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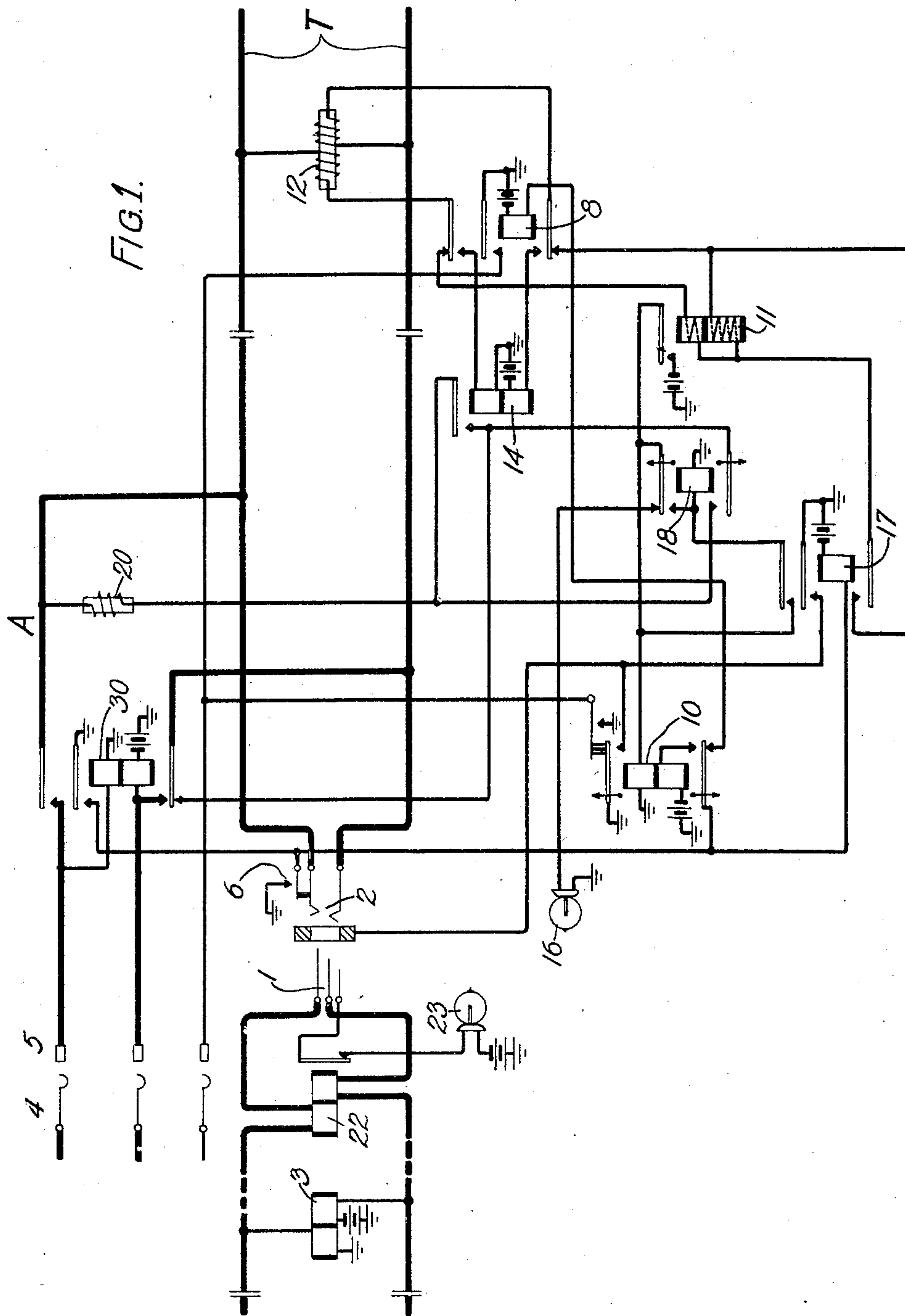
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1,752,550

TELEPHONE SYSTEM

Filed May 21, 1927

2 Sheets-Sheet 1



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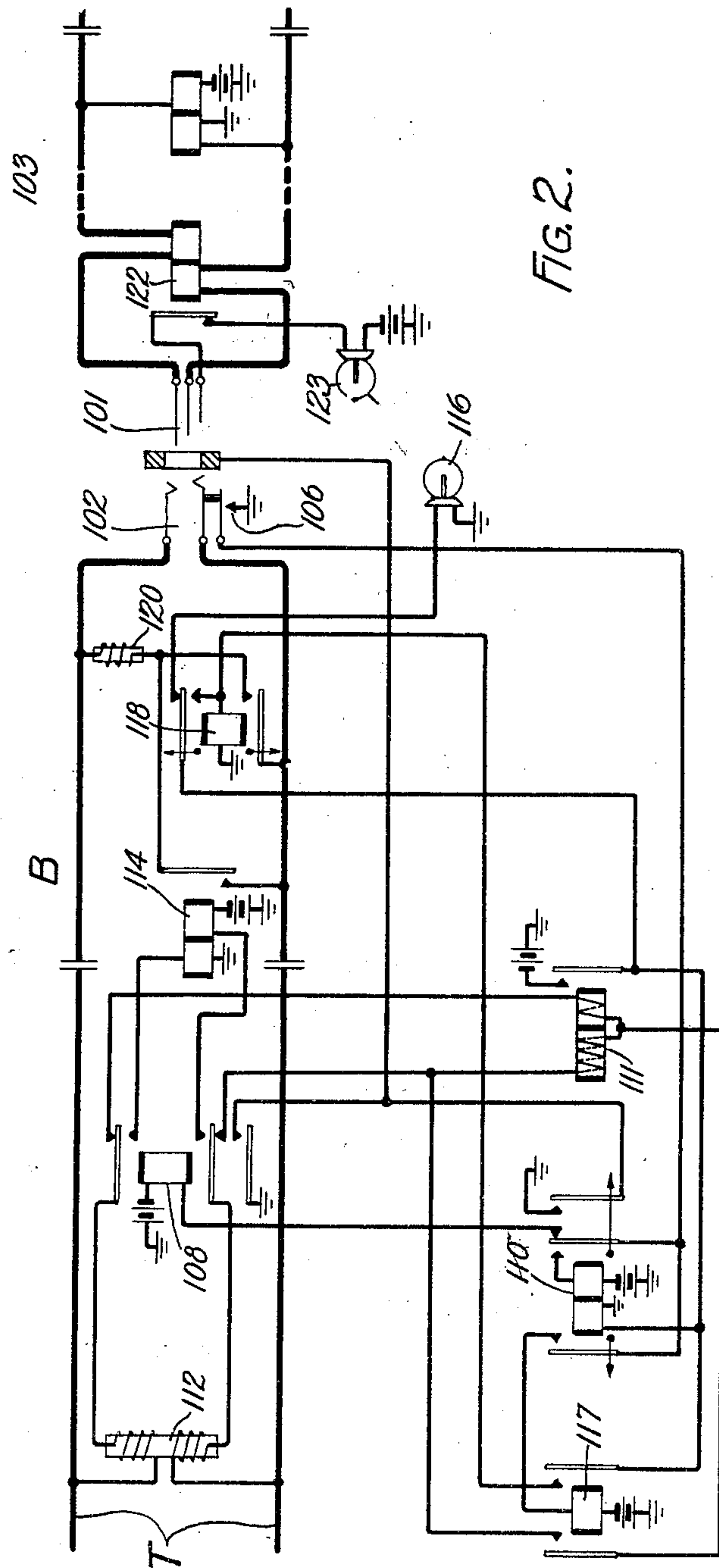


FIG. 2.

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## UNITED STATES PATENT OFFICE

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## TELEPHONE SYSTEM

Application filed May 21, 1927. Serial No. 193,146.

This invention relates to telephone systems, and has for its object improvements in tie lines for use between exchanges.

In accordance with this invention, means are provided at the terminal stations of a tie line whereby supervision in both directions for a connection established over said line is effected through the battery supply at the calling station.

A feature of this invention is a system with two supervisory relays at each station, one connected to a battery supply and the other having a low resistance winding and a high resistance winding normally connected in series in a bridge across the line conductors. Supervision from the calling station is effected by removing the bridged relay and connecting the battery at this station through the other relay to the line conductors and thereby actuating the bridged relay at the other station, while supervision from the called station is provided by short circuiting the high resistance winding of the bridged relay at this station to actuate the connected relay at the calling station. The battery supply at the two stations need not, therefore, be of the same voltage, as the battery at the calling station is used to control supervision from both stations.

This invention has been illustrated in the accompanying drawings in which,

Fig. 1 shows the circuits of a tie line at one private branch exchange; and

Fig. 2 shows the circuits of this tie line at another private branch exchange.

The circuits at station A in Fig. 1 are so arranged that calls may be made from this station by seizing the tie line T either manually through a jack 2 from a cord circuit, partially shown at 3, or automatically through a selector, the brushes of which are diagrammatically indicated at 4; while the circuits at station B in Fig. 2 are so arranged that calls originating from this station may be made by seizing the tie line manually through a jack 102 from a cord circuit partially shown at 103.

To illustrate the features of this invention embodied in this type of tie line circuit a description will first be made of how a manu-

ally originating call and an automatically originating call from station A to station B may be made, followed by a description of how a manually originating call from station B to station A is made.

Assuming then that the private branch exchange operator at station A has answered a call from a private branch exchange subscriber by means of a cord 3 terminating in the calling plug 1 in the usual manner and has initiated the extension of the connection over tie line T by inserting plug 1 into jack 2, the springs 6 of this jack are closed to provide a circuit for the operation of relays 17 and 8 as follows: The circuit for relay 17 is obvious, and relay 17 in operating closes a connection to ground at its upper inner armature and front contact for the sleeve circuit to cause the lighting of supervisory lamp 23. The circuit for relay 8 may be traced from battery through winding of relay 8, lower armature and back contact of relay 10 to ground at the contacts 6. Relay 8 in operating its upper outer armature and lower armature disconnects the relay 11 from the bridge across the tip and ring conductors of line T and connects battery and ground through the windings of relay 14 in this bridge through the windings of the retardation coil 12. A circuit is now completed over the line T for the operation of the bridged relay 111 as follows: battery, lower winding of relay 14, lower armature and front contact of relay 8, one winding of retardation coil 12, ring conductor of trunk T, one winding of retardation coil 112, the lower inner armature and back contact of relay 108, high resistance winding and low resistance winding of relay 111 in series through the upper armature and back contact of relay 108, the other winding of retardation coil 112, tip conductor of line T, the other winding of retardation coil 12, upper outer armature and front contact of relay 8, upper winding of relay 14 to ground. Due to the high resistance of the left hand winding of relay 111, relay 14 will not operate in this circuit, but sufficient current will be supplied for this circuit to cause the operation of relay 111. This relay in operating closes an obvious circuit for the lighting of



lamp 116, which thereby indicates to the private branch exchange operator at station B that a connection is desired over line T. The operation of relay 111 also closes an obvious circuit for the operation of relay 110. This relay in operating closes circuits hereinafter to be described.

When the private branch exchange operator at B answers this call by inserting plug 101 of cord 103 into jack 102, a connection is closed to ground at the contacts 106 for the operation of relay 117 as follows: battery, winding of relay 117, left hand armature and front contact of relay 110, contacts 106 to ground. The closing of contacts 106 also provides an obvious locking circuit for relay 110 through its right hand winding and inner right hand armature and front contact. Relay 117 in operating closes a circuit for the operation of relay 118 as follows: battery, armature and front contact of relay 111, right hand armature and front contact of relay 117, winding of relay 118 to ground. This relay in operating closes a locking circuit for itself directly to the battery at the armature and front contact of relay 111 independent of its original energizing circuit. The operation of relay 118 opens the circuit for lamp 116 which is now extinguished and establishes a bridge across the tip and ring terminals of jack 102, through the retardation coil 120 and this bridge now causes the operation of the supervisory relay 122 to prevent the lighting of the supervisory lamp 123 in the sleeve circuit.

Relay 117 in operating also, by closing its left hand armature to the corresponding front contact, short circuits the high resistance winding of relay 111, to cause relay 14 to operate. Relay 14 in operating closes a bridge through retardation coil 20 across the tip and ring conductors of the line T at station A and this bridge causes the operation of the supervisory relay 22 of cord 3 to extinguish lamp 23 to indicate to the private branch exchange operator at this station that the call has been answered at station B. The operator at station A may now transmit the wanted private branch exchange subscriber's number to the operator at station B and when this operator has established a connection to this subscriber in the usual manner and the subscriber has answered the call, the conversation between the calling subscriber and called subscriber may begin.

When conversation ceases and in case the operator at station B disconnects first by removing plug 101 from jack 102, relay 117 is released by the opening of spring contacts 106. The release of this relay reinserts the high resistance winding of relay 111 in the circuit for relay 14 so that this relay will now release. Relay 14 in releasing removes the bridge through the retardation coil 20 from the tip and ring conductor at station A and

the supervisory relay 22 releases to cause lamp 23 to be lighted to indicate to the operator at this station that disconnection is desired. This operator may now remove plug 1 from jack 2, thus causing the release of relays 8, 17, 111, 110 and 118.

If disconnection is originated at station A by the operator at this station removing plug 1 from jack 2, relays 17 and 8 release and relay 8 in releasing causes the release of relays 14 and 111. Relay 111 in releasing causes the release of relay 118 which now removes the bridge through the retardation coil 120 and thus causing the release of supervisory relay 122 and the lighting of lamp 123 to indicate to the operator at this station that disconnection is desired. The operator at this station in removing the plug 101 from jack 102 causes the release of relays 110 and 117.

In establishing a connection automatically from station A, the selector whose brushes 4 have been shown seize the terminals 5 to cause the operation of relay 30. It should be understood that any well known step-by-step selector may be used for this purpose, and as such a selector forms no part of this invention, no description of its operations will be made. If it is desired to trace the actions of a selector suitable for use in this connection reference may be had to the selector circuit shown in the applicant's Patent No. 1,705,906 of March 19, 1929 issued on an application, Serial No. 194,033, filed May 25, 1927. The operation of relay 30 closes a circuit for the operation of relays 17 and 8. Relay 17 applies busy potential on the sleeve circuit for jack 2. Relay 30 also connects the tip and ring conductors from the terminals 5 through to the tip and ring conductors of the line T. The operations of the circuits from this point on are identical with the previously described operations for establishing connections from cord 3, up to the point where the operator at station B releases.

If the connection over line T is originated at station B, the insertion of plug 101 into jack 102 causes the operation of relay 108. This relay in operating disconnects the bridged relay 111 from the line and bridges relay 114 across the tip and ring conductors, through the retardation coil 112. This causes the operation of the bridged relay 11 at station A and this relay in operating closes an obvious circuit for the operation of relay 10 and a circuit for the lighting of lamp 16 to indicate to the operator at this station that a connection is desired over line T. Relay 10 places busy potential on the sleeve of jack 2.

The operator at station A in answering this call by inserting plug 1 into jack 2 provides a locking circuit for relay 10, causes relay 17 to operate and lamp 23 to light. Relay 17 in operating closes a circuit for the operation of relay 18 due to the operation of relay 11. Relay 18 in operating provides a locking cir-



cuit for itself under control of relay 11 and causes lamp 16 to be extinguished and operates relay 22 to extinguish lamp 23. Relay 17 in operating also short circuits the high resistance winding of relay 11 and thereby causes the operation of relay 114 at station B. This relay in operating closes a bridge through the retardation coil 120 for the operation of supervisory relay 122 and the extinguishing of supervisory lamp 123 to indicate to the operator at station B that the call has been answered by station A.

When the operator at station A has received the wanted subscriber's number and has established a connection to this subscriber, conversation may begin. The release of the connection is identical with the release of the connections as hereinbefore described for calls originating at station A, except that in this case the circuits at station A and B will function in the reverse manner from that described.

From the above descriptions it is apparent that battery is supplied at the call originating station for supervision in both directions. It is, therefore, evident that it is immaterial whether or not the battery supplies for relays 14 and 114 are of the same strength, as the relays controlled by the battery supply at one station are independent of the relays controlled by the battery supply at the other station. Hence, private branch exchange stations having different battery supplies may be connected by means of tie lines arranged in accordance with this invention.

The particular type of tie line described above should merely be considered as illustrative of one application of the various features of this invention to a practical system and it should be understood that the invention may equally well be incorporated in various other types of connecting lines without departing from the spirit thereof.

What is claimed is:

1. In a telephone system, two stations, a line connecting said stations, battery supply at each station, means for supervising a connection established over said line from either station with the battery supply for said supervision furnished from the call originating station which may be either station.

2. In a telephone system, two stations, a line connecting said stations, means including two sets of relays and associated battery supplies each set comprising one relay at each station, means for signaling over said line in both directions between said stations with one set of relays and the associated battery supply involved in said signaling if it originates at one station and with the other set of relays and the associated battery supply involved in said signaling if it originates at the other station.

3. In a telephone system, two stations, a line connecting said stations, signaling means

at each station, battery supply at each station, means responsive to the seizure of the line at either station for operating the signaling means at the opposite station under control of the battery at the station where the line was seized, and means responsive to the subsequent seizure of the line at the opposite station for actuating the signaling means at the station where the line was first seized under control of the same battery supply.

4. In a telephone system, a first and a second station, a line connecting said stations, battery supply at each station, two relays at each station, one relay at the first station and one relay at the second station arranged to be fed from the battery supply at the first station and the other relays arranged to be fed from the battery supply at the second station, means responsive to the seizure of the line at either station for actuating the relay at the opposite station fed from the battery at the seizing station, and means responsive to the subsequent seizure of the line at the opposite station for actuating the relay at the first station fed from the battery at said first station.

5. In a telephone system, two stations, a line connecting said stations, means for calling from either station over said line, means including two relays at each station, one of said relays connected to a battery supply and the other having a high resistance winding and a low resistance winding connected in series in a bridge across the line conductors, means for connecting the battery through the windings of the corresponding relay at the call originating station to the line and disconnecting the bridged relay at this station from the line for actuating the bridged relay at the other station, and means at the other station for subsequently short circuiting the high resistance winding of the bridged relay at this station for actuating the connected relay at the call originating station.

6. In a telephone system, two stations, a line connecting said stations, signaling means at each station, means for calling from either station over said line, means including two relays at each station for actuating said signaling means, one of said relays having its windings connected to battery and the other relay having a high resistance winding and a low resistance winding connected in series in a bridge across the line conductors, means for connecting battery through the windings of the corresponding relay at the call originating station across the line conductors and for disconnecting the bridged relay at this station from the line for actuating the bridged relay at the other station to operate the signaling means thereat, and means at said other station for subsequently short circuiting the high resistance winding of the bridged relay thereat for actuating the con-



nected relay at the call originating station to operate the signaling means thereat.

7. In a telephone system, two stations, a line connecting said stations, signaling means at each station, means for calling from either station over said line, means including two relays at each station for actuating said signaling means, one of said relays connected to battery and the other relay having a high resistance winding and a low resistance winding connected in series in a bridge across the line conductors, means for connecting battery through the windings of the corresponding relay at the call originating station to the line and for disconnecting the bridged relay at this station from the line for actuating the bridged relay at the other station to operate the signaling means thereat, and means at said other station for subsequently short circuiting the high resistance winding of the bridged relay thereat for disabling the signaling means at this station and for actuating the connected relay at the call originating station to operate the signaling means thereat.

In witness whereof, I hereunto subscribe my name this 18th day of May, A. D. 1927.

JOSEPH W. DEHN.