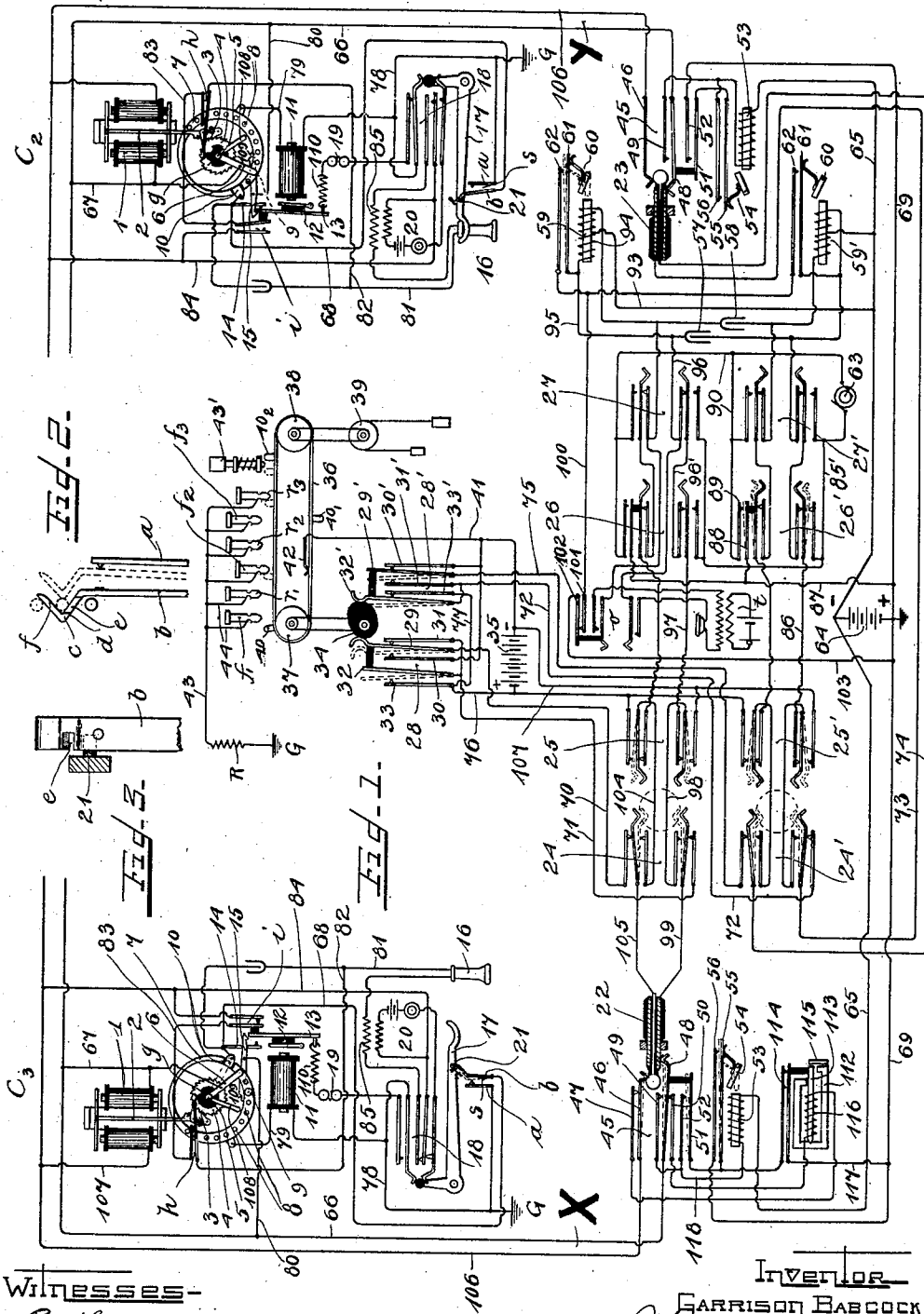


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MULTIPARTY LINE TELEPHONE EXCHANGE SYSTEM.
APPLICATION FILED AUG. 4, 1904.

901,669.

Patented Oct. 20, 1908.



WITNESSES-

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GARRISON BABCOCK, OF ROCHESTER, NEW YORK, ASSIGNOR TO STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, OF ROCHESTER, NEW YORK, A CORPORATION OF NEW YORK.

MULTIPARTY-LINE TELEPHONE-EXCHANGE SYSTEM.

No. 901,669.

Specification of Letters Patent.

Patented Oct. 20, 1908.

Application filed August 4, 1904. Serial No. 219,419.

To all whom it may concern:

Be it known that I, GARRISON BABCOCK, citizen of the United States, residing at Rochester, in the county of Monroe and State of New York, have invented a certain new and useful Improvement in Multiparty-Line Telephone-Exchange Systems, 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 multi-party telephone exchange systems and may be considered as an improvement over the system outlined in Patent No. 824,701, issued to me July 3rd, 1906.

The object of my present invention is to provide a multi-party line system which employs a central common battery for supplying the substations with signaling current.

As will be hereinafter pointed out, my invention also contemplates improvements in the supervisory means whereby the proper cut-off signals from the subscribers are obtained.

Other features of improvement are also added and the system will be best understood by reference to the accompanying drawings, in which:

Figure 1 illustrates two substations of different party lines to be connected together for conversation through a central exchange apparatus, and Figs. 2 and 3 are detail views of a passing contact switch actuated by the substation switch hooks.

At each substation there is a polarized electromagnet 1 whose armature is provided with an arm 2 terminating in pawl mechanism 3. A ratchet wheel 4, mounted upon a shaft 5, is engaged by said pawl mechanism to step forward a switch arm 6, secured to the shaft. The end of the arm 6 travels over a ring 7, provided with a plurality of equally spaced holes 8, 8, into any one of which may be placed a contact pin 9, adapted to be engaged by the arm 6 upon its rotation about the ring 7. The contact 10 is disposed above the ring, but insulated therefrom, and the arm 6 is normally in engagement with said contact. A relay 11 is connected in circuit between the ring 7 and the earth and controls an armature 12 to which is secured a switch arm 13, adapted, when the armature is attracted, to close con-

tact with the contact spring 14, and a detent lever 15 serves to maintain a contact between the switch arm 13 and the spring 14. A receiver 16 normally rests on the switch hook 17, which engages the switch springs 18 to normally include the signal bells 19 in circuit between the switch arm 13 and ground, and a local transmitter circuit 20 is also associated with the switch springs 18. The switch hook is provided with an actuating stud 21 for closing a passing contact switch *s* only upon depression of the hook. This switch consists of a spring *a*, connected with ground, and an actuating spring *b*, connected with the spring 14 and the normal contact 10.

As seen in Figs. 2 and 3, the actuating spring *b* is bent at its end to form a V-shaped cam *c*, the lower member *d* of which is provided with an opening *e*, through which the stud 21 may pass upon elevation of the switch hook. Thus, as the hook is raised, the stud passes through the opening *e* and engages the under surface of the upper member *f* and the spring *b* will not engage the spring *a*. Upon depression of the switch hook, however, the stud engages the top surface of the cam and the switch *b* will form a passing contact with the switch *a*. At each substation I provide an actuating cam *g*, of insulating material, secured to the shaft 5. A switch *h* is opened when the arm 6 is in its normal position on the contact 10. An additional switch *i* is normally closed and upon attraction of the armature 12 by the electromagnet 11 is opened. The switches *h* and *i* are connected serially in a local circuit including the receiver and, as will appear later, this local circuit locks out the receivers at all the undesired substations when conversation is carried on over the line.

At the central station I have shown a cord circuit provided with a rear plug 22 and a front plug 23, the rear plug engaging the spring jack connected with the line X to which is connected the calling subscriber C., and the front plug being inserted in the spring jack connected with the line Y to which is connected the called subscriber C. Selective keys 24 and 24', releasing keys 25 and 25', selective ringing keys 26 and 26', and metallic ringing keys 27 and 27' are respectively associated with the rear plug and the front plug of the cord circuit. Circuit

changing switching mechanism 28 is associated with the rear plug and circuit changing mechanism 28' is associated with the front plug. The circuit changing mechanism 28 consists of an actuating spring 29 adapted to alternately engage springs 30 and 31, and the spring 32 is connected with, but insulated from, the spring 29 and alternately makes and breaks contact with a switch spring 33.

The circuit changing mechanism 28' consists of a spring 29' adapted alternately to engage springs 30' and 31' and an actuating spring 32' is rigidly secured to, but insulated from, the spring 29', and alternately makes and breaks contact with the spring 33'. A cam 34 of insulating material revolves between the actuating springs 29 and 32', whereby the circuit changing mechanisms are actuated to alternately short circuit the lines connected therewith and to connect with said lines a source of current 35, whereby current impulses are sent through the substation electromagnets 1 to step forward the switch arms 6. After the switch arms 6 at the desired substations have traveled to engage the associated contact pin 9, it is desired that current be sent through the relay 11 to telephonically connect the desired subscribers with the line. At the central exchange I associate a plurality of actuating buttons with each plug, these buttons being disposed in two rows, the front row of buttons f_1, f_2, f_3 , etc. being associated with the front plug, while buttons r_1, r_2, r_3 , etc. in the rear row are associated with the rear plug, there being sufficient buttons in each row to provide for any number of substations on a line, each substation being represented by a button. Below these buttons I dispose an endless conductor, which may be in the shape of a band 36, adapted to travel over carrier wheels 37 and 38. The wheel 38 may be driven by weight mechanism 39, as shown, while the carrier wheel 37 is in driving relation with the cam 34. Equally spaced contact ridges 40 project from the band 36 and serve to engage and to restore the keys which have been depressed. The band 36 is continually connected with the negative side of the battery 35 through a conductor 41 and a wiper contact 42, while the buttons f_1 , etc. and r_1 , etc. are continually in connection with the earth through a conductor 43, contact springs 44 and a resistance R.

Each line terminates at the central exchange in a spring jack 45. The tip spring 46 of the jack connected with line X is normally disengaged from the contact spring 47, and the sleeve spring 48 normally engages the contact spring 49, and upon insertion of a plug engages a contact spring 50. In each jack a spring 51 is secured to, but insulated from, the sleeve spring 48, and normally engages a contact spring 52. A line relay 53 is associated with each line

and has an armature 54 adapted upon attraction to engage a spring 55 with a spring 56. The cord circuit is divided into two conductively insulated sections by condensers 57 and 58, included serially in the cord strands, and bridged across the cord strands at each side of the condensers is a supervisory relay 59 having an armature 60 adapted upon attraction to engage spring 61 with a spring 62. A ringing circuit is supplied from a source 63 which may be a source of alternating current or a polarity changer, and a main battery 64 supplies signaling current for the substations and for the exchange signals.

The operation of the system is as follows: Suppose the subscriber C_3 on line X desires to converse with subscriber C_2 on line Y; he removes his receiver from the hook and depresses the switch hook to momentarily close the switch s . A current will flow as follows: From the negative pole of the battery 64 at the central exchange to conductor 65, through the winding of the line relay 53, through the contact springs 49 and 48, through the line limb 66, through conductor 67, through switch arm 6, contact 10, conductor 68 and through the switch s to ground and thence to the positive side of the battery 64. The armature 54 of the line relay will thus be momentarily attracted but, upon such attraction, will engage the spring 55 with the spring 56 to close a local circuit, traced as follows: From the negative side of the battery 64, through conductor 65, the line relay winding, springs 52 and 51, springs 55 and 56, and through conductor 69 to the positive side of the battery, and thus the line relay will remain energized and the operator will receive the signal and will thereupon insert the rear plug 22 into the spring jack. By so doing, she disengages the spring 51 from the spring 52 and the spring 48 from the spring 49, thereby disrupting any circuit through the line relay winding, which becomes inert. Upon actuation of her listening key o and connection with the line of her telephone set t , the operator may ascertain the desired subscriber and she thereupon inserts the front plug 23 into the spring jack connecting with line Y. She now actuates the selective keys 24 and 24', as shown, and depresses actuating button f_2 corresponding with substation C_2 and actuating button r_3 corresponding with substation C_3 . One of the contact ridges 40 is disposed at the left of the actuating buttons just in front of the button f_1 . The starting key 43' has been pulled upwardly, as shown, to release the contact ridge 40, to allow the weight mechanism to revolve the band 36 and at the same time to revolve the cam 34, the cam in the figure being shown as just depressing the actuating spring 32', and when said actuating spring and the associ-

ated spring 29' are fully depressed to the right and the actuating spring 29 and the associated spring 32 are entirely retracted toward the right, the contact ridge 40 will be directly below the actuating button f_1 , and the circuit changing mechanism 28 serves to short circuit the line X through the following circuit: actuating spring 29, conductor 70, through the selective key 24 to the tip of the rear plug, thence through the substations on the line back to the sleeve of the rear plug, to selective key 24, to conductor 71 and to spring 31, any static charge on the line being thus removed. The circuit changing mechanism 28', however, sends a positive impulse through the substations on line Y through the following circuit: actuating spring 32', conductor 72, selective key 24', conductor 73 to the sleeve of the front plug 23, through the substation apparatus on line C_2 back to the tip of the front plug, through conductor 74, through the selective key 24', conductor 75, spring 29', spring 30', conductor 41 to the battery 35, conductor 76, conductor 77 and spring 33'. This current is in a direction to actuate the electromagnets 1 at each of the substations on line Y, and the switch arm 6 at the substations will be stepped forward to be disposed over the first hole in the ring 7.

At the next half revolution of the cam, switch mechanism 28' will serve to short circuit the line Y and switch mechanism 28 will be actuated to allow a current impulse to pass through the electromagnets 1 at the substations connected with line X and thus each line is alternately short circuited and alternately receives a positive impulse of current. After the second current impulse over the line Y, the switch arms will be disposed over the second hole which, at substation C_2 , is provided with a contact pin 9, the contact ridge 40 at the central exchange at the same time engaging the depressed button f_2 , and a current will flow as follows: from the negative side of the battery 35 to conductor 41, wiper contact 42, contact band 36, contact ridge 40, actuating button f_2 and the associated spring 44, conductor 43, resistance R to ground, and thence through the ground conductor 78 at the substation C_2 , through the relay 11, through conductor 79, through the ring 7 and pin 9 connected therewith, through arm 6, through conductor 67, through the line limb 66 to the sleeve of the front plug, to the conductor 73, through the selective key 24', conductor 72, actuating spring 32', spring 33', conductor 77 and through conductor 76 back to the positive side of the battery. The relay 11 at substation C_2 is thus energized to attract its armature 12 and the switch lever 13 connected therewith into engagement with the contact 14, and the detent lever 15 drops to maintain this engagement. Upon the en-

gagement of the detent 15 with the switch arm 13, the signal bells 19 which are normally grounded through switch mechanism 18 will be connected with the sleeve line limb 66 through the conductor 80. Relays 11 at the other substations on line Y will not be energized as substation C_2 is the only one in which the contact pin 9 is inserted in the second hole.

Upon the first impulse over the line, the cam g will move to close the switch h and at all the substations we have a local shunt circuit about the receiver which may be traced as follows: from the receiver 16, through the conductor 81, conductor 82, through the switch h to conductor 83, through the switch i to conductor 84, through springs of the switch mechanism 18 and through the secondary winding 85 back to the receiver. This shunt circuit about the receiver will be maintained at all substations excepting those desired for conversation, at which substations the arm 6 is in contact with the contact pin 9 to close a circuit through the relay 11 which attracts its armature to open the associated switch i to again open this shunt circuit and the receivers at the desired substations are connected with the line, and conversation may be carried on. Thus an effective locking out system is provided which absolutely cuts out from the undesired substations any means for hearing any of the conversation passing over the line.

Upon a third impulse over the line X, the arm 6 at substation C_2 will engage the contact pin 9 and at the same time ridge 40 will engage the depressed button r_2 to close a circuit through the relay 11 and attraction of armature 12 will result to open the shunt circuit about the receiver and to connect substation C_2 with the line and with substation C_3 . In a similar manner as on line Y the remaining subscribers on line X will be locked from the telephonic circuit.

Having thus set up the apparatus at the desired substations and locked out the apparatus at the other substations, the operator releases selective keys 24, 24' and actuates the calling key 26' connected with the plug 23, and the ringing circuit may be traced as follows: from the source of ringing current 63 to the conductor 85', through the ringing key 26', conductor 86, through key 25', through selective key 24', through conductor 73, through the sleeve of the plug 23, through the sleeve line limb 66, through the conductor 80, through detent lever 15, switch arm 13, signal bell 19, through springs on the switch mechanism 18, to ground, from thence through the ground conductor 87 at the central exchange, through switch springs 88 and 89 associated with the calling key 26', and through conductor 90 back to the ringing source.

As the relay at substation C_2 is the only one on line Y which has been energized, the corresponding signal bells 19 would be the only ones affected upon actuation of ringing keys 26' and thus substation C_2 is selectively and independently signaled. The subscriber at substation C_2 now removes his receiver from the hook and is in communication with the subscriber at substation C_3 through the following circuit: From the receiver 16 at substation C_2 through conductor 81, through contacts 14 and 13, lever 15, conductor 80, line limb 66 to sleeve spring 48, through conductor 73, through the middle spring of the ringing key 24' which is released through the inner spring of said key to the middle spring of the key 25', to the inner spring of said key, to conductor 86, through key 26', through key 27', to conductor 95, through conductor 96, keys 27 and 26, through conductor 97, through key 25, through key 24 which has been released, through conductor 99 to the sleeve member of the plug 22, to the sleeve springjack contact 48, to the conductor 66 of the line X, through conductor 80, lever 15 at substation C_3 , through contacts 13 and 14, to conductor 81, through the receiver 16 and through the switch hook springs to conductor 84 to line limb 106 back to the tip springjack 46 through conductor 105, through keys 24 and 25, through keys 26 and 27, through condenser 58, through keys 27', 26', 25' and 24', through conductor 74, to the tip member of the plug 23, to the tip jack spring 46, to the limb 106 of line Y, to conductor 84 at substation C_2 , and through the switch hook springs back to the receiver 16.

Upon completion of conversation, both subscribers return their receivers to the hooks and the actuating studs on the hooks engage the corresponding switches s , as above described, to cause momentary closure thereof, and circuits will be closed through the corresponding supervisory relays 59. For instance, when switch s at substation C_3 is closed the circuit may be traced as follows: from the negative side of the battery 64, through conductor 65, through conductor 93, through winding 94 of the supervisory relay 59, through conductor 95, conductor 96, through the lower side of the key 27, through conductor 96', through the lower side of key 26, through conductor 97, through key 25, through the conductor 98, through key 24, to sleeve strand 99, through the sleeve of plug 22, to sleeve spring 48, through sleeve line limb 66, through conductor 80, through detent lever 15, switch arm 13, spring 14, conductor 68, through switch s to ground and thence to the grounded side of the battery 64 at the central exchange. Upon this momentary flow of current through the above circuit, the armature of the relay 59 will be attracted to engage its spring 61 with the

spring 62, whereupon a local circuit will be closed through the winding 94 as follows: from the negative side of the battery 64, through conductor 65, conductor 93, winding 94, springs 61 and 62, conductor 100, springs 101 and 102 associated with the operator's listening key o and through conductor 103 to the positive side of the battery 64. The armature will thus remain attracted and the operator notified that conversation at substation C_3 has been completed, and in the same manner completion of conversation at substation C_2 will be indicated by the supervisory relay 59'. Where the line resistance is not too great, the local circuits including the supervisory relay windings may be omitted as a line circuit will permanently include the supervisory relay when the switch hook is down, this circuit being traced as above but including the arm 13, signal bell 19 and switch mechanism 18, instead of the passing contact switch s .

As the supervisory relays 59 and 59' are connected with the cord strands at opposite sides of the condensers 57 and 58, the circuits through the relays will act independently of each other and each subscriber independently signals the exchange operator. The conductor 93 connecting each relay winding through the battery 64 to earth is intermediately connected to the winding so that the proper amount of impedance will be included at either side of the conductor 93, whereupon a perfect balance of the system will be maintained. It will also be noticed that upon actuation of the operator's listening key o the positive side of the battery 64 will be disconnected from the local supervisory circuits, this preventing interference with conversation passing over the line should the operator at any time listen in.

Having thus received the cut off signal from both subscribers, the operator actuates the releasing keys 25 and 25' to send current through the setting-up magnets 1 in a reverse direction to the setting-up impulse currents, and the following circuit through the line X, for instance, may be traced: from the positive side of the battery 35, through key 25 to conductor 104, through key 24 to tip strand 105, through the tip of the plug 22 to the tip spring 46, tip line limb 106, through the electromagnets 1 connected with the line, back to the sleeve line limb 66, through sleeve spring 48 and sleeve of plug 22 to sleeve conductor 99, through key 24, conductor 98, key 25, through conductor 107 back to the negative side of the battery 35. The direction of this current is opposite to the polarity of the setting-up impulses and, consequently, the armatures of the electromagnets 1 will be moved in opposite direction to withdraw the pawl mechanism 3 from the toothed wheels 4 and, as the shafts 5 are provided with spring mechanism, not shown, the arms 6

will be returned to their normal position to engage the contacts 10. Each shaft 5 is also provided with a cam arm 108, adapted upon release of the shaft to engage a cam surface 5 109 at the rear of the detent lever, and thus as the arms 6 return to their contacts 10, the cam arms 108 will engage the detent levers 15 to disengage these levers from the switch arms 13, which are returned to their normal 10 positions by means of springs 110 and these operations cause the switch *i* and *h* in the shunt circuit about the receiver to be respectively closed and opened.

The same circuits may be traced through 15 the substations connected with line Y and, having thus presumably released and restored the apparatus at all the substations, the operator withdraws the plugs from the jacks. If all the apparatus at the substations has been properly restored, there will be no actuation of the line signals as there will be no ground connections at the substations. Should, however, the apparatus at any substation have failed to be properly 25 restored and the switch arm 13 not released from the detent lever 15, there will still be a circuit to ground from the sleeve line limb through the detent lever 15, switch arm 13, signal bells 19 and through the switch mechanism 18 and current will flow through this 30 circuit to the ground connection at the battery 64 at central, through this battery, through the conductor 65, the winding of the line relay 53, through springs 49 and 48 back to the sleeve line limb and the local circuit heretofore traced will be also closed 35 through the line relay winding and the operator receiving the signal knows immediately that proper release and restoration has not taken place and she again inserts the plug into the jack and again manipulates the corresponding releasing key to send a further impulse of releasing current into the 45 line, and this is done until there is no actuation of the line signal upon withdrawal of the plug. It may, however, happen that owing to the high combined resistance of the bell at a substation and the line, there will be insufficient energy flowing through the 50 winding of the line relay to cause attraction of its armature and, consequently, the operator will not be signaled even though the proper restoration has not been accomplished. To insure a signal to the operator 55 upon such non-release, I provide an auxiliary relay which may be of the kind described in the co-pending application of William Kaisling, Serial No. 182,390, filed November 23, 1903, which relay consists of 60 a permanent magnet 112, an armature 113 and a switch 114 actuated by the armature, a magnetic brake 115 serving to impede the attraction of the armature in the direction, in this particular case, to open the switch 114, 65 the operation of this relay being more mi-

nutely described in the above referred to co-pending application.

The armature 113 is provided with a winding 116 connected with the alternate contact springs 47 and 50 of the spring jack and 70 upon insertion of the plug 22 in the jack, this winding will be bridged across the line limbs and also across the battery 35 upon actuation of selective key 24. Upon selective current impulses passing into the line 75 from the battery 35, current will flow through the winding 116 to polarize the armature which will be attracted by the permanent magnet core 112 to close the switch 114. As the operator upon completion of conversation actuates the releasing key 25 to send 80 releasing current of opposite polarity into the line from the battery 35, the armature 113 will be oppositely polarized and the tendency will be for the magnet 112 to 85 attract the armature to open the switch 114, and with this polarity of the armature, the brake 115 will be attracted to retard the movement of the armature and, consequently, a great deal of energy will be 90 required to cause opening of the switch 114. On the other hand, the electromagnets 1 at the substations are of delicate adjustment and require very little energy for actuation and the presumption is that if the 95 releasing current is sufficiently strong to actuate the auxiliary relay, it will be more than strong enough to have actuated all the electromagnets 1 to cause proper release thereof to allow perfect restoration of the 100 substation apparatus. If the auxiliary relay has not been sufficiently energized to open the switch 114, the operator, upon withdrawal of the plug, will be notified by actuation of the armature 54, since a local 105 circuit flows as follows through the winding of the line relay: from the positive side of the battery 64, through conductor 117, switch 114, springs 51 and 52 of the spring jack, conductor 118, through the line relay 110 winding and through conductor 65 back to the negative side of the battery, and she must reinsert the plug and send a further releasing impulse over the line. If the 115 energy is then sufficient to actuate the auxiliary relay to open the switch 114, any circuit through the line relay 53 will be opened and the operator is certain that proper restoration has taken place.

I thus provide a system in which the ap- 120 paratus at the substations on two lines may be practically operated at the same time from the central exchange and in which only the desired substations are connected for conversation, the others being absolutely 125 locked out. By means of the double supervisory signal system, the operator has independent supervision of each line and, by means of the releasing and restoring supervisory apparatus, the operator is at all times 130

certain that the substation apparatus has been restored to its proper normal condition, all the setting-up, locking-out and supervisory apparatus being actuated from a central common source of current.

As many modifications may be made without departing from the spirit of the invention, I do not wish to be limited to the precise arrangement as shown, but

Having described my invention I wish to secure by Letters Patent the following claims:—

1. In a telephone exchange system, the combination with a central exchange, of a telephone line leading therefrom and terminating in a sub-station, a source of current at the exchange, a line signal at the exchange associated with said line, a normally open passing contact switch at the sub-station associated with a receiver hook, said passing contact hook being adapted to momentarily close a circuit through said source of current and said line signal upon depression of said receiver hook, local means at the central exchange for maintaining actuation of said line signal, and switch mechanism at the sub-station adapted to be actuated from the central exchange to cause said passing contact switch to be disconnected from said line circuit.

2. In a telephone exchange system, the combination with a central exchange, of a telephone line leading therefrom and terminating in a sub-station, a source of current at the exchange, a line signal at the central exchange associated with said line, a normally open passing contact switch at the sub-station associated with a receiver hook, said passing contact switch being adapted to momentarily close a circuit through said source of current and said line signal upon depression of the receiver hook, local means at the central exchange for maintaining actuation of said line signal, switch mechanism at the sub-station operated from the central station to disconnect said passing contact switch from the line circuit, signal bells at the sub-station, and switch mechanism for connecting said signal bells with the line circuit.

3. In a telephone exchange system, the combination with a central exchange, of a telephone line extending therefrom and terminating in a sub-station, a source of current at the central exchange, a line relay for said telephone line, a line signal controlled by said line relay, a normally open passing contact switch at the sub-station associated with a receiver hook, said passing contact switch being adapted to momentarily close a circuit through said source of current and said line signal upon depression of said receiver hook, local means at the central exchange for maintaining actuation of said line signal, switch mechanism at the sub-

station operated from the central exchange for disconnecting said passing contact switch from the line, and a relay at the sub-station controlled by said switch mechanism, said relay controlling switch springs whereby the signal bells for the sub-station may be connected with the line circuit.

4. In a telephone exchange system, the combination with a central exchange, of a telephone line extending therefrom and terminating in a sub-station, a source of current at the central exchange, a line relay for said telephone line, a line signal controlled by said line relay, a passing contact switch at the sub-station associated with a receiver hook, said passing contact switch being adapted to momentarily close a circuit through said source of current and said line relay only upon depression of the receiver hook, local means at the central exchange for maintaining actuation of said line signal, switch mechanism at the sub-station controlled from the central exchange for disconnecting said passing contact switch from the line, signal bells at the sub-station, and a relay controlling switch springs whereby said signal bells may be connected with the circuit, the circuit through said relay being controlled by said switching device whereby said signal bells may be connected with the line after said passing contact switch has been disconnected therefrom.

5. In a telephone exchange system, the combination with a central exchange, of a telephone line leading therefrom and terminating in a substation, a cord circuit at the central exchange, a source of current at the central exchange connected with said telephone line, a line signal at the central exchange for said telephone line, switching mechanism at the substation, a receiver hook at the substation, a passing contact switch controlled by said switch hook, a line circuit normally including said source of current, said line signal, said switching apparatus and said passing contact switch to be momentarily closed upon depression of said receiver hook, whereby said line signal is actuated, local means at the central exchange for maintaining actuation of said line signal, means upon connection of the cord circuit with said telephone line for causing said line signal to become inert, a signal bell at the substation normally disconnected from said line circuit, and means for actuating said switching mechanism from the central exchange to cause said passing contact switch to be disconnected from said line circuit and to cause connection with said line circuit of said substation signal bell, said signal bell then controlling the continuity of said line circuit upon disconnection of said cord circuit from said telephone line.

6. In a telephone exchange system, the combination with a central exchange, of a

plurality of telephone lines leading therefrom, each connecting with a plurality of substations, a cord circuit at the central exchange for connecting lines together, a source of current at the central exchange for supplying signaling current to the substations, a line signal for each telephone line, a passing contact switch at each substation adapted to be closed only upon depression of the associated receiver hook to momentarily close a line circuit through the corresponding line signal, local means for each line signal for maintaining actuation thereof, connection of the cord circuit with the lines causing the corresponding line signals to become inert, means for dividing the cord circuit into two conductively insulated parts, and a supervisory relay for each part connected in bridge of the cord strands, said supervisory relays being momentarily energized upon actuation of the corresponding substation passing contact switch upon depression of the receiver hook, and local circuits for the supervisory relays for maintaining actuation thereof.

7. In a telephone exchange system, the combination with a central exchange, of telephone lines leading therefrom, each connecting with a plurality of substations, a cord circuit at the central exchange for connecting lines together, a common source of current at the central exchange for supplying signaling current to all the substations, a line signal for each telephone line normally connected with one line limb and a third conductor, a passing contact switch at each substation connected with said line limb and the third conductor, actuation of said contact switch upon depression of an associated receiver hook causing momentary closure of a line circuit containing said source of current and the corresponding line signal, a local circuit for each line signal for maintaining actuation thereof, means for dividing the cord circuit into two conductively insulated parts, a supervisory signal for each part bridged across the cord strands, a winding of each supervisory signal connected with the third conductor, connection of the cord circuit with the lines causing the corresponding line signal to become inert and the corresponding supervisory signal to be momentarily actuated upon depression of the corresponding receiver hook, and a local circuit for each supervisory signal for maintaining actuation thereof.

8. In a telephone exchange system, the combination with a central exchange, of a telephone line leading therefrom and terminating in a substation, a cord circuit at the central exchange, a line relay normally connected with the telephone line adapted to be actuated upon actuation of substation apparatus, connection of said cord circuit with the line causing said line signal to be dis-

connected therefrom, an auxiliary relay normally connected with the line, means connected with the cord circuit for sending current into the line whereby said auxiliary line relay is energized, switching mechanism closed by said auxiliary relay upon energization thereof, and a local circuit including said switching mechanism and the winding of said line relay upon disconnection of the cord circuit from the line.

9. In a telephone exchange system, the combination with a central exchange, of a telephone line leading therefrom and terminating in a substation, a spring jack connected with the telephone line at the central exchange, a line relay normally connected with said telephone line through spring jack contacts, an auxiliary line relay normally disconnected from the line, a switch controlled by said auxiliary relay, a local circuit adapted to include said switch and the line relay winding, a cord circuit at the central exchange, connection of said cord circuit with the spring jack causing disconnection of the line relay, and connection with the spring jack and line of said auxiliary relay, contacts of said spring jack partly controlling said local circuit, and means associated with the cord circuit for sending current impulses through the spring jack, whereby said auxiliary line relay is energized to close its associated switch and the local circuit through said switch, disconnection of the cord circuit from the jack causing said spring jack contacts to completely close the local circuit, whereby said line relay is actuated.

10. In a telephone exchange system, the combination with a central exchange, of a telephone line extending therefrom and terminating in a substation, a spring jack connected with the line, a line relay normally connected with the line through said spring jack, a line signal controlled by said line relay, actuation of substation apparatus causing actuation of said line relay to display its signal, a polarized auxiliary line relay normally disconnected from said spring jack, a switch controlled by said auxiliary line relay, a local circuit adapted to include said switch and the winding of said line relay, jack contacts normally included in said local circuit, a cord circuit at the central exchange provided with plugs, insertion of a plug into said spring jack causing said line relay to be disconnected from said line, said auxiliary relay to be connected with said cord circuit and said local circuit to be opened at said spring jack contacts, means associated with the cord circuit for sending current impulses of one polarity through said spring jack and into the line to actuate substation apparatus and to energize said auxiliary line relay to close the associated switch included in the local circuit, and ad-

ditional means associated with said cord circuit for sending currents of opposite polarity through the spring jack and into the line, whereby said auxiliary line relay is energized to open the associated switching mechanism and to open the local circuit at this point, whereby the line relay will not be energized upon withdrawal of the plug from the spring jack.

11. In a telephone exchange system, the combination with a central exchange, of a telephone line extending therefrom and terminating in a sub-station, a source of current at the central exchange for supplying signaling current to said telephone line, a line signal at the central exchange for the telephone line, a passing contact switch at the sub-station associated with the receiver hook adapted to momentarily close a circuit through said source of current and said line signal, said passing contact switch consisting of a contact spring and an actuating spring, said actuating spring being provided with a V-shaped head for engagement with a stud on said receiver hook, said stud being adapted upon depression of said receiver hook to pass about said V-shaped head whereby said actuating spring may make contact with said contact spring, and being adapted to pass through said V-shaped head when said hook is raised whereby effectual actuation of said actuating spring is prevented.

12. In a telephone exchange system the combination with a central exchange, of a telephone line extending therefrom and terminating in a sub-station, a source of current at the central exchange, a line signal at the central exchange for the telephone line, and a passing contact switch at the sub-station associated with the switch hook for

momentarily closing the circuit through said line signal, said passing contact switch consisting of a contact spring and an actuating spring, said actuating spring having a V-shaped cam head for engagement with a stud on said receiver hook, said stud being adapted upon depression of said hook to pass about said V-shaped cam whereby said actuating spring is brought into engagement with said contact spring, and being adapted when said hook is raised to pass through a slot in said spring whereby it may pass through the V-shaped head, thereby preventing effectual actuation of said actuating spring.

13. In a telephone exchange system, the combination with a central exchange, of a telephone line extending therefrom and terminating in a sub-station, a source of current at the central exchange for supplying current to the telephone line, a line signal at the central exchange for the telephone line, a contact spring at the sub-station, an actuating spring associated with said contact spring, and a cam head for said actuating spring, said cam head having a cam surface to be engaged by a stud on the receiver hook at the sub-station upon depression thereof whereby said actuating spring is brought into engagement with said contact spring, said stud being adapted when said hook is raised to pass through a slot in the cam head whereby said actuating spring is prevented from being effectually actuated.

In witness whereof, I hereunto subscribe my name this 26th day of July A. D. 1904.

GARRISON BABCOCK.

Witnesses:

S. A. CROSTON,
FREDERICK W. COTT.