

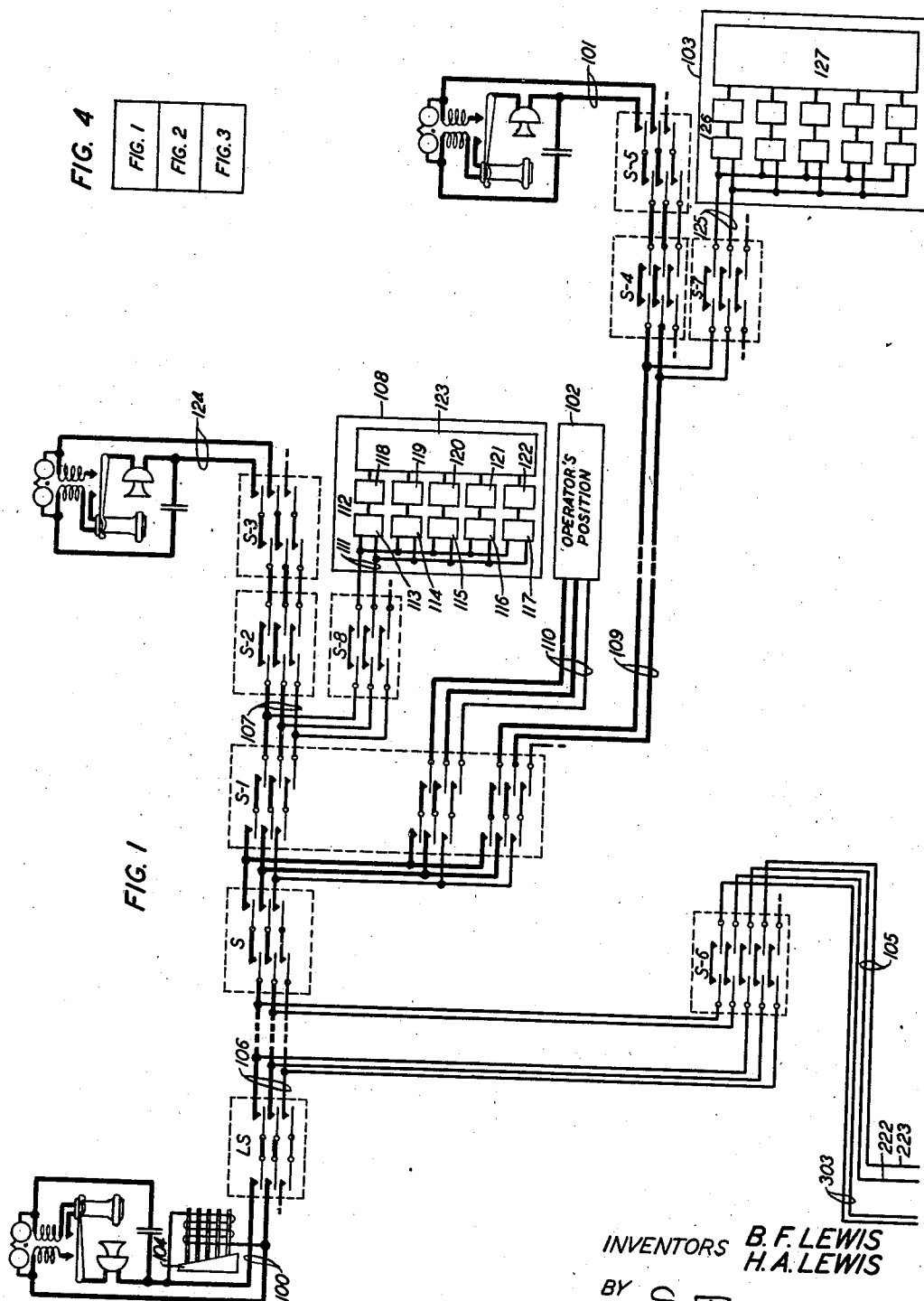
Jan. 13, 1942.

B. F. LEWIS ET AL
TELEPHONE SYSTEM

2,269,462

Filed June 21, 1940

3 Sheets-Sheet 1



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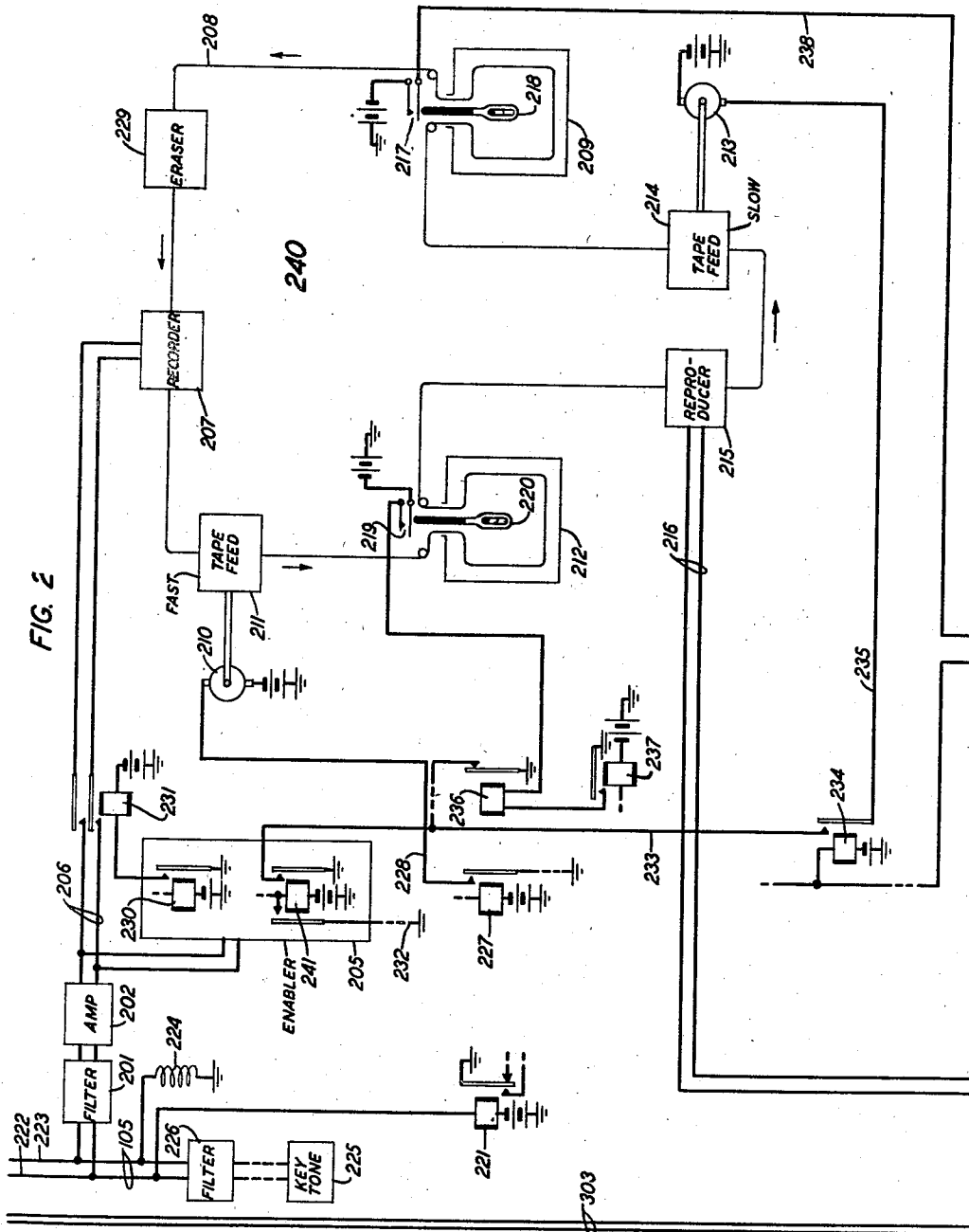
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3 Sheets-Sheet 2



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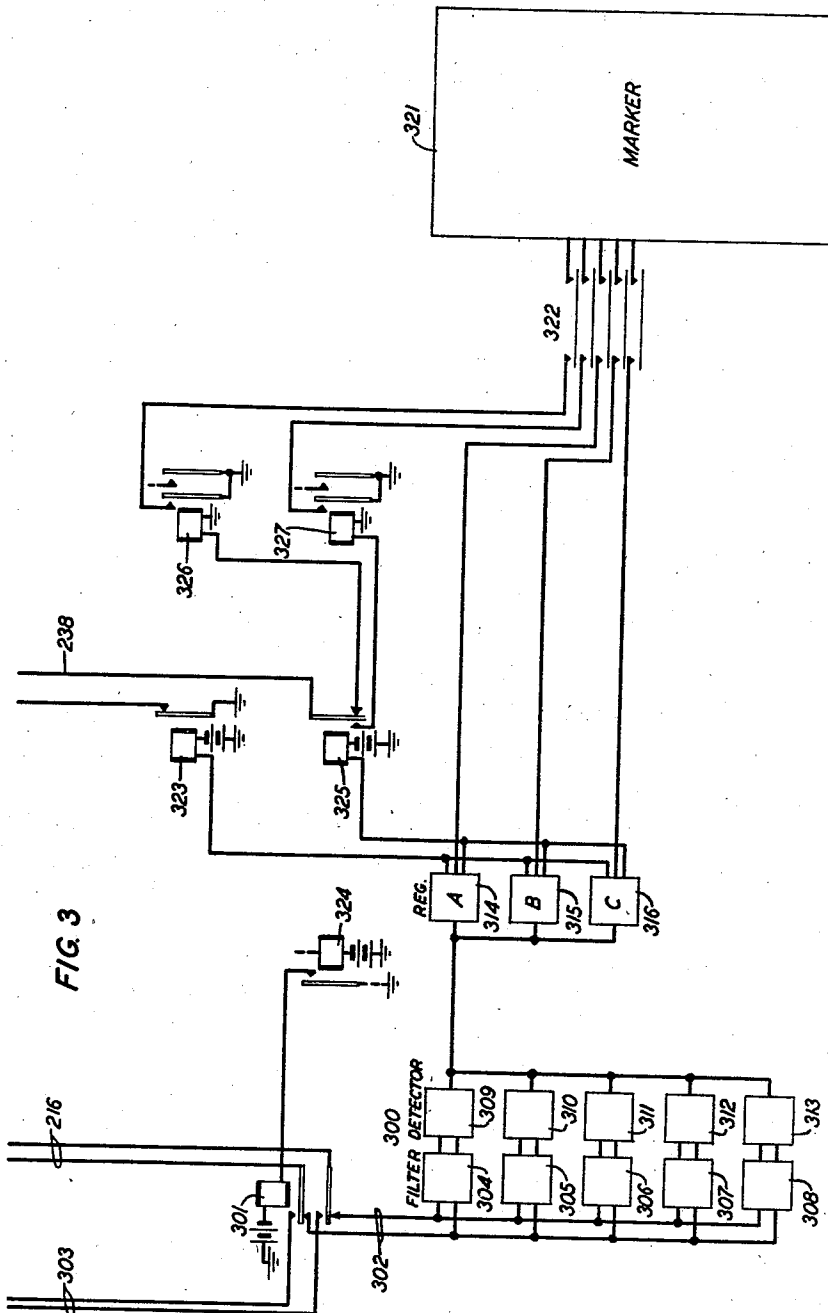
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TELEPHONE SYSTEM

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UNITED STATES PATENT OFFICE

2,269,462

TELEPHONE SYSTEM

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Application June 21, 1940, Serial No. 341,631

14 Claims. (Cl. 179—18)

This invention relates to telephone systems and particularly to systems in which automatic switching devices are used in the establishment of connections.

The objects of the invention are to facilitate the transmission and utilization of telephone designations; to increase the speed with which these designations may be transmitted from one station and recorded at another; to simplify the process of retransmitting recorded designations for further recording; and in other respects to effect improvements in systems of the character above noted.

It has already been proposed to facilitate the acts of a subscriber in sending the wanted telephone numbers by providing his station with push buttons instead of a dial. These push buttons pluck vibratory reeds which send alternating currents to the central office, each digital character usually being represented by a code of two or more frequencies transmitted simultaneously. At the central office the component frequencies of each digit are separated by selective filters and utilized to operate digit registers. The registration thus established on the digit registers is then used to control the selective operation of the automatic switches to set up the desired connection in the central office. Such a system expedites the completion of connections in the local office. However, many calls initiated by a calling subscriber must be extended to distant offices for completion to the called lines. And in these prior systems, in which frequency codes are sent from the subscriber's station and registered in the originating office, usually on registers of the relay or stepping switch type, the selective operation of the switches in the distant called office is controlled by direct-current impulses transmitted from one office to the other in accordance with the setting of said registers.

According to the present invention the advantage of using codes of alternating current frequencies for sending telephone designations is applied not only to the transmission from the subscriber's station to the central office but also to the transfer of the designation from one office to another when interoffice connections are required. More specifically the office code and numerical digits of a wanted line designation are transmitted in succession from the calling station to the central office by frequency codes, and the alternating currents comprising these codes are recorded directly upon a magnetic tape or wire. The office code recorded on the tape is

utilized immediately to control the automatic switches to extend the connection, either to other automatic switches in the same office if the call is a local one, or over an outgoing trunk if the call is intended for a distant office. When the call is a local one, the numerical part of the designation recorded on the tape is transferred to switch-controlling registers in the local office which serve to control the remaining automatic switches therein to complete the connection. However, if the call is for a distant office, the numerical designation recorded on the magnetic tape is reproduced and transmitted over the interoffice trunk to the distant office as alternating current signals in codes of frequencies corresponding to those originally transmitted from the subscriber's station. At the distant office they are received by switch-controlling registers, utilized to control the switches therein to complete the desired connection.

A particular advantage of the invention is that the senders in both originating and terminating offices may be designed to receive the same kind of designation signals for controlling the switches in their respective offices. Also, as above noted, the advantage inherent in the use of alternating currents for signal transmission is extended to the transfer of the designation from one office to another, the trunks interconnecting them oftentimes being of considerable length.

Another feature of the invention is a designation recording system in which the movement of the recording tape or similar medium is utilized to detect the presence of a permanent signal on a subscriber's line and to route the line automatically to a service operator's position.

A further and related feature is a recording system in which the movement of the recording tape is utilized to cause the automatic routing of a line to an operator's position in the event the subscriber fails to complete his transmitting operation.

These and other features of the invention will be discussed more fully in the following detailed specification.

In the drawings accompanying the specification, Figs. 1, 2 and 3, when arranged in the order illustrated in Fig. 4, disclose an automatic telephone system incorporating features of the invention.

Fig. 1 shows a calling subscriber's line appearing in a local central office and having access through automatic switches therein to local called subscribers' lines and to operators' posi-

tions. This figure also shows the switches and equipment in a distant office over which calls from the local office may be completed to subscribers' lines in said distant office.

Figs. 2 and 3 show a common recording sender and a common switch-controlling marker in the local automatic office. Fig. 2 illustrates the signal receiving equipment in the sender including a magnetic signal recording device, and Fig. 3 shows the designation registers for controlling the selective operation of the switches. This figure also illustrates diagrammatically one of the switch-controlling markers.

The subscribers' lines, including the line 100, appear in line switches LS in the local office. These line switches are joined to first or district selector switches S by means of link circuits or junctors 106. The district selectors S have access to office selectors S—1 through interconnecting junctors. The office selectors S—1 have access to trunks 107 extending to the local switching equipment, including incoming selectors S—2 and final selectors S—3 for completing calls in the same office. Also the office selectors S—1 have access to trunks 109 extending to distant offices for completing interoffice calls. The particular trunk 109 illustrated in the drawings terminates in an incoming selector switch S—4 in the distant office, which has access through a final selector switch S—5 to a called line 101. Furthermore, the office selector switch S—1 in the local office has access to operators' positions, such as the position 102. The link circuit 106 interconnecting the line switch LS and selector S appears in a sender selector S—6 which serves to select and make connection with an idle recording sender. The local trunks 107 extending to the incoming selectors S—2 also have access through sender selector switches S—8 to terminating senders in the local office, such as the sender 108.

At the distant office the incoming end of the trunk 109 also appears in a sender selector switch S—7 which serves to associate the trunk with an idle incoming recording sender 103. The distant office will also be provided with markers which cooperate with the recording senders for controlling the incoming and final switches S—4 and S—5 to complete the connection to the called subscriber's line.

Although the invention is not so limited it has been assumed for the purpose of the present disclosure that switches of the cross-bar type are used and that the operation of these switches is controlled by recording senders and common markers.

It is also assumed that the system disclosed herein is arranged for the transmission of telephone designations in the form of alternating currents of different frequencies, each of the several digital characters of a designation being represented by a particular combination of frequencies. For example, if five different frequencies are employed, each digital character may be represented by a combination of two of the five frequencies. In order that these designation signals may be transmitted over a subscriber's line to the central office, the substation is equipped with a transmitter of any suitable type which the subscriber may manipulate to send the successive signals, two frequencies at a time, characterizing the wanted designation. A reed type of sender in which the manipulation of keys by the subscriber plucks the reeds to generate alternating currents is suitable for this purpose, and one of these transmitters 104 is illus-

trated at the substation of line 100. A transmitter of this type is disclosed and described in the patent to R. F. Mallina, No. 2,147,710 of February 21, 1939.

At the central office the recording sender is arranged to receive and record the alternating current signals transmitted over the subscriber's line and to utilize the recorded signals either for completing the connection to a subscriber's line in the local office or for extending the line over an interoffice trunk to a distant office and then transmitting over the extended connection that part of the recorded designation which is necessary for controlling the operation of the switches in the distant office to further extend the connection toward the desired line. The alternating current signals incoming from the subscriber's line pass through the sender selector switch S—6 and over the signaling circuit to the sender where they are selected by a band-pass filter 201. After passing through the filter 201 the signal currents are amplified by an amplifier 202 and delivered to the output circuit 206. Some of the output energy from the amplifier is applied to an enabling device 205. The enabler 205 serves to extend the output circuit 206 to the recording unit 207 of a magnetic recording mechanism 240. Generally speaking, the function of the enabling device 205 is to respond to the incoming signals and to prepare a circuit at the proper time for delivering these signals to the recorder and to maintain the prepared circuit for the necessary period of time. Since the specific structure of the enabler is not necessary to an understanding of the present invention, it has been shown in diagrammatic form. For a complete description of the manner in which apparatus of this kind functions, reference may be had to the patent to A. A. Lundstrom, 2,237,742 of April 8, 1941.

The magnetic recording mechanism 240 of the sender includes a movable wire or tape 208, a substantial portion of which is normally stored in the container 209. When the recorder is taken in use, the driving motor 210 is started, and the feed mechanism 211 drives the tape in the direction indicated by the arrows, withdrawing it from the supply container 209 and advancing it through the recording unit 207 to the second storage container 212. As the tape passes through the recording unit 207 it is magnetized in accordance with the incoming signals to record both the office and numerical designations, and the magnetized tape is then stored in the container 212. The areas of permanent magnetism thus produced in the tape are retained until they have served their purpose and have been erased as will be described hereinafter.

During the time the incoming signals are being received a second driving motor 213 is operated to drive a second tape feed mechanism 214. This second mechanism operates the tape at a speed somewhat slower than the operating speed of the feed mechanism 211. The function of the feed mechanism 214 is to withdraw the prepared tape from the container 212, move it through the reproducing unit 215, and return it to the storage container 209. As the magnetized tape passes through the reproducing unit 215 the recorded signals are reproduced in their original form, whereupon alternating current signals representing the office code designation are transmitted over the circuit 216 to the signal receiver 300 of the sender. The office code signals flowing in the common input circuit 302 are applied to the channel filters 304, 305, 306, 307 and 308. Since

the speed of the feed device 214 is somewhat slower than that of feed device 211, the frequencies of the reproduced signals are correspondingly lower than the frequencies of the original signals sent from the substation. The filters 304, 305, 306, 307 and 308 are, therefore, tuned to select the five reproduced frequencies, respectively. The output circuits of these filters lead to signal detectors 309, 310, 311, 312 and 313, and the currents passing these detectors are utilized to operate the office code registers 314, 315 and 316.

As soon as the office code is registered on the registers 314, 315 and 316, the sender seizes an idle marker 321 through the marker connector 322, and the office code is transferred to the marker. Thereupon the marker associates itself in the well-known manner with the district and office switches S and S-1 and operates these switches to seize either a local trunk 107 extending to the local incoming selector S-2 or an interoffice trunk 109 extending to the distant office, depending upon the nature of the office code. If the call is a local one, the seizure of trunk 107 causes the operation of sender selector S-8 to associate an idle terminating sender 108. Similarly if the call is destined for the distant office illustrated, the seizure of trunk 109 causes the operation of sender selector S-7 in the distant office to seize an idle incoming sender 103.

Following the operation of the district and office switches S and S-1 to seize either the local or the interoffice trunk and as soon as all of the numerical digits have been received from the calling line and recorded on the tape 208, the feed device 214 is again started in operation to transfer the numerical designation signals from the tape directly to the receiving circuit of the local incoming sender 108, in the event of a local call, or to the receiving circuit of the distant incoming sender 103 in the event of an interoffice call.

The advantages of this system of recording and utilizing designations for switch-controlling purposes will now be understood more clearly from the foregoing discussion. These designations are transmitted over the subscriber's line in the form of alternating currents. The frequencies of these currents are selected within the voice frequency range in order to take full advantage of the transmission characteristics of the line. They are recorded directly on a magnetic medium in the originating sender, and the office code portion of the designation is immediately translated into office code registrations on registers of the usual type, such as relay registers, to extend the connection to a terminating sender either in the local office or in a distant office. Thereupon the recorded alternating current signals representing the numerical designation are reproduced and transmitted directly from the originating sender to the terminating sender. Here they are received and translated into registrations on registers of the usual type for the purpose of completing the desired connection. By using a magnetic recording medium from which the recorded signals may be readily reproduced in their original form it is possible to obtain the advantages incident to the use of alternating current signals in the voice frequency range for transferring the designations from one sender to another over trunks which may extend to considerable distances. Moreover the same type of receiving circuit may be used in both local and interoffice incoming senders.

It was mentioned above that the feed mecha-

nism 211 drives the tape 208 at a greater speed than the feed mechanism 214. This speed differential may be selected with respect to the amount of tape normally stored in the container 209 such that the supply in said container is always sufficient for the normal holding time of the sender. In other words, if the call proceeds normally, the sender will have completed its functions and released before the supply of tape in the container 209 is exhausted. However, if the feed mechanism 211 is set in motion and the mechanism 214 fails to start thereafter or if both mechanisms are permitted to run simultaneously for a period of time in excess of the predetermined holding time of the sender, the supply of tape in the container 209 becomes exhausted. The depletion of the tape supply in container 209 may indicate either that the subscriber's line has a permanent signal condition thereon or that the subscriber has failed to complete the sending operation. To detect this condition the container 209 is provided with any suitable mechanism for closing the circuit contacts 217. As illustrated the tape engages a plunger 218 when the tape supply runs low, and the upward movement of the plunger closes the contacts. The closure of these contacts may be utilized to operate a routing relay, the function of which is to cause the sender and marker to extend the subscriber's line over the district and office switches and over a service trunk 110 to an operator's position 102.

The container 212 is also provided with a set of contacts 219 and an operating plunger 220. The purpose of these contacts is to stop the drive mechanism 214 when the tape has all been transferred from the storage container 212 to the container 209 following the use of the recorder.

It was noted above that the switches are assumed to be of the cross-bar type. Since these switches are well known in the art it is not considered necessary to disclose them in detail. Likewise the common controlling senders and the common markers are illustrated largely in diagrammatic manner, many of their details being omitted for the sake of clearness. For a better understanding of the principles of the cross-bar system and the details of operation, reference is made to the following: Carpenter Patent No. 2,089,921 of August 10, 1937; Carpenter Patent No. 2,093,117 of September 14, 1937; and Carpenter Patent No. 2,235,803 of March 18, 1941. Also reference is made to the patent to Lundstrom et al. No. 2,201,296 of May 21, 1940, for an understanding of the manner in which the incoming code signals of alternating currents are received by the filter-detector circuits of the senders, such as receiver circuit 300, and transferred to the registers, such as the office code registers 314, 315, and 316.

While the magnetic recorder illustrated herein uses a tape or wire of magnetic material it will be understood that any suitable form of magnetic medium may be employed, such as magnetic discs and cylinders.

The detailed operation of the system will now be described. When a call is initiated on one of the subscribers' lines, such as line 100, the line switch LS and the sender selector switch S-6 are operated to extend the calling line over the junctor 106 to the district selector S and also to the idle sender disclosed in Figs. 2 and 3. The seizure of the idle sender results in the establishment of a signaling and controlling circuit 105 which may be traced from battery through the winding of control relay 221, over conductor

222, through the sender selector S—6 and the line switch LS over the loop of the line 100 and returning through the line switch and sender selector connector 223 through the winding of reactance coil 224 to ground. Seizure of the sender also results in the closure of a circuit from the tone source 225 through the filter 226 to the signaling circuit 105. The current passed by the filter 226 flows over the subscriber's line and produces a tone in his receiver which he recognizes as a signal that the equipment is now ready to receive the wanted designation. Furthermore, the seizure of the sender results in the operation of a control relay 227 and the closure of a circuit from ground through the contacts of said relay over conductor 228 through the motor 210 to battery. The motor 210 operates feed mechanism 211, and the tape 208 is drawn from the supply container 209 through the eraser 229, which neutralizes all previously magnetized areas, and through the recording unit 207 into the container 212.

The subscriber transmits the wanted designation by manipulating the reed transmitter 104 to send the three successive characters of the office code followed by the four successive characters representing the number of the called line. The alternating current signals representing these designation characters are passed by the filter 201, amplified by the amplifier 202 and delivered to the output circuit 206. Each signal passing through the amplifier 202 is applied to the enabling device 205. The enabling device may serve to introduce a preliminary delay between the arrival of a signal and the operation of a control relay 230. When the relay 230 operates at the end of this delay period, relay 231 is energized, and the output circuit 206 is connected through to the magnetizing element 207 of the recorder. The arrival of the first signal also causes the operation of relay 241 associated with the enabler and this relay locks over a control conductor 232. Relay 241 closes a circuit from ground through its armature and contact, conductor 233 through the contacts of an operated control relay 234, conductor 235 through the motor 213 to battery. The motor 213 drives the feed mechanism 214, and the tape 208 is withdrawn from the container 212 and passed through the reproducing unit 215. As the subscriber continues to transmit the alternating current signals the recording unit 207 responds to them and magnetizes the moving tape 208 to record them, representing first the three office code characters and then the four numerical digits of the designation.

As the magnetized tape passes through the recording unit 207 and into the container 212 it is immediately withdrawn therefrom and driven through the reproducing unit 215. When the magnetized areas of the tape representing the office code reaches the reproducer 215, alternating current signals are produced in the circuit 216 of somewhat lower frequencies and of the same combinations as those transmitted over the subscriber's line. These signals, representing the office code, flow over circuit 216 through the normal contacts of relay 301 to the circuit 302 and are applied to the five selective filters 304, 305, 306, 307 and 308. Since each signal may be assumed to comprise two different frequencies the currents of these frequencies are selected by the corresponding filters, detected by the corresponding detectors 309, 310, 311, 312 and 313, 75

and utilized to operate the registers 314, 315 and 316 to register the office code. The receipt of the code designation by the registers 314, 315 and 316 may serve in any well-known manner to operate a control relay 323 to release relay 234 to open the circuit of the motor 213. The withdrawal of the tape from the container 212 is thus stopped until the office selections have been performed.

At the proper time following the receipt of the office code designation the sender seizes an idle marker 321 through the connector 322, and the office code designation is transferred from the registers 314, 315 and 316 to registers in the marker. The marker translates the office code information and in the well-known manner associates itself with the frames containing the district and office selector switches S and S—I and operates these switches to extend the calling line and junctor 106 to an idle trunk in the required group. Following the selection of the idle trunk outgoing from the office switch S—I the marker 321 releases and becomes available for the use of other senders. If the call is for a local subscriber, the office selector switch S—I makes connection with a local trunk, such as the trunk 107, and the sender selector switch S—8 seizes a local incoming sender 108.

As soon as the incoming sender 108 has been seized and is ready to receive the numerical information, relay 234 in the originating sender is reoperated to again start the tape feed mechanism 214. Also relay 301 operates in a circuit closed through the contacts of relay 324 to ground, the latter relay having operated in the meantime. The tape 208 is drawn through the reproducer 215, and the recorded alternating current signals representing the numerical designation of the called line are reproduced in the circuit 216 which now extends through the operated contacts of relay 301, over circuit 303, through the contacts of sender selector S—6, through the contacts of selector switches S and S—I, over the conductors of trunk 107, through the contacts of sender selector S—8 to the input circuit 111 of the signal receiver 112 in the incoming sender 108. The signal receiver 112, like the receiver 300, is provided with five selecting channels including the filters 113, 114, 115, 116 and 117 and associated detectors 118, 119, 120, 121 and 122. The successive alternating current signals are selected by the receiver 112 and utilized to cause the registration of the numerical designation on the registers 123 in the incoming sender. Thereupon the sender 108 seizes a marker (not shown), and the numerical registration is utilized to operate the incoming and final switches S—2 and S—3 to complete the connection to the local called line 124.

The originating sender, having completed its functions, now proceeds to release. Ground potential having been removed from conductor 228 the tape feed mechanism 211 comes to rest. The tape feed 214 continues to operate, however, to withdraw any tape that may remain in the container 212 and to return it to the container 209. When all tape has been withdrawn from the container 212 the plunger 220 closes the contacts 219, and a circuit is closed through the winding of relay 236 to the contact of a control relay 237 which has operated in the meantime. Relay 236 removes ground potential from conductor 235, all other sources of ground potential having previously been disconnected from this conductor, and motor 213 and the feed mechanism 214 come

to rest. All other operated relays in the originating sender are released, the sender selector S—6 is released, the sender 108 and sender selector S—8 are released, and the conversational connection is now held under the control of the subscribers' lines.

Assuming that the call from the subscriber's line 100 is intended for subscriber's line 101 in a distant office, the office code designation received by the marker 321 in the manner above described determines this fact, and the marker operates the district and office selectors S and S—1 to extend the calling line over the interoffice trunk 109 to the distant office. The seizure of trunk 109 causes the operation of sender selector S—7 in the distant office and the seizure of an idle incoming sender 103. Following the seizure of the sender 103 the originating sender in the calling office proceeds as above described to extend the signaling circuit 216 through the front contacts of relay 301, over circuit 303, through the contacts of sender selector S—6, through the district and office selectors S and S—1, over the interoffice trunk 109, through sender selector S—7 to the input circuit 125 of the signal receiver 126 in the incoming sender 103. The signal receiver 126, like the receivers 300 and 112, is provided with five channels each having a filter and a detector and with registers 127 for registering the four digits of the numerical designation. The signaling circuit having thus been established between the originating sender and the receiving circuit in the incoming sender at the distant office, the tape 207 is again started and driven through the reproducer 215 to reproduce the alternating current signals representing the called subscriber's number. These signals are transmitted over the interoffice trunk and are received by the signal receiver 126 and utilized to register the designation on the registers 127. Thereafter the sender 103 seizes an idle marker (not shown), and the incoming and final switches S—4 and S—5 are operated to complete the connection to the called line 101. When the connection has been completed, the markers and senders are released, and the connection is held under the control of the subscribers' lines.

A description will now be given of the manner in which the system operates when a permanent signal condition occurs on a subscriber's line and when a subscriber initiates a call and fails to complete the sending operation.

Assume first that the loop of subscriber's line 100 is inadvertently closed either at the substation or elsewhere. This closure, known as a permanent signal condition, has the appearance of an actual call. It initiates the operation of the line switch LS and sender selector switch S—6, and an idle sender is seized. The seizure of the sender results in the operation of the relay 227 and the starting of the tape feeding mechanism 211. The feed mechanism 214, however, remains at rest since no signals are received from the subscriber's line, and the supply of tape in the container 209 becomes exhausted after a predetermined interval of time. When all of the tape has been withdrawn from the container 209, contacts 217 close, and a circuit is established from battery through these contacts, conductor 238, normal contact of relay 325, through the winding of relay 326 to ground. The operation of relay 326 is an indication to the sender that a permanent signal condition exists. Thereupon the sender seizes the marker 321, a special

code, determined by the operation of relay 326, is transmitted from the sender to the marker, and the marker proceeds to operate the district and office selector switches S and S—1 to seize a trunk 110 extending to an operator's position 102. The operator challenges on the subscriber's line and takes the necessary steps to have the trouble remedied.

Assume next that the subscriber of line 100 initiates a call and transmits one or more digits and then fails to complete the sending operation. Since one or more of the office code digits is received in the originating sender, one or more of the registers 314, 315 and 316 are operated resulting in the operation of relay 325. In this case both of the tape feed mechanisms 211 and 214 are set in operation. As previously explained, the mechanism 211 is started when the sender is seized, and the mechanism 214 is started when the first designation signals are received in the sender. Although both mechanisms are running, the supply of tape in container 209 eventually becomes exhausted since the feed device 211 withdraws the tape faster than it can be returned by the feed device 214. Hence after the necessary time has expired, the contacts 217 are closed, and the circuit over conductor 238 extends through the front contact of relay 325 and the winding of relay 327 to ground. The operation of relay 327 is an indication that the subscriber has failed to complete the sending operation. The marker is seized, and the switches are operated to extend the calling line to an operator's position. She converses with the calling subscriber and instructs him to replace his receiver and initiate the call again.

What is claimed is:

1. In a telephone system, a central office, a line terminating in said central office, a trunk outgoing from said central office, means for transmitting over said line alternating current signals of different frequencies representing a telephone designation, a magnetizable medium in the central office, means responsive to said signals for producing permanent magnetizations in said medium to record said designation thereon, means for establishing a connection to said trunk, means for reproducing the alternating current signals recorded on said medium and transmitting them over said trunk, and means responsive to the signals transmitted over said trunk for further extending said connection.

2. In a telephone system, a central office, a subscriber's line terminating in said office, means at the subscriber's station for transmitting alternating current signals in codes of different frequencies representing the characters of a wanted telephone designation, a movable magnetic tape in the central office, means responsive to said signals for magnetizing said tape to record the wanted designation thereon, a distant central office, a trunk outgoing from said first central office to said distant office, means for extending a connection from said subscriber's line over said trunk to said distant office, means controlled by said magnetic tape for reproducing and transmitting over said trunk alternating current signals of corresponding frequencies and in the same codes as those recorded thereon, and means in said distant office responsive to said signals for further extending the connection established over said trunk.

3. In a telephone system, a central office, a subscriber's line terminating therein, means at the subscriber's station for transmitting over said

line alternating current signals of different frequencies representing the office code and numerical designations of a wanted line, a switch controlling sender in said office including a movable magnetic medium, means responsive to said alternating current signals for magnetizing said medium to record said office and numerical designations thereon, automatic switches in said office, a trunk accessible to said switches, means controlled in accordance with the office code recorded on said medium for operating said automatic switches to extend said line to said trunk, means for reproducing and transmitting over said trunk alternating current signals of frequencies corresponding to those recorded on said medium, and means responsive to the signals transmitted over said trunk for further extending the connection toward the wanted line.

4. In a telephone system, a local office, a subscriber's line terminating therein, a distant office, a sender in said local office including a magnetizable medium, means responsive to the initiation of a call on said line for associating the line with said sender, means at the subscriber's station on said line for transmitting alternating current signals in codes of different frequencies representing the office code and numerical designations of a wanted line, means responsive to said signals for magnetizing said medium to record said designations thereon, automatic switches in said local office, trunks accessible to said switches, certain of said trunks extending to said distant office, means controlled in accordance with the office code designation recorded on said medium for operating said automatic switches to extend the subscriber's line to one of said trunks, means effective if the connection is extended to one of said interoffice trunks under the control of the office code designation for reproducing and transmitting over said interoffice trunk the alternating current signals representing the numerical designation recorded on said medium, frequency selective means in said distant office responsive to the alternating current signals transmitted over the interoffice trunk, and automatic switches controlled by said frequency selective means for further extending the connection toward the wanted line.

5. In a telephone system, a local office, a subscriber's line terminating therein, a distant office, called lines appearing in said offices, a sender in said local office including a magnetizable medium, means responsive to the initiation of a call on said subscriber's line for associating the line with said sender, means at the subscriber's station on said line for transmitting alternating current signals in codes of different frequencies representing the office code and numerical designations of a called line, means responsive to said signals for magnetizing said medium to record said designations thereon, automatic switches in said local office, local trunks accessible to said switches for completing connections to called lines in the local office, outgoing trunks accessible to said switches and extending to said distant office, means controlled in accordance with the office code designation recorded on said medium for operating said automatic switches to extend the subscriber's line either to one of said local trunks or one of said interoffice trunks according to the destination of the call, means controlled in accordance with the numerical designation recorded on said medium for operating the automatic switches in said local office to complete the connection extended over said local

trunk to the called line in the event the called line appears in said local office, means effective if the connection is extended over one of said interoffice trunks to the distant office for reproducing and transmitting over said interoffice trunk the alternating current signals representing the numerical designation recorded on said medium, and means in the distant office responsive to said alternating current signals for completing the extended connection to the called line therein.

6. In a telephone system, a local central office, a subscriber's line terminating in said office, a distant central office, a trunk interconnecting said offices, means at the subscriber's station for transmitting over said line to the local central office currents in codes of different frequencies representing a telephone designation, a magnetizable medium in the local central office, means responsive to said designation currents for producing areas of permanent magnetism in said medium to record the designation thereon, means for extending a connection from the local central office over said trunk to said distant office, means controlled by said medium for reproducing and transmitting over the extended connection currents of frequency codes corresponding to those transmitted over the subscriber's line, frequency selective means in said distant office for separating the frequencies of said codes, and means in the distant office controlled in accordance with the designation codes received by said frequency selective means for further extending said connection.

7. In a telephone system, a central office, a calling subscriber's line terminating in said office, a trunk line outgoing from said office, called lines terminating in said office, means at the calling subscriber's station for transmitting over said calling line alternating currents representing a telephone designation, a movable magnetizable medium in the central office, means responsive to said designation signals for recording them on said magnetizable medium, and means effective either to reproduce said signals and utilize them for establishing a connection to one of said called lines or for reproducing said signals and transmitting them over said trunk line.

8. In a telephone system, a telephone line, means for transmitting current signals over said line representing a telephone designation, a recording mechanism including a movable magnetizable medium, means for starting said medium in operation, means responsive to said current signals for magnetizing said medium to record the telephone designation, a conversational circuit, and means dependent upon the extent of movement of said magnetizable medium for automatically establishing a connection with said conversational circuit.

9. In a telephone system, a telephone line, means for transmitting current signals over said line representing a telephone designation, a recording mechanism including a movable magnetic tape, means for starting said tape in operation when said mechanism is taken in use, a trunk circuit, and means effective in response to the movement of said tape through a predetermined distance for establishing a connection to said trunk circuit.

10. In a telephone system, a subscriber's line, means for transmitting current signals over said line representing a telephone designation, a recording mechanism including a movable magnetic tape, means responsive to a calling condi-

tion on said line for seizing said mechanism and starting said tape in operation, means responsive to said current signals for magnetizing said tape to record the telephone designation, a trunk circuit, means effective to release said mechanism after the designation signals have been received and utilized, and means responsive to the continued movement of said tape if the designation signals are not received within a predetermined time for establishing a connection to said trunk circuit.

11. In a telephone system, a central office, a subscriber's line terminating therein, a recording mechanism including a movable magnetic tape, means responsive to a calling condition on said line for seizing said mechanism and starting said movable tape in operation, a trunk circuit in said central office, means for transmitting signals over said line representing a telephone designation, means responsive to said signals for magnetizing said tape to record the same thereon, means for releasing said recording mechanism after the designation has been received and utilized, and means controlled by said tape after it has moved through a predetermined distance if no designation signals are received for establishing a connection to said trunk circuit.

12. In a telephone system, means for transmitting signal currents representing a telephone designation, a movable magnetic tape, means responsive to said signals for magnetizing said tape to record the telephone designation thereon, a storage reservoir for said tape, driving means for said tape, means for starting said driving means in operation to withdraw the tape from said reservoir, a conversational circuit, and means controlled by said tape when the supply thereof in said reservoir is reduced to a predetermined amount for establishing a connection to said conversational circuit.

13. In a telephone system, a line, a recording mechanism including a magnetizable movable tape, means responsive to a call on said line for seizing said mechanism, means for transmitting signals over said line representing a telephone designation, means responsive to said signals for magnetizing said tape to record the telephone designation thereon, a storage container normally having a supply of said tape therein, a driving device for said tape, means effective when the recording mechanism is seized for starting said driving mechanism to withdraw the tape from said container, a second driving mechanism operable in response to said signals for returning the tape to said container, a telephone circuit, and means effective when the supply of tape in said container is reduced to a predetermined amount for automatically establishing a connection to said telephone circuit.

14. In a telephone system, a line, a recording mechanism including a movable magnetic medium, means for transmitting signals over said line, means responsive to said signals for magnetizing said medium to record a telephone designation thereon, a container for said medium normally having a supply of the medium therein, a second container for said medium, driving means controlled over said line for moving said medium out of the first container and into said second container, a second driving means for withdrawing said medium from the second container and returning it to said first container, a telephone circuit, and means effective if the supply of medium in said first container is reduced to a given amount for establishing a connection to said telephone circuit.

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