

Aug. 12, 1930.

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1,772,713

AUTOMATIC TELEPHONE SYSTEM

Filed Sept. 10, 1927

5 Sheets-Sheet 1

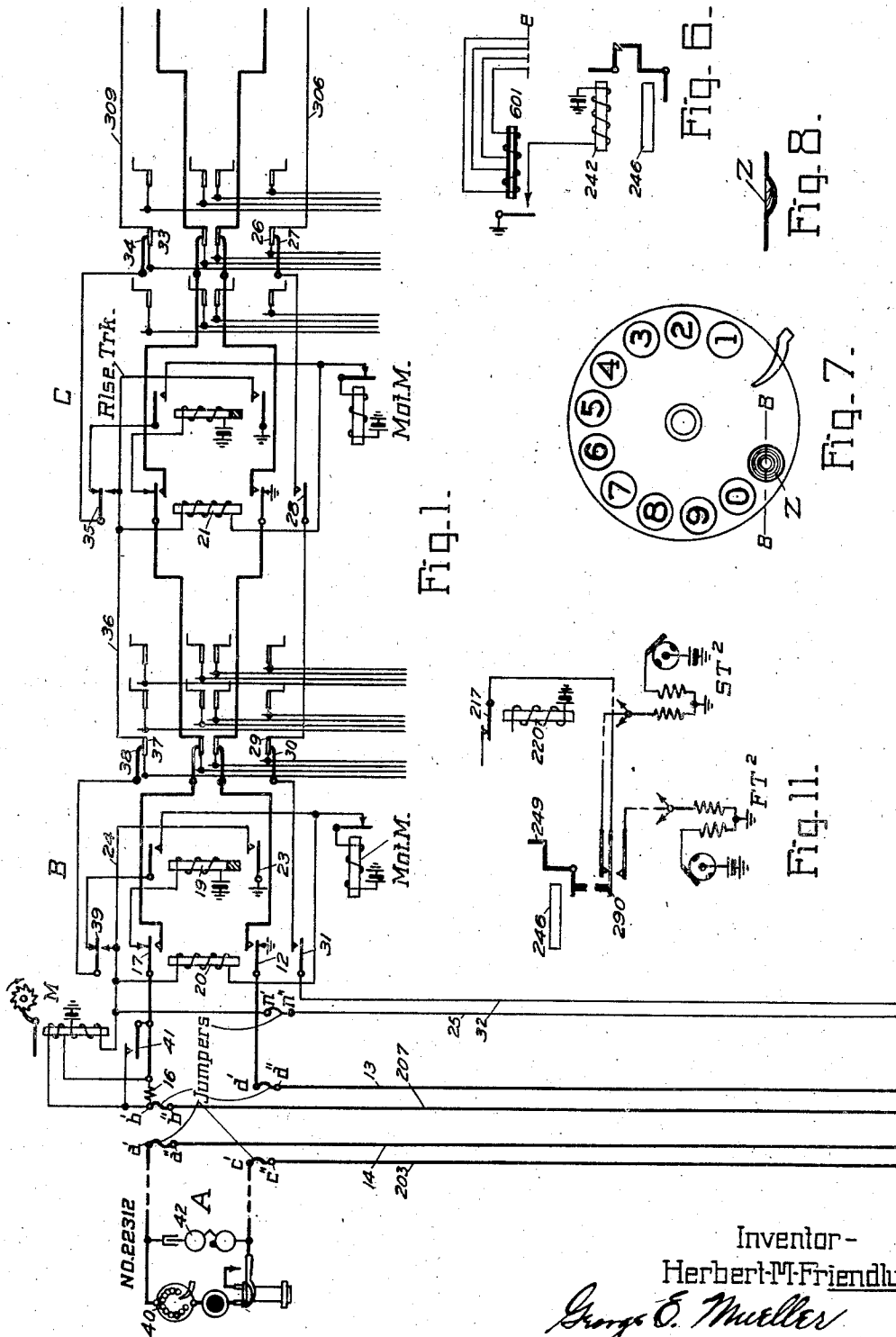


Fig. 1.

Fig. 8.

Fig. 7.

Fig. 9.

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5 Sheets-Sheet 2

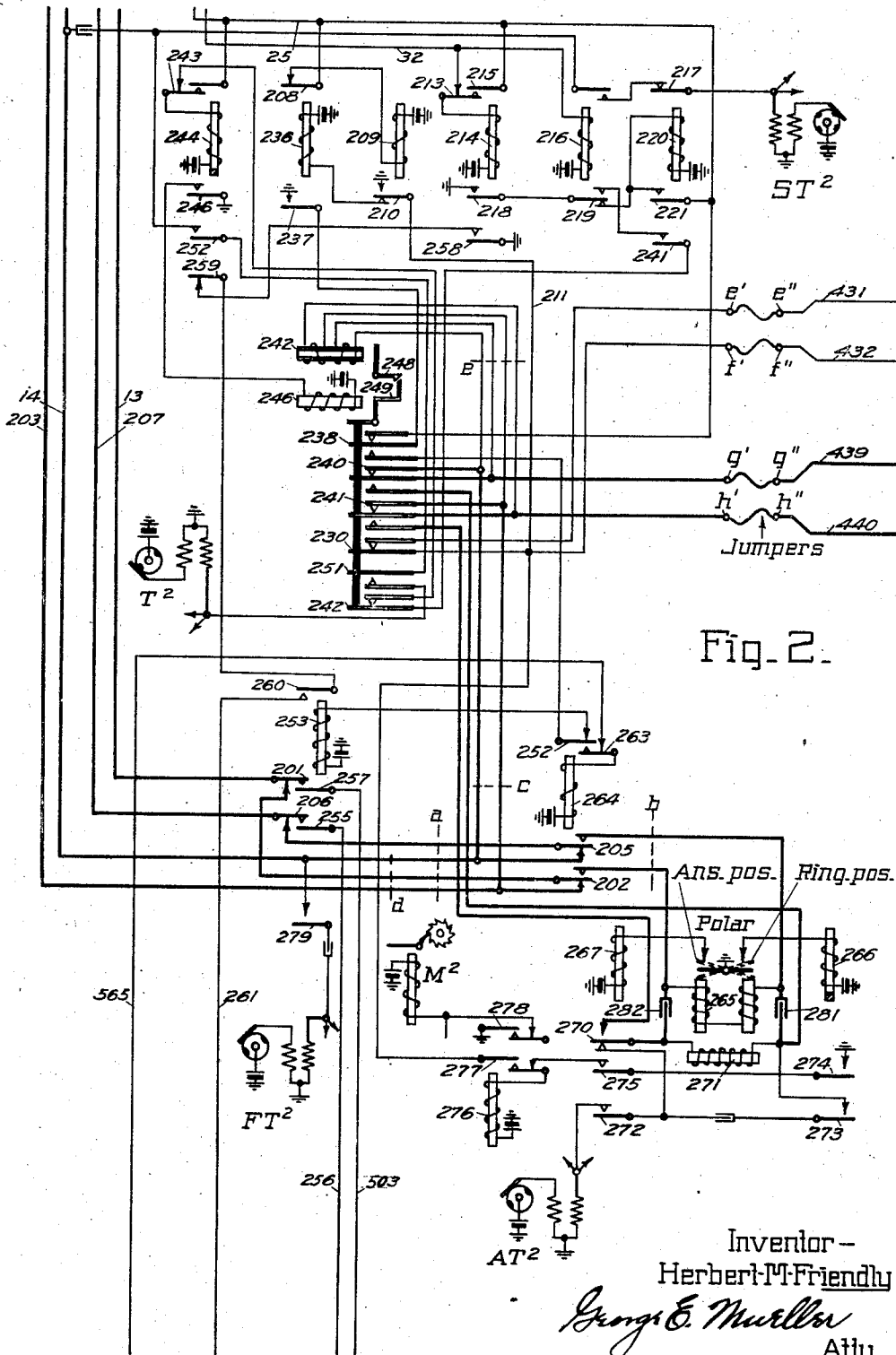


Fig. 2.

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5 Sheets-Sheet 3

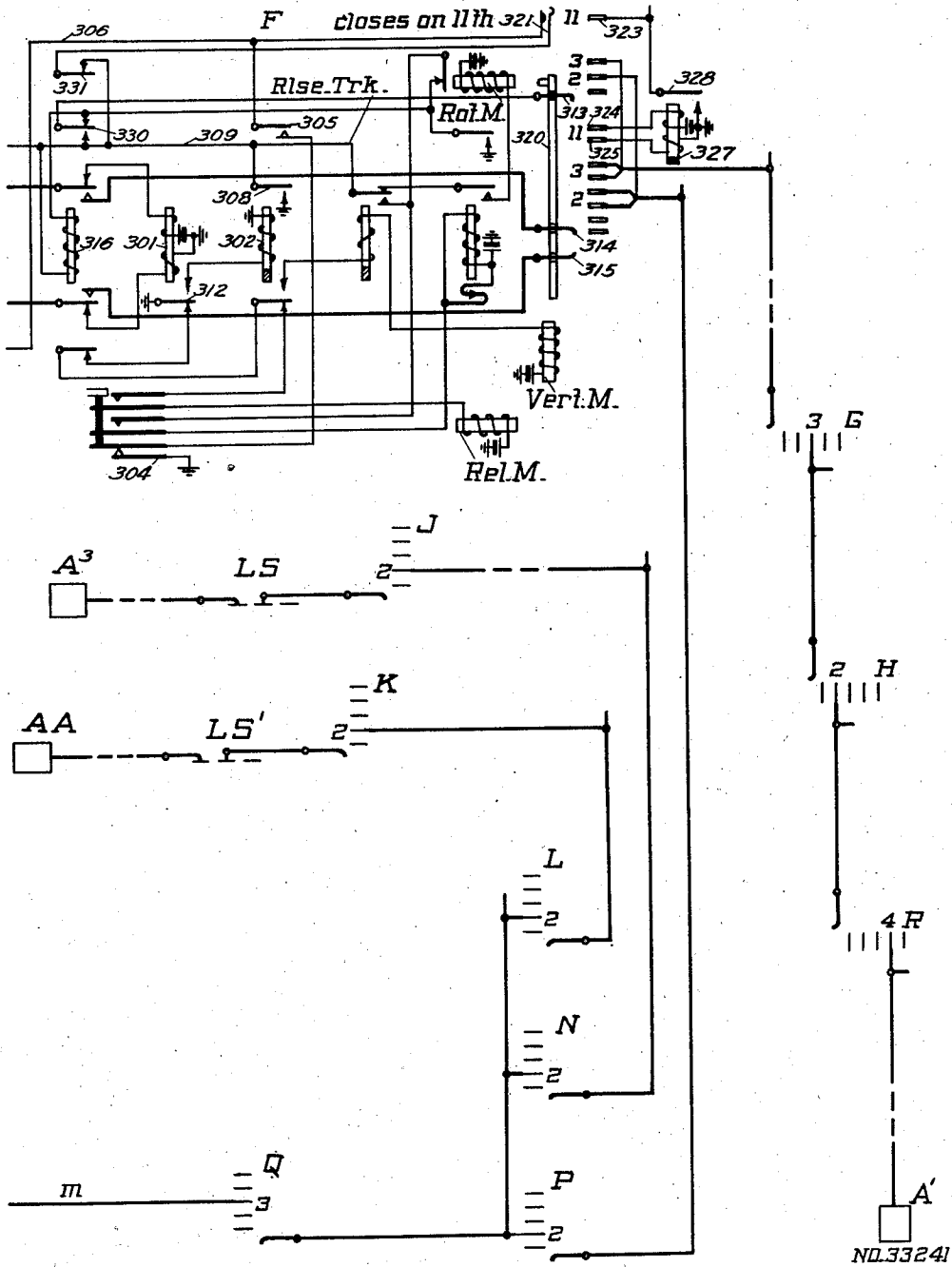


Fig. 3.

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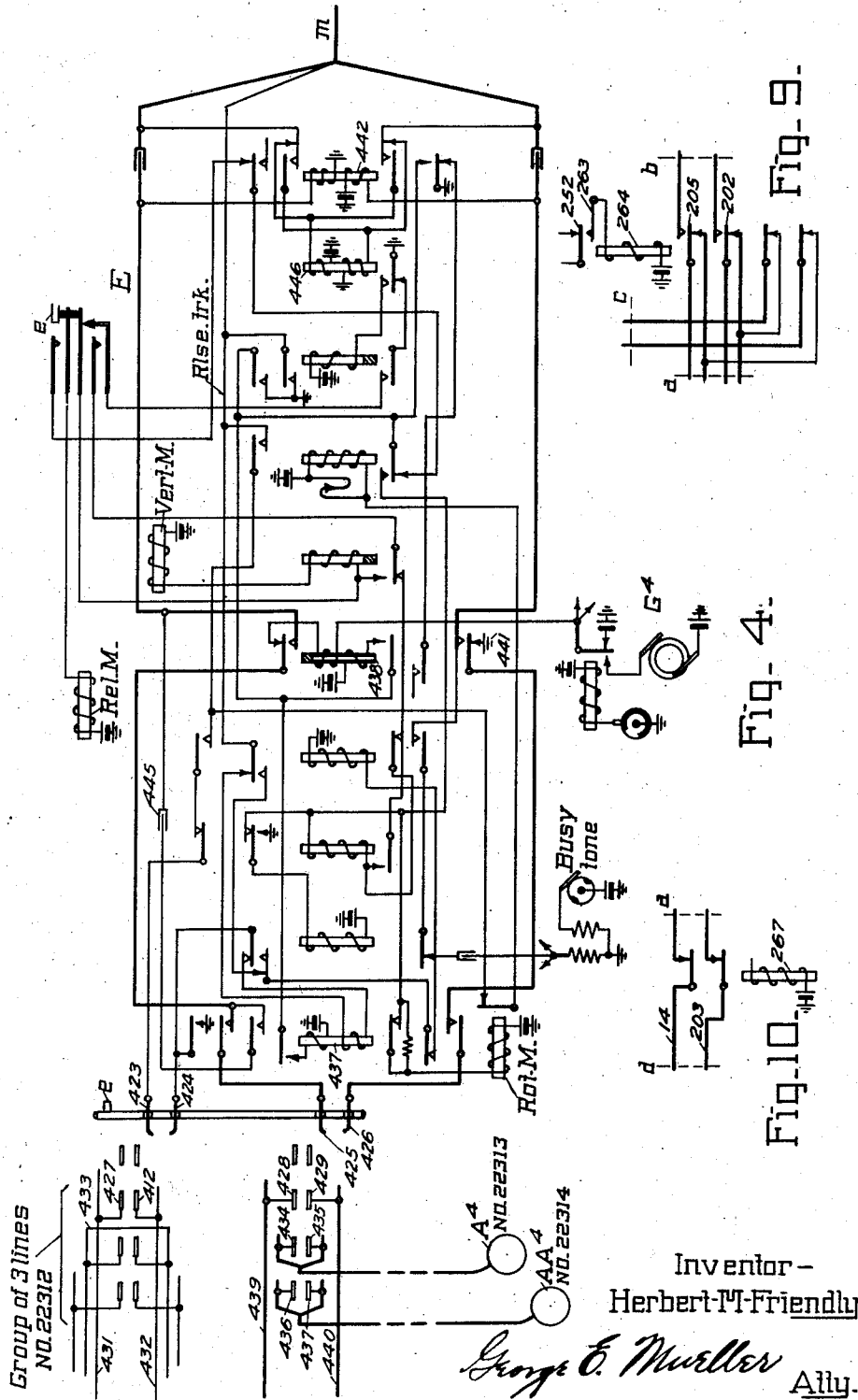
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AUTOMATIC TELEPHONE SYSTEM

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5 Sheets-Sheet 4



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AUTOMATIC TELEPHONE SYSTEM

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5 Sheets-Sheet 5

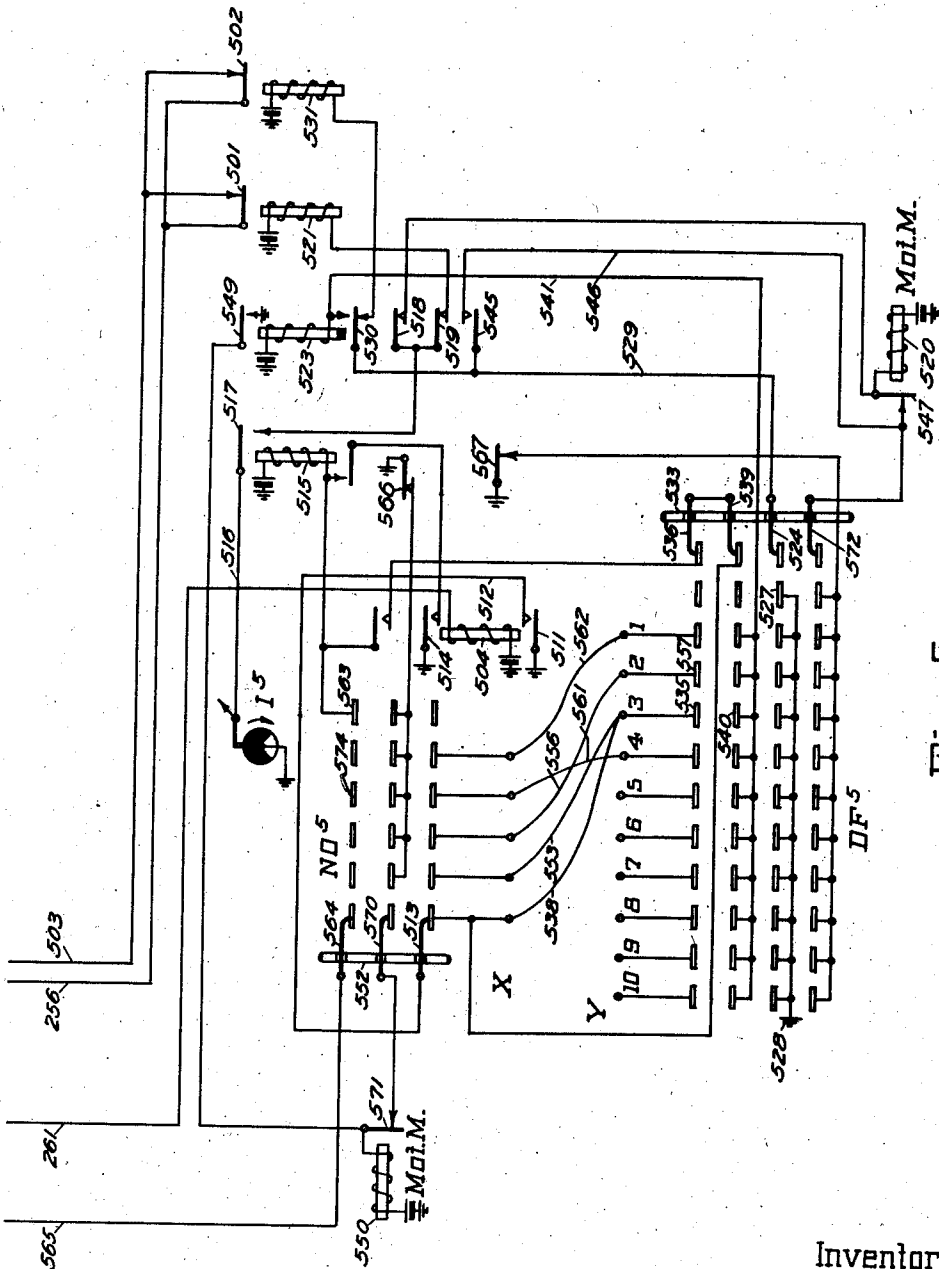


FIG. 5.

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UNITED STATES PATENT OFFICE

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AUTOMATIC TELEPHONE SYSTEM

Application filed September 10, 1927. Serial No. 218,605.

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

General objects

The general object of the present invention is to enable a subscriber of the automatic telephone system, who contemplates leaving the location of his telephone, to directly 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 subscriber's line or other line. The latter said line may terminate at the switchboard of an operator who is charged with responding to such calls and imparting such information to the party calling as instructed by the absent subscriber primarily called. That is, for example, a physician, before leaving his office 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 fingerhold 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 returned, he will restore his receiver, leaving his central office call-forwarding equipment in the set condition.

As will appear presently, that due to the said set condition, any call extended to the terminals of the said subscriber's line will not only ring the bell of his telephone in the usual manner, but the call will be thereupon automatically extended or forwarded in accordance with the said set condition to an attendant who may possibly serve many such subscribers, or it may, as referred to, be extended to a random subscriber's telephone line as may be predetermined.

It will also appear presently, that if the subscriber has returned and hears the bell he may respond in the usual manner and intercept the call to the line to which in ac-

cordance with the set condition of his central office call forwarding apparatus the call would be otherwise finally destined. This interception also effaces the said set condition so that his line becomes in normal condition and remains so after the termination of the call and until again directly set to forward calls as before.

If the call is not intercepted by the subscriber as referred to, the central office apparatus specific to the primarily called subscriber's line will cause the call to be forwarded to the prearranged line. It will appear presently, that in case the call is forwarded to a switchboard operator who may attend to calls for a number of subscribers accorded this class of service, the calls extended to her switchboard may be extended thereto over a group of trunks common to all calls.

It will thus be perceived that the general object of the present invention is to provide for saving calls in the temporary absence of the called subscriber. This not only relieves the subscriber of the duty of remaining near his telephone to receive possible calls, but it saves the toll for the otherwise futile call to the operating concern. That is, ordinarily, if no response is made to a call no charge is collected for establishing the connection and the time the switching equipment is held. Under the arrangement contemplated in the present invention, if no response is promptly made the call is forwarded to a switchboard or telephone where most likely there will be someone to respond to it.

Another feature of the present invention is the provision for metering the calls and assessing a toll on any desired basis, as taking into account the time of day the call durates, the destination of the call and the time the call durates. This metering arrangement assesses a charge for a completed call from the calling subscriber to the called subscriber's line for which the calling subscriber pays as if it were an ordinary, normally responded call, as well as also assesses a toll against the subscriber primarily called covering the forwarding of the call. That is to say, the calling subscriber will pay for the call to the

line primarily called and the subscriber of the line primarily called will pay for forwarding it to the point to which it is forwarded. The operating concern thus in place of being unable to receive remuneration for a futile call, receives toll for two calls involved in the primary call and the forwarded call.

Calls requiring forwarding will usually occur at off-business hours of the day when there is a surplus of equipment, so that the forwarding of calls in which the double toll is collected logically comes at a time when there is ample equipment and correlated plant in idleness to handle it. Of course, such forwarding may occur during time of logically peak traffic, but the percentage of such latter calls will be relatively low because telephones will usually have attendance at such times.

While a meter M for registering the number of calls completed and forwarded has been indicated in Fig. 1, in order to simplify the disclosure, it will be understood that any method of metering or prepayment collection may be employed under the contemplated use of the invention. For example, the operation of the meters may be determined in part by time of day the call is made, the destination of the call and the duration of the call. That is, methods of operating the meter contemplated in any well known or other methods, as for example, the methods shown in my Patents 1,694,169, granted Dec. 4, 1928; 1,694,170, granted Dec. 4, 1928; and 1,726,983, granted Sept. 3, 1929. It also contemplates the collection of pre-payment deposit as well known, and also set forth in the latter said patent.

Drawings

With reference to the accompanying drawings:—

Fig. 1 shows a subscriber's telephone A and companion line switch B; the said line switch having common access to the switch group containing the secondary line switch C.

Fig. 2 shows apparatus, nearly all of which is specifically employed in forwarding calls which are primarily destined to telephone A.

Fig. 3 shows a first selector F accessible from the switch group containing secondary line switch C, together with other indicated automatic switches and called telephones of well known systems.

Fig. 4 shows a well known so-called group-selecting connector E, a group of such connectors having access to a group of lines including the line extending to telephone A in Fig. 1.

Fig. 5 shows the impulse train transmitting apparatus cooperative with the apparatus shown in Fig. 2.

Fig. 6 shows a preferred modification of Fig. 2.

Fig. 7 shows a plan view of the dial of the

present invention used on the calling device (40) on telephone A.

Fig. 8 shows a cross section along the line 8—8 in Fig. 7 disclosing the detail of the finger-hold of the present invention provided for sending a series of eleven open impulses.

Fig. 9 shows a modification of Fig. 2.

Fig. 10 shows a preferred modification of Fig. 2.

Fig. 11 shows a preferred modification of Fig. 2.

The accompanying five sheets containing the drawings illustrating the exemplary embodiment of the present invention chosen to disclose it are assembled so that correspondingly designated lines extending toward margins register.

The so-termed preferred modifications illustrated in Figs. 6, 10 and 11 are to be considered as forming a part of Fig. 2. These modifications were not actually included in Fig. 2 in order that the drawings would be less involved and the disclosure thereof more simple. That is, it has been deemed expedient to first disclose the main operation independent of certain detailed, preferred operations in its comprehensive embodiment.

Equipment

The telephone A is of the well known common battery automatic type, but equipped with an automatic calling device and dial of the present invention shown in Figs. 7 and 8 so that a series of eleven impulses can be sent therefrom by operating the dial from a novel finger-hold of the present invention.

The primary line switch B and the secondary line switch C are of the well known rotary class as described in the third edition of Hershey's Automatic Telephone Practice, page 53. However, the lower wiper, as well as the lower armature of the left-hand relay shown on these switches, are specific to the present invention.

The first selector F is of the well known class as described in the said book on pages 59 to 61. However, the lower set of off-normal springs, the upper armature of the release relay, the upper armature of the switching relay and associated circuits are specific to the present invention.

The switch elements NO^s and DF^s have the same general mechanical structure and operation as the line switch B, though the operating circuits are specific to the present invention.

The dial of the calling device shown in Figs. 7 and 8 (and the calling device not shown) belong to the well known class as described in the said book of Hershey's on pages 15 to 17. However, the finger-hold or depression used in setting the calling device to send eleven open impulses is specific to the present invention.

The line switches LS and LS' are like line switch B.

The selectors G, H, J, K, L, N, P and Q are well known selectors as disclosed on pages 59 to 61 in the said book of Hershey's.

The connector R is like connector E.

The telephones AA, A' and A^s are like telephone A.

The connector E is of the well known so-called group-selecting type as designated Fig. 111 in Hershey's fourth edition of his book Automatic Telephone Practice.

The selectors G, H, J, K, L, N, P and Q indicated in Fig. 3 may be of the exact class described in the third edition of said book of Hershey's, on pages 59 to 61.

The connector R indicated in Fig. 3 is of the exact type of connector E in Fig. 4, or it may be any other suitable connector, as for example, the connector described in the third edition of the said book of Hershey's, on pages 36 to 39.

While the telephone A is shown leading to its individual line switch B, and the latter said switch having access to the first selector F through the secondary line switch C, it will be understood that any suitable type of line switch or finder switch arrangement may be substituted for extending a connection from the telephone A to an idle first selector as F responsive to the initiation of the call at telephone A, without departing from the spirit of the present invention.

Initiating a call from telephone A to telephone A'

Upon removing the receiver from the switch-hook of telephone A a circuit path can be traced from ground, armature 12, conductor 13, make-before-break spring 201, armature 202, conductor 203, telephone A, conductor 14, armature 205, make-before-break spring 206, conductor 207, resistor 16, armature 17, winding of slow-releasing relay 19 to grounded battery, the latter said relay operating. In view of the stated well known operation of the switch B, its detailed operation in selecting and seizing the first accessible idle secondary line switch C will be understood. For the same reason, the detailed operation of the switch C in selecting the first accessible idle first selector F will be understood. The first available idle selector F is thus seized responsive to the subscriber removing the receiver from the switch-hook of telephone A.

A large group of line switches containing switch B have common access to a smaller group of secondary line switches containing switch C. The group of secondary line switches containing switch C then has common access to a smaller group of first selectors containing switch F. The group of first selectors containing selector F has common access to a group of second selectors contain-

ing selector G. The group of second selectors containing selector G has common access to a group of third selectors containing selector H, and the group of third selectors containing selector H has common access to a group of connectors containing connector R. The group of connectors containing connector R has common access to the telephone line leading to telephone A'.

When the telephone A has been extended to the first selector F, as set forth, switching relay 20 of switch B is actuated. Also, switching relay 21 of switch C is actuated. Also, line relay 301 and slow-releasing release relay 302 of switch F are actuated.

When relay 19 actuated forthwith responsive to the removal of the receiver from the switch-hook of telephone A, ground on armature 23 is applied over release trunk conductor 24, conductor 25, armature 208 to the winding of relay 209, the latter relay actuating to apply ground through its armature 210, conductor 211 to private bank contact 412 and its multiples to guard the line leading to telephone A against intrusion by a connector of the group containing connector E.

Tone to indicate when call has been extended to first selector

When relay 302 in selector F actuated, a circuit was thereby closed from grounded off-normal spring 304, armature 305, conductor 306, bank terminal 26, wiper 27, armature 28, bank terminal 29, wiper 30, armature 31, conductor 32, make-before-break spring 213 to the winding of relay 214, the latter said relay actuating and locking through its armature 215 to ground on conductor 25. At the time relay 214 was energized ground on conductor 32 also energized relay 216, the relays 214 and 216 thus actuating simultaneously. Specific tone from source ST^s is thereupon applied through armature 217 upper armature of relay 216 to talking conductor 14, audible to the party at telephone A, indicative that the connection has been extended to first selector F and that the first selector F is in readiness to respond to the dial of telephone A.

It will be noted, in this connection, that the conductor 25 now receives ground back from attracted armature 308, release trunk 309, bank terminal 33, wiper 34, armature 35, release trunk 36, bank terminal 37, wiper 38, armature 39 to the conductor 25, and it will appear presently that conductor 25 will be maintained grounded from ahead so long as the receiver of telephone A is kept off the switch-hook so that relay 214 will remain locked until the call is abandoned by the calling subscriber at telephone A.

Calling subscriber sends first digit of called line number

Upon the calling subscriber operating his calling dial 40 in accordance with the first

digit 3 of the telephone number 33241 of the line extending to telephone A', the relay 301 will momentarily retract its armature 312 three times responsive thereto, causing the wipers 313 to 315 to be aligned with the third level of bank terminals and there rotate-in and select the first idle trunk leading to second selector G, the operation of selector F being understood in view of the reference to the third edition of Hershey's book, need not be detailed. However, it may be stated that after the second selector G has been seized switching relay 316 is the only relay in the selector F operated, relays 301 and 302 deactuating in sequence responsive to the actuation of the relay 316 in effecting the seizure. The release trunk 309 will receive ground back from selector G, in the well known manner before armature 308 retracts so there is no lapse of ground potential on conductor 25.

Calling subscriber sends last four digits

It is thought, in view of the reference to the third and fourth editions of Hershey's book, the successive operation of the selectors G and H responsive to the second and third digits and the operation of the connector R responsive to the last two (fourth and fifth) digits to complete the connection from the telephone A to the called telephone A' will be fully understood.

At the time the wipers 313 and 315 were stepped off-normal and spring 304 disconnected from its cooperative spring the ground traced to relay 216 is thereby disconnected, so that relay 216 deactuates responsive to the first impulse sent from the dial 40 and disconnects the tone source ST². However, due to the locked condition of relay 214 ground applied through armatures 218 and 219 is conducted to the winding of relay 220, causing the latter said relay to lock by its armature 221 to conductor 25, thus positively disabling the application of tone from source ST² so long as the present call is maintained.

Response at telephone A'

When the subscriber at telephone A' removes his receiver from the switch-hook in responding to the ringing of his bell, current traversing the heavy talking conductors, and including the telephone A, will be thereby reversed in direction. This will cause the differentially energized magnet of the meter M to operatively energize cumulatively to register a call against the telephone A.

It will be noted that the (lower) polarizing winding of the magnet of the meter M will be energized when the conductor 24 becomes grounded when the call is first initiated. The current then traversing the shunted (upper) operating winding of the magnet of the latter said meter is then in opposition to the polarizing winding. However, when the called subscriber at telephone A' removes his

receiver from the switch-hook and causes the direction of current traversing the shunting resistor 16 and the operating winding of the magnet of the meter M to be changed in direction the two windings of the magnet of the latter said meter energize cumulatively and cause the meter to register and the armature 41 to short-circuit the resistor 16 and the operating winding. In view of the adjustment of the magnet of the meter M, after the armatures thereof operatively attract they will be maintained in their attracted position by the polarizing winding, regardless of the fact that the armature 41 has short-circuited the resistor 16 and the operating winding to improve the talking transmission.

Abandoning the call by subscriber at telephone A

When the subscriber at telephone A replaces his receiver on the switch-hook the connector R will be restored and this will incidentally remove the ground from the release trunk forward extension of conductor 25, so that all relays maintained locked from this ground deactuate. The circuits are now at normal and idle. It will be noted in this connection, that had the calling subscriber at telephone A hung up his receiver first, while the called subscriber at telephone A' maintained his receiver off the switch-hook the connector R would not restore until the latter said subscriber hangs up his receiver, although the ground will be momentarily removed from the release trunk back from the connector R to unlock all relays dependent upon ground being maintained on the release trunk including conductor 25.

Call from telephone A to telephone A under normal conditions

In view of the reference to the third and fourth editions of Hershey's book, it is thought that the extension of a call from the telephone A², through line switch LS, first selector J, second selector N, third selector Q and wipers 423 to 426 of connector E to the bank terminals 427, 412, 428 and 429, respectively, (being telephone number 22312) will be fully understood.

Only first line of group of three arranged for forwarding call in exemplified embodiment

However, in this connection, it will be explained that the line leading to telephone A is the first one of a group of three lines belonging to the same subscriber all of which may be called by calling the same telephone number 22312. If the first line is busy the wipers 423 to 426 of the connector E will pass on and seize the first idle line of the group tested, and if none are idle will cause a busy tone to be applied audible in the receiver of the calling telephone.

In view of the reference to the fourth edi-

tion of Hershey's book, it will be noted that the private bank terminal of the first line of the group cooperative with private wiper 424 will be tied to its companion group private bank terminal cooperative with wiper 423; this being the arrangement for all but the last line of the group, there being no such tie for the last line of the group. The said tie enables the connector to automatically step its wipers on to the next bank terminals corresponding to the next positioned line of the group if the tested line is busy. The absence of this said tie disables the connector for automatically stepping its wipers on if the tested line is busy. The absence of the said tie also enables the connector to apply a busy tone audible in the calling telephone in the event the last line of the group is busy. That is, a connector as E will only apply the busy tone if all the lines of the group it is operated into selective relation with are busy. Of course, one line may constitute the "group" and in that event if the line is busy the wipers will not be stepped on and the busy tone will be thereupon applied, since the bank terminals cooperative with wipers as 423 and 424 are not to be tied together under the condition.

There is usually a group of connectors as E having common access to groups of lines and perhaps single lines as well. The usual practice is to multiple the respective bank terminals corresponding to 427 to a conductor as 431, and the terminals corresponding to 412 to a conductor as 432. These conductors from pairs of companion bank terminals are connected to the corresponding bank terminals of each common connector and the pairs of conductors corresponding to 431 and 432 are left unconnected only if the corresponding line is the last line of a group or is a single line. That is, respective pairs of conductors as 431 and 432 corresponding to companion terminals simultaneously engaged by wipers as 423 and 424 are tied together for all lines of a group excepting the last line thereof. This admits of assembling groups and individual lines at random in the bank.

It will be noted that bank terminals 427 and 412, and respective multiples, corresponding to the first trunk of the group designated by the calling number 22312 are tied together over conductors 431 and 432 through spring 230 and that the corresponding bank terminals (cooperative with wipers 423—424) for the next succeeding line of the group are permanently tied together by tie 433, while the corresponding bank terminals for the next (third as well as last) succeeding line of the group are not tied. The arrangement is thus because only the first line of the group of three lines is arranged for forwarding. The last two lines of the group lead directly from pairs of line terminals 434—435 and 436—437, to telephones A⁴ and AA⁴, respec-

tively, but are only indicated to avoid involving the disclosure unduly.

When first line of group is set for forwarding the following lines of the group are barred when group number is called

So it will be understood that normally the first idle line of the group of three belonging to the subscriber having telephone A will be seized and rung upon responsive to setting the wipers 423 to 426 upon the bank terminals (427—412—428—429) corresponding to telephone number 22312. However, the last two lines of the group (occupying numerical positions 22313 and 22314) will be disabled so far as being connected to by calling the telephone number 22312 at such time as the subscriber may set his first line of the group leading to telephone A so that calls to telephone number 22312 will be forwarded as contemplated by the present invention, as will appear presently. That is to say, only under the said set condition all calls wherein the wipers 423 to 426 (or corresponding wipers of any connector of the group containing connector E) are set upon bank terminals corresponding to the first line of the group 22312 will then be forwarded to a predetermined line (in the present instance telephone A') outside of the group, and if this first line of the group is busy to give the busy tone to the calling party. One call can be forwarded and maintained so at a time, in the arrangement shown in the drawings illustrating the present system; though, it will be fully disclosed presently how this may, if desired, be applied to all the lines of the group. It has been illustrated in the limited manner to avoid unduly involving the complete disclosure.

When first line of group is not set for forwarding, calling group number will complete connection to first idle line of group

It will be noted that the first line of the said group is numbered 22312, while the following two of the group are positioned as numbers 22313 and 22314, respectively. The second and third lines may be reached by directly calling the corresponding said telephone numbers or by directly calling the number of the first line of the group only under normal non-set condition, wherein the connector will automatically advance to the second or third line of the group responsive to the first or second line of the group being busy, as is well known, in view of the reference to the fourth edition of Hershey's book.

With the foregoing explanations regarding the group of lines denoted by telephone number 22312, the operation of the system responsive to setting the wipers 423 to 426 upon the first line of the group will be proceeded with, having in mind the line leading to telephone A is not set for forwarding calls.

It will be assumed that the first line of the group extending to telephone A is idle, and therefore battery potential derived through the winding of relay 236 and armature 210 will exist on bank terminal 412 to cause the well known operation in the connector for effecting the seizure of the first line of the group by the actuation of the so-called wiper-closing relay 437 of the connector E.

Line leading to telephone A busy

If it is assumed for the moment that the line extending to telephone A is busy by having been seized by another connector of the group containing connector E or a call has been initiated from telephone A, the private bank terminal 412 and the companion group private terminal 427 tied through spring 230 will constitute ground potential. The initiation of a call from telephone A causes the ground to be applied to bank terminal 412 (and its companion tied terminal 427) by armature 210 in a manner peculiar to the present invention as has been described. The well known operation of the connector E will cause the private terminal 412 and companion terminal 423 to constitute ground potential if the line to telephone A is connected with by a connector of the group containing connector E.

Under the condition, the wipers of a connector set upon the line terminals corresponding to the line leading to telephone A will step on to the next successive set of bank terminals corresponding to the second line (leading to telephone A⁴) of the group, in the well known manner for connectors of the stated type.

Line leading to telephone A idle

When the connector E seizes the line extending to telephone A (now assumed to be idle) its wiper-closing relay 437 will cause ground potential to be applied through wiper 424, bank terminal 412 (and multiples) conductor 432, conductor 211, armature 210 to the winding of relay 236, the latter said relay actuating, its armature 237 applying ground through spring 238 to conductor 25, effective to disconnecting the relay 19 and the ground normally applied through armature 12, in the well known manner and in view of the reference to the third edition of Hershey's book.

The ringing current from source G⁴ is applied from the connector through upper winding of ring-cut-off relay 438, wiper 425, bank terminal 428, conductor 439, spring 240, conductor 14, bell 42 and condenser of telephone A, conductor 203, spring 241, conductor 440, bank terminal 429, wiper 426 to ground 441. The ringing current will be intermittently applied to the bell 42 until the calling subscriber at telephone A⁴ abandons the call, or the subscriber at telephone A moves his receiver from the switch-hook in

responding. If the latter, the telephone A is energized through the back-bridge relay 442 of the connector E, after the ring-cut-off relay 438 operates.

It will be noted that the springs 240 and 241 short-circuit the right-hand and left-hand windings of unlatching magnet 242, the object of which magnet will appear presently.

The calling telephone A⁴ and the called telephone A are now in talking relation, the actuation of relay 442 having reversed the direction of current traversing the telephone A⁴. The talking path from the wipers 425 and 426 to telephone A is the same as that traced for the ringing current to bell 42. The connector E will restore responsive to the last said party to the connection hanging his receiver on the switch-hook.

Setting the line leading to telephone A so calls directed thereto will be forwarded to telephone A', the number of which is 33241

Let it be assumed that the subscriber of telephone A desires to have all calls directed to his line group No. 22312 forwarded to telephone number 33241, which is tributary to a different central office from that to which the line to telephone A is tributary though the call may in like manner be sent to a line tributary to any office of the system.

Remembering that the dial 40 on telephone A is like that shown in Figs. 7 and 8, the subscriber at telephone A will remove the receiver from the switch-hook to initiate the call, causing the telephone A to be extended to first selector F and the relays 209, 214 and 216 to actuate for the objects before mentioned.

The subscriber will now apply his finger to the depression Z of the dial as shown in Figs. 7 and 8 and draw the dial around until his finger encounters the finger-stop and thereupon release the dial to restore to its normal position, the while sending a series of eleven open impulses. It will be noted that the depression Z takes the place of a hole for a finger-hold corresponding to the digits from 1 to 0. This depression hold is employed so as to not confuse the subscriber when sending digits by employing the numeral holes in the dial.

The selector F will operate in the manner before referred to; but this time aligning its wipers with the eleventh level of bank terminals, in place of the third level. The relay 216 in Fig. 2 will deactuate responsive to the first off-normal movement of the wipers 313 to 315 of selector F, and relay 220 in Fig. 2 will thereupon actuate and lock to conductor 25 in the manner as before described. However, upon the wipers 313 to 315 aligning with the eleventh level of bank terminals, the shaft 320 will cooperate with the springs 321 and close them, the wipers

thereafter automatically rotating in and seizing bank terminals 323 to 325. The windings of slow-releasing relay 327 will now be in series with the telephone A, and attracted armature 328 will apply ground through bank terminal 323, wiper 313, armature 330 to release trunk conductor 309 before armature 308 has had time to retract, so that ground is maintained on conductor 24 and extensions, for the purposes above mentioned.

At the time the shaft 320 closes the springs 321, and before the wipers have had time to rotate in and seize the terminals 323 to 325 wherein relay 316 will actuate, a circuit can be traced from grounded armature 308, conductor 309, armature 331, springs 321, conductor 306, and over the traced path to conductor 32, to re-energize relay 216, causing the later said relay to actuate to close a path from ground, armatures 218, 219, 241, spring 242, make-before-break spring 243, to the winding of slightly slow-releasing relay 244, the latter said relay actuating and locking to grounded conductor 25. Ground on armature 245 is applied to energize relay 246 causing it to operate its spring contacts and tripping the dog 248 behind the armature projection 249 on the relay 246.

Tone indicates when set condition becomes effective

When the relay 246 actuates, distinctive tone from source T² will be applied through spring 251, armature 252 to talking conductor 14, audible to the subscriber at telephone A, indicative to him that the relay 246 has actuated to set the first line of his group for forwarding all calls directed to the group when the first line is idle and for barring successive lines of his group against seizure by group-selection operation of the connector concerned. Of course, directly calling the second line of the group will cause the selected line to be seized if idle and the connector to rotate off to the third line of the group in the normal manner as if the stated setting for forwarding calls had not been made.

Means for barring successive lines of group

The barring of the successive lines of the group under the condition mentioned in the foregoing paragraph is accomplished through the agency of the spring 230 disengaging its companion contact and thereby opening the tie between conductors 431 and 432 so that busy ground potential cannot be applied to bank terminal 427 and its multiples.

It will be noted, in this connection, that at the time the relay 246 actuated the short-circuits were thereby removed from the windings of the magnet 242. This included them in series with the telephone A, so that the dog 248 was thereby raised out of engage-

ment with the projection 249, but to no operative result.

The subscriber at telephone A upon hearing the tone from source T² and therefore knowing that his line has been duly set, will replace his receiver on the switch-hook. The windings of magnet 242 will forthwith deenergize, allowing the dog 248 to retract and drop over the projection 249. The ground will be maintained on the release trunk conductor 24 consistent with the slow-releasing characteristic of the release relay 329, so that an interval of time will occur after the dog 248 retracts before the relay 244 will unlock and thereby deenergize the relay 246. When the latter occurs, its armature projection 249 is mechanically locked by the dog 248, so that the springs of relay 246 are held in their actuated positions, although the winding of the relay 246 is unenergized. The line leading to telephone A is now set so that any calls directed to it will be forwarded to telephone A', the numerical position or telephone number of which is 33241.

Subscriber at telephone A may make outgoing calls while the line is set to forward incoming calls

Let it be assumed that the subscriber at telephone A desires to make an outgoing call during the time the line is set for forwarding calls made to it. It will be noted that the relation between the line conductors leading between the telephone A and the winding of relay 19 and ground on the resting contact of armature 12 of the primary line switch B has not been disturbed by the set condition of relay 246, so that outgoing calls from telephone A will be normal under all conditions when the line is idle.

Call to line leading to telephone A while relay 246 is locked, and the line is therefore set to forward calls to telephone A'

Let it be assumed that at the time a call was assumed extended from telephone A through connector E, the setting relay 246 is in its locked condition. This is having in mind that even when the relay 246 is actuated and the receiver is off the switch-hook of telephone A the line leading to telephone A will be barred due to busy ground potential now applied to private bank terminal 412 due to the actuated state of relay 209 under the condition.

When the line leading to the telephone A (assumed idle) is seized by the connector E, busy ground is applied by the connector E to private bank terminal 412, and this ground is then applied over conductors 432 and 211, armature 210 to operatively energize relay 236. Ground is thus applied through armature 237, spring 238, armature 252 to the winding of relay 253, the latter said relay actuating. This opens the talking path be-

tween the telephone A and the primary line switch B. However, it will be noted that the ringing path to the bell 42 is the same as before described, with the sole exception that the windings of the magnet 242 are in series therewith. The core of the latter said magnet is so designed (as by shielding it by a copper tube) that it will not be operatively susceptible to the alternating ringing current, from source G, when in series with a condenser at the bell 42, but will operate if an energized conductive path is closed through a source of direct current, as by the removal of the receiver from the switch-hook of telephone A. The bell 42 will thus start ringing responsive to the said seizure by the connector E, so that in the event the subscriber of telephone A hears the bell he may respond and thereby un-set his line and proceed as if his line had not been set when the call was extended to his line. This operation will be taken up in detail later on.

Forwarding operations

Returning to the actuation of relay 253 responsive to the connector E seizing the line leading to telephone A, a circuit can be traced from the winding of slow-releasing line relay 19 in the primary line switch B, armature 17, conductor 207, make-before-break spring 206, armature 255, conductor 256, armatures 501 and 502 in multiple, conductor 503, armature 257, make-before-break spring 201, conductor 13, armature 12 to ground, the relay 19 actuating. It will be noted that the loop including the armatures 17 and 12 of the primary line switch B is equivalent to the condition when a call was described initiated from telephone A, so that it will be clear that the primary line switch B will operate to extend the connection from multiplied armatures 501 and 502 to a secondary line switch as C, and that the latter will then further extend the connection to a first selector as F.

When the first selector F is seized and ground from spring 304 is applied back over the before traced path to the windings of relays 214 and 216, the latter two relays actuating the relay 214 locking to release trunk ground, as before described. Ground will now be applied from armature 258, through armatures 259 and 260, conductor 261 to the winding of relay 504, the latter said relay actuating to start the predetermined directive impulse series train corresponding to the number of telephone A'.

Inasmuch as in the assumed case the call is to be forwarded to telephone number 33241 (telephone A'), the terminals on the cross-connecting rack set X corresponding to the numerical orders of the five digits of the telephone number of the telephone line leading to telephone A' will be jumpered to digit terminals Y on the cross-connecting rack having the designated digit value corre-

sponding with the numerical order rank of the digits of the latter said telephone number, the cross-connecting rack terminals Y being designated in accordance with their digit value to correspond to the bank positions of corresponding digit value of the switch DF^s.

It will be clear, presently, that if it were desired to forward the call to any other telephone number, in lieu of telephone A', it would only be necessary to correspondingly run the five jumpers leading from the numerical order terminals X to the desired digit terminals Y.

Relay 504 being actuated, armature 511 applies ground over conductor 512 through wiper 513 to the digit terminal of group Y corresponding to digit 3. The ground on wiper 513 is also applied through wipers 539—536, upper armature of relay 504 to the winding of relay 515, the latter said relay actuating and locking to the attracted armature 514. This closes the conductor 516 leading from interrupter I^s through armature 517 of relay 515 to armatures 518—519 to prepare for sending directive impulses as will appear presently.

However, in this connection, it will be noted that unless the wipers 513, 536 and 539 are in their normal resting or home position as shown in the drawing the relay 515 cannot actuate and lock as has been described. This is so that in the event the call is abandoned and the line corresponding to telephone A is therefore un-busied and therefore subject to seizure while the shafts 552 and 533 of switches NO^s and DF^s, respectively, are off-normal the relay 515 will be prevented from being energized responsive to a new seizure of the line leading to telephone A until the wipers 513, 536 and 539 are in their drawn positions. That is to say, the line corresponding to telephone A may be seized, causing the relay 504 to reactuate, before the switches NO^s and DF^s have had time to restore, but the relay 515 cannot initiate the sending of impulses until the latter said switches have first restored to normal. This operation will be described in more detail presently.

The interrupter I^s revolves at approximately twelve revolutions per second, being the rate it is desired to send directive impulses to the switches forwarding the call. The first impulse delivered over conductor 516 through armature 517 after the actuation of relay 515 will be applied through armatures 518 and 519 to operate the motor magnet 520 and relay 521 in multiple, respectively. The said motor magnet 520 and relay 521 will attract their armatures responsive to the interruptions effected by interrupter I^s until relay 523 actuates, as will appear presently. However, it will be noted that the traced path including conductors

256 and 503 will not be opened by the attraction of the armature 501 so long as armature 502 remains retracted. When wiper 524 is stepped to bank terminal 527 responsive to the interrupter I^e ground is applied from ground 528 over conductor 529 through armature 530 to the winding of relay 531, the latter said relay actuating.

Sending of forwarding impulses

10 The wipers on shaft 533 will be driven forward responsive to the interrupter I^e until the terminal 535 corresponding to digit 3 is encountered by wiper 536, the relay 531 being maintained constantly actuated from 15 ground 528, and the armature 501 of relay 521 transmitting open impulses effective to the selector F. At the time wiper 536 engages bank terminal 535 three open impulses 20 from armature 501 will have caused the wipers of the selector F to align with the third level of bank terminals. Also, at time wiper 536 engages bank terminal 535 a circuit path can be traced from grounded armature 511, wiper 513, jumper 538, digit 25 terminal 3 of the cross-connecting rack group Y, bank terminal 535 wiper 536, wiper 539, bank terminal 540, conductor 541 to the winding of slow-releasing relay 523, the latter 30 said relay actuating, armature 530 locking it through wiper 524 to ground 528 so long as wiper 524 is off the bank terminal it is shown resting upon. When the relay 523 actuates, armatures 501 and 502 will retract 35 to maintain the closure of the circuit path including the conductors 256 and 503 in order to give the selector F time to rotate in and seize the first idle trunk extending in the direction of the telephone A'; leading to 40 second selector G. Armature 545 applies ground received from conductor 529 over conductor 546 and through the interrupter contact and armature 547 to operate the motor magnet 520 to restore the wipers on shaft 533 to the drawn position at which position 45 the ground 528 is free of conductor 529.

Armature 549 applies ground to the winding of motor magnet 550, so when relay 523 deactuates the wipers on shaft 552 will be 50 advanced one step. Wiper 513 now applies ground over jumper 553 to bank terminal 535, corresponding to digit 3. Also, due to the deactuation of relay 523, the interrupter I^e will start driving the wipers on shaft 533 in the manner as before described until the wiper 536 encounters bank terminal 535, causing 55 three open impulses to be transmitted from armature 501 effective to selector G, the wipers on shaft 533 restoring to the drawn position thereafter as before described when the first series of three open impulses were sent. The shaft 552 will be caused to advance its wipers when the relay 523 deactuates following the sending of the second digit 60 3. Wiper 513, now applies ground over

jumper 556 to bank terminal 557 corresponding to digit 2.

The wipers on shaft 533 will now be driven until wiper 536 encounters bank terminal 557, at which time the relay 523 will actuate and lock and the wipers on shaft will be restored to the drawn position in the manner as before described, the armature 501 having sent a series of two open impulses effective to third selector H. In view of the jumpers 561 and 562 two more series of open impulses will be sent; the one corresponding to jumper 561 being a series of four, and the one corresponding to jumper 562 being a single impulse. The last two series serve to set the connector R on the terminals of the line (assumed idle) leading to telephone A', the connector R thereupon applying ringing current to operate the signal bell of telephone A'.

Bell of telephone A is rung while call is being forwarded and until subscriber at telephone A' responds

During the sending of the train of series of open impulses to effect the forwarding extension to the line leading to telephone A' the bell 42 of telephone A has been periodically ringing responsive to source G, applied from the connector E, so that the subscriber thereof (telephone A) if at hand may respond and thereby efface the extension of the call towards or to the telephone A' and thereby destroy the set-up condition by operating the magnet 242, as will appear presently.

Let it be assumed that the subscriber of telephone A does not respond to the call during the time the forwarding extension train of series was being sent or before the response at telephone A'.

At the time the motor magnet 550 retracts the fifth time following the termination of the fifth digit series and before the shaft 533 has had time to step its wipers in two steps, ground is applied from bank terminal 563 (where ground potential has existed since the relay 515 first actuated and so constantly maintained), wiper 564, conductor 565, make-before-break spring 263 to the winding of relay 264, the latter said relay actuating and locking through armature 252, spring 238, armature 237 to ground, it being remembered that the ground is maintained on the armature 237 of relay 236 by the connector E energizing the latter said relay.

Subscriber at telephone A can answer calling party until calling party hangs up

Responsive to the actuation of relay 264, the relays 253 and 504 will deactuate in sequence. Under the present condition, the extension to the telephone A has the windings of the magnet 242, one in series with each conductor 14 and 203, so that the subscriber at telephone A can remove the receiver

at any time until the call is abandoned by the calling subscriber and thereby come in on the connection and efface the forwarded extension and become in direct talking communication with the calling party, as if the line extending to telephone A had not been set to forwarded calls directed thereto.

When the relay 264 actuated and relay 253 deactuated, the windings of the polarized relay 265 is placed in bridge of conductors 13 and 207 extended to connector R. While the bell of telephone A' is being rung, the armature of the polarized relay 265 is tilted counter-clock-wise so that the slow-releasing relay 266 will be operatively energized.

Response at telephone A' causes current to be reversed through calling telephone A^s

When the receiver is removed from the switch-hook of telephone A' the current projected back from the front-bridge relay of connector R responsive to the actuation of the back-bridge relay of connector R will be reversed in direction through the winding of the polarized relay 265, under which condition its armature will tilt clock-wise so that relay 267 will be operatively energized, the relay 266 deactuating consistent with its slow-releasing characteristic.

The armature 270 will now close a conductive path including the retardation coil 271 in series for operating the ring-cut-off relay 438 in connector E, followed by the actuation of the back-bridge relay 442. So the current will not only be reversed back to the polarized relay 265 responsive to the subscriber at telephone A' removing the receiver from the switch-hook, but the current will be reversed back over the line including calling telephone A^s by the operation of relay 442, consequent thereto.

Tone to indicate call is a forwarded one

It will be noted that after relay 267 actuates, and before relay 266 has had time to deactuate, the distinctive tone from source AT² is applied through armatures 272, 273 audible to the party at telephone A' and the party at telephone A^s indicative to them that the call was a forwarded one.

Recording number of calls forwarded

It will also be noted that after relay 267 actuates, and before relay 266 has had time to deactuate, ground is applied through armatures 274 and 275 to operatively energize relay 276. Relay 276 will be locked through its armature 277 to conductor 211 which is grounded by the private wiper 424 of the connector E. At the time relay 276 actuates its armature 278 applies a momentary ground operative to the meter M² which is individual to the subscriber having telephone A and may be multiply connected as

indicated so it will be operated by any relay of his group corresponding to relay 276, should more than one line of his group be equipped for forwarding calls made thereto, it being remembered that only the first line of his group is so arranged in the drawings in order to simplify the disclosure. The subscriber having telephone A will therefore be charged for the forwarding of the call; at least there will be a record made on the meter of a completed call.

Meter of line primarily called registers forwarded calls

It will be noted that the reversal of the current back from the connector R when the party at telephone A' responds will affect the meter M associated with the primary line switch B as when a call was described as initiated at telephone A and responded to at telephone A', so a call is registered against the subscriber of telephone A covering the forwarding of the call. The meters M and M² thus enable detailed information to be had as to the number of calls assessed to the subscriber of telephone A and the number of these which represent forwarded calls.

Indication by tone given calling party while call is being forwarded from the called line

While the call is being forwarded, and the relay 253 is therefore operated, the armature 279 applies distinctive tone from source FT² to conductor 14, right hand winding of magnet 242, audible to the calling subscriber through condenser 445 in connector E. However, it will be clear that the make contact co-operative with armature 279 may be alternatively connected to the conductor leading from spring of relay 246 to the right hand terminal of the winding of retardation coil 271 to effectuate the stated object.

Talking path between calling telephone A^s and called telephone A'

When the relay 267 actuated, the talking path from telephone A^s to conductors 439—440 is continued through condensers 281—282, armatures 205—202, springs 206—201, conductors 207—13, armatures 17—12 respectively, and over the heavy talking conductors to the telephone A'. From conductors 439—440 a line pair leads through windings of magnet 242, line conductors 14—203, respectively, to telephone A, the impedance of the windings of magnet 242 being sufficient to prevent undue attenuation of the currents constituting sound which pass between the telephone A^s and A' because of the electro-static capacity of the line conductors leading to telephone A.

Subscriber at telephone A' replaces receiver on switch-hook while subscriber at telephone A² retains his receiver off

If the subscriber at telephone A' first replaces his receiver after terminating the conversation, the deactuation of the back-bridge relay in connector R resultant thereto will cause the direction of current over the call extension to be restored so as to operate the polarized relay 265 to deenergize relay 267 and thereby remove the retardation coil 271 from the bridge, so that the back-bridge relay 442 in connector E will deactuate. The winding of polarized relay 265 is still in series with the front-bridge relay in connector R, so that the latter said connector is still in seizure of the line leading to telephone A'.

Subscriber at telephone A³ replaces receiver on switch-hook

Upon the subscriber at telephone A³ now replacing his receiver on the switch-hook the front-bridge relay 446 in connector E will deactuate and cause the obvious circuit for the release magnet of connector E to energize to restore said connector E. This will remove the ground from conductor 211, so that armature 237 will retract and deenergize relay 264, thus removing the winding of polarized relay 265 from the said series relation with the front-bridge relay in connector R, so that the said connector R and antecedent switches employed in forwarding the call will thereupon be restored, the circuits employed in the call being now normal and in readiness for a new use.

Subscriber at telephone A³ replaces receiver on switch-hook while subscriber at telephone A' retains his receiver off

If the subscriber at telephone A³ first replaces his receiver after terminating the conversation, the deactuating of the front-bridge relay 446 in connector E resultant thereto, will cause a circuit to be prepared for the release magnet of said connector E and the ground removed from the release trunk so the antecedent switches Q, N, J, and LS will restore, the said connector E remaining in seizure, since the retardation coil 271 is still in series with the back-bridge relay 442. The winding of the polarized relay 265 is still in series with the front-bridge relay of connector R, so that the replacing of the receiver at telephone A³ produces no operative effect beyond connector E.

Subscriber at telephone A' replaces receiver on switch-hook

Upon the subscriber at telephone A' now replacing his receiver on the switch-hook the back-bridge relay of connector R will deactuate to restore the direction of current traversing the winding of polarized relay

265 so that the relay 267 will be deenergized and thereby remove the retardation coil 271 from the bridge, so that the back-bridge relay 442 in connector E will deactuate. The winding of the polarized relay 265 is still in series with the front-bridge relay in connector R, so the latter said connector is still in seizure of the line leading to telephone A'.

When the back-bridge relay 442 in connector E deactuates it closes the obvious circuit for the release magnet of connector E to operate to restore said connector E. This will remove the ground from conductor 211, so that armature 237 will retract and deenergize relay 264, thus removing the winding of the polarized relay 265 from the said series relation with the front-bridge relay in connector R, so that the said connector R and antecedent switches employed in forwarding will thereupon be restored, the circuits employed in the connection being now normal.

Restoration of impulse sending apparatus

At the time relay 253 deactuated following the last impulse of the train, the armature 260 opened the energizing circuit for relay 504 and its dependent relay 515. Ground from armature 566 will be applied through wiper 570 and through the interrupter armature 571, causing the shaft 552 to restore the wipers thereon to the position drawn. Ground from armature 567 will be applied through wiper 572 and through the interrupter armature 547, causing the shaft 533 to restore the wipers thereon to the position drawn.

Calling party abandons the call while forwarding impulse train is being sent

Assume that the calling subscriber at telephone A³ abandons the call while the forwarding impulses are being sent and the connector E restores, removing ground from conductor 211. Relays 504 and 515 will deactuate in sequence. It will be further assumed that this deactuation of relays 504 and 515 occurs while one or both elements NO⁵ and DF⁵ are off-normal.

When the conductor 211 becomes ungrounded there is no ground on bank terminal 412 and multiples thereof to bar the line leading to telephone A against seizure, so that the line leading to telephone A may therefore become immediately seized by a connector of the group containing connector E before one or both of the shafts 552 and 533 of elements NO⁵ and DF⁵ restore to the drawn position. This is having in mind that at the time conductor 211 is ungrounded, the conductor 25 may still constitute ground due to the slow-releasing release relay concerned not yet having deactuated. This will cause relay 209 to momentarily actuate the cause armature 210 to apply ground to conductor 211. However, the conductor 211 may be

come finally ungrounded before the elements NO² and DF² have had time to restore.

In order to prevent the relay 515 from being reactuated responsive to a new seizure of the line leading to telephone A until the latter said elements have restored to normal position, which said actuation would vitiate the call by starting the impulse train prematurely, wherein the proper train may not be sent, the circuit energizing relay 515 cannot be closed until the wipers of the latter said elements have restored so that ground from armature 511 may be applied through wiper 513 and its normally engaged bank terminal and the normally engaged bank terminals cooperative with wipers 536 and 539.

Line leading to telephone A' encountered busy when call is forwarded thereto

If the line leading to telephone A' is encountered busy when the call primarily directed to telephone A is forwarded thereto, the busy tone applied to the talking conductor in connector R will pass over the lower talking conductor to conductor 13, spring 201, armature 202, condenser 282, armature 270, tone condenser, armature 273, conductor 439, wiper 425, ringing tone condenser 445, audible to the subscriber at telephone A³, having in mind that this tone will be particularly distinguishable during the silent ringing periods with respect to generator G⁴, since there will be a ringing generator (G⁴) tone audible during the live ringing periods.

Unsetting of the line leading to telephone A so calls directed thereto will not be forwarded

The set condition referred to will endure until a call is responded to by the subscriber at telephone A wherein a conductive path is included in series with the windings of magnet 242, energized from the ring-cut-off relay 438 and back-bridge relay 442 of a connector as E. That is, a subscriber may return to his telephone and if any call comes to it he will answer it and thereby unset the forwarding apparatus, but if no call comes in he can leave again with the forwarding apparatus still in its set condition, notwithstanding that he may have made outgoing calls from his telephone.

Forwarding calls to an attendant's position provided for answering calls forwarded when random lines are called

In the foregoing descriptions the calls to a specific telephone line leading to telephone A were forwarded to telephone A'. It will be clear that random lines may have the same cross connections in the respective impulse transmitting devices so that calls may be forwarded from any number of lines to the telephone A'. Moreover, a group of lines number 33241 leading from the group of connec-

tors containing connector R may be used so a plurality of calls may be received by the subscriber A' on a corresponding plurality of telephones, or on an attendant's switchboard, for example. Again, a group of trunks leading from selector H may extend to an attendant's switchboard. If this latter group is assumed to be in the second bank level, in place of extending to the group of connectors containing connector R, the cross-connecting jumpers 561 and 562 corresponding to the last two digits will be omitted, and in that event the conductor leading to bank terminal 563 will be moved to bank terminal 574. Of course, the jumpers on the cross-connecting rack may be changed from time to time as desired, so that calls directed to the corresponding telephone line will be forwarded to any desired telephone number.

Pause between series of the impulse train

Due to the slow-releasing characteristic of the relay 523, after it actuates to terminate a digit series, a predetermined time will ensue before it deactuates to enable the next series to start. Due to the fact that the wipers on the shaft 533 may pass over more or less bank terminals in restoring to the drawn position, depending upon the antecedent digit series sent, there will be a slight variation in the pause between digit series. That is, the space after a short series, as digit 2, for example, will be longer than the space after a long series, as that constituting digit 9, for example.

Modification of circuits to disable the line extension to telephone A as soon as the last impulse of the forwarded train has been sent.

Fig. 9 shows a modification of the circuits in Fig. 2, introduced as indicated by the dotted section lines *a*, *b* and *c*, so that when relay 264 actuates when the forwarding impulse train has terminated, the extension to telephone A is cut off by relay 264 and the bell at telephone A will cease to ring. This arrangement thus prevents the forwarded extension (to telephone A') from being intruded upon by the subscriber at telephone A after the forward extension is completed, and it also cuts off the leg to telephone A during the conversation between the telephone A³ and A'.

Preferred modification which disables subscriber at telephone A from intruding only after subscriber on line finally called responds

Another modification of the circuits of Fig. 2, and which is the preferred one, is shown in Fig. 10, introduced as indicated by the dotted section lines *a* and *d*, so that when the relay 267 actuates upon the response at the telephone A' the leg leading to telephone A will be cut off.

Modification of circuits to denote by distinctive tone audible in telephone A when a call is initiated whether line is or is not set for forwarding

5 Fig. 11 shows a preferred modification of the circuits in Fig. 2 involving the addition of an extra spring 290 and make and break cooperating contacts on the relay 246. A specific tone source FT² is added. It will be clear that when the relay 246 is locked, and the line leading to telephone A is thereby set so that calls directed thereto will be forwarded to telephone A', the tone source FT² will be substituted for tone source ST² to armature 217 on relay 220. Thus, if the subscriber removes his receiver off the switch-hook after setting his line for forwarding he will perceive the specific tone from source FT² indicative that the setting is made. The tone received will also prompt him of the condition when initiating an actual call.

Means for unsetting the apparatus so calls will not be thereafter forwarded

25 If the subscriber at telephone A desires to have the said set condition of his line effaced, so that calls will not be responded to if he does not choose to do so from his telephone A, he may call his own telephone number from some other telephone of his group, perhaps, but not from telephone A (because to initiate a call from telephone A will bar his corresponding line against seizure), and when the bell of telephone A starts ringing remove the receiver thereof from the switch-hook and thereby unlock the relay 246, in the manner before described wherein the windings of the magnet 242 energized in series with telephone A on incoming calls when the relay 246 is locked. Of course, the subscriber at telephone A may alternatively call some subscriber, perhaps the subscriber of telephone A' and report his return and request that his line (leading to telephone A) be called so that he may respond to the call and thereby unlock the relay 246.

50 With reference to the last foregoing paragraph, it will in most cases not be desired to directly unset the forwarding apparatus as any call made to the line leading to telephone A will be responded to on the latter said line before it has been forwarded to telephone A' and this will unlock relay 246. In case the subscriber of telephone A again leaves wherein no call has been responded to by him since setting the relay 246 the set-up condition still endures. There is no means for a party at a telephone other than at telephone A to unlock the relay 246, unless it be the central office attendant manually unlocking relay 246 by tripping dog 248.

Modification of unlatching magnet

65 The modification of Fig. 2 shown in Fig.

6 changes the winding on magnet 242 in Fig. 2 to a simple winding and the shielded core to a simple core. The windings taken from the magnet 242 are placed on the core of the relay 601. The core of the latter said relay is shielded by a copper tube to make it unresponsive to alternating or ringing current from the source G⁴. The magnet 242 is then energized in a local circuit of the relay 601. The magnet 242 requires considerable energy to operate its dog to unlatch the relay 246, so that a relatively few turns of windings on the relay 601 will suffice, as compared to the number of turns required where the two windings are placed on the magnet 242 as shown in Fig. 2.

Commercial embodiment

85 It will be noted, that in the commercial embodiment of the present invention, sets or units of equipment as shown in Figs. 2 and 5 (in view of the preferred embodiments mentioned) will be provided in sufficient number at the central office. Then any subscriber requesting to be supplied this special service will have such a unit cross-connected into his line as indicated by the jumpers joining the respective terminals a'-a'', b'-b'', c'-c'', d'-d'', e'-e'', f'-f'', g'-g'', h'-h'' and n'-n''. That is, if no special unit as contemplated by the present invention is to be employed, the jumpers shown joining the last said sets of terminals will be removed and jumpers or tie conductors inserted between terminals a'-b', c'-d', e'-f', g'-b', h'-d', f'-n'.

100 The subscriber obtaining the service contemplated by the present invention wherein calls will be forwarded to a predetermined line of the exchange when desired, will perhaps pay a monthly rental or other consideration for the special service provided for him, and this charge may also comprehend the number of calls forwarded as indicated by the meters M and M².

110 While only the first line of the group of three is shown arranged for forwarding, it will be clear that all the lines may be so arranged by the use of like circuits, having in mind that if the second line of the group is thus equipped the circuit through the spring 230 will be permanently closed. And, if the third line of the group is thus arranged the circuit corresponding to the last referred to for the second line of the group will also be permanently closed. The circuit for the third trunk corresponding to the last referred to will be left permanently open under the condition of being arranged for forwarding calls directed to it.

125 Where the term "relay" is employed in the subjoined claims, this term is to be understood as referring to any electro-magnetically operated circuit-switching device, such for example, a wiper step-by-step switch. 130

Having set forth an exemplary embodiment of the present invention, it will be understood that the invention is capable of modification and special use within the scope of the subjoined claims.

I claim:—

1. In a telephone system, a calling line, a first called line, switch apparatus for extending a call from said calling line to said first called line, a second called line, automatic switch mechanism, a manual switch on said first called line, and means the operation of which is predetermined by an operation of said manual switch for predetermining whether said automatic switch mechanism will operate to forward the connection from the calling line to said second called line responsive to effecting connection from said calling line to said first called line wherein a portion of said first called line forms a link of the connection to said second called line.

2. In a telephone system, a movable switch terminal, a first called line, a fixed terminal of said line cooperative with the movable terminal, a second called line, a relay, automatic switch mechanism, a manual switch on said first called line, means controlled over a talking conductor of said first called line for operating said relay and for retaining it operated responsive to the operation of the manual switch, means for setting said movable terminal on the fixed terminal to thereby effect connection from the movable terminal to said first called line, and means dependent upon said relay being operated when the movable terminal is set upon the fixed terminal for causing said automatic switch mechanism to operate to link a connection forward from said fixed terminal to said second called line wherein a portion of said first called line forms a link of the connection to said second called line.

3. In a telephone system, a movable switch terminal, a fixed terminal cooperative with said movable terminal, a directive device, switch mechanism, a called line, a relay, means for energizing said relay over a talking conductor of the called line to set the relay, and means operated responsive to setting said movable terminal on said fixed terminal only if said relay has been previously set for causing the directive device to operate the switch mechanism to link a connection from the fixed terminal to the called line.

4. In a telephone system, a calling line, a first called line, a first automatic switch mechanism for linking a connection from the calling line to said first called line, a relay, means controlled over a talking conductor of the called line for energizing the relay to set the relay, a second called line, a second automatic switch mechanism for linking a connection from the said first called line to

said second called line, and means the operation of which is determined by the set condition of said relay only if the set condition is existant at the time said first called line is connected to it for forwarding said connection by operating said second automatic switch mechanism to complete the connection to said second called line wherein both said mechanisms are links of the connection to the said second called line.

5. In a telephone system, a calling line, a first called line, a first automatic switch mechanism for linking a connection from the calling line to said first called line, a relay, means controlled over a talking conductor of the called line for energizing the relay to set the relay, a second called line, a second automatic switch mechanism for linking a connection from the said first called line to said second called line, means the operation of which is determined by the set condition of said relay only if the set condition is existant at the time said first called line is connected to it for forwarding said connection by operating said second automatic switch mechanism to complete the connection to said second called line wherein both said mechanisms are links of the connection to the said second called line, and means controlled over said first called line for unsetting the relay.

6. In a telephone system, a calling line, a first called line, a first automatic switch mechanism for linking a connection from the calling line to said first called line, a relay, means controlled over a talking conductor of the called line for energizing the relay to set the relay, a second called line, a second automatic switch mechanism for linking a connection from the said first called line to said second called line, means the operation of which is determined by the set condition of said relay only if the set condition is existant at the time said first called line is connected to it for forwarding said connection by operating said second automatic switch mechanism to complete the connection to said second called line wherein both said mechanisms are links of the connection to the said second called line, and means controlled over said first called line for unsetting the relay and for thereupon effacing the forwarded extension to said second called line.

7. In a telephone system, a calling line, a first called line, another line, first switch mechanism for linking a connection from said calling line to said first called line, second switch mechanism for linking a connection from said first called line to said another line, a signal device on each said lines, a setting relay, means including said first switch mechanism for extending a call to said first called line and for thereupon causing the corresponding said signal device to operate, means controlled over a talking conductor of said first called line for operating said set-

ting relay before said connection is established, and means operated responsive to extending connection to said first called line only if said relay was beforehand set to cause said second switch mechanism to forward the connection from said first called line to the said another line and cause the corresponding said signal device to operate while not disabling the operation of said signal device on said first called line.

8. In a telephone system, a calling line, a first called line, another line, first switch mechanism for linking a connection from said calling line to said first called line, second switch mechanism for linking a connection from said first called line to said another line, a signal device on each said lines, a setting relay, means including said first switch mechanism for extending a call to said first called line and for thereupon causing the corresponding said signal device to operate, means controlled over a talking conductor of said first called line for operating said setting relay before said connection is established, means operated responsive to extending connection to said first called line only if said relay was beforehand set to cause said second switch mechanism to forward the connection from said first called line to the said another line and cause the corresponding said signal device to operate while not disabling the operation of said signal device on said first called line, and means controlled over said another line for disabling the operation of the signal device on the said first called line while maintaining connection from the calling line to the said another line wherein a portion of said first called line is a link of the connection.

9. In a telephone system, a calling line, a first called line, another line, first switch mechanism for linking connection from said calling line to said first called line, second switch mechanism for linking a connection from said first called line to said another line, a signal device on each said lines, a setting relay, means including said first switch mechanism for extending a call to said first called line and for thereupon causing the corresponding said signal device to operate, means controlled over a talking conductor of said first called line for operating said setting relay before said connection is established, means operated responsive to extending connection to said first called line only if said relay was beforehand set to cause said second switch mechanism to forward the connection from said first called line to the said another line and cause the corresponding said signal device to operate while not disabling the operation of said signal device on said first called line, means controlled over said another line for disabling the operation of the signal device on the said first called line while maintaining connection from the calling line

to the said another line wherein a portion of said first called line is a link of the connection, and means controlled over the said first called line for disabling the operation of the signal device on said another line while maintaining connection from the calling line to said first called line.

10. In a telephone system, a calling line, a first called line, another line, first switch mechanism for linking connection from said calling line to said first called line, second switch mechanism for linking a connection from said first called line to said another line, a signal device on each said lines, a setting relay, means including said first switch mechanism for extending a call to said first called line and for thereupon causing the corresponding said signal device to operate, means controlled over a talking conductor of said first called line for operating said setting relay before said connection is established, means operated responsive to extending connection to said first called line only if said relay was beforehand set to cause said second switch mechanism to forward the connection from said first called line to the said another line and cause the corresponding said signal device to operate while not disabling the operation of said signal device on said first called line, means controlled over said another line for disabling the operation of the signal device on the said first called line while maintaining connection from the calling line to the said another line wherein a portion of said first called line is a link of the connection, and means controlled over the said first called line for effacing the forwarded extension to said another line while maintaining connection from the calling line to the said first called line.

11. In a telephone system, a calling line, a first called line, another line, first switch mechanism for linking a connection from said calling line to said first called line, second switch mechanism for linking a connection from said first called line to said another line, means controlled over said first called line only before said first switch mechanism links connection to said first called line for preparing a condition for causing said second switch mechanism to link a connection from the said first called line to said another called line responsive only to said connection being linked to said first called line.

12. In a telephone system, a calling line, a first called line, another line, first switch mechanism for linking a connection from said calling line to said first called line, second switch mechanism for linking a connection from said first called line to said another line, means controlled over said first called line only before said first switch mechanism links connection to said first called line for preparing a condition for causing said sec-

- ond switch mechanism to link a connection from the said first called line to said another called line responsive only to said connection being linked to said first called line, a meter for registering the number of calls made to said first called line, and means controlled only over a said forwarded extension from said first called line for operating the meter.
18. In a telephone system, a calling line, a first called line, another line, first switch mechanism for linking a connection from said calling line to said first called line, second switch mechanism for linking a connection from said first called line to said another line, means controlled over said first called line only before said first switch mechanism links connection to said first called line for preparing a condition for causing said second switch mechanism to link a connection from the said first called line to said another called line responsive only to said connection being linked to said first called line, and means controlled over a talking conductor of said first called line for effacing the forwarded extension from said first called line while maintaining the connection to said first called line.
14. In a telephone system, a calling line, a first called line, another line, first switch mechanism for linking a connection from said calling line to said first called line, second switch mechanism for linking a connection from said first called line to said another line, means controlled over said first called line only before said first switch mechanism links connection to said first called line for preparing a condition for causing said second switch mechanism to link a connection from the said first called line to said another called line responsive only to said connection being linked to said first called line, a tone source, and means controlled over the said another line for applying said tone source audible on the calling line and the said another line to indicate to the users thereof that the connection is one that has been forwarded.
15. In a telephone system, a calling line, a first called line, another line, first switch mechanism for linking a connection from said calling line to said first called line, second switch mechanism for linking a connection from said first called line to said another line, means controlled over said first called line only before said first switch mechanism links connection to said first called line for preparing a condition for causing said second switch mechanism to link a connection from the said first called line to said another called line responsive only to said connection being linked to said first called line, a tone source, and means for applying said tone source audible on the calling line to indicate that the call is being forwarded from said first called line responsive to the said first called line being connected to only if said prepared condition exists.
16. In a telephone system, a subscriber's line, automatic switch mechanism, a called line, means controlled over the subscriber's line for directing the operation of the switch mechanism for linking a connection from said subscriber's line to the called line, another subscriber's line, means for extending connection from said another subscriber's line to first said subscriber's line by way of a terminal of the latter said line, a set relay, means for energizing said set relay to set same, and means operated responsive to effecting said connection to said terminal only if said relay is set beforehand for causing said switch mechanism to forward said connection to said called line wherein said terminal of first said subscriber's line forms a link of the connection.
17. In a telephone system, a subscriber's line, automatic switch mechanism, a called line, means controlled over the subscriber's line for directing the operation of the switch mechanism for linking a connection from said subscriber's line to the called line, another subscriber's line, means for extending connection from said another subscriber's line to first said subscriber's line by way of a terminal of the latter said line, a set relay, means for energizing said set relay over a talking conductor of the first said subscriber's line to set same, and means operated responsive to effecting said connection to said terminal only if said relay is set beforehand for causing said switch mechanism to forward said connection to said called line wherein said terminal of first said subscriber's line forms a link of the connection.
18. In a telephone system, a subscriber's line, automatic switch mechanism, a called line, means controlled over the subscriber's line for directing the operation of the switch mechanism for linking a connection from said subscriber's line to the called line, another subscriber's line, means for extending connection from said another subscriber's line to a first said subscriber's line by way of a terminal of the latter said line, a set relay, means for energizing said set relay over a talking conductor of the first said subscriber's line and a portion of said switch mechanism to set same, and means operated responsive to effecting said connection to said terminal only if said relay is set beforehand for causing said switch mechanism to forward said connection to said called line wherein said terminal of first said subscriber's line forms a link of the connection.
19. In a telephone system, a subscriber's line, automatic switch mechanism, a called line, means controlled over the subscriber's line for directing the operation of the switch mechanism for linking a connection from said subscriber's line to the called line, another

other subscriber's line, means for extending connection from said another subscriber's line to first said subscriber's line by way of a terminal of the latter said line, a set relay, means for energizing said set relay to set same, means operated responsive to effecting said connection to said terminal only if said relay is set beforehand for causing said switch mechanism to forward said connection to said called line wherein said terminal of first said subscriber's line forms a link of the connection, a tone source, and means controlled over the said subscriber's line for applying tone from said source over said subscriber's line to specifically indicate if the relay is set or is not set.

20. In a telephone system, a first called line, switch apparatus for extending connection to said called line, a second called line, automatic switch mechanism, a manual switch, a directing device, a set relay, means whereby the set relay can be operated over said first called line by the manual switch, and means operated only if said set relay is in predetermined operated state responsive to extending connection to said first called line for causing said directing device to operate to thereby direct said automatic switch mechanism to further extend said connection to said second called line.

21. In a telephone system, a first called line, switch apparatus for extending connection to said called line, a second called line, automatic switch mechanism, a manual switch, a directing device for sending impulses, a set relay, means whereby the set relay can be operated over said first called line by the manual switch, and means operated only if said set relay is in predetermined operated state responsive to extending connection to said first called line for causing said directing device to operate to send impulses to thereby direct said automatic switch mechanism to further extend said connection to said second called line.

22. In a telephone system, a first called line, switch apparatus for extending connection to said called line, a second called line, automatic switch mechanism, a directing device, a set relay, and means operated only if said relay is in a predetermined operated state responsive to extending connection to said first called line for causing said directing device to operate to thereby direct said automatic switch mechanism to further extend said connection to said second called line.

23. In a telephone system, a first called line, switch apparatus for extending connection to said called line, a second called line, automatic switch mechanism, a directing device, a set relay, means operated only if said relay is in a predetermined operated state responsive to extending connection to said first called line for causing said directing device

to operate to thereby direct said automatic switch mechanism to further extend said connection to said second called line, and means responsive to a single maintained closure of a circuit path involving a conductor of said first called line for effacing said operated state of the set relay.

24. In a telephone system, a first called line, switch apparatus for extending connection to said called line, a second called line, automatic switch mechanism, a directing device, a set device having two windings, means controlled over said first called line for energizing one of said windings to operate said set device, means controlled over said first called line for energizing the other of said windings to restore the operated state of said set device, and means operated only if said set device is in its operated state responsive to extending connection to said first called line, for causing said directing device to operate to thereby direct said automatic switch mechanism to further extend said connection to said second called line.

25. In a telephone system, a first called line, switch apparatus for extending connection to said called line, a second called line, automatic switch mechanism, a directing device, a call signal device on the respective said lines, means operated responsive to extending connection to said first called line for applying current over the said first called line from said switch apparatus for causing the operation of the signal device on the said first called line and for causing the operation of said directing device to direct said automatic switch mechanism to further extend said connection to said second called line and for applying current over said second called line from said switch mechanism for operating the signal device on said second called line wherein said signal device on said first called line will be operated antecedent to the operation of the signal device on said second called line.

26. In a telephone system, a first called line, switch apparatus for extending connection to said called line, a second called line, automatic switch mechanism, a directing device, a call signal device on the respective said lines, means operated responsive to extending connection to said first called line for applying current over the said first called line for causing the operation of the signal device on the said first called line and for causing the operation of said directing device to direct the automatic switch mechanism to further extend said connection to said second called line and for applying current over said second called line for operating the signal device on said second called line wherein the said signal device on the said first called line will be operated antecedent to the operation of the signal device on the said second called line.

27. In a telephone system, a first called subscriber's line, switch apparatus for extending connection to said called line, a second called subscriber's line, automatic switch mechanism, a directing device, a call signal device on the respective said lines, means operated responsive to extending connection to said first called line for applying current over said first called line for causing the operation of the signal device on said first called line and for causing the operation of said directing device to direct the automatic switch mechanism to further extend said connection to said second called line and for applying current over said second called line for operating the signal device on said second called line wherein the said signal device on the said first called line will be operated antecedent to the operation of the signal device on said second called line, and means responsive to the subscriber on said first called line responding to the signal thereon for destroying the extension towards the said second called line, last said means being disabled from operating responsive to the subscriber on said second called line responding to the signal thereon.

28. In a telephone system, a first called subscriber's line, switch apparatus for extending connection to said called line, a second called subscriber's line, automatic switch mechanism, a directing device, a call signal device on the respective said lines, means operated responsive to extending connection to said first called line for applying current over said first called line for causing the operation of the signal device on said first called line and for causing the operation of said directing device to direct the automatic switch mechanism to further extend said connection to said second called line and for applying current over said second called line for operating the signal device on said second called line wherein the said signal device on the said first called line will be operated antecedent to the operation of the signal device on said second called line, and means responsive to the subscriber on said second called line responding for preventing the subscriber on said first called line from thereafter intruding upon the connection.

29. In a telephone system, a first called subscriber's line, switch apparatus for extending connection to said called line, automatic switch mechanism, a directing device, a call signal device on the respective said lines, means operated responsive to extending connection to said first called line for causing the operation of the signal device on the said first called line and for causing the operation of said directing device to direct the said automatic switch mechanism to further extend said connection to said second called line and for operating the signal device on the said second called line wherein the said signal device on said first called line will be operated

antecedent to the operation of the signal device on said second called line, and means whereby the subscriber first responding will disable the other subscriber from affecting the connection.

30. In a telephone system, a first called subscriber's line, switch apparatus for extending connection to said called line, automatic switch mechanism, a directing device, a call signal device on the respective said lines, means operated responsive to extending connection to said first called line for causing the operation of the signal device on the said first called line and for causing the operation of said directing device to direct the said automatic switch mechanism to further extend said connection to said second called line and for operating the signal device on the said second called line wherein the said signal device on said first called line will be operated antecedent to the operation of the signal device on said second called line, and means whereby the subscriber first responding will cut off the other subscriber's station from the connection.

31. In a telephone system, a calling line, a first called line, a subscriber's line, first switch mechanism for linking a connection from said calling line to said first called line, second switch mechanism for linking a connection from said first called line to said subscriber's line, means controlled over said first called line only before said first switch mechanism links connection to said first called line for preparing a condition for causing said second switch mechanism to link a connection from the said first called line to said subscriber's line responsive only to said connection being linked to said first called line, a tone source, and means operated responsive to a response on said subscriber's line while said connection is made thereto for momentarily applying the tone source to the connection to indicate to the users thereof that the connection is a forwarded one, regardless of how long the responded condition endures.

32. In a telephone system, a calling line, a first called line, another line, first switch mechanism for linking a connection from said calling line to said first called line, second switch mechanism for linking a connection from said first called line to said another line, means controlled over said first called line only before said first switch mechanism links connection to said first called line for preparing a condition for causing said second switch mechanism to link a connection from said first called line to said another called line responsive only to said connection being linked to said first called line, and means controlled over said another called line for applying a signal from a point on the connection antecedent of said another called line to said calling line to indicate that the connection has been forwarded.

33. In a telephone system, a calling line, a first called line, another line, first switch mechanism for linking a connection from said calling line to said first called line, second switch mechanism for linking a connection from said first called line to said another line, a directing device, means responsive to extending connection to said first called line for starting the operation of said directing device to in turn direct the operation of said second switch mechanism to extend the connection on to the said another line, a tone source, means for applying said tone source audible on the calling line to indicate that the call is being forwarded from said first called line, and means for terminating the application of the tone source responsive to the operation of said directing device in extending the connection, regardless of control over said another line.

34. In a telephone system, a calling line, a first called line, another line, first switch mechanism for linking a connection from said calling line to said first called line second switch mechanism for linking a connection from said first called line to said another line, a directing device, means responsive to extending connection to said first called line for starting the operation of said directing device to in turn direct the operation of said second switch mechanism to extend the connection on to the said another line, means for applying a signal to the calling line to indicate that the call is being forwarded from said first called line, and means for terminating the application of the signal responsive to the operation of said directing device in extending the connection, regardless of control over said another line.

35. In a telephone system, a subscriber's calling and receiving line, a variably directionally controlled switch for extending connection away from or to said subscriber's line, a first relay individual to said line, a second set relay individual to said line for rendering said subscriber's line subject to employment as a link intermediate of a call extension, a conductor common to said relays and individual to said line, means including said conductor and a normally open contact pair on said switch for causing said first relay to operate responsive to only initiating a call upon said line, means made thereupon operative responsive to directive control over said line for correspondingly operating said switch, means responsive to operation of said switch for deenergizing said first relay, means including said conductor operated responsive to a predetermined extent of operation of said switch for again operating said first relay to thereby operate and lock said set relay, and means dependent upon the set relay being operated when a call is extended to said line for causing said connection to be ex-

tended over a portion of said line as a link towards a predetermined other line.

36. In a telephone system, a subscriber's calling and receiving line, a variably directionally controlled switch for extending connection away from or to said subscriber's line, a first relay individual to said line, a second set relay individual to said line for rendering said subscriber's line subject to employment as a link intermediate of a call extension, a conductor common to said relays and individual to said line, means including said conductor and a normally open contact pair on said switch for causing said first relay to operate responsive to only initiating a call upon said line, means made thereupon operative responsive to directive control over said line for correspondingly operating said switch, means responsive to operation of said switch for deenergizing said first relay, means including said conductor operated responsive to a predetermined extent of operation of said switch for again operating said first relay to thereby operate and lock said set relay, means for retaining said relay locked although the initiated condition of said line is effaced, and means dependent upon the set relay being operated when a call is extended to said line for causing said connection to be extended over a portion of said line as a link towards a predetermined other line.

37. In a telephone system, a calling line, a first called line, automatic switch mechanism, directive means for the calling line for directionally operating the automatic switch mechanism for extending connection from the calling line to said first called line, a second calling line, means for extending connection from said second calling line to first said calling line, directive mechanism set by control over the calling line, and means whereby depending upon the said set condition of the said directive mechanism existing at the time connection is extended to first said calling line for thereupon causing the automatic switch mechanism to be directionally operated to further extend said connection to first said calling line to said first called line.

38. In a telephone system, a calling line, a first called line, automatic switch mechanism, directive means for the calling line for directionally operating the automatic switch mechanism for extending connection away from said calling line, a second calling line, means for extending connection from said second calling line to first said calling line, an impulse sending device, a set relay, and means whereby depending upon the set condition of said relay existing at the time connection is extended to first said calling line to thereupon cause the operation of said impulse sending device to in turn directionally operate the automatic switch mechanism to extend connection from first said calling line

in the direction of a predetermined other line of the system.

39. In an automatic telephone system, a calling line, a dial calling device on the calling line having ten numeral finger-hole holds for sending impulses constituting an equal number of different numeral digits, wherein each said hold refers to a specific single digit, to operate switch mechanism of the system to extend calls away from the calling line, a set relay individual to the calling line, a switch on the calling line for initiating a call thereon and for maintaining the call initiated subject to the restoration of the switch, an additional finger hold depression of said dial for sending a specific series of impulses for operating and locking the set relay only under the condition of a call being initiated on the calling line, and means whereby effacing the initiated state of the calling line will not restore the set relay.

40. In a telephone system, a group of lines, a selective switch having successive access to the terminals of said lines, means for making certain of said lines busy, testing means for preventing said switch from stopping upon the terminal of a busy said line tested, means for causing the switch to stop upon the terminal of the first idle line tested, and means controlled over one of said lines for disabling said means for preventing the switch from stopping upon the terminal of a busy line.

41. In a telephone system, a group selecting connective switch, terminals of a group of lines, each said line individual to a said terminal, means for making certain of said lines busy, means whereby when said switch is operated into selective relation to said group said switch will thereupon operate to test over said group in predetermined order and stop upon the terminal of the first idle one of said lines tested, a set relay, and means operated over one of said lines for operating the set relay to thereby prevent said switch from thereafter testing certain lines of the group although all lines of the group having antecedent order were tested by said switch and found busy.

42. In a telephone system, a group selecting connective switch, terminals of a group of lines, each said line individual to a said terminal, means for making certain of said lines busy, means whereby when said switch is operated into selective relation to said group said switch will thereupon operate to test over said group in predetermined order and stop upon the terminal of the first idle one of said lines tested, a set relay, and means operated over one of said lines for operating the set relay to thereby curtail the number of lines subject to being tested over by the switch, regardless of the busy or idle state of the lines of the group.

43. In a telephone system, a group of sub-

scriber lines, switch means for successively testing the lines of said group in predetermined order and for appropriating the first idle line encountered for service to the subscriber's station, and means controlled over one of said lines from the subscriber's end of last said line for curtailing the number of lines of said group subject to a said appropriation, while the lines rendered non-subject to appropriation remain idle.

44. In a telephone system, a group of lines, switch means for appropriating all of said lines for coincident individual calls on the respective said lines, and a device operated over one of said lines from the end opposite the location of the switch means, for confining the calls to a curtailed number of specific lines of the group, regardless of the idle or busy state of the respective lines of the group.

45. In a telephone system, a group of lines, switch means for appropriating all of said lines for coincident individual calls on the respective said lines, a device operated over one of said lines from the end opposite the location of the switch means, for confining the calls to a curtailed number of specific lines of the group, regardless of the idle or busy state of the respective lines of the group, and means controlled over one of said lines from the end opposite the location of the switch means for effacing the operated state of said device to thereby render all said lines which are idle again subject to appropriation by the switch means.

46. In a telephone system, a calling line, a subscriber's line, a second subscriber's line, first switch means for linking connection from said calling line to first said subscriber's line, automatic switch mechanism for forwarding connection made to first said subscriber's line to said second subscriber's line, a directing device, means whereby when the call is effected to first said subscriber's line the directing device will thereupon operate to in turn direct the operation of the automatic switch mechanism to forward said connection to the said second subscriber's line, the operation of said directing device to forward the call being dependent upon a predetermined operation applied over first said subscriber's line antecedent to the connection from said calling line to first said subscriber's line.

47. In a telephone system, a calling line, a subscriber's line, a second subscriber's line, first switch means for linking connection from said calling line to first said subscriber's line, automatic switch mechanism for forwarding connection made to first said subscriber's line to said second subscriber's line, a directing device, means whereby when the call is effected to first said subscriber's line the directing device will thereupon operate to in turn direct the operation of the automatic switch mechanism to forward said con-

nection to the said second subscriber's line, and means for manifesting a momentary signal on the connection to indicate that the connection is one forwarded from a called subscriber's line, last said means operated responsive to the subscriber on said second called subscriber's line responding to the forwarded call.

branches for opening the Y branch to the station on the other of said branches.

48. In a telephone system, a calling line, first and second called lines, stations on the respective said lines, first switch apparatus for extending connection from the calling line to the station on said first called line, automatic switch mechanism, a call directing apparatus, and means whereby if a response is not made from the station on said first called line within a certain time after connection is extended thereto said automatic switch mechanism will be directly operated by said call directing apparatus to thereby link a connection to the station on the second called line from a point intermediate of the stations on the calling line and said first called line, forming a Y connection between the three said stations.

51. In a telephone system, a calling line, first and second called lines, stations on the respective said lines, first switch apparatus for extending connection from the calling line to the station on said first called line, a plurality of automatic switches, a call directing apparatus, and means whereby if a response is not made from the station on said first called line within a certain time after connection is extended thereto said plurality of automatic switches will be directly operated by said call directing apparatus to thereby link a connection to the station on the second called line from a point intermediate of the stations on the calling line and said first called line, forming a Y connection between the three said stations.

49. In a telephone system, a calling line, first and second called lines, stations on the respective said lines, first switch apparatus for extending connection from the calling line to the station on said first called line, automatic switch mechanism, a call directing apparatus, means whereby if a response is not made from the station on said first called line within a certain time after connection is extended thereto said automatic switch mechanism will be directly operated by said call directing apparatus to thereby link a connection to the station on the second called line from a point intermediate of the stations on the calling line and said first called line, forming a Y connection between the three said stations, and automatic means operable only after a certain elapsed time governed by said call directing apparatus for opening the Y branch extending to the station of the first called line.

52. In a telephone system, a calling line, first and second called lines, stations on the respective said lines, first switch apparatus for extending connection from the calling line to the station on said first called line, automatic switch mechanism, a call directing apparatus, a setting device, and means including said setting device operated prior to effecting said connection to said first called line and by control over said first called line for rendering last said means operable, whereby if a response is not made from the station on said first called line within a certain time after connection is extended thereto said automatic switch mechanism will be directly operated by said call directing apparatus to thereby link a connection to the station on the second called line from a point intermediate of the stations on the calling line and said first called line, forming a Y connection between the three said stations.

50. In a telephone system, a calling line, first and second called lines, stations on the respective said lines, first switch apparatus for extending connection from the calling line to the station on said first called line, automatic switch mechanism, a call directing apparatus, means whereby if a response is not made from the station on said first called line within a certain time after connection is extended thereto said automatic switch mechanism will be directly operated by said call directing apparatus to thereby link a connection to the station on the second called line from a point intermediate of the stations on the calling line and said first called line, forming a Y connection between the three said stations, and automatic means controlled over one of said

53. In an automatic telephone system, a calling line, a called line, a receiving line, first automatic switch mechanism for extending connection from the calling line to the called line, a call directing apparatus, second automatic switching mechanism, and means including the call directing apparatus and said second automatic switching mechanism whereby the calling line will become directly linked through said second automatic switch mechanism to the receiving line unless prevented responsive to control over said called line within a certain time after connection is made to said called line.

54. In an automatic telephone system, a calling line, a called line, a receiving line, first automatic switch mechanism for extending connection from the calling line to the called line, a call directing apparatus, second automatic switching mechanism, means including the call directing apparatus and said second automatic switching mechanism whereby the calling line will become directly linked through said second automatic switch mechanism to the receiving line unless

prevented responsive to control over said called line within a certain time after connection is made to said called line, and automatic means operated independent of control over the calling line for destroying connection to said called line.

55. In a telephone system, a subscriber's line, called lines, automatic switch mechanism, means on the subscriber's line for directing the automatic switch mechanism to extend a connection from the subscriber's line to a desired one of the called lines, a calling line, switch mechanism for extending a connection from the calling line to the terminals of the subscriber's line, and pre-setting means directly set by control over the subscriber's line for causing the automatic switch mechanism to be directly operated to further the connection effected to the subscriber's line to a predetermined one of said called lines via the terminals of the subscriber's line, responsive to effecting said connection to the subscriber's line only if said pre-set condition ensues.

56. In a telephone system, a subscriber's line, called lines, automatic switch mechanism, means on the subscriber's line for directing the automatic switch mechanism to extend a connection from the subscriber's line to a desired one of the called lines, a calling line, switch mechanism for extending a connection from the calling line to the terminals of the subscriber's line, pre-setting means directly set by control over the subscriber's line for causing the automatic switch mechanism to be directly operated to further the connection effected to the subscriber's line to a predetermined one of said called lines via the terminals of the subscriber's line, responsive to effecting said connection to the subscriber's line only if said pre-set condition ensues, and a meter individual to the subscriber's line and the calling line, respectively, coincidentally operated responsive to a response occurring on the called line.

57. In a telephone system, a subscriber's line, called lines, automatic switch mechanism, means on the subscriber's line for directing the automatic switch mechanism to extend a connection from the subscriber's line to a desired one of the called lines, a calling line, switch mechanism for extending a connection from the calling line to the terminals of the subscriber's line, pre-setting means directly set by control over the subscriber's line for causing the automatic switch mechanism to be directly operated to further the connection effected to the subscriber's line to a predetermined one of said called lines via the terminals of the subscriber's line, responsive to effecting said connection to the subscriber's line only if said pre-set condition ensues, and a meter for the subscriber's line operated responsive to a response on a called line to which the subscrib-

er's line may be connected, regardless of whether the call has been directed from the subscriber's line or said calling line.

58. In a telephone system, a subscriber's line, called lines, automatic switch mechanism, means on the subscriber's line for directing the automatic switch mechanism to extend a connection from the subscriber's line to a desired one of the called lines, a calling line, switch mechanism for extending a connection from the calling line to the terminals of the subscriber's line, pre-setting means directly set by control over the subscriber's line for causing the automatic switch mechanism to be directly operated to further the connection effected to the subscriber's line to a predetermined one of said called lines via the terminals of the subscriber's line, responsive to effecting said connection to the subscriber's line only if said pre-set condition ensues, and a supplemental meter for recording only the calls made via the said terminals of the subscriber's line and not for calls originating on the subscriber's line, responsive to a response on the called line.

59. In a telephone system, a telephone line, called lines, automatic switch mechanism, means on the telephone line for directing the automatic switch mechanism to extend a connection from the telephone line to a desired one of the called lines, a calling line, switch mechanism for extending a connection from the calling line to the terminals of the telephone line, an impulse sending mechanism, a set relay, means for directing the set relay by control over the telephone line to prepare the impulse sending mechanism for directing the automatic switch mechanism to further the connection effected to the telephone line to a predetermined one of said called lines via the telephone line responsive to effecting said connection to the telephone line only if said set relay is in its set condition.

60. In a telephone system, a telephone line, called lines, automatic switch mechanism, means on the telephone line for directing the automatic switch mechanism to extend a connection from the telephone line to a desired one of the called lines, a calling line, switch mechanism for extending a connection from the calling line to the terminals of the telephone line, an impulse sending contact-set, a sending mechanism for directing the impulse sending contact-set, a set relay, means for directing the set relay by control over the telephone line to prepare the sending mechanism for introducing the impulse sending contact-set into the connection and for thereupon directing the automatic switch mechanism to further the

connection effected to the telephone line to a predetermined one of said called lines via the telephone line and thereupon restore the sending contact-set from the connection, responsive to effecting said connection to the telephone line only if the set relay is in its set condition.

61. In a telephone system, a service line, a telephone line, switch mechanism for extending connection to terminals of the service line, automatic switch mechanism for extending connection from the terminals of the service line to the telephone line, and call directing means made effective only if a response is not made within a certain time after connection is made to said terminals for directively operating the automatic switch mechanism to complete a connection from the first said switch mechanism to the telephone line, while maintaining the first said switch mechanism in connection with said terminals.

In witness whereof, I hereunto subscribe my name this third day of September, 1927.

HERBERT M. FRIENDLY.