

Oct. 18, 1949.

G. G. LIGHT ET AL.

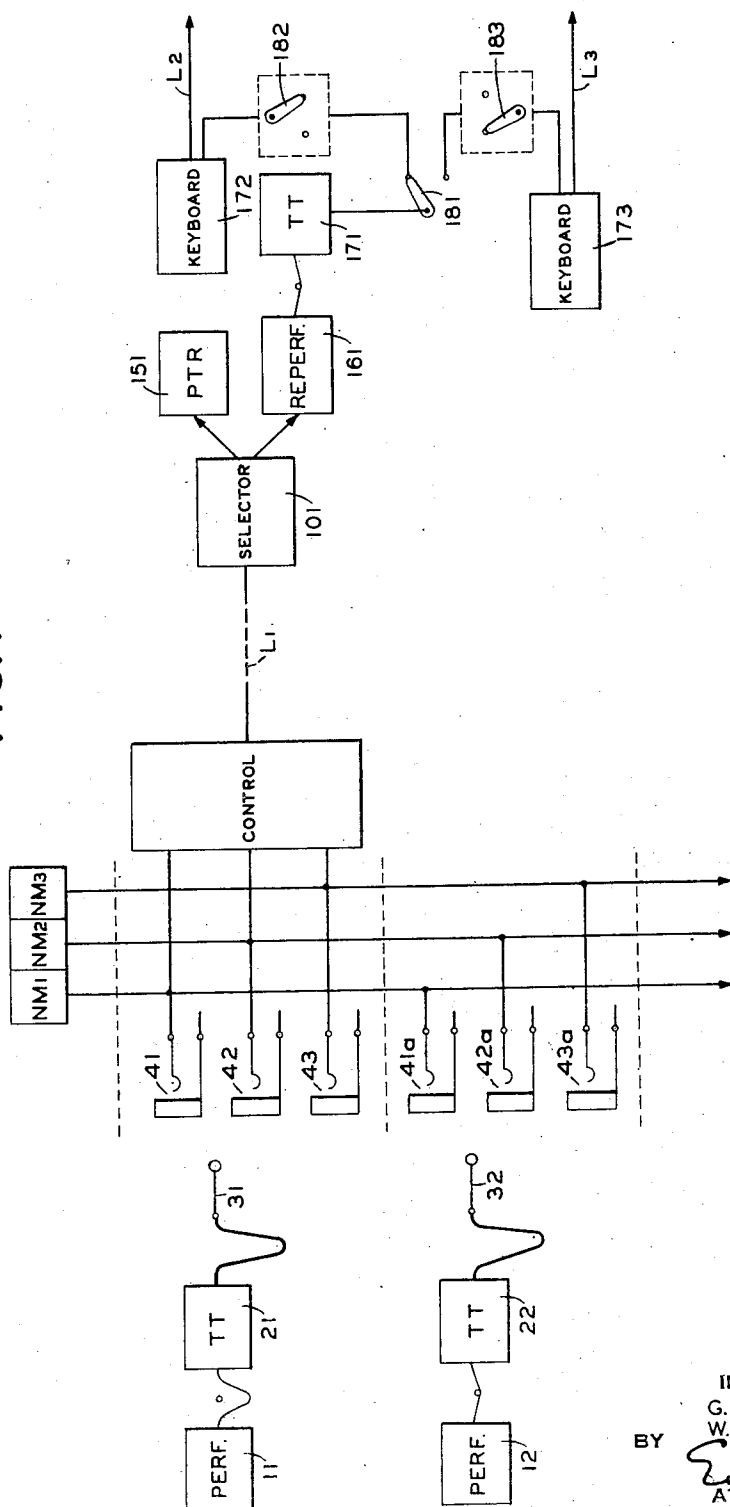
2,484,838

TELEGRAPH EXCHANGE SYSTEM

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5 Sheets-Sheet 1

FIG. 1



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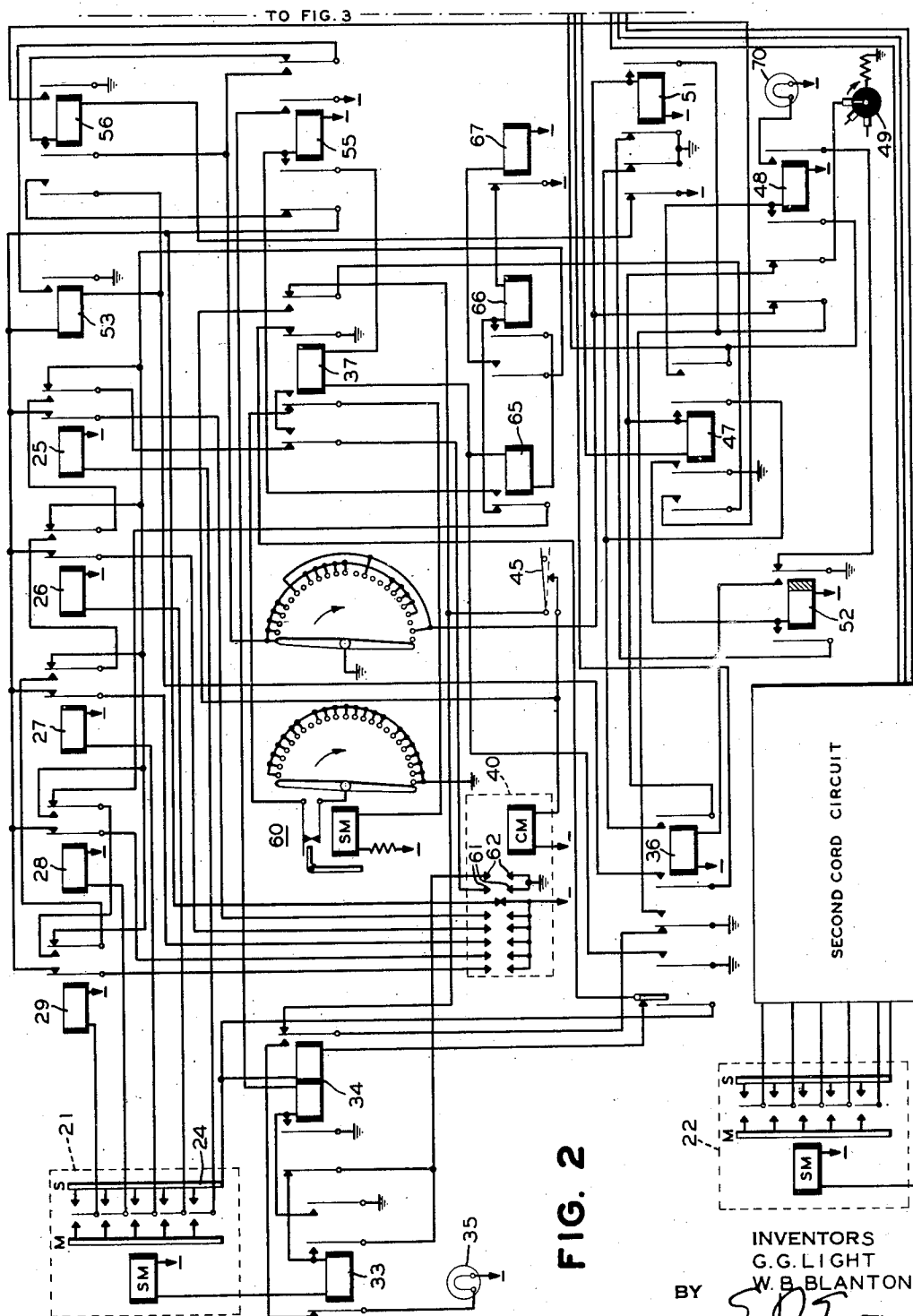
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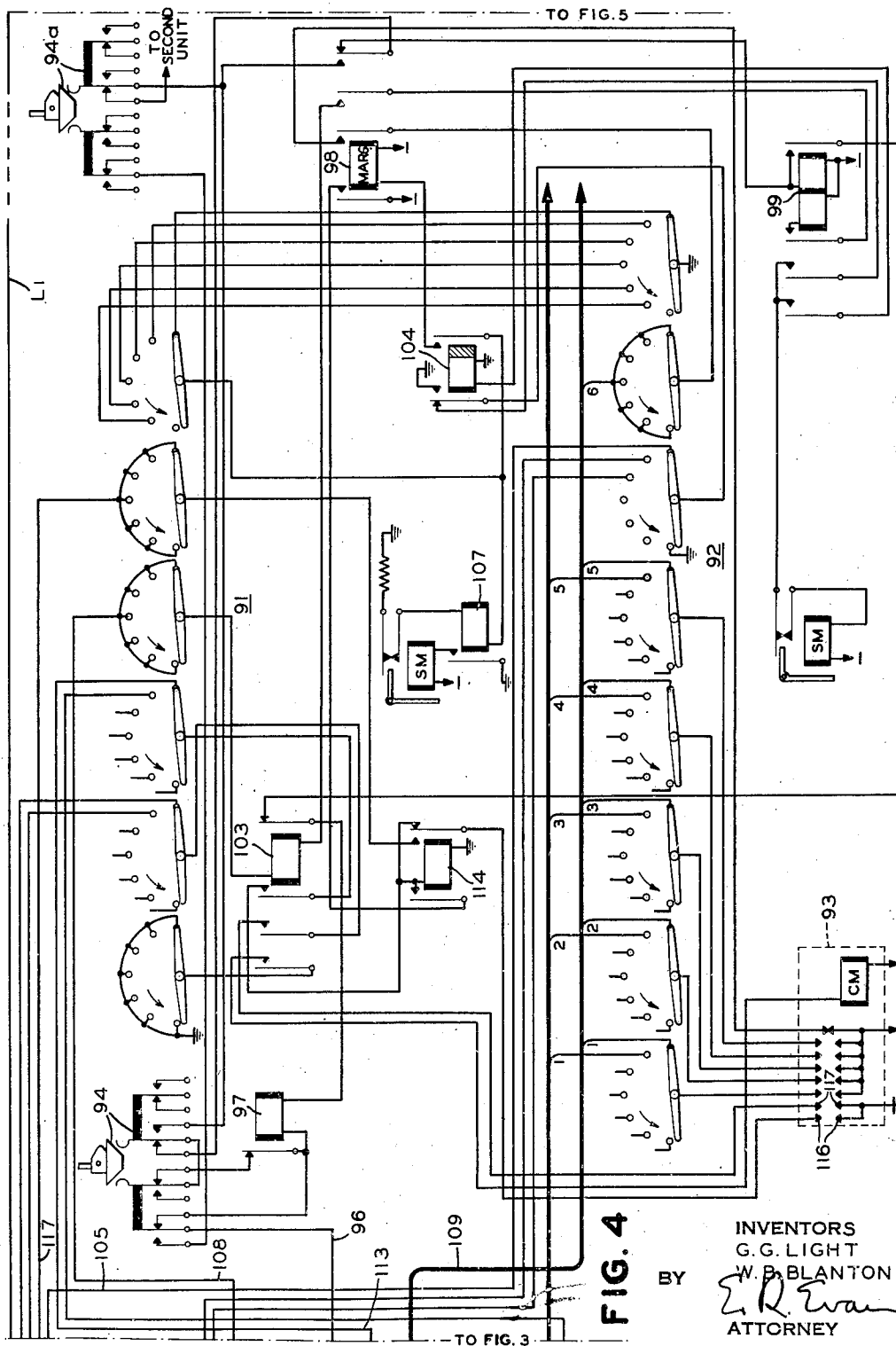


FIG. 4

BY

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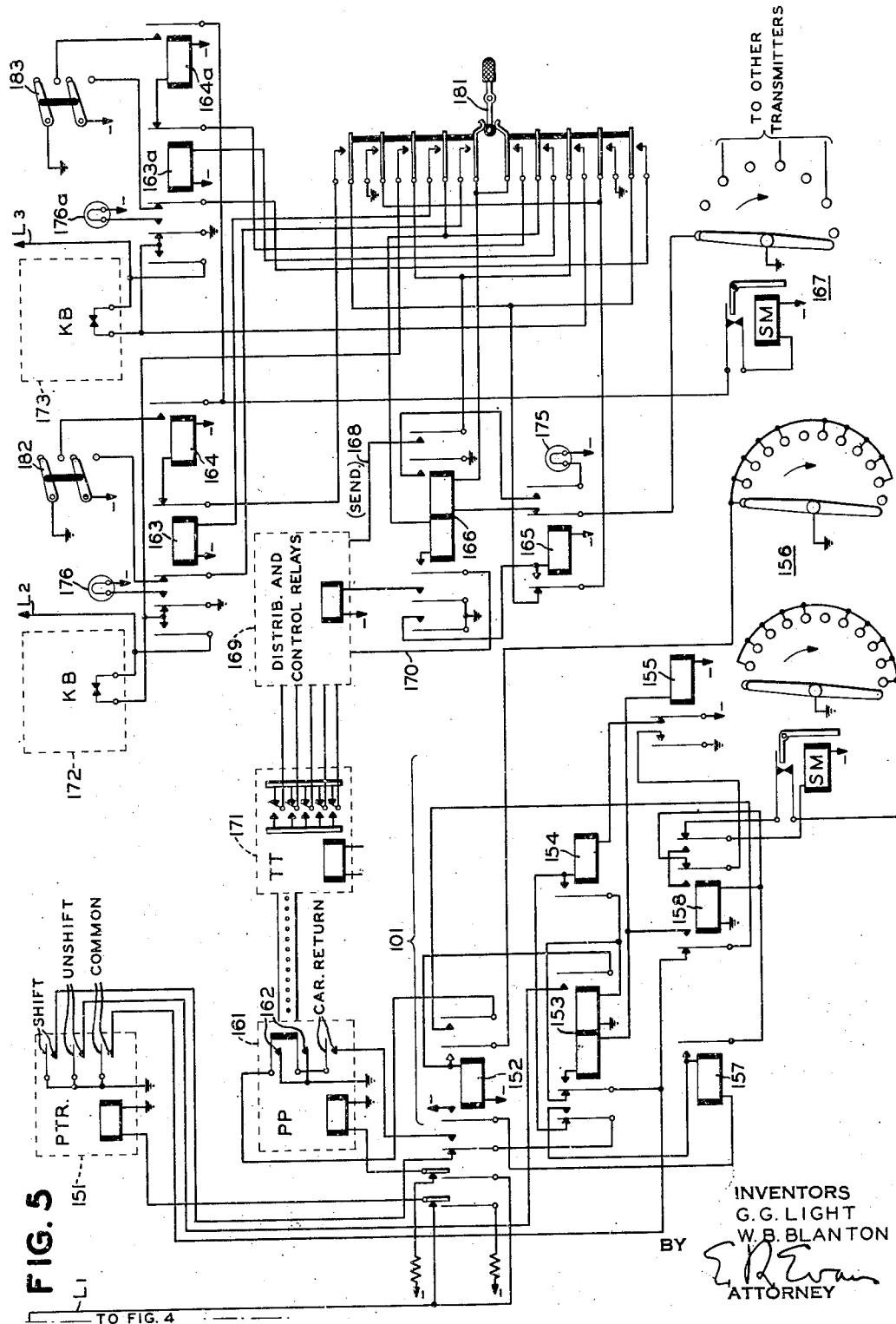
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## UNITED STATES PATENT OFFICE

2,484,838

## TELEGRAPH EXCHANGE SYSTEM

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Application August 3, 1940, Serial No. 350,402

20 Claims. (Cl. 178—2)

1

This invention relates to telegraph exchange systems and more particularly to systems of this character in which telegraph lines or channels are interconnected under the control of a switchboard operator or attendant at the exchange.

Line switching systems for interconnecting telegraph offices or patrons under the control of a switching operator or attendant at an exchange are disclosed in the prior patents to Wheeler et al. 2,193,810 and Blanchard et al. 2,193,811, granted March 19, 1940. In the systems disclosed in said patents, connections are made to outgoing lines or channels through a manual switchboard or equivalent switching equipment under the control of a switching operator. After connection has been made to a selected line or channel, transmission of the message is started as soon as the line or channel is available, and the line or channel is automatically released at the end of the message.

One object of the present invention is to enable the switching operator in a system of the above-described character to select at a remote point any desired one of a plurality of receiving or repeating units whereby messages sent over a single outgoing line circuit may be switched to separate receiving or terminal points. Each line circuit or channel preferably is provided with a plurality of switching terminals or switchboard jacks at the exchange and, in accordance with another feature of the invention, the particular jack or terminal selected by the operator determines the selection at the remote point without requiring the operator to send a selection code or a series of controlling impulses for switching the call.

The above-mentioned patents also disclose means for automatically transmitting service code signals accompanying successive messages sent over outgoing trunks or channels. Thus, for example, the messages transmitted over any particular line or channel may be numbered with consecutive numbers to facilitate the checking of accurate transmission and enable messages to be re-transmitted when desired. In accordance with another object of the present invention, means is provided for automatically transmitting consecutive numbers accompanying each series of messages to a particular destination even though the messages to different points may be transmitted over a common line circuit or channel. In this manner the messages for different destinations are numbered consecutively in each instance even though certain messages for dif-

2

ferent destinations are sent over the same line circuit or channel.

Another object of the invention is to provide an improved selector for telegraph communication which is controlled over the line circuit or channel used in the transmission of intelligence signals.

A still further object of the invention is to interlock the transmitting or repeating equipment sharing a common channel to prevent transmitting equipment from seizing a channel which is already in use or interfering with transmission in progress over said channel.

Other objects and advantages of the invention will become apparent from the following description of a preferred embodiment thereof shown in the accompanying drawings, wherein

Fig. 1 is a condensed diagram of the system; and

Figs. 2 to 5 are detailed circuit diagrams of the system shown in Fig. 1.

Referring to Fig. 1, a system embodying the invention may comprise a manual switchboard or equivalent means for connecting printing telegraph transmitters or repeating equipment to selected outgoing line circuits or channels. As shown, tape perforators 11 and 12 representing any sources of signals to be transmitted through the telegraph system have associated therewith tape transmitters 21 and 22 for repeating the signals stored in the tape through the cord circuits and connecting plugs 31 and 32. The switchboard in the arrangement shown for purposes of illustration comprises a plurality of sections represented by the switchboard jacks 41, 42, 43, 41a, 42a, 43a, into which the connecting plugs shown are inserted to extend connections from the tape transmitters to selected outgoing line circuits. It will be understood that the switchboard may include any number of sections and the corresponding jacks of each section are multiplied together, and that while only the three switchboard jacks at each section of the switchboard associated with a single outgoing line circuit 11 are shown, as many cord circuits and switchboard terminals are provided as are required to handle the traffic through the exchange.

Each series of multiplied switchboard jacks or line terminals of the line 11 is provided with a code transmitter or numbering machine NM1, NM2, NM3, in order that the messages for different destinations transmitted over the line 11 may be consecutively numbered in each instance. At the remote end of the line 11 a selector 101 is

provided which is controlled by signals transmitted by the numbering machines. Thus if the cord circuit of any transmitter, such as the transmitter 21 in cord circuit 31, having a message to transmit, is plugged into the jack 41, the numbering machine NM1 transmits a code which contains the number of the message and which leaves the line circuit L1 connected to the printer 151. If, however, the cord circuit is plugged into the jack 42 or 43, the selector 101 connects the line circuit L1 to the reperforator 161, and the message is numbered depending upon the number of the last message sent over the line L1 destined for either the line L2 or L3 to which connection is to be made through the reperforator 161 and its associated tape transmitter 171.

The local operator at the remote office notes the address of the message received on the reperforator 161 in case the repeating apparatus is intended to work into more than one line and selects the proper line by throwing the switch 181. Each of the lines L2 and L3 have keyboards or local transmitters 172 and 173 respectively associated therewith, whereby the operator may transmit messages over said lines when the repeater is not connected thereto. The switches 182 and 183 are provided for connecting the lines L2 and L3 either to transmitter 171 or to the local keyboard with interlocking features to prevent operation of the keyboard if the tape transmitter 171 has not released the transmitting circuit and to prevent the selection of the line by the switch 181 from rendering the tape transmitter 171 operative if the line has not been released from the local keyboard.

#### *Detailed description of the cord circuit*

The detailed circuits of the system shown in Fig. 1 are shown in Figs. 2 to 5, Fig. 2 representing a cord circuit arranged to extend the connection from the tape transmitter 21 through connecting plug 31 to the switchboard.

Referring to Fig. 2, it will be noted that only the complete circuit diagram of one cord circuit is shown, the cord circuit associated with the second tape transmitter 22 being indicated diagrammatically since it is identical with the cord circuit associated with the tape transmitter 21.

The tape connected to the tape transmitter 21 may be perforated by a printer perforator such for example as that shown in the patent to Dirkes et al., 2,174,731, granted October 3, 1939. The tape transmitter may be similar to that shown in the patent to Angel, 2,172,269, granted September 5, 1939. A distributor transmitter 40 is operatively associated with the tape transmitter 21, said distributor transmitter being similar in construction to that shown in the patent to Rothermel, 1,805,374, granted May 12, 1931, and comprises a series of contacts which are opened and closed at a predetermined time in order to control the operation of the tape transmitter and to time the transmission of the code impulses from the tape transmitter through the transmitting circuit including the tip contact of the connecting plug 31.

The operator notes the destination of each message received and inserts the plug 31 in the proper switchboard jack. As soon as the selected circuit becomes idle, the tape transmitter is rendered operative to repeat the message stored in the tape over the selected circuit in a manner similar to that disclosed in the above mentioned patents to Wheeler et al. and Blanchard et al. Each message is terminated by an end-of-mes-

sage signal which stops transmission and releases the line circuit. In the particular system shown by way of example, the end-of-message signal consists of a double carriage return (fourth impulse only marking) and each message is spaced from adjacent messages by at least six "unshifts" (all marking code combinations).

As shown, the marking bus bar of the tape transmitter is open circuited and the spacing bus bar 24 is connected to ground through circuits to be described below so that marking impulses are represented by zero current and spacing impulses by ground potential. The selectively operable contacts of the tape transmitter are connected respectively to the windings of relays 25, 26, 27, 28 and 29, so that said relays become energized when each contact engages the spacing bus bar. The storing relays 25 to 29 are thus operated in response to spacing impulses from the transmitter 21, and said relays control transmission of the permutation code signals through the cord circuit and switchboard, converting the marking impulses of the code into current impulses and the spacing impulses of the code into no-current impulses. The autostop contacts associated with the loop of tape between the reperforator and the tape transmitter are indicated at 45, said contacts being open when the tape loop becomes taut and being closed when the tape loop lengthens when a message is received on the reperforator.

When the cord circuit is not in use, the circuit of the spacing bus bar 24 of the tape transmitter may be traced through the right hand winding of relay 34, the normally closed contacts of the make-before-break contacts associated with the outer left hand armature of relay 36 and the right hand inner armature and back contact of relay 37 to ground. When a message is received on the reperforator associated with the tape transmitter 21, the contacts 45 close in response to the lengthening of the tape loop and close a circuit for energizing the clutch magnet of the distributor transmitter 40 which may be traced through the right hand armature and back contact of relay 34 and the second left hand armature and back contact of relay 36. The clutch magnet of the distributor transmitter 40 releases its cam shaft for one revolution thereby closing the circuit to the stepping magnet of the tape transmitter 21 through a circuit including the winding of relay 33, the left hand outer armature and back contact of relay 34, and the eighth contacts 62 of the distributor transmitter 40. The contacts 62 close momentarily at the end of the fifth pulse of the code transmitted by the transmitter 21 under the control of the distributor transmitter. Relay 33 becomes energized and locks up through a circuit including its right hand inner armature and front contact that is independent of the contacts of relay 34. When the stepping magnet of the tape transmitter 21 is energized, the pins are withdrawn from the tape and the contacts are all actuated into engagement with the spacing bus bar whereupon relay 34 becomes energized through the above described circuit to the contacts of the tape transmitter and through said contacts and the windings of relays 25, 26, 27, 28 and 29 to battery. Relay 34 becomes energized and opens the above described circuit to the clutch magnet of the distributor transmitter 40. When the contacts 62 of the distributor transmitter open, relay 33 and the stepping magnet of the tape transmitter 21 become deenergized. If

the character in the tape is the "unshift" or all marking code combination, all of the contacts of the tape transmitter engage the marking bus bar, thereby opening the circuit of relay 34 and said relay becomes deenergized to re-operate the distributor transmitter 40 and the tape transmitter 21 in the same manner as described above. In this manner the series of "unshift" code combinations perforated in the tape between messages are stepped through the tape transmitter without waiting for the connection to be made at the switchboard. However, as soon as the first code combination other than the all-marking code combination reaches the pins of the tape transmitter, relay 34 remains energized since at least one impulse of the code is spacing, thereby holding the circuit of the clutch magnet of the distributor transmitter 40 open. A circuit is now closed through the second left hand armature and back contact of relay 36, the right hand armature and front contact of relay 34, and the left hand armature and back contact of relay 33 for lighting the "message waiting" lamp 35 to indicate that a message has been received for retransmission through the switchboard.

When the operator plugs into the switchboard jack, a circuit is closed as will be described in detail hereinafter connecting battery potential through the ring contact of the switchboard jack, the winding of relay 47, second left hand armature and back contact of relay 48 and contacts of the interrupter 49 to ground, whereupon relay 47 becomes energized if the line circuit is idle. As explained in the above mentioned Blanchard patent, the purpose of the interrupter 49 and guard relay 47 is to prevent the cord circuit from transmitting to a busy line and to connect each one of a plurality of cord circuits plugged into the same line for operation one after the other. Assuming that the line circuit is idle, relay 47 locks up through a circuit including its right hand inner armature and front contact, the second left hand armature and back contact of relay 51 that is independent of the contacts of the interrupter 49. Thus a low resistance connection to the ground is provided for the ring contact of the switchboard jack which serves as a guard potential for the multiple jacks of the same line circuit.

Upon the energization of relay 47 a circuit is closed from ground upon the sleeve conductor through the right hand outer armature and front contact of relay 47 for energizing relay 48; said relay locks up through its left hand inner armature and front contact directly to the sleeve contact of the connecting plug 31. Upon the energization of relay 47 a circuit is also closed through its left hand inner armature and front contact for energizing slow release relay 52 and said relay locks up through its left hand armature and front contact to ground at the left hand inner armature and back contact of relay 51. The energization of relay 52 closes a circuit from ground through the right hand armature and front contact of said relay for energizing relay 36 whereupon the line circuit is closed to the tip contact of the connecting plug 31 through a circuit which may be traced from the left hand inner armature and front contact of relay 36, the winding of relay 53 and the normally closed or rest contacts of the distributor transmitter 40 to battery. It will be understood that the first five contacts of the distributor transmitter which are connected to battery in parallel with the rest contacts serve to time the five code impulses set up on the contacts of the

tape transmitter and thereby transmit the code impulses in succession through the transmitting circuit just described including the tip contact of the connecting plug 31.

The energization of relay 36 closes through its right hand armature and front contact a second locking circuit for relay 47; opens at the contacts associated with the outer left hand armature of said relay the circuit of the clutch magnet of the distributor transmitter 40 employed for idling the "unshift" code combinations through the tape transmitter; opens the circuit of relay 34 and transfers the circuit of the spacing bus bar 24 of the tape transmitter 21 to ground through a circuit that is independent of relay 34. The cord circuit is now in readiness to transmit when the control relay to be referred to hereinafter is operated. This closes the transmitting circuit through the tip of the switchboard plug to battery at the contacts of the distributor transmitter 40 whereupon relay 53 becomes energized and closes a circuit through its armature and front contact, the right hand outer armature and back contact of relay 55, the winding of relay 56 and the left hand outer armature and back contact of relay 51 whereupon relay 56 becomes energized and closes a circuit through its left hand outer armature and front contact for shunting out the winding of relay 53 from the line circuit. Relay 56 locks up through a circuit including its left hand armature and front contact and the first bank contact of the second switch wiper of the step-by-step switch 60. The energization of relay 56 also closes a circuit for energizing the clutch magnet of the distributor transmitter 40 which circuit may be traced through said clutch magnet, contact 45, the right hand outer armature and back contact of relay 37, the left hand outer armature and front contact of relay 47, and the right hand armature and front contact of relay 56. Thereupon the distributor transmitter 40 is rendered operative to control the stepping of the tape transmitter for transmission of the successive characters in the message through the line circuit described above including the tip contact of the switchboard plug 31.

As stated above, successive special code combinations such as No. 4 marking ("carriage return") are appended to the message as an end-of-message signal, followed by at least six "unshifts" for spacing messages in the tape. When a character having only the fourth impulse marking reaches the pins of the tape transmitter 21, relays 25, 26, 27 and 29 will be energized and relay 28 deenergized. When the contacts 61 of the distributor transmitter 40 close during the fourth pulse (remaining closed until the end of the fifth pulse) a circuit is closed through the left hand outer armature and back contact of relay 37, the right hand outer armature and front contact of relays 25, 26, 27 and 29, the right hand outer armature and back contact of relay 28, the armature and back contact of relay 65, the winding of relay 66, the armature and back contact of relay 67 to battery, whereupon relay 66 becomes energized. When the contacts 51 of the distributor transmitter open at the end of the fifth pulse, relay 65 becomes energized through a circuit that may be traced through the inner armature and locking contact of relay 66 and winding of relay 65, and the third left hand armature and front contact of relay 36 to ground. If the following character is not a "carriage return," a circuit is closed upon receipt of this character for energizing relay 67 through the left hand outer arma-

7

ture and front contact of relay 66, and the outer armature and back contact of one of the relays 25, 26, 27 or 29, the left hand outer armature and back contact of relay 37 and the contact 61 of the distributor transmitter 40, whereupon relay 67 becomes energized and releases relays 55 and 66. If, however, two "carriage returns" are transmitted in succession, a circuit is closed through the contacts of relays 25 to 29, the armature and front contact of relay 65, and the winding of relay 55 for energizing the latter relay. When the contacts 61 open, relay 37 operates in series with the locking contact of relay 55, relay 37 operating at substantially the end of the fifth pulse of the second "carriage return" signal. The energization of relay 55 as described removes a short circuit through its left hand outer armature and back contact around the winding of relay 53 and closes a circuit through its right hand inner armature and front contact to the left hand winding of relay 34 to cause the latter to operate and lock up when relay 33 operates. The energization of relay 37 as described opens at its outer right hand armature and back contact a circuit through the autostop contacts 45 for controlling the clutch magnet of the distributor transmitter 40. The energization of relay 37 also opens at its inner right hand armature and back contact the ground connection to the spacing bus bar of the tape transmitter so that if the distributor transmitter 40 is operated, "unshifts" or all-marking code combinations will be transmitted through the cord circuit to the line regardless of the position of the contacts of the tape transmitter. In addition, the contacts 61 of the distributor transmitter 40 are connected through the two left hand armatures and front contacts of relay 37 to the operating magnet of the step-by-step switch 60 whereby the wipers of said switch will be advanced one step for each cycle of operation of the distributor transmitter until the relay 37 is released. The distributor transmitter 40 is now operated since the circuit of the clutch magnet thereof is closed through the right hand outer armature and front contact of relay 37, the left hand outer armature and front contact of relay 47, and the right hand armature and front contact of relay 56 to ground. During each rotation of the cam shaft of the distributor transmitter an "unshift" or all-marking code combination is transmitted to the line and the wipers of the step-by-step switch 60 are stepped from one bank contact to the next. The tape transmitter 21 remains inoperative and no tape is stepped therethrough during the transmission of these "unshift" code combinations. At the end of the fifth all-marking code combination, the switch wipers of the switch 60 step into engagement with their sixth contacts and the holding circuit of relay 56 is opened at the second switch wiper of said step-by-step switch. However, relay 56 remains locked up through its left hand inner armature and front contact and the right hand outer armature and front contact of relay 55 to ground at the armature and front contact of relay 53 until relay 53 opens upon the start pulse of the sixth all-marking code combination. The deenergization of relay 56 opens at its right hand armature the circuit of the clutch magnet of the distributor transmitter 40 and its cam shaft stops at the end of the sixth "unshift" code combination. Thus the wipers of the step-by-step switch 60 step into engagement with their seventh bank contacts at the end of the sixth all-marking code combination and a

8

circuit is closed from ground through the second switch wiper, the seventh bank contact in engagement therewith, the winding of relay 51 to battery, whereupon relay 51 becomes energized. Relay 51 locks up through its right hand armature and front contact to ground at the second left hand armature and front contact of relay 36. The energization of relay 51 opens the circuits of relays 47 and 52 whereupon said relays become deenergized, relay 52 closing a circuit through its right hand armature and back contact and the right hand armature and front contact of relay 48 for lighting the disconnect lamp 70. The deenergization of relay 52 releases relay 36 to open the line circuit and to release relays 37, 55, 65 and 66, which are locked up through the third left hand armature and front contact of relay 36. Relay 52 is slow to release in order to permit relay 36 to hold up until the release of the relays associated with the line circuit has placed idle battery back on the line to prevent a momentary interruption of the line circuit.

#### *Line circuit control and transmission by numbering machine*

Referring to Figs. 3 and 4, when the plug 31 is inserted in the jack 41, a circuit is closed through the upper make contacts of said jack and the winding of relay 81. Upon the energization of relay 81 a circuit is closed from ground through relay 47 of the cord circuit, the ring conductors of the plug and jack, the winding of relay 82, the left hand armature and back contact of relay 83, the left hand outer armature and back contact of relay 84, the armature and front contact of relay 81, the inner left hand armature and back contact of relay 84 and resistance 85 to battery. Relay 82 becomes energized and connects a shunt circuit including resistance 86 around the resistance 85 to drop the voltage on the sleeve contacts of the switchboard jacks to condition the jack circuit at the time of disconnect until the control relays release. The energization of relay 82 closes a circuit through its inner right hand armature and front contact for initiating the operation of the numbering machine NM1. In a similar manner if the plug 31 has been inserted in jack 42, relay 82a would have been operated instead of relay 82 and the numbering machine NM2 would be rendered operative instead of the numbering machine NM1. Additional switchboard jacks, control relays and numbering machines may be provided as indicated.

In the system shown a single distributor may be seized temporarily by any of the numbering machines while the number is being transmitted and then released for operation with other numbering machines, associated with either the same or another outgoing line. The switches 91 and 92 shown in Fig. 4 are utilized to temporarily associate the distributor 93 with a numbering machine, for example NM1 in case the cord circuit is plugged into the jack 41. The distributor 93 may also be similar to that shown in the above mentioned patent to Rothermel. A second distributor may also be provided and when the busy key 94 is operated, the start circuit for the switches 91 and 92 is switched through the second key 94a to the second distributor control unit. The switches 91 and 92 are arranged to connect the circuits of the distributor contacts to any of the numbering machines and therefore the description of the operation in connection with one of the machines will suffice. Upon energization of relay 82 as described a circuit is

closed from ground through the right hand inner armature and front contact of relay 82, the third left hand armature and back contact of relay 84, the left hand armature and back contact of relay 95, conductor 96, the normally closed contacts of the key 94, the armature and back contact of relay 97, the right hand outer armature and back contact of marginal relay 98 and the right hand winding of relay 99 to battery. Relay 99 becomes energized and locks up through its right hand armature and front contact, the right hand armature and back contact of relay 103 and the winding of relay 97 to ground at the contacts of relay 82, which circuit is independent of contacts of relay 98. Upon the energization of relay 99 a stepping circuit for the switch 92 is closed through the stepping magnet of said switch, the second left hand armature and front contact of relay 99, the left hand armature and back contact of relay 104, the sixth switch wiper of the switch 92 in engagement with its first bank contact, conductor 105, and the inner right hand armature of relay 82 when said relay is deenergized. This causes the switch 92 to step over the contacts individual to relays 82, 82a, and so forth, which are not operated. Assuming, however, that the relay 82 is energized as described, the switch 92 will not step since the first bank contact corresponds to the switchboard jack 41 and a circuit is closed through the stepping magnet of the switch 92 and battery, the left hand outer armature and front contact of relay 99, and the winding of relay 104 for energizing said relay to ground the contact associated with the sixth switch wiper of the switch 92 so that other finder switches in multiple will not stop on the first bank contact. The energization of relay 104 also closes a circuit from battery through the winding of marginal relay 98, the right hand armature and front contact of relay 104 and the winding of relay 107 to ground at the interrupter contacts associated with the stepping magnet of switch 91. Marginal relay 98 does not become energized in series with relay 107 but the latter becomes energized and closes a self-interrupting circuit for stepping the step-by-switch 91 until the sixth wiper thereof engages the bank contact which is grounded through the eighth wiper of the switch 92. The switches 91 and 92 then have their wipers in corresponding positions to jointly control the circuits of the numbering machine NM1 to be operated and the contacts of the distributor 93. Ground potential on the sixth wiper of switch 91 applied directly through the right hand armature and front contact of relay 104 to the winding of relay 98 causes said relay 98 to become energized thereby shunting the relay 107 to cause switch 91 to stop stepping. The energization of relay 98 transfers the start circuit through its right hand outer armature and front contact to the second distributor in case another numbering machine is operated before the distributor 93 is released. A circuit is now closed through the second left hand armature and back contact of relay 84, the winding of relay 95, conductor 108, the fourth switch wiper of switch 91, the winding of relay 103, the second right hand armature and front contact of relay 98, the left hand inner armature and front contact and left hand winding of relay 99 to battery, whereupon relay 95 becomes energized to open the start circuit including the conductor 96 and remove idle battery from the line circuit. The line circuit now extends through the normally

closed contacts of the make-before-break contacts associated with the outer right hand armature of relay 84, conductor No. 6 of the cable 109, the seventh switch wiper of switch 92, the inner right hand armature and front contact of relay 98 and the rest contacts of the distributor 93. The clutch magnet circuit of the distributor 93 is closed through the left hand outer armature and front contact of relay 103 to ground at the first switch wiper of switch 91. The operation of the distributor 93 closes a stepping circuit for the numbering machine NM1 through the right hand armature and back contact of relay 83, the second switch wiper of switch 91, the second left hand armature and front contact of relay 103, and the contacts 117 of the distributor. The numbering machines may be similar to those disclosed in the patent to Dirkes et al. 2,193,809, granted March 19, 1940 (Figs. 17 to 20). The numbering machine operates as described in said patent to transmit a series of code combinations to the line including the number of the message to the particular destination selected. The series of code combinations transmitted by the numbering machine also includes as the first three elements of said series three "unshift" code combinations. This operates to transmit the message to the printer 151, Fig. 5. On the other hand the numbering machines NM2, NM3 send as the first three elements of the series of code combinations, "shift," "unshift," "unshift," which is operative as will be explained below to select the reperforator 161 in the case of messages being transmitted over line L2 or L3. As the numbering machine steps in the tenth character, the control contacts 112 close to connect battery through the conductor 113, the third switch wiper of the switch 91, and the left hand inner armature and front contact of relay 103, to the winding of relay 114, whereupon said relay becomes energized and locks up through its left hand armature and front contact to battery at the left hand armature and front contact of relay 98. Immediately following the fifth pulse of the tenth character the closure of the contacts 116 of the distributor 93 closes a circuit through the right hand armature and front contact of relay 114, the fifth switch wiper of switch 91, conductor 117 and the winding of relay 84 to battery whereupon relay 84 becomes energized. The energization of relay 84 switches the line circuit from the numbering machine through the right hand outer armature of said relay to the tip of the jack 41 and causes the operation of relay 53 in the cord circuit to start the operation of the tape transmitter 21 in the manner described above. The energization of relay 84 opens at its second left hand armature and back contact the operating circuits of relays 95 and 103 and the holding circuit of relay 99, whereupon the distributor control and numbering machine circuits are restored to normal. Relay 104 is a slow release relay in order to delay the release of relay 98 until the cam shaft of the distributor 93 has come to rest. Relay 99 is now in readiness to respond to a request for connection to some other sending circuit whereby the distributor 93 may be utilized by another numbering machine.

At the termination of the message, relay 51 becomes deenergized as described above, thereby opening circuits through the ring contact of the plug and jack which causes relay 82 to release. The release of relay 82 opens at its second right hand armature and front contact the locking circuit of relay 84, whereupon said relay becomes

deenergized and connects line battery at the contacts of relay 95 to the line circuit L1. The sending circuit is now in readiness to operate when another circuit is plugged into a jack connected in multiple with the jack 41.

If desired, electromagnetic counters 120 may be connected to contacts 121 of the numbering machine to indicate the actual number last transmitted by said machine. The counters 120 may be disposed on the switchboard or within view of the operator in order to make it possible for the operator to number the message blanks at the transmitting office in accordance with the numbers transmitted over the line.

#### *Receiving circuit and line selector*

At the remote office or station (Fig. 5), the line circuit L1 terminates at the printer 151 but may be transferred by the energization of relay 152 in a manner to be described hereinafter to the printer perforator 161. The perforator 161 and associated tape transmitter 171 constitute a signal repeater for storing and retransmitting messages between lines L1 and L2 or L1 and L3.

The printer 151 is provided with contacts which are closed upon the receipt of predetermined code combinations such as the "shift" and "unshift" code combinations as indicated. For example these contacts may be operated by the pull bars or elements connected to said bars in the usual manner. The printer is also provided with other contacts labeled "common contacts" which are closed during each cycle of operation of the printer for a period which overlaps the momentary closure of the "shift" and "unshift" contacts. Similarly, the printer perforator 161 may be provided with selectively operable contacts closed upon the receipt of the "carriage return" code combination, for example in the manner disclosed in the patent to Dirkes et al. 2,143,828, granted January 10, 1939 (see Figs. 8 and 9). The printer perforator 161 is further provided with a pair of contacts 162 operated for example by the punch bar to be closed during each cycle of operation of the perforator.

If the message is preceded by three "unshift" code combinations transmitted as described above by the automatic code transmitter NM1, the line circuit remains connected to the printer 151 which receives the message. On the other hand if the message is preceded by a "shift" code combination followed by two "unshift" code combinations, the relay 152 becomes energized and transfers the line circuit through its third left hand armature and make contact to the printer perforator 161, connecting the printer 151 to battery through the outer left hand armature and make contact of said relay. It will be apparent that the receipt of the first "shift" code combination closes a circuit from ground through the "shift" contacts of the printer 151, the second left hand armature and back contact of relay 152, the outer left hand armature and back contact of relay 153, the winding of relay 154 and the inner armature and back contact of relay 155 to battery whereupon relay 154 becomes energized. When the "shift" contact at the printer opens, relay 154 locks up through its armature and front contact and the right hand winding of relay 153, whereupon relay 153 also becomes energized. If the next contact is anything except "unshift," the closure of the common contacts operates the release relay 155 through the left hand winding and inner left hand armature and front contact of relay 153, thereby releasing relays

153 and 154 when the common contacts of the printer open. If, however, the second code combination is an "unshift" code combination, the closure of the "unshift" contacts of the printer 151 closes a circuit through the right hand armature and front contact of relay 153 for energizing relay 152 to transfer the line circuit to the printer perforator 161. An additional "unshift" code combination is sent in order to prevent any possibility of the printer perforator dropping or mutilating the first character of the message. Relay 152 remains locked up through its inner right hand armature and front contact to the right hand switch wiper of the step-by-step switch 156 during the transmission of the message.

At the end of the message, the receipt of the end-of-message signal consisting of two "carriage return" code combinations and six "unshifts" causes the line circuit to be transferred back to the printer 151 by the release of relay 152. When the "carriage return" contacts of the perforator 161 close, a circuit is closed through the common contacts and carriage return contacts of the perforator 161, second left hand armature and front contact of relay 152, the left hand outer armature and back contact of relay 153, the winding of relay 154 and the inner armature and back contact of relay 155 whereupon relay 154 becomes energized and locks up in series with the right hand winding of relay 153 when the "carriage return" contacts of the perforator open. The receipt of a single "carriage return" code combination followed by a different code combination releases relays 153 and 154 in an obvious manner. However, if the first "carriage return" code combination is followed by a second identical code combination, a circuit is closed through contacts of the perforator 161, the second left hand armature and front contact of relay 152, the outer left hand armature and front contact of relay 153, the winding of relay 157 and the inner left hand armature and front contact of relay 152 to battery, whereupon relay 157 becomes energized. When the punch hammer or common contacts 162 of the perforator 161 close, a circuit is closed through said contacts, the outer right hand armature and front contact of relay 152, the left hand armature and back contact of relay 153, the inner left hand armature and front contact and left hand winding of relay 153, and the winding of relay 155, whereupon relay 155 becomes energized. The operation of relay 155 releases relays 153 and 154, and when relay 155 releases at the end of the carriage return, thereby removing ground from the right hand terminal of the winding of relay 153, relay 153 becomes energized in series with relay 157.

Upon the receipt of the next code combination which may be assumed to be the "unshift" code combination, the closure of the punch hammer contacts of perforator 161 closes a circuit through the right hand outer armature and front contact of relay 152 and the left hand armature and front contact of relay 158 for reoperating relay 155. The energization of relay 155 closes a circuit through its outer armature and front contact and the right hand armatures and front contacts of relay 158 for energizing the stepping magnet of the switch 156 and the wipers of said switch take their first step upon the deenergization of the stepping magnet. In a similar manner the intermittent closure of the punch hammer contacts of perforator 161 upon the receipt of the following code combinations effects the continued

13

stepping of the switch 156 until the wipers engage their sixth contacts. When the right hand switch wiper of the switch 156 engages its sixth bank contact, the locking circuit of relay 152 is opened and said relay becomes deenergized. The deenergization of relay 152 opens the circuits of relays 157 and 158 and said relays are also released. However, the switch 156 takes one additional step by reason of the circuit closed through the left hand switch wiper in engagement with its sixth bank contact, the interrupter contacts of said switch and the right hand outer armature and back contact of relay 158 for energizing the stepping magnet of the switch. Thus it will be seen that at the end of each message which has been switched to the printer perforator 161, the line is switched back to the printer 151.

Assume that the message received on the printer perforator 161 is to be transmitted over the line L2. The local operator notes the destination of the message and actuates the three-position locking key 181 to close its upper set of contacts. The keyboards 172 and 173 have their contacts connected in series relation to the lines L2 and L3 respectively so that when the switches 182 and 183 are in the positions shown, the operation of either keyboard transmits signals over the corresponding lines L2 and L3. In order to release the keyboard and permit transmission over the lines L2 or L3 from the tape transmitter 171, the switches 182 and 183 are actuated to their alternate positions and the subsequent actuation of the key 181 connects the tape transmitter to one or the other of said lines.

Upon the closure of the upper set of contacts of the key 181 and assuming that the switch 182 has been operated to release line L2 and connect battery and ground to the contacts of relays 163 and 164, a circuit is closed through the winding of relay 164, the right hand armature and back contact of relay 163, the upper contacts of the key 181, the left hand armature and back contact of the transmitter holding relay 165, and the second upper set of contacts of key 181 to ground, whereupon relay 164 becomes energized. If the wiper of the allotter switch 167 is not in engagement with its bank contact corresponding to the position shown, a circuit is closed to the stepping magnet and interrupter contacts of the switch 167 and the armature and front contact of relay 164 to ground at the switch 182 to drive the switch 167. When the wiper of the switch 167 reaches the position shown, a circuit is closed from ground through said wiper, the right hand inner armature and back contact of relay 165, the right hand winding of the transmitter start relay 166, the fifth set of contacts of the key 181, the left hand inner armature and back contact of relay 163 and the switch 182 to battery, whereupon relay 166 becomes energized and closes the sending circuit 168 from the distributor transmitter 169, through the right hand outer armature and front contact of said relay, the third set of contacts of the key 181 and the left hand outer armature and front contact of relay 163. Relay 163 becomes energized in response to the energization of relay 166 through a circuit that may be traced through the fourth set of contacts of the key 181, the left hand winding and left hand inner armature and front contact of relay 166 to ground on the conductor 170 which is grounded at the distributor 169 until the end of the message, in a similar manner to the operation of the distributor and control relays in the cord circuit of Fig. 2.

14

The energization of relay 166 also closes a circuit through the outer left hand armatures and front contacts thereof for energizing the clutch magnet of the distributor 169 and relay 165. Relay 165 becomes locked up through its left hand armature and front contact to ground at the second set of contacts of the key 181 and closes the circuit of the lamp 175 through its right hand outer armature and front contact, said lamp remaining lighted until relay 166 is released at the end of the message. The energization of relay 163 lights the "busy" lamp 176 at the keyboard to indicate to the operator that transmission to a line is being effected through the repeater equipment. The tape transmitter 171 may be connected to line L3 in a similar manner by actuating the key 181 to close the lower set of contacts. When the transmission of a message is completed, the operator restores the key 181 after noting that the lamp 175 has been extinguished thereby releasing the line and the associated control relays. It will be noted that even if the switch 182 or 183 is restored to the position shown during transmission from the tape transmitter 171, the operation of the tape transmitter is not affected and the keyboard 172 or 173 cannot be utilized to transmit to the line which is in use since the contacts of said keyboard are short circuited by the left hand outer armature and front contact of relay 163 or 163a.

Various modifications in the system shown and described 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.

We claim:

1. A telegraph exchange system comprising a first office, a second office remote from said first office, a line or channel connecting said offices, said line or channel having a plurality of terminals at said first office and terminating in selective switching equipment at said second office, means at the first office for extending calls to said line or channel and means automatically controlled by the particular line terminal selected at said first office in switching through a call for directly controlling said selective switching equipment at said second office.
2. A telegraph exchange system comprising a first office, a second office remote from the first office, a line or channel connecting said offices, printing telegraph apparatus at said offices including transmitting means at the first office, selective switching equipment at the second office for extending calls to any one of a plurality of receiving points, an automatic code transmitter at the first office, means including said code transmitter for directly controlling said selective switching equipment over said line or channel and means for initiating the operation of said code transmitter when a call is made to said second office over said line or channel.
3. A system as set forth in claim 2 in which means is provided for initiating the operation of the code transmitter upon the connection of the transmitting means at said first office to the line or channel to the second office.
4. A system as set forth in claim 2 in which the line or channel is provided with a plurality of sending terminals at the first office and an automatic code transmitter is operatively associated with each of said terminals and arranged to send different codes to variably control said selective switching equipment.

5. A system as set forth in claim 2 embodying means whereby the code transmitter sends both switch-controlling impulses and service code signals or numbers to the printing telegraph apparatus.

6. In a telegraph system, lines or channels, switching means for selecting a desired one of said lines or channels, means for numbering successive calls over said lines or channels, means for controlling said numbering means to send consecutive numbers accompanying messages to the same destination even though messages for different destinations are sent over the same line or channel and means including said numbering means to control said switching means.

7. A printer selector for connecting a normally inoperative circuit or receiving unit to a transmitting line comprising contacts, means for operating said contacts upon the receipt of a predetermined code combination, other contacts, means for operating said other contacts during each cycle of the printer and circuit-controlling means jointly controlled by said contacts.

8. In a telegraph system, a printer, a line terminating at said printer, a repeater adjacent said printer, means including the printer for switching the line to said repeater and means for switching the line back to said printer at the end of every message sent to the repeater.

9. In a telegraph system, a line, a keyboard transmitter for transmitting over said line, repeating apparatus for repeating printer signals over said line, a manually operable switch for releasing said line from said keyboard transmitter and means for rendering said repeating apparatus operative when said switch is operated and preventing the operation of said keyboard transmitter until the repeating apparatus has completed transmission of a message.

10. A telegraph exchange system comprising an office, outgoing lines or channels from said office, printing telegraph transmitting apparatus for transmitting messages over said lines or channels, means including a plurality of service code transmitters operatively associated with a single one of said lines or channels for appending a variable predetermined group of signals to the messages sent over said single line or channel, switching means at the remote end of said single one of said lines or channels and means including one of said service code transmitters for controlling said switching means.

11. A telegraph exchange system comprising an office, outgoing lines or channels from said office, printing telegraph transmitting apparatus for transmitting messages over said lines or channels, means including a code signal generating means associated with a single one of said lines or channels for sending a selecting code accompanying each message sent over said single line or channel, means for successively initiating the operation of said code signal generating means and means responsive to the selecting codes for switching the messages to different points.

12. A telegraph exchange system comprising an office, outgoing lines or channels from said office, printing telegraph apparatus in said office, switching means in said office for selectively connecting said apparatus to said lines or channels, code-transmitting means associated with each of said lines or channels, means for initiating the operation of said code-transmitting means after each connection to a line or channel and means to vary the transmitted code in accordance with the mode of operation of said switching means.

13. A telegraph exchange system comprising a plurality of lines or channels, a switchboard containing terminals of said lines or channels, certain of said lines or channels having more than one terminal in each section of the switchboard, a plurality of storage transmitters, cord circuits for selectively connecting said transmitters to desired lines or channels at said switchboard, code transmitters for generating predetermined code signal groups in the respective lines or channels, means for rendering said code transmitters operative when connections are made to said lines or channels, and means for selecting a desired code transmitter for operation in response to the selection of a particular terminal in the case of transmission over one of said certain lines or channels having a plurality of terminals.

14. Line switching mechanism comprising a printer responsive to code impulses, said printer being provided with means for operating contacts only upon the receipt of predetermined code signals and for operating other contacts during each operating cycle of the printer, relays connected to both said contacts and said other contacts of the printer, and a line switching device controlled by said relays upon the receipt of predetermined code signals by the printer.

15. Line switching mechanism for a telegraph line comprising a first printer and a second printer responsive to code impulses, a relay arranged to connect said line alternatively to either printer, contacts on both printers and means for operating the same only upon the receipt of predetermined code signals by the operating printer, and means connected to said contacts for controlling the energization and deenergization of said relay.

16. A telegraph system comprising a line, two printers at one end of said line each provided with code-responsive contacts, and means including said contacts for rendering either printer responsive to signals transmitted over the line and excluding the other printer until it is selected.

17. A printing telegraph system comprising a line circuit terminating in a printer, means for transmitting messages separated by switching signals over said line circuit, a reperforator adjacent said printer, means responsive to switching signals for switching the line circuit to said reperforator for some but not all of the messages and for invariably switching the line circuit back to the printer after reception of a message switched to the reperforator and means including said reperforator for repeating messages received thereby.

18. A printing telegraph system comprising an incoming line, an outgoing line, repeating apparatus for retransmitting over said outgoing line signals received over said incoming line, a local transmitter for said outgoing line and means whereby the repeating apparatus controls the local transmitter to prevent interference in case of concurrent operation of said transmitter and said repeating apparatus.

19. The method of operating two telegraph systems, the second of which includes a storage controlled transmitter, which comprises sending from a station on the first system to a station common to the first and a second system a series of code combinations including a code combination designed to identify a station of the second system together with each message, causing the code combination to control the recording of the message at the common station when the code combination identifies the common station, and causing the storage of the message in the storage of

the storage controlled transmitter of the second system when the code combination identifies some station of the second system other than the common station.

20. A combination of signaling equipment comprising an incoming transmission channel supplying permutation codes including directing codes and message codes, a plurality of recording instruments capable of recording said message codes, means normally associating one of said instruments with said source for recording of incoming message codes, selective switching means controlled by one of said instruments in response to directing code combinations for disassociating said one instrument from operative association with said source and associating the other therewith, and means including means responsive to an end-of-message signal for returning said one instrument to the normal association with said channel.

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