

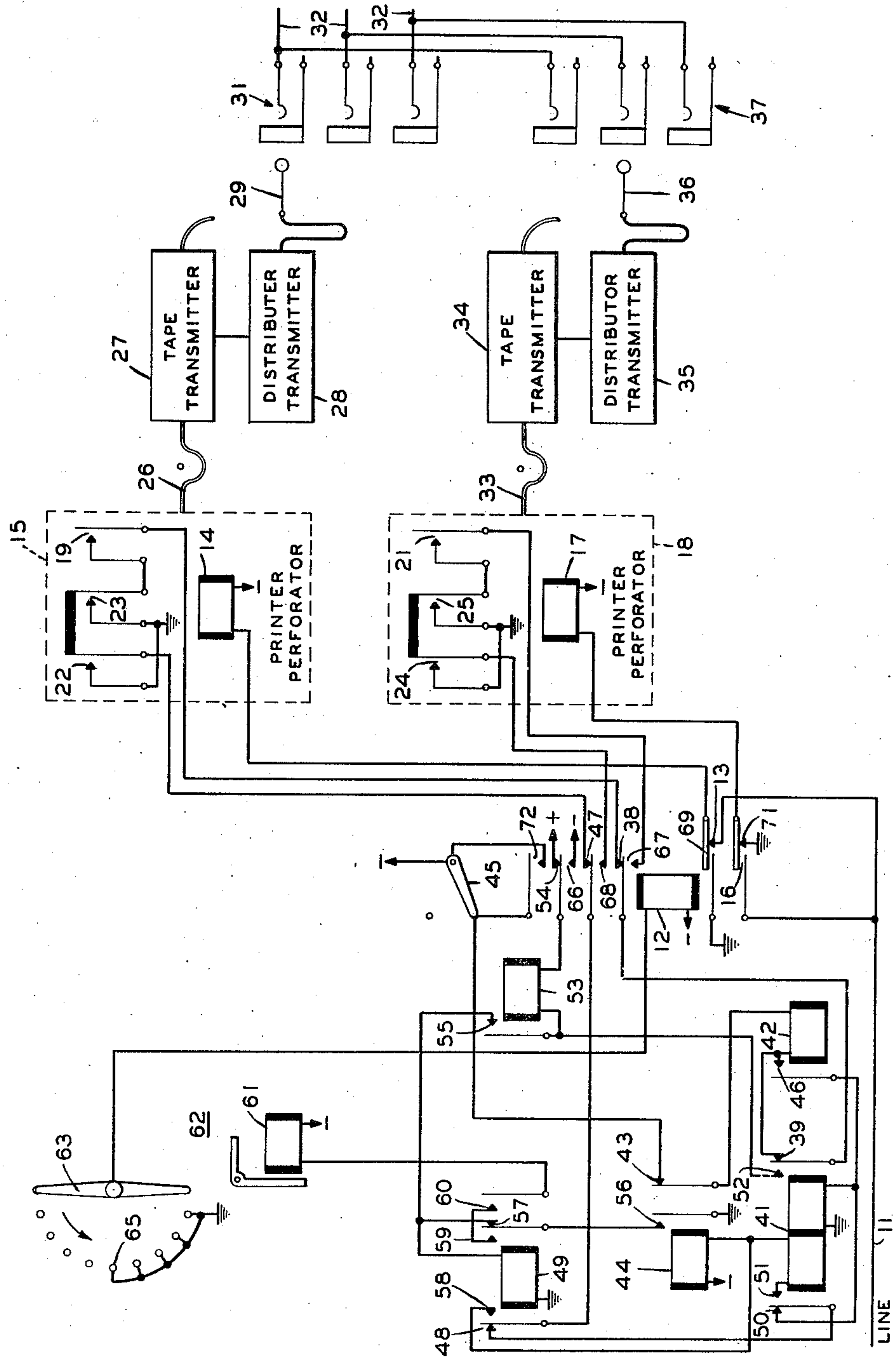
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TELEGRAPH SWITCHING SYSTEM

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TELEGRAPH SWITCHING SYSTEM

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This invention relates to printing telegraph systems and has particular reference to a receiving arrangement which may be employed in certain types of telegraph exchange systems, although it is not limited to such use.

There are in use at the present time a number of printing telegraph exchange systems in which messages are received at a switching station from a number of incoming lines. The received messages are temporarily stored in the form of perforated tape and are subsequently transmitted over any one of a number of outgoing lines each connected to one of a plurality of receiving stations. At the switching station the usual practice is to make a manual connection to the proper outgoing line by means of switchboard jacks and cooperating plugs whereby a transmitter actuated by the perforated tape sends the temporarily stored message to the proper receiving station. In order to facilitate the switching operations at the switching station, the receiving instrument is usually a printer-perforator, by means of which the received message characters are simultaneously perforated in code forms and also printed on a record sheet. Thus, by means of the printed matter appearing on the tape, the attendant at the switching station may read the address of the message and make the appropriate connection to the proper outgoing line connected to the station to which the message is addressed. It may be preferable to operate the incoming and outgoing lines at substantially the same signal frequency. In such case, if an attempt is made to terminate each incoming line in a single storage device and if the incoming line is heavily loaded so that one message follows immediately after another, the amount of tape perforated by the receiving apparatus is almost sure to accumulate for the reason that it necessarily requires some time to inspect the tape to determine the destination of the message and to perform the necessary switching operations. Also, it may be that the outgoing line to which a storage device and its associated transmitter is connected is engaged, at the time of the connection, in transmitting a message from another storage device. In such a case suitable apparatus is employed at the switching station to delay the transmission of the message from the second transmitter connected to an outgoing line while that line is in use. Consequently, while the transmitter associated with a single storage device is delayed, the perforated tape awaiting transmission will accumulate.

Hence, it is the primary object of the instant

invention to provide facilities to obviate the deficiencies of as single storage termination of a heavily loaded line.

Another object of the invention is to provide for the alternate reception of incoming messages on two storage devices.

Still another object of the invention is to provide means responsive to an end-of-message signal to switch an incoming line alternately between two receiving devices.

Another object of the invention is to provide transfer apparatus operable by either of two receivers for alternately switching an incoming line between said two receivers.

The provision of two or more storage devices associated with an incoming line and of means for switching the line from one device to another will prevent any appreciable accumulation of tape in any one device. For example, if two storage devices are employed, each will be engaged in perforating tape in response to the received signals only half of the time. During the period in which one storage device is connected to the incoming line the other device has an opportunity to dispose of its accumulated perforated tape. The system is of such a character that the tape prepared by one of the storage devices may be utilized by a transmitter while the storage device is engaged in preparing the tape. Thus, by providing an additional period for the utilization of the tape during which further preparation of tape is prevented, the probability of accumulating an excessive quantity of unused prepared tape by any one storage device is minimized.

In general, the invention comprises two printer-perforators, each having associated therewith a tape transmitter and a distributor. Each distributor may be connected by means of a plug to any one of a plurality of jacks which are connected respectively to a plurality of outgoing lines. The jack terminals of the outgoing lines are multiplied to a number of groups of jacks, each group appearing in a different section of the switchboard whereby the transmitting equipment associated with the printer-perforators may be connected to any of the outgoing lines. The incoming line is normally connected to one of the printer-perforators. Following the transmission of each message sent over the incoming line is a series of signals which are employed to selectively operate auxiliary contacts of the printer-perforator. Each of the incoming messages is followed by the same series of signals. These signals are employed to operate, in a step-

by-step manner, a group of relays and a stepping switch. The stepping switch is employed for a counting purpose more fully described hereinafter and also for controlling the operation of a transfer relay. This transfer relay is alternately operated and released and, in this cycle of operations, the incoming line is switched first to one perforator and then to the other. Whichever one of the perforators is connected to the incoming line controls the operation of the transfer apparatus by means of its auxiliary contacts in response to the characteristic end-of-message signal.

The invention may be more readily understood by referring to the accompanying drawing, the single figure of which illustrates one embodiment of the invention. As disclosed herein the invention is incorporated in a system operated on a start-stop basis. Obviously, the invention may be employed with equal facility in a synchronous multiplex system.

The incoming line 11 is connected to the contacts of a transfer relay 12. When the transfer relay is in its released position, as shown in the drawing, the incoming line is connected by contact 13 to the selector magnet 14 of a printer-perforator 15. When the transfer relay is operated, the incoming line is connected by means of contact 16 to the selector magnet 17 of a second printer-perforator 18. These printer-perforators, which are shown diagrammatically herein, may be of any suitable type, numerous examples of which are to be found in the prior art, such as that shown in the Patent No. 2,174,731, granted October 3, 1939, to R. F. Dirkes et al., or Patent No. 2,143,828, granted January 10, 1939, to R. F. Dirkes et al. The former patent covers a combination telegraph printer and perforator for use with start-stop signals, while the latter covers a similar instrument better adapted for use with multiplex signals. Consequently, in a start-stop system such as that disclosed herein either of the above devices may be used by making suitable obvious modifications. The instrument covered by Patent 2,174,731 is susceptible of use in the present system when modified in accordance with the disclosures of Patent 2,143,828, to include selectively operated auxiliary contacts. The printer-perforator 15 includes a normally open contact 19, and the printer-perforator 18 includes a similar normally open contact 21. Both of these contacts are similar to the contact disclosed in Patent 2,143,828 and are closed after a "carriage return" selection is made by the respective printer-perforator. The contacts are closed, under the control of the storage mechanism to which the received signals are transferred by the selector mechanism, at the time that the signal immediately following the carriage return signal is being received. Also, the printer-perforator 15 includes a pair of contacts 22 and 23 which are closed under the control of any cyclically operating member of the printer-perforator. In this case the contacts 22 and 23 are momentarily closed by means of a suitable linkage operated by the punch hammer which is actuated for each operation of the selector mechanism to control the apparatus employed to perforate the tape. The printer-perforator 18 is also provided with similar contacts 24 and 25. These contacts will be referred to hereinafter as the punch hammer contacts, and the contacts 19 and 21 will be referred to as the carriage return contacts of the respective printer-perforators.

The tape 26 which is prepared by the printer-

perforator 15 contains a perforated and a printed record of the respective signals and is passed through a tape transmitter 27 which is used to control a distributor-transmitter 28. The output circuit of the distributor-transmitter is connected to a plug 29 which may be inserted for connection in any one of the jacks 31 comprising one group of the switchboard jacks which are connected respectively to each of the outgoing lines 32. The tape 33 which is prepared by the printer-perforator 18 is fed into a tape transmitter 34 which is employed to control the operation of a distributor-transmitter 35 which also is connected to a plug 36. The plug 36 may be inserted in any of the jacks 37 which comprise another switchboard group and which also are connected in multiple with the respective jacks 31 to the outgoing lines 32. The tape transmitter may be of any suitable type found in the prior art, such as, for example, the tape transmitter covered by Patent No. 2,172,269, granted September 5, 1939, to H. Angel et al. The distributor-transmitters 28 and 35 are also conventional elements well-known to the prior art, one form of which is disclosed in a Patent No. 1,805,374, granted May 12, 1931 to S. W. Rothermel.

Following all of the messages which are transmitted over the incoming line 11 there is transmitted a series of signals which are employed to operate the transfer relay, if it is released, and to release it, if it is operated. Thus, the messages which are received at the switching station are utilized to operate the storage devices 15 and 18 alternately. The series of switching signals which has been selected to perform the desired switching operations in this embodiment of the invention comprises two successive "carriage return" signals followed without interruption by at least six "letter shift" signals. The invention is not limited to the employment of this particular series of signals, although it will be noted that all of the signals employed for switching purposes are of such a character that they are effectively deleted from the printed record at the printer-perforator. However, the reception of these signals by either of the printer-perforators and the selections performed thereat in response to these signals affect the closure of the auxiliary contacts.

For the description of the operation of the system embodying the invention, assume that all of the apparatus shown in the drawing is in the condition shown. The signals which are received from line 11 are transferred by means of contact 13 of the transfer relay 12 to the selecting magnet 14 of the printer-perforator 15. Following the reception of the intelligence conveying signals and the storing and recording of these signals in the tape 26, the switching signals are transmitted. The selector controlled storage mechanism, in response to the first carriage return signal, closes contact 19 and a circuit is prepared whereby, when the punch hammer contact 23 closes, ground connected to this contact is connected through a break contact 38 of the transfer relay 12, a break contact 39 of relay 41, winding of relay 42, break contact 43 of relay 44, through the lower contact of a cutout switch 45 to battery. The completion of this circuit energizes relay 42 and closes a make contact 46, thereby connecting the normally ungrounded terminal of the grounded right-hand winding of relay 41 to one terminal of the winding of relay 42. It will be noted that, so long as the printer-perforator contacts 23 and 19 are closed, this terminal of the winding of relay 42 is at ground

potential, thereby preventing the operation of relay 41. In order to provide additionally for the non-operation of relay 41 at this time a second ground connection is made to the normally ungrounded terminal of this relay through the punch hammer contact 22, break contact 47 of the transfer relay 12, break contact 48 of relay 49, and break contact 50 of relay 41. However, the closing of contacts 19 and 23 is very short and, as soon as the grounds controlled by these contacts are removed from the operating circuit of relay 42, the winding of this relay and the right-hand winding of relay 41 are connected in series from the ground appearing at one terminal of the latter winding and the battery connected to the cutout switch 45. Consequently, relay 41 operates and locks in series with relay 42.

Before completing the description of the operation of the apparatus in response to an end-of-message switching signal, assume that at this time the first carriage return signal is followed by something other than another carriage return signal. When the punch hammer operates to perforate the received character in the tape 26, the closure of contact 22 applies ground through a break contact 47 of the transfer relay 12, through a break contact 48 of relay 49, through a make contact 51 and the left-hand winding of relay 41 to one terminal of the winding of relay 44. The other terminal of this winding is connected to battery so that the closure of the circuit described energizes the relay and opens the break contact 43. Thus, the locking circuit through relay 42 at the right-hand winding of relay 41 is interrupted, thereby releasing relay 42. Relay 41 is not immediately released, since the operating circuit of relay 44 includes the left-hand winding of relay 41. However, as soon as the punch hammer contact 22 is opened, relays 41 and 44 release and the apparatus is restored to the condition in which it was prior to the reception of the first carriage return signal.

Suppose that the first carriage return signal has been received and has been utilized to operate relays 41 and 42. The reception of the second carriage return signal closes the punch hammer contact 22 to close the operating circuit of relay 44 to release relay 42 and to prepare for the release of relay 41 as previously described. Also when this second carriage return signal is received and contacts 19, 22 and 23 are closed, ground is connected through contacts 19 and 23 through break contact 38 of the transfer relay 12, make contact 52 of relay 41 (this relay is not released until the auxiliary printer-perforator contacts open), through the winding of relay 53 and break contact 54 of the transfer relay 12 to positive battery. As soon as relay 53 operates, the ground is connected through make contact 55 of this relay to the normally ungrounded terminal of the grounded winding of relay 49, thereby preventing the operation of this relay. To insure the non-operation of this relay until after relay 44 is released, an additional ground is applied to this terminal through make contact 56 of relay 44 and break contact 57 of relay 49. As soon as contacts 19 and 23 open, and relay 44 is released, relay 49 operates and locks in series with relay 53 to the positive battery connected to the break contact 54 of the transfer relay 12. The reception of the first of the six letter shift signal combinations by the printer-perforator momentarily closes the punch hammer contact 22. The ground which is connected thereto is applied through the break contact 47 of the trans-

fer relay 12 and through the make contact 58 of relay 49 to the winding of relay 44, thereby operating this relay. The closure of make contact 56 of relay 44 connects a ground through make contacts 59 and 60 of relay 49 to the winding of the stepping magnet 61 of the stepping switch 62. The other terminal of this winding is connected to battery, and therefore the winding becomes energized. The closure of the punch hammer contact 22 is short, thereby producing a short impulse in the winding 61 of the stepping magnet. When the stepping magnet is deenergized, wiper 63 is advanced in the direction of the arrow to the next stud. Similarly, the reception of the next four letter shifts by the printer-perforator 15 produces momentary operations of the relay 44 and also momentary pulsations of the stepping magnet 61. The wiper 63 is thus advanced successively over its studs to rest, at the end of the fifth step, on stud 65.

The engagement of wiper 63 with stud 65 connects a ground to one terminal of the winding of the transfer relay 12. Since the other terminal of this winding is connected to battery, the operation of the contacts controlled by the transfer relay is effected. The series connection of the relays 49 and 53 is disconnected from the positive battery of break contact 54 and is connected through the make contact 66 of the transfer relay to negative battery. Normally, the time elapsing between the opening of break contact 54 and the closing of the make contact 66 is sufficient to release relay 53 and open the locking circuit for this relay and relay 49 at the make contact 55. However, to insure the release of these relays, the polarity of the battery connected to the winding of relay 53 is reversed from positive to negative. Thus, while the current is passing through zero, the contacts which have been made by these relays are opened, and since one of these contacts was in series with the relay windings, reoperation of these relays is prevented. Thus, all of the relays 41, 42, 44, 49 and 53 are restored to normal after the reception of the fifth letter shift signal. Also, the line 11 is disconnected from the printer-perforator 15 by means of the opening of contact 13 of the transfer relay and is connected by means of the closure of contact 16 of this relay to the printer-perforator 18.

The purpose served by the sixth in the group of letter shift signals will be described in a subsequent position of the specification.

The intelligence signals, comprising a second message, which are transmitted over the line 11 following the operation of the switching apparatus are employed by the printer-perforator 18 to prepare the tape 33 in accordance with the received signals. While these signals are thus being stored by the printer-perforator 18, an attendant may refer to the portion of the tape 26 prepared by the printer-perforator 15 containing the address of the message. In accordance with the address of the message, the attendant inserts the plug 29 into the appropriate one of the jacks 31. If the line 32 which is connected to the selected jack is not being used for the transmission of a message originating elsewhere at the switching station, the message which is stored in the tape 26 is immediately transmitted over the outgoing line. Irrespective of the immediate transmission or the delay of transmission of the signals stored in the tape 26, there is no additional tape being prepared by the printer-perforator 15, during the reception of the second message, since at

this time the signals which are being received from the line 11 are being used to prepare a portion of the tape 33 by the printer-perforator 18. At the end of the second group of intelligence characters comprising a message, a series of switching signals which is identical to the series of switching signals transmitted at the end of the first group of intelligence signals is received from the line 11.

In this case the second series of switching signals controls the operation of the printer-perforator 18 in a manner to perform the desired switching. The reception of the first carriage return signal effects the closure of the carriage return contact 21 and the punch hammer contact 25. A circuit is thus completed from the ground connected to the punch hammer contact 25 through this contact, through the carriage return contact 21, through the make contact 67 of the transfer relay 12, the break contact 39 of relay 41, the winding of relay 42, the break contact 43 of relay 44 and the lower contact of the cut out switch 45 to battery. Relay 42 is thus operated and, when either one or both of the contacts 21 and 25 of the printer-perforator 18 are opened, this relay locks in series with the right-hand winding of relay 41 as before, thereby causing the operation of relay 41. When the contacts 21 and 25 of the printer-perforator are closed in response to the reception of the second carriage return signal, relay 53 is operated by means of a circuit which extends from the ground connected to the punch hammer contact 25 through this contact, the carriage return contact 21, the make contact 67 of transfer relay 12, make contact 52 of relay 42, the winding of relay 53 and through the make contact 67 of the transfer relay 12 to negative battery. The opening of either one or both of the contacts 21 and 25 of the printer-perforator 18 causes the operation of relay 49 as before, locking this relay and relay 53 in series. The reception of the second carriage return signal also effects the release of relays 41 and 42 in a manner similar to that previously described. The reception of the first five of the six letter shift signals resulting in the five successive closures of the punch hammer contact 24 causes relay 44 to pulsate by reason of the momentary closures of a circuit extending from ground through contact 24, make contact 68 of the transfer relay 12, make contact 58 of relay 49, and through the winding of relay 44 to battery. The successive closures of contact 56 of relay 44 causes the stepping magnet 61 of the stepping switch 62 to advance the wiper 63 in a step-by-step manner over the lower group of studs associated therewith.

As long as the wiper 63 of the stepping switch 62 is in contact with the stud 65 or any of the four following studs, the transfer relay 12 is maintained in its operated condition. After the fifth letter shift signal has been received by the printer-perforator 18, the wiper 63 of the stepping switch will have been stepped to the position in which it is shown in the drawing. The operating circuit of the transfer relay 12 is thereby interrupted and allows the armatures controlled by this relay to be restored to their back contacts as shown. The transfer of the locking circuit of relays 49 and 53 from the make contact 67 to the break contact 54 of the transfer relay 12 reverses the polarity of the battery applied to these relays, thereby causing their release and preventing their reoperation. The line circuit 11

is transferred from the printer-perforator 18 by the opening of the make contact 16 of the transfer relay to the printer-perforator 15 by the closure of the break contact 13 of the transfer relay.

Provisions are made herein for keeping the printer-perforator which is not connected to the line 11 from cycling. This is accomplished by maintaining the circuit of the selector magnet of the idle printer-perforator closed. For example, just before the line circuit 11 is disconnected from the printer-perforator 15 by the opening of the transfer relay contact 13, the make contact 69 is closed, thereby providing a ground to energize the selector magnet 14. Just prior to the operation of the transfer relay the selector magnet 17 of the printer-perforator 18 is energized by means of the ground connection effected through the break contact 71 of the transfer relay. Simultaneously with the closure of make contact 69, the make contact 16 is closed thereby connecting the line circuit 11 to the selector magnet of the printer-perforator 18. Thus, by means of these continuity preserving contacts, the line circuit is never interrupted and the selector magnet circuits of the printer-perforators are always continuous so far as the transfer mechanism is concerned either to ground or to the line circuit.

It has been previously stated that the switching signals include six letter shift signals and only the first five of these signals are needed to operate the transfer mechanism. The reason for this is that the closure of the auxiliary contacts, in response to the fifth letter shift signal, occurs at the time that the sixth letter shift signal is being received by the printer-perforator selector apparatus. Since the transfer of the line circuit from one printer-perforator to the other occurs during the reception of the sixth letter shift signal, this signal will be split, part of it being received by one storage instrument and part of it by the other instrument. However, the letter shift signal comprises five marking impulses whereby the line circuit, and the selector apparatus connected thereto, is closed. Hence, if the line circuit is being transferred from the printer-perforator 15 to the printer-perforator 18, the selector mechanism controlled by the magnet 14 is engaged in receiving the first part of the sixth letter shift signal. Since all of the impulses of this signal combination are marking, the selector magnet 14 would be energized during the entire time of the reception of this signal. Consequently, when the transfer relay 12 operates to switch the line circuit 11 away from the printer-perforator 15, the selector magnet 14 remains energized by reason of the continuity preserving character of the transfer contacts and the response of the printer-perforator 15 is the same as if the last part of the sixth letter shift signal were received by it. Similarly, before the transfer of the line circuit the selector magnet 17 of the printer-perforator 18 is energized and the reception by it of the last part of the sixth letter shift signal maintains the selector magnet energized.

It will be appreciated that if the signal received from the line 11 immediately following the fifth letter shift signal is the first character signal of the succeeding message, part of it would be received by the printer-perforator 15 and part of it by the printer-perforator 18. Consequently, there would be no accurate recording of this char-

acter by either printer-perforator and if the latter part of the character signal contained one or more spacing impulses, the printer-perforator 18 would respond to such a spacing signal as if it were a "start" signal. The result of such a false operation would cause the printer-perforator 18 to lose synchronism with respect to the apparatus transmitting the signals over the line 11 and it is possible that synchronism would not be restored for an appreciable time. Hence, it is seen that even though the sixth letter shift signal included in the series of switching signals is not needed for the operation of the transfer mechanism, it does serve a useful purpose in providing conditions whereby the transfer from one receiving instrument to the other may be made without the possibility of the loss of any of the message characters or of producing an asynchronous condition between the transmitting and receiving devices.

The switching system is provided with facilities for cutting off one of the printer-perforators if for any reason it is desired to receive all of the signals transmitted over the line 11 on one printer-perforator. The cutout switch 45 is employed for this purpose and is moved to its upper contact whenever single storage of the received signals is desired. In this case it is seen that, when the apparatus is in the condition illustrated in the drawing, the line signals are received by the printer-perforator 15. With the switch 45 engaged with its upper contact, the closure of the carriage return contact 19 is ineffective to cause the operation of relay 42, since the operating circuit for this relay is open at the lower contact of the cutout switch 45 since, without the operation of relay 42, it is impossible to operate the relays 49 and 53 and the stepping switch 62 cannot be actuated to a position which will operate the transfer relay 12. Therefore, the switching signals which are received following a group of intelligence signals operate the printer-perforator 15 in the usual manner, but the switching apparatus is no longer under the control of the printer-perforator auxiliary contacts.

If the cutout switch 45 is moved to its upper contact while the line circuit 11 is connected to the printer-perforator 15, the line circuit remains connected to this storage device. However, if the line circuit 11 is connected to the printer-perforator 18, the apparatus is arranged so that the switch 45 may be moved to its upper contact at any time during the reception of a group of intelligence characters by the printer-perforator 18. The transfer relay is operated at this time so that the make contact 72 is closed. Consequently, when the first carriage return signal effects the closure of contacts 21 and 25 of the printer-perforator 18, the relay 42 is operated because its operating circuit is completed from the lower contact of the switch 45 through the make contact 72 of the transfer relay to battery. The reception of the following switching signals effects the operation of the switching apparatus as described, thereby releasing the transfer relay 12 which transfers the connection of the line 11 from the printer-perforator 18 to the printer-perforator 15. Thereafter, however, as long as the switch 45 remains in its upper contact, operation of the switching apparatus is prevented.

The nature of the invention may be ascertained from the foregoing description of an illustrative embodiment thereof, it being understood that nu-

merous modifications thereof may be made within the scope of the appended claims without departing from the spirit of the invention.

What is claimed is:

1. In a telegraph system, a line circuit conveying groups of intelligence signals, each of said groups being followed by a switching signal, a plurality of signal receiving devices, switching means associated with said line circuit and said receiving devices operable to connect said line circuit successively to each of said receiving devices, and means controlled by any of said receiving devices in response to said switching signals when connected to said line circuit to operate said switching means.

2. In a telegraph exchange system, an incoming line conveying groups of intelligence signals, each of said groups being followed by a switching signal, a plurality of outgoing lines, two signal storage devices, a signal transmitting device associated with each of said storage devices, means for connecting either of said transmitting devices to any of said outgoing lines, and means controlled by said storage devices in response to said switching signals to connect said incoming line alternately to said storage devices.

3. In a telegraph system, a signal circuit for alternate groups of intelligence and switching signals, a plurality of signal receivers each operable by said signals when individually connected to said signal circuit, each of said receivers having contacts selectively operable by certain of said switching signals, and apparatus controlled by operations of said contacts of a receiver connected to said signal circuit to transfer the connection of said signal circuit from the receiver responding to the switching signals to another of said receivers.

4. In a telegraph system, a signal circuit over which are transmitted groups of intelligence signals interspersed with other groups of switching signals, two signal storage devices each having auxiliary contacts including contacts selectively operated in response to certain of said switching signals, a transfer relay operable to switch said signal circuit alternately to said storage devices, and a relay chain operable in response to said selectively operated auxiliary contacts of the storage device then connected to said signal circuit to control the operation of said transfer relay.

5. In a telegraph system, a signal circuit over which are transmitted groups of intelligence signals interspersed with a predetermined minimum number of switching signals, two signal storage devices each having a cyclically operable contact and a contact selectively operable in response to the first of said switching signals, a transfer relay operable to switch said signal circuit from either of said storage devices to the other of said storage devices, a stepping switch operable to control said transfer relay after the reception of a predetermined number of said switching signals, and a relay chain controlled by said selectively operable contacts of the storage device then connected to said signal circuit to render said stepping switch responsive to said cyclically operable contact of the connected storage device whereby the previously connected storage device is disconnected from and the previously disconnected storage device is connected to said signal circuit.

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