

No. 843,245.

PATENTED FEB. 5, 1907.

H. G. WEBSTER.
TELEPHONE TRUNKING SYSTEM.

APPLICATION FILED DEC. 8, 1902.

2 SHEETS—SHEET 1.

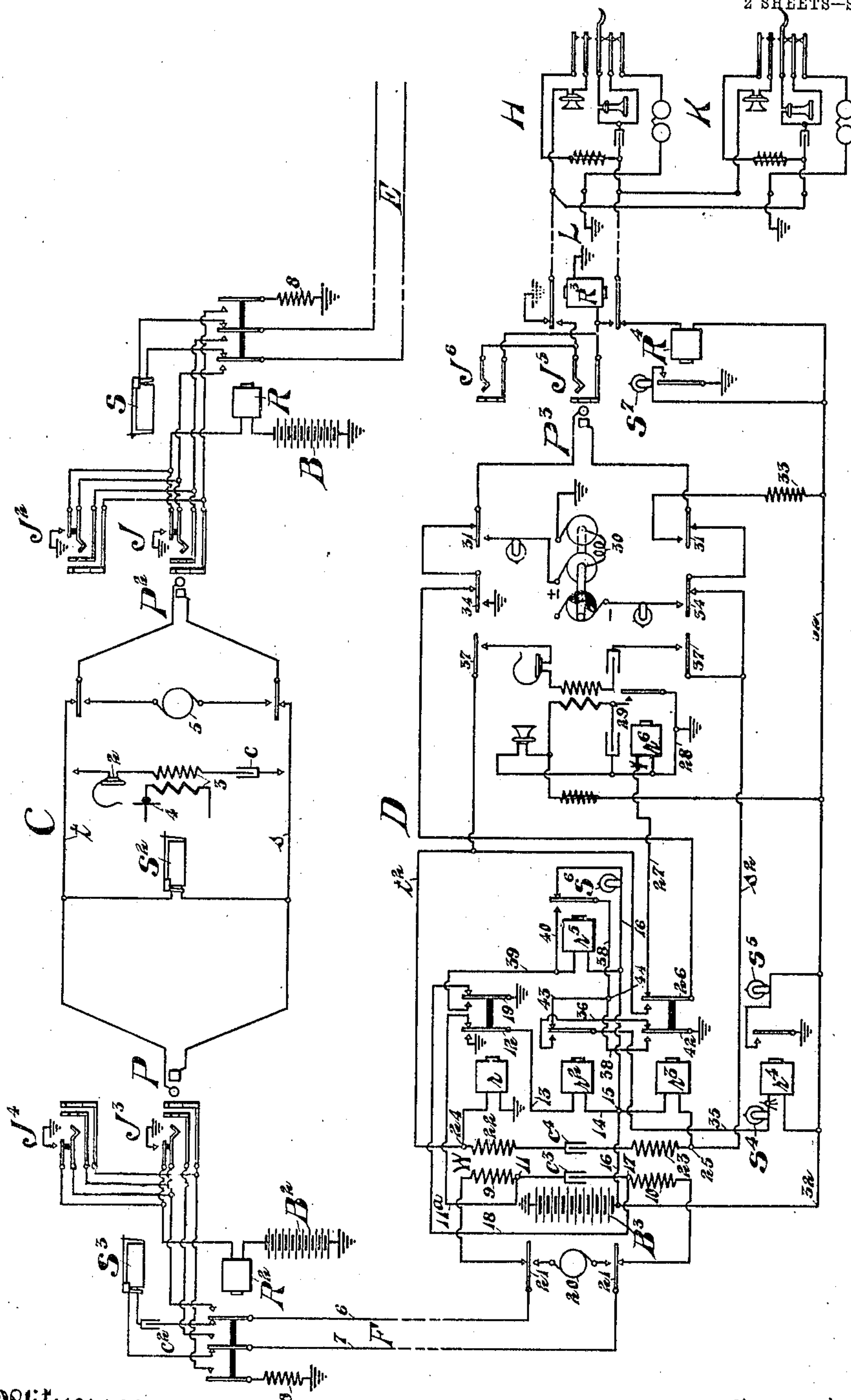


Fig. 1.

Witnesses.

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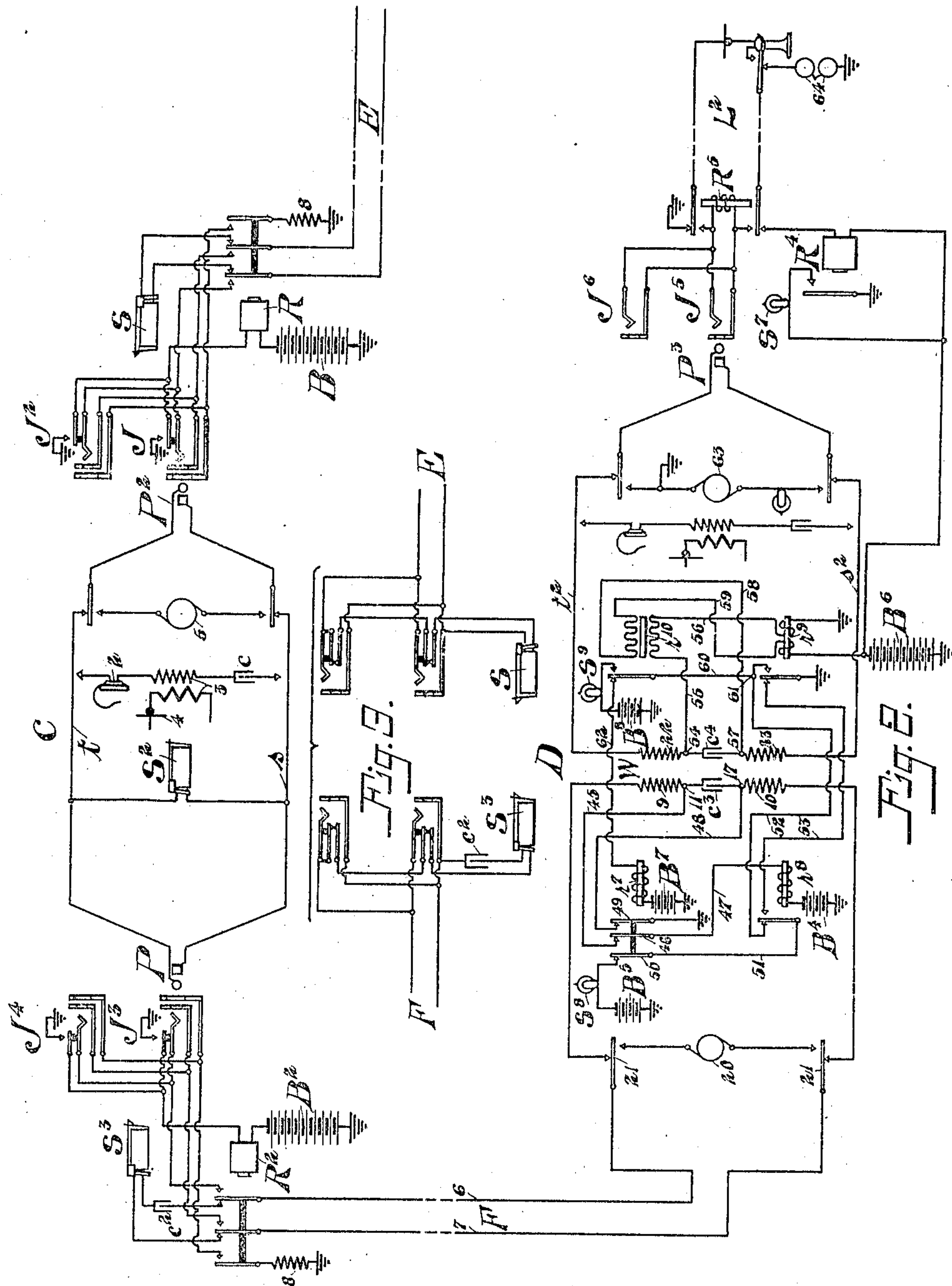
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UNITED STATES PATENT OFFICE.

HARRY G. WEBSTER, OF CHICAGO, ILLINOIS, ASSIGNOR TO KELLOGG SWITCH-BOARD AND SUPPLY COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

TELEPHONE TRUNKING SYSTEM.

No. 843,245.

Specification of Letters Patent.

Patented Feb. 5, 1907.

Application filed December 8, 1902. Serial No. 134,263.

To all whom it may concern:

Be it known that I, HARRY G. WEBSTER, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Telephone Trunking Systems, of which the following is a specification.

My invention relates to improvements in telephone-toll trunking systems. In systems of this type the toll-lines or long-distance lines terminate usually at the main or at least at one central office in a city, and it is necessary or desirable to connect the local-subscribers' lines of common-battery branch or other exchanges in the same city with such toll or long-distance lines.

My invention is designed particularly for this purpose. The long-distance lines may, as usual, be multiplied before the toll operators at the main exchange, and the trunk-lines extending from said main exchange to the auxiliary exchanges are also multiplied before the toll operators at the main exchange or outgoing end of the trunk, while at its other end or the branch exchange they preferably terminate in flexible cords and plugs to enable them to be readily connected with the local-subscribers' lines. These trunk-lines are also arranged for reciprocal operation, so that the calls may originate at either end.

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

Figure 1 is a diagram of a trunk extending between the toll-board at the main office and the branch exchange. Fig. 2 is a diagram of a modification in the jacks or connection-terminals of the toll-lines and the trunks, and Fig. 3 is a diagram of a modified type of trunk to connect with a different type of line-circuit at the branch exchange.

Referring to Fig. 1, C designates the main central office, and D the auxiliary or branch exchange. At the former a toll-line E is shown terminating in suitable connection-terminals, preferably in the form of spring-jacks J J², which may be provided in any number desired and before each of the toll operators. A line-signal S is provided for and is normally connected with the toll-line E through the contacts of a cut-off relay R, the latter being designed when a connecting-

plug is inserted in any of the jacks of the toll-line to have its circuit completed through normally open contacts of the said jack, so that current from the battery B will operate the same to sever the connection with the signal S and complete the connection of the external line-circuit with the connection-terminals to arrange the line for conversation. At the same time the test or outer ring-contacts of the several jacks, which are always insulated from the talking-circuit, are connected through a suitable resistance 8 to ground by means of a third normally open contact of the cut-off relay R.

Cord-circuits of the type shown at the central office C are provided in suitable numbers for each of the toll operators. This circuit comprises the plugs P and P², united by continuous strands *t* and *s*, extending between the tips and sleeves, respectively, of the said plugs. A clearing-out drop S², having sufficient impedance to prevent the passage of voice-current, is bridged across the cord-circuit. The operator's receiver 2, the secondary of her induction-coil 3, and a condenser *c* are adapted to be bridged across the cord-circuit by means of any suitable listening-key. Her transmitter 4 and the primary winding of her induction-coil are arranged in a local circuit, which may be charged from any suitable current source. A ringing-generator 5 is also provided and is adapted to be connected with the calling-plug by means of any suitable ringing-key.

The trunk-circuit extending between the main and auxiliary exchange comprises the two limbs 6 and 7, which are normally connected through the contacts of a cut-off relay R² with the signal S³, together with a condenser *c*². Upon the operation of the cut-off relay R², by the insertion of a connecting-plug in one of the jacks J³ or J⁴ of the trunk, which completes through normally open contacts the circuit of said cut-off relay from the battery B², the said signal and condenser are disconnected and the line conductors 6 and 7 are connected with the tip and sleeve conductors of the jacks J³ and J⁴ to place the line in condition for conversation. Simultaneously the test-rings of the jacks are connected through the resistance 8 to ground and are thereby placed in condition to test busy.

At the office D the trunk-conductors 6 and

7 normally terminate in the windings 9 and 10 of the repeating-coil W, which windings are inductively connected through a condenser c^3 . From the point 11 between the winding 9 and the condenser c^3 a conductor 11^a leads to the normal contact of spring 12 of the tip-relay r , this spring being joined by conductor 13 with the trunk-relay r^2 , which is in turn connected by conductor 14 to the junction-point 15, located upon the battery-lead 16, extending to the live pole of the battery B^3 , the other pole of which is grounded. From the point 17 between the winding 10 and condenser c^3 a conductor 18 leads to the normal contact of grounded spring 19 of the tip-relay r . The battery B^3 is thus seen to be normally connected in the metallic circuit of the trunk F. A calling-generator 20, alternating in character, is adapted to be connected with the trunk F by means of the springs 21 of a suitable ringing-key, which when operated disconnect the remainder of the trunk. The other windings 22 and 23 of the repeating-coil W, together with the condenser c^4 , are connected between the tip and sleeve strands t^2 and s^2 of the trunk-cord, which terminate in the corresponding contacts of the trunk-plug P^3 . The tip-relay r is connected between ground and junction-point 24 on the tip-strand t^2 of the trunk-cord, while the sleeve-relay r^3 is connected between point 25 on the sleeve-strand s^2 and junction-point 15 upon the battery-lead 16. A disconnect or calling lamp S^4 is suitably controlled through the contacts of the trunk-relay r^2 and the sleeve-relay r^3 to indicate a call when a connection is established with the main end of the trunk-line or to indicate a disconnection when after the conversation has terminated the cord-circuit is withdrawn at the main office. A suitable pilot-signal S^5 common to each operator's position is controlled through a suitable pilot-relay r^4 , which is preferably in series with the lamp S^4 . A ringing-lamp S^6 serves to indicate when the called subscriber has responded and is locked out after being once rendered inert by means of the locking-relay r^5 , suitably controlled through the contacts of the tip and sleeve relays. The tip-strand of the cord-circuit is normally open at spring 26 of the sleeve-relay r^3 , and its forward portion is thereby normally connected with a conductor 27, leading to a high-resistance and high-impedance test-relay r^6 , also common to each operator's cords and the opposite terminal of which is grounded through conductor 28. The armature of this relay serves when attracted to close a grounded connection from the point 29, located upon the operator's local circuit to cause a momentary flow of current through the primary of the operator's induction-coil, which produces inductively a "click" in the operator's receiver. The subscriber's line L, shown terminating at this exchange,

may be of the party-line type and has located thereon two stations H and K, the bells of which are grounded from the opposite line conductors at the stations. A cut-off relay R^3 is logged to ground from the sleeve side of the switchboard-section of the line leading to the jacks J^5 and J^6 , which when operated serves to disconnect the line-relay R^4 and to connect said switchboard-section with the external line. The line-relay R^4 controls the line-signal S^7 . A ringing-generator 30 is arranged when the springs 31 31 of a suitable ringing-key are operated to connect said generator with the tip-conductor of the line to send alternating current thereover and ring the K subscriber's bell. At the same time current from the battery B^3 is directed over conductor 32 through the resistance-coil 33 to maintain the cut-off relay R^3 of the line operated. When the springs 34 34 of the ringing-key are operated, the generator is arranged to deliver a negative pulsating current to the sleeve side of the line, which serves to ring the subscriber's bell at station H and to also maintain the cut-off relay R^3 operated.

The operation is now obvious. A call coming in over the toll-line E for a connection with a subscriber located at the exchange D is received by the toll-operator at station C and a connecting-plug of one of her cord-circuits is inserted in one of the jacks of the toll-line, thus cutting off the signal S. In response to the order the other plug is connected with the trunk-line F. The insertion of this plug cuts off the signal S^3 and permits current to flow from the battery B^3 at the D end of the trunk over the metallic trunk-line through the drop S^2 of the cord-circuit at C. This current is through the trunk-relay r^2 at the exchange D, which attracts its armature and completes the circuit for the pilot-relay r^4 and the calling-signal S^4 from the battery-lead 32 through said devices, conductor 35, spring and forward contact of trunk-relay r^2 , conductor 36, back contact and grounded spring of sleeve-relay r^3 . This lights the calling-lamp, as well as the pilot-lamp S^5 . The trunk-operator seeing these connects her receiver with the trunk-line by means of the listening-key springs 37 37 and receives the order. The wanted line is tested by touching the tip of the plug P^3 to the test-ring of one of the jacks, with the result that if a line is busy a flow of current takes place over the tip-strand of the cord-circuit, spring 26 of sleeve-relay r^3 , conductor 27, and through the high-resistance and high-impedance test-relay r^6 to ground. Upon finding the line idle the plug is inserted, which closes a path for current from the battery B^3 through the sleeve-relay r^3 and over the sleeve-strand s^2 of the trunk-cord and the cut-off relay R^3 to ground. The operation of the said cut-off relay places the line-circuit L in condition for

conversation, and the actuation of the sleeve-relay r^3 serves, first, to disconnect and extinguish the calling-lamp S^4 , and, secondly, to complete through its forward contact and conductor 38, leading to the spring of the locking-relay r^5 , the circuit of the ringing-lamp S^6 , which is directly connected by means of conductor 16 with the live pole of the battery B^3 . This lamp is therefore lighted and remains so until the subscriber responds. A third result accomplished by the operation of the sleeve-relay is to disconnect the test-relay and complete the tip-strand for conversational purposes. Immediately upon inserting the plug P^3 the operator depresses the springs of one of the ringing-keys to call the wanted subscriber. Upon the response of the called subscriber a complete path over the metallic line is provided for current from the battery B^3 , which results in the operation of the tip-relay r , thereby disconnecting the battery and ground connections from the trunk-line conductors 6 and 7, completing through the grounded forward contact of spring 12 the circuit of the trunk-relay r^2 to maintain it actuated during conversation and also establishing through spring 19 and conductor 39 the circuit for the locking-relay r^5 . This latter relay is energized to open the circuit of the ringing-lamp S^6 and to also close a locking-circuit for itself, which is established through conductors 40 and 41 and spring 42 of the sleeve-relay r^3 . This relay therefore remains energized until the sleeve-relay r^3 is deenergized, which takes place only when the plug P^3 is withdrawn. The parties are now in conversation. The battery B^3 is furnishing current to the local subscriber of the line L for conversation and for the operation of the various supervisory and other relays. The other end of the trunk-circuit is completed by means of a direct metallic line with the toll-trunk, so that the conversational currents are not impeded by the presence of relays or other devices in the circuit. At the termination of the conversation the subscriber on the line L hangs up his receiver, with the result that the tip-relay r is deenergized, thereby connecting the battery B^3 in the metallic circuit of the trunk, thus throwing down the drop S^2 in the cord-circuit at the exchange C . The operator at this exchange observing the drop withdraws the plugs of the cord-circuit, thereby cutting off current from the trunk-relay at the D office, which permits its spring to complete the circuit of the signal-lamp S^4 through its back contact and conductor 43, leading to point 44 upon the conductor 38, and thence through the forward contact of spring 42 of sleeve-relay r^3 . This serves as a disconnecting signal, in obedience to which the operator withdraws the trunk-plug, thus restoring all parts to normal condition. In establishing toll connections arising at the station D

practically the same operation takes place, except that the trunk-operator inserts the trunk-plug P^3 in the jack of the calling-line in response to an order transmitted in the usual way over an order-circuit from the subscriber's answering operator and then depresses the springs 21 21 of the calling-key, which connects the ringing-generator 20 in the trunk-circuit and operates the signal S^3 of the trunk at the exchange C . The answering operator having charge of these trunks will insert the plug of the cord-circuit in one of the jacks of the trunk and in response to the order will complete the connection, calling the wanted party at the other end of the toll-line E by means of generator 5.

When the toll-lines are multiplied before several operators, as is shown in the drawings, the operator completing the connection is provided with means for testing the idle or busy condition of said lines. Such means may be of the usual or desired type and are therefore not shown in the drawings. The disconnecting-signal at the termination of the conversation will be given in the same manner as just described for the connections that originate at the other office.

During conversation the battery B^3 is furnishing current over the line L for conversation and for the operation of the various relays associated with the trunk and line at the central office, while current for transmission purposes over the toll-line is provided from the other end of the same, usually by means of a local battery. The cord-circuit at the station C is of the type known generally as a "through-toll" cord, the conductors of the toll and trunk lines being conductively joined together by the strands of the said cord. The several grounds mentioned at each of the exchanges are usually one and the same, and the batteries B and B^3 at the exchange C may also be the same.

Fig. 2 shows the same apparatus at the main central office as that shown in Fig. 1; but the incoming end of the trunk is equipped for use with a different type of line, preferably that in which the cut-off relays are bridged across the line, and are actuated by current over both sides of the talking-circuit. Grounded signaling-bells are also provided at the subscribers' stations, so that when the receiver of a line is upon its hook the corresponding side of the line is grounded through the signaling-bell. The trunk conductors 6 and 7 are connected together through the windings 9 and 10 of the repeating-coil W and the condenser c^3 , as in the previous figure, and from the point 11 conductor 45 extends to the normal contact of a spring 46 of relay r^7 , which spring is connected by conductor 47 with the relay r^8 and thence with the grounded battery B^4 . From the point 17 on the sleeve side of the condenser c^3 a conductor 48 extends through the normal

contact of grounded spring 49 of relay r^7 . When the relay r^7 is deenergized, therefore, the battery B^4 is connected in series in the metallic circuit of the outgoing end of the trunk. A battery B^5 serves to excite the lamp-signal S^8 , which is connected with the normal contact of spring 50 of relay r^7 , which is itself connected by conductor 51 with the spring of the relay r^8 . The normal contact of this relay-spring is joined by conductor 52 with the forward contact of the grounded spring of relay r^9 , while the forward contact of the spring of relay r^8 is joined by conductor 53 with the normal contact of the spring of relay r^9 . The tip-strand t^2 and the sleeve-strand s^2 of the trunk-cord terminate in the connecting-plug at one end and in the windings 22 and 23 of the repeating-coil W of the other, which windings are connected together through the condenser c^4 . From the point 54 between the winding 22 and the condenser c^4 a conductor 55 extends through one winding of the differentially-wound relay r^{10} , thence by conductor 56 through one winding of the relay r^9 , and thence to ground. From the point 57 between the winding 23 and the condenser c^4 a conductor 58 extends through the second winding of the differentially-wound relay r^{10} and thence by conductor 59 through the other winding of the relay r^9 and through battery B^6 to ground. The spring of relay r^{10} , which is joined by conductor 60 to junction-point 61 upon conductor 52, is closed in its normal position with the conductor 62, that includes the winding of relay r^7 , and is connected through a battery B^7 to ground, and in the forward position the spring of the relay r^{10} closes the circuit of the signal-lamp S^9 , which is completed through the battery B^8 to ground. The operator's receiver is adapted to be bridged between the tip and sleeve strands of the trunk-cord for purposes of testing and for talking, while the ringing-generator 63, which is grounded upon its tip side, is adapted likewise to be connected between the strands t^2 and s^2 of the trunk-cord. The line-circuit L^2 is provided with a cut-off relay R^5 , bridged between the line conductors, and with a grounded signaling-bell 64 at the substation.

The operation is as follows: A call originated at the main office results upon the insertion of the plug of the toll-cord in energizing relay r^8 at the branch office from battery B^4 , which closes the circuit of the signal-lamp S^8 from the battery B^5 , over conductors 51 and 53 and through the normal contacts of the relay r^9 . In response to the lighting of this lamp the operator connects her head-telephone with the trunk-cord circuit and upon learning the order tests the wanted line by touching the tip of the trunk-plug to a test-ring thereof, and if the line is busy a path for current is continued over the tip-strand of

the trunk-cord, which changes the potential of the two sides of the trunk-cord and causes a readjustment of the charge of the condenser in the operator's bridge, and thereby causes a click in her receiver. If the line is idle, no click is received and the plug P^3 is inserted. The grounded calling-generator is then connected with the plug P^3 and operates the grounded bell 64 at the substation, the relay r^5 being constructed to respond to the alternating ringing-current, as in Reissue Patent No. 12,031 to Dunbar, dated September 16, 1902. After ringing the battery B^6 causes current to flow through one winding of the relay r^9 , one winding of the differential relay r^{10} , and thence over the sleeve side of the cord-circuit and through the cut-off relay R^5 , thence back over the tip side and through the other winding of the differential relay r^{10} to the other winding of the relay r^9 . The windings of this relay are serially arranged as distinguished from the differential arrangement. At the same time current flows over the sleeve side of the line-circuit and through the grounded bell, thus unbalancing the magnetic effects of the current flowing through the relay r^{10} and causing its spring to close upon its forward contact, thereby completing the circuit of the lamp S^9 , which is lighted from the battery B^8 over conductor 60 and through the forward contact and spring of relay r^9 , which is also operated at this time. The operation of the latter relay opens the circuit of the lamp S^8 , thus extinguishing it. The response of the called subscriber cuts off the ground at the substation, thus leaving only the metallic line completed for current from the battery B^8 , which causes the relay r^{10} to be deenergized, thus extinguishing the lamp S^9 and completing the circuit of the relay r^7 , which is energized from the battery B^7 over conductors 62 and 60 to ground. The actuation of the relay r^7 disconnects the battery B^4 from one side of the trunk-circuit and the ground from the other side and also opens the circuit of the lamp S^8 , which remains unexposed even though the relay r^8 be now deenergized. This is the condition for talking, and current for transmission over the local line is provided from the battery B^6 , while current for transmission over the toll-line may be provided in any usual way, such as a local battery at the other end of the toll-line. At the termination of the conversation the return of the telephone to the hook at the local substation causes the relay r^{10} to become excited, which lights lamp S^9 and permits the relay r^7 to close its normal contacts, and thereby again connect the battery B^4 in the metallic circuit of the trunk-line, which throws the drop in the cord-circuit at the main exchange. The operator at the main exchange withdraws the cord-circuit, thus deenergizing relay r^8 , and thereby completing a path for current through the signal-lamp

S⁸ over conductors 51 and 52, and through the forward contacts of relay *r*⁹ to ground, whereby this lamp is a disconnect-signal for the trunk-operator, who now takes down the connection and restores all parts to normal condition. The subscriber at the local exchange is enabled at any time by operating her hook to throw the drop in the main cord-circuit to attract the operator's attention.

When calls are originated at the D office, the plug P³ is inserted in the jack of the calling-line and the generator 20 is connected with the line F to operate the signal S³. The operator at the C office then completes the connection. The disconnect is given in the same manner as before.

The testing of the toll-line in case it is multiplied before the toll operators is accomplished in any suitable way, as by grounding the middle point of the operator's receiver, or any other point of her bridge on the sleeve side of the receiver through a battery.

The several grounds may be one of the common office return and the batteries and generators may be one.

Fig. 3 shows a modification of the system just described in that the jacks of the toll-line E, as well as the jacks of the trunk F, are of the series type—that is, they are permanently connected with the lines—and the circuits of the signals are completed through series contacts of each of the jacks, whereby when a connection is established at any of the jacks the series contacts are opened and the signals rendered inoperative. It will be noted that in all figures the condenser is omitted in the circuit of the signal of the toll-line, for the reason that it is unnecessary to provide against the operation of the same by means of steady current on the line, as is true of the signal for the trunk. This modification does not otherwise affect the operation of the system.

I claim—

1. The combination with a toll-line terminating in a jack, of a cord-circuit to connect to said toll-line, of a trunk-circuit adapted at one end to connect to said cord-circuit and at the other end to connect to a subscriber's telephone-line, a source of steady current and a source of varying current associated with one end of said trunk-circuit, two signals for said end of the trunk actuated by current from said steady source, means whereby one of said signals is displayed when connection is established between the trunk-circuit and the toll-cord and further means whereby this signal is effaced and the second signal displayed when connection is established between the trunk and the subscriber's line, said latter signal being again effaced when the subscriber answers his call, a disconnect-signal associated with the toll-cord circuit adapted to be operated by steady current from the trunk-circuit or by varying current from the

toll-line, a second line or call signal normally connected with the toll end of the trunk and adapted to be operated only by varying current over the toll-line, substantially as described.

2. In a telephone system, the combination with a trunk-line, of a cord-circuit adapted to be connected with one end thereof, a clearing-out drop bridged across the cord-circuit, a subscriber's line adapted to be connected with the other end of said trunk-line, a switch-hook associated with the subscriber's station, a source of direct current associated with the trunk-line, a signal for the trunk and a trunk-relay to control the circuit of said signal, means whereby current from said source may be directed through said clearing-out drop and through the coil of said trunk-relay in series by the actuation of said switch-hook after connections have been established throughout and conversational conditions have existed, substantially as described.

3. In a telephone system, the combination with a trunk-line extending between a toll-board and a local board; of a through conductive cord-circuit at the toll-board adapted to connect said trunk-line with the toll-lines, a clearing-out drop bridged across said cord-circuit, subscribers' telephone-lines terminating at said local board, a central source of direct current at the latter board with which the subscribers' lines are adapted to be connected for both signaling and talking, said trunk-line being adapted to connect with any of these lines, a signal for the trunk and a trunk-relay to control the circuit of said signal, and means after the subscriber has been put into conversation with the toll-line whereby current from said direct source will be directed through said clearing-out drop and through the coil of said trunk-relay in series when the subscriber replaces his receiver on the hook, substantially as described.

4. The combination with a toll-line and a subscriber's line, of a cord-circuit adapted to connect with the toll-line, and a trunk-circuit adapted to connect between said cord-circuit and the subscriber's line, a clearing-out drop bridged across said cord-circuit, a source of current, a signal and a trunk-relay to control the circuit of said signal associated with said trunk-line, a switch at the station of said telephone-line, and means controlled by the position of said switch for sending current from said source through said trunk-relay over the trunk-line and through said clearing-out drop, whereby the drop will be actuated and whereby the trunk-relay will be deenergized to display said signal when the cord-circuit is removed from its connection with the trunk, substantially as described.

5. The combination with a toll-line and a subscriber's line, of a cord-circuit adapted to

connect with the toll-line, and a trunk-circuit adapted to be connected between said cord-circuit and the subscriber's line, a source of current, a signal and a relay to control said signal associated with the trunk-circuit, a clearing-out signal bridged across the cord-circuit, means depending upon the condition of the subscriber's telephone for including said relay either in a local circuit with said source, or in a circuit with said source including the trunk-line and said clearing-out signal, whereby said signal may be energized from the subscriber's station and said relay may be deenergized by the removal of the connection between said cord and trunk, substantially as described.

6. The combination with a trunk-circuit, of a source of current associated with said circuit, a signal for said circuit, and a relay to control said signal, a called-subscriber's line with which said trunk is adapted to be con-

nected at its incoming end, and a cord-circuit adapted to be connected with said trunk at its outgoing end, an impedance bridged across said cord-circuit, means depending upon the condition of the subscriber's telephone for actuating said relay from said source either over a local circuit or over a circuit including the outgoing end of said trunk, a portion of said cord-circuit and said impedance, whereby under said latter condition the relay may be deenergized by the removal of the connection between the cord and the trunk, substantially as described.

Signed by me at Chicago, county of Cook, State of Illinois, this 2d day of December, 1902.

HARRY G. WEBSTER.

Witnesses:

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GAZELLE BEDER.