

July 11, 1939.

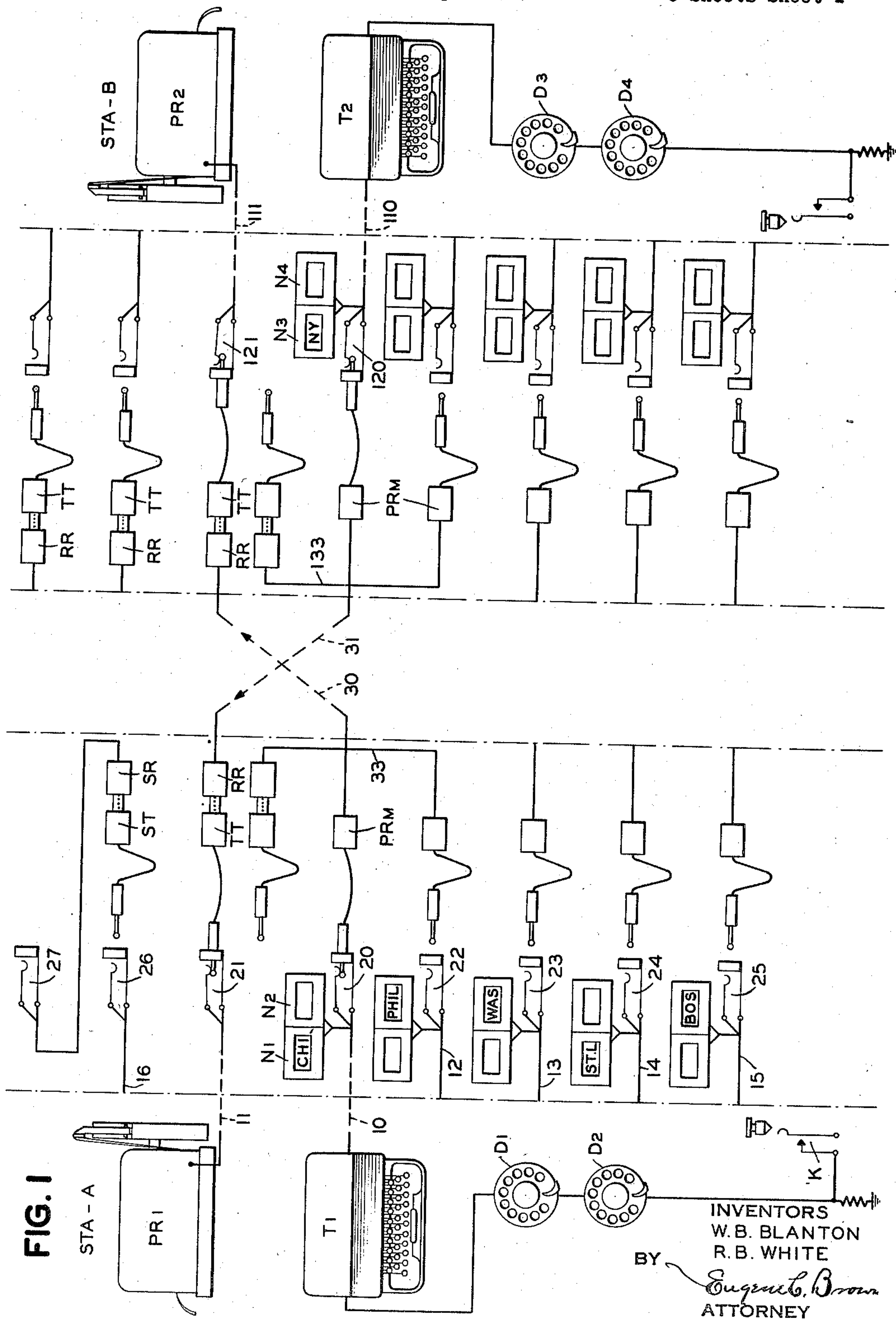
W. B. BLANTON ET AL

2,165,780

TELEGRAPH EXCHANGE SYSTEM

Filed April 28, 1936

3 Sheets-Sheet 1



July 11, 1939.

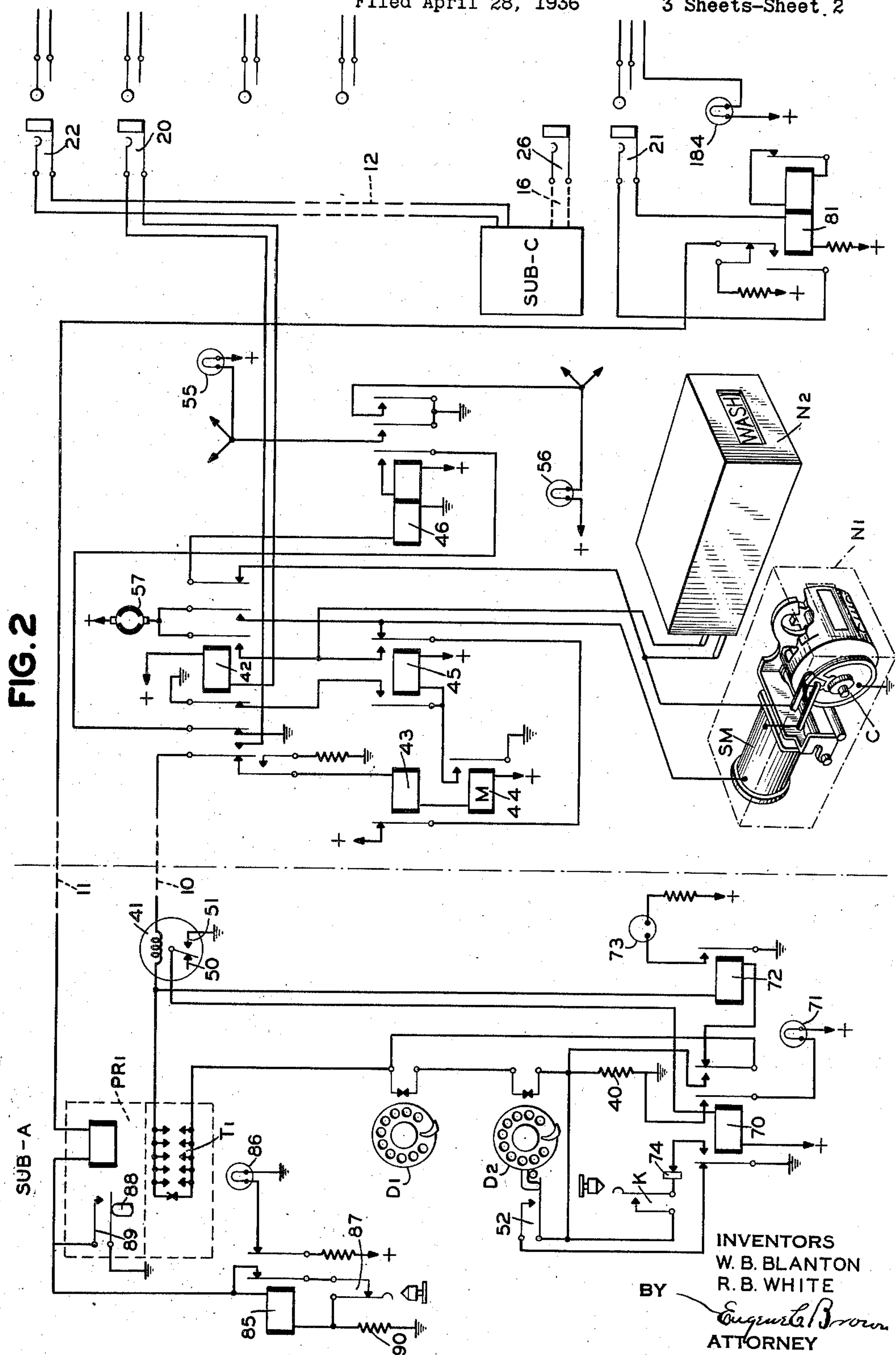
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TELEGRAPH EXCHANGE SYSTEM

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3 Sheets-Sheet 2



July 11, 1939.

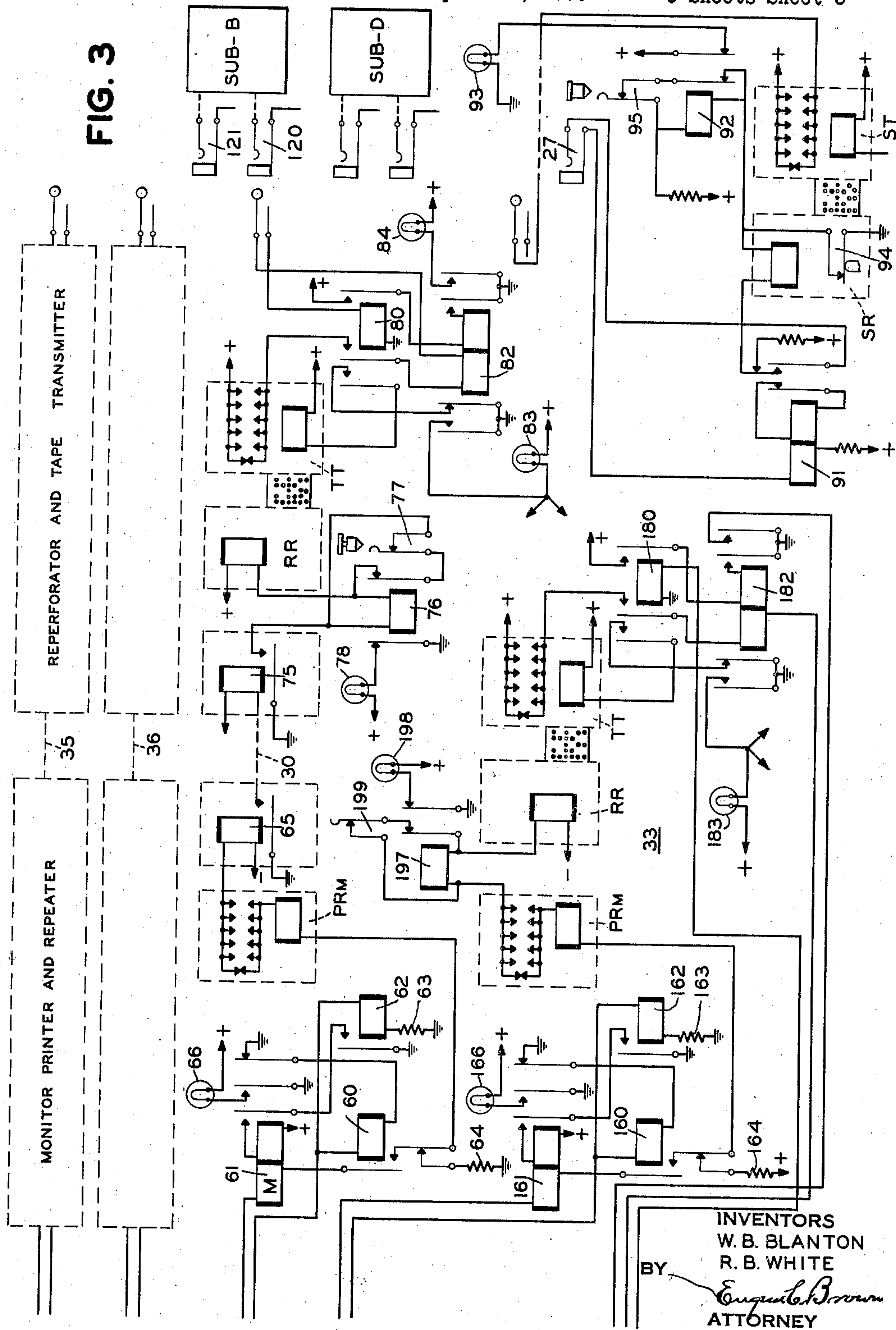
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TELEGRAPH EXCHANGE SYSTEM

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3 Sheets-Sheet 3



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TELEGRAPH EXCHANGE SYSTEM

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20 Claims. (Cl. 178--2)

This invention relates to telegraph exchange systems and more particularly to systems wherein a telegraph station may be connected to any one of a plurality of other stations representing subscribers or patrons of the telegraph company and to methods of inter-connecting and transmitting messages between the stations in systems of this character.

One object of the invention is to provide an improved system of the type wherein a subscriber or patron having a keyboard or similar transmitter and a printer may be connected to any one of a number of other subscribers for the rapid transmission of individual messages between such subscribers.

In prior systems of this character, a monitor printer was provided at the exchange. The calling subscriber initiates a call by operating a signal at the exchange. The operator or attendant at the exchange plugs the monitor equipment into the calling line and signals the calling subscriber, who transmits the name and address of the wanted subscriber to the attendant by means of his keyboard and the monitor printer at the exchange. The operator then secures the called subscriber and operates the printer at the calling station to notify the calling subscriber that connection has been extended to the called station. In the case of a call to a subscriber in a different city from that where the call originates, the name and address of the called subscriber was repeated to the operator in the distant city by means of a monitor printer at the remote exchange. A substantial time is required to signal the remote operator, obtain a response from the operator, transmit the name and address of the called subscriber, extend the connection to the called station and transmit the further response from the remote exchange to the local exchange and to the calling subscriber when the called station has been obtained. It is the object of the present invention to obviate this delay and expedite the transmission of messages, particularly on intercity calls, as well as to simplify the system and operating method in other particulars.

In accordance with the present invention, each subscriber's station is provided with selectively operable controlling equipment, such as dial impulse transmitting means, adapted to control an indicator at the local exchange to indicate the exchange (or city) where the called subscriber is located. In initiating a call from New York to a subscriber in Chicago, therefore, without waiting for a response from the exchange, the New York subscriber dials "Chicago" and thereby op-

erates an indicator at the local exchange and the word "Chicago" is displayed. The exchange operator thereupon connects an idle trunk to Chicago to the terminal of the calling subscriber's line whereupon a signal is operated at the calling subscriber's station to indicate that the circuit has been extended to Chicago. The receiving side of each intercity trunk terminates in signal storage apparatus for cumulatively storing the entire message or a part thereof so that the New York subscriber may commence immediately to transmit the message, preceded by the name and address of the called subscriber.

It will be apparent, therefore, that it is an object of the invention to provide a system wherein the transmission of the message may be begun and completed much sooner than in the prior system referred to above, the operation of the indicator and the connection to an idle trunk only requiring a few seconds. Even if the called subscriber's printer is in use, the message will be received and recorded in the exchange local to such subscriber without delay, and may be sent to the called station as soon as the printer is idle.

In the preferred embodiment of the invention, the signal storage unit connected to the receiving side of each intercity trunk comprises a combined printer and tape reperforator. As soon as the address portion of the message has been received, the operator connects a tape transmitter associated with the printer-reperforator to the called subscriber's printer, whereupon the message signals are repeated to the called subscriber's station. The calling subscriber upon the completion of the transmission of the message, operates a disconnect signal at the first exchange whereupon the operator disconnects the trunk and renders the same available for calls from other stations. A disconnect signal is also provided at the second exchange to apprise the operator at said exchange of the end of the message. Each station is preferably provided with separate sending and receiving terminals at the local exchange whereby a station while receiving may transmit to the station from which it is receiving a message or any other station.

Other features of the invention will become apparent from the following description of an embodiment thereof shown in the accompanying drawings, wherein:

Fig. 1 is a diagrammatic view of the general arrangement of the system, and

Figs. 2 and 3 are detailed circuit diagrams of the system shown in Fig. 1.

As shown in Fig. 1, the preferred embodiment

of the invention involves manual switching operations at the exchange or, in the case of calling and called subscribers in different cities, at both exchanges. In the drawings, two subscribers' stations A and B are shown. Printers PR1, PR2 and transmitters T1, T2 are provided, one at each station. One or more controlling devices is also provided at each station for controlling one or more selectively operable indicators at the exchange, there being an indicator or group of indicators individual to each line. At station A, controlling devices such as impulse dials D1 and D2 are shown for controlling step-by-step indicators N1 and N2 at the exchange. Similar dials D3 and D4 are provided at station B for controlling the indicators N3 and N4.

The transmitter T1 and printer P1 at station A are connected to the exchange by the lines 10 and 11 respectively. The line 10 terminates at the exchange in a jack 20 or equivalent manually operable selective switching apparatus for extending a call to a distant exchange through an intercity trunk or channel, such as the trunk 30, representing an idle trunk or channel to the remote exchange of the called subscriber, or for extending a call to a local subscriber through a link circuit 33. As shown, the sending side of each intercity trunk circuit and each link circuit includes a plug for insertion in the line jacks, and a monitor printer PRm. The line circuits to the transmitters at other subscribers' stations are indicated at 12, 13, 14 and 15. The intercity telegraph circuits may be derived in any known manner, i. e., a metallic circuit, a channel of a multiplex, a carrier channel, et cetera. Suitable repeater equipment is provided for repeating the signals from the keyboard transmitters over said circuits.

On the receiving side of each of the intercity trunks or channels, for example the trunk 31 terminating at the first exchange, and also the link circuit 33, is provided a receiving tape reperforator RR providing for cumulative storage of any desired part of the message and an associated tape transmitter TT which may be subsequently connected by selective switching apparatus to the printer at any of the local subscribers' stations to record the message previously stored at least in part at the exchange. As shown, the line 11 terminates in a jack 21 adapted to receive any one of a plurality of connector plugs connected to the contacts of the respective tape transmitter TT. Each of the receiving line circuits terminates in a similar jack, the line circuit 16 to a second subscriber's station terminating in a jack 26. In addition, a jack 27 provides access to a storage reperforator SR. In case a message is received for a subscriber whose printer is in use, the message may be stored in the storage reperforator SR by plugging the tape transmitter into the jack 27, thereby preventing the accumulation of messages for other subscribers on the tape behind the message for the busy printer. When the busy printer becomes idle, the tape transmitter ST associated with the reperforator SR may be plugged into the jack forming the terminal of said printer and the message signals transmitted to the printer in the same manner as in the case of signals stored by one of the receiving reperforators RR.

In the system shown in Fig. 1, the station B is connected to a second exchange, the equipment at the second exchange being similar to that at the first exchange. Trunks such as 30 and 31 connect the various exchanges in a complete sys-

tem to provide for the interconnection of any two subscribers. Each transmitter in the system is connected to the local exchange by a circuit such as is represented by the conductors 10 and 110 of transmitters T1 and T2, and each printer is connected to the exchange by a separate circuit such as is represented by the conductors 11 and 111 of printers P1 and P2. Each sending and receiving circuit terminates at the exchange in a separate jack, such as the jacks 20 and 120 of lines 10 and 110 and the jacks 21 and 121 of lines 11 and 111. Link circuits 133 are also provided at the second exchange corresponding to the link circuit 33. A storage reperforator may also be provided at the second exchange corresponding to the storage reperforator SR at the first exchange.

Assuming that the subscriber at station A desires to send a message to the subscriber at station B at another exchange, one of the indicators N1, N2 is operated to display the name of the city where the station B is located. This is effected by actuating one of the impulse dials D1 and D2. The dial D1 is arranged to control the indicator N1 and the dial D2, the other indicator. Each finger hole of the respective dials is allotted to a separate remote exchange, except that one finger hole may be designated "Operator" and used for signalling the local operator. Thus by the use of two standard impulse dials and two indicators separately controlled thereby, the subscriber may select any one of nineteen cities or exchanges by a single dialing operation. The number of cities in a larger system would require more dials, with means at the exchange to distinguish one dial from another, or dials having a larger range than ten impulses. If desired, two or more figure combinations may also be used to designate each city but the dialing operation is simplified if the selection is made by merely dialing once.

As soon as the dial D1 or D2 is operated, the name of the city or exchange wanted is displayed on the indicator N1 or N2. The exchange operator immediately selects an idle trunk or channel, such as the trunk 30, to the remote exchange and connects the terminals thereof to the line 10 extending to the calling subscriber's transmitter T1. The connection of the trunk 30 restores the indicator N1 or N2 to normal and operates a signal at station A to indicate that the subscriber may proceed to send the message.

The monitor printer PRm and the receiving reperforator RR on the receiving side of the trunk 30 respond to the message signals. At the end of the message, the calling subscriber appends an end-of-message signal to the message and actuates the key K. A disconnect signal is operated at the local exchange and the operator disconnects the trunk 30, rendering it available for messages from other subscribers.

The receiving reperforator RR is preferably a combined printer reperforator adapted to print the message characters and also store the message signals in a perforated tape so that the message can be repeated by a tape transmitter. As soon as sufficient of the message has been received at the second exchange to inform the operator there the name of the wanted subscriber B, the tape transmitter is connected to the line 111 extending to the printer PR2. Thus the message may be started to the called printer before the calling subscriber has completed it. The end-of-message signal functions to stop the transmitter TT and operate a disconnect signal associated

with the line 111 whereupon the operator pulls down the connection. While the system essentially provides one-way service, in that a calling subscriber is provided only with a transmitting connection to the called subscriber, the latter may immediately initiate a call to the station A, for example over the trunk 31, so that transmission may be carried on in both directions at the same time. On the other hand, a subscriber may transmit a message to another subscriber while receiving a message from a third subscriber. The system may also be arranged to connect subscribers at the same exchange through link circuits 33, 133, and to clear out the receiving repeforators in the case of a message for a busy printer, as described above. Other extensions and modifications of the system may be made without departing from the scope of the invention. Various types of signalling, transmitting and receiving apparatus, including signal storage and repeating apparatus familiar to those skilled in the art, may be substituted for the specific apparatus herein described for the purpose of explaining the invention.

Detailed description

Referring to Figs. 2 and 3, illustrating the detailed circuits of the system shown in outline in Fig. 1, in order to initiate a call, the subscriber at substation A (Fig. 2) operates the dial D1 or D2 controlling the indicators N1 and N2 at the local exchange. The operation of dial D1 opens the line circuit one or more times depending upon which finger hole is selected by the subscriber, the line circuit including a resistance 40, the interrupter contacts of dials D2 and D1, the normally closed rest contacts of transmitter T1, the winding of polar relay 41, line conductor 10 to the exchange, the left hand outer armature and back contact of relay 42, the winding of relay 43 and the winding of marginal relay 44. Relay 43 is normally energized by the current flowing in the line circuit and responds to the interruptions produced by the dial D1 but relay 44 is so adjusted that it does not operate on normal line current or until resistance 40 is shortcircuited as described hereinafter. Polar relay 41 is so adjusted that its armature remains in contact with the contact 50 as long as positive battery is connected to the line circuit at the exchange and when the line circuit is interrupted, its armature remains against the contact with which it happens to be in engagement.

Upon each interruption of the line circuit by the dial D1, relay 43 becomes momentarily de-energized and closes a circuit from battery through its armature and back contact, the right hand armature and back contact of relay 45, the stepping magnet SM of the indicator N1, the commutator C on the axis of the indicator cylinder, the outer right hand armature and back contact of relay 42 and the left hand winding of relay 46 to ground. The magnet SM is grounded at the commutator C after the indicator cylinder is actuated from its normal position but relay 46 remains locked up by the closure of a locking circuit from battery through its right hand winding, inner armature and front contact and the second left hand armature and back contact of relay 42 to ground.

The indicator cylinder of the indicator N1 is thus positioned in accordance with the number of impulses received by relay 43 in response to the operation of dial D1. The detailed construction of the indicator N1 shown is similar to that

disclosed in the application of M. L. Haselton, Ser. No. 423,599, filed January 27, 1930, patented August 4, 1936, No. 2,049,499, or in the patent to Ewart, No. 1,979,028 dated October 30, 1934. The specific operating and restoring mechanism of the indicator is fully disclosed and claimed in said prior patents and therefore need not be described in detail herein. Various forms of indicators adapted to be controlled by a remote controlling device might be substituted for that shown but the step-by-step indicator is simple and reliable, and presents certain advantages over other devices of a more complicated character.

The operation of dial D2 is arranged to control the indicator N2. This dial is provided with an off-normal switch 52 having contacts which are closed as soon as the dial is turned from the normal position, thereby closing a shunt circuit from the dial contacts to ground in shunt relation to the resistance 40. As soon as the dial D2 is operated therefore, the normal line current is increased and marginal relay 44 operates, thereby closing through its armature and front contact the circuit of relay 45. Relay 45 becomes energized and locks up through its left hand armature and front contact to ground at the left hand inner armature and back contact of relay 42. As the impulse relay 43 responds to the release of the dial D2, a circuit is closed through the right hand armature and front contact of relay 45 for stepping the indicator N2. The latter responds therefore to the operation of dial D2 in precisely the same manner as indicator N1 responds to the dial D1.

The indicators associated with the lines from the respective subscribers' transmitters may be grouped in various ways, as for example, in vertical tiers adjacent the answering jacks 20, 22. Calling signals, such as the lamps 55 and 56, are connected to the contacts of relay 46 to be operated when said relay becomes energized as described above. The lamp 55 is associated with the switchboard section containing the indicators N1 and N2 whereas the lamp 56 is arranged adjacent the particular row of indicators containing the indicators N1 and N2 to call the attention of the operator to the location of the call that has been received. As indicated, the circuit of lamp 55 is multiplied to all of the relays 46 individual to the lines of a particular switchboard section and the circuit of lamp 56 to the relays 46 individual to the lines terminating in one row or group of said section.

The operator at the exchange notes the city to which the call should be extended and plugs a trunk or channel to said city into the jack 20 forming the terminal of the calling line. In Fig. 3 three intercity trunks 30, 35 and 36 are shown, the apparatus associated with the trunk 30 being shown in detail. Assuming that the trunk 30 is connected to the calling line as described above, upon the insertion of the associated plug into the jack 20 a circuit is closed from battery through the winding of relay 42, the sleeve contact of the plug and the jack 20, the winding of relay 60 and the outer armature and back contact of relay 61 to ground whereupon relays 42 and 60 become energized. The winding of a relay 62 is in parallel with the winding of relay 60 and although the current through said parallel winding is small because of the high resistance thereof or of a resistance 63 in series therewith, relay 62 also becomes energized.

The energization of relay 60 as described above disconnects resistance 64 and ground from the

circuit through the monitor printer PR_m and the repeater relay 65 and closes a circuit from negative battery through the winding of the last mentioned relay, the normally closed rest contacts and the operating magnet of printer PR_m , the contacts of relay 60, the left hand winding of relay 61, the tip contacts of the plug and jack 20, the left hand outer armature and front contact of relay 42 and the line circuit 10 whereupon the armature of polar relay 41 is actuated into engagement with contact 51 as a result of the reversal of the polarity of the line circuit. The marginal relay 61 is so adjusted that it does not operate on normal line current and therefore it does not operate upon the closure of the above described circuit.

The energization of relay 42 disconnects the impulse relay 43 from the line circuit 10 but the latter is maintained energized through a holding circuit including make-before-brake contacts associated with the left hand outer armature of relay 42. The energization of relay 42 also interrupts at its second left hand armature and back contact the locking circuit of relay 46 whereupon this relay becomes deenergized and the calling lamps 55 and 56 are extinguished unless another call is waiting in the same section and row of switchboard indicators. The energization of relay 42 further opens the locking circuit of relay 45 and closes a circuit from battery through the rotary interrupter 57 to the stepping magnet SM of the indicator N1 or N2 which was operated by the subscriber at station A, the other terminal of the stepping magnet being grounded at the commutator C except in the normal position of the indicator cylinder, whereupon the indicator is restored to normal or the position in which a blank is exposed through the indicator window.

The operation of polar relay 41 as described above closes the circuit of relay 70, whereupon this relay becomes energized and closes a circuit through its right hand inner armature and front contact for lighting the lamp 71. The lighting of this lamp indicates to the calling subscriber that he has obtained a trunk to the wanted exchange and may proceed with the message. At its outer or right hand armature, relay 70 opens the circuit of relay 72 and closes a circuit in shunt relation to the interrupter contacts of the dials D1 and D2; at the same time the ground connection to the off-normal switch 52 of dial D2 is opened at the left hand armature and back contact of relay 70. Therefore, further operation of either of the dials D1 or D2, accidental or otherwise, does not affect the line circuit.

Before relay 70 is operated, relay 72 is connected across the transmitting contacts of the transmitter T1 and is shortcircuited by the normally closed rest contacts of the transmitter. If the subscriber should attempt to send before being connected to a trunk, however, relay 72 becomes energized and closes the circuit of a bell or buzzer 73 to indicate the improper operation of the apparatus. This feature is particularly advantageous where "blind sending" is used; i. e., where as in the system shown the local printer PR1 is not arranged to make a copy of the message sent by transmitter T1.

The permutation code signals from the transmitting contacts of the transmitter T1 pass over the line circuit already described to the repeater relay 65 which responds to the signals and repeats the same over the trunk 30 terminating in a second repeater 75. It will be apparent that any type of repeater equipment and any type of

trunk or channel desired may be utilized for transmitting the signals. The operating magnet of a reperforator RR or other suitable storage unit is connected to the repeater 75. The stored signals are repeated to the printer at the called station B after connection has been made there-to by the tape transmitter TT. The transmitter T1 and printer PR1 at each subscriber's station may be a Tape Teletype (Model 14) described in Bulletin No. 126 of the Morkrum-Kleinschmidt Corporation. The monitor printer associated with each trunk repeater may also be a printer of this type. The storage unit RR is preferably a combined printer-reperforator similar to that shown in the patent to Rothermel, No. 1,936,956, dated November 28, 1933, or that shown in the copending application of Robert F. Dirkes and Evan R. Wheeler, Ser. No. 42,692, filed September 28, 1935. These combined printers and reperforators print the message characters received and also perforate a tape in such manner that when the tape is passed through the associated tape transmitter, the message signals will be repeated. Each reperforator may be provided with mechanism similar to that shown in the patent to Dirkes and Kimball, No. 1,931,790 dated October 24, 1933, for advancing a predetermined length of tape therethrough at the end of each message group of signals. The tape transmitters TT may be of the type shown in the patent to Benjamin, No. 1,298,440 dated March 25, 1919. Obviously, the invention is not limited to these types of transmitting, storing, repeating and printing apparatus.

A normally energized relay 76 has the winding thereof connected in series relation with the operating magnet of the reperforator RR. When the subscriber at station A starts to transmit over the trunk 30, the spacing signal deenergizes relay 76 whereupon the winding of said relay is shortcircuited through its right hand armature and back contact and the contacts of key 77 and the relay remains deenergized while the message signals are recorded by the reperforator RR. At its left hand armature and back contacts, relay 76 closes the circuit of a signal lamp 78 to indicate to the switching operator that there is an incoming message requiring attention.

The calling subscriber at station A ends the message with an end-of-message signal, for example "figures shift, upper case J and letters shift", and then actuates key K. The closure of the contacts of key K closes a circuit in shunt to the resistance 40, said circuit including the left hand armature and front contact of relay 70 and a unidirectional current conducting device 74 which is poled to pass current when negative battery is connected to the line circuit at the exchange. The resulting increase in line current operates the marginal relay 61 whereupon said relay becomes locked up through a circuit including its right hand winding, inner armature and front contact and the armature and front contact of relay 62. The energization of relay 61 lights the disconnect lamp 66 and interrupts the circuit of relay 60 but relay 62 remains energized in series with relay 42 until the answering plug is removed from the jack 20. When the plug is removed from the jack, relays 61 and 62 becomes deenergized and the lamp 66 is extinguished. Even before the plug is withdrawn from the jack 20, however, relay 42 becomes deenergized at the moment that relay 61 becomes energized since the combined resistance of relay 62 and resistance 63 reduces the current traversing relay 42 to such

a low value that it is insufficient to hold the armatures or relay 42. It is therefore possible for the subscriber at station A to operate the indicator N1 or N2 to initiate a second call before the answering plug has been withdrawn from the jack 20. If the subscriber is still holding the key K closed when the relay 42 becomes deenergized, a circuit which includes the unidirectional current conducting device 74 is still established in shunt relation to the resistance 40. However, by reason of the unidirectional conducting characteristic of the device 74 practically all of the line current from the battery in series with relay 44 will flow through the resistance 40 and the line current will be substantially normal. Thus the accidental operation of marginal relay 44 by the key K is prevented.

Upon the reversal of the polarity of the line circuit as a result of the deenergization of relay 42 at the end of the message, the armature of polar relay 41 is moved against contact 50, thereby opening the circuit of relay 70 and extinguishing the lamp 71. Thus the operation of key K lights the disconnect lamp 66, extinguishes the lamp 71 and restores the exchange equipment associated with the indicators N1 and N2 to normal and restores the trunk repeater to normal. The lamp 66 is extinguished upon withdrawing the plug from the jack 20.

In the second exchange, the switching operator in response to the lighting of the lamp 78 plugs the tape transmitter TT into the jack 121 forming the terminal of the called station B, the name or code number of the called station being recorded by the reperforator RR in advance of the message. The circuits associated with the sending and receiving jacks 120 and 121 of the station B are the same as those associated with the corresponding sending and receiving jacks 20 and 21, respectively, of the station A. The transmission of the message to the called station may be commenced before the entire message has been recorded by the reperforator RR. After the transmission of the message over the trunk 30 has been completed, the operator may actuate the key 77, thereby extinguishing the lamp 78 until another message is received over the trunk 30.

When the tape transmitter TT is plugged into the jack 121 to repeat the message to the printer at the called station, relay 80 becomes energized through the sleeve contacts of jack 121 in series with a slow-to-pull-up relay corresponding to relay 81 (Fig. 2). The energization of relay 80 closes the transmitting circuit of the transmitter TT, said circuit including the transmitting contacts of said transmitter, the inner left hand armature and front contact of relay 80, the left hand winding of marginal relay 82, the tip contacts of the plug and jack 121 and the armature of the relay corresponding to relay 81. The last-mentioned relay is provided with make-before-break contacts normally maintaining the circuit of the printer magnet at station B closed, and by reason of the slightly slow to operate characteristic of said relay, the connection of the tape transmitter TT to the receiving printer is effected without any interruption in the line current. This prevents the printer at station B from printing a false character as connection is made to the tape transmitter. Relay 82 does not attract its armatures as it is so adjusted that it will not operate on normal line current.

The energization of relay 80 also closes a circuit through its outer left hand armature and front contact and the left hand inner armature and

back contact of relay 82 for energizing the clutch magnet of the tape transmitter TT whereupon the latter is rendered operative to repeat the message signals to the printer at station B. The first spacing signal sent over the line causes normally energized relay 85 to become deenergized, thereby lighting the call lamp 86 at the called station. Since relay 85 is shortcircuited by its inner armature and back contact, the relay remains deenergized until the message is completed when the relay may be reset and the lamp 86 extinguished by actuating the key 87.

The end-of-message signal consisting of "figures shift, upper case J and letters shift" causes the member 88 connected to the upper case J pull bar of the printer to be operated to close the contacts 89, thereby shortcircuiting the winding of relay 85 and the resistance 90 in the line circuit and causing a momentary increase in line current. Marginal relay 82 responds to this increase in line current and becomes locked up through its right hand inner armature and front contact, its right hand winding and the right hand armature and front contact of relay 80. The energization of relay 82 opens at its inner left hand armature and back contact the circuit of the clutch magnet of the tape transmitter TT, thereby stopping the transmitter. The energization of relay 82 further lights a disconnect lamp 83 common to all the cord circuits and a lamp 84 individual to the cord in use to indicate that transmission of the message has been completed and the connection should be pulled down.

Upon noting the disconnect signal, the operator withdraws the plug inserted in the jack 121, whereupon relays 80 and 81 become deenergized. Upon the deenergization of relay 80 the locking circuit of relay 82 is broken and said relay also becomes deenergized and extinguishes the lamps 83 and 84, unless lamp 83 is energized from another of the cord circuits. The control relays associated with the tape transmitter TT are now restored to normal and the transmitter remains inoperative, even though another message or messages may be stored on the tape from the reperforator RR, until the transmitter is plugged into the receiving jack of another subscriber's station.

During or after the transmission of the message to the station B, the subscriber at that station may transmit a message to station A or to any other station in the system. Every subscriber's station is provided with sending and receiving jacks corresponding to the jacks 20 and 21 at station A and 120 and 121 at station B, as indicated in the case of station C (Fig. 2) and station D (Fig. 3). A sufficient number of interoffice trunks or channels are provided between each exchange in the system to take care of the maximum number of calls between the respective exchanges under all conditions. The equipment provided in connection with each trunk may be similar to that shown in connection with trunk 30, as indicated diagrammatically in connection with the trunks 35 and 36.

In case the printer at the called station is busy, the connection of the tape transmitter to the printer as described is delayed until the previous message has been completed, which ordinarily requires only a short time. Occasionally a printer at one of the stations may be tied up for a considerable period and thus cause the accumulation of additional messages on the tape between the reperforator RR and the tape transmitter TT.

In order to clear out the tape transmitter, it may be plugged into the jack 27 providing access to a storage reperforator SR having an associated tape transmitter ST adapted to repeat the stored message when the called subscriber's printer becomes idle.

When the tape transmitter TT is plugged into the jack 27, a circuit is closed through the winding of relay 80, the sleeve contacts of the plug and jack 27 and the left hand winding of relay 91 whereupon relays 80 and 91 become energized. The energization of relay 80 renders the tape transmitter TT operative as described above, and relay 91 corresponding to relay 81, Fig. 2, connects the operating magnet of the storage reperforator in series relation with the transmitting contacts of the tape transmitter through the tip circuit of the plug and jack 27. The make-before-break contacts of relay 91 and the slightly slow-to-operate characteristic of this relay transfer the circuit of the reperforator magnet without a break thereby avoiding the printing of a false character. Upon the transmission of the first spacing signal, the normally energized relay 92 becomes deenergized, closing through its inner armature and back contact a short circuit around its winding and through its outer armature and back contact the circuit of a signal lamp 93. The lighting of the lamp 93 indicates that a message is recorded on the storage reperforator. When the printer at the called station becomes idle, the operator plugs the transmitter ST into the receiving jack of the called station whereupon the message is repeated to the called station in the same manner as described above in connection with relaying messages from the reperforator RR. If more than one message is stored on the tape between the reperforator SR and the tape transmitter ST, the operation of the latter is stopped at the end of each message by the closure of the contacts 89 at the called station printer upon receipt of the end-of-message signal as described above. Likewise, the reperforator SR is provided with bell bar contacts 94 responsive to the end-of-message signal for automatically stopping the connected tape transmitter at the end of a message. When the last message on the tape between the storage reperforator SR and the associated tape transmitter ST is being transmitted, the operator actuates the key 95 to open the shortcircuit around the winding of relay 92 thereby extinguishing the lamp 93 until another message is received on the storage reperforator.

Where the wanted station, for example station C, is at the same exchange as the calling station A, the transmitter at station A is connected to the printer at station C through a link circuit 33 having an answering plug adapted to be inserted in the sending jack 20 and a calling plug adapted to be inserted in the receiving jack 26. The link circuit 33, as shown in Fig. 3, may be provided with a monitor printer PR_m similar to those associated with the interoffice trunks and with a reperforator RR and tape transmitter TT similar to the reperforator and tape transmitter associated with the receiving sides of the interoffice trunks. The control circuits of each link circuit 33 are similar to those of the interoffice trunks except that no trunk repeaters are required and the corresponding elements of the system are designated by the same reference characters with the prefix 100. The storage and repeating of message characters is effected in the same manner as described above in connection

with the transmission of messages over interoffice trunks and need not be described in detail. Since the monitor printer PR_m may be located at a receiving switchboard or position and the storage and repeating equipment at a separate sending switchboard or position, a normally energized relay 197 may be connected in series relation between the printer and the reperforator to light a signal lamp 198 at the sending position when a message is received on the reperforator. Upon the occurrence of the first spacing signal, relay 197 becomes deenergized, thereby closing a shortcircuit through a key 199 around its own winding and a circuit through the lamp 198. When the recording of the message has been completed, the lamp 198 may be extinguished by actuating the key 199.

A number of link circuits 33 are provided at each exchange sufficient to accommodate the local traffic. The monitor printers PR_m on the respective link and trunk circuits make a copy of each message sent through the exchange. The printers are preferably provided with a keyboard, as indicated, to permit an operator at any exchange to correspond with any subscriber in the system.

The foregoing detailed description of the preferred embodiment of the invention shown on the accompanying drawings is for the purpose of explaining the invention and various changes may be made in the system and in the types and arrangement of apparatus employed without departing from the scope of the invention as defined in the appended claims. Thus, instead of permutation code transmitters and printers, other types of telegraph transmitting and receiving apparatus may be utilized, including facsimile sending and receiving units.

What we claim is:

1. In a multi-office telegraph exchange system, the method of communication between two stations at separate exchanges which comprises signaling the designation of the wanted exchange independently of the telegraph receiving instruments in the system, connecting a trunk to the calling station, cumulatively storing the message transmitted over said trunk at the exchange of the called station and repeating the message to the printer at the called station after storage of a considerable portion of the message has been effected.

2. In a telegraph exchange system comprising a plurality of exchanges and a plurality of subscribers' stations connected to each of the exchanges, each station including a telegraph transmitter and a printer, the method of operation which comprises operating a signal at one exchange from a local calling station to display the exchange designation of the wanted station, connecting a trunk to the latter exchange to said calling station, immediately commencing the transmission of message signals over said trunk and subsequently repeating said signals to the printer at the wanted station.

3. In a telegraph exchange system comprising a plurality of exchanges and a plurality of subscribers' stations connected to each of the exchanges, each station including a telegraph transmitter and a printer and each exchange being connected to each of the other exchanges by trunks or channels having multiple-character signal storage and repeating apparatus associated with the receiving sides of said trunks or channels, the method of operation which comprises connecting to the calling station a trunk or chan-

nel to the called exchange in response to a call, cumulatively storing the character signals at the the latter exchange as they are transmitted over said trunk and subsequently repeating said signals to the printer at the wanted station after a number of characters have been stored.

4. The method as set forth in claim 3 in which a message destined for a busy station printer is stored a second time in order to clear out the storage apparatus associated with the trunk.

5. In a telegraph exchange system, an exchange, a plurality of subscribers' stations, an indicator at said exchange individual to each subscriber's station, said indicator being adapted to provide a plurality of distinctive indications and means for operating said indicators from the respective calling stations in accordance with the designation or grouping of a called station.

6. In a telegraph exchange system, an exchange, a plurality of subscribers' stations, an indicator at said exchange individual to each subscriber's station, said indicator being adapted to provide a plurality of indications corresponding to groups of interoffice trunks terminating at said exchange, means for operating said indicators from the respective stations in accordance with the interoffice trunk desired and signal storage means on the receiving end of each trunk.

7. In a telegraph exchange system, two exchanges, subscriber's stations, a group of trunks connecting said exchanges, the receiving sides of each of said trunks being provided with signal storage and repeating apparatus, trunk or exchange indicating means at one exchange, means for operating said indicating means from one of said subscriber's stations, means for connecting a trunk to the called exchange to the said one of said subscriber's stations and means at the called exchange for connecting the repeating apparatus associated with said trunk to the called subscriber's station.

8. In a telegraph exchange system, a plurality of exchanges, subscriber's stations individual to each exchange, a plurality of trunk or exchange indicating units for each station at the local exchange, means at each subscriber's station for selectively operating one of the trunk or exchange indicating units individual thereto in accordance with the designation of the wanted trunk or exchange and means associated with the receiving side of a connected trunk for extending the connection to a called station.

9. In a telegraph exchange system, a plurality of exchanges, subscriber's stations adjacent each exchange, a telegraph printer and transmitter at each station, a rotary step-by-step indicator for each station at the local exchange, controlling means for said indicators at each subscriber's station and means at the exchanges for switching calls in accordance with the operation of said indicators.

10. In a telegraph exchange system, a plurality of subscriber's stations having transmitting, receiving and impulse-dial controlling apparatus, an exchange, line circuits connecting said apparatus at the subscriber's stations to said exchange, indicators at the exchange, means including said controlling apparatus for selectively actuating said indicators as calls are initiated through the exchange and means for thereafter rendering the indicators non-responsive to the controlling apparatus.

11. In a telegraph exchange system, a plurality of subscriber's stations having transmitting, receiving and impulse-dial controlling apparatus,

an exchange, line circuits connecting said apparatus at the subscriber's stations to said exchange, trunk-indicating means at the exchange controlled by said controlling apparatus and means at each station for indicating that the station transmitter has been connected to a wanted trunk at the exchange.

12. In a telegraph exchange system, a plurality of subscriber's stations having transmitting, receiving and impulse-dial controlling apparatus, an exchange, line circuits connecting said apparatus at the subscriber's stations to said exchange, trunk-indicating means at the exchange controlled by said controlling apparatus and means at each station for indicating that the station transmitter has been connected to a wanted trunk at the exchange and that the station printer has been seized for the recording of a message from another station.

13. In a telegraph exchange system, a plurality of subscriber's stations having transmitting, receiving and impulse-dial controlling apparatus, an exchange, line circuits connecting said apparatus at the subscriber's stations to said exchange, trunk-indicating means at the exchange controlled by said controlling apparatus, means at the exchange for connecting said line circuits to other trunks and circuits, an alarm at each station and means for operating said alarm if the transmitter at a calling station is operated before connection is made to a circuit or trunk at the exchange.

14. In a telegraph exchange system, a plurality of subscriber's stations having transmitting, receiving and impulse-dial controlling apparatus, an exchange, line circuits connecting said apparatus at the subscriber's stations to said exchange, said transmitting and impulse-dial controlling apparatus at each of said stations being connected to a single line circuit, trunk indicating means at said exchange controlled by said impulse-dial controlling apparatus, trunks terminating at said exchange, means for connecting any of said trunks to any of the line circuits from said stations, means including said transmitting apparatus at a calling station for transmitting message signals over said trunks, a disconnect signal at said exchange and means for operating said disconnect signal from the calling station over the transmitting and indicator-controlling line circuit to the exchange.

15. In a telegraph exchange system, a plurality of subscriber's stations having transmitting, receiving and selective controlling apparatus, an exchange, line circuits connecting said apparatus at the subscriber's stations to said exchange, trunk-indicating means at said exchange controlled by said selective controlling apparatus, a second exchange, trunks connecting said exchanges, means for connecting any of said trunks to any of the line circuits from said stations at the first-mentioned exchange, means including said transmitting apparatus at one of said stations for transmitting message signals over said trunks, means for repeating signals from the second exchange to a called station, a disconnect signal associated with said repeating means at the second exchange and means for operating said disconnect signal from the first exchange.

16. In a telegraph exchange system, a plurality of subscriber's stations having transmitting, receiving and selective controlling apparatus, an exchange, line circuits connecting said apparatus at the subscriber's stations to said exchange, trunk-indicating means at said exchange con-

trolled by said selective controlling apparatus, a second exchange, trunks connecting said exchanges, means for connecting any of said trunks to any of the line circuits from said stations at the first-mentioned exchange, means including
 5 said transmitting apparatus at one of said stations for transmitting message signals over said trunks, means for repeating signals from the second exchange to a called station, a disconnect
 10 signal associated with said repeating means at the second exchange and means for operating said signal in response to an end-of-message signal transmitted from the first exchange.

17. In a telegraph exchange system, a plurality
 15 of subscriber's stations having transmitting, receiving and selective controlling apparatus, an exchange, line circuits connecting said apparatus at the subscriber's stations to said exchange, trunk-indicating means at said exchange controlled by said selective controlling apparatus
 20 over said line circuits, interoffice trunks terminating at said exchange, means for connecting said line circuits to said trunks and means for restoring the trunk-indicating means to normal upon the connection of an associated line circuit
 25 to a trunk.

18. In a telegraph exchange system, a plurality of subscriber's stations having transmitting, receiving and selective controlling apparatus, an
 30 exchange, line circuits connecting said apparatus at the subscriber's stations to said exchange, interoffice trunks terminating at said exchange, trunk-indicating means at said exchange controlled by said selective controlling apparatus,
 35 means associated with said trunks for storing message signals transmitted thereover, additional

storage means common to a plurality of trunks for storing message signals destined for a busy station and means for repeating the message signals stored in said additional storage means when the wanted station is available. 5

19. In a multioffice telegraph exchange system having interoffice trunks connecting the offices or exchanges and circuits connecting transmitting and receiving stations to said offices, the method of communication between two stations at separate exchanges or offices which comprises signaling the designation of the wanted office over the circuit from the calling station to its exchange, connecting a trunk extending to the exchange of the called station to said calling station, transmitting character signals over said circuit and trunk from the calling station to the exchange of the called station, cumulatively storing a plurality of character signals transmitted over said trunk at the exchange of the
 20 called station and thereafter repeating the character signals to the called station. 15

20. In a telegraph exchange system, a plurality of exchanges, subscriber's stations individual to each exchange, transmission circuits connecting
 25 each of said stations to its exchange, means at the exchange individual to each station for indicating a wanted trunk terminating at the exchange, means including said transmission circuits for controlling said trunk indicating means
 30 and means for transmitting character code signals over the same circuits from a calling station and to a called station. 20

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