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E. P. G. WRIGHT

1,829,774

AUTOMATIC OR SEMIAUTOMATIC TELEPHONE SYSTEM

Filed May 26, 1930

3 Sheets-Sheet 1

FIG. 1

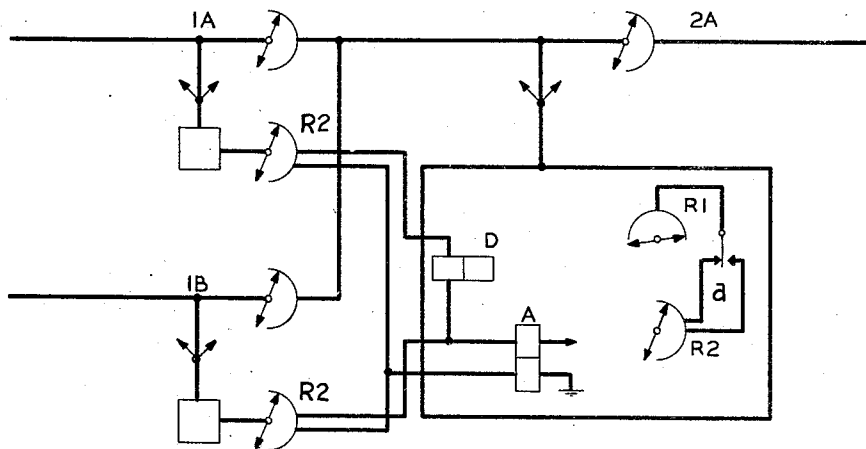
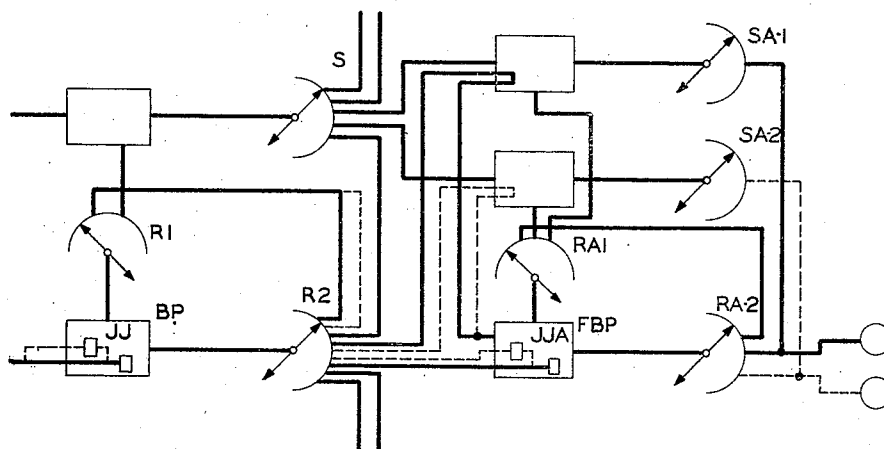


FIG. 2



INVENTOR
ESMOND P.G. WRIGHT
BY *F. Hutchinson*
ATTORNEY

Nov. 3, 1931.

E. P. G. WRIGHT

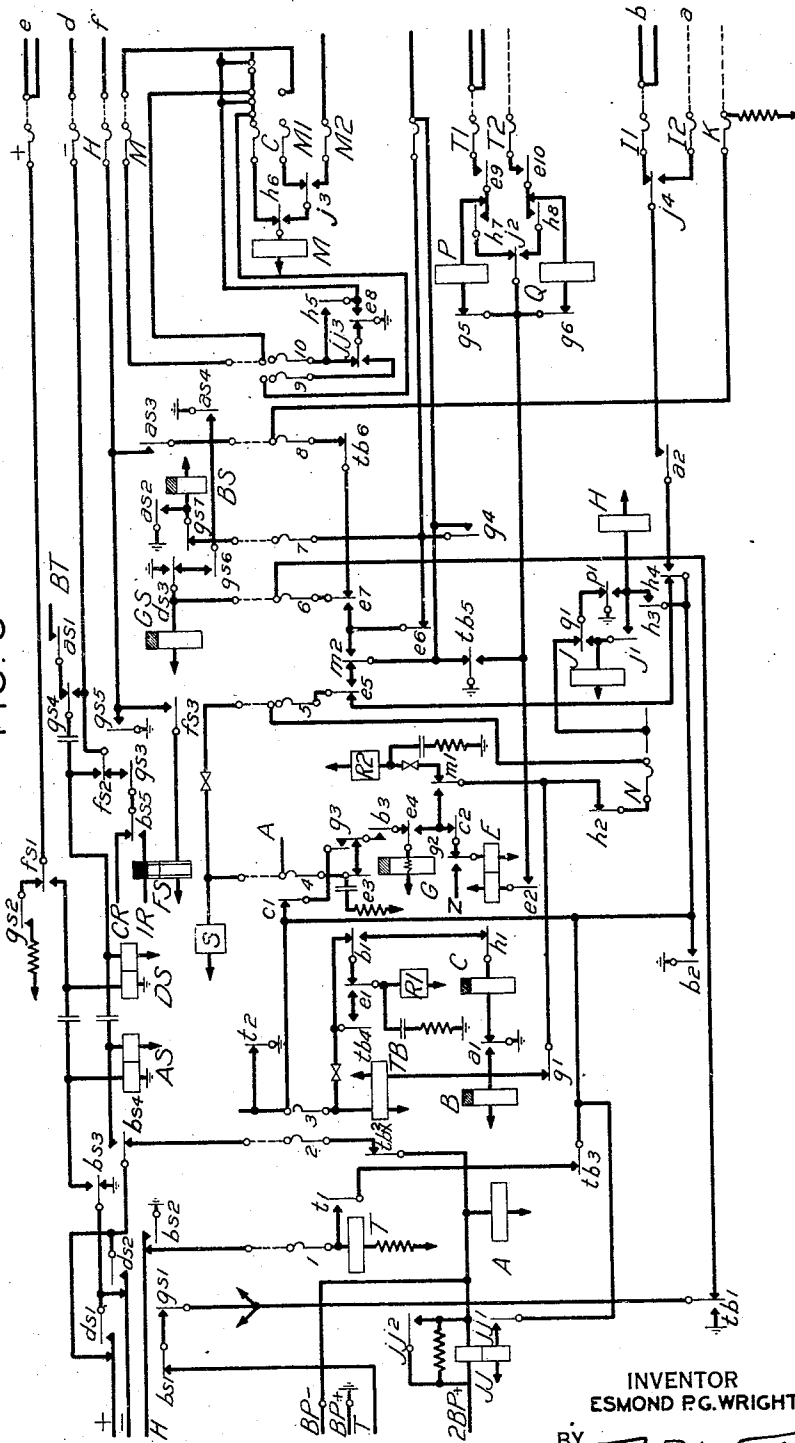
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3 Sheets-Sheet 2

FIG. 3



INVENTOR
ESMOND P. G. WRIGHT

BY *J. Hutchinson*
ATTORNEY

Nov. 3, 1931.

E. P. G. WRIGHT

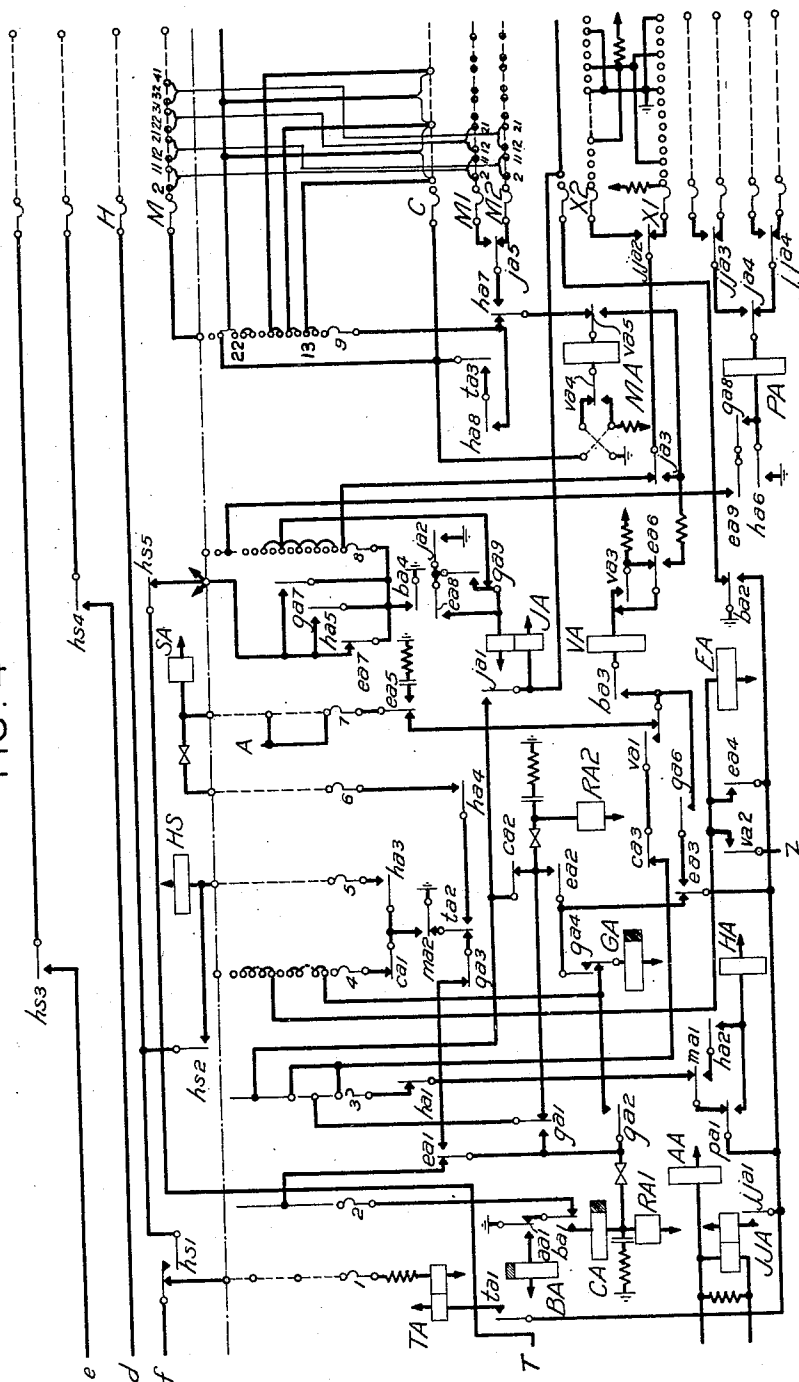
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3 Sheets-Sheet 3

FIG. 4



INVENTOR
ESMOND P.G. WRIGHT

BY F. Hutchinson
ATTORNEY

UNITED STATES PATENT OFFICE

ESMOND PHILIP GOODWIN WRIGHT, OF ALDWYCH, LONDON, ENGLAND, ASSIGNOR TO
INTERNATIONAL STANDARD ELECTRIC CORPORATION, OF NEW YORK, N. Y.

AUTOMATIC OR SEMIAUTOMATIC TELEPHONE SYSTEM

Application filed May 26, 1930, Serial No. 455,637, and in Great Britain June 5, 1929.

This invention relates to automatic or semi-automatic telephone systems, in which means is provided at one or more selecting stages to determine in part the outlet or group of outlets to be tested in accordance with the path of entry into the switch.

The main feature of the invention comprises a circuit arrangement for an automatic or semi-automatic telephone exchange system comprising selector switches, characterized in this, that discriminating means is provided which is associated in common with a plurality of said switches and which is adapted to be operated variably in accordance with the path of access used in setting up a connection.

The invention will be described with respect to a selector system in which the conversational switches are arranged in groups each group being associated with a single control circuit.

The control circuit comprises two switches, one of which is a marking switch, and the other a selecting switch.

The marking switch is set in response to digital impulses and marks an outlet or group of outlets in the banks of the selecting switch, which in turn marks the selected idle or wanted outlet in the banks of the conversation switch in use. After the first switch has performed its marking function, it hunts for the selected conversation circuit and connects the control circuit thereto. A temporary bye-path is set up through the second switch in the succeeding bye-path.

The bye-path or selector switch selects an idle bye-path control circuit together with an associated idle conversation circuit in the succeeding selector stage and forms a temporary bye-path circuit to the succeeding control circuit. All the switches used are of the single-motion type.

Fig. 1 shows schematically the lay-out of a system of the kind referred to with a common switching stage and conversational and bye-path routes.

Fig. 2 shows a selector stage connected to one of a plurality of final stages each comprising two groups of switches in parallel.

Fig. 3 shows a conversational switch and bye-path circuit at an intermediate stage.

Fig. 4 shows a final conversational switch and bye-path circuit.

The problems to which the embodiment of the invention to be described relate concern the provision of switching means for obtaining access to stations or trunks the traffic to which is small, and for which therefore a small number of access switches are required. Instances that may be given are special service stations such as complaint, enquiry, and fault operators, and junctions leading from a town exchange to a number of exchanges the traffic to which is small.

The former case will be discussed in more detail with reference to Figure 1 of the accompanying drawings. In this case traffic from two directions through switches 1A, 1B is combined to pass through a common switching stage 2A, conversational and bye-path routes being shewn in each case.

It will be supposed that the switching stage 2A is reached over two or more different outlets or groups of outlets of the switching stages 1A, 1B, and that the digits dialled into or through 2A may be identical for different stations reached thereover. It will be seen therefore that discrimination is necessary in 2A in accordance with the outlet from the preceding stage.

The control or bye-path circuit associated with 2A is taken into use from the R2 or selector switch of 1A or 1B, and relay A alone, or relays A and D are operated. Relay D is the discriminating relay, the marking switch R1 marking its R2 switch differently in accordance with the position of contact *d*.

It will be appreciated that if the stage 2A is a final stage for example, certain of the digit combinations, which could be used therein may not be required in which case fewer outlets than usual would be necessary therefrom.

In the particular example to be described with reference to Figures 2, 3 and 4 of the accompanying drawings, of which Figure 2 is a layout drawing, the invention is described with reference to an automatic or semi-auto-

matic system in which connection is set up or completed over a selector stage to one of a plurality of final stages each comprising two groups of switches in parallel. Common
 5 bye-path circuits are provided at each stage. These switching stages are provided to deal with calls in a number of thousand groups—as shewn in two such groups—in which numbers in two only of the hundred-groups of
 10 each thousand, or two hundred numbers in all distributed in more than two of the hundreds groups of each thousand, are used.

In a call from an operator, the thousands digit is not dialled, but a key is thrown individual to the thousands digit, so that the bye-path circuit associated with the selector stage is seized over a route indicative of said digit. If the selector stage is seized from a preceding selector stage, the path of access there-
 20 from is again indicative of the thousands digit.

In the particular example, with two alternative paths of access relay JJ in the bye-path is or is not operated in accordance with
 25 the path used; operation of JJ would alter the marking circuit between switch R1, R2 so as to mark groups of outlets to the required group in the final stage. When a digit is dialled switch R1 is stepped, while switch R2 chases and afterwards hunts for an idle outlet
 30 in the required group. Switch R1 meanwhile hunts in the second part of its bank for the trunk taken into use, and the conversational switch S then hunts for the outlet marked by switch R2. The final bye-path
 35 circuit FBP is seized over one of two paths of access which correspond to the two sets of switches in the final selector stage, and relay JJA is adapted to operate over one of
 40 said paths.

The final digits are dialled to switch RA1 which marks RA2 and RA1 then finds the final conversational switch marked from the preceding stage. Switch RA2 like all the
 45 other by-path switches is a 50 point switch, while the conversational switches may be double-wiper 50-point switches serving one hundred outlets. Switch RA2 has four test wipers, one pair being chosen in accordance
 50 with the path of access by relay JJA, and the required one of the pair in accordance with the odd or even value of the first digit dialled to the final stage.

It will be understood that the description
 55 in this specification is given by way of example only and that the invention is capable of any desired variation within the scope of the appended claims.

The example described generally with reference to Figure 2 above will now be described in detail with reference to Figures
 60 3 and 4.

An operator tests for a free trunk associated with a free bye-path circuit over a circuit from conductor T, contacts *bs1*, *gs1*, *tb1*,

wiper 6, and home contact of switch R1, *e7*, *tb6*, wiper 8 and home contact of switch R2 to battery. The contacts *bs1* and *gs1* are normal contacts individual to the trunk while the remaining
 65 contacts and wipers indicate the free condition of the bye-path circuit. When the operator seizes the trunk a circuit is formed for relay A over one of two circuits in accordance with a key operation on the part of the operator. Thus, relay A will be energized either in a circuit from earth via conductor BP+, the operators dialling loop, conductor BP-, winding of relay A to battery,
 70 or alternatively, from earth over the operators dialling loop as before to conductor 2BP-, through the upper winding of relay JJ, winding of relay A to battery. Thus, in response to an action on the part of the operator or in accordance with the thousands digit, the relay JJ is or is not operated in order to give discrimination in this switching stage. The operation of relay A closes an obvious circuit for relay B, which pulls
 75 up and closes a circuit for relay TB through the wiper 3 and home contact of the switch R1 to ground to *b2*. Contacts *tb1* connect ground potential to the bye-path test conductor. At the first impulse relay A releases and closes the following circuit: battery and winding of the magnet R1, *a1*, *b1*, *h1*, winding of the relay C, *a1* to ground. Relays B and C are both of the slow to release type and relay B does not therefore release during impulsing. Relay C operates on the first impulse and remains operated throughout impulsing. The magnet R1 takes one step for each impulse received. When the switch R1 reaches the position 2, a circuit is closed for the magnet R2 through its interrupter springs, *m1*, *h2*, wiper and home contact N of the switch
 80 R2, the second bank contact and wiper 5 of the switch R1, *h5*, *h4*, *b2* to ground. The switch R2 takes one step and opens this circuit, substituting ground through *p1*, *q1* and off normal contacts of its bank N. The switch R2 has access to ten groups of outlets, and as the switch has two sets of wipers M1, T1, I1, and M2, T2, I2 and two sets of contact banks the groups are each split into two portions, which are arranged in corresponding positions in the two contact banks. Thus, if the first group comprises ten outlets, five outlets are connected to contacts 2—6 in one set of contact banks, contact 1 being the home position, and the other five outlets are connected to contacts 2—6 in the other set of contact banks. A single marking bank C is provided for switch R2 since the groups start on corresponding contacts in both sets of contact banks. The groups do not correspond to ten different values of the digit received by R1, since half these groups correspond to one path of access and the other half to the other path of access, and corresponding

groups in each half have the same digital value. Thus, the first group in bank C of R2 is marked by contact 2 in bank 9 of R1, the second group in bank C by contact 2 of bank 10 of R1, the third and fourth groups in bank C by contacts 3 in banks 9 and 10 respectively, and so on. The discriminating relay JJ decides which set of marking conductors is to be used by its contacts *jj3* in accordance with the path of access used. The R1 switch will be set to one of positions 2—6 for instance in accordance with the number of tens-impulses received and each of these positions in banks 9 and 10 of R1 is connected by a marking conductor to the contact in bank C of R2 corresponding to the first outlets of the different groups; for example, contact 2 of bank 9 of R1 to contact 2 of bank C of R2, and contact 2 of bank 10 of R1 to contact 7 of bank C of R2, and so on. After the switch R2 is set to the correct group of outlets it hunts for an idle outlet as will be described, but if all the outlets are busy, it is necessary to prevent the switch continuing to hunt for an idle outlet in the next group. For this purpose the contacts in the bank C of R2 corresponding to the last outlets of each group in the banks of R2 are multiplied together and are connected to the front contact of armature *e8* of relay E to form a circuit, the closure of which stops the switch as described below if all the outlets in a group are busy.

The digital values designating the groups of outlets from R2 may be any desired five values out of the possible ten, thus values 2, 4, 5, 9, 0 might be used, according to circumstances. It may be that two or three groups of outlets only are required for each path of access in which case, two or three contacts only in banks 9 and 10 of R1 will be used for marking purposes. When the R2 switch starts stepping it will in time reach a position in which a circuit will be completed for the relay M through *h6*, wiper and bank contact C, bank contact and wiper 10 for instance, *jj3*, *e8* to ground. This will cause the operation of the relay M and the opening of the driving circuit of the magnet R2 by *m1*. If further impulses are received the subsequent operation of the switch R1 will open the circuit of relay M thereby permitting the switch R2 to continue stepping. When the digit is finished, and R2 finds the contact finally marked by R1, relay M again energizes and will therefore open the driving circuit of R2 as already explained. When the slow relay C releases, a circuit will therefore be completed for the relay E through contacts *g2*, *e2*, *m1*, *h2*, the wiper N and its off normal arc *q1*, *p1* to ground. The relay E closes a circuit for the switch R1 through contacts *e1*, *tb4*, interrupter springs, wiper and off normal bank contact 3, *t2* to ground. The switch R1 continues stepping until the

relay T operates over a circuit which will be described later. Relay E also closed the testing circuit for relays P and Q at *e9*, *e10* and opened at *e8*, the operating circuit of relay M. The release of relay M closes the circuit for the switch R2 and as a result the outlets will be tested two at a time. The contacts in the banks T1, T2 will be connected to the test wires T of the corresponding final conversational switches. If all the outlets are busy relay M will re-operate at the last set of terminals of the group of contacts over *h6*, wiper and bank contact C of the switch R2, *e8* to ground. A circuit is then closed for relay G through contacts *e4*, *m1*, *h2*, wiper and off-normal arc N, *q1*, *p1* to ground. Relay G is of high resistance and slow to operate and consequently a time period is provided to enable relay P and Q to operate if there is a circuit for them. The operation of relay M prevents R2 taking any further steps. If one of the outlets searched over by the wiper T1 is free, relay P will be operated from battery in the succeeding bye-pass switch over bank contact and wiper T1, *e9*, *h7*, winding of relay P, *g5*, *tb5* to ground. Relay P closes the circuit for the relay H at *p1* and contact *h7* then opens the circuit of relay P and places a ground potential from *tb5* on the test wire, contact *h8* opens the operating circuit of relay Q, and contacts *h5* and *h6* prepare a marking circuit for the conversational switch. Contacts *h4* close an impulsing circuit to the succeeding bye-pass, contact *h3* provides a locking circuit for the relay H to earth at *b2*, contact *h2* opens the operating circuit of relay G and contact *h1* opens the local impulsing circuit. If one of the outlets searched over by the wiper T2 was found to be free relay Q would have operated in a similar manner, operating relay J over the obvious circuit and relay H over contacts *j1*, *q1*, *p1*. Relay J provides a wiper discrimination and when operated the forward impulsing circuit and the marking circuit would be switched over to the required set of contacts. If relays P and Q operate simultaneously, there will be no circuit for relay J and relay H will operate alone. It will be seen that corresponding contacts in both marking levels I1, I2 lead over the same path of access to the final by-pass.

The operation of relay T will take place when the switch R1 reaches the contact corresponding to the conversational switch which has been predetermined. As already explained the ground potential is placed on the hold conductor which is extended over contacts *bs2* to the bank contact of the wiper 1 of switch R1. Relay T in operating opens the obvious circuit for the relay TB and closes a locking circuit through contacts *t1*, *tb3* and *b2* to ground. The release of relay TB also removes ground from the bye-pass test conductor thus releasing supervisory

lamps at the operator's position or if the call is through a previous bye-pass, the latter is released. Contacts *tb5* complete a driving circuit for the magnet S of the conversational switch through its interrupter springs, bank contact and wiper 5 of the switch R1, contacts *e5*, *m2*, *tb5* to ground. The contacts searched over by the M wiper of the conversational switch are multiplied to the contacts searched over by the wipers M1 and M2 of the switch R2 and when the conversational switch has been stepped to the outlet corresponding to that which has been seized by the switch R2, a circuit will be closed for relay M through contacts *h6*, *j3*, wiper and bank contact M1 or M2, bank contact and wiper M of conversational switch, bank contact and wiper 10 of the switch R1, *h5*, *e8* to ground. Contacts *m2* open the driving circuit of the selector S and close a circuit through *e7*, wiper 6 and bank contact of switch R1 and relay GS, which will operate. Relay GS completes a circuit from the continuous ringing lead CR through *bs5*, *gs3*, *fs2* to the negative wiper and from the positive wiper to contacts *fs1*, *gs2* to the ringing tone battery. No current will, however, pass over these contacts until the final selector has made connection with the called line. As has already been described, if all the outlets in the wanted group are engaged, relay G will be operated and on the release of relay TB ground will be extended through contacts *tb5* and *g4*, wiper and bank contact 7 and thence to the relay BS which will operate. Contacts *bs3* and *bs4* complete a loop circuit for relay AS which will also operate. Contacts *as2* provide an alternative circuit for the relay BS. Busy tone is fed to the calling party by means of contacts *as1*, *gs4*, return condenser to the negative line.

If relay JJ was operated it will lock over its second winding at contacts *jj1* to ground at *b2*. Contacts *jj2* provide a short circuit across the operating winding of JJ to prevent distortion of impulsing. The operation of relay JJ opens the marking circuit over the bank contacts of the switch R1 and bank contacts C of the switch R2 and completes similar circuits over the contacts 9 of the switch R1 and contacts C of the switch R2. As a result the switch R2 will be guided to a different set of contacts when the relay JJ has been operated.

Fig. 4 shows the final conversational switch and bye-path which has been seized over the bye-path test conductor from battery, home contact and wiper X1 of the switch R2 *ja2*, *ja3* home contact and wiper 8 of the switch R1, contacts *ea7*, *hs5* to the bye-path test lead leading to the previous switches. In accordance with the path over which the final selector has been seized, the impulsing relay AA of the final bye-path will be operated via wiper I1 or I2, *j4*, *a2*, *b2* to earth, either alone

or in series with relay JJA. Relay AA closes the obvious circuit for relay BA and at the first set of impulses a circuit is closed for the magnet RA1 through the winding of relay CA, contacts *ba1*, *aa1* to ground. Bank contacts 2 and 3 of the bank 9 of the switch RA1 are wired to bank contact 2 of the bank C of the switch RA2; in a similar way contacts 4 and 5 are wired to contact 12 and contacts 6 and 7 to the contact 22. The magnet RA2 commences stepping as soon as the switch RA1 steps off-normal through contacts *ga1*, first off-normal arc and wiper 3 of the switch RA1, contacts *ha1*, *ma1*, *pa1*, and *ba2* to ground. When the switch RA2 reaches the position marked by the switch RA1 after the train of impulses is completed a circuit is completed for relay MA from battery on wiper C of the switch RA2, bank contact and wiper 9 of the switch RA1, *ha7*, *va5*, winding of relay MA, *va4* to ground.

At the end of the first series of impulses the relay CA will release and close the following circuit for the relay GA; battery and windings of GA, *ga4*, bank contact and wiper 4 of the switch PA1, *ca1*, *ma2* to ground. Relay GA will lock up via contacts *ga4*, *ea3* to ground at *ba2*. Relay GA closes the circuit for the magnet RA1 through its interrupter springs, contact *ga2*, contact and wiper 4 of the switch RA1, *ca1*, *ma2* to ground, and when relay MA releases due to the movement of the switch RA1 a further stepping circuit is formed over *ga1*, bank contact and wiper 3 of the switch RA1, *ha1*, *ma1*, *pa1*, *ba2* to ground. The circuit for the magnet RA1 is opened when wiper 3 reaches position 12 and this switch waits in this position for the units impulses to be dialled. The switch RA1 is adapted to control the selection of the wanted line in the selected groups in RA2 by marking conductors which extend in multiple from the positions in bank 9 to which RA1 is set by the units impulses to the individual contacts in the groups in bank C of RA2. As stated, the switch RA1 is in position 12 awaiting the units impulses, and steps to one of the positions 13—22 in accordance with the value of the units digit.

The groups in RA2 comprise contacts 2—11, 12—21, —42—51 and the contacts in bank 9 are multiplied to bank C as follows: contact 13 in bank 9 to contacts 3, 13—43 in bank C, contact 14 to contacts 4, 14—44, and contact 21 to contacts 11, 21, —51. Contacts 2, 12—42 in bank C correspond to units value "0", and as RA2 is set to the required one of these positions in response to the tens digit, switch RA2 must not move in response to the units digit if its value is "0". For this purpose, contact 22 of bank 9 which corresponds to units digit "0" is connected as shown to operate test relay MA immediately if "0" is dialled as described below. Position 22 is connected to contacts *ta3* for a

purpose which will be described later. When the units impulses commence a circuit is closed for the magnet RA1 and this switch will step forward one step for each impulse.

When relay CA which is of the slow release type releases at the end of the units impulses a circuit is closed for the magnet RA2 through its interrupter springs, contacts *ca2*, second contact arc (covering contacts 13—22) and wiper 3 of the switch RA1, contacts *ha1*, *ma1*, *pa1*, *ba2* to ground and switch RA2 continues stepping until the circuit already described for MA is again closed. If the units digit was "0", relay MA would operate immediately RA1 reached position 22; earth, *va4*, MA, *ha7*, wiper 9, contact 22, battery. The operation of MA would prevent switch RA2 stepping on, so that the switch would remain on the first contact of the group which corresponds to units digit "0". When relay MA does operate the following circuit is closed for relay EA; battery and winding of the relay EA, bank contact and wiper 4 of the switch RA1, contacts *ca1*, *ma2* to ground. Relay EA locks up over contacts *ea3* to ground. The operation of the relay EA opens at *ea3*, the locking circuit of the relay GA. This relay is of the slow to release type and does not release immediately. Meanwhile a circuit is closed from ground, *ba4*, over the wiper and bank contact 8 of switch RA1, *ea9*, *ga8*, winding of relay PA, *ja4*, *jja4* to the test wiper. The operation of relays JA, JJA in controlling the test circuit, will be described later. If the line called is free relay PA will operate, contact *pa1* closing the obvious circuit for relay HA which will be provided with a locking circuit through contacts *ha2*. When the conversational switch is found, as described later, ground is connected to the hold wire due to the operation of HS. The contact on which wiper H then stands is multipled to the contact of RA2 to which relay PA is connected so that PA will then be short-circuited but HA will hold via *ha2*, *ma1*, *pa1*. It will be seen that the contact *ga7* extends ground from *ba4* to the bye-path test conductor after relay EA operates opening the path through contacts *ea7*. Contacts *ha5* replace the path which will be opened when the relay GA releases due to the operation of relay EA and contacts *ha7* open the circuit of relay MA which release. If the called subscriber's line is busy the release of relay GA will remove the ground from the bye-path test conductor at *ga7* thereby opening the locking circuit for relay E in the penultimate bye-path since relay HA is not operated. The release of relay E closes the circuit for relay BS over *gs7* the bank contact and wiper 7 of the switch RA1 contact *ea6*, *ma2*, *tb5* to ground. As already explained relay BS closes the circuit for the relay AS and applies busy tone to the calling line.

When the switch R1, Fig. 3, made connection with the selected path, a relay was operated at the operator's position, so that the bye-path circuit for A was broken, and A was held via *tb2*, wiper 2, *bs4*, operator's position, *bs3*, earth. The operation of *bs4* opens the circuit for relay A which in turn opens the circuit for relay B and thereby releases the bye-pass and the final selector. If relay HA in the final bye-pass operates due to the called subscriber's line being free the switch RA1 will again step, when the relay GA releases, over its interrupter springs, contacts *ea1*, *ga3*, *ta2*, *ma2* to ground until it reaches the conversational switch indicated by a ground potential on the hold conductor. This circuit may be traced from battery, right hand winding of the relay TA, non-inductive resistance, wiper and bank 1 of the switch RA1, contacts *hs1*, bank contact and wiper H of the penultimate conversational switch, *gs5* to ground. Relay TA locks up over its second winding *ta1*, to ground at *ba2*. The relay TA also closes the following circuit for the final selector switch SA through its interrupter springs, bank contact and wiper 6 of the switch RA1, *ha4*, *ta2*, *ma2* to ground. The switch SA has access to all the lines tested by RA2 and the contacts corresponding to the same line in bank M of SA and banks M1, M2, of RA2 are connected by marking contacts. The final selector hunts for the line selected by RA2 and when this is found a circuit is closed for the relay MA; ground, *va4*, winding of the relay MA, *va5*, *ha7*, *ja5*, wiper and bank contact M1 or M2 of the switch RA2, the bank contact and wiper M of the final selector, bank contact 9 of the switch RA1, *ha8*, *ta3*, to battery. Relay MA opens the driving circuit of the final selector and closes the obvious circuit for relay HS through wiper 5 of switch RA2, contacts *ha3* and *ma2* to earth. Relay HS switches through the positive and negative conductors and continuous ringing is extended from the penultimate path to the subscriber's line. Relay HS locks up over contacts *hs2*, wiper and bank contact H of the conversational switch to the ground supplied to the test wire over contact *ha6*. The ground on the hold wiper is also extended by the operation of contacts *hs1* to the hold wiper of the penultimate path. Contact *hs5*, however, opens the bye-pass test conductor thereby dropping relay E in the penultimate bye-pass. The release of relay E in the penultimate bye-path opens the circuit of relay GS which is slow to release and thereby provides a period during which ringing current is supplied to the called party. This ensures that ringing tone is applied immediately the connection is switched through and obviates the possibility of delay which occurs when only interrupted ringing is supplied. When the relay GS has released a

circuit is completed for relay BS through the contacts *gs7*, bank contact and wiper 7 of the switch RA1, *e6*, *m2*, *tb5* to ground. Relay BS completes the circuit of relay AS and as a result GS is re-operated from ground on the hold wire through contacts *as3*, bank contact and wiper 8 of the switch RA1, contacts *tb6*, *e7* wiper and bank contact 6 of the switch RA1, windings of GS to battery. A locking circuit is provided for GS through the contacts *gs6* *as4* to ground. The operation of relay GS completes the circuit for the interrupted ring lead IR through the upper winding of ringing trip relay FS, *bs5*, *gs3*, *fs2*, negative wiper, subscriber's bell, positive wiper, *fs1*, *gs2* to ringing tone battery. When the subscriber answers relay FS trips and locks on its second winding through contact *fs3*, *gs5* to ground. A circuit is now completed for the relay DS from battery, one winding of relay DS, *fs2*, subscriber's loop, *fs1*, second winding of DS to ground. Contacts *ds1* and *ds2* reverse the battery in the calling subscriber's loop for the purpose of metering and supervision. The relay DS also provides a locking circuit for the relay GS at the contact *ds3*. If the calling subscriber releases before the called subscriber releases relays AD and BS will release but relay DS will hold GS operated thereby keeping open the bye-path test wire. The preceding switches will be released by contacts *bs2*. If the called subscriber releases first relay DS only will release.

As already described an alternative impulse circuit from the penultimate bye-path is provided introducing relay JJA which will operate in series with the relay AA. If relay JJA is operated in series with relay AA it will lock up over its second winding to ground at *ba2*. The purpose of relay JJA is to discriminate in accordance with the value of the hundreds digit, and it is arranged that the final bye-path represented in Fig. 4 operates in conjunction with a plurality of final conversational switches such as that shown in Fig. 4 serving 100 lines and a further plurality of conversational switches serving another 100 lines. No discrimination is effected on the bye-path test conductor in the final bye-path but the subsequent operation or failure to operate the relay JJA discriminates which 100 lines is required. Four test wipers are provided each searching over 50 lines and suitably controlled by contacts *ja4*, *jja3*, and *jja4*. As explained relay JJA determines the 100 lines whereas relay JA is used to determine whether the tens are odd or even. This discrimination is effected in the following manner. Contact positions of bank 8 of the switch RA1 are wired via *ga9* to relay JA and ground from *ba4* is connected to this wiper. Relay JA will operate and release as the switch is stepping forward

and if operated when the relay GA operates JA will remain locked through contacts *ga9*, *ja2* to ground and subsequently *ea8* and *ja8* to ground. If relay JA is released when relay GA operates it will not operate subsequently. Provision is made for a maximum of 50 P. B. X. lines in each 100 contacts, *jj2* determining whether the test shall be made over wiper X1 or X2. The P. B. X. lines all have odd tens digits, so that *ja3* is operated for P. B. X. calls. The bank contacts M of both groups of final selectors are marked from levels M1 and M2 of the switch RA2 and no discrimination by relay JJA is necessary since the required final conversation switch has already been selected. In order that the final bye-path shall not be held indefinitely by a fault or the failure of a subscriber's dial, a ground pulse conductor A is provided and, when the switch RA is in the home position, is connected through wiper 7, contacts *ea5*, *va1*, *ba3* to the winding of relay VA and thence through contacts *ea6* to battery.

If the line called had been the first of a P. B. X. group relay JA would be operated and a circuit would be provided from battery, bank contact and wiper X1 or X2 of the switch RA2, *jja2*, *ja3*, *ea6*, normal contacts controlled by armature *va3*, winding of the relay VA, *ba3*, *ga6*, *ea3*, *ba2*, ground. Relay VA operates and locks to battery at *va3*. The operation of *va5* opens the circuit of relay MA thereby reclosing the operation circuit of RA2 through its interrupter springs, *ca2*, bank contact and wiper 3 of switch R1, *ha1*, *ma1*, *pa1*, *ba2*, to ground. The testing circuit of the relay PA is maintained as switch RA2 steps forward. If a free line is found relay PA operates and the subsequent operations are as already described for a regular line. If all the lines in the group are engaged a circuit will be closed for relay MA from battery *va4*, winding of MA, *va5*, *ja3*, *jja2*, wiper and bank contact X1 or X2 of the switch RA2 to ground. The operation of relay MA opens the driving circuit for RA2, and at the same time the hold circuit for relay GA which after a period will release removing the ground from the bye-path test conductor at *ga7* and causing the operation of relay BS in the penultimate path as already described. If any line in a P. B. X. other than the first is called relay VA will not operate and only one line will be tested.

What is claimed is:

1. In or for an automatic or semi-automatic telephone system, a group of conversational switches each of which is accessible over a plurality of different paths and is adapted to be positioned in response to a digit or digits, and a discriminating means common to said group of switches which is adapted to be temporarily connected to any

one of said switches to be used in setting up a connection and to be operated, in accordance with the path of access used to determine in part the selection of the wanted outlet or outlets of the said switch.

2. In or for a telephone system, a group of conversational switches with access to a group of outlets or lines, another group of conversational switches with access to a different group of outlets or lines and an auxiliary control circuit which is associated with both groups of switches and which comprises discriminating means adapted to operate when the said circuit is in use for setting up a connection over any one of said switches in a manner distinctive to the particular group of switches involved.

3. A telephone system comprising a group of conversational switches, a plurality of different paths over which each of said switches is accessible, and discriminating means common to said group of switches adapted to be connected to any one of said switches in response to the initiation of a call thereover, to be operated in accordance with the path over which the call is made and to be released upon the establishment of the call.

4. A telephone system comprising a group of conversational switches, adapted to be set by series of impulses, a plurality of paths over which each of said switches is accessible, and discriminating means common to said group of switches adapted to be connected to any one of said switches in response to the initiation of a call thereover and to be operated prior to the receipt of said series of impulses, in accordance with the path over which the call is made.

5. In or for an automatic or semi-automatic telephone system, a number of conversational switches, a plurality of control circuits each of which is associated in common with a number of said switches and comprises a marking switch, a plurality of paths of access to said selector switches and associated control circuits and discriminating means in the control circuit which is adapted to be operated in response to the path of access over which the common control circuit is taken into use, said marking switch being adapted to mark different outlets or groups of outlets from the said selecting stage in response to the same digit or digits received thereby in accordance with the setting of the said discriminating means.

6. In or for an automatic or semi-automatic telephone system, a selector stage comprising conversational switches and a plurality of bye-path control circuits each of which is associated in common with a plurality of conversation switches and comprises a marking switch and a bye-path switch having a plurality of sets of wipers, a plurality of paths of access to said selector stage, discriminating means in the bye-path control circuits

which are adapted to be operated in accordance with the path of access over which the control circuit is taken into use and wiper switching means which is adapted to select one of said sets of wipers in accordance with the setting of said discriminating means.

7. Circuit arrangement as claimed in claim 6, in which each bye-path switch comprises a plurality of pairs of test wipers one of which is adapted to be selected in accordance with the setting of the discriminating means and further wiper switching means which is adapted to be operated in accordance with the odd or even value of a digit received by said marking switch to select one of said pairs of test wipers.

8. In an automatic or semi-automatic telephone system, a selector stage, switching means which is adapted to be operated to connect continuous ringing tone to a selected line for a predetermined interval and further switching means which is adapted to connect interrupted means to said line after said predetermined interval so that ringing tone is applied to the selected line immediately connection is made thereto.

9. In or for an automatic or semi-automatic telephone system, a final selecting stage comprising conversation switches and a plurality of bye-path control circuits each comprising a bye-path switch having a plurality of levels, one or more of which is reserved for P. B. X. groups, a plurality of paths of access to said final selecting stage, discriminating means in said control circuits which are adapted to be operated in response to a path of access over which the circuit is taken into use, wiper switching means which is adapted to select one of said levels in accordance with the setting of said discriminating means and switching means which is adapted to be operated when the P. B. X. level or one of the P. B. X. levels is selected and in response to the operation of which the said switch hunts automatically in a selected P. B. X. group.

10. In or for an automatic or semi-automatic telephone system, a selecting stage comprising two groups of single-motion conversation switches, each having access to different sets of outlets, a bye-path control circuit which is adapted to be taken into use together with a conversation switch in either of said groups for setting up a connection over said switch, discriminating means in the bye-path control circuit, which is adapted to operate in accordance with which one of the said groups is involved in a connection and a single-motion bye-path switch in said circuit which comprises a test level or levels corresponding to each of said sets of outlets, and a common marking level or levels for controlling the setting of a conversation switch of either group, the said discriminating means being adapted to control the selection of the

test level or levels to be used in setting up a connection.

11. A telephone system comprising a selector stage, conversation switches and a bye-path control circuit belonging to said stage, said control circuit being adapted to be temporarily connected to any one of said conversation switches during the setting up of a connection and having a marking switch and a bye-path switch with groups of outlets, said marking switch being provided with two marking levels adapted to mark said groups of outlets and two different paths of access for said control circuit, the path of access used determining the marking level selected.

In witness whereof I hereunto subscribe
my name this twelfth day of May, 1930.

ESMOND PHILIP GOODWIN WRIGHT.