

M. L. JOHNSON.

TELEPHONY.

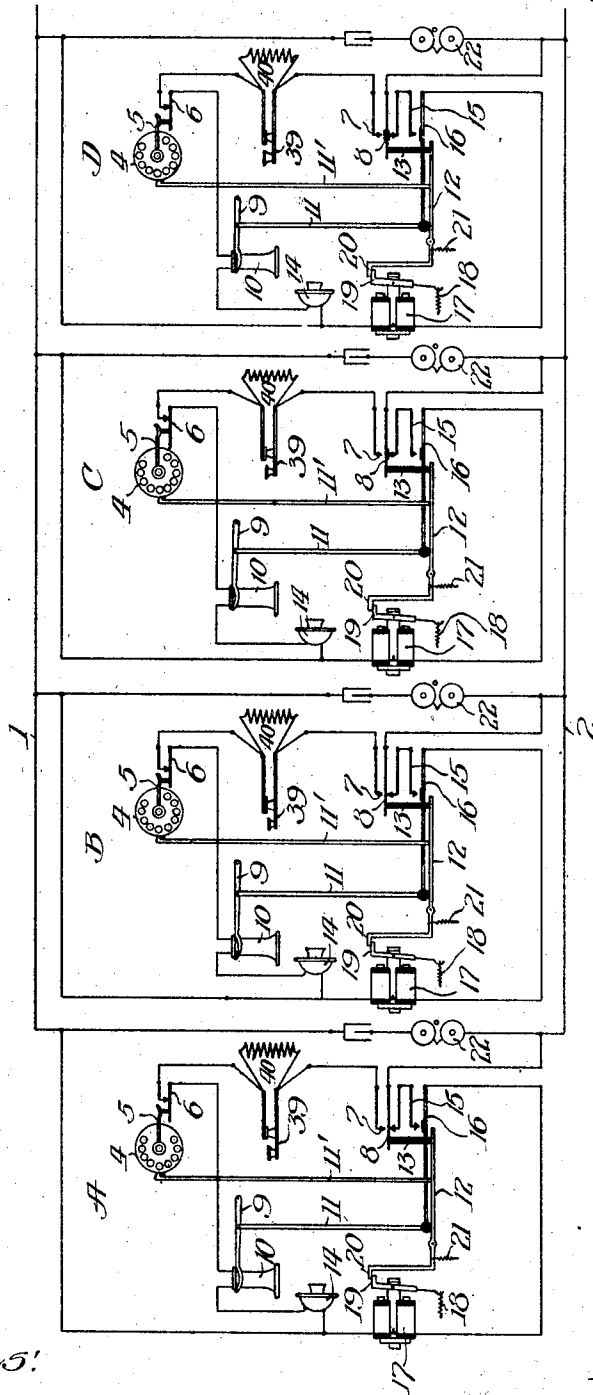
APPLICATION FILED MAY 22, 1911.

1,056,424.

Patented Mar. 18, 1913.

3 SHEETS—SHEET 1.

Fig. 1



Witnesses:

Geo. O. Davison

Harold B. Barrett

Inventor:

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By *H. K. Cragg* Atty.

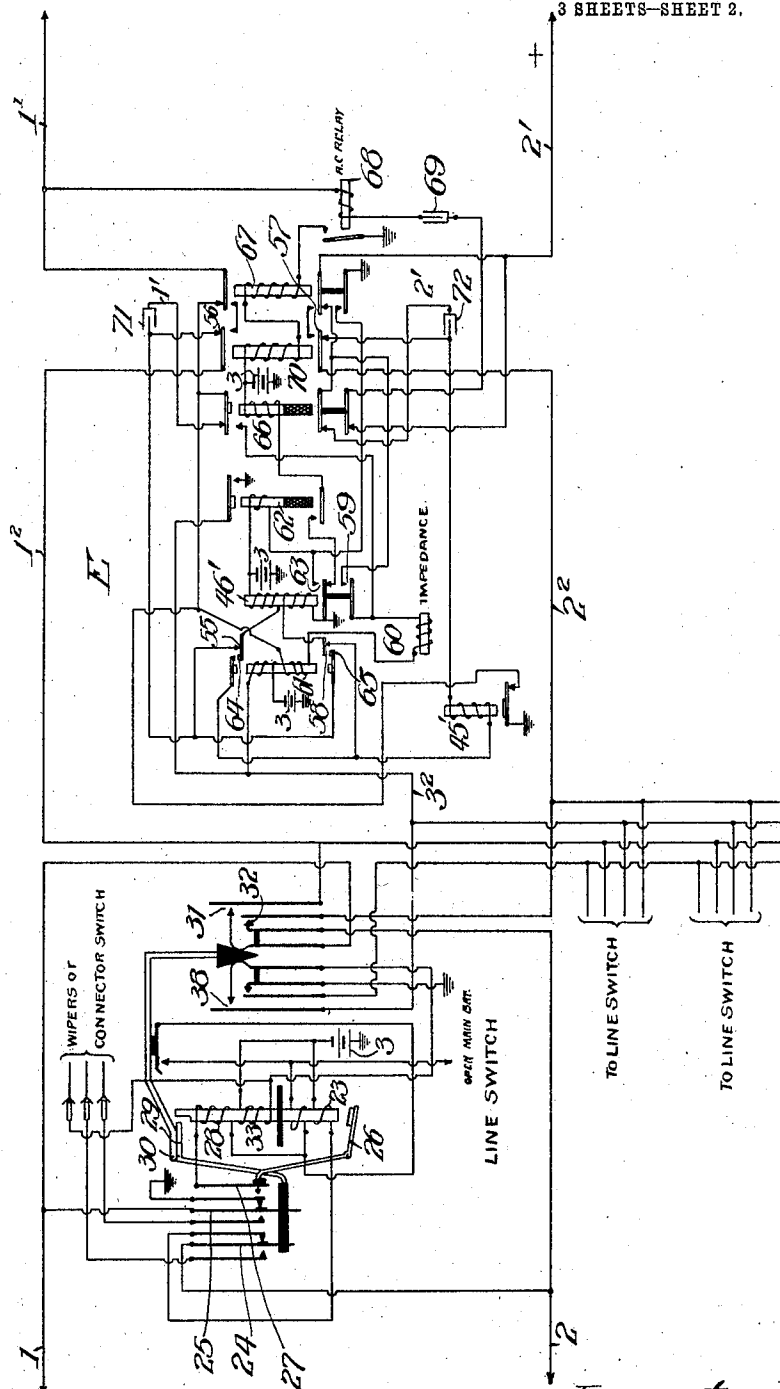
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3 SHEETS—SHEET 2.

Fig. 2



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3 SHEETS—SHEET 3.

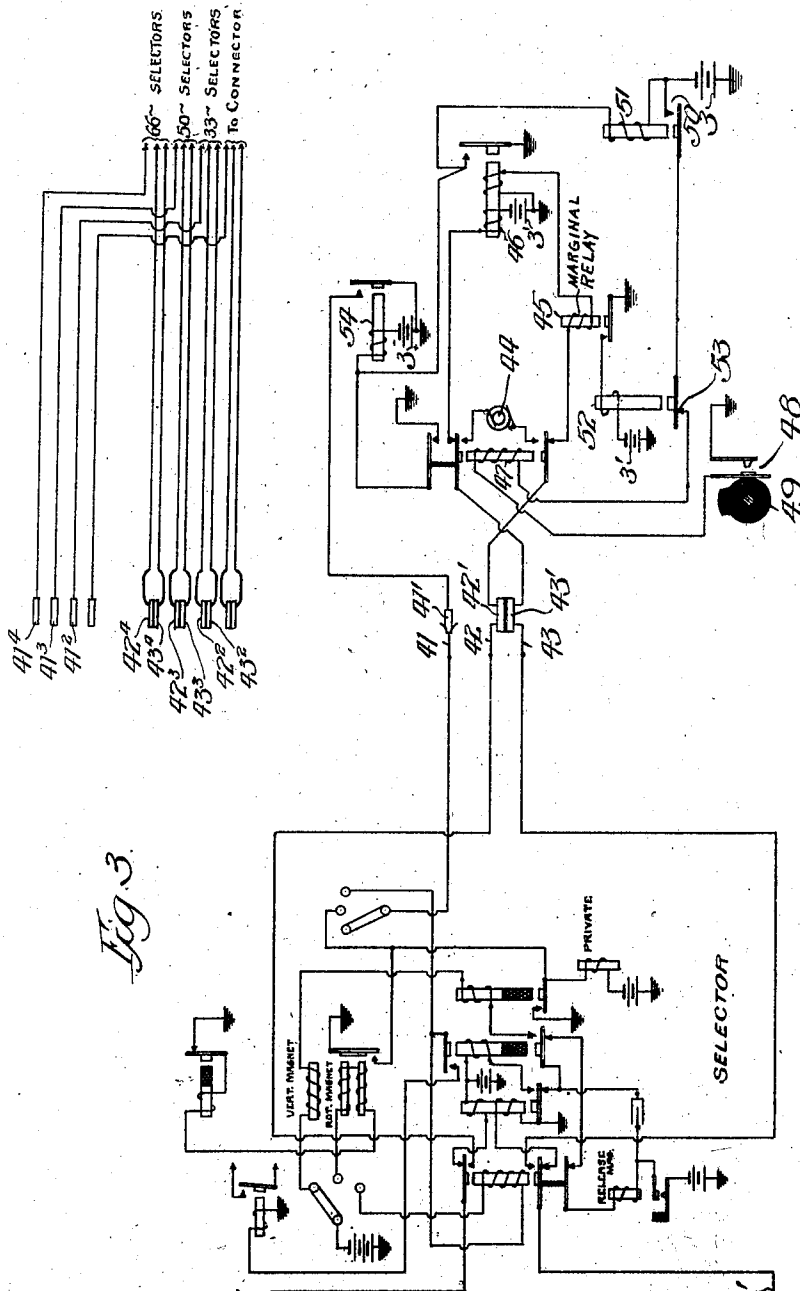


Fig. 3.

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UNITED STATES PATENT OFFICE.

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TELEPHONY.

1,056,424.

Specification of Letters Patent.

Patented Mar. 18, 1913.

Application filed May 22, 1911. Serial No. 628,779.

To all whom it may concern:

Be it known that I, MORTON L. JOHNSON, citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Telephony, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to telephone exchange systems and, in one of its aspects, relates to those telephone exchange systems in which telephone lines extend from party line stations to an exchange and are adapted for connection with telephone lines extending to another exchange through the agency of trunks extending between the two exchanges. In order to simplify the trunking equipment I have organized a system which may generally be described as a telephone exchange system including a telephone line that extends from one exchange to a second exchange where means are provided for extending the connection of the trunk, a source of signaling current, means at the second exchange for applying the source of signaling current to the trunk, and means at the first exchange governing the aforesaid means at the second exchange and in turn governed by the apparatus at a station upon said line whereby the calling party at a party line station may cause the application of signaling current to the signal receiver at another station upon the same line.

I have embodied my invention in a system in which the exchange to which the telephone line extends is provided with selecting mechanism for selecting an idle trunk extending to the second exchange where selecting mechanism is also employed for extending the idle trunk, as for example, by connecting it with a called party line connected with the second exchange. By means of my invention I am enabled to use the trunk that is employed for connecting the telephone line with the second exchange for conveying signaling current to the telephone line at the will of a calling party upon said line in order that such calling party may call another station upon the same line. In automatic telephone exchange practice each trunk may desirably include two conductors, though I do not limit myself to the number of conductors that are employed.

Another feature of my invention resides in the provision of means, exterior to the exchange with which the telephone line is connected, irrespective of the nature of such exchange, automatic or otherwise, and irrespective of the means by which said exchange is connected with the telephone line, whether by a trunk line or directly, whereby apparatus is removed from such circuit association with the line as would interfere with the proper transmission of signaling current.

Specifically, my invention further resides in a system, hereinafter to be described, having these characteristics and the invention in its broad and specific aspects will be pointed out in the claims.

I will explain my invention more fully by reference to accompanying drawings showing an embodiment thereof in the form of an automatic telephone exchange system, and in which drawings—

Figure 1 shows a party telephone line with four stations connected therewith; Fig. 2 diagrammatically illustrated a station where selecting mechanism (such as line switches) is employed for selectively connecting trunks with party lines whereby the sides of a party line may be extended to a main exchange where the party line is further to be extended in accordance with automatic or semi-automatic practice; and Fig. 3 shows selecting mechanism at a main exchange for automatically effecting further extension of the party line and also for connecting a source of ringing current with the party line when the called station is on the same line with a calling station, the equipment illustrated in Fig. 3 being that of an automatic telephone exchange to which I do not limit myself.

I will first describe, somewhat in detail, the particular party line station equipment illustrated in Fig. 1, it being understood that I do not limit myself, however, to the particular equipment shown.

The telephone line extends from the exchange to two limbs 1, 2 and, in the embodiment of the invention illustrated, is normally connected at its two sides with the poles of a battery 3, the side 1 being grounded and connected through the ground to the positive pole of the battery 3, and the negative pole of the battery 3 being connected with the side 2 of the line. The current fur-

nished by the battery 3 is preferably unidirectional. Mechanism is provided at the exchange for reversing the current applied to the line after a party at one of the telephone stations upon the line takes the line for use, the source of current 3 being itself then reversed so that the side 1 is charged from the negative pole of the battery and the side 2 is charged from the positive pole of the battery. The apparatus by which the battery 3 is reversed, and which is illustrated in Fig. 2, is familiar to those that are skilled in the art of automatic telephony and will be later more fully referred to.

I have shown four party line stations A B C D though I do not limit myself to the number of stations that are connected with the party line. As the invention is illustrated, the equipments at the four stations are identical except, if desired, the signal receivers at the different stations may be of harmonic type to respond to wave form current of different periodicities to be selectively impressed upon the line at the exchange. The signal receivers may be alike, if desired, in which event code signals should be employed.

Similar parts at the different stations will be given similar characters of reference, one station being specifically described. In the system illustrated, being an automatic telephone exchange system, I have illustrated a well known type of switching mechanism at each telephone station for operating the selecting mechanism at the exchange. In the embodiment of the invention illustrated, the switching mechanism is controlled by a well known dial mechanism that includes a spring winding finger ring or dial 4. The lever 5 engaged by the finger at the limit of the dial stroke releases the spring actuated device that intermittently operates the circuit opening switch 6 during the return of the spring actuated mechanism to normal. It is not necessary to describe in further detail the switching mechanism that is employed to operate the selecting mechanism at the exchange and furthermore, the invention is not to be limited to the particular type of switching mechanism illustrated. It should be said, however, that it is usual, where dial mechanism is used, to employ a master switch including contacts 7 and 8, in conjunction with the switching device 6 and in serial relation therewith, this master switch being controlled by the switch hook 9. The telephone receiver 10, when upon its switch hook, operates to depress the element 8 of the master switch and there open the circuit through switch 6, through the intermediation of the depressing finger 11 and the right hand end portion of the lever 12 then depressed by the finger 11, the right hand end portion of the lever 12 being mechanically

connected with the switching element 8 by means of a strut 13. The switch hook, when depressed, causes pawl 11¹ to lock the dial. There is a low resistance bridge conductor at each telephone station that includes the telephone transmitter 14 having one terminal telephonically connected with the limb 1 of the telephone line, and the receiver 10 in serial relation with the transmitter 14, the dial switch 6, and the contacts 7 and 8. The normally open connection which has just been traced between the sides of the telephone line is in parallel relation with another bridge conductor which is desirably of high resistance and is preferably normally open at the contacts 15, 16. This second bridge conductor includes a magnet 17 which is preferably polarized, and the entire resistance of this second bridge conductor is preferably located in the magnet which may be wound, for example, to ten thousand ohms resistance. The armature of the polarized magnet 17 is preferably held in predetermined normal position by means of a spring 18 that normally locks the nose or angular extension 19 of the armature beneath the nose or angular extension 20 of the intermediately pivoted lever 12. A spring 21 normally presses the nose 20 against the nose 19. The contact element 16 is mechanically connected with the finger 11 so that said contact 16 is permitted to engage the contact 15 when the associated telephone receiver 10 at a calling station is removed from its hook, whereby the high resistance bridge conductor including the magnet 17 is closed whereupon current from the battery 3 is permitted initial flow over the line sides in a direction that will enable the magnet 17 to respond and draw its armature 19 from engagement with the nose 20 of the lever 12 against the force of the spring 18 whereupon the spring 21 is permitted to swing the lever 12 in a counter clock wise direction, the finger 11 having previously been raised owing to the removal of the telephone from its switch hook. The contacts 7 and 8 of the master switch are thereupon engaged, whereafter the low resistance bridge conductor is intermittently broken at 6 in a manner which is well understood and for the purpose of operating the selecting mechanism at the exchange to extend the telephone line in a manner well known. The low resistance shunts at the stations permit of sufficient flow of current through the selecting mechanism at the exchange to enable such selecting mechanism to operate. The high resistance shunts that include the magnet 17 do not permit of the diversion of sufficient current from the low resistance shunts to interfere with the control that the switching mechanism in such a low resistance shunt at a station which has ap-

propriated the line has over the selecting mechanism at the exchange. It is of course understood that the electro-magnet 17 is responsive only to the current that is initially impressed upon the line owing to the normal connection of the battery 3 with said line, this magnet at other times maintaining the telephone bridge open. By mechanism which is well understood, and which will later be mentioned more fully, the battery 3 has its connections with the sides of the telephone line reversed so that the current impressed upon the line immediately after the line is taken for use is such that the magnets 17 will not respond thereto, whereby those stations upon the line that are late in seeking to take the line for use cannot appropriate the line owing to the fact that the lever 12 at any station later to seek appropriation of the line is locked by the armature of the magnet at such station, whereby the contacts 7 and 8 of the master switch cannot be engaged to close the gap in the low resistance bridge at this later station, which closure is essential to enable a station to take a line for use, pawl 11 then locking the dial. While current at any station at any time may be permitted to flow through the magnet 17 at such station, yet such magnet will not respond if the battery 3 has been reversed since the magnet will then be so energized as merely to tend to move its armature in the same direction in which such armature is pulled by the spring 18 without effecting readjustment of the parts that enter into the control of the receiver circuit and the control of the switching mechanism that governs the operation of the selecting mechanism. I therefore speak of the magnet 17 as being unresponsive to current that is caused to flow over the telephone line in a direction opposite to the normal flow of the current.

The signal receiver 22 responds to wave form current that is preferably an alternating current and is operated in a manner which is well understood.

I have described the operation of the equipment at a single telephone station in detail under the assumption that such a station is a calling station, and under such assumption the battery 3 is immediately reversed after the line has been taken for use. When any of the stations upon the line is a called station, the battery 3 should have its normal connection with the telephone line preserved, at least until the called station has responded in order that the magnet 17 at the called station may respond to permit the closure of the contacts 7 and 8 thereat and thereby enable the inclusion of the telephone equipment at the called station in bridge of the telephone line.

Referring now more particularly to Fig. 2, the battery 3 has its negative pole nor-

mally connected with the side 2 of the telephone line through an energizing winding 23, the switch spring 24 and the normal contact of such spring. The positive pole of the battery 3 is connected with the side 1 of the telephone line through ground and the switch spring 25 and its normal contact. When the telephone line is taken for use by a calling party at one of the stations, circuit for the battery 3 is closed at the contacts 15, 16 at that telephone station, whereupon magnet 17 at such station is operated with results which have been described. Later, the contacts 7 and 8 at the line appropriating station are engaged to close the low resistance shunt at such appropriating station, whereupon current from the battery 3 is increased sufficiently to energize the winding 23 (this winding not having been previously operatively energized owing to the presence of the high resistance magnet 17 in circuit therewith) to cause the armature 26 to be attracted. The armature 26, in being attracted, pushes the contact 27 into engagement with the normal contact of the switch spring 25, thereby to bring the energizing winding 28 into a closed local circuit that may be traced from the grounded normal contact of the switch spring 25 through the winding 28 to the grounded battery 3, whereby the armatures 29 and 30 are attracted with the result that the battery 3 has its connections with the sides of the telephone line reversed, these connections being then traceable from the side 1 of the telephone line, the contacts 31 that are closed by the armature 30, the switch 56 and its normal contact, the switch 55 and its normal contact, the upper winding of magnet 46¹ (the illustration of the battery 3 being repeated many times for the sake of clearness) to the negative pole of the battery, the positive pole of the battery being connected with the line side 2 by a connection which may be traced through the contact 32 closed by the armature 30, the lower armature switch of relay 70 and its normal contact, the winding of relay 45', the armature switch 58, the lower winding of relay 46¹, to ground. Battery 3 is thus reversed instantly upon the closure of the contacts 7 and 8 at a calling station with the results which have been described. This association of the battery and telephone line is preserved during the time the receiver at the calling station is free of its hook owing to the establishment of a locking circuit through the locking winding 33 which may be traced from the grounded battery 3, the winding 33, the contacts 38 when closed upon the operation of armature 30, the upper armature switch of relay 62 to the grounded contact of the latter armature switch.

The equipment thus far described contains

novel characteristics forming the subject matter of my co-pending application Serial No. 628,777, filed May 22, 1911, but it is to be understood that while I prefer the equipment just described, I do not limit myself thereto.

Each party line station low resistance bridge conductor includes a key 39 adapted when depressed to introduce a resistance 40, which may be of three thousand ohms, in what was previously the low resistance bridge conductor for the purpose of sufficiently reducing the current and as a consequence causing the inclusion of ringing current in circuit with the party line to enable one station upon such line to call another station.

I have diagrammatically illustrated relay mechanism at E in Fig. 2 that intervenes between the line switch there diagrammatically shown and the sides 1¹, 2¹ of a trunk line intervening between the exchange where the apparatus shown in Fig. 2 is located and the exchange where the selecting mechanism is located for further extending the trunk line, it being understood that the stations upon the party line whose sides extend into the first exchange are equipped with apparatus whereby such party line may select an idle trunk line 1¹, 2¹. By means of the relay mechanism illustrated at E the three conductors that usually intervene between the line switches and the first selectors are replaced by the two conductors 1¹, 2¹, a result which is very important where trunk lines intervene between distinct exchanges, particularly where such exchanges are wide distances apart. For the sake of clearness, I will for the present omit a description of the relay equipment illustrated at E and will assume that the party line has been continued from the line switch shown in Fig. 2 to the first selector shown at the left of Fig. 3, whereafter I will describe the equipment whereby the selected section 1¹, 2¹ of the party line is interposed between the party line proper and said first selector. Referring now more particularly to Fig. 3, I have employed the first selector, indicated at the middle of the figure, for enabling the application of calling current to a calling party line, but it is to be understood that I do not limit myself to any particular switching mechanism entering into the line extending selecting mechanism for including the calling party line in circuit relation with a source of current, nor do I limit myself to the transfer of ringing current over the talking sides of the party line. The selector shown in Fig. 3 is of a type which is well known by those skilled in the art and is a form of mechanism that is installed by the Automatic Electric Company. As is well known, this selector has wipers which swing in horizontal planes and which

are vertically adjustable so as to move in different levels, bank or waiting contacts being located in these levels which are connected with conductors that extend to connectors directly or through the intermediation of other selectors, whereby called lines are automatically connected with calling lines. The wipers of the selector shown in Fig. 3 are marked 41, 42 and 43 and these wipers are caused to swing in the selected level to suit the connection that they are to effect. One or more of the levels in which these wipers move includes bank contacts that are associated with sources of signaling current. In the embodiment of the invention illustrated code signaling is not employed, the signal receivers at the party line stations being responsive to currents of different character. For example, the signal receiver 22 at station A may respond to alternating current of sixteen cycles, the signal receiver at station B may respond to alternating current of thirty-three cycles, the signal receiver at station C may respond to alternating current of fifty cycles, and the signal receiver at station D may respond to alternating current of sixty-six cycles. If the invention is thus to be embodied, that is if the signal receivers are to be responsive to currents of different character, then there should be a plurality of levels of waiting or bank contacts associated with sources of ringing current of different character, the contacts in each of these levels being separately connected with a plurality of generators producing current of similar character so that some generator producing current of desired character may be available to enable a calling party line station to signal another station upon the same line. In Fig. 3 I have illustrated but one set of waiting contacts 41¹, 42¹ and 43¹ in one level, a single set of waiting contacts 41², 42² and 43² in the next level, a single group of contacts 41³, 42³ and 43³ in the next level, and a single group of contacts 41⁴, 42⁴ and 43⁴ in the next level. I have shown but one generator 44 in connection with the level containing the contacts 41¹, 42¹ and 43¹, it being understood that other groups of waiting contacts in this level are similarly associated with similar generators 44. I have not illustrated any equipment in association with the bank contacts of the remaining levels, it being understood, in the embodiment of the invention illustrated, that the generators associated with the first level produce alternating current of sixteen cycles, the generators associated with the contacts of the next level producing alternating current of thirty-three cycles, the generators associated with the contacts of the next level producing alternating current of fifty cycles, and the generators associated with the contacts of the next level produc-

ing alternating current of sixty-six cycles. The calling party line party may select the level containing the waiting contacts that are associated with the calling generators producing current of the frequency or other character suited to the operation of the signal receiver 22 at the station upon the party line that is to be called. Having caused the wipers 41, 42 and 43 to occupy the desired level, these wipers are stepped around until waiting contacts associated with an unemployed generator 44 are encountered, the mechanism and circuits by which idle waiting contacts are engaged and busy waiting contacts are passed over being so well known as not to require explanation.

It is assumed that any of the stations B, C, D is a calling party line station and station A is the party line station upon the same line to be called. The calling station, in such case, selects the level containing the bank contacts 41¹, 42¹ and 43¹ and it is assumed that these contacts which are illustrated in Fig. 3 were previously free for selection and are engaged by the wipers 41, 42 and 43 for the purpose of associating the generator 44, previously unemployed, with the party line. The wipers stopping upon these waiting contacts cause the establishment of a circuit through the relays 45 and 46 and the inclusion of the battery in such circuit relation with the party line as to have the side 1 connected with a positive battery pole and the side 2 connected with a negative battery pole in order to enable the party at the called party line station to bring his telephone into circuit relation with the party line. The source of ringing current 44 has terminals in the form of the alternate contacts of armature switches of the ringing magnet 47 whose circuit includes a switch 48 periodically closed and opened by a revolving cam 49. The circuit of the ringing magnet 47 also includes a switch 50 that is closed through the agency of the armature switch of the relay 46 and the magnet 51 in direct association with the switch 50. As will more fully appear, switch 50 is maintained closed during the time the telephone bridge at the calling party line station is closed whether such bridge includes the resistance 40 or does not include such resistance, the relay 46 being suitably adjusted for this purpose. The relay 45, however, is adjusted to drop its armature when the resistance 40 at a calling party line station is included in the telephone bridge, whereby the circuit previously established through the relay 52 is opened and the switch 53 controlled by the relay 52 is closed. During the time that the generator is upon the line, the armature switches of the magnet 47 are removed from their normal contacts so that the circuit of the relay 46 is then open. The switch 50 is maintained closed, however, ow-

ing to the establishment of an alternate circuit for the relay 51 which may be traced from the grounded battery 3¹ through the winding of the relay 51 to the uppermost armature switch of the magnet 47 and the grounded contact then engaged by said uppermost armature switch.

Having thus generally indicated the operations that are governed at the station end of the party line, I will now describe the relaying functions of the relay equipment illustrated at E through which party line station equipment operates upon the equipment connected with the party line by means of the selector shown in Fig. 3 for the purpose of effecting the application of ringing current to a calling party line.

Each trunk line 1¹ 2¹ has a relay equipment E individual thereto and the line switch individual to each party line is adapted to select and appropriate an idle trunk line 1¹, 2¹ together with the idle relay mechanism E individual to such trunk line, the conductors 1², 2², 3² extending to the relay mechanism at E being selectable by the line switch of a calling line, as were the three conductors of trunk lines in prior equipments. An idle set of conductors 1², 2², 3² having become operatively associated with the line switch of a calling line, circuit is established through the relay 46¹ of the relay mechanism E, which circuit may be traced from the battery 3 through the upper winding at 46¹, the switch 55, the switch 56 and its normal contact, the switch 31 to the side 1 of the calling party line, thence across the telephone bridge at the calling party line station to the side 2 of the calling party telephone line, the switch 32, the conductor 2², the switch 57 and its alternate contact, the relay device 45¹, the switch 58, thence through the lower coil of the relay device 46¹ to the ground. The armature switches of the relay device 46¹ are consequently moved whereby a bridge is established between the conductors 1¹, 2¹ of the trunk individual to the selected relay mechanism E for the purpose of controlling the selector switch shown in Fig. 3, this bridge being broken at 59 each time the circuit is interrupted at the calling party line station, whereby the selector is operated just as though it were directly connected with the telephone bridge at the calling party line station. The bridge established across the sides 1¹ 2¹ of the selected trunk includes an impedance 60 for the purpose of preventing loss of voice current transmission. The relay device 61 has a companion coil that is included in circuit with the battery 3 and the upper armature switch of a relay device 62, which latter device has circuit closed therethrough, in order to operate its armature, by the relay device 46¹; this circuit being traceable through the bat-

tery 3, the winding of relay device 62, the
 switch 63 to ground, the relay device 62 be-
 ing sluggish so that the interruption occa-
 sioned in the telephone bridge at the call-
 ing station by the operation of the dial
 switch will not be followed by the release
 of the armature of the device 62. Prior to
 the time that the selector illustrated in Fig.
 3 has selected an idle generator, current
 flows from the batteries 3, 3¹ in opposition
 and, the coils of the magnet 61 being in op-
 position, this magnet is not effectively ener-
 gized. When, however, the selector shown
 in Fig. 3 has selected an idle generator 44,
 the battery 3¹ is reversed whereupon the
 magnet 61 is effectively energized to operate
 its armature switches and open the contacts
 at 55 and 58 and establish contacts at 64
 and 65 whereby the battery 3, which was
 previously reversed from normal connection
 by the line switch of the calling line, is re-
 stored to normal connection with the party
 line, in which the side 1 is connected with
 the positive pole of the battery and the side
 2 is connected with the negative pole of the
 battery whereby the calling party line party
 is enabled to remove his telephone from its
 switch hook and include it in bridge of the
 line during the time the key 39 at the call-
 ing station is depressed, since the exclusion
 of the resistance 40 from the telephone
 bridge would permit the diversion of enough
 current from the battery 3 to prevent the
 operation of the relay 17 at the called sta-
 tion.

During the operation of the dial, the mag-
 net 62 is energized and remains energized
 as has been stated during which time another
 magnet 66 is energized by a circuit estab-
 lished through the battery 3 and the lower
 armature switch of the magnet 62. The
 magnet 66 operates sluggishly so that it also
 is not effectively deenergized during the
 operation of the dial. The bridge contain-
 ing the impedance 60 is broken at the normal
 contact of the upper armature switch of the
 magnet 66. A substitute bridge is estab-
 lished between the sides 1¹, 2¹ which may be
 traced from the side 1¹ through the upper
 armature switch of relay 67 and its normal
 contact, the upper armature switch of relay
 66 and its alternate contact, the arma-
 ture switch 59, the intermediate armature
 switch of magnet 67 and its contact
 57 to the side 2¹. This bridge is broken
 at 59 each time the dial mechanism
 breaks the low resistance bridge conductor
 at the calling telephone station so that the
 circuit of the battery 3¹ (Fig. 3) is broken
 each time the low resistance bridge conduc-
 tor at the calling station is broken, whereby
 the selector shown at the left in Fig. 3 is
 operated in the usual manner. When the
 operation of the dial has been completed at
 the calling station, magnet 66 is included

in open circuit owing to the continued re-
 moval of the intermediate armature switch
 of relay 46¹ from its normal contact, thus
 restoring the bridge previously traced
 through the impedance 40. The idle gener-
 ator 44 having been selected, current is trans-
 mitted therefrom over the party line as a
 consequence of the energization of the mag-
 net 47 due to the concurrent closure of the
 switches at 48, 53 and 50. The relay 45 is
 controlled in its operation by the relay 45¹,
 the relay 45¹ being responsive to current that
 is permitted to flow through the low resist-
 ance bridge at the calling station, but drop-
 ping its armature when the key 39 at the
 calling station is depressed for the purpose
 of including the resistance 40 in circuit with
 the relay 45¹. When the armature of the
 relay 45¹ is dropped, a ground is placed upon
 the side 1¹ of the trunk line by way of the
 armature switch of relay 45¹ and the upper
 armature switch of magnet 67, as a conse-
 quence of which relay 45 (Fig. 3) is shunted
 so that it is permitted to drop its armature
 whereby the circuit previously established
 through the relay 52 by way of this latter
 armature is opened. Switch 53 of relay 52
 is then closed to close one gap in the circuit
 of the ringing magnet 47. The gap 50 in
 this circuit of the ringing magnet is const-
 antly closed owing to the circuit estab-
 lished therethrough that may be traced from
 the battery 3¹ through the winding of the
 magnet 51 controlling the switch at 50 and
 either the armature switch of magnet 46
 (which magnet is energized when the ring-
 ing magnet 47 is deenergized whether the re-
 sistance 40 at the calling station is in or out
 of circuit), or the uppermost armature
 switch of the ringing magnet 47 when said
 ringing magnet is energized. The ringing
 current is consequently applied to the sides
 1¹, 2¹ of the trunk line and the sides of the
 party line at the will of the calling party
 during the time the key 39 at the calling sta-
 tion is depressed, the calling current being
 interrupted at 47 periodically in accordance
 with the best accepted practice. I provide
 a relay 68 at the station where the relay
 mechanism E is located for the purpose of
 freeing the party line from connection with
 any parts of the selecting mechanism and ele-
 ments associated therewith that would inter-
 fere with the proper transmission of signal-
 ing current from the selected generator 44.
 This relay 68 is desirably included in bridge
 of the trunk conductors 1¹, 2¹ and is prefer-
 ably energized by a shunted portion of the
 ringing current, said relay being designed
 so as to keep its armature attracted during
 the presence of ringing current upon the
 line. When the relay 68 is included in
 bridge and is caused to respond to alternat-
 ing current, I desirably include a condenser
 69 in series therewith and in the same bridge

for the purpose of preventing the improper shunting of battery current. As I have employed the relay 68, it serves when energized to establish circuit through magnets 67 and 70 which may be traced from the battery 3 through the windings of said magnets and the armature switch of relay 68 when actuated by said relay. The upper armature switches of the magnets 67 and 70 are provided with connected alternate contacts so that when said magnets are energized the trunk side 1¹ and the conductor 1² are directly metallically connected. The lower armature switches of the magnets 67 and 70 are also provided with connected alternate contacts whereby the trunk side 2¹ and the conductor 2² are directly connected when these magnets are energized. In this way the condensers 71 and 72 (that are serially included respectively between the conductors 1¹, 1² and the conductors 2¹, 2² by the normal contacts of the armature switches of the magnets 67 and 70 during the time that ringing current is absent from the line and for the purpose of preventing the flow of battery current between the stations shown in Figs. 2 and 3) are excluded from the path of the ringing current, a desirable result when wave form current of differing frequency is to be selectively placed upon the party line. Other apparatus at the station shown in Fig. 2 which is connected with the party line when ringing current is absent, is also removed by the operation of the armature switches of the magnets 67 and 70 also for the purpose of preventing interference with the function of the ringing current. In order to prevent the possibility of the relay 68 responding to the interruptions occurring at the dial switch of the calling party line subscriber, I include the lowermost armature switch of the magnet 66 in serial relation with the relay 68 so that when the magnet 66 is energized as it is during the operation of the dial owing to its sluggish nature as previously described, the bridge containing the relay 68 is open. As another incidental feature of the equipment illustrated, the lowermost armature switch of the relay 67 serves when actuated to close circuit through the magnet 62 whose upper armature switch thereupon establishes a circuit through locking coil 33 by way of the contacts 38 to prevent the line switch from being restored to normal when the magnets 67 and 70 are energized.

As the invention is illustrated, the called party can not secure telephonic connection with the party line until the battery current flows in normal direction over the line, which condition occurs when the circuit through the ringing magnet 47 is opened at 48. I, however, do not limit myself to this characteristic which is simply preferred for engineering reasons. When the called party

responds, a low resistance bridge is established across the sides of the party line through the telephone at the called party line station, whereby the magnet 45 is energized and the magnet 52 is consequently energized in order to open the circuit of the ringing magnet 47 at 53 during the presence of the low resistance shunt across the line at the called station under the assumption that the calling party has released his key 39. Thus the generator 44 is removed from circuit relation with the line after the called party has responded or the calling party has excluded the resistance 40 from his telephone bridge. In passing it should be stated, in the embodiment of the invention illustrated, that the calling party keeps his key 39 depressed during the interval in which he expects the called party to respond in order that the telephone bridge at the calling station may include the resistance 40 for the purpose of enabling sufficient current to pass through the magnet 17 at the called station. When the relay 46 is energized, circuit is closed through the magnet 54 by way of the grounded armature switch of the relay 46 and the contact of such switch then engaged, the winding of the relay 54 to the grounded battery 3¹. When the ringing current is applied to the party line, circuit for the relay 54 is closed through the uppermost armature switch of the magnet 47, the winding of the relay 54 and the grounded battery 3. The armature of relay 54 is thus constantly attracted so as to place a guarding potential or condition upon the contact 41¹ to prevent another calling line station from appropriating the contacts 42¹, 43¹ that are in service. This guarding potential also prevents the selector and associated switches from releasing in the manner well known.

I prefer to connect the ringing current with the trunk line by means of selecting mechanism that is also of service in connecting the trunk line with a continuation, but I do not limit myself to this characteristic since an important feature of my invention resides in the provision of the relay mechanism at E having control over the means for applying the calling current to the line, the relay mechanism at E being responsive to the operation of the dial mechanism at the calling station and replacing this dial mechanism in direct control of the application of ringing current to the party line so that the dial mechanism serves indirectly to control the application of ringing current to the line.

That feature of my invention embracing the relay 68 is of importance irrespective of the means by which the generator is connected with the line, whether such means be automatically operated or otherwise, this feature of my invention also being of im-

portance irrespective of the manner in which a calling party secures connection with the exchange, whether such connection is automatically effected or otherwise. This feature of the invention is also of importance whether or not the calling and called parties are upon the same party line since results are secured by clearing interfering apparatus from the line when signaling current is being transmitted over the line.

In my application Serial No. 628,778 filed May 22, 1911, I have broadly claimed a system wherein the selecting mechanism operates to apply ringing current to a called party line. The prior art is exemplified by British Patent No. 1298 of 1910.

While I have herein shown and particularly described a telephone exchange system employing apparatus for connecting called lines with calling lines, I do not wish to be limited to such system nor to the precise details of apparatus and circuit connections illustrated as changes may readily be made without departing from the spirit of my invention.

Having thus described my invention I claim as new and desire to secure by Letters Patent the following:—

1. A telephone exchange system including a line connecting a plurality of telephone stations with an exchange; trunks extending from said exchange to another exchange; selecting mechanism at the first exchange for selectively connecting a trunk with said telephone line; selecting mechanism at the second exchange for extending the selected trunk; a source of signaling current adapted to be connected with the trunk by the selecting mechanism at the second exchange; and mechanism at the first exchange for governing the operation of the selecting mechanism at the second exchange and in turn governed at a party line station whereby a calling party at a party line station may cause the application of signaling current to the signal receiver at another station upon the same line.

2. A telephone exchange system including a line connecting a plurality of telephone stations with an exchange; trunks extending from said exchange to another exchange; selecting mechanism at the first exchange for selectively connecting a trunk with said telephone line; a source of signaling current; means at the second exchange for connecting it with the selected trunk; and mechanism at the first exchange for governing the operation of said means at the second exchange and in turn governed at a party line station whereby the calling party at a party line station may cause the application of signaling current to the signal receiver at another station upon the same line.

3. A telephone exchange system including

a telephone line extending from a plurality of stations to an exchange; a trunk extending from this exchange to a second exchange where means are provided for extending the connection of the trunk; a source of signaling current; means at the second exchange for applying the source of signaling current to the trunk; and means at the first exchange governing the aforesaid means at the second exchange and in turn governed by the apparatus at a station upon said line whereby the calling party at a party line station may cause the application of signaling current to the signal receiver at another station upon the same line.

4. A telephone exchange system including a telephone line extending from a station to an exchange; a trunk line extending from this exchange to a second exchange and having equipment interfering with the proper transmission of signaling current; a source of signaling current; means governed at the second exchange for controlling the application of signaling current to the line; and means at the first exchange for removing trunk line apparatus from such circuit association with the line as would interfere with the proper transmission of signaling current.

5. A telephone exchange system including a telephone line extending from a station to an exchange; a trunk line extending from this exchange to a second exchange and having equipment interfering with the proper transmission of signaling current; a source of signaling current at the second exchange; means at the second exchange and there governed for controlling the application of signaling current to the trunk and the line connected therewith; and means at the first exchange for removing trunk line apparatus from such circuit association with the line as would interfere with the proper transmission of signaling current.

6. A telephone exchange system including a telephone line extending from a station to an exchange; a trunk line extending from this exchange to a second exchange and having equipment interfering with the proper transmission of signaling current; a source of signaling current; means governed at the second exchange for controlling the application of signaling current to the line; and means at the first exchange for removing trunk line apparatus from such circuit association with the line as would interfere with the proper transmission of signaling current, there being means at the second exchange for governing this latter means.

7. A telephone exchange system including a telephone line extending from a station to an exchange; a trunk line extending from this exchange to a second exchange and having equipment interfering with the proper transmission of signaling current; a

source of signaling current at the second exchange; means at the second exchange and there governed for controlling the application of signaling current to the trunk and the line connected therewith; and means at the first exchange for removing trunk line apparatus from such circuit association with the line as would interfere with the proper transmission of signaling current, there being means at the second exchange for governing this latter means.

8. A telephone system including a telephone line connecting a telephone station with an exchange and having equipment interfering with the proper transmission of signaling current; means at the exchange for applying signaling current to the line; and means for removing apparatus from such circuit association with the line as would interfere with the proper transmission of signaling current.

9. A telephone exchange system including a telephone line extending from a station to an exchange; a trunk line extending from this exchange to a second exchange and having equipment interfering with the proper transmission of signaling current; a source of signaling current; means governed at the second exchange for controlling the application of signaling current to the line; and means at the first exchange and responsive to the signaling current for removing trunk line apparatus from such circuit association with the line as would interfere with the proper transmission of signaling current.

10. A telephone exchange system including a telephone line extending from a station to an exchange; a trunk line extending from this exchange to a second exchange and having equipment interfering with the proper transmission of signaling current; a source of signaling current at the second exchange; means at the second exchange and there governed for controlling the application of signaling current to the trunk and the line connected therewith; and means at the first exchange and responsive to the signaling current for removing trunk line apparatus from such circuit association with the line as would interfere with the proper transmission of signaling current.

11. A telephone exchange system includ-

ing a telephone line extending from a station to an exchange; a trunk line extending from this exchange to a second exchange and having equipment interfering with the proper transmission of signaling current; a source of signaling current; means governed at the second exchange for controlling the application of signaling current to the line; and means at the first exchange and responsive to the signaling current for removing trunk line apparatus from such circuit association with the line as would interfere with the proper transmission of signaling current, there being means at the second exchange for governing this latter means.

12. A telephone exchange system including a telephone line extending from a station to an exchange; a trunk line extending from this exchange to a second exchange and having equipment interfering with the proper transmission of signaling current; a source of signaling current at the second exchange; means at the second exchange and there governed for controlling the application of signaling current to the trunk and the line connected therewith; and means at the first exchange and responsive to the signaling current for removing trunk line apparatus from such circuit association with the line as would interfere with the proper transmission of signaling current, there being means at the second exchange for governing this latter means.

13. A telephone system including a telephone line connecting a telephone station with an exchange and having equipment interfering with the proper transmission of signaling current; means at the exchange for applying signaling current to the line; and means responsive to the signaling current for removing apparatus from such circuit association with the line as would interfere with the proper transmission of signaling current.

In witness whereof, I hereunto subscribe my name this fourth day of May A. D., 1911.

MORTON L. JOHNSON.

Witnesses:

MARGARET D. ROBB,
G. L. CRAGG.