

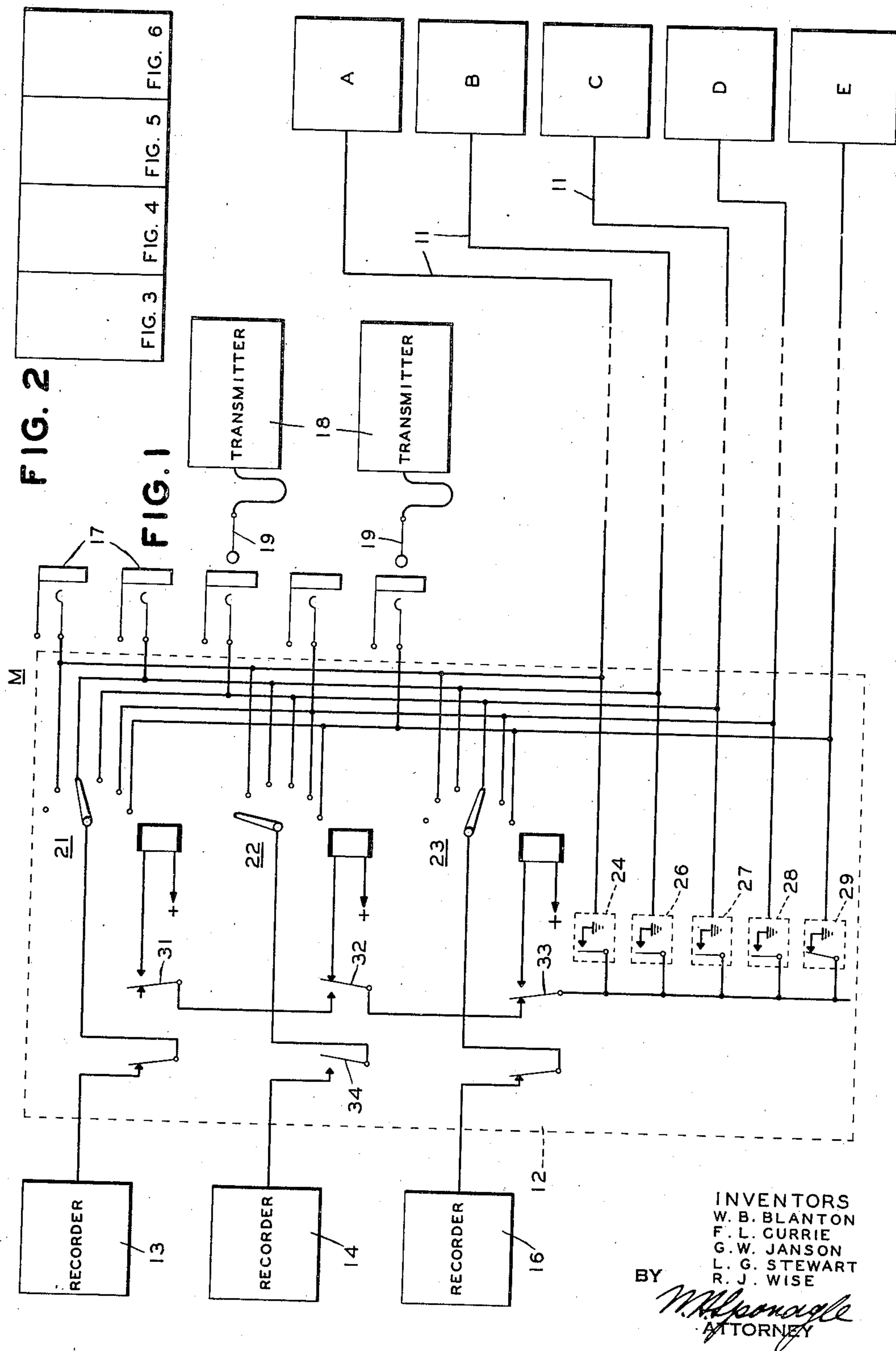
Dec. 9, 1941.

W. B. BLANTON ET AL
FACSIMILE TELEGRAPH SYSTEM

2,265,339

Filed Oct. 11, 1939

5 Sheets-Sheet 1



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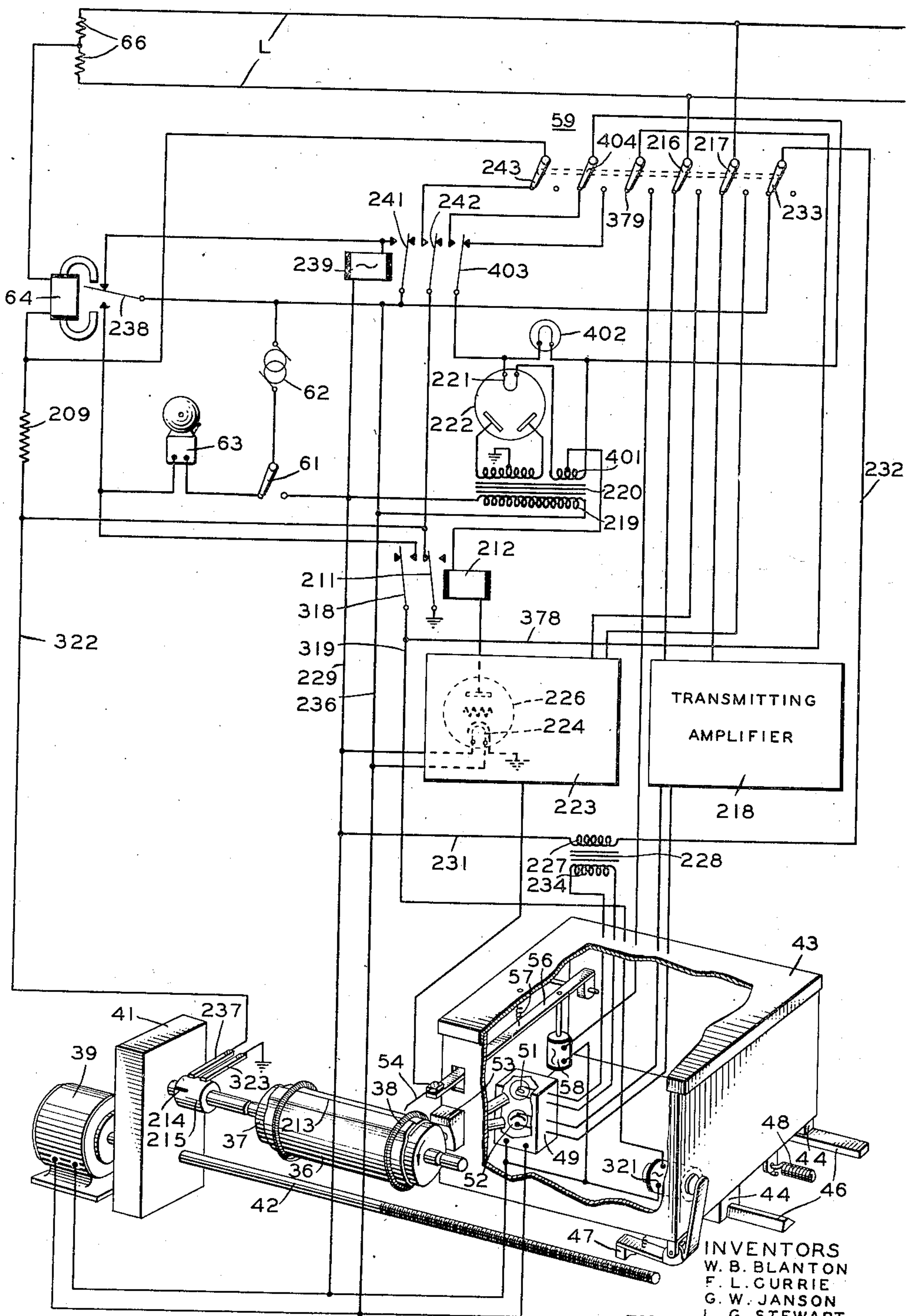


FIG. 3

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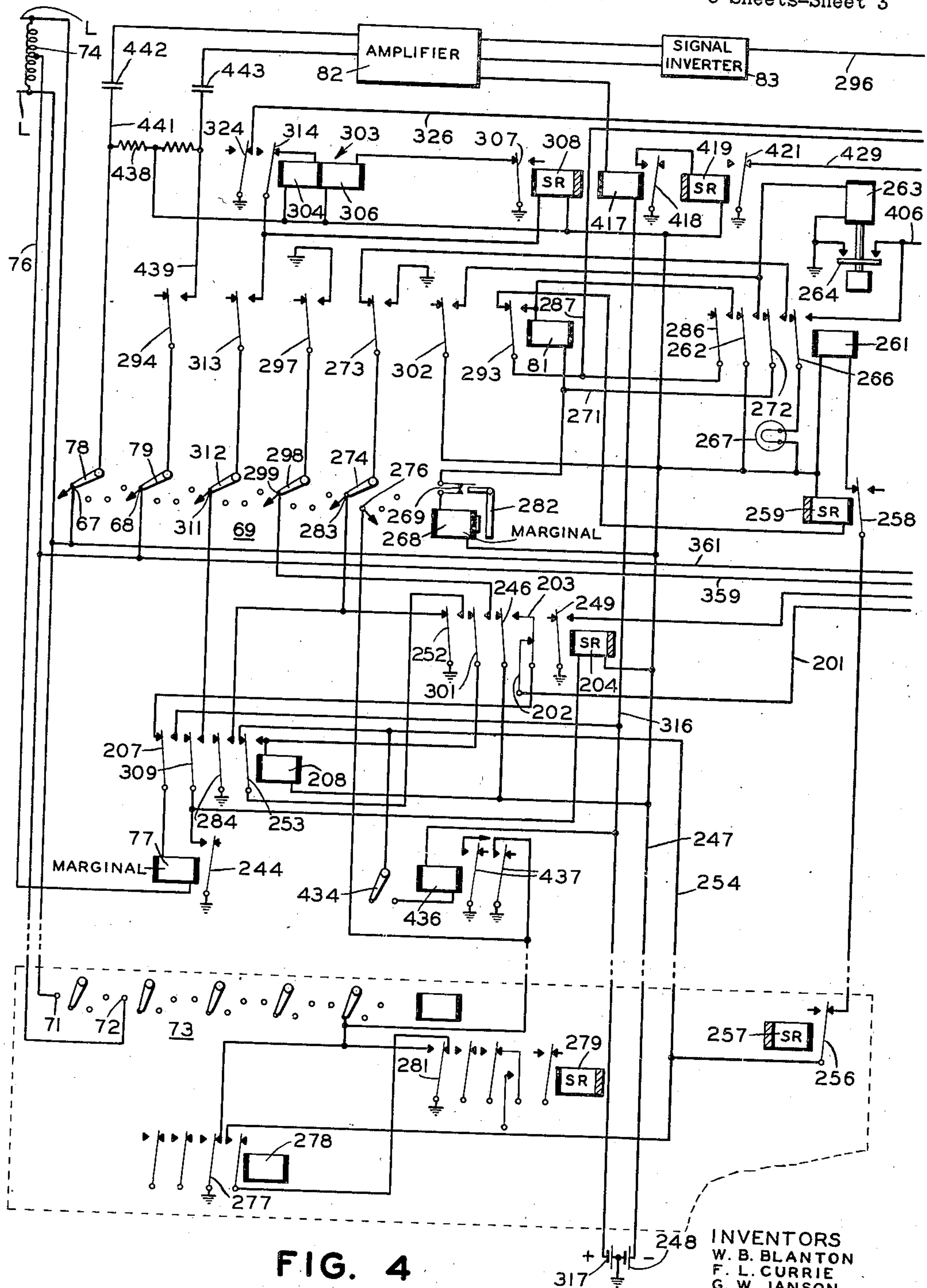


FIG. 4

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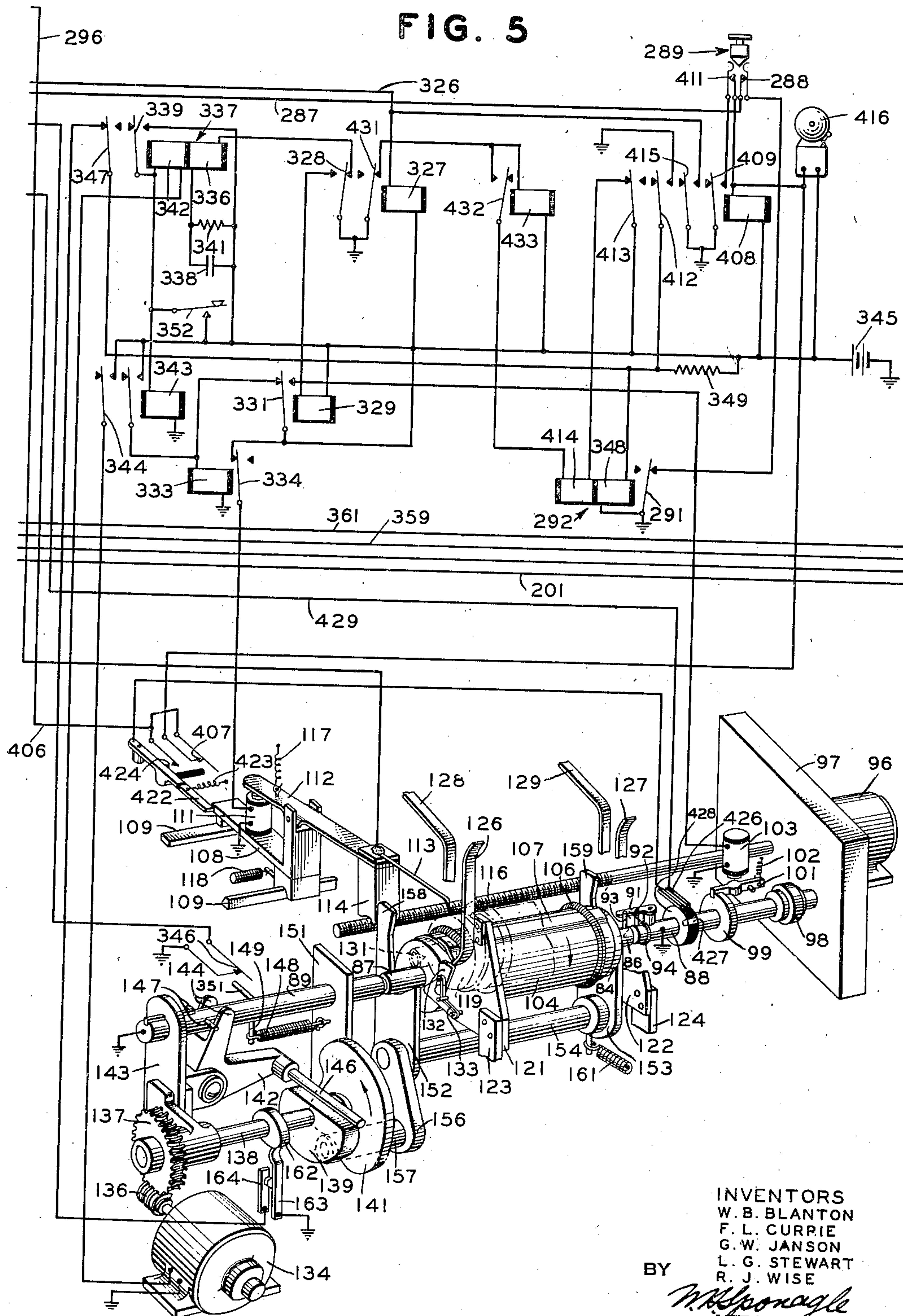
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5 Sheets-Sheet 4

FIG. 5



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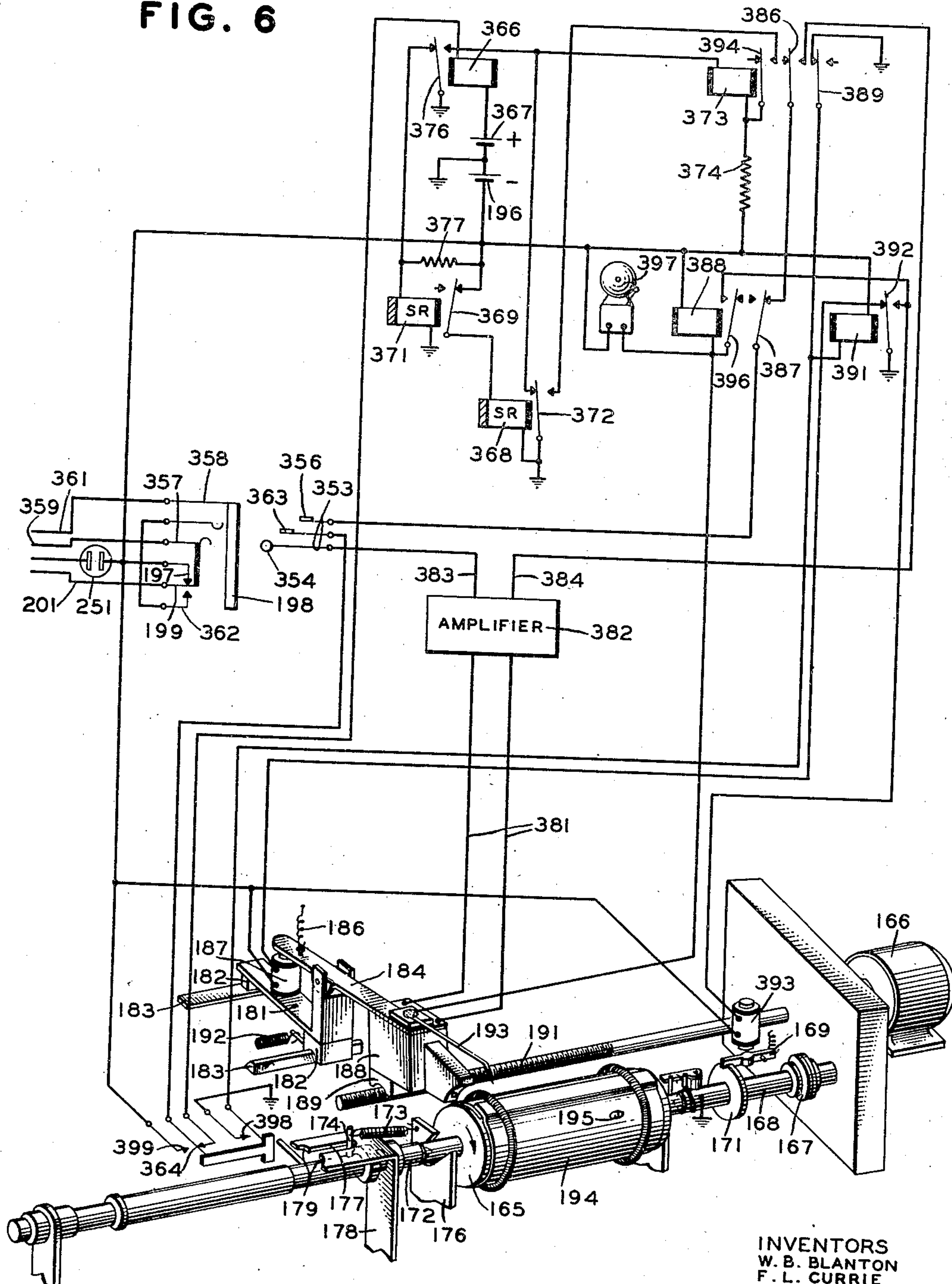
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FIG. 6



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2,265,339

FACSIMILE TELEGRAPH SYSTEM

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Application October 11, 1939, Serial No. 298,872

21 Claims. (Cl. 178—6.6)

This invention relates to communication systems and has particular reference to a novel telegraph system employing facsimile equipment and comprising a plurality of stations such as subscribers' substations or telegraph branch offices having circuits which are concentrated at a central point such as a telegraph main office.

The primary object of the invention is to provide automatic switching facilities whereby any one of a plurality of substations may be connected with a central station for communicating purposes.

Another object of the invention resides in the provision of a system employing switching means for automatically connecting facsimile apparatus located in a main office to any one of a plurality of branch offices and in which said switching means is normally controlled exclusively from the branch office after the connection is made.

Still another object of the invention is to provide an organization of instrumentalities whereby any one of a plurality of branch offices may be connected to a main office for transmitting or receiving over a single circuit and in which the automatic switching apparatus employed to connect a branch office transmitter with a central office recorder is rendered responsive to a call initiated at said branch office and unresponsive to a call initiated at the central office and destined for one of said plurality of branch offices.

A further object of the invention is to provide, in a system in which a plurality of substations are associable with a main station by means of concentrator switching apparatus, means whereby a connection established between one of the substations and the main station is maintained until released from the substation.

A still further object of this invention is to provide, in a concentrator employing multi-contact stepping switches, means for securing a low resistance of the contacts of said switches.

Another object of the invention is to provide facilities whereby one or more of a plurality of substations associable by automatic switching apparatus with any of a limited number of main station recorders are given a preferred status permitting seizure of the first one of said recorders to become idle.

Still another object of the invention is to insure complete transmission of messages by novel guard features.

Further objects will become apparent from the following description of an illustrative embodiment of the invention taken in conjunction with the accompanying drawings of which:

Fig. 1 is a schematic representation of a facsimile concentrator system embodying the invention;

Fig. 2 shows the arrangement of Figs. 3, 4, 5 and 6 assembled as a system in accordance with the invention;

Fig. 3 is a diagrammatic showing of one form of substation or branch office facsimile apparatus;

Fig. 4 illustrates the circuits comprising one unit of the concentrator switching apparatus;

Fig. 5 is a diagrammatic representation of one central station recording apparatus; and

Fig. 6 shows diagrammatically one facsimile transmitting apparatus of the central station.

Having reference first to Fig. 1, there is shown a plurality of facsimile substations or branch offices A, B, C, D and E, each of which is connected by means of individual communication channels 11 with a central station M. Switching equipment 12 is located at the central station and is used to connect any of the channels 11 to any one of a plurality of recording instruments 13, 14 and 16. A plurality of jacks 17, one for each channel, are also located in the central station M. A plurality of central station facsimile transmitters 18 are each provided with a plug 19 for the purpose of connecting the transmitters with any of the communication channels 11 by insertion in one of the jacks 17.

Associated with each recorder in a stepping switch such as 21, 22 and 23 for the purpose of connecting a recorder to any of the channels 11 which are terminated in multiple on the contacts of the stepping switches. Individual relay apparatus 24, 26, 27, 28 and 29 is associated with each of the communication channels and each is responsive to a start or calling signal initiated at its associated substation for the purpose of actuating one of the stepping switches to connect a recorder with the calling substation. An answer-next switch is associated with each facsimile recorder for the purpose of routing an incoming call to the lowest numbered idle recorder. Such switches are 31, 32 and 33. As shown in Fig. 1, the stepping switch 21 connects substation B with recorder 13 and stepping switch 23 connects substation C with recorder 16. Assuming that at this time a call is initiated by substation E, the lower call registering device 29 is operated to close a circuit through the switching member 33 and its left hand contact, the switching member 32 and its right hand contact, to the winding of the stepping switch 22. This stepping switch is actuated to travel over its contacts until connection is made to the communication channel

associated with substation E, in which position it is arrested. Following this operation the switching members 32 and 34 are moved to their respective left hand contacts as viewed in this figure. The engagement of the switch 34 with its left hand contact completes a circuit between recorder 14 and the substation E. The engagement of the switching member 32 with its left hand contact isolates the operating magnet of the stepping switch 22 from the calling circuit so that subsequent calls arriving at the central station during the operative engagement of recorder 14 with substation E and of recorder 16 with substation C are passed to a higher numbered recorder. Following the transmission of a message between any of the substations and one of the main station recorders the switching members such as 32 and 34 are restored to their respective right hand contacts provided that the recorder is reconditioned for receiving as described more fully hereinafter. Thus, the recorder is made available for the reception of other calls.

The substations A, B, C, D and E are provided with facsimile apparatus which is capable of transmitting or recording facsimile signals. Thus, if it is desired to transmit subject matter from the central station M to any one of the substations while the latter is idle, an appropriate connection is made by means of one of the plugs 19 and the jack 17 corresponding to the substation to which transmission is desired. It will be noted that the same communication channels are used in both transmitting to and receiving from the branch stations. Means are provided so that the switching apparatus located at the central station is unaffected by facsimile or control signals sent over the circuit when transmission is occurring from the central station to the branch office.

Branch office apparatus

In Fig. 3 there is shown the facsimile apparatus and the control equipment therefor which is located at one of the branch offices. The facsimile apparatus comprises a combination machine which is capable of transmitting or recording facsimile signals. One type of such a machine is disclosed and claimed in a copending application of R. J. Wise et al., Serial No. 293,188, filed Sept. 2, 1939, and entitled "System and apparatus for facsimile telegraphy." The facsimile machine shown diagrammatically in the instant application is different in a few non-essential respects from that disclosed in the above mentioned application of Wise et al., but is nevertheless capable of producing the same results and is shown in this form solely for the sake of convenience of illustration. Obviously, the invention is not limited to either form of apparatus but may be employed with any facsimile machine performing similar functions. A sheet 36 containing the subject matter to be transmitted is mounted on a cylinder 37 and is secured thereto by means of a plurality of circular elastic members 38. The cylinder is continuously rotated in the direction of the arrow by means of a driving motor 39 acting through suitable reduction gearing 41. The driving motor is also employed to rotate a feed screw 42 by means of which the sheet 36 is scanned.

A carriage 43 is located adjacent the drum 37 and is equipped with sliding members 44. These sliding members cooperate with a pair of rails 46 extending parallel to the longitudinal axis of

the drum 37 so that the carriage may be propelled when a threaded split-nut 47 is moved into engagement with the feed screw 42. As viewed in this figure the carriage 43 is normally urged by means of a spring 48 toward a position at the right of the drawing.

Housed in the carriage 43 is an optical scanning device 49 including a source of light 51 and a light responsive device such as a photoelectric cell 52. Cooperating with the source of light is a light chopper (not shown) for the purpose of periodically interrupting the beam of light which is directed through a projector 53 onto the surface of the sheet 36. The light reflections from the sheet 36 are directed onto the photoelectric cell 52 in any well known manner, one of which is shown in the Wise et al., application hereinbefore referred to.

A recording stylus 54 is mounted on a lever 56 which is normally held in its upper position by means of a retractile spring 57. The lever 56 is arranged to be pivoted in such a manner that the stylus 54 may be brought into registry with the sheet 36 by the energization of an electromagnet 58.

A send-receive switch 59 is included in the apparatus employed to control the operation of the branch office facsimile machine. When it is desired to transmit signals from the branch office, the switch 59 is placed in its left hand position, as shown, and when the machine is to be used for recording, the switch 59 is moved to its right hand position. The substation apparatus is conditioned for operation by first moving a control switch 61 to its right hand contact, thereby connecting a local source of alternating current power 62 to the substation apparatus. The operations occurring subsequent to the movement of the switch 61 to its right hand contact and resulting in the complete operative conditioning of the apparatus will be described in detail in a later portion of the specification. The control switch is maintained on its left hand contact during idle periods so that a signal such as a bell 63 may be operated under the control of the contacts of a polarized relay 64.

The winding of the relay 64 is included in a simplex circuit formed by making a connection to an intermediate point of an impedance 66 which is bridged across a pair of line conductors L. The conductors L constitute the facsimile signaling circuit and are employed to transmit the modulated alternating current comprising the facsimile signals. These signals are superimposed upon one of a plurality of steady state conditions by which signaling over the simplex circuit is effected. The line conductors L are extended from the substation to the main station, the switching equipment of which will now be briefly described.

Central office switching apparatus

Fig. 4 shows the switching apparatus and the circuits therefor of one complete unit of the concentrator equipment. The line conductors L, which are connected with the branch office equipment just described are connected to a pair of studs 67 and 68 of a multi-level stepping switch 69. The switching equipment shown in the upper and middle portions of Fig. 4 is associated with one of the central office recorders. Similar equipment is associated with each of the other central office recorders and the system is so designed that any one of the branch offices connected to the concentrator equipment may have

access to any of the facsimile recorders located at the central office. Accordingly, the conductors of line L which are shown connected to contacts 67 and 68 of the stepping switch 69 are also connected to corresponding contacts 71 and 72 of a stepping switch 73 which is included in the concentrator equipment associated with a second one of the central office recorders. Similarly, the conductors are connected to a like pair of contact studs on each of the other stepping switches used.

An impedance in the form of an inductor 74 is bridged across the line conductors L and is provided with a center tap which is connected by means of a conductor 76 to a line relay 77. Thus, the direct current simplex signals passing over the line conductors L are employed to control the operation of the line relay 77 which, in turn, controls local circuits at the concentrator by means of which the switching apparatus performs its function in a manner which will be described in detail subsequently.

When the stepping switch 69 has been actuated to effect contact between the terminals 67 and 68 and the respective brushes or wipers 78 and 79, and when the contacts controlled by the relay winding 81 are operated, the line circuit is extended to the input side of an amplifier 82. The amplified facsimile signals are then impressed upon signal inverting apparatus 83 and then applied to the recording apparatus of Fig. 5 associated with the illustrated unit of the switching equipment.

Central office recording apparatus

The preferred form of recording apparatus to be used with the facsimile system comprising the instant invention is shown diagrammatically in Fig. 5. The mechanical structure of such a machine is disclosed and claimed in a copending application of R. J. Wise et al., Serial No. 110,760, filed November 13, 1936, entitled "System and apparatus for facsimile telegraphy." The machine comprises a drum 84 which is provided with two axially extending arbors 86 and 87 and is supported for rotation between centering spindles 88 and 89 arranged to cooperate with the drum arbors. An arm 91 is pivoted on the spindle 88 and extends in the direction of the drum to engage a pin 92 projecting radially from the spindle and also a pin 93 which extends radially from the arbor 86. The arm 91 is urged into said engagement by means of a spring 94, one end of which is attached to the arm and the other end of which is attached to the spindle 88. This linkage serves to drive the cylinder 84 when the spindle 88 is rotated. Rotation of the spindle is effected by means of a driving motor 96 acting through suitable reduction gearing 97. Also included in the driving mechanism is a friction clutch 98 which permits the arresting of the shaft 88. A disc 99 having a notch formed in the periphery thereof is secured to the centering shaft 88. An arm or latch 101 is arranged to engage the peripheral notch of the disc 99 when acted upon solely by a retractile spring 102. An electromagnet 103 is provided so that, upon energization, the latch 101 is lifted and becomes disengaged from the disc 99 and thereby permits rotation of the shaft 88.

A sheet of recording material 104 is wrapped around the cylinder 84 and secured thereto by means of a plurality of circular elastic members 106. The sheet 104 is mounted on the drum 84 so that the lap 107 formed therein invariably bears a definite relation to the notch formed in

the disc 99. Such an arrangement is for the purpose of securing the proper phasing between the recorder and the substation transmitter and will be described in greater detail subsequently.

A carriage 108 is arranged to be slidably moved on a pair of rails 109 parallel to the longitudinal surface of the cylinder 84. An electromagnet 111 is mounted on the carriage and, when energized, serves to pivot a lever 112 into the retracted position shown on the drawing. A recording stylus 113 is attached to one extremity of the lever 112 and, as illustrated, is held out of engagement with the sheet of recording material 104 during idle periods. A threaded split-nut 114 is also attached to the lever 112 and is adapted for engagement with a threaded feed screw 116 which is rotated at a suitable speed by the driving motor 96 acting through its associated reduction gearing 97. When the electromagnet 111 is deenergized, the lever 112 is moved by means of a spring 117 in such a manner that the split-nut 114 engages the feed screw 116 and the stylus 113 is brought into contact with the surface of the recording sheet 104. The engagement of the split-nut with the feed screw results in the movement of the carriage 108 toward the right, as viewed in this figure, against the restraining action of a retractile spring 118. Obviously, at the end of a scanning operation when the lever 112 is pivoted to disengage the split-nut from the feed screw, the carriage is returned by means of the retractile spring 118 to the extreme left hand position shown.

The recording machine illustrated is provided with facilities for automatically discharging a drum after a recording operation and for feeding a fresh drum into the machine. The machine is normally provided with a copious supply of such fresh copyholders or drums, one of which, 119, is shown fragmentarily. A rack or magazine is used to store the cylinders and comprises two rail members 121 and 122 mounted on a pair of supporting brackets 123 and 124 and spaced apart slightly more than the length of the cylinder 84. A pair of resilient upright members 126 and 127 are secured to the rail members 121 and 122 respectively and cooperate with an auxiliary pair of spaced rails 128 and 129 respectively to guide the stored cylinders toward the scanning device. The cylinder 119 awaiting positioning in the facsimile recorder is held in readiness by having its arbors such as 131 supported by the upper end of a pair of detents, one of which, 132, is shown. Each of the detents is pivoted adjacent its lower end on the respective rail members and is normally held in this cylinder restraining position by means of one of a pair of resilient members such as 133 attached thereto and also to the rail member 121.

Upon completion of a scanning operation, a drum changing motor 134 is started and drives a worm gear 136 which in turn drives a cooperating pinion gear 137. The pinion gear is keyed to a shaft 138 upon which is also secured a pair of cams 139 and 141. A bell crank 142 is pivoted on any convenient stationary member such as the bracket 143 and is provided with a forked portion 144 adjacent the extremity of one arm thereof and also with a rod or cam follower 146 adjacent the extremity of the other arm thereof. The rotation of the shaft 138 brings the raised portion of the cam 139 into engagement with the rod 146 thereby pivoting the bell crank 142 and bringing the bifurcated portion 144 into engagement with a pair of pins 147 attached to the centering shaft

89. Further movement of the bell crank caused by the continued rotation of the cam 139 moves the shaft 89 toward the left as viewed in the drawing against the action of a spring 148, one end of which is attached to a pin 149 extending from the shaft and the other end of which is secured to a stationary bracket 151.

The withdrawal of the centering shaft 89 as described permits the drum 84 to drop so that the arbors 86 and 87 thereof rest in a cradle formed by grooves in a pair of members 152 and 153. These members are secured adjacent their lower extremities to a rocker shaft 154 which is suitably journaled in bearings mounted in any convenient fixed brackets (not shown). Also secured to the rocker shaft 154 is an arm 156 carrying at its outer extremity a cam follower in the form of a roller 157. This roller is adapted to cooperate with the cam 141 so that when the shaft 138 is rotated by means of the mechanism driven by the motor 134, the engagement of the roller 157 with the raised portion of the cam 141 results in a clockwise movement of the arm 156 as viewed from the left hand end of the facsimile machine, thereby imparting a rocking movement to the spaced members 152 and 153.

As the rocker shaft 154 is rotated as described, the cradle members 152 and 153 are moved forward until a position is reached whereby the drum or copyholder 84 is permitted to roll from the recesses formed in these members into any suitable receptacle or conveyor. A continuation of the rocking movement brings the upwardly extending arms 158 and 159 respectively of the members 152 and 153 into engagement with the respective detents such as 132. These detents are moved out of the downward path of the arbors such as 131 of the copyholder 119 thereby permitting the copyholder to drop so that the arbors thereof rest on the upper edges of the arms 158 and 159. When, by continued rotation of the cam 141, the rocker shaft 154 is permitted to return the members 152 and 153 to their upright positions under the influence of a spring 161 attached to one of the members and to any convenient stationary member, the upper edges of the arms 158 and 159 are withdrawn from under the arbors of the copyholder 119 thereby allowing these arbors to roll into the recesses formed in the cradle members. The new copyholder 119 is thus carried into a position such that when the members 152 and 153 have been fully restored to their upright positions, the indentations formed in the ends of the arbors may be engaged by the conical centering points formed on the shafts 88 and 89. Prior to this engagement, the axis of the copyholder as it rests in the recesses of the cradle members, lies slightly below the center of rotation provided by the centering shafts. However, because of the conical configuration of the ends of these shafts, the subsequent movement of the rod 89 toward the copyholder is instrumental in lifting the copyholder slightly so that it may rotate freely.

The initiation of the drum changing cycle just described is effected by applying power to the motor 134 subsequent to a scanning operation, or at any other desired time, by means which will be described more fully in the Operation portion of the specification. A cam 162 is mounted on the cam shaft 138 for cooperation with a movable contact member 163. The cam 162 is oriented with respect to the cams 139 and 141 so that, at the completion of a drum changing cycle, the contact 163 is moved out of engagement with a

cooperating contact member 164. It will be seen from the Operation portion of the specification that the momentary opening of these contacts causes the power to be disconnected from the motor 134. However, the mechanism is so designed that before the motor can be braked to a stop, the cam 162 becomes disengaged from the contact 163 thereby permitting the reclosure of these contacts.

Central station transmitting apparatus

A preferred form of transmitting apparatus to be used in the facsimile system comprising the invention is shown diagrammatically in Fig. 6. The mechanical details of one such machine are disclosed and claimed in Patent No. 2,158,391, granted to R. J. Wise on May 16, 1939, and entitled System and apparatus for facsimile telegraphy. Only enough of the mechanism disclosed in said patent is shown herein to afford those skilled in the art an understanding of the instant invention. This facsimile machine also employs a cylindrical drum or copyholder 165 which is supported for rotation and driven by means of a motor 166 substantially in the same manner as that described in connection with Fig. 5. A friction clutch 167 is used to permit the stopping of the driving shaft 168 during idle periods when latch 169 is engaged with a peripheral notch formed in a disc 171. This facsimile machine, as shown, is not provided with automatic drum changing facilities although it is contemplated that such an arrangement may be used without departing from the invention. A dead center or spindle 172 which acts to support one end of the copyholder 165 is urged toward its drum engaging position by a spring 173 attached to a radially extending pin 174 attached to the spindle and also to any convenient stationary member such as a bracket 176. When it is desired to remove one drum from the machine and to place another in position to be scanned, the spindle 172 is manually moved toward the left as viewed in this drawing. During this movement the pin 174 slides in a slot 177 formed in a bracket member 178. Adjacent the extremity of the angular bracket 178 are formed two notches 179 on either side of the slot 177. When the spindle 172 is withdrawn a sufficient distance, the pin 174 may be placed in either of the notches 179 by giving the spindle 172 a slight twist in either direction. Thus the spindle is restrained in its withdrawn position while one copyholder is being removed from the machine and another one inserted in its place.

A carriage 181 is located adjacent the copyholder supporting and driving mechanism and is provided with a plurality of sliding members 182 which are arranged for movement over a pair of rails 183. A lever 184 is pivoted on the carriage and arranged to be tilted upward or downward by either a spring 186 or an electromagnet 187 when the latter is energized. An optical scanning device 188 is mounted on the carriage 181 preferably in the manner shown in the Wise patent hereinbefore referred to, but as shown herein at one extremity of the lever 184. A threaded split-nut 189 is also carried adjacent this extremity of the lever so that when the latter is moved downward under the influence of the spring 186, a threaded feed screw 191 may be engaged. As in previously described facsimile apparatus this engagement effects a scanning movement of the carriage 181 which is returned to an extreme left hand position by means of a

retractile spring 192 at the end of a scanning movement when the split-nut 189 is disengaged from the feed screw 191. A stylus 193 is supported on the lever 184 and is moved into contact with a sheet 194 having subject matter to be transmitted inscribed thereon during a scanning operation. After said scanning operation has been completed the carriage 181 and the apparatus mounted thereon including the stylus 193 will have been moved far enough to the right as viewed in this figure to permit the engagement of the stylus with a hole or aperture 195 formed in the sheet 194. This engagement permits the stylus 193 to make a momentary contact with the metallic portion of the drum 185 which is at ground potential thereby applying the ground to the stylus 193 for the purpose of giving an indication of the completion of the scanning operation as described more fully hereinafter.

Operation

The operation of the facsimile system will now be described in connection with Figs. 3, 4, 5 and 6 arranged as indicated in Fig. 2. All of the apparatus employed in the system is shown in its idle condition. Most of the relays used for control purposes are shown deenergized. However, during the idle period a few of these relays are held operated and such relays are so shown on the drawings.

As previously described, the alternating current facsimile signals are transmitted over a pair of line conductors L superimposed upon a direct current potential impressed equally upon the conductors. The direct current signaling channel is utilized to perform the various control functions necessary for the operation of the system. During an idle period the line conductors are maintained at a negative potential with respect to ground. This potential is supplied by a negative battery 196 located at the transmitting equipment of Fig. 6 and is connected to the upper transfer contact 197 of jack 198. The connection is further extended through a lever spring 199 of the jack and conductor 201, through contacts 202 and 203 of concentrator relay 204 of Fig. 4, back contact and tongue 207 of relay 208, the winding of relay 77, and conductor 76 to the midpoint of the inductance 74. This simplex signaling circuit is completed at the branch office of Fig. 3 through the winding of the polarized relay 64, a resistance 209, back contact and tongue 211 of a relay 212. The current flowing in the circuit just described is limited to a relatively low value by the resistance 209 so that concentrator relay 77 is insufficiently energized to operate its tongue to the front contact.

When the branch office desires to transmit subject matter to the central office a sheet 36 containing the subject matter is mounted on the cylinder 37 as described. This sheet is applied to the drum so that the lap 213 which is formed therein bears a definite relation to a short insulating segment 214 of a disc 215. When the branch office transmitting equipment is thus made ready the send-receive switch 59 is positioned on its left hand contacts as shown connecting the line conductors L through blades 216 and 217 and their respective left hand contacts to the output of the transmitting amplifier 218, the input of which is connected to the scanning device 49. The start switch 61 is moved to its right hand contact thereby connecting the al-

ternating current potential 62 to the substation apparatus.

The primary winding 219 of a transformer 220 is energized from the alternator 62 through an obvious circuit. Thus, voltage is applied to the filament or cathode heating device 221 of a rectifier 222. Also the alternating current is connected to the heating elements of both the transmitting and receiving amplifiers 218 and 223 respectively. One such heating element 224 of the tube 226 is shown. The primary winding 227 of a filament transformer 228 is energized by a circuit which may be traced from one side of the alternating current supply 62 through the switch 61 and its right hand contact, conductors 229 and 231, winding 227, conductor 232, and switch blade 233 and its left hand contact to the other side of the alternating current supply. Thus the secondary winding 234 of transformer 228 becomes energized by induction to supply potential to the scanning lamp 51. The connection of alternating current to the conductors 229 and 236 results in the starting of the driving motor 39 and the light chopper motor which is housed in the scanning device 49.

The starting of the motor 39 initiates rotation of the cylinder 37 and the feed screw 42 thus conditioning the facsimile scanning apparatus for operation as soon as the desired connection has been made to the central station and other preparations which will be subsequently described have been made. It will be noted that the simplex signaling circuit is permanently connected to ground as long as relay 212 remains unenergized regardless of the periodic engagement of brush 237 with the insulating segment 214.

Since the tongue 238 of the polarized relay 64 is positioned on its upper contact in response to the negative potential applied to the simplex signaling circuit, relay 239 is operated by the closure of the switch 61. Subsequent to its operation this relay is locked in this position through its tongue 241 in cooperation with its front contact. The operation of relay 239 closes the tongue 242 against its front contact thereby short circuiting the resistance 209, one terminal of which is connected to the tongue 242 and the other terminal of which is connected through the switch blade 243 and its left hand contact to the front contact of relay 239 which is associated with the tongue 242. The short circuiting of resistor 209 produces an increase in the current of the simplex signaling circuit. The increased value of the signaling current constitutes a calling signal which is transmitted to the concentrator switching equipment.

Relay 77 of Fig. 4 responds to the relatively high value of current flowing in the simplex circuit to operate its tongue 244 to its front contact thereby operating relay 204. The operation of this relay effects engagement between tongue 246 and contact 203 which applies the negative potential supplied to conductor 247 by a negative battery 248 to the simplex circuit and, at the same time, disconnects from this circuit the potential originally supplied by battery 196 of Fig. 6. The closure of tongue 249 of relay 204 on its front contact operates a gaseous conduction device such as a neon lamp 251 which is located adjacent jack 198 for the purpose of indicating that the line associated with this jack is busy. The operation of contact 252 of relay 204 to its front contact applies a ground through the tongue 253 and back contact of relay 208 to

a conductor 254. The application of ground to this conductor is for the purpose of bidding for connection to one of the central office recording machines and may be made from any unit of the switching apparatus. There is shown in Fig. 4 a portion of the switching apparatus associated with another branch office signaling channel and it is assumed that the transmitter associated therewith is operatively engaged with one of the central office recorders. Thus, tongue 256 of relay 257 is positioned on its back contact so that the ground applied to conductor 254 is further transferred to tongue 258 of relay 259 which is similar to relay 257 but, being associated with switching equipment which is idle and with a recorder which is in condition to receive, the tongue is positioned on its front contact, whereby the ground originating at tongue 252 of relay 204 is applied to relay 261 causing its operation.

The energization of relay 261 causes the engagement of tongue 262 with its front contact thereby energizing the operating winding of a dash pot relay 263. The mechanism associated with this relay is timed so that the bridging member 264 is not effective to close the contacts associated therewith for a predetermined period of time. The purpose of this arrangement is to provide a guard against faulty operation of the switching equipment whereby, if the desired connection is not completed within said predetermined time, certain alarm facilities are actuated by the operation of this relay and will be discussed in greater detail in a later portion of this specification. Another tongue 266 of relay 261 prepares a circuit through its front contact for the operation of a lamp or other visual signal 267 if the bridging member 264 of relay 263 closes its associated contacts while relay 261 is energized. The operation of relay 261 also prepares a circuit for the operation of the stepping switch 69 to locate the channel connected to the calling sub-station. This circuit may be traced from the negative potential of conductor 247 through the operating coil 268 of the stepping magnet, interrupter contacts 269, conductor 271, tongue 272 and front contact of relay 261, back contact and tongue 273 of relay 81, to the wiper 274 of the stepping switch. When the wiper is in contact with any of its studs such as 276 which is associated with another communication channel, the circuit for the operating winding 268 is completed to ground irrespective of whether the second channel is busy or idle. If the channel is busy, ground is applied to the contacts of all of the stepping switches corresponding to stud 276 of the switch 69 by the engagement of tongue 277 of relay 278 with its front contact. If the channel is idle, relay 279 is deenergized and the ground is applied to the stepping switch contacts by the engagement of tongue 281 with its back contact. Hence engagement of the stepping switch wiper 274 with a contact stud associated with any of the channels other than the one calling for connection results in the movement of the wipers of the stepping switch 69 to the next adjacent studs. The stepping switch is provided with the usual interrupter mechanism including an armature 282 for the purpose of momentarily opening the contacts 269 whenever the winding 268 is energized. When the wiper 274 reaches the contact stud 283 which is the one associated with the calling sub-station, the circuit for the operation of the stepping magnet 268 is open, since relay 204 is energized thereby

disconnecting the ground connected to tongue 252 from the contact stud and since relay 208 has not been operated at this stage thereby leaving the ground connected to its tongue 284 disconnected from the contact stud. Thus, further stepping of the switch 69 is prevented.

A second conduction path through the stepping switch operating winding 268 is provided through the operating winding of relay 81, the front contact and tongue 286 of relay 261, conductor 287, to the normally closed contact 288 of a push button 289, and back contact and tongue 291 of relay 292 to ground. This circuit is established all during the time that the stepping switch 69 is operating but as long as the wiper 274 is connected with a ground, the winding of relay 81 is short circuited. However, as soon as the wiper 274 becomes engaged with contact stud 283, the short circuiting ground is removed, permitting the operation of relay 81. This relay is then locked to the ground of tongue 291 of relay 292 through its tongue 293 and associated front contact and remains in this condition for the remainder of the connection of the sub-station to the central office recorder. The current necessary for the operation and locking of relay 81 is insufficient to cause further operation of the stepping switch.

As soon as the relay 81 is operated, the ground connected to the front contact associated with tongue 273 is applied to the stepping switch wiper 274 which transfers it to contact stud 283 and corresponding ones on all other stepping switches, thereby preventing any of the other stepping switches from stopping in this position. The engagement of wipers 78 and 79 with the respective contact studs 67 and 68 and the engagement of tongue 294 of relay 81 with its front contact connects the line conductors L through the amplifier 82 and the signal inverting apparatus 83 to conductor 296 which is connected to the recording stylus 113 of the facsimile machine of Fig. 5. Thus, it is seen that the desired connection has been made between the calling sub-station and the recording apparatus of the central office.

The operation of tongue 297 of relay 81 to its front contact connects a ground through wiper 298 and contact stud 299 of the stepping switch 69, through the front contact and tongue 301 of relay 204 to the winding of relay 208 which results in the operation of this relay. The connection of the tongue 253 of this relay with its front contact locks the relay in its operative position. Also tongue 284 applies a ground to the contact stud 283 of the stepping switch thereby busying it to all other stepping switches. The disengagement of tongue 253 of relay 208 from its back contact removes the ground of armature 252 of relay 204 from conductor 254. Consequently, relay 261 becomes deenergized and releases its armatures. Thus, it is no longer possible to operate the signal 267 even though the relay 263 becomes fully operated at some later time. The circuit extending between the stepping magnet 268 of switch 69 and the wiper 274 is opened by the release of tongue 272 of relay 261. The front contact associated with tongue 262 is connected to the front contact associated with the tongue 302 of relay 81 which in turn is connected to the negative potential of conductor 247. This arrangement permits the continued energization of relay 263.

The disengagement of tongue 293 of relay 81 from its back contact deenergizes relay 259 per-

mitting its tongue 258 to be restored to its back contact, thereby transferring the answer-next circuit to a higher numbered recorder and preventing calls arriving during the operative condition of the unit of the switching apparatus being described from operating such equipment. Relay 259 is of the slow-to-release type so that, even though it is deenergized at substantially the same time that relay 208 is energized, it does not release its armature 258 until the ground originating at tongue 252 of relay 204 has been disconnected from the conductor 254. This arrangement prevents the possible erroneous operation of another stepping switch corresponding to switch 69 which will happen if the answer-next circuit is transferred to another recorder with a ground still connected to the conductor 254. Of course, in the case of another sub-station waiting for connection to a recorder, the transfer is made under these circumstances, but the subsequent operation of the other stepping switch is normal.

A relay 303 having two operating windings 304 and 306, one terminal of each of which is connected to the negative potential of conductor 247, is maintained in an operative condition during the switching operation just described by the connection of a ground to the other terminal of winding 306 through the back contact and tongue 307 of relay 308. Following the operation of relay 208 the ground connected to tongue 244 of relay 77 is extended through the tongue 309 and front contact of relay 208, contact stud 311 and wiper 312 of the stepping switch 69, tongue 313 and front contact of relay 81 and tongue 314 and front contact of relay 303 to the winding 304. This ground is also applied to the winding of relay 308 causing the operation of this relay, which opens the circuit through the winding 306 of relay 303. But this relay is maintained in its operative condition by the energization of its winding 304.

Also, when relay 208 is operated the simplex signaling circuit, which is connected to tongue 207 of this relay, is switched to the front contact associated with this tongue for connection to the positive potential which is supplied to conductor 316 by a battery 317. Thus, the potential applied to the simplex circuit is reversed from negative to positive thereby constituting a signal indicating to the sub-station apparatus that the desired connection has been made.

The positive simplex potential applied to the polarized relay 64 of Fig. 3 effects the movement of the tongue 238 to its lower contact thereby connecting one terminal of the alternating current power supply 62 to the front contact associated with tongue 318 of relay 212. It should be noted that following the reception of the calling signal at the central station, the resultant switching operations initiated thereby are normally completed in a very short time so that the simplex signal transmitted from the central station to the sub-station indicative of the completion of the switching operation will normally be received at the sub-station before the thermionic rectifier and amplifier have had an opportunity to become operatively conditioned. However, as soon as rectifier 222 and the amplifier 223 have been properly conditioned for operation, the plate current which is supplied to the tube 226 is conducted through relay 212 thereby operating the tongues 211 and 318 to their respective front contacts. The engagement of tongue 318 with its front contact connects one side of the

alternating current supply through conductor 319 to one terminal of an electromagnet 321, the other terminal of which is connected to the opposite side of the alternating current supply through switch 61 and its right hand contact. The energization of electromagnet 321 moves the split-nut 47 into operative engagement with the feed screw 42 thereby initiating the scanning function of the sub-station transmitting equipment. The disengagement of tongue 211 of relay 212 from its back contact removes one ground connection from the simplex circuit which is thereafter extended through conductor 322 to brush 237 and to the ground connected to brush 323 when the brushes are both in contact with the conducting portion of the disc 215. On the first revolution of the disc 215 following the operation of relay 212, when the brush 237 is in contact with the insulating segment 214, the simplex circuit is momentarily interrupted. The interruption of the simplex circuit constitutes a phasing signal which is transmitted to the central station apparatus for the purpose of initiating the scanning function of the recording apparatus.

The interruption of the simplex circuit deenergizes relay 77 of Fig. 4, permitting the armature 244 to leave its front contact thereby momentarily opening the circuits controlled thereby. The momentary opening of the circuit through relay 204 is ineffective to release the armatures of this relay because of the fact that this relay is of the slow-to-release type and is designed to remain operated during the short time that the simplex circuit is opened by a phasing signal. However, the interruption of the circuit through winding 304 of relay 303 permits the armatures of this relay to move to their respective back contacts. Relay 308 is also of the slow-to-release type and is unaffected by the momentary interruption of its operating circuit. Thus, it is seen that when the armature 244 of relay 77 re-engages its front contact, relay 303 remains unoperated since the circuits through both of its operating windings are incomplete.

The disengagement of tongue 324 of relay 303 from its front contact removes the ground from conductor 326, resulting in the release of relay 327 of Fig. 5. The engagement of tongue 328 of this relay with its back contact operates relay 329, the disengagement of the armature 331 of which from its back contact releases relay 333. The restoration of tongue 334 of relay 333 to its back contact opens the circuit of electromagnet 111, thereby permitting the lever 112 to be pivoted so that the split-nut 114 becomes engaged with the feed screw 116 and the stylus 113 is moved into engagement with the surface of the recording sheet 104. Engagement of tongue 331 of relay 329 with its front contact completes a circuit through the winding of the electromagnet 103. Thus, the latch 101 is disengaged from the notch of the disc 99 permitting rotation of the cylinder 84. This completes the necessary arrangements for effecting the scanning function of the recording apparatus. It will be noted that the operations just described are initiated by the engagement of brush 237 with the insulating segment 214 at the branch station so that the respective scanning functions at the branch transmitting station and the central recording station occur substantially simultaneously.

Normally, the central office recorder is permitted to run until released by the branch office. When the branch office transmitting equipment has finished scanning the subject matter, the

switch 61 is moved to its left hand contact. The operation of this switch may be manual or automatic as desired. One device for automatically restoring this switch to its idle position is shown in the Wise, et al. application, Serial No. 293,188. The branch office equipment is thereby restored to its idle condition. The disengagement of tongue 242 of relay 239 from its front contact removes the short circuit from the resistance 209 thereby reducing the value of the simplex signaling current. As previously described, this relatively small value of current is insufficient to maintain the operation of relay 77. Hence relay 204 is released, thereby releasing relay 208. The movement of tongue 207 of relay 208 to its back contact applies negative potential to the simplex circuit which is effective at the sub-station to move tongue 233 of relay 64 to its upper contact.

The release of relay 77 also results in the restoration of tongue 307 of relay 308 to its back contact, thereby completing a circuit through winding 306 of relay 303. This relay becomes operated to connect the ground of tongue 324 to conductor 326, thereby operating relay 327 of the recording apparatus. Thus, relay 329 is released to deenergize the electromagnet 103, allowing the latch 101 to be reengaged with the peripheral notch of disc 99 and to operate relay 333. The operation of this relay energizes the electromagnet 111, which disassociates the recording stylus 113 and the split-nut 114, respectively, from the recording sheet 104 and the feed screw 116. The retractile spring 118 becomes effective to move the carriage 108 to its extreme left hand position.

The engagement of tongue 328 of relay 327 with its front contact closes a circuit through winding 336 of relay 337, which circuit is completed through a condenser 338. The current which flows in this circuit to charge the condenser is sufficient to cause the operation of relay 337, which is then locked through its tongue 339 and front contact. The steady state current which is permitted to flow through winding 336 through a relatively high resistance 341 is insufficient to maintain the relay in its operative condition, but it is seen that at this time the relay is locked through an auxiliary winding 342. The engagement of tongue 339 of relay 337 with its front contact closes a circuit to operate relay 343. The operation of tongue 344 of this relay to its front contact connects a source of potential 345 to the drum changing motor 134. Thus, is initiated the drum changing cycle previously described. At the completion of this cycle contacts 163-164 are opened by the cam 162 thereby interrupting the circuit through the winding 342 of relay 337, which causes the relay to be released. Relay 343 also releases to open the circuit through the motor 134.

Provisions are made for disabling the concentrator apparatus during a recorder drum changing cycle. As long as the recorder contact 346 is closed and the armature 347 of relay 337 is engaged with its back contact, winding 348 of relay 292 is short circuited. But when relay 337 is operated to initiate a drum changing cycle, winding 348 of relay 292 becomes energized through a resistance 349. The movement of the tongue 291 of this relay from its back contact opens the locking circuit for relay 81 at the concentrator, thereby permitting the tongues of this relay to be moved to their respective back contacts. It also prevents the operation of relay 259 since the circuit through its winding stands open at

the back contact associated with tongue 291. Thus, during the drum changing cycle of the recorder the switching equipment associated therewith is restored to normal and means are provided for preventing a call from being received by this unit of the concentrator equipment. If, at the completion of a drum changing cycle, when armature 347 of relay 337 is restored to its back contact, a fresh drum is not placed in the recorder, the spindle 89 is permitted to move far enough toward the right to open contact 346 by means of a pin 351. Consequently relay 292 remains operated thereby disabling the switching equipment until such time as the recorder is furnished with a fresh drum. However, during normal operations the machine is provided with an additional copyholder and relay 292 is released after each drum changing cycle. Relay 259 becomes energized when tongue 291 of relay 292 re-engages its back contact and moves its tongue 258 to its front contact, thereby conditioning the switching equipment to accept another call.

The recording apparatus is provided with a manually operated push button 352 by which winding 342 of relay 337 may be energized to initiate a drum changing cycle independently of control signals from the sub-station transmitter. One purpose of this facility will be pointed out in a subsequent portion of the specification.

In operation of the system, the apparatus of Fig. 6 transmits copy from the central station to any sub-station. A sheet 194, containing the subject matter to be transmitted, is placed upon a drum 165 which is placed in the facsimile transmitter as shown on this drawing. A plug 353 is inserted in the jack 198 which is associated with the circuit connected to the desired branch office. The tip 354 and sleeve 356 of the plug are connected respectively to corresponding contacts 357 and 358 of the jack and then by means of conductors 359 and 361, respectively, to the line conductors L. The simplex signaling circuit connected to the lever 199 of jack 198 is transferred from its connection to the negative battery 196, made through transfer contact 197, to a transfer contact 362 from which it is further extended by means of the ring connection 363 of the plug 353 through a closed transmitter contact 364 and winding of relay 366 to the positive potential of battery 367. It is assumed that, at the central office transmitting apparatus, motor 166 is supplied with power to drive the transmitting apparatus and the latter is consequently conditioned for operation.

Prior to the energization of relay 366 by the insertion of the plug 353 into the jack 198, relay 368 is operated by the engagement of the armature 369 of relay 371 with its back contact. Accordingly, the armature 372 of relay 368 is connected with its front contact to operate relay 373 through resistance 374. Following the energization of relay 366 its armature 376 is disengaged from its back contact to remove a short circuit from the winding of relay 371 permitting the energization of this relay through a resistance 377. The engagement of tongue 376 of relay 366 with its front contact applies a ground to the winding of relay 373 which is supplementary to the one applied by the armature 372 of relay 368. The movement of armature 369 of relay 371 to its front contact deenergizes relay 368 which releases its armature 372 to engage its back contact. It will be noted that, prior to the opening of the original operating circuit for relay 373 by the release of relay 368, a second operating circuit

is completed by the operation of relay 366. The connection of the positive potential of battery 367 through the winding of relay 366 to the simplex signaling circuit constitutes a calling signal which is transmitted to the branch office of Fig. 3.

Reversal of the simplex signaling potential from negative to positive causes the armature 238 of polarized relay 64 of Fig. 3 to be moved to its lower contact thereby connecting the alternating current source 62 to a bell 63 or equivalent signal. This signal may be replaced or supplemented by a visual signal to attract the attention of the substation attendant. In response to the simplex signal indicating that the central office desires to transmit subject matter to the branch office, the attendant at the latter station places a sheet 36 of recording material on the drum 37 of the substation apparatus. The send-receive switch 59 is moved to its right hand contacts and the start switch 61 is moved to its right hand contact. Signal 63 is silenced and the alternating current potential is applied to the facsimile apparatus as previously described. However in this instance the relay 239 is not operated since the operating circuit therefor is open at the upper contact of relay 64. Also the resistance 209 is not short circuited since the circuit therefor is open by the disengagement of switch blade 243 from its left hand contact. Accordingly, the simplex signaling current is maintained at its low value. The line conductors L are connected by switch blades 216 and 217 and their respective right hand contacts to the receiving amplifier 223, the output of which is connected to the recording stylus 54. The system is now in condition for operation as soon as the rectifier 222 and the receiving amplifier 223 become operatively conditioned.

The operation of relay 212 in response to the heating of the rectifier and the receiving amplifier transfers the simplex signaling circuit to the brush 237 from which the phasing impulse is transmitted in the manner previously described. By the operation of tongue 318 of relay 212 to its front contact the alternating current is applied to the electromagnet 321 by which carriage feed is effected. In addition, the operation of this relay armature connects the alternating current potential to conductor 378, which is connected through blade 379 of switch 59 and its right hand contact to the electromagnet 58. The energization of this electromagnet depresses the lever 56, thereby lowering the recording stylus 54 into contact with the sheet 36.

The phasing signal which is transmitted from the branch office is received at the central office transmitting apparatus of Fig. 6 and results in the deenergization of relay 366. The operating circuit for relay 373 is thus interrupted permitting the armatures of this relay to be moved to their respective back contacts. The facsimile signals which are generated by the scanning device 188 are connected by a pair of conductors 381 to the input terminals of an amplifier 382. One of the output terminals of this amplifier is connected by conductor 383 directly to the tip terminal of the plug 353 through which connection to one of the line conductors L is made. Following the release of the armatures of relay 373, the other output terminal of the amplifier is connected by conductor 384 through the back contact and tongue 386 of relay 373 and the back contact and tongue 387 of relay 388 to the sleeve terminal 356 of the plug 353 from which it is transferred to the other of the line conductors L. The disengagement of tongue 389 of relay

373 from its front contact deenergizes relay 391 permitting its armature 392 to be moved from its front to its back contact. The disengagement of this armature from its front contact deenergizes the electromagnet 187 thereby allowing the spring 186 to pivot the lever 184 so as to engage the split-nut 189 with the feed screw 191 and to move the stylus 193 into registry with the surface of the sheet 194. The scanning apparatus 188 is thus moved into operative position relative to the subject matter to be scanned. The engagement of tongue 392 of relay 391 with its back contact energizes the phasing electromagnet 393 which disengages the latch 169 from the disc 171 thereby permitting rotation of the driving spindle 168 to rotate the drum 165. In this manner the scanning function of the transmitting apparatus is initiated in response to the phasing signal transmitted from the branch office recorder. The release of armature 394 of relay 373 to its back contact connects the ground of armature 372 of relay 368 to one terminal of the winding of relay 373 so that, upon the reoperation of relay 366, immediately following its release because of the short duration of the phasing signal, relay 373 is not reoperated, its winding being short circuited. This condition is made possible by the character of relays 371 and 368 both of which are of the slow-to-release type and are unaffected by momentary operations of the armature 376 of relay 366.

After the scanning operation has been completed and the carriage 181 is moved sufficiently toward the right hand limit of its travel, the stylus 193 engages the opening 195 in the sheet 194 to apply a ground to the winding of relay 368. This relay then operates and locks through its tongue 396 and its front contact and the tongue 392 and back contact of relay 391. A signal 397 is also actuated to call the attention of the attendant to the fact that the scanning operation has been completed. Also, the facsimile signaling circuit is opened by the disengagement of armature 387 of relay 388 from its back contact. The attendant then withdraws the spindle 172 to remove the cylinder 165 from the facsimile transmitter and also removes the plug 353 from the jack 198. The withdrawal of the spindle 172 opens contact 364 and closes contacts 398 and 399. Either the opening of contact 364 or the removal of the plug from the jack releases relay 366, the tongue 376 of which is released to its back contact, thereby short circuiting the winding of relay 371. The armature 369 of this relay is restored to this back contact to energize the winding of relay 368. The movement of the armature 372 of this relay from its back contact removes the short circuit from the winding of relay 373 and the engagement of the armature with its front contact closes an operating circuit through the winding of relay 373. The disengagement of armature 386 of relay 373 from its back contact opens the facsimile signaling circuit at a second point. The closure of contact 398 by the withdrawal of the spindle 172 energizes the winding of relay 391 which locks through the tongue 389 and the front contact of relay 373. The operation of relay 391 unlocks relay 388, thereby silencing the signal 397 and partially reclosing the facsimile signaling circuit through armature 387 and its back contact. The movement of tongue 392 of relay 391 from its back to its front contact deenergizes the electromagnet 393 which releases the latch

169 to reengage the notch in the disc 171, thereby stopping rotation of the drum 165, and also energizes the electromagnet 187 which moves the scanning device 188 and the stylus 193 from their operative positions and effects the function of returning the carriage 181.

At the conclusion of transmission from the central office to the branch office, it is immaterial whether the attendant at the central office first removes the plug 353 from the jack 198 or removes the drum 165 from the transmitting apparatus. In either case the simplex signaling circuit is restored to its idle condition in which negative potential is applied thereto.

At the branch office of Fig. 3 the reversal of the simplex signaling potential from positive to negative operates the tongue 238 of relay 64 to its upper contact which causes the operation and subsequent locking of relay 239. Despite the closure of armature 242 of this relay on its front contact the resistance 209 is not short circuited since the lever 243 of switch 59 is engaged with its right hand contact. Hence, there is no response of any of the concentrator switching apparatus to the operation of relay 239.

However, it is to be noted that in series with winding 401 of transformer 220 and the heating element 221 of the rectifier 222 is a lamp 402. Prior to the operation of relay 239 this lamp is short circuited by the engagement of armature 403 and back contact of this relay and right hand contact and blade 404 of switch 59. When the tongue 403 is disengaged from its back contact, the short circuit is removed thereby permitting the lamp 402 to be lighted. This is an indication to the attendant at the branch office that the transmission from the central office has been completed and that the sub-station apparatus may be disconnected. The shutting down of the branch office equipment may be effected by moving the switch 61 to its left hand contact thereby disconnecting the alternating current power source 62 from the equipment or means may be provided on the facsimile apparatus in accordance with the disclosure of the co-pending application of R. J. Wise et al. Serial No. 293,188 whereby the switch 61 is moved to its left hand contact automatically at the end of the scanning operation.

Special features

The facsimile system disclosed herein is provided with a number of special features designed to insure the correct manipulation of the branch office apparatus and to insure the complete transmission of messages. Branch offices are usually staffed with attendants who are not trained operators of the telegraph equipment and consequently cannot be relied upon to invariably follow a fixed operating routine. Also it has been found that in some circumstances the desired connections between a calling substation and a central office recorder may not be made as expeditiously as some of the equipment is designed to normally operate. Such a condition may arise when all of the central office recorders are busy and another sub-station initiates a call. Normally there is ample time to complete the switching operation to effect the desired connection before the sub-station apparatus has had an opportunity to become operatively conditioned. If any substation has to wait an appreciable length of time before an idle recorder is secured, means are provided for rendering the phasing signals ineffective to initiate the

scanning function at the branch office until a connection has been made to a central office recorder regardless of the length of time it may take to establish such a connection. Numerous other possibilities for the loss of messages by transmission from a branch office without a recorder being properly connected to receive the transmission are guarded against by suitable apparatus and circuits and will be set forth in detail in the following description of said apparatus and circuits.

If all of the central office recorders are busy when an additional call is initiated at another sub-station, the call is stored at the concentrator and the sub-station apparatus is prevented from transmitting until a connection has been established with a central office recorder. The operation of the switch 61 of Fig. 3 results in the operation of relays 77 and 204 of Fig. 4 as described. But, since all recorders are busy, the answer-next circuit is not connected to any of the relays such as 261. Hence, the connection of the ground of tongue 301 of relay 204 to conductor 254 is ineffective at this time to cause the operation of one of the stepping switches such as 69. Before one of the central office recorders becomes idle so that the normal switching operations may be completed, the sub-station apparatus may have sufficient time to become operatively conditioned. As described previously, relay 212 of Fig. 3 then operates to remove the permanent ground from the simplex circuit and permit the transmission of interruptions from the phasing commutator 215. These interruptions, one of which normally constitutes a phasing signal, cause momentary releases of relay 77 of Fig. 4 but are not repeated thereby to the phasing apparatus since the switching operations are incomplete. Also, the operating circuit for the split-nut magnet 321 of Fig. 3 is extended through the armature 318 and front contact of relay 212 to the lower contact of relay 64. However, since the polarity of the simplex signaling current is still negative, armature 238 of this relay is held on its upper contact, thereby preventing the energizing of the magnet 321 and the initiation of the scanning function of the sub-station transmitter.

As soon as one of the central office recorders is released and supplied with a fresh recording blank, the concentrator relay 259 of Fig. 4 associated therewith is operated to connect the answer-next circuit to relay 261. The switching apparatus then operates to connect the calling sub-station with the recorder as described. The operation of relay 208 reverses the polarity of the simplex signaling current from negative to positive, thereby moving the armature 238 of relay 64 of Fig. 3 to its lower contact to start the scanning function of the sub-station transmitter. The first of the interruptions transmitted from the phasing commutator 215 after the completion of the switching operation operates the central office phasing apparatus as previously described.

One feature which is also described in detail in the Wise, et al. application, Serial No. 293,188 is provided at the branch office where relatively unskilled operators are often in attendance. In addition to mounting the appropriate sheet on the cylinder 37 of the machine, the branch office attendant must manipulate switches 59 and 61. Depending upon whether the apparatus is to be used for sending or receiving the switch 59 is positioned respectively on its left hand or right hand contacts as described. Also, by reason of

the different conditioning of the simplex circuit under these two operating conditions, the switch 59 and the armatures of relay 239 must bear a definite relationship to one another. In order to insure that this relationship is invariably established, the lamp 402 in series with the winding 401 and the heating element 221 is employed. When the relationship is correct, the lamp is short circuited by the tongue 403 of relay 239 and either of its contacts in cooperation with blade 404 of switch 59 in cooperation with its respective contacts. An incorrect relation between these two devices results in the lighting of the lamp and, because of the resistance thereof, the heating element 221 of the rectifier 222 is insufficiently energized to allow the rectifier to function. Thus the apparatus is arranged so that a signal is actuated to warn an attendant of an incorrect relationship between the switch 59 and the relay 239 and it is impossible to operate the branch office apparatus until this relationship is correctly established.

It has been seen that the concentrator switching equipment which is associated with one of the central office recorders is prevented from receiving a call from a branch office during the time that a drum changing operation is occurring at the recorder. Also, if at the completion of a drum changing operation, a fresh drum is not placed in the recording apparatus, the switching equipment is continued in its disabled condition. Until the concentrator relay 259 is operated to switch the answer-next circuit to the winding of relay 261, the unit of the switching apparatus shown in Fig. 4 is prevented from receiving a call from any of the branch offices. Relay 259 may not be operated until armature 291 of relay 292 is engaged with its back contact. As described, this relay is energized to attract its armature to its front contact during the drum changing operation by the disengagement of tongue 347 of relay 337 from its back contact. At the completion of a drum changing operation the tongue 347 is moved to its back contact by the deenergization of relay 337, but if a fresh drum is not installed in the recording apparatus, the spindle 89 is permitted to move toward the right a sufficient distance to open the contact 346. The opening of this contact maintains the relay 292 in its operated condition, thereby preventing the operation of relay 259. This unit of the central office recording apparatus remains in a disabled condition until the recorder storage magazine is supplied with one or more fresh copyholders and the push button 352 is depressed to insert one of the stored copyholders into the recorder as described. Following the drum changing cycle in which the fresh drum is installed in the recorder, relay 292 releases to operate relay 259 thereby rendering the recording apparatus receptive to another branch office call.

It may be that for some reason after a branch office call has been received at the concentrator apparatus and the desired connection to a recorder made, the recorder carriage 103 does not start to feed within a predetermined time, such as 40 seconds for example. The concentrator relay 263 is adjusted to move the bridging member 264 into engagement with its associated contacts at the end of this predetermined time. A circuit is thus closed from the ground connected to one of these contacts through conductor 406, a closed contact 407 and the winding of a relay 408 to the source of potential 345. This relay operates and locks through armature 409 and its

associated front contact, and contact 411 of the push button 289. Armature 412 applies a ground through its front contact to short-circuit winding 348 of relay 292. The disengagement of armature 413 from its back contact opens the operating circuit through winding 414 of relay 292. Thus, this relay is prevented from operating, thereby holding the concentrator relay 81 locked in its operated position. The central office switching apparatus is therefore maintained in its operated condition with the wiper contacts of the stepping switch 69 engaged with the contact studs associated with the calling branch office. The purpose of locking the call in the concentrator equipment is to enable an attendant to refer to the number of the position of the stepping switch 69 so that the identity of the calling substation may be established, and the appropriate steps taken to notify the branch office that the subject matter transmitted has not been received. Thus, the branch office may be given another opportunity to transmit the message to the central office.

In addition to locking the call in the concentrator as described, the operation of relay 408 moves its armature 415 to its front contact to hold relay 327 operated even though subsequently the concentrator relay 303 may be released. In this way the scanning function of the recording apparatus is prevented from being started asynchronously and a drum changing operation is not effected. However, if the phasing signal has been received by the concentrator apparatus to release relay 327 but has been ineffective to initiate scanning by the recorder, this relay is re-operated to start a drum changing cycle. In either case, control of relay 327 is taken away from the concentrator apparatus.

The operation of relay 408 also completes a circuit through armature 409 and contact 411 of the push button 289 to a signal 416, by means of which the attention of the central office attendant may be attracted. The operation of this signal is an indication that the apparatus is not functioning correctly. The attendant may then refer to the recording machine to determine whether or not a drum changing operation has been started, and if not may then refer to the concentrator equipment where the calling substation may be identified as described. After correcting the trouble the central office equipment may be restored to normal by depressing the push button 289. The opening of contact 411 releases the alarm relay 408 and restores the circuits controlled thereby to their normal conditions. The opening of contact 288 of this switch opens the locking circuit through relay 81 thereby releasing the concentrator apparatus and restoring it to its normal condition in readiness to accept another call.

It may be that the substation call is properly received and the recording apparatus started in response to the phasing signal transmitted from the branch office. However, the facsimile signals may be interrupted during the transmission of the subject matter. The facsimile circuit is tested for the presence of the facsimile tone or alternating current signals at a predetermined time after the transmission of the phasing signal. This predetermined time is chosen so as to occur after the transmission of the subject matter appearing in the date line of the message. Another of the concentrator relays 417 is connected to the amplifier 82 at some convenient point such as in the output of an in-

intermediate stage and is therefore responsive to the facsimile tone. As long as this tone is being received, the armature 418 of this relay is attracted to its front contact, thereby energizing the winding of a slow-to-release relay 419. This latter relay is of the slow-to-release type so that momentary interruptions of its operating circuit due to the reception of facsimile signals representative of darkened portions of the subject matter being transmitted do not effect the release of its armature 421. The armature 421 of this relay is thus held out of engagement from its back contact. The predetermined time for testing the facsimile signals may be selected while a marginal portion is being scanned, although substantially any other time has been found to be satisfactory. At that time the carriage 108 of the central office recorder will have started to move toward the right thereby allowing a contact arm 422 to also be moved toward the right by a spring 423. The contact arrangement is such that after the carriage has moved a distance sufficient to record the date line of the message, a contact 424 is closed. Also while the marginal or other prearranged portion of the transmitted subject matter is being scanned, a pair of brushes 426 are both in contact with a conducting segment 427 of a disc 428 attached to the driving spindle 88. If no tone has been received for a continuous period immediately preceding this time and sufficiently long to permit the deenergization of relay 419, armature 421 of this relay is engaged with its back contact to apply a ground to conductor 429. This ground is further extended by the engagement of the brushes 426 with the conducting segment 427, through the closed contact 424, the closed contact 407 to the winding of relay 408, thereby operating this relay.

The operation of relay 408 actuates the signal 416, locks the concentrator equipment in position by the disabling of relay 292 and energizes the winding of relay 327 which in this instance is released since the phasing impulse had been previously received to start the scanning function of the recording apparatus. The operation of this relay restores the recording apparatus to its idle condition and operates relay 337 to start a drum changing operation as described. The calling subscriber may be identified from the recorded subject matter appearing on the sheet 104 or if the facsimile signals failed prior to the reception of the first part of the message, the subscriber's identity may be established by having reference to the stepping switch 69 as described. After the necessary repairs have been made, the push button 289 is depressed to restore the apparatus to its normal idle condition and the subscriber may be notified to retransmit the message which was not properly recorded. It is obvious that the retransmission of the message in this or the previously described case may be recorded on any of the central office apparatus including that in which the failure occurred, providing, of course, that it is restored to an operative condition.

In either of the described cases involving the operation of relay 408 in response to a failure of the system to operate properly, normal functioning of the apparatus causes the contact 407 to be opened by the continued movement of the recorder carriage 108 to the right. The timing of the various apparatus is arranged so that, normally, this contact is opened and relay 408 is isolated before the full operation of the dash

pot relay 263. Thus, the ultimate engagement of the bridging member 204 of the dash pot relay with its contacts is ineffective to operate relay 408.

Because of the relatively unskilled operators employed at the branch offices, the start switch 61 may be operated to its right hand contact and almost immediately restored to its left hand contact. In accordance with the foregoing description the operation of this switch to its right hand contact causes the central office switching equipment to respond and, if an idle recorder is available, to make a connection between it and the branch office. This connection is normally made in a very short time so that, when the switch 61 is quickly moved to its left hand contact, concentrator relay 303 is released to release relay 327, the purpose of which normally is to initiate scanning at the recording apparatus. However, relay 308 soon releases its armature 307 because the simplex signaling current is not sufficient to reoperate relay 77. Engagement of armature 307 of relay 308 with its back contact operates relay 303 which in turn reoperates relay 327. When the armature 328 of this relay is first released from its front contact, the circuit through winding 336 of relay 337 is interrupted and the condenser 338 begins to discharge through the resistance 341. This resistance is of a relatively high value so that the condenser requires four or five seconds in which to become completely discharged. Consequently, the reengagement of armature 328 with its front contact almost immediately thereafter does not produce a large charging current through the winding 336 of relay 327 since the condenser 338 is only slightly discharged. The value of this small charging current is insufficient to operate relay 337. Therefore, the drum changing cycle is not started under these conditions.

The reengagement of armature 431 of relay 327 with its front contact closes a circuit through the back contact and tongue 432 of relay 433 and the winding 414 of relay 292. At the same time the winding 433 is also energized to disengage the armature 432 from its back contact. However, before the operation of armature 432 the circuit through winding 414 of relay 292 is completed for a sufficient time to allow this relay to disengage its tongue 291 from its back contact. The momentary opening of this contact interrupts the locking circuit for the concentrator relay 81, thereby releasing the switching equipment to its idle condition. Thus, it is seen that the rapid manipulation of the branch office switch 61 as described does not interfere with the normal operation of the central office switching and recording apparatus.

Facilities are provided in the concentrator switching equipment so that one or more branch offices may be provided with a preferred type of service. This is desirable for the reason that the apparatus is so arranged that, in the case of two simultaneously initiated branch office calls, the switching apparatus associated with the lowest numbered recorder starts seeking one of the calling branch office circuits. From the foregoing description it is apparent that the stepping switch 69 is arrested as soon as one of the calling branch office lines is located. Normally, however the desired connection between one of the branch offices and a central office recorder is quickly established and the concentrator apparatus switched to another unit associated with

another idle recorder. In this manner the second calling branch office is provided with its desired connection to a recorder with only a slight delay. The delay in a case of this nature is so small that the connection is completed before the branch office amplifier equipment has had an opportunity to become operatively conditioned.

However, in the case where all of the central office recorders are busy, an incoming call results only in the operation of relay 77 and relay 204. The operation of this latter relay applies a ground through the armature 252 to the conductor 254 so that as soon as one of the recorders is released the remaining switching apparatus may be operated as described. If two or more branch offices initiate calls at a time when all central office recorders are busy, their associated line relays, similar to relays 77 and 204, are operated to also apply grounds to conductor 254 by which these sub-stations make a bid for connection to a recorder. As soon as one of the central office recorders becomes available for a new connection the stepping switch 69 associated with this recorder is operated until it becomes connected with one of the branch office lines, not necessarily the line over which the first call was initiated. Consequently, the other branch offices must wait until another central office recorder is released and it will be seen that, under adverse conditions, the first calling substation may be made to wait for a considerable time.

Any one or more of the substations may be provided with apparatus which will insure the branch office of a connection with the central office recorder which first becomes available. Such a provision may be made by moving a switch 434 of Fig. 4 to its right hand contact. When the substation associated with this unit of the switching equipment initiates a call to operate relays 77 and 204, the engagement of armature 252 of the latter relay with its front contact, in addition to applying the ground to conductor 254, energizes a relay 436. The operation of the armatures 437 of this relay to their respective front contacts applies a ground to the contact studs of all other branch office lines except the one associated with the preferred branch office. Therefore, if, when the preferred branch office puts in a call to the central office, all of the recorders are busy and a number of other branch office calls may be waiting ahead of it, the stepping switch which is associated with the first released recorder will pass over the contact studs associated with the branch office lines awaiting connection and will not stop until the lines associated with the preferred branch office are located.

Inserted in the conductors over which the facsimile signals are transmitted to the central office recording apparatus are a number of switch contacts. Since the potential of the facsimile signals is relatively low there is the possibility that sufficient contact resistance may exist in the circuits to mutilate the signals. Provisions are made herein to obviate such a condition. When the desired connection between the branch office transmitter and the central office recorder is established, the positive potential of conductor 316 (Fig. 4) is applied to the midpoint of the inductance 74 as described. Between the line conductors L and the amplifier 82 are two of the contacts of the stepping switch 69 and the tongue 294 and front contact of relay 81 in series with the conductors comprising the facsimile circuit. A relatively high resistance 438 is bridged across

the conductors 439 and 441 which extend the facsimile circuit respectively from the front contact associated with tongue 294 of relay 81 and the wiper 78 of the stepping switch 69 to the amplifier 82. All of the contacts included in the facsimile circuit therefore lie between the inductance 74 and the resistance 438. The midpoint of resistance 438 is connected to the negative potential of conductor 247. Thus, it is seen that the combined potential of the batteries 248 and 317 is impressed across the contacts included in the facsimile circuit. This potential is considerably greater than that of the facsimile signals and is adequate to prevent the formation of a film on any of the contacts and thereby insures a low resistance of such contacts. The direct current which is applied to the conductors 439 and 441 is prevented from reaching the amplifier 82 by the inclusion of blocking condensers 442 and 443 in series with the respective conductors at points between the resistance 439 and the amplifier.

The automatic switching apparatus shown in Fig. 4 may be expanded to accommodate a large number of sub-stations having the transmitter-receiver apparatus of Fig. 3 and a suitable number of central station recorders such as shown in Fig. 5. The number of the latter will be determined by the probable simultaneous service demands of the sub-stations. A group of line relays such as 77, 204 and 208 of Fig. 4 is necessary for each sub-station connected to the switching equipment. For each central office recorder employed in the system relay equipment corresponding to that, except the aforementioned relays, shown outside of the dotted lines of Fig. 4 is required.

The nature of the invention may be ascertained from the foregoing description of an illustrative embodiment, it being understood that changes in the invention herein disclosed may be made within the scope of what is claimed without departing from the spirit of the invention.

What is claimed is:

1. In a facsimile telegraph system, a plurality of facsimile transmitters, a plurality of facsimile recorders located at a central station, switching means individual to each of said recorders and associable with any of said transmitters, means at said central station responsive to a signal initiated at one of said transmitters for operating one of said switching means to connect said signal initiating transmitter with one of said recorders, and means controlled by said switching means and responsive to the establishment of said connection to initiate scanning by said one transmitter.

2. In a facsimile telegraph system, a plurality of branch stations having facsimile transmitting apparatus, a main station having a lesser plurality of facsimile recorders and a multi-contact stepping switch individual to each of said recorders, means including said switches for associating any of said recorders with any of said transmitters, means at said branch station for transmitting a calling signal, means responsive to a calling signal when one of said recorders is idle to operate one of said switches, means including said calling signal responsive means for holding a call at said main station when all recorders are busy, and means for connecting said calling signal transmitting station to the first recorder which becomes idle.

3. In a facsimile telegraph system, a plurality

of facsimile transmitters, a plurality of facsimile recorders located at a central station, a multi-contact stepping switch associated with each of said recorders and adapted to establish connection to any of said transmitters, means at said central station responsive to a calling signal from one of said transmitters to render operative the switch associated with an idle one of said recorders for locating the calling transmitter, and means including said operative switch to connect said calling transmitter with said idle recorder.

4. In a facsimile telegraph system, a plurality of facsimile transmitters, a plurality of facsimile recorders arranged in a predetermined sequence, a multi-contact stepping switch associated with each of said recorders and adapted to establish connection to any of said transmitters, means responsive to a calling signal from one of said transmitters to render operative the switch associated with the lowest numbered idle one of said recorders for locating the calling transmitter, and means including said operative switch to connect said calling transmitter with said idle recorder.

5. In a facsimile telegraph system, a plurality of facsimile transmitters, a plurality of facsimile recorders, means including a connector relay for each of said recorders operable to connect its associated recorder to any of said transmitters, an answer-next relay for each of said recorders, the contacts of said answer-next relays being interconnected and positioned according to the busy or idle condition of their associated recorders, and means including said answer-next relays to render those of said connector relays associated with busy recorders unresponsive to a signal initiated at one of said transmitters and to render the one of said connector relays associated with an idle recorder responsive to said signals.

6. In a facsimile telegraph system, a plurality of facsimile transmitters, a plurality of facsimile recorders, means for connecting any of said transmitters with any of said recorders, an answer-next relay for each of said recorders, the contacts of said answer-next relays being interconnected and positioned according to the receptive or non-receptive condition of their associated recorders, and means for preventing the connection of a transmitter to an idle recorder when the latter is not conditioned for reception.

7. In a facsimile telegraph system, a plurality of facsimile transmitters, a plurality of facsimile recorders, a switch responsive to a signal initiated at one of said transmitters to connect said one transmitter to one of said recorders, a relay to control the scanning function of said one recorder, means responsive to the establishment of said connection to prepare said relay for exercising its control function, and means responsive to the operative conditioning of said one transmitter for actuating said relay to initiate the scanning function of said one recorder.

8. In a facsimile telegraph system, facsimile apparatus including a transmitter and a recorder, a signaling circuit interconnecting said transmitter and said recorder for correlating the scanning functions of said facsimile apparatus, means at said recorder effective after the operative conditioning thereof for periodically transmitting phasing signals over said circuit, a first relay at said transmitter responsive to the first of said phasing signals to initiate scanning by said transmitter, and a second relay at said transmitter

for rendering said first relay unresponsive to phasing signals received subsequent to said first signal, said second relay being responsive to a disconnect signal transmitted over said circuit for actuating said first relay to arrest scanning by said transmitter.

9. In a facsimile telegraph system employing relatively low potential alternating current signals, a pair of conductors constituting a path for said signals, a contact in each of said conductors, impedances bridged across said conductors on either side of said contacts, and a relatively high direct current potential connected between points of said impedances intermediate the terminals thereof to effect the circulation of direct current through the local circuits formed by said contacts and said impedances and thereby reduce to a minimum the resistance of said contacts to said alternating current signals.

10. In a facsimile telegraph system employing alternating current signals, a path for said signals including a conductor, a contact in said conductor, and a shunt circuit around said contact including a source of direct current potential whereby direct current is conducted through said contact to insure a minimum of resistance by said contact to said alternating current signals.

11. In a facsimile telegraph system, a plurality of facsimile transmitters including one having a preferred status, a plurality of facsimile recorders, means including stepping switches associable in a predetermined sequence with all of said transmitters for connecting any of said transmitters for communication with any of said recorders, and means for controlling one of said stepping switches to connect said preferred transmitter to the first one of said recorders to become idle irrespective of the number of non-preferred transmitters awaiting connection to one of said recorders becoming associated with said switch before said preferred transmitter is reached.

12. In a telegraph system, a plurality of transmitters, means responsive to a call originating at any of said transmitters for testing said transmitters invariably in a predetermined sequence, means for normally arresting said testing means when a calling transmitter is located, and means responsive to a call originating at a preferred one of said transmitters for continuing the operation of said testing means until said preferred transmitter is located irrespective of the number of other calling transmitters tested prior to the location of said preferred transmitter.

13. In a facsimile telegraph system, a facsimile transmitter, a facsimile recorder, switching apparatus responsive to a calling signal originating at said transmitter for interconnecting said transmitter and said recorder for communication, means responsive to a phasing signal originating at said transmitter to initiate the scanning functions of said transmitter and said recorder and means responsive to a failure of the recorder to start scanning within a predetermined time after the actuation of said phasing signal responsive means to prevent said switching apparatus from responding to another calling signal.

14. In a facsimile telegraph system, a facsimile transmitter, a facsimile recorder, switching apparatus responsive to a calling signal originating at said transmitter for interconnecting said transmitter and said recorder for communication, means responsive to a phasing signal originating at said transmitter to initiate the scan-

ning functions of said transmitter and said recorder, and means responsive to a failure of the recorder to start scanning within a predetermined time after the actuation of said phasing signal responsive means to operate an alarm signal.

15. In a facsimile telegraph system, a facsimile transmitter, a facsimile recorder utilizing individual subject matter copyholders and provided with apparatus for automatically changing said copyholders, a signaling channel for interconnecting said transmitter and said recorder for communication, means responsive to a phasing signal originating at the transmitter to initiate the scanning functions of said transmitter and said recorder, and means responsive to a failure of the recorder to start scanning within a predetermined time after the actuation of said phasing signal responsive means to actuate said automatic copyholder changing apparatus.

16. In a facsimile telegraph system, a facsimile transmitter and a facsimile recorder, each having scanning apparatus, a signalling channel for interconnecting said transmitter and said recorder for communication, means responsive to a phasing signal to initiate simultaneously the movement of the scanning apparatus of said transmitter and said recorder, and means responsive to the non-receipt of facsimile signals during a scanning operation to arrest movement of the scanning apparatus of said recorder.

17. In a facsimile telegraph system, a facsimile transmitter, a facsimile recorder utilizing individual subject matter copyholders and provided with apparatus for automatically changing said copyholders, a signaling channel for interconnecting said transmitter and said recorder for communication, means responsive to a phasing signal originating at said transmitter to initiate the scanning functions of said transmitter and said recorder, and means responsive to the non-receipt of facsimile signals during a scanning operation to actuate said automatic copyholder changing apparatus.

18. In a facsimile telegraph system, a facsimile transmitter, a facsimile recorder, switching apparatus associated with said transmitter and said recorder, means responsive to a calling signal originating at said transmitter for operating said switching apparatus to connect said transmitter and said recorder for communication, means responsive to a disconnect signal sent from said transmitter after a predetermined period following the transmission of said calling signal to disconnect said transmitter from said recorder and to recondition said recorder for reception,

and means responsive to a disconnect signal sent during said predetermined period to disconnect said transmitter from said recorder and to prevent the reconditioning of said recorder for reception.

19. In a facsimile telegraph system comprising a plurality of facsimile transmitters, a plurality of facsimile recorders located at a central station, a multi-contact stepping switch individual to each of said recorders and associable with any of said transmitters, means at said central station individual to each of said transmitters and responsive to a calling signal originating at its associated transmitter to start one of said switches stepping over its contacts, means for stopping said switch on the contact associated with the transmitter originating said calling signal, and means including said stopped switch for connecting said calling transmitter with the recorder associated with said switch.

20. A facsimile telegraph system comprising a plurality of facsimile transmitters, a plurality of signaling channels each having one terminal thereof connected to respective ones of said transmitters and the other terminals thereof located in a central station, a plurality of facsimile recorders at said central station, a multi-contact switch individual to each of said individual recorders and having the contacts thereof connected to respective ones of the central station terminals of said signaling channels, a line relay connected to each of said signaling channels to actuate one of said switches in response to a calling signal originating at its associated transmitter, and means including said actuated switch for connecting the recorder associated therewith to the signaling channel associated with said calling transmitter.

21. In a facsimile telegraph system, a plurality of facsimile transmitters, a plurality of facsimile recorders located at a central station, means at said central station including a stepping switch associated with each of said recorders for operating in response to a calling signal originating at one of said transmitters to locate said calling transmitter, means operative upon the location of the calling transmitter to connect said calling transmitter with one of said recorders, and means controlled by said connecting means to initiate scanning at said calling transmitter.

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