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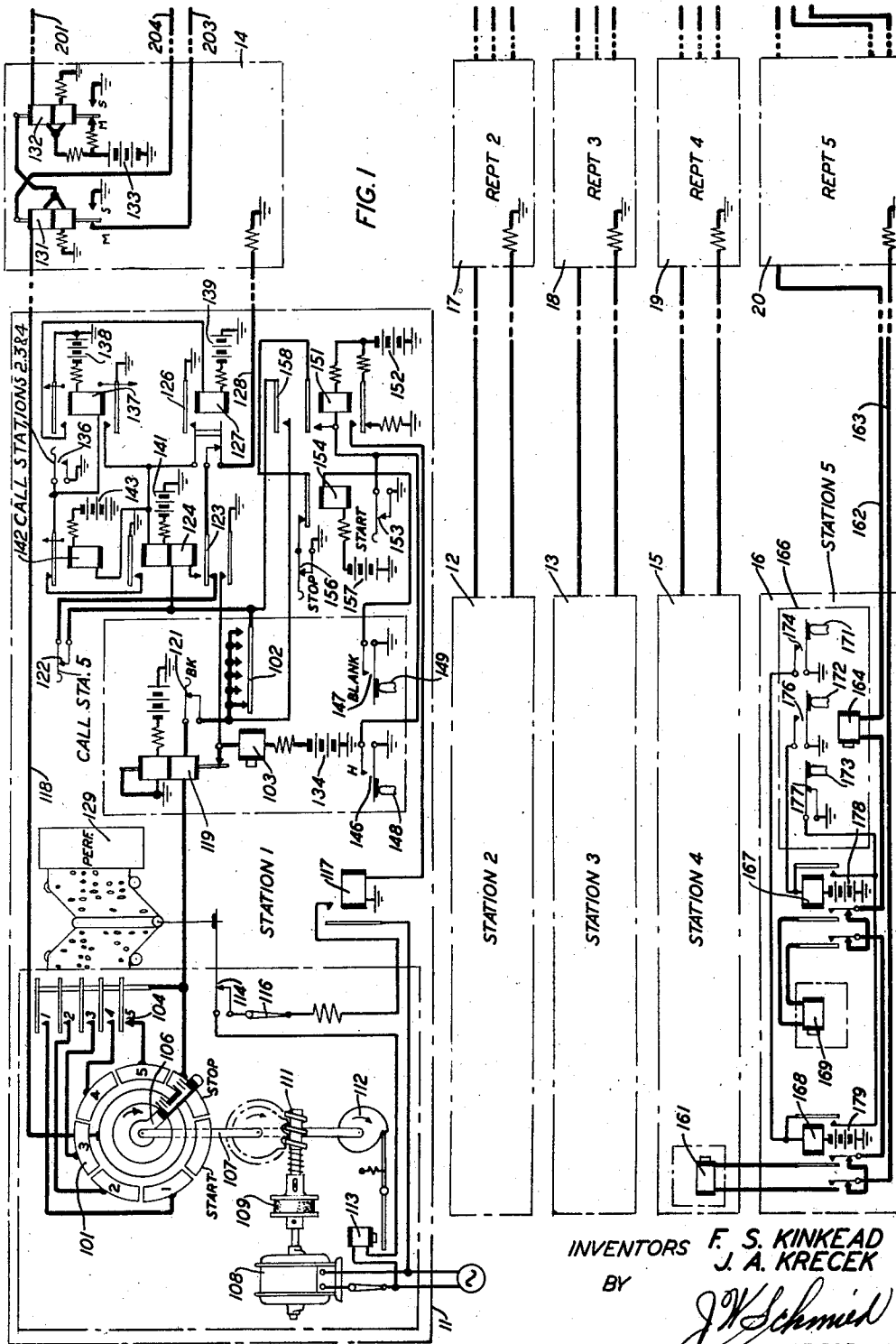
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2,369,578

TELEGRAPH STATION SELECTOR SYSTEM

Filed July 30, 1941

4 Sheets-Sheet 1.



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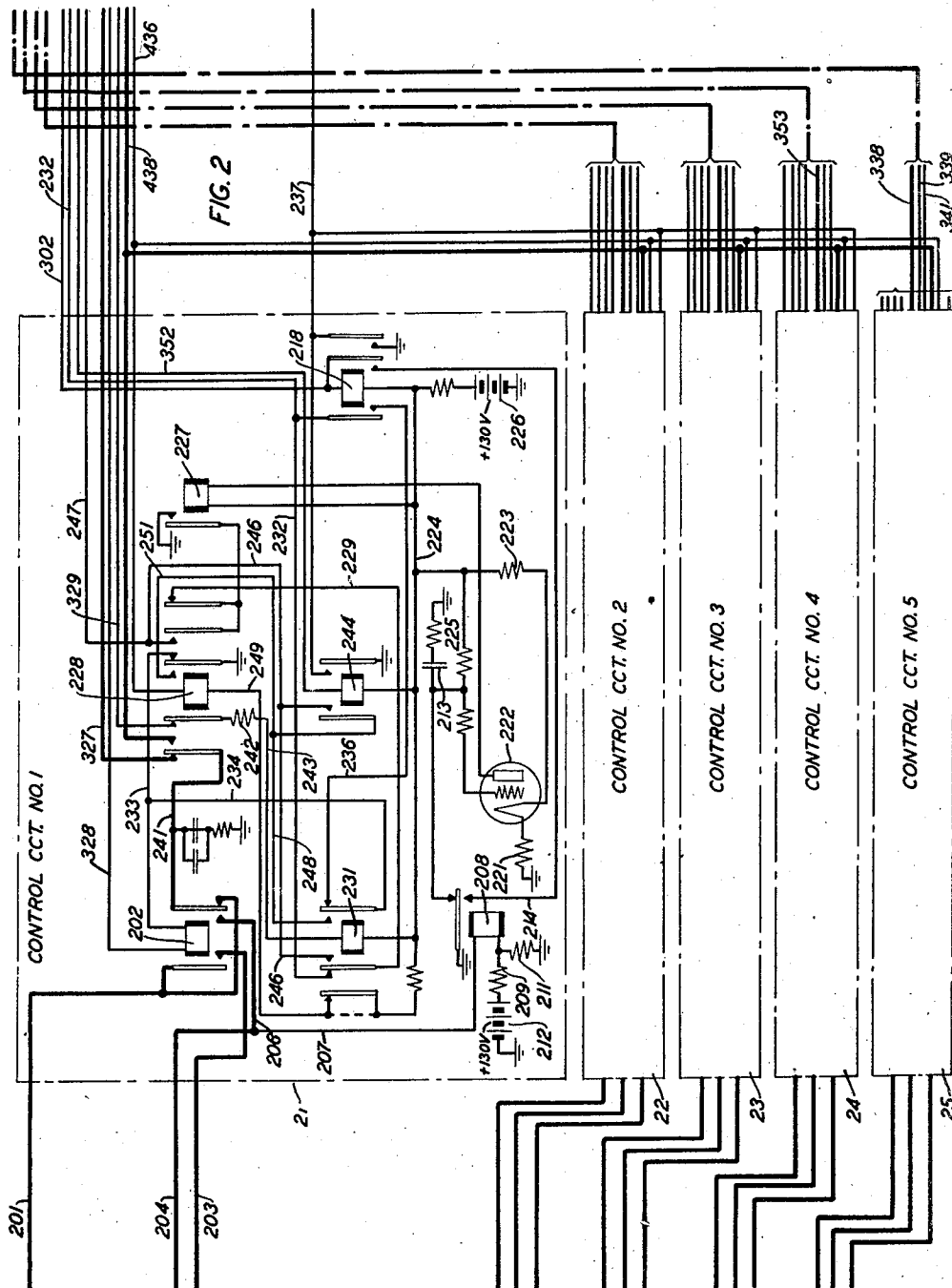
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TELEGRAPH STATION SELECTOR SYSTEM

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4 Sheets-Sheet 2



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TELEGRAPH STATION SELECTOR SYSTEM

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4 Sheets-Sheet 3

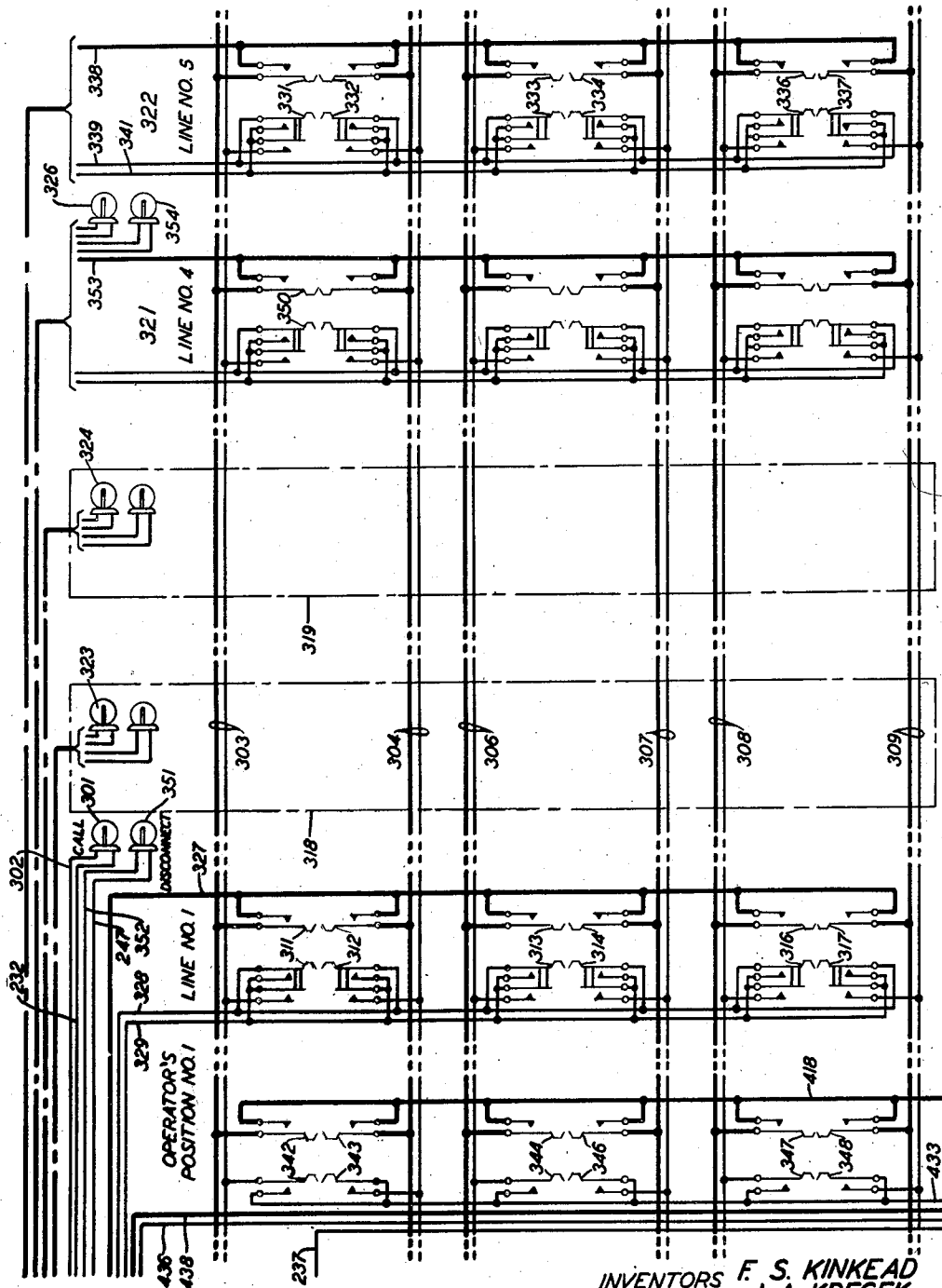


FIG. 3

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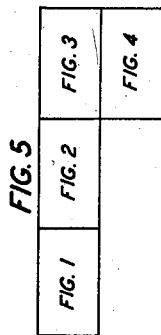
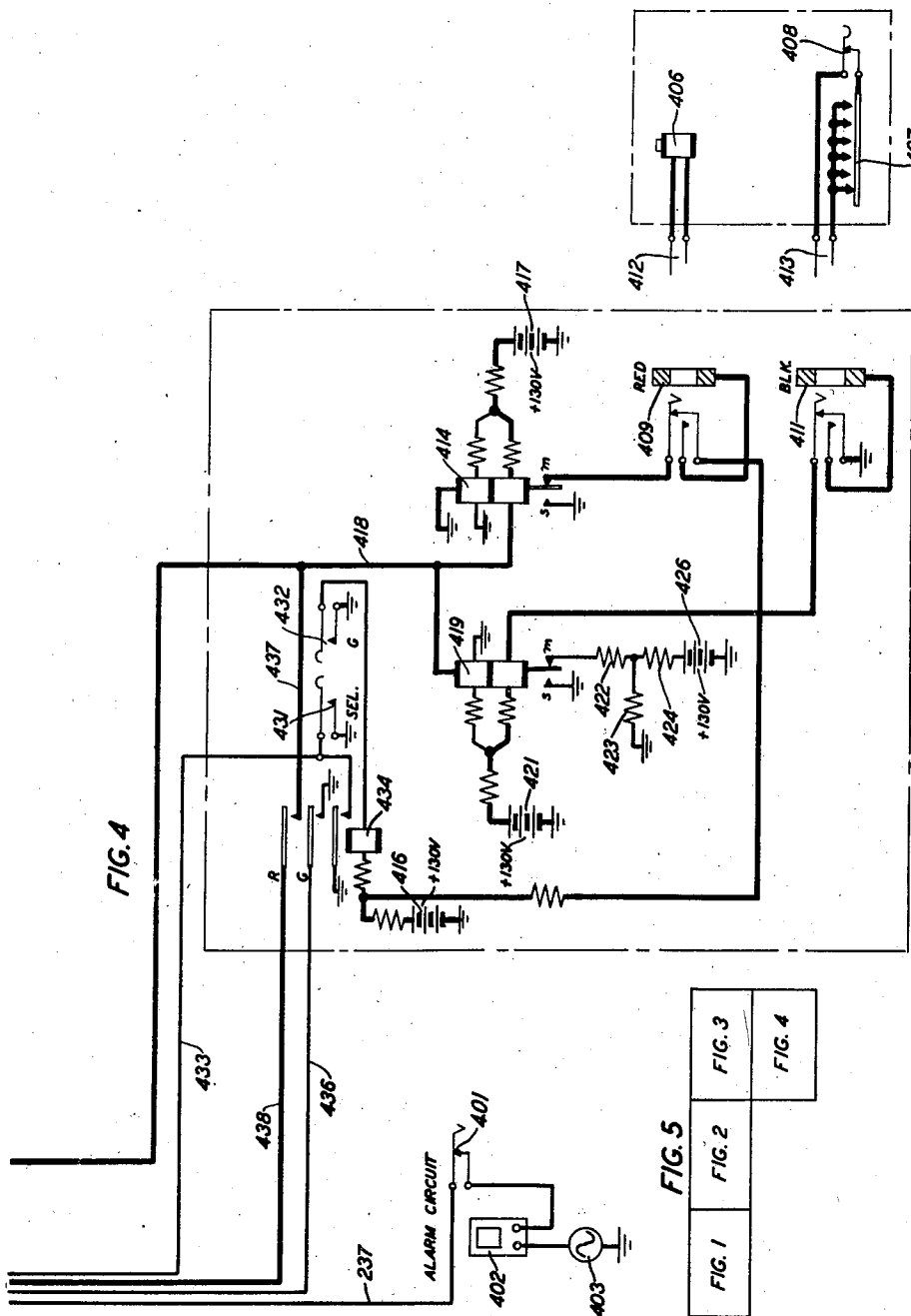
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TELEGRAPH STATION SELECTOR SYSTEM

Filed July 30, 1941

4 Sheets-Sheet 4



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UNITED STATES PATENT OFFICE

2,369,578

TELEGRAPH STATION SELECTOR SYSTEM

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Application July 30, 1941, Serial No. 404,602

25 Claims. (Cl. 178—4)

This invention relates to a telegraph system, and particularly to a system having a plurality of telegraph stations to be interconnected through the medium of switching apparatus located in a central office station.

An object of the invention is to provide a call destination indicator device under the control of a station and operable in different characteristic ways to indicate different destinations of messages to be transmitted.

Another object of the invention is to operate the call destination indicator device in different characteristic ways over a communication channel and in accordance with the condition of the communication channel as determined at a remote station on the channel.

Another object of the invention is to control from a central office switching station the disablement of the call destination indicator device by terminating the communication line condition established at the remote station which effected characteristic operation of the call destination indicator device.

A further object of the invention is to provide starting means for a transmitter at a remote station controlled from a central office switching station and to provide stopping means for the transmitter controlled by a signal generated by the transmitter which signal also controls a disconnect indicator at the central office switching station.

The invention features means at the central office station for placing a call destination indicator device under the control of a communication channel extending to the remote station to which the call destination indicator pertains.

The invention also features a self-interrupting relay system located at the remote or call initiating station and arranged to be set in operation under local control at that station for establishing alternate marking and spacing conditions on the communication channel whereby to cause intermittent operation of the call destination indicator device associated with the communication channel.

The invention also features a lamp employed as a call destination indicator device and arranged to be energized steadily to indicate one destination of a message to be transmitted and to be energized intermittently, thereby producing a flashing effect, to indicate another destination of a message to be transmitted.

In accordance with the preferred embodiment of the invention the telegraph system includes a central office switching station and a plurality of telegraph stations individually connected to the central office switching station by communication channels. Certain of the stations may be considered as belonging to one class of stations and at least one of the stations may be considered as

belonging to a different class of stations which difference may be characterized by physical attributes of the station or by message traffic conditions, or both. One of the stations, which may be of either class, may be intimately associated with the central office switching station, or all stations may be remote from the central office station.

The central office station is provided with switching means for interconnecting any two or more of the telegraph stations and is also provided with at least one operator's set for affording intercommunication between an operator and the telegraph stations in the system, such as for informing the operator of the destination of a message to be transmitted.

At the central office switching station, call destination indicator lamps are associated with certain of the communication channels, and in the preferred embodiment of the invention, these channels extend to the stations of one class, and the other class comprises only one station, or if it includes more than one station there is no distinction between them as regards message destination indications. Each of the telegraph stations having a communication channel with which a call destination indicator lamp is associated is provided with means for causing its call destination indicator lamp to be illuminated steadily or to flash. One of these operative conditions of the lamp indicates a call directed to another station of the same class and instructs an operator at the switching station to answer the call, to ascertain the destination of the message which is to be transmitted and to interconnect the communication channel of the calling and called stations by means of switching apparatus. Operation of the indicator lamp in the other of the two characteristic ways of operation directs the operator at the switching station to interconnect the communication channels of the calling station and of the station or stations of the other class by means of the switching apparatus without answering the call or inquiring as to the destination, since the particular mode of operation of the lamp indicates the destination.

Each of the stations of the class which controls call indicator lamps is provided with a storage transmitter which, in the preferred embodiment of the invention, is a perforated tape transmitter which has associated with it starting means controllable from the central office switching station, whereby the operator at the central office station, having determined the destination of a message either by inquiry or by direct indication of the indicator lamp, and having established a connection between the calling and the called telegraph stations, may start the transmitter at the calling station without further attention of an attendant or operator at the

calling station. The stations having the storage transmitters are provided with means responsive to a signal appearing at the end of a message contained in the storage record, and generated by the transmitter at the end of the message, for stopping the transmitter independently of any mechanical transmitter arresting means, such as a tape tension responsive device. Each of the communication channels extending from the stations that are provided with the storage transmitters have disconnect indicator lamps associated therewith at the central office switching station, and the signal which causes arrestment of the transmitter at the end of a message also causes the disconnect signal lamp to be operated to serve as an instruction to the operator at the central office station to disestablish the communicative connection between the calling and called stations by restoring the switching apparatus to normal condition.

It is within the contemplation of the invention that one of the stations connected to a communication channel extending to the central office switching station may be provided with signal responsive switching mechanism for selectively determining which of two or more telegraph receivers, certain of which may be located at points remote from the signal responsive switching mechanism, shall receive a message to be transmitted from one of the other telegraph stations in the system. With this arrangement a primary destination of a message is indicated by the call destination indicator lamp and a subordinate destination is indicated by signals preceding the message which do not require any action on the part of the operator at the central office switching station.

For a complete understanding of the invention reference may be had to the following detailed description to be interpreted in the light of the accompanying drawings wherein:

Fig. 1 is a schematic view showing, somewhat in detail, a telegraph station of the local loop type connected to a repeater, and in diagrammatic form three other stations of the same class and one station of a different class;

Fig. 2 is a schematic view showing, in detail, at a central office switching station, a closed line control circuit individual to the local telegraph station shown in detail in Fig. 1 and in diagrammatic form the control circuits for the four other stations shown in Fig. 1;

Fig. 3 is a schematic view showing, at the central office switching station, key switching circuits respectively connected to the control circuits of Fig. 2 and a key switching circuit for an operator's telegraph set;

Fig. 4 is a schematic view showing an operator's set connected to the operator's switching key circuit including operators' transmitting and receiving apparatus; and

Fig. 5 is a diagrammatic view showing how the previously identified figures of the drawings may be arranged relative to each other to form a complete communication system in accordance with the invention.

Referring now to the drawings, and particularly to Fig. 1, the reference numerals 11, 12 and 13 designate three telegraph stations which may be identical and only one of which, the station 11, is shown in detail. The principal communication elements of the station 11 are the tape transmitter 101, the keyboard transmitter 102 and the receiving printer 103 indicated symbolically by a selector magnet. The tape trans-

mitter 101 may be generally similar to the tape transmitter shown in Patent 2,055,567 granted September 29, 1936, to E. F. Watson. The keyboard transmitter 102 and receiving printer 103 may be a combination unit wherein printing is performed on a tape, as exemplified in Patent 1,745,633 granted February 4, 1930, to S. Morton et al. or may be of the type in which printing is accomplished on page width paper, as in Patent 1,904,164 granted April 18, 1933, to S. Morton et al. The disclosures of the three patents above identified are incorporated herein by reference as a part of this specification.

The tape transmitter 101 includes perforated tape controlled contacts 104 which set up code combinations on the segments of a segmented ring which is traversed by brushes of a distributor arm 106 which impresses the code combinations on a continuous ring. Distributor brush arm 106 is carried by shaft 107 which is driven by motor 108 through friction clutch 109 and gears 111 under the control of a start cam 112 controlled by start magnet 113. The energizing circuit for start magnet 113 includes tape tension responsive contacts 114, manually operable switch 116 and front contact and armature of normally deenergized relay 117. The continuous ring of the distributor is connected to conductor 118 which represents one side of the communication channel loop with which the station 11 is directly associated and the stop segment of the distributor and one side of each of the pairs of transmitting contacts 104 is connected through the operating winding of polarized line relay 119, normally closed break contacts 121, normally closed stop contacts of keyboard transmitter 102, normally closed call initiating key 122, back contact and inner lower armature 123 of relay 124, normally closed contacts controlled by make-before-break armature 126 of relay 127, to conductor 128 which represents the other side of the communication channel loop connected to station 11. Perforated tape for storing signals to be transmitted by tape transmitter 101 may be prepared in a keyboard perforator represented symbolically at 129. The keyboard perforator 129 may be of the type shown in Patent 1,182,179 granted May 9, 1916, to C. L. Krum et al.

Assuming that the station 11 is located within a distance from its central office switching station not greater than the mileage resistance limitation for loop operation, the station 11 is connected to the central office switching station through a two-relay loop repeater 14. The loop side of the repeater is a balanced or differential loop arrangement with the line conductor 118 connected through the operating winding of repeater relay 131, to the armature of repeater relay 132, and the line conductor 128 connected to ground either at the station 11, or as shown in Fig. 1 at the repeater 14, the system shown in Fig. 1 contemplating a full metallic communication loop circuit between station 11 and repeater 14.

The spacing contacts of both of the repeater relays 131 and 132 are connected to ground and the marking contact of relay 132 is connected to grounded battery 133 through a resistor. The armature of repeater relay 132 is normally maintained in engagement with its marking contact whereby a closed circuit is normally maintained from battery 133 through the armature of relay 132, operating winding of relay 131, line conductor 118, continuous ring and stop segment of tape transmitter 101, operating winding of line relay

119, break key 121, stop signal contacts of keyboard transmitter 102, call initiating key 122, back contact and armature 123 of relay 124, closed contacts controlled by armature 126 of relay 127 and line conductor 128 to ground. With current from battery 133 flowing in this closed circuit the grounded armature of line relay 119 engages its marking contact to which is connected one end of the winding of the selector magnet of receiving printer 103, the other end of which is connected to grounded battery 134. Thus the receiving printer 103 is normally maintained in the marking condition.

In addition to the call initiating key 122, there is also a normally open call initiating key 136, one spring of which is connected to ground and the other spring is connected through the winding of a slow-release relay 137 to grounded battery 138. The upper armature of relay 137 is connected to ground and cooperates with a front contact to complete the energizing circuit for the previously identified relay 127 which has one end of its winding connected to battery 139 and the other end connected to the upper front contact of relay 137. The grounded lower armature of relay 137 cooperates with a front contact which is connected to one end of the operating winding of relay 124, the other end of which is connected to grounded battery 141. The lower front contact of relay 137 is also connected to one end of the winding of a slow-release relay 142, the other end of which is connected to grounded battery 143. The system of relays 124, 126, 137 and 142 comprises a vibratory system for effecting the alternate energization and deenergization of relay 127.

Upon the closure of key 136 the relay 137 becomes energized and its upper armature completes the energizing circuit for relay 127. The lower armature of relay 137 completes the energizing circuits for the relays 124 and 142 so that all four of the relays are now energized and attract their armatures. The armature of relay 127 first engages its front contact and provides a ground connection for the energizing winding of relay 124 and for the relay 142 in parallel with the ground connection provided by the lower armature of relay 137. As armature 126 of relay 127 moves into its fully operated position it opens the normally closed contacts in the communication circuit, thus opening the loop circuit. This causes line relay 119 and repeater relay 131 to shift their armatures to the spacing positions, but the lower armature of relay 124, which is grounded, engages a front contact connected to the selector magnet of receiving printer 103, so that the printer is maintained in marking condition and does not respond to the spacing condition of the communication channel. The armature 123 of relay 124 moves from engagement with its back contact to engagement with its front contact, which is connected to one end of the holding winding of relay 124, the other end of which is connected to the communication line on the grounded side of the loop between keyboard transmitter 102 and call initiating key 122. Thus the holding winding of relay 124 is placed in the communication circuit. The upper armature of relay 124, which is grounded, engages a front contact which is connected to the back contact of slow-release relay 142. The armature of relay 142, which at this time is out of engagement with the back contact, is connected to the winding of slow-release relay 137 in parallel with call initiating key 136.

Upon the opening of key 136 the energizing circuit for slow-release relay 137 is interrupted and after an interval this relay releases its armatures. The upper armature opens the energizing circuit for relay 127 and the lower armature removes one of the ground connections for the operating winding of relay 124 and for relay 142. Due to the make-before-break arrangement of the contacts controlled by armature 126 of relay 127, the communication circuit is reclosed before armature 126 becomes disengaged from its front contact and while relays 124 and 142 are held energized by the ground connection afforded by the armature 126. The reclosed communication circuit now includes the holding winding of relay 124 so that that relay remains energized and does not release its armatures after armature 126 of relay 127 moves out of engagement with its front contact. However, the energizing circuit of slow-release relay 142 is interrupted at the armature of relay 127 and after an interval the relay 142 releases its armature.

When the armature of relay 142 moves into engagement with its back contact it completes an energizing circuit for the relay 137 from ground through the upper armature and front contact of relay 124 and through the back contact and armature of relay 142 in parallel with the now open call initiating key 136. Thus relay 137 becomes reenergized and in turn completes the energizing circuit for the relay 127 and slow-release relay 142. The relay 137 also completes the circuit of the operating winding for relay 124 so that when the armature 126 of relay 127 opens the contacts in the communication circuit the relay 124 will not be released. The energization of slow-release relay 142 causes its armature to interrupt the energizing circuit for slow-release relay 137 which releases in the manner previously described to release the relays 127 and 142. The relay 127 recloses the communication circuit and relay 142, releasing after an interval, again completes the energizing circuit for the relay 137. This cycle of operations recurs to effect the alternate opening and closing of the communication circuit at the contacts controlled by the armature 126 of relay 127 until the system is disabled in a manner which will be described later.

The station 11 is provided with means for starting and stopping the tape transmitter 101 under the control of signals on the communication channel. For controlling the mechanism which starts and stops the tape transmitter 101, the receiving printer 103 is provided with normally open contacts 146 and 147 controlled by function members 148 and 149, respectively. The manner in which contacts may be controlled by function members of a receiving printer is fully disclosed in the Morton et al. Patent 1,904,164. One of the contacts 146 is connected to ground and the other contact is connected to one end of the winding of a relay 151, the other end of which is connected to grounded battery 152. A set of manually operable normally open contacts 153 is connected in parallel with the contacts 146 to provide for operation of relay 151 under manual control. The lower armature of relay 151, which is also connected to battery 152, is engageable with a front contact that is connected to one terminal of the winding of relay 117, the other terminal of which is grounded. Upon the operation of the receiving printer controlled contacts 146 or the manually operable contacts 153, the relay 151 becomes energized and completes the energizing circuit for relay 117, which attracts

its armature to complete the energizing circuit for start magnet 113 if tape tension responsive contacts 114 and manually operable switch 116 are then closed. Start magnet 113 operates to withdraw a lever from blocking relation to start cam 112, so that distributor shaft 107 of tape transmitter 101 is released for rotation.

A holding circuit for the relay 151 is completed from a front contact through the upper armature of the relay, armature and back contact of a relay 154 and normally closed manually operable contacts 156 to ground. The relay 154 has one end of its winding connected to battery 157 and the other end connected to one of the contacts 147, the other contact being connected to ground. Upon the operation of contacts 147 by function member 149 of the receiving printer, the energizing circuit of relay 154 is completed and the relay attracts its armature to interrupt the holding circuit for relay 151. The relay 151, upon releasing its lower armature, interrupts the energizing circuit for the relay 117 which interrupts the circuit for the start magnet 113 of the tape transmitter 101 whereby the armature of the start magnet arrests start cam 112 and thus the transmitter 101 is stopped. The manually operable key 156 is operable to provide local manual control of the release of the holding circuit for relay 151, whereby the transmitter 101 may be stopped independently of the contacts 147. The relay 151 is provided with an armature 158 which cooperates with a front contact to short-circuit the transmitting contacts of the keyboard transmitter 102 so that the keyboard transmitter may not be operated to interfere with the transmission of signals from the tape transmitter 101 when relay 151 has been energized to set in operation the tape transmitter.

The operating winding of the relay 132 which repeats signals transmitted to the station 11 has one end connected to battery 133 and the other end connected by conductor 201 to the left-hand armature of a relay 202 of a control circuit 21 forming part of the central office switching station and permanently associated with the telegraph station 11 through the repeater 14. The control circuit 21 and repeater 14 are similar to control circuits and repeaters disclosed in Patent No. 2,280,292 granted April 21, 1942, to F. S. Kinkead et al. The disclosure of the Kinkead et al. patent is incorporated herein by reference as a part of this disclosure. Conductor 201 is also connected to the right-hand back contact of relay 202. The marking contact of repeater relay 131 is connected to the left-hand front contact of relay 202 by conductor 203 and the armature of relay 131 is connected through conductors 204 and 206 to the right-hand front contact of relay 202 and through conductors 204, 207 and the winding of relay 208 to a potentiometer which comprises the resistors 209 and 211. One end of the potentiometer is connected to grounded battery 212 and the other end of the potentiometer is connected to ground.

Upon the opening of the communication circuit between station 11 and repeater 14, such as directly by the operation of call initiating key 122, or indirectly through the operation of call initiating key 136 which causes relay 127 to be operated to open the communication circuit, the armature of repeater relay 131 will move from its marking to its spacing position, thus connecting ground over conductors 204 and 207 to relay 208, to cause relay 208 to become energized and its armature to be moved into engagement with

its front contact. The armature of relay 208 is grounded and the back contact is connected to one side of a condenser 213, the other side of which is connected through a resistor to ground.

The front contact of relay 208 is connected by conductor 214 to the inner right-hand front contact of a relay 218. The side of condenser 213 which is connected to the back contact of relay 208 is also connected through resistor 225 and conductor 224 to battery 226.

Upon the operation of relay 208 the short circuit across condenser 213 afforded by the ground at the armature of relay 208 is removed, so that charging current for the condenser may flow through resistor 225 from battery 226. When condenser 213 is short-circuited the grid of tube 222 is biased sufficiently negatively to render tube 222 non-conductive. The capacity of condenser 213 is such that in an interval preferably substantially as long as but not longer than a permutation code combination the condenser 213 will become charged and raise the potential of the grid of tube 222 sufficiently to cause the tube to become conductive. The reason for the timing circuit consisting of the condenser 213 and discharge tube 222 is to prevent the relay 208 from effecting a control condition as it responds to spacing impulses occurring during normal signaling. The plate circuit of tube 222 includes a relay 227 which becomes energized when the tube 222 becomes conductive and attracts its armature into engagement with its grounded front contact.

The relay 227 completes a circuit from ground through its front contact and armature, outer right-hand armature and back contact of a relay 228, conductor 229, inner left-hand armature and back contact of a relay 231, conductor 232 extending into Fig. 3, call destination indicator lamp 301, conductor 302 extending back into Fig. 2 and winding of relay 218 to grounded battery 226. Relay 218 thus becomes energized through the call destination indicator lamp 301, and a holding circuit for the relay 218 is established from ground at the right-hand inner armature of relay 228 through the back contact of relay 228, conductor 233, conductor 234, right-hand armature and back contact of relay 231, conductor 236, front contact and left-hand armature of relay 218, conductor 232 extending into Fig. 3, call destination indicator lamp 301, conductor 302 extending back into Fig. 2, and winding of relay 218 to grounded battery 226. The inner right-hand armature of relay 218 completes a second holding circuit for the relay 218 from the grounded armature of relay 208 through the front contact of that relay, conductor 214, inner right-hand front contact and armature of relay 218, winding of the relay to grounded battery 226, which holding circuit parallels the first holding circuit but does not include the call destination indicator lamp 301. As long as the relay 208 remains operated the lamp 301 is short-circuited by the second holding circuit for the relay 218 and is not operated. The outer right-hand armature of relay 218 cooperates with a grounded front contact to complete a circuit from the ground through the front contact and armature, conductor 237, key 401 at an operator's position (Fig. 4), alarm device 402 to grounded power source 403. The alarm device 402 is operated over this circuit to call the attention of an operator to the fact that a call destination indicator lamp is about to be operated, indicating

that a connection through the switching apparatus is desired.

Upon the reclosure of the communication circuit between station 11 and the repeater 14, whether by closure of key 122 or by the deenergization of relay 127 incident to the operation of the vibratory relay system, the armature of repeater relay 131 will be restored to marking position to disconnect ground from the relay 208. Upon the release of the armature of relay 208, the second holding circuit for relay 218 is interrupted, leaving only the first holding circuit for the relay 218 which includes the call destination indicator lamp 301. If the call has been initiated by operation of the key 122 at station 11, there will be no further interruption of the communication circuit at that station and lamp 301 will operate uninterruptedly. However, if the call has been initiated by operation of the key 136 the relay 127 at station 11 will be alternately energized and deenergized to open and close alternately the communication circuit between station 11 and repeater 14. The relay 208 will respond to these interruptions of the communication circuit to supplement the first holding circuit of relay 218 with the second holding circuit. Each time this occurs the call destination indicator lamp 301 will be extinguished due to a shunt condition so that under the control of the vibratory relay circuit of station 11, the lamp 301 will be caused to flash.

The stations with which the telegraph station 11 may desire to communicate are the stations 12, 13, 15 and 16 in Fig. 1. As previously stated, stations 12 and 13 are assumed to be identical with station 11. Station 15 is assumed to include apparatus identical with that shown at station 11 and, in addition thereto, a receiving-only printer 161, represented symbolically by the selector magnet enclosed in the broken line rectangle, connected to the station 16.

In accordance with the present invention, station 16 is presumed to differ significantly from the other telegraph stations in the system. It need not differ physically from the other stations but may differ functionally, such as, for example, being the recipient of a large percentage of the messages originating at other stations in the system. In conformity with the latter distinction between station 16 and the other telegraph stations, the station 16 has been shown as a receiving-only station. Furthermore, it has been shown as including a signal responsive selector mechanism whereby a message directed to the station 16 may be recorded at that station or may be recorded at the receiving-only printer 161 associated with the station 15.

The stations 12, 13, 15 and 16 have their line conductors terminating in the repeaters 17, 18, 19 and 20, respectively. These repeaters may be identical with the repeater 14 shown in detail, and operable in half duplex manner, from which it will be understood that communication may be had alternatively in either direction but that simultaneous two-way communication is not contemplated. Since station 16 is presumed to be a receiving-only station, use will not be made, in the repeater 20 of its ability to accommodate transmission of signals which might have their origin at the station 16. However, by providing a repeater of this type the station 16 may at any time be converted to a full sending and receiving station by the addition of transmitting apparatus without modification of the repeater 20. The signal responsive switching selector mechanism

which has been shown diagrammatically at station 16 in Fig. 1 may be of the type disclosed in Patent 2,120,235 granted June 14, 1938, to J. F. Beattie et al., and the disclosure of this patent is incorporated herein by reference as a part of the present disclosure. The communication loop comprising the conductors 162 and 163 extending between the repeater 20 and the station 16 includes the selector magnet 164 of the switching selector mechanism 166, the normally closed contacts in series controlled in make-before-break manner by the left-hand armatures of relay 167 and the normally closed contact in series controlled in make-before-break manner by the left-hand armatures of relay 168. The selector magnet of the receiving-only printer 161 located at station 15 is connected between the left-hand armatures of relay 168, and the selector magnet of the receiving-only printer 169 located at station 16 is connected between the left-hand armatures of relay 167.

The selector magnet 164 controls, among other things, the selection and operation of several selectable members 171, 172 and 173. The selectable members 171 and 172 operate normally open contacts 174 and 176, respectively, and the selectable member 173 operates normally closed contacts 177. One of the contacts 176 is connected to ground and the other is connected to one end of the winding of relay 167, the other end of which is connected to grounded battery 178. Upon the closure of contacts 176 and energization of relay 167, a holding circuit for the relay is established from ground through the normally closed contacts 177 and through the right-hand armature and front contact of relay 167 and its winding to grounded battery 178. The left-hand armatures of relay 167 are operable to insert the selector magnet of receiving-only printer 169 in the loop circuit of station 16, and the make-before-break operation of the contacts controlled by the armatures assures that the addition of the selector magnet of printer 169 to the loop circuit is accomplished without interruption of the loop circuit.

In a similar manner the contacts 174 are operable to complete, to grounded battery 179, the energizing circuit for relay 168, for which a holding circuit is completed through the right-hand armature and front contact of the relay from ground at the normally closed contacts 177 to battery 179. The left-hand armatures of relay 168 are operable to insert the selector magnet of receiving-only printer 161 in the loop circuit. Either or both of the printers 161 and 169 may be connected into the loop circuit by the selective operation of either or both of the sets of contacts 174 and 176 in response to their assigned code signals. When the transmission of message material to either or both of the receiving-only printers 161 and 169 has been completed and it is desired to remove those printers from the loop circuit, this may be accomplished by the transmission of the code signal which effects the selection and operation of selectable member 173. The selectable member 173 opens contacts 177, thereby interrupting the holding circuits for either of the relays 167 and 168 or both, if both are operated, and printers 161 and 169 are disconnected from the loop circuit, which is maintained uninterrupted during the disconnecting operation by the make-before-break arrangement of the contacts controlled by the relay armatures, and is maintained uninterrupted

thereafter by the series arrangement of the contacts.

Three conductors corresponding to the conductors 201, 203 and 204 extend from the repeaters 17, 18, 19 and 20 to control circuits 22, 23, 24 and 25, respectively, which are similar to the control circuit 21 (Fig. 2). As will be more fully set forth hereinafter, the control circuit 21 affords two-way communication in accordance with half duplex principles and the control circuits 22, 23, 24 and 25 accommodate similar communication. As in the case of the repeater 20 the control circuit 25 accommodates transmission which station 16 cannot initiate, since station 16 is presumed to be a receiving-only station. However, the control circuit 25 requires no modification in the event that station 16 is converted to a transmitting and receiving station by the addition of transmitting equipment. In this connection it is to be noted that station 16 does not require a call destination indicator lamp at the switching station nor does it have occasion to operate the call indicating alarm at the operator's position. Accordingly, stub conductors only are indicated at the control circuit 25 for lamp and alarm controlling circuits.

It will be fully apparent at this point that the telegraph stations 11, 12, 13 and 15, disregarding the receiving-only printer 161 at the latter station, may be considered as representing stations of one class and that the station 16 may be considered as representing a different class of stations, only one of which is shown. For these two classes of call destinations, the lamp 301 (Fig. 3) affords two call destination indications, one represented by steady illumination of the lamp and the other represented by flashing operation of the lamp. For the purpose of the following description, it will be assumed that steady operation of the lamp 301, which results from opening of key 122 for an interval at least as long as one permutation code signal combination, indicates that connection to station 16 is desired, and flashing operation of lamp 301, initiated by closure of key 136 at station 11 for a similar interval, indicates that the connection to one of the stations 12, 13 and 15 is desired.

As shown in Fig. 3 the switching apparatus, which is generally similar to that shown in the Kinkead et al. patent, includes a plurality of hub circuits comprising pairs of conductors, of which six pairs have been shown, designated by the reference numerals 303, 304, 306, 307, 308 and 309. For each of the telegraph stations 11, 12, 13, 15 and 16, six switching keys are provided, each key consisting of three make contacts. The six keys are individually associated with the six hub circuits and the keys for the line extending to station 11 are designated by the reference numerals 311, 312, 313, 314, 316 and 317. The six keys may, if desired, be arranged in pairs with either of the keys of a pair operable by a single lever movable to one or the other of two extreme positions from an intermediate normal position of the lever in which neither of the keys associated therewith is operated. The banks of switching keys for the stations 12, 13, 15 and 16 are indicated generally by the reference numerals 318, 319, 321 and 322. The call destination indicator lamps for the stations 12, 13 and 15 are identified by the reference numerals 323, 324 and 326. As previously stated, there is no call destination indicator lamp for the station 16.

Two of the springs of each of the six keys 311

to 317 are connected to the two conductors comprising the hub circuit with which the key is directly associated. Of the remaining four springs of the six switches, corresponding ones are connected in multiple and those at the extreme right hand of each switch are connected to a conductor 327 for connecting that conductor to the upper conductor of any of the six hub circuits. The right-hand spring on the left-hand side of each switch is connected to a conductor 328 and the two middle springs on the left-hand side of each switch are connected together and to a conductor 329. The conductor 327 extends into Fig. 2 to the outer left-hand back contact of relay 228, and the outer left-hand armature of the relay is connected by conductor 241 to the right-hand armature of relay 202. The conductor 328, which also extends into Fig. 2, is connected to one end of the winding of relay 202 and the other end of the winding is connected by conductor 233 to the inner right-hand back contact of relay 228. Conductor 329 is connected to the inner left-hand back contact of relay 228 and the inner left-hand armature of that relay is connected through resistor 242, conductor 243, winding of relay 231, and conductor 224 to grounded battery 226.

Assume now that call initiating key 122 has been opened and reclosed to initiate the series of operations previously described whereby lamp 301 is steadily illuminated through locked relay 218 and audible alarm device 402 is operated. At the operator's set, key 401 is operated manually to disable the audible alarm device 402 and one of the keys 311 to 317, inclusive, is operated to connect the control circuit 21 for station 11 to an idle hub circuit. It will be assumed that key 311 is operated to associate the control circuit 21 with hub circuit 303. Conductor 327 will thus be connected to the upper of the hub circuit conductors 303. This will be accomplished by the two right-hand springs of the key 311. By the operation of the two left-hand pairs of springs of the key, the conductors 328, 329 and the lower of the hub circuit conductors 303 will be connected together. From the ground at the inner right-hand armature of relay 228 a circuit may be traced through the armature and back contact of that relay, conductor 233, winding of relay 202, conductor 328, left-hand springs of key 311, conductor 329, back contact and inner left-hand armature of relay 228, resistor 242, conductor 243, winding of relay 231, conductor 224 to grounded battery 226. Thus, relays 202 and 231 will be energized in series.

Relay 202 is a cut-through relay and its left-hand armature will engage the left-hand front contact to interconnect the conductors 201 and 203 extending between control circuit 21 and repeater 14. Thus the circuit of the operating winding of repeater relay 132, which normally extends over conductor 201, right-hand back contact and armature of relay 202, conductor 241, left-hand armature and back contact of relay 228 and conductor 327 to the several keys 311 to 317, inclusive, which are normally open, is changed to extend over conductor 201, left-hand armature and front contact of relay 202, conductor 203, marking contact and armature of repeater relay 131, conductor 204, to the right-hand front contact of relay 202. Since by the operation of key 311, relay 202 has been energized, the circuit just described is extended from the right-hand front contact of relay 202, over the right-hand armature, conductor 241, left-

hand armature and back contact of relay 228, conductor 327 and the right-hand spring of key 311 to the upper conductor of the hub circuit 303. No other connection to this conductor of the hub circuit has yet been made but the marking condition of relay 132 is not altered. A complete communication circuit through the operating winding of repeater relay 132 includes sources of potential of the same magnitude and polarity at opposite ends of the circuit so that the batteries are in opposition and no current flows through the operating winding of the relay 132, the armature of the relay being held on the marking contact by current through the biasing winding. A spacing condition is established by grounding the remote end of the communication circuit so that current flows through the operating winding of the repeater relay 132 to shift the armature to the spacing contact. The relay 132 does not distinguish between a closed circuit with properly poled batteries at both ends and an open circuit condition, and accordingly the extension of the circuit of the operating winding of repeater relay 132 to the hub circuit 303, where the circuit is open, and the addition of the armature and marking contact of repeater relay 131 to that conductive path has not changed the condition of repeater relay 132.

Since relay 231 became energized in series with relay 202 its left-hand inner armature moves from back to front contact to prepare an energizing circuit for disconnect relay 244. The right-hand armature moves from back to front contact to interrupt the holding circuit for the call destination indicator lamp relay 218 and to prepare a holding circuit for the disconnect relay 244. As the holding circuit for relay 218 included the call destination indicator lamp 301, this lamp is extinguished and the right-hand armature of relay 218 removes the ground connection for the audible indicator 402 at the operator's position.

Since the steady illumination of lamp 301 indicated a call for station 16 the operator next completes the connection through to that station. The switching keys for the station 16 are contained in the key bank 322 and are identified by the reference numerals 331, 332, 333, 334, 336 and 337. The key which must be operated to connect station 16 to the hub circuit 303 is key 331 and accordingly the operator closes this key. Relays in the control circuit 25 corresponding to the relays 202 and 231 are operated to place the repeater 20 in the same condition as the repeater 14 with reference to the hub circuit 303 and to prepare an energizing circuit for the disconnect relay in the control circuit 25. The latter is an idle operation, since the station 16 is a receiving-only station and is not provided with means for sending a disconnect signal, nor is there any disconnect indicator lamp to be controlled by the disconnect relay in the control circuit 25. The establishment of a communication path from the hub circuit is accomplished over the conductor 338 which corresponds to the conductor 327, and the operation of the relays is accomplished over the conductors 339 and 341 which correspond to the conductors 328 and 329.

Connections have now been established for the transmission of a message from the station 11 to the station 16. There remains to be performed the further operation of starting the transmitter 101 at station 11 into which the attendant at that station had placed the perforated tape con-

taining the message prior to operating the call initiating key 122. The signal for effecting the starting of the transmitter 101 must be transmitted by the operator at the central office switching station. Referring to Fig. 4, the operator's position is provided with a receiving printer indicated symbolically at 406 by the selector magnet, and a keyboard transmitter 407 which has in series therewith a break key 408. Separate closed circuit jacks 409 and 411 are provided for receiving the plugs 412 and 413, respectively, connected to the receiving printer 406 and the keyboard transmitter 407, respectively. One of the terminals of jack 409 is connected to the marking contact of a polarized line relay 414, the armature of which is connected to ground, and the other terminal of jack 409 is connected to battery 416. The spacing contact of line relay 414 is grounded. One terminal of the operating winding of line relay 414 is connected to grounded battery 417 and the other end is connected to conductor 418 which is connected to one of the right-hand springs of each of the operator's hub circuit switching keys 342, 343, 344, 346, 347 and 348. The other of the right-hand springs of the keys 342 to 348 are connected to the upper conductors of the hub circuits 303 to 309.

One of the terminals of jack 411 which serves the transmitter 407 is connected to one terminal of the operating winding of a transmitting relay 419 the other terminal of which is connected to ground battery 421. The marking contact of transmitting relay 419 is connected through resistor 422 to a potentiometer consisting of resistors 423 and 424 in series, one end of the potentiometer being connected to grounded battery 426 and the other end being connected to ground. The spacing contact of transmitting relay 419 is connected to ground and the armature of the relay is connected to operator's communication conductor 418. The other terminal of jack 411 is connected to ground.

In order to transmit the signal for starting the tape transmitter 101 at station 11, the operator inserts plug 413 into jack 411 and closes key 342. Batteries 417 and 426 of the same polarity and magnitude as battery 133 at repeater 14 (Fig. 1) and a corresponding battery at repeater 20 thus become connected to the upper conductor of the hub circuit 303 and no current flows to energize the operating windings of any of the relays connected to the hub circuit. The operator then operates keyboard transmitter 407 to send the permutation code signals which will cause the selectable member 148 at station 11 to be selected and operated. This selectable member may be responsive to a signal frequently assigned to functional operations, such as the upper case H signal which involves the transmission of the upper case or figures shift signal followed by the transmission of the code signal representing the letter H. Spacing signals generated by the keyboard transmitter 407 cause the armature of transmitting relay 419 to move to the spacing position whereby ground is connected to conductor 418 and thus to the upper conductor of the hub circuit 303. Due to the removal of the battery connection afforded by the potentiometer consisting of the resistors 423 and 424 and the substitution of ground to the hub circuit current flows through the operating winding of repeater relay 132 from battery 133 and through the operating winding of a corresponding relay from a corresponding battery in repeater 20 and through

the operating winding of operator's receiving relay 414. Thus the armature of relay 132 is operated to repeat the signals into the loop circuit to the station 11 consisting of the conductors 118 and 128. It will be understood that the signals which control the selection of selectable member 148 at the station 11 and to which the selector magnet 164 at station 16 also responds should not perform any switching operations in the switching selector mechanism located at station 16.

Upon the closure of the contacts 146 controlled by selectable member 148 at station 11, relay 151 is operated as previously described to effect the energization of start magnet 113 and the release of distributor shaft 107 for rotation to transmit signals over the loop circuit of station 11. No further attention of the operator controlling the apparatus in Fig. 4 to the transmission of the message from station 11 to station 16 is required and, accordingly, the operator may open key 342 to disconnect the operator's set from the hub circuit 303.

In response to the signals generated by the tape transmitter 101, the armature of repeater relay 131 at repeater 14 is oscillated between its marking and spacing contacts. When the armature is on the marking contact, continuity of the circuit from battery 133 through the operating winding of relay 132, through the hub circuit and through a relay corresponding to the relay 132 to battery at repeater 20 is preserved so that the receiving relay at the repeater 20 does not operate. When the armature of relay 131 moves to the spacing contact ground is connected over the hub circuit to the receiving relay at the repeater 20 so that that relay operates to its spacing position to repeat the spacing condition to the loop circuit comprising the conductors 162 and 163. The armature of relay 131 in leaving the marking contact opens the circuit of the operating winding of repeater relay 132 so that the armature of that relay does not move to its spacing condition and thus does not reflect the signals generated by the tape transmitter 101 back into the loop circuit comprising the conductors 118 and 128.

The first signals in the tape are those which will cause either or both of the selectable members 171 and 172 to be selected, and if both are to be operated, they will be selected successively in response to successive signals. In response to those signals, either the receiving-only printer 169 at station 16 or the receiving-only printer 161 at station 15 or both of these printers will be connected to the loop circuit comprising the conductors 162 and 163 to respond to the message signals generated by the tape transmitter 101 at station 11.

In the tape which contains the message to be transmitted by tape transmitter 101, there should have been perforated by the attendant a signal at the end of the message to which the line relay 119 and printer 103 will respond to select the selectable member 149. This signal is preferably the blank or all-spacing signal in order to provide a continuous spacing condition on the communication channel of sufficient duration to cause electron discharge tube 222 to respond. In response to the final signal the selectable member 149 operates contacts 147 to complete the energizing circuit for the relay 154. This relay operates to open the holding circuit for the relay 151 which releases the energizing circuit for the start magnet 113 which, in turn, releases its armature and tape transmitter 101 is stopped. The release of armature 158 of relay 151 removes the short cir-

cuit across the transmitting contacts of keyboard transmitter 102, restoring that transmitter to operative condition. The blank signal may, if desired, be employed for selecting the selectable member 173 at station 16 to open the contacts 177 and release the holding circuit for either or both of the relays 167 and 168 to disconnect the receiving-only printers 161 and 169 from the loop circuit comprising the line conductors 162 and 163, thus restoring station 16 to normal condition.

In response to the blank or all-spacing signal, the relay 208 in the control circuit 21, which is at all times responsive to signals on the communication channel, holds its grounded armature on its front contact a sufficient length of time to cause condenser 213 to charge and raise the potential of the grid of electron discharge tube 222 so that the tube becomes conductive and plate current flows through relay 227 to energize the relay. A circuit is completed from the grounded front contact of relay 227 through the armature of that relay, right-hand armature and back contact of relay 228, conductor 229, inner left-hand armature and front contact of relay 231, conductor 246, conductor 247, disconnect indicator lamp 351, conductor 352, winding of relay 244, conductor 224 to grounded battery 226. Thus the disconnect lamp becomes operated in series with relay 244. A holding circuit for relay 244 through the disconnect indicator lamp 351 is completed from ground through the inner right-hand armature and back contact of relay 228, conductor 233, conductor 234, right-hand armature and front contact of relay 231, conductor 248, left-hand armature and front contact of relay 244, conductor 246, conductor 247, lamp 351, conductor 352, winding of relay 244, conductor 224, to grounded battery 226, whereby lamp 351 is maintained illuminated uninterruptedly. After the transmission of the blank signal which caused the disconnect indicator lamp 351 to be operated, the tape transmitter 101 comes to rest with the brushes engaging the stop segment so that a steady marking condition is established in the communication circuit and relay 208 is restored to the de-energized condition. Upon the engagement of the back contact of relay 208 by its armature, the condenser 213 is discharged and the conductivity of the electron discharge tube 222 interrupted so that relay 227 is released. Thus the relay 244 is held energized solely by the previously identified holding circuit.

The right-hand armature of relay 244 which is connected to ground, completes a circuit through the right-hand front contact of the relay and through conductor 237 and key 401 at the operator's position to the audible alarm 402 whereby the alarm is operated. This attracts the attention of the operator who observes that lamp 351 is operated to indicate that the message transmission from station 11 to station 16 has been completed. In compliance with this indication the operator restores keys 311 and 331 to normal position. Upon the opening of key 311, conductor 327 is disconnected from the hub circuit and conductor 328 is disconnected from conductor 329 at the left-hand springs of key 311. The energizing circuit for the relays 202 and 231 in series includes the conductors 328 and 329 as previously described so that upon the disconnection of these conductors both of the relays are released. Relay 202 upon being restored to normal condition removes the left-hand or marking contact of repeater relay 131 from the circuit of the operating winding of relay 132 and restores

the circuit of repeater 14 to normal condition. The relay 231 upon being restored to normal condition interrupts the holding circuit for relay 244 at the right-hand armature of relay 231 so that relay 244 is released, thus disabling the operation of the disconnect indicator lamp 351 and removing ground from the circuit of the audible alarm device 402. The opening of key 331 releases the relays in the control circuit 25 corresponding to the relays 202 and 231 of the control circuit 21, thus restoring the control circuit 25 and the repeater 20 to normal or idle condition.

It will now be assumed that the attendant at station 11 operates call initiating key 136 to indicate a message to be transmitted to one of the stations 12, 13 and 15. This calls into operation the vibratory system consisting of the relays 124, 127, 137 and 142 to open the loop circuit consisting of the conductors 118 and 128 which results in the operation of relays 208, 227 and 218 in succession in that order. The relay 218 establishes its holding circuit as in the previously described operation, and as soon as the attendant at station 11 releases key 136 and permits it to remain open, the vibratory relay system operates to cause relay 127 to open and close alternately the loop circuit. The relay 208 follows the alternating conditions of the line and cyclically provides an energizing circuit for the relay 218 in shunt with the holding circuit through call destination indicator lamp 301 so that the lamp flashes. Also, the audible alarm device 402 is operated.

The flashing lamp indicates to the operator that the telegraph station 11 desires to communicate with one of the stations 12, 13 and 15. No more definite information than this is conveyed by the lamp to the operator so it is necessary for the operator to determine the destination of the message through the medium of telegraph signals to be transmitted from station 11. Assuming that hub circuit 303 is idle, the operator closes keys 311 and 342 and inserts plug 412 into jack 409 and plug 413 into jack 411. Key 311 operates as previously described to extend the communication circuit from station 11 to the hub circuit 303 and to energize relays 202 and 231, the latter of which releases the holding circuit for the relay 218 whereby the flashing call destination indicator lamp 301 is disabled. The operation of the key 342 connects the operator's position apparatus to the hub circuit 303. These operations do not disable the vibratory relay mechanism at the station 11 and it is necessary for the operator to effect the disablement of that mechanism. This is accomplished by opening the operator's break key 408 to place the communication circuit extending from the operator's position to the repeater 14 in spacing condition. The opening of break key 408 causes the armature of repeater relay 132 to move to its spacing position thus disconnecting marking battery 133 from the operating winding of repeater relay 131 and from the loop circuit comprising the conductors 118 and 128. The loop circuit must be maintained in spacing condition by the relay 132 long enough to assure that the operation of the vibratory system has reached a portion of its cycle in which relay 127 is deenergized and the loop circuit contacts controlled by its armature 126 are closed. When the vibratory system is in that condition the operating winding of relay 124 is deenergized. With the marking battery 133 disconnected from the loop circuit, the circuit through the holding winding of relay 124 is interrupted so that the relay 124 releases its

armature 123 to remove its holding winding from the loop circuit, removes the holding ground from the selector magnet of printer 103 which prevented the printer from following the call destination indicator lamp operating oscillations of the line, and interrupts the circuit through the armature and back contact of relay 142 for energizing relay 137. Thus the relay 137 cannot become reenergized and the vibratory circuit system is disabled.

After holding break key 408 open for a sufficient length of time to cause the vibratory relay circuit to be disabled the operator transmits signals by means of keyboard transmitter 407 to instruct the attendant at station 11 to proceed with the transmission of the destination of the message to be transmitted from station 11. The attendant at station 11 thereupon operates keyboard transmitter 102 and transmits signals conveying the identity of the station that is being called. The station identification information is recorded by the operator's receiving printer 406. Assuming that the message destination information received from station 11 indicated to the operator that connection with station 15 is desired, the operator closes the uppermost key in the bank of keys 321, this key being identified by the reference numeral 350, to connect the communication conductor 353 of control circuit 24 to the hub circuit 303 and to operate relays in the control circuit 24 corresponding to the relays 202 and 231 in the control circuit 21. The control circuit 24 conditions the repeater 19 for message transmission between station 15 and the hub circuit 303 in accordance with half duplex principles and also prepares an energizing circuit for the disconnect relay in control circuit 24 corresponding to the disconnect relay 244 in control circuit 21. Following the closure of key 350 the operator operates keyboard transmitter 407 to instruct the attendant at station 11 to proceed with the transmission of the message.

If the message transmission from station 11 is to be accomplished by direct keyboard transmission the attendant proceeds to operate keyboard transmitter 102. If the message intended for station 15 has been perforated in a tape and the tape has been placed in tape transmitter 101 the attendant at station 11 may initiate the tape transmission by operating start key 153 which causes relay 151 to become energized and held over the previously identified locking circuit which it establishes. It will be understood that the message is not recorded at station 15 on the receiving-only printer 161 but is recorded by a printer corresponding to the receiving printer 103 at station 11.

At the conclusion of intercommunication between stations 11 and 15 the disconnect signal may be given from either station. In the event that the message is transmitted by tape transmitter 101 from station 11 and there is no occasion for station 15 to reply while the connection between the two stations is maintained, the blank signal combination may be included in the tape at the end of the message to cause the operation of selectable member 149 whereby contacts 147 are momentarily closed to effect the release of relay 151. If the message transmission is effected by operation of keyboard transmitter 102 the disconnect signal may be transmitted merely by opening break key 121 for an interval at least as long as a permutation code combination. This causes relay 208 in the control circuit 21 to operate electron discharge tube 222 and a correspond-

ing relay in control circuit 24 to operate a corresponding electron discharge tube in that control circuit. In the control circuit 21 relays 227 and 244 will be operated in succession to cause disconnect lamp 351 to be operated. In the control circuit 24, relays corresponding to the relays 227 and 244 will be operated to cause disconnect indicator lamp 354 associated with the bank of keys 321 to be operated. Thereupon the operator at the central office switching station will restore keys 311 and 350 to normal whereupon the relays in the control circuits 21 and 24 will be restored to normal.

In accordance with one contemplated adaptation of the system according to the present invention, traffic conditions are such that there is little or no occasion for communication between stations 15 and 16 due to the fact that the stations 15 and 16 may be located in different departments of a general office in a single geographical location. It is also contemplated that one of the other telegraph stations, such as the station 13, may be located at a general headquarters office of the system in a different geographical location from the stations 15 and 16 and also from the stations 11 and 12 and whereas a large percentage of the traffic from stations 11 and 12 and also of the traffic initiated by the station 13 may be intended for the station 16, a large percentage of the traffic initiated by the station 15 may be intended for the general headquarters office 13. With traffic conditions existing as outlined above, the operator at the central office switching station may be instructed that calls originating at the stations 11, 12 and 13 and indicated by steady illumination of the call destination indicator lamps 301, 323 and 324 indicate messages to be transmitted to the station 16 which may be completed by direct switching operations without answering to inquire as to the destination of the message to be transmitted. Similarly, the operator may be instructed that calls initiated by the station 15 represented by steady illumination of call destination indicator lamp may be switched directly to the general headquarters office station 13 without inquiry by the operator as to the destination. It will follow from this that calls initiated from any of the stations 11, 12, 13 and 15 evidenced by flashing of their call destination indicator lamps 301, 323, 324 and 326 are to be answered by the operator and inquiry made as to the destination of the call, the inquiry to be followed by operation of the proper station connecting keys after the call destination information has been received. It is to be understood that this operating routine is predicated upon the particular traffic conditions outlined and upon particular relationships of the stations from an organizational standpoint and that different traffic conditions or different organizational relations may render desirable the practice of different operating routines in response to steady or flashing operation of the several call destination indicator lamps.

As is fully disclosed in the hereinbefore identified patent of F. S. Kinkead et al. the operator's position apparatus includes keys 431 and 432 for setting up broadcast conditions upon selective or group basis to enable the operator to broadcast to certain ones or all of the telegraph stations. The key 431 provides for selective station broadcast and utilizes the second or lower conductor of one or more of the hub circuits in cooperation with a line key of each of the stations to which the message is to be broad-

cast to effect the energization in the control circuits of the selected stations of the relays corresponding to the relay 231 in the control circuit 21 without effecting the energization of the cut-through relay 202, since the latter relay may remain in the normal or deenergized condition for transmission to the telegraph station 11 associated therewith.

Upon the closure of key 431 ground is connected through the key and through conductor 433 to the left-hand spring of each of the keys 342 to 348 by which the operator's position apparatus may be connected to the hub circuit. Assuming that the operator closes key 342, the ground from selective broadcast key 431 will be connected to the lower of the hub circuit conductors 303. Assuming also that telegraph station 11 is one of those to which the operator wishes to broadcast, the key 311 will be closed and, whereas in the previous description of intercommunication between station 11 and one of the other stations, the conductors 328 and 329 were merely connected together at the key 311, both of those conductors will be grounded at the key 311 due to the fact that the lower of the conductors of hub circuit 303 is grounded. Conductor 328 extends through the winding of cut-through relay 202 and through the back contact and inner right-hand armature of relay 228 to ground so that the relay 202 will not be energized. Conductor 329 extends through the back contact and inner left-hand armature of relay 228 and the circuit continues through resistor 242, conductor 243, winding of relay 231 and conductor 224 to grounded battery 226 whereby the relay 231 will be energized independently of the relay 202.

The communication circuit is completed from the operator's position over the upper conductor of the hub circuit 303 and through communication conductor 327, back contact and outer left-hand armature of relay 228, conductor 241, right-hand armature and back contact of relay 202 to conductor 201 which extends to repeater 14. Thus the operator may transmit to station 11 but station 11 may not transmit to the hub circuit 303 because the circuit of the transmitting armature of relay 131 is opened at the front contacts of relay 202. If the station 11 interferes with the reception of the broadcast material by opening the loop circuit either by means of the break key 121 or by one of the call initiating keys 122 or 136, the relay 208 of the control circuit will respond and will operate the timing circuit of electron discharge tube 222 to effect the operation of relay 227. This will not cause the call indicator lamp of station 11 to be operated but will cause the disconnect indicator lamp to be operated, because the relay 231 has been operated and has interrupted the energizing circuit for the relay 218 and has prepared the energizing circuit for the disconnect relay 244. The operation of the disconnect indicator lamp will inform the operator that station 11 has interfered with the reception of the broadcast material and this may be employed for the purpose of indicating to the operator that the station 11 has a message of extreme urgency awaiting transmission which would justify the operator in interrupting the broadcast transmission and delaying it until station 11 has had an opportunity to transmit the urgent message.

At the conclusion of the selective broadcast transmission the operator opens key 431, key 342 and key 311 and any others, such as the keys

311 to 317 or any of the keys in the key banks 318, 319, 321 or 322, which may have been operated to include stations in the broadcast. The opening of the switching key 311 will cause the relay 231 to be released and this relay will in turn release relay 244 if that relay had been operated. Similarly, the relay corresponding to the relay 231 in all of the control circuits which had participated in the broadcast transmission will be released.

Group broadcasting contemplates that permanent connections shall exist between certain or all of the control circuits shown in Fig. 2 and apparatus at the operator's position so that direct transmission from the operator's position to certain or all of the telegraph stations may be accomplished without operating the line keys in the switching apparatus. Group broadcasting is initiated by closure of key 432 which grounds one terminal of the winding of relay 434, the other terminal of which is connected to grounded battery 416. Upon the energization of relay 434 the middle armature engages its grounded front contact to complete the circuit from ground over conductor 436, winding of relay 228, conductor 249, back contact and outer left-hand armature of relay 231 if broadcasting is on a nonseizure basis, otherwise through a conductor represented by the dotted line shunting the back contact and outer left-hand armature of relay 231 when broadcasting is on a seizure basis, and conductor 224 to grounded battery 226. The uppermost armature and front contact of relay 434 completes a signal transmission path from the transmitting armature of the operator's transmitting relay 419 over conductor 418, conductor 437, front contact and uppermost armature of relay 434, conductor 438, front contact and outer left-hand armature of relay 228 which is now energized, conductor 241, right-hand armature and back contact of relay 202 to conductor 201 which extends to repeater 14. Thus a transmission path is extended from the operator's position directly to the station 11 without operating any of the keys 311 to 317. It is to be noted in Fig. 2 that branch conductors extend from the conductors 436 and 438 to other control circuits for operating the broadcast relays in those circuits and for extending the direct transmission path from the operator's set.

The relay 228, upon being energized, accomplishes certain results other than the transfer of the communication channel extending to a telegraph station, such as the station 11, from the line keys directly to the operator's set. The inner left-hand armature opens at its back contact the energizing circuit for the relay 231 so that that relay cannot become energized even if a line key for a station included in the group broadcast should be closed. The inner right-hand armature of relay 228 prepares a holding circuit for disconnect relay 244 from the grounded armature and front contact of relay 228 over conductor 251 to the left-hand armature of relay 244. This provision is made for preparation of a holding circuit for relay 244 because relay 231 which normally prepares a holding circuit for relay 244 is at this time deenergized. At the middle right-hand armature and front contact of relay 228 an energizing circuit is prepared for the disconnect relay 244 directly to the conductor 247 and not through the conductor 229 and inner left-hand armature of relay 231 since that relay is at this time deenergized. The extreme right-hand armature of relay 228 interrupts a conductive path which extends from its back contact through the

conductor 229, inner left-hand armature and back contact of relay 231 which is now deenergized and conductor 232, which path extends through the call destination indicator lamp 301 and winding of call initiating relay 218 to grounded battery 226. Thus, the broadcast relay 228 prepares conditions for the operation and holding of relay 244 similar to the preparations made by relay 231 in connection with selective broadcast so that if a telegraph station to which broadcast signals are being transmitted interferes with the reception of the signals such interference will be evidenced by operation of the disconnect indicator lamp pertaining to that station and not by the call destination indicator lamp.

Assuming that not all of the telegraph stations are arranged for group broadcast reception, there may be circumstances under which it is desirable to add a particular station or stations for reception of broadcast messages along with a group. Provision is made for this by the grounded innermost armature of relay 434, the front contact of which is connected to conductor 433. The grounded armature thus extends ground connection to the left-hand springs of all of the keys 342 to 348 and by the closure of one or more of these keys hub circuits may be conditioned for broadcast transmission in the same manner as is contemplated by the selective broadcast key 431. Any stations not included in the group broadcast arrangement may be added selectively to receive the group broadcast transmission by operating their line keys to connect them to the hub circuit or circuits which have been prepared by operation of one or more of the keys 342 to 348. The ground afforded by the inner armature of relay 434 will then complete a circuit over conductors corresponding to the conductor 329 to energize in the control circuits of the stations that are to be added to the broadcast transmission, relays corresponding to the relay 231 to prepare the energizing and holding circuits for the disconnect relays in those control circuits and to interrupt the energizing circuits for the call initiating relays in those control circuits. As in the case of pure selective broadcast service, any interference with the reception of broadcast material at a station which is added selectively to a group broadcast transmission will be evidenced by operation of the disconnect lamp associated with that station.

Group broadcast transmission may be terminated by opening key 431, which will release the relays corresponding to the relay 228 in the control circuits that are associated with the group broadcast and by opening those of the keys 342 to 348 and the line keys that were operated to add selectively certain stations to the broadcast service. The opening of those switching keys will release the relays corresponding to the relay 231.

Although a particular embodiment of the invention has been shown in the drawings and described in the foregoing specification, it is to be understood that the invention is not limited to such specific embodiment but is capable of modification and rearrangement without departing from the spirit of the invention and within the scope of the appended claims.

What is claimed is:

1. In a telegraph system, a plurality of stations of one class, at least one station of another class, a switching mechanism, a communication channel extending from each of said stations to said switching mechanism, means in said switching

mechanism for interconnecting any two of said stations, a call indicator at said switching mechanism associated with the communication channel of each of the stations of said one class, and means at each of the stations of said one class for actuating its indicator according to one characteristic to indicate the message destined for another station of the same class and for actuating its indicator according to another characteristic to indicate a message destined for a station of said other class.

2. In a telegraph system, a plurality of stations of one class, at least one station of another class, a switching mechanism, a communication channel extending from each of said stations to said switching mechanism, means in said switching mechanism for interconnecting any two of said stations, a call destination indicator lamp at said switching mechanism associated with the communication channel of each of the stations of said one class, and means at each of the stations of said one class for causing its call destination indicator lamp to be operated uninterruptedly to indicate a message destined for a station of one of the classes and for causing its indicator lamp to be operated intermittently to indicate a message destined for a station of the other of the classes.

3. In a telegraph system, a plurality of stations of one class, at least one station of another class, a switching mechanism, a communication channel extending from each of said stations to said switching mechanism, means in said switching mechanism for interconnecting any two of said stations, a call destination indicator at said switching mechanism associated with the communication channel of each of the stations of said one class, means local to the switching mechanism for rendering each call destination indicator responsive to the condition of its associated communication channel, means at each of the stations of said one class for initiating the operation of the call destination indicator associated with its communication channel and for establishing a steady condition of said channel, and alternatively operable means at each of the stations of said one class for initiating the operation of the call destination indicator associated with its communication channel and for establishing a variable condition of said channel.

4. In a telegraph system, a plurality of stations of one class, at least one station of another class, a switching mechanism, a communication channel extending from each of said stations to said switching mechanism, means in said switching mechanism for interconnecting any two of said stations, a call destination indicator at said switching mechanism associated with the communication channel of each of the stations of said one class, means local to said switching mechanism for causing each of said call destination indicators to operate in accordance with the condition of the communication channel associated therewith, means at each of the stations of said one class for momentarily changing the condition of the communication channel associated therewith and for restoring said channel to normal condition for causing its call destination indicator to be set in operation and to operate steadily, and alternatively operable means at each of the stations of said one class for causing continuous alternation of the condition of the communication channel associated therewith to cause intermittent operation of its call destination indicator.

5. In a telegraph system, a plurality of stations of one class, at least one station of another class, a switching mechanism, a communication channel normally in marking condition extending from each of said stations to said switching mechanism, means in said switching mechanism for interconnecting any two of said stations, a call destination indicator at said switching mechanism associated with the communication channel of each of the stations of said one class, means local to the switching mechanism for setting in operation each of said call destination indicators, and for rendering it operable in accordance with the condition of its associated communication channel, means at each of the stations of said one class for momentarily changing its associated communication channel to spacing condition, and for restoring the communication channel to marking condition to cause its call destination indicator to be set in operation and to operate steadily, and alternatively operable means at each of the stations of said one class for steadily alternating its associated communication channel between marking and spacing conditions to cause its associated call destination indicator to be set in operation and to operate intermittently.

6. In a telegraph system, a plurality of stations of one class, at least one station of another class, a switching mechanism, a communication channel extending from each of said stations to said switching mechanism, means in said switching mechanism for interconnecting any two of said stations, a call destination indicator at said switching mechanism associated with the communication channel of each of the stations of said one class, means local to said switching mechanism for conditioning each of said call destination indicators to be operated and for rendering said indicators operable according to the conditions of their communication channels, means at each of the stations of said one class for operating said indicator conditioning means and for establishing a steady condition of its associated communication channel, alternatively operable means at each of the stations of said one class for operating said indicator conditioning means and for establishing a fluctuating condition of its communication channel, and means associated with said switching mechanism for terminating the operation of said indicators and for disabling said line condition fluctuating means.

7. In a telegraph system, a central office station including switching apparatus, a plurality of remote stations, a communication channel connecting each of said stations to said switching apparatus, storage type telegraph signal transmitters at said remote stations, indicator means local to the switching apparatus and associated with said communication channels, means at said stations for operating the indicators associated with their respective lines according to one characteristic to indicate a destination of a message to be transmitted from said station and for operating said indicator according to another characteristic for indicating another destination of a message to be transmitted from said station, and means in said switching apparatus for setting in operation the storage transmitter at any station which has actuated its message destination indicator.

8. In a telegraph system, a central office station including switching apparatus, a plurality of remote stations, a telegraph transmitter at each

of said stations, means for storing signals to be transmitted by said transmitters, a communication channel connecting each of said stations to said switching apparatus, indicator means local to the switching apparatus and associated with said communication channels, means at said remote stations for operating the indicators associated with their respective lines according to one characteristic to indicate a destination of a message to be transmitted from their transmitters and for operating said indicators according to another characteristic for indicating another destination of a message to be transmitted from their transmitters, means at each of said stations controlled by said switching apparatus for starting its transmitter, and means associated with each transmitter and controlled thereby for stopping the transmitter at the end of transmission of the signals contained in said signal storing means.

9. In a telegraph system, a central office station including switching apparatus, a plurality of remote stations, a stored signal transmitter at each of said remote stations, a communication channel connecting each of said remote stations to said switching apparatus, call destination indicator means local to the switching apparatus and associated with said communication channel, means at said remote stations for operating the indicators associated with their respective communication channels according to one characteristic to indicate a destination of a message to be transmitted from their transmitters and for operating said indicators according to another characteristic for indicating another destination of a message to be transmitted from their transmitters, a disconnect indicator for each of said communication channels in said switching apparatus, means at each of said remote stations controlled by said switching apparatus for starting the stored signal transmitter, means controlled by said transmitter for stopping said transmitter at the conclusion of transmission of stored signals, and means controlled by the transmitter for operating said disconnect indicator.

10. In a telegraph system, a plurality of stations of one class, a station of another class, a switching mechanism, an operator's answering apparatus associated with said switching mechanism, a communication channel extending from each of said stations to said switching mechanism, means in said switching mechanism for interconnecting any two of said communication channels, a call destination indicator at said switching mechanism associated with the communication channel of each of the stations of said one class, and means at each of the stations of said one class for actuating its indicator according to one characteristic to direct operation of said switching mechanism to interconnect a station of said one class with the station of the other class and for actuating its indicator according to another characteristic to direct operation of said switching mechanism to connect said operator's answering apparatus to a station of said one class for receiving call destination information.

11. In a telegraph system, a first telegraph station including a code transmitting device, a second telegraph station, a communication channel interconnecting said stations, means at said first station for automatically impressing ultra-code signaling conditions continuing throughout an interval of indeterminate duration on said channel independently of said code transmitting

device, and means at said second telegraph station for causing said ultra-code signaling conditions to be terminated.

12. In a telegraph system, a first telegraph station including a code transmitting device, a second telegraph station, a normally closed communication channel connected to said first station, a channel connected to said second station, two-way repeater means interconnecting said channels, means at said first station for automatically opening and closing the communication channel associated with said first station in ultra-code manner repetitiously independently of said code transmitting device, and means at said second station for transmitting over said channels and repeater to said first station a signaling condition to terminate operation of said automatically operable channel opening and closing means.

13. In a telegraph system, a telegraph station including a code transmitting device and a receiving device, a communication channel connected to said station, means at said station for automatically impressing signaling conditions on said channel independently of said code transmitting device, and means controlled by said last-mentioned means for rendering said receiving device unresponsive to said signaling conditions.

14. In a telegraph system, a telegraph station including a code transmitting device and a receiving device, a communication channel connected to said station, means at said station for automatically impressing signaling conditions on said channel independently of said code transmitting device, and means controlled by said last-mentioned means and effective continuously during the operation thereof for disabling said receiving device.

15. In a telegraph system, a telegraph station including a code transmitting device and a receiving device, a normally closed communication channel connected to said station, a pair of relays each having means for closing and opening the energizing circuit for the other, manually operable means for closing the energizing circuit of one of said relays, and means controlled by said one relay when it is energized for opening said communication channel to establish an off-normal signaling condition independently of said code transmitting device.

16. In a telegraph system, a telegraph station including a code transmitting device and a receiving device, a normally closed communication channel connected to said station, a first relay, manually operable means for completing the energizing circuit of said relay, a second relay energizable under the control of said first relay, means controlled by said second relay for completing the energizing circuit of said first relay, means controlled by said first relay for opening said normally closed communication channel, and means responsive to opening of said channel independently of said last-mentioned means for depriving said second relay of control over the energizing circuit of said first relay.

17. In a telegraph system, a telegraph station including a code transmitting device and a receiving device, a central office switching station, a normally closed communication channel interconnecting said stations, means at said telegraph station for automatically opening and closing said channel repetitiously, manually operable means at said telegraph station for setting in operation said automatic line opening and closing means, a relay at said central office switching station

operable in response to opening of said communication channel, a second relay controlled by said relay having in series with the energizing circuit thereof an indicator lamp, means for completing a holding circuit for said second relay, and means controlled by said second relay for preparing a substitute energizing circuit for said second relay to be completed by said first relay in short-circuiting relation to said indicator lamp in response to the repetitious opening of said communication channel.

18. In a telegraph system, a first station, a second station, a communication channel interconnecting said stations, a call indicator at said second station, relay means at said second station responsive to signals generated at said first station, timing means controlled by said relay means and operable after a predetermined interval of maintenance of a predetermined condition of said relay means, second relay means associated with said call indicator and operable with said call indicator by said timing means, and means operable by said second relay for placing said call indicator under the control of said first-mentioned relay means.

19. In a telegraph system, a first station, a second station, a communication channel interconnecting said stations, a call indicator lamp at said second station, relay means at said second station responsive to signals generated at said first station, timing means controlled by said relay means and operable after a predetermined interval of off-normal condition of said relay means, second relay means energizable in series with said indicator lamp under the control of said timing means, means associated with said second relay means for establishing a holding circuit therefor including said indicator lamp, and means also associated with said second relay means for establishing a substitute holding circuit therefor in short-circuiting relation to said indicator lamp under the control of said first-mentioned relay means whereby to cause said indicator lamp to operate in accordance with the signal responsive operation of said first-mentioned relay means.

20. In a telegraph system, a central station, a plurality of outlying stations, telegraph lines extending from said central station to said outlying stations, call indicators associated with said lines at said central station, disconnect indicators associated with said lines at said central station, means for establishing communicative connection between said central station and a plurality of said lines on selective basis or fixed group basis, and means controlled by said last-mentioned means for rendering only said disconnect indicator operable in response to call initiating operations at said outlying stations.

21. In a telegraph system, a central station, a plurality of outlying stations, telegraph lines extending from said central station to said outlying stations, call indicators associated with said lines at said central station normally responsive to call initiating operations at said outlying stations, disconnect indicators associated with said lines at said central station normally responsive to disconnect signals transmitted from said outlying stations, means for establishing communicative connection between said central station and a plurality of said lines on selective basis or fixed group basis, and means controlled by said last-mentioned means for rendering only said disconnect indicators operable in response to call initiating operations at said outlying stations.

22. In a telegraph system, a central station, a plurality of outlying stations, telegraph lines extending from said central station to said outlying stations, call indicators associated with said lines at said central station normally responsive to call initiating operations at said outlying stations, disconnect indicators associated with said lines at said central station normally responsive to disconnect signals transmitted from said outlying stations, means for establishing communicative connections between said central station and the plurality of said lines on selective basis or fixed group basis for signal transmission from said central station to said outlying stations only, and means controlled by said last-mentioned means for rendering only said disconnect indicators operable in response to call initiating operations at the stations so connected.

23. In a telegraph exchange system, a central office station, a plurality of remote stations, a communication channel extending from each of said remote stations to said central office station, means at said central office station for interconnecting any two of said channels, means associated with all but one of said channels at said central office station for indicating a message destined for said one channel and for indicating a message destined for any other of said channels, and means at all of said remote stations except the station associated with said one channel for selectively causing its indicating means at said central office to produce either of said indications.

24. In a telegraph exchange system, a central office station having a teletypewriter set, a plurality of remote stations each having a teletypewriter set, a communication channel extending from each of said remote stations to said central office station, switching means at said central office station for connecting the teletypewriter set thereat to any of said channels and for interconnecting any two of said channels, means associated with all but one of said channels at said central office station for indicating a message destined for said one channel and for indicating a message destined for any other of said channels or said teletypewriter set at said central office station, and means at all of said remote stations except the station associated with said one channel for selectively causing its indicating means at said central office station to produce either of said indications.

25. In a telegraph exchange system, a central office station having a teletypewriter set, a plurality of remote stations each having a teletypewriter set, a communication channel extending from each of said remote stations to said central office station, manually operable switching means at said central office station for connecting the teletypewriter set thereat to any of said channels and for interconnecting any two of said channels, means associated with all but one of said channels at said central office station for indicating a message destined for said one channel and for indicating a message destined for any other of said channels or said teletypewriter set at said central office station, and means at all of said remote stations except the station associated with said one channel for selectively causing its indicating means at said central office station to produce either of said indications.

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