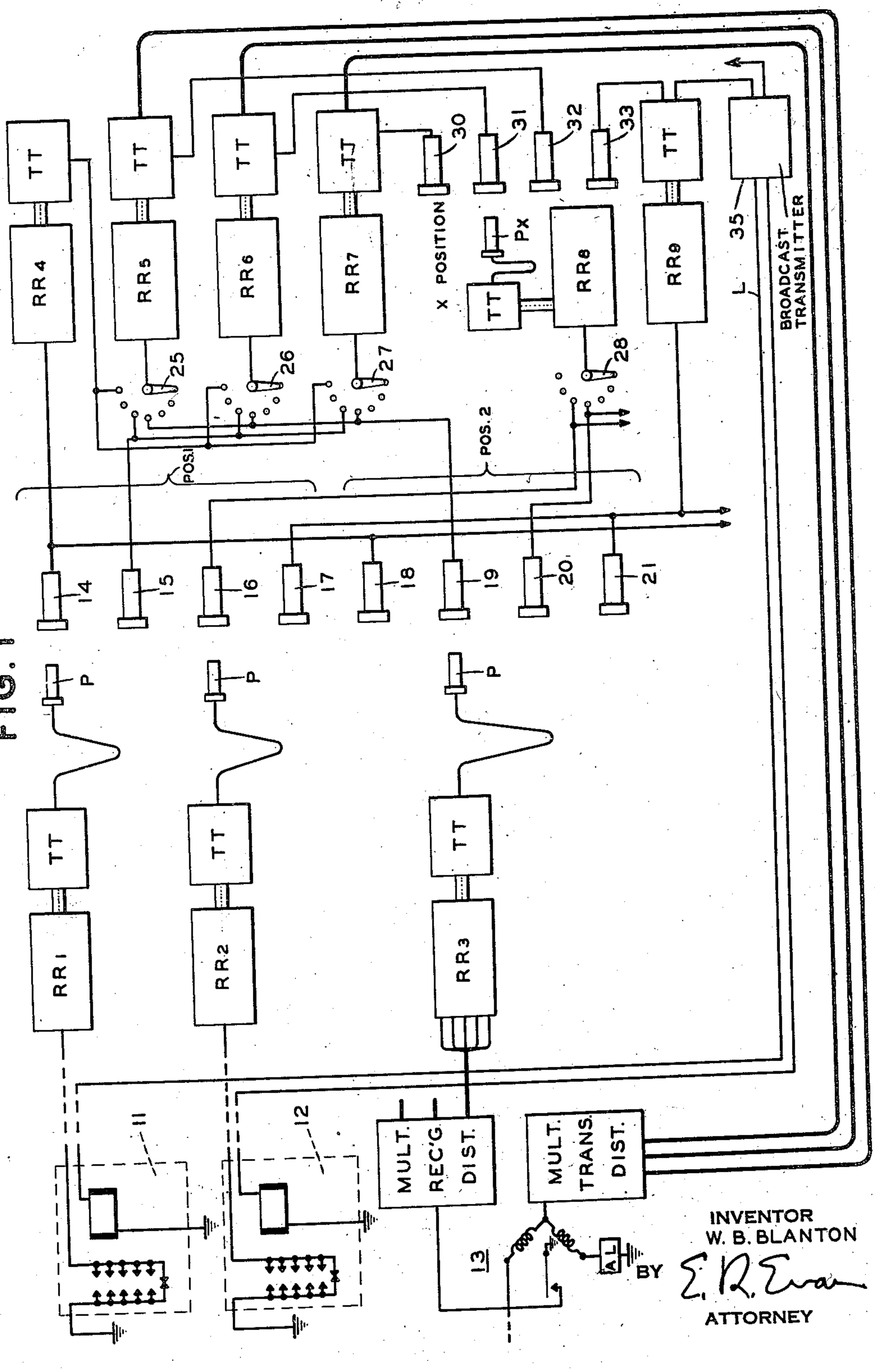
April 14, 1942. W. B. BLANTON 2,279,295

TELEGRAPH EXCHANGE SYSTEM

Filed Oct. 14, 1939 9 Sheets-Sheet 1

FIG. 1



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TELEGRAPH EXCHANGE SYSTEM

Filed Oct. 14, 1939 9 Sheets-Sheet 2

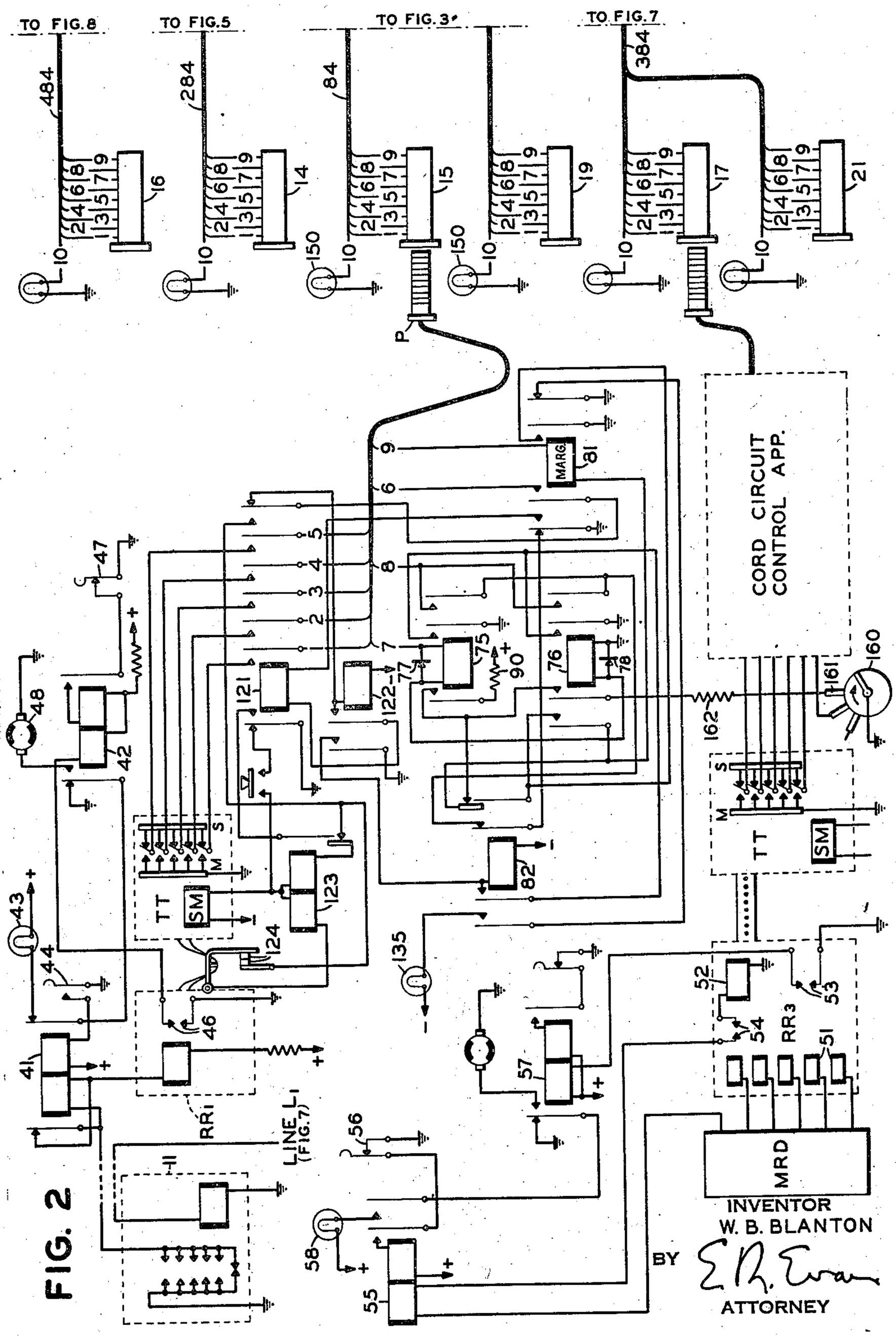

FIG. 2

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TELEGRAPH EXCHANGE SYSTEM

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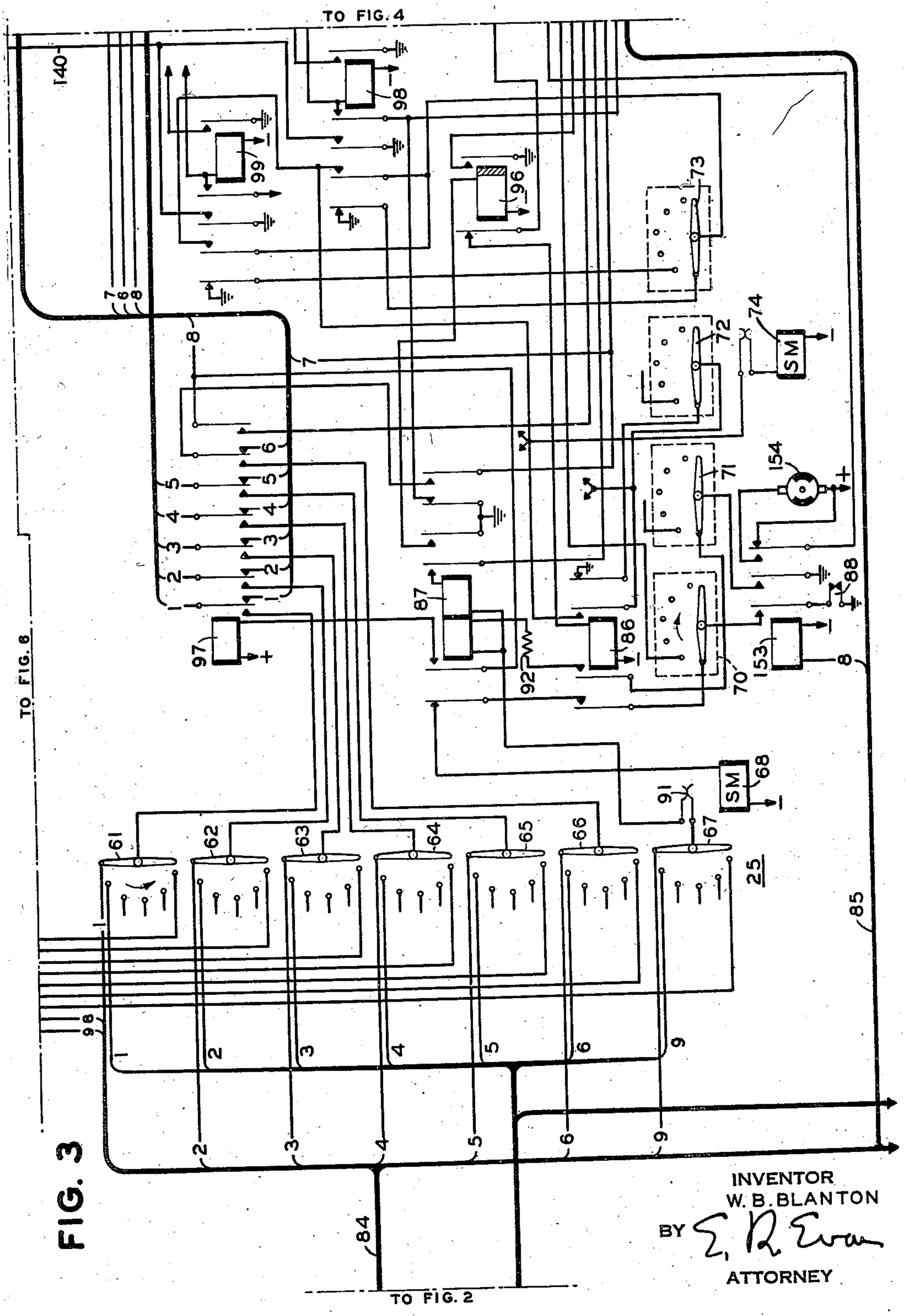

FIG. 3

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TELEGRAPH EXCHANGE SYSTEM

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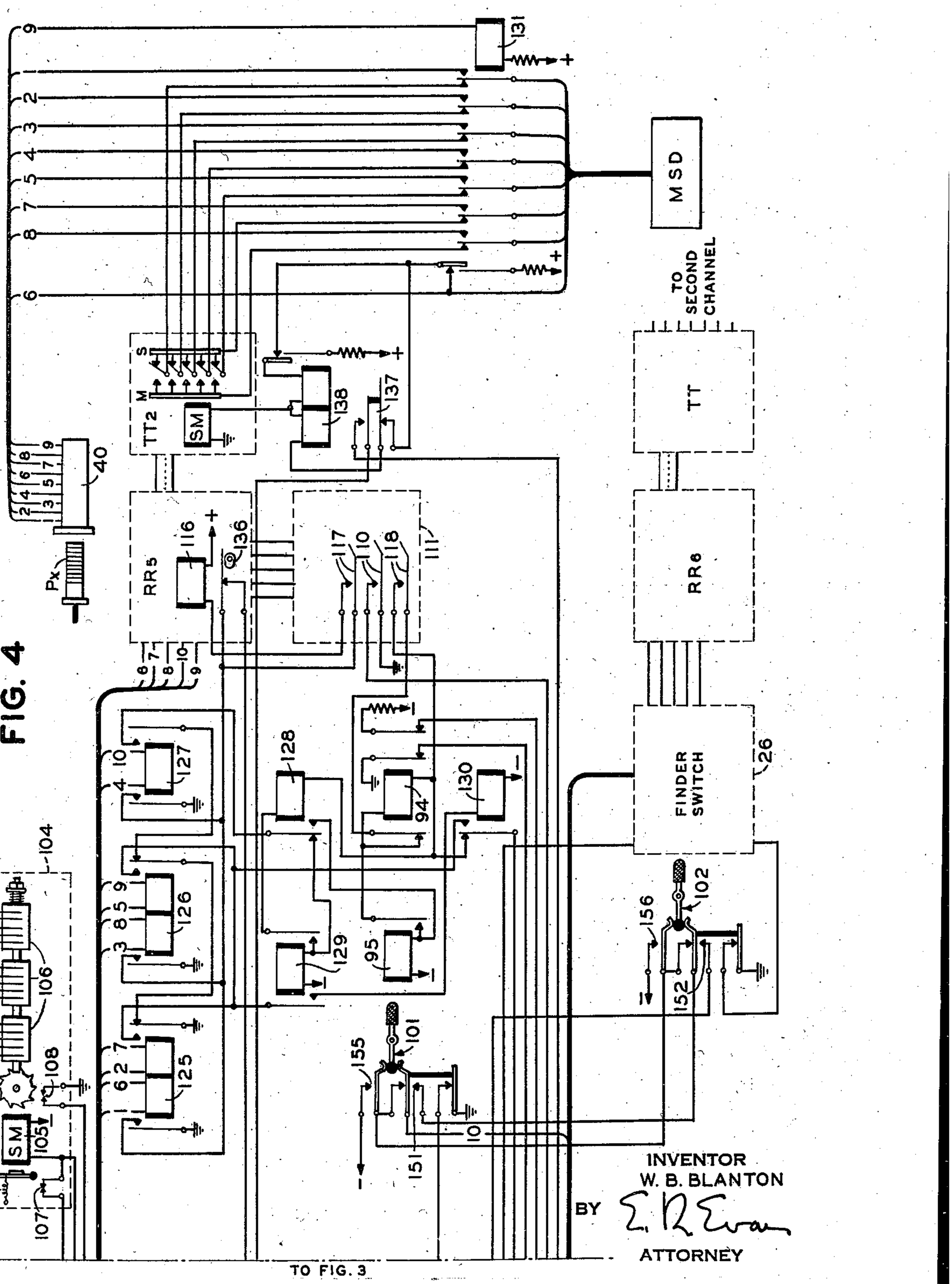

FIG. 4

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TELEGRAPH EXCHANGE SYSTEM

Filed Oct. 14, 1939 9 Sheets-Sheet 5

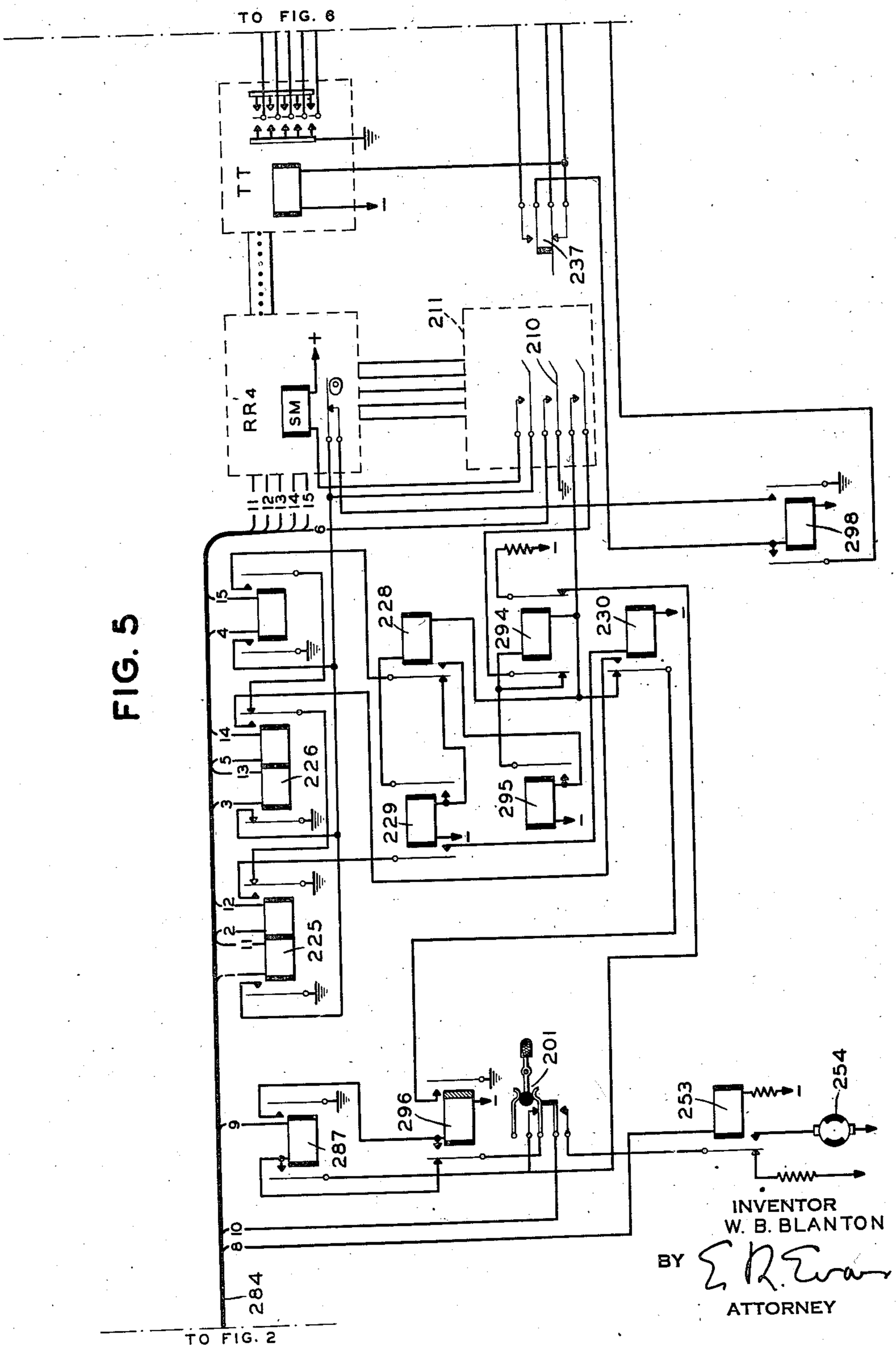

FIG. 5

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TELEGRAPH EXCHANGE SYSTEM

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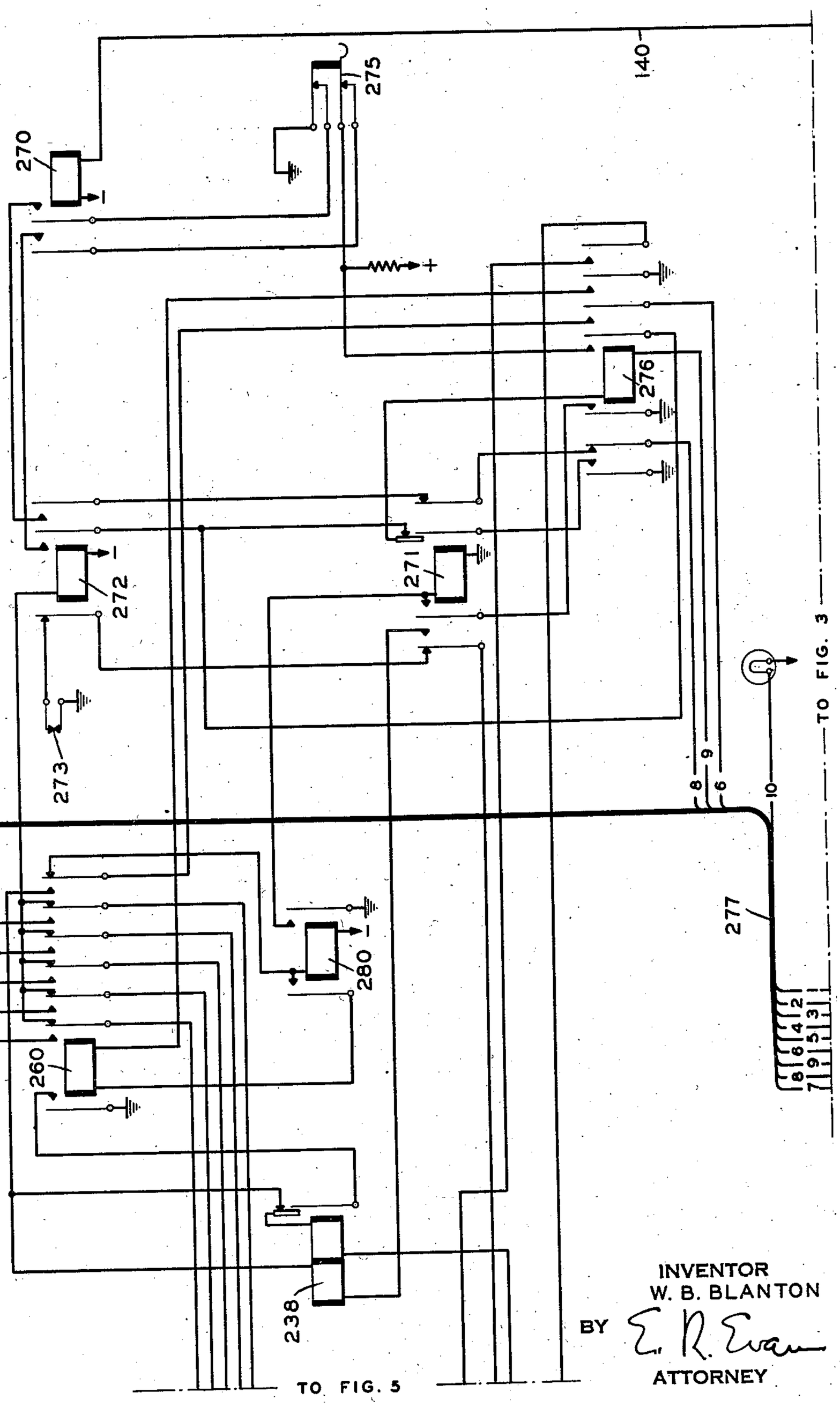

FIG. 6

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TELEGRAPH EXCHANGE SYSTEM

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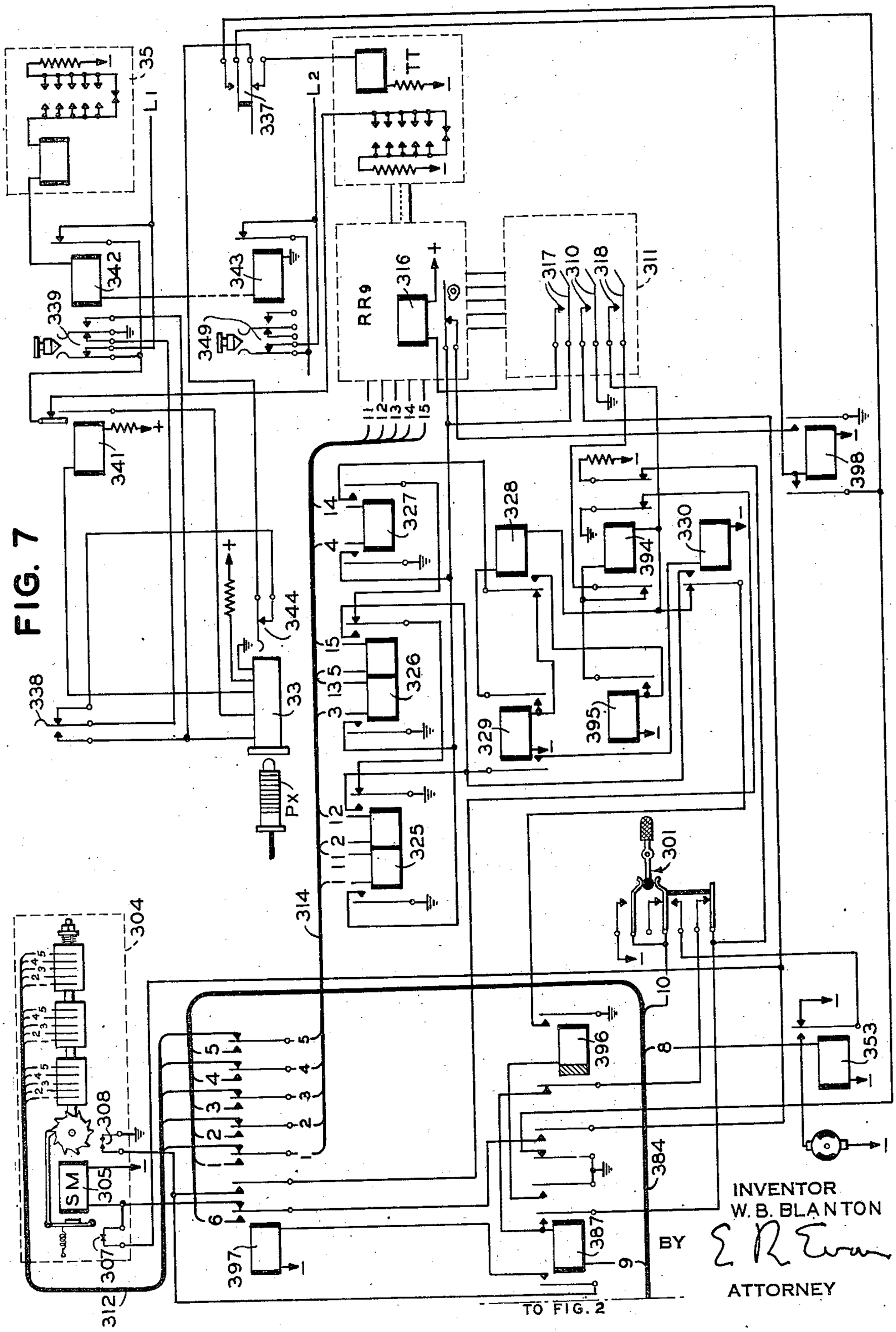

FIG. 7

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TO FIG. 2

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TELEGRAPH EXCHANGE SYSTEM

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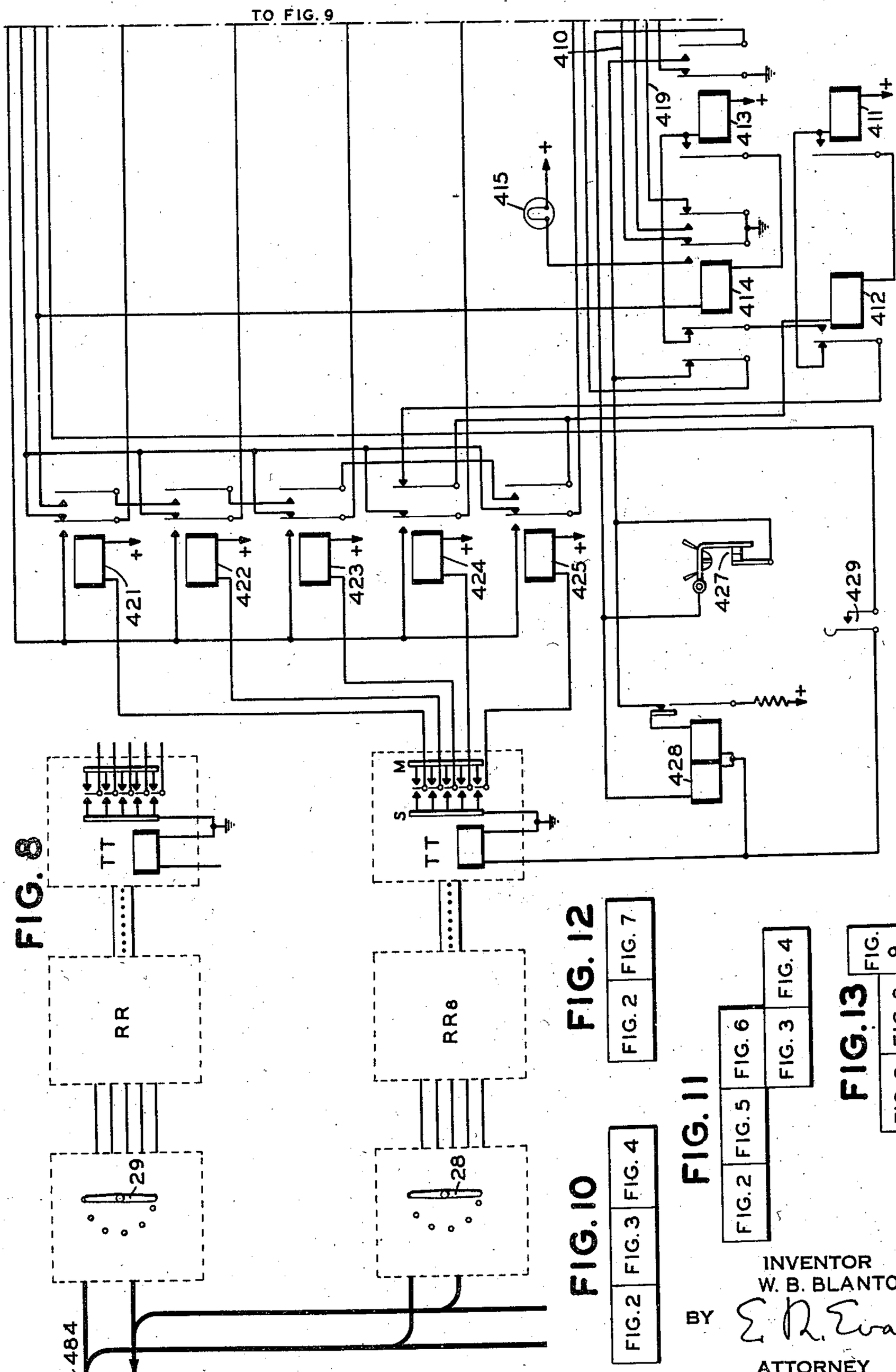

FIG. 8

FIG. 12

FIG. 2	FIG. 7

FIG. 11

FIG. 2	FIG. 6	FIG. 4
FIG. 5		FIG. 3

FIG. 13

FIG. 2	FIG. 8	FIG. 9

FIG. 10

FIG. 2	FIG. 3
FIG. 4	

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TELEGRAPH EXCHANGE SYSTEM

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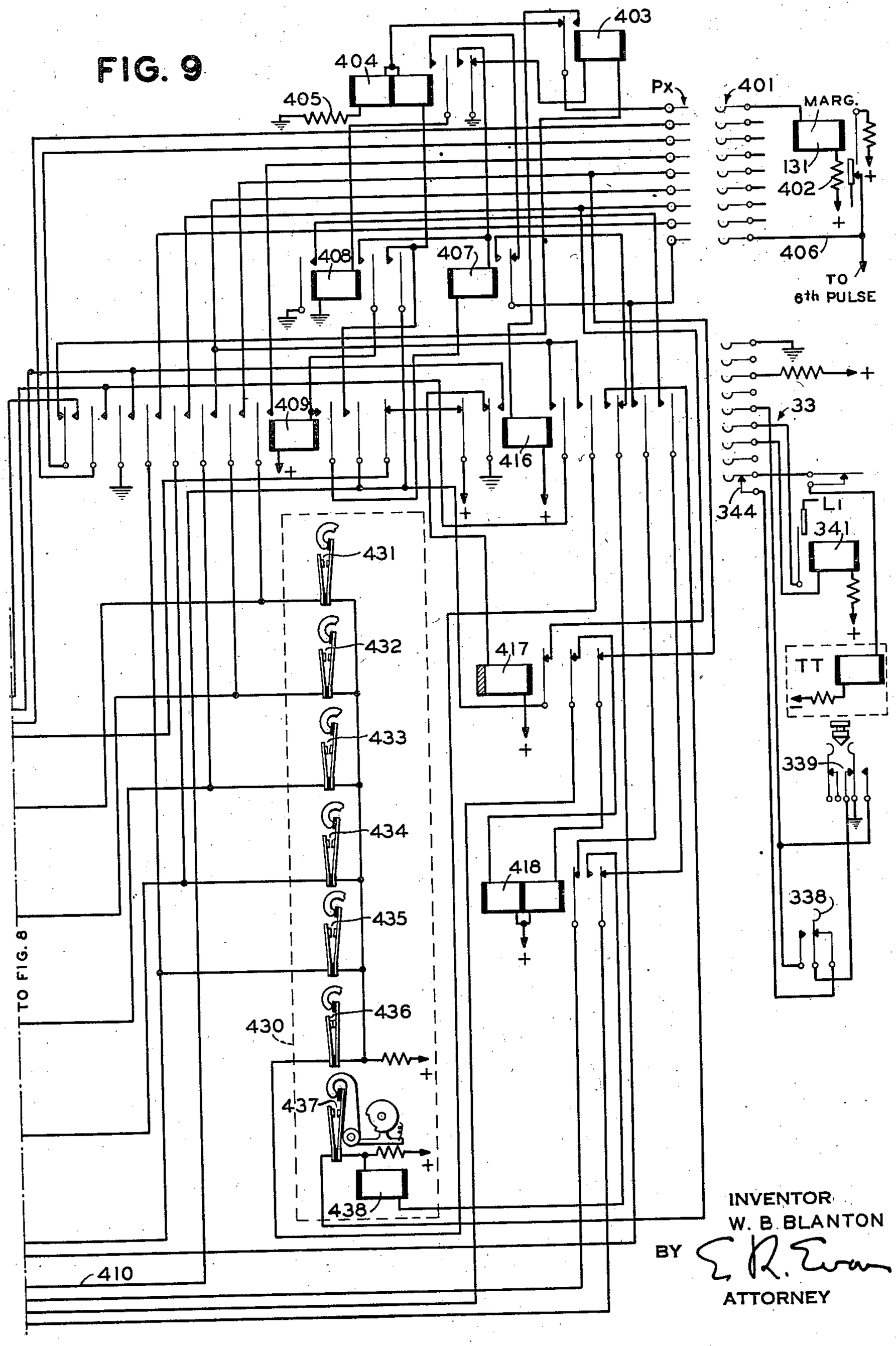
FIG. 9



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Patented Apr. 14, 1942

2,279,295

UNITED STATES PATENT OFFICE

2,279,295

TELEGRAPH EXCHANGE SYSTEM

William B. Blanton, Merrick, N. Y., assignor to The Western Union Telegraph Company, New York, N. Y., a corporation of New York

Application October 14, 1939, Serial No. 299,408

25 Claims. (Cl. 178—2)

This invention relates to telegraph exchange systems and more particularly to line switching systems adapted to handle different classes of telegraph messages.

In the transmission of messages to any particular office in a telegraph exchange system, it is often desirable to transmit certain messages ahead of other messages which may have been received earlier, or to delay the transmission of certain messages. For example in handling telegrams by the manual relay methods of the prior art, it has been customary to forward or repeat certain messages, commonly designated "X" messages, ahead of ordinary messages awaiting transmission. On the other hand day letters, night letters, and other so-called "deferred" messages which are handled at reduced cost to the patron, usually are not transmitted until the complete file of ordinary or rush messages has been transmitted. This procedure involves difficulties in exchange systems wherein switching means is provided for interconnecting lines because all messages would normally be transmitted from the exchange to a remote office or exchange substantially in the order that they are received or as soon as an idle channel is available.

In line-switching systems wherein the telegraph messages are stored, for example by tape perforating or other storage mechanism, and provision is made for switching the storage repeaters to the proper outgoing circuit or channel under the control of an attendant at the office or exchange, it is necessary to provide for automatic control of the repeaters in accordance with the condition of the transmitting circuit. Thus in order to conserve the time of the attendant by confining his duties to the acts of selecting and connecting to the desired channel (or the repeater associated therewith) and subsequently breaking down the connection, means are provided for automatically starting transmission when the channel or the sending repeater thereof is available and for releasing the same automatically as soon as the message has been transmitted in order that the transmitting apparatus of the outgoing channel may be available for other traffic before the attendant has restored the switching equipment to normal. In a system of this character it is desirable to permit transmission to be interrupted for the purpose of sending rush messages or news flashes. Obviously it is desirable to provide an arrangement whereby a special message may be interposed in the transmission over any outgoing circuit irrespective of the condition of the circuit, viz., whether it is idle or in use at the moment. It is further necessary to transmit the message without waiting for the end of a message which is being transmitted since the switching equipment is adapted to transmit successive messages substantially without interruption, one after the other. Furthermore the news flashes and stock quotations are frequently sent at the same time to two or more outgoing circuits and it would be undesirable to wait until all of the circuits become idle.

The principal features of the present invention relate to means for sending or repeating telegraph messages out of turn in a telegraph exchange or office of the above-mentioned character in order that certain messages may be expedited and others deferred; means for interrupting transmission over the line circuits or channels from a switching office without mutilating or losing messages being transmitted concurrently therewith; and in general a switching system for a telegraph office having switching and control equipment interconnected in a manner to provide for the efficient handling of telegraph messages in large volume and to meet other requirements of a large commercial telegraph system.

A primary object of the present invention is to provide an improved telegraph switching system adapted to handle different classes of messages, giving one class preference over another as to time of transmission.

Another object of the invention is to provide in a system wherein messages are stored as received, means for repeating "deferred" messages only after all regular messages for a circuit or channel to the remote office have been transmitted or have been stored at the sending position in case a storage repeater is provided.

Another object of the invention is to provide a system of the above-noted character in which the "deferred" messages are cleared out of the receiving position in order not to hold up the regular messages received subsequently but before an opportunity is presented for transmitting such "deferred" messages.

Another object of the invention is to provide a telegraph system having means for storing and repeating messages, with means for interrupting transmission of one message and interpolating a special or rush message between the beginning and the end of the other message without mutilation or loss of a part of either message.

Another object of the invention is to provide a telegraph system having means for storing and

repeating messages, with means for automatically controlling the repeating of messages from one point in accordance with the handling of other messages, for example to delay the transmission of messages from a "deferred" position or instrument if there is an accumulation of regular messages to be transmitted over the outgoing channel.

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

Fig. 1 is a condensed diagram of a telegraph exchange system embodying the invention;

Figs. 2 to 9, inclusive, are wiring diagrams which taken together show the detailed circuits of the system shown in Fig. 1, and

Figs. 10 to 13, inclusive, show the manner in which the previous figures of the drawings are fitted together to illustrate the various features of the invention.

The embodiment of the invention illustrated in the drawings is a telegraph exchange system providing for the relaying of telegraph messages received in an office or exchange to outgoing channels or circuits from said office without manual retransmission of the messages. In accordance with the invention, switching means is provided for extending the connection from the receiving positions, where messages received are stored, for example in perforated tape, to any desired transmitting circuit or channel over alternative routes. This arrangement permits messages transmitted over one route to take precedence over those transmitted over another route whereby rush messages are expedited and "deferred" messages may be delayed until the regular file has been transmitted; although in the case referred to, three alternative routes would be provided for rush, regular and "deferred" messages, respectively, a different number of routes could be provided for a different number of classes of messages.

In the embodiment of the invention illustrated, a manual switchboard with plugs and jacks for interconnecting the receiving positions with the transmitting apparatus of outgoing lines or channels from the exchange is provided but any equivalent switching means might be substituted, preferably under the control of the operators or attendants at the office or exchange. A plurality of jacks or line terminals are provided for each outgoing line or channel and if the circuit from a receiving position is plugged into the regular jack, the message is repeated as soon as the line or channel or the storage apparatus associated therewith becomes idle. If, however, the circuit is plugged into the "deferred" jack the message is transmitted to a "deferred" storage position associated with the outgoing line or channel where it is stored for a period depending upon the accumulation of messages awaiting transmission over said line or channel.

In the case of rush or "X" messages, the circuit from a receiving position is plugged into an "X" jack which is not individual to any particular outgoing line or channel but provides access to the "X" storage position where connection is made to the desired sending channel and the message is repeated without delay, interrupting transmission on the sending circuit if necessary. Other features and advantages of the invention will be apparent from the following detailed description of the particular system shown in the drawings for the purpose of illustration.

Referring to Fig. 1, two printers 11 and 12 are shown which are connected respectively to receiving perforators RR1 and RR2 at a receiving position in the telegraph exchange or office. The printers 11 and 12 may be located in two branch offices for example. The reperforators RR1 and RP2 may be similar in construction to that shown in the patent to Rothermel, No. 1,936,956 dated November 28, 1933, or patent to Dirkes et al., No. 2,174,731, dated Oct. 3, 1939. Similarly multiplex systems such as 13 terminating in the office or exchange may have the receiving distributor thereof connected to receiving reperforators, such as RR3 at the receiving position in order to store up messages received over the respective channels of the multiplex system. The reperforator RR3 may be similar in construction to that shown in the patent to Hoover et al., No. 1,851,838 dated March 29, 1932, or the printer reperforator shown in the patent to Dirkes et al., No. 2,143,828 dated January 10, 1939. The messages stored in the form of perforated tape by the reperforators RR1, RR2 and RR3 are repeated by the associated tape transmitters TT, the operation of which is initiated automatically when the circuit is extended through the switchboard represented by the jacks 14 to 21, inclusive, and the plugs P associated with each tape transmitter. The message switching and repeating system thus far described is similar to that disclosed and claimed in the patent to R. F. Blanchard, W. B. Blanton, and H. L. Browne, No. 2,193,811, dated March 19, 1940, but is is contemplated that other equivalent character storage and repeating mechanism and other selective switching apparatus may be substituted for that shown, if desired.

The tape transmitters at the receiving positions and their associated cord circuits and plugs P are all alike and are adapted to work into signal storage and signal repeating devices connected to either start-stop line circuits, or multiplex channels, or signal storage and signal repeating devices located at "deferred" storage positions or the "X" message switching position. When a plug P is inserted into a jack 15 or 19 for connecting to the repeating equipment of one of the multiplex channels of the multiplex system 13, a selector switch 25, 26 or 27 depending upon which of the multiplex channel repeaters is idle serves to extend the connection from the switchboard jack to the reperforator RR5, RR6 or RR7. The associated tape transmitter TT, subject to control from the "X" message switching position, thereupon repeats the message over one of the channels of the multiplex system through the conventional transmitting distributor shown. Thus the selector switches 25, 26 and 27 serve to distribute the calls from the switchboard to idle channels of the multiplex system 13 which may be assumed to be a heavily loaded intercity circuit. Additional selector switches are similarly arranged to distribute calls from other jacks to other multiplex channels.

In the case of messages for local branch offices which are usually operated start-stop, the jacks are multipled together as represented by the jacks 17 and 21, and connected to a reperforator, such as RR9 having an associated tape transmitter TT which is operative to repeat the message to the selected line L. The tape transmitters TT for multiplex channels may be of the construction shown in the patent to Benjamin No. 1,298,440 dated March 25, 1919, and those employed for transmitting seven-unit start-stop code signals may be constructed as shown in the patent to

Rothermel, No. 1,805,374 dated May 12, 1931. In the case of multiple-wired jacks such as 17 and 21, when two or more cord circuits are plugged at the same time into jacks of one multiple circuit, the system is arranged to prevent more than one tape transmitter operating at the same time in the manner that will be described.

In the case of "deferred" messages for one of the multiplex channels of the multiplex system 13, the circuit is plugged into one of the jacks 14 or 18, which are also multiple-wired jacks, thus extending the circuit to the "deferred" storage apparatus comprising reperforator RR4 and associated tape transmitter TT. The "deferred" tape transmitter TT is connected to contacts of the selector switches 25, 26 and 27, whereby the stored messages may be repeated over the associated multiplex channels in the same manner as regular messages. The repeating of messages from the "deferred" storage position is manually or automatically controlled to give preference to regular messages, preferably in such a manner as to prevent the repeating of "deferred" messages over any particular circuit or channel if there is an accumulation of regular messages awaiting transmission thereover.

When a rush or "X" message is received at a receiving position, a signal is operated to call the attention of the operator to the character of the message. The tape transmitter TT is then plugged into a jack, such as the jack 16 or 20 providing access to the "X" message switching position. The "X" message switching equipment comprises a selector switch 28, a reperforator RR3 and associated tape transmitter TT, the contacts of which may be extended through the plug Px and the switchboard jacks, such as 30, 31, 32 and 33 to the line circuit or channel to the desired device. A plurality of selectors and storage-repeater units may be provided at the "X" position if desired. As soon as the complete message is stored at the "X" message switching position, the operator at that position plugs the tape transmitter into the proper jack, whereupon transmission is interrupted over the selected circuit or channel if it is in use and the message is sent immediately. At the end of the message the circuit or channel is restored to normal and transmission of the interrupted message over such circuit or channel is resumed.

In accordance with another feature of the invention, a broadcast transmitter 35 is provided which is common to the line circuits extending to the local branch offices or patrons. This transmitter is arranged to send special messages such as news flashes, stock or commodity quotations, et cetera to any of these offices or simultaneously to any two or more of the offices. Since it might not be practicable to delay transmission of such messages until the wanted office or offices become idle, the connection of the broadcast transmitter 35 to any line circuit is arranged to interrupt the transmission over such circuit if it is in use. This interruption in the transmission of a message to one of the offices is accomplished without loss or mutilation of any characters and when the circuit is released, the storage and transmitting devices associated with the switchboard are again rendered operative to resume transmission of the interrupted message.

Thus it will be apparent that in accordance with the preferred embodiment of the invention, the switching means for extending the circuits to the outgoing lines or channels provides alternative routes which determine the preference to be given to any particular message. In the case of a manual switchboard, a plurality of jacks are provided for each outgoing line or channel, and if the storage and transmitting apparatus at the receiving position is plugged into one jack, the message is repeated as soon as possible over the selected line or channel in its regular turn. If the connection is extended through another jack, the transmission of a message is deferred in the event that messages are awaiting transmission over the selected line or channel. A third switchboard jack provides access to special equipment arranged to interrupt regular transmission over any selected line or channel in order to expedite the transmission of special or rush messages. The operation of the system in detail will appear from consideration of the detailed circuits shown in Figs. 2 to 9, inclusive, of the accompanying drawings.

Detailed Description

Connection to multiplex channel

The circuits involved in the repeating of a message to a multiplex channel are shown in Figs. 2, 3 and 4 of the drawings when these figures are arranged as shown in Fig. 10. Referring to Fig. 2 the printer 11 at a branch or patron's office for example may be connected to the exchange or main office through two line conductors as shown, one being used for transmitting and the other for receiving signals at the branch office. If desired, the connection may be effected over one line conductor worked duplex or in any other conventional manner.

As shown the transmitting contacts of printer 11 are connected in series relation with the left hand winding of relay 41 and with the operating magnet of the receiving reperforator RR1. The relay 41 is normally energized by the current flowing over the described line circuit but upon the first spacing signal received when a message is transmitted to the main office, relay 41 becomes deenergized and closes through its left hand armature and back contact a short-circuit around the left hand winding of said relay so that the relay does not respond to the line signals. A circuit is also closed upon the deenergization of relay 41 from ground through the left hand armature and back contact of relay 42, the right hand armature and back contact of relay 41 and the "call" lamp 43 to battery, whereupon the lamp 43 is lighted to show that a message is waiting at this receiving position. The message is stored in tape fed through the receiving reperforator RR1 in the usual manner so that after connection is made to the desired outgoing circuit or channel, the message may be automatically repeated by the associated tape transmitter TT. The address preceding the message on the tape enables the operator or attendant to extend the connection to the proper outgoing circuit or channel. After the message has been completely stored in the tape and transmission has ceased from the branch office, the operation of a restoring key 44 reenergizes relay 41 and extinguishes the "call" lamp 43.

An "X" message is ordinarily preceded by bell signals. The contacts 46 of the receiving reperforator RR1 are closed upon receipt of a bell signal and complete a circuit through the left hand winding of relay 42 whereupon said relay becomes energized. The arrangement of the contacts 46 to be operated in response to a predetermined signal may be similar to that shown in the patent to Dirkes et al., No. 2,143,828, dated

January 10, 1939 (see Figs. 8 and 9). Upon the energization of relay 42, a locking circuit for said relay is closed through its right hand winding, right hand armature and front contact and the contacts of the key 47. A circuit is also closed through the interrupter 48, the left hand winding and front contact of relay 42, the right hand winding and front contact of relay 42, the right hand winding and back contact of relay 41 and the "call" lamp 43 whereupon the "call" lamp is flashed to indicate to the operator that the message is an "X" message. The operation of the key 47 unlocks the relay 42 and restores the supervisory equipment to normal.

As many storage and repeating units are provided as there are incoming circuits or channels, and each tape transmitter of such units terminates in a cord circuit and switchboard plug P adapted to be inserted in the jacks of the switchboard at the receiving position. The cord circuits associated with all of the tape transmitters are identical and are adapted to work into the repeating apparatus of either start-stop circuits or multiplex channels, or into local storage equipment.

In the case of multiplex receiving channels, each channel of the receiving distributor MRD is connected to a reperforator such as the reperforator RR3 in the usual manner. The reperforator RR3 is provided with five selecting magnets 51, an operating magnet 52, contacts 53 which are closed upon receipt of the bell signal, and contacts 54 which are arranged in the sixth pulse or stepping circuit and are closed only when a character other than a "blank" or all-spacing character is set up on the selecting magnets of the reperforator. The contacts 54 controlling the circuit of the tape-stepping magnet 52 and also the circuit of the associated control relay 55 may be arranged as shown in the above-mentioned Dirkes Patent No. 2,143,828 (contacts 173, Figs. 3 and 17). Since the contacts 54 remain open as long as "blanks" are received over the receiving channel, the relay 55 is normally deenergized. Upon the receipt of the character other than a "blank" however, contacts 54 close and energize relay 55 whereupon the said relay becomes locked up through its right hand winding and right hand inner armature and front contact and the contacts of key 56. Upon the energization of relay 55, a circuit is closed from ground through the left hand armature and back contact of relay 57, right hand cuter armature and front contact of relay 55 and the "call" lamp 58 to battery whereupon the lamp 58 is lighted to signal the operator. Relay 57 corresponds to relay 42 already described and serves to flash the lamp 58 in case of an "X" message as described in connection with the start-stop channels.

As stated above the cord circuit control equipment associated with each tape transmitter at the receiving position is identical and therefore the description of one cord circuit will be sufficient to explain the operation. The switchboard jacks 15 and 19 provide access to one multiplex system and may be located at two separate positions of the switchboard as indicated in Fig. 1. The multiplex system may be assumed to comprise two or more multiplex channels to the same point, one channel being shown in Fig. 4. Other multiplex systems are connected to other switchboard jacks in a manner similar to that shown in the case of the jacks 15 and 19. Each channel of each multiplex system is provided with a finder switch similar to the switch 25 (see Fig. 3), said finder switch comprising seven rotary switch wipers 61 to 67 as shown actuated by the operating or stepping magnet 68 in the usual manner. The terminals of the switchboard jacks corresponding to one multiplex system, such as the jacks 15 and 19, are connected to separate contacts in the respective contact banks of switch 25 and are multipled to the contacts of the other finder switches of the same multiplex system in the same manner, one of these switches being indicated at 26 in Fig. 4. The finder switch 25 is arranged to connect any of the switchboard jacks allotted to the multiplex system shown to one channel thereof through the reperforator RR5 and associated tape transmitter TT2. In a similar manner the finder switch 26 connects any of said jacks to a second channel of the same multiplex system through the reperforator RR6 and associated tape transmitter TT, the detailed circuits of which are omitted for the sake of simplicity since they are identical with those shown in connection with the first channel.

A load-distributor control switch comprising rotary switch wipers 70, 71, 72 and 73, and an operating magnet 74 for distributing successive calls to the respective channels of the multiplex system by controlling the operation of the respective finder switches is also provided for each group of finder switches. The first contacts of the respective contact banks engaged by the switch wipers 70—73 are connected to the control relays of the finder switch 25 and the first multiplex channel; the second contacts to the second finder switch 26 and so on. Except for its control of the "deferred" storage channels as described below, the load-distributor is of conventional character, and other equivalent control apparatus may be employed in lieu of that shown, if desired.

Assuming that a message has been received at the receiving position shown in Fig. 2 which is to be repeated over one of the channels of the multiplex system shown in Fig. 4, the operator plugs the multiple-conductor connecting plug P associated with the reperforator RR1 and tape transmitter TT into the switchboard jack 15. A contact of the switchboard jack 15 forming a terminal of said multiplex system is connected to positive battery whereby a positive potential is applied to the conductor 7 of the cord circuit when the plug is inserted in the jack. A circuit is closed upon insertion of the plug into the jack 15 from positive battery to conductor 7 of the cord circuit and through the windings of relays 75 and 76 to ground. Relay 75 is shunted by a rectifier 77 and relay 76 is shunted by a rectifier 78, said rectifiers being oppositely poled in the described circuit between the conductor 7 and ground. Therefore relay 75 becomes energized whereas relay 76 is short-circuited by the low resistance path through the rectifier 78 and remains deenergized. In the case of a connection through the switchboard to a start-stop or branch office circuit, the contact of the branch office switchboard jack which is connected to the conductor 7 when the plug P is inserted in the jack is connected to negative battery. Therefore when the plug is inserted into this jack, relay 76 becomes energized and relay 75 remains deenergized so that the control equipment of the cord circuit functions in a different manner depending upon the type of circuit into which the repeating equipment is plugged. Obviously if desired the neutral relays 75 and 76 with their

associated rectifiers might be replaced by polar relays.

Upon the energization of relay 75 as described, a start circuit for the load distributor switch 70—73 is closed, said circuit extending from ground through the left hand outer armature and back contact of relay 81, the right hand inner armature and back contact of relay 82, the right hand outer armature and front contact of relay 75, conductor 8 of the cord circuit and its associated plug and jack contacts in the switchboard, conductor 8 of the cables 84 and 85 extending from jack 15 to the finder switch 25 and the winding of the start relay 153. The energization of relay 153 causes the load distributor to commence to hunt for an idle finder switch. The circuit of the stepping magnet 74 of the control switch may be traced through the interrupter contacts associated with said magnet, the inner right hand armature and front contact of any relay 86 of an idle multiplex channel (said relay being energized except when the corresponding channel is operating upon the intra-office or switchboard circuit, or when the multiplex channel is cut out of service, as explained below), the switch wiper 72 assumed to be in engagement with a bank contact individual to a busy channel, and the right hand outer armature and back contact of relay 86 of such channel. Thus when the switch wipers 70—73 reach an idle channel, which may be assumed to be that of the finder switch 25, the wipers stop on said contacts. The circuit of relay 86 may be traced through the left hand armature and back contact of relay 96 to ground at the lower normal contacts of the key 101. Thereupon the circuit of the operating magnet 68 of the finder switch 25 is closed, said circuit including the left hand outer armature and back contact of relay 87, the left hand outer armature and front contact of relay 86, the load distributor switch wiper 70, the inner armature of relay 153 and interrupter 88. Thereupon the operating magnet 68 is intermittently energized to step the respective switch wipers 61 to 67 into the positions shown in which said wipers engage the bank contacts individual to the switchboard jack 15. At this time a circuit is closed from positive battery through the resistor 90, left hand armature and front contact of relay 75, normally closed make-before-break contacts associated with the outer right hand armature of relay 82, the winding of relay 81, conductor 9 of the cord circuit and the associated plug and jack contacts, conductor 9 of the cable 84, wiper 67 of the finder switch 75, the interrupter contacts 91 associated with the stepping magnet 68, the left hand winding of relay 87, resistor 92, the left hand inner armature and front contact of relay 86, switch wiper 71 and the middle armature and front contact of relay 153, to ground. Relays 81 and 87 become energized and relay 87 becomes locked up through the described circuit including the finder switch 25, the right hand winding and right hand inner armature and front contact of relay 87 and the right hand outer armature and back contact of relay 94 to negative battery.

The energization of relay 87 opens at its left hand outer armature and back contact the circuit of the stepping magnet 68 of the finder switch 25 so that the switch wipers remain in engagement with their bank contacts which are connected to the switchboard jack 15. At this time the circuit of the tape transmitter TT at the receiving position could be extended to the multiplex channel if desired but preferably service code signals are first stored in the tape at the reperforator RR5 associated with said channel. These service code signals may include consecutive numbers transmitted with consecutive messages over said channel from the numbering machine 104 in order to facilitate tracing lost or mutilated messages and for other purposes. The numbering machine and system are disclosed and claimed in the patents to Dirkes et al., Nos. 2,193,809 and 2,193,810, dated March 19, 1940. Consequently the numbering machine is not shown in detail except for the stepping magnet 105 operating a plurality of code drums 106 and the contacts 107 and 108 of which the latter is closed at the completion of the cycle of operation of the numbering machine to transfer the circuit of the reperforator RR5 to the tape transmitter at the receiving position.

The energization of relay 87, as described, closes the circuit of the stepping magnet 105 of the numbering machine, said circuit extending from ground through the sixth pulse contacts 110 of the pulsing unit 111 associated with reperforator RR5, the right hand outer armature and front contact of relay 87, the sixth armature and back contact of relay 97, conductor No. 6 of the cable 112 and the winding of the stepping magnet 105 to negative battery. Upon each closure of the intermittent contacts 110 the stepping magnet 105 is energized to step the code drums 106 through successive angular positions whereby the number of the particular message is perforated in the tape by the reperforator RR5 in advance of the storage of the message at that point. The circuits of the selecting magnets of the reperforator RR5 from the numbering machine include the cable 112, the first five armatures and back contacts of relay 97 and the cable 114 extending to the reperforator. The selecting magnets are preferably connected as indicated by the conductors 115 to pulsing contacts of pulsing unit 111 in order that the selective operation of the reperforator elements may be effected in properly timed relation to the rotation of the code drum 106 and the operation of the punch magnet 116. Punch magnet 116 is likewise connected to contacts 117 of the pulsing unit 111 to insure that the punch magnet is energized immediately after the closure of the circuits of the selecting magnets of the reperforator. Pulsing unit 111 is further provided with other intermittent contacts 118 for the purpose of controlling the associated control relays in a manner to be described.

The energization of relay 87, as described above, also closes a circuit from ground through its second right hand armature and front contact for energizing slow-release relay 96. The operation of relay 96 opens at its left hand armature and back contact the circuit of relay 86 which, as will be apparent from the foregoing description, busies the first channel associated with the line finder switch 25 to other calls through the switchboard. At the end of the transmission of the message the circuit of relay 96 is opened to reclose the circuit of relay 86 and by reason of the slow-release characteristic of relay 96 sufficient time is obtained for all of the equipment to be restored to normal before the circuit may be seized for another call. A key or switch 101 is provided in connection with the first channel of the multiplex system whereby the channel may be rendered busy if it is desired to cut the same out of service. The key 101 is a three-way key

which when thrown to the upward position opens the circuit of relay 86 at its lower contacts and, as explained above, as long as this relay is de-energized the first channel will not be selected by the load distributor 70—73. Similar keys, such as key 102 associated with the second channel, are provided for each of the channels as indicated.

When the numbering machine 104 has completed its cycle the contacts 108 are closed whereupon a circuit is closed through said contacts, conductor No. 6 of the cable 112, the inner left hand armature and front contact of relay 87 and the winding of relay 97. The energization of relay 97 transfers the circuits of the reperforator RR5 from the numbering machine through the respective switch wipers 61 to 66 of the finder switch 25 and the switchboard to the tape transmitter TT associated with the receiving-reperforator RR1. The energization of relay 97 interrupts the described operating circuit from the sixth pulse contacts 110 to the stepping magnet 105 of the numbering machine but another circuit is closed from said contacts through the conductor No. 7 of the cable 112 and the contacts 107 of the numbering machine whereby upon the generation of the next sixth pulse, the code drum 106 of the numbering machine are stepped back to the starting position whereupon the contacts 107 are opened to interrupt the circuit of the magnet 105. The numbering machine is thus restored to normal in readiness to transmit another series of service code signals preceding the following message over the first channel of the multiplex system. Each multiplex channel and each line circuit may be provided with such an automatic code transmitter if desired.

The energization of relay 81 as described above when the finder switch 25 reached the terminals connected to the jack 15 opens at its outer left hand armature and back contact the start circuit for relay 153 of the load distributor switch 70—73. As soon as the numbering machine 104 has completed its cycle and operated relay 97, the sixth pulse or transmitter stepping impulse circuit is connected from the pulsing contacts 110 through the right hand outer armature and front contact of relay 87, the sixth armature and front contact of relay 97, switch wiper 66 of the finder switch 25, conductor No. 6 of the cable 84, the contacts of the switchboard jack 15 and the plug P, conductor 6 of the cord circuit, the left hand inner armature and front contact of relay 81, the right hand outer armature and back contact of relay 121, and the winding of relay 122 to negative battery. When the next sixth pulse or transmitter stepping pulse is transmitted by the pulsing contacts 110, relay 122 becomes energized. The energization of relay 122 closes a circuit from ground through its left hand outer armature and front contact and the winding of relay 82 to negative battery whereupon relay 82 becomes energized and locks up through a circuit that is independent of relay 122 including the left hand inner armature and front contact of relay 82 and the right hand inner armature and front contact of relay 75. As soon as the contacts 110 of the pulsing unit 111 open and remove ground from the winding of relay 122, the latter relay locks up through its left hand inner armature and front contact, the winding of relay 121 and the left hand outer armature and front contact of relay 81 to ground, thereby maintaining relay 122 operated and operating relay 121. The energization of relay 121 transfers the sixth pulse circuit at the outer right hand armature and front contact of said relay to the stepping magnet of the tape transmitter TT, this circuit including the contacts and windings of the conventional auto-stop relay 123. The auto-stop relay 123 is connected to the stepping magnet of the tape transmitter and to the auto-stop contacts 124 associated with the tape loop between the reperforator RR1 and the tape transmitter TT in the same manner as disclosed in the patent to Houghtaling, No. 1,275,559 dated August 13, 1918. The purpose of this control equipment is to open the circuit of the stepping magnet of the tape transmitter whenever the tape loop between the reperforator and the transmitter becomes taut. Under normal conditions repeating of the message stored in the tape through the switchboard is not commenced until the entire message has been received at the receiving position and thereafter sufficient blank tape is stepped out of the reperforator to enable the tape transmitter to repeat the entire message before the loop of tape becomes taut. Furthermore, as explained in the prior patent of Blanchard et al. referred to above, the rate of transmitting code signals from the receiving position to the storage apparatus associated with the outgoing line or channel is considerably faster than the normal rate of transmission from the branch office printer 11 to the exchange whereby the time required for the switching operation is made up and the accumulation of tape under busy traffic conditions at the receiving position is obviated.

The initial operating circuit of relays 81 and 87 as pointed out above includes the right hand make-before-break contacts of relay 82 and the left hand armature and front contact of relay 76 to positive battery. Upon the energization of relay 82 as described, this circuit is transferred through the right hand outer armature of relay 82 to ground at the right hand inner armature and front contact of relay 81. The release of the cord circuit is therefore independent of relay 75 and is effected in a manner to be described.

The code combinations perforated in the tape fed to the tape transmitter TT effect the selective operation of the movable contacts of the transmitter with respect to the marking and spacing contacts. Ground potential connected to the left hand or marking busbar of the tape transmitter is connected through the first five right hand armatures and front contacts of relay 121, the cord circuit, plug P and jack 15 of the switchboard, conductors 1 to 5 of the cable 84, the switch wipers 61 to 65 of the finder switch 25, the first five armatures and front contacts of relay 97, conductors 1 to 5 of the cable 114, the windings of relays 125, 126 and 127 and conductors 6 to 10 inclusive of the cable 114 to the five selecting magnets of the reperforator RR5. After the selective operation of the magnets of the reperforator for each character, the contacts 117 of the pulsing unit 111 operate the punch magnet 116 to perforate the characters in the tape associated with said reperforator. The de-energization of the punch magnet 116 of the reperforator steps the tape therethrough, and closure of the contacts 110 advances the tape in the tape transmitter TT to set up the next character. In this manner the message perforated in the tape at the receiving position is again stored in perforated tape in the sending position to be repeated over the multiplex channel. The

tape transmitter TT associated with the reperforator RR5 is controlled by the multiplex distributor in the usual manner, the contacts of the tape transmitter being connected through the armatures and back contacts of relay 131 to the sending ring of the multiplex sending distributor MSD. Thus it will be seen that after a connection is made through the switchboard from the storage and repeating equipment at the receiving position to one of the multiplex channels selected by the load distributor, the massage is repeated over the selected multiplex channel. The selection of the proper outgoing circuit is determined by the switchboard attendant who plugs the storage and repeating equipment at the receiving position into a jack individual to the proper circuit but the message is preferably stored at the sending position represented by the reperforator RR5 and associated tape transmitter TT in order to permit the transmission of the message through the switchboard at a different rate and preferably a higher rate than that employed in transmitting the message over the multiplex system to the remote office. Since a certain amount of time is required to select and connect to the different outgoing circuits or channels at the switchboard, this arrangement prevents the accumulation of messages at the receiving position when the traffic is heavy and messages are continually transmitted from the branch office.

At the end of each message the branch office operator appends an end-of-message signal or signals which are operative to release the channel of the multiplex system so that it is available for other messages before the connection through the switchboard is broken down by removing the plug from the switchboard jack. The end-of-message signal in the system shown consists of two consecutive period-dot code combinations although it will be apparent that any other code combination or series of code combinations not employed for regular transmission may be used for this purpose. The relays 125, 126 and 127 are arranged to distinguish between the period-dot code combination and all other code combinations.

As shown the two windings of relay 125 are in series with the first and second conductors of the cable 114, respectively, the two windings of relay 126 are in series with the third and fifth conductors of said cable, respectively, and the winding of relay 127 is in series with the fourth conductor. Thus the transmission of the period-dot code combination in which only the fourth impulse is "marking" causes relay 127 to be energized while relays 125 and 126 remain deenergized. For all other code combinations either relay 127 will be deenergized or one or both of the relays 125 and 126 will be energized at the same time as relay 127. The relays 125, 126 and 127 also serve to prevent the stepping of the reperforator RR5 upon the receipt of a blank or all-spacing signal, which of course is not perforated in the tape. It will be noted that the circuit of the punch magnet 116 of the reperforator includes the left hand armature and front contact of one of said relays, and therefore if none of the relays is operated, as in the case of a blank signal being transmitted from the tape transmitter at the receiving position, the circuit of the punch magnet remains open when the normal operating contacts 117 thereof are closed.

When a period-dot combination having only the fourth pulse marking is transmitted from tape transmitter to receiving position, relay 127 is energized and relays 125 and 126 remain deenergized. Thus a circuit is closed from ground through the right hand armatures and back contacts of relays 125 and 126, the right hand armature and front contact of relay 127, the left hand armature and back contact of relay 128 and the winding of relay 129 to negative battery. Relay 129 becomes energized and closes a locking circuit for its own winding through its right hand armature and front contact, the winding of relay 128, the armature and back contact of relay 130 and the right hand armature and front contact of relay 96 to ground. Relay 128 does not become energized immediately, however, because it is short-circuited by the connection to ground described above at the right hand armature of relay 125. However at the end of the fourth pulse which operates relay 127, relay 128 becomes energized by the deenergization of relay 127. If the next character transmitted by said tape transmitter is any code combination other than a blank or a period-dot, a circuit is closed from negative battery through the winding of relay 130, the left hand armature and front contact of relay 129 and the right hand armature and front contact of either relay 125 or 126 whereupon relay 130 becomes energized. The energization of relay 130 opens at its back contact the described locking circuits of relays 128 and 129, whereupon said relays are restored to normal.

As stated above, the end-of-message signal consists of two successive period-dot code combinations, the first of which causes the energization of relays 128 and 129 in the manner described. Upon receipt of the second period-dot code combination, a circuit is closed from ground through the right hand armatures and back contacts of relays 125 and 126, the right hand armature and front contact of relay 127, the armature and front contact of relay 128 and the winding of relay 95 to negative battery, whereupon relay 95 becomes energized. The energization of relay 95 closes a locking circuit for said relay through its armature and front contact, the winding of relay 94, the armature and back contact of relay 130 and the right hand armature and front contact of relay 96 to ground. Upon the resetting of the tape transmitter which causes the interruption of the described operating circuit of relay 95, relay 94 becomes energized in series with relay 95. The energization of relay 94 interrupts at its outer right hand armature and back contact the holding circuit for relays 81 and 87, whereupon these relays become deenergized. The deenergization of relay 87 interrupts the circuits of relays 96 and 97, thereby restoring the control equipment associated with the finder switch 25 to normal so that the multiplex channel is released for another call even though the plug P has not been removed from the switchboard jack 15. In this manner the counting relays 94, 95, 128 and 129 respond to the transmission of a plurality of period-dot code combinations forming the end-of-message signal and cause the release of the multiplex channel.

The release of the cord circuit control equipment is effected as follows: Upon the deenergization of relay 81 as described, all of the relays associated with the cord circuit are restored to normal except relays 75 and 82. The circuit of relay 75 is completed as long as the plug P remains in the switchboard jack and relay 82 is locked up through its inner left hand armature

and front contact and the inner right hand armature and front contact of relay 75. The circuit of the "disconnect" lamp 135 is closed through the left hand outer armature and front contact of relay 82 and the right hand outer armature and back contact of relay 81. The lighting of the lamp 135 denotes to the operator that the message has been transmitted and the operator withdraws the plug P from the jack 15 to restore relays 75 and 82 to normal whereupon the "disconnect" lamp 135 is extinguished. The cord circuit is then in readiness for another call which is put through upon insertion of the plug P in the same or any other switchboard jack.

In the foregoing description it was assumed that the storage and repeating apparatus of the first channel of the multiplex was idle. If the first channel had been busy the load distributor 70–73 would have caused the finder switch 26 to extend the connection from the jack 15 through the cable 85 to the second channel of the multiplex system in a manner similar to that described above in connection with the first channel. Other channels may also be provided and connected in multiple to the switchboard jack 15 through finder switches similar to the switch 25. It will be apparent that the finder switches such as 25 and 26 under the control of load distributor serve to distribute the calls made through the switchboard to the respective multiplex channels of the mutiplex system.

Since the transmission from the receiving positions to the sending storage and repeating apparatus is preferably at a higher rate than the transmission over the outgoing channels, the load distributor tends to distribute the calls uniformly to the respective channels. The storing of the message signals in the tape at the reperforator RR5 or RR6 may commence immediately even if a part of the previous message has not yet been transmitted by the associated tape transmitter TT.

As soon as the accumulation of traffic for the multiplex channel has been transmitted and for the time being no further message signals are received by the reperforator RR5, the operation of the tape transmitter TT at the sending position will take up the slack in the tape between said reperforator and the transmitter. The shortening of the tape loop raises the tape lever 137 and closes the upper contacts thereof to complete a circuit from ground through the third right hand armature and back contact of relay 87, the upper contacts of the tape lever 137 and the winding of relay 98 to negative battery whereupon relay 98 becomes energized and locks up through a circuit including its left hand inner armature and front contact that is independent with the contacts of the tape lever. The energization of relay 98 closes a circuit from ground through its right hand armature and front contact, the tape feed-out mechanism 136, the punch operating contacts 117 of the pulsing unit 111 and the punch magnet 116 to step out blank tape from the reperforator. As soon as a sufficient blank tape has been stepped out to enable the last character code signal to reach the tape transmitter TT, the tape feed-out mechanism 136 of conventional construction opens the circuit to the punch magnet and no further tape is fed out until another message is received on the reperforator. As soon as the lower contacts of the tape lever 137 open, a circuit is completed for the stepping pulse from the multiplex distributor through the make-before-break contacts associated with the outer armature of the relay 131, and make-before-break contacts and the right hand winding of the auto-stop relay 138, whereupon said relay 138 becomes energized in series with the stepping magnet of the tape transmitter and the stepping of tape through the tape transmitter ceases. "Blank" signals are transmitted over the channel of the multiplex system until perforated tape again is fed into the tape transmitter from the reperforator RR5.

The tape feed-out control relay 98 closes a circuit through its second left hand armature and front contact for applying ground potential to the conductor 140 leading to the "deferred" storage equipment (see Figs. 5 and 6), and is used to indicate that one of the multiplex channels is idle and available for handling "deferred" messages. Thus the operation of the "deferred" storage equipment in a manner that will be described is made dependent upon the accumulation of ordinary messages for the multiplex channels so that the "deferred" traffic is not transmitted until no regular messages are awaiting transmission to the repeating apparatus of at least one of the channels of the multiplex system. Similar tape feed-out control relays, such as indicated at 99 associated with the other channels, are also arranged to apply ground potential to the conductor 140 in order that the "deferred" storage equipment may be operated as soon as any one of the multiplex channels is available.

When any one of the multiple channels is to be cut out of service the key 101 or 102 individual to said channel is thrown upward. As described above, the circuit of relay 86 includes the lower contacts of the key 101 so that when this key is operated to open said contacts, the relay 86 becomes deenergized, which connects ground to the bank contact of the wiper 72 of the load distributor to prevent the operation of the associated finder switch 25 and cause all calls to be transmitted over the other channel or channels of the multiplex system. If the multiplex system is closed down on account of line or equipment troubles, all of the keys 101, 102, etc., are thrown upward to close out the individual channels. A circuit is then closed through the lamp 150 in the switchboard adjacent to jack 15, conductor 10 of the cables 84 and 85, contacts 151 of the key 101, contacts 152 of the key 102, corresponding contacts of the keys of other channels, if any, the armature and back contact of relay 153 to battery, whereupon the lamp 150 lights to indicate to the switchboard operator that the multiplex system has been cut out of service and no calls are to be placed through the multipled jacks associated with said multiplex and arranged in multiple to the jack 15. It will be understood that lamps 150 are arranged in parallel to that shown at each position of the switchboard adjacent jacks, such as 19, also leading to the same outgoing circuit or channel. In cases of this kind where a line or apparatus unit at the office is taken out of service, it is important to prevent attempts to use the disabled line or equipment, both because of the possibility of delay in relaying a message and because it is necessary to prevent the loss of messages which might be accidentally sent into an open circuit. Thus it is an important feature of the invention to arrange a signal such as the lamp 150 adjacent each switchboard terminal which is operated by the act of cutting out the circuit or channel equipment. In accordance with a further feature of the invention, if an attempt is made to

plug a call into the jack 15 when all of the channels have been cut out as described, the closure of the start circuit energizes the relay 153 to interpose the interrupter 154 in the circuit of the lamps 150, causing the lamps to commence to flash as soon as the operator plugs in a cord circuit. As soon as the operator notes the flashing of the lamp at the point where she has inserted the switchboard plug, she will withdraw the plug at once and attempt to route the call in some other manner to its destination.

In case the multiplex system is stopped because the remote office is closed down, as for example during the night, the key 101 or 102 associated with one of the multiplex channels is thrown downward to close the contacts 155 or 156. Thereupon battery is connected through said contacts to the conductor 10 of the cables 84 and 85 to light the lamps 150 at the switchboard. If the operator has a "deferred" message for the multiplex system shown the call may be plugged into the "deferred" jack associated with the said multiplex system for storage until the multiplex system is again placed in service. The lamps 150 adjacent the regular switchboard jacks indicate that regular messages are not to be plugged into the jacks while the lamps are lighted because of the fact that the remote office is closed down for example. Under these circumstances an attempt to transmit a regular message through the usual channels would result in delay whereas in some cases such messages may be routed through other offices for prompt delivery even though the regular channels are cut out of service.

Connection to deferred storage equipment for multiplex channels

The circuits involved in repeating a "deferred" message to the multiplex system (Fig. 4) are shown in Figs. 2 to 6 inclusive, when these figures are arranged as shown in Fig. 11. In the case of a "deferred" message it should be understood that the message is to be cleared out of the receiving position promptly in order to prevent the accumulation of messages at that position, but is to be transmitted over the outgoing line or channel in such a manner as to avoid delaying regular traffic, as for example by holding up the "deferred" message until there is no regular message for the repeater equipment of the selected outgoing line or channel. In accordance with the present invention this is accomplished by transferring the message to a "deferred" storage position from which it is automatically repeated over the outgoing line or multiplex as soon as all of the regular messages awaiting transmission on the line or one channel of the multiplex have been sent to the line or the repeater at the sending position.

Since each of the cord circuit control equipments at every receiving position are identical it may be assumed for purposes of explanation that a "deferred" message has been stored at the receiving reperforator RR1, Fig. 2, for transmission over the multiplex system shown in Fig. 4. In this instance the operator or attendant plugs the cord circuit and transmitter TT into the switchboard jack 14 individual to the multiplex system shown but bearing a suitable designation indicating that it is allotted to "deferred" traffic. The cable 284 extending from the jack 14 to the deferred storage apparatus shown in Figs. 5 and 6 is also multipled to the corresponding jacks at the other switchboard positions in the manner indicated for the local or branch office jacks 17 and 21 in Fig. 2. In the case of the multipled jacks referred to, control equipment in the cord circuit is arranged to permit transmission from only one cord circuit at a time when two or more are plugged up to the same "deferred" storage unit or branch office circuit.

Assuming that the "deferred" storage equipment shown in Figs. 5 and 6 is idle when the plug P is inserted in the jack 14, the tape transmitter TT at the receiving position is operative immediately to transmit the "deferred" message to the reperforator RR4 at the "deferred" storage position. As soon as a part of the message has been received, in a manner that will be described in detail, the loop of tape between the reperforator RR4 and its associated transmitter TT becomes slack and permits the closure of the normally open lower contacts of the tape lever 237, whereupon the stored message is transmitted to one of the channels of the multiplex system of Fig. 4 as soon as one of the channels becomes idle and the associated finder switch 25 or 26 is stepped to the position corresponding to the "deferred" storage repeating apparatus. As stated above, the finder switches 25 and 26 are not operative to connect to the "deferred" storage equipment until the associated channel storage and repeating apparatus has no regular messages waiting so that the transmission of the "deferred" message will not involve any delay in the transmission of regular traffic.

The detailed operation of the circuit is as follows: Upon the insertion of the plug P in the jack, negative battery is applied through conductor 7 of the cord circuit by a contact in the jack 14, whereupon relay 76 connected between ground and the conductor 7 and poled for negative battery becomes energized. The energization of relay 76 closes the test circuit from the cord circuit allotter switch 160. The allotter switch 160 comprises a rotating grounded contact member which periodically and successively grounds the test circuits of the respective cord circuits. Under the assumed idle condition of the "deferred" storage apparatus, when the contact of the allotter switch 160 engages the brush 161, a circuit is closed from ground through said brush, resistor 162, left hand inner armature and front contact of relay 76, the make-before-break contacts associated with the right hand outer armature of relay 82, the winding of relay 81, conductor 9 of the cord circuit and contacts of the plug P and jack 14 connected thereto, conductor 9 of the cable 284, the winding of relay 287 (Fig. 5), left hand armature and back contact of relay 296, the normally closed upper contacts of the key 201, the right hand armature and back contact of relay 294 and resistance to negative battery, whereupon relays 81 and 287 become energized. Since corresponding or similar control elements are used at the regular and "deferred" storage equipments, similar reference numerals have been applied to these elements of the "deferred" equipment with the prefix "2". Thus for example the relay 287 corresponds to the relay 87 of Fig. 3. The energization of relays 81 and 287 initiates the repetition of the received message from the transmitter TT at the receiving position (Fig. 2) to the reperforator RR4 at the "deferred" storage position in a manner that will be apparent from the foregoing description of the repeating of regular messages from a receiving position to the reperforator RR5. In this case however the messages are not numbered as each

message will be numbered when it is sent into the regular line storage.

In the case of multipled jacks, the energization of relay 76 instead of relay 75 places the circuit of relay 81 under the control of the contacts of the allotter switch 160. If the cord circuit is plugged into a jack in multiple to another jack which has already been selected by an operator, conductor 9 of the cord circuit is grounded at the first switchboard connection through the low-resistance winding of relay 81 of the first circuit plugged up, the left hand outer armature and front contact of relay 76 of said circuit, the right hand inner armature and front contact of relay 81. Therefore when a second cord circuit is plugged into a multipled jack of the deferred storage equipment, the relay 81 of the second cord circuit does not become energized until the relay 81 of the first cord circuit becomes de-energized at the end of the message. Since the test circuits including the windings of relays 81 of the respective cord circuits are closed one at a time, only one cord circuit can be connected through to the deferred storage position at any one time regardless of how many are connected in multiple at the switchboard jacks. Upon the energization of relay 81 as described, a locking circuit is closed for relays 81 and 287 through left hand outer armature and front contact of relay 76 and the right hand inner armature and front contact of relay 81. Since this circuit is independent of the contacts of the allotter switch 160, relays 81 and 287 remain locked up after the original operating circuit of said relays is broken at the allotter switch.

The energization of relay 287 as described closes a circuit through its right hand armature and front contact for energizing relay 296 which is a slow-release relay corresponding to relay 96, Fig. 3, arranged to control the release of the control relay equipment. Upon the occurrence of the first stepping or sixth pulse from the contacts 210 of the pulsing unit 211, a circuit is closed through the sixth conductor of the cable 284, corresponding contacts of the plug and jack 14, sixth conductor of the cord circuit, the left hand inner armature and front contact of relay 81, the right hand outer armature and back contact of relay 121 and the winding of relay 122 to negative battery whereupon relay 122 becomes energized. The locking circuit of relay 122 may be traced through the inner armature and front contact thereof, the winding of relay 121 and the left hand outer armature and front contact of relay 81 so that at the end of the first sixth pulse as described relay 121 becomes energized in series with relay 122. The energization of relay 121 connects the tape transmitter TT of the cord circuit through the switchboard jack and cable 284 to the "deferred" storage equipment of Fig. 5; and also transfers the sixth-pulse circuit at its outer right hand armature and front contact to the autostop relay 123 and stepping magnet of the tape transmitter TT so that succeeding sixth pulses operate the stepping magnet at the tape transmitter to step the characters perforated in the tape by the reperforator RR1 through said tape transmitter.

The relays 225, 226 and 227 corresponding to relays 125, 126 and 127 of Fig. 4 are arranged to differentiate between the period-dot code combination and all other code combinations as described above in connection with the part of the system shown on Figs. 3 and 4. The counting relays 228, 229 and 294 and 295 and the associated control relay 238 operate in the same manner as the corresponding relays of Fig. 4 to stop the transmitter and release the storage apparatus at the deferred storage position in response to the end-of-message signal consisting of a double period-dot combination. Thus at the end of one message, if another receiving storage and repeating unit similar to RR1—TT had been plugged into the switchboard for the "deferred" storage position shown, the reperforator RR4 is connected thereto and immediately commences to perforate tape in accordance with the second message.

The tape transmitter TT associated with the reperforator RR4 is automatically connected to the multiplex system shown in Fig. 4 as soon as the tape lever contacts of the tape lever 237 indicate in response to the lengthening of the tape loop that a message is awaiting transmission from this point provided all of the multiplex channels are not being used for regular messages. As described above, the tape feed-out relays 98, 99, etc. of the respective multiplex channels are employed to feed out blank tape from each reperforator at the end of a message if there is no other message immediately following in order that the character code signals in the tape may reach the feeler pins of the tape transmitter TT. Thus the operation of the tape feed-out relays indicates that the regular messages waiting transmission at the switchboard for the multiplex channels have been cleared out and at least one channel is available for "deferred" traffic.

The operation of relay 98 of the first multiplex channel, assuming that the regular messages for this channel have been cleared out, causes the load distributor 70—73 to advance to the #1 channel position, thus causing the reperforator RR5 to take the next message, either regular or deferred. The step-by-step operation of the load distributor is effected by applying ground to the stepping magnet 74 through the outer left hand armatures and back contacts of relays 99 associated with busy channels, switch wiper 73 and the third left hand armature and front contact of relay 98, which circuit is interrupted when the wiper 73 reaches the position shown corresponding to the first channel. If the second channel instead of the first had become idle, the energization of relay 99 would similarly cause the operation of switch 70—73 to select the second channel and finder switch 26 of such channel.

The operation of relay 98 or 99 applies ground potential to the conductor 148 which extends to the winding of relay 270, Fig. 6. Relay 270 thus becomes energized whenever one of the multiplex channels is available for "deferred" traffic. If a message has been stored at the "deferred" storage position by the reperforator RR4, as described, the lengthening of the tape loop between the reperforator and the associated tape transmitter will cause the lower contacts of the tape lever switch 237 to close, thereby closing the circuit of the stepping magnet of the tape transmitter through the said contacts, the left hand outer armature and back contact of relay 271, the left hand armature and back contact of relay 272 and the tape stepping or interrupter contacts 273 to step blank tape through the transmitter. The stepping of the tape transmitter in this manner continues until a character code combination other than a blank is set up in the tape transmitter, this code combination causing ground potential to be applied through one of

the contacts of the tape transmitter from the marking bus bar, one of the right hand armatures and back contacts of the relay 260 and the winding of relay 272 to battery, whereupon relay 272 becomes energized. The energization of relay 272 interrupts the described stepping circuit of the tape transmitter and the transmitter stops with the first character code combination of the message opposite the pins of the transmitter.

As soon as relay 270 becomes energized, as described, the energization of relay 272 closes a circuit from ground through the upper contacts of the key or switch 275, the inner armature and front contact of relay 270, the outer right hand armature and front contact of relay 272, the outer right hand armature and back contact of relay 271, the second left hand armature and back contact of relay 276 and conductor 8 of the cable 277 to the start relay 153 of the load distributor. As has already been assumed, the channel associated with the finder switch 25 is the idle channel that is clear of all regular traffic, and the load distributor has functioned due to the operation of relay 98 to designate finder switch 25 to take the next call. The operation of the start relay completes two circuits through the load distributor 70—73 in a manner to initiate the operation of said finder switch 25 to connect to the cable 277 extending to the "deferred" storage position. When the finder switch wipers reach the sixth contacts of the respective contact banks corresponding to the "deferred" storage position, a circuit is closed for stopping the rotation of the finder switch which includes the windings of relay 87, the switch wiper 67, conductor 9 of the cable 277, the winding of relay 276, the make-before-break contacts associated with the inner right hand armature of relay 271, the right hand inner armature and front contact of relay 272, the outer armature and front contact of armature 270, and the lower contacts of the switch or key 275 to battery. The energization of relay 87 causes the operation of the numbering machines, and relay 97 is energized in the contacts 108 as described above.

Upon the reception of the first stepping or sixth impulse from the pulsing unit 111 of the reperforator RR5 through conductor 6 of the cable 277 after relay 97 has operated, relay 280 becomes energized, the circuit of said relay including the right hand outer armature and back contact of relay 290 and the second right hand armature and front contact of relay 276. At the end of the sixth pulse which operates relay 280, said relay locks up through its left hand armature and front contact in series with the winding of relay 290 and the third right hand armature and front contact of relay 276, whereupon relay 290 becomes energized. The energization of relay 280 closes at its right hand armature and front contact the circuit of relay 271 which locks up the release relay 276 through a circuit that is independent of relays 270 and 272 and of the switch 275. The energization of relay 290 connects the tape transmitter TT at the "deferred" storage position through its first five right hand armatures and front contacts to the cable 277 leading to the storage equipment associated with the multiplex system shown in Fig. 4. The stepping circuit of the tape transmitter TT is also transferred at the outer right hand armature and contact of relay 290 to parallel circuits including the windings of the auto-stop relay 238, one of said circuits including the left hand outer armature and front contact of relay 271 and the contacts of the tape lever switch 237. The operation of the tape transmitter is thus placed under the control of the tape lever switch 237 in the conventional manner.

In this manner the "deferred" messages are stored for transmission over the multiplex channels in the same manner as in the case of regular messages during the periods when one or more channels are not being used for regular traffic. The release of the control equipment at the end of each message is effected in substantially the same manner as described above in connection with Figs. 2, 3 and 4. The repeating of messages from the "deferred" storage position may be prevented when desired by opening the key 275, thereby interrupting the start and holding circuits of the finder switches 25 and 26 to prevent the connection through said switches to the multiplex channels as long as the key 275 remains operated. If the multiplex system is closed down at night, for example, the key 275 may be opened during such periods without preventing the storage of "deferred" messages from the receiving positions where such messages are accepted for transmission the following day.

Connection to local branch office

The circuits involved in repeating a message to a local branch office are shown in Figs. 2 and 7 when these figures are arranged as shown in Fig. 12. The multipled jacks 17 and 21 are arranged to provide access to a start-stop receiving printer in a local branch office which is assumed to be connected to the line L1, Fig. 7. When a cord circuit is plugged into one of the jacks 17 and 21, the circuit is extended to the cable 384 leading to the storage equipment at the sending position associated with the said local branch office. When more than one call is plugged into the multipled jacks leading to this storage equipment of which only two are shown, the operation of the allotter switch 160 renders the respective code circuits operative one after the other in the same manner as described above in connection with the extension of calls to the multipled jacks leading to the "deferred" storage position (Figs. 5 and 6).

When the plug P is inserted in the jack 17, the repeating of the message from the receiving position to the storage equipment associated with the line L1 and the subsequent release of the storage equipment and the restoration of the cord circuit are effected in substantially the same manner as in the case of a call to the "deferred" storage equipment. However, the numbering machine 304 corresponding to the numbering machine 104 of Fig. 4 is first rendered operative in order to number the successive messages to the branch office. The numbering machine 304 and the control relays associated with the storage equipment are similar to the corresponding elements of Figs. 3 and 4 and have been given similar reference numerals with the prefix "3". Thus the relay 387 corresponding to the relay 87 of Fig. 3 is operated when the connection is made at the switchboard and prepares a circuit for operating the stepping magnet 305 of the numbering machine, which circuit may be traced through the inner armature and back contact of relay 397, the outer right hand armature and front contact of relay 387 and the sixth pulse contacts 318 of the pulsing unit 311 associated with the reperforator RR9. The next sixth pulse following the operation of relay 387 starts the numbering machine 304, the operating circuit for the stepping magnet 305 of the numbering

machine being closed through contacts 307 after the machine has started its cycle through a circuit that is independent of relays 397 and 387. When the numbering machine 304 has completed its cycle during which service code signals are stored therefrom in the reperforator RR9, the contacts 308 are closed to energize relay 397 which transfers the sixth pulse circuit through the inner armature of said relay to the cord circuit whereupon the tape transmitter TT at the receiving position is operated to repeat the message to the reperforator RR9. At the end of the message, the code-reading relays 325, 326, 327, corresponding to relays 125, 126 and 127 described above, and the counting relays 328, 329, 394 and 395, corresponding to relays 128, 129, 94 and 95 of Fig. 4, respond to the end-of-message signal to release the cord circuit. The other control features of the storage equipment are similar to those of the reperforators RR4 and RR5 and need not be described in detail. The key 301 corresponding to the key 101 or 102 associated with the multiplex channels is operated to cut out the branch office circuit from service and light the switchboard lamps 150 associated with the switchboard jacks individual to said line circuit to indicate that the same is out of service.

The messages stored by the reperforator RR9 are repeated by the associated tape transmitter TT to the branch office connected to the line L1, Fig. 7. Upon the recording of a message in the tape at the sending position, the loop of tape between the reperforator RR9 and the associated tape transmitter TT lengthens, thereby closing the lower contacts of the tape contact lever 337. The tape transmitters on the branch office lines are preferably adapted to send seven unit start-stop code signals, and for example may be similar to that shown in the above mentioned patent to Rothermel, No. 1,805,374. Upon the closing of the contacts associated with the tape lever 337 as described, a circuit is closed for energizing the clutch magnet of the transmitter through the said contacts, the normally closed contacts 344 of the jack 33 at the "X" message switching position (Figs. 7 and 9) the normally closed contacts of the key 338 and the normally closed right hand contacts of the key 339 to ground, whereupon the transmitter TT is rendered operative. The transmitting circuit of said transmitter includes the transmitter contacts, the make-before-break contacts associated with the armature of relay 341 and the normally closed left hand contacts of the key 339 connected to the line L1. As soon as the message has been sent, the opening of the contacts of the tape lever 337 by the taut tape interrupts the circuit of the clutch magnet to stop the transmitter. If the message has been completely stored by the reperforator RR9 and the cord circuit released, a circuit is closed to ground through the third right hand armature and back contact of relay 387, the upper contacts of the tape lever switch 337 and the winding of the tape feed-out relay 398, whereupon said relay becomes energized. The energization of the tape feed-out relay 338 serves to step out enough blank tape from the reperforator RR9 so that the last character code combination of the message reaches the pins of the tape transmitter as described above in connection with the feed-out relay 98 and associated reperforator RR9 (Figs. 3 and 4).

It will be noted that the clutch magnet of the tape transmitter associated with the branch office line L1 is under control of the contacts 344 of the switchboard jack 33 at the "X" message switching position which are opened when the plug Px is inserted in the jack, and under the control of the keys 338 and 339. Thus if a "X" message is plugged into the jack 33, transmission from the tape transmitter TT is interruped during the transmission of the "X" message by opening the circuit of the clutch magnet of the transmitter in the jack. Likewise transmission may be interrupted manually when desired by operation of the key 338.

Broadcasting messages to local offices

A broadcast transmitter 35 is also provided in connection with the local or branch office lines of which two are indicated at L1 and L2 in Fig. 7. This transmitter may be used to send news flashes or other messages to any one of the branch offices or simultaneously to two or more of said offices. The offices to which the messages are to be transmitted by the transmitter 35 are selected by the keys 339, 349, et cetera, associated with respective branch office lines. As explained above, the operation of the key 339 interrupts transmission from the regular transmitter TT and the actuation of said key further opens the line circuit through the left hand contacts thereof. The line circuit is then connected through the armature and back contact of relay 342, the make-before-break contacts associated with the armature of relay 341 and the normally closed rest contacts of the regular transmitter to negative battery. Relay 342 responds to the start-stop signals from the transmitter 35 and impresses corresponding signals upon the line to control the printer at the branch office in accordance with the signals sent from the transmitter 35. The relays 342, 343, et cetera, associated with the respective branch office lines are connected in series relation in such a manner that the signals from the transmitter 35 broadcast simultaneously over all of the branch office lines having the selecting keys 339, 349 et cetera operated. In this manner normal transmission from the regular sending positions over any of the branch office lines may be interrupted for the transmission of a message or messages from the broadcast transmitter. When the keys 339 and 349 are restored at the end of the news flash from the transmitter 35, transmission from the regular transmitter is resumed.

Connection to "X" message switching position

The circuits involved in extending a call through the "X" message switching position are shown in Figs. 2, 8 and 9 of the drawings when these figures are arranged as shown in Fig. 13. When the storage and repeating equipment at a receiving position is plugged into the jack 16 at the switchboard, the message stored at the receiving position is repeated through cable 484 to a reperforator such as the reperforator RR8 at the "X" message switching position in substantially the same manner as described above in connection with Figs. 2, 3 and 4 illustrating the storage of a message at the multiplex sending position. A jack similar to the jack 16 is provided at each section of the switchboard for handling "X" messages and the calls through these jacks are distributed to the storage and transmitting equipment at the "X" message switching position by selector switches similar to the finder switches 25, 26 and 27 associated with the multiplex system of Fig. 4. As shown, two

storage and repeating units are provided, including selector switches 28 and 29, but additional units may be provided if desired. Since the cord circuits associated with the "X" position tape transmitters TT are all identical, a description of one of the cord circuits which is illustrated in detail will be sufficient.

After the "X" message has been stored in the tape at the reperforator RR8 for example, the operator at the "X" message switching position notes the address of the message and inserts the plug Px, Fig. 9, in the jack forming a terminal of the wanted line or channel which is assumed to be the multiplex channel jack 401 or the start-stop line jack 33 extending to a local branch office. The cord circuit of the switching apparatus at this position is designed to work into either multiplex or start-stop line transmitting apparatus, to interrupt any message which is being transmitted over the selected line or channel for the transmission of the "X" message and then to resume transmission of the previous message without mutilation or loss of a character.

When the switchboard plug Px is inserted in the jack 401, a circuit is closed from positive battery through the resistance 402, the winding of marginal relay 131 (Figs. 4 and 9), the upper contacts of the jack 401 and plug Px, the armature and back contact of relay 403, the left hand winding of relay 404, and the resistance 405 to ground whereupon a current flows through the windings of relay 131 and 404. Relay 131 is a marginal relay having a low resistance winding and does not become energized at this time on account of the resistance of the circuit but relay 404 becomes energized. Since the transmission of a character over the multiplex channel may be occurring at the moment the plug is inserted in the jack, the transfer of the channel to the transmitting apparatus associated with the cord circuit at the "X" switching position is not effected until this character has been completely transmitted. Upon the occurrence of the next sixth pulse from the local ring of the multiplex sending distributor, current flows through the conductor 406, lowermost contacts of the jack 401 and the plug Px, the armature and back contact of relay 407, the inner armature and front contact of relay 404, and the winding of relay 408 to ground whereupon relay 408 becomes energized. Upon the energization of relay 408, a circuit is closed from ground through the outer armature and front contact of relay 404, the inner right hand armature and front contact of relay 408 and the winding of relay 409 to battery whereupon relay 409 becomes energized. At the end of the sixth pulse from the multiplex sending distributor, relay 408 becomes deenergized, but relay 409 is maintained energized through a locking circuit including its inner right hand armature and front contact, the winding of relay 407 and the outer armature and front contact of relay 404, whereupon relay 407 becomes energized. Upon the energization of relay 409 as described, a circuit is closed from battery through the resistance 402, the winding of relay 131, the upper contacts of the jack 401 and the plug Px, the armature and back contact of relay 403, the right hand winding of relay 404, the second right hand armature and front contact of relay 409, the conductor 410, and the inner right hand armature and back contact of relay 414 to ground causing an increase in the current through relay 131, thereby energizing said relay. The energization of relay 131 closes a circuit through its outer armature and front contact for holding the stepping magnet of the tape transmitter (Fig. 4) energized whereby transmission from said tape transmitter is stopped until the "X" message has been sent.

The contacts of the tape transmitter TT associated with the reperforator RR8 are connected to the windings of relays 421 to 425, respectively, so that the characters perforated in the tape engaged by the pins of the transmitter are set up on the contacts of said relays, each of the relays being energized for the corresponding spacing element of the code since the spacing bus bar of the transmitter is grounded and the marking bus bar is open-circuited. When relay 409 becomes energized as described, the five inner armatures of relays 421 to 425 are connected through separate armatures of the relay 409 and contacts of the plug Px and switchboard jack 401 to the segments of the sending ring of the multiplex distributor. The front and back contacts associated with said armatures of the relays 421 to 425 are connected to spacing and marking potentials through the left hand outer armatures and front contacts of relay 409 and the seventh and eighth contacts of the plug Px through circuits from the multiplex distributor, since different marking and spacing potentials or polarities may be used on certain multiplex channels from those used on other channels. Therefore as soon as relay 409 becomes energized, the character set up in the tape transmitter TT is also set up on the segments of the multiplex distributor to be transmitted upon the next rotation of the distributor brushes.

Upon the energization of relay 407 as described, the sixth pulse circuit through the lower contacts of the plug Px and jack 401 is transferred through the armature and front contact of relay 407, the third right hand armature and back contact of relay 416, the left hand outer armature and back contact of relay 414, the auto-stop contacts 427 and the windings of auto-stop relay 428 in parallel to the stepping magnet of the tape transmitter TT so that the tape transmitter is stepped to send the successive stored character code combinations to the bank of storage relays 421 to 425 which through the plug and switchboard jack control the multiplex sending distributor.

An end-of-message signal consisting of a double period-dot code combination is appended to the message by the originating operator as in the case of regular and deferred messages. When the first period-dot code combination is set up on the relay bank 421 to 425, relays 421, 422, 423 and 425 are energized, while relay 424 becomes deenergized since this code combination has the fourth impulse marking. Thereupon a circuit is closed from battery through the winding of relay 411, the armature and back contact of relay 412, the right hand outer armature and back contact of relay 424, the right hand outer armatures and front contacts of relays 425, 423, 422 and 421, and the sixth left hand armature and front contact of relay 409 to ground whereupon relay 411 becomes energized. It will be noted that the circuit of relay 411 will only be closed when relay 424 is deenergized and relays 421, 422, 423 and 425 are energized upon the occurrence of a period-dot code combination, the circuit being open for all other code combinations impressed upon the storage relay bank associated with the tape transmitter. Relay 411 prepares a

locking circuit including its armature and front contact and the winding of relay 412 that is independent of the contacts of relays 412 and 424. However, upon the receipt of the next sixth pulse by the tape transmitter TT, the tongues of the transmitter are drawn to the spacing positions and relay 424 becomes energized and removes the short-circuit around the winding of relay 412. Thereupon relay 412 becomes energized in series relation with relay 411.

At the end of the sixth pulse referred to, the second period-dot code combination in the tape causes the deenergization of only relay 424 in the storage relay bank whereupon a circuit is closed from battery through the windings of relay 413, the left hand inner armature and back contact of relay 414, the right hand outer armature and back contact of relay 424 and the right hand outer armatures and front contacts of relays 425, 423, 422 and 421 to ground at the sixth left hand armature and front contact of relay 409 whereupon relay 413 becomes energized. The energization of relay 413 closes the circuit of relay 414 through its left hand armature and front contact but said relay is short-circuited by the contacts of relays 412, 414 and 421—425 and does not become energized until the short-circuit is removed.

When the next sixth pulse is impressed upon the stepping magnet of the tape transmitter TT from the multiplex distributor, relays 421 to 425 all become energized in accordance with the spacing condition of the transmitter contacts, thereby removing the short-circuit around the winding of relay 414 and relay 414 becomes energized in series relation with relay 413. The energization of relay 414 opens at its inner right hand armature and back contact the circuit through the right hand winding of relay 404 comprising a parallel path for marginal relay 131, and relay 131 becomes deenergized since the current flow through the winding thereof is reduced. This restores the transmitter at the regular sending storage position to operative condition, and transmission of the interrupted message from that position may be resumed. The energization of relay 414 further closes a circuit through its inner right hand armature and front contact for lighting the "disconnect" lamp 415 whereupon the operator at the "X" message switching position removes the plug P*x* from the jack 401 to restore the cord circuit to normal. When the plug is removed from the jack, the circuit through the left hand winding of relay 404 is interrupted at the jack and this relay becomes deenergized. Upon the deenergization of relay 404, the circuit of relays 407 and 409 is interrupted at the right hand outer armature and front contact of relay 404, and relays 407 and 409 become deenergized. The deenergization of relay 409 interrupts at its sixth left hand armature and front contact the locking circuit of relays 411 to 414 whereupon these relays become deenergized and the "disconnect" lamp 415 is extinguished.

The auto-stop contacts 427 and the auto-stop relay 428 are arranged in the conventional manner to stop the stepping of the tape transmitter when the tape from the reperforator becomes taut. In order to insure the reception of the final sixth pulse at the tape transmitter after the double period-dot code combination, the outer right hand armature and front contact of relay 413 close a shunt circuit around the auto-stop contacts 427 to prevent the operation of the auto-stop relay if the tape should happen to become taut immediately preceding that sixth pulse. The key 429 is provided for the purpose of energizing the stepping magnet of the tape transmitter when desired, for example, to withdraw the pins from the tape to permit the operator to pull tape through the transmitter in order to avoid the wasted line time that would be required to transmit blank or unwanted characters from the transmitter.

In the case of an "X" message for the branch office connected to the jack 33, the plug P*x* is inserted in said jack and transmission proceeds from the tape transmitter TT over the line circuit connected to the fourth contact of the jack through the contacts of relay 341 (see Figs. 7 and 9). In this instance, however, the successive code combinations set up on the storage relays 421 to 425 by the contacts of the tape transmitter are converted into seven unit start-stop printer code by the distributor 430 comprising contacts 431 to 437 and a clutch magnet 438. The distributor may be a cam controlled mechanism similar to that shown in the above-mentioned patent to Rothermel 1,305,374.

When the plug P*x* is inserted in the jack 33, the contacts 344 in the jack are opened, whereupon the above described circuit to the clutch magnet of the regular transmitter TT associated with the reperforator RR9 is interrupted to stop the transmitter. A circuit is closed to positive battery through the seventh contacts of the jack 33 and plug P*x*, the left hand outer armature and back contact of relay 409, the winding of relay 403, and the outer armature and back contact of relay 404 to ground, whereupon relay 403 becomes energized. A circuit is then closed from ground through the upper contacts of the jack 33 and plug P*x*, the armature and front contact of relay 403, and the winding of relay 416 to battery, whereupon relay 416 becomes energized. The energization of relay 416 opens at its inner left hand armature and back contact the circuit of the normally energized slow-release relay 417, and after a short interval the armatures of relay 417 engage their back contacts. The timing of relay 417 is arranged to prevent the starting of the transmission from the "X" message position for a sufficient time to permit the distributor of the local transmitter, Fig. 7, to complete its revolution in case a character was being sent over the line at the instant the plug was inserted in the jack. Thus the insertion of the plug in the jack 33 stops transmission from the regular transmitter without mutilating or dropping out the last character sent from such transmitter.

Upon the deenergization of relay 417 as described, a circuit is closed from battery through the left hand winding of relay 418, the second armature and back contact of relay 417, conductor 419 and the outer right hand armature and back contact of relay 414 to ground, whereupon relay 418 becomes energized. Relay 418 is a differential relay having two windings wound in opposition. The second or right hand winding of the relay is connected through the outer armature and back contact of relay 417, the fifth contacts of the plug P*x* and jack 33 to the normally open contacts of the keys 338 and 339 at the local position so that said circuit may be closed by the operation of either of said keys as described above in connection with the part of the system shown in Fig. 7. Thus, for example, when the broadcast transmitter 35 is to

be operated to transmit over line L1, the operation of key 339 causes relay 418 to release its armatures and stop transmission over the line L1 from the "X" message switching position in case the transmitter TT at said position had been plugged into the jack 33.

The transmitting circuit from the distributor 430 may be traced from battery through the normally closed rest contacts 436, the second right hand armature and front contact of relay 416, the fourth contacts of the plug Px and jack 33 and the line contacts of the relay 341, the last mentioned relay being energized through the circuit including the third contacts of the jack 33 and plug Px, the inner armature and back contact of relay 417, conductor 410 and the right hand inner armature and back contact of relay 414. Upon the energization of relay 418 as described, the circuit of the clutch magnet 438 of the distributor 430 is also closed through the outer armature and front contact of said relay and the inner right hand armature and back contact of relay 413 so that the distributor cam shaft is released. The five selecting contacts 431 to 435 of the distributor are each arranged to connect positive battery successively to the armatures of the storage relays 421 to 425, the storage relays in accordance with their positions as controlled by the associated transmitter, converting the current impulses from the distributor to marking impulses on the line circuit through a circuit which may be traced from each of the respective distributor contacts through the inner armatures and back contacts of the relays 421 to 425 which are deenergized or in the marking position, the right hand inner armature and front contact of relay 416 and the fourth contacts of the plug Px and jack 33.

At the completion of each cycle of the distributor 430, the sixth pulse contacts 437 close momentarily to apply battery to the stepping magnet of the tape transmitter TT through a circuit that includes the windings of the autostop relay 428, the autostop contacts 427, the left hand outer armature and back contact of relay 414 and the third right hand armature and front contact of relay 416. Thus the tape transmitter is operated to set up the successive character code combination perforated in the tape by the reperforator RR8 on the storage relays 421 to 425. The code combinations are transmitted over the line in accordance with the operation of the contacts 431 to 435 of the distributor 430, with the "start" and "rest" pulses added by the contacts 436. At the end of the message, the end-of-message signal stops the tape transmitter, restores the line circuit to the regular transmitter and lights the disconnect lamp 415 to signal the operator that the message has been transmitted in substantially the same manner as described above in connection with the transmission of the message over the multiplex channel. Relays 403 and 416 remain energized and relay 417 remains deenergized as long as the plug Px remains in the jack 33, but relay 418 becomes deenergized by the operation of relay 414 in response to the end-of-message signal, relay 418 opening the stepping circuit of the tape transmitter TT. When the plug is removed from the jack 33, relays 403 and 416 become deenergized and the counting relays 441 to 414 also become deenergized, the deenergization of relay 414 extinguishing the "disconnect" lamp 415, whereupon the circuit is restored to normal in readiness for another call.

It will be apparent from the foregoing description of a preferred embodiment of my invention that an arrangement has been provided for changing the order in which messages are repeated through an office so as to give certain messages preference over regular messages and to defer messages such as night letters, so that the transmission thereof does not interfere with regular traffic. While the detailed description of the system shown for the purpose of explaining the invention has included reference to specific forms of storage, transmitting and switching apparatus, other storage, switching and transmitting apparatus may be employed if desired without departing from the scope of the invention as defined in the appended claims.

I claim:

1. In a telegraph exchange system, incoming and outgoing lines, switching means for enabling transmission from any one of said incoming lines to any selected one of said outgoing lines over alternative routes and means whereby message signals transmitted over one route to an outgoing line invariably take precedence over concurrent message signals transmitted over the alternative route to said outgoing line.

2. In a telegraph exchange system for handling regular and "deferred" messages, incoming and outgoing lines, switching means for enabling transmission from any one of said incoming lines to any selected one of said outgoing lines in one manner for regular messages and in a different manner for "deferred" messages and means associated with the switching means for "deferred" messages for delaying such messages destined for any line until all regular messages for the same line have been transmitted, said last mentioned means including storing means individual to each of the outgoing lines.

3. In a telegraph exchange system for handling regular and "deferred" messages, incoming and outgoing lines or channels, switching means for enabling transmission from any one of said incoming lines or channels to any selected one of said outgoing lines or channels and means responsive to the busy condition of each line or channel for delaying the transmission of "deferred" messages over outgoing lines or channels for which regular messages are awaiting transmission.

4. In a telegraph exchange system for handling regular and "deferred" messages, incoming and outgoing lines or channels, switching means for enabling transmission from any one of said incoming lines or channels to any selected one of said outgoing lines or channels, means for storing and repeating "deferred" messages and means controlling said repeating means for "deferred" messages in accordance with the busy or idle condition of the respective outgoing lines or channels.

5. In a telegraph exchange system, a plurality of printing telegraph transmitters, a plurality of lines or channels, switching means for extending the circuit of any one of said transmitters to any one of said lines or channels over alternative routes and means whereby the traffic over one route to an outgoing line or channel invariably takes precedence over the traffic over the other route to said line or channel.

6. In a telegraph exchange system for handling regular and "deferred" messages, a plurality of printing telegraph transmitters, a plurality of lines or channels, selective switching means for connecting any one of said transmitters to any

one of said lines or channels and means associated with said switching means for repeating "deferred" messages in accordance with the busy or idle condition of the respective lines or channels, said last mentioned means including storage means individual to each of said lines or channels for "deferred" messages.

7. In a telegraph exchange system provided with a switchboard and connecting plugs for extending connections to outgoing lines or channels and for discriminating between regular messages and "deferred" messages, said connecting plugs forming terminals of cord circuits, means associated with said cord circuits for storing and repeating message signals, means associated with the lines or channels for controlling said repeating means to initiate transmission when the line or channel selected becomes idle and for disabling the repeating means and releasing the line or channel at the end of each message and means operatively associated with said switchboard for controlling the repeating of "deferred" messages in accordance with the busy or idle condition of the selected line or channel.

8. In a telegraph exchange system, an exchange, a plurality of outgoing lines or channels terminating at said exchange, selective switching means for extending connections to said lines or channels, means including printer-code storage and transmitting devices for repeating messages over selected lines or channels, means responsive to an end-of-message signal for stopping transmission from a connected transmitting device and releasing the line or channel, other selective switching means for extending connections to said lines or channels and means including said other switching means for connecting to a busy line or channel, interrupting transmission thereover and interposing a rush message whereby the latter may be relayed promptly irrespective of traffic conditions on the selected line or channel.

9. In a telegraph exchange system, an exchange, a plurality of outgoing lines or channels terminating at said exchange, selective switching means for extending connections to said lines or channels, means including printer-code storage and transmitting devices for repeating messages over selected lines or channels, means for stopping transmission and releasing the lines or channels at the end of a message, other selective switching means for extending connections to said lines or channels and means including said other switching means for momentarily interrupting transmission over a busy line or channel, rendering the selected line or channel immediately available and thereafter continuing the transmission of the interrupted message.

10. In a telegraph exchange system, an exchange, a plurality of outgoing lines or channels terminating at said exchange, selective switching means for extending connections to said lines or channels, means including printer-code storage and transmitting devices for repeating messages over selected lines or channels, means responsive to an end-of-message signal for releasing the lines or channels at the end of each message to render the same available for the transmission of another message and means under the control of an operator at said exchange for seizing a busy line or channel irrespective of the previous selection and concurrent use of said line or channel for transmission purposes.

11. In a telegraph exchange system, an exchange, a plurality of outgoing lines or channels terminating at said exchange, selective switching means for extending connections to said lines or channels, means including printer-code storage and transmitting devices individual to each of the outgoing lines or channels for repeating messages over selected lines or channels, certain of said storage and transmitting devices being allocated to regular messages and others to "deferred" messages, means operative at the ends of messages for controlling said certain storage and transmitting devices to start transmission of another regular message and means associated with the respective lines or channels for controlling said other storage and transmission devices to repeat "deferred" messages when no regular message is awaiting transmission over the particular line or channel to be used for transmission of a "deferred" message.

12. In a telegraph exchange system, an exchange, a plurality of outgoing lines or channels terminating at said exchange, selective switching means for extending connections to said lines or channels, means including printer-code storage and transmitting devices for repeating messages over selected lines or channels, certain of said storage and transmitting devices being allocated to regular messages and others to rush messages, means operative at the ends of messages for controlling said certain storage and transmitting devices to start transmission of another regular message and means to disable said certain storage and transmitting devices and render one of the other devices operative to transmit a rush message ahead of regular messages awaiting transmission.

13. In a telegraph exchange system, a line or channel, means including printer-code storage and transmitting devices for transmitting messages in succession over said line or channel, means for supplying current impulses to each of said transmitting devices to render the same operative and operator-controlled means for controlling said current-impulse supplying means to interrupt transmission of a message stored in one of said storage devices over said line or channel in the middle of a message and for thereafter resuming transmission of the interrupted message from the point where the interruption occurred.

14. In a telegraph exchange system, an exchange, an outgoing line or channel, means including printer-code storage and transmitting devices for transmitting messages in succession over said line or channel from the exchange, means whereby the order in which messages are transmitted is substantially determined by the order in which they are stored by said storage devices and means whereby messages are given preference as to the order of transmission when desired.

15. In a telegraph exchange system, a line or channel, means including a plurality of independent printer-code storage and transmitter devices for transmitting messages in succession over said line or channel, and auxiliary transmitting means for transmitting rush messages over said line or channel irrespective of the busy condition thereof, said auxiliary means including means to interrupt transmission temporarily from said storage and transmitting devices either prior to or during the transmission of a message.

16. In a telegraph exchange system, a plurality of outgoing lines or channels, a manual switchboard for selecting said lines or channels and containing terminals of said lines or channels,

means associated with said switchboard for storing message signals to be repeated through the switchboard, a second switchboard accessible through said first-mentioned switchboard for also extending connections to said lines or channels and means whereby the connection to a busy line or channel at the section switchboard interrupts the normal transmission over said line or channel for interposing a rush message.

17. In a telegraph exchange system, a plurality of outgoing lines or channels, two manual switchboards for extending connections to said lines or channels and containing terminals of said lines or channels, means associated with each switchboard for storing message signals to be repeated through the switchboard to said lines or channels and means whereby transmission to a line or channel through one switchboard takes precedence over transmission to the same line or channel through the other switchboard.

18. In a telegraph exchange system, a plurality of outgoing lines or channels, a manual switchboard for extending connections to said lines or channels, keys for cutting out any circuit or channel and means at the switchboard controlled by said keys to indicate that a circuit has been cut out.

19. In a telegraph exchange system, a manual switchboard, a plurality of outgoing lines or channels individual to the respective jacks in said switchboard, a lamp adjacent each switchboard jack, means for cutting any line or channel out of service and for concurrently lighting the lamps adjacent the switchboard jacks individual to said disabled line or channel and means for causing the lamp to flash if an attempt is made to connect to the line or channel which has been cut out.

20. In a telegraph exchange system, incoming and outgoing lines, means including line switching means for repeating messages from the incoming to the outgoing lines and means associated therewith for interconnecting said lines in a different manner for different messages and including means responsive to such manner of connection whereby rush messages to a particular outgoing line take precedence over regular messages on the same line.

21. In a telegraph exchange system, an exchange, an outgoing line or channel, means including printer code storage and transmitting devices for transmitting messages over said line or channel from the exchange and means for switching messages to said devices in such a manner that the transmission of rush messages takes precedence over regular messages and "deferred" messages are held up with respect to the transmission of either rush messages or regular messages.

22. In a telegraph exchange system, an exchange, a line circuit for start-stop signal transmission terminating at said exchange, a synchronous multiplex system terminating at said exchange, signal storage and transmitting apparatus at said exchange, means for connecting said apparatus to either the start-stop line circuit for a channel of the multiplex system, means including a start-stop distributor associated with said connecting means for generating start-stop signals when connection is made to the start-stop line circuit and means for rendering said distributor inoperative and for producing multiple element code signals for transmission over the multiplex system when connection is made to one of the channels thereof.

23. In a telegraph exchange system, an exchange, a plurality of outgoing lines or channels terminating at said exchange, a switchboard for selecting said lines or channels, means for repeating message signals through said switchboard to any of said lines or channels, means for interrupting transmission over a line or channel to which connection has been made at the switchboard for transmitting a rush message ahead of the remainder of the interrupted message and means whereby the interruption occurs only at the end of a code combination during the sequence of transmission of the characters over the line or channel to prevent the mutilation of a character.

24. In a telegraph exchange system, an exchange, incoming and outgoing lines or channels terminating thereat, means including switching means for repeating messages from said incoming lines or channels over said outgoing lines or channels, a broadcast transmitter and means including said transmitter for seizing and transmitting a message simultaneously over a plurality of said outgoing lines or channels irrespective of their busy or idle condition.

25. In a telegraph exchange system, an exchange, a start-stop line circuit terminating thereat, a multiplex system terminating thereat, a switchboard jack forming a terminal of said line circuit, another switchboard jack forming a terminal of a channel of said multiplex system, a cord circuit terminating in a connecting plug adapted to be inserted in either of said jacks, a code transmitter associated with said cord circuit, control relays in said cord circuit for conditioning said circuit to transmit either start-stop or multiplex signals and circuits through said plug and jacks for operating said control relays in a different manner depending upon whether the plug is inserted in one type of jack or the other whereby the transmitter is operative to transmit start-stop signals to the start-stop circuit and multiplex signals to the multiplex channel.

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