

March 19, 1940.

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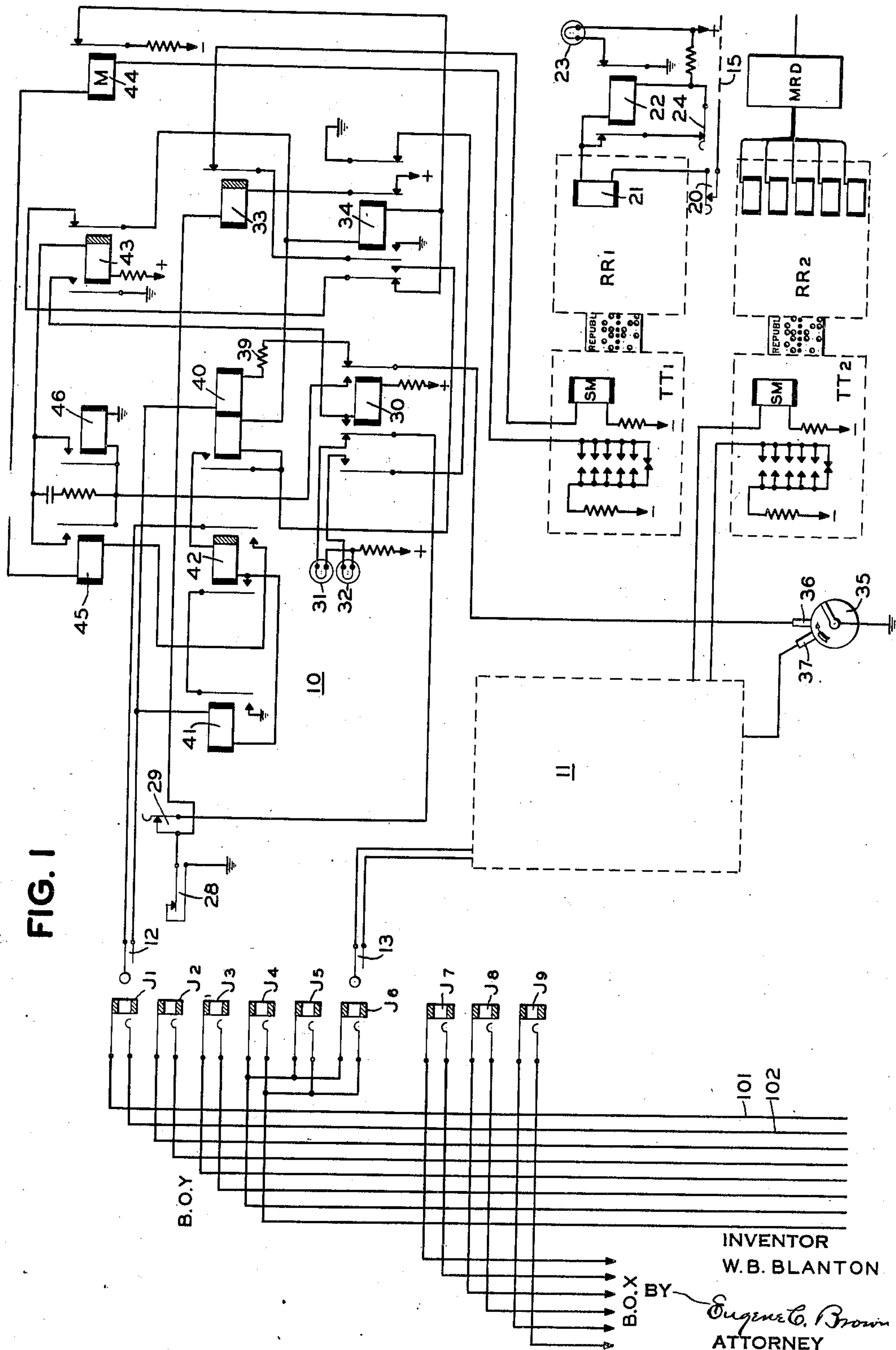
2,193,812

TELEGRAPH EXCHANGE SYSTEM

Original Filed Oct. 30, 1936

3 Sheets-Sheet 1

FIG. 1



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3 Sheets-Sheet 2

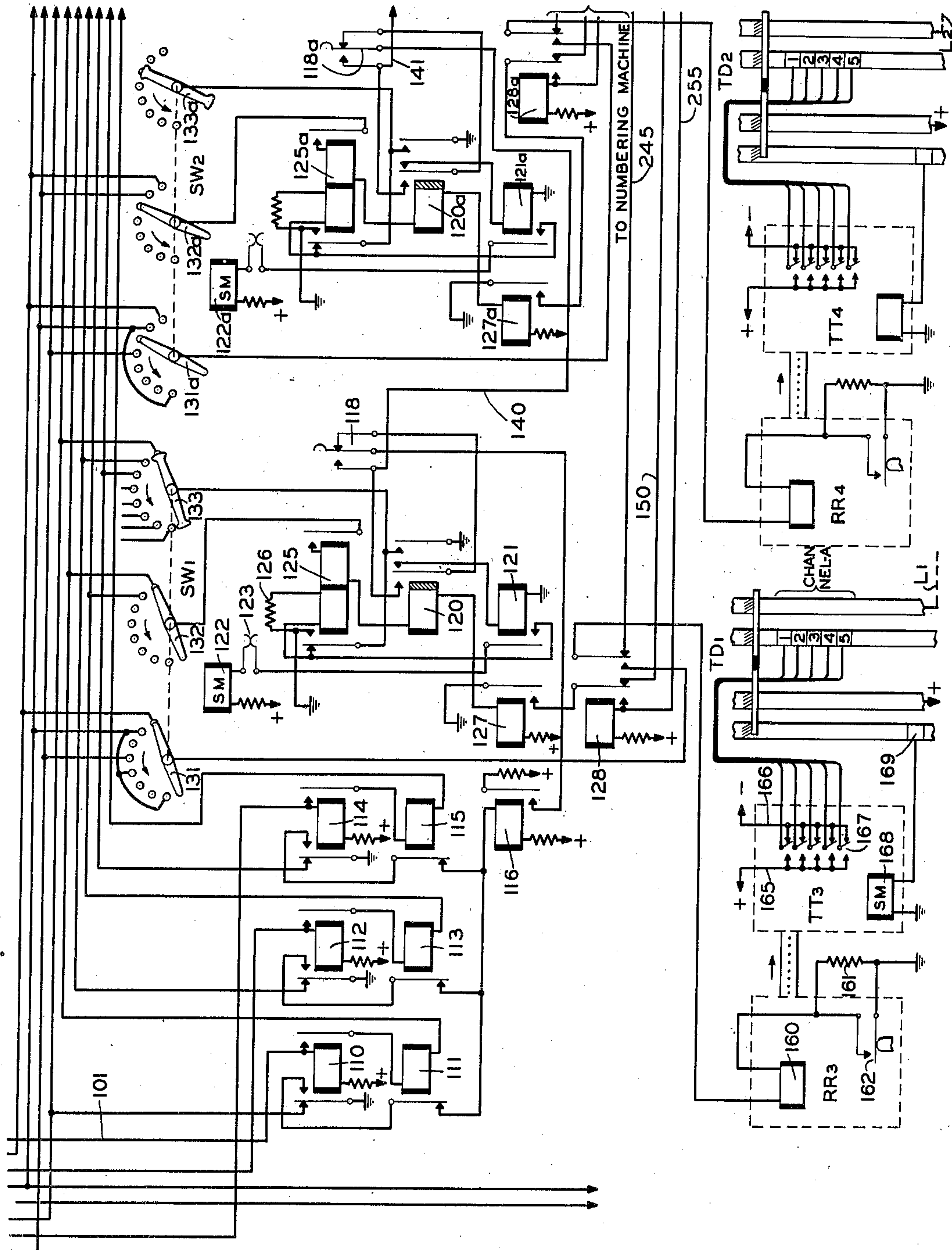


FIG. 2

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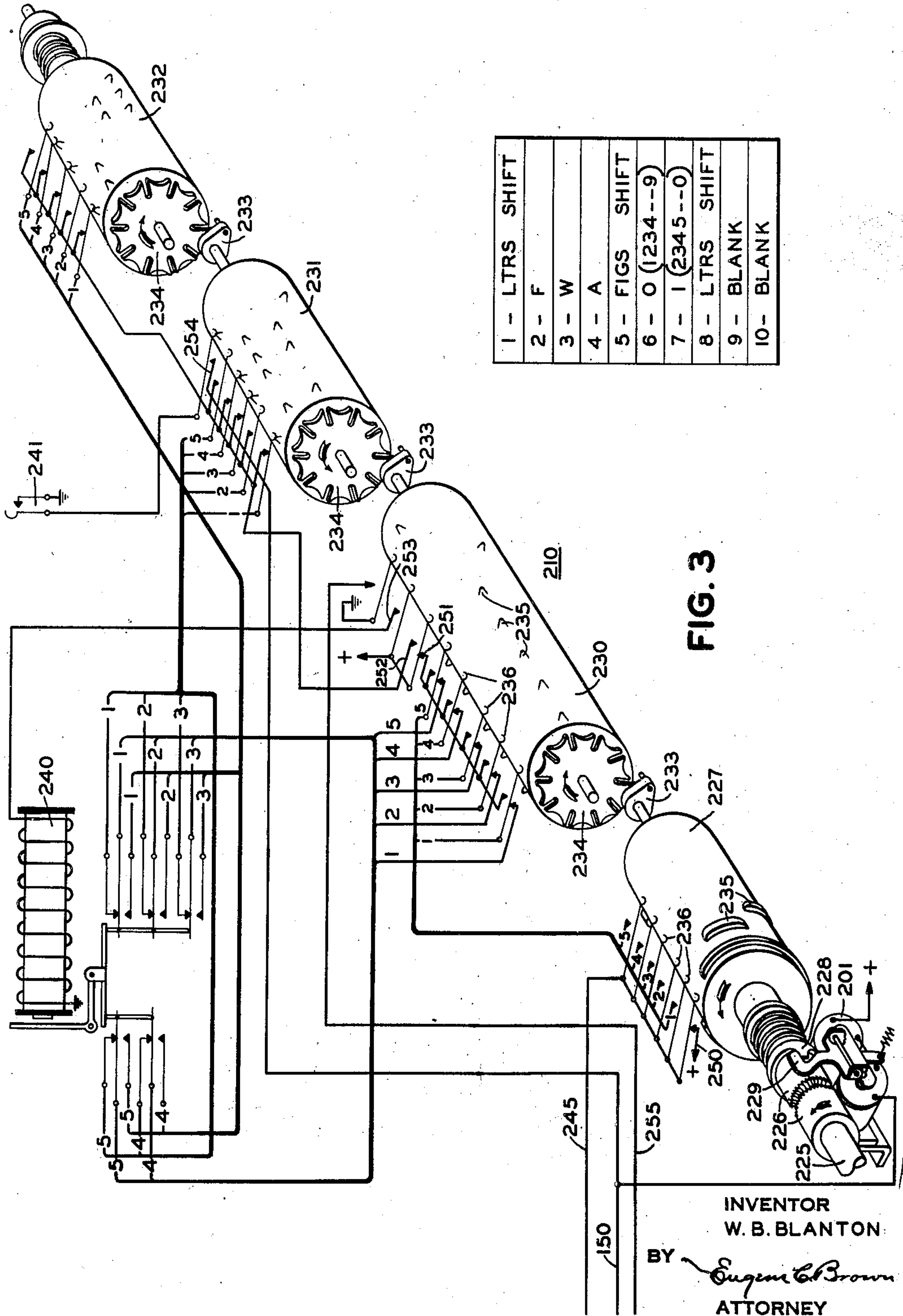
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TELEGRAPH EXCHANGE SYSTEM

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3 Sheets-Sheet 3



1 -	LTRS	SHIFT
2 -	F	
3 -	W	
4 -	A	
5 -	FIGS	SHIFT
6 -	O	(1234--9)
7 -	I	(2345--0)
8 -	LTRS	SHIFT
9 -	BLANK	
10 -	BLANK	

FIG. 3

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2,193,812

TELEGRAPH EXCHANGE SYSTEM

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Application October 30, 1936, Serial No. 108,495
Renewed November 15, 1939

16 Claims. (Cl. 178—2)

This invention relates to telegraph exchange systems and more particularly to printing telegraph systems provided with machine switching apparatus for distributing calls or messages to idle lines or channels of a group, such as a group of interoffice trunks or channels.

One object of the invention is to provide, in a telegraph exchange system having selective switching apparatus, improved means for seizing an idle line or channel of a selected group.

Another object of the invention is to provide in a system of the character described signal-storage and repeating means individual to each interoffice trunk or channel, preferably arranged to store message signals from the transmitters at a higher rate than the signals may be repeated over the trunk or channel.

A further object of the invention is to provide a system of the character described in which transmission is stopped automatically and the trunk released at the end of each message group of signals.

A further object of the invention is to provide a message distributing system in a telegraph exchange wherein different classes of messages are handled differently; for example, deferred traffic is limited to one or a predetermined number of a group of trunks even though there are several deferred messages awaiting transmission.

A still further object of the invention is to provide in a system of the character described novel means for numbering messages sent over each of a group of trunks or channels.

For a better understanding of the invention, reference should be had to the accompanying drawings, of which the respective figures taken together illustrate diagrammatically a preferred embodiment thereof.

In accordance with the preferred embodiment of the invention shown, a plurality of storage transmitters, such as tape perforators and associated tape transmitters, are provided at a telegraph office for storing and retransmitting permutation code signals adapted to operate a telegraph printer. A plurality of groups of interoffice trunks or channels terminate at said office and selective switching means are provided for extending a communication circuit from any one of the storage transmitters to the desired group of trunks in the case of a message destined for a remote office or exchange. In the system shown, the selective switching means comprise connecting plugs, individual to the respective storage transmitters, and switchboard jacks providing access to the groups of interoffice trunks

but it will be apparent that any conventional automatic or manually operable switching means may be employed. A switch individual to each interoffice trunk is provided and, in response to the selection of a group of trunks in an interoffice call, one of said switches is automatically operated to connect the operative storage transmitter to an idle trunk in the selected group. As soon as the interoffice trunk has been seized, the transmission of the message (preceded if desired by a message number) is started automatically.

In accordance with a further feature of the invention, each interoffice trunk or channel is provided with signal storage and repeating means hereinafter termed a trunk repeater adapted to store the signals from the storage transmitters and repeat the same over the interoffice trunk or channel. This trunk repeater may be of a type to receive start-stop code signals and retransmit code signals without the start-stop pulses over a channel of a synchronous multiplex system where start impulses between successive characters are not employed to maintain synchronism or it may be of a type to receive start-stop code signals and retransmit the same type of signals over a trunk operated on the start-stop principle of maintaining synchronism. A further advantage of this arrangement is that the transmitting speeds of the storage transmitter and trunk repeater may be different since it is desirable to operate the respective equipment units at their most efficient speeds and it is usually possible to transmit over the short intraoffice circuits at a higher speed than over long interoffice trunks. It will be apparent that if the intraoffice circuit is operated at a higher rate than the interoffice trunk circuit, the latter will be utilized to its full capacity while there are message signals to be transmitted in spite of the transmitting time lost on the intraoffice circuit in establishing connection to the trunk circuit.

According to a further feature of the invention, the storage transmitter is stopped automatically at the end of each message group of signals even though there may be another message stored therein since the second message may be destined for a different office or printer; and the interoffice trunk or channel is released immediately so that it is available for other messages thus enabling the trunk to be utilized to its full capacity. Preferably the release of the trunk is not dependent upon the restoration of the selective switching equipment in order to avoid delay from that source.

This invention will be more clearly understood

from the following detailed description in connection with the accompanying drawings.

Figure 1 is a diagrammatic illustration of a plurality of signal storage and repeating means with cord circuits and connecting plugs providing access to interoffice trunks of the exchange system.

Figure 2 is a diagram showing the circuit connections of two multiplex interoffice channels of the exchange system.

Figure 3 is a schematic illustration of a code signal transmitter employed in the exchange system.

Referring to Fig. 1, there are shown two storage transmitters adapted to be connected through cord circuits 10 and 11, and connecting plugs 12 and 13, respectively, to any one of a series of jacks J1—J6 providing access to interoffice trunks extending to a remote office or jacks J7, J8 and J9 providing access to trunks extending to a second remote office. It will be understood that in a complete system, each group of trunks to each remote office would have a switchboard jack or group of jacks in each of one or more operator's positions, and the switchboard might also contain jacks providing access to local branch offices and other line circuits as disclosed in the copending application of R. F. Blanchard, W. B. Blanton and H. L. Browne, Ser. No. 65,702, filed February 25, 1936.

The storage transmitter associated with the cord circuit 10 comprises a character storage unit such as a tape reperforator RR1 and tape transmitter TT1 which may be regarded as exemplary of suitable signal storage and transmitting devices. The reperforator RR1 may be similar in construction to the reperforator disclosed in the patent to Rothermel, No. 1,936,956 dated November 28, 1933, or that shown in the copending application of R. F. Dirkes and E. R. Wheeler, Ser. No. 42,692, filed September 28, 1935. The reperforator RR1 responds to start-stop code signals transmitted over the line 15 from a local keyboard, a branch office transmitter or other source. The tape transmitter TT1 arranged to repeat the signals perforated in the tape may be of the type disclosed in the patent to Rothermel, No. 1,805,374, dated May 12, 1931.

The storage transmitter RR2—TT2 associated with the second cord circuit 11 may be similar to that associated with the first cord circuit but as shown comprises a reperforator of the type disclosed in the patent to Hoover and Haupt, No. 1,851,838, dated March 29, 1932, or a combined printer and reperforator similar to that disclosed in Patent No. 2,143,828, granted Jan. 10, 1939 to R. F. Dirkes and R. Wentworth, either of which is adapted to store signals received over a channel of a multiplex receiving distributor MRD.

Two multiplex interoffice channels are shown in Fig. 2 in connection with the parallel line circuits L1 and L2 to a remote office. It will be understood that the other channels of the multiplex transmitting distributors TD1 and TD2 of the lines L1 and L2 may also be utilized, as well as additional trunks or channels sufficient to handle the traffic to the remote office, by duplicating the call-distributing equipment shown. Two finder switches SW1 and SW2, individual to the respective channels shown, are operated when transmitters are plugged into the jacks J1—J6 to connect the transmitters to idle channels thus enabling a small group of channels to be utilized in transmitting messages from a large

number of transmitters. The traffic-distributing equipment associated with the jacks J7—J9 and with the trunks or channels to a second remote office X is not shown, being similar to that illustrated in connection with the first group of interoffice trunks to office Y.

Certain additional features and advantages of the system illustrated in the drawings will become apparent from the following detailed description thereof. Referring again to Fig. 1, the line 15 extending to a remote branch office where it is normally grounded at the originating transmitter is connected through a switch 20 to the operating magnet 21 of reperforator RR1 and to the winding of a normally energized relay 22, the other terminal of said winding being connected to battery. Upon the receipt of the first spacing signal over the line 15, relay 22 becomes deenergized and closes the circuit of a calling lamp 23 at the right hand armature and back contact of said relay. Relay 22 is short circuited through its left hand armature and back contact and the contacts of a key 24 so that the signal lamp 23 remains lighted during the transmission of the message and until the key 24 is manually operated by the switching operator or attendant.

The message is recorded in the form of a perforated tape and preferably also printed upon the tape in the manner described in the above-mentioned application of Dirkes and Wheeler. The operator, noting the lighting of the lamp 23, reads the destination of the message from the perforations or printed characters on the tape and plugs the associated connecting plug 12 into one of the jacks providing access to the desired group of outgoing trunks, for example the jack J1. The other storage transmitters, such as RR2—TT2, are similarly routed to the desired group of interoffice trunks and as soon as an idle trunk or channel has been seized, the transmitters TT1, TT2 are operated to repeat the characters stored in the tape. In the case of deferred messages, the jacks J4, J5 and J6 multiplied to a single intraoffice circuit are selected and the system is arranged to send the deferred messages one at a time so that only a single interoffice trunk is utilized for the deferred traffic.

When the switchboard plug 12 is raised from its seat, the plug seat switch 28 is closed thereby closing a circuit through switch 29 and the left hand inner armature and back contact of relay 30 for lighting supervisory lamp 31. The plug seat switch 28 also closes a second circuit through the winding of slow release relay 33 and the inner right hand armature and back contact of relay 34, whereupon relay 33 becomes energized and opens at a second point the circuit through the start magnet SM of transmitter TT1 to guard against premature starting of the transmitter.

Upon the insertion of the plug 12 in the jack J1, a circuit is closed from ground through the rotating contact segment of the cord circuit allotter 35, contact 36, the right hand armature and back contact of relay 30, resistance 39, right hand winding of test relay 40, sleeve contacts of the plug 12 and jack J1, conductor 101 and the winding of relay 110 to battery, whereupon relays 40 and 110 become energized. The cord circuit allotter 35 comprises a plurality of spaced brushes 36, 37, et cetera, one for each cord circuit, and a rotating contact segment arranged to connect each of said brushes momentarily and successively to ground.

The energization of relay 40 closes a circuit from positive battery through the winding of re-

lay 110, conductor 101, the sleeve contacts of jack J1 and plug 12, the windings of relays 41 and 42, the left hand armature and front contact of relay 40, the left hand winding of relay 40, the right hand armature and back contact of slow release relay 43, the left hand outer armature and back contact of relay 34 and the armature and back contact of marginal relay 44 to negative battery, thereby energizing relays 41 and 42. The energization of relays 41 and 42 places a ground upon the described circuit between the windings of relays 41 and 42 through the left hand armature and front contact of relay 42 and the armature and front contact of relay 41 for a purpose to be described hereinafter. The described circuit also locks test relay 40 energized after the circuit through the right hand winding thereof is interrupted at the contacts of the circuit allotter 35. The energization of relay 42 also connects the contacts of transmitter TT1 to the tip contact of the plug 12 through the right hand armature and front contact of said relay and the windings of relays 44 and 45 but the transmitting circuit is held open at the finder switch equipment until an idle trunk has been seized.

Upon the energization of relay 110 as described, a circuit is closed through the left hand armature and front contact of said relay and the armature and back contact of relay 111 for energizing start relay 116. The energization of start relay 116 closes a circuit from battery through the armature and front contact of said relay, the normal contacts of a key 118 and the inner armature and back contact of relay 120 for energizing relay 121. The energization of relay 121 closes a circuit through the stepping magnet 122 of switch SW1, interrupter contacts 123 of said magnet, the armature and front contact of relay 121, the left hand winding of relay 125 and a resistance 126; and also a circuit in parallel to the left hand winding of relay 125 and including the left hand armature and back contact of relay 125 and the contact arm 133 of switch SW1. Assuming that no other jack circuit is seeking an idle trunk, the contacts of the contact bank of arm 133 except the first are grounded at the left hand armatures of relays 112, 114, et cetera, and the stepping magnet 122 is energized to step the contact arms 131, 132 and 133 to the first contacts of the respective contact banks, the operation of relay 125 being prevented since the left hand winding thereof is short circuited by the low resistance path through the left hand armature and back contact of relay 125 to ground at the contact arm 133. When the contact arm or wiper 133 reaches the first contact, or the position shown in the drawings, since said contact is ungrounded relay 125 becomes energized. The current through the stepping magnet 122 which is in series with the left hand winding of relay 125 and the resistance 126 is insufficient to attract the magnet armature and the contact wipers 131, 132 and 133 remain in engagement with the first contacts of their respective contact banks.

Upon the energization of relay 125, the bank contact of finder switch SW1 in engagement with the wiper 133 is grounded at the left hand armature and front contact of said relay. Therefore, other switches, such as SW2 having contacts multiplied to the contacts of switch SW1, when seeking other jacks, are prevented from seizing the jack J1, which is now connected to one of the interoffice trunks through the switch SW1. The energization of relay 125 also closes a circuit from battery through the windings of relays 121

and 120, the right hand winding of relay 125, the right hand armature and front contact of relay 125, contact wiper 132 of switch SW1, the winding of relay 111, the right hand armature and front contact of relay 110, conductor 101, the sleeve contacts of jack J1 and plug 12, the winding of relay 41, the left hand armature and front contact of relay 42 and the armature and front contact of relay 41 to ground whereupon relays 120, 127 and 111 are energized and the locking winding of relay 125 is energized.

The energization of slow release relay 120 closes a circuit from the wiper 133 to ground through the outer armature and front contact of said relay which insures that guard potential will be maintained on the multiple contacts connected to said wiper until said relay releases its armatures. At its inner armature relay 120 transfers the circuit from the start relay 116, which was connected to switch SW1, to the switch SW2, through conductor 140. Thus when another cord circuit and transmitter is plugged into one of the jacks J2—J6, the reenergization of relay 116, which was deenergized by the operation of relay 111, will render the switch SW2 operative to connect the calling transmitter to an idle channel of the line L2. In a similar manner, the start circuit is then transferred to conductor 141 extending to another switch (not shown). However, as soon as the transmission of the first message is completed, the start circuit will immediately be reconnected to the switch SW1 which will operate to connect the next calling transmitter to the channel of the multiplex distributor TD1 individual thereto. In this manner the calls are distributed to the channels according to an arbitrary grouping, the first channel taking preference over the others, the second channel taking preference over all but the first, and so on. Any channel may be cut out of service, however, by actuating the keys 118, 118a, associated with each channel, thereby disconnecting relays 121, 121a, from the start circuit and extending the start circuit to the next switch.

Relays 112 and 113 correspond to relays 110 and 111 and control the call distributing equipment when a plug is inserted in jack J2 in the same manner as described above in connection with jack J1. Likewise relays 114 and 115 control the call distributing equipment when a plug is inserted in jack J4, J5, or J6. When transmitters are plugged into two or more of these multiplied jacks at the same time, the circuit allotter 35 renders the calling transmitters operative one after the other in a manner to be described hereinafter. When all calls have been distributed to separate channels in the manner described above, relay 116 is deenergized so that the idle finder switches do not step around when there are no calls to be answered.

When relay 127 is energized as described above, a circuit is closed from ground through the armature and front contact of said relay, the inner armature and back contact of relay 128 and conductor 150 for energizing the clutch magnet 201 of the numbering or service code transmitter 210. The numbering device 210, of which one is provided for each channel or circuit to the remote office, is arranged to transmit a group of service code signals with each group of message signals transmitted over the associated channel. As shown, the numbering device is arranged to precede each message with a number, which is changed for successive messages, in order to facilitate tracing lost or mutilated messages. Ob-

viously, the device may be arranged to send any predetermined signals accompanying each message, either varying with successive messages or invariable in character.

5 The code signal transmitter shown in Fig. 3 is of the motor-driven cam switch type described and claimed in the copending application of Dirkes, Hoover and Wheeler, Ser. No. 51,522, filed November 25, 1935, but may be of any suitable type, for example one in which the code
10 signals are stored in a perforated tape or other storage medium.

In the embodiment of the invention illustrated, when a storage transmitter is connected to channel A of the line L¹ by the switch SW¹, the associated numbering mechanism 210 transmits identifying code signals over said channel and thereafter the storage transmitter is rendered operative to transmit the message over said channel.
15 The channel is released by an end-of-message signal and the next message over the same channel is preceded by a different code signal group set up in the numbering mechanism 210. The signals from both the number code transmitter 210 and the storage transmitter are stored in the tape passing through the reperforator RR³ and are repeated by the tape transmitter TT³ under the control of the transmitting distributor TD¹.
20 In this manner the system may be arranged to provide for a higher rate of transmission in the local office circuit than that permissible over the line circuit extending to the remote office whereby the signalling equipment is utilized at maximum efficiency and idle line time of channel A of the interoffice trunk is obviated whenever there are message signals to transmit since the associated storage repeater RR³—TT³ stores the message signals at a rate higher than the rate they can be transmitted over the line circuit.

40 In the embodiment shown, the numbering mechanism 210 comprises a constantly rotating drive shaft 225 adapted to be connected through a clutch 226 to the normally stationary cam drum 227. When the clutch magnet 201 is energized, the clutch 226 is engaged and the drum 227 rotates with the drive shaft 225. The clutch 226 is provided with a cam 228 and a stop arm lever 229 controlled by the clutch magnet 201 to disengage the clutch and stop the cam drum 227 in a predetermined start position after the clutch magnet 201 is deenergized. The numbering mechanism further comprises a letters code drum 230, a units code drum 231 and a tens code drum 232, each of said drums being intermittently stepped during the rotation of the transmitting code drum 227. As shown, a Geneva cam 233 and Geneva wheel 234 are disposed between each pair of drums in such manner that the letters code drum 230 is stepped once for each revolution of drum 227; the units code drum 231 is stepped once for each revolution of drum 230 and the tens code drum 232 is stepped once for each revolution of the drum 231.
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Each of the rotatable drums is provided with projecting pins or cam members 235 adapted to engage movable contact members 236 having cooperating front and/or back contacts. The operation of the contact members 236 in properly timed relation and in predetermined sequence by the drums 227, 230, 231 and 232 is arranged to send marking and spacing signals to the storage reperforator RR³ over the transmitting circuit 245. The code signals sent automatically during each cycle of operation of the numbering mecha-
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nism 210 may be readily changed by properly rearranging the pins or cam members 235.

The mechanism 210 further comprises a relay 240 and a restoring switch 241, the latter being used for restoring the units code drum 231 to a predetermined starting position when desired. The tens code drum 232 is preferably also arranged to permit resetting manually when desired, as for example by disengaging the Geneva wheel 234 of said drum from the cooperating cam 233 thus permitting the drum to be turned to its starting position as described in the above mentioned copending application of Dirkes, Hoover and Wheeler.
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Upon the energization of the clutch magnet 201, the transmitting cam drum 227 rotates and during each rotation a character or code signal is transmitted over the conductor 245. Ten revolutions of the cam drum 227 constitute one complete cycle of the numbering mechanism. Each code signal may comprise a start no-current interval, five marking or spacing impulses and a stop or current pulse whereby the signals are adapted to control the ordinary start-stop printer. When battery is connected to the conductor 245, the operating magnet 169 of the reperforator RR³ is energized, said operating magnet being connected in series with a resistance 161. The reperforator RR³ thus responds to the signals transmitted by the numbering mechanism 210 and is then connected to the storage transmitter to respond to the signals from said transmitter. The message has appended thereto an end-of-message signal which is arranged to operate the contacts 162 of the reperforator RR³ to stop the storage transmitter and disconnect channel A from said transmitter. The signals stored in said reperforator are repeated by the tape transmitter TT³ of usual construction and which may be similar to the tape transmitter disclosed in the Benjamin Patent No. 1,298,440, granted March 25, 1919. As shown the tape transmitter comprises a marking bus bar 165 and a spacing bus bar 166 together with selectively operable contacts 167 arranged to apply the code signals stored in the tape on the transmitting segments of channel A of the transmitting distributor TD¹ in the usual manner. The tape transmitter TT³ is stepped by the operating magnet 168 under the control of a local segment 169 of the transmitting distributor.
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Referring again to the numbering mechanism 210, the movable contact members 236 of the transmitting cam drum 227 are connected together and to the conductor 245. Battery is connected to a back contact 250 cooperating with the first contact member 236 of drum 227. Upon the initial movement of the drum 227 from its normal position, the circuit including contact 250 is opened thus opening the line during the start interval. This circuit through contact 250 remains open until the drum 227 returns to its initial position. After five successive impulses are sent to the line by the successive operation of the remaining contact members 236 of drum 227, the drum completes one revolution and recloses the line circuit to contact 250 to send the stop pulse. The code signal sent during each revolution of drum 227 is controlled by connecting or removing battery potential from the make contacts corresponding to the second, third, fourth, fifth and sixth contact members 236 of drum 227 in accordance with the setting of code drums 230, 231 and 232. The ten revolutions of drum 227 during each cycle of operation of the
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numbering mechanism cause drum 230 to make one complete revolution and drum 231 to make one-tenth of a revolution during each cycle, whereas the tens code drum 232 is stepped once in ten cycles.

The first five contact members 236 of the drum 230 are connected to the make contacts of drum 237 and when actuated are connected to battery through the back contact 251 of the sixth contact 236 of drum 230. In the normal or first position of the code drum 230, the code pins 235 engaging the cooperating contact members 236 of the drum 230 connected to the make contacts of drum 227 may be arranged in accordance with the code signal representing "letters shift". Upon the first rotation of the cam drum 227 a "letters shift" signal will be sent to the line so that when received over channel A of the line L1 the remote printer will be adjusted to print letter characters. During the transmission of the stop and start impulses by contact 250, the letters code drum 230 is stepped to its second position wherein the code representing a character identifying channel A of line L1, for example, is set up on the pins. This character may be the letter F where the characters FWA are employed to designate said channel. Upon the succeeding rotations of the drum 227 the signals representing W and A and then "figures shift" are sent to the line under the control of letters code drum 230.

In the sixth position of the letters code drum 230, only the sixth and seventh contact members 236 of drum 230 are actuated by the pins 235. The sixth contact member 236 connects battery to the make contacts of drums 231 and 232 through make contact 252 of drum 230. The seventh contact 236 of the drum 230 closes through its make contact 253 the circuit of transmitting cam drum 227 are thus connected through the back contacts of drum 230 and the armatures and front contacts of relay 240 to the movable contact members 236 of the tens code drum 232 and during the first nine cycles of the numbering mechanism the digit 0 (zero) will be sent by the code set up on the tens code drum 232. After each ten cycles of the numbering mechanism, the stepping of the code drum 232 will change the code signal set up from 0 to 1, 2, etc.

After the tens digit has been sent, the stepping of letters code drum 230 opens the circuit including make contact 253 and the winding of relay 240 whereupon relay 240 becomes deenergized and transfers the code sending circuit from drum 232 to drum 231. In its initial position, the units code drum 231 is arranged to send a signal representing the digit 1 and during the successive cycles of the numbering mechanism, the drum 231 changes the code signals set up from 1 to 2, from 2 to 3, etc. In this manner, the numbering mechanism 210 interposes consecutive numbers between each message group of signals and the messages are consecutively numbered from 01 to 99, or (1)00.

In the eighth position of the letters code drum 230, the sixth contact member 236 of said drum is restored to normal, thereby breaking the battery connection to the contacts of drums 231 and 232 through the contact 252 and connecting battery to the make contacts associated with the first five contact members 236 of the drum 230. The drum 230 is then operative to send the "letters shift" signal to the line and during the ninth and tenth revolutions of transmitting drum 227, to send blank or other desired signals. When

the drum 230 is being stepped from its ninth position to its tenth position, the eighth contact member 236 of the drum 230 applies ground potential momentarily to conductor 255 thereby energizing relay 128 (Fig. 2).

The operation of relay 128 closes a locking circuit through its inner armature and front contact to ground at the contacts of relay 127, and opens at its inner armature and back contact the circuit of the clutch magnet 201 of the numbering device 210. At this moment cam 228 has advanced so far that the stop arm lever 229 does not immediately engage said cam and the transmitting drum 227 continues to rotate for almost another revolution. Then the cam 228 engages the stop arm lever 229 when the drum 227 is in its rest position wherein contact 250 engages its associated contact member 236, and the drum 230 has been restored to its initial position. When the drum 230 comes to rest in its initial position, the described circuit of relay 128 is interrupted but said relay remains locked up as described above.

The energization of relay 128 further disconnects at its outer armature and back contact the operating magnet 160 of the reperforator RR3 from the transmitting conductor 245 of the service code transmitter and connects said magnet through its outer armature and front contact, wiper arm 131 of switch SW1, conductor 102, the tip contacts of jack J1 and plug 12, the right hand armature and front contact of slow release relay 42 and the windings of relay 45 and marginal relay 44 to the transmitting contacts of the storage transmitter TT1. Relay 45 becomes energized but the current through the winding of marginal relay 44 is insufficient to attract its armature on account of the resistance 161 in circuit therewith. However, if the transmitting circuit to the reperforator RR3 becomes grounded accidentally, which would ground the signals and stop the operation of the reperforator, relay 44 becomes energized and stops the transmitter TT1 to prevent loss of signals as will be described hereinafter.

Upon the energization of relay 45, a circuit is closed from battery through the winding of slow release relay 43, the armature and front contact of relay 45 and the winding of relay 46 to ground whereupon relays 43 and 46 become energized. Relay 46 closes a locking circuit for itself through its armature and front contact so that it does not become deenergized each time relay 45, which responds to the line signals, becomes deenergized. Upon the energization of relay 43, a circuit is closed through its left hand armature and front contact for energizing relay 30, and at its right hand armature and back contact, relay 43 opens a short-circuit around the winding of relay 34 whereupon relays 30 and 34 become energized. The energization of relay 30 opens the circuit of supervisory lamp 31, extinguishing said lamp to indicate to the switching operator that transmission of the message has started, and closes through its left hand inner armature and front contact a locking circuit independent of relay 43. At its right hand armature, relay 30 opens the circuit of the right hand winding of test relay 40 and connects the contact 36 of the circuit allotter 35 to the winding of relay 46 whereby the latter relay is periodically short-circuited by the circuit allotter to test the operativeness of the transmission circuit as disclosed in the above-mentioned copending application of Blanchard, Blanton and Browne.

The energization of relay 34, as described, opens at its inner right hand armature and back contact the circuit of slow release relay 33 whereupon this relay becomes deenergized and closes through its armature and back contact and the left hand inner armature and front contact of relay 34 the circuit of the start magnet SM of transmitter TT1. Upon the energization of the start magnet SM, the transmitter TT1 starts to transmit the signals stored in the tape from the reperforator RR1, and said signals are stored by the trunk repeater RRs—TT3 associated with channel A of the multiplex distributor TD1. The contacts 167 of the transmitter TT3 are operated in accordance with the characters recorded in the tape received from the reperforator RR3 and upon each rotation of the brush arm of the distributor TD1, a character is transmitted over channel A, the stepping magnet 168 of the transmitter being operated by a pulse from the local segment 169 during each cycle in the usual manner. The rate of transmission over the interoffice channel is determined by the rotative speed of the distributor brush arm and in general will not correspond with the transmitting rate between the transmitter TT1 and the reperforator RR3. Each circuit and the associated equipment may thus be used at maximum capacity.

At the end of each group of signals forming a complete message, the operator at the originating office sends an end-of-message signal differing from any of the ordinary message characters. The end-of-message signal, for example the bell signal, upper case "j", is repeated by the transmitter TT1 to the reperforator RR3 and the bell bar closes the contacts 162, momentarily short-circuiting the resistance 161. The line current is increased above its normal value and marginal relay 44 opens the battery circuit of relays 34, 40 and 42 whereupon relays 34 and 40 are deenergized and slow release relay 42 releases its armatures after a short interval.

When relay 34 is deenergized, the circuit of the start magnet SM of the transmitter TT1 is opened and the transmitter stops even though there may be other characters perforated in the tape (constituting another message awaiting transmission). The deenergization of relay 34 further closes a circuit through its right hand inner armature and back contact for energizing relay 33 and this relay opens the circuit of the start magnet SM of transmitter TT1 at a second point; and relay 34 closes a circuit through its outer right hand armature and back contact and the outer left hand armature and front contact of relay 39 for lighting the supervisory lamp 32 to indicate that transmission has ceased and the connecting plug 12 should be withdrawn by the operator from the jack J1.

Upon the deenergization of relay 42, the transmission circuit between the storage transmitter and the channel repeater is opened at the right hand armature and front contact of said relay, and at its left hand armature and front contact relay 42 breaks the circuit of relays 41, 110, 111, 125, 126 and 127, whereupon these relays become deenergized. When the transmitting circuit is opened, relays 44 and 45 in series relation therewith become deenergized. The deenergization of relay 45 interrupts the circuit through the windings of relays 46 and 43 in shunt relation to the contacts of relay 46 whereupon these relays become deenergized as soon as the relay 46 is short-circuited by the circuit allotter 35. Upon the deenergization of relay 43 the circuit of relay

30 is opened but this relay remains locked up through its locking circuit through the contacts of switches 28 and 29.

Upon the deenergization of relay 110 (Fig. 2) as described above, a circuit is closed from ground through the left hand armature and back contact of said relay to the first contact of the contact back of switch SW1 engaged by the wiper 133, said bank contact being also grounded through the wiper 133 and the outer right hand armature and front contact of slow release relay 120 until said relay releases its armatures. Upon the deenergization of relay 127 as described above, the locking circuit of relay 128 is interrupted at the armature and front contact of said relay, and relay 128 is restored to normal. Slow release relay 120 is timed to permit relays 110, 111, 125, 127 and 128 to be restored before it releases its armatures.

Thus it will be seen that as a result of the end-of-message signal and the closing of contacts 162 of the reperforator RR3 in response thereto to increase the current in the transmitting circuit, the transmitter TT1 has been stopped, the transmitting circuit to the channel repeater has been opened, the signal lamp 32 has been lighted, the channel has been released and switch SW1 rendered operative to connect the channel to another call. All of the relays associated with the cord circuit 10 have been deenergized except relays 30 and 33. The lamp 32 indicates to the operator that the transmission of the message has been completed and the interoffice channel released. It will be apparent that the same functions would result from accidental grounding of the transmission circuit between the transmitter TT1 and the channel repeater, since this would also energize relay 44, thus preventing loss of signals as a result of an inoperative transmission circuit. The failure to send the complete message would be apparent to the operator from the position of the tape in the transmitter TT1, and the operator would take the necessary precautions to avoid the loss of the message.

Unless there is another message on the tape for the same branch office, the operator withdraws the plug 12 from the switchboard and restores it to its seat. The opening of the contacts of the plug seat switch 28 opens the circuits of relays 30 and 33 whereupon these relays are deenergized and the lamp 32 is extinguished. The cord circuit is then restored to normal in readiness for the transmission of another message in the same manner as the first message. If a second message or the initial portion thereof destined for the same branch office is received before the plug 12 is withdrawn from the jack, the operator instead of withdrawing the plug actuates the key 29, thereby restoring the relay 30 to normal and extinguishing the lamp 32. The first idle channel of the same group is connected to the storage transmitter RR1—TT1 by the associated switch SW individual to said channel and the message preceded by the service code signals is transmitted in the usual manner.

In the case of transmitters plugged at the same time into the "deferred" jacks J4, J5, J6, the transmitters are rendered operative one after the other by the circuit allotter 35. In this manner, overloading of the channels is avoided when there is an accumulation of deferred messages since only a single interoffice trunk is utilized for the deferred traffic. Assuming that a storage transmitter has been already connected to channel A of line L1 through jack J4 when cord cir-

cuit 10 is plugged into jack J5, when the grounded segment of the circuit allotter 35 engages brush 36, the above-described circuit through the right hand winding of test relay 40 is closed.

5 However, the sleeve circuits of jacks J4 and J5 are grounded through the winding of a relay corresponding to relay 41 of the cord circuit plugged into jack J4 and the contacts of relays corresponding to relays 41 and 42 of said cord circuit.

10 The resistance of the circuit of the right hand winding of relay 40 is such that relay 40 will not be operated when shunted by the winding of relay 41 of the first cord circuit and thus the circuit of the start magnet SM of transmitter

15 TT1 is held open by relays 33 and 34 until the prior message has been sent and the transmitter disconnected from the trunk repeater. The trunk or channel may be preselected by any number of transmitters having deferred messages since

20 the circuit allotter tests the busy or idle condition of the channel successively and periodically for each transmitter that has been plugged into the jacks J4, J5 and J6. Although only three multiplied jacks for sending deferred messages

25 are shown, any desired number of jacks may be connected in multiple or two or more groups of jacks may be allotted to two or more deferred channels, the latter channels being also available for regular messages in the system shown. It will

30 be noted also that although the deferred traffic only utilizes a single interoffice trunk at one time, any of the interoffice trunks are available for this traffic. Thus if one of a plurality of transmitters plugged into jacks J4, J5 or J6 is transmitting

35 over the trunk individual to the switch SW2 and the trunk individual to the switch SW1 becomes idle, the next deferred message will be sent over the latter trunk.

The invention is not limited to the specific types of storing, repeating or switching apparatus herein described since many changes may be made in the system and apparatus disclosed for the purpose of explaining the invention without departing from the scope of the invention as set forth in the appended claims.

I claim:

1. In a telegraph system, a plurality of permutation code transmitters, a group of lines or channels, selective switching means for extending the circuit of any of said transmitters to said group of lines or channels, a switch individual to each of said lines or channels, means for operating said switches to connect the respective transmitters to idle lines or channels in response to the operation of said selective switching means and means responsive to the operation of said switches for rendering connected transmitters operative.

2. In a telegraph system, a plurality of permutation code transmitters, a group of lines or channels, manually operable selective switching means for extending the circuit of any of said transmitters to said group of lines or channels, a switch individual to each of said lines or channels, means for operating said switches to connect the respective transmitters to idle lines or channels in response to the operation of said selective switching means and means for rendering the transmitter operative only after the circuit thereof has been extended to an outgoing line or channel.

3. In a telegraph system, a plurality of permutation code transmitters, a group of lines or channels, selective switching means for extend-

ing the circuit of any of said transmitters to said group of lines or channels, a switch individual to each of said lines or channels, means for operating said switches to connect the respective transmitters to idle lines or channels in response to the operation of said selective switching means and means associated with each line or channel for storing code signals from a connected transmitter and repeating the same over said lines or channels.

4. In a telegraph system, a plurality of permutation code transmitters, a group of lines or channels, selective switching means for extending the circuit of any of said transmitters to said group of lines or channels, signal storage repeating means associated with each of the lines or channels of said group and having provision for storing message signals and repeating the same over the associated line or channel, finder switches, means for operating said switches to connect the respective transmitters to idle lines or channels and means for thereupon controlling the storage repeating means in accordance with the connected permutation code transmitter.

5. In a telegraph system, a plurality of permutation code transmitters, a group of lines or channels, selective switching means for extending the circuit of any of said transmitters to said group of lines or channels, finder switches, means for operating said switches to connect the respective transmitters to idle lines or channels, signal storage means associated with each line or channel, means including said permutation code transmitters for operating said signal storage means at one rate and means for repeating the signals stored on said signal storage means over the associated line or channel at a different rate.

6. In a telegraph system, a plurality of permutation code transmitters, a group of lines or channels, selective switching means for extending the circuit of any of said transmitters to said group of lines or channels, finder switches, means for operating said switches to select an idle line or channel and mean for rendering each of a plurality of transmitters operative one at a time.

7. In a telegraph system, a plurality of permutation code transmitters, a group of lines or channels, selective switching means for extending the circuit of any of said transmitters to said group of lines or channels, finder switches, means for operating said finder switches to connect the respective transmitters to idle lines or channels and means including said finder switches for connecting a plurality of transmitters having deferred messages awaiting transmission one at a time to one of said idle lines or channels.

8. In a telegraph system, a plurality of code transmitters, a group of lines or channels, a transmitter associated with each one of said lines or channels for repeating code signals thereover, selective switching means for extending the circuit of any of said first-mentioned transmitters to said group of lines or channels, finder switches, means for operating said switches to connect the first-mentioned transmitters to the repeater transmitters of idle lines or channels and means for stopping one of said first-mentioned transmitters and releasing the connected repeater transmitter at the end of a message group of signals.

9. In a telegraph system, a plurality of code transmitters, a group of lines or channels, a transmitter associated with each one of said lines or channels for repeating code signals

thereover, selective switching means for extending the circuit of any of said first-mentioned transmitters to said group of lines or channels, finder switches, means for operating said switches to connect the first-mentioned transmitters to the repeater transmitters of idle lines or channels and signal-responsive mechanism associated with each of said repeater transmitters responsive to an end-of-message signal to stop the associated one of the first-mentioned transmitters.

10. In a telegraph system, a plurality of code transmitters, a group of lines or channels, a transmitter associated with each one of said lines or channels for repeating code signals thereover, selective switching means for extending the circuit of any of said first-mentioned transmitters to said group of lines or channels, finder switches, means for operating said switches to connect the first-mentioned transmitters to the repeater transmitters of idle lines or channels and signal-responsive mechanism associated with each of said repeater transmitters responsive to an end-of-message signal to disconnect the associated repeater transmitter from its connected code transmitter and render the repeater transmitter available for another call.

11. In a telegraph system, a plurality of code transmitters, a group of lines or channels, a service code transmitter associated with each line or channel embodying mechanism for transmitting predetermined signals whenever it is rendered operative, selective switching means for extending the circuit of any of said first-mentioned transmitters to said group of lines or channels, finder switches and means for operating said switches to connect the first-mentioned transmitters to idle lines or channels and thereupon rendering the service code transmitter of the selected line or channel operative.

12. In a telegraph system, a plurality of code transmitters, a group of lines or channels, a numbering mechanism associated with each line or channel embodying means for transmitting code signals representing consecutive numbers each time it is rendered operative, selective switching means for extending the circuit of any of said code transmitters to said group of lines or channels, finder switches, means for op-

erating said switches to connect the code transmitters to idle lines or channels, means responsive to the seizure of an idle line or channel for rendering the numbering mechanism operative and means for thereafter rendering the connected code transmitter operative.

13. In a telegraph system, a plurality of code transmitters, a group of trunks or channels, means including trunk finder switches for seizing an idle trunk or channel and means for controlling said first mentioned means to connect transmitters having regular messages to transmit in one manner to said trunks or channels and to connect transmitters having deferred messages to transmit in another manner to avoid overloading the trunks or channels upon the occurrence of an accumulation of deferred messages.

14. In a telegraph system, a plurality of code transmitters, a group of trunks or channels, means including trunk finder switches for seizing an idle trunk or channel and means for controlling said first mentioned means to connect transmitters having concurrent regular messages to transmit simultaneously to separate trunks or channels and to connect transmitters having concurrent deferred messages to transmit one at a time to a trunk or channel.

15. In a telegraph system, a plurality of code transmitters, a group of trunks or channels, means including trunk finder switches for seizing an idle trunk or channel and means for controlling said first mentioned means to distribute calls from transmitters having regular messages to transmit to separate trunks or channels and to divide the line time of a single trunk or channel between transmitters having deferred messages to transmit.

16. In a telegraph system, a plurality of code transmitters, a group of channels, signal storage and repeating means associated with each channel, means including finder switches for connecting said transmitters to the repeating means of idle channels, means responsive to such connection for rendering the connected transmitter operative and means responsive to the grounding of the transmitting circuit for stopping the transmitter.

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DISCLAIMER

2,193,812.—*William B. Blanton*, Merrick, N. Y. TELEGRAPH EXCHANGE SYSTEM.
Patent dated Mar. 19, 1940. Disclaimer filed May 22, 1945, by the assignee, *The Western Union Telegraph Company*.

Hereby enters this disclaimer to claim 1 of said patent.

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