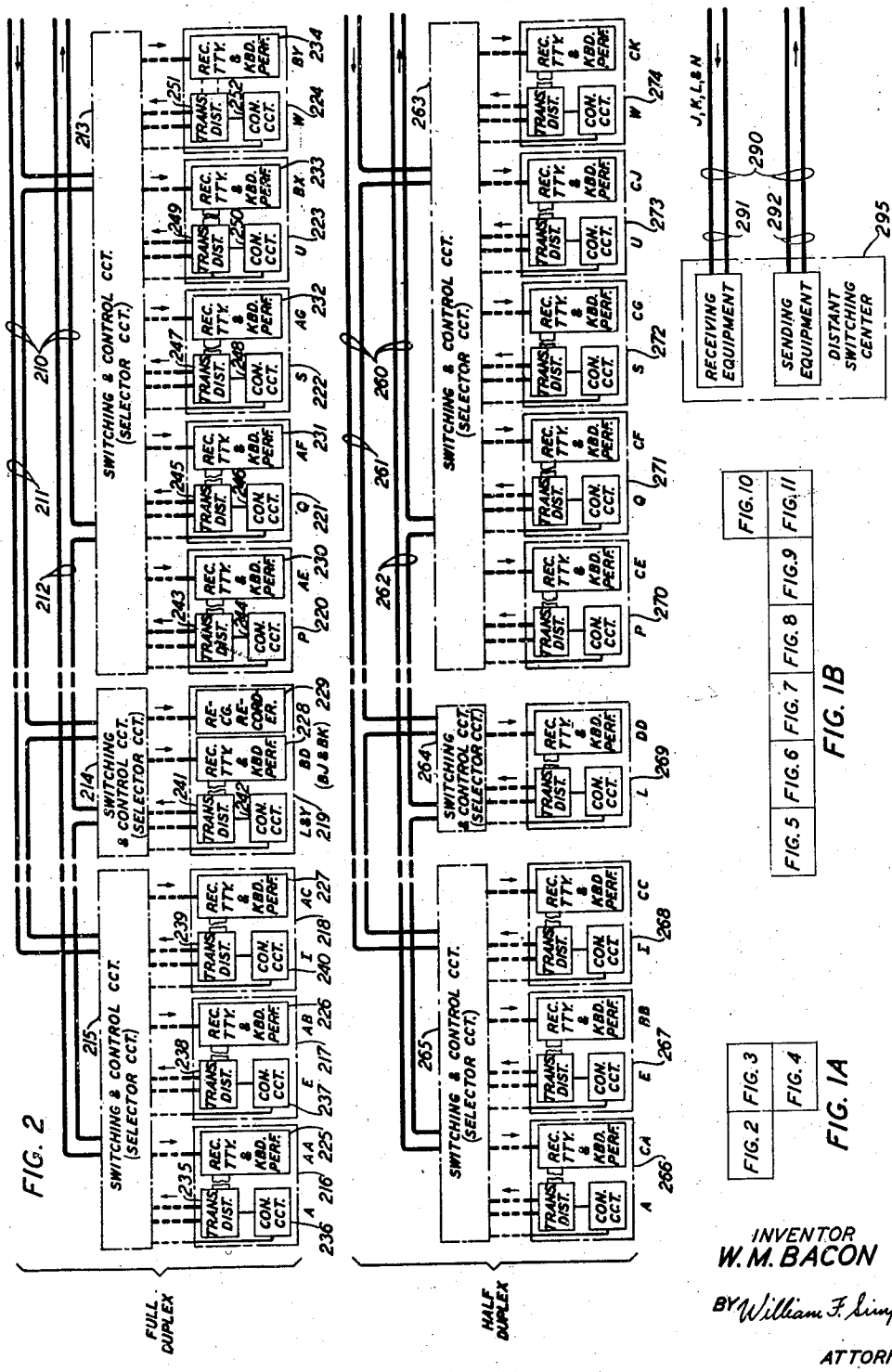
Dec. 10, 1946. W. M. BACON 2,412,198

TELEGRAPH SWITCHING SYSTEM

Filed Sept. 24, 1943 10 Sheets-Sheet 1




INVENTOR
W. M. BACON
BY William F. Simpson.
ATTORNEY

Dec. 10, 1946. W. M. BACON 2,412,198

TELEGRAPH SWITCHING SYSTEM

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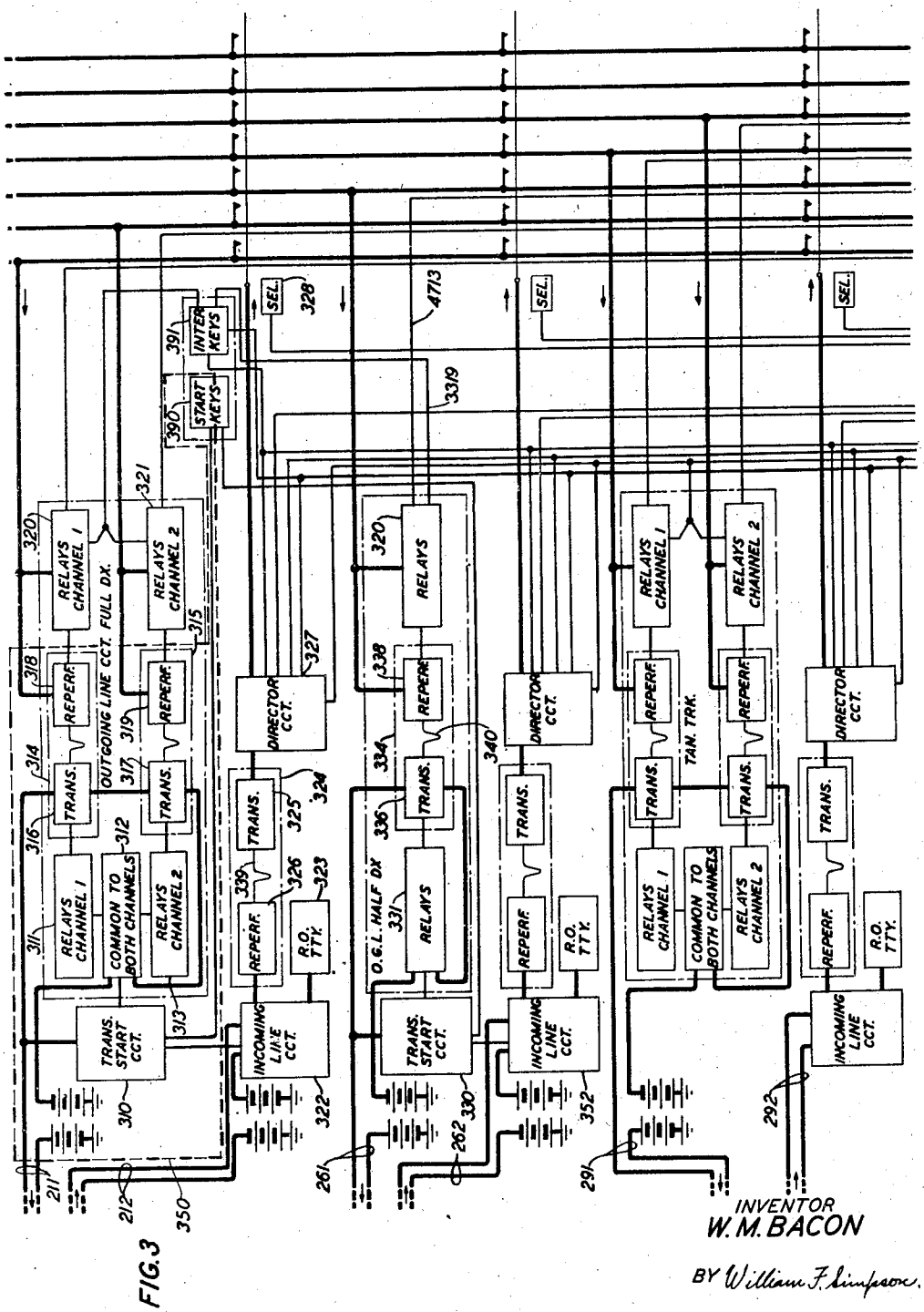



FIG. 3

INVENTOR
W. M. BACON

BY William F. Simpson

ATTORNEY

Dec. 10, 1946. W. M. BACON 2,412,198

TELEGRAPH SWITCHING SYSTEM

Filed Sept. 24, 1943 10 Sheets-Sheet 3

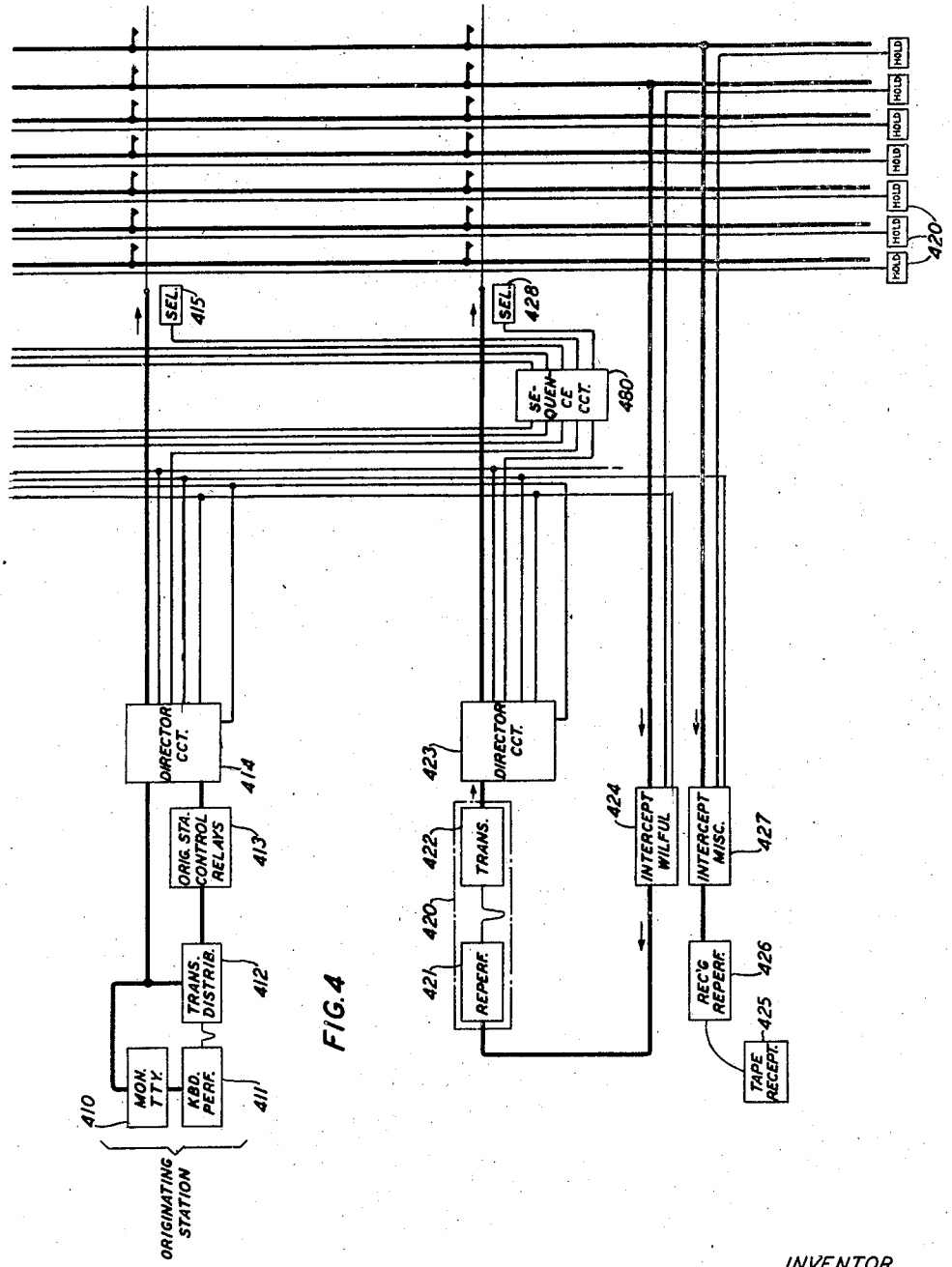



FIG. 4

INVENTOR
W. M. BACON
BY William F. Simpson
ATTORNEY

Dec. 10, 1946. W. M. BACON 2,412,198

TELEGRAPH SWITCHING SYSTEM

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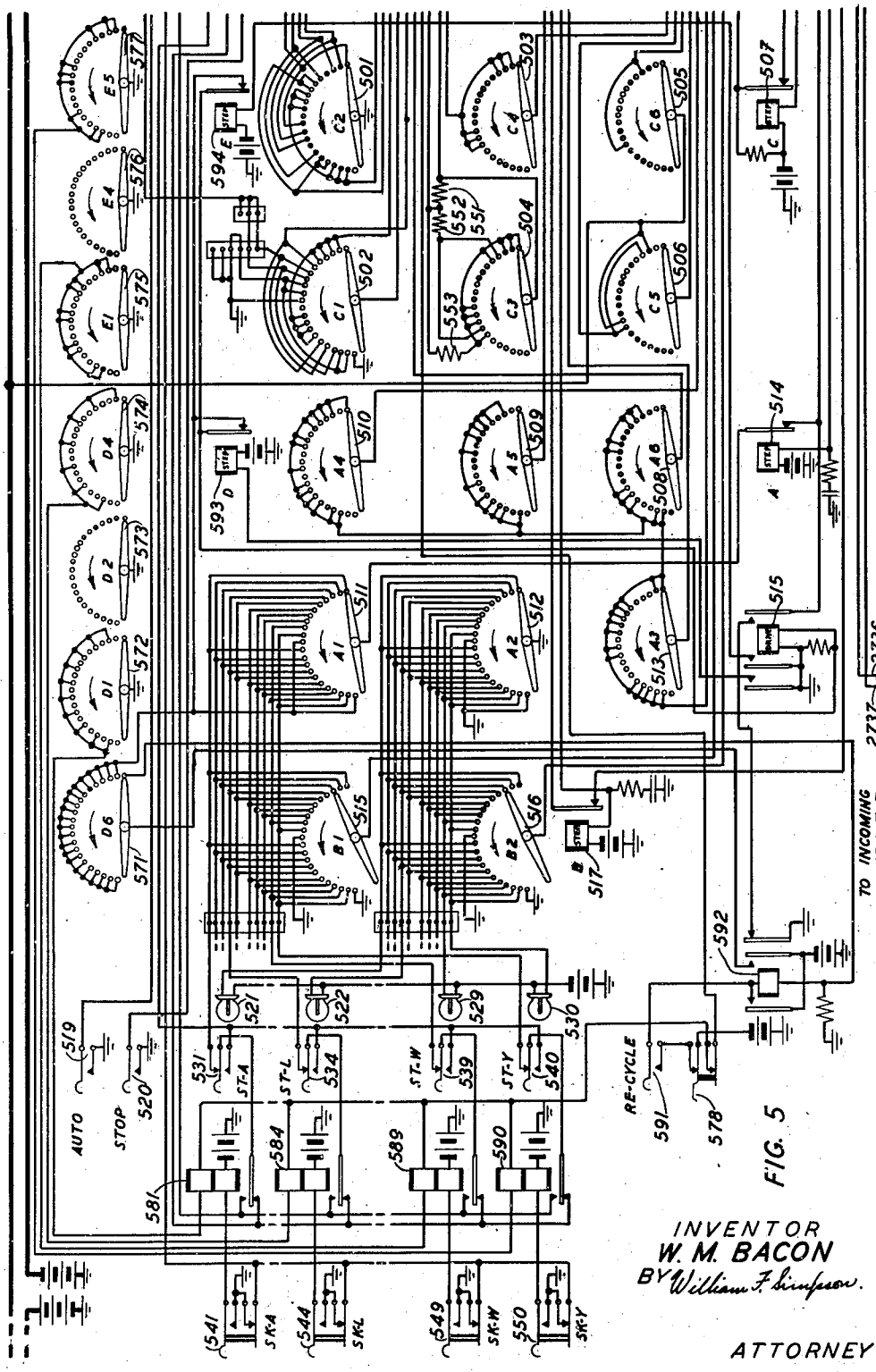



FIG. 5

INVENTOR
W. M. BACON
BY William F. Simpson.

ATTORNEY

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TELEGRAPH SWITCHING SYSTEM

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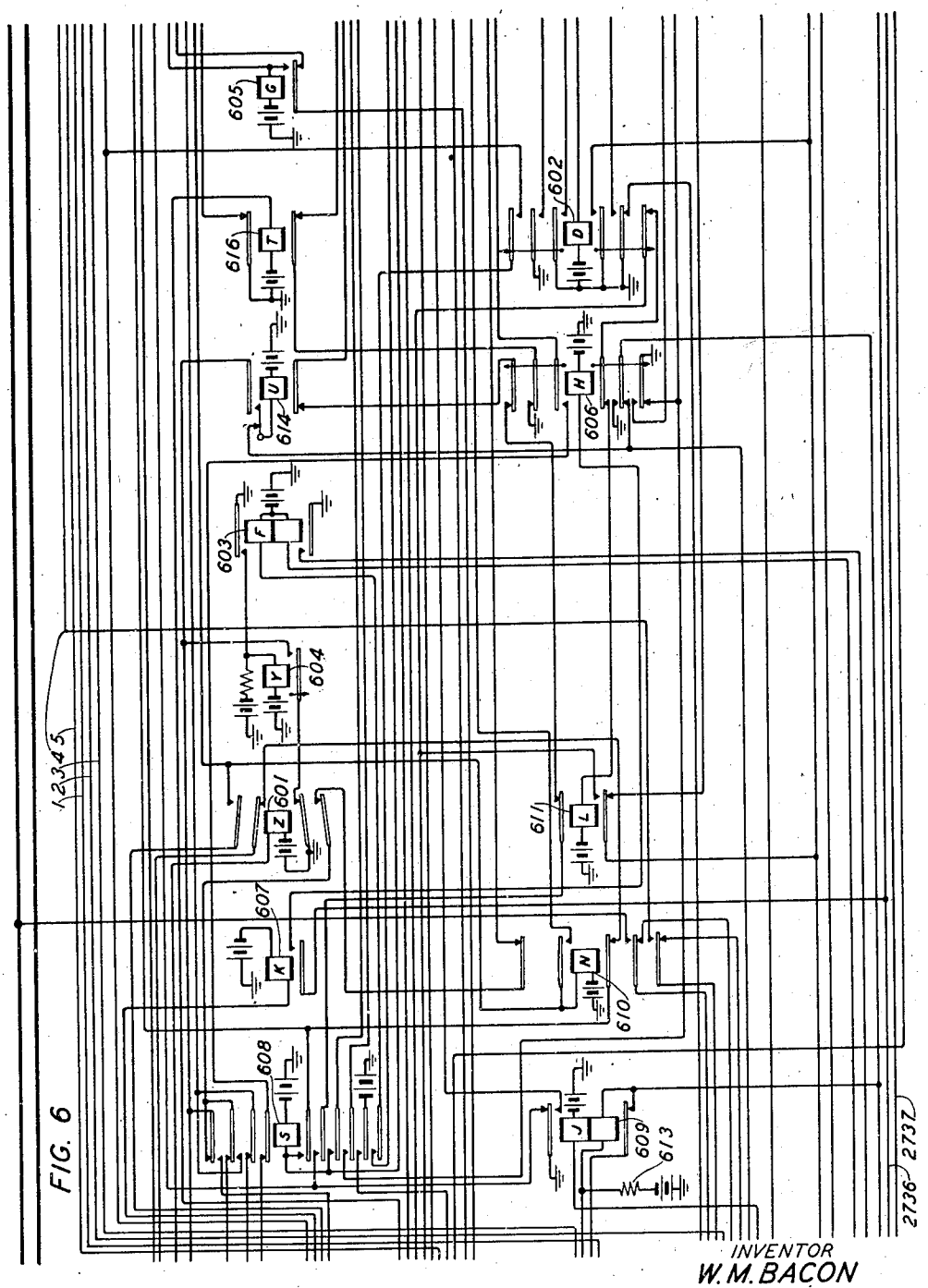



FIG. 6

INVENTOR
W. M. BACON
BY William F. Simpson.
ATTORNEY

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TELEGRAPH SWITCHING SYSTEM

Filed Sept. 24, 1943 10 Sheets-Sheet 6

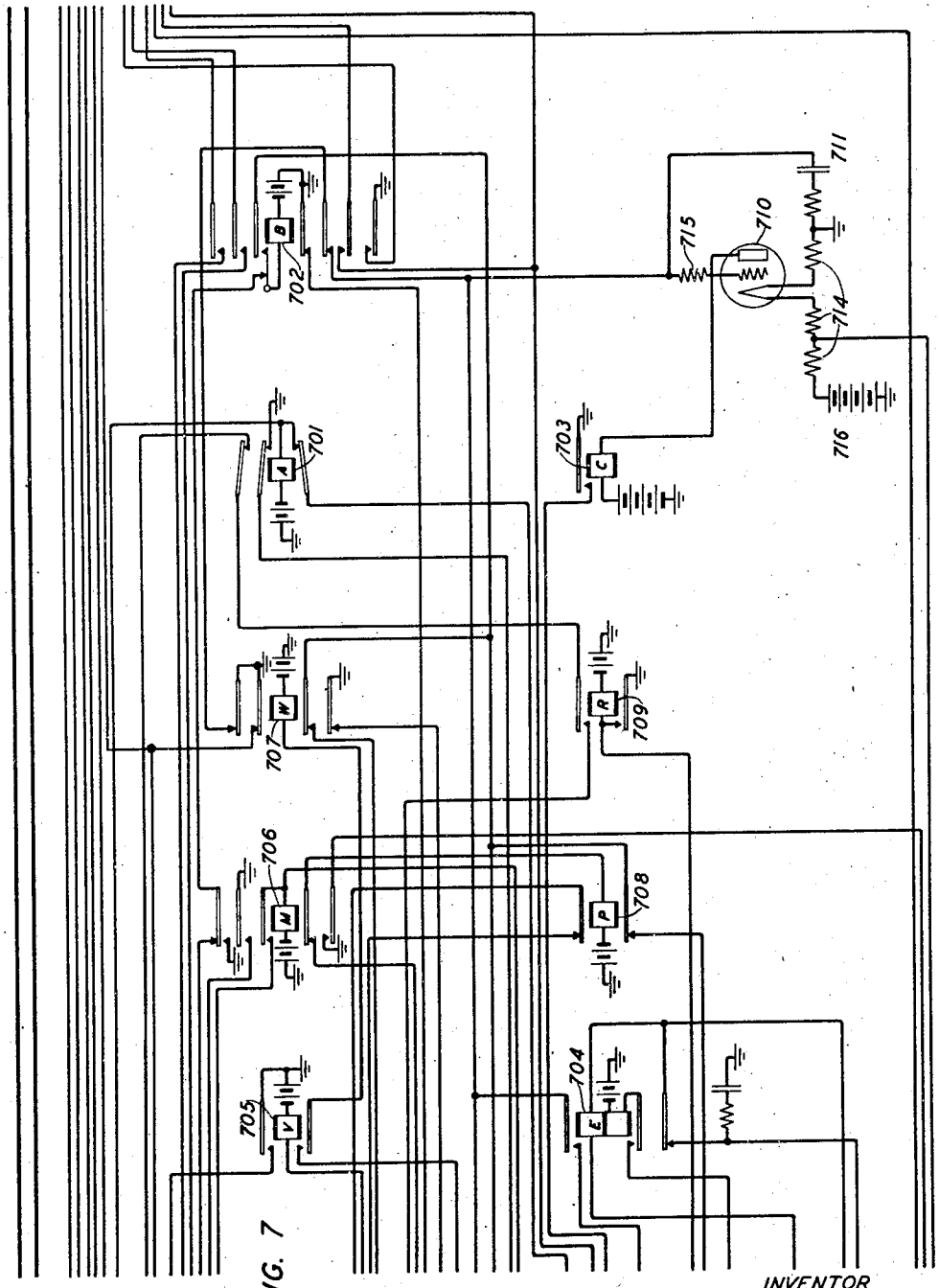



FIG. 7

INVENTOR
W. M. BACON
BY William F. Simpson

ATTORNEY

Dec. 10, 1946. W. M. BACON 2,412,198

TELEGRAPH SWITCHING SYSTEM

Filed Sept. 24, 1943 10 Sheets-Sheet 7

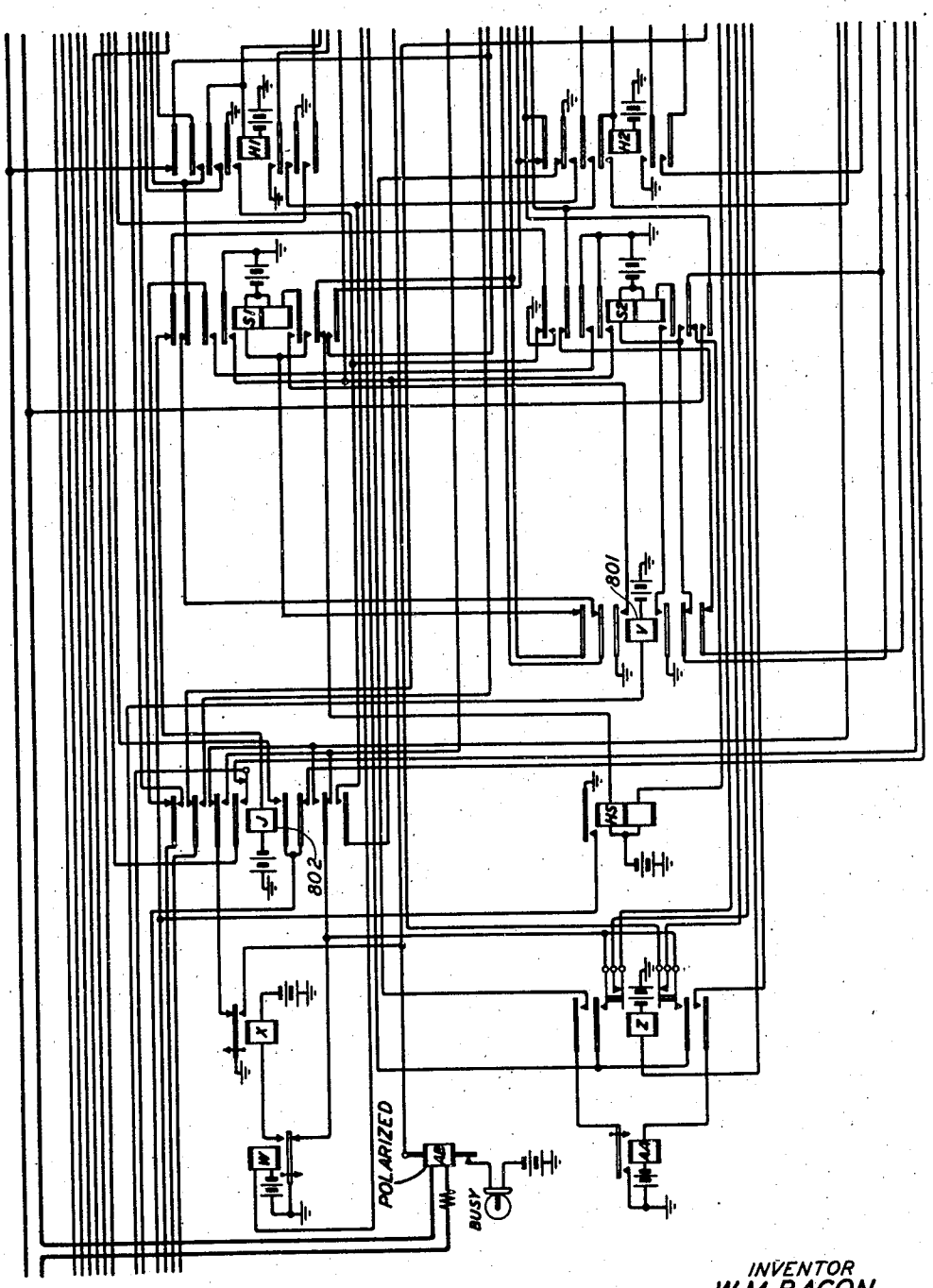



FIG. 8

INVENTOR
W. M. BACON

BY William F. Simpson

ATTORNEY

Dec. 10, 1946. W. M. BACON 2,412,198

TELEGRAPH SWITCHING SYSTEM

Filed Sept. 24, 1943 10 Sheets-Sheet 8

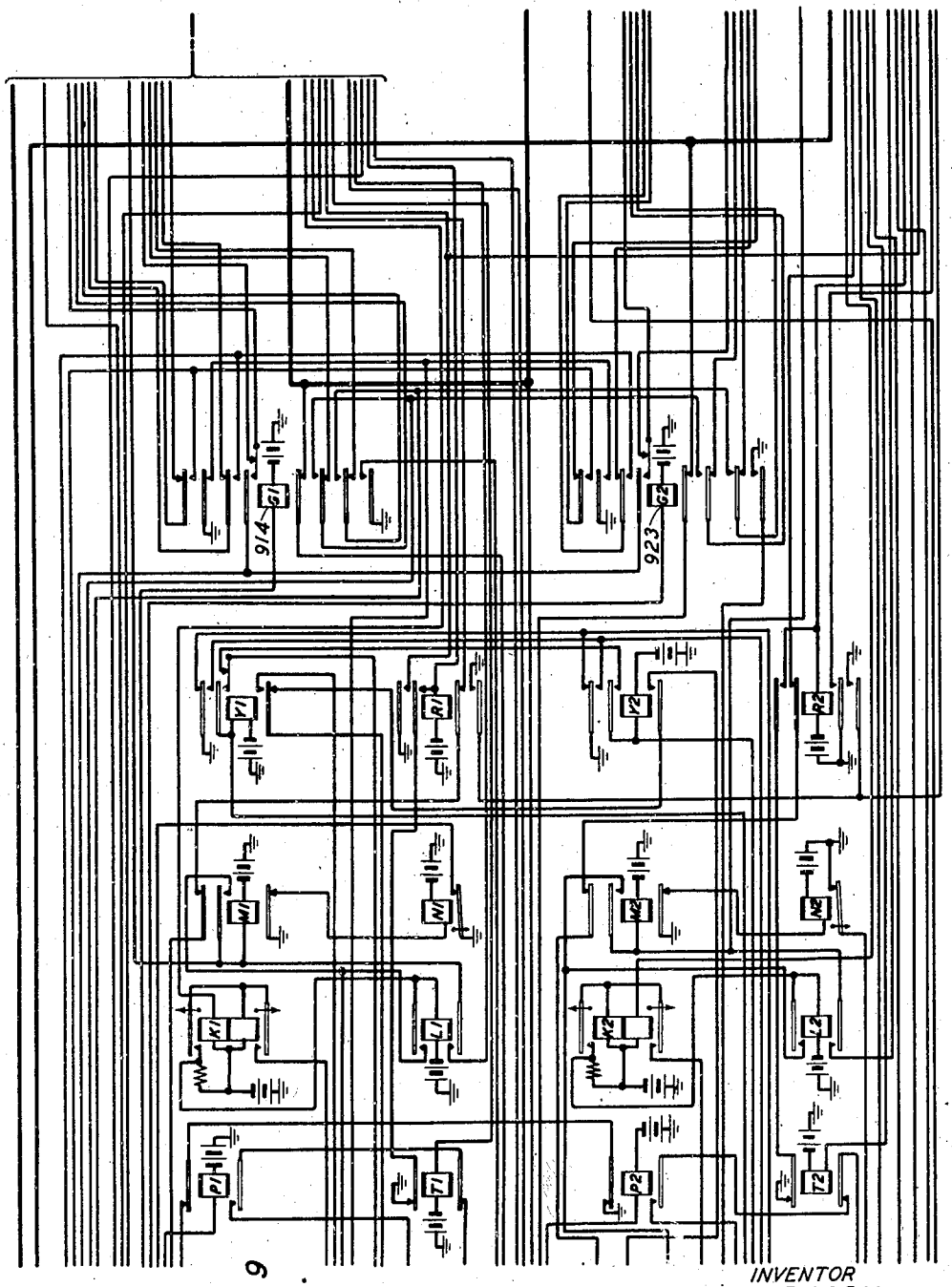



FIG. 9

INVENTOR
W. M. BACON
BY William F. Simpson.
ATTORNEY

Dec. 10, 1946. W. M. BACON 2,412,198

TELEGRAPH SWITCHING SYSTEM

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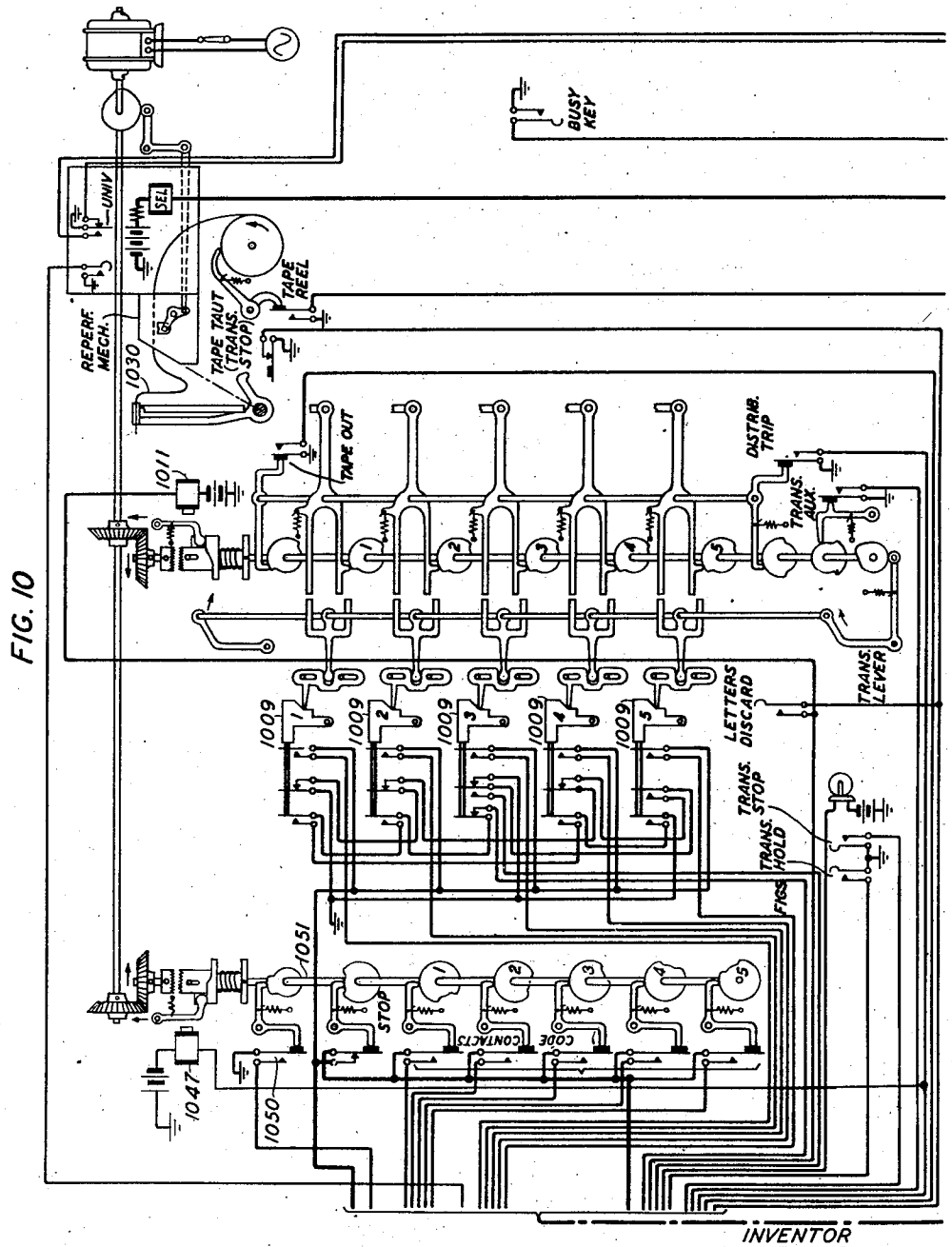



FIG. 10

INVENTOR
W. M. BACON
BY William F. Simpson.
ATTORNEY

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TELEGRAPH SWITCHING SYSTEM

Filed Sept. 24, 1943 10 Sheets-Sheet 10

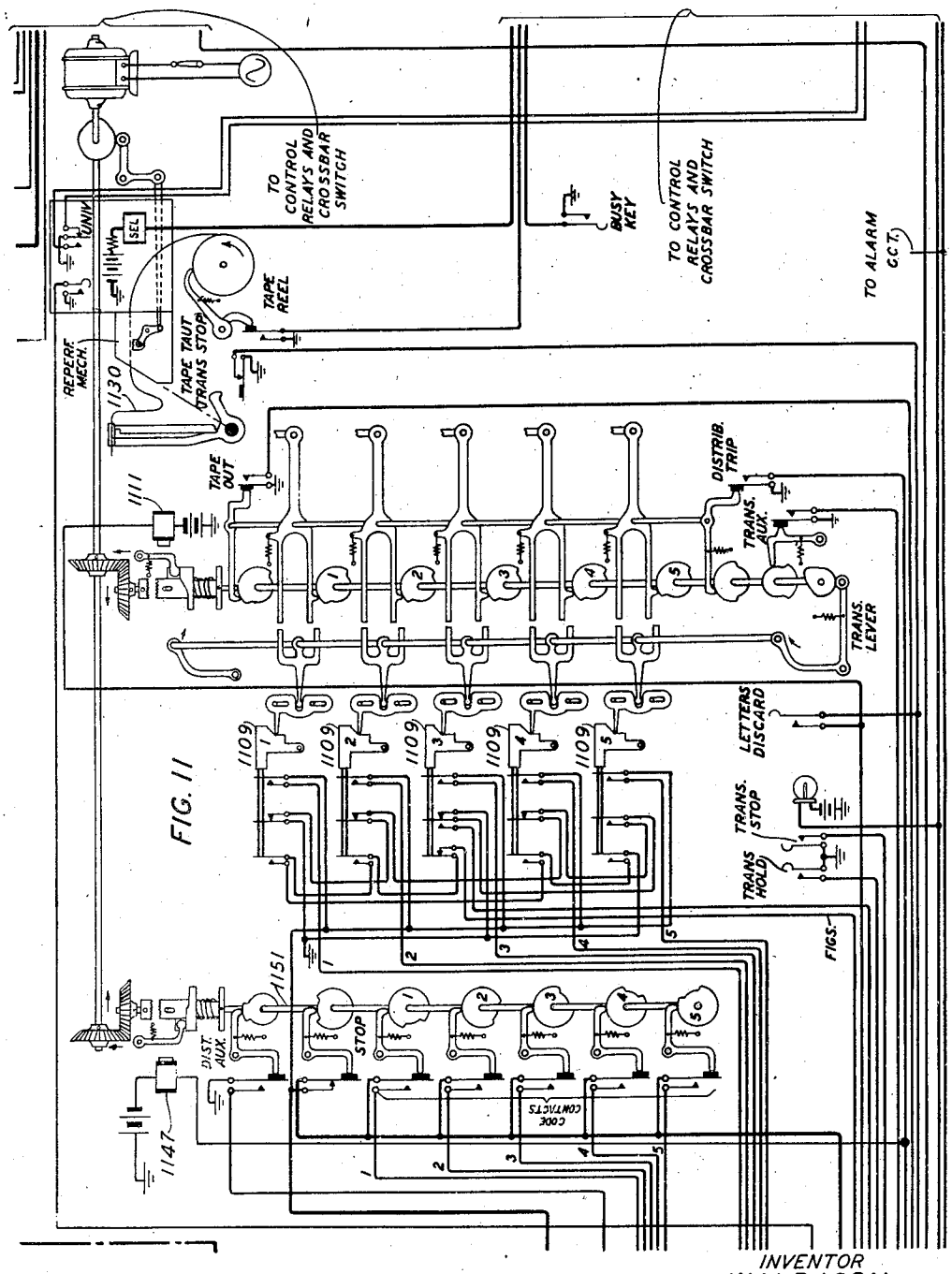



FIG. 11

INVENTOR
W. M. BACON
BY William F. Simpson.
ATTORNEY

Patented Dec. 10, 1946 2,412,198

# UNITED STATES PATENT OFFICE

2,412,198

## TELEGRAPH SWITCHING SYSTEM

Walter M. Bacon, New York, N. Y., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

Application September 24, 1943, Serial No. 503,599

18 Claims. (Cl. 178—3)

1

This invention relates to communication systems and more particularly to automatic telegraph switching systems in which storage controlled transmitting apparatus at outlying telegraph stations is automatically set into operation for transmitting stored messages from the outlying stations to the central switching station under control of equipment at the central switching station.

The object of the present invention is to provide an improved telegraph system with increased flexibility in the manner of controlling transmission from a plurality of outlying transmitters to a central switching station.

In accordance with an exemplary embodiment of the invention, the system disclosed in United States patent application, Branson et al. Serial No. 448,878, filed June 27, 1942, has been improved to increase the flexibility of the control arrangement for initiating the transmission of messages from the outlying stations to the central switching station.

In accordance with the system disclosed in the said Branson application, means are provided to enable the operator or attendant at the central switching station to manually at will start the transmission of any transmitter associated with any of the lines extending from the central switching station, provided that line is not engaged in the transmission of a message from some transmitter to the central switching station. Means are also provided to interrupt transmission from any transmitter toward the central switching station and thereafter initiate transmission from any other transmitter. In that application, means are also disclosed for automatically testing these transmitters for storage material available for transmission to the central switching station and initiating transmission from transmitters which are provided with such material in rotation one at a time.

In the system disclosed in said Branson application means are also provided for testing and initiating transmission from certain of the transmitters more often than from others of the transmitters. This means, however, requires extensive wiring changes and at times the utilization of an individual code for each turn given to any transmitter in the complete cycle of testing all of the transmitters. In addition in said application manual means are provided for preventing the testing and initiation of transmission of any one or more of the transmitters.

In accordance with this previous application, the system is arranged so that the transmitters

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are tested in the same order during each cycle of operation and the same number of times, unless a manual operable key individual to each transmitter has been operated or released.

In accordance with the present invention, means are provided for automatically changing the order and frequency of testing of the various transmitters in cyclic order without requiring the necessity of changing solder connections, without manually operating any key individual to each of the transmitters and without requiring an individual code combination or group of code combinations for each turn or test of a transmitter during a cycle of operation. In other words, a feature of the present invention relates to provision of an automatic skip circuit which may be arranged to cause the transmitter start or control equipment to automatically skip any one or more of the transmitters associated with any line during any cycle operation of the transmitter start circuit.

Thus, in accordance with the present invention, means are provided for automatically varying the frequency and/or order of testing the various transmitters associated with any of the party lines, thus enabling the traffic from the various stations to be handled most expeditiously and enabling the system to be operated at its highest efficiency.

A feature of the present invention relates to apparatus for incorporating the above apparatus and features embodying the present invention in the system disclosed in said Branson application without interfering with or eliminating any of the features of the system described in said above-identified copending Branson application.

The foregoing objects and features of the present invention, the novel features of which are specifically set forth in the claims appended hereto, and may be more readily understood from the following description when read with reference to the attached drawings, in which:

Fig. 1A shows the manner in which Figs. 2, 3 and 4 should be arranged adjacent one another to show in outline form various circuits and equipment of an exemplary system in accordance with the present invention as well as to illustrate the routes of messages through the system;

Fig. 1B shows the manner in which Figs. 5 through 11, inclusive, should be arranged adjacent one another to show the circuit arrangements in detail in exemplary form of the invention;

Figs. 2, 3 and 4 when arranged as shown in Fig.

1A show in outline form a typical system embodying the present invention; and

Figs. 5 through 11, inclusive, when arranged as shown in Fig. 1B show in detail the various circuits comprising an exemplary embodiment of the present invention. Figs. 5 through 11, inclusive, show in detail the circuits indicated in outline form in the heavy line **350** of Fig. 3. Furthermore, said Figs. 5 through 11, inclusive, of the present application may be substituted without material alteration for Figs. 14, 15, 16, 17, 18, 19 and 20 of said Branson et al. application. Said Figs. 5 through 11 may also be substituted for other figures of said Branson application associated with the half-duplex line without material modification.

Referring now to Figs. 2, 3 and 4 when arranged as shown in Fig. 1A, Fig. 2 shows two typical party lines and the station and control equipment associated therewith. One party line is designated **210** which comprises a receiving channel **211** and a transmitting channel **212**. Similarly, party line **260** comprises a receiving channel **261** and a transmitting channel **262**. Both transmitting and receiving channels are illustrated in Fig. 2 and also Fig. 3 by means of telegraph lines or conductors. It is to be understood, however, that these lines or channels may include any type of telegraph transmission equipment normally employed for the transmission of telegraph signaling pulses or code combinations of pulses. These lines or channels may, for example, include open wire lines, cable lines, channels of voice frequency or high frequency carrier current systems, radio systems, time division multiplex systems or telegraph channels of composite telephone and telegraph transmission systems or of any other type of pulse transmission channels or systems suitable for the transmission of signaling pulses such as employed in telegraph systems. The various party lines and channels thereof may include or comprise any or all of the foregoing types of transmission systems or any or all combinations of such types of transmission systems.

The transmission systems of the various types comprising the party lines operate in their usual and well understood manner so a description of the operation thereof need not be included herein because it would serve no useful purpose and only tend to obscure the other elements and features of the present invention.

Each of the party lines shown in Fig. 2 extends to a plurality of outlying subscriber or way stations. It is to be understood also that it is within the scope of this invention to extend lines individually from one or more of the outlying stations to the central switching exchange. In this case certain of the control equipment associated with each of the party lines need not be provided as will be readily apparent to those skilled in the art.

Each of the lines which extends to more than one outlying station is provided with control equipment located at or near the outlying stations of the party line. Control equipment may be provided which is individual to each of the outlying or way stations in case the way stations are rather widely separated or the control equipment may be provided common to a group of outlying stations which are located more closely together. In addition, certain of the control equipment may be individual to certain outlying stations, while other control equipment provided for the same party line may be common to a plurality of the outlying stations.



As shown in Fig. 2, three separate and distinct sets of switching and controlling circuits, sometimes referred to as a secondary switching center, are associated with each of the party lines. For example, party line **210** extends to the switching and control circuits or secondary switching centers **213**, **214** and **215**. The control equipment **214** is individual to a station at **219**. Control equipment **215** is common to stations **216**, **217** and **218**, while control equipment **213** is common to stations **220** to **224** inclusive. Each of the outlying stations is provided with a receiving instrument, a transmitting equipment, and control equipment. In the specific system described herein, the transmitting equipment comprises a keyboard perforator for perforating paper tape in accordance with the signals to be transmitted and a tape controlled transmitter for transmitting signals in accordance with the perforations in the tape. For example, at station **216** the receiving instrument and the keyboard perforator is illustrated diagrammatically and designated **225** in Fig. 2, the transmitting distributor is designated **235**, while the control equipment is designated **236**. Similar equipment is provided at the other stations. In addition, station **219** is provided with a receiving recorder or reperforator for again perforating tape in accordance with messages received from the system. This reperforator is provided at those stations at which other telegraph lines or circuits may terminate so that the messages intended for stations connected to these other lines may be recorded at station **219** and later automatically transmitted over the proper line without requiring the time of an operator to retransmit the message.

In order to transmit messages over this system, the attendant or subscriber at the outlying or way stations perforates messages in paper tapes for later transmission over the system. Preceding each message, an address or group of switching signals is perforated in the tape and following each message an end of message or disconnect signal is also perforated in the tape. Following the end of message signal, the subscriber may perforate any address signal followed by another message intended for the station designated by the address. Following this message and each of the messages, the operator will then perforate a disconnect signal in the tape. Furthermore, the operator or attendant will usually perforate an end of transmission signal in the tape after the disconnect signal following the last message available for transmission from the station then transmitting.

The attendant or operator at the outlying station will then insert a tape in the transmitter for transmission over the system. At a later time the transmitter is started under the control of an operator or switching circuits at the central switching station. Thereafter the messages are transmitted to the central switching station and recorded thereat.

The circuits at the central switching station are illustrated in Figs. 3 and 4. Fig. 4 shows the originating position or station at the central switching station comprising a keyboard perforator **411**, a monitoring receiving instrument **410**, transmitter or transmitting distributor **412**, control relays **413** and a director circuit **414**. Fig. 4 also shows a miscellaneous intercept circuit **427** and a receiving reperforator **426** and a tape receptacle **425**. A wilful intercept circuit **424** is also shown. This intercept circuit is provided with a repeating instrument **420** comprising a

recorder or reperforator **421** and a transmitting device **422**. A director **423** is also associated with the wilful intercept circuit.

Each of the party lines terminating at the switching office or center is provided with an incoming line circuit **322** and a receiving only machine **323**, a storage repeater **324** and associated transmitter **325**. Incoming line circuit **322** causes the messages intended for the central switching station to be recorded on the receiving only receiver **323** and causes the messages intended for other stations of the system to be recorded by the reperforator **326**. Director circuit **327** is associated with the transmitter **325** and serves to connect the transmitter **325** selectively to any of the lines terminating at the central switching station under control of the address characters preceding each message.

Each of the party lines is also provided with transmitter start circuits, such as **310**, and outgoing line circuits and equipment for transmitting messages over the party line. An outgoing line circuit is associated with party line **210**. Briefly, messages directed to stations of party line **211** are transmitted to storage repeaters associated with line **211** under control of the director circuits of the lines upon which the messages originate for later transmission over the outgoing lines.

Figs. 2 and 3 also show a trunk circuit **290** comprising two transmission channels **291** and **292** extending to a distant switching center **295**. The terminal equipment associated with the trunk circuits is similar to the terminal equipment associated with each of the party lines as described above.

The operation of the various circuits referred to above is described in detail in the above-identified copending patent application of Branson et al. Since the respective circuits referred to above forming parts of the system referred to herein operate in substantially the same manner as described above in said patent application of Branson et al., which patent application has been made a part hereof as if fully included herein, a more detailed description has therefore not been repeated.

As stated above, the attendants at the outlying stations will insert the tape in the tape control transmitters located at the respective stations. Thereafter the operator at the central switching station will manually set into operation the transmitter start circuit which will cause certain signals to be transmitted over the receiving channel of the respective party lines for testing the transmitters associated therewith and initiating operation of these transmitters which are supplied with storage material available for transmission.

In the system described in the above-identified application of Branson et al., it is necessary for the operator to start or initiate the operation in the transmitter start circuit manually the first time each day. Thereafter the operator may operate an automatic key which will cause the transmitter start circuit to automatically test the transmitters associated with the respective party lines in rotation. Means are also provided for enabling the operator by the operation of a manual key to prevent the testing of any one or more of the transmitters associated with the respective party lines.

In accordance with the present invention an additional key and group of circuits and apparatus are provided which will automatically cause the skipping of the testing of certain of the transmitters associated with any party line during certain cycles of operation of the transmitter start circuit. According to the present invention the automatic skip feature is made flexible so that the testing of different transmitters may be skipped during different cycles of operation of the transmitter start circuit. In this way an extremely flexible arrangement is provided for controlling the transmission from the respective transmitters associated with the party line. Not only may the order of testing be varied at will but also the frequency or relative frequency of testing and initiation of operation of the transmitters may be readily varied during any cycle of operation of the transmitter start circuit in accordance with any predetermined plan or system.

The circuit details of one exemplary embodiment of the invention showing how the varying of the frequency of testing of the transmitter may be accomplished in accordance with the present invention is shown in Figs. 5 through 11, inclusive, when arranged adjacent one another as shown in Fig. 1B.

Inasmuch as the present invention relates more particularly to the automatic operation of the transmitter start circuit, the operation of this circuit under manual control will not be repeated here since it is described in detail in the above-identified application of Branson et al. incorporated herein and to which reference is made for a detailed description of the operation of the circuit under manual control.

Assuming for purposes of illustration that the circuit has been set into operation and transmission has been started from some one of the transmitters associated with the party line to which the transmitter start circuit shown in Figs. 5 through 11, inclusive, is connected. Under these conditions the stepping switch comprising brush arms **501** through **506**, inclusive, has been advanced to the No. 5 position by means of magnet **507** in the manner set forth in the above-identified application of Branson et al. Similarly, the stepping switch comprising brush arms **508** to **513** as well as the stepping switch comprising arms **515** and **516** have stepped to terminals assigned to the transmitter which has been set into operation. In addition, relay **606** and **607** and **609** are maintained operated so long as the transmitter set into operation continues to transmit signals to the central switching station. Assuming further for the purpose of illustration that the automatic start key **519** has also been operated after the transmitter has been set into operation. Under these circumstances, a circuit is completed for the operation of relay **608** which relay remains operated as long as the automatic key **519** remains operated. Further assume that the stepping switches comprising brushes **571** to **577**, inclusive, have been positioned in the position shown in the drawings in any suitable manner such as will be described hereinafter.

During the transmission of signals from any of the transmitters of the party line, a ground connection is maintained to lead **2736** by the incoming line circuit in a manner described in the above-identified application of Branson et al. So long as this ground is maintained on lead **2736** the circuits are maintained in the position described above. It should be noted that one of the lamps **521** to **530**, inclusive, associated with the operating transmitter will be lighted during operation of that transmitter.

At the completion of transmission from the transmitter in question or under certain trouble

conditions as set forth in the above-identified application of Branson et al., the incoming line circuit of the party line in which the transmitter start circuits in Figs. 5 to 11, inclusive, will remove ground from lead **2736** and thus permit relay **606** to release. The release of relay **606** completes a circuit for the operation of relay **611** at this time. Relay **611** in operating causes the C stepping switch comprising brush arms **501** to **506**, inclusive, to be stepped to its initial position. A detailed description including the tracing of the circuits of the various relays and the times of operation thereof during the return of this switch to its initial position has not been repeated here because it is clearly set forth in the above-identified application of Branson et al. and inasmuch as the circuit works in substantially the same manner at this time, little, if anything, can be gained by further so complicating the present disclosure.

During the return of the stepping switch comprising brush arms **501** to **506**, inclusive, to its initial position or to a position equivalent to its initial position, various relays may operate. However, the operation of these relays at this time is without significance. Consequently, their operation need not be described at the present time.

When the C stepping switch returns to its No. 1 position, relay **611** releases and prevents the further advance of the switch at this time. The return of this switch to its No. 1 position completes a circuit for the operation of relay **701** which relay operates and completes a circuit for the operation of relay **702**. Relay **702** in operating completes a circuit for maintaining itself operated under control of various relays including relay **606**. The operation of relay **702** completes a circuit for the operation of relay **801**, the operation of which relay stops the operation of either of the transmitting instruments shown in Figs. 10 and 11. The operation of relay **801** interrupts the circuit of release magnets of these transmitters and thus insures that the transmitter will come to rest at the completion of the code combination then in progress of transmission over the party line.

The operation of relay **702** in addition removes ground from the right-hand terminal of condenser **711** and permits this terminal to be charged from battery **716** through high resistances **551** and **533** in parallel. Condenser **711** is connected through high resistance **715** to the grid of tube **710**. By a proper choice of the values of resistances **714** as well as the constants of tube **710**, the size of condenser **711**, and potential battery **716** of the anode path through tube **710**, this tube is maintained non-conductive so long as ground is connected to the right-hand terminal of condenser **711** and for an appreciable interval of time thereafter until the right-hand terminal of condenser **711** is charged to a predetermined positive potential. In an exemplary embodiment of the present invention, the values of the resistances **551** and **533**, the size of condenser **711**, the constants of tube **710**, and the value of resistance **714** have been selected so that it requires approximately .7 of a second after ground is removed from the right-hand terminal of condenser **711** for tube **710** to pass sufficient anode current to operate relay **703**. This .7 of a second allows ample time for either of the transmitting instruments shown in Fig. 10 or 11 to complete the transmission of the code combination in progress of transmission at the time relay **801** operates.

The operation of relay **703** completes an obvious circuit for the operation of relay **602**.

The operation of relay **602** completes a circuit for maintaining relay **701** operated and also completes a circuit for the operation of either relay **914** or **923**, depending upon which of the two transmitters shown in either Fig. 10 or 11 was the last to transmit. If the transmitter shown in Fig. 10 was the last transmitter to transmit relay **914** will operate whereas if the transmitter shown in Fig. 11 was the last transmitter to transmit, relay **923** will operate. The operation of either one or the other of these relays prepares circuits for the operation of the corresponding transmitter under control of the transmitter start circuit as will be described hereinafter. The operation of relay **602** also completes a circuit for the operation of relay **603** which relay in turn completes a circuit for the operation of stepping magnet **514**. The brush arms **508** and **513** do not advance at this time, however, because they advance upon the release of magnet **514** and not upon the operation thereof.

The operation of relay **602** also completes a circuit for the operation of the stepping magnet **507** but the associated brush arms **501** through **506** do not advance at this time. However, the operation of the stepping magnet **507** removes the short circuit from around the upper winding of relay **704** and permits this relay to operate. The operation of relay **704** completes a circuit for maintaining itself operated under control of relay **602**. The operation of relay **704** interrupts the operating circuit from the stepping magnet **507** which permits magnet **507** to release and advance the brush arms **501** through **506** one step to their No. 2 position. Brush arm **501** in advancing one step interrupts the operating circuit of relay **603** and thus permits relay **603** to release and in turn releases stepping magnet **514**. The release of stepping magnet **514** causes the brush arms **508** through **513**, inclusive, to advance one step and thus partially condition the transmitter start circuit for transmission of the final code in the transmitter start pattern which designates the transmitter that is to be tested and set into operation by the transmitter start circuit if it is provided with storage material available for transmission. The advance of brush arm **512** at this time also interrupts the locking circuit of relay **609**. The release of relay **609** completes a circuit for the operation of relay **705**.

The operation of relay **704** again connects ground to the right-hand terminal of condener **711** and thus to the grid of tube **710**. As stated above, with ground connected to the grid of tube **710** the anode-cathode path is blocked so that relay **703** will release and in turn cause the release of relay **602**. Relay **602**, however, is slow in releasing so that various circuits and relays will have sufficient time to function, as pointed out above, before relay **602** releases. The release of relay **602** in turn causes the release of relay **704**.

The release of relay **602** at this time completes a circuit for the operation of either the distributor release magnet **1047** or **1147**, depending upon which of the transmitters was previously transmitting. Assume for the purpose of illustration relay **914** previously operated due to the fact that the transmitter shown in Fig. 10 was the last transmitter to transmit prior to the operation of relay **801**. Under these circumstances the dis-

tributor release magnet 1047 will operate upon the release of relay 602. The operation of the distributor release magnet 1047 at this time releases the distributor shaft 1051 for rotation through one revolution. During the rotation through this revolution a blank code combination, that is, a code combination in which all the impulses are spacing, is transmitted over the receiving channel of party line 210.

Near the beginning of the revolution of shaft 1051 the auxiliary contacts 1050 are closed and complete a circuit for the operation of relay 605 which relay operates and completes a circuit for maintaining itself operated under control of relay 602. The operation of relay 605 interrupts the operating circuit of magnet 1047 thus insuring that this magnet will release and stop the distributor shaft 1051 at the end of the revolution during which the blank code combination has been transmitted.

The release of relay 602 removes ground from the right-hand terminal of condenser 711, which condenser again starts to charge from battery 716 through the high resistances 551 and 553, as described above.

If the terminal upon which brush arms 508 through 515, inclusive, have been advanced to and are resting upon during the time brush arm 501 is in its No. 2 position has been assigned to a station upon which one of the skip keys 541 through 550, inclusive, has been operated, a circuit will again be completed for the operation of relay 603 and the stepping magnet 514 will cause the stepping switch to advance to the first terminal on which the associated skip key has not been operated.

At the end of approximately .7 of a second after the release of relay 602 condenser 711 will again be charged to the potential required to initiate a discharge current through the anode circuit of tube 710 and the winding of relay 703. The operation of relay 703 at this time again completes a circuit for the operation of relay 602. The reoperation of relay 602 causes relay 605 to release.

The reoperation of relay 602 again completes a circuit for the operation of stepping magnet 507 which magnet in operating permits the reoperation of relay 704. Relay 704 operates and interrupts the operating circuit of magnet 507, thus permitting this magnet to release and advance the brush arms 501 through 506, inclusive, to their third position. The operation of relay 704 again connects ground to the right-hand terminal of condenser 711 and thus causes the release of relay 703. Relay 703 in releasing again permits relay 602 to release and remove ground from the right-hand terminal of condenser 711 which terminal again starts to charge to the potential required to again initiate a discharge through tube 710.

Meantime, however, the release of relay 602 interrupts the locking circuit of relay 704 and permits this relay to release. The release of relay 602 also again completes a circuit for the operation of the distributor start magnet 1047 and permits the distributor shaft 1051 to rotate through another revolution. This time the brush arms 501 through 506, inclusive, are in their No. 3 position where they condition the contacts controlled by the distributor shaft 1051 so that a line feed code combination is transmitted over the receiving channel of the party line at this time.

Near the beginning of the revolution of shaft 1051 contacts 1050 will close and complete a circuit for the operation of relay 605 which relay operates and completes a circuit for maintaining itself operated under control of relay 602. The operation of relay 605 also interrupts the circuit of the distributor release magnet 1047 and permits this magnet to release and stop the transmitter shaft 1051 at the end of the revolution during which the line feed code combination was transmitted.

At the end of the third .7 second time interval relay 703 will again operate and complete a circuit for the reoperation of relay 602. Relay 602 in operating at this time interrupts the locking circuit of relay 605 and permits relay 605 to release. The operation of relay 602 at this time again completes a circuit for the operation of the stepping magnet 507. The operation of the stepping magnet 507 permits the operation of relay 704. The operation of relay 704 interrupts the operating circuit of magnet 507 and permits this magnet to release and advance the brush arms 501 through 506 to their No. 4 position. The operation of relay 704 connects ground to the right-hand terminal of condenser 711 and thus interrupts the current flowing through the anode-cathode circuit of tube 710 and the winding of relay 703 thus causing the release of relay 703. Relay 703 in releasing interrupts the operating circuit of relay 602. Relay 602 in turn releases after a short interval of time and removes ground from the right-hand winding terminal of condenser 711. Inasmuch as brush arm 504 is now in its No. 4 position the charging circuit of the right-hand terminal of condenser 711 now extends from battery 716 through the right-hand portion of resistance 714 and resistance 552 in parallel with resistance 551. The time constants of condenser 711, together with the constants of the circuits of tube 710, are such that it requires approximately 1.9 seconds for the right-hand terminal of condenser 711 to be charged to the value required to initiate the discharge through tube 710.

Meantime the release of relay 602 again completes a circuit for the operation of the distributor release magnet 1047 thus permitting the distributor shaft 1051 to rotate through a third revolution. At this time the brush arms 501 through 506 are in their No. 4 position. Consequently the code combination transmitted by the distributor at this time will be determined by the connections to the terminals of the banks cooperating with brushes 508, 509, 510 and 513 upon which these brushes are resting at this time. Near the beginning of the revolution of shaft 1051 contacts 1050 will again be closed and complete a circuit for the operation of relay 605. Relay 605 completes a circuit for maintaining itself operated under control of relay 602 and interrupts the operating circuit of the release magnet 1047 thus insuring that the distributor shaft 1051 will stop at the end of the third revolution.

On the transmission of this third code combination a complete set of transmitter start signals has been transmitted over the receiving channel of the party line to which the transmitter start circuit is connected. If the transmitter to which this set of transmitter start signals has been assigned is provided with storage material available for transmission, transmission to the central office will be initiated therefrom some time during the 1.9 second charging interval of condenser 711 or during the subsequent .7 second charging interval to be described. At the

end of the 1.9 second charging interval relay 703 will again operate and complete a circuit for the operation of relay 602 which relay operates at this time and completes a circuit for the operation of stepping magnet 507. Magnet 507 operates and removes the short circuit from around the upper winding of relay 704, thus permitting this relay to operate and interrupt the operating circuit of the stepping magnet 507. The release of magnet 507 causes the brush arms 501 through 506 to advance to their No. 5 position.

The operation of relay 704 also completes a circuit for connecting ground to the right-hand terminal of condenser 711 thus causing relay 703 to release which in turn causes the release of relay 602.

The release of relay 602 removes ground from the right-hand terminal of condenser 711 and thus permits this terminal to again be charged from battery 716 through resistances 553 in parallel with 551. The time constant of this charging circuit, as pointed out above, is approximately .7 of a second.

With brush arm 501 in its No. 5 position a circuit is completed for the operation of relay 607. With relay 607 operated a circuit is completed from conductor 2736 extending from the incoming line circuit to the winding of relay 606. If the corresponding transmitter has started to transmit message material, relay 606 will operate and interrupt the locking circuit of relay 702 thus permitting relay 702 to release.

The operation of relay 606 also completes a circuit for the operation of the stepping magnet 517 thus permitting this magnet to operate and remove a short circuit from around the lower winding of relay 609, whereupon relay 609 operates and interrupts the operating circuit of stepping magnet 517 thus causing the advance of brush arms 515 and 516. The above cycle of operations of magnet 517 and relay 609 is repeated until the brush arms 516 and 515 rest in the same position as the brush arms 501 through 506. At this time a circuit is completed through the upper winding of relay 609 for maintaining this relay operated.

The operation of relay 606 interrupts the operating circuit of relay 705 and permits relay 705 to be released. Release of relay 705 interrupts the operating circuit of relay 707 and either causes this relay to release or prevents its operation.

The release of relay 702 as described above interrupts the operating circuit of relays 801 and 914 which in turn allows the operation of the transmitting device shown in Fig. 10 under control of tape 1030 and thus resumes transmission of the interrupted message.

The release of relay 702 also connects ground to the right-hand terminal of condenser 711, thus discharging the condenser and interrupting the anode current of tube 710 and preventing the operaton of relay 703.

Thereafter circuits are maintained in this condition so long as the transmission is received from any transmitter associated with the party line. At the end of the transmission from this transmitter, or in response to a pause in transmission longer than a predetermined length, ground will be removed from lead 2736 by incoming line circuit and interrupt the operating circuit of relay 606. The release of relay 606 at this time will cause relay 611 to operate as described above and advance the brush arms 501 through 506 to their No. 1 position where the above cycle of operation of the transmitter start circuit will be repeated.

Assume now that the transmitter start circuit has functioned as described above and has transmitted the third character or code combination of a transmitter start pattern during the 1.9 seconds during which brush arms 501 through 506 are in their No. 4 position and that thereafter these brush arms advanced to a No. 5 position and caused the operation of relay 607 as described above. In this case, however, assume that no material was available for transmission from the transmitter assigned to the particular transmitter start pattern which has just been transmitted from the transmitter start circuit. Under these circumstances, no signals can be received by the incoming line circuit during the .7 of a second during which brush arms 501 through 506 remain in their No. 5 position. Consequently no ground will be connected to lead 2736 during this time and relay 606 will not operate. At the end of the .7 second time interval, the potential on the right-hand terminal of condenser 711 will reach the value required to initiate a flow of current through the anode-cathode path 710 and cause the operation of relay 703. Relay 703 then operating completes the circuit for the operation of relay 602. Relay 602 in operating at this time completes the circuit for the operation of the stepping magnet 507 which magnet in operating removes a short circuit from around the upper winding of relay 704 and permits this relay to operate. The operation of relay 704 interrupts the operating circuit and stepping magnet 507 and permits this magnet to release and advances brush arms 501 through 506 to the No. 6 position. The operation of relay 704 also connects ground to the right-hand terminal of condenser 711 thus discharging this condenser and causing the release of relays 703 and 602.

When brush arm 501 reaches its No. 6 position, a circuit is complete for the operation of relay 611 and brush arms 501 through 506 restored to their No. 1 position again. The above cycle of operation is then completed and a different transmitter start pattern transmitted causing the brush arms 508 through 513, inclusive, to advance one step during each cycle of operation of brush arms 501 through 506. Consequently, a different transmitter start circuit pattern is usually transmitted during each cycle of operation of brush arms 501 through 506, unless, of course, the same code combination is set up on adjacent terminals of the banks cooperating with brush arms 508, 509, 510 and 513.

When the brush arms 508 through 513 step off of the No. 10 terminals and onto the N terminals brush arm 511 completes a circuit for the operation of relay 595. Relay 595 in operating completes circuits for the operation of stepping magnets 593 and 594 and relay 603. Relay 603 in operating completes a circuit for the operation of stepping magnet 514. The operation of magnets 593 and 594 interrupts the operating circuit of relay 595. Relay 595 in turn causes the release of magnets 593 and 594 and relay 603. Relay 603 in releasing causes the release of magnet 514. The release of magnets 514, 593 and 594 causes the respective brush arms 508 through 513 and 571 through 577 to be advanced one step. Consequently brush arms 508 through 513 are advanced from their No. 10 position to their No. 1 position without remaining in their N position.

The above cycle of operations of the transmitter start circuit is repeated until either trans-

mission is started from one of the transmitters, or until brush arms 508 through 513 are advanced to the same position as brush arms 515 and 516. It will be recalled that brush arms 515 and 516 were advanced to the position indicating the last transmitter to transmit. When brush arms 508 through 513 have advanced through all of their positions and have again returned to the position assigned to the last transmitter to transmit without finding any stored material available for transmission from any of the transmitters, they will cause the transmitter start circuit pattern assigned to that transmitter to be retransmitted to the transmitter start circuit. However, with brush arms 501 through 506 in their No. 1 position causing brush arms 508 through 513 to advance to the same position as brush arms 515 and 516, a circuit will be completed through the upper winding of relay 609 thus causing the operation of this relay. Inasmuch as relay 705 has been operated during the testing of all the other transmitters, the operation of relay 609 completes a circuit for the operation of relay 707. Thereafter the brush arms 501 through 506 are advanced to their No. 1, No. 2, No. 3 and No. 4 positions during the transmission of respective portions of transmitter start pattern assigned to the last transmitter which transmitted. If transmission is not initiated from this transmitter during the time brush arms 501 through 506 are in their No. 5 position, then at the end of the .7 second on the No. 5 position of brush arms 501 through 506, relay 703 will operate and complete the circuit for the operation of relay 602. Relay 602 will operate and cause brush arms 501 through 506 to be advanced to the No. 6 position due to the successive operation of stepping magnet 507 and relay 704 and the subsequent release of magnet 507 and relay 704. This time relay 707 is operated and consequently relay 611 will not operate. The right-hand terminal condenser 711, which was previously discharged due to the combined operation of relays 602 and 704, will again start the charge from battery 716. At this time, however, the charging circuit extends through resistance 551 only. The value of resistance 551, together with the value of condenser 711 and the other constants of the tube 710 and associated circuits are such as to require approximately two minutes for condenser 711 to be charged sufficiently to cause the operation of relays 703 and 602. Upon the operation of these relays, brush arms 501 through 506 will be advanced to the next position and the above cycle of operations completed until brush arms 501 through 506 are advanced through the intervening positions to their No. 1 position. As described in the above-identified application, Branson et al, a suitable number of steps of two seconds may be provided depending upon the stripping or connections to the contact terminals cooperating with brush arm 502. Furthermore the number of steps may be varied depending upon whether or not the outgoing or receiving channel of the associated party line is employed in the transmission of messages to some one or more of the stations associated with the party line.

Thus during periods when no message material is available for transmission, each of the transmitters is tested in rotation and then the circuits pause for a predetermined interval of time, after which the transmitters are again tested.

As indicated above, if it is desired to prevent the testing of any of the transmitters, skip keys 541 through 550 have been provided. If any of these keys is operated, the corresponding relays 581 through 590 are also operated. As described above, when brush arms 501 through 506 are advanced to their No. 2 position and brush arms 508 through 513 are advanced to terminals, the corresponding skip keys and associated skip relays 581 through 590 of which are operated, brush arms 508 through 513 will be advanced to their next position or will be advanced step by step until they rest upon a set of terminals associated with some transmitter or station the skip relay of which has not be operated. Thus it is possible to prevent testing of any of the transmitters during the operation of transmitter start circuit by the operation of any of the skip keys 541 through 550.

In accordance with the present invention, provision has been made to cause the transmitter start circuit to automatically skip any one or more of the transmitters during any cycle of operation of the transmitter start circuit. Means has also been provided for varying the transmitters skipped during different cycles of operation of the transmitter start circuit. This additional equipment comprises a group of brush arms 571 through 577 and associated banks of contacts, as shown in Fig. 5. It will be readily understood by persons skilled in the art that a brush arm and an associated group of contacts is provided for each of the stations or transmitters to be started in addition to the brush arm 571. These brush arms are advanced by means of stepping magnets 593 and 594 or additional magnets to these if more are required. A recycle key 591 has been provided and when operated completes the circuit for the operation of relay 592. Relay 592 when operating completes the circuit for maintaining itself operated if brush arm 571 is in any position other than its normal or No. 1 position. The operation of relay 592 also completes the circuit for the operation of the driving relay 595 if brush arm 571 is in any position other than its No. 1 position. The operation of relay 595 completes the circuit for operation of stepping magnets 593 and 594. The operation of these magnets interrupts the operating circuit of relay 595, permits this relay to release, and releases the magnets 593 and 594, thus advancing all the brush arms 571 through 577 to their next position. The above cycle of operation is then repeated until brush arms 571 through 577 are restored to their initial or No. 1 position.

If key 578 is operated to the position shown in the drawings when key 519 is operated then each time brush arms 508 through 513 are advanced from their No. 10 position through their N position to their No. 1 position, a circuit will be completed for the operation of relay 595 and the subsequent advance of brush arms 571 through 577 to their next position. The terminals cooperating with the brush arms 572 through 577, inclusive, are connected to the upper windings of relays 581 through 590, inclusive, and consequently depending upon the connection of terminals to these windings, relays 581 through 590 will be operated when the brush arms 572 through 577 are in various of their positions. When these relays are operated, they will cause the transmitter start circuit to skip the testing of the associated transmitter. Thus by properly connecting the bank terminals associated with the brush arms 572 through 577 to the upper windings of the skip

relays 581 through 590, the testing of the various transmitters will be skipped during each cycle of operation of the transmitter start circuit and the respective transmitters skipped will be automatically varied in accordance with the connections to the bank terminals cooperating with brush arms 572 through 577.

The automatic skip equipment, in accordance with this invention, may be disabled by the operation of key 578 to the position opposite to the position shown in the drawings. The operation of key 578 to that position disables the recycle key 591 and prevents the operation of the skip relays 581 through 590 under control of brush arms 572 through 577 and thus renders the automatic skip equipment ineffective. Consequently, under these conditions the transmitter start circuit and equipment operates substantially as set forth in the above-identified application of Branson et al, incorporated herein.

This additional equipment in no way interferes with the operation of the transmitter start circuit during manual operation of the transmitter start circuit because battery is connected to the upper windings of skip relays 581 through 590 only during automatic operation by the operation of relay 608 which relay is operated only during automatic operation of the transmitter start circuits.

The transmitter start circuit shown in detail in the drawings provides numerous other features and manners of operation which are fully set forth in the above-identified application of Branson et al. However, inasmuch as these other features do not affect the operation of the automatic skip feature, their description has not been repeated herein. It is to be understood, however, that these features are provided and operate in substantially the same manner as described in the above-identified application of Branson et al.

What is claimed is:

1. In a telegraph system, a plurality of tape controlled transmitters for transmitting over a common channel of transmission, a control circuit for testing said transmitters one at a time in sequence for the presence of stored message material available for transmission, apparatus for causing said control circuit to skip and thereby omit testing of any one or more of said transmitters, and apparatus for automatically changing said control circuit to change the transmitter or transmitters skipped during successive sequences of testing said transmitters.

2. In a telegraph system, a plurality of record controlled transmitters arranged to transmit over a common channel of transmission, a transmitter start circuit for cyclically testing each of said transmitters for record material available for transmission, apparatus for causing said start circuit to omit testing of predetermined ones of said transmitters, and apparatus operative incident to the operation of said start circuit for changing the transmitter or transmitters skipped during successive cycles of testing said transmitters.

3. In a telegraph system, a plurality of record controlled transmitters arranged to transmit over a common channel of transmission, a transmitter start circuit for cyclically testing each of said transmitters for record material available for transmission, apparatus for causing said start circuit to omit testing of any of said transmitters, and apparatus for automatically changing the individual transmitters skipped over by said start circuit during different ones of said cycles of operation thereof.

4. In a telegraph system, a plurality of geographically separated storage controlled transmitters, a common telegraph transmission channel extending to each of said transmitters, a start circuit for testing said transmitters one at a time and in rotation for the presence of storage material available for transmission therefrom one at a time and in successive order, automatically controlled apparatus for causing said start circuit to skip and thereby omit testing different ones of said transmitters during predetermined sequences of testing.

5. In a telegraph system, a plurality of telegraph transmitters associated with a channel of transmission for transmitting thereover one at a time, a control circuit for transmitting to said transmitters a plurality of control patterns of code combinations for selectively initiating transmission from any of said transmitters and automatic means for automatically varying the order of supplying said patterns to said control circuit.

6. In a telegraph system, a plurality of geographically separated telegraph transmitters associated with a channel of telegraph transmission for transmitting thereover one at a time, a transmitter start circuit for transmitting to said transmitters a plurality of control patterns of code combinations for selectively initiating transmission from any one of said transmitters and automatic means for supplying said patterns to said transmitter start circuit one at a time and in rotation, and control apparatus operative concurrently with said transmitter start circuit for reducing the supply of certain of said patterns to said transmitter start circuit.

7. In a telegraph system, a plurality of tape controlled transmitters, a telegraph transmission channel extending to all of said transmitters, switching apparatus for connecting each of said transmitters to said channel, a transmitter start circuit for controlling said switching apparatus comprising apparatus for sending the transmitter start patterns assigned to each of said transmitters one at a time and in rotation, and automatically controlled apparatus for varying the frequency of supply of predetermined of said patterns during predetermined rotations of the operation of said transmitter start circuit.

8. In a telegraph system, a plurality of tape controlled transmitters, a telegraph transmission channel extending to all of said transmitters, switching apparatus for connecting each of said transmitters to said channel, a transmitter start circuit for controlling said switching apparatus comprising apparatus for sending transmitter start patterns assigned to each of said transmitters one at a time and in rotation, apparatus for preventing the supply of any of said patterns during any rotation of the operation of said transmitter start circuit, and automatically controlled apparatus for cyclically varying the number of transmitters omitted during the operation of said transmitter start circuit.

9. In a telegraph system, a plurality of tape controlled telegraph transmitters, a telegraph transmission channel extending to all of said transmitters, switching apparatus for connecting each of said transmitters to said channel, a transmitter start circuit for controlling said switching apparatus comprising apparatus for sending the transmitter start patterns assigned to each of said transmitters one at a time and in rotation, apparatus for causing said start circuit to skip

transmission of said start patterns, manually controlled apparatus for designating the patterns to be skipped by said start circuit, and automatic apparatus to automatically vary additional patterns skipped by said start circuit.

10. An automatic telegraph transmitting arrangement for transmitting a series of telegraph signal patterns one after another, automatic skipping means for causing said transmitting arrangement to skip the transmission of different ones of said telegraph signal patterns, and means automatically operable between said series of patterns to change the patterns to be skipped during the transmission of the succeeding series of patterns.

11. An automatic telegraph transmitting arrangement for cyclically transmitting a series of different telegraph signal patterns one after another, apparatus for causing said telegraph arrangement to omit the transmission of any of said patterns, manual control means for designating the patterns to be omitted, and automatic control means for automatically designating the patterns to be omitted during different cycles of operation of said transmitting arrangement.

12. In a telegraph system, a plurality of record controlled transmitters arranged to transmit over a common channel of transmission, a transmitter start circuit for cyclically testing said transmitters for record material available for transmission, and apparatus for automatically changing the number of times at which certain of said transmitters are tested for record material available for transmission, as compared to the number of times other transmitters are tested.

13. In a telegraph system, a plurality of telegraph transmitters associated with a channel of transmission for transmitting thereover one at a time, a control circuit for transmitting to said transmitters a plurality of control patterns of code combinations for selectively initiating transmission from any of said transmitters, and apparatus operative incident to the operation of said control circuit for automatically changing the number of times certain of said control patterns are transmitted relative to the number of times others of said control patterns are transmitted.

14. In a telegraph system, a plurality of record controlled transmitters, a common channel of transmission extending adjacent said transmitters, switching equipment adjacent said transmitters for selectively connecting said transmitters to said channel one at a time, a transmitter start circuit for cyclically transmitting a plurality of control patterns of code combinations for controlling said switching apparatus to selectively test said transmitters for record material available for transmission, control apparatus for said transmitter start circuit for automatically varying the relative number of occasions of testing of certain of said transmitters for record material available for transmission.

15. In a telegraph system, a plurality of tape controlled transmitters at least one of which is located remote from the other of said transmitters, a telegraph transmission channel extending to all of said transmitters, switching apparatus for connecting each of said transmitters to said channel, a cyclically operating transmitter start circuit for controlling said switching apparatus, and apparatus operative incident to cycles of operation of said transmitter start circuit for causing certain of said transmitters to be connected to said channel less frequently on some cycles than others of said transmitters.

16. In a telegraph system, a plurality of record controlled transmitters arranged to transmit over a common channel of transmission, a transmitter start circuit for testing each of said transmitters for record material available for transmission and apparatus operative incident to the operation of said transmitter start circuit for cyclically changing the order in which said transmitters are tested for record material available for transmission.

17. In a telegraph system, a plurality of record controlled transmitters arranged to transmit over a common channel of transmission, a transmitter start circuit for cyclically testing each of said transmitters for record material available for transmission, apparatus for controlling said start circuit for testing certain of said transmitters oftener than others of said transmitters, and means for automatically changing in accordance with a predetermined schedule the number of times a predetermined transmitter is tested relative to the number of times others of said transmitters are tested for record material available for transmission.

18. In a telegraph system, a plurality of tape controlled transmitters, a telegraph transmission channel extending to all of said transmitters, switching apparatus for connecting each of said transmitters to said channel, a transmitter start circuit for controlling said switching apparatus comprising equipment for sending a plurality of different transmitter start patterns each of which is assigned to one of said transmitters, apparatus operative incident to the operation of said transmitter start circuit for causing one or more of said patterns to be transmitted more frequently than others of said patterns, and means for changing the transmission of certain of said patterns relative to transmission of others of said patterns.

WALTER M. BACON.