May 2, 1944. F. S. KINKEAD ET AL 2,347,831

COMMUNICATION SYSTEM

Filed Aug. 28, 1941 5 Sheets-Sheet 1

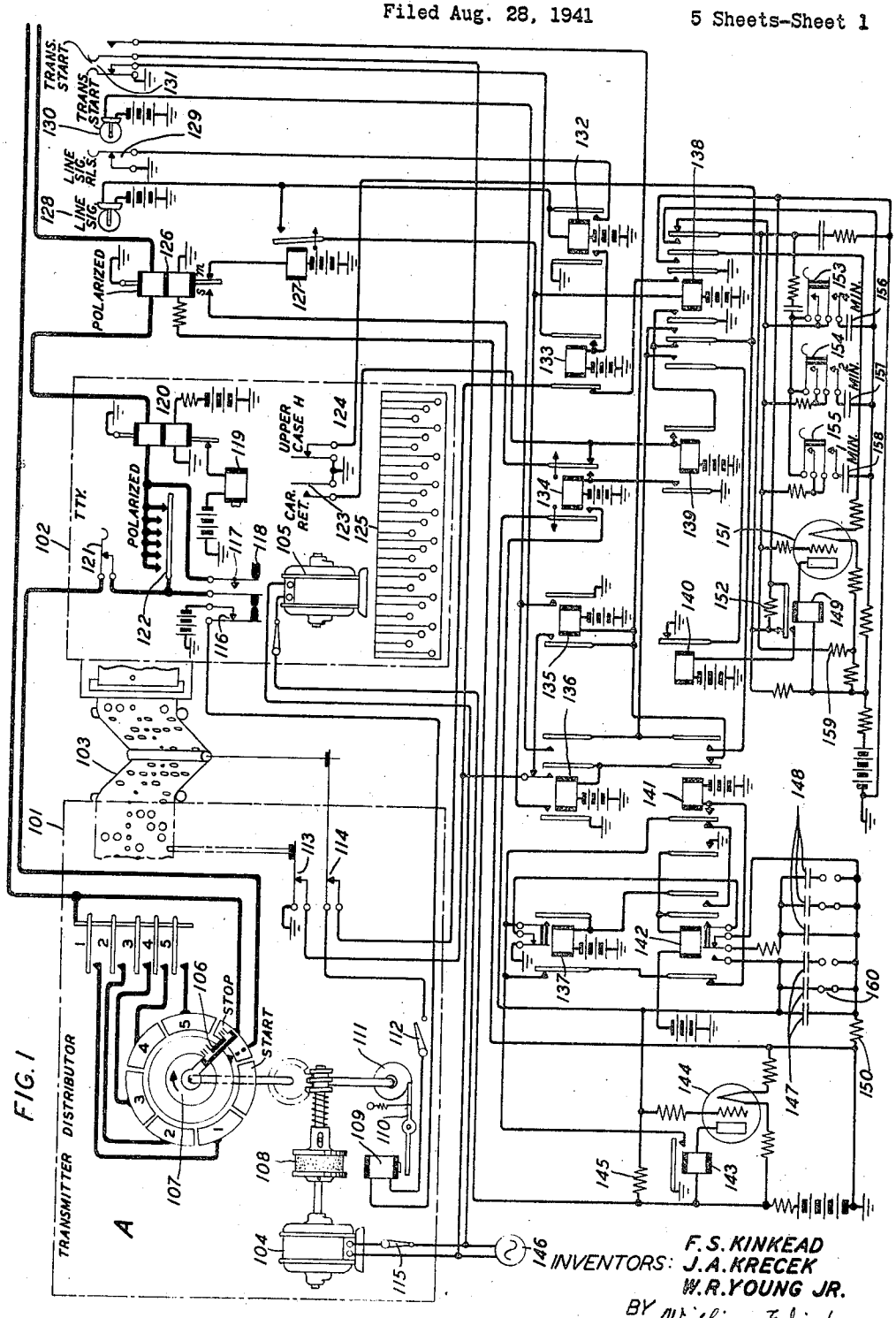

FIG. 1

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COMMUNICATION SYSTEM

Filed Aug. 28, 1941 5 Sheets-Sheet 2

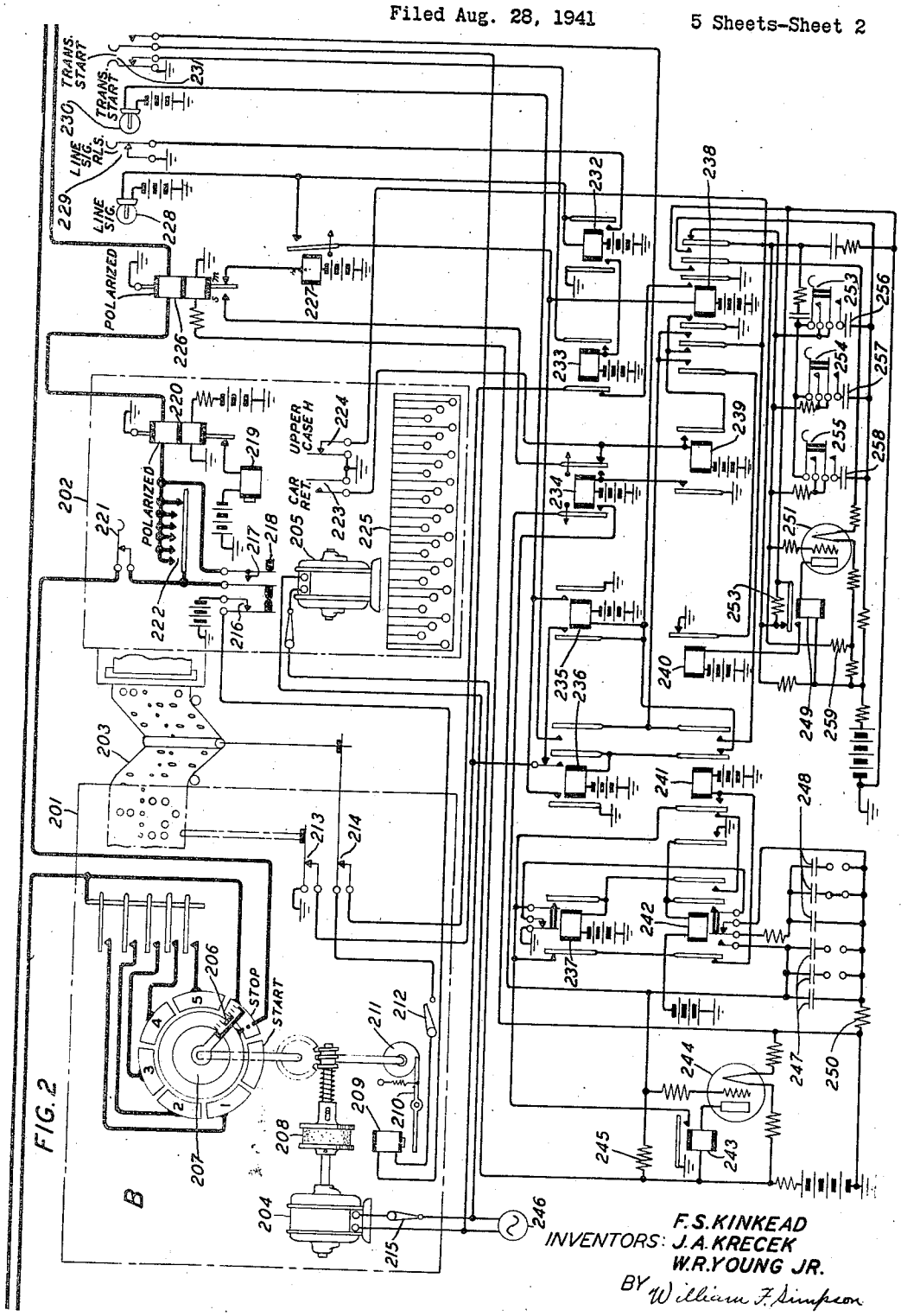

FIG. 2

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COMMUNICATION SYSTEM

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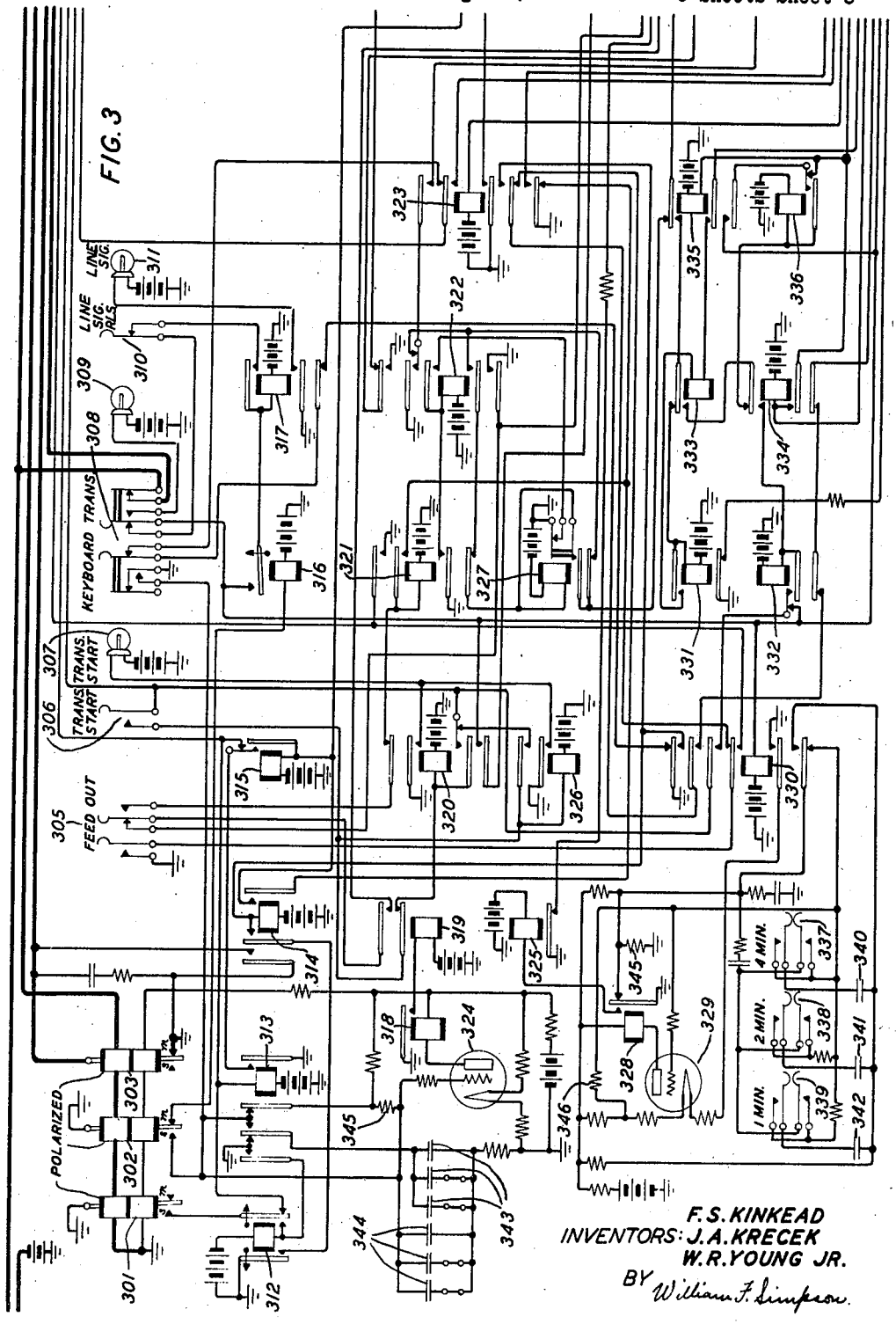
FIG. 3



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COMMUNICATION SYSTEM

Filed Aug. 28, 1941 5 Sheets-Sheet 4

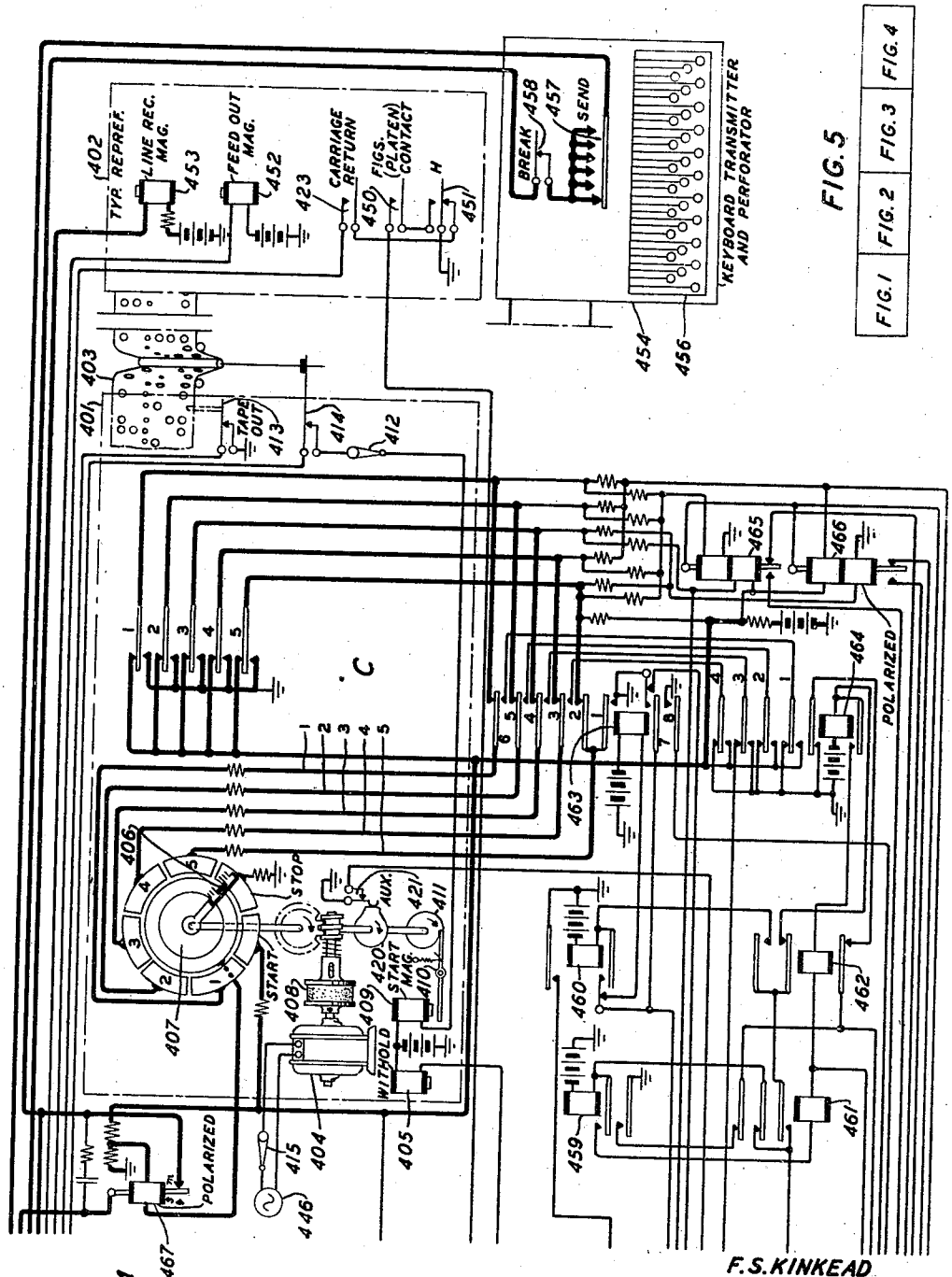

FIG. 4

FIG. 5

FIG. 1	FIG. 2	FIG. 3	FIG. 4

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COMMUNICATION SYSTEM

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FIG. 7

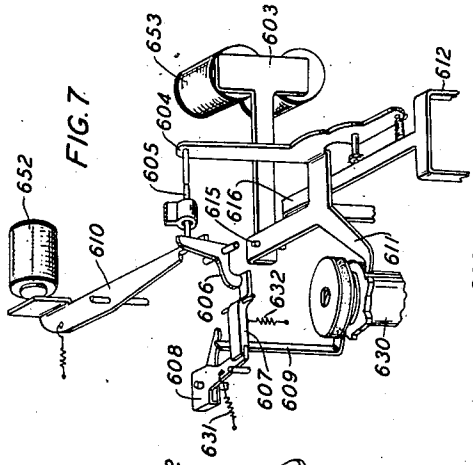


FIG. 8

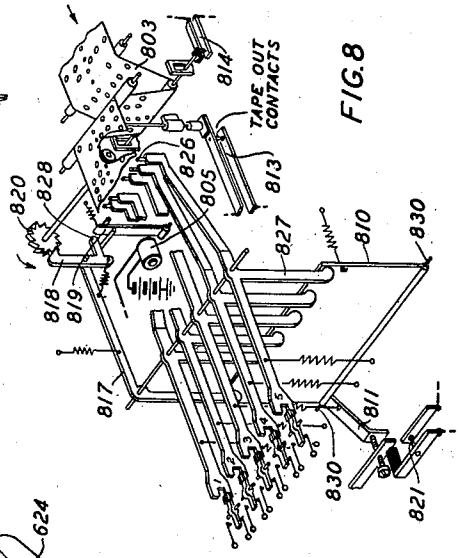
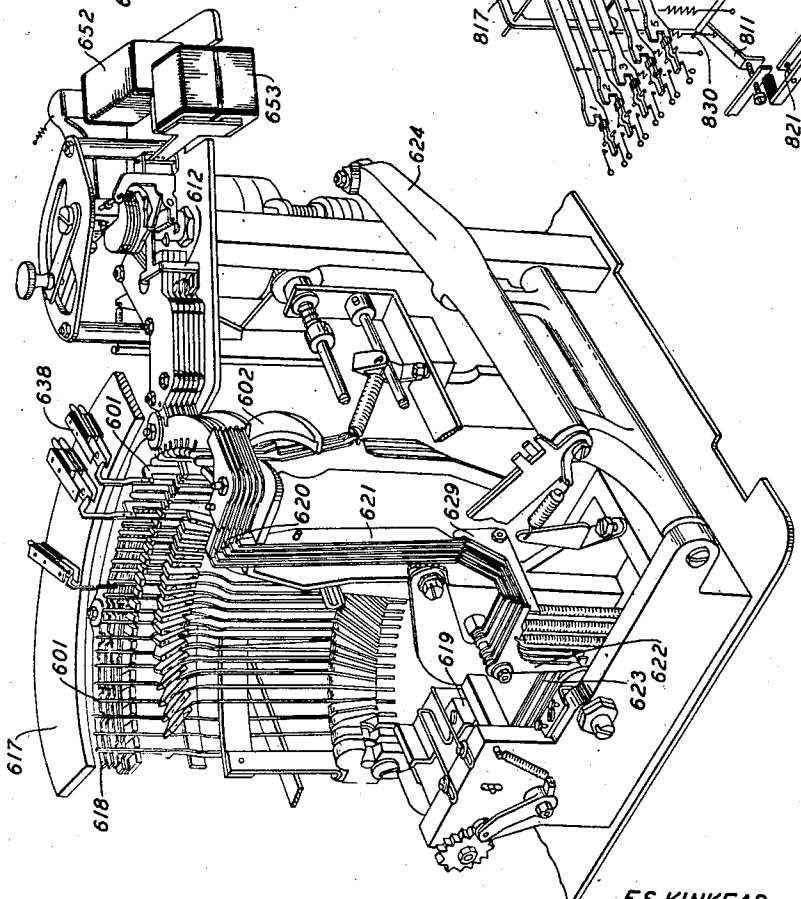


FIG. 6



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Patented May 2, 1944 2,347,831

UNITED STATES PATENT OFFICE

2,347,831

COMMUNICATION SYSTEM

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Application August 28, 1941, Serial No. 408,605

45 Claims. (Cl. 178—3)

This invention relates to communication systems and more particularly to telegraph systems in which a plurality of telegraph stations are connected to a telegraph transmission path.

It is the object of this invention to provide an improved telegraph transmission and switching system in which the control of the various stations connected to a telegraph line is improved so as to more fully utilize the entire line time for the transmission of telegraph signals representing messages.

Another object of this invention is to provide a telegraph system in which the distribution of the line time between the various stations connected to a line may be readily controlled and varied from time to time so that the distribution of time between the various stations may be arranged somewhat commensurate with the message materials to be transmitted from the various stations.

A feature of this invention relates to means for controlling a plurality of geographically separated tape or storage telegraph transmitters for transmission over a two-way telegraph transmission path in such a way that they cannot interfere with each other.

A feature of this invention relates to an arrangement in which each station or the transmitter located thereat is given an opportunity to transmit a specified interval of time after the transmission of the end of the last or preceding message transmitted from another station. In accordance with a feature of this invention a time delay circuit is provided at each of the stations having a different delay period or interval at each of the stations connected to a common transmission path.

Another feature of this invention relates to circuit arrangements and apparatus for providing an opportunity for the transmitters at each of the stations to transmit over the circuit before any transmitter may transmit over the circuit a second time. In accordance with another object of this invention a second time delay circuit is provided at all but one of the stations connected to a common transmission path having a delay period longer than the longest delay period of the delay circuits of but shorter than the delay period of said one station.

Another feature of this invention relates to switching apparatus for using said timing circuits alternately.

Another feature of the invention is an arrangement for terminating the transmission from any station at the completion of the first message transmitted therefrom.

Another feature of the invention is to provide an arrangement for terminating a transmission from any station at the completion of the first message after a station has been transmitting for a predetermined interval of time.

Another feature of this invention is an arrangement at a control station for repeatedly reconditioning the timing apparatus at the respective stations so that each station is periodically provided with an opportunity to transmit messages over the system when desired.

Another feature of this invention relates to apparatus for enabling the attendant at any of the stations to transmit a break signal over this circuit to interrupt the transmission over the system then in progress and seize control for the transmission of any urgent messages or information over the system.

Another feature of this invention relates to arrangements for permitting an attendant to insert a tape in the tape controlled transmitter at the respective stations and condition the circuit so that at the next opportunity provided the message will automatically be transmitted without any further attention or effort on the part of the attendant.

Another feature of this invention relates to providing suitable lamps or other type of signals before the attendants at the various stations to enable them to readily see at a glance the condition of the circuit and their equipment under the various conditions normally encountered during the transmission of messages over the transmission channel.

Another feature of this invention relates to apparatus and circuits for automatically and periodically transmitting a conditioning signal from the control station to the other stations connected to the system.

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

Figs. 1 through 4 illustrate details of a typical embodiment of this invention;

Fig. 5 shows the manner in which Figs. 1 to 4 are arranged adjacent to each other to illustrate a typical embodiment of this invention; and

Figs. 6, 7 and 8 show mechanical details of certain of the receiving and transmitting appa-

ratus employed in a typical embodiment of the invention.

The circuits and equipment shown on Fig. 1 are located at the outlying station the most remote from the control station. Fig. 2 shows details of the equipment and circuits of an outlying station intermediate between the most remote station and the control station.

Figs. 3 and 4 show details of the circuits and equipment located at the control station of the system.

General description

As may be readily appreciated by those skilled in the art, any suitable number of outlying stations may be connected to the system in order to fully and economically load the transmission line extending between the stations.

As shown in the drawings, a full metallic transmission path is shown extending to all of the stations of the system over which these stations may both transmit to receive messages. As will be readily understood by those skilled in the art, this transmission path may include any suitable type of telegraph or impulse transmission system including both grounded and full metallic circuits, telegraph channels of composited telephone and telegraph lines, voice frequency carrier current systems, high frequency carrier current systems, radio channels, etc. This transmission channel may also include any combination of the various types of systems as well as the usual types of terminal and interconnecting equipment. The channel may also include any suitable types of repeaters provided with any of the features which may be necessary or desirable, such as, bias control and gain control. These channels may also include regenerating repeaters and all other types of equipment and accessories necessary or desirable for proper transmission of telegraph signaling impulses over the system. These systems and related equipment and apparatus may be operated in their usual manner.

Inasmuch as all of these types of systems are well understood in the art and operate in their usual manner, it is not thought wise to further complicate the disclosure of this invention with the details of all of the possible types of transmission systems in combination with which it may be employed. The essential requirement of the transmission system extending to all these stations is that when current flows through the transmission circuit at any one of the stations it will flow through all of them and when the flow of current through any loop of the system extending from any of the stations is interrupted, it will be interrupted at all of the other stations as soon as these various current conditions may be transmitted over the system from one of the stations to the other stations.

Briefly, in accordance with the specific embodiment of this invention, the attendant at the outlying stations will perforate tape in accordance with the message to be transmitted over the system. Details of typical keyboard perforating mechanisms and associated transmitters suitable for use in this invention are described in United States Patents 1,965,572 granted to Burcky et al., July 10, 1934; 1,965,602 granted to Lake, July 10, 1934; and 1,969,891 granted to Lake et al., August 14, 1934. The above patents are hereby made a part of this application as if fully included and set forth herein.

Usually preceding the message the address or designation of each message is perforated in the tape and following each message an end-of-message signal is perforated in the tape. As a part of the end-of-message signal or in addition thereto the attendant will usually perforate a group of one or more letters signals in the tape, i. e. signals comprising a spacing start pulse and the remaining pulses all marking. These letters signals cause the tape to be stepped out of the perforating apparatus, provide a sufficient separation between the messages to permit the tape to be torn between messages, and also provide time for switching circuits at the various stations to function between messages without mutilating any of the characters of the messages. Letters signals may also be inserted after the switching or directing codes to provide sufficient time for the circuits to function so they will be ready to respond to the next significant code combination. In addition, near the beginning of each message a carriage return signal is also perforated on the tape. The carriage return signal is usually perforated in the tape to properly position the receiving equipment for responding to the text of the message as well as to print the heading and other information preceding a message in the proper position on the page. The first carriage return signal of each message in addition to conditioning the receiving equipment is also employed to control certain of the switching circuits as described hereinafter. After the attendant has perforated this tape, she will insert it in the transmitter at her station and operate a key entitled transmitter start key. Thereafter the message will be transmitted from that station in its proper turn.

In order to provide means for transmitting these messages in turn from the respective stations, a timing circuit is provided at each of the stations which is arranged to be controlled by means of signals received over the system. In the specific embodiment of this invention shown in the drawings the operation of the timing circuits at all of the stations is initiated by a pause in the transmission following the end-of-message signals following each message. If no further signals are transmitted over the system after an end-of-message signal, and the system remains in the normal marking condition indicating that the transmission path is operative, one of the stations will be then given an opportunity to transmit at the end of a predetermined interval of time. If a tape has been inserted in its transmitter and the transmitter start key operated prior to the termination of this interval of time, the transmitter at this station will be started at the termination of this first interval of time. If no tape has been inserted in the transmitter at this station and the transmitter start key has not been operated at this time, this transmitter will not be started. As shown in the drawings the timing circuits at the respective stations are arranged so that the delay time at the stations may be readily varied so that the order of transmission may be readily controlled and so that stations may be readily added and removed from the common transmission path. To effect the necessary and desirable changes the straps on the various condenser groups are altered. Thus the straps provided on condensers 147 and 247 determine the time and order of transmission from these stations. These straps are so provided that the delay times at the various stations are all different. However the total number of stations connected to a common path

determine the straps and thus the size of the combined condensers 147 and 148 and 247 and 248. At the completion of a second and longer interval of time a transmitter at another station will be started provided a tape has been inserted therein and the transmitter start key operated. After all of the stations have been thus given an opportunity to transmit, without transmission from any of them, an end-of-message signal is automatically transmitted from the control station which again initiates the above cycle of operations.

If any of the stations have messages to transmit that have been inserted in the transmitter and the transmitter start key operated, these messages will be transmitted over the system. Upon the completion of the transmission of these messages an end-of-message signal is transmitted over the system followed by a pause which again initiates the operation of the timing equipment at each of the stations. Additional timing equipment at each station is provided in addition to the timing apparatus at each station referred to above, and upon transmission from that station, or after the time interval assigned to that station has passed without transmission therefrom, the second or the combined first and second so that the timing equipment does not respond to the same time interval as before. Instead, the timing equipment at this station now requires a much longer time interval before it will respond so that all of the other stations on the system will be given an opportunity to transmit before the above cycle is repeated and tranmission initiated from any of the stations which previously transmitted.

A third timing circuit is provided at each of the stations to time the length of transmission from those stations. By operating suitable keys in these circuits, the attendant at these stations may condition the equipment for the transmission from that station during different intervals of time. At the completion of this interval of time the transmitter will be stopped at the end of the message then in progress of transmission and other stations of the system will then be given an opportunity to transmit.

In addition to the tape transmitters and keyboard perforator located at each of the stations, a keyboard transmitter is provided for emergency or urgent transmission of messages over the system. A break key is provided at each of these stations so that the operator or attendant thereat can stop the transmission over the system and take control and transmit the necessary information or urgent messages. In addition, a receiving device is located at each of these stations which records all of the messages transmitted over the system. At the control station a typing reperforator is provided as a receiving device. All of the messages, except the messages transmitted from the control station, are recorded by this typing reperforator both as printed matter and as perforations in a tape. This tape may then be carried to any other transmitter located in the control station and associated with any other line and the messages transmitted over these lines as required. The perforator need not completely perforate the tape but may only partly punch the tape so as to leave small tabs at each perforation attached to the tape upon which the message may be printed. These tabs will facilitate the reading of the printing on the tape by the operator so that she may readily determine the transmitter to which the tape should be taken for transmission over the associated line.

Starting the first station

First assume that power has been applied to the system and that the various motors driving the equipment are operating. In addition, assume that switch 112 shown in Fig. 1 at station A and switch 212 at station B shown in Fig. 2 and switch 412 at station C have all been closed. Further assume that the attendant at each of these respective stations has inserted a tape 103 in transmitter 101 at station A, a tape 203 in transmitter 201 at station B and a tape 403 in transmitter 401 at station C. Further, assume that the attendant at each of these respective stations has operated respective transmitter start keys 131, 231 and 306. The operation of key 131 at station A completes a circuit for the operation of relay 135 from battery through the winding of relay 135 and contacts of key 131 to ground through the closed contacts 113. Relay 135 in operating also completes a circuit for maintaining itself operated from battery through its winding, the break contacts of relay 136 to ground through contact 113. The operation of relay 135 at this time completes a circuit for lighting lamp 130. If relay 141 is not released when key 131 is operated, relay 135 operates and locks operated. Then when relay 141 releases a circuit is completed for the operation of relay 136 from ground through contacts 113, the break contacts of relay 136, the left-hand operated contacts of relay 135 to battery through the right-hand inner break contacts of relay 141 and the winding of relay 136. Relay 136 in operating at this time first completes a circuit for maintaining itself operated, as described hereinafter. However under the assumed conditions relay 141 will be released at this time so the operation of key 131 also completes a circuit for the operation of relay 136, from battery through the winding of relay 136, the right-hand inner break contacts of relay 141, the operated contacts of key 131, to ground through the contacts 113. Inasmuch as tape 103 has been inserted in the transmitter 101, contacts 113 will be closed at this time. Consequently, relay 136 will operate and complete a circuit for maintaining itself operated from battery, through its winding and right-hand inner operated contacts to ground through the closed contacts 113. Relay 136 in operating interrupts the locking circuit of relay 135 which relay releases. Relay 136 in operating, also completes an obvious circuit for lighting the transmitter start lamp 130.

Similarly, the operation of key 231 at this time at station B completes a circuit for the operation of relay 236 which relay in turn completes a circuit for maintaining itself operated and for lighting lamp 230. The operating circuit for relay 236 may be traced from battery, through the winding of relay 236, the right-hand inner break contact of relay 241, operated contacts of key 231 to ground through closed contacts 213. At station C, the operation of the transmitter start key 306 completes a circuit for the operation of relay 326, from battery, through the winding of relay 326, the operated contacts of the transmitter start key 306 to ground through closed contacts 413. Contacts 413 will be closed since tape 403 has been inserted in the transmitter 401. If, as assumed, relay 319 is released at

this time relay 320 is also operated when key 306 is operated.

When power is applied to the system and the transmission path between all the stations established, the line relays 126, 226, 301 and 302 are all operated to their marking positions. In addition, the repeating relays 120, 220 and 303 are likewise operated to their marking positions. All of these relays are provided with a biasing winding which tends to operate them to their spacing positions but the effect of the current flowing over the line through their line windings overcomes the effect of the current through their biasing windings and causes the armatures of these relays to be held to their marking positions.

Under these circumstances, the operation of the timing circuit at each of the stations A, B and C is initiated. That is, upon the application of power to the system condenser 247 at station B, condenser 147 at station A and condenser 344 at station C start to charge. In addition, upon the application of power to the system, the filament circuits of the tubes 144, 244 and 324 are energized, thus conditioning the respective vacuum tubes for operation. Prior to the application of power to the system, condensers 147, 247 and 344 had both their terminals at ground potential because the positive potential is cut off. The potential of the grids or control elements in the respective tubes are controlled by the potential of the upper terminal of these condensers. Since at the start the upper terminal of these condensers and thus the grids are at ground potential while the filaments of the tubes are at a positive potential with respect to ground, the grids will be negative with respect to the filaments and prevent the flow of sufficient current through the tubes to operate the respective relays 143, 243 and 318.

When power is applied to the system at station B, the upper terminal of condenser 247 will start to charge to a positive potential through the high resistance 245 when the line relay 226 is in its marking position and relay 234 released as under the assumed conditions. The time constant of resistance 245 and condenser 247 together with the constants of tube 244 and the potentials applied thereto are such that it requires approximately one second for the upper terminal of condenser 247 to charge sufficiently to permit tube 244 to pass sufficient current to operate relay 243.

At station A, a condenser 147 comprises two condensers connected in parallel as shown by the strap 160. In other words, condenser 147 has considerably more capacity than condenser 247 so that it will require appreciably longer, say three seconds, for the upper terminal of the condenser 147 to reach the potential required to cause tube 144 to pass sufficient current to operate relay 143.

At station C, condenser 344 comprises three condensers connected in parallel so that it requires approximately five seconds for the upper terminal of this condenser to acquire a sufficiently high positive potential through the high resistance 345 to cause tube 324 to pass sufficient current to operate relay 318. Thus the timing circuit comprising the condenser corresponding to condenser 247 and the resistance corresponding to resistance 245 has different constants at each of the stations connected to the system.

Consequently, at the end of approximately one second, relay 243 will operate but relay 143 at station A and relay 318 at station C will not operate.

The operation of relay 243 at station B completes a circuit for the operation of relay 241 from ground, through the operated contacts of relay 243, the left-hand break contacts of relays 237 and 242 to battery through the winding of relay 241. The operation of relay 241 completes a circuit for maintaining itself operated from battery, through its winding and left-hand inner operated contacts to ground, through the operated contacts of relay 243. The operation of relay 241 interrupts the operating circuit of relay 236 so that this relay cannot be operated at this time. However, under the assumed conditions, it has been previously operated and is maintained operated at this time by current flowing through its locking circuit.

The operation of relay 241 completes a circuit for the operation of relay 238 from battery, through the winding of relay 238, right-hand outer operated contacts of relays 236 and 241 to ground, through the break contacts 224. Relay 238, in operating, completes a circuit for maintaining itself operated from battery, through its winding, the right-hand outer operated contacts of relay 236, the left-hand outer operated contacts of relay 238 to ground, through the break contacts of relay 240. A second locking circuit for maintaining relay 238 operated may also be traced from battery, through the winding of relay 238, the right-hand outer operated contacts of relay 236, the center set of left-hand operated contacts of relay 238, to ground, through the break contacts 224.

The operation of relay 238 also completes a circuit for operating the start magnet 209 of transmitter 201 from ground through the right-hand inner operated contacts of relay 238, the left-hand break contacts of relay 233, closed tape control contacts 214, the closed switch 212, winding of start magnet 209 to battery through the closed contacts 216.

The operation of start magnet 209 attracts its armature 216 which in turn disengages the stop cam 211, thus releasing the brush arm 206 of the distributor 207 of transmitter 201 for rotation. The rotation of brush arm 206 causes the message, stored in tape 203 together with any address or directing information preceding the message to be transmitted over the transmission system extending both to stations A and C. The message is recorded by the receiving apparatus 102 at station A, 202 at station B, and the printing reperforator 402 at station C.

Upon the transmission of the first start impulse from transmitter 201 in response to the rotation of brush arm 206, relays 126, 226 and relays 301 and 302 are operated to their spacing positions. At station B relay 226, in operating to its spacing position, completes a circuit for the operation of relay 239 from battery through the winding of relay 239, the right-hand break contacts of relay 234 to ground through the spacing contact and armature of relay 226. Relay 239, in operating completes a circuit for maintaining itself operated from battery, through its winding and right-hand operated contacts to ground through the left-hand inner operated contacts of relay 238.

Relay 239, in operating, completes an obvious circuit for the operation of relay 234. Relay

234, in operating, completes a circuit for maintaining itself operated from battery, through its winding and right-hand operated contacts to ground, through the spacing contact and armature of relay 226. Relay 234 is slow in releasing so that it will be maintained operated by current flowing through its locking circuit during the continuous transmission of signals over the telegraph transmission system. During the continuous transmission of signals over the system, the armature of relay 226 moves alternately between its marking and spacing positions in response to the signals and will be in its spacing position sufficiently long to maintain relay 234 operated.

Relay 241 in operating, as described above completed an obvious circuit for the operation of relay 242. Relay 242, in operating, completes a circuit for maintaining itself operated from battery, through its winding and right-hand inner operated contacts to ground through the right-hand break contacts of relay 237. The operation of relay 242 connects condenser 248 in parallel with condenser 247. Since condenser 248 is discharged prior to the operation of relay 242, when it is connected in parallel with condenser 247 it will cause the potential of the upper terminal of condenser 247 to fall to such a value that current through tube 244 will be reduced so that relay 243 will release and interrupt the locking circuit of relay 241. Relay 241 releases at this time but relay 242 is maintained operated by current flowing through its locking circuit.

Generally, relay 234 will operate after relay 242 has operated and relay 243 has released. Consequently, the subsequent operation of relay 234 connects ground to the upper terminal of condensers 247 and 248 and thus interrupts the charging of the upper terminals of these condensers and prevents the flow of current through tube 244, thus preventing the operation of relay 243 at this time.

Thereafter the message will be transmitted from station B by the transmitter 201 in accordance with the signals stored in tape 203.

When the first spacing signal transmitted from station B arrives at station A, relay 126 will be operated to its spacing position where it completes a circuit for the operation of relay 139 from battery through the winding of relay 139, the right-hand break contacts of relay 134 to ground through the spacing contact and armature of relay 126. Relay 139, in operating, completes a circuit for maintaining itself operated from battery through its winding and right-hand operated contacts, the center set of left-hand break contacts of relay 138 to ground through the break contacts 124.

Relay 139, in operating, completes a circuit for the operation of relay 134. Relay 134, in operating, completes a circuit for maintaining itself operated from battery through its winding and right-hand operated contacts to ground through the spacing contact and armature of relay 126. Relay 126 follows the signals transmitted over the transmission path and during the continuous transmission of signals over the system will be in its left-hand position sufficiently long to maintain the slow-release relay 134 operated.

The operation of relay 134 connects ground to the upper terminal of condenser 147 and thus completely discharges this condenser in a very short interval of time. So long as relay 134 remains operated, ground remains connected to the upper terminal of condenser 147 and thus prevents relay 143 from operating. Thereafter, the circuits at station A remain in this condition during the transmission of the first message from station B.

When the first spacing signal transmitted from transmitter 201 arrives at station C it will cause relays 301 and 302 to be operated to their spacing positions. The operation of relay 302 to its spacing position connects ground to the upper terminal of condenser 344 which discharges condenser 344. During the transmission of the signals, relay 302 operates to its spacing position sufficiently often to maintain condenser 344 substantially discharged because this condenser discharges very rapidly and charges quite slowly through the high resistance 345. Due to the fact that condenser 344 remains substantially discharged, relay 318 cannot operate during the transmission from transmitter 201.

The operation of relay 301 to its spacing position completes a circuit for the operation of relay 313 from battery through the winding of relay 313 and the right-hand break contacts of relay 312 to ground through the spacing contact and armature of relay 301. Relay 313 when operating completes a circuit for maintaining itself operated from battery through its winding and the break contacts of relay 315 to ground through the right-hand operated contacts of relay 313. Relay 313, in operating, connects condenser 343 in parallel with condenser 344. However, relay 302 follows the signals and is operated to its spacing position a substantial proportion of the time the signals are transmitted over the system. These condensers will therefore remain substantially discharged.

Relay 313, in operating, completes a circuit for the operation of relay 312. Relay 312, in operating, completes a circuit for maintaining itself operated from battery through its winding and right-hand operated contacts to ground through the spacing contact and armature of relay 301. Relay 312 is slow in releasing so that it will be maintained operated by current flowing in this locking circuit during the time signals are being continuously transmitted over the transmission path.

Thereafter, the circuits at station C remain in substantially this condition during the remainder of the transmission of the message from station B.

Transmission

The signals recorded in the tape 203 are then transmitted by the transmitter 201 over the transmission path to stations A and C. The repeating relays 120 at station A, 220 at station B and 303 at station C follow the signals and repeat them to the respective selector magnets 119, 219 and 453. Magnet 119 causes the receiving apparatus at station A to record the signals transmitted by the transmitter 201. The selector magnet 219 at station B causes signals to be likewise recorded at station B to provide a "home copy" of the message transmitted over the system. Details of typical receiving apparatus suitable for use at the various stations are described in United States Patents 1,745,633 granted February 4, 1930, to S. Morton et al. and 1,904,164 granted April 18, 1933, to S. Morton et al. The disclosure of these patents is hereby made a part of this application as if fully included and set forth herein.

Magnet 453 causes the printing reperforator 402 to both print the signals upon the tape and to

perforate the tape in accordance with the various elements of the signal. The tape from the recording device 402 will then be available for insertion in transmitter 401 or a similar transmitter connected with any other transmitting path at the control station.

The details of the other transmission paths which may terminate at the control station have not been disclosed in this application. It is to be understood, however, that they may include paths similar to the one disclosed herein or any other suitable type of transmission circuit together with a transmitter capable of transmitting signals in accordance with stored representations of signals constituting messages.

Returning now to the operation of equipment at the transmitting station B, it should be noted that a number of keys 253, 254 and 255 are provided. If none of these keys are operated, positive potential is applied to the grid of tube 251 upon the operation of relay 238 which removes the ground connected thereto. The operation of relay 238 also completed the filament circuit to tube 251. Consequently, a short interval of time after relay 238 has operated, tube 251 will be energized and pass sufficient current to operate relay 249. Relay 249 in operating completes an obvious circuit from ground for the operation of relay 240. Relay 240, in operating, interrupts one of the locking circuits holding relay 238 operated. Relay 238, however, does not immediately release because it is maintained operated by current flowing through the locking circuit extending through the break contacts 224.

However, had one of the keys 253, 254 or 255 been operated prior to the operation of relay 238, the associated condensers 256, 257 and 258 would have been charged so that their upper terminals will be at ground potential and their lower terminals at the potential of the positive battery. The potential of the grid of tube 251 is controlled by the potential of the upper terminal of these condensers so that under these circumstances, with the grid at ground potential, insufficient current will pass through tube 251 to cause relay 249 to operate. Upon the operation of relay 238, as described above, ground is connected to the lower terminals of the condensers 256, 257 and 258 in a path extending from ground through the break contacts of relay 253 and right-hand outer operated contacts of relay 238 to the lower terminals of these condensers 256, 257 and 258. Since the upper terminals of these condensers were charged to a potential equal to the potential of the battery more negative than the lower terminals of these condensers, the potential of the grid of tube 251 is made more negative at this time. Consequently, tube 251 will conduct substantially no space current at this time.

The operation of relay 238 also removes the ground connected to the upper terminals of the condensers and thus removes a short circuit from around the high resistance 259 whereupon the upper terminals of many of the condensers connected to the circuit begin to discharge and then become charged to a positive value. The time constants of resistance 259 and the condensers 256, 257 and 258 together with the value of the bias and other potentials and constants of tube 251 are so related that it requires an appreciable period of time for the upper terminals of these condensers to discharge and to be charged to the positive value required for tube 251 to conduct sufficient space current to operate relay 249.

In a typical embodiment of this invention, the various constants of the circuits together with the capacity of condenser 258 are such that it requires substantially a minute for relay 249 to operate after relay 238 has operated. The constants of condenser 257 are such that it requires substantially two minutes for relay 249 to operate after relay 238 has operated. The constants of condenser 256 are such that it requires approximately four minutes for relay 249 to operate.

As is well understood, more than one of these keys may be operated at the same time and thus cause a greater delay in the operation of relay 249.

Assume now that one or more of keys 253, 254 or 255 were operated previous to the operation of relay 236. Furthermore assume that a number of different messages were recorded in the tape 203. Assume further that the transmission of these messages individually do not require the entire time interval measured by the timing circuit of the connected condensers 256, 257, 258 and high resistance 259 and tube 251.

At the end of the first message, the operator will perforate a figures signal followed by an H signal in the tape 203. This figures signal and part or all of the succeeding letters signals followed by the H signal comprise an end of message indication which indicates that the previously transmitted message has been completed. When the figures signal followed by the H signal is received by the selector magnet 219, it will cause contacts 224 to momentarily open. The manner in which contacts 224 are opened in response to the figures signal followed by an H signal is clearly described in the above-identified patents to Morton et al. and need not be repeated here. The momentary operation of contacts 224 at this time interrupts one of the locking circuits of relay 238. If relay 240 is not operated at this time and under the assumed conditions it will not have operated by this time, the operation of contacts 224 will not cause relay 238 to release. Consequently, relays 239 and 234 will remain operated and condensers 247 and 248 remain discharged. Immediately following the transmission of the figures signal followed by the H signal, the signals representing the succeeding message stored in tape 203 will be transmitted from the transmitter 201 since under the assumed conditions, several messages were stored in tape 203 in succession. The circuits at station B thus remain in their previous condition during the transmission of this message.

When the figures signal followed by the H signal which were transmitted at the end of the first message by transmitter 201 are received by the selector magnet 119, the selector mechanism will momentarily open contacts 124 in the manner described in the above-identified patents to Morton et al.

The momentary operation of contacts 124 interrupts the locking circuit of relay 139 which relay thereupon releases and interrupts the operating circuit of relay 134. However, if the signals are continuously transmitted by transmitter 201 at this time as they normally will be since a second message will be immediately transmitted by transmitter 201, relay 134 will be maintained operated by current flowing through its locking circuit extending through its right-hand operating contacts and spacing contact of relay 126. Near the beginning of the second message from station B, a carriage return signal will be transmitted. When the carriage return signal is received by the selector magnet 119, it will cause the selector to momentarily close the

contacts 123 and complete a circuit for the operation of relay 139. Relay 139 then locks operated in the circuit traced above and completes the operating circuit of relay 134. Thus, the circuits at station B are returned to the same condition they were during the transmission of the first message.

When the figures signal following the first message arrives at station C, it will cause the platen controlled contacts 450 to close. U. S. Patent 2,120,235 granted June 14, 1938, to Beattie et al. shows a typical and suitable apparatus for the operation of platen controlled contacts. The disclosure of that patent is hereby made a part of this application as is fully set out and fully included herein.

Then when the H signal is received, contacts 451 are momentarily operated and complete a circuit for the operation of relay 315 from ground through the operated contacts 451 and 450 to battery, through the winding of relay 315. The operation of relay 315 completes a circuit for maintaining itself operated under control of relay 313. Relay 315, in operating, also interrupts the locking circuit of relay 313 and thus permits this relay to release. The release of relay 313 interrupts the operating circuit of relay 312. Relay 312, however, does not release at this time because it is maintained operated due to current flowing through its locking circuit when relay 301 is in its spacing position. Then when a carriage return signal is received by the typing reperforator 402, shortly after the beginning of the next message contacts 423 will be momentarily closed and complete a circuit for the operation of relay 313 from battery, through the winding of relay 313 to ground, through the operated contacts 423 and the break contacts 451. Relay 313, in operating, completes a circuit for maintaining itself operated, as described above, and reestablishes the operating circuit through the winding of relay 312, thus maintaining this relay operated.

Thus the same circuits are reestablished at the control station C during the transmission of the second message from the transmitter 201 at station B as were established during the transmission of the first message from transmitter 201.

The operation of the circuits at the respective stations at the termination of each message and the beginning of the next message transmitted from station B are substantially the same as described above so long as the time assigned for transmission from station B has not elapsed.

End of transmission from one station and starting the next station

If none of the keys 253, 254 or 255 had been operated, relay 240 will operate without substantial delay after the operation of relay 238. If any of these keys had been operated, the operation of relay 240 is delayed as described above.

If all of the messages recorded in tape 203 are transmitted before the end of the time allotted from station B, tape 203 will pass out of the transmitter 201 and permit contacts 213 to open. Contacts 213, in opening interrupt the locking circuit of relay 236, thus permitting this relay to release. The release of relay 236 interrupts the circuit of lamp 230, thus extinguishing this lamp. The release of relay 236 also interrupts both locking circuits of relay 238, thus permitting this relay to release.

If all the messages are not transmitted within the time allotted to station B, the tape will not run out of the transmitter so contacts 213 will remain closed. However, relay 240 will operate at the end of the time interval assigned to station B for transmission. After relay 240 has operated and the message in progress of transmission at that time has been transmitted, the figures signal followed by the H signal following this message will cause contacts 224 to momentarily open. Under these circumstances, both locking circuits of relay 238 are interrupted. Consequently, this relay will release at this time.

The release of relay 238, due either to the opening of contacts 213 or to the operation of relay 240 and the subsequent opening of contacts 224, interrupts the circuit of the start magnet 209 of transmitter 201. Start magnet 209 then releases its armature 216 and causes the brush arm 206 to come to rest and thus stop transmission over the transmission path. Thereafter, relays 126, 226 and 301 and 302 will be maintained in their marking positions. The release of relay 236 and the momentary operation of contacts 224 interrupt the locking circuits of relay 239 and thus permit this relay to release. The release of relay 239 interrupts the operating circuit of relay 234. Since relay 226 is now maintained in its marking position, the locking circuit through its spacing contacts for maintaining relay 234 operated will be interrupted. Consequently, a short interval of time later, relay 234 will release and remove ground from the upper terminal of condensers 247 and 248 which are now connected together due to the fact that relay 242 was previously operated and locked operated under the control of relay 237 as described above.

At station A the reception of the figures signal followed by the H signal cause contacts 124 to momentarily operate and interrupt the locking circuit of relay 139, thus permitting relay 139 to release. The release of relay 139 interrupts the operating circuit of relay 134. Since relay 126 is now maintained in its marking position, the locking circuit of relay 134 which extends through the spacing contacts of relay 126 will be interrupted. Consequently, relay 134 will release a short interval of time later. The release of relay 134 removes ground from the upper terminal of condenser 147. This terminal of condenser 147 then starts to charge to a positive potential through the high resistance 145. It should be noted that relay 142 at station A has not been operated. Consequently, only condenser 147 starts to charge since condenser 148 is not connected in parallel with condenser 147 at this time.

At station C, the figures signal which was received at the end of the last message transmitted from the transmitter 201 causes the platen contacts 450 to close and remain closed so long as the platen remains in the upper case position. The following H signal causes contacts 451 to be operated and complete a circuit for the operation of relay 315, as described above. Relay 315, in operating, interrupts the locking circuit of relay 313 and permits this relay to release. The release of relay 313 interrupts the operating circuit of relay 312. Inasmuch as relay 301 is now maintained in its marking position the locking circuit of relay 312 extending through the spacing contacts of relay 301 is interrupted. Therefore, a short interval of time after relay 313 releases, relay 312 will release.

Inasmuch as relay 302 is also maintained in its marking position, ground will be removed from the upper terminal of condensers 344 and thus permit them to charge to a positive potential

through the high resistance 345. It should be noted that since relay 313 is released condensers 343 are not connected in parallel with condensers 344. Consequently, only condensers 344 begin to charge. Thus ground is removed from the upper terminals of condensers 247, 248, 147 and 344 at substantially the same time and positive potential applied to the upper terminals of these condensers so that they all start to charge at substantially the same time. As pointed out above, the time constants of condenser 344 together with the charging resistance 345 are such that it requires a longer time for them to charge sufficiently to operate relay 318 than it does for condenser 147 to acquire a sufficiently high positive potential to cause relay 143 to operate. With condensers 247 and 248 connected in parallel, the constants of these condensers are so related to the charging resistance 245 that it requires a longer time to charge these condensers sufficiently to operate relay 243 than is required to charge condensers 147 through resistance 145.

Under these conditions, relay 143 will operate first. The operation of relay 143 completes a circuit for the operation of relay 141 from battery through the winding of relay 141, the left-hand break contacts of relays 142 and 137 to ground through the operated contacts of relay 143. The operation of relay 141 completes a circuit for maintaining itself operated under the control of the contacts of relay 143.

Assuming now that relay 136 has been previously operated due to the operation of key 131 and the insertion of tape 103 in transmitter 101, as described above, the operation of relay 141 completes a circuit for the operation of relay 138 similar to the circuit described above with reference to relay 238.

Relay 141, in operating as described above, also completes a circuit for the operation of relay 142. Relay 142, in operating, connects condensers 148 in parallel with condensers 147. Inasmuch as condensers 148 are discharged at the time they are connected in parallel with condensers 147, the potential of the upper terminals of the combined condensers 147 and 148 will fall to a sufficiently low value to cause relay 143 to release and thus interrupt the locking circuit of relay 141.

The operation of relay 138, as described above, completes a circuit for the operation of the start magnet 109 of transmitter 101, thus releasing the brush arm 106 for rotation. The rotation of brush arm 106 causes the transmitter 101 to transmit the message recorded in tape 103 over the transmission system. Relay 126 will follow the signals transmitted from transmitter 101 and upon the transmission of the first break impulse the armature of this relay will move to its spacing position where it completes a circuit for the operation of relay 139. Relay 139 in operating completes a circuit for maintaining itself operated under control of relay 138. Relay 139 in operating also completes a circuit for the operation of relay 134. The operation of relay 134 connects ground to the upper terminals of condensers 147 and 148 thus discharging these condensers which in turn causes relay 143 to release. The release of relay 143 causes the release of relay 141. However, since relay 138, in operating, completes two locking circuits, one under the control of contacts 124 and the other under the control of relay 140, the release of relay 141 does not cause the release of relay 138. Neither does the release of relay 141 cause the release of relay 142 because relay 142 is locked operated under the control of relay 137.

Thereafter the circuits at this station remain in this condition during the transmission of the message from station A.

When these messages arrive at station B, relay 226 will respond to them by moving its armature to its spacing position in accordance with the signals where a circuit is completed for the operation of relay 239. The operation of relay 239 completes a circuit for maintaining itself operated under the control of contacts 224 and also completes a circuit for operating relay 234. Relay 234, in operating, completes a circuit for maintaining itself operated under the control of the spacing contact of relay 226. The operation of relay 234 also connects ground to the upper terminal of condensers 247 and 248, thus preventing the upper terminals of these condensers from being charged to a sufficiently high positive potential to cause relay 243 to operate. Thereafter, during the transmission of messages from station A, the circuits at station B remain in the above conditions.

Relays 301 and 302 at station C also respond to and follow the signals transmitted by the transmitter 101 at station A. Relay 301, in operating to its spacing position in response to spacing impulses transmitted from station A, completes a circuit for the operation of relay 313. Relay 313, in operating, completes a circuit for maintaining itself operated under the control of relay 315. Relay 313, in operating, also completes a circuit for the operation of relay 312.

Relay 302 also responds to the signals transmitted from transmitter 101 at station A by moving its armature to its spacing position in response to spacing impulses transmitted from station A. In its spacing position, relay 302 connects ground to the upper terminal of condenser 344, thus discharging condenser 344 and preventing the upper terminal of this condenser from acquiring a sufficiently high positive potential to cause relay 318 to operate during the continuous transmission of signals from station A.

Thereafter, the circuits at station C remain in this condition during the transmission of the remainder of the message from station A. Following the transmission of each message a figures signal followed by an H signal are transmitted from station A. The circuits at station C respond to these signals in the same manner that they responded to the figures signal followed by the H signal transmitted from station B following each message, as described above. The circuits at each station B respond to this figures signal followed by the H signal transmitted after or between each message in the same manner that the circuits at station A responded to these same signals when transmitted between these messages from station B, as described above.

Starting the control station

If the supply of perforated tape 103 runs out of the transmitter 101 before the end of the transmission interval assigned to station A, contacts 113 will open and interrupt the locking circuit of relay 136 which relay releases and interrupts both locking circuits of relay 138.

If the supply of perforated tape 103 does not run out before the end of the transmission time interval assigned to station A, relay 140 operates at the end of this time interval. Then at the end of the message in progress of transmission when relay 140 operates, the figures signal fol-

lowed by the H signal cause contacts 124 to momentarily open and interrupt the second and last locking circuit of relay 138, thus permitting this relay to release.

Relay 138 in releasing interrupts the circuits of the start magnet 109 which magnet will then release its armature 110 and cause brush arm 106 to come to rest and stop transmission over the transmission circuit. Thereafter, the relays 126, 226, 301 and 302 will be maintained in their marking positions. The release of relay 138 interrupts the locking circuit of relay 139 and permits this relay to release. The release of relay 139 interrupts the operating circuit of relay 134. Since relay 126 is now maintained in its marking position, relay 134 will release a short interval of time later and remove ground from the upper terminals of condensers 147 and 148 which are now connected in parallel because relay 142 is now operated as described above.

Similarly, at station B, contacts 224 are momentarily opened in response to the figures signal followed by the H signal. The momentary opening of contacts 224 interrupts the locking circuit of relay 239. The subsequent release of relay 239 interrupts the operating circuit of relay 234. Since relay 226 is then maintained in its marking position, relay 234 will release a short interval of time later and remove ground from the upper terminals of condensers 247 and 248, thus permitting the upper terminals of these condensers to acquire a positive potential through high resistance 245.

At station C, the figures signal followed by the H signal first cause contacts 450 to close and then contacts 451 and complete a circuit for the operation of relay 315. Relay 315 interrupts the locking circuit of relay 313 and permits this relay to release. The release of relay 313 interrupts the operating circuit of relay 312 which relay in turn releases because its locking circuit is interrupted at the spacing contacts of relay 302 which is maintained in its marking position at this time. With relay 302 maintained in its marking position, the upper terminals of condensers 344 will start to charge to a positive potential through the high resistance 345. It should be noted that since relay 313 is released condensers 343 are not connected in parallel with condensers 344.

Here again, the charging of the condensers at the respective stations is initiated at substantially the same time by transmission of the figures signal followed by the H signal and the subsequent maintaining of the transmission system in its marking condition.

The time constants of the circuits at stations A, B and C under these conditions are such that condensers 147 and 148 when connected in parallel and condensers 247 and 248 when connected in parallel will be charged to sufficiently high positive potential to cause the respective relays 143 and 243 to operate prior to the time the upper terminal of the condenser 344 is charged to a sufficiently positive potential to cause relay 318 to operate.

Relays 143 and 243 operate substantially at the same time under these conditions. It is not material which one operates first. The operation of relay 143 at this time completes the circuit for the operation of relay 137 from battery through the winding of relay 137, right-hand operated contacts of relay 142 and left-hand inner break contacts of relay 141 to ground through the operated contacts of relay 143. The operation of relay 137 at this time first completes a circuit for maintaining itself operated from battery through its winding and right-hand operated contacts to ground through the operated contacts of relaly 143. The operation of relay 137 interrupts the locking circuit of relay 142 thus permitting this relay to release.

The circuits at station A thereafter remain in this condition until signals are received over the transmission path.

Similarly at station B relay 243 in operating completes a circuit for the operation of relay 237 which relay in turn locks operated under control of relay 243 and interrupts the locking circuit of relay 242. Relay 242 thereupon releases and disconnects condenser 248 from condenser 247 and discharges condenser 248. Thereafter the circuits at station B remain in this condition until signals are received over the transmission path.

A short interval of time after relays 143 and 243 have operated the upper terminal of condenser 344 will become charged to a sufficiently high positive potential to cause relay 318 to operate. Relay 318 in operating completes an obvious circuit for the operation of relay 319. Relay 319 in operating completes a circuit for the operation of relay 463 from battery to the winding of relay 463 through the lower break contacts of relay 460, the break contacts of key 305, and the operated contacts of relay 319 to ground through the lower break contacts of relay 463.

Relay 463 in operating completes a circuit for maintaining itself operated from battery through its winding and the lower break contacts of relay 460 to ground through the lower inner operated contacts of relay 463.

Relay 463 in operating also completes a circuit for the operation of relay 323. Relay 323 in operating completes a circuit for the operation of relay 314 from battery through the winding of relay 314 and lower operated contacts of relay 323 to ground through the upper break contacts of relay 330. Relay 314 in operating completes a circuit for maintaining itself operated under control of relay 312. Relay 323 in operating completes a circuit for the operation of magnet 405. Magnet 405 in operating renders the tape advancing means of the transmitter 401 inoperative so that during the time magnet 405 is operated tape 403 is not advanced through transmitter 401 during the operation of transmitter 401.

The manner in which the operation of magnet 405 prevents the advance of the tape may be more readily understood by reference to Fig. 8 which shows the manner in which this feature is applied to the tape controlled transmitter disclosed in United States Patent 2,055,567 granted to Watson on September 29, 1936. This patent is hereby made a part of this application as if fully included and set forth herein.

Magnet 805 of Fig. 8 corresponds to magnet 405 shown in Fig. 4. Magnet 805 in operating attracts its armature 819 and rotates it in a counter-clockwise direction as shown in Fig. 8 so that its upper end will engage lug 828 on the feed paul 818 when it is lowered during the operation of the transmitter as described in the above identified patent to Watson.

When lug 828 engages member 819 when paul 818 is lowered paul 818 is rotated in a counter-clockwise direction so that it disengages the ratchet wheel 820 when lever 817 is rotated in a clockwise direction by plate 810.

Consequently, as long as magnet 805 is operated its armature 819 engages lug 828 so tape 803 will not be advanced when the sensing fingers 826 are withdrawn from tape 803. These fingers therefore sense the same row of perforations for every cycle of operation of the transmitter.

Returning now to the operation of the circuits, relay 314 in operating also short-circuits the contacts of relay 303 and thus prevents relay 303 from repeating signals to the typing reperforator 402.

Relay 323 in operating completes a circuit for the operation of relay 459 when the transmitter brush arm 406 comes to rest. Normally transmitter brush arm 406 will be at rest at this time consequently relay 323 in operating will complete a circuit for the operation of relay 459 from battery through the winding of relay 459, the upper inner break contacts of relay 461, the upper operated contacts of relay 323, the upper inner break contacts of relay 322, lower break contacts of relay 327, the upper break contacts of relay 335 to ground through the closed contacts 421. Relay 459 in operating completes a circuit for operating the start magnet 409 from ground through the lower operated contacts of relay 459 the upper break contacts of relay 461, the upper inner operated contacts of relay 323, tape controlled contacts 414 and switch 412 to battery through the winding of magnet 409. The operation of start magnet 409 releases the brush arm 406 for rotation.

Near the beginning of this rotation contacts 421 open and remove ground from the left winding terminal of the winding 461. Relay 461 thereupon operates in series with the locking circuit for relay 459 from battery through the winding and the lower inner operated contacts of relay 459 and winding of relay 461 to ground through the lowermost operated contacts of relay 323. The operation of relay 461 at this time interrupts the operating circuit of the start magnet 409 thus insuring that the brush arm 406 will come to rest at the end of this revolution.

During this revolution of the brush arm 406 and transmitter 401, relay 463 will be operated as described above. Consequently the potentials applied to segments 1 to 5 of the distributor 407 are such as to cause this distributor to transmit a figures signal. This signal is represented in the usual code signal impulses comprising a marking 1st, 2nd, 4th and 5th impulses and a spacing third impulse. When these impulses are transmitted, together with the start and stop impulses to stations A and B they will cause relays 139 and 134 at station A to operate and relays 239 and 234 at station B to operate. At station A the operation of relay 134 connects ground to the upper terminal of condensers 147 and 148 thus discharges these condensers and interrupts the flow of current through tube 144. Relay 143 thereupon releases and interrupts the locking circuit of relay 137 which relay in turn releases.

Similarly at station B the operation of relay 234 connects ground to the upper terminal of condensers 247 and 248 and thus causes these condensers to discharge which in turn causes relay 243 to release. The release of relay 243 interrupts the locking circuit of relay 237 which relay in turn releases.

At the control station relay 301 follows the figures signal transmitted to stations A and B and completes a circuit for the operation of relay 313 which relay in operating completes a circuit for the operation of relay 312. Relay 302 also follows the signals transmitted at stations A and B at this time and grounds the upper terminal of condenser 344 which in turn interrupts the flow of current through tube 324 and causes relay 318 to release, which in turn causes relay 319 to release.

Near the end of the revolution of brush arm 406 during which this figures signal is transmitted contacts 421 will again be operated or closed. The operation of contacts 421 at this time completes a circuit for the operation of relay 464 from battery through the winding of relay 464, the upper break contacts of relay 462, the upper inner operated contacts of relay 461, the upper outer operated contacts of relay 323, the upper inner break contacts of relay 322, lower break contacts of relay 327, the upper break contacts of relay 335 to ground through the operated contacts 421.

The operation of relay 464 applies the necessary potentials to segments 1 to 5 of the distributor 407 so that during the next revolution brush arm 406 an H signal will be transmitted. That is, a signal combination in the usual code in which the first, second and fourth impulses are spacing, the third and fifth impulses are marking. The operation of relay 464 also completes a circuit for the operation of the start magnet 409 from ground through the innermost upper operated contacts of relay 464, lower break contact of relay 462, the upper inner operated contact of relay 323, tape controlled contacts 414 and switch 412 to battery through the winding of start magnet 409. The operation of start magnet 409 at this time releases the brush arm 406 for rotation. Near the beginning of rotation of brush arm 406 contacts 421 open and remove a short circuit from around the winding of relay 462. Relay 462 thereupon operates in series with the locking circuit of relay 464 from battery through the winding and lower operated contacts of relay 464 and the winding of relay 462 to ground through the lower outer operated contacts of relay 323. The operation of relay 462 interrupts the circuit of start magnet 409 and thus permits this magnet to release and stop the brush arm 406 at the completion of this revolution.

During the ensuing revolution of brush arm 406 an H signal will be transmitted by the transmitter 401 to stations A and B. A short interval of time after this signal is received at station A contacts 124 will be momentarily opened by the selector mechanism of the teletypewriter 102 at this station and interrupt the locking circuit of relay 139 thus permitting this relay to release. The release of relay 139 interrupts the operating circuit of relay 134. If no further signals are transmitted at this time, relay 126 will be maintained in its marking position. Consequently relay 124 will release and remove ground from the upper terminal of condenser 147. This terminal condenser 147 will thereupon start to charge to a positive potential. Similarly the reception of the figures signal followed by the H signal at station B will cause contacts 224 of the selector 202 to operate and interrupt the locking circuit of relay 239 which relay in turn releases and interrupts the locking circuit of relay 234. At this time relay 226 is maintained in its marking position so that relay 234 will release and remove ground from the upper terminal of condenser 247. Thereupon

condenser 247 will also start to charge to a positive potential.

However, under the assumed conditions with messages awaiting transmission from the main or control station C relays 134 and 234 may or may not release. If these relays do not release relays 139 and 239 will be operated upon reception of the first carriage return signal of the succeeding message by the closure of contacts 123 and 223 by the selector mechanisms in response to the reception of this signal.

At the completion of the revolution during which the H signal is transmitted by brush arm 406, contacts 421 will again close and complete a circuit for the operation of relay 460 from battery through the winding of relay 460, the upper operated contacts of relays 462 and 461, the upper outer operated contacts of relay 323, the upper inner break contacts of relay 322, lower break contacts of relay 327, the upper break contacts of relay 335 to ground through the closed contacts 421. The operation of relay 460 at this time interrupts the locking circuit of relay 463 and permits this relay to release. The release of relay 463 interrupts the operating circuit of relay 323 which relay in turn releases and releases relays 459, 461, 462, 460 and 464 and also magnet 405. The release of magnet 405 will permit tape 403 to be advanced through the transmitter in the normal manner when the transmitter is again operated.

Under the assumed conditions the operator had previously inserted a tape 403 in transmitter 401 and had operated the transmitter start key 306. Consequently when relay 460 operates as described above a circuit is completed for the operation of relay 330 from ground through the upper operated contacts of relay 460 and the lower operated contacts of relay 320 to battery through the winding of relay 330. Relay 460 is sufficiently slow in releasing to provide time for the operation of relay 330.

The operation of relay 330 completes the filament circuit of tube 329 and thus conditions this tube and its related circuits for operation. The operation of relay 330 also initiates the discharging and charging of any of the condensers 340, 341 or 342 which may be connected to the grid of tube 329 by the operation of the respective keys 337, 338 and 339.

The operation of relay 330 completes an obvious circuit for the operation of relay 314 if it is released at this time. Relay 314, in operating, prepares a circuit for maintaining itself operated under control of relay 312 when relay 312 operates, as described hereinafter. The operation of relay 314 short-circuits the contacts of repeating relay 303 so that the message transmitted from transmitter 401 will not be repeated to the typing reperforator.

The operation of relay 330 completes a circuit for maintaining itself operated from battery through its winding, the lower inner break contacts of relay 332, upper operated contacts of relay 330, to ground, through the tape controlled contacts 413 which are closed so long as there is a supply of tape 403 passing through transmitter 401.

The operation of relay 330 also completes a circuit for the operation of the start magnet 409 from battery through the winding of start magnet 409, switch 412, tape controlled contacts 414, the upper break contacts of relay 323, left-hand inner break contacts of key 308, lower break contacts of relay 317, upper operated contacts of relay 330, lower break contacts of relays 332 and 334, the right-hand contact and armature of relay 466, the lower inner break contacts of relay 332, the upper operated contacts of relay 330 to ground, through the tape controlled contacts 413. Start magnet 409 attracts its armature 410 and releases the brush arm 406 for rotation. Brush arm 406 in rotating causes the transmitter 401 to transmit the message stored in tape 403 over the transmission circuit.

As before, relays 126, 226, 301 and 302 all respond to the signals transmitted over the circuit. In response to the spacing impulse transmitted from the transmitter 401, relay 301 operates to its spacing position and completes a circuit for the operation of relay 313, if this relay is released at this time. Relay 313, in operating, completes a circuit for maintaining itself operated under the control of relay 315 and completes a circuit for the operation of relay 312. Relay 312 completes a locking circuit for maintaining itself operated under control of relay 301. In addition, relay 312 completes a circuit for maintaining relay 314 operated, as described above. This insures that none of the message transmitted from the transmitter 401 will be repeated back to the typing reperforator 402.

The operation of relay 302 to its spacing position connects ground to the upper terminals of condensers 344 and 343, thus preventing these condensers from acquiring a sufficiently high positive potential to cause relay 318 to operate.

Similarly, at stations A and B, the operation of relays 126 and 226 to their spacing position is in response to the first spacing impulse transmitted from the transmitter 401 to cause the circuits at these stations to be conditioned, as described above when the transmission was from some other station of the system. The circuits at various stations are maintained in these conditions, as described above, during the transmission of the remainder of the message from the transmitter 401 at station C.

It should be noted that all of the messages transmitted from any of the stations are recorded at all of the stations of the system excepting that messages transmitted from the control station are not again recorded at the control station. Otherwise, all of the messages transmitted over this system are recorded at all of the stations connected to the transmission path.

Transmission from the control station

The transmitter 401 then transmits the message stored in tape 403 to the transmission path extending to stations A and B. The message transmitted from station C are recorded by both A and B as described above. At station C, as at stations A and B, if none of the keys 337, 338 and 339 are operated relay 328 will operate immediately following the operation of relay 330. However, if one or more of the keys 337, 338 or 339 are operated the respective condensers 340, 341 and 342 will be discharged and then charged through the high resistance 346. The time constants of the charging circuit of these condensers are of the same order as described with reference to condensers 256, 257 and 258 and 156, 157 and 158.

Assume that the first message recorded in tape 403 is completely transmitted before the end of this time interval and that other messages are recorded in tape 403.

So long as relay 325 remains released relay 465 is maintained in its left-hand position by current

flowing from ground through the break contact of relay 325 through the lower winding of relay 465 to battery. Consequently relay 465 will not respond to the figures signal transmitted by the transmitter 401 at the end of the first message, neither will relay 466 respond to the following H signal. Relay 466 is maintained in the position shown in the drawings by current flowing from battery to its upper winding to ground through the lower break contact of relay 331.

When this figures signal followed by the H signal is received at stations B and C they respond as described above when the message is transmitted over the system from some station other than the respective stations A and B to these stations A and B.

This mode of operation is repeated during and between the transmissions of each of the messages recorded in tape 403 so long as relay 325 does not operate.

Assume now that the time interval allotted to station C has elapsed and that at the end of this interval relay 328 operates. The operation of relay 328 applies a positive potential to the lower terminals of any of the condensers 341, 342 and 343 that may be connected to the grid of tube 329. This causes a sudden increase in the potential of the grid of tube 329 thus increasing the current flowing through relay 328 and makes its operation at this time more positive. The operation of relay 328 completes an obvious circuit for the operation of relay 325. Relay 325 interrupts the circuit traced above through the lower winding of relay 465. The armature of relay 465 is then controlled by the currents flowing through the windings of relay 465 in accordance with position of the contacts 1 to 5 of the tape transmitter 401. The position of the contacts 1 to 5 are controlled by the perforations in the tape 403 and assume the various positions in accordance with the permutation code signals recorded in tape 403 and transmitted by distributor 407 of transmitter 401. The windings of relay 465 are so connected to battery and ground and the contacts 1 to 5 through suitable resistances so that relay 465 will have current flowing through its windings in such a direction as to maintain its armature in its right-hand position for all settings of the contacts 1 to 5 except the code combination representing the figures signal. When the figures signal following the message, which was being transmitted at the time relay 325 operates, arrives over the sensing pins and sets contacts 1 to 5 in the combination representing the figures signal the current through both windings of relay 465 fails to substantially zero because battery is applied to both terminals of the lower winding and ground to both the terminals of the upper winding. With substantially no current flowing through the windings of this relay its armature will move to its left-hand position under the influence of a biasing spring where it completes a circuit for the operation of relay 335 from battery through the winding of relay 335, the left-hand contact and armature of relay 465, the lower inner break contact of relay 332, an upper operated contact of relay 330 to ground through the tape controlled contacts 413. Relay 335 in operating completes a circuit for maintaining itself operated from battery through its winding, the lower break contacts of relay 336, lower outer operated contacts of relay 335, lower inner break contacts of relay 332 and upper operated contacts of relay 330 to ground through the tape controlled contacts 413. It is to be noted that the tape 403 is still in the transmitter 401 so contacts 413 will be closed at this time.

At the completion of the revolution of the brush arm 406 during which the figures signal was transmitted, cam 420 caused contacts 421 to close to a circuit for the operation of relay 331. Relay 331 in operating interrupts the circuit through the upper winding of relay 466 as described above so that relay 466 is then controlled by the currents flowing through both of its windings under the control of the setting of contacts 1 to 5 of transmitter 401. As the transmitter brush arm 406 starts the next revolution for the transmission of the signal recorded in tape 403 contacts 421 will open and cause relay 333 to operate in the circuit from battery through the winding of relay 331, the operated contacts of relay 331, the winding of relay 333, the lower operated contacts of relay 335 through the right-hand contact and armature of relay 465, lower inner break contacts of relay 332 and upper operated contacts of relay 330 to ground through contacts 413. If the next signal recorded in tape 403 is a figures signal relay 465 will again operate and interrupt the locking circuit of relays 331 and 333. If this is the case, the above cycle of operation will then be repeated when brush arm 406 nears the completion of the revolution during which the second figures signal is transmitted, contacts with 421 will again close and complete a circuit for the operation of relay 331. The operation of relay 331 again prepares a circuit for the operation of relay 333. Relay 333 however does not operate at this time because it has ground connected to both of the terminals in its winding. When brush arm 406 starts upon the next revolution contacts 421 will open and remove ground from the upper winding of terminals of relay 333 and thus cause this relay to operate. If the signal immediately following the figures signal is an H signal relay 466 will be operated to its left-hand position where it completes a circuit for the operation of relay 334 from battery through the winding of relay 334, left-hand contact and armature of relay 466, lower inner break contacts of relay 332 and upper operated contacts of relay 330 to ground through the tape controlled contacts 413.

If any combination other than an H signal or another figures signal is perforated in the tape 403 following the figures signal, relay 466 will not operate so relay 334 will not operate at this time. Consequently if any code combination other than a figures signal or an H signal is recorded in tape 403 following the figures signal, contacts 421, when they close near the end of the transmission of this signal following the figures signal, a circuit will be completed for the operation of relay 336 from ground through contacts 421, the upper operated contacts of relay 335, the operated contacts of relay 333, the upper unoperated contacts of relay 334 and the winding of relay 336 to battery. The operation of relay 336 at this time interrupts the locking circuit of relay 335 which relay releases and in turn interrupts the locking circuit of relays 331 and 333 thus canceling the effect of the figures signal.

If, however, the H signal immediately follows the figures signal relay 334 operates as described above and locks operated in a circuit extending from battery through its winding and lower inner operated contacts, the break contacts of relay 336, lower outer operated contacts of relay 335, lower inner break contacts of relay 332 and

upper operated contacts of relay 330 to ground through closed contacts 413.

The operation of relay 334 interrupts the circuit of the start magnet 409 consequently the brush arm 406 will come to rest at the completion of the revolution during which the H signal was transmitted. Near the completion of this revolution of brush arm 406, cam 420 will again close contacts 421 and complete a circuit for the operation of relay 332 from battery through the winding of relay 332, the upper operated contacts of relays 334, 333 and 335 to ground through the operated contacts 421.

Relay 332 in operating interrupts the locking circuit of relay 330 and also of relays 335 and 334 which relays release and in turn interrupt the locking circuit of relays 331 and 333 which relays then release. The release of relay 330 interrupts the locking circuit of relay 332 and permits this relay to release.

The release of relay 330 interrupts the filament circuit of tube 329 and removes ground from the lower terminals of condensers 340, 341 and 342 and connects ground to the upper terminals of these condensers thus restoring the timing circuit comprising these condensers, tube 329 and resistance 346 to normal. Relay 330 in releasing also interrupts the operating circuit of the start magnet 409 of transmitter 401 and thus insures a transmitter will not restart when relay 332 releases.

The release of relay 330 completes a circuit for the operation of relay 315 from battery through the winding of relay 315, the right-hand operated contacts of relay 314, lower break contacts of relay 323 to ground through the upper outer break contacts of relay 330. Relay 315 in operating interrupts the locking circuit of relay 313 and permits this relay to release. The release of relay 313 interrupts the locking circuit of relay 312. Inasmuch as transmitter 401 remains at rest as do all the other transmitters connected to the circuit, relay 301 will be maintained in its right-hand position where it interrupts the operating circuit of relay 312 thus permitting relay 312 to release. The release of relay 312 interrupts the locking circuit of relay 314 thus permitting this relay to release. Inasmuch as no signals are being transmitted over this system relay 302 is also maintained in its right-hand position consequently the upper terminals of condensers 344 will start to receive a charge through the high resistance 345.

When the figures signal followed by the H signal at the end of the last message transmitted by the transmitter 401 is received at stations A and B it will cause relays 139 and 134 at station A to release and relays 239 and 234 at station B to release. The upper terminals of condensers 147 at station A and 247 at station B will then start to receive a positive charge. The circuit is now in the same condition as assumed at the beginning of the description. If all of the stations still have message material for transmission and tape perforated in accordance with this material and has been inserted in the transmitters and the respective transmitter start keys operated the system will operate as described above.

If the supply perforated tape 403 runs out of the transmitter 401 prior to the end of the time interval assigned to station C, contacts 413 will open shortly after the transmission of figures and H signals following the transmission of the final message stored in tape 403. The opening of contacts 413 at this time interrupts the circuit of the start magnet 409 and thus stops the operation of transmitter brush arm 406. The opening of contacts 413 also interrupts the locking circuit of relay 330 which relay releases and restores the circuit to its initial condition as described above. There will be no carriage return signal perforated in the tape 403 following the figures and H signals perforated in tape 403 at the end of the last message stored in this tape. Consequently, relay 139 at station A, relay 239 at station B and relay 313 at station C will not be reoperated. Consequently, the timing circuits at these stations will operate as described above.

Assume now that none of the stations have any message material to transmit. Consequently, the end of approximately one second relay 243 will operate and complete a circuit for the operation of relay 241. Relay 241 in turn will operate and complete a circuit for operating relay 242 which relay completes a circuit for maintaining itself operated under control of relay 237.

Since there is no message material awaiting transmission at station B relay 236 will not be operated. Consequently, the operation of relay 241 will not cause the operation of relay 238. No transmission will therefore be started from the transmitter 201 at station B. The operation of relay 242 at station B connects the discharged condenser 248 in parallel with condenser 247 and thus interrupts the flow of current to tube 244 as described above which, in turn, causes relay 243 to release and in turn release relay 241. Thereafter condensers 247 and 248 will continue to be charged. However, as pointed out above it will require approximately at least 4 seconds addition of time for the upper terminals of these condensers to require sufficiently high positive potential to cause relay 242 to again operate.

Meantime, condensers 147 have been charging so that at the end of approximately 3 seconds from the time of the transmission signal of the H signal following the last message relay 143 will operate and complete a circuit for the operation of relay 141. Relay 141 in operating completes a circuit for the operation of relay 142 which relay in turn operates and completes a circuit for maintaining itself operated.

Since no message material is awaiting transmission from station A relay 138 will not be operated by the operation of relay 141 because relay 136 was not previously operated.

Even if tape 103 had been inserted in transmitter 101 and the transmitter start key 131 operated during the time relay 141 was operated but after relay 141 operated, still transmission will not start from transmitter 101 because it is necessary to operate the key 131 and thus relay 136 prior to the operation of relay 141 because the operating circuit for relay 136 is interrupted by the break contacts of relay 141 when relay 141 is operated. The operation of key 131 during the time relay 141 is operated but after relay 141 has operated establishes an obvious circuit for the operation of relay 135. Relay 135 when operated completes a circuit for maintaining itself operated under the control of contacts 113 which will be closed if tape is inserted in repeater 101. Consequently when relay 141 later releases relay 136 will then be operated and lock operated under control of contacts 113. The circuit for the operation of relay 136 at

this time may be traced from battery through the winding of relay 136, the right inner break contacts of relay 141, left-hand operated contacts of relay 135, the right-hand break contacts of relay 136 to ground through contacts 113.

The operation of relay 142 as described above connects the discharged condenser 148 in parallel with condenser 147 which causes the upper terminal of the parallel combination to be reduced to such a value that the flow of current through tube 134 is interrupted and relay 143 released. The release of relay 143 at this time interrupts the locking circuit of relay 141 and permits this relay to release. Thereafter condensers 147 and 148 continue to be charged to a positive potential. As described before, the parallel combination of condensers 147 and 148 and the parallel combination of condensers 247 and 248 receive a sufficient positive charge to cause relays 143 and 243 to operate at about the same time. This time interval is of the order of 5 seconds from the time of the transmission of the last figures signal followed by the H signal as described above. The operation of relay 143 at this time completes a circuit for the operation of relay 137 which relay in turn interrupts the locking circuit of relay 142 and permits this relay to release. Thereafter the circuits at station A remain in this condition until signals are received over the transmission loop. Similarly, the operation of relay 243 at station B completes a circuit for the operation of relay 237 which relay in turn interrupts the locking circuit of relay 242 which releases. Thereafter the circuits at station B remain in this condition until signals are received over the transmission loop.

Approximately 2 seconds after relays 143 and 243 operate relay 318 will again operate and operate relay 319. Relay 319 completes a circuit for the operation of relay 463 as described above and the above-described cycle of operations repeated during which a figures signal followed by an H signal is transmitted over the transmission path extending to stations A and B. The figures signal followed by the H signal will first cause relays 139, 239 and 313 at their respective stations to be operated and then later released as described above. The operation of these relays and their subsequent release discharges the condensers 147 and 247 at their respective stations A and B. The figures signal followed by the H signal also causes condenser 344 at station C to be discharged after which the above cycle of operations was repeated. If in the meantime any attendant at any of the stations has inserted a tape in the transmitter and has operated the transmitter start key signals stored in that tape will be transmitted and then the above cycles of operation will be repeated.

Break signals

At any time an operator at any of the stations may transmit a break signal over the system and seize control of the transmission circuit. The break signal when transmitted over this system during the transmission from any of the stations causes the transmitter then transmitting to stop. Assume for example that transmission is from transmitter 201 at station B and that the operator at station A wishes to interrupt this transmission and seize control of the transmission path. In order to accomplish this the operator at station A will operate the break key 121 and hold it operated for a short interval of time. The operation of key 121 causes a break signal to be transmitted over the transmission path. Consequently all of the line relays will remain in their spacing positions during the time key 121 is held operated. The receiving instruments at each of the stations A and B will respond to this break signal and cause member 118 at station A to actuate contacts 116 and 117. At station B the member 218 will be actuated by the receiving device 202, and cause contacts 217 and 218 to be actuated.

The manner in which these contacts are actuated is clearly described in the above-identified patent to Morton et al. patent with reference to the so-called send-receive-break mechanism. The operation of the contacts 216 at station B interrupts the circuit of the start magnet 209 thus permitting this magnet to release and stop the transmission from transmitter 201.

At station B relay 226 responds to the break signal by remaining in its spacing position sufficiently long to permit relay 227 to release. The release of relay 227 completes a circuit for the operation of relay 232 from battery through the winding of relay 232, break contacts of relay 227, right-hand outer operated contacts of relay 236 and left-hand operated contacts of relay 238 to ground through contacts 224. The operation of relay 232 completes a circuit for maintaining itself operated under control of the release key 229. The operation of relay 232 also completes a circuit for the operation of relay 233. Relay 233 in operating also interrupts the operating circuit of the start magnet 209 thus insuring that the transmitter 201 will not restart upon the operator restoring contacts 216 and 217 to the position shown in the drawings. The release of relay 227 also lights the lamp 228 to indicate to the operator that some trouble has occurred over the transmission path or else some other operator has seized control of the system and wishes to communicate to station B or some other station of the system.

If any of the other stations are transmitting at the time the attendant operates the break key, the equipment at these other stations operates in a similar manner to stop the transmitter and indicate to the operator that another operator wishes to seize control of the circuit or that some trouble condition exists on the circuit.

It should be noted that the transmitter 201 at station B, under these conditions cannot be restarted until key 229 is operated which in turn releases relays 232 and 233 and extinguishes lamp 228.

After the operator at station A has operated the break key 121 she may then restore contacts 116 and 117 to the positions shown in the drawings and thereafter communicate over the circuit with the other stations connected to the transmission path.

If the operator had operated key 221 at a time when no signals were being transmitted over the system relays 139 and 134 at station A and relays 239 and 234 at station B will operate as described above and stop the operation of the time circuits at these stations. Similarly relay 302 at station C will be operated during the transmission of the break signal and stop the charging of condenser 344 and thus arresting the action of the timing circuit at this station. At the completion of the transmission by the operator who seized control of the circuit or any other operator transmitting thereafter, the last operator to transmit may transmit a figures

signal followed by an H signal. The circuits at the various stations respond to these signals as described above. If no figures signal and a following H signal are transmitted by the last operator to transmit over the system condensers 344 and 343 will start to charge to a positive potential in parallel. After an appreciable period of time, of the order of about 30 seconds, relay 318 will operate in turn operate relay 319. Relay 319 in operating causes a figures signal followed by an H signal to be transmitted over this system. The transmission of these signals initiates the operation of the timing circuits at the respective stations whereupon they are each given an opportunity to transmit in turn as it has been recorded in tapes at the respective stations and the transmitter starts to operate as described above.

In order for the operator at the control station C to seize control of the circuit and transmit from her keyboard 456 it is necessary for her to first operate the locking key 308 to its operated position. The operation of key 308 removes a short circuit from around the keyboard controlled transmitting contacts 457 and thus permits these contacts to transmit over the transmission path. The operation of key 308 also connects ground to the upper terminals of condensers 344 and 343 since they will normally be connected in parallel during the time transmission is taking place over this system. The operation of a key 308 also interrupts the circuit of start magnet 409 of transmitter 401 thus preventing the transmission from tape by transmitter 401. The operation of key 308 also interrupts the locking circuit of relays 316 and 317 and thus extinguishes the line lamp 311 had it been lighted due to the fact that the transmission had been from station C when the operator or attendant at station C or at some other station seized control of the transmission path.

Timing out

If at any time during the time assigned for transmission from any station the transmission system remains in its marking condition for a prolonged interval of time indicating the trouble condition upon the circuit or at the transmitting station, the armature of relay 302 will be maintained in its marking position. This will permit the upper terminals of condensers 343 and 344, which are connected in parallel, to be charged to a positive potential through high resistance 345. If this condition continues to exist for a period determined by the time constant of these circuits, which may be of the order of 30 seconds or more, the upper terminals of these condensers will be charged to a sufficiently high positive potential to cause tube 324 to pass sufficient current to operate relay 318. Relay 318 establishes a circuit for the operation of relay 319. The operation of relay 319 completes a circuit for the operation of relay 403 which relay thereupon operates and causes a figures signal followed by an H signal to be transmitted over the circuit. These signals when received at the station conditioned for transmission cause the operated relays to be released and initiate the operation of the timing circuits at all of the stations so that the transmission will be started from the other stations of the system provided they have any message material for transmission. Thus an operator can not maintain the control of the system indefinitely by merely holding the circuit in a marking condition by causing the tape controlled contacts at any of the outlying stations to operate or by failing to transmit or perforate a figures signal followed by an H signal.

This timing out feature is also employed in case "hits" or interfering currents or signals are encountered during the time no signals are transmitted over the system and the time delay apparatus is in operation. The effect of "hits," i. e., interfering currents and signals is to stop the action of the timing circuits at each of the various stations. In order to again initiate the operation of these timing circuits it is necessary to send another figures signal followed by an H signal over the system.

When the interfering currents or signals are received at stations A and B, when no signals are being transmitted over the system and the timing circuits at the various stations are in operation, they cause relays 139 and 134 at station A and relays 239 and 234 at station B to operate and complete circuits for maintaining themselves operated. The operation of these relays restores their timing circuits to their normal condition. When interfering currents are received at the control station during these times they cause relays 313 and 312 to operate and complete circuits for maintaining themselves operated. Thereafter when no further signals are received over the system for the specified period the above described timing out action is repeated and a figures signal followed by an H signal is transmitted over the system which signals initiate the operation of the respective timing circuits as described above.

Automatic perforation of tape

It may be desirale to cause the printing reperforator 402 to automatically perforate a supply of tape to permit the end of the last message recorded in the tape 403 to be readily removed from the machine. To accomplish this key 305 is provided. The operator will operate key 305 if she wishes the tape to be perforated. If transmission is taking place over the system from station C at this time relay 314 will be operated, consequently the selector magnet 453 of the reperforator 402 will be maintained in its marking position so letters signals will be perforated in the tape. The operation of key 305 under these circumstances completes a cricuit from ground through the left-hand operated contacts of key 305 and the inner upper operated contacts of relay 330 to battery through the feed-out magnet 452.

The manner in which magnet 452 causes the printing reperforator to automatically feed out and perforate an additional supply of tape may be more fully understood by reference to Figs. 6 and 7. Here magnet 652 corresponds to magnet 452 of the printing reperforator 402 shown in Fig. 4. In addition the printing magnet 453, Fig. 5, is illustrated by magnet 653 in Figs. 6 and 7. The printing or selecting magnet 653 controls the selecting equipment in the usual manner as is well understood and described in the above-identified patents to Morton et al. The code combinations are set up on the code bars 618 in the usual manner to select one of the pull bars 601 which is then actuated by the pull bar bail 602 to print the desired character on the tape. Member 619 represents the platen at which point the printing takes place. The tape in Figs. 6 and 7 is not shown in order that some of the details of the mechanism may be shown.

The code combinations are transferred from the code bars 618 through the linkage levers 620, 621, 629, and 622 to the interponents 623 which control the perforations in the tape in the usual manner which is clearly shown and described in the above-identified patents to Burcky et al., Lake, and Lake et al. and also in Patents 2,005,748, granted June 25, 1935, to Larson and 2,042,783, granted June 2, 1936, to Krum, which patents are hereby made a part of this application as if fully included herein. It is to be understood that there are as many of each of the levers 620, 621, 629, 622, and 623 as there are code bars and that one of each of these levers is individual to each of the code bars.

During the normal operation of this receiving equipment in response to signals received by magnet 653, the receiving cam barrel 630 is released for rotation through one revolution for each code combination received representing some character or function of the receiving apparatus. The release of the cam barrel 630 is accomplished by magnet 653 releasing its armature 603. This permits the armature assembly to rotate in a clockwise direction about pivot 615 and causes extension 604 to move to the left, pushing pin 605 to the left. When pin 605 moves to the left it rotates a lever 606 in a counter-clockwise direction which in turn rotates lever 607 in a clockwise direction. This releases the stop latch 608 and permits it to rotate in a counter-clockwise direction as viewed in Fig. 7 under the influence of extension 609 from the cam barrel 630 thus permitting the cam barrel to rotate. This operation precedes the reception of each group of impulses representing a character or function as is well understood in the art and described in the above-identified patents.

When magnet 562 operates it attracts its armature 610 and causes it to rotate in a clockwise direction which in turn causes the member 606 to rotate in a counter-clockwise direction and in turn rotate member 607 in a clockwise direction thus releasing the latch 608 and permitting the cam barrel 630 to rotate. Thus, the members 606, 607, 608 and the cam barrel 630 are operated in the same manner by the operation of magnet 652 as they are by magnet 653 preceding the reception of each code combination in response to the reception of the start impulse. So long as magnet 652 remains operated these members 606 and 607 remain in their operated position so that the cam barrel 630 continues to rotate.

During the rotation of cam barrel 630 under these circumstances magnet 653 will be operated. This is due to the fact that relay 314 shown in Fig. 3, is maintained operated at this time so no signals are repeated to magnet 454 at this time. Consequently, all of the code bars 618 will be positioned in their so-called marking positions and in turn will cause the interponents 623 controlled thereby through the linkages described above to also be positioned in their so-called marking positions where they will all cause corresponding perforations in the tape. This operation continues so long as magnet 652 remains operated. Upon the release of magnet 652 its armature will be rotated in a counter-clockwise direction and allow members 606 and 607 to return to their normal position under influence of spring 632 and thus engage a stop latch 608 and cause cam barrel 630 to come to rest at the completion of the revolution then in progress whereupon the receiving equipment is in condition to receive further signals repeated to magnet 653.

Thus so long as transmission continues from station C and the operator maintains key 305 depressed reperforator 402 will perforate letters signals in the tape. However, if either key 305 is released or relay 330 released due to the termination of transmission from station C the operating circuit of magnet 452 is interrupted, thus stopping the automatic perforation of tape.

If the operator presses key 305 at any other time it will be ineffective unless relay 319 happens to be operated at that time or unless the operator holds the key pressed until relay 319 has operated. In other words, the operator can only cause the reperforator to automatically perforate the tape during the time assigned for the transmission from the control station. The operation of key 305 and the operation of relay 319 completes a circuit for the operation of relay 321 from battery through the winding of relay 321, the upper break contacts of relay 320, right-hand operated contacts of key 305, upper operated contacts of relay 319 to ground through the lower inner break contacts of relay 463. It should be noted that if a tape has been inserted in transmitter 401 and key 306 operated the operation of key 305 will not cause the operation of relay 321 because the operating circuit of relay 321 is interrupted at the upper break contact of relay 320 which will be operated. However, assume that no messages are awaiting transmission from the control station so that relay 321 will be operated as described above. Relay 321 in operating completes a circuit for maintaining itself operated extending from battery through the winding of relay 321 to ground through the lower break contacts of relay 323. Relay 321 also completes a circuit for the operation of tape feed-out magnet 452. The operation of this magnet causes the printing reperforator 402 to automatically perforate tape. The operation of relay 321 also completes an obvious circuit for operation of relay 322. Relay 322 in operating completes a circuit for maintaining itself operated under control of relay 327. Relay 322 in operating also completes a circuit for the operation of relay 463. Relay 463 in operating, completes a circuit for the operation of relay 323. Relay 323, in operating, completes a circuit for the operation of relay 314 from battery, through the winding of relay 314, lower operated contacts of relay 323 to ground, through the upper break contacts of relay 335. Relay 314, in operating, short-circuits the contacts of relay 303, and thus maintains a circuit of the selecting magnet 453 of the typing reperforating 402 closed. Thus when magnet 452 operates and releases the selector of the typing reperforator 402 in the manner described above, the selecting magnet 453 will remain operated. Consequently, letters signals will be perforated in tape 403.

Relay 323, in operating, also completes a circuit for the operation of relay 459 from battery, through the winding of relay 459, the upper inner break contacts of relay 460 and the upper outer operated contacts of relay 323 to ground, through the upper operated contacts of relay 322. The operation of relay 459 at this time completes a circuit for the operation of the transmitter start magnet 409 from battery, through the winding of magnet 409, switch 412, contacts 414, upper inner operated contacts of relay 323, upper break contacts of relay 461 to

ground, through the lower operated contacts of relay 459, thus permitting brush arm 406 of the distributor 407 to rotate. The operation of relay 323, however, completes an obvious circuit for operating magnet 405. Magnet 405, in operating, prevents the transmitter 401 from advancing tape 403.

In addition, the operation of relays 463 and 322 connects marking potential to all of the segments 1 through 5 of the distributor 407. Consequently, when this distributor rotates at this time it will transmit letters signals, that is signals comprising five marking impulses, over the transmission path to the two stations A and B. These signals when they are received at stations A and B cause relays 139 and 134 at station A and 239 and 234 at station B to operate and stop the operation of the timing circuit at these stations and discharge the timing condensers. Thereafter during the time key 305 is held depressed, the typing reperforator 402 will automatically perforate letters signals in the tape and transmitter 401 will transmit letters signals over the transmission path. These signals will not cause anything to be recorded by the printing apparatus at either station A or B.

When key 305 is released, the locking circuit of relay 321 is interrupted, which relay then releases. The release of relay 321 interrupts the circuit of the feed-out magnet 452 and thus stops the automatic perforation of the tape by the typing reperforator 402.

The release of relay 321 also completes a circuit for the operation of relay 327 from battery through the winding of relay 327, the lower break contacts of relay 321, lower inner operated contacts of relay 322, lower break contacts of relay 327, the upper break contacts of relay 335 to ground through contacts 421. Contacts 421 will close near the end of the last revolution of the brush arm 406 and complete this circuit for the operation of relay 327. Relay 327, in operating first completes a circuit for maintaining itself operated from ground through the contacts 421 and contacts of relays 335 and 327 and then interrupts its operating circuit. Relay 327 also interrupts the locking circuit of relay 322. Relay 322 thereupon releases and interrupts the operating circuit of relay 463. Relay 463, however, does not release at this time.

It should be noted that magnet 409 is not released at this time. Consequently, brush arm 406 will continue rotation and shortly after the beginning of the next revolution contacts 421 will open and remove ground from the left-hand winding terminal of relay 461, thus permitting this relay to operate in series with the locking circuit of relay 459. Thereafter, the operation of the circuits comprising the transmitter 401 and relays 460, 461, 462, 463, 464, 459 and 323 operate to send out a figures signal followed by an H signal as described above. At the completion of these signals, the operation of the timing circuits at all these stations is initiated. Thereafter, the circuits operate as described above and permit each station to transmit any messages it may have prepared for transmission in its proper turn.

What is claimed is:

1. In a telegraph system including a plurality of geographically separated stations, a single two-way transmission path extending between said stations, an automatic telegraph transmission apparatus controlled by stored signals located at each of said stations, a receiving apparatus also located at each of said stations, apparatus for normally preventing the operation of said transmitting apparatus at each of said stations, apparatus for conditioning said transmitting apparatus for transmission of signals, and time delay apparatus at each of said stations having a different period of delay at each station, a signal responsive apparatus for initiating the operation of said time delay apparatus, and an operating connection between said time delay apparatus and said transmitting apparatus for starting transmission from said conditioned transmitters.

2. In a telegraph system, a plurality of remote telegraph stations, a telegraph transmission path extending between said stations, a storage transmitter located at each of said stations, apparatus for normally preventing the operation of said storage transmitter, and signal responsive apparatus at each station for causing the operation of said transmitters at different intervals of time following the reception of predetermined signals received over said path.

3. A plurality of remote telegraph stations, a control station, a two-way telegraph channel extending between said stations, time measuring apparatus at each of said stations each measuring a different interval of time, a storage transmitter at each of said stations normally maintained non-operating, operative connections between said time measuring apparatus and said transmitter for controlling the operation of said transmitter by said time measuring apparatus.

4. A telegraph system comprising a plurality of telegraph stations, a telegraph channel extending therebetween, storage transmitters located at each of said stations having stored message signals and control signals, time measuring apparatus at each of said stations for initiating the operation of said transmitters, signal responsive devices at each of said stations for initiating the operation of said time measuring apparatus, and means at each of said stations for transmitting predetermined signals for initiating the operation of said time measuring apparatus.

5. In a telegraph system including a plurality of telegraph stations, a telegraph transmission path extending to all of said stations and a storage transmitter located at a plurality of said stations, means for conditioning said storage transmitters for transmission, apparatus for normally preventing the operation of conditioned transmitters, signal responsive apparatus for initiating the operation of said transmitters upon the reception of predetermined signals followed by pauses in the reception of signals of predetermined and different lengths.

6. In a telegraph system including a telegraph transmission path and a plurality of telegraph transmitters operatively associable with said path, means for conditioning said transmitters for transmission, signal responsive means responsive to signals transmitted over said path for initiating the operation of said transmitters at different intervals of time following the transmission of predetermined signals over said path.

7. In a telegraph system including a telegraph transmission channel and a plurality of telegraph storage transmitters operatively associable with said channel for transmission thereover, instrumentalities for conditioning said transmitters for transmission, signal responsive apparatus for initiating the operation of the respective conditioned transmitters in response to the transmission of a predetermined code combina-

tion signal over said channel followed by the transmission of a distinctive type of signaling condition of different lengths of time.

8. In a telegraph system, a plurality of remote stations, a central station, a telegraph channel extending between said stations, time delay apparatus located at each of said stations and each having a different delay period, signal responsive means at each of said stations responsive to the telegraph signals received over said channel for initiating the operation of said time delay apparatus at each of said stations, apparatus responsive to further signals transmitted over said channel for interrupting the operation of said time delay apparatus at each of said stations.

9. In a telegraph system including a telegraph transmission channel and a plurality of storage telegraph transmitters operatively associable with said channel for transmission thereover, time delay apparatus individual to each of said transmitters and each having a different delay period for initiating the operation of its respective transmitter at the end of its delay period, apparatus to initiate the operation of said delay apparatus, and apparatus responsive to signals transmitted from any of said transmitters to arrest the operation of said delay apparatus.

10. In combination, an impulse transmission channel, a plurality of automatic impulse transmitters operatively associable with said channel, control apparatus for initiating the operation of said transmitters in rotation comprising timing apparatus for measuring a different interval of time assigned to each of said transmitters, and equipment responsive to transmitted impulses to initiate the operation of said timing apparatus following the transmission from any of said transmitters and to arrest the operation of said timing apparatus upon the initiation of transmission from any of said transmitters.

11. A control system for controlling the operation of a plurality of geographically separated automatic signal transmitters operatively associable with a single communication transmission path comprising time measuring equipment for operatively associating and starting said transmitters having a different time interval assigned to each of said transmitters, apparatus responsive to predetermined signals transmitted over said path followed by the transmission of a specified distinctive signaling condition for initiating the operation of said transmitters and equipment responsive to the transmission of signals over said system for resetting said timing apparatus.

12. A telegraph system comprising a plurality of geographically separated storage transmitters, a telegraph transmission channel extending to said transmitters, time measuring apparatus at each of said stations having two time intervals, apparatus at each of said stations for making the first of said time intervals different at all of said stations and other apparatus at each of said stations for making the second of said time intervals longer than said first interval at a plurality of said stations, and signal responsive equipment for initiating the operation of said time measuring apparatus, and an operative connection between said transmitters and the respective time measuring apparatus for controlling the operation of said transmitters.

13. A telegraph system comprising a plurality of geographically separated storage transmitters, a telegraph transmission channel extending to said transmitters, time delay apparatus at each of said stations having two delay periods, apparatus at each of said stations for making the first of said delay periods different at all of said stations and other apparatus at each of said stations for making the second of said delay periods longer than said first interval at a plurality of said stations, signal responsive equipment for initiating the operation of said time delay apparatus, an operative connection between said transmitters and the respective time delay apparatus for controlling the operation of said transmitters, and equipment responsive to the termination of the first delay period at the respective stations for causing the respective time delay apparatus to respond only at the end of the second delay period.

14. A telegraph system comprising a plurality of geographically separated storage transmitters, a telegraph transmission channel extending to said transmitters, timing apparatus at each of said stations having two timing intervals, apparatus at each of said stations for making the first of said time intervals different at all of said stations and other apparatus at each of said stations for making the second of said time intervals longer than said first interval at a plurality of said stations, signal responsive equipment for initiating the operation of said timing apparatus, an operative connection between said transmitters and the respective timing apparatus for controlling the operation of said transmitters, equipment responsive to the termination of the first interval of time at the respective stations for causing the respective timing apparatus to respond only at the end of the second delay period, and apparatus responsive to the termination of said second time interval for causing said delay apparatus to again respond to the first of said intervals of time.

15. In a telegraph system comprising a two-way telegraph transmission path and a plurality of transmitters operatively associable with said channel, time interval measuring apparatus for operatively associating said transmitters with said channel one at a time having a first time interval assigned to each of said transmitters which is different than the first time interval assigned to each of the other of said transmitters and a second time interval assigned to all but one of said transmitters which is substantially the same for all of said transmitters to which said second interval is assigned and shorter than the first time interval assigned to said one transmitter but longer than the first time interval assigned to all of the other of said transmitters, and signal responsive means for initiating the operation of said time interval measuring apparatus, apparatus responsive to the transmission from any transmitter for resetting said time interval measuring apparatus, equipment responsive to the actuation of each transmitter at the end of each interval assigned to that transmitter for rendering that transmitter responsive only to the operation of said time interval measuring apparatus at the end of the combined first and second intervals assigned to that transmitter.

16. A control system for initiating the transmission from a plurality of transmitters over a common transmission channel one at a time in a predetermined order which comprises time delay apparatus for controlling the operation of said transmitters having different delay periods assigned to each transmitter the length of which periods assigned to each transmitter determines the order of transmission, a second delay period of substantially the same length assigned to a

plurality of said transmitters the length of which is determined by the number of transmitters which may transmit over said channel, signal responsive devices for initiating the operation of said time delay apparatus in response to predetermined signals transmitted over channel followed by a distinctive signaling current applied to said channel, and means for restoring said time delay apparatus in response to any further signals transmitted over said path.

17. A telegraph system comprising a plurality of geographically separated storage transmitters, a telegraph channel extending to said transmitters, time delay apparatus at each of said transmitters for initiating the operation of said transmitters, signal responsive means for initiating the operation of said time delay apparatus at each of said stations and apparatus at said control station for periodically transmitting predetermined signals over said channel for initiating the operation of said time delay apparatus.

18. A telegraph system comprising a plurality of geographically separated storage transmitters, a telegraph channel extending to each of said transmitters, time measuring apparatus for controlling the operation of said transmitters, signal responsive devices for initiating the operation of said time measuring apparatus in response to the transmission of predetermined signals over said channel, signal responsive equipment for resting said time measuring apparatus, and transmission apparatus at one of said stations for periodically transmitting said predetermined signals over said channel when said channel is idle.

19. In a signaling system comprising a plurality of automatic signal transmitters for transmitting signals composed of a plurality of signaling conditions, a signal transmission path extending between said transmitters, timing apparatus for controlling the operation of said transmitters, signal responsive means for initiating the operation of said timing apparatus and for restoring said timing apparatus, and signal transmitting apparatus at one of said stations for transmitting controlling signals for initiating the operation of said timing apparatus after a specified signaling condition has been applied to said path for a predetermined interval of time.

20. In a telegraph system comprising a plurality of geographically separated stations, a telegraph transmission channel extending between said stations and a storage transmitter located at a plurality of said stations for transmitting over said channel, time delay apparatus for starting transmission from said transmitters one at a time, signal responsive apparatus for controlling said delay apparatus, and equipment for initiating the operation of said delay apparatus after the transmission from any of said transmitters.

21. In a telegraph system comprising a plurality of geographically separated stations, a telegraph transmission channel extending between said stations and a storage transmitter located at a plurality of said stations for transmitting over said channel, timing apparatus for starting transmission from said transmitters one at a time and signal responsive apparatus for controlling said timing apparatus, equipment for initiating the operation of said timing apparatus after the transmission from any of said transmitters, and instrumentalities responsive to the application of any prolonged distinctive signaling condition for transmitting controlling signals from one of said stations for initiating the operation of said timing apparatus.

22. In a telegraph system comprising a plurality of geographically separated stations, a telegraph transmission channel extending between said stations and a storage transmitter located at a plurality of said stations for transmitting over said channel, timing apparatus for starting transmission from said transmitters one at a time and signal responsive apparatus for controlling said timing apparatus, equipment for initiating the operation of said timing apparatus after the transmission from any of said transmitters, and instrumentalities responsive to the cessation of signals for a prolonged period during the transmission from any of said transmitters for transmitting controlling signals from one of said stations for initiating the operation of said timing apparatus.

23. A telegraph system comprising a plurality of geographically separated telegraph stations, a single two-way telegraph channel extending between said stations, a normally inoperative storage transmitter located at each of said stations, signal responsive means for initiating the operation of any one of said transmitters supplied with storage material available for transmission, and apparatus for preventing the operation of said transmitter a second time prior to testing all of the other of said transmitters for message material for transmission over said channel.

24. In a telegraph system comprising a plurality of telegraph stations, a telegraph transmission path extending to all of said stations, a storage transmitter located at each of said stations for transmission over said path, signal controlled apparatus for permitting said transmitters to transmit over said path one at a time, and apparatus at each of said stations for seizing control of said path and stopping the operation of any transmitter then transmitting.

25. In a signaling system comprising a transmission path and a plurality of transmitting stations, an automatic signal transmitter located at each of said stations, apparatus controlled by signals transmitted over said transmission path for automatically starting said transmitters in rotation one at a time, and instrumentalities at each of said stations for seizing control of said transmission path and interrupting the operation of said apparatus for automatically controlling the operation of said transmitters.

26. In a signaling system comprising a plurality of stations each having an automatic transmitter and a signaling channel extending to all of said stations, timing apparatus for controlling the operation of said transmitters, signal responsive devices for controlling said timing apparatus for starting transmission from said transmitters one at a time and in rotation, other apparatus at each of said stations for seizing control of said channel and transmitting signals thereover and apparatus for automatically returning the control of said channel to said timing apparatus.

27. In a signaling system comprising a plurality of stations each having an automatic transmitter and a signaling channel extending to all of said stations, time delay apparatus for controlling the operation of said transmitters, signal responsive devices for controlling said time delay apparatus for starting transmission from said transmitters one at a time and in

rotation, other apparatus at each of said stations for seizing control of said channel and transmitting signals thereover and other time delay apparatus for automatically returning the control of said channel to said first time delay apparatus after the cessation of transmission of signals over said system for a predetermined interval of time.

28. In a telegraph system comprising a plurality of geographically separated stations, a telegraph transmission path extending between said stations, a storage transmitter located at each of a plurality of said stations, timing apparatus for starting each of said transmitters one at a time, means for initiating the operation of said timing apparatus comprising switching devices for causing one of said transmitters to operate independently of the signals stored therein including mechanical elements to prevent the advance of the stored signals through said transmitter, and switching apparatus to control the code combinations transmitted independently of stored signals.

29. In a telegraph system including a plurality of telegraph stations, a telegraph transmission channel extending to said stations, a tape-controlled transmitter for transmitting intelligence signals over said channel in accordance with signals stored in said tape, switching apparatus for causing said transmitter to transmit other signals over said channel independently of said tape, and apparatus to prevent the advance of the tape through said transmitter during the transmission of said other signals.

30. In a telegraph communication system including a transmission circuit, a telegraph transmitter for transmitting over said circuit, a source of stored telegraph signals, an operative connection between said transmitter and said source for normally controlling said transmitter in accordance with stored signals and apparatus for advancing said stored signals, switching apparatus for transmitting a predetermined group of signals by said transmitter independently of said stored signals, and mechanical blocking elements for preventing the advance of the stored signals during the transmission of these predetermined signals.

31. In a telegraph system comprising a plurality of telegraph stations, a two-way telegraph transmission channel extending between said stations, telegraph tape-controlled transmitters at a plurality of said stations for transmitting message signals over said channels, control apparatus for starting the transmission from said transmitters one at a time and in rotation, apparatus located at one of said stations responsive to a prolonged pause in transmission over said path for causing the transmitter located thereat to transmit control signals over said path independently of any tape which normally controls said transmitter.

32. In a telegraph system including a plurality of telegraph stations, a telegraph transmission channel extending to all of said stations and a storage transmitter located at each of said stations for transmission over said channel, automatic means for initiating the operation of said transmitters one at a time, a receiving device located at one of said stations for recording received signals on a record medium, means for automatically advancing said record medium through receiving device, and apparatus for rendering said advancing means ineffective except during the time allotted for transmission from said one station.

33. In a telegraph system including a telegraph transmission channel extending to a plurality of geographically separated telegraph stations, an automatic telegraph transmitter located at each of said stations for transmitting over said channel, instrumentalities for conditioning said transmitters for transmission, automatic time delay apparatus for starting said transmitters in rotation one at a time when they are conditioned for transmission, receiving apparatus located at at least one of said stations for recording received signals in printed form upon a record medium, apparatus for advancing said form through said receiving apparatus when no signals are received thereby, and apparatus for rendering said advancing means ineffective except during the transmission time assigned to said stations.

34. In a telegraph system including a plurality of geographically separated telegraph stations, a telegraph transmission path extending between said stations, automatic telegraph transmitting apparatus located at a plurality of said stations for transmission over said path, automatic time delay apparatus having a time interval assigned to each of said stations for causing the transmitters at each of said stations which are supplied with signals to be automatically started one at a time and in rotation.

35. In a telegraph system including a plurality of automatic telegraph transmitters, a telegraph transmission channel extending between said transmitters, automatic time delay apparatus for permitting said transmitters to transmit over said channel one at a time, a telegraph receiving device associated with at least one of said transmitters for recording received signals in physical form in a record medium, apparatus for automatically advancing said record form through said receiving apparatus independently of received signals, and instrumentalities for preventing the operation of said automatic advancing apparatus except when the associated transmitter is transmitting over said channel.

36. In a telegraph system including a plurality of geographically separated stations, a telegraph transmission path extending to all of said stations, a storage transmitter located at a plurality of said stations for transmitting over said path, automatic time delay apparatus for permitting the operation of said transmitters in rotation, receiving apparatus located at a plurality of said stations and connected to said transmission path, at least one of said receiving devices comprising apparatus for recording received signals in physical form in a recording tape, instrumentalities for causing said receiving device to automatically advance said tape through said device in the absence of received signals and operative connection between said advancing instrumentalities and said storage transmitter for causing said storage transmitter to transmit predetermined signals during the automatic advance of said tape through said receiving device for preventing the transmission of any other of said transmitting devices.

37. In a telegraph system including a plurality of geographically separated telegraph stations, a telegraph transmission path extending between said stations, automatic telegraph transmitters located at a plurality of said stations, apparatus for starting said transmitters one at a time for transmission over said path, a telegraph receiving device located at a plurality of said stations including a recording medium, automatic advancing apparatus for advancing said medium through

said receiving device, and instrumentalities for preventing the transmission of any other stations during the automatic advance of said medium.

38. The method of operating a telegraph system including a plurality of automatic telegraph transmitters located at geographically separated stations which are connected by a two-way telegraph transmission path, which comprises (1) conditioning said transmitters for transmission over said path; (2) transmitting a predetermined signal over said system on the completion of transmission from each transmitter; (3) starting the conditioned transmitters at different intervals of time after the reception of said predetermined signal; and (4) preventing the operation of all other transmitters when one transmitter starts to transmit.

39. The method of controlling a plurality of automatic signal transmitters located at geographically separated points and capable of transmission over a single two-way telegraph transmission path which comprises (1) starting each of said transmitters at different time intervals after the completion of transmission from a previous transmitter; (2) preventing the starting of all other transmitters on the starting of one transmitter; and (3) changing the time delay interval assigned to each station in response to transmission from that station so that it is longer than the time intervals assigned to a plurality of the time intervals assigned to other stations.

40. A signal transmitting system comprising a plurality of automatic signal transmitters located at geographically separated stations, a signal transmission path extending between said stations, instrumentalities for conditioning said automatic transmitters for transmission over said path, apparatus for normally preventing the operation of conditioned transmitters, time delay apparatus having a different delay interval assigned to each of said stations for initiating the operation of each of said transmitters one at a time and in rotation, signal responsive apparatus for initiating the operation of said time delay apparatus, other instrumentalities responsive to the signals transmitted over said path arresting the operation of said time delay apparatus, switching apparatus at each of said stations for changing the time interval assigned to that station in response to transmission therefrom, receiving apparatus located at at least one of said stations for recording received messages in a tape, apparatus for automatically advancing said tape through said receiving apparatus when no signals are received thereby, transmitting devices for transmitting predetermined signals over said path through the operation of said automatic device for preventing the starting of transmission over said path from any other transmitter, other devices at a plurality of said stations for interrupting the automatic operation of all of the other equipment at all of said stations and for seizing control of said transmission path, and further apparatus for automatically restoring control to said automatic equipment upon the cessation of transmission over said path.

41. In a telegraph system, including a plurality of telegraph stations, a telegraph transmission channel extending between said stations, telegraph transmitters for transmitting groups of message signals interspersed with end of message signals over said channel, apparatus for controlling said transmitters, timing apparatus, and instrumentalities responsive conjointly to said end of message signals and said timing circuit for stopping an operating transmitter.

42. In a telegraph system, a plurality of storage control transmitters supplied with groups of storage message signals separated by end of message signals, a telegraph channel connected to said transmitters, control apparatus for initiating the operation of said transmitters one at a time, a time interval measuring means, and equipment responsive to said end of message signals for stopping the operation of an operating transmitter in response to the first end of message signal transmitted thereby after the end of the time interval measured by said time interval measuring means.

43. Telegraph system comprising a plurality of geographically separated transmitters, a telegraph channel extending to each of said transmitters, time delay apparatus at each of said transmitters for initiating the operation thereof, signal responsive means for initiating the operation of said time delay apparatus at each of said stations in response to the transmission of a predetermined signal, time interval measuring apparatus at each of said stations, means for initiating the operation of said time interval apparatus when the associated transmitter starts to transmit, and control apparatus for stopping the associated transmitter upon the transmission of the first predetermined signals after the end of said time interval.

44. In a telegraph system including a plurality of telegraph stations, telegraph transmission path extending to all of said stations, a storage telegraph transmitter located at a plurality of said stations for transmitting groups of message signals separated by predetermined signals, means for conditioning said storage transmitters for transmission, apparatus for normally preventing the operation of conditioned transmitters, signal responsive apparatus for initiating the operation of said transmitters upon the reception of predetermined signals followed by pauses, in the reception of signals, of predetermined and different lengths at the respective stations, and control apparatus for stopping each of said transmitters upon the transmission of said predetermined signals after transmission during a predetermined interval of time.

45. A telegraph system comprising a plurality of geographically separated storage transmitters, a telegraph channel extending to said transmitters, time delay apparatus cooperating with each of said transmitters for initiating the operation of said transmitters, signal responsive equipment responsive to a predetermined group of signaling conditions for initiating the operation of said time delay apparatus at each of said stations, and apparatus responsive to the transmission of said predetermined group of signal conditions after transmission from the respective transmitters for predetermined intervals of time for stopping the operation of the respective transmitters and initiating the operation of said time delay apparatus for starting another transmitter.

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