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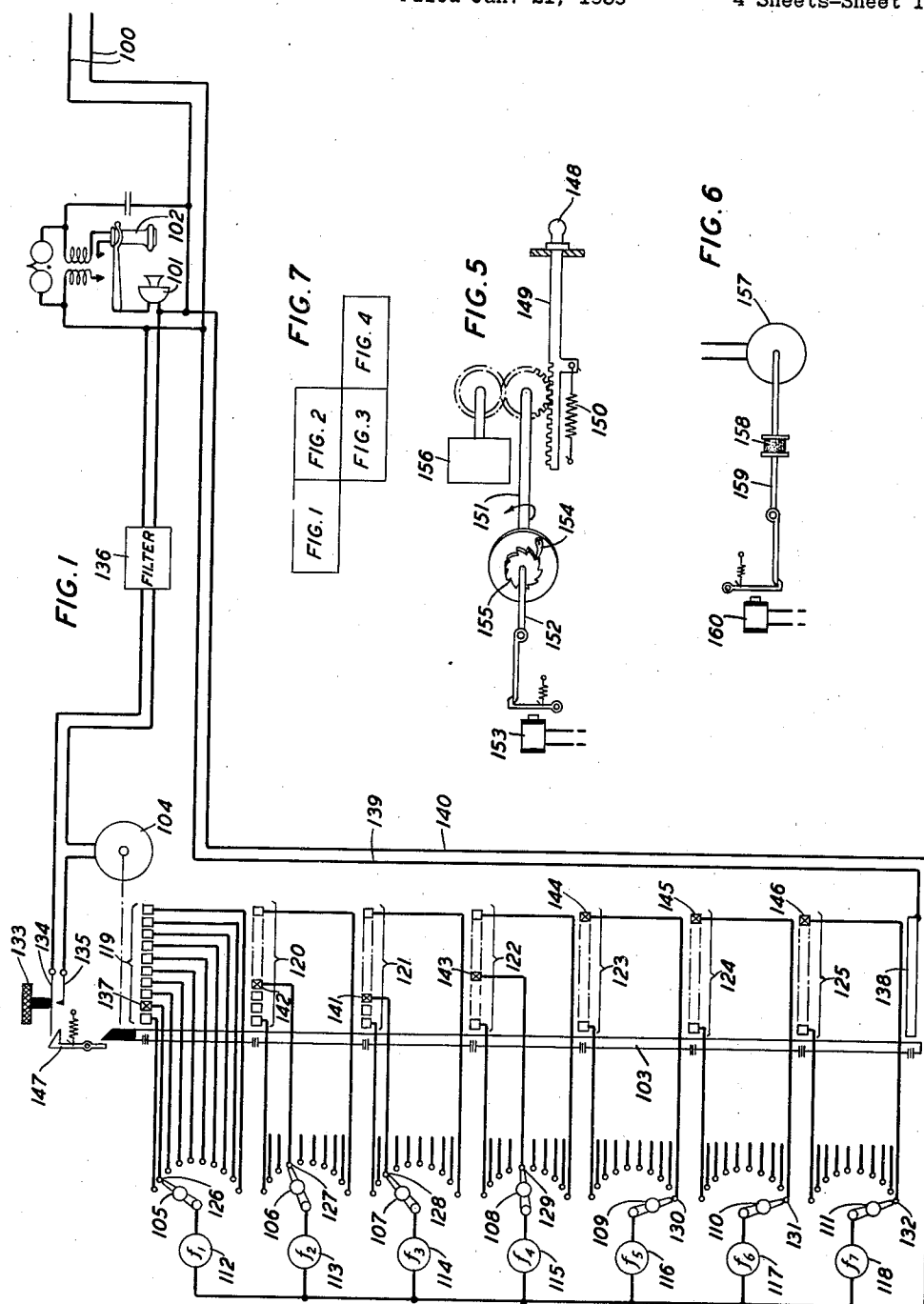
W. A. MARRISON

2,211,020

TELEPHONE SYSTEM

Filed Jan. 21, 1939

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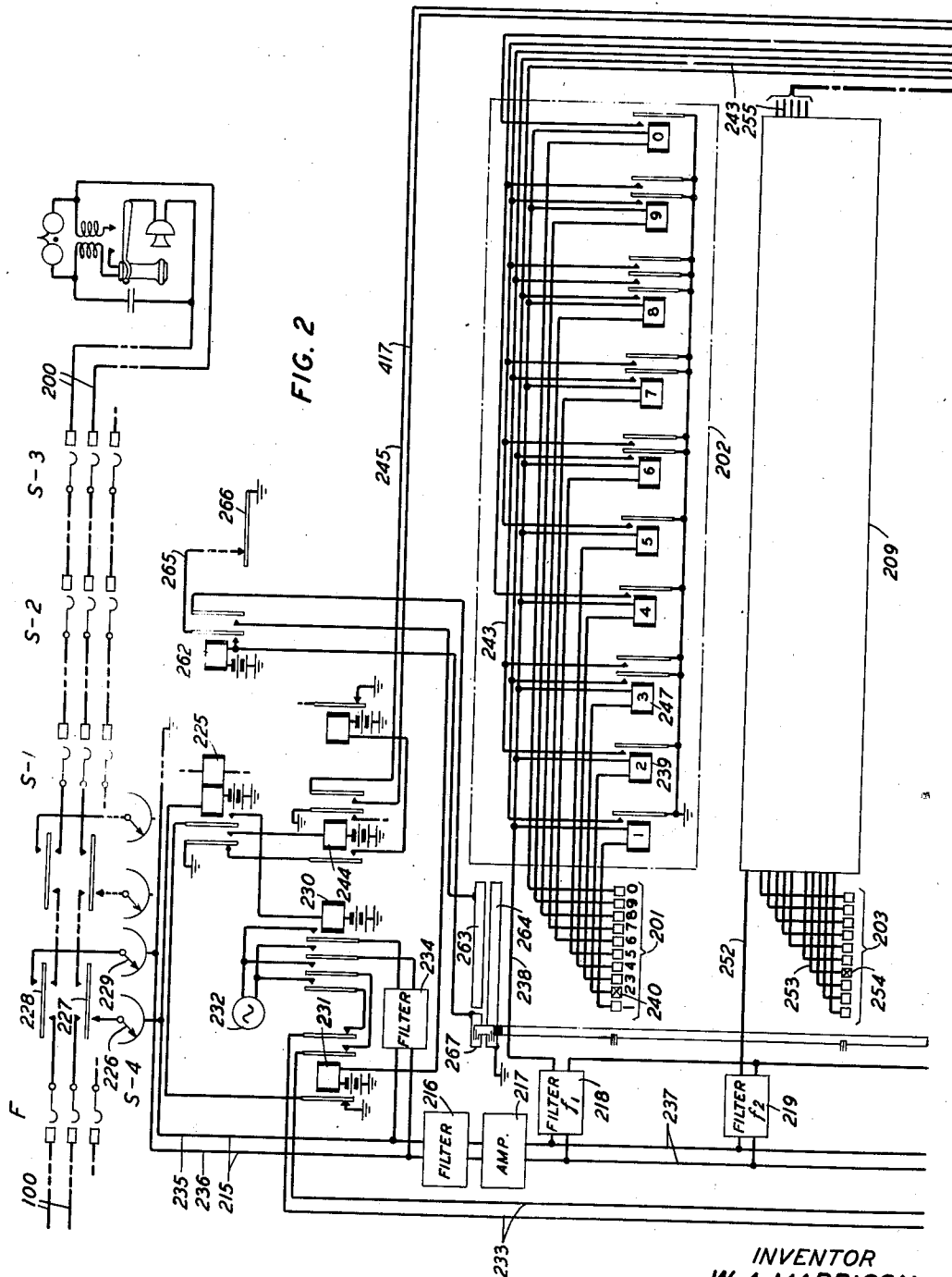
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TELEPHONE SYSTEM

Filed Jan. 21, 1939

4 Sheets-Sheet 2



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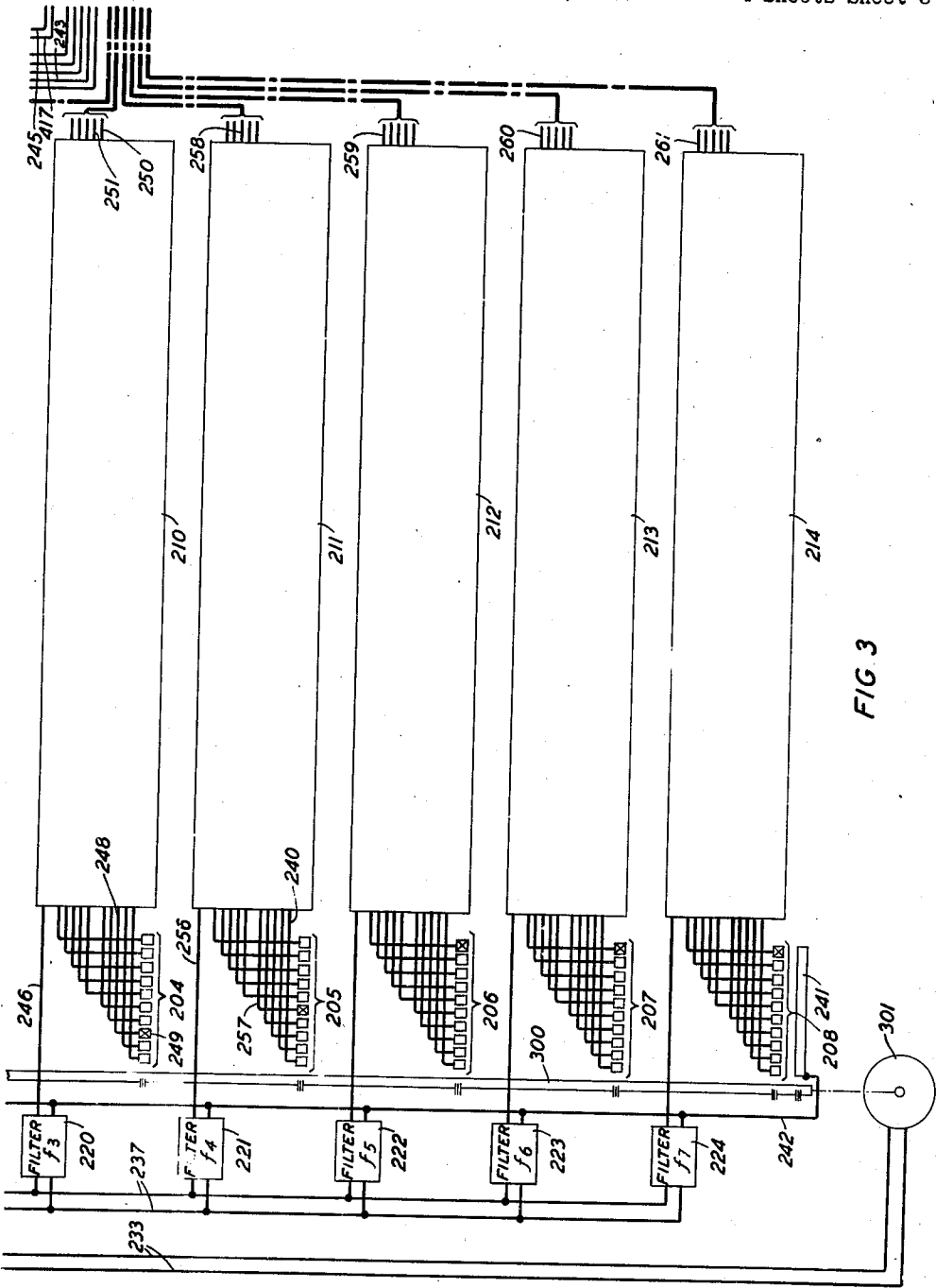
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4 Sheets-Sheet 3



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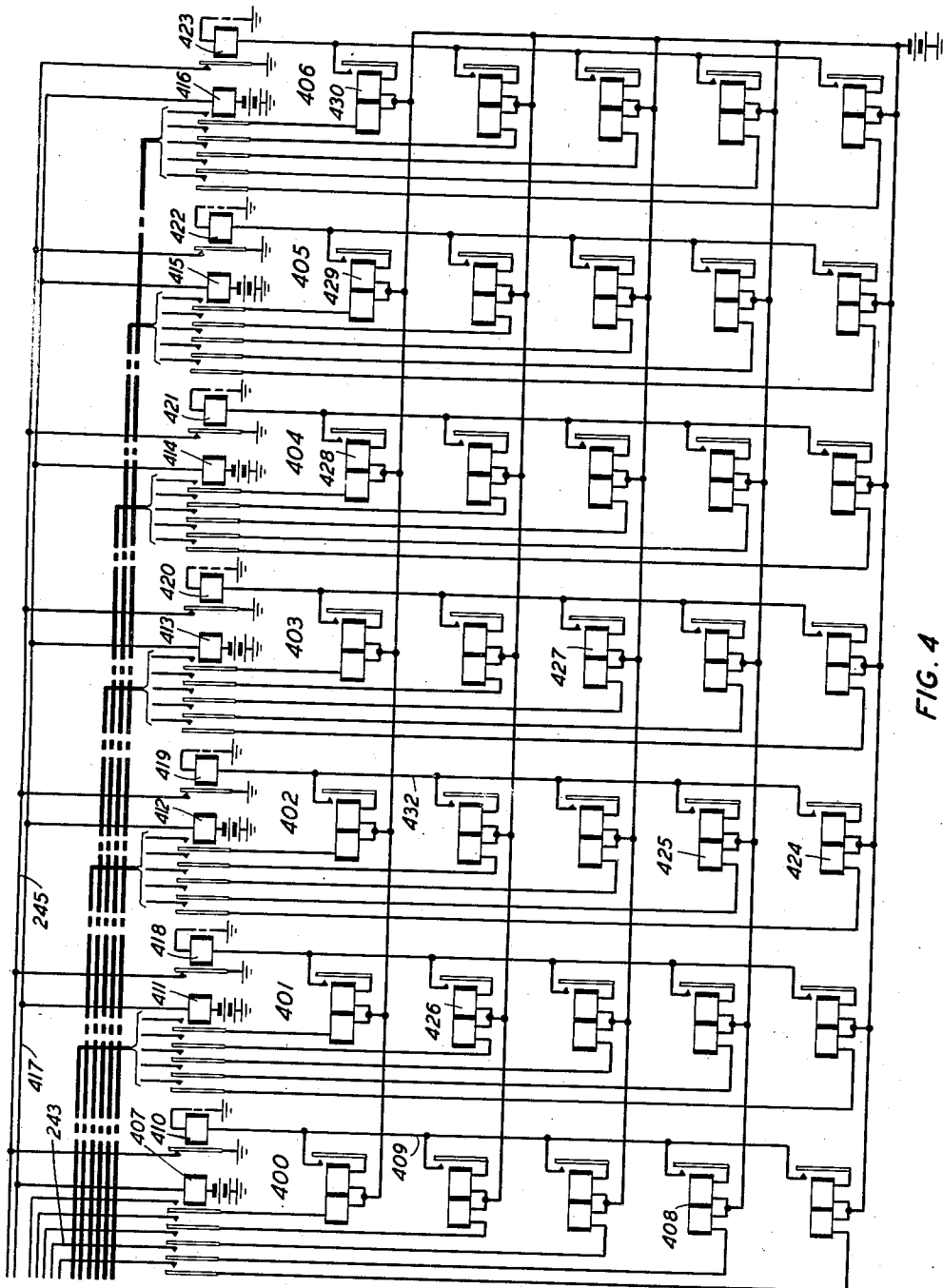
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4 Sheets-Sheet 4



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TELEPHONE SYSTEM

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Application January 21, 1939, Serial No. 252,117

19 Claims. (Cl. 179-16)

This invention relates to telephone systems and particularly to those in which automatic switching equipment is used in the establishment of telephone connections.

5 The objects of the invention are to obtain greater efficiency and increased speed in the transmission of telephone designations; to simplify the operations involved; to reduce the holding time of the equipment at the central office; and otherwise to secure improvements and advantages in systems of this kind.

10 Systems have been proposed in the past for transmitting telephone designations, such as the numbers of subscribers' lines or the numbers of trunk circuits, from one point to another by means of currents of different frequencies, the frequencies singly or in combination serving to identify the different numerals or other characters of the designation. Where, however, 15 each character or numeral of a digital place in the designation is represented by a single frequency it has been necessary to transmit in succession the characters of the successive digital places, since any given frequency might 20 be used for two or more places in the same designation. Also where the currents representing all of the digital places are sent simultaneously it has been necessary in these prior systems to utilize combinations of different frequency groups 25 for each digital place, the frequencies of a group serving one digital place differing from those of the groups serving other places.

The present invention secures advantages over these prior arrangements in that it is possible 30 to transmit within the same brief period of time the characters of all digital places in a subscriber's designation by using only one frequency for each of the several places.

40 According to a feature of the invention, this advantage is achieved by a transmission system in which the successive digital places of the designation are represented by different frequencies, one for each such digital place, and in which current of the frequency representing each place 45 is transmitted for a brief interval of time, the relative position of this interval in the total transmission period serving to identify the character of the digital place. If, for example, a subscriber's designation has seven digital or 50 character places, seven different frequencies of alternating current are provided, one for each of the seven digital places in the designation. The total period of transmission is then divided into as many successive intervals as there are 55 variations in the character or numeral of each

digital place. Usually, of course, a digital place will have ten different characters corresponding to the numerals 1 to 0. To send the numeral character 1, therefore, current of the frequency representing the digital place in the designation 5 is applied to the transmission line during the first brief interval in the total transmission period. To send the character 5, for instance, in the same digital place current of the same frequency would be transmitted during the fifth 10 successive interval in the transmission period. Likewise the other characters of the same place are identified by the transmission of the frequency during the corresponding intervals of the period.

15 In order that the different frequencies representing the different digital places and the relative positions of the current intervals during the total transmission period may be identified at the central office the system is arranged for synchronous operation of the substation transmitter and the central office receiving mechanism. 20

One of the advantages achieved by the present invention is the ability of the calling subscriber to set up the entire designation on a pre-set type of transmitter before any of the designation currents are transmitted over the line. 25 Another advantage is a distinct reduction in the holding time of the common central office equipment, such as the register sender, which receives the transmitted designation and utilizes the same for the purpose of controlling the selective operation of the switches.

The foregoing and other features of this invention will be discussed more fully in the following detailed specification. 35

In the drawings accompanying the specification, Figs. 1 to 4, inclusive, when arranged in the order illustrated in Fig. 7, disclose sufficient parts of a telephone exchange system to illustrate 40 the present invention.

Fig. 1 shows the equipment at a subscriber's station, including the designation transmitter;

Fig. 2 illustrates the automatic switches in the central office together with a portion of one of the common register senders. This figure also illustrates a called subscriber's line;

Figs. 3 and 4 disclose the remainder of the central office sender partially shown in Fig. 2;

Fig. 5 shows an alternative form of driving mechanism for the substation transmitter; and

Fig. 6 shows a detail of the driving mechanism for the receiving device at the central office.

The invention is applicable particularly to systems in which the digital information for a call 55

is registered in a common register sender in the central office, the registered information being utilized to control the switches in the central office to establish the desired telephone connection. To this end the system chosen to illustrate the invention is one in which the central offices are equipped with automatic switches of the well-known panel type. It will be understood, however, that other forms of switches, such as step-by-step switches and cross-bar switches, could be used to establish the connections. In the system shown in the drawings many details have been omitted, such as the structure and circuits of the selective switches, the manner in which the sender selectors seize idle senders in response to incoming calls, the manner in which the registers function to control the operation of the selector switches, and numerous other details of operation. For a better understanding of these details reference may be had to many patents in the prior art relating to systems of this general character and in particular to the following patents: Stearn et al. No. 1,395,977 of November 1, 1921; Stearn No. 1,505,171 of August 19, 1924; and Raymond et al. No. 1,862,549 of June 14, 1932.

Referring to the drawings, the subscriber's line 100 is equipped at the substation with the usual transmission elements, including the talking transmitter 101 and the receiver 102. The designation transmitter, which is also provided at the substation in lieu of the usual dial, includes a rotary distributor shaft 103 driven by a synchronous motor 104 to move a plurality of brushes over corresponding rows of fixed segments. The designation transmitter also includes a plurality of manually-operable devices by means of which the subscriber sets the transmitter in accordance with the several digital characters of the designation he desires to transmit. These manually-operable devices are illustrated as rotary contact keys 105 to 111, inclusive, although they may be push buttons or levers, or in any other desired form. These digit keys serve to connect corresponding sources of alternating current to the contacts in the corresponding rows of fixed segments in the rotary distributor.

The sources of alternating current are illustrated in the drawings as a series of generators or oscillators 112 to 118, inclusive. Each one of these generators corresponds to a digital place in a subscriber's designation and produces a current of a single frequency characteristic of such digital place. For example, generator 112 produces frequency f_1 which corresponds to and identifies the first digital place in all designations that may be transmitted from the substation. Generator 113 produces frequency f_2 corresponding to the second digital place, generator 114 produces frequency f_3 corresponding to the third place, and, in like manner, generators 115 to 118 produce frequencies f_4 to f_7 , inclusive. The digit key 105 associated with the generator 112 is capable of engaging any one of ten positional contacts which are connected respectively to the ten successive segments of the first distributor group 119. These ten segments correspond to the ten transmission intervals which make up the full transmission period. If key 105 engages the first contact, connected to the first segment in the group 119, the frequency f_1 is transmitted during the first interval of the period and characterizes the digital character 1. Similarly if key 105 is in engagement with any one of the successive nine positional contacts corresponding to any one of

the successive nine segments of the group 119, the frequency f_1 is transmitted during the corresponding interval in the period and identifies the corresponding numeral 2 to 0. The same is true with respect to each of the remaining digital keys 106 to 111 and the corresponding groups of segments 120 to 125, inclusive.

As will be explained more fully hereinafter, the synchronous motor 104 is set in motion by current supplied from the central office to rotate the distributor shaft 103 through a single revolution, corresponding to the total transmission period, during which the brushes of the shaft 103 wipe over the corresponding groups of fixed segments to which the generators have been connected by the selective positioning of the digital keys.

The subscriber's line 100 appears in the bank of a line finder switch F at the central office, and the finder F is connected to a first or district selector switch S-1. The switch S-1, together with the second or incoming selector S-2 and the final selector S-3, serves to complete the connection to a called subscriber's line 200 in the event of a local call. In case the calling subscriber wishes to converse with a subscriber in a distant office the selector switch S-1 seizes a trunk extending to the distant office where incoming and final selectors are positioned under the control of the register sender to complete the connection to the desired line.

The central office is provided with a plurality of common register senders, one of which is illustrated in Figs. 2, 3 and 4. These register senders are selected by means of sender selector switches, one of which, such as the sender selector S-4, is provided for each link circuit comprising a line finder F and a district selector S-1. The sender selector S-4 is set in motion in response to the act of the finder F in finding the calling line. Selector S-4 hunts for and seizes the first idle register sender and associates it with the calling subscriber's line through the link circuit and the brushes of the line finder F.

The register sender in the central office comprises numerous circuit controlling relays, a receiving synchronous distributor similar to the one provided at the substation, receiving relays and sets of register relays corresponding to the successive digital places of a designation. The receiving distributor comprises a rotary shaft 300 operated by a motor 301, which is driven in synchronism with the motor 104 at the substation, and groups of stationary segments corresponding to the successive digital places. For example, the group of stationary segments 201 corresponds to the first digital place of the designation and serves to bring about the operation of one of a series of receiving relays 202 depending upon the value of the digit. Similarly the succeeding groups of segments 203, 204, 205, 206, 207 and 208 correspond to the successive digital places and serve to operate the relays of the corresponding groups of digit receiving relays 209 to 214, respectively.

The currents of the several frequencies characterizing the digits of a complete designation are received in the central office sender by the common receiving circuit 215. After passing through the filter 216, and after being amplified by a suitable amplifier 217, these currents are applied to the successive filters 218 to 224, inclusive. These filters are designed to pass selectively the respective frequencies corresponding to the generators 112 to 118. Filter 218 passes the frequency f_1 and no other frequencies, filter 219 passes fre-

quency f_2 , filter 220 passes frequency f_3 , and, similarly, filters 221 to 224 pass frequencies f_4 to f_7 , respectively.

The currents passing the filters 218 to 224 cause the operation of certain relays in each of the groups 202 to 214, and these relays in turn cause the selective operation of the corresponding sets of register relays shown in Fig. 4. There are seven sets of these registers 400 to 406, inclusive, representing in that order the seven successive digital places of a subscriber's designation. After the designation has been registered on the registers of Fig. 4, these registers then serve, through the agency of controlling circuits not shown in the drawing, to control the selective operation of the automatic switches S—1, S—2 and S—3 to extend the calling subscriber's line 100 through to the called line 200.

The operation of the system will now be described in detail, assuming, for this purpose, that the subscriber of line 100 desires to call the subscriber of line 200 and that the designation of the line 200 is CH 3-5000. It will be noted that the first two digital places in this designation are occupied by letters instead of numerals. This practice makes for ease in remembering the designation, since the letters are usually the first letters of the office name. They are, however, the equivalent of numerals with regard to the effect they have on the central office mechanism.

First the calling subscriber sets up the desired designation on his transmitter. To do this he moves the digital key 105 to its second position contact 126 and the key 106 to the fourth position contact 127, corresponding respectively to the letters "C" and "H" of the called designation. He then positions the key 107 on the third contact 128, which corresponds to the character "3" in the office code part of the designation "CH 3". Finally he positions the key 108 on its fifth position contact 129, and the keys 109, 110 and 111 on their "0" position contacts 130, 131 and 132, corresponding to the numerical portion "5000" of the designation. The subscriber then depresses the button 133, which latches and closes the contact springs 134 and 135 to prepare the circuit for the synchronous motor 104. Finally he removes his receiver 102 from the switchhook, closing the loop of the line 100 and initiating the operation of the line finder F at the central office.

When the finder F finds the calling line 100 and the selector S—4 extends this line through to the idle register sender, a circuit is completed from battery to the left winding of relay 225, sender selector brush 226, through the contacts of sequence switch spring 227, thence over the brush of line finder F over the lower side of the line 100, through the substation circuit and returning over the upper side of the line through the brush of finder F, contacts of sequence switch spring 228, brush 229 thence to ground in the register sender. The relay 225 operates and closes a circuit from battery through the winding of relay 230, contact of relay 225 to ground at the left back contact of relay 231. Relay 230 operates and connects the source of alternating current 232 to the synchronous motor 301 associated with the receiving distributor of the sender and simultaneously to the synchronous motor 104 associated with the transmitter at the subscriber's station. The circuit for motor 301 may be traced from the generator 232, through the outer contacts of relay 230, right contacts of relay 231 and thence over the circuit 233 to

the motor 301. The circuit for motor 104 at the substation may be traced from generator 232 through the inner contacts of relay 230 through filter 234 thence over circuit 215 through the brushes 226 and 229 and thence over the subscriber's line 100 through the filter 136 to the windings of the motor 104.

The filters 136 and 234 pass current of the frequency produced by the generator 232 and exclude currents of other frequencies. Similarly the filter 216 prevents current from source 232 from passing to the common receiving circuit 237.

When relay 225 operates, it also closes an obvious circuit for relay 244. Relay 244 closes a circuit from battery through the windings of all of the relays 407, 411, 412, 413, 414, 415 and 416 in parallel, thence over common conductor 417, outer contacts of relay 244, thence over conductor 245 to ground over the contacts of each of the relays 410, 418, 419, 420, 421, 422 and 423. The relays 407, 411, 412, 413, 414, 415 and 416 serve respectively to connect the successive registers 400 to 406 through to the contacts of the digit receiving relays 202, 209, 210, 211, 212, 213 and 214.

The distributor shafts 103 and 300 rotate in synchronism with each other through a complete cycle, which corresponds to the transmission period. Since these shafts are in synchronism with each other, their brushes engage simultaneously the segments corresponding to the ten successive positions 1 to 0. When the shaft 300 moves out of its normal position, a circuit is closed from battery through the winding of relay 262, segment 263 and thence through the brushes of the distributor to the grounded segment 264. Relay 262 operates and locks to a holding circuit, such as the circuit 265, which extends to ground through a contact 266 of the controlling sequence switch associated with the register sender.

When the shafts 103 and 300 reach the second position segments, the first impulse is sent for the assumed designation. The circuit for this purpose is closed from the right pole of generator 112 through the key 105, contact 126, segment 137 of the group 119, distributor shaft 103, common segment 138, conductor 139, thence over the lower conductor of line 100 through the finder F, spring 227, brush 226, conductor 235 to the filter 216. The other side of the circuit may be traced from the other pole of the filter 216, back over conductor 236 through the brush 229, spring 228 through the finder switch F, thence over the upper side of the line through conductor 140 and finally to the left pole of the generator 112. Current of the frequency f_1 is transmitted to the central office, where it passes the filter 216 and is amplified by the amplifier 217 and delivered to the circuit 237, which is common to all of the filters 218 to 224, inclusive. Since the current thus transmitted is of the frequency f_1 , it is passed selectively by the filter 218 and current is caused to flow in the output circuit of the filter, which may be traced by way of conductor 238 through the winding of the receiving relay 239 of the group 202, thence to the second position segment 240, with which the brush shaft 300 is now in engagement, over said brush shaft through the common segment 241, conductor 242 to the other terminal of the output circuit of filter 218. Relay 239 operates in this circuit and closes a circuit from ground through its contact, conductor 243 through the closed

contact of relay 407, left winding of register relay 408 to battery. Relay 408 operates and locks in a circuit from battery through its right winding and contact, conductor 409 through its winding of relay 410 to ground. Relay 410 operates in series with the register relay and removes its ground connection from the common conductor 245. Relay 407, however, remains operated as long as ground is present on the common conductor 245.

When the distributors reach their third position contacts, a circuit is closed from the right terminal of generator 114, digit key 107, terminal 128, segment 141, shaft 103, common segment 138 thence over the line circuit to the filter 216 and returning over the line by way of conductor 140 to the other pole of generator 114. A current of frequency f_3 is transmitted over this circuit and thence to the common circuit 237. Since the filter 220 is tuned to frequency f_3 , current flows in the output circuit of filter 220 over conductor 246 through a relay in the group 210 corresponding to relay 247, over conductor 248, segment 249, shaft 300, common segment 241, conductor 242 to the other terminal of the filter 220. The operated relay of the group 210 applies ground potential to conductors 250 and 251, which extend through the contacts of relay 412 to the windings of register relays 424 and 425. Relays 424 and 425 operate and lock through their right windings and contacts over conductor 432 to the winding of relay 419 to ground, operating relay 419.

When the distributors reach their fourth position contacts the generator 113 at the substation is connected by way of digit key 106 and segment 142 to the line, and a current of frequency f_2 is transmitted. Current of this frequency passes the selective filter 219 and operates the fourth receiving relay of the group 209 by way of a circuit including conductor 252, conductor 253 and segment 254. The operated relay of the group 209 applies ground potential to conductor 255 which extends through a closed contact of relay 411 to the left winding of register relay 426. Register relay 426 operates and locks through its right winding and the winding of relay 418. Relay 418 also operates and removes its ground connection from the common conductor 245.

When the synchronous distributors reach their fifth position segments, the generator 115 is connected to the line by way of digit key 108 and segment 143. Current of the frequency f_4 flows over the line and is passed by the filter 221 in the sender. Current flowing in the output circuit of the filter 221 causes the operation of the fifth relay of the group 211 by way of a circuit including conductor 256, conductor 257 and the fifth segment 205 of the distributor. The operated relay of the group 211 applies ground potential to conductor 258, which extends through the operated contacts of relay 413 to the left winding of register relay 427. Relay 427 operates and locks in series with relay 420, the latter relay also operating.

Since the numeral "0" occurs in each of the last three places of the designation, no more currents are transmitted until the synchronous distributors reach their last or 0 position segments. On reaching the last segments in the distributor groups, circuits are closed for connecting the three generators 116, 117 and 118 simultaneously to the line. The generator 116 is connected by way of digital key 109 and distributor segment 144, generator 117 is connected

by way of key 110 and distributor segments 145, and generator 118 is connected by way of key 111 and distributor segment 146. Currents of frequencies f_5 , f_6 , and f_7 are transmitted over the line and are selected respectively by filters 222, 223 and 224. In the manner already described currents flowing in the output circuits of these filters cause the operation of the tenth relay in the relay groups 212, 213 and 214. These relays apply ground potential to conductors 259, 260 and 261, which extend respectively through the contacts of relays 414, 415 and 416 to the windings of relays 428, 429 and 430. These register relays operate and lock, respectively, through the windings of relays 421, 422 and 423. Relays 421, 422 and 423 operate, and, since all of these relays are now energized, ground potential is removed from the common conductor 245 to permit the release of relays 407, 411, 412, 413, 414, 415 and 416. These relays disconnect the receiving relays shown in Figs. 2 and 3 from the register relays shown in Fig. 4.

The entire designation has now been transmitted to the central office and registered on the register relays in the sender. It will be noted that the order in which the short current impulses are transmitted over the line does not bear any definite relation to the sequence of the digital places in the designation. Instead the order of transmitting the impulses representing the different digital places depends upon the value of the digit. These current impulses may be transmitted in succession if the digit values occur in that manner or two or more of them may be transmitted simultaneously, as in the case of the last three digits in the assumed designation. Or the impulses in some cases may be sent in the inverse order of the sequence of digital places.

As the distributor shaft 103 at the substation approaches its normal position the uppermost end thereof engages the dog 147, causing it to tilt and release the switch springs 134 and 135. This opens the circuit of the motor 104, bringing the distributor to rest in its normal position. Also as the distributor shaft 300 of the distributor at the central office approaches its normal position, a circuit is closed for the relay 231 extending from battery through the winding of said relay, closed contacts of relay 262, segment 267 thence through brushes of the distributor to the grounded segment 264. Relay 231 opens its right contacts and also releases relay 230. Thus the source of current 232 is disconnected from the subscriber's line and also from the synchronous motor 301, and the distributor shaft 300 comes to rest in its normal position.

The register sender now proceeds to control the selective operation of the switches S-1, S-2 and S-3 in accordance with the designation registered on the register relays of Fig. 4 to extend the calling subscriber's line 100 through to the called line 200. Thereafter the register sender restores to normal and is ready for use in connection with another call.

If it is desired to dispense with the synchronous motor for operating the distributor at the substation, this may be accomplished by providing a driving mechanism the power for which is stored up by an act of the subscriber and which is controlled by a governing device to operate the distributor at a speed which corresponds substantially to the speed of the distributor in the central office sender. A driving mechanism for the substation distributor is illustrated in Fig. 5. To set the device for operation the sub-

scriber seizes the knob 148 and pulls the bar 149 outwardly against the tension of the spring 150. The rack on the bar 149 rotates the shaft 151 through an angle corresponding to a rotation of the distributor shaft 103. The subscriber then releases the bar 149, and the spring 150, being under tension, tends to drive the shaft 152 through the pawl 154 and ratchet 155. However, shaft 152, to which the ratchet 155 is attached, is held in its position by the latch magnet 153. When the system is ready for the transmission of impulses, current flowing from the central office over the line causes the operation of the latch magnet 153, which attracts its armature and releases the driving mechanism. The spring 150 thereupon rotates the shaft 151, and, through the pawl and ratchet connection, the shaft 152, which in turn drives the distributor shaft. The speed of the distributor shaft is closely regulated by a governor device 156. At the same time the distributor in the central office sender is set in rotation and operates in synchronism with the distributor at the substation.

An alternative form of driving mechanism for the distributor at the central office is illustrated in Fig. 6. Here the synchronous motor 157 is connected through a friction clutch 158 to the shaft 159 which drives the distributor. To release the distributor for operation following the application of current to the motor 157, an impulse is transmitted to operate the trip magnet 160. The magnet 160 withdraws the latch and allows the motor 157 to drive the shaft 159 through the friction clutch 158.

What is claimed is:

1. In a telephone system, a telephone line having a subscriber's station thereon, means for producing currents of a plurality of different frequencies, each frequency representing a different digital place in a telephone designation, a transmitting device at said station having a period of operation comprising a plurality of successive intervals of time, said transmitting device including means for applying to said line current of each of said frequencies for a time equal to one of said intervals, and means for selecting any one of the successive intervals of said period for application to designate the value of the character in the digital place represented by the frequency applied.

2. In a telephone system, a telephone line having a substation thereon, means for producing alternating currents of a plurality of different frequencies, a single frequency serving to identify a particular one of the several digital places in a telephone designation, a transmitting device at the substation having a definite cycle of operation which is divided into a plurality of short successive intervals of time, said transmitting device including means for applying to the line each one of said frequency currents for a time equal to one of said intervals within a single cycle of operation of said transmitting device, and manually operable means under control of the subscriber at the substation for varying in said cycle the relative position of the interval of application of each of said frequency currents to designate the value of the digital character in each of the digital places of the designation.

3. In a telephone system, a telephone line having a subscriber's station thereon, means for producing currents of a plurality of different frequencies, each frequency representing a different digital place in a telephone designation, a transmitting device at said station having a period of operation

comprising a plurality of successive intervals of time, said transmitting device including means for applying to said line current of each of said frequencies for a time equal to one of said intervals, means capable of being positioned in advance by the subscriber for selecting any one of the successive intervals in said period for the application of each of said frequency currents to designate the value of the characters in each of the digital places, and means for operating said transmitting device after the selections for all digital places have been made.

4. In a telephone system, a telephone line having a subscriber's station thereon, means for producing currents of a plurality of different frequencies, each frequency representing a different digital place in a telephone designation, a transmitting device at said station having a period of operation comprising a plurality of successive intervals of time corresponding to the different characters in a digital place, a plurality of digit keys capable of being preset by the subscriber in accordance with a wanted designation, each key representing a different frequency and serving to select any one of said successive intervals, and means for operating said transmitting device to send over the line current of all of said frequencies during the particular intervals of said period determined by the settings of the corresponding keys.

5. In a telephone system, a central office, a subscriber's line, automatic switches in the central office for extending said line, a transmitting device at the substation of said line having a period of operation, means for operating said device to send over the line a plurality of current impulses of different frequencies, each frequency serving to identify a digital place in a telephone designation, means for varying the chronological position of each impulse in said period to identify the character in the corresponding digital place, means at the central office for selecting said impulses in accordance with their frequencies, and means for utilizing the selected impulses to control the operation of said automatic switches.

6. In a telephone system, a central office, a subscriber's line, automatic switches in the central office for extending said line, a transmitting device at the substation of said line having a period of operation, means for operating said device to send over the line a plurality of current impulses of different frequencies, each frequency serving to identify a digital place in a telephone designation, means for varying the chronological position of each impulse in said period to identify the character in the corresponding digital place, registers at the central office for controlling said automatic switches, said registers corresponding respectively to the digital places of the designation, means for selecting each impulse transmitted in accordance with its frequency, and means operable in accordance with the chronological position of each selected impulse for setting the corresponding register.

7. In a telephone system, a central office, a subscriber's line, automatic switches in the central office for extending said line, a transmitting device at the substation of said line having a period of operation, means for driving said device through its period of operation to send over the line a plurality of current impulses of different frequencies, each frequency corresponding to a digital place in a telephone designation, means for varying the chronological position of each im-

pulse in said period to determine the value of the digit in the corresponding digital place, means at the central office for selecting said impulses according to their frequencies, registers for controlling said automatic switches, and means operating in synchronism with the transmitting device for determining the chronological position of the selected impulses and for causing the operation of said registers to register the transmitted designation.

8. The method of transmitting designations in a telephone exchange system which comprises applying to a telephone line during the period of transmission a pattern of current impulses in which the digital places of a designation are distinguished from each other by differences in the frequencies of said impulses and the characters of the digital places are identified by the chronological positions of the current impulses in said transmission period.

9. The method of transmitting designations in a telephone system which comprises applying to a telephone line during a definite period of transmission a pattern of current impulses in which each digital place of a telephone designation is identified by a single impulse of a distinctive frequency and the characters of each digital place are identified by the relative position of the impulse in said transmission period.

10. The method of transmitting a digit of a multidigit telephone designation which comprises applying to a telephone line an impulse of alternating current which identifies the character of the digit by the chronological position of the time interval in which the impulse occurs during the transmission period and distinguishes its digital place from other digital places in the designation by the frequency of the impulse.

11. The method of transmitting a multidigit telephone designation in a given time period, in which the several digital places are represented respectively by brief intervals of current of distinguishing frequencies applied to a telephone line, and in which the character value of each digital place is determined by the position in the transmission period of the brief interval of current representing such digital place.

12. The method of transmitting, within a period of time consisting of a plurality of successive brief intervals, a multidigit telephone designation which comprises identifying each of the digital places of the designation by transmitting a single impulse of current of distinguishing frequency over a telephone line during any one of said brief intervals, and identifying the characters of the digit of each place by transmitting the impulse of distinguishing frequency during the corresponding one of said intervals.

13. The method of transmitting designations in a communication system, in which a designation comprises a series of units, in which the several units are represented respectively by brief intervals of current of distinguishing frequencies applied within a given period of time to a transmission circuit, and in which the character of each unit is identified by the chronological position of the current interval in said period.

14. The method of transmitting in a given period of time a signal comprising a series of

units, in which each of the signal units is represented by an interval of current of a distinguishing frequency, and in which the character of the signal unit is identified by the chronological position of the interval of current in the transmission period.

15. The method of transmitting information in a communication system which comprises applying to a transmission circuit within a given period of time a current pattern in which different portions of the information are represented by intervals of current of distinguishing frequencies, and in which the character of each portion of the information is identified by the chronological position of the current interval in said period of time.

16. In a telephone system, a telephone line having a subscriber's station thereon, means for producing currents of a plurality of different characteristics, each characteristic representing a different digital place in a telephone designation, a transmitting device at said station having a period of operation comprising a plurality of successive intervals of time, said transmitting device including means for applying to said line current of each of said characteristics for a time equal to one of said intervals, and means for selecting any one of the successive intervals of said period for application to designate the value of the character in the digital place represented by the characteristic current applied.

17. In a telephone system, a telephone line having a subscriber's station thereon, means for producing currents of a plurality of different characteristics, each characteristic representing a different digital place in a telephone designation, a transmitting device at said station having a period of operation comprising a plurality of successive intervals of time corresponding to the different characters in a digital place, a plurality of digit keys capable of being preset by the subscriber in accordance with a wanted designation, each key representing a different characteristic current and serving to select any one of said successive intervals, and means for operating said transmitting device to send over the line currents of all of said characteristics during the particular intervals of said period determined by the settings of the corresponding keys.

18. The method of transmitting designations in a telephone exchange system which comprises applying to a telephone line during the period of transmission a pattern of current impulses in which the digital places of a designation are distinguished from each other by differences in the characteristics of said impulses and the characters of the digital places are identified by the chronological positions of the current impulses in said transmission period.

19. The method of transmitting a multidigit telephone designation in a given time period, in which the several digital places are represented respectively by brief intervals of current of distinguishing characteristics applied to a telephone line, and in which the character value of each digital place is determined by the position in the transmission period of the brief interval of current representing such digital place.

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