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W. A. RHODES

TELEPHONE SIGNALING SYSTEM

Filed Oct. 25, 1919

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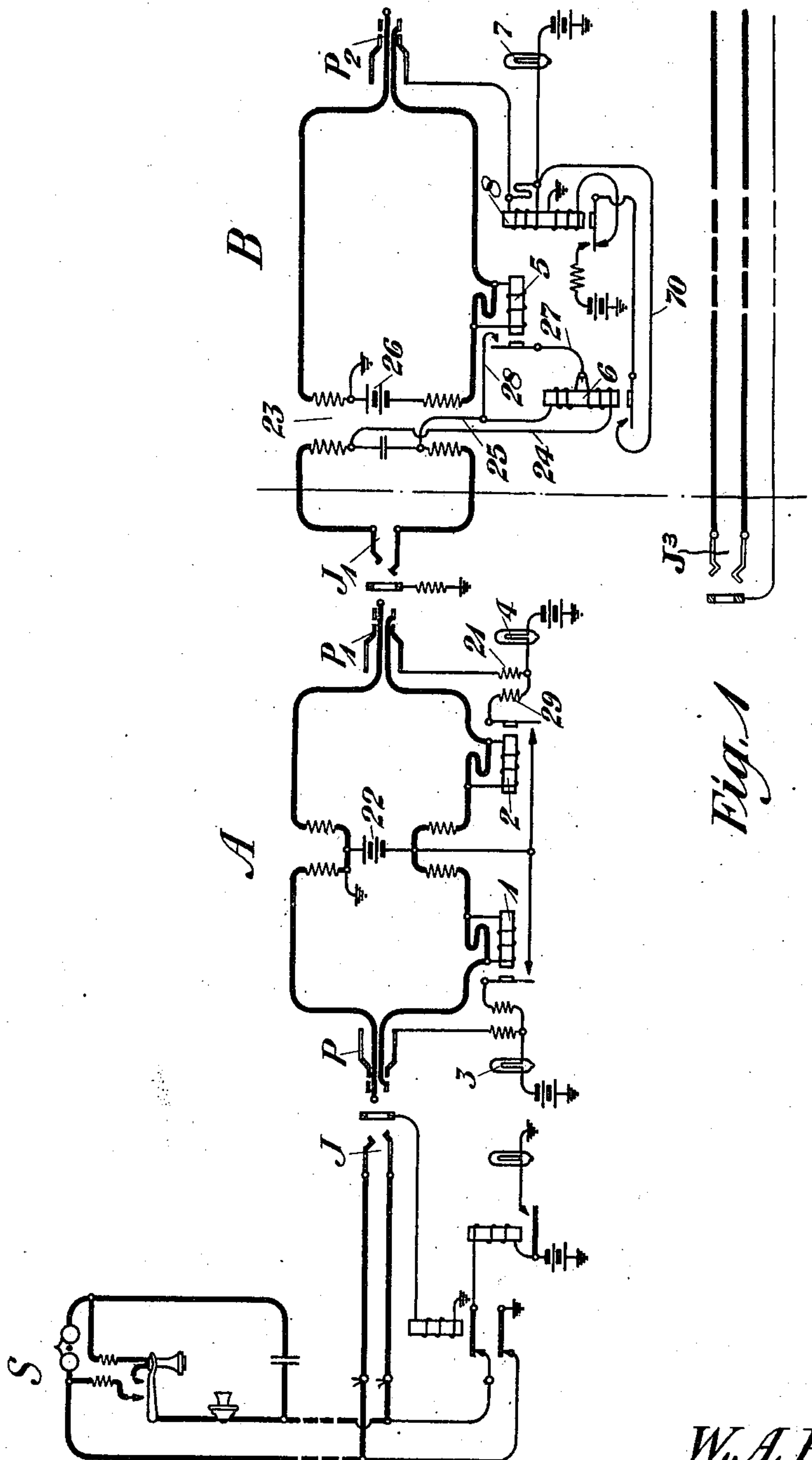


Fig. 1

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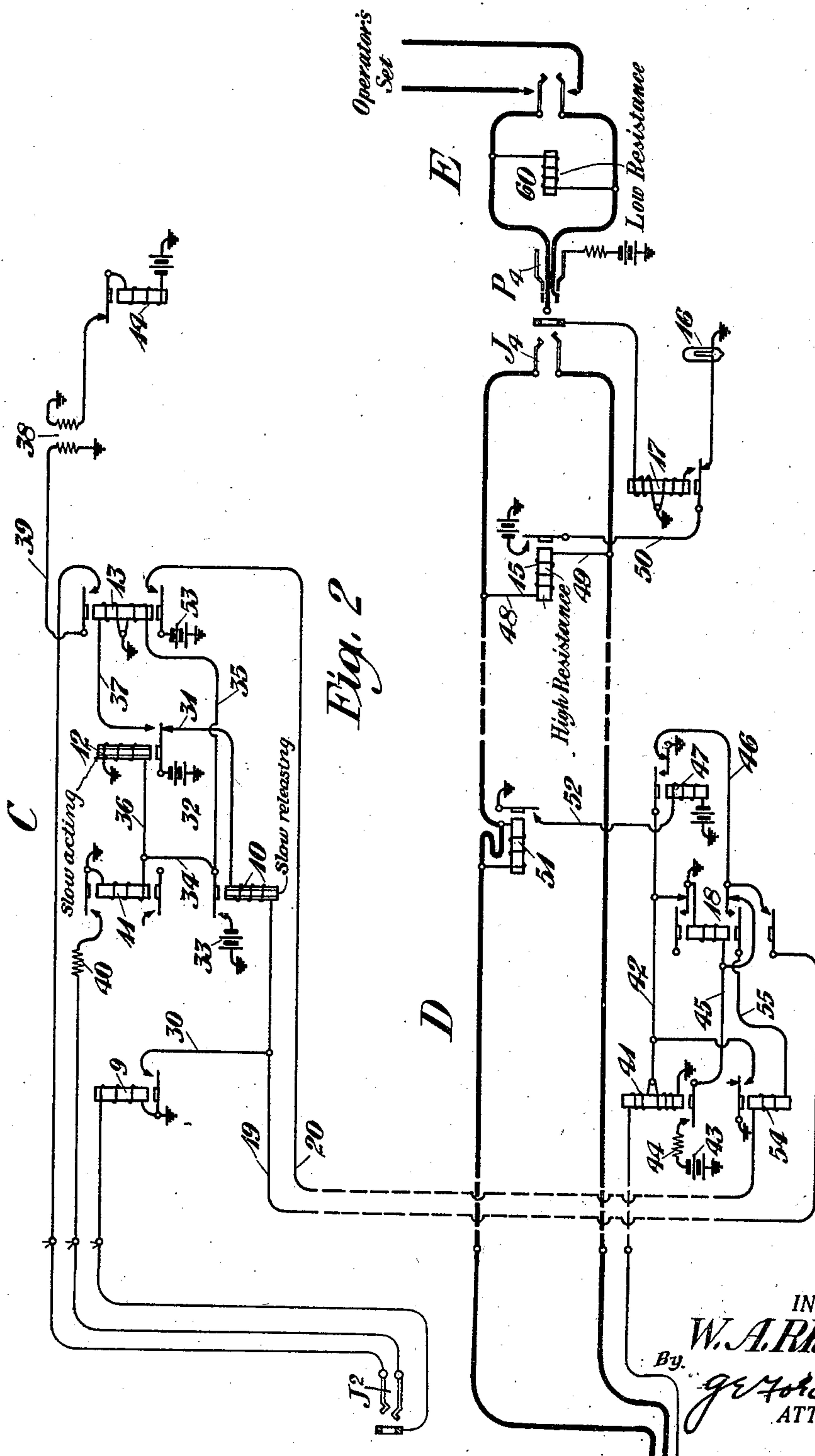
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2 sheets-sheet 2



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UNITED STATES PATENT OFFICE.

WILLIAM A. RHODES, OF NEW YORK, N. Y., ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

TELEPHONE SIGNALING SYSTEM.

Application filed October 25, 1919. Serial No. 333,320.

To all whom it may concern:

Be it known that I, WILLIAM A. RHODES, residing at New York, in the county of New York and State of New York, have invented certain Improvements in Telephone Signaling Systems, of which the following is a specification.

This invention relates to telephone systems, and more particularly to means for providing disconnect and busy signals for such systems.

The invention consists in the provision of improved means whereby a signal is transmitted to an operator at an originating position for informing said operator to disconnect her cord from a recording toll trunk. It further consists in the provision of improved means for furnishing busy indications on local connections. Other and further objects of the invention will hereinafter appear.

A telephone call between subscribers' lines associated with different central offices or exchanges is completed by means of trunk circuits interconnecting such offices. The operator at the office wherein the call originates communicates with a connecting operator at the exchange with which the called subscriber's line is associated, and then connects her cord circuit with a trunk circuit designated by the latter operator which trunk circuit is then connected with the line of the called subscriber and the call is completed. Should the line of the called subscriber be found busy, the operator at the central office where the called subscriber's line terminates will connect the trunk circuit with one of a set of busy back jacks. These busy back jacks are connected with busy back circuits which include apparatus which operates intermittently and when associated with the trunk circuits and the cord circuits of the connecting and initiating operators cause a supervisory signal at the initiating operator's position to flash and inform the operator of the busy condition of the called line. The calling subscriber is also informed in case the called line is busy by a tone produced in the receiver at the substation, and upon receiving such indication should restore the receiver to its hook.

Should the operator, after connecting one end of her cord circuit with the calling line, find that a long distance or toll call is desired, she will connect the other end of said

cord with a trunk circuit terminating at a toll recording operator's position. After the calling subscriber has transmitted the desired long distance number to the recording operator, and the latter has disconnected, the originating operator should immediately disconnect her cord circuit from the calling line because the recording operator after disconnecting immediately orders up the calling subscriber's line over a toll switching trunk in a well known manner, and, if the originating operator is not prompt in disconnecting, the calling subscriber's line will be held busy and a connection will not be built up through a toll switching position without undue delay. Therefore, in order that good traffic conditions may prevail, it is necessary that the local operator should disconnect her cord circuit as soon as possible. Accordingly it is one of the principal objects of this invention to provide a peremptory signal at the local operator's position in order to insure a prompt disconnect on the part of the local operator when the recording operator disconnects.

In the accompanying drawings, one embodiment of this invention is diagrammatically illustrated. Figure 1 represents a subscriber's station, together with a local cord circuit and a call circuit trunk. Fig. 2 shows a circuit which functions as a busy back when associated with a local circuit and when associated with a recording trunk provides a peremptory disconnect signal at the local operator's position after a recording operator has disconnected from said recording trunk. Fig. 3 illustrates a recording trunk and a recording toll operator's position.

In Fig. 1 as illustrated a subscriber's station and a type of cord circuit and trunk circuit suitable for completing local calls therefrom to another subscriber's station. These types of circuits are well known in the art and only portions thereof essential for the operation of this invention are illustrated. The subscriber's station S terminates in jack J, and adapted to be associated therewith is a local cord circuit A with the customary plugs P and P₁. Associated with the ring side of cord A are supervisory relays 1 and 2 which respectively control supervisory lamps 3 and 4. The local cord circuit A may be associated with the local trunk circuit B by means of plug P₁ and jack

J_1 . Associated with the talking conductors of trunk B is the supervisory relay 5 which serves when operated to close a short circuit about the high resistance winding of relay 6 which controls the operation of relay 2 of cord A. The relay 6 controls the usual type of guard or disconnect signal, such as lamp 7 associated with the sleeve relay 8 of the plug P_2 .

In Fig. 2 is shown the busy back circuit C. If the called line is found busy the operator at the plug end of trunk B associates plug P_2 with jack J_2 of the circuit C, and a busy back signal to the subscriber S and also to the operator at A is thereby provided, as will later appear. Included in the sleeve conductor of circuit C is the relay 9 which is energized upon the association of the plug P_2 and jack J_2 . The operation of this relay serves to energize relays 10, 11, 12 and 13 intermittently. An interrupter 14 operating continuously, places a tone on the subscriber's line each time relay 13 is energized and each time relay 11 is released supervisory lamp 4 of cord A is flashed.

In Fig. 3 is illustrated a recording trunk D and an operator's position E. When a toll or a long distance connection is desired the operator at A will insert plug P_1 in jack J_2 of recording trunk D, whereupon relay 15 which is associated with the talking conductors of the recording trunk will operate, causing lamp 16 to light. The recording operator E will respond by inserting plug P_4 in jack J_4 thereby operating relay 17 and extinguishing lamp 16, and after having ascertained the number desired will dissociate plug P_4 from jack J_4 . The removal of said plug will cause the release of relay 47 of recording trunk D as will be pointed out later. The relay 47 upon releasing will connect lead 19 to ground through a contact of relay 18, which operated when the recorder answered, whereupon the relays 10, 11, 12 and 13 will operate and set in operation relay 54 which is also grounded by the release of relay 47. Relay 54 operating intermittently will cause the supervisory lamp 4 associated with cord A to flash rapidly, and thus notify the operator thereat to take down the connection between the subscriber S and recording trunk D in order that said station line shall not test busy, should the toll operator wish to order up and hold the line over a toll switching trunk.

The invention may now be more fully understood from the following description of its operation:

In response to a call from station S, the operator A will insert plug P into jack J and if said operator finds that the subscriber S desires a local connection with a line associated with another central office, she communicates with the operator at such office by means of a call wire circuit, and is

informed by the latter operator of a suitable trunk circuit, such as the trunk circuit B, with which to connect her cord circuit, such as the cord circuit A. When the cord circuit A is connected with trunk B by means of the plug P_1 being inserted in the jack J_1 , the following circuit is completed. From battery, filament of lamp 4, resistance 21, sleeve contacts of plug P_1 and jack J_1 to ground. The closing of this circuit will light lamp 4. The insertion of plug P_1 into jack J_1 also closes the following circuit: From one side of battery 22, tip conductor of cord A, tip contacts of plug P_1 and jack J_1 , tip conductor of trunk B, upper left hand winding of coil 23, conductor 24, low and high resistance windings of relay 6, conductor 25, lower left hand winding of coil 23, ring conductor of trunk B, ring contacts of jack J_1 and plug P_1 , ring conductor of cord A, winding of relay 2, to opposite side of battery 22. The upper windings of relay 6, however, is of sufficiently high resistance so that the closing of this circuit will not at this time operate supervisory relay 2. Relay 6 is operated at this time and lights lamp 7 over the following circuit: From ground, lower winding of relay 8 back contact and armature of said relay, armature and contact of relay 6, conductor 70, filament of lamp 7 to battery. Relay 8 is so adjusted that it will not operate at this time. The local call is completed by the operator at the central office with which the called subscriber's line is associated by inserting the plug P_2 of trunk B into the jack of the called subscriber's line. When the called subscriber (not shown) responds, the following circuit is closed: From ground, upper right hand winding of coil 23, tip conductor of cord B, tip contact of plug P_2 , out over the subscriber's line in a well understood manner, through the subscriber's station back over the subscriber's line, ring contact of plug P_2 winding of relay 5, lower right hand winding of coil 23 to battery 26. The closing of this circuit will energize relay 5, which will pull up its armature and close a short circuit including conductors 27 and 28 about the high resistance winding of relay 6 so that the circuit formerly closed through relay 2 will no longer include the high resistance winding of relay 6, and relay 2 will now operate, closing a circuit from grounded battery, filament of lamp 4, low resistance 29, armature and contact of relay 2 to battery. The closing of this circuit will extinguish signal lamp 4, and thus inform the operator at A that the connection has been completed.

Should the line of the called subscriber be busy, the operator at the central office with which the subscriber is associated will insert the plug P_2 of trunk B into one of the jacks of the busy back apparatus shown in Fig. 2.

Such, for example, as the jack J_2 , thereby closing the following circuit: From battery, filament of guard or disconnect lamp 7, winding of relay 8, sleeve conductor of plug P_2 , sleeve contacts of plug P_2 and jack J_2 , sleeve conductor of jack J_2 , and winding of relay 9 to ground. This circuit will operate relay 9 and close the following circuit: From ground, armature and contact of relay 9, conductor 30, winding of relay 10, conductor 31, back contact and armature of relay 12 to battery 32. This circuit will operate relay 10 and close a circuit from battery 33, contact and armature of relay 10, conductor 34, winding of relay 11 to ground, thereby causing the last mentioned relay to operate. The operation of relay 10 also closes a circuit from battery 33, contact and armature of relay 10, conductor 35, lower winding of relay 13 to ground, thus operating the latter relay. An additional circuit is also closed by the energization of relay 10, from battery 33, contact and armature of relay 10, conductors 34 and 36, winding of relay 12 to ground. Relay 12 which is slower in action than relays 11 and 13 is after an interval operated by this circuit and pulls up its armature and breaks the circuit through relay 10. Relay 10 is slow in releasing and an interval elapses before its release occurs, during which a circuit is closed from battery 32 through the armature and contact of relay 12, conductor 37, upper winding of relay 13 to ground and current flowing in both windings of relay 13 causes it to release, since the windings of relay 13 are connected differentially. Relay 10, upon releasing releases relay 11 and by opening the circuit through the lower winding of relay 13, causes it to operate. Moreover, the release of relay 10 results, after an interval, in the release of relay 12, which in turn causes the release of relay 13 and the restoration of the entire circuit to the condition it was in when relay 9 operated. The cycle of operation described above, consequently will be repeated until such time as relay 9 is released. During this cycle relay 13 will operate upon the energization of either of the relays 10 and 12 and will release upon the energization or upon the deenergization or both, and will therefore operate and release at twice the frequency of relay 11. Each time relay 11 operates a circuit will be closed from ground, over armature and contact of said relay, resistance 40, ring contacts of jack J_2 and plug P_2 , ring conductor of trunk B, winding of relay 5, lower right hand winding of coil 23 to battery 26. Each time this circuit is closed relay 5 will be operated and attract its armature closing a short circuit, by way of conductors 27 and 28, around high resistance winding of relay 6. The closing and opening of this circuit will oper-

ate and release relay 2 by a circuit over the tip and ring conductors of cord A including battery 22, and the supervisory lamp 4 of said cord will be flashed as previously outlined. A tone is also induced in the transformer coil 38 due to the operation of the buzzer 14 and this tone when relay 13 is operated, is transmitted to the calling subscriber over the tip conductor of the circuit B and tip and ring conductors of circuit A and of the subscriber's line. This tone is interrupted intermittently at the frequency of operation of relay 13 and will furnish a distinctive signal to the subscriber. The subscriber upon receiving this tone in the receiver will restore it to its hook, and the operator at A noting the flashing of her supervisory lamp will take down the connections at A. The relay 6 of trunk B will then release and the shunt around lamp 7 will be removed and the lamp lighted. This serves as a disconnect signal to the operator at B, who disconnects plug P_2 from jack J_2 and consequently restores circuit C to normal.

Should the operator at A, in response to a call from station S, find that a long distance or toll call is desired, she will insert plug P_1 in jack J_3 of the recording trunk D, which terminates at a recording toll operator's position E, thereby establishing the following circuit: From battery, supervisory lamp 4, resistance 21, sleeve conductor of cord A, sleeve contacts of P_1 and jack J_3 , sleeve conductor of circuit D, upper winding of relay 41, conductor 42, contact of relay 18 to ground. Relay 41 will be energized by the previously described circuit, but in operating will perform no useful function at this time. The insertion of plug P_1 in jack J_3 also closes a circuit from battery 22, tip and ring conductors of cord A, including winding of relay 2, tip and ring contacts of plug P_1 , and jack J_3 , tip and ring conductors of trunk D, winding of relay 51, conductors 48 and 49 and winding of high resistance relay 15. Relays 2 and 51 due to the high resistance of relay 15 receive insufficient current at this time to permit their operation, but relay 15 will be energized by this circuit, and upon operating closes the following circuit: From battery, front contact and armature of said relay, conductor 50, armature and back contact of relay 17, filament of lamp 16 to ground, thereby lighting lamp 16. The recording operator E, observing that the lamp 16 is lighted, will insert plug P_4 in jack J_2 and establish the following circuit: From battery, sleeve contacts of plug P_4 and jack J_4 , upper winding of relay 17 to ground. This circuit energizes relay 17, which in operating extinguishes lamp 16 and closes a locking circuit from ground through lower winding of relay 17, conductor 50, armature

and contact of relay 15 to battery. The insertion of plug P_4 in jack J_4 also establishes a circuit through the winding of the low resistance relay 60 in the operator's cord E, over the tip and ring contacts of plug P_4 and jack J_4 and winding of high resistance relay 15 of the trunk D, thus connecting the low resistance relay 60 and high resistance relay 15 in parallel, thereby reducing the resistance in the circuit sufficiently to allow relays 2 and 51 to operate. The operation of relay 2 extinguishes the supervisory lamp 4 in an obvious manner. The operation of relay 51 closes a circuit over its armature and contact from ground, conductor 52 and winding of relay 47 to battery, said circuit energizing relay 47. The operation of relay 47 removes ground from conductor 46 and thence from conductor 45 and thereby allows relay 18 to operate over a circuit from battery 43, resistance 44, conductor 45, winding of relay 18 to ground. Relay 47 also places ground on conductor 42 so that the subsequent operation of relay 18 does not at this time affect the condition of the A cord sleeve circuit.

When the recording operator at E has ascertained the number desired from the operator at A, she removes plug P_4 from jack J_4 . The removal of said plug disconnects the low resistance therein so that there is insufficient current to maintain relays 2 and 51 energized, and they release. The release of relay 51 breaks the circuit previously described for energizing relay 47, and the latter relay upon releasing closes a circuit from ground through its contact and armature, conductor 46, through lower contact and armature of relay 18, conductor 19, through winding of relay 10, back contact and armature of relay 12 to battery 32. The closing of this circuit sets in operation relays 10, 11, 12 and 13, and the apparatus and circuit at C function in a manner similar to that described in connection with the association of trunks B with circuit C. The operation of relay 13 in this case supplies intermittent battery through its lower armature and contact over conductor 20, through the winding of relay 54, conductor 55, lower inner armature of relay 18, conductor 46, normal contact of relay 47 to ground. Relay 54 is energized by this circuit and operates and releases in unison with relay 13. The supervisory lamp 4 of cord A does not light until relay 54 is operated due to the high resistance of the circuit from battery, filament of said lamp, resistance 21, sleeve contacts of plug P_1 and jack J_3 , through upper low resistance and lower high resistance windings of relay 41 to ground. The operation of relay 54, however, short circuits the lower high resistance winding of relay 41 and connects ground by way of its armature and con-

tact to the upper low resistance winding of relay 41, thereby permitting sufficient current to flow over the sleeve circuit to light the supervisory lamp 4. Thus each time relay 54 operates, under control of relay 13 in the circuit C, the lamp 4 of cord A will flash, the cycle of operation in circuits C and D, continuing until the operator at A observing the rapid flashing of said lamp, will disconnect plug P_1 from jack J_3 .

While the invention has been disclosed as embodied in certain specific arrangements which have been deemed desirable, it will be understood that it is capable of embodiment in many and widely varied forms without departing from the spirit of the invention as defined in the appended claims.

Having thus described the invention, what it is desired to secure by Letters Patent is:

1. In a telephone system, a trunk circuit, a recording circuit, a cord circuit adapted to be associated with either of said circuits, an indicating circuit adapted to be associated with said trunk circuit or said recording circuit, a differential relay in said indicating circuit, and a plurality of sequentially operated relays in said indicating circuit for intermittently energizing said differential relay whereby a busy indication is produced in the cord circuit upon the association of the trunk circuit with said indicating circuit and whereby a peremptory disconnect signal is produced in said cord circuit upon the association of said recording circuit with said indicating circuit.

2. In a telephone system, a trunk circuit, a recording circuit, a cord circuit adapted to be associated with either of said circuits, an indicating circuit adapted to be associated with said trunk circuit or recording circuit, a differential relay in said indicating circuit, and a plurality of sequentially operated relays in said indicating circuit for intermittently energizing said differential relay whereby a signal is produced in the cord circuit upon the association of the trunk circuit with the indicating circuit and whereby said signal is produced at double the frequency in said cord circuit upon the association of said recording circuit with said indicating circuit.

3. In a telephone system, a trunk circuit, a recording circuit, a cord circuit associated with the incoming end of said recording circuit, a second cord circuit adapted to be associated with the trunk circuit or with outgoing end of said recording circuit, an indicating circuit including relays adapted to be associated with said trunk circuit or said recording circuit, means included in said indicating circuit whereby a signal is produced in the second mentioned cord circuit upon the association of the cord circuit with said trunk circuit and said trunk circuit with the indicating circuit, and means

- whereby the association of said second cord circuit directly with said recording trunk causes said indicating circuit to operate a signal in the second mentioned cord at
5 twice the frequency of the first mentioned signal, said means being controlled by the dissociation of the first mentioned cord circuit from the incoming end of said recording circuit.
- 10 4. In a telephone system, a subscriber's station, a cord circuit adapted to be associated therewith, a busy back circuit, a trunk circuit whereby said cord circuit is connected with said busy back circuit, a relay in said
15 busy back circuit controlled by the connection of said trunk with said busy back circuit, a plurality of relays controlled by said relay, a differential relay controlled by said plurality of relays whereby an intermittent
20 signal is produced in the cord circuit, an interrupter, and a transformer controlled by said differential relay and said interrupter whereby a tone is produced at said subscriber's station upon the connection of said trunk with said cord circuit and busy back circuit.
5. In a telephone system, a cord circuit, an indicating circuit, a recording circuit, a second cord circuit associated with said recording circuit in talking connection with
30 said first cord circuit, means in said recording circuit responsive to the disconnection of said second cord circuit therefrom for connecting said indicating circuit with said recording circuit, a plurality of sequentially operated relays in said indicating circuit responsive to the connection of said recording circuit therewith, a first relay in
35 said indicating circuit controlled by said sequentially operated relays, and a second relay in the recording circuit operable in unison with said first relay for operating a signal in the first mentioned cord circuit.
- 40 In testimony whereof, I have signed my name to this specification this 23rd day of
45 October, 1919.

WILLIAM A. RHODES.