

Dec. 16, 1924.

1,519,271

F. M. SLOUGH

TELEPHONY

Filed Aug. 3, 1917

2 Sheets-Sheet 1

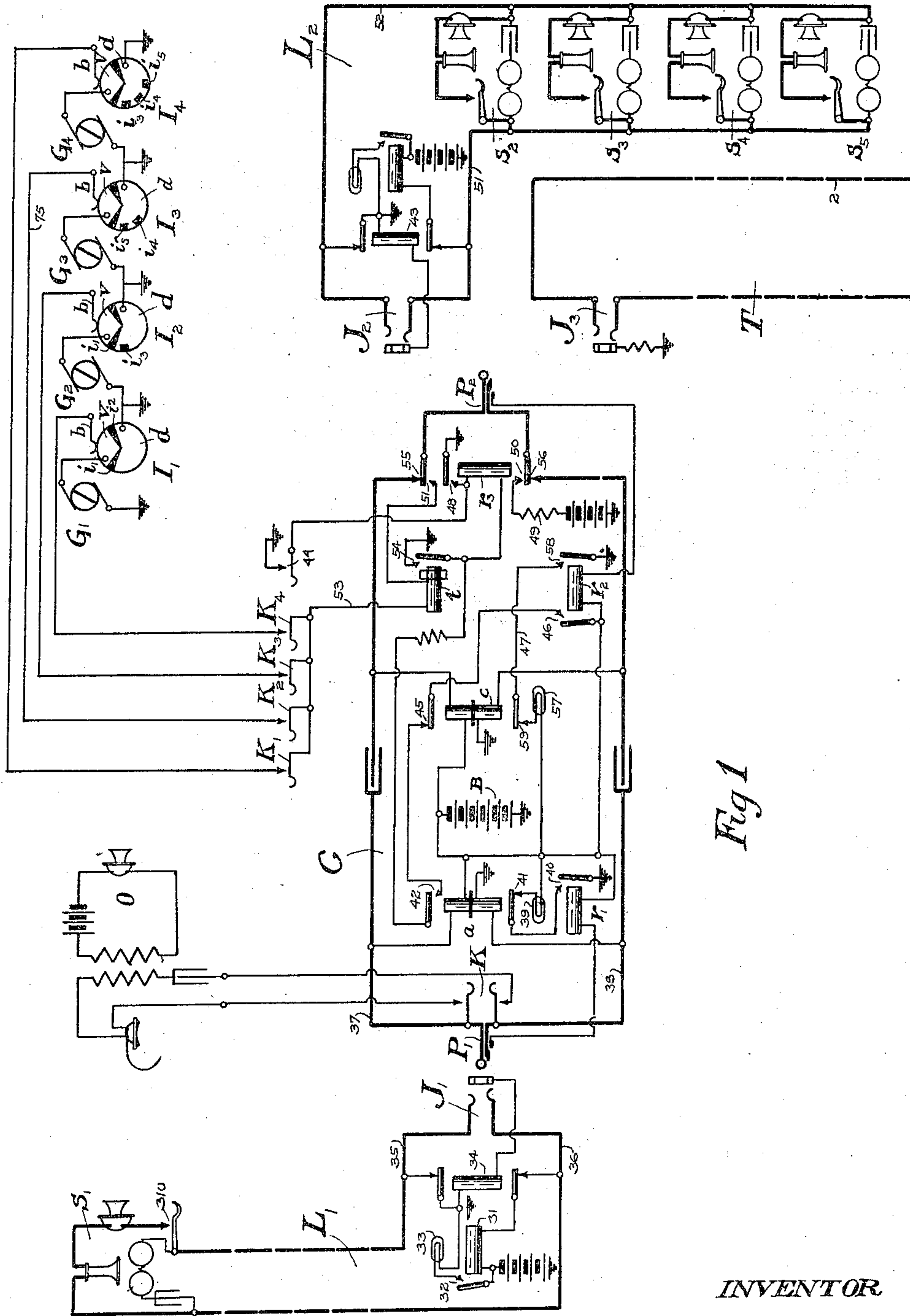


Fig 1

INVENTOR

Frank M. Slough



**Dec. 16, 1924.**

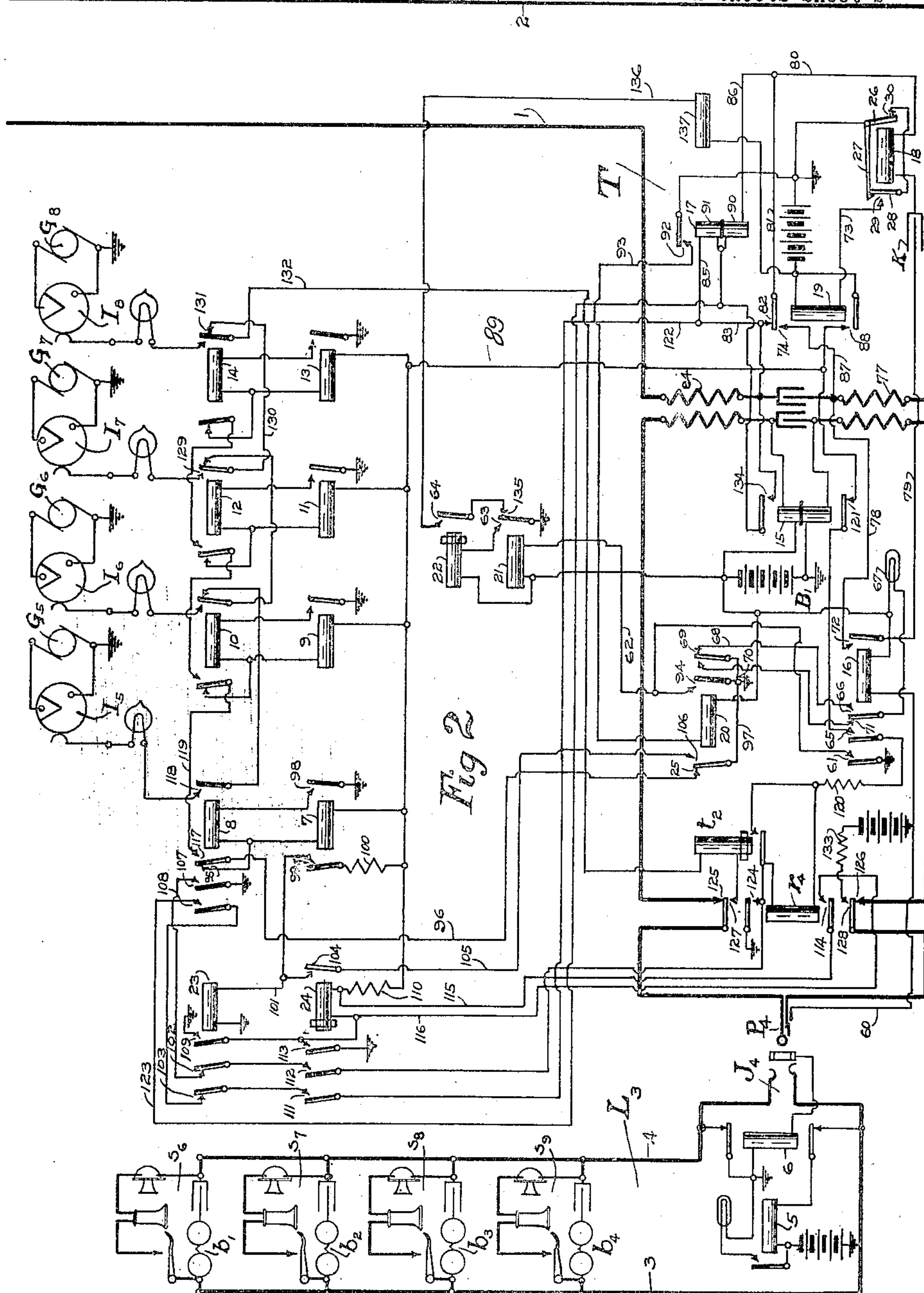
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2 Sheets-Sheet 2



*INVENTOR*

Frank M. Slough



## UNITED STATES PATENT OFFICE.

FRANK M. SLOUGH, OF ROCHESTER, NEW YORK, ASSIGNOR TO THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, OF ROCHESTER, NEW YORK, A CORPORATION OF NEW YORK.

TELEPHONY.

Application filed August 3, 1917. Serial No. 184,252.

*To all whom it may concern:*

Be it known that I, FRANK M. SLOUGH, a citizen of the United States, residing at Rochester, in the county of Monroe and State of New York, have invented certain new and useful Improvements in Telephony, of which the following is a specification, reference being had therein to the accompanying drawings.

10 An object of my invention is to provide means whereby an "A" operator may select and apply any desired ringing current or ringing combination at a "B" position, the same as at her own position, without the  
15 "B" operator being required to do anything except to put up and take down the desired connection. The "A" operator also supervises both at her own and the "B" end of the trunk, and signals the "B" operator for  
20 disconnection when she finally removes her plug from the trunk jack.

It is also an object of my invention to accomplish the aforesaid object without requiring the manipulation of any additional  
25 key or selective apparatus by the "A" operator than would be the case were the "A" operator selectively signaling a party line subscriber whose line terminates at a jack at her own switchboard.

30 It has been the common practice in trunking calls between exchanges for the "B" operator to select the current or combination of circuits necessary to call a wanted subscriber if he be on a party line. Means have  
35 been devised to supervise the connection, and means have also been devised to enable an "A" operator to select the current to call a party line subscriber at a distant switchboard through a trunk line by the use of a  
40 special key which was required to be tapped by the "A" operator in order to send pulsations of current over the trunk line for the purpose of selecting the ringing current to be applied to the called line. This last arrangement is very unsatisfactory as it requires additional time to be consumed by the  
45 operator in establishing a connection, and is therefore uncommercial, and so far as I am aware has never been used in a working telephone exchange since traffic requirements call more and more for additional speed in operating both at the "A" and at the "B" switchboards.

Another desired traffic condition which was not met in the previous arrangement 55 above mentioned and which is satisfied in the present invention, is that the operators of the exchange in order to best perform their work should establish all kinds of connections in as nearly as possible the same 60 way.

Specifically stated, and referring to a particular system of harmonic selection, in the system of my invention I preferably place a set of step-by-step relays at the "B" exchange, controlling the circuits of four generators, each adapted to furnish current suitable for ringing the bell at a particular station and no other. Any one of four stations on a line may be called by selecting and connecting the proper generator of this set to that line. 70

I have illustrated a use of my invention in connection with the ordinary multiparty automatic ringing system of the art at the 75 "A" operator's switchboard. This is a preferred embodiment of my invention. At the "A" operator's switchboard I so construct the interrupters associated with each of the ringing generators of the exchange so as to 80 have additional contact making segments, the said segments being operative during the so called silent interval of a ringing period to send current impulses over the trunk line, these current impulses being operative 85 to selectively operate the step-by-step relays above mentioned, to select the particular ringing generator at the "B" operator's switchboard which is capable of signaling the desired party on the called line, and 90 which generator corresponds to the selective properties of the generator at the "A" operator's switchboard in whose circuit the selecting segments are placed. These additional segments placed on the ordinary ringing interrupter have no effect on the automatic ringing system on calls local to the "A" switchboard, the ringing mechanism being operative in the usual way on such calls. 95

My invention is not limited to an automatic ringing system or to manual switchboard systems, but may obviously be applied without alteration to automatic and semi-automatic systems, or to manual systems not employing so-called automatic ringing mechanism. The most frequent applica- 100 105



tion will be to branch exchange work, or what we may call clearing house systems, wherein a main central office is provided with manually operated switchboard apparatus, and the branch exchanges are equipped with apparatus adapted to be controlled through trunk lines from the main office.

Other objects of my invention and the invention itself will be better understood from the description of the same which follows, reference being had to the two sheets of drawing forming a part of this specification and illustrating a preferred embodiment of my invention.

Fig. 1 shows the apparatus at the "A" operator's switchboard consisting of two lines  $L_1$  and  $L_2$  extending from substations to the exchange, and terminating thereat in jacks  $J_1$  and  $J_2$ . On the line  $L_1$  the substation  $s_1$  is connected, and on the line  $L_2$  a plurality of substations  $s_2, s_3, s_4$  and  $s_5$  are connected. The line  $L_2$  is a party line containing four substations, the bells of which are understood to be of the "harmonic" selective type, that is, they are each tuned to respond to alternating currents of a particular frequency; each being differently tuned with regards to frequency. On each of the lines the usual line and cut-off relays are shown connected in a common manner.

A cord circuit is also shown in Fig. 1 for the purpose of interconnecting telephone lines such as lines  $L_1$  and  $L_2$ , and is also adaptable to connect one of the lines to a trunk circuit T a jack terminal of which is illustrated in Fig. 1 at  $J_3$ . The link circuit C terminates in plugs  $P_1$  and  $P_2$ , and these plugs are adapted to cooperate with the different line and trunk jacks to interconnect any two of the same. Harmonic ringing generators are illustrated at  $G_1, G_2, G_3$  and  $G_4$ , and are driven at such a rate of speed to generate each a particular frequency of alternating current adapted to operate a particular one of the four lines on the party line connected to the exchange, as the line  $L_2$ .

Interrupters  $I_1, I_2, I_3$  and  $I_4$  of special construction to be more fully described later, are connected in the circuit of the ringing generators just mentioned so that during the ringing period the ringing of the bells may not be continuously intermittent, there being a short ringing interval which may be of one second duration, and a long silent interval which may be of five seconds duration; these being time values commonly employed in commercial systems.

The cord circuit C of Fig. 1 contains the usual supervisory relays,  $a$  and  $c$  being the answering and calling supervisory relays respectively, and also contains the usual local circuit supervisory relays  $r_1$  and  $r_2$  adapted to cooperate with the answering

and calling supervisory relays to control the ordinary supervisory signals of the cord circuit.

The relays  $r_2, c$  and  $a$  also control the automatic ringing circuit in the usual manner which will be later described. Automatic ringing relays are also shown in this cord circuit consisting of the trip relay  $t$  and the ringing relay  $r_3$ , the latter being for the purpose of connecting the ringing generators to the telephone line to signal the called-for station thereof; and the trip relay being for the purpose of dissociating the said generators and the said substations, and to restore the telephonic connection between the calling and the called-for line, this being the common practice in the art.

I also show in the cord circuit a listening key K adapted to connect an operator's telephone set O to the cord circuit whereby the operator may converse with the connected subscribers at will. I also show in connection with the cord circuit C a plurality of party line ringing keys  $K_1, K_2, K_3$  and  $K_4$  connected in the usual manner between the party line generators and the trip relay  $t$ , and adapted by their manual operation to connect a particular one of the generators to the ringing circuit to signal a desired station on the connected called party line.

So far, with the exception of the noted special construction of the interrupters associated with the ringing generators, the description is that of the ordinary telephone system of the art.

The trunk circuit T terminating in a jack  $J_3$  in Fig. 1 is extended by limbs 1 and 2 to the circuits of Fig. 2, which figure shows the trunk circuit apparatus at the "B" switchboard, this apparatus consisting in part of the well-known trunk circuit apparatus of the art, and in part of special apparatus provided for the purpose of illustrating an embodiment of my invention. The trunk circuit is shown as terminating at the "B" board in a plug  $P_4$  which is adapted to make connection with a jack  $J_4$  of a line  $L_3$ . It will be understood that both the cord circuit C of Fig. 1 and the trunk circuit T of Fig. 2 is adapted to make connection with any of a plurality of telephone lines only enough of which are illustrated in the drawings to enable the invention to be properly described.

The line  $L_3$  of Fig. 2 is shown extending from a plurality of stations  $s_6, s_7, s_8$  and  $s_9$  by line conductors 3 and 4 to the "B" switchboard terminating in the jack  $J_4$ , and at the "B" switchboard there is shown the line relay 5 and the cut-off relay 6 which are the ordinary line and cut-off relays commonly used with common battery telephone lines. The substations  $s_6, s_7, s_8$  and  $s_9$  have telephone bells  $b_1, b_2, b_3$  and  $b_4$ , each of the harmonic type and adapted to be operated



by alternating current of a frequency corresponding to the special tuning of the particular bell.

5 Ringing generators are also arranged at the "B" board and adapted to be connected in circuit with the substation bells. Interrupters of the ordinary pattern  $I^5$ ,  $I^6$ ,  $I^7$  and  $I^8$  are also associated with the said ringing generators to break up the ringing period into silent and ringing intervals. Generator selecting relays 7, 8, 9, 10, 11, 12, 13 and 14 are also provided to select the proper ringing generator to ring the particular bell belonging to the called-for station. The trunk circuit proper contains the usual automatic ringing relay  $r_4$  and ringing trip relay  $t_2$ , supervisory relay 15, third strand local circuit relay 16, trunk line relay 17, and in addition the trunk circuit contains additional relays 18, 19, 20, 21, 22, 23 and 24 whose functions will later be described.

Referring again to Fig. 1, the interrupters  $I_2$ ,  $I_3$  and  $I_4$ , each have a ringing segment  $v$  to which is connected the associated ringing generator  $G_1$ ,  $G_2$ ,  $G_3$  or  $G_4$  as the case may be. The ground pole of battery is connected to the other segment of each of the interrupters, and in the ordinary construction of such interrupters in the art, this last-named ground segment is un-broken, that is, its surface is continuously conductive throughout its entire length. Associated with each of the interrupters is a brush  $b$  adapted to contact with the rotating interrupters, and thus to make contact with the outer surface of the revolving interrupter segments.

In the embodiment of my invention illustrated, I interrupt the conducting surface of the ground segment of certain of the interrupters and divide this conducting surface into parts, each interrupter being differently divided in this way for the selecting function to be later described. The first interrupter  $I_1$  I provide with the ringing segment  $v$  as before noted, and considering that the interrupters revolve clockwise the brush  $b$  will make contact with this ringing segment and immediately following thereafter an insulating segment  $i_1$  will pass under the brush, the insulating segment being a very narrow segment and will pass rapidly under the brush. The rotation continuing, contact will now be made with the ground connected conducting segment of  $d$  with which it will make contact for a relatively long interval until a second short insulating segment  $i_2$  is encountered which rapidly passes under the brush  $b$ , the brush will immediately thereafter make contact with the ringing segment  $v$ . Thus when the generator  $G_1$  is operative there will be a cycle of circuit changes performed by the interrupter  $I_1$  during one revolution thereof consisting of a 1 second ringing interval, a  $\frac{1}{5}$  second insulating interval, a 4.8 ground

interval, and a  $\frac{1}{5}$  insulating interval making a cycle of 6 seconds total duration.

The second interrupter  $I_2$  is similarly constructed except that following the like insulating segment  $i_1$  there will be a short ground connected conducting segment  $d_1$ . Then another short insulating segment  $i_2$  followed by the main ground connected conducting segment  $d$  corresponding to the smaller segment  $d$  of interrupter  $I_1$ , the balance of the interrupter being similarly constructed to the similar parts of the interrupter  $I_1$ . The interrupter  $I_3$  is the same as the interrupter  $I_2$  except that an additional insulating segment  $i_4$  is provided on the surface of the segment  $d$  a short distance from the insulating segment  $i_3$ . The interrupter  $I_4$  is constructed like the other interrupters except that while an additional insulating segment  $i_5$  is interposed in the conducting segment  $d$ , the insulating segments  $i_2$ ,  $i_4$  and  $i_5$  of the interrupter  $I_4$  being spaced an equal distance from each other and the width of the insulating segment being approximately the same as the width of the conducting surface between them and so proportioned that it will take each one of the insulating segments approximately  $\frac{1}{5}$  of a second to pass under the brush  $b$  associated with the interrupter. These proportions are assumed to be the same for the different interrupters and may be varied if desired, the values given being those which I have found to be well suited to the purpose.

As above described it will be seen that the interrupters are much alike, being only different in the number of the short insulating segments interposed on the surface of the ground connected conducting segment  $d$  thereof.

The selecting apparatus of Fig. 2 adapted to cooperate with the interrupters  $I_1$ ,  $I_2$ ,  $I_3$  and  $I_4$  to select a ringing generator at the "B" board to be applied to the called-for line  $L_2$  consists of certain relay mechanism which will now be briefly discussed.

At the top of the figure I show a group of relays in pairs, there being four like pairs of relays as follows:—7—8, 9—10, 11—12, 13—14; each of the aforesaid pairs serving when operated to select a particular ringing generator to be applied to the called-for line, the particular generator to be applied depending upon the number of pairs of these relays operated. These pairs of relays are operated in sequence one after the other by intermittently made contacts in their energizing circuit which is extended to each of the relays successively as they are operated. The controlling contacts for operating these relays are primarily the contacts of the interrupters  $I_1$ ,  $I_2$ ,  $I_3$  and  $I_4$  at the "A" switchboard which intermittently cause the operation of the trunk relay 17, causing its contacts to be intermittently operated



and in turn intermittently break and make the contacts 25 of the relay 20 by the intermittent operation of the relay 20 under the control of the relay 17, and the contacts 25 are placed in the energizing circuit for the pairs of selecting relays above mentioned and control the operation of the same. Other relays 23, 24, 21, 22, 19 and 18 are auxiliary controlling relays whose functions will be better understood from the description of the operation of the system which will follow:—

The relay 18 is of what is known as the drop relay type. This relay has a condenser  $\frac{1}{2}$  included in its circuit so that it is unaffected by direct current, the condenser being opaque to the flow of direct current, but can be operated by alternating current passing through its winding and through the condenser, the said alternating current causing it to attract its armature 26 to which is attached the latch lever 27 which will be lifted to allow the drop shutter 28 to fall and make contact with the contact piece 29. Such a drop relay is illustrated in the issued patent to this applicant 900,435, patented Oct. 6, 1908 for a "Self-restoring drop relay" so that for a better understanding of the operation of such a relay and the mechanical interlocking of certain of the parts, reference can be had to the disclosure of the above patent. During the attraction of the armature 26, contacts 30 will be maintained broken and will be closed again at the end of the ringing period causing the operation of the relay 19, which will then be operatively included in the circuit which serially includes both the contacts 30 and the contacts 28—29 closed.

Having thus briefly described the apparatus employed in the above embodiment of my invention, I will now describe the operation of the same in the embodiment illustrated.

Assuming it is desired to make a call from the substation  $s_1$  on the line  $L_1$  to the substation  $s_4$  on the line  $L_2$ , these lines both terminating in the same exchange at the "A" switchboard, the subscriber will operate the switchhook of the substation  $s_1$  and close the contacts 310 and complete a circuit including the line relay 31 of the line operating it, and causing it to close its contacts 32 to operate the line lamp 33 in the usual manner. The operator observing the lamp will answer the call by inserting the plug  $P_1$  in the jack  $J_1$ , and operate the listening key  $K$  to connect her telephone set  $O$  to the talking conductors of the line. The cut-off relay 34 will be operated over a circuit including battery and winding of the relay  $r_1$  of the cord circuit, and in the usual way operating also the relay  $r_1$ . The supervisory relay  $a$  will also be operated from the source of

current  $B$  included in circuit with its windings which are connected to the talking strands of the line 35 and 36 by means of the talking strands of the cord circuit 37 and 38 through cooperating contacts of the plug and jack switch  $P_1$ — $J_1$ , the circuit of the relay  $a$  being completed by contacts 31 of the calling substation switchhook. The answering supervisory lamp 39 which would otherwise be lighted by the closure of contacts 40 of the relay  $r_1$  will be retired by the opening of the contacts 41 of the relay  $a$ . The closure of contacts 42 of the relay  $a$  conditions in part the circuit of the automatic ringing relay  $r_2$  for operation. The operator upon learning the number of the called-for line from the calling subscriber, and assuming that it is the line  $L_2$  that is called, will insert the plug  $P_2$  into the jack  $J_2$  making connection there- by between the cord circuit  $C$  and the circuit of the line  $L_2$ , and will cause the relays  $r_2$  and 43 to be operated, the relay 43 being the ordinary cut-off relay of the line, and the relay  $r_2$  being the ordinary third strand local circuit supervisory relay of the cord circuit, these two relays being operated in series when the plug and jack connection was made in the usual manner. The cut-off relay 43 of the line  $L_2$  and also the cut-off relay 34 of the line  $L_1$  are the usual cut-off relays of the art and perform their functions in the usual way.

In addition to learning the number of the line called for, the operator will have learned from the calling subscriber which party line subscriber is wanted on the called-for line. Assuming that it is a particular one of the subscribers having substation telephone sets  $s_2, s_3, s_4$ , or  $s_5$  on the line  $L_2$ , the operator will now depress that one of the ringing keys  $K_1, K_2, K_3$  or  $K_4$  corresponding to the particular party of the line desired, and the depressal of the particular key will cause its contacts to close including in the ringing circuit a particular generator  $G_1, G_2, G_3$  or  $G_4$ . Associated with these generators are four interrupters, one for each of the generators, the interrupters being  $I_1, I_2, I_3$  and  $I_4$  respectively.

The construction of these interrupters has been previously described as having a ringing segment separated from the balance of the interrupter disc by an insulating segment on either side of the ringing segment, the balance of the conducting portion of the disc being connected to the ground pole of battery. And it has been previously described how very short insulating pieces are placed on portions of the ground connected segment, the number of insulating pieces being different in different interrupters. These insulating pieces are very narrow and have no apparent effect in the operation of the system when con-



necting two telephone lines terminating in the "A" switchboard in the ordinary course of making such a connection by means of the cord circuit C outside of the usual effect to be had by the usual interrupter of the art.

At the time one of the ringing keys are depressed as before mentioned a pair of contacts 44 are also closed, these contacts being common to the group of keys. The closure of these contacts will cause the operation of the ringing relay  $r_3$ , the circuit being traced as follows:—from the ground pole of battery, the contacts 44, the winding of the relay  $r_3$ , the now closed contacts 42 of the relay  $a$ , the normally closed contacts 45 of the relay  $c$ , and the now closed contacts 46 of the now operated relay  $r_2$ , circuit conductor leading to the negative pole of battery B, this battery being included in the circuit and causes the operation of the relay  $r_3$ . This relay being operated it will remain operated regardless of the opening of the contacts 44 occurring when the operator releases the ringing key because of the holding contacts 48 which are now closed by the operation of the controlling relay  $r_3$ . These holding contacts complete a locking circuit to ground independent of the initiating circuit including the contacts 44. The ringing of the called-for subscriber will now be traced from the negative pole of battery, the resistance coil 49, now closed contacts 50 of the relay  $r_3$ , the cooperating ring contacts 51 of the plug and jack switch  $P_2-J_2$ , line conductor 51 of the called line  $L_2$ , the condenser and ringer coils of the called-for substation on the line  $L_2$ , circuit conductor 52 of the line, cooperating tip contacts of the plug and jack switch  $P_2-J_2$ , now closed contacts 51 of the relay  $r_3$ , the winding of the trip relay  $t$ , circuit conductor 53, the now closed contacts of the depressed ringing key  $K_1, K_2, K_3$  or  $K_4$ , and the circuit conductor leading to the particular brush  $b$ , resting on the surface of the particular interrupter associated with the particular generator selected by the operation of the ringing key; the circuit being completed from the brush  $b$  through the said interrupter and thence alternately through the ringing generator to ground, and through the segment  $d$  of the interrupter to ground.

It will be seen that in addition to the circuit being completed for the flow of ringing current from the generator that it is at all times conditioned for the flow of direct current from the negative pole of battery to the ground pole thereof, and as soon as the called-for subscriber hearing his bell responds thereto by taking his receiver from the hook, the contacts of the said hook will be closed completing a circuit for the flow of direct current over the line and including

the winding of the trip relay  $t$  which will thereupon be operated whether the act of the subscriber is performed during the ringing period, that is, if the segment  $v$  when the operating interrupter is under its brush  $b$ , or whether on the so-called silent interval when the ground connected segment  $d$  is passing under the brush  $b$ . The insulating pieces  $i_3, i_4$  and  $i_5$ , one or all of them as the case may be, located upon the surface of the operating interrupter being operative to interrupt the flow of direct current for too short intervals to produce any appreciable effect upon the operation of the relay  $t$ , the relay  $t$  being what is known as a slow releasing relay and which relay will not "flutter" for such quick interruptions of current as these insulating pieces would produce. The trip relay being operated will close its contacts 54 and short circuit the relay  $r_3$  which will be released opening the locking circuit at the contacts 44, and the ringing system will thereupon be restored to normal re-establishing the talking circuit by the closure of the contacts 55 and 56 of the relay  $r_3$ . The supervisory lamp which has been previously lighted over a circuit including now closed contacts 58 of the relay  $r_2$  and normally closed contacts 59 of the relay  $c$  will now be extinguished by the opening of the contacts 59 of the relay  $c$ , advising the operator the called-for subscriber has answered the call.

The above assumption has been included for the purpose of explaining how in applicant's structure the added insulating pieces on the interrupters fail to have any harmful effect in the usual operation of the ringing system of the cord circuit C when the cord circuit C is being used to establish connection between two "A" board subscribers.

We will assume that instead of the line  $L_2$  being the called-for line, that the called-for line is the line  $L_3$  terminating in a branch office at which is located a "B" operator's switchboard, and at which switchboard the trunk circuit T terminates in a plug  $P_4$ , the other end of the trunk circuit terminating at the "A" switchboard in a jack  $J_3$ . In such a case the "A" operator upon learning the number of the called-for line and the party line designation for the particular party on the line desired, will depress an order wire key not shown in the drawings and over an order wire not shown but the connection of which is well understood in the art, advise the "B" operator of the number of the line with which connection is desired, and the "B" operator having a number of trunk lines, such as T available for the connection will reply to the "A" operator advising her in the usual way that it is the trunk circuit T that is to be used for the connection, it being common practice to designate the trunk lines by numerals.



Upon receiving the trunk line assignment the "A" operator will insert the plug  $P_2$  of the cord circuit C into the jack  $J_3$  of the trunk line, and the "B" operator upon receiving the assignment of the called-for line will insert the plug  $P_4$  into the jack  $J_4$  of the called-for line  $L_3$ . So far the establishing of this connection from the "A" switchboard and from the C cord circuit to the called-for line does not differ from the usual practice. The "A" operator however, instead of having advised the "B" operator of the party line station desired only advises the "B" operator of the line itself that is desired, and in order to provide for the proper party's telephone on the line being selectively signaled will now depress the particular ringing key  $K_1$ ,  $K_2$ ,  $K_3$  or  $K_4$  corresponding to the particular party on the line to be called, thus applying selective ringing current intermittently to the trunk line T, just as ringing current was applied intermittently to the called-for line  $L_2$  as has been previously described. Thus, the "A" operator upon making different connections operates her apparatus in much the same way providing uniformity of operation.

At the "B" switchboard is located a drop relay 18, which has been previously described, and this relay is the first apparatus of the trunk line at the "B" board operated under the control of the "A" board apparatus. However, prior to the operation of this relay, the relay 16 which is the third strand local circuit relay of the trunk circuit at the "B" board must be operated. This relay will be operated over a circuit including the cut-off relay 6 of the called-for line  $L_3$ , and the circuit is traced from the ground pole of battery through the winding of the cut-off relay 6, cooperating contacts of the plug and jack switch  $P_4$ — $J_4$ , circuit conductor 60, the winding of the relay 16 to the negative pole of battery. This circuit being closed battery will flow over the same operating the cut-off relay which performs its usual function of dissociating the line relay from the line, and the relay 16 will also be operated attracting its armatures and switching various circuits.

The contacts 61 of the relay 16 will be closed completing a circuit for the operation of the relay 21, this circuit being traced as follows:—from the ground pole of battery, now closed contacts 61 of the relay 16, circuit conductor 62, the winding of the relay 21 to the negative pole of battery. This relay 21 will be operated operating in turn the slow releasing relay 22 over a circuit traced as follows: from the ground pole of battery, the now closed contacts 63 of the relay 21, the winding of the slow releasing relay 22 to the negative pole of battery. This slow releasing relay being operated

will close its contacts 64, but the closing of these contacts will not have any function at the present time, but will have a function when the connection is taken down as will be later described. The contacts 65 of the relay 16 being closed will condition a circuit for the ringing relay  $r_4$ , but this relay  $r_4$  is kept from operating at the present time by other contacts which must first be operated. The contacts 66 of the relay 16 will now be closed completing a circuit including the source of current  $B_1$  and the trunk signal lamp 67, this circuit being traced as follows: from the negative pole of battery  $B_1$ , the signal lamp 67, the now closed contacts 66 of the relay 16, circuit conductor 68, the normally closed contacts 69 of the relay 20, circuit conductor 70 leading to the ground pole of battery. Thus current flowing over will operate the signal lamp 67 which will display a signal indicating to the "B" operator that connection had been completed at the "B" end of the trunk line only. Whenever connection is completed at the "A" switchboard the relay 20 will be operated as will be later seen opening the contacts 69 and extinguishing the signal lamp 67, indicating to the "B" operator that connection had been made at both ends of the trunk line. The contacts 71 of the relay 16 will be broken when the relay 16 is operated for a signaling function to be later described in connection with the description of the operation of the signal lamp 67. Contacts 72 of the relay 16 will now also be closed completing a circuit for the drop relay 18 whenever the "A" operator has made connection with the trunk line T by inserting the plug  $P_2$  of the cord circuit C into the jack  $J_3$  of the trunk line T and depressed the proper ringing key corresponding to the particular party line station desired on the line  $L_3$ . This the "A" operator will do as soon as she has made connection with the trunk line and we will first consider that she depresses the key  $K_2$  locking the contacts thereof in closed circuit and closing momentarily the contacts 44 common to the group of selective keys  $K_1$ ,  $K_2$ ,  $K_3$  and  $K_4$ . The closing of the contacts 44 will operate the ringing relay  $r_3$  causing it to attract its armatures, which when attracted will switch circuits in a manner just as was the case when connection was made to the line  $L_2$  terminating in a jack  $J_2$  at the "A" switchboard, and which has been previously described, and this part of the description need not here be repeated; sufficient to say that the ringing relay  $r_3$  will be operatively locked by its locking contacts 48, and that the contacts 51 and 50 when closed will connect the signaling generator circuits through to the terminals of the trunk line T, battery being superposed over the ringing circuit in addition to the intermittent enclosure of



generator current in this circuit. The contacts  $K^2$  being operated thereby select the generator  $G_3$  to perform the ringing function, and this generator will therefore, when the segment  $v$  of its associated interrupter  $I_3$  revolves to the suitable position, make a connection for generator current through said segment and the associated brush  $b$  to the terminals of line conductors 1 and 2 of the trunk line  $T$ . Until ringing current is thus applied to the trunk line conductors, the drop relay 18, cannot be operated since the condenser  $k$  is included in its circuit at the "B" board and the condenser being opaque to the flow of direct current, direct current flowing over the circuit through the interrupter  $I_3$  will not influence the drop relay to operate, but when the ringing interval occurs due to the revolving of the interrupter  $I_3$  as has been described, this ringing current being alternating in character, will cause the magnet of the drop relay 18 to operate, the circuit causing this operation being traced as follows: from the ground pole of battery at the "A" switchboard, the generator  $G_3$ , the segment  $v$  of the interrupter  $I_3$ , the brush  $b$  thereof, circuit conductor 73, the now closed contacts of the key  $K_2$ , circuit conductor 53, the winding of the trip relay  $t$ , the contacts 51 of the relay  $r_3$ , circuit conductor 76, the tip contact of the plug  $P_2$ , the tip spring of the jack  $J_3$ , circuit conductor 2 of trunk line leading to the "B" switchboard, the winding 77 of the repeating coil at the "B" switchboard, circuit conductor 78, the now closed contacts 72 of the relay 16, circuit conductor 79, the condenser  $k$ , the winding of the relay 18, circuit conductor 80, circuit conductor 81, the normally closed contacts 82 of the relay 19, circuit conductor 83, the winding 84 of the repeating coil, the trunk line conductor 7 leading to the "A" switchboard, the ring spring of the jack  $J_2$  located at the "A" switchboard, the ring contact of the plug  $P_2$ , now closed contacts 50 of the relay  $r_3$ , the resistance coil 49 to the negative pole of battery. Alternating current from the circuit  $G_3$  will flow over this circuit and cause the operation of the relay 18. The relay 18 being operated over the circuit just described will attract its armature 26, which will raise the lever 27 and let fall the shutter 28 thereof. The falling of this shutter will close contacts 28—29 of the drop relay, but the contacts in circuit therewith will remain open throughout the ringing interval since the armature 26 during this time remains close to the core of the relay 18, and therefore keeps broken the contacts 30 for the entire interval. At the end of the ringing interval however, the contacts 30 will be re-established, but the contacts 28—29 will remain closed and a circuit will therefore be completed for the relay 19, this circuit be-

ing traced as follows: from the ground pole of battery, the armature 26, the contacts 30 and the contacts 28—29 of the relay 18, circuit conductor 73, the winding of the relay 19 to the negative pole of battery. Battery current will flow over this circuit including the winding of the relay 19 and will operate the relay 19 causing it to attract its armatures switching circuits to be described. The contacts 74 of the relay 19 will be closed short circuiting the drop relay 18 with its serially connected condenser  $k$  and serially connected contacts 72 of the relay 16.

Contacts 82 of the relay 19 will now also be opened, thus opening the short circuit which has been up to this time placed about the windings of the relay 17 by the conductors 81 and 83, and the contacts 82, and the relay 17 will have its windings, a high resistance winding and a low resistance winding serially connected in circuit with the trunk line wires 1 and 2 leading from the "A" switchboard through the windings 77 and 84 of the repeating coil at the "B" switchboard, and through conductors 85, 86 and 81, the now made contacts 74 of the relay 19 and conductor 87. The relay 17 being now placed in circuit with the trunk line wires will be operative whenever current is sent over the trunk line following the ringing period as will be later described.

The contacts 88 of the relay 19 will now be closed connecting the negative pole of battery by means of conductor 89 to certain portions of the circuits of the group of relays 7 to 14 inclusive, as well as the relays 23, 24, and in a sense the relay  $r_4$ . This conductor 89 is the common battery supply wire for the above-named relays, and the contacts 88 of the relay 19 the common battery controlling contacts of their circuits. These contacts remain made until both the "A" and "B" operators have dis-established the trunk line connection at the two ends of the trunk line as will be later described.

Now following the ringing interval, the interrupter  $I_3$  at the "A" switchboard will continue revolving until the brush  $b$  contacts with an insulated portion of the interrupter for a moment. At this time the contacts 92 of the relay 17 are opened and the relay 20 deenergized, therefore, the closing of the contacts 88 of the relay 19 will complete a circuit for the relay 7; the circuit being traced as follows: from the negative pole of battery, the battery controlling contacts 88, the battery supply conductor 89, the winding of the relay 7, the normally made contacts 95 of the relay 8, circuit conductor 96, the normally made contacts 25 of the relay 20, circuit conductor 97 to the ground pole of battery. The relay 7 will attract its armatures closing contacts 98 and 99. Contacts 98 will condition a circuit for the



operation of the relay 8 whenever the contacts 25 are broken as will be described, the contacts 25 at this time maintaining a short circuit about the winding of the relay 8.

5 The contacts 99 of the relay 7 being closed, a circuit is completed for the operation of the relay 23 traced as follows:—from the negative pole of battery, the closed contacts 88 of the relay 19, common battery conductor 89, the resistance coil 100, the now closed contacts 99 of the relay 7, circuit conductor 101, and the winding of the relay 23 to the ground pole of battery. The relay 23 will therefore be operated attracting its armatures and switching circuits to be later described.

In passing it will be noted that there is a circuit provided to shunt the winding of the relay 23 consisting of contacts 104, circuit conductor 105, normally opened contacts 106 of the relay 20, and conductor 97 leading to the ground pole of battery. The function of this shunting circuit will be later further described.

At the time the relay 23 was operated the contacts 102 and 103 were broken, but the breaking of these contacts at this period of the operation of the system performs no function, and the contacts 107 and 108 of the relay 8 in circuit with the aforesaid contacts at this time being opened.

The contacts 109 of the relay 23 now being closed will complete a circuit for the operation of the relay 24, the circuit being traced as follows:—from the ground pole of battery, the contacts 109, the winding of the relay 24, the resistance coil 110, circuit conductor 89, the closed contacts 88 of the relay 19 to the negative pole of battery. Current flowing over this circuit will operate the relay 24 attracting its armatures and closing contacts 111, 112 and 113. The closure of the contacts 111 and 112 will not perform any function at this time due to the continued opened condition of the contacts 107 and 108 in circuit thereof. The closure of the contacts 113 however, will provide a locking circuit for the relay 24 to keep this relay operative independent of the operation of the contacts 109 of the relay 23.

In passing it will be noted that a shunt including the contacts 114 of the relay  $r_4$  and conductors 115 and 116 is placed about the winding of the relay 24, to de-energize the same; but this shunt will not now be operative due to the opened condition of the contacts 114.

The interrupter  $I_3$  continuing to revolve will cause the brush  $b$  to leave the insulated segment following the ringing segment  $v$  to contact with a ground connected contacting portion of the segment  $d$  of the interrupter. Such a contact is only made momentarily, but it is of sufficient duration to cause battery to flow over the trunk line from the

ground connected segment through the brush  $b$ , conductor 75, the contacts of the key  $K_2$ , the winding of the trip relay  $t$ , contacts 51 of the relay  $r_3$ , conductor 76, the tip of the plug  $P_2$  and the tip of the jack  $J_3$ , conductor 2 of the trunk line, the winding 77 of the repeating coil, conductor 87, contacts 74 of the relay 19, conductor 81, conductor 86, the low resistance winding 90 of the relay 17, the high resistance winding 91 thereof, conductor 85, repeating coil winding 84, trunk line conductor  $l$ , the sleeve spring of the jack  $J_3$ , the sleeve contact of the plug  $P_2$ , the contacts 50 of the ringing relay  $r_3$  at the "A" switchboard, and the resistance coil 49 to the negative pole of battery.

The momentary flow of battery over the circuit just described will cause a momentary operation of the relay 17, causing it to close its contacts momentarily, completing the circuit for the relay 20 from the ground pole of battery, the now closed contacts 92 of the relay 17, circuit conductor 93, the winding of the relay 20 to the negative pole of battery. This circuit being closed battery will flow over the same energizing the relay 20, causing it to attract its armatures, switching circuits to be described.

The contacts 94 being closed will at this time perform no additional function. Contacts 25 being opened will remove the short circuit which has been noted as being placed about the winding of the relay 8 by these contacts, and the relay 8 will therefore be operative in series with the relay 7, the circuit being traced as follows:—from the ground pole of battery, the now closed contacts 98 of the relay 7, the winding of the relay 8, the winding of the relay 7, circuit conductor 89, now closed contacts 88 of the relay 19 to the negative pole of battery.

The relay 8 being operated will attract its four armatures closing contacts 107, 108, 117 and 118, and will open its contacts 95 all for purposes which will be later described.

The closure of the contacts 107 and 108 will not be operative to perform any operative function at this time since at this time the serially connected contacts 102 and 103 of the relay 23 are in their opened position. The closing of the contacts 107 and 108 however, is for the purpose of conditioning the circuits in which they are included for later operation as will be later described.

The opening of the contacts 95 and the closing of the contacts 117 is for the purpose of extending the counting relay operating conductor 96 to contacts 95 from their operative connection to the pair of relays 7 and 8 to a similar operative connection to the relays 9 and 10 in a manner which is well understood, the conductor 96 thereby being extended by means of conductor 119 to an armature of relay 10. The operation of the



contacts 118 conditions the generator  $G_5$  and its associated interrupter  $I_5$  to be connected to the ringing circuit. However, since the "A" operator has depressed the key  $K_2$

5 instead of  $K_4$ , there will be operated additional counting relays of the chain to again dissociate the ringing generator  $G_5$  from the ringing circuit before it has been fully connected to the called line as will be later  
10 seen.

During the momentary attraction of the relay 20 the shunt circuit which has been previously mentioned as being operative is operable to short the relay 23, momentarily  
15 placing a short circuit about the winding of the relay 23; but as is well known a short circuited relay releases its armatures very slowly, and the duration of the operation of the relay 20 is so short that the relay 23 will  
20 not have time to release its armatures before the relay 20 is again in its un-operative condition. It will now be easily understood how the various pairs of counting relays 7—8, 9—10, 11—12, 13—14 will be operated  
25 in sequence by successive impulses of current flowing over the trunk line by the operation of the particular interrupter  $I_1$ ,  $I_2$ ,  $I_3$  or  $I_4$  chosen by the act of the operator depressing her ringing key. In the case of  
30 the interrupter  $I_3$ , the operation of which I have been specifically describing, there will be three successive operations of the relay 17 which will close the contacts 92 successively three times, the last impulse of current being a long impulse of current, the  
35 contacts 92 on the last impulse will be closed a correspondingly long time. The impulse being relayed by the relay 20 and contacts 25 thereof to the conductor 96, which we  
40 will call the impulse conductor, the operation of the successive pairs of counting relays before mentioned will be initiated by current flowing over this conductor, which conductor will be extended from one pair to  
45 the next succeeding pair of relays by the operation of the second relay of each of the pairs. Therefore, by the well-known action of such relays it will be seen how the two short impulses and the long impulse of current will cause to operate the relays 7, 8, 9,  
50 10, 11 and 12 thereby selecting the generator  $G_7$  for connection to the ringing circuit at the "B" switchboard over a circuit which will be later traced.

55 The ringing relay  $r_4$  will now be operated, the same being at this time operated because the relay 20 is operated for a longer period on this last impulse which is a long impulse of current; the operation of the relay 20  
60 therefore causing the relay 23 to be short circuited, by the contacts 106 of the relay 20, for a sufficiently long time to allow the relay 23 to release its armatures closing contacts 103 and 102, and opening contacts 109 there-  
65 of. The opening of the contacts 109 will

for the moment have no effect upon the serially connected relay 24, since this relay is for the time being locked in circuit by its own contacts 113.

The closure of the contacts 102 however, 70 since the contacts 107 of the relay 8 and the contacts 112 of the relay 24 are now closed, complete a circuit for the operation of the relay  $r_4$ , this circuit being traced as follows: 75 from the ground pole of battery, the contacts 107 of the relay 8, the contacts 102 of the relay 23, contacts 112 of the relay 24, the winding of the relay  $r_4$ , the resistance coil 120, the now closed contacts 65 of the relay 16, the normally closed contacts 121 of 80 the relay 15, and now closed contacts 88 of the relay 19 to the negative pole of battery. The ringing relay  $r_4$  will now therefore operate by current flowing over this circuit attracting its armatures and switch- 85 ing circuits later to be described.

The closure of the contacts 103 of the relay 23 will cause the high resistance winding 91 of the relay 17 to be short circuited momentarily for the purpose of operating the trip 90 relay  $t$  at the "A" switchboard to cause the disconnection of the ringing circuit at the "A" switchboard, and to reestablish the talking circuit at the "A" switchboard in the well-known manner. 95

In passing it may be said that the high resistance winding of the relay 17 will preferably be made so high so as to have no effect upon the trip relay  $t$ , and the low resistance winding will be made very low so 100 that when the high resistance winding is short circuited the low winding will allow sufficient battery current to flow over the circuit to cause immediate operation of the trip relay which will perform in the usual 105 manner, only short circuiting the ringing relay at the "A" switchboard and cause it to restore its armatures to normal position.

The shunted circuit for the high resistance winding 91 of the relay 17 may be traced 110 as follows:—from the conductor 85, the circuit conductor 122, the now closed contacts 111 of the relay 24, the now closed normal contacts 103 of the relay 23, the now closed 115 contacts 108 of the relay 8, and circuit conductor 123 to the other side of the winding 91 of the relay 17. The short circuiting of this high resistance winding will be of short duration, preferably only a fraction of a 120 second, so that the effect, if any, upon the supervisory signal at the "A" switchboard will be negligible.

The relay  $r_4$  being operated will cause its contacts 124 to be closed, thereby providing 125 a locking circuit for the relay  $r_4$  through these contacts locking the relay  $r_4$  in operation regardless of the controlling contacts initiating the operation just described. The contacts 114 of the relay  $r_4$  will also now be 130 closed short circuiting the winding of the



relay 24 and deenergizing the same slowly. The relay 24 will therefore release its armatures opening the initiating circuit of the relay  $r_4$ , and remove the shunt about the high resistance winding 91 of the relay 17.

Contacts 125 and 126 in the talking strands of the trunk circuit at the "B" board are now broken, and the contacts 127 and 128 in the ringing circuit are closed, thereby completing the said ringing circuit from the generator  $G_7$ , and dissociating interrupter  $I_7$  from the exchange to the bells of the called line, the said generator illustrated being a selective ringing generator, preferably of the "harmonic" types and ringing current will therefore flow from the said generator over a circuit which will now be described, ringing a particular one of the bells on the line which will be such a bell as is adjusted to operate in connection with the particular generator  $G_7$ , and therefore the desired substitution on the called-for line will be signaled. The ringing circuit can be traced as follows:—from ground through the generator  $G_7$  and the interrupter  $I_7$ , through the lamp in circuit thereof, the contacts 129 of the relay 12, circuit conductor 130, normally closed contacts 131 of the relay 14, circuit conductor 132, the winding of the trip relay  $t_2$ , the now made contacts 127 of the relay  $r_4$ , the tip of the trunk plug, the tip of the trunk jack  $J_4$ , the conductor 4 of the called line through the four bell circuits of the four stations on the line, the line conductor 3, the ring spring of the jack  $J_4$ , the ring jack of the plug  $P_4$ , the now closed contacts 128 of the relay  $r_4$ , and resistance coil 133 leading to the negative pole of battery. Ringing current passing over this line will pass through the windings of the bells on the line, and will select that one of them corresponding to the ringing generator.

When the called-for subscriber responds as by taking the receiver from the hook and making a path for direct current across the called line, the trip relay  $t_2$  in the ringing circuit will be operated by the direct current flowing over this circuit in the usual way, thus short circuiting the relay  $r_4$  which will release its armatures and restore the contacts associated therewith to normal, including the opening of the contacts 124 which are the locking contacts of the relay  $r_4$ . The talking strands will be reestablished at the contacts 125 and 126 of the relay  $r_4$ . The supervisory relay 15 will be operated in the well-known manner and will keep open the contacts 121 in the circuit of the ringing relay  $r_4$  to prevent reringing the operatively connected called subscriber, and will close contacts 134 which short circuits the high resistance winding 91 of the trunk relay 17; and in the usual manner thereby provides a comparatively low resistance path for the flow of battery current from the "A" switch-

board through the windings of the supervisory relay  $c$ , thus operating this supervisory relay and extinguishing the supervisory signal in the usual manner.

When the called-for subscriber has finished the conversation with the called subscriber at the "A" switchboard he will retire his telephone from the circuit restoring the supervisory relays at the "B" and "A" switchboards to normal, and the "A" operator will thus get the disconnect signal by the relighting of the signal lamp 57, and will take plug  $P_2$  from the jack  $J_2$  which will cause battery to be withdrawn from the trunk line T, and will deenergize the trunk relay 17 at the "B" switchboard, thus restoring it to normal and in turn the relay 20 to normal, and will light the trunk line lamp 67 by means of the contacts 66 of the relay 16 and contacts 69 of the relay 20. This will give the disconnect signal to the "B" operator who will disestablish the connection at the "B" switchboard by taking the plug  $P_4$  from the jack  $J_4$ , thus restoring the line circuit to normal and the relay 16 to normal which in turn will restore its control circuits to normal, including the circuit of the relay 21. This relay will be deenergized and will cause the contacts 135 to be again closed completing a path for current from ground to the said contacts 135, the still closed contacts 64 of the relay 22, circuit conductor 136 leading to magnet 137, and from thence to the negative pole of battery. Current momentarily flowing over this circuit will energize the restoring magnet 137 which will restore the drop relay 18 to its normal position and open the contacts 28—29 thereof, and restore its controlled relay 19 which in turn will restore the circuits controlled thereby to normal. The trunk circuit is now in condition for another call.

From the above description it will be understood how other interrupters and the interrupter  $I_3$  sending a different number of current impulses over the trunk line during the so-called silent interval of the ringing current will operate varying numbers of the counting relays, and thereby include different selective ringing generators in circuit with the called line at the trunk switchboard.

Other features of operation which are well understood have not been specifically described, their operation and functions being apparent.

What I claim is:

1. In a telephone system, the combination of an "A" switchboard, a "B" switchboard, a cord circuit at the "A" switchboard, a trunk line circuit leading from the "A" switchboard to the "B" switchboard, ringing keys at the "A" switchboard adapted to select ringing circuits, a plurality of circuit interrupters, each capable of producing a different characteristic series of circuit in-



5 interruptions, a plurality of ringing gen-  
 erators at the "B" switchboard adapted to  
 selectively signal telephone substations, a  
 called line at the "B" switchboard having  
 10 a plurality of telephone substations with  
 selective ringing means included therein,  
 and electromagnetic means at the "B"  
 switchboard adapted to selectively associate  
 15 a particular ringing generator with the  
 called line, means to include one of the said  
 ringing circuits in circuit with the said  
 trunk line, means to include one of the said  
 circuit interrupters in the said ringing cir-  
 20 cuit, and registration means at the "B"  
 switchboard operating under the control of  
 the included interrupter to register the char-  
 acter of the series of interruptions produced  
 by the said included interrupter, said elec-  
 25 tromagnetic means at the "B" switchboard  
 being under the control of the said register-  
 ing means.

2. In a telephone system, the combination  
 of an "A" switchboard, a "B" switchboard,  
 25 a trunk line interconnecting the switch-  
 boards, a called line at the "B" switchboard,  
 selective bells on the called line, selective  
 ringing generators at the "B" switchboard,  
 electromagnetic means to select a particular  
 30 one of the said ringing generators at the  
 "B" switchboard to ring a particular selec-  
 tive bell on the called line, like ringing gen-  
 erators at the "A" switchboard adapted to  
 selectively operate selective bells and ring-  
 35 ing keys at the "A" switchboard controlling  
 the connection of any of the last named  
 ringing generators and the trunk line, cur-  
 rent impulse contacts and a source of cur-  
 rent also adapted to be included in circuit  
 40 with the said trunk line by the said ringing  
 keys, said contacts controlling the operation  
 of the said electromagnetic means at the  
 "B" switchboard.

3. In a telephone system, the combination  
 45 with a link circuit at a call originating switch-  
 board section, of a link circuit extended  
 from the said switchboard section to a call  
 extending switchboard section, a called line  
 at the last-named switchboard section con-  
 50 taining a plurality of selective telephone  
 signals, selective signal operating means at  
 the last-named switchboard section to op-  
 erate the said signals, selective electromag-  
 netic means to select a particular one of said  
 55 signal operating means to operate a par-  
 ticular one of the said telephone selective  
 signals, like signal operating means at the  
 extending section, a plurality of switching  
 contacts each adapted to include a particular  
 60 signal operating means in circuit with the  
 said call extending link circuit, and impulse  
 means likewise included in the circuit of the  
 said switching contacts whereby the said  
 impulse means selectively controls the op-  
 65 eration of the said electromagnetic means at  
 the call extended switchboard section.

4. In a telephone system, the combination  
 of an "A" switchboard, a "B" switchboard,  
 a plurality of party line ringing keys for  
 the "A" switchboard, a plurality of selective  
 ringing generators associated therewith, a 70  
 trunk line interconnecting the switchboards,  
 a called line at the "B" switchboard, means  
 to interconnect the said trunk line and said  
 called line, a plurality of selective telephone  
 75 signals on the called line, a plurality of  
 ringing generators at the "B" switchboard  
 adapted to selectively operate the said sig-  
 nals, interrupters at the "A" switchboard to  
 break the ringing period into ringing and  
 80 silent intervals, impulse contacts for the said  
 interrupters adapted to be included in cir-  
 cuit with the said trunk line during the said  
 silent interval, and electromagnetic means  
 controlling the selection of the ringing gen-  
 85 erators at the "B" switchboard under the  
 control of the said impulse contacts at the  
 "A" switchboard.

5. In a telephone system, the combina-  
 tion of an "A" switchboard, a "B" switch-  
 board, a trunk line terminating in switching 90  
 terminals at each of the switchboards, a plu-  
 rality of ringing generators at the "A"  
 switchboard, means to selectively include one  
 of the said ringing generators in circuit  
 with said switching terminals, a selective 95  
 key for associating a particular one of the  
 said generators with a pair of the said  
 switching terminals, interrupters for the  
 said generators adapted to break the ring-  
 100 ing period into ringing and silent intervals,  
 contacts operated by the said interrupters  
 during the silent interval, a different num-  
 ber of contacts being so operated for each  
 of the ringing generators, selectively op-  
 105 erated means at the "B" switchboard adapt-  
 ed to be selectively controlled by the said  
 contacts, a telephone line at the "B" switch-  
 board adapted to be associated with the  
 said trunk line by the other pair of switch-  
 110 ing terminals, said telephone line having  
 a plurality of selective signals thereon, a  
 plurality of selective ringing means at the  
 "B" switchboard, each adapted to selec-  
 115 tively operate the said selective signals on  
 the said telephone line, the said selective  
 operated means controlling the connection  
 of the said selective ringing means to the  
 said switching terminals.

6. In a telephone system, the combination  
 120 of an "A" switchboard, a "B" switchboard,  
 a cord circuit at the "A" switchboard, a  
 trunk line circuit leading from the "A"  
 switchboard to the "B" switchboard, ring-  
 125 ing keys at the "A" switchboard adapted  
 to control selective ringing circuits, an auto-  
 matic ringing relay controlled thereby, a  
 trip relay for the said automatic ringing  
 relay, interrupters included in the said ring-  
 130 ing circuits, a plurality of ringing genera-  
 tors at the "B" switchboard, a called line



at the "B" switchboard, and selective step-by-step means to associate any one of the said ringing generators with the said called line, said selective step-by-step means being  
5 under the control of the said interrupters.

7. In a telephone system, the combination of an "A" switchboard, a "B" switchboard, a cord circuit at the "A" switchboard, a trunk line circuit leading from the "A" switchboard to the "B" switchboard, ringing keys at the "A" switchboard adapted to control selective ringing circuits, an automatic ringing relay controlled thereby, a trip relay for the said automatic ringing  
15 relay, interrupters included in the said ringing circuits, a plurality of ringing generators at the "B" switchboard, a called line at the "B" switchboard, selective step-by-step means to associate any one of the said  
20 ringing generators with the said called line, said selective step-by-step means being under the control of the said interrupters, and means at the "B" switchboard operating after a connected interrupter has completed a cycle of interruptions to cause the  
25 said trip relay to operate the said automatic relay whereby the said automatic ringing relay will dissociate the said ringing circuits from the said trunk line.

8. In a telephone system, the combination of an "A" switchboard, a "B" switchboard, a cord circuit at the "A" switchboard, a trunk line circuit leading from the "A" switchboard to the "B" switchboard, ringing keys at the "A" switchboard adapted to control selective ringing circuits, an automatic ringing relay controlled thereby, a trip relay for the said automatic ringing  
35 relay, interrupters included in the said ringing circuits, a plurality of ringing generators at the "B" switchboard, a called line at the "B" switchboard, selective step-by-step means to associate any one of the said ringing generators with the said called line,  
40 said selective step-by-step means being under the control of the said interrupters, means at the "B" switchboard operating after a connected interrupter has completed a cycle of interruptions to cause the  
45 said trip relay to operate the said automatic relay whereby the said automatic ringing relay will dissociate the said ringing circuits from the said trunk line, and supervisory signaling means at each of the switch-  
50 boards made operative after the operation of the said trip relay.

9. In a telephone system, the combination of an "A" switchboard, a "B" switchboard, a cord circuit at the "A" switchboard and  
60 a trunk line interconnecting the said cord with the "B" switchboard, a ringing circuit for the said cord circuit, an automatic ringing means at the "A" switchboard including ringing generators and a  
65 source of direct current for controlling

said ringing circuit, commutating contacts adapted to be alternately included in said ringing circuit, step-by-step means at the "B" switchboard adapted to be operated by the said commutating contacts, a telephone  
70 line at the "B" switchboard having a plurality of selective signals thereon each of said signals being of a type adapted to be selectively operated by a particular generator at the "B" switchboard said step-by-  
75 step means selecting the particular generator to operate a desired signal at the said telephone line.

10. In a telephone system, the combination of a call extending switchboard, a  
80 trunking switchboard, a link circuit at the call extending switchboard and a trunk line leading from the said call extending switchboard to the trunking switchboard to interconnect the said link circuit and the said  
85 trunking switchboard, switch terminals for the trunk circuit at the trunking switchboard to extend the trunk circuit to connection with a called line and a ringing circuit associated with the said link circuit,  
90 a plurality of commutators producing different successive series of circuit interruptions, means to interconnect the said ringing circuit to the said trunk circuit through co-operating terminal contacts of said link  
95 circuit and said trunk circuit, a switch to include any of said commutators in said ringing circuit, means to interconnect co-operating terminal contacts of said link circuit and a desired called line, signal bells  
100 on the said called line adapted to be operatively included in the said ringing circuit to ring the said bells, a plurality of selective ringing circuits at the trunking switchboard, sources of current connected  
105 thereto, selective switch contacts adapted to operatively include one of the said ringing circuits with the trunking switchboard called line to selectively operate a signal bell on the said line, said selective switch-  
110 ing contacts being operated under the control of a commutator included in the ringing circuit at the call extending switchboard to operatively include a particular selective signaling circuit at the trunking  
115 switchboard in circuit with the called line, through said trunk circuit switching terminals, said selected selective ringing circuit corresponding to the particular commutator included in the said link circuit ringing  
120 circuit.

11. In a telephone system, a plurality of groups of telephone lines terminating in switching terminals in a plurality of switching stations, a trunk line to interconnect  
125 telephone lines of two of the said groups, said trunk line comprising a pair of talking conductors, a plurality of substations on one of the telephone lines, signals at each of the said substations adapted to be se-  
130



lectively operated, means to connect one end of the said trunk line to the switching terminals of the said line, switching means at the distant switching station adapted to  
 5 associate a link circuit at the said station with the other end of the said trunk line, a ringing circuit associated with the said link circuit including a ringing generator, step-by-step switching means associated with the  
 10 end of the trunk line distant from the connected link circuit, a plurality of selective ringing generators, said step-by-step switching means being adapted to variably connect one or another of said selective ringing  
 15 generators to the circuit of the said line to selectively signal one or another of the stations thereon, a source of current and a circuit breaker included in the ringing circuit associated with the said link circuit,  
 20 current from the said source being capable of being projected through the said circuit breaker and over the said ringing circuit and the said trunk line, talking conductors to variably operate the step-by-step switching means whereby said circuit breaker by  
 25 its variable operation controls the selection of a desired station on the said line.

12. In a signaling system, the combination of a step-by-step mechanism, a plurality of  
 30 signaling generators one or another of which is adapted to be included in a signaling circuit by the operation of the said step-by-step mechanism, relay controlling means for the said switching mechanism,  
 35 circuit conductors extending from the said switching mechanism and the said controlling means to a distant impulse sending station, a source of alternating current and a source of direct current at the said station,  
 40 a commutator at the said station controlling the connection of the said sources of current to the said switching mechanism over the said circuit conductors, the said commutator having contacts adapted to be  
 45 operated one after the other in periods, one of the said contacts being connected to the alternating current source, a plurality of other contacts being connected to the said direct current source whereby the said commutator causes current from the said source  
 50 through the said contacts to flow over the trunk line and the said switching mechanism in sequence, electromagnetic means associated with the said switching mechanism, controlling means adapted to be operated  
 55 by the said alternating current source, contacts operated by the said electromagnetic means to make operable the said switching mechanism whereby the said switching mechanism can operate to select any of the  
 60 said signaling generators until after the connection of the said alternating source through the said commutator to the said switching mechanism.

65 13. In a signaling system, the combina-

tion of a step-by-step mechanism, a plurality of signaling generators one or another of which is adapted to be included in a signaling circuit by the operation of the said step-by-step mechanism, relay controlling means  
 70 for the said switching mechanism and the said controlling means to a distant impulse sending station, a source of alternating current and a source of direct current at the said station, a commutator at the said station  
 75 controlling the connection of the said sources of current to the said switching mechanism over the said circuit conductors, the said commutator having contacts adapted to be operated one after the other in  
 80 periods, one of the said contacts being connected to the alternating current source, a plurality of other contacts being connected to the said direct current source whereby the said commutator causes current from the  
 85 said source through the said contacts to flow over the trunk line and the said switching mechanism in sequence, electromagnetic means associated with the said switching mechanism, controlling means adapted to  
 90 be operated by the said alternating current source, contacts operated by the said electromagnetic means to make operable the said switching mechanism whereby the said switching mechanism can operate to select  
 95 any of the said signaling generators until after the connection of the said alternating source through the said commutator to the said switching mechanism, and additional electromagnetic means adapted to be operated  
 100 by the last impulse of direct current preceding the next succeeding alternating current impulse to operatively lock the said switching mechanism to operatively connect a selected signaling generator to a signaling  
 105 circuit common to the said generators.

14. In a signaling system, the combination of a step-by-step mechanism, a plurality of signaling generators one or another of which is adapted to be included in a signaling circuit by the operation of the said  
 110 step-by-step mechanism, relay controlling means for the said switching mechanism and the said controlling means to a distant impulse sending station, a source of alternating current and a source of direct current  
 115 at the said station, a commutator at the said station controlling the connection of the said sources of current to the said switching mechanism over the said circuit conductors, the said commutator having contacts adapted to be operated one after the  
 120 other in periods, one of the said contacts being connected to the alternating current source, a plurality of other contacts being connected to the said direct current source whereby the said commutator causes current from the said source through the said  
 125 contacts to flow over the trunk line and the said switching mechanism in sequence, elec- 130



tromagnetic means associated with the said switching mechanism, controlling means adapted to be operated by the said alternating current source, contacts operated by the  
 5 said electromagnetic means to make operable the said switching mechanism whereby the said switching mechanism can operate to select any of the said signaling generators until after the connection of the said  
 10 alternating source through the said commutator to the said switching mechanism, and a relay included in the circuit of the said commutator by the operation of the said electromagnetic means operating under the control  
 15 of the said commutator from the source of direct current to control the said controlling means and the said switching mechanism.

15. In a telephone system, the combination of an "A" switchboard, a "B" switchboard, a  
 20 telephone line terminating at the "B" switchboard, said telephone line having a plurality of stations connected thereto, a link circuit at the "A" switchboard adapted to be connected to the trunk line, said trunk line being adapt-  
 25 ed to connect at its other end to the said telephone line, a supervisory signal in the said link circuit, a supervisory signal in the said trunk circuit, a supervisory relay in the said trunk circuit operating under the control of the said substations, said supervisory relay controlling the operation of the  
 30 said supervisory signal of the link circuit, a trunk relay associated with said trunk line at the "B" switchboard adapted to be operated by current from the link circuit to control the operation of the trunk line,  
 35 supervisory signal and ringing circuit for the link circuit at the "A" switchboard, a commutator included therein, said commutator adapted to automatically operate the said trunk relay intermittently after a ringing period, a plurality of ringing generators,  
 40 a step-by-step mechanism at the "B" switchboard under the control of said trunk relay to select one of said ringing generators, each of the said ringing generators being adapted to operate a particular one of the said stations on the said telephone line, the particular generator selected and the par-  
 45 ticular station signaled depending upon the number of operations of the said trunk relay by the said commutator.

16. In a telephone system, the combination of a link circuit, an extension circuit  
 55 therefor, a ringing generator adapted to be associated with the said link circuit, a switch to cause such association, a commutator to interrupt the circuit of the said ringing generator and to substitute a source of direct  
 60 current, switching means to associate the said link circuit with said extension circuit, and automatic step-by-step mechanism in the said extension circuit under the control of the said commutator.

65 17. In a telephone system, the combina-

tion of a link circuit, an extension circuit therefor, a ringing generator adapted to be associated with said link circuit, a switch to cause such association, a commutator to interrupt the circuit of the said ringing  
 70 generator and to substitute a source of direct current, switching means to associate the said link circuit with the said extension circuit, automatic step-by-step mechanism in the said extension circuit under the control  
 75 of the said commutator, a plurality of different sources of ringing current associated with the said extension circuit, a signaling circuit therefor, said automatic step-by-step mechanism being adapted to associate any  
 80 of the said different sources of ringing current with the said signaling circuit.

18. In a telephone system, the combination of a link circuit for interconnecting  
 85 telephone lines, a ringing circuit for the said link circuit, said ringing circuit including a commutator and alternating and direct current sources, the said direct current connection being intermittently broken by the  
 90 said commutator, and remotely controlled selective switching mechanism adapted to be associated with the said link circuit under the control of the said commutator and the said direct current source.

19. In a telephone system, a plurality of  
 95 exchanges, party lines terminating in one of said exchanges, telephone lines terminating in a second exchange, means for extending a telephone connection from one of said telephone lines through said exchanges to  
 100 a wanted party line, a plurality of sources of ringing current at said first mentioned exchange to selectively signal a wanted party on the selected party line, other  
 105 sources of current of different character, a plurality of impulse sending devices at the second exchange cooperating with said other sources of current to select ringing current of the proper characteristics to signal the  
 110 wanted party, and key controlled means to select the proper impulse sending device.

20. In a telephone system, a plurality of  
 115 exchanges, party lines terminating in one of said exchanges, telephone lines terminating in a second exchange, means for extending a telephone connection from one of said telephone lines through said exchanges to a  
 120 wanted party line, a plurality of sources of ringing current at said first mentioned exchange to selectively signal a wanted party on the selected party line, other sources of current of different character, impulse sending mechanism at the second exchange cooperating with said other sources of current to select ringing current of the proper characteristics to signal the wanted party, and  
 125 means responsive to said impulse sending mechanism to apply the ringing current of the selected characteristic to the selected party line.



21. In a telephone exchange system, a first exchange, a second exchange, telephone lines terminating in each exchange, a plurality of signals responsive to currents of different characteristics and bridged between the two sides of the telephone lines, means for interconnecting the telephone lines at said first exchange and for extending a telephone connection from any line at said first exchange to any line at said second exchange, sources of current of different characteristics at each of said exchanges to which said signals are selectively responsive, a key set at said first exchange to directly connect the sources of current at said first exchange to signals of lines terminating thereon, impulse sending device at said first exchange, and means at said second exchange cooperating with said key set and responsive to said impulse sending device and key set to select and apply current of the proper characteristic to actuate said signals.

exchange, a second exchange, telephone lines terminating in each exchange, a plurality of signals responsive to currents of different characteristics and bridged between the two sides of the telephone lines of said second exchange, means for extending a telephone connection from any line at said first exchange to any line at said second exchange, a ringing machine interrupter at said first exchange, sources of current of different characteristics at said second exchange to which said signals are selectively responsive, a key controlled impulse sending device at said first exchange including said ringing machine interrupter, and a group of relays at said second exchange variably responsive to said impulse sending device to select and apply current of the proper characteristic to actuate a desired signal.

In witness whereof, I hereunto subscribe my name this 31st day of July A. D. 1917.

22. In a telephone exchange system, a first

FRANK M. SLOUGH.