

Dec. 10, 1940

C. A. BORGESON ET AL

2,224,250

COMMUNICATION SYSTEM

Filed Nov. 13, 1937

3 Sheets-Sheet 1

FIG. 1

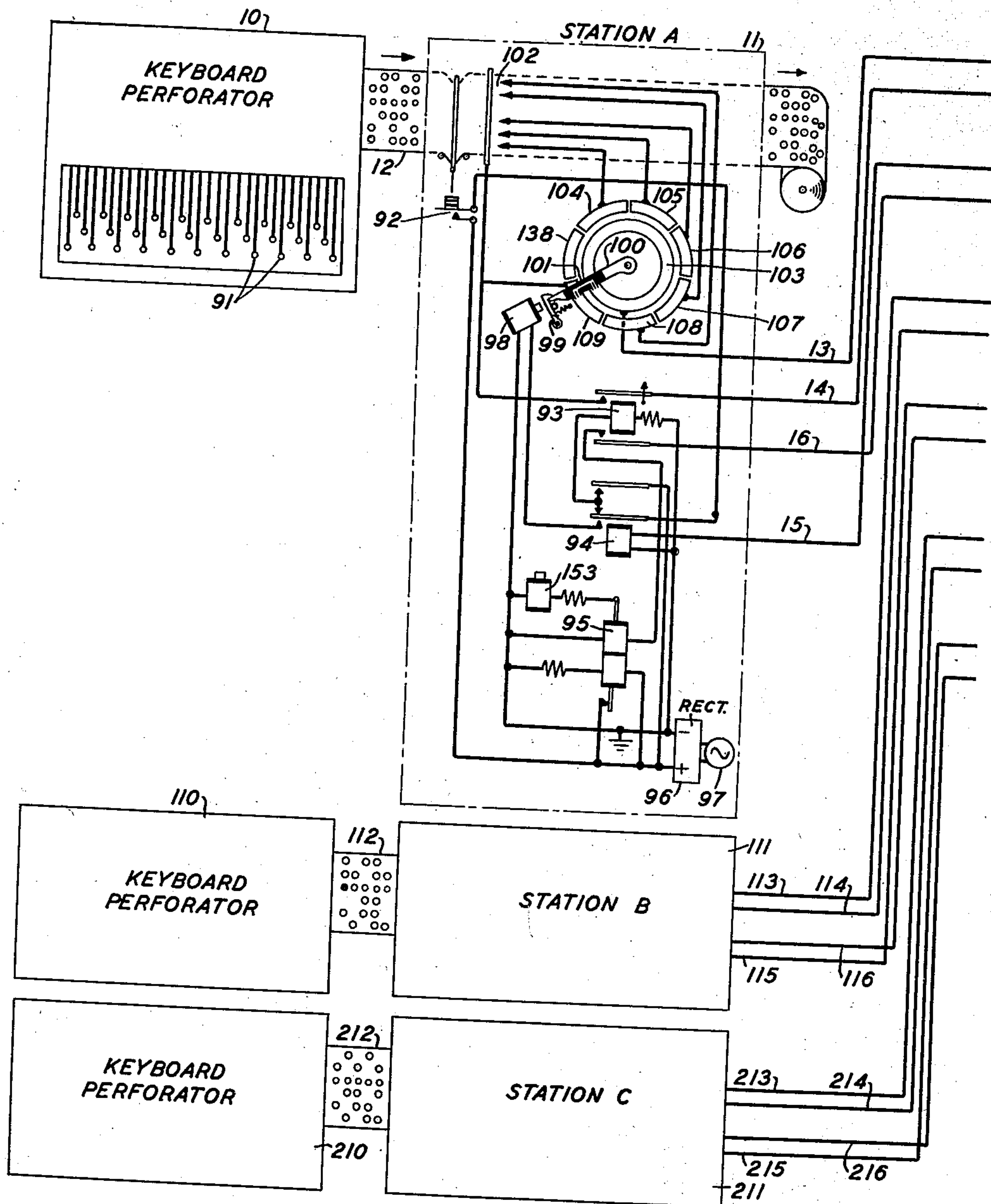
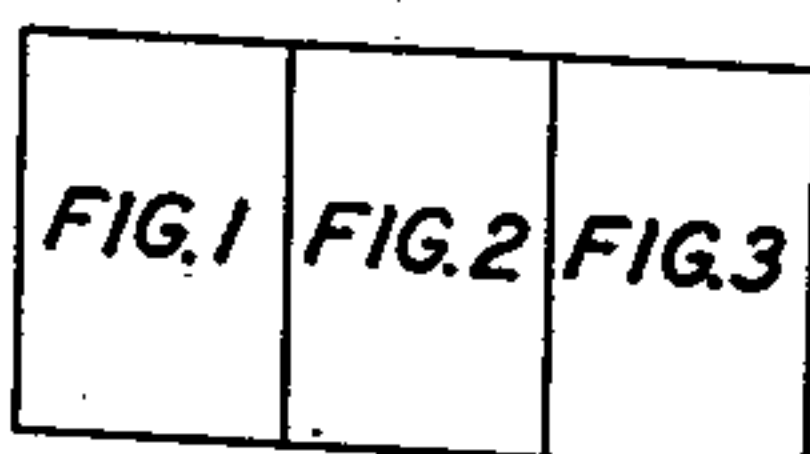


FIG. 4



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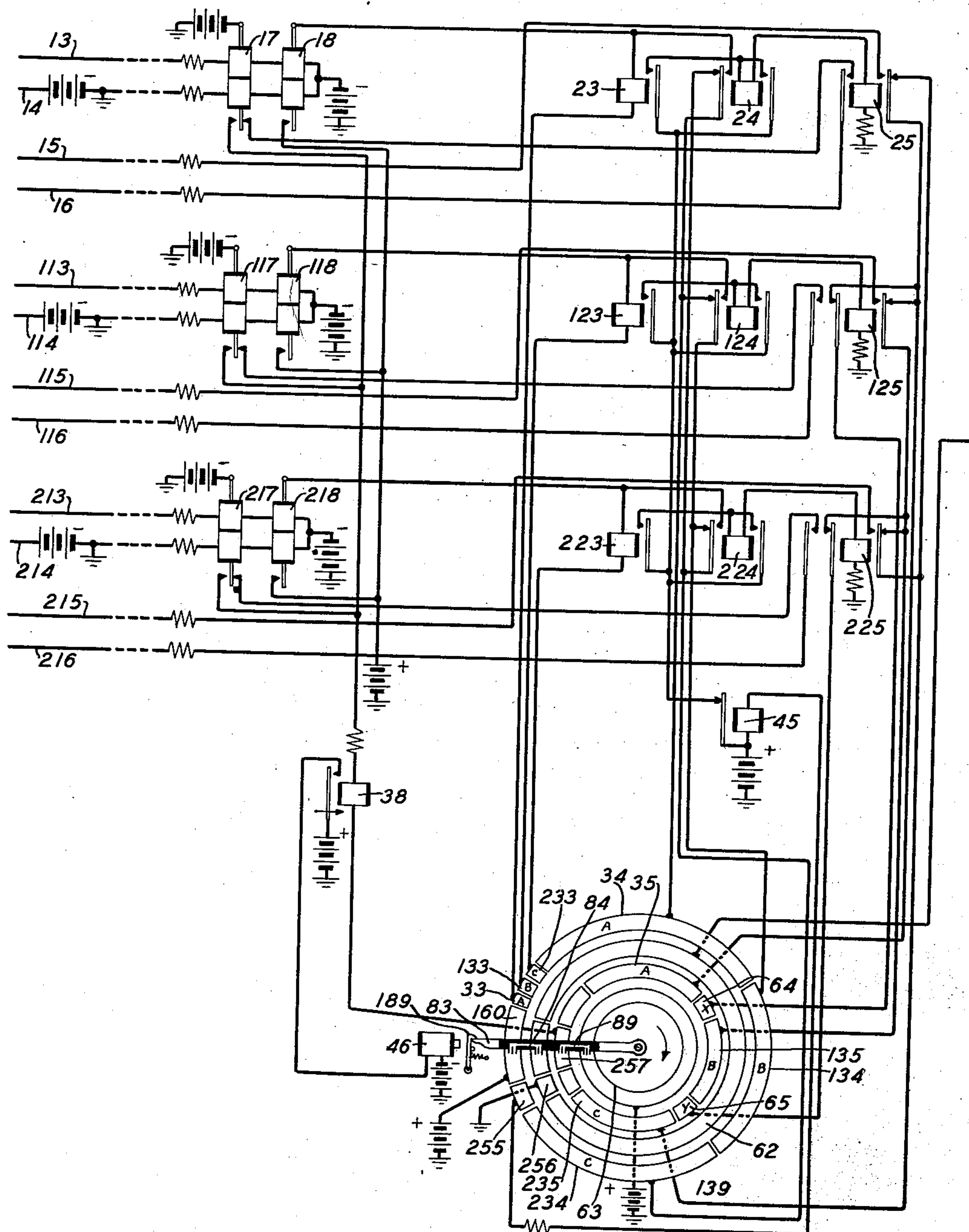
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3 Sheets-Sheet 2

FIG. 2



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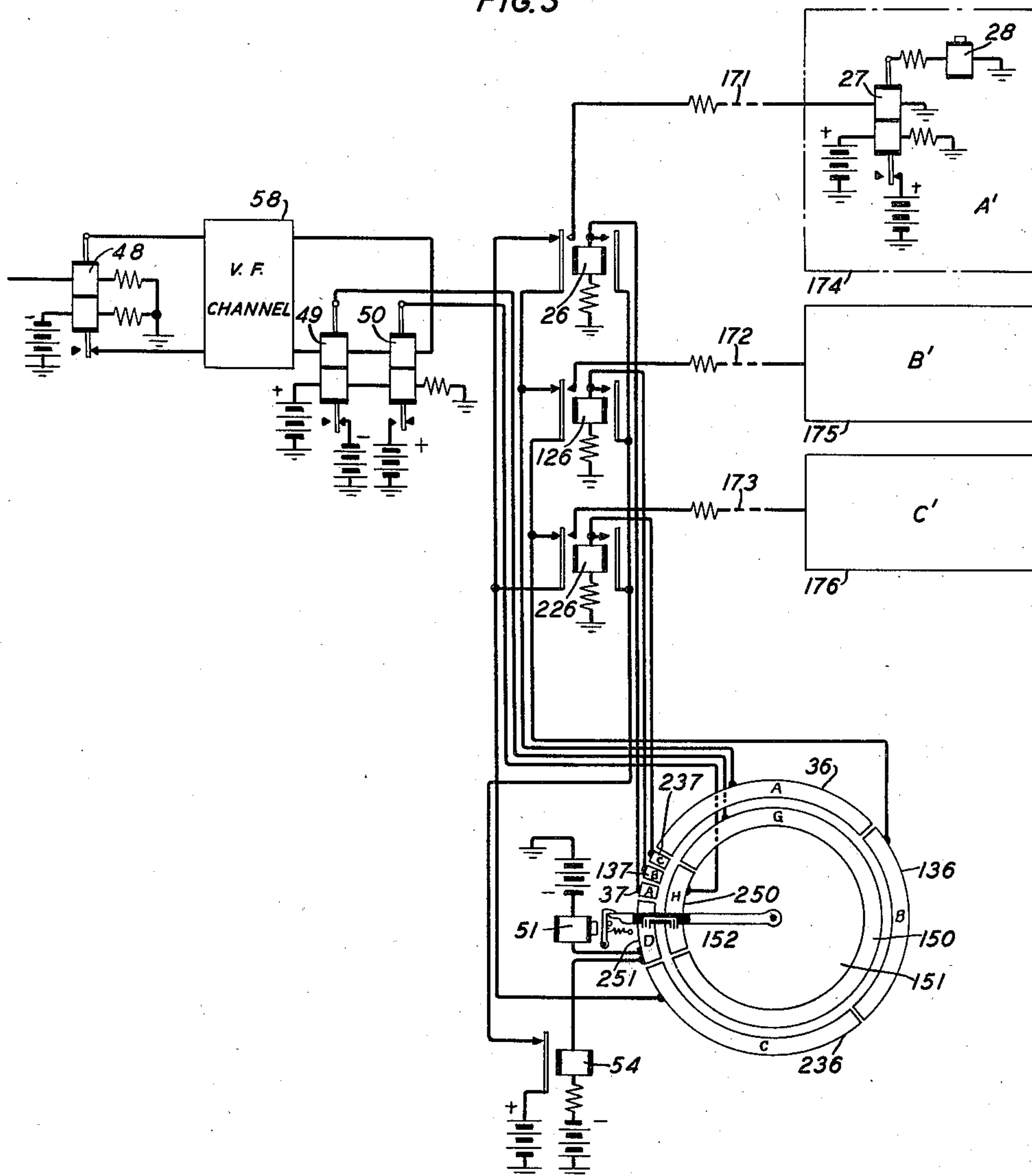
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COMMUNICATION SYSTEM

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3 Sheets-Sheet 3

FIG. 3



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2,224,250

COMMUNICATION SYSTEM

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Application November 13, 1937, Serial No. 174,468

6 Claims. (Cl. 178—52)

This invention relates to communication systems in which a plurality of message currents are transmitted over the same communication path or channel.

An object of this invention is to provide a communication circuit in which the main line or channel time is divided in accordance with the number of different currents to be transmitted thereover at substantially the same time.

A further object of this invention is to transmit current impulses over the main line which indicate the origin of the message currents.

A still further object of this invention is to provide circuit arrangements for utilizing substantially the entire time of the main line when it is desired to transmit less than the maximum number of different message currents over the main line at the same time.

In accordance with a specific embodiment of this invention the main telegraph line or channel is provided with start-stop transmitting and receiving distributors connected to its ends. A plurality of extension lines are associated with each end of the main line. These extension lines are provided with tape controlled telegraph transmitters for transmitting telegraph signaling impulses. These transmitters operate in accordance with the well-known principles of start-stop telegraph systems.

Operating connections are provided between each of the extension lines and the distributors connected to the main line which is arranged so that a path is completed from each of the extension lines to the main line for an interval of time during each revolution of the main line start-stop distributors. The connections are arranged so that in case one or more of the extension lines are idle, connections between them and the main line will be transferred to the active lines, i. e., lines which are transmitting message currents or attempting to transmit message currents.

In addition, the system is arranged to send impulses over the main line during each revolution of the main line distributors to indicate the extension lines which will be assigned time for transmission over the main line during the remainder of the revolutions and until indicating impulses are again transmitted during the next revolution.

In a preferred embodiment of this invention it is desirable to interrupt the transmission over the main line for short intervals of time between the transmission from the various extension lines to allow sufficient time for switching

the circuits at each end of the main line from one extension line to the next succeeding extension line. However, in case the transmission is to be from the same extension line during successive transmitting intervals, the interrupting arrangement is rendered ineffective so that the message currents may be transmitted for substantially the entire line time, that is, for both the transmitting and the switching time intervals.

The foregoing objects of this invention may be more readily understood when the following description of a preferred embodiment is read with reference to the attached drawings in which:

Figures 1, 2 and 3 show details of a telegraph system embodying the invention; and

Fig. 4 shows the manner in which Figs. 1, 2 and 3 are arranged to form a complete system.

Fig. 1 shows the apparatus located at three local or extension telegraph stations. These stations are connected to a central telegraph station shown in Fig. 2. Fig. 2 in turn is connected to a second central station. The second central station has connected to it three extension or local stations. As shown in Figs. 1, 2 and 3 the system is arranged for the transmission of message currents from the stations A, B and C of Fig. 1 to the respective stations A', B' and C' of Fig. 3. It is to be understood that it is within the scope of this invention to provide a similar system for the transmission of message currents from the extension stations A', B' and C' of Fig. 3 to the respective extension stations of Fig. 1.

As shown in Fig. 1, station A is provided with a keyboard perforator 10 for perforating tape 12 in accordance with the message currents to be transmitted.

The keyboard perforator 10 is not shown in detail because apparatus of this type is well known and because the keyboard perforator 10 operates in the usual manner. Details of typical perforators are more fully described in U. S. Patents 2,019,505, H. A. Reiber, November 5, 1935, and 1,969,891, R. A. Lake et al., August 14, 1934.

From the perforator 10 the tape 12 passes through a tape transmitter 11. The tape transmitter 11 is similar to the tape transmitter shown in U. S. Patents 1,965,572, W. C. Burcky et al., July 10, 1934; 1,965,602, R. A. Lake, July 10, 1934; and 2,055,567, E. F. Watson, September 29, 1936. The transmitter distributor 11 is provided with a group of tape controlled contacts 102, transmitting distributor 100 and associated con-

trol relay equipment. Extension stations B and C shown in Fig. 1 are provided with similar keyboard perforators 110 and 210 and the transmitter distributors 111 and 211 respectively.

5 The transmitting distributor 11 of station A is connected over leads 13, 14, 15 and 16 to the central or repeater station shown in Fig. 2. Suitable control relay equipment is provided at the central station, as shown in Fig. 2. Fig. 2 is also
10 provided with a transmitting distributor 139 which is connected through relay 48 and main line 58 to a second central or repeater station which is similarly provided with a distributor 151. The main line distributor 151 of the sta-
15 tion shown in Fig. 3 is connected to three local stations 174, 175, 176.

The main line 58 is shown in Fig. 3 as a channel of a voice frequency carrier telegraph system. In systems of this type the relays, such as
20 49 and 50, at the receiving end of the line follow the operations of transmitting relays, such as relay 48, at the sending end of the line or channel. As shown in Fig. 3, relays 49 and 50 are provided with biasing windings which are the lower wind-
25 ings and which are connected in an obvious biasing circuit. Each of these relays is also provided with an upper winding which is the line winding. These upper windings are connected in series and to suitable apparatus at the receiving end of the
30 carrier current channel or system. The currents flowing through the circuits of these two sets of windings are so adjusted that these relays respond to the operation of relay 48 at the transmitting end of the channel or system. Thus,
35 when the armature of relay 48 is operated to its left-hand position, the armatures of relays 49 and 50 are likewise caused to operate to their left-hand positions and when the armature of relay 48 is operated to its right-hand position
40 the armatures of relays 49 and 50 are likewise caused to operate to their right-hand positions. Carrier current telegraph systems of this type are described in detail in an article entitled "Carrier Current Telephony and Telegraphy" by E. H.
45 Colpitts and O. B. Blackwell, published at page 205 of vol. XL of the Transactions of the American Institute of Electrical Engineers for 1921, and in an article entitled "Voice-Frequency Carrier Telegraph System for Cables" by B. P. Hamilton,
50 H. Nyquist, M. B. Long and W. A. Phelps, published in the Journal of the American Institute of Electrical Engineers for March 1925, vol. XLIV, No. 3. It is to be understood, however, that this main line may comprise any of the well known
55 types of telegraph systems including duplex, simplex, polar, neutral, open wire, full metallic cable circuits, radio channel or any combination of these various types of circuits which is capable of transmitting telegraph signal impulses from
60 one station to another.

Normally, when the system is idle, that is, no messages or signals are being transmitted over it, the various relays remain in position as shown in the drawings. In addition the various distributor brush arms are held at rest by their respective stop latches. It is to be understood that these brush arms are driven through suitable friction clutches from continuously operating motors or other suitable motive power which op-
70 erates at substantially constant speed in accordance with the usual manner of operating start-stop telegraph systems.

One station sending

75 Assume first that only one of the three sta-

tions A, B and C, say station A in Fig. 1, desires to transmit message currents to its associated station A' of Fig. 3. The operator at station A of Fig. 1 perforates tape 12 by operating keys 91 of the keyboard perforator 10 in accordance with
5 the message to be transmitted. It is to be understood, of course, that the local power supply for the keyboard perforator, as well as for the transmitter distributor 11 which is shown at 97, is turned on so that the equipment at station A is
10 energized ready for operation.

When the operator perforates tape 12, the tape becomes loose and allows tape control contact 92 to close. Tape control contacts 92 in closing
15 complete a circuit for the operation of relay 93 from the positive terminal of rectifier 96 through tape control contacts 92, the upper break contacts of relay 94, winding of relay 93 to the negative terminal of rectifier 96 and ground.

Relay 93 in operating completes a circuit for
20 the operation of relays 17 and 18 at the central station shown in Fig. 2 to their left-hand contacts over a circuit from negative battery through the upper windings of relays 17 and 18, line 13, distributor segments 103 and 109 and distributor
25 brush 101, upper operated contacts of relay 93, line 14 to positive battery at the central station shown in Fig. 2.

The operation of relay 17 completes a circuit for the operation of relay 38, from negative bat-
30 tery through its left-hand contacts, winding of relay 38, segments 257 and 63 and brush 89 of distributor 139 to positive battery. Relay 38 in operating completes an obvious circuit for the operation of the start magnet 46 of distributor
35 139. The operation of the start magnet 46 withdraws the stop latch 189 and permits brush arm 83 to start to rotate.

Brush arm 83 in rotating carries brush 84 in contact with segments 62 and 160, which com-
40 pletes a circuit for the operation of relay 48 to its left-hand position from ground through the upper winding of relay 48, segment 62, brush 84 and segment 160 to positive battery. Relay 48 is normally held in its right-hand position by cur-
45 rent flowing in an obvious circuit through its lower winding. However, the current flowing through its upper winding overcomes the effects of the current flowing through the lower winding and causes the relay armature to move to its
50 left hand position. The operation of relay 48 to its left-hand position transmits a start impulse over line 53 to the distant central station for starting the brush arm carrying brush 152 of distributor 151.
55

The start impulse, when it arrives at the main station shown in Fig. 3, causes relays 49 and 50, which are normally maintained in their right-hand positions, to operate to their left-hand po-
60 sitions. In the left-hand position relay 50 completes a circuit for the operation of the start magnet 51 from positive battery through its left-hand contacts, segment 250, brush 152, segment 251, winding of start magnet 51 to negative bat-
65 tery.

The operation of relay 50 to its left-hand position by the start pulse also completes a circuit for the operation of relay 54 from positive bat-
70 tery through the contacts of relay 50, segment 250, brush 152 and segment 251 to negative bat- tery through the winding of relay 54. Operation of relay 54 interrupts a locking circuit for relays 26, 126 and 226, and permits these relays to release if they had been locked operated.

The operation of start magnet 51 withdraws 75

the stop latch and permits the brush arm carrying brush 152 to start to rotate. The speeds of the motors driving brush arm 83 and the brush arm carrying brush 152 should be maintained substantially the same and so that these brush arms remain substantially in phase with each other during each revolution in accordance with the usual manner and practice of operating start-stop distributors.

Returning now to Fig. 2, the operation of relay 18 prepares a circuit for the operation of relay 23. When brush arm 83 carries brush 84 over segment 33, a circuit is then completed for the operation of relays 23 and 48 from ground through the upper winding of relay 48, segments 62 and 33, brush 84 of distributor 139, winding of relay 23, operated left-hand contacts of relay 18 to positive battery. Relay 48 operates to or remains in its left-hand position in this circuit and transmits an impulse to the distant central station shown in Fig. 3.

When the impulse arrives at the main station shown in Fig. 3, brush 152 will be passing over segment 37. Consequently a circuit is completed for the operation of relay 26 from battery through the left-hand contacts of relay 50, which is operated to its left-hand position by the impulse, segment 250, brush 152, and segment 37 of distributor 151, winding of relay 26 to ground. Relay 26 in operating, completes a locking circuit from battery through the contacts of relay 54, right-hand operated contacts of relay 26 to ground through the winding of relay 26. The operation of relay 26 also connects line 171 from station 174 to distributor 151.

Returning again to Fig. 2, the operation of relay 23 completes a circuit for the operation of relays 24 and 25 from positive battery through the break contacts of relay 45, the operated contacts of relay 23 and windings of relays 24 and 25 to ground.

The operation of relay 24 as previously described completes a transmission circuit from contacts of relay 18 through the left-hand operated contacts of relay 24. The right-hand contacts of relay 24 complete a locking circuit for relays 24 and 25 from battery through the left-hand break contacts of relay 45, right-hand operated contacts of relay 24 to ground through the windings of relays 24 and 25.

The operation of relay 25 prepares a circuit for the operation of relay 94 of the transmitter distributor shown in Fig. 1. Then when brush arm 63 carries brush 89 over segment 35, a circuit is completed for the operation of relay 94 from positive battery through ring 63, brush 89, segment 35 of distributor 139, operated contacts of relay 25, line 15, winding of relay 94 to ground. The operation of relay 94 completes a locking circuit for relay 93 from ground through the winding of relay 93, the operated uppermost contact of relay 94, to the positive terminal of rectifier 96. The operation of relay 94 also completes a circuit for the operation of the start magnet 98 of the distributor 11 from ground through the winding of the start magnet 98, operated inner contacts of relay 94, contacts 92 controlled by the tape to the positive terminal of rectifier 96. The operation of the start magnet 98 removes the stop latch 99 from engagement with the brush arm 100 and permits the brush arm 100 to rotate to transmit the signaling impulses in accordance with the perforations in the tape under the tape control contacts 102.

Relays 17 and 18 of Fig. 2 follow the signaling

impulse transmitted by the transmitting distributor 11 at station A. Relay 18 repeats the impulse in a circuit from positive battery through its contacts, the operated contacts of relay 24, segment 34, brush 84 and segment 62 of distributor 139 to relay 48. Relay 48 then repeats the signals over the line 58 to a distant station. Relay 17 repeats the signals through its right-hand contacts, the left-hand contact of relay 25, line 16 and lower contacts of relay 93 to relay 95 at station A. Relay 95 repeats the signaling impulses to the printer magnet 153 and causes them to be recorded at station A for the "home copy" of the signals transmitted therefrom.

At the distant station shown in Fig. 3 the signals are received by relays 49 and 50. Relay 49 repeats the signaling impulses to relay 27, associated station A' or 174 over a circuit from negative battery through its contacts, segment 150, brush 152, segment 36 of distributor 151, operated left-hand contacts of relay 26, line 171, upper winding of relay 27 to ground. Relay 27 repeats the signal impulses to the printer magnet or other receiving device 28 at station 174 where the signals are received.

Thus, during the time brush 84 is passing over segment 34 and brush 89 is passing over segment 35 of distributor 139, and brush 152 is passing over segment 36 of distributor 151, a transmission circuit is completed from station A of Fig. 1 to station A' of Fig. 3. During this time transmitting distributor 139 will permit transmitting distributor 11 at station A to transmit messages stored in tape 12 so long as there is a sufficient amount of perforated tape available to transmit from. It is to be noted that the transmission path is completed during the time brush 84 is passing over segment 34 but that transmission takes place only when brush 89 is passing over segment 35 plus the short interval required to complete the transmission of the last character being transmitted when brush 89 passes off of segment 35.

If, as assumed above, station A is the only station transmitting, transmission and control circuits between station A of Fig. 1 and station A' of Fig. 3 are also completed during the most of the remainder of the revolution of brush arms carrying brushes 84, 89 and 152. With only station A transmitting, only relays 17, 18, 23, 24, 25 and 26 will be operated as brushes 84 and 152 pass over the respective segments 33, 133 and 233; and 37, 137, 237. The remaining relays 117, 118, 123, 124, 125, 126, 217, 218, 223, 224, 225 and 226 will remain unoperated.

Under these conditions, during the time brush 84 is passing over segment 134 of distributor 139 and brush 152 is passing over segment 136 of distributor 151, a transmission path is completed from the contacts of relay 18, operated left-hand contacts of relay 24, left-hand break contacts of relay 124, segment 134, brush 84, segment 62 to relay 48. At the second central station shown in Fig. 3 the transmission path extends from the contacts of relay 49, segment 150 and brush 152, segment 136 of distributor 151, left-hand break contacts of relay 125 and left-hand make contacts of relay 26 to station 174 (station A') over the line 171. Similarly, during the time brush 84 is passing over segment 234 and brush 152 is passing over segment 236, the transmission path may be traced from contacts of relay 18 through the operated left-hand contacts of relay 24, the left-hand break contacts of relay 124, left-hand break contacts of relay 224, segment 234, brush

84, segment 62 to relay 48, line 58, relay 49 and from relay 49 through segment 150, brush 152, segment 236, distributor 151, left-hand break contacts of relay 226, left-hand break contacts of relay 126, left-hand make contacts of relay 26 to station 174 over line 171.

In addition a control circuit of relay 94 over line 15 is also closed during this time. The path for the operation of relay 94 during the time brush 89 is passing over segment 35 has already been traced. During the time brush 89 is passing over segment 64, a circuit may be traced from ring 63, brush 89, segment 64, left-hand break contacts of relay 125, right-hand operated contacts of relay 25 to line 15. During the time brush 89 is passing over segment 135, this circuit may be traced from ring 63 to brush 89, segment 135, right-hand break contacts of relay 125, right-hand operated contacts of relay 25 to line 15 and thence through winding of relay 94 to ground. During the time brush 89 is passing over segment 65, the circuit may be traced from segment 63, through brush 89, segment 65, left-hand break contacts of relay 225, right-hand break contacts of relay 125, right-hand operated contacts of relay 25 and thence to relay 94 over line 15. During the time brush 89 is passing over segment 235, the circuit is traced from battery through ring 63, brush 89, segment 235, right-hand break contacts of relay 225, right-hand break contacts of relay 125, right-hand operated contacts of relay 25 over line 15 to relay 94.

Thus during the major portion of the revolution of the start-stop distributors 139, 151 the transmission and control circuits for the transmission of impulses from station A of Fig. 1 to station 174 of Fig. 3 are completed so that the message current impulses may be transmitted between these stations. It is to be noted that at the beginning of the revolution an impulse is transmitted over line 58, which conditions apparatus at the second station so that all of the impulses are directed to station 174.

In order to prevent brush 84 from momentarily interrupting the transmission circuit when it passes from segments 34 to 134 and from segments 134 to 234, brush 84 should be designed so that it will make contact with segment 134 a short interval before it breaks contact with segment 34. It should also make contact with segment 234 before it breaks contact with segment 134.

Had the impulses been transmitted from stations B or C of Fig. 1, similar transmitting paths to the corresponding stations 175 and 176 of Fig. 3 could be traced through the system thus provided for transmitting impulses from these stations during substantially all of the line time if only one of the stations A, B or C desires to transmit to its associated station 174, 175 or 176 at any given time.

Just before the brush arm of the distributor 139 has come to rest, a circuit is completed for the operation of relay 45 (Fig. 2) in a circuit from ground to the segment 256, brush 84, segment 255 to battery through the winding of relay 45. The operation of relay 45 interrupts the locking circuits for relays 24 and 25 and causes them to release and restore the circuit to its normal condition.

If station A is still the only station which wishes to transmit signal impulses, the above cycle of operation will be repeated.

If the supply of perforated tape at station A becomes exhausted, the tape controlled contacts

92 will be opened. This interrupts the operating circuit of the start magnet 98, which in turn releases the stop latch 99. After completion of transmission of the group of impulses then in progress, brush arm 100 will engage stop latch 99 and come to rest, thus interrupting the transmission of impulses from station A. It is noted, however, that the relay 93 does not interrupt the transmitting circuit until the control circuit of relay 94 is interrupted at the central station. When this occurs relay 94 releases, which in turn releases relay 93. Relay 93 will release and interrupt the transmission circuit of station A. This permits relays 17 and 18 to return to their right-hand positions due to current flowing in an obvious circuit through their lower windings, thus restoring the entire system to its idle condition.

Relay 93 is made slow in releasing so that it will maintain the transmission circuit closed a short interval of time after the control circuit of relay 94 is released. This is to insure that the transmission circuit to station A will remain closed until after the transmission of the last impulse of the code combination being transmitted when the control circuit is opened at the central station. This insures the transmission of the proper code combination to the distant station.

Two or more stations transmitting at the same time

Assume now that during the transmission of messages from station A it is desired to transmit from station B. The operator at station B will operate the keys (not shown) of the keyboard perforator 110 and perforate a supply of tape 112. This will permit a contact, similar to contact 92, at station B to close. This in turn causes relays 117 and 118 to operate to their left-hand positions. Relay 117 in this case merely prepares a circuit for the operation of relay 38 since the brush arm 83 will not usually be in the stop position. Similarly relay 118 prepares a circuit for the operation of relay 123. Nothing further takes place except in the transmission of station A as described above until brush arm 83 returns to its stop position. When brush arm 83 returns to its stop position, the circuit is completed for the operation of relay 38. It should be noted that relay 38 is made slow in operating so as to maintain the brush arm 83 at rest for a short interval of time to insure that the brush arm carrying brush 152 at the distant station will have ample time to complete its revolution and come to rest against the stop latch controlled by start magnet 51. Relay 38 in operating completes an obvious circuit for the operation of start magnet 46, which in turn again releases brush arm 83 and permits it to rotate. As described above, this transmits a starting impulse over line 58 and causes the brush arm carrying brush 152 to start to rotate. The start pulse also causes relay 54 to operate, which in turn interrupts a locking circuit for relay 26 and permits this relay to release.

As before, when brush 84 passes over segment 33 it transmits an impulse over line 58, which is repeated by relay 50 through segment 37 to relay 26, which causes the relay 26 to operate and lock, as described above. Then, when brush 84 passes over segment 133, a circuit is completed for the operation of relays 123 and 48. The operation of relay 48 transmits an impulse over the line 58. When this impulse is received from line 58 by

relay 50, brush 152 will be passing over segment 137 of the distributor 151 and will complete a circuit for the operation of relay 126 from the left-hand contacts of relay 50, segment 250, brush 152 and segment 137 of distributor 151 to ground through the winding of relay 126. Relay 126 in operating completes its locking circuit from battery through the break contacts of relay 54 and right-hand contacts of relay 126 to ground through the winding of relay 126. Relay 126 also connects line 172 from station 175 to distributor 151.

Relay 123 in operating completes a circuit for the operation of relays 124 and 125 from battery through the break contacts of relay 45, the operated contacts of relay 123 to ground through the windings of relays 124 and 125. Relay 124 in operating extends the transmission circuit from station B to distributor 139 through its left-hand contacts. Relay 124 in operating completes a circuit for locking relays 124 and 125 operated from battery through the break contacts of relay 45, the right-hand operated contacts of relay 124 to ground through the windings of relays 124 and 125.

As described above, during the time brush 84 is passing over segment 34 and brush 152 is passing over segment 36, the transmission circuit between station A of Fig. 1 and station 174 (station A' of Fig. 3) is completed. During the time brush 89 passes over segment 35, the control circuit of relay 94 is closed, causing the transmitting distributor 11 to transmit impulses over the transmission circuit during this time. It is to be noted that the segment 35 is somewhat shorter than segment 34, thus insuring that the transmission circuit is fully established when the transmission from station A starts and remains closed a short interval of time after the transmission stops so that all of the message current impulses transmitted from station A will be received by station 174.

In this case, with both stations A and B transmitting, when brush 89 passes over segment 64 the transmission over line 58 will be interrupted because none of the control circuits of any of the stations A, B or C will be completed since the circuit of segment 64 is open at the left-hand inner contact of relay 125.

During the time brush 84 is passing over segment 134 and brush 152 is passing over segment 136, a transmission circuit is completed from station B of Fig. 1 to station 175 (station B' of Fig. 3). This transmission circuit may be traced from the contacts of relay 118, the operated left-hand contacts of relay 124, segment 134, brush 84 and segment 62 of distributor 139 to relay 48. At the distant station the transmission circuit may be traced from the contacts of relay 49 through segments 150, brush 152 and segment 136 of distributor 151, left-hand operated contacts of relay 126 to station 175 over line 172. Similarly control circuit of station B is completed when brush 89 passes over segment 135 from positive battery through ring 63, brush 89, segment 135, operated right-hand contacts of relay 125, to station B over line 115. During this time the signaling impulses are transmitted from station B to the associated station 175, Fig. 3.

Under the conditions assumed with both stations A and B transmitting, the transmission circuit as well as the control circuit will be completed for the transmission of signaling impulses from station B of Fig. 1 to the associated station

175, Fig. 3, during a large portion of the remainder of the revolution of brush arm 83. During the time brush 84 is passing over segment 234, the transmission circuit of relay 118 may be traced from the contacts of relay 118, left-hand operated contacts of relay 124, left-hand break contacts of relay 224, segment 234, brush 84, segment 62 to ground through the upper winding of relay 48. At the distant station during this time brush 152 passes over segment 236 and completes the transmission path from the contacts of relay 49 through the segment 150, brush 152 and segment 236 of distributor 151, left-hand break contacts of relay 226 and the left-hand operated contacts of relay 126 to station 175 over lead 172.

During this time the control circuit for station B is completed by brush 89 passing over segment 65 and 235. During the time brush 89 is passing over segment 65, the control circuit may be traced from battery connected to ring 63, brush 89 and segment 65 of distributor 139, left-hand break contacts of relay 225, right-hand operated contacts of relay 125 to station B over lead 115. During the time brush 89 is passing over segment 235, the control circuit may be traced from battery connected to ring 63, brush 89, segment 235, right-hand break contacts of relay 225, right-hand operated contacts of relay 125 to station B over line 115.

Thus when both stations A and B wish to transmit at the same time, the transmitting path is completed from station A during the time brush 84 is passing over segment 34 of distributor 139 and the actual transmission from station A will take place during the time brush 89 passes over segment 35. Then, during the time brush 89 passes over segment 64, transmission over the main line is interrupted.

During the time brush 84 is passing over segments 134 and 234, the transmission path from station B is completed and transmission from station B takes place during the time brush 89 is passing over segments 135, 65 and 235.

If stations A and C wish to transmit at the same time, directing impulses will be transmitted over line 58 during the time brush arm 84 passes over segments 33 and 233. These impulses will cause relays 26 and 226 to operate at the distant central or repeater office. Then, during the time brush 89 is passing over segments 35, 64 and 135, transmission will take place from station A; while the brush 89 is passing over segment 65, transmission over line 58 is interrupted. During the time brush 89 is passing over segment 235, transmission takes place from station C of Fig. 1 to station 176.

Similarly, if B and C wish to transmit impulses at the same time, impulses will be transmitted from station C during the time brush 89 is passing over segment 35 and over segment 235. Impulses will be transmitted from station B during the time brush 89 is passing over segment 135 and transmission of impulses over line 58 will be interrupted during the time brush 89 is passing over the segments 64 and 65.

In case all three stations A, B and C wish to transmit impulses at the same time, impulses will be transmitted from station A during the time brush 89 is passing over segment 35, from station B during the time brush 89 is passing over segment 135, and from station C during the time brush 89 is passing over segment 235.

Thus transmission over the main line is interrupted for an interval of time between the trans-

mission from successive stations in order to allow sufficient time to insure transmission circuits at both ends of the line have been switched from one station circuit to another. In addition, in case one or more of the lines or extension stations are idle, connection between it and the main distributor for transmitting the impulses over the line to the distant station is transferred to an active station, i. e., the station desiring to transmit signal impulses at that time. In addition, it should be noted that at the beginning of each revolution directing impulses are transmitted over line 58 for conditioning the apparatus at the distant central or repeater office so that the impulses will be transmitted to the respective receiving stations.

It is to be noted that after brush 84 passes over segments 33, 133 and 233, the circuits at both ends of the line remain set for the remainder of the revolution of the main distributors so that transmission cannot start from any of the other stations until after the completion of that particular revolution.

In case two or more of the stations simultaneously wish to start transmission, the operation of the circuits will be substantially as described above since the circuits will be properly set at the beginning of the first revolution of the main line distributors.

What is claimed is:

1. In a telegraph system, a main line, a single start-stop distributor connected to one end of said main line for providing a number of operative connections to said main line, a plurality of extension lines, means for rendering said extension lines active, and switching apparatus for extending all of said operative connections to active extension lines.

2. A telegraph system comprising a main line, a single start-stop distributor connected to one end of said main line, a second start-stop distributor connected to the other end of said main line, a number of extension lines cooperating with one end of said main line, the same number of extension lines cooperating with the other end of said main line, means for establishing an operative connection between said start-stop distributors and the respective extension lines for completing a transmission path from each of said extension lines associated with one end of said main line to a corresponding extension line associated with the other end of said main line during each revolution of said start-stop distributors, and switching apparatus for extending all of said operative connections to active extension lines.

3. A telegraph system comprising a main line,

a plurality of extension lines, means individual to each of said extension lines for rendering said extension lines active, a single start-stop distributor connected to one end of said main line for providing at least as many operative connections to said main line as there are extension lines, and switching apparatus for extending all of said operative connections to active extension lines.

4. In a telegraph system, a main line, a plurality of extension lines, a start-stop distributor connected to the end of said main line, means for establishing an operative connection between said start-stop distributor and each of said extension lines for completing a transmission path from each of said extension lines to said main line during each revolution of said start-stop distributor, and an additional apparatus for transmitting signaling impulses during each revolution of said start-stop distributor for indicating active extension lines.

5. A communication system comprising a main line, start-stop distributors connected to the ends thereof, a plurality of extension lines, transmitting and receiving apparatus connected to said extension lines, means for establishing an operative connection between said start-stop distributors and said extension lines for completing a communication path between each of said extension lines and said main line during each revolution of said start-stop distributors, means for interrupting the transmission over said system for short intervals of time between the transmission from one of said extension lines and the transmission from a succeeding line, switching apparatus for extending all of said operative connections to active extension lines, and means for rendering said transmission interrupting means ineffective when the transmission continues from the same extension line for successive intervals.

6. The method of operating a multichannel communication system which comprises dividing the line time into a continuously repeated series of a number of intervals of time, assigning one of said intervals of time of each series for the transmission of impulses indicating the channels conditioned to transmit during a succeeding series of intervals of time, and assigning all the remaining intervals of time of each series to only the channels of said system which are conditioned to transmit impulses thereover.

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