp of the former at this point in the process of establishing the connection being dark, responsive to the receiver at the calling station being off the hookswitch, while the lamp of the latter is aglow, the receiver of the called station not yet having been removed from the hookswitch. When the latter is removed from the hookswitch in answer to the call, the lamp aglow is extinguished. Both lights being out, is a signal to the operator that the calling party and the called party are conversing. Replacing of the receivers after completion of the conversation, causes both lamps to relight. The two lighted lamps are a signal to the operator to take down the connection. Either party may intermittently flash his respective lamp by operating the hookswitch to attract the operator's attention for a recall.

The mode of operation in setting up a connection for conversation between a private branch exchange station and a subscriber connected with a central energy manual exchange is as follows:

At the station desiring a connection the receiver is removed from the hook switch of the telephone, which lights the usual lamp, forming part of the line terminal equipment in the switchboard. The operator in response to the signal, inserts the answering plug of an idle pair in the line jack of the calling station, which extinguishes the lamp. She then moves the lever of the operator's telephone set key and ascertains the number of the station with which the connection is desired. Having obtained the number of the exchange subscriber, she inserts the calling plug into a jack connected to a trunk line from the central office.

The insertion of the plug automatically signals the exchange operator, who upon answering the call is given the number of the subscriber wanted, either by the operator

or by the person initiating the call. The exchange operator proceeds to call the desired party in the usual way. Assuming the called party has answered and is conversing with the calling party, both supervisory lamps of the central office pair of cords are out, likewise those of the pair of cords at the private branch exchange station switchboard. The replacing of the receiver at the calling station, after completion of the conversation, lights both the answering and calling supervisory lamp at the private branch exchange station switchboard, and also lights the answering supervisory lamp at the central office. The lighting of the lamps is a signal to both operators to take down the connections. In the event that the calling party wishes to recall, the three lamps will intermittently flash in unison with the upward and downward movements of the hook.

The mode of operation in setting up a connection, for a conversation between a private branch exchange station and a subscriber connected with an automatic exchange is as follows:

At the station desiring a connection, the receiver is removed from the hookswitch of the telephone, which lights the usual lamp, forming part of the line terminal equipment in the switchboard. The operator in response to the signal inserts the answering plug of an idle pair in the line jack of the calling station, which extinguishes the lamp. She then moves the lever of the operator's telephone set key and ascertains the number of the station with which a connection is desired. Having been told that an automatic exchange connection is wanted, she inserts the calling plug into a jack connected to a trunk line from the automatic exchange.

The calling party then proceeds to dial the number. Both supervisory lamps at this time are extinguished. After completion of the conversation, replacing of the receiver at the calling station relights both lamps, which is a signal for the operator to disconnect. The calling station can immediately make a recall by one downward movement of the hookswitch which will clear the trunk ready to make a second call.

The circuit arrangements are such, that the operator can do the dialing for the party at the calling station if desired.

The mode of operation for a conversation between a subscriber of either a common battery manual exchange or automatic exchange calling for a station of a private branch exchange system is as follows:

A signal from either exchange causes the usual lamp, common in switchboards associated with a jack connected to an incoming trunk line, to light. The operator inserts the answering plug of applicant's cord circuit in the associated jack, which extin-

guishes the lamp. She then throws the operator's telephone set key and obtains the number or name of the station wanted, whereupon she inserts the calling plug into the jack of the station and rings.

At this point the supervisory lamp T of the calling cord is lighted, while the lamp of the answering cord is out. When the called station responds, the calling supervisory lamp is extinguished; when the receiver at the called station is replaced upon completion of the conversation, both lamps of applicant's cord circuit and the lamp associated with the exchange cord circuit light up as a disconnect signal. The intermittent flashing of both lamps as before indicates that the operator's attention is wanted.

It is desirable that a cord circuit be so arranged as to enable the operator receiving the call for an automatic connection, to dial the called party. In order to meet this requirement applicant has provided a dial key O connected with the usual dialling device P diagrammatically indicated in the drawings.

Operation of circuits.

The operation of the circuit in the process of establishing a connection for conversation between two stations of a private branch exchange system is as follows:

At the station desiring a connection the receiver is removed from the hook switch of the telephone, which lights the usual lamp (Fig. 3) forming part of the line terminal equipment in the switchboard. The operator inserts the answering plug U of an idle pair in the line jack I, which puts out the lamp and operates relay A, ground from jack I (Fig. 3) to lower armature contact of relay D to winding of A to battery to ground, which in turn connects relay B across cord circuit; ring of plug to lower inner armature front contact relay A to lower winding relay B to battery to ground to upper winding B to front contact upper armature relay A to tip of cord. This relay immediately operates and prevents the supervisory lamp S from lighting; the receiver being off the hook, ground to upper winding relay B to front contact upper armature relay A through instrument to lower inner armature relay A front contact to lower winding B to battery to ground. It is the function of relay B to supply current to the telephone transmitter and to cause the lamp to light up as a disconnect signal when the receiver is replaced, and also to cause the lamp to flash in unison with the upward and downward movements of the hook-switch.

The operator having ascertained the number of the station wanted, inserts the calling cord V of the pair in the line jack I of the station wanted and rings in the usual way.

The insertion of the plug operates relay G, ground from jack I (Fig. 3) to inner lower armature back contact relay D, to winding G to battery to ground, which in turn connects relay F across the cord circuit and also lights lamp T from ground lower outer armature relay G lower armature relay F and through lamp T to battery to ground.

The operator then moves the ringing key lever and connects ringing current to the line, which actuates the bell of the called station in the ordinary way. Upon removal of the receiver in response to the call, relay F becomes energized; ground to upper winding relay F to upper armature front contact relay G through instrument to lower inner armature front contact relay G to lower winding relay F to battery to ground, thereby extinguishing the lamp T, by breaking lower contact relay F. The two stations are now connected for conversation; the energizing current for the transmitters and relays B and F, which latter control the supervisory lamps being supplied from a common source, which may be either a local storage battery as shown, or supply leads extending from the central office and terminating at the branch exchange.

The condensers K' as shown are interposed between the current supply relays B and F so as to confine the direct current to the individual stations when relay A and G are actuated.

Upon completion of the conversation replacing of the receivers relights the supervisory lamps, thereby signaling the operator that the conversation has terminated.

The relays A and G remain energized until the operator takes down the connections, thereafter the parts are restored to their normal inactive positions. Thus, the insertion of the answering and calling plugs find ground for circuits to energize relays A and G which are associated with, and control, circuit controlling means for first connecting current supplying sources across the tip and ring strands of the cord circuit, for the instruments of the called and calling party and then opening a signaling circuit associated with one of said current supplying sources, the flow of the current from said sources and the opening of said signaling circuit being controlled from the hookswitches of the respective instruments.

The circuit operation in establishing a connection for a private branch exchange station calling for a subscriber connected with a central energy, manual exchange is as follows:

At the station desiring a connection the receiver is removed from the hookswitch of the telephone which lights the usual lamp (Fig. 3) forming a part of the line terminal equipment in the switchboard. The operator

inserts the answering plug U of an idle pair in the line jack I, which extinguishes the lamp and operates relay A, which in turn connects relay B across the line in the manner just described in the foregoing, regarding connections between two private branch exchanges. The function of relay B is to supply current to the telephone transmitter. The operator having obtained the exchange subscriber's number inserts the calling plug V into jack J (Fig. 4) connected to a trunk line from the central energy office thereby automatically signalling the operator at the central office.

The insertion of the plug into jack J disconnects the local battery from the private branch exchange station line, and substitutes a supply of current from the central energy office line terminal and operates as follows: from negative battery central office line relay A' (Fig. 4) over tip strand W of calling cord to upper armature back contact relay G to winding relay E to upper armature relay B to ground. Obviously relay E now becomes energized, effecting the following action; ground to contact armature relay E to winding relay D through battery to ground. Relay D now becoming energized opens the circuit through relay A, ground to jack I (Fig. 3) to lower armature relay D to winding relay A to battery to ground; thus deenergizing relay A which in turn deenergizes relay B by releasing its own upper and lower inner armature. Thus the current supply from relay B supplying the transmitter from the private branch exchange is cut off and a current supplying source from central energy office simultaneously cut in. At this point in the process of establishing the connection, relays E and D are still energized and no supervisory lamps are lighted, the local station transmitter being now supplied, as described in the foregoing, with current from the central office.

The called party is now connected in the usual way by the operator at the central energy manual exchange, the connection being thereby completed for conversation. It will be noted that the tip side condenser K' of the private branch exchange cord circuit is shunted by relay E, the functions of the latter being, to provide a path (hereinbefore described) for the direct current to the local station transmitter and to control the relays which cut off the local battery source.

After completion of the conversation, replacing of the receiver at the local station opens the direct current path at the hook-switch, thereby deenergizing relay E, which in turn causes relay D to deenergize. Releasing of the lower armature of relay D, reenergizes sleeve relay A grounding one of its armatures, and thereby relighting both supervisory lamps. The circuits of the supervisory lamps may be traced from the ground,

lower armature front contact relay A to lower armature relay B upper armature relay C thence through two paths in multiple, each comprising a supervisory lamp; one of said paths leading through the answering supervisory lamp S to battery and the other through lower armature back contact of relay G lower armature relay F, calling supervisory lamp T to battery. At the same time the central office answering supervisory lamp Y (Fig. 4) likewise lights up as a disconnect signal.

Thus, it will be noted, that not only the supervisory lamps at the private branch exchange are lighted but also the supervisory light at the central energy manual exchange, this result being effected solely by the operation of replacing the receiver by the calling party, thus securing what is known in the art as through supervision.

Relays A and B operate and function precisely as in connection for conversation between two stations of a private branch exchange described in the foregoing, but relays F and G remain inactive because no ground is found in the sleeve of jack J. The supervisory lamps are therefore controlled solely by the relay A which alone remains energized when the receiver is restored, but becomes deenergized upon removal of the answering plug, whereafter the lights become dark.

The circuit operation in establishing a connection for a private branch exchange station calling for a subscriber connected with an automatic exchange may be described as follows:

The calling proceeds as if for a central energy manual exchange connection, just described.

The operator having been told that an automatic connection is wanted, inserts the calling cord of the pair into jack J (Fig. 5) connected to a trunk from the automatic exchange. The insertion of the plug connects the calling station with the automatic equipment, and, by reason of a negative battery C' (Fig. 5) being on the tip side of the trunk connected with tip of plug V whereby relay E is operated. The operation of the circuit thereafter being identical with that just described in the process of setting up a connection for a private branch exchange and central energy manual exchange subscriber. However, the circuit interruptions, due to the dialing by the local station as hereinbefore referred to in the outline of mode of operation, would permit ordinary relays to follow each impulse, which would intermittently light the supervisory lamps. To prevent this, relay D is made slow acting.

At this point in the process of establishing the connection, relays E and D are still energized and function precisely as described in the foregoing with respect to the

connection between a private branch exchange and central energy manual exchange.

The circuit operation in the process of establishing a connection for a subscriber of a common battery manual exchange station with a private branch exchange station, may be described as follows:

An operator at the manual exchange station receiving a call for a station of a private branch exchange system inserts a calling cord in the jack of the trunk line extending to the private branch exchange system and rings in the usual way, which lights the usual lamp D' (Fig. 4) at the private branch exchange. The operator at the private branch exchange then inserts the plug of the answering cord of a pair in the jack J, associated with the lamp, after which she throws the listening key. The insertion of the plug puts out the calling lamp D', and the operation of the listening key forms a bridged circuit across the tip and ring sides (W and X respectively) of the answering cord, as follows: tip side of answering cord, upper armature back contact relay A to make contact listening key L, to winding relay C, to lower inner armature back contact relay A to ring side X of answering cord. This bridge, which consists of the winding relay C, extinguishes the calling supervisory lamp P' at the central office and cuts off the ringing current when the mode of ringing is of the machine type. The current from the manual exchange central office calling cord now energizes relay C forming a locking circuit which may be traced from the manual exchange office as follows: negative battery a' thru manual exchange office ring cord relay b' to tip side of trunk, tip of answering plug, ringing key contact M upper armature back contact relay A to upper armature relay D lower armature relay C winding of relay C lower inner armature back contact relay A ringing key contact M ring of answering plug and back over ring side X of line to tip side of calling cord at manual exchange office to ground.

The private branch exchange operator having been informed of the station wanted, inserts the calling plug in the line jack I (Fig. 3) of the station wanted and operates the ringing key. The insertion of the plug, by reason of the grounded sleeve I (Fig. 3) energizes relay G which lights the supervisory lamp T (the upper armature relay C being operated prevents lamp S from operating) the line as hereinbefore described. When the receiver is taken down from the hookswitch in response to the call, relay F becomes energized. The attraction of its lower armature extinguishes the supervisory lamp T and the attraction of its upper armature forms a circuit thru relay E as follows: ground upper armature relay F winding relay E upper armature relay back contact

relay A to break contact ringing key M tip side of plug to tip side of line thru central office sleeve cord relay b' to battery, which in turn operates and closes a local circuit of which relay D forms a part.

The operation of relay D releases, by attracting its inner lower and its upper armature, the sleeve relay G and the relay C, thereby breaking the locking circuit. The release of relay G deenergizes relay F which prepares the circuit for relighting of the supervisory lamps. It also bridges the series relay E across the tip side condenser K'.

At this point in the process of establishing the connection, relays E and D alone are in energized condition. The former is in the path thru which direct current flows from the central office to the called station transmitters; the latter (by means of its upper armature) prevents the bridging of the winding of relay C across the line when the operator moves her listening key during the conversation.

Upon completion of the conversation the act of replacing the receiver at the called station causes both supervisory lamps at the private branch exchange together with the calling supervisory lamp at central office switchboard to light.

The circuit operation in establishing a connection for a subscriber of an automatic exchange with a private branch exchange station may be described as follows:

The exchange subscriber dials the number of the private branch exchange wanted and awaits a response from the operator. The usual lamp forming a part of the trunk terminal equipment lights up shortly after the dialing of the last figure, which attracts the operator's attention. The operator inserts the answering plug U into the trunk jack J (Fig. 5) which extinguishes the lamp, and then throws the listening key and ascertains what station is wanted. The operation of the listening key forms a bridged circuit across the tip and ring sides of the answering cord, which cuts off the ringing current.

Having obtained the information, the operator inserts the calling plug V in the line jack I of the called station (Fig. 3) and rings. At this point of the connection relays C and G alone are in operated condition. The winding of the former is bridged across the two sides of the line thru the listening key L contacts, while the latter is energized because of the circuit having been formed from the grounded sleeve of the jack I, thru its winding, armature and break contact of relay D to battery. The energization of this relay G lights the calling supervisory lamp T, ground to front contact lower armature relay G to lower armature back contact relay F thru lamp to battery to ground, and connects relay F across the line. When at the called station the receiver is re-

moved to answer the call relay F becomes energized, which extinguishes the supervisory lamp by attracting its lower armature, and closes a circuit by attracting its upper armature, said circuit actuating relay E. This circuit may be traced from ground, upper armature front contact relay F to relay E, and upper armature relay A, tip side of line to negative battery at the automatic exchange connector. The operation of relay E closes a local circuit of which relay D forms a part, the energization of the latter breaking by means of its upper armature the locking circuit of relay C and also deenergizing relay G.

The breaking of the locking circuit removes the bridge from the line and the deenergization of relay G disconnects relay F from the line and connects series relay E in shunt around the tip side condenser. Relay E is now kept in operated condition by current fed from the automatic exchange. As described in the foregoing in the connection between a private branch exchange and subscriber connected with a central energy manual exchange station, upon completion of the conversation the act of replacing the receiver at the called station causes both supervisory lamps to light up. To accommodate incoming and outgoing calls on Sundays or holidays or when the private branch exchange operator is absent a cut out key Z is provided to disconnect battery. The circuit operation may be described as follows from tip side of plug to upper armature relay A thru relay E to upper armature relay G to tip of plug and from ring lower inner armature relay A to lower inner armature relay G to ring of plug.

The operator simply leaves the calling and answering plugs inserted until her return, incoming and outgoing calls passing thru the private branch exchange cord circuit to the central office where the connections are effected in the usual way, thereby eliminating the use of plain cords usually used for this purpose. The conductors L' of the listening key L lead to the operators set.

I claim:

1. In a telephone system, the combination with called and calling subscribers' lines, a central exchange in connection with certain of said lines and a current source at said exchange; of a cord circuit including calling and answering plugs for interconnecting said lines, a current supply, means including a circuit responsive to connection of said answering plug with a subscriber's line for connecting said current supply across said cord circuit and means in said cord circuit operated by the connection of said calling plug with a certain one of said lines for simultaneously cutting off the current supply across said cord circuit and cutting in the current source from said central exchange.

2. In a telephone system, the combination with called and calling lines, a called line extending through an automatic central exchange, and a current supply at the exchange bridged across said called line; of a cord circuit comprising tip and ring conductors connected at their respective ends to a calling plug, and an answering plug a condenser in series in the tip conductor between the calling and answering sides of the cord circuit, a current source connectable across said tip and ring conductors, means responsive to connection of the answering plug with the calling line for connecting said current source to said cord circuit, and means operated by said current supply and rendered operative by the connection of the calling plug with the called line for establishing a shunt path about said condenser and disconnecting said current source from said cord circuit.

3. In a telephone system, the combination with the called and calling lines and their instruments, an automatic central exchange, a trunk terminating thereat, the called line having connection with said automatic central exchange trunk and a current source associated with the called line at said central exchange; of a cord circuit comprising tip and ring conductors terminating at their respective ends in plugs to interconnect said trunk and calling line, a current supply, a feed relay connected with said current supply, sleeve relays having armatures, controlling circuits for said sleeve relays, certain of said armatures serving to bridge said feed relay across said tip and ring conductors responsive to the engagement of the answering plug with the calling line, a condenser in the tip conductor, a series relay connected to the tip conductor about said condenser and operated through the calling plug by said current source at the central exchange, a local circuit including a slow acting relay, an armature associated with said series relay to close said local circuit, said slow acting relay functioning to break said sleeve relay circuits, supervisory lamps, and circuits therefor including armatures associated with said sleeve and feed relays.

4. In a telephone system, the combination with an exchange, a subscriber's telephone line and a trunk connected thereto, other telephone lines serving as calling and called lines, telephone instruments including receivers and switch hooks for said lines, jacks of the called line and calling lines, signaling means and a current source at the exchange, the jacks of certain of the subscribers' line circuits having said current source connected thereto; of a cord circuit comprising tip and ring conductors, an answering plug and a calling plug for said conductors to connect the telephone lines through said exchange and trunk, a listen-

ing key associated with said tip and ring conductors, a relay associated with said conductors and said listening key, said relay arranged to be bridged across the answering end of the cord circuit on actuation of said key to connect said relay with said exchange over said trunk, supervisory lamps, normally open circuits for said lamps, means including a circuit controlled by connection of the calling plug with the called line, said means being operated by the called line circuit for first operating one of said supervisory lamps, then rendering and holding the latter inoperative and breaking said relay bridge to cut out said current source, and means operated by said last-named means responsive to the replacing of the receivers on their respective hook-switches for rendering said exchange signaling means and cord circuit lamps effective.

5. In a private branch exchange system having connection with local stations and with trunk lines from a central energy manually operated switchboard and lines from an automatic exchange with the line circuits controlled by the subscribers; of a cord circuit comprising a calling and answering cord for inter-connecting local stations or a local station and any of said lines, a listening key in connection with said cord circuit, plugs for each cord, primary and secondary signaling means, current sources, means for connecting said signaling means to said current source with said local station lines and operating said primary signaling means, and auxiliary means controlled by actuation of said listening key and answering plug for operating said secondary signaling means.

6. In a telephone system including subscriber-controlled lines local lines and trunk lines, telephones including receivers and hook-switches for certain of said lines, a manually operated central exchange having a current source connected to certain of said lines, an operator's listening key, a cord circuit comprising tip and ring conductors, a plug at each end thereof, inter-related relays associated with said tip and ring conductors, certain of said relays being arranged to form two groups, a normally open local relay circuit in each group connected with a current source and with tip and ring conductors, each of said circuits arranged to be associated with a local station through said plugs, normally open lamp circuits, supervisory lamps in said circuits common to all the said line connections to be operated by said lamp circuits when they are closed, said relay and lamp circuits being operated by connection of the cord circuit with said local stations, said current source circuits being closed when the respective receivers of the connected lines are off their respective hook-switches, means re-

sponsive to manipulation of said plugs to effect connections between a called line of a local station and a calling line connected with a manually operated central exchange said means comprising a locking circuit to bridge said tip and ring conductors and adapted on closing to connect into said circuit said exchange current source by operation of said listening key, a relay in said locking circuit to hold open one of said normally open circuits, and a third group of relays associated with one of said groups of relays of said cord circuit and rendered operative by the latter to break said locking circuit when the line circuit is closed, one of the first named group of relays holding open a normally open circuit, the latter being closed responsive to the breaking of the line circuit by the called subscriber.

7. In a telephone system comprising called and calling subscribers' lines, a listening key, local station lines, trunk lines from a central energy manual exchange and trunk lines from an automatic exchange, a cord circuit including a tip and a ring conductor and a calling and an answering plug to inter-connect subscribers' lines or subscribers' lines with trunk lines, a normally open supervisory circuit, current supply connections for the answering and calling sides of the cord circuit, means effective responsive to connection of the cord circuit with certain of said lines for closing said supervisory circuit and connecting said current supply across said tip and ring conductors at the calling and answering sides of the cord circuit, a condenser in series in each of said tip and ring conductors between said current supply connections, and means associated with said last named means for shunting said tip and ring conductors around said condensers on the connection of said cord circuit with other lines.

8. In a telephone system, local telephone stations, trunk lines, a central exchange, distant telephone stations connectable with said trunk lines at said exchange, a listening key, a cord circuit comprising a tip and a ring conductor, a contact plug at each end thereof, series condensers in the tip and ring conductors, relays, armatures therefor, a shunt about the condenser in the tip conductor including certain of said armatures, a shunt including certain of said armatures about the condenser in the ring conductor, means including a local circuit for each end of the cord circuit associated with said plugs and said armatures for effecting a talking connection between two local stations, means associated with the local circuit at the calling end of said cord circuit and certain of said armatures and listening key to effect a talking connection between a local station and a distant telephone station, and means for holding open

said local circuits to render all of the named means inoperative during said last-mentioned telephone connection.

9. In a telephone system, primary and secondary exchanges, telephone lines terminating at each exchange, trunk lines extending between said exchanges, a cord circuit at the primary exchange terminating at each end in plug contacts and having its ends inductively connected but conductively separated from each other, a source of current at said primary exchange, a relay at each end of said cord circuit through which said source of current may be connected to each end of said cord circuit, a second relay associated with each of said first relays, said second relay being operated by the connection of its associated plug, contacts with a telephone line to connect one of said first relays and a source of current to the telephone lines through said cord circuit, a supply of current at said second exchange, means operative responsive to the connection of said cord circuit with said trunk for conductively connecting the ends of said cord circuit and extending said cord circuit over a trunk line to the supply of current at said second exchange, and means effective to disable said second relays of the cord circuit on the connection of said cord circuit to said trunk line.

10. In a telephone system, primary and secondary exchanges, telephone lines terminating in each exchange, trunk lines extending between said exchanges, means for connecting a telephone line at one exchange with a trunk line, a cord circuit at said second exchange for interconnecting telephone lines terminating thereat or for interconnecting one of said telephone lines with one of said trunk lines, said cord circuit including tip and ring conductors, the ends of each conductor being inductively connected but conductively separated, a sleeve conductor for each end of said cord circuit, a sleeve relay normally connected to each sleeve conductor a source of current at said second exchange, a current feed relay, a circuit extending from said source of current through the winding of said current feed relay and a contact of the sleeve relay to one of the conductors of said cord circuit, a supply of current at said first mentioned office, and means responsive to the connection of said cord circuit with said first mentioned exchange over a trunk line for disconnecting said current feed relay from said cord circuit conductor and for extending thereto a supply of current at said first mentioned exchange.

11. In a telephone system, a primary exchange, a secondary exchange, trunk lines for connecting said exchanges, telephone lines terminating at each exchange, a transmitter for each telephone line means for con-

necting a telephone line at the primary office to one of said trunk lines leading to said secondary office, a source of transmitter current at said primary office, a cord circuit for interconnecting said trunk line at one end to said telephone lines terminating at said secondary office, the ends of said cord circuit being inductively connected together but conductively separated from each other, a source of transmitter current at said secondary office, means including a current feed relay associated with each end of said cord circuit through which said last mentioned source of transmitter current is connected to the respective ends of said cord circuit, a second relay for each end of said cord circuit controlling the connection of said last mentioned source of current to the ends of said cord circuit, and means controlled at one of said second relays for disconnecting said second source of transmitter current and for connecting said first source of transmitter current to both ends of said cord circuit.

12. In a telephone system, a primary exchange, a secondary exchange, trunk lines for interconnecting said exchanges, telephone lines terminating at each exchange, a transmitter for each telephone line, means for connecting a telephone line at the primary office to one of said trunk lines leading to said secondary office, a source of transmitter current at said primary office, a cord circuit for interconnecting said trunk line and one of said telephone lines terminating at said secondary office, said cord circuit having a plurality of conductors, the ends of said cord circuit being inductively connected together but conductively separated from each other, a source of transmitter current at said secondary office and means including a current feed relay associated with each end of said cord circuit through which said last mentioned source of transmitter current is connected to the respective ends of said cord circuit, a second relay for each end of said cord circuit controlling the connection of said last mentioned source of current to the ends of said cord circuit, and a relay serially included in one of said conductors and controlled at one of said second relays for governing the disconnection of said second source of transmitter current and for connecting said first source of transmitter current to both ends of said cord circuit.

13. In a telephone system, a primary exchange and a secondary exchange, trunk lines extending between said primary and said secondary exchanges, telephone lines terminating at each of said exchanges means for interconnecting a telephone line at one exchange with a telephone line terminating at a second exchange including one of said trunk lines and a cord circuit at said secondary exchange, a signal at said pri-

mary exchange for indicating the condition of said connection, a sleeve relay for each end of said cord circuit, a source of transmitting current at said secondary exchange, a current feed relay connected to said last mentioned current, said sleeve relays functioning to connect said last mentioned current to both ends of said cord circuit through a current feed relay, supervisory lamps associated with each end of said cord circuit for indicating the condition of said cord circuit, means for operating said signal and said supervisory lamps at the termination of a connection, said last mentioned means including a circuit controlled at the sleeve and current feed relays associated with each end of the cord circuit, and means controlled from the primary office for governing said sleeve relays.

14. In a telephone system, a primary exchange, a secondary exchange, trunk lines for interconnecting said exchanges, telephone lines terminating at each exchange, each telephone line including a transmitter, means for connecting a telephone line at the primary office to one of said trunk lines leading to said secondary office, a source of transmitter current at said primary office, a cord circuit for interconnecting said trunk line and one of said telephone lines terminating at said secondary office, said cord circuit having a plurality of conductors, the ends of said cord circuit being inductively connected together but conductively separated from each other, a source of transmitter current at said secondary office, means including a current feed relay associated with each end of said cord circuit through which said mentioned source of transmitter current is connected to the ends of said cord circuit, a sleeve relay for each end of said cord circuit controlling the connection of said last mentioned source of current to the ends of said cord circuit, a relay serially included in one of said conductors through contacts of one of said current feed relays and one of said sleeve relays, and a slow relay governed by said last mentioned relay, said slow relay effecting the disconnection of said second source of transmitter current and for connecting said first source of transmitter current to both ends of said cord circuit.

15. In a telephone system, a primary exchange, a secondary exchange, trunk lines interconnecting said exchanges, telephone lines terminating at each exchange, each telephone line including a transmitter, means for connecting a telephone line at the primary office to one of said trunk lines leading to said secondary office, a source of transmitter current at said primary office, a cord circuit for interconnecting said trunk line and one of said telephone lines terminating

at said secondary office, said cord circuit having a plurality of conductors, the ends of said cord circuit being inductively connected together but conductively separated from each other, a source of transmitter current at said secondary office and means including a current feed relay associated with each end of said cord circuit through which said mentioned source of transmitter current is connected to the ends of said cord circuit, a sleeve relay for each end of said cord circuit controlling the connection of said last mentioned source of current to the ends of said cord circuit, a supervisory lamp for said cord circuit controlled by one of said current feed relays, a relay serially included in one of said conductors through contacts of one of said current-feed relays, and a slow relay governed by said last mentioned relay, said slow relay effecting the disconnection of said second source of transmitter current and for connecting said first source of transmitter current to both ends of said cord circuit.

16. In a telephone system, a primary exchange, a source of transmitter current at said exchange, a secondary exchange, trunk lines extending between said primary and said secondary exchanges, telephone lines terminating at each of said exchanges, means for interconnecting a telephone line at one exchange with a telephone line terminating at a secondary exchange including one of said trunk lines and a cord circuit at said secondary exchange, a signal at said primary exchange for indicating the condition of said connection, a sleeve relay for each end of said cord circuit, a source of transmitter current at said secondary exchange, current feed relays one connected to said last mentioned source of current and to each end of the cord circuit through contacts of a sleeve relay, supervisory lamps associated with each end of said cord circuit for indicating the condition of said cord circuits, circuits for operating said lamps under the control of the telephone lines, one of said circuits extending through the front contacts of one of said sleeve relays and through the back contacts of a current feed relay, and a slow relay controllable from the primary exchange, a circuit for the other supervisory lamp extending through the back contacts of the other current feed relay and through the front contacts of said other sleeve relay, and circuits for said sleeve relays, completed at the back contacts of said slow relay.

In testimony whereof I affix my signature in presence of a witness.

ARTHUR J. SEYMOUR.

Witness:

GEORGE VOELKER.