May 20, 1930. H. M. FRIENDLY 1,759,190

AUTOMATIC TELEPHONE SYSTEM

Filed March 5, 1928 7 Sheets-Sheet 1

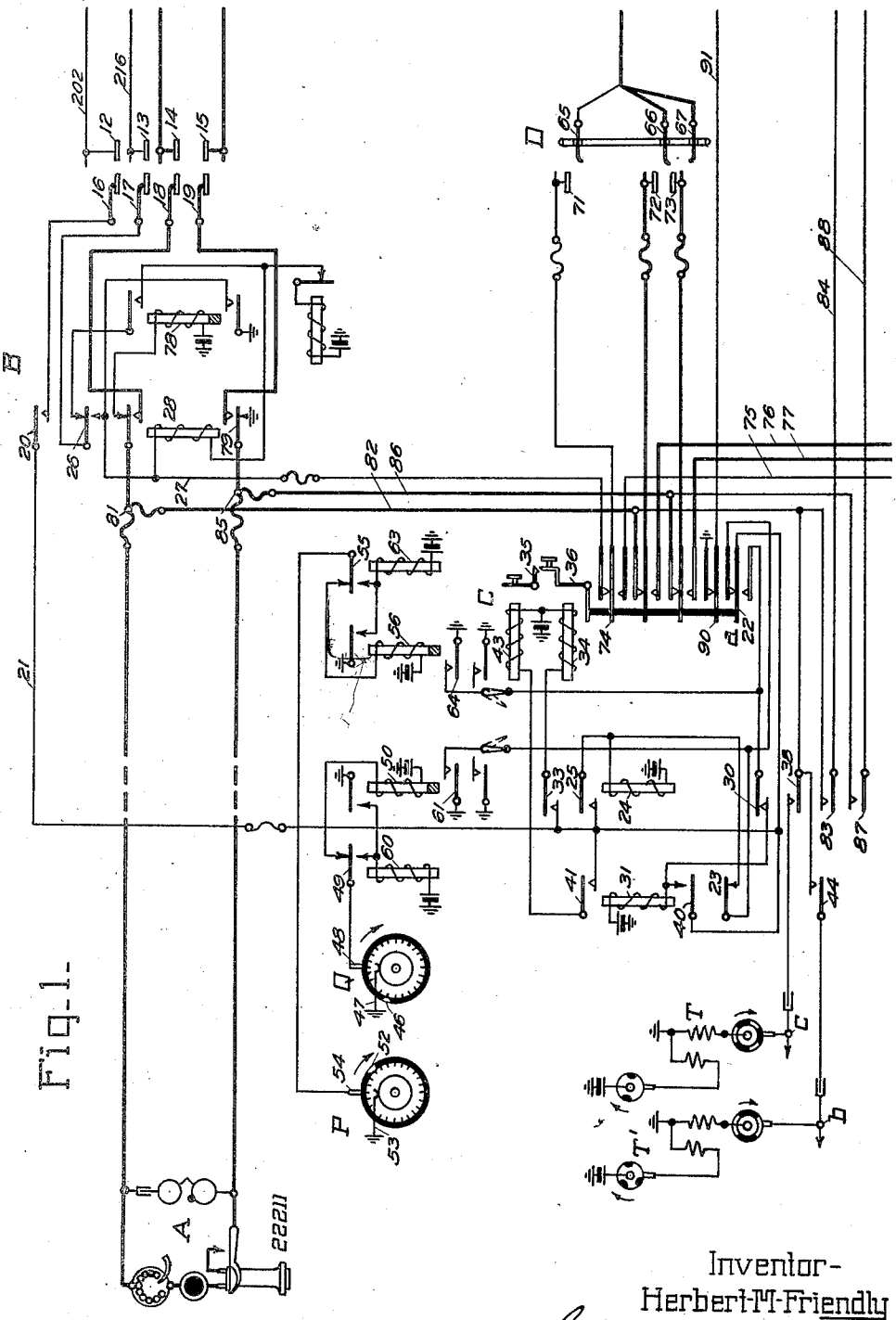


Fig. 1.

Inventor-
Herbert M. Friendly
George E. Mueller
Atty.

May 20, 1930. H. M. FRIENDLY 1,759,190

AUTOMATIC TELEPHONE SYSTEM

Filed March 5, 1928 7 Sheets-Sheet 2

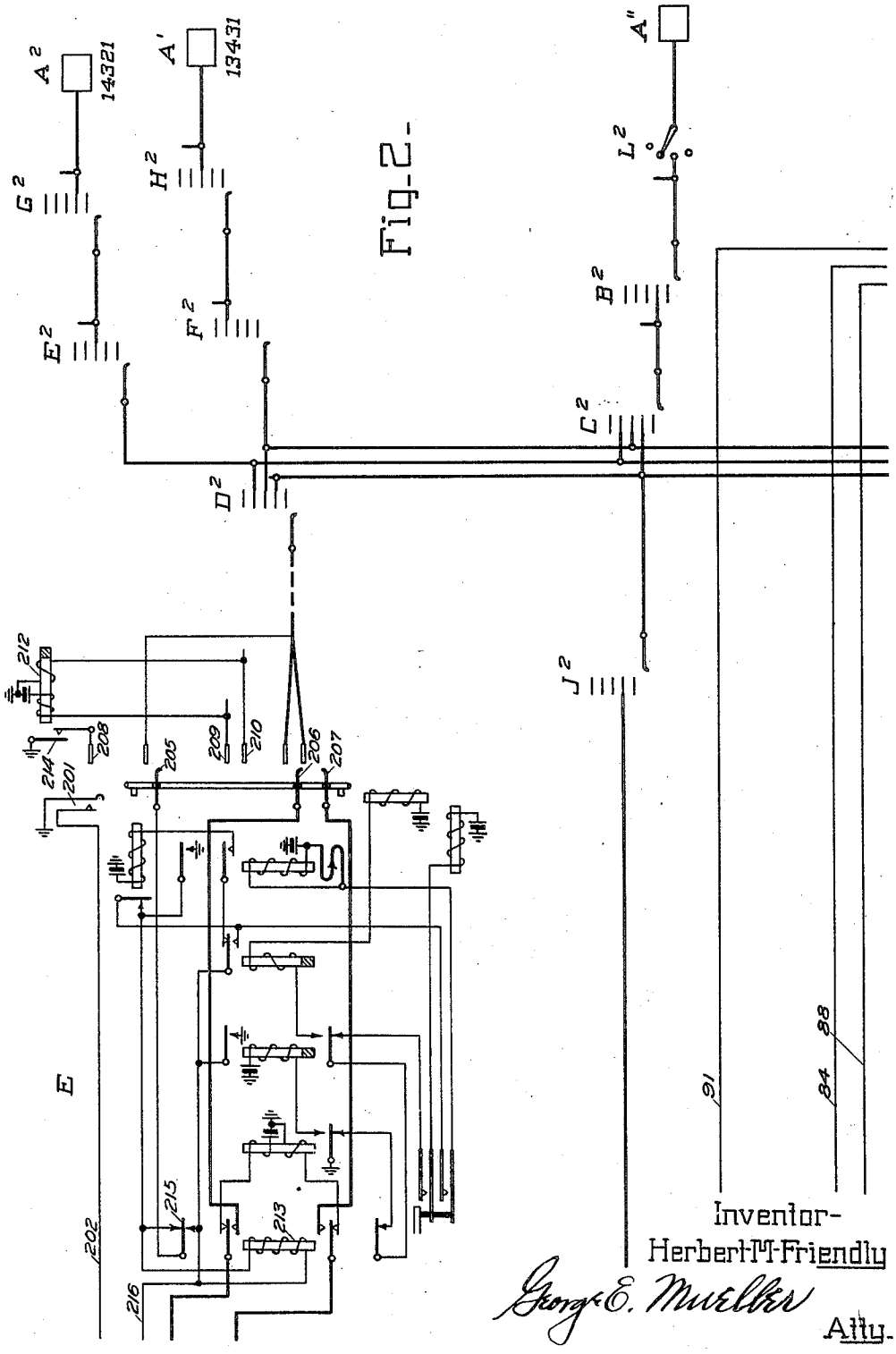



Fig-2-

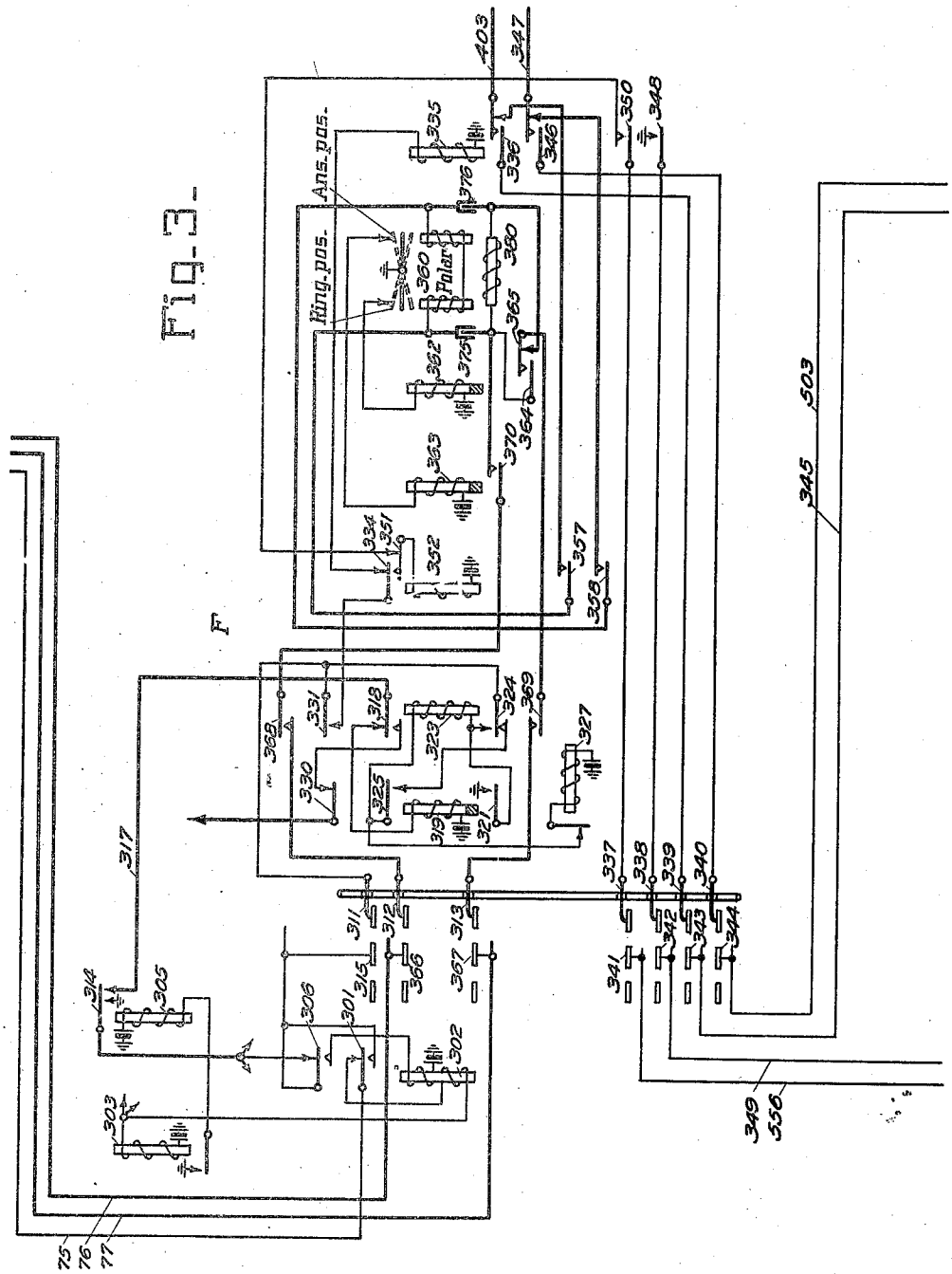
Inventor-
Herbert M. Friendly
George E. Mueller
Atty.

May 20, 1930. H. M. FRIENDLY 1,759,190

AUTOMATIC TELEPHONE SYSTEM

Filed March 5, 1928 7 Sheets-Sheet 3

Fig. 3.




Inventor-
Herbert M. Friendly
George E. Mueller
Atty.

May 20, 1930. H. M. FRIENDLY 1,759,190

AUTOMATIC TELEPHONE SYSTEM

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Fig. 9.

| | | | |
|---|---|---|---|
| 2 | 4 | | 7 |
| 1 | 3 | 5 | 6 |

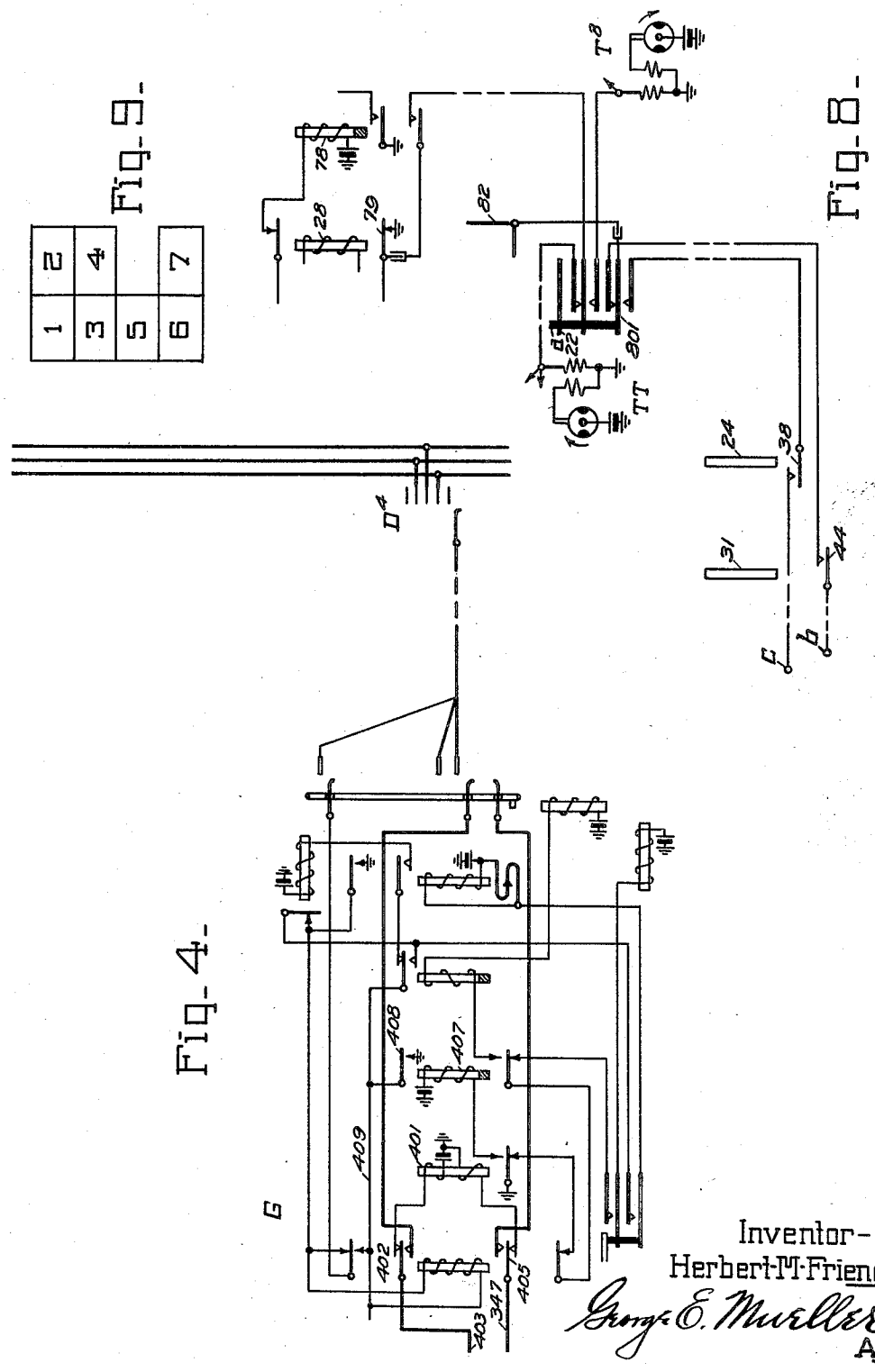



Fig. 8.

Fig. 4.

Inventor-
Herbert M. Friendly
George E. Mueller
Atty

May 20, 1930. H. M. FRIENDLY 1,759,190

AUTOMATIC TELEPHONE SYSTEM

Filed March 5, 1928 7 Sheets-Sheet 5

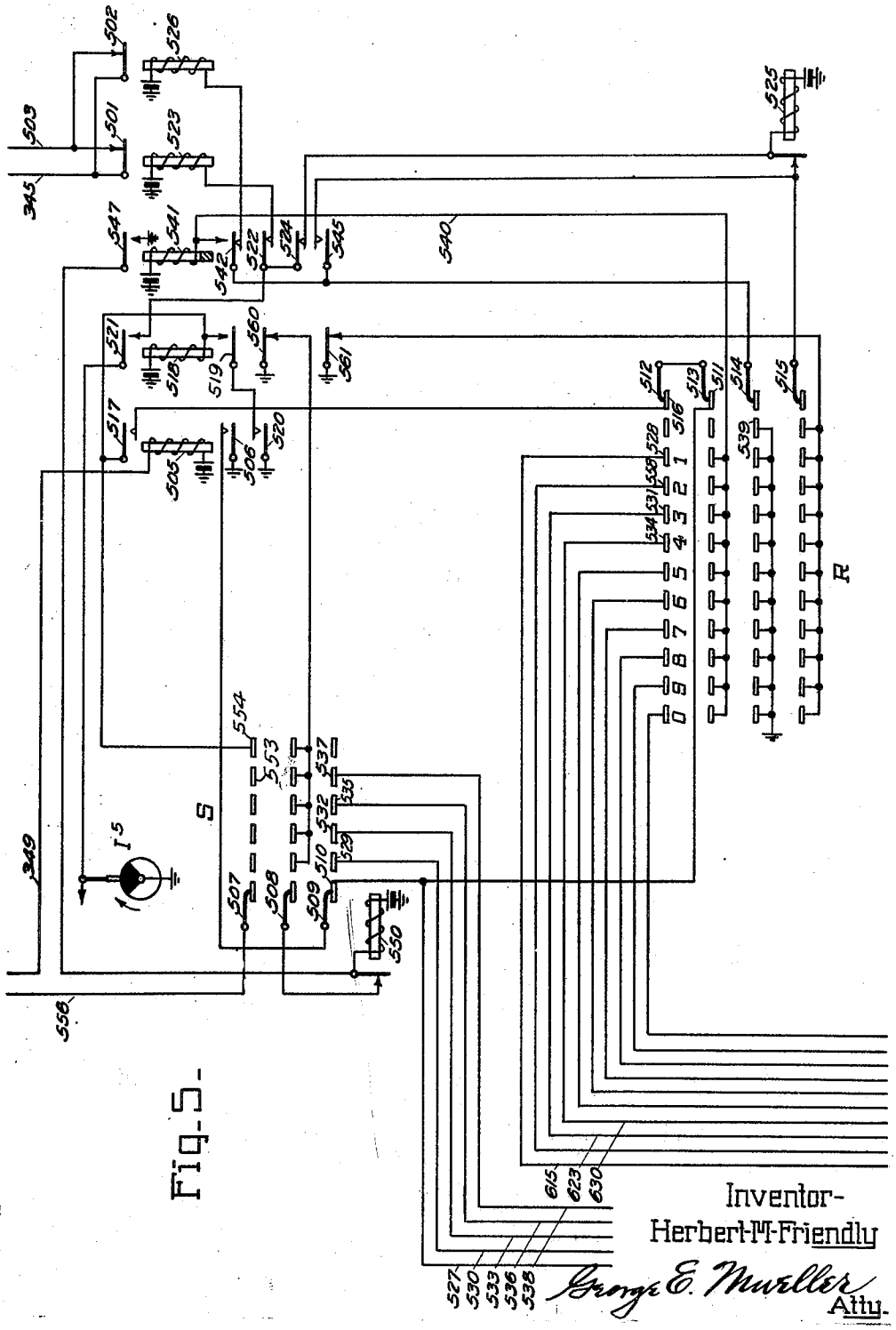



Fig. 5.

Inventor-
Herbert M. Friendly
George E. Mueller
Atty.

May 20, 1930. H. M. FRIENDLY 1,759,190

AUTOMATIC TELEPHONE SYSTEM

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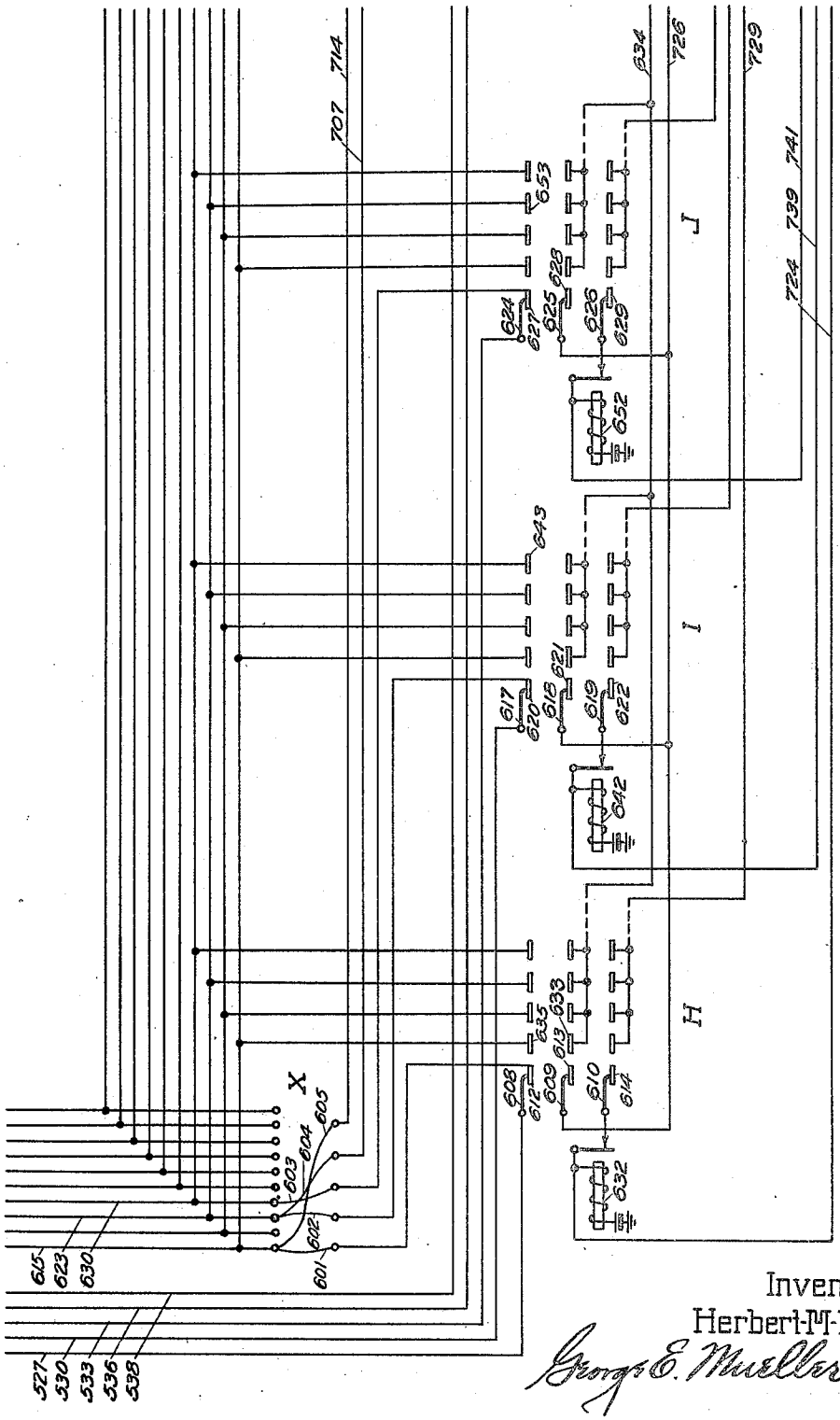



Fig. 6.

Inventor-
Herbert M. Friendly
George E. Mueller
Atty.

May 20, 1930. H. M. FRIENDLY 1,759,190

AUTOMATIC TELEPHONE SYSTEM

Filed March 5, 1928 7 Sheets-Sheet 7

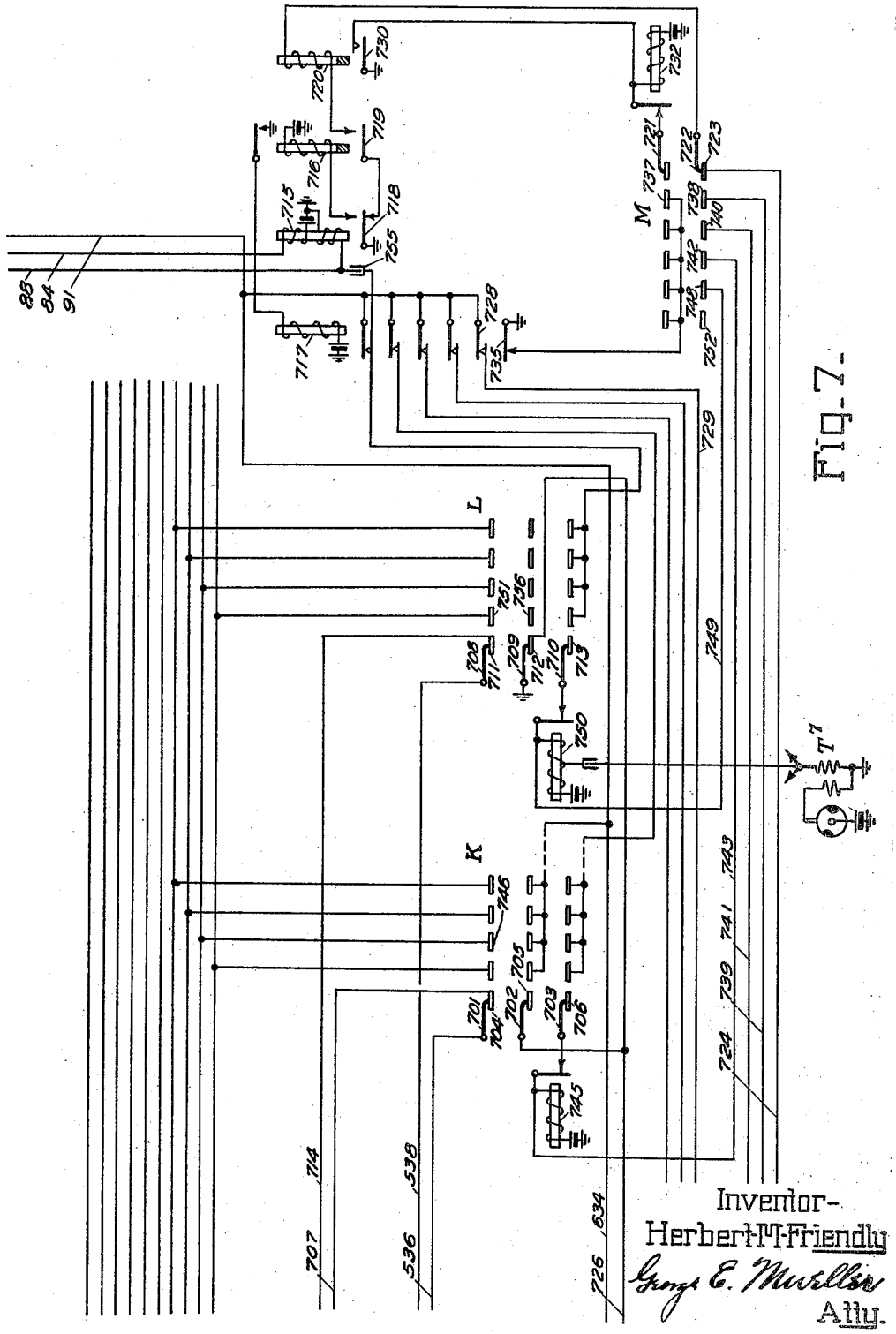



Fig. 7.

Inventor-
Herbert M. Friendly
George E. Muellen
Atty.

Patented May 20, 1930 1,759,190

# UNITED STATES PATENT OFFICE

HERBERT M. FRIENDLY, OF CHICAGO, ILLINOIS

## AUTOMATIC TELEPHONE SYSTEM

Application filed March 5, 1923. Serial No. 259,047.

The present invention relates to telephone systems; more particularly so-called automatic or machine switching telephone systems.

### *General objects*

The general objects of the present invention are to enable a subscriber of the automatic telephone system, who contemplates temporarily leaving the location of his telephone, to directively set central office apparatus or call-forwarding equipment associated with his line through the agency of his automatic calling device dial on his telephone so that in case any calls are thereafter directed to his line, the latter said calls will be further extended or forwarded to a predetermined random subscribers' line or other line of the system. That is, for example, a subscriber before leaving the premises may remove the receiver of his telephone as if to initiate a call, and then operate his calling device dial by placing his fore-finger in a specific depression finger-hold of the dial and then draw the dial until his finger encounters the finger-stop, so that when the dial is released it will send a series of eleven open impulses. After the dial has restored, he will restore the receiver, leaving the central office call-forwarding equipment in the set condition. The same kind of manual operation will unset the set condition.

However, in accordance with the present invention, in the event that the before-mentioned (normally) predetermined line is not the line to which it is in the particular instance desired to have the calls forwarded, the said predetermined line may be directively changed. The latter is accomplished by annexing the telephone number of the line to which it is desired to have calls forwarded in the particular instance, forthwith after operating the dial to effect the series of eleven open impulses mentioned. The receiver will then be restored to the switch-hook, leaving the set line in condition for forwarding calls directed to it to the specific line indexed by the number annexed after primarily setting the line by the series of eleven open impulses. That is to say, not only is there a normally predetermined line to which calls may be forwarded when a set condition exists on a line called, but this normally predetermined line may be temporarily changed to a random desired line of the exchange.

In connection with the last foregoing, relating to changing from the normally predetermined line to a random desired line to which calls will be forwarded under the set condition, when the subscriber's line is to be unset it is done by initiating a call thereon and then sending a series of eleven open impulses. The later effaces not only the said set condition accomplished responsive to the first said sending of the eleven open impulses, but it also effaces the substituted random desired line setting and renders the normally predetermined line subject to being called when the subscriber next causes his line to be set by sending the series of eleven open impulses and without annexing any digits.

It will thus be perceived that the present invention is adapted for use in connection with a subscriber's telephone line wherein it may be desired to have calls which may be made thereto, in the absence of the subscriber, forwarded to a desired random line of the exchange as may be predetermined by the subscriber when he sets his line for forwarding calls made thereto. That is, a residence subscriber may leave his residence and go to the residence of some other random subscriber, and desires that all calls made to his telephone be forwarded to the telephone of the subscriber where he will be found. Moreover, a business establishment may wish to have some employee respond to after business hours calls. The line will, therefore, be set to forward calls made to it to any desired telephone of an employee, perhaps a different employee being selected for successive days. That is, there may be a predetermined employee who will be charged with responding to such calls responsive to the normal setting of the set relay, while this may at will be changed to a random telephone line by simply annexing the number of the latter telephone line, after normally setting the line for forwarding.

The set condition may be at will effaced. It will be effaced at a predetermined time automatically. Of course, a manual setting may be made in the central office, in the event the subscriber neglected to set the line and a duly authenticated request from him is made for such manual setting.

*General operation*

Reference is made to my pending applications for Patent Ser. No. 218,605, filed Sept. 10, 1927; Ser. No. 257,480, filed Feb. 27, 1928; also U. S. Patent 1,744,696, granted Jan. 21, 1930. These pending applications and patent are directed to a telephone system and apparatus having objects broadly as set forth in the foregoing statements. The present invention has features believed to be novel not disclosed in the said cited pending applications. Some of these latter said novel features will be specifically described and pointed out in the present specifications, while other said novel features will be apparent in view of the disclosures specifically set forth in the specifications and drawings.

Among the features of the present invention believed to be novel are:

*a.* Time controlled means for setting the subscriber's line at a predetermined time so that calls thereafter directed to it will be forwarded to a predetermined line of the system.

*b.* Time controlled means for unsetting the subscriber's line at a predetermined time so that calls thereafter directed to it will not be forwarded.

The means set forth in paragraphs *a* and *b* therefore obviate the directed sending of the series of eleven open impulses to set and unset the subscriber's line. Moreover, this time controlled setting and unsetting will not interfere with the manually directed setting and unsetting. That is, the subscriber's line can be subscriber directively set or unset in advance of the predetermined time for automatically setting and unsetting it by the time controlled mechanism. The automatic time controlled mechanism thus insures that no oversight will occur in setting the line or unsetting the line; at least by a time of day limit.

*c.* Specific tone sources are provided to indicate to the subscriber when he has operated his calling device to set and to unset the line that this operation has actually become effective, and thus confirms the operation which takes place. This is having in mind that the subscriber may set his line for forwarding calls directed to it and then because of forgetting about it performs the same directive operation subsequently, which latter operation will change back the condition. Remembering that the same manual operation is made by the subscriber for setting and unsetting, it will be clear that if some tone or some other indicating means is not employed to confirm the operation, the subscriber would not be certain of the condition existing. The tone will thus prompt the subscriber if the unintended operation occurred.

*d.* Specific tone sources are provided for indicating to the subscriber when he removes his receiver, as when initiating a call, whether his line is in the set or unset condition. The subscriber may thus at any time verify the set or unset condition of his line by simply removing his receiver to perceive one or the other specific indicating tone.

*e.* When the subscriber's line is initially set responsive to the subscriber applied directive operation and a prearranged line of the exchange is thereby designated for receiving all calls forwarded from the said subscriber's line, this prearranged line may be changed to a desired random line of the exchange by thereupon annexing digits by the calling device on the subscriber's telephone in accordance with the said desired random line. That is, the subscriber will initially set his line by the series of eleven open impulses to cause calls directed to his line to be forwarded to the said predetermined line. However, he may, by thereupon sending digits corresponding to some desired random telephone line, cause the latter said line to be the line to which calls will be forwarded, in lieu of said predetermined line. The subscriber may now hang up his receiver, leaving his line set. He will unset his line by removing his receiver and operating his calling device to send eleven open impulses.

*f.* When the subscriber has set his line for forwarding calls directed to it to some desired random line, he will perceive a specific tone responsive to sending the last digit of the latter said line in effectuating the setting.

*g.* When the subscriber hangs up his receiver after causing his line to be set for forwarding calls directed to it to a desired random line, he may remove his receiver and initiate and make an outgoing call as if his line were not in the set condition. In fact, he may make an outgoing call while his telephone number is in a called condition wherein the call is being forwarded towards or is forwarded to the predetermined line to receive such forwarded calls.

*Drawings*

With reference to the accompanying drawings:—

Fig. 1 shows a calling telephone A leading-in to a line switch B. It also shows a set relay C for changing the so-termed normal conductors from the line leading to the line switch B to the corresponding bank terminals accessible from line finder switch F in Fig. 3. The indicated connector D nor-

mally has access to the line leading to telephone A.

Fig. 2 shows a first selector E of a group accessible from line switch B. It also indicates a calling telephone A'' leading to a line switch $L^2$, the latter having access to first selector $B^2$, second selector $C^2$, third selector $J^2$, and connector D in Fig. 1, in sequence to complete a call from telephone A'' in Fig. 2 to the telephone A in Fig. 1.

Fig. 3 shows a line finder switch F involving auxiliary apparatus, the said switch F having access to terminals of a plurality of lines which may be called through connector D in Fig. 1, or random connectors in the exchange office containing connector D wherein contact springs of a set relay similar to C are interposed. Each said line accessible from the switch F has a line relay as shown on the left aligned with the relays of the said switch. When the switch F operates and seizes a set of its bank terminals corresponding to a line called, its lower group of four wipers are then co-operative with bank terminals which correspond to the impulse sending mechanism which is individual to the said line called, so that while the finder switch F is common to a plurality of lines, the sending mechanisms are each individual to a said line.

Fig. 4 shows a first selector G companion to and individual to the switch F in Fig. 3. The first selector G has access to other switches in common with first selector E in Fig. 2.

Fig. 5 shows the impulse sending mechanism for directing the forwarding of calls. The said impulse sending mechanism is individual to the line leading to telephone A, and it is seized by the switch F when the latter said switch seizes the bank terminals which are companion to the connector bank terminals of the line leading to telephone A.

Fig. 6 shows switches H, I and J, being the digit setting switches for the first three digits of the number (of five digits) of the line to which calls directed to the line leading to telephone A are to be forwarded to.

Fig. 7 shows switches K and L, being the digit setting switches for the last two digits of the number of the line to which calls directed to the line leading to telephone A are to be forwarded to. Fig. 7 also shows the switch M which distributes to the switches H to L.

Fig. 8 shows a preferred modification of Fig. 1 and is introduced where indicated by the reference characters, for the objects set forth in the foregoing paragraph *d*.

Fig. 9 is a diagram showing the assembly of the seven sheets of accompanying drawings to disclose the circuits employed to exemplify the present invention. The lines extending towards the margins which register are continuations of the same line.

*Equipment*

The telephone A in Fig. 1 is the well known common battery series type, but is equipped with an automatic calling device and dial as disclosed in my said pending application Ser. No. 218,605, filed Sept. 10, 1927, and illustrated in Figs. 7 and 8 thereof. The dial enables a series of eleven open impulses to be sent responsive to operating and releasing a specific finger-hold depression positioned after the "0" digit finger-hold.

The line switch B is of the well known rotary class as described on page 53 of Hershey's Automatic Telephone Practice, third edition. However, the line switch B has an added upper wiper for objects of the present invention.

The connector D in Fig. 1 is of the well known type as shown in Fig. 73 of the fourth edition of the said book.

The first selector E in Fig. 2 is of the well known type sometimes called a Powell selector, and described on pages 59 to 61 of the said third edition of Hershey's book. However, a set of eleventh vertical position off-normal springs and connected circuits have been introduced for the purposes of the present invention. It also has eleven levels of bank terminals.

The first selector G in Fig. 4 is of the well known said Powell type.

The selectors $B^2$, $C^2$, $E^2$, $F^2$ and $J^2$ in Fig. 2 and $D^4$ in Fig. 4 are like selector G in Fig. 4.

The line switch $L^2$ in Fig. 2 is like switch B in Fig. 1.

The connectors $H^2$ and $G^2$ in Fig. 2 are like connector D in Fig. 1.

The line finder switch F in Fig. 3 is of the class shown and described on pages 55 to 57 of the said third edition of Hershey's book. However, modified for the purposes of the present invention.

The switch elements R and S in Fig. 5, and the switch elements H, I and J in Fig. 6, and the switch elements K, L and M in Fig. 7 belong to the class of switch B in Fig. 1, modified in accordance with the present invention.

It will be understood that any other suitable switches may be substituted for the said well known switches mentioned, without departing from the spirit of the present invention. Also, that the switches specific to the present invention may be modified by those skilled in the art without departing from the spirit of the present invention, as defined by the subjoined claims.

It will, of course, be understood that in a commercial embodiment of the present invention a plurality of switches in a group will be employed in place of the exemplary single switches used in disclosing the present invention, so that a plurality of calls may be coexistent, the switches in the groups having

predetermined order of use with respect to antecedent co-operative switches.

*Detailed operation—initiating a call from telephone A to telephone A'*

Upon removing the receiver from the switch-hook of telephone A, the line switch B will operate in the well known manner to seize the first idle selector E. The calling party will then operate his calling device in accordance with the five digits 1—3—4—3—1 of the telephone number of the line leading to telephone A' and thus correspondingly set the selectors E, $D^2$ and $F^2$ and connector $H^2$. The connection may then be released in the well known manner, responsive to the calling party replacing his receiver on the switch-hook. A call to telephone $A^2$, the telephone number of which is 14321, will be effected in a generally like manner. It will be noted that the telephones A' and $A^2$ are both located tributary to the "1" office of the exchange; reached through the "1" level of first selector E. Of course, other telephones of the system (not indicated) may be reached through other levels of the selector E and, therefore, belong to corresponding offices of the exchange. Thus, outgoing calls from telephone A under normal conditions are made in the well known manner and employ well known switches, with due regard to the special modifications in switches B and E before mentioned, which modifications are not brought into play under normal calling conditions.

*Setting the line leading to telephone A so that calls directed to said line will be forwarded to telephone A'*

Let it be assumed that the party at telephone A desires to set his line so that calls directed thereto will be forwarded to telephone A'. The party at telephone A will remove his receiver as if to initiate an ordinary call. This will cause the line switch B to operate and select a first selector as E. The party at telephone A will then operate his calling device dial in accordance with the special finger-hold depression to effect a series of eleven open impulses which will step the shaft of selector E vertically in accordance therewith and operate the eleventh vertical off-normal springs 201. The latter operation will cause ground to be applied over conductor 202, bank terminal 12 of set 12 to 15, wiper 16 of set 16 to 19, armature 20, conductor 21, spring 22 of set relay C, armature 23 to the winding of relay 24, the latter said relay actuating. The relay 24 will, by its armature 25 lock itself to the conductor 21, and thus remain actuated as long as the ground is maintained on conductor 21.

At the time the off-normal springs 201 operated, the selector E operated in the well known manner to rotate-in and seize by its wipers 205 to 207 the first set of idle bank terminals 208 to 210 of the eleventh level. The latter said set will be the ones corresponding to slow-releasing relay 212. The latter said relay will actuate responsive to the seizing by seector E when its relay 213 actuates, and ground from armature 214 will be applied through bank terminal 208, wiper 205, armature 215, release trunk conductor 216, bank terminal 13, wiper 17, armature 26, conductor 27. This ground to the release trunk will, therefore, maintain the relays 213 and 28 actuated as long as the windings of relay 212 are maintained energized through the telephone A by the party thereat maintaining his receiver off the switch-hook. The ground from the springs 201 is similarly maintained on conductor 21 until the shaft of selector E is restored under control of the party at telephone A.

At the time relay 24 actuates, its armature 30 disconnects the winding of relay 31. Armature 33 at the same time applies ground from conductor 21 to the winding of magnet 34 of the set relay C. The latter said magnet will cause the springs of relay C to be operated, and the dog 35 latched over the catch 36 to retain the springs of relay C operated after the winding of magnet 34 has been deenergized.

When the springs of relay C become operated, in a local circuit of relay 24, tone from source T is being applied through armature 38, audible to the party at telephone A, indicative to him that the relay C is in its latched or set condition, assuming that its circuit energized from the relay 24 is operative. The tone from armature 38 may be applied through a normally disengaged spring of relay C so as to positively prevent the tone from being applied audible to the party at telephone A unless the relay C actually operated. This spring is shown introduced in the preferred modification Fig. 8.

The party at telephone A, upon hearing the tone from source T will know that his line is in set condition and will hang up his receiver, leaving his line set, the dog 35 retaining the springs of relay C operated. It will be noted that the relay 24 is maintained actuated and the relay 31 disconnected as long as ground is maintained on conductor 21, which ground endures until the party at telephone A hangs up his receiver to cause the relay 212 to deenergize and remove the holding ground from the release trunk 216, which will cause the shaft of the selector E to restore in the obvious manner, in view of the citations as to what is well known.

*Unsetting the line leading to telephone A so that calls thereafter directed to said line will not be forwarded therefrom, the said line then being in normal condition*

Let it be assumed that the party at telephone A desires to unset his line, by unlock-

ing the relay C and thus cause the springs thereof to restore to normal condition. The party at telephone A will remove his receiver as if to initiate an ordinary call, having in mind that even if the springs of relay C are operated and locked by the dog 35, outgoing calls from telephone A through the line switch B will be effected normally as if the springs of relay C were not in their operated condition.

The party at telephone A will then operate his calling device dial in accordance with the special finger-hold depression to effect a series of eleven open impulses which will step the shaft of selector E vertically in accordance therewith and operate the eleventh vertical off-normal springs 201 and select the relay, as 212, as when the party at telephone A directed the setting of his line by the relay C. That is, ground will be applied from the springs 201 to the conductor 21. However, since the catch 36 is held in its actuated position by the dog 35, the relay 24 is now disabled from operating because the spring 22 is flexed out of contact with its resting spring and is into engagement with its make spring. Thus, the ground received over conductor 21 is now applied through spring 22, armature 30 to the winding of relay 31, the latter said relay actuating. A locking circuit for the relay 31 is through its armature 40 to the conductor 21, which as before referred to, remains grounded until the party at telephone A hangs up his receiver. At the time relay 31 actuates, its armature 23 disconnects the winding of relay 24. The winding of relay 24 is thus maintained disconnected as long as relay 31 is maintained energized.

At the time relay 31 actuates and disconnects the winding of relay 24, its armature 41 applies ground from conductor 21 to the winding of unlatching magnet 43 of the set relay C. This will operate the latter said magnet to unlatch the dog 35 from the catch 36 and cause the springs of relay C to restore to normal condition.

Having in mind that the relay 31 is actuated and held so until the ground is removed from conductor 21, it will be obvious that tone from the source T′ will be applied through armature 44 audible to the party at telephone A, indicative that the relay C has been unset. The tone from armature 44 may be applied through a normally closed contact set of relay C so as to positively prevent the tone from being applied audible to the party at telephone A unless the relay C actually deactuated to unset the line, while the relay 31 is actuated. This spring is shown introduced in the preferred modification Fig. 8.

The party at telephone A, upon hearing the tone from source T′ will know that his line has been unset, and will, therefore, hang up his receiver. The latter will cause the shaft of selector E to be restored and the ground removed from conductor 21, so that relay 31 will deactuate and restore the circuits to normal condition, in the manner before explained.

It will be noted that by manually operating the catch 36 it may be locked by the dog 35, and also by manually operating the dog the catch 36 and springs of relay C may be restored to normal condition.

*Relay C is locked and unlocked according to prearranged time schedule*

The time controlled circuit grounding devices P and Q revolve continuously in the indicated direction at uniform speed, making a revolution in twenty-four hours. The conductive segment 46 applies ground received from brush 47 through brush 48, armature 49 to the winding of slow-releasing relay 50, the latter said relay actuating at 5 p. m. This is assuming that the drawn position of the device Q is as at 12 m. The conductive segment 52 applies ground received from brush 53 through brush 54, armature 55 to the winding of slow-releasing relay 56, the latter said relay actuating at 9 a. m. This is assuming that the drawn position of the device P is as at 12 m.

In view of the indicated direction of revolution of the devices P and Q, the device Q will be the first one to apply ground through its brush 48. This will occur at 5 p. m., as stated. Responsive to relay 50 actuating, relay 60 will actuate and lock to ground on armature 49 until the ground applied through brush 48 is removed because of the segment 46 moving from under the brush 48. When relay 60 actuates it deenergizes the relay 50, and the latter said relay will then deactuate consistent with its slow-releasing characteristic. Only during the short time that relay 50 is actuated, ground from armature 61 will be applied through armature 23 to the winding of relay 24. The relay 24 will actuate in the manner before described to in turn cause the energization of the magnet 34 from the ground applied from armature 61 through armatures 25 and 33, to operate and lock the springs of set relay C.

At 9 a. m. following the operation of relay 50, ground will be applied from brush 54 of device P effective to operate the relay 56. Responsive to relay 56 actuating, relay 63 will actuate and lock to ground on armature 55 until the ground applied through brush 54 is removed because of the segment 52 moving from under the brush 54. When relay 63 actuates, it deenergizes the relay 56 and the latter said relay will then deactuate consistent with its slow-releasing characteristic. Only during the short time that relay 56 is actuated ground from armature 64 will be applied through armature 30 to the winding of relay 31. The relay 31 will actuate in the

manner before described to in turn cause the energization of the magnet 43 from the ground applied from armature 64 through armatures 40 and 41, to disengage the dog 35 so that the springs of relay C will restore to normal condition, and, therefore, the relay C will be in its unset condition.

It will be particularly noted that if, for example, the relay C was in its set condition at the time relay 50 actuated, the relay 24 will be caused to actuate as before described to energize the winding of the magnet 34, but to no effective purpose with respect to the set condition of relay C. In the same manner if the relay C is at normal and the relay 56 actuated, the relay 31 will be caused to actuate as before described to energize the winding of magnet 43, but to no effective purpose with respect to the unset condition of relay C. It will be thus clear that while applying ground over conductor 21 will change the condition of relay C, the relays 50 and 56 can only set the relay C or unset it, respectively. Thus, if the party at telephone A has set the relay C at 4:45 p. m. and at 5 p. m. the relay 50 operates, no confusion can occur. In the same manner, if the party at telephone A has unset the relay C at 8:30 a. m. and at 9 a. m. the relay 53 operates, no confusion can occur. However, in the event the subscriber through inadvertence fails to operate his set relay C before leaving for the night, the relay C will be automatically set at 5 p. m.

In this connection it will be understood that there will be as many sets corresponding to P and Q and their individual pair of relays 56 and 63, and 50 and 60, respectively, as there are times of day when set relays, as C, are to be operated, the various set relays being associated with the proper said device as P and Q depending upon the time of day it is to be automatically set and unset.

*Call to the line leading to telephone A under normal condition wherein the relay C is not set*

Assume that the party at telephone A'' desires to call the telephone A, under normal conditions. The dial at telephone A'' will be operated in accordance with digits 2—2—2—1—1 after initiating the call. This will successively operate the selectors $B^2$, $C^2$ and $J^2$ and connector D so that wipers 65, 66 and 67 will seize bank terminals 71, 72 and 73, respectively. Ground from the connector will be applied over private wiper 65, bank terminal 71, spring 74 to the winding of relay 28, the latter said relay operating to disconnect the line relay 78 and the ground on the resting contact of armature 79, in the well known manner. The connector D will now apply signaling current effective to the bell at telephone A, in the well known manner, the effective circuits being those well known from Hershey's book cited.

*Call to the line leading to telephone A under the condition that the set relay C is in operated condition*

Now assume that at the time the wipers 65 to 67 are set upon the bank terminals 71 to 73, respectively, the set relay C is in its operated and latched condition. Under the latter said condition the relay 28 will not be energized since the normal conductors are disconnected from the line leading to telephone A. However, the latter said condition does not prevent the party at telephone A normally extending calls from said telephone.

It will be noted that the conductors leading from bank terminals 71 to 73, disconnected from the line leading to telephone A, are now connected to conductors 75 to 77, respectively. Thus, when the connector D seizes the line terminals 71 to 73, ground is applied from the connector over wiper 65, bank terminal 71, spring 74, conductor 75, armature 301, lower winding of relay 302, winding of common relay 303 to grounded battery, the relay 303 actuating and causing the dependent common relay 305 to actuate. Armature 306 on relay 302 will attract from its resting contact to its make contact, while armature 301 remains inert for the time being. This condition causes all the bank terminals accessible from the wiper 311 of the group of wipers 311 to 313 to be grounded by the armature 314 of relay 305, excepting the bank terminal 315 corresponding to the relay 302, due to the attracted condition of armature 306. Ground is applied from the armature 314, conductor 317, armature 318 to the winding of slow-releasing relay 319, the latter said relay actuating.

The armature 321 applies ground to the lower terminal of the winding of relay 323, while the ground on the bank terminals successively engaged by wiper 311 is applied through armatures 324 and 325 to the upper terminal of the winding of relay 323. The latter said ground is also applied through the interrupter armature of motor magnet 327 to the winding thereof, the said motor magnet operating to successively step advance the wipers 311 to 313. When wiper 311 encounters bank terminal 315 it will not receive ground because of the attracted condition of armature 306, so that the short-circuit is removed from the winding of relay 323 and the direct ground is removed from the winding of the motor magnet 327. Due to the marginal adjustment of the motor magnet, it will cease operating under the condition, but the relay 323 will operatively energize under the condition. When relay 323 actuates, ground through armature 321 will be applied through attracted armature 324, wiper 311, bank terminal 315, armature 306, upper winding of relay 302, the latter said relay fully

operating. This disconnects the lower winding of the latter said relay 302 at armature 301 and connects ground received from the connector D over conductor 75 through armature 301, bank terminal 315, wiper 311 to armature 324 to maintain the relay 323 locked before the armature 321 has had time to retract. The relays 303 and 305 will now deactuate if there is no other relay like relay 302 with its lower winding energized, due to a waiting call. If the relays 303 to 305 are actuated after relay 302 fully actuates, the ground applied over conductor 317 will be continued through armatures 318 and 330 to the armature corresponding to 318 of the next finder switch (not shown) like F of the group of which switch F is one.

The ground received over conductor 75 is applied through armatures 331 and 334 to the winding of relay 335, the latter said relay actuating. Resultant to the actuation of the relay 335 a circuit path can be traced from grounded battery, upper winding of relay 401, armature 402, conductor 403, armature 336, wiper 339 of set 337 to 340, bank terminal 343 of set 341 to 344, conductor 345, armatures 501 and 502 in multiple, conductor 503, bank terminal 344, wiper 340, armature 346, conductor 347, armature 405, lower winding of relay 401 to ground, the latter said relay actuating, followed by slow-releasing release relay 407. Ground will now be applied through armature 408 to release trunk conductor 409.

Ground is applied through armature 348, wiper 338, bank terminal 342, conductor 349 to the winding of relay 505, the latter said relay actuating. Ground will now be applied from armature 506, wiper 509 of set 507 to 509, bank terminal 510, bank terminal 511, wiper 513 of set 512 to 515, bank terminal 516, armature 517 to the winding of relay 518, the latter said relay actuating and locking through armatures 519 and 420 to ground.

In this connection, it will be noted that the interrupter $I^5$ revolves at the rate of approximately twelve times per second, so that the next ground impulse applied thereby will be applied through armature 521, armature 522 to the winding of relay 523, and through armature 524 to the winding of motor magnet 525 of switch R, the said relay 523 and magnet 525 coincidently operating. The wipers 512 to 515 will thus be step advanced responsive to the groundings of the interrupter $I^5$. It will be noted that while the armature 501 will attract coincident with the first energization of the motor magnet 525, the armature 502 on relay 526 will maintain the relay 401 in selector G energized until the wiper 514 encounters ground on the first off-normal bank terminal co-operative therewith and thereby energizes relay 526 over an obvious path, after which time the relay 401 in selector G will be under the sole control of armature 501.

It will appear presently that the call in the present instance is to be forwarded to telephone A′, the number of which is 13431, and accordingly, jumpers 601 to 605 in Fig. 6 are run between the cross connecting terminals X to predetermine that the sending mechanism in Fig. 5 will send a corresponding train of series of directive digit impulses. It will be noted that bank terminal 510 of switch S is connected over conductor 527 to wiper 608 of set 608 to 610 of switch H, bank terminal 612 of set 612 to 614, jumper 601, conductor 615 to bank terminal 528 of switch R, the latter said terminal corresponding to a single open impulse for the digit "1". In the same manner, bank terminal 529 of switch S is connected over conductor 530, wiper 617 of set 617 to 619 of switch I, bank terminal 620 of set 620 to 622, jumper 602, conductor 623 to bank terminal 531 of switch R. Bank terminal 532 of switch S is connected over conductor 533, wiper 624 of set 624 to 626 of switch J, bank terminal 627 of set 627 to 629, jumper 603, conductor 630 to bank terminal 534 of switch R. Bank terminal 535 of switch S is connected over conductor 536, wiper 701 of set 701 to 703 of switch K, bank terminal 704 of set 704 to 706, conductor 707, jumper 604, conductor 623 to bank terminal 531 of switch R. Bank terminal 537 of switch S is connected over conductor 538, wiper 708 of set 708 to 710 of switch L, bank terminal 711 of set 711 to 713, conductor 714, jumper 605, conductor 615 to bank terminal 528 of switch R.

Returning to the operation of the mechanism in Fig. 5, for each step that the wipers of switch R are advanced the relay 523 will attract its armature 501. However, until the wipers of switch R have been moved one step off-normal so that wiper 514 rests on bank terminal 539, when the relay 526 will be energized and maintained so until the wipers return to normal, the armature 501 is disabled from effecting open impulses.

In view of the fact that ground on armature 506 is applied through wiper 509, bank terminal 510, conductor 527, jumper 601, conductor 615 to bank terminal 528, when the wiper 512 encounters the latter said terminal the armature 501 will have sent one open impulse effective to the relay 401 in selector G. At the time wiper 512 receives ground from bank terminal 528, this ground is applied through wiper 513 and the bank terminal it is resting upon, conductor 540 to the winding of slow-releasing relay 541, the latter said relay actuating and locking by its armature 542, wiper 514 and the bank terminal it is resting upon to ground. The relay 541 will thus be maintained locked until the wipers of switch R are returned to normal position, the relay 541 then deactuating consistent with

its slow-releasing characteristic to cause a delay between the series of the train to allow for trunk hunting by the selector last operated.

Coincident with the actuation of the relay 541, the said locking ground received through wiper 514 is also applied through armature 545, interrupter armature to the winding of motor magnet 525, the latter said magnet operating to restore the wipers 512 to 515 of switch R to the normal position as drawn, whereat wiper 514 does not derive ground.

At the time relay 541 actuates, ground is applied through armature 547 to the winding of the motor magnet 550 of the switch S. So when the relay 541 deactuates, the retraction of the armature of the latter said motor magnet causes the wipers of switch S to advance one step so that wiper 509 will then rest on bank terminal 529.

Ground applied through wiper 509 will now be on bank terminal 531. Therefore, when the wiper 512 encounters the latter said bank terminal in its new step movement responsive to the deactuation of relay 541, three open impulses will have been sent from armature 501.

The first impulse (series) sent from the armature 501 causes the selector G to operate its wipers into alignment with the first level of bank terminals and in the well known manner select the first idle trunk therein leading to second selector $D^4$. The second series of three impulses sent by the armature 501 will be effective to operate the second selector $D^4$ in the well known manner to select third selector $F^2$.

It is thought that in view of the foregoing explanations it will be clear how the wipers of switch R will be restored to normal following the sending of each digit series and that the wipers of switch S will thereupon be advanced one step when the relay 541 deactuates to start the next following series. So that in view of the jumpering (jumpers 601 to 605) the connection will be progressed to telephone A′, the number of which is 13431, responsive to the relay 335 of switch F actuating.

At the time relay 541 deactuates following the last (fifth) digit series sent while wiper 507 still rests on bank terminal 553, and the said wiper 507 then moves to bank terminal 554, ground received from armature 520 will be applied through bank terminal 554, wiper 507, conductor 556, bank terminal 341, wiper 337, armature 350, make-before-break spring 351 to the winding of relay 352, the latter said relay actuating, followed by the deactuation of relay 335.

At this time the windings of the line relay in the connector $H^2$ will be energized over a series path including the conductors 403—447, armatures 357—358 and winding of the polarized relay 360. The current derived from the line relay in the connector $H^2$ will energize relay 360 so that its armature will tilt clockwise into the indicated "ring. pos.", the connector $H^2$ now applying signaling current to the called line leading to telephone A′.

When the party at telephone A′ removes his receiver from the switch-hook in responding, the current fed back from the said line relay in connector $H^2$ will be reversed in direction so that the armature of relay 360 will tilt counter-clockwise into the indicated "ans. pos." When the armature of relay 360 tilts clockwise, slow-releasing relay 362 actuates from the ground on the latter said armature. Then, when the latter said armature tilts counter-clockwise, the rlay 363 actuates and relay 362 deenergizes. There will, therefore, be a time when both relays 362 and 363 are actuated due to the slow-releasing characteristic of relay 362, and during this time a short-circuit through armature 364 and make-before-break spring 365 is across the talking path including conductors 76—77, bank terminals 366—367, wipers 312—313, armatures 368—369 and armature 370. This will cause the ring-cut-off relay in connector D to actuate in the well known manner to complete a talking connection over the traced path including condensers 375—376 between the calling telephone A″ and the finally called telephone A′ to which the call to the line leading to telephone A was forwarded. When the relay 362 deactuates the retardation coil 380 becomes in series with the windings of the back-bridge relay in connector D and this holds the latter said relay actuated.

It will be understood that any well known or other suitable so-termed trunk repeater may be introduced into the trunk leading-in to selector $D^4$ from the banks of selector G. This will also apply to the trunk leading-in to selector $D^2$ from the banks of selector E. The effective operation will be the same as if the said repeaters were not employed, being used for translating from three wires to two wires for the inter-office trunk.

*Calling party at telephone A″ abandons call while call is being forwarded*

If it is assumed that the calling party at telephone A″ abandons the call while the call is being forwarded from the primarily called line to telephone A′, it will be clear that connector D and antecedent switches will restore to normal positions, subject to new use. This will remove the ground from conductor 75, so that relays 323 and 335 of the switch F will deactuate to render said F subject to new use. Relay 505 will deenergize responsive to the deactuation of relay 335, so that relay 518 will unlock. The armature 560 of relay 518 will now apply ground through wiper

508 to cause motor magnet 550 to restore wipers 507 to 509 to normal position as drawn. The armature 561 of relay 518 will now apply ground through wiper 515 to cause motor magnet 525 to restore the wipers 512 to 515 to normal position as drawn.

*Dispensing with relay 362 or retardation coil 380*

It will be noted, in this connection, that by making the resistance of retardation coil 380 of lower ohmic value so that the ring-cut-off relay and back-bridge relay in connector D will pick-up through its winding, relay 362 may be dispensed with and the connection shown including make-before-break spring 365 made permanent. Moreover, retardation coil 380 may be dispensed with, but retaining relay 362 under this condition. However, dispensing with coil 380 will cause the back-bridge relay in connector D to deactuate consistent with the deactuation of relay 362, which would cause the current projected towards calling telephone A'' to be restored to its original direction forthwith after it momentarily changed resultant to the response at telephone A'. Under certain operating conditions, this might not be desirable, and in the latter event coil 380 could not be dispensed with.

*Encountering the line leading to telephone A' busy*

Had the line leading to telephone A' been encountered busy, conductor $H^2$ would have applied busy tone back over the lower talking conductor including conductor 347, condenser 376, audible to the calling party at telephone A''.

*Releasing connection—Called party hangs up first*

If it is assumed that the called party at telephone A' hangs up first upon the termination of the conversation, this will reverse the direction of current in the winding of polarized relay 360, causing relay 363 to deactuate and open the path including the windings of the back-bridge relay in connector D, notwithstanding relay 362 actuates and armature 364 is, therefore, attracted. The connector D will not release its wipers under the present condition. Also, connector $H^2$ will not release its wipers under the present condition because the line relay of the latter said connector is still maintained energized through the windings of relay 360.

When the calling party at telephone A'' now hangs up his receiver, and in view of the fact that the back-bridge relay in connector D is deactuated, connector D will release its wipers, and the connection from telephone A'' up to and including connector D will be released to normal, subject to new use. Ground being thus removed from the conductor 75, relay 352 will deactuate and open the path including the winding of the relay 360, so that the front bridge relay in connector $H^2$ will deactuate and cause the latter said connector to release its wipers, and the antecedent selectors $F^2$, $D^2$, $D^4$ and G to release their wipers, the circuits used in the call being now at normal.

*Releasing connection—Calling party hangs up first*

If it is assumed that the calling party at telephone A'' hangs up first upon the termination of the conversation, this will cause the line relay of connector D to deactuate, followed by the release of the antecedent switches $D^2$, $C^2$, $B^2$ and $L^2$, connector D remaining in seizure. When the called party at telephone A' hangs up, the current traversing the winding of relay 360 will be reversed, causing relay 363 to deactuate to open the path including retardation coil 380 so that the back-bridge relay in connector D will deactuate to release the wipers of the latter said connector. When connector D releases, ground is removed from the conductor 75, so that relays 323 and 352 will deactuate to open the circuit path including the winding of relay 360 and cause the line relay of connector $H^2$ to deactuate. Since the back-bridge relay of this connector $H^2$ deactuated responsive to the party at telephone A' hanging up, the wipers of connector $H^2$ will release, the circuits used in the call being now normal.

*Party at telephone A may change the normal prearranged setting for forwarding call to telephone A' to a random desired line*

In the foregoing descriptions the wipers of switches H, I, J, K and L were assumed in the normal drawn position. The bank terminal 510 of switch S is connected to the wiper 608 of switch H. The four successive bank terminals 529, 532, 535 and 537 following bank terminal 510 are connected to wipers 617, 624, 701 and 708 of switches I, J, K, and L, respectively.

Before the party at telephone A hung up his receiver after causing set relay C to be actuated and locked, at which time he perceived the tone from source T, the said party could have changed the setting from that to cause calls to be forwarded to telephone A' as has been described.

Let it be assumed that it is his desire to have the calls directed to his line leading to telephone A forwarded to a random desired line leading to telephone $A^2$, the telephone number of which is 14321. The party at telephone A will operate his dial to annex the digits 1—4—3—2—1, following the sending of the series of eleven open impulses to set relay C.

It will be noted that under the condition

of causing relay C to be set as assumed, the relay 24 will be in its actuated condition while the party at telephone A maintains his receiver off the switch-hook, so that a circuit can be traced from line terminal 81, conductor 82, attracted armature 83, conductor 84, upper winding of relay 715 to grounded battery. Also, a circuit can be traced from terminal 85, conductor 86, attracted armature 87, conductor 88, lower winding of relay 715 to ground, the latter said relay actuating. The slow-releasing relay 716 actuates, energized in a local circuit of relay 715. Relay 717 then actuates, energized in a local circuit of relay 716.

When the party at telephone A hangs up his receiver after setting relay C, forthwith, without annexing any digits, the relay 715 will deactuate, its armature 718 applying ground through armature 719, winding of slow-releasing relay 720, wiper 722 of set 721 and 722, bank terminal 723, conductor 724 to the winding of motor magnet 632, the latter said magnet stepping the wipers of switch H one step from the drawn position. Relays 716 and 717 will deactuate consistent with the slow-releasing characteristic of relay 716.

It will be noted that wiper 709 normally grounds conductor 726, and, therefore, similarly normally ground wipers 609, 618, 625, and 702. So when the wiper 609 moved to bank terminal 633 this ground is continued over conductor 634, armature 728, conductor 729 to all the bank terminals engageable by wiper 610 at off-normal positions. Thus, the motor magnet 632 will operate by interrupter action to restore the wipers of switch H to the drawn position, so that no upset will occur to the setting effected by relay C. It will also be noted that when relay 720 actuates, its armature 730 applies ground to the winding of motor magnet 732 of switch M, so that when relay 720 deactuates following the impulse sent to the motor magnet 625, the armature of the motor magnet 732 will advance the wipers 721 and 722 one step. When the relay 717 deactuates, ground will be applied through armature 735, bank terminals co-operative with wiper 721, interrupter armature on the motor magnet 732 to the winding of lattter said motor magnet, causing it to operate and step the wipers 721 and 722 of switch M around to the drawn position.

However, in the present instance, the party at telephone A does not hang up his receiver forthwith after setting relay C, but, on the other hand, annexes the five digits 1—4—3—2—1 designating the random line leading to telephone $A^2$, for example. The sending of first digit 1, constituted of one open impulse, will cause relay 715 to momentarily retract armature 718, so that a ground impulse will be sent from said armature 718, armature 719, winding of relay 720, wiper 722, bank terminal 723, conductor 724 to the winding of motor magnet 632, the wipers of switch H being thereby stepped one step so wiper 608 will now rest on bank terminal 635 when the armature of said motor magnet 632 retracts. The armature 730, when retracting, will cause the operation of motor magnet 732 to advance the wipers of switch M one step, so that wiper 721 will now rest on bank terminal 737.

The sending of second digit "4", constituted of four open impulses, will cause relay 715 to momentarily retract its armature 718 four times, so that four ground impulses will be sent from the armature 718, armature 719, winding of relay 720, wiper 722, bank terminal 738, conductor 739 to the winding of motor magnet 642, the wipers of switch I being thereby stepped four steps so that wiper 617 will now rest on bank terminal 643. The retraction of armature 730 will cause the operation of motor magnet 732 to advance the wipers of switch M one step, so wiper 722 will now rest on bank terminal 740.

The sending of third digit "3", constituted of three open impulses, will cause relay 715 to momentarily retract its armature 718 three times, so that three ground impulses will be sent from armature 718, armature 719, winding of relay 720, wiper 722, bank terminal 740, conductor 741 to the winding of motor magnet 652, the wipers of switch J being thereby stepped three steps, so that wiper 624 will now rest on bank terminal 653. The retraction of armature 730 will cause the operation of motor magnet 732 to advance the wipers of switch M one step, so wiper 722 will now rest on bank terminal 742.

The sending of fourth digit "2", constituted of two open impulses, will cause relay 715 to momentarily retract its armature 718 two times, so that two ground impulses will be sent from armature 718, armature 719, winding of relay 720, wiper 722, bank terminal 742, conductor 743 to the winding of motor magnet 745, the wipers of switch K being thereby stepped two steps so that wiper 701 will now rest on bank terminal 746. The retraction of armature 730 will cause the operation of motor magnet 732 to advance the wipers of switch M one step, so wiper 722 will now rest on bank terminal 748.

The sending of the fifth digit "1", constituted of one open impulse, will cause relay 715 to momentarily retract its armature 718 one time, so that one ground impulse will be sent from armature 718, armature 719, winding of relay 720, wiper 722, bank terminal 748, conductor 749 to the winding of motor magnet 750, the wipers of switch L being thereby stepped one step so wiper 708 will now rest on bank terminal 751. The retrac-

tion of armature 730 will cause the operation of motor magnet 732 to advance the wipers of switch M one step, so wiper 722 will now rest on bank terminal 752.

It will be noted that under the last foregoing condition, the bank terminals 510, 529, 532, 535, and 537, co-operative with wiper 509, are now connected through wipers 608, 617, 624, 701, and 708 over the obvious circuit paths to terminals 528, 534, 531, 558, and 528, respectively. Under this condition, it will be clear that the sending mechanism will be set to send the train of digits 1—4—3—2—1 responsive to the terminals 71 to 73 being seized by the wipers of connector D.

In this connection, it will be understood that although the jumpers 601 to 605 set the sending mechanism to send the digits 1—3—4—3—1 corresponding to the telephone number of telephone A′, when the wipers 608, 617, 624, 701, and 708 are in their normal positions as drawn, this same set-up may be attained by directively setting the latter said wipers on the bank positions corresponding to digits 1—3—4—3—1, respectively. That is to say, it is not necessary to have the jumpers 601 to 605, but to do away with them will make it necessary to always directively set, not only relay C, but also the switches H to L in accordance with a telephone number.

*Tone indicates when switch L is set*

When the party at telephone A has set the switch L responsive to the last digit of the desired number 14321, for example, tone from source $T^7$ will be applied through a portion of the winding of the motor magnet 750, wiper 710, a co-operating bank terminal, condenser 755, conductor 88, audible to the party at telephone A. This will indicate that the last switch L operated.

Upon the party at telephone A hanging up his receiver, relays 24, 715, 716, and 717 will deactuate; also, the relay 212, the windings of which have been in multiple with the windings of relay 715. The wiper 709 being off the bank terminal it is drawn resting upon, and is resting upon bank terminal 756, when relay 717 deactuates there will be no ground applied through the armatures of this relay from wiper 709, so the wipers of the switches H to L will not be restored at this time. However, retracted armature 735 causes the wipers of switch M to restore to the drawn position by interrupter action of its motor magnet 732.

*If only part of switches H to L are set they will restore*

In this connection it will be noted that if the party at telephone A, when setting the switches H to L, had failed to set all of the latter said switches, by leaving off one or more of the five digits, the wiper 709 would then be in the drawn position, resting on bank terminal 712. So when relay 717 deactuates responsive to the hanging up of the receiver of telephone A, the ground on wiper 709 will be applied through bank terminal 712, conductor 726, and in multiple through those of wipers 609, 618, 625 and 702 as are in off-normal position, respective bank terminals co-operated with the latter said wipers, conductor 634, and through the multipled armatures of said relay 717 to the bank contacts co-operated with wipers 610, 619, 626 and 703 to the respective motor magnets of the switches H to K, the wipers of which are off-normal, to restore the wipers of these switches to the drawn normal positions, the switch M restoring to the drawn normal position responsive to the retraction of armature 735, in the manner before described.

Under the latter said restored condition of the switches H to M any calls directed to the line leading to telephone A will be forwarded to telephone A′ in accordance with the jumpers 601 to 605 and the settings of the switches when in the drawn positions, since only relay C will not be set.

*Unsetting the relay C and the switches H to L*

When the party at telephone A desires to unset his line for forwarding calls directed thereto, he will remove his receiver as if to initiate a call, and thereupon operate his calling device dial in accordance with the finger-hold used in sending a series of eleven open impulses. This will cause the relay 31 to operate in the manner before described to unlatch the catch 36 to release the springs of the relay C. Ground will not be applied through spring 90, conductor 91, multipled armatures on relay 717, bank terminals co-operative with wipers 610, 619, 626, 703 and 710, through the interrupter contacts of the motor magnets of switches H to L, respectively, to restore said switches to the drawn positions. The latter said restorations efface the specifically set up condition effected by the switches H to L. The line leading to telephone A will therefore become in its normal, unused condition when the party at telephone A hangs up his receiver and causes selector E to restore and relay 31 to unlock.

The switches H to L are drawn with five sets of bank terminals. In a commercial embodiment there would be eleven such sets; a normal position set, and a position set for each digit from 1 to 0, so that numbers having digits of random value may be set by the switches H to L, and not limited to the digit "4" in each case, as in the exemplary embodiment in the accompanying drawings.

The five switches H to L contemplate a train of five digit series. It will be clear that more switches may be added to increase this

range, the switch M having corresponding bank positions added.

*Preferred modification*

By introducing Fig. 8 into Fig. 1 according to the index designations, it will be clear that when the party at telephone A removes his receiver to initiate a call, he will perceive tone from source $T^s$ or TT, depending upon whether the relay C is or is not set, respectively. This modification also discloses the spring 801 and co-operating springs to disable the tone source T and T' from being applied in the manner before set forth unless relay C operated as intended responsive to the actuation of relay 24 or relay 31. However, it is to be understood that the details of said Fig. 8 is not merely an alternative structure or modification, but on the contrary, is to be understood as belonging to the structure to which it refers; that is as an element of the main embodiment first described to which it relates. The disclosure in Fig. 8 has been so illustrated separately solely to simplify the disclosure as a whole to which it is to be considered a component part.

I claim:—

1. In an automatic telephone system, a first line, a second line, first automatic switch means for extending connection to said first line, second automatic switch means for extending connection from said first line to said second line, and mechanism operated automatically in accordance with the time of day for determining whether or not responsive to effecting a connection to said first line will thereupon cause said second switch means to progress the connection to said second line.

2. In an automatic telephone system, a first line, a second line, first automatic switch means for extending connection to said first line, second automatic switch means for extending connection from said first line to said second line, mechanism operated automatically in accordance with the time of day for determining whether or not responsive to effecting a connection to said first line will thereupon cause said second switch means to progress the connection to said second line, and means directly operated over said first line responsive to manual movement for operating last said mechanism regardless of the time of day.

3. In an automatic telephone system, a called line, a selective switch, connective terminals accessible from said switch, an impulse sending device, switch mechanism directed by said impulse sending device for extending connection from said terminals to the called line, mechanism operated automatically in accordance with the time of day for determining whether or not responsive to effecting a connection to said terminals by said selective switch will thereupon cause said switch mechanism to progress the connection from said terminals to said called line.

4. In an automatic telephone system, a calling line, a called line, a plurality of other lines, first automatic switch mechanism for extending a connection from the calling line to the called line, second automatic switch mechanism for extending connection from said called line to a random one of said other lines, means for causing operation of said second automatic switch mechanism to further extend connection from said called line to a random one of said other lines responsive to extending connection to said called line, and automatic means for predetermining prior to effecting connection to said called line to which particular one of said random other lines the connection will be extended to.

5. In an automatic telephone system, a calling line, a called line, a plurality of other lines, first automatic switch mechanism for extending a connection from the calling line to the called line, second automatic switch mechanism for progressively linking connection from said called line to a random one of said other lines, means for causing operation of said second automatic switch mechanism to further link connection from said called line to a random one of said other lines responsive to extending connection to said called line, and automatic means for predetermining prior to effecting connection to said called line to which particular one of said random other lines the connection will be linked to.

6. In an automatic telephone system, a calling line, a called line, a plurality of other lines, first automatic switch mechanism for extending a connection from the calling line to the called line, second automatic switch mechanism for extending connection from said called line to a random one of said other lines, means for causing operation of said second automatic switch mechanism to further extend connection from said called line to a random one of said other lines responsive to extending connection to said called line, and automatic means controlled over the said called line for predetermining prior to effecting connection to said called line to which particular one of said random other lines the connection will be extended to.

7. In an automatic telephone system, a calling line, a called line, a plurality of other lines, first automatic switch mechanism for extending a connection from the calling line to the called line, second automatic switch mechanism for extending connection from said called line to a random one of said other lines, a set mechanism individual to the said called line, means including said set mechanism for causing operation of said second automatic switch mechanism to further extend

connection from said called line to a random one of said other lines responsive to extending connection to said called line, means controlled over the called line for variably setting said set mechanism prior to effecting connection to said called line, and means predetermined by said setting of said set mechanism for determining to which said other line the connection will be forwarded to responsive to effecting connection to said called line.

8. In an automatic telephone system, a calling line, a called line, a plurality of other lines, first automatic switch mechanism for extending a connection from the calling line to the called line, second automatic switch mechanism for extending connection from said called line to a random one of said other lines, a set mechanism individual to the said called line, means including said set mechanism for causing operation of said second automatic switch mechanism to further extend connection from said called line to a random one of said other lines responsive to extending connection to said called line, means for setting said set mechanism prior to effecting connection to said called line, means predetermined by said setting of said set mechanism for determining to which said other line the connection will be forwarded to responsive to effecting connection to said called line, and means for making an additional setting of the setting mechanism prior to effecting connection to said called line without effacing the first mentioned setting for predetermining that the call will be forwarded to another of said other lines in lieu of the line predetermined by first said setting.

9. In an automatic telephone system, a calling line, called lines, switch mechanism for extending connection from the calling line to a random one of the called lines, a register, an impulse sending device, means controlled over the calling line for registering the resignation of a random one of said called lines in said register to prepare the impulse sending device to thereafter send impulses to direct the operation of the switch mechanism to complete a connection from the calling line to the random called line, a selective switch having access to the calling line, and means operated responsive to said selective switch selecting the calling line to cause the impulse sending device to direct the operation of the switch mechanism to extend a connection from the calling line to said random called line.

10. In an automatic telephone system, a calling line, called lines, switch mechanism for extending connection from the calling line to a random one of the called lines, a register, an impulse sending device, means controlled over the calling line for registering the designation of a random one of said called lines in said register to prepare the impulse sending device to thereafter send impulses to direct the operation of the switch mechanism to complete a connection from the calling line to the random called line, and means directively operated over the calling line after the designation has been registered for causing the impulse sending device to operate in accordance with the registration in the register to extend the connection from the calling line to said random called line.

11. In an automatic telephone system, a calling line, called lines, switch mechanism for extending connection from the calling line to a random one of said called lines, a register, an impulse sending device, means controlled over the calling line for registering the designation of a random one of said called lines in said register to prepare the impulse sending device to thereafter send impulses to direct the operation of said switch mechanism to complete a connection from the calling line to said random called line, means directively operated over the calling line after the designation has been registered for causing the impulse sending device to operate in accordance with the registration in the register to cause said switch mechanism to extend the connection from the calling line to said random called line, means for effacing the connection to said random called line, and directively operated automatic means for causing the impulse sending mechanism to operate to cause said switch mechanism to again extend the connection from the calling line to said random called line without again registering the designation of said random called line in said register.

12. In an automatic telephone system, a calling line, called lines, a first impulse sending device on said calling line, a register, a second impulse sending device, means for operating the register responsive to said first impulse sending device to record the designation of a desired one of the called lines, means for operating said second impulse sending device under control of said register due to the specific recorded condition in the register, switch mechanism for extending connection from the calling line to the said random called line, means for directively operating said switch mechanism by said second impulse sending device under control of said register to effect connection from the calling line to said random called line, and means for applying an indication to the calling line responsive to said register having operated to complete the recording of said designation.

13. In an automatic telephone system, a first line, a relay, a register, said relay set over said line responsive to a predetermined operation, said register set over said line responsive to a predetermined operation following first said operation, a plurality of called lines, switch mechanism for extending connection from said first line to a designated one of said called lines, switch means for ex-

tending connection to said first line, means whereby depending upon if only said relay is set when connection is made to said first line the switch mechanism will extend connection from said first line to a predetermined one of said called lines responsive to extending connection to said first line, and means whereby if said register is set in addition to said relay the connection will be extended from said first line to a different one of said called lines corresponding to the setting of said register responsive to extending connection to said first called line.

14. In an automatic telephone system, a first line, a relay, a register, said relay set over said first line responsive to a single manual operation, said register set over said line responsive to a plurality of manual operations, a plurality of called lines, switch mechanism for extending connection from said first line to a designated one of said called lines, switch means for extending connection to said first line, means whereby depending upon if only said relay is set when connection is made to said first line the switch mechanism will extend connection from said first line to a predetermined one of said called lines responsive to extending connection to said first line, means whereby if said register is set in addition to said relay the connection will be extended from said first line to a different one of said called lines corresponding to the setting of said register responsive to extending connection to said first line, and means for effacing the set condition of said register without effacing the set condition of the relay only if the register is not fully set due to all said plurality of manual operations not having been applied.

15. In an automatic telephone system, a first called subscriber's line, a plurality of other called lines, a set register, first switch mechanism for extending connection to said first called line, second switch mechanism for extending connection from said first line to a random one of said other called lines, means operated over said first line prior to extending connection to said first line by said first switch mechanism for setting said register in accordance with the designation of a random one of said other lines, and means effective due to said set condition responsive to effecting connection to said first line for causing said second switch mechanism to further extend connection from said first called line by said second switch mechanism to said random one of said other called lines.

16. In an automatic telephone system, a first called subscriber's line, a plurality of other called lines, a set register, first switch mechanism for extending connection to said first called line, second switch mechanism for extending connection from said first line to a random one of said other called lines, means operated over said first line prior to establishing connection to said first line by said first mechanism for setting said register in accordance with the designation of a random one of said other lines, means effective due to said set condition responsive to effecting connection to said first line for causing said second switch mechanism to further extend connection from said first called line by said second switch mechanism to said random one of said other called lines, and means whereby last said connection can be effaced and thereafter reestablished as often as connection is extended to said first called line without resetting the set register, responsive to extending connection to said first called line.

17. In an automatic telephone system, a first called subscriber's line, a plurality of other called lines, a set register, first switch mechanism for extending connection to said first called line, second switch mechanism for extending connection from said first line to a random one of said other called lines, means operated over said first line prior to establishing connection to said first line by said first switch mechanism for setting said register in accordance with the designation of a random one of said other lines, means effective due to said set condition responsive to effecting connection to said first line for causing said second switch mechanism to further extend connection from said first called line by said second switch mechanism to said random one of said other called lines, and means controlled over the said first line for effacing the set condition of said register.

18. In an automatic telephone system, a first called subscriber's line, a plurality of other called lines, a first set register, a second set register, first switch mechanism for extending connection to said first called line, second switch mechanism for extending connection from said first line to a random one of said other called lines, means operated over said first line prior to extending connection to said first line by said first switch mechanism for setting said first register, means operated over said first line prior to extending connection to said first line by said first switch mechanism for setting said second register in accordance with the designation of a random one of said other lines, means effective due to said set condition responsive to effecting connection to said first line for causing said second switch mechanism to further extend connection from said first called line by said second switch mechanism to a particular one of said other called lines if only said first register is set, and means effective due to said set condition responsive to effecting connection to said first line for causing said second switch mechanism to further extend connection from said first called line by

said second switch mechanism to a random one of said other called lines corresponding to the setting of said second register only if said second register is set.

19. In a telephone system, a first called line having fixed incoming connective terminals, switch means for extending connection to said terminals, second lines, directively controlled automatic switch means for extending connection from said terminals to a random one of said second lines responsive to extending connection by said switch means to said terminals, and automatic means variably operated prior to extending connection by said switch means to said terminals for predetermining to which particular one of said second lines the connection will be extended.

20. In a telephone system, a first called line having fixed incoming connective terminals, switch means for extending connection to said terminals, second lines, directively controlled automatic switch means for extending connection from said terminals to a random one of said second lines responsive to extending connection by said switch means to said terminals, and automatic means variably operated over said first called line prior to extending connection by said switch means to said terminals for predetermining to which particular one of said second lines the connection will be extended.

21. In a telephone system, a first called line having fixed incoming connective terminals, switch means for extending connection to said terminals, second lines, directively controlled automatic switch means for extending connection from said terminals to a random one of said second lines responsive to extending connection by said switch means to said terminals, an impulse sending device for operating said automatic switch means, a plurality of set switches all of which are variably operated for setting up a stored condition in said impulse sending device, and automatic means for operating the set switches in accordance with the designation of a desired one of said second lines whereby the set condition of the set switches will determine to which one of said second lines the call will be extended responsive to said switch means effecting connection to said terminals.

22. In a telephone system, a first called line having fixed incoming connective terminals, switch means for extending connection to said terminals, second lines, directively controlled automatic switch means for extending connection from said terminals to a random one of said second lines responsive to extending connection by said switch means to said terminals, an impulse sending device for operating said automatic switch means, a plurality of set switches all of which are variably operated for setting up a stored condition in said impulse sending device, and automatic means operated over said first called line for operating the set switches in accordance with the designation of a desired one of said second lines whereby the set condition of the set switches will determine to which one of said second lines the call will be extended responsive to said switch means effecting connection to said terminals.

23. In a telephone system, a first called line having fixed incoming connective terminals, switch means for extending connection to said terminals, second lines, directively controlled automatic switch means for extending connection from said terminals to a random one of said second lines responsive to extending connection by said switch means to said terminals, an impulse sending device for operating said automatic switch means, a plurality of set switches all of which are variably operated for setting up a stored condition in said impulse sending device, automatic means for setting up a stored condition in said impulse sending device in accordance with a predetermined one of said second lines without operating any one of said set switches, and automatic means for directively operating said set switches to change first said stored condition to a new stored condition in accordance with a desired random one of said second lines whereby the set condition determining the new stored condition will determine to which one of said second lines the call will be extended responsive to said switch means effecting connection to said terminals.

24. In a telephone system, a first called line, having fixed incoming connective terminals, switch means for extending connection to said terminals, second lines, directively controlled automatic switch means for extending connection from said terminals to a random one of said second lines responsive to extending connection by said switch means to said terminals, an impulse sending device for operating said automatic switch means, a plurality of set switches all of which are variably operated for setting up a stored condition in said impulse sending device, automatic means operated over said first called line for setting up a stored condition in said impulse sending device in accordance with a predetermined one of said second lines without operating any one of said set switches, and automatic means operated over said first called line for directively operating said set switches to change first said stored condition in accordance with a desired random one of said second lines whereby the set condition determined by the new stored condition in accordance with a random one of said second lines whereby the set condition determining the new stored condition will determine to which one of said second lines the call will be extended responsive to said switch means effecting connection to said terminals.

25. In a telephone system, a first line having fixed incoming connective terminals, switch means for extending calls to said first line via said terminals, other called lines, automatic switch mechanism for extending calls from said terminals to said other called lines, and automatic means variably directively operated over said first line prior to extending a call to said first line for causing said call to be diverted over said automatic switch mechanism to a predetermined random one of said other called lines, the particular said other line being governed by the specific operation of said automatic means.

26. In a telephone system, a first line having fixed incoming connective terminals, switch means for extending calls to said first line via said terminals, other called lines, automatic switch mechanism for extending calls from said terminals to said other called lines, and automatic means variably directively operated prior to extending a call to said first line for causing said call to be diverted over said automatic switch mechanism to a predetermined random one of said other called lines, the particular said other line being governed by the specific operation of said automatic means.

27. In a telephone system, subscribers' lines each having a set of fixed incoming connective terminals, switch means for extending calls to a random one of said subscribers' lines via the corresponding set of said terminals, other lines, a register for each of said subscribers' lines, an impulse sending device for each of said subscribers' lines set by the corresponding register, a common finder switch for cooperating the subscriber's line called and the corresponding impulse sending device, automatic switch mechanism for extending connection away from the finder switch towards a desired one of said other lines, automatic means operated over each of the subscribers' lines for setting the corresponding register in accordance with a desired said other line prior to extending connection to the subscriber's line, and means operative to extending connection to a random one of said subscribers' lines for causing the finder switch to operate to cooperate the said random line with its corresponding register and impulse sending device and for thereupon operating the switch mechanism via the finder switch by impulses from the corresponding impulse sending device to extend the connection made to said terminals in the direction of the line indexed by the set condition of the register.

28. In a telephone system, a line, a set relay operated over said line, means for locking said relay operated responsive to its operation, means operated over said line for unlocking said relay, and automatic means for applying a specific signal to said line to positively indicate which said locked or unlocked condition the relay assumed.

29. In a telephone system, a line, a set relay operated over said line, means for locking said relay operated responsive to its operation, means operated over said line for unlocking said relay, and automatic means whereby responsive to a manual operation applied at will on the line for applying a specific signal to said line to indicate the ensuing locked or unlocked condition of said relay.

30. In a device for sending impulses of equal short length, a first relay, a second relay, an impulse sender for sending long impulses over a circuit to said first relay to actuate it, said second relay actuating in a local circuit of said first relay, said second relay locked dependent upon said impulse condition of said circuit being maintained, said first relay thereupon deactuating, and an impulse circuit local to said first relay over which equal length short impulses are sent responsive to the long impulses sent for operating said first and second relays wherein the long impulses may not be of equal length.

31. In a telephone system, a subscriber's line, other lines, a register individual to said subscriber's line, automatic means controlled over the subscriber's line for variably setting the register in accordance with the designation of a random one of said other lines, and means whereby when a call is directed to said subscriber's line under the condition of the register being set, for causing the said call to be diverted to the one of said other lines corresponding to the setting of said register.

32. In a telephone system, a subscriber's line, other lines, a register individual to said subscriber's line, automatic means controlled over the subscriber's line for variably setting the register in accordance with the designation of a random one of said other lines, and automatic switch means whereby when a call is directed to said subscriber's line under the condition of the register being set, for causing the said call to be progressively diverted over said automatic switch means under direction of said register to the one of said other lines corresponding to the setting of said register.

33. In a telephone system, a set of terminals, switch means for effecting connection to said terminals, a register sender for said set of terminals, automatic means for setting said register sender responsive to a single manual operation for sending a predetermined train of series of impulses responsive to extending connection by said switch means to said set of terminals, and automatic means whereby annexing manual operation to said single manual operation will re-set said register sender for sending a different train having the same number of series as first said train responsive to extending connection by said switch means to said set of terminals.

34. In a telephone system, a set of terminals, switch means for effecting connection to said terminals, a register sender for said set of terminals, automatic means for setting said register sender responsive to a single manual operation for sending a predetermined train of series of impulses responsive to extending connection by said switch means to said set of terminals, automatic means whereby annexing manual operation to said single manual operation will re-set said register sender for sending a different train having the same number of series as first said train responsive to extending connection by said switch means to said set of terminals, and automatic directive switch mechanism for extending the connection made to said set of terminals in accordance with the train of series sent by the register sender.

35. In a telephone system, a subscriber's line having a set of leading-in terminals, other lines, switch means for effecting connection to said terminals, a register sender for said set of terminals, automatic means operated over said line for setting said register sender responsive to a single manual operation for sending a predetermined train of series of impulses corresponding to one of said lines responsive to extending connection by said switch means to said set of terminals, automatic means operated over said line whereby annexing manual operation to said single manual operation will re-set said register sender for sending a different train having the same number of series as first said train and corresponding to another one of said lines responsive to extending connection by said switch means to said set of terminals, and automatic directive switch mechanism for extending the connection made to said set of terminals to a particular one of said other lines with correspondence to the train of series sent by the register sender.

36. In a telephone system, a set of terminals, switch means for effecting connection to said terminals, a register sender for said set of terminals, automatic means for setting said register sender responsive to a single manual operation for sending a predetermined train of series of impulses responsive to extending connection by said switch means to said set of terminals, and a cross connecting rack in said register sender for altering the train of impulses sent as desired for said setting of the register.

37. In a telephone system, a register sender, the register comprising a plurality of switch elements, an impulse device for sending a train of series of short impulses to set said elements of the register for resending a train of series of impulses from said sender with predetermined correspondence to the train sent to said register, means whereby each series of the train sent to the register will operate a single one of said switch elements, means whereby when all said switch elements are set they cannot be unset without special operation of said impulse device, and means for causing the switch elements set to restore to unset position by sending a single long impulse only if all of said switch elements have not been set.

38. In a telephone system, a set of terminals, switch means for effecting connection to said terminals, a register sender for said set of terminals, automatic means for presetting said register sender by a first setting operation for sending a predetermined train of impulses responsive to extending connection by said switch means to said set of terminals, and for further pre-setting said register sender by a second supplemental automatic setting operation for sending a different predetermined train of series of impulses responsive to extending connection by said switch means to said set of terminals.

39. In a telephone system, a telephone line having a set of terminals, switch means for effecting connection to said terminals, a register sender for said set of terminals, automatic means operated over said line for setting said register sender by a first setting operation for sending a predetermined train of impulses responsive to extending connection by said switch means to said set of terminals, and for further setting said register by a second supplemental setting operation over said line for sending a different predetermined train of series of impulses responsive to extending a connection by said switch means to said set of terminals, other lines, automatic switch mechanism, and means whereby said automatic switch mechanism will be directively operated by the train of impulses to extend the connection from said set of terminals to a particular one of said other lines corresponding to the particular train of impulses sent.

40. In a telephone system, a link, switch means for extending connection to said link, lines, automatic switch means for extending connections made to said link away from said link to a random one of said lines responsive to effecting connection to the link by said switch means, automatic means for pre-setting any desired one of a plurality of possible different conditions of said link, and means directively operated in a specific way dependent upon the particular one of said plurality of possible conditions of said link that exists when connected to by said switch means for directing the operation of said automatic switch means to extend connection thereby away from said link to a particular one of said lines with correspondence to the said condition existing on said link when connected to by said switch means.

41. In a telephone system, a plurality of lines, a link circuit, switch means for extending connection to the near end of said link

circuit, automatic switch means for extending connections away from the far end of said link circuit to a random one of said plurality of lines responsive to extending connection to the near end of the link circuit, and automatic means at the near end of the link circuit operated over said link circuit previous to extending connection to the near end of the link circuit which will predetermine to which particular one of said lines the connection will be extended from the far end of the link circuit responsive to extending the connection to the near end of the link circuit.

42. In a telephone system, a plurality of lines, a link circuit, switch means for extending connection to the near end of said link circuit, automatic switch means consisting of directively operated common automatic switches a plurality of which are adapted to be linked in tandem connection for extending connections away from the far end of said link circuit to a random one of said plurality of lines responsive to extending connection to the near end of the link circuit, and automatic means at the near end of the link circuit operated over said link circuit previous to extending connection to the near end of the link circuit which will predetermine to which particular one of said lines the connection will be extended from the far end of the link circuit responsive to extending the connection to the near end of the link circuit.

43. In a telephone system, a link circuit, switch means for extending connection to said link circuit, a register sender comprising a plurality of switch elements, a home normal resting position for said elements, means whereby responsive to the switch means extending connection to said link while said switch elements are in the home position will cause said sender to send a predetermined train of impulses responsive to a set condition in the register due to the home positions of said switch elements, and automatic means for operating said switch elements into off normal positions to cause a new set condition in the register for causing the sender to send a different train from first said train responsive to the switch means extending a connection to said link.

44. In a telephone system, a link circuit, switch means for extending connection to said link circuit, a register sender comprising a plurality of switch elements, a home normal resting position for said elements, means whereby responsive to the switch means extending connection to said link while said switch elements are in the home position will cause said sender to send a predetermined train of impulses responsive to a set condition in the register due to the home positions of said switch elements, and automatic means for variably operating the respective switch elements into off normal positions to cause a desired variable new set condition in the register for causing the sender to send a different desired train from first said train responsive to the switch means extending a connection to said link.

45. In an automatic telephone system, a link circuit, a register device for said circuit, automatic switch mechanism for extending connection away from said link circuit under directive control of said register device only when in a completely set condition, means automatically directively operated over said link circuit for progressively setting the register device, and a tone source for application to the link circuit to indicate that the said directive operation was effective to completely set the register device.

In witness whereof, I hereunto subscribe my name this 3rd day of March, 1928.

HERBERT M. FRIENDLY.