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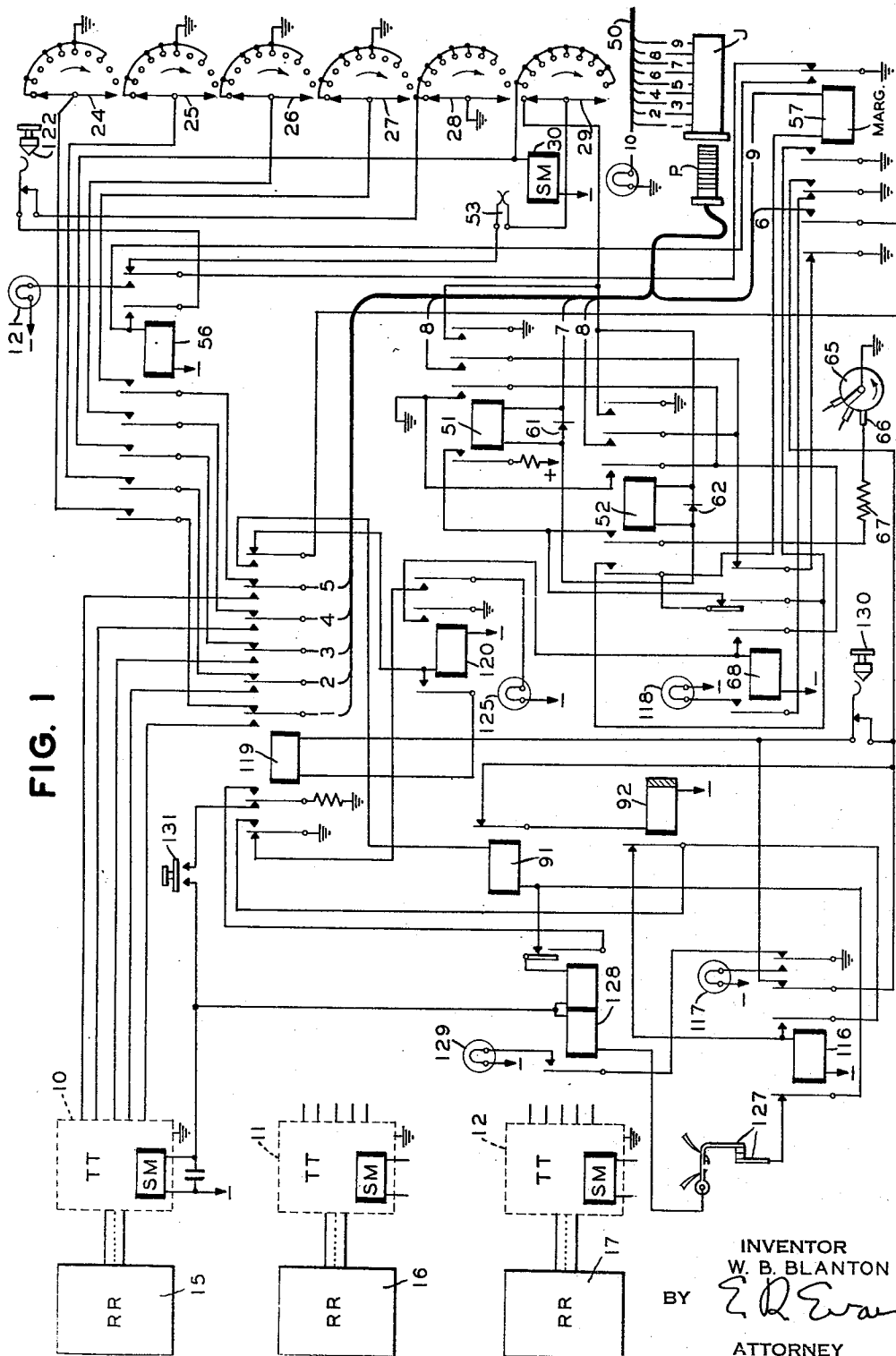
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2,293,704

TELEGRAPH REPEATER SYSTEM

Filed Oct. 18, 1939

2 Sheets-Sheet 1



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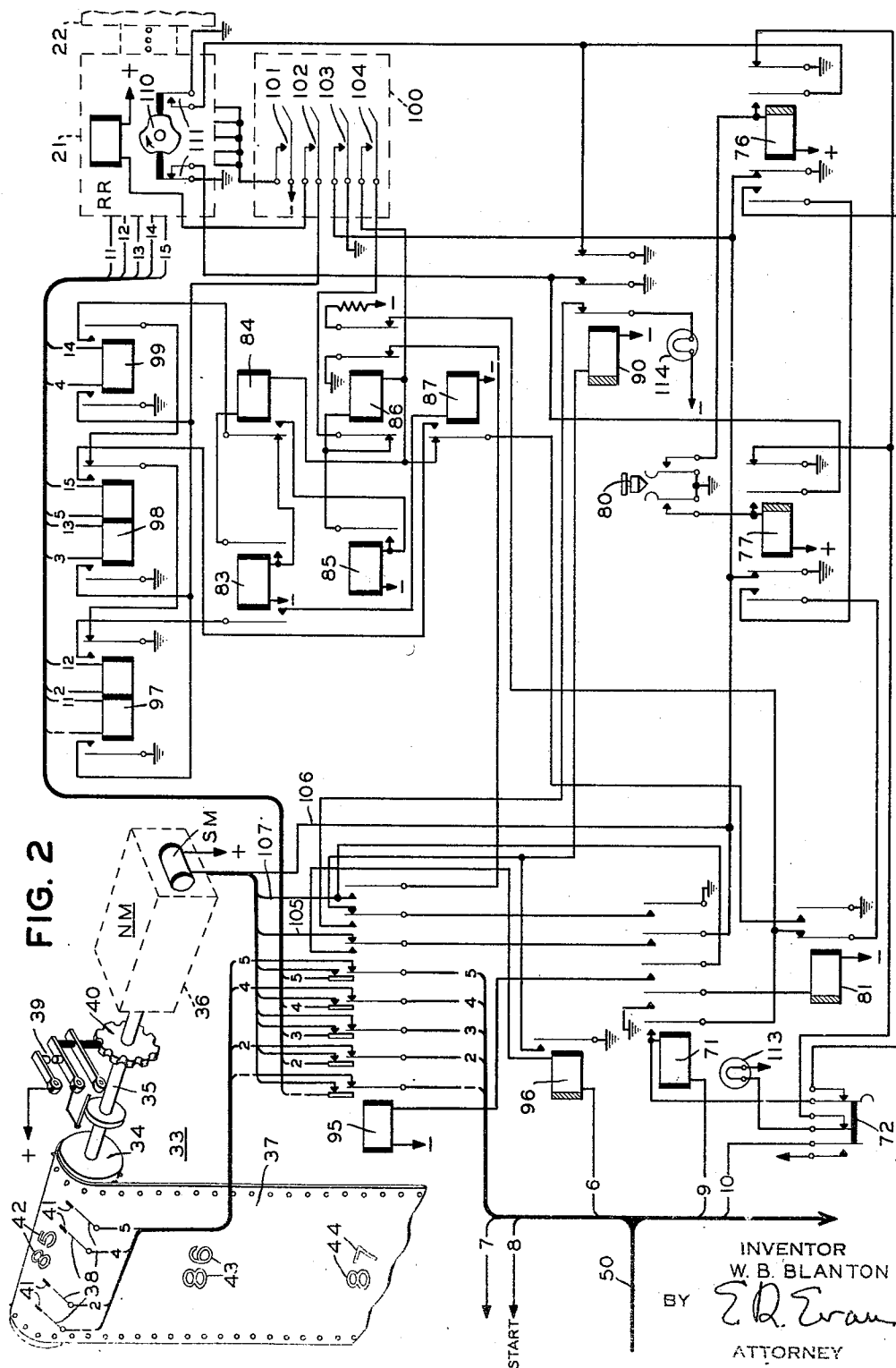
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2 Sheets-Sheet 2



UNITED STATES PATENT OFFICE

2,293,704

TELEGRAPH REPEATER SYSTEM

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Application October 18, 1939, Serial No. 299,981

14 Claims. (Cl. 178—3)

This invention relates to telegraph repeater systems and more particularly to arrangements for checking the operation of and guarding against trouble in such systems.

In telegraph exchange systems wherein signals are repeated through a manual switchboard or machine switching apparatus arranged to interconnect receiving and sending positions associated with incoming and outgoing lines, respectively, the switching apparatus provides a temporary connection between any of the receiving positions and any of the sending positions. While this connection is established a message may be repeated from any receiving position to any sending position for transmission over the desired outgoing channel or line. It may happen occasionally because of failure of the telegraph repeating apparatus or trouble in the intraoffice connection, that a message is not received at a sending position or is received in a mutilated condition, perhaps with the address portion of the message rendered undecipherable. This difficulty is of great importance even through its occurrence is infrequent because of the possibility of losing or garbling a message. Since the intraoffice connection may have been broken down before the difficulty is discovered and the record obtained may not indicate the origin of the message, it is often a difficult matter to trace the original message in order to retransmit the same.

In certain cases of failure of apparatus at the sending position, it is possible to detect the failure and stop the repeating apparatus at the receiving position automatically. In the preferred system for example, messages are stored at the sending positions in tape by means of tape perforators, the tape being fed into an associated tape transmitter connected to the outgoing channel or line. A minor failure of the perforator, such as would result from the feed holes in the tape tearing out, would cause the perforator to become temporarily inoperative, and heretofore means has been provided for detecting this condition. Upon the occurrence of such a condition at a sending position it is necessary to stop transmission from the receiving position through the switchboard or machine switching equipment to the defective or inoperative storage unit. Furthermore, after the apparatus has been adjusted properly at the sending position it would be desirable to provide independent controls at both sending and receiving positions for restarting the transmission to the sending position, both of which must be operated to recom-

mence operation. Thus the circuit equipment at both receiving and sending positions must be properly conditioned in order to resume service.

An object of the invention is to provide a telegraph exchange system embodying means for determining or recording the identity of the signal sources or receiving positions connected at various times to the sending positions through the switchboard or machine switching equipment.

A further object of the invention is to provide in a system of this character means for numbering the successive messages over any outgoing circuit and means operatively associated with the numbering means for indicating and/or recording at the sending positions in the exchange the receiving position at which each message originated.

A still further object of the invention is to provide an improved system for guarding against the loss or only partial transmission of messages.

For a better understanding of the invention reference may be had to the accompanying drawings illustrating a preferred embodiment thereof and in which

Fig. 1 is a diagram of the control circuits at a receiving position in a telegraph exchange, and

Fig. 2 is a diagram of the control circuits at the sending position of a line or channel which has been selected at the switchboard.

In accordance with the system shown for purposes of illustration, a switchboard is provided for extending calls received from branch offices for example to selected outgoing lines or channels in order that messages may be repeated over such lines or channels without manual relay. The received messages may be stored at a receiving position and switched by an operator or attendant at the exchange to the desired outgoing circuit or channel, in substantially the same manner as shown in my copending application, Ser. No. 299,408, filed October 14, 1939 or in the patent to Wheeler et al. No. 2,193,810, granted March 19, 1940. In a system of this character, in the case of apparatus troubles in the exchange it is difficult to trace an occasional message which is lost or mutilated during intraoffice transmission after the connection is pulled down at the switchboard. Accordingly a code transmitter or equivalent device is provided for each cord circuit at the receiving position and a supervisory recorder arranged at the sending position for recording the identity of each of the receiving positions from which the successive messages originate as they are repeated through the

switchboard to the sending positions. This facilitates the tracing of lost or mutilated messages after the switchboard connections are pulled down. Preferably the messages sent over each outgoing line or channel are given successive numbers by an automatic numbering machine at each sending position, and the code circuit designations or records are combined with the numbers of the respective messages so that a record is made of the origin and number of each successive message at each sending position.

In accordance with a further feature of the invention, mechanism is provided in connection with the repeater equipment for automatically stopping transmission through the switchboard upon failure of said equipment to function properly, and after the faulty apparatus has been repaired or replaced, the system is preferably so arranged that operation cannot be restarted at either the receiving or sending position alone but only after keys or equivalent means at both of said positions have been operated to insure that the equipment at both positions is in readiness to start.

Referring to the drawings, a telegraph repeater system is shown for purposes of illustration which is similar to a part of the telegraph exchange system disclosed in my copending application, above referred to or in general to that disclosed in the above mentioned patent to Wheeler et al. The systems disclosed therein relate to the repeating of signals from any of a plurality of incoming lines or receiving positions to any of a plurality of outgoing lines or sending positions through a manual switchboard.

In Fig. 1, a plurality of tape transmitters 10, 11 and 12 are shown representing a plurality of sources of signals of any suitable character. These sources of signals may be any type of telegraph transmitting apparatus at three receiving positions and in the case of tape transmitters, the perforated tape for the same may be obtained from local perforators or from reperforators 15, 16 and 17 controlled by signals received from telegraph patrons or branch offices of the telegraph system.

While automatic switching apparatus may be employed, in the arrangement shown each tape transmitter has connected thereto a cord circuit terminating in a plug adapted to be inserted in a switchboard jack. Only the cord circuit and plug P of the first tape transmitter 10 is illustrated as the cord circuit and plug of each other transmitter may be identical with that shown. Likewise only a single switchboard jack J is shown, although in practice the switchboard embodies a plurality of jacks providing access to a plurality of sending positions as explained in my copending application. In Fig. 2 the reperforator 21 and associated tape transmitter 22 represent one sending position for repeating signals over an outgoing line or channel.

In accordance with the principal feature of the invention, a position code transmitter is provided in connection with each receiving position. This auxiliary code transmitter is shown in Fig. 1 as a step-by-step switch comprising the six switch wipers 24 to 29 and a stepping magnet 30. The operation of this auxiliary transmitter is initiated automatically whenever plug P is inserted in a jack in the switchboard and controls an electrical recording mechanism 33 associated with the selected sending position, a similar supervisory recording mechanism being provided for each sending position. It will be

understood that the position code transmitter associated with each cord circuit is adapted to send different code signals by strapping the bank contacts in various ways so that the record produced by the recording mechanism identifies the signal source or receiving position which is connected through the switchboard to the selected sending position at any particular time.

The recording mechanism in general comprises a drum 34 connected to the shaft 35 of a numbering machine 36 associated with the sending position shown, said drum carrying a sheet of record paper 37 adapted to be electrically marked by potentials applied to the points or styli 38 engaging the record paper. Recording paper adapted to be employed in the recording mechanism which is marked by the passage of an electrical current is well known in the art and suitable recording paper is described in the patent to Milnor et al., No. 1,775,687, dated September 16, 1930, or in British Patent No. 494,143, dated October 18, 1938, assigned to The Western Union Telegraph Company.

The numbering machine 36 is a code transmitter adapted to append code signals to each message sent from the local sending position, and may be of the type shown in the patent to Dirkes et al., No. 2,193,809, dated March 19, 1940. Accordingly, this numbering machine or automatic transmitter is not shown in detail, it being sufficient for the purposes of the present explanation to point out that the cyclic operation of the numbering machine is initiated immediately after connection is made at the switchboard to the associated sending position, whereupon the shaft 35 would make one complete revolution. This causes the contacts 39 to be closed ten times by the rotating cam 40 to connect battery intermittently to the drum 34. During this time certain of the marking elements 38 of the recording mechanism will be grounded by the position code transmitter and by reason of the difference of potential between said elements and the drum, distinctive markings as indicated at 41 are produced upon the record sheet 37. The record sheet further bears numbers as indicated at 42, 43 and 44 corresponding to the numbers being transmitted from the numbering machine 36 so that any particular message to which a number is assigned by the numbering machine may be identified as originating at a particular receiving position to which the sending position is temporarily connected through the switchboard.

The detailed operation of the system is as follows—Assuming that a message has been perforated in the tape by the reperforator 15 which is to be transmitted by the tape transmitter 22 at the sending position to the associated line or channel, the operator at the receiving position plugs the plug into jack J individual to the desired line circuit. In the case of messages for other lines, the cord circuit is plugged into jacks individual to those lines, the corresponding sending positions including apparatus similar to that shown in Fig. 2 for one sending position.

When the plug P is inserted in the jack, a circuit is closed from negative battery through the seventh conductor of the cable 50, the seventh contacts of the plug and jack of the switchboard, the seventh conductor of the cord circuit, the windings of relays 51 and 52, wiper 29 of the auxiliary code switch and the first or normal contact of the contact bank associated with said wiper, the interrupter contacts 53 associated

with the stepping magnet 30, the outer right hand armature and back contact of relay 56 and the right hand armature and back contact of marginal relay 57 to ground. It will be noted that relays 51 and 52 are short-circuited by rectifier elements 61 and 62 so that relay 51 will be short-circuited by a low resistance path when negative battery is applied to the seventh conductor of the cord circuit while the other relay 52 will be short-circuited if the potential on said conductor is reversed. The purpose of this arrangement is to control the operation of the cord circuit in different ways depending upon the type of sending position to which the switchboard jack is connected as explained in my copending application referred to above. This feature is not involved in the present invention and it will suffice to assume that in the present instance relay 52 becomes energized when the cord circuit is plugged into the jack J.

The allotter switch 65 is provided for testing the busy or idle condition of the jack into which the cord circuit is plugged since the same sending position may already have been seized by another cord circuit. The allotter switch 65 comprises a rotating contact adapted to close a circuit from ground successively to each of the cord circuits. Assuming that the sending position reperforator 21 is idle, the cord circuit shown is controlled by the switch 65 to render the tape transmitter 10 operative and to busy the multiplied connections of the jack J so that if another cord circuit is plugged up to the same sending position it will be locked out. When the rotating contact of the switch 65 engages the contact 66, a circuit is closed from ground through the allotter switch, the resistance 67, the left hand inner armature and front contact of relay 52, normally closed break contacts associated with the middle right hand armature of relay 68, the winding of marginal relay 57, conductor 9 of the cord circuit and its associated plug and jack contacts, conductor 9 of the cable 50, the winding of relay 71, the right hand break contacts of the busying key 72, the left hand outer armatures and front contacts of the normally energized slow-release relays 76 and 77, the inner armature and back contact of slow-release relay 81 and the outer armature and back contact of relay 86 to negative battery whereupon relays 57 and 71 become energized.

Relay 57 closes a locking circuit for itself and relay 71 which may be traced from ground through the inner left hand armature and front contact of relay 57 and the left hand outer armature and front contact of relay 52 that is independent of the circuit allotter switch 65. It will be further noted that the closure of this circuit places a low-resistance ground connection to conductor 9 of the cord circuit which prevents marginal relay 57 from attracting its armatures when one cord circuit is already plugged into a jack in the switchboard connected in multiple to the jack J because the described circuit is in shunt relation to the operating circuit through the circuit allotter switch 65 and the winding of the marginal relay 57 of the other cord circuit. The low current traversing marginal relay 57 under these circumstances is insufficient to operate the relay and the control apparatus of the second cord circuit is inoperative until the first cord circuit is released.

Relays 76 and 77 which are described as normally energized were originally operated by the reset key 80 and each of said relays locks up

through its inner right hand armature and front contact to ground at the back contacts of relay 90.

The energization of relay 57 as described closes a circuit from ground through the second left hand armature and front contact of relay 57, the armature and back contact of relay 91 and the winding of slow-release relay 92 to battery, whereupon relay 92 becomes energized. The energization of relay 57 also closes a circuit from ground through its right hand armature and front contact and the winding of relay 56 to battery whereupon relay 56 becomes energized and connects the auxiliary code transmitter of the cord circuit through its left hand armatures and front contacts to the code impulse transmitting conductors of the cord circuit and cable 50. In this manner upon operation of the transmitter under the control of the stepping magnet 30, code impulses are transmitted through the switchboard and the cable 50 to the code recording mechanism 33 at the sending position.

The energization of relay 71 at the sending position closes a circuit from ground through its second armature and front contact for energizing slow-release relay 81, thereby interrupting the above described circuit of relays 57 and 71 but these relays remain locked up through a locking circuit including the inner armature and front contact of relay 71 that is independent of the contacts of the key 72 and relays 76, 77 and 81. The energization of relay 71 also closes a circuit from ground through its outer armature and front contact, the seventh armature and back contact of relay 95 and the winding of slow-release relay 90, whereupon relay 90 becomes energized. The energization of relay 90 interrupts the locking circuits of relays 76 and 77, but the subsequent operation of the reperforator 21 which will be described, maintains said relays energized so long as the reperforator functions properly.

A pulsing unit 100 is provided in connection with the reperforator 21, said pulsing unit including intermittently closed sets of contacts for controlling the operation of the reperforator and of the associated apparatus. The contacts 101 of the pulsing unit are arranged to connect battery to the respective selecting magnets of the reperforator at the proper time to control the setting of the punch selector elements in a manner which is well known to those skilled in the art. Contacts 102 are provided for controlling the punch magnet of the reperforator in properly timed relation to the energization of the selecting magnets. The contacts 103 of the pulsing unit are "sixth pulse" contacts for generating transmitter stepping impulses in order that the remote transmitter 10 or auxiliary transmitter 36 may operate in step with the reperforator. The contacts 104 of the pulsing unit are timing contacts for controlling the release of the control relays at the end of the message as described in my copending application.

Since the pulsing unit 100 operates continuously, the next impulse generated by the closure of the sixth pulse contacts 103 steps the numbering machines 36 from its first to its second position through a circuit that may be traced from said contacts through the fourth armature and front contact of relay 71, the sixth armature and back contact of relay 95, the conductor 105 to the stepping magnet of the numbering machine. As the main drum of the numbering machine turns, the cam 40 momentarily closes the

contacts 39 thereby completing a circuit from battery to the drum 34 of the recording unit 33. As shown the first contacts of the contact banks associated with the wipers 24, 25, 26 and 27 of the code position transmitter are grounded and therefore ground potential is applied through the contacts of relays 56 and 119, the cable 50 and the contacts of relay 95 to the marking elements 38 to produce marks on the record paper indicated at 41.

The next sixth pulse from the contacts 103 of the pulsing unit energizes the stepping magnet of the numbering machine through the conductor 106 and contacts on the machine which were closed when the drum stepped from its normal position. A circuit is also closed from said sixth pulse contacts through contacts of the number machine (not shown), the third armature and back contact of relay 95, the third conductor of the cable 50 and associated contacts of the plug and jack, the third conductor of the cord circuit, the third right hand armature and back contact of relay 119, the third left hand armature and front contact of relay 56 and the winding of stepping magnet 30 to negative battery whereupon the stepping magnet becomes energized to step the wipers 24 to 29 into engagement with their second bank contacts. This stepping switch is of the forward drive type; that is, when the magnet 30 is energized the wipers are advanced. The stepping magnet of the numbering machine 36 is of the reverse drive type; that is, when the magnet is energized energy is stored in a spring which actuates the rotatable drums of the machine when its stepping magnet is deenergized. Therefore during the second transmitter step pulse, the wipers of the code position switch are advanced to the second position and at the end of the pulse, the numbering machine 36 is advanced to its third position and at this time the record sheet 37 is marked in accordance with the code set up on the second contacts of the code position switch. At each position or the numbering machine after its normal or initial position, code impulses are generated, as described in the above mentioned Dirkes patent, which operate the selecting magnets of the reperforator 21 through the make contacts associated with the five inner armatures of relay 95, whereby the service code signals generated by the numbering machine are perforated in the tape by the reperforator 21 in advance of the message. The numbering machine 36 continues to step through its cycle and the record strip 37 of the recorder 33 is marked in accordance with the grounded or ungrounded condition of the respective wipers 24 to 27 of the code position switch, no mark being produced on the sheet 37 during such time as the switch wipers are ungrounded.

The ninth transmitter stepping pulse steps the position code switch to its ninth position and at the end of said pulse, the numbering machine is stepped to the tenth position. When it advances to the tenth position, the code switch does not cause the record sheet 37 to be marked since the ninth contacts of the code switch are not grounded. When the numbering machine reaches the tenth position, the closure of contacts (not shown) closes a circuit from ground at the numbering machine through the conductor 107, the third armature and front contact of relay 71 and the winding of relay 95 whereupon relay 95 becomes energized to transfer the circuits of the selecting magnets of the reperforator 21 from

the numbering machine 36 to the code impulse conductors 1 to 5 of the cable 50 through which connection will be made to the tape transmitter 10 at the receiving position (Fig. 1).

The tenth transmitter stepping pulse steps the numbering machine back to its normal or initial position and operates relays 96 and 120 (Fig. 1) through a circuit that may be traced from battery through the winding of relay 120, the outer armature and back contact of relay 119, the third left hand armature and front contact of relay 57, the sixth conductor of the cord circuit, the associated contacts of the plug P and jack J, the sixth conductor of the cable 50, the winding of relay 96, the sixth armature and front contact of relay 95, the fourth armature and front contact of relay 71, and the contacts 103 of the pulsing unit 100. The energization of relay 96 closes another operating circuit for slow-release relay 90 and said relay remains energized although the original operating circuit through the seventh armature of relay 95 is now broken. The energization of relay 120 as described closes a circuit from ground through the inner right hand armature and front contact of said relay and the winding of relay 68 whereupon relay 68 becomes energized. At the end of the operating pulse which energized relay 120, said relay becomes locked up through its left hand armature and front contact, the winding of relay 119, the contacts of key 130 and the second left hand armature and front contact of relay 57 thus holding relay 120 energized and energizing relay 119. The energization of relay 119 connects the tape transmitter 10 through the first five armatures and front contacts of said relay to the plug P and jack J, said circuits being continued through the contacts of relay 95 as described above to the selecting magnets of the reperforator 21. The succeeding sixth pulses or transmitter stepping pulses from the contacts 103 of the pulsing unit step the tape transmitter 10 through a circuit that includes the sixth conductor of the cable 50, corresponding contacts of the jack J and plug P, sixth conductor of the cord circuit, the third left hand armature and front contact of relay 57, the right hand outer armature and front contact of relay 119, the winding of relay 91 and in parallel through the opposed windings of the autostop relay 128 to the stepping magnet of the tape transmitter. Each time relay 91 operates it momentarily interrupts the circuit of slow-release relay 92 but relay 92 holds its armature open as long as the transmitter stepping impulses are received. The transmitter 10 thus transmits the stored message to the sending storage reperforator 21.

As shown the release of the channel and operation of a "disconnect" signal represented by the lamp 118 are effected by an end-of-message signal appended to the message by the originating operator. As described in my copending application above referred to, the end-of-message signal consists of a double period-dot code combination which is detected by the code reading relays 97, 98 and 99 and the associated counting relays 83, 84, 85 and 86 in the same manner as described in detail in said application. The sending position is thus released when the complete message has been stored up and will be connected to a second receiving position if the latter is already plugged into another jack in the switchboard connected in multiple to the jack J.

In case a tape tie-up occurs and tape fails to

feed through reperforator 21 during transmission of the message, for example as a result of the tearing out of the feed holes in the tape, this condition is detected by the two sets of contacts 111. The contacts 111 are intermittently operated by the movement of the tape in any suitable manner. As shown, a rotatable cam 110 frictionally driven by the tape in the same manner as shown in the patent to Anderson et al, No. 2,142,880, dated January 3, 1939, is arranged to open and close each set of contacts alternately. The contacts 111 are arranged in the locking circuits of slow-release relays 76 and 77, and since both contacts cannot remain closed at the same time regardless of where the cam 110 stops when tape tie-up occurs, one or the other of the relays 76 and 77 becomes deenergized when the tape stops. Thereupon a circuit is closed from ground through the left hand inner armature and back contact of either relay 76 or 77 which is in shunt relation to the transmitter stepping circuit through the contacts 103 of the pulsing unit. Accordingly steady ground is placed upon the transmitting stepping circuit to hold relay 91 and the stepping magnet of the tape transmitter 10 energized.

At the sending position the circuit of the trouble lamp 113 is closed through the normally closed contacts of key 72 and the right hand outer armature and back contact of either relay 76 or 77, causing the trouble lamp to light and indicate to the attendant that tape tie-up has occurred at the reperforator. At the receiving position the continuous energization of relay 91 interrupts the circuit of relay 92 for a time sufficient to release its armature, whereupon a circuit is closed from battery through the winding of relay 16, the armature and back contact of relay 92 and the left hand outer armature and front contact of relay 119 to ground, whereupon relay 116 becomes energized. The energization of relay 116 closes through its right hand outer armature and front contact the circuit of trouble lamp 117 to indicate to the operator at the receiving position that a tape tie-up has occurred.

While the stepping of the tape transmitter 10 may also be stopped as a result of the opening of the auto-stop contacts 127 associated with the loop of tape between the reperforator and the tape transmitter 10, this does not cause the lighting of the trouble lamp 117. When the shortening of the tape loop opens the contacts 127 of the tape lever, the next transmitter stepping pulse passes through only the right hand winding of the auto-stop relay 128 and causes said relay to become energized in the usual manner. The energization of relay 128 interrupts the circuit of relay 91 at its make-before-break contacts and relay 91 maintains relay 92 energized. The lamp 129 becomes lighted by the closure of the contacts 128 to indicate tight tape at the transmitter 10.

When tape tie-up occurs at the sending position and the transmitter 10 at the receiving position is automatically stopped as described above, the operator at the receiving position may move the tape back in the transmitter 10 in order to resend the message from the beginning and then operate the reset key 130. This will not restart transmission unless the reset key at the sending position has also been operated although relays 119 and 120 will be momentarily released. Since the steady ground remains on the sixth pulse circuit (the sixth conductor of the cord circuit), relays 119, 120, 91 and 116

will again be energized and the lamp 117 lighted when the reset key 130 is released. When the reperforator 21 at the sending position has been repaired or replaced, the reset key 80 is operated to re-operate the relays 76 and 77. When both relays 76 and 77 are operated, steady ground is removed from the transmitter stepping circuit through the sixth conductor of the cable 50 and the cord circuit. Now when the reset key 130 is actuated, relays 116 and 119 are released and re-transmission of the message from the beginning is effected.

Whenever relay 119 is deenergized, the operator may withdraw the pins of the tape transmitter 10 from the tape by closing the push button 131 whereupon the tape may be freely pulled through the transmitter in order to eliminate the time required to send blanks if such blanks are automatically perforated in the tape between messages, for example.

At the end of the message the release of the cord circuit as described above causes all of the control relays associated with said circuit to become deenergized. When relay 56 becomes deenergized, a circuit is closed through the winding of the stepping magnet 30, the contact bank associated with the wiper 29, the wiper 29, the interrupter contacts 53, the right hand outer armature and back contact of relay 56 and the right hand outer armature and back contact of relay 57 to ground, whereupon the position code switch is stepped back to its normal or home position. If an operator should plug up to the switchboard and then pull down the connection before the complete code has been sent by the position code switch, the wipers of said switch will be on some position ahead of the No. 9 position. In this case a locking circuit is closed for relay 56 through the right hand inner armature and front contact of said relay, the contacts of the key 122 and the contacts of the contact bank associated with wiper 28 to ground. Thus a circuit is closed for lighting the trouble lamp 121 through the outer right hand armature and front contact of relay 56 and the right hand armature and back contact of relay 57 to indicate that the position code switch has stopped in an off-normal position. A supervisor can then go to the sending storage position to which the connection was made and record the number of the incomplete position code which should have been received there. The position code switch may then be reset by unlocking relay 56 by the reset key 122. The failure of the stepping magnet of the position code switch to function properly can also be detected in this manner.

Various modifications in the detailed system shown and described above for the purpose of explaining the invention will occur to those skilled in the art and may be made without departing from the scope of the invention as defined in the appended claims.

I claim:

1. In a telegraph system, a plurality of sources of signals, an auxiliary code transmitter for each of said sources, means including any one of said auxiliary code transmitters for repeatedly sending an invariable group of code signals characteristic of the particular auxiliary transmitter, an outgoing line or channel, repeating means for transmitting messages over said line or channel from any of said signal sources and means controlled by said auxiliary code transmitters and associated with said line or channel for identi-

fyng the source of every successive message by its characteristic code signal group.

2. In a telegraph system, a plurality of sources of signals, outgoing lines or channels, switching means for interconnecting any of said sources to any of said lines or channels, electrically controlled means for recording the identity of the source or sources of signals connected to a particular line or channel for the transmission of messages and means for operating said recording means as each connection is established to enable transmission from one of said sources.

3. In a telegraph system comprising a line or channel and a plurality of sources of signals for said line or channel, electrically operated means for recording the identity of the source of signals which is operative at any particular time, said recording means including a sheet of material marked by the passage of current therethrough and a current-conducting marking element engaging said sheet, and auxiliary position code transmitting means for controlling said recording means.

4. In a telegraph repeater system, a plurality of sources of signals, a line or channel, signal storing and repeating means at the terminal of said line or channel, selective switching means for interconnecting said sources of signals and said storing and repeating means, and additional signal-responsive means adjacent said storing and repeating means to record which of said sources of signals was connected to the storing and repeating means for any particular connection.

5. In a telegraph repeater system, a plurality of outgoing lines or channels, means including line-switching apparatus for repeating signals over said lines or channels, means for transmitting service code signals accompanying the messages sent over said lines or channels, said service code transmitting means including auxiliary transmitters operating through a definite cycle for each message, and recording mechanism combined with said service code transmitter, said recording mechanism being attached to a movable element of said auxiliary code transmitter.

6. In a telegraph repeater system, a plurality of receiving and sending positions, means at said positions for repeating telegraph signals, switching means for interconnecting any of said receiving and any of said sending positions, means including a numbering machine at each sending position for sending consecutive numbers accompanying each consecutive message sent therefrom, an auxiliary transmitter at each receiving position and means jointly controlled by the numbering machine and the auxiliary transmitter of connected sending and receiving positions for making a record of the number and origin of messages repeated from receiving to sending positions.

7. In a telegraph repeater system, a plurality of receiving and sending positions, means at said positions for repeating telegraph signals, switching means for interconnecting any of said receiving and any of said sending positions, means including a numbering machine at each sending position for sending consecutive numbers accompanying each consecutive message sent therefrom, an auxiliary transmitter at each receiving position and recording means actuated by the numbering machine and controlled by the auxiliary transmitter of the receiving position connected through said switching means.

8. In a telegraph repeater system, a plurality

of receiving and sending positions, means at said positions for repeating telegraph signals, switching means for interconnecting any of said receiving and any of said sending positions, code transmitting devices associated with each of said receiving positions, each adapted to send a different code signal from the others, means for cyclically operating each of said code transmitting devices when its receiving position is re-connected through the switching means to a sending position and means controlled by said code transmitting devices for recording the identity of the particular receiving positions involved in the repeating of messages through the system.

9. In a telegraph repeater system, a plurality of lines or channels, a switchboard for extending connections to wanted lines or channels, a number-code transmitter for sending consecutive numbers with consecutive messages over an outgoing line or channel, said transmitter embodying a movable element, a record sheet advanced by said element and means for marking on said sheet the origin of each call placed through the switchboard for the associated outgoing line or channel.

10. In a telegraph system, an exchange, a plurality of lines or channels terminating thereat, switching means at said exchange for extending connections from lines or channels over which messages are received to outgoing lines or channels, supervisory recording means in said exchange for recording the identity of connected lines or channels, means for operating the recording means to effect a record from which the line or channel connected to a particular outgoing line or channel may be identified for each message switched and means for transmitting messages over said outgoing lines or channels.

11. In a telegraph repeater system, a plurality of lines or channels, means including cord circuits and a switchboard for extending connections to wanted lines or channels, recorders one for each of said lines or channels, means for operating the recorder of a connected line whenever connection is made through said switchboard to any of said lines or channels, and means associated with the respective cord circuits for varying the record made by said recorder in accordance with the identity of the particular cord circuit employed.

12. In a telegraph repeater system, a plurality of receiving and sending positions, receiving apparatus at each of the receiving positions, repeating apparatus at each of the sending positions, switching means for interconnecting any of said receiving and any of said sending positions, means for indicating the identity of the receiving position connected to a sending position for each connection, and means operatively associated with the receiving apparatus at the receiving positions for controlling said indicating means.

13. In a telegraph repeater system, a plurality of receiving and sending positions, receiving apparatus at said receiving positions for permutation code signals, repeating apparatus at said sending positions, selective switching means for interconnecting any of said receiving and any of said sending positions, recording means at each of said sending positions, said recording means comprising a record sheet, a plurality of marking elements engaging said sheet and means for advancing the sheet, and means at the receiving positions for controlling said recording means to produce significant records identifying the particular receiving positions connected at different times to the sending positions.

14. In a telegraph repeater system, a plurality of receiving and sending positions, receiving apparatus at said receiving positions for permutation code signals, repeating apparatus at said sending positions for repeating message signals received at said receiving positions, code transmitters at each of said sending positions and each

of said receiving positions, and means for initiating the operation of both code transmitters at interconnected sending and receiving positions to send predetermined code signals from both transmitters when a single message group of signals is handled by said repeater system.

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