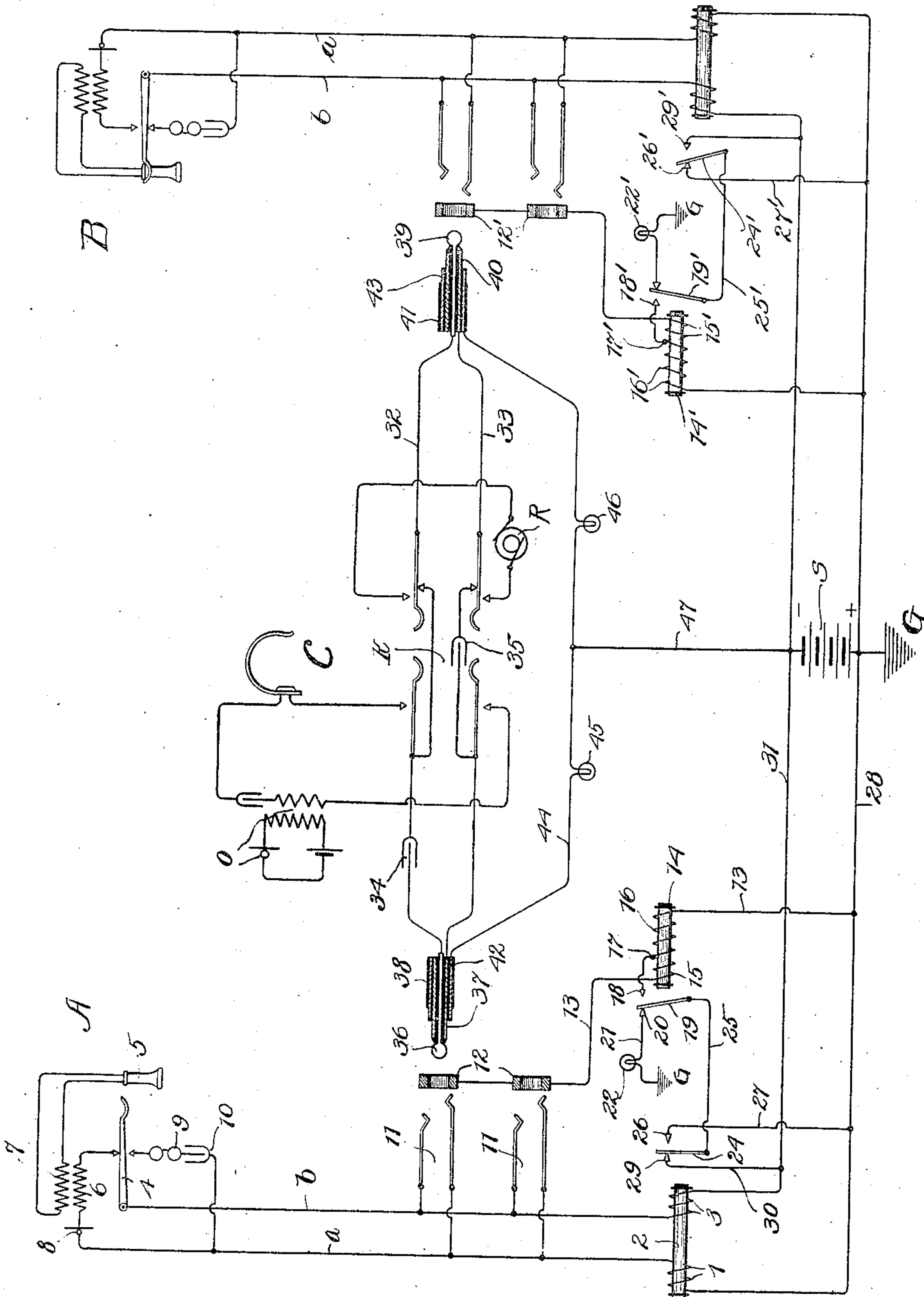


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S. B. FOWLER.
TELEPHONE EXCHANGE SYSTEM.
APPLICATION FILED MAY 22, 1906.



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TELEPHONE-EXCHANGE SYSTEM.

No. 877,921.

Specification of Letters Patent.

Patented Feb. 4, 1908.

Application filed May 22, 1906. Serial No. 318,155.

To all whom it may concern:

Be it known that I, SAMUEL B. FOWLER, citizen of the United States, residing at La Fayette, in the county of Tippecanoe and State of Indiana, have invented a certain new and useful Improvement in 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 telephone exchange systems, and its object is to provide an improved arrangement of signaling and indicating mechanism and circuits at the central exchange.

In my invention I employ a single line relay and a single supervisory relay, each having one armature, the line signal being mutually controlled by the position of the armature. When the cord circuit is connected with the line the entire winding of the supervisory relay is primarily connected in circuit, and during this time there will be insufficient current flow to the supervisory lamp, which will remain unilluminated. Immediately upon actuation of the supervisory relay and when the line relay is inert, a short circuit path will be provided and the supervisory relay becomes illuminated. When the subscriber answers and causes actuation of the line relay, a short circuit path will be closed to shunt out the supervisory lamp. The exact arrangements in my invention will be best understood by reference to the accompanying drawing, which diagrammatically illustrates a telephone exchange system and telephone lines leading thereto.

I have shown substations A and B connected with the central exchange through line limbs *a* and *b*, the line limb *a* connecting with the positive terminal of the central battery S and including a winding 1 of the indicating relay 2, while the line limb *b* connects with the negative terminal of the battery and includes the winding 3 on the line relay, these windings being cumulative in their effect. At each substation is the usual telephonic apparatus comprising the receiver hook 4, receiver 5, primary winding 6, secondary winding 7 and transmitter 8, a signal bell 9 with the condenser 10 being normally bridged across the line. Multiple springjacks 11—11 connect in bridge of the line limbs and their test thimbles 12 are connected serially to-

gether and connect through conductor 13 with the positive side of battery S. In this conductor is interposed the supervisory relay 14 having two winding sections 15 and 16. The common terminal 17 of the winding sections connects with the front contact 18 adapted, when the relay is energized, to be engaged by the armature tongue 19 which normally rests against contact 20 from which leads the conductor 21 including the indicating lamp 22 and terminating in the ground connection G. The armature tongue 24 of the line relay connects through conductor 25 with the armature tongue 19. The normal contact 26 of the armature tongue 24 connects through conductor 27 with the positive bus bar 28, while the alternate contact 29 connects through conductor 30 with the negative bus bar 31.

The cord circuit C comprises the operator's key K of well known construction interposed in the cord strands 32 and 33, condensers 34 and 35 being interposed to divide the cord circuit into two conductively separated paths. The strands, 32 and 33, at the left end terminate in tip and sleeve contacts 36 and 37 of the answering plug 38, while the right end of the strands terminates in tip and sleeve contacts 39 and 40 of the calling plug 41. A third contact 42 for the plug 38 and a third contact 43 for the plug 41 are provided and connected together through conductor 44 including the supervisory lamps 45 and 46, a conductor 47 connecting between the negative side of battery and with conductor 44 at a point between the supervisory lamps. Upon actuation of the listening side of the key the operator's telephonic apparatus O is bridged across the cord circuit, while upon actuation of the ringing side of the key the generator R will be connected in bridge of the cord strands.

The operation of the system is as follows: A substation A is shown as the calling substation, the receiver being removed from the hook, and a circuit is then closed which includes the central source of current, the windings of the line relay and the transmitter, primary winding and switch hook at the substation. Armature tongue 24 is attracted against the contact 29 and current will flow locally from the negative bus bar through conductor 30, through armature tongue 24, conductor 25, supervisory relay

armature 19, through the back contact of this armature and through the indicating lamp 22 to earth, the positive side of the battery being also grounded. The line lamp becomes illuminated and in response the operator inserts the answering plug into one of the springjacks connected with the calling line. Immediately upon such connection current will flow from positive battery through conductor 13, serially through winding sections of the supervisory relay to the jack thimbles, to the third contact 42, through conductor 44, through supervisory lamp 45 and through conductor 47 to the negative side of the battery. The adjustment of the supervisory relay is such that when both its windings are thus serially included in circuit with the supervisory lamp, there will be insufficient current flow to cause illumination of the lamp. The current flow is, however, sufficient to cause the relay to attract its armature 19 into engagement with the front contact 18 thereby cutting out the line lamp. If the line relay were inert, as shown at the right of the figure, the armature tongue 24 would be in engagement with the contact 26 connected with the positive pole of the battery, and there would be a branch circuit path from the positive pole of the battery to the common terminal 17, this circuit being traceable as follows: From positive battery through conductor 27, armature tongue 24, conductor 25, armature tongue 19, contact 18, and terminal 17, the combined current flow then passing through winding section 15, through conductor 13, the test thimbles, the plug, conductor 44, supervisory lamp 45 and conductor 47 to negative side of battery. Sufficient current will now flow through the supervisory lamp to cause illumination thereof. The receiver at substation A, however, being off the hook, the line relay is energized and the connection 27 to positive battery opened, the armature tongue being against the front contact 29 connected with negative battery through conductor 30. The armatures of both relays being attracted, we now have the condition that the common terminal 17 is connected through two paths with negative battery, that is, the path before traced extending through winding section 15, through the test thimbles, plug, supervisory lamp and conductor 47, the other path being a short circuit path including the contact 18, armature 19, conductor 25, armature 24, contact 29 and conductor 30, and as all the current will pass through this short circuit path the supervisory lamp will not be illuminated.

The operator upon manipulation of her listening key ascertains that the connection desired is with substation B, and thereupon inserts the calling plug 41 into one of the springjacks connected with the line leading

to substation B. Immediately upon such connection the local circuit will be closed including the windings 16' and 15' of the supervisory relay 14', the test thimbles 12', the third contact 43 of the engaging plug, conductor 44, supervisory lamp 46 and conductor 47 and the central battery, the armature tongue 19' being attracted to isolate the signal lamp 22'. The line relay being inert, the low resistance branch circuit from the positive battery through conductor 27', armature 24', contact 26', conductor 25', armature tongue 19' and contact 18' to the common terminal 17' will become effective and sufficient current allowed to flow to illuminate the supervisory lamp. The operator actuating her ringing key connects the generator R with the cord strands to ring the bell at substation B, and the subscriber in answer removes the receiver from the hook, thereby establishing current flow through the line relay to draw its armature into connection with the contact 29 and to break the low resistance path to the common terminal just traced. The short circuit path from the common terminal 17 to the negative pole of the battery is, however, closed upon attraction of the armature 24' and the supervisory lamp shunted out. The subscribers are now in conversation, and when finished replace their receivers on the hook with the result that the line relays become deenergized, and upon attraction of their armatures, the short circuit path is broken and the low resistance path to the common terminal becomes effective, thus allowing the supervisory lamps to glow, and in response to this signal the operator withdraws the plugs from the jacks, and upon consequent deenergization of the supervisory relay the conditions are normal.

When both armatures are attracted and the terminal 17 connected through the short circuit path with the negative pole of the battery, there will be current flow through the winding section 16, and as the relay remains in circuit during the entire time that the plug is connected with the line, this winding should be of sufficient resistance to prevent undue or waste current flow. The resistance of the winding section 15 may also be such that the supervisory lamp may be of the same rating as the other lamps in the system, making it, therefore, unnecessary to use special lamps for this purpose. With this condition the lamps will not be subjected to injury due to excessive current flow should the winding section 15 become short circuited.

As changes may readily be made without departing from the spirit of my invention, I do not wish to be limited to the precise arrangement herein shown, but I claim as new and desire to secure by Letters Patent.

1. In a telephone exchange system, the

combination with a telephone line leading from a central exchange to a substation, of a cord circuit and a source of current at the central exchange, a supervisory relay and a
 5 supervisory signal at the central exchange, means upon connection of the cord circuit with the line for causing closure of a circuit primarily including said source of current,
 10 of the supervisory relay, the resistance of said circuit being too great to allow actuation of the supervisory signal, there being sufficient current flow to allow actuation of the supervisory relay, and means upon actua-
 15 tion of the supervisory relay for removing part of the resistance from said circuit to allow actuation of the supervisory signal.

2. In a telephone exchange system, the combination with a telephone line leading
 20 from a central exchange to a substation, of a cord circuit and a source of current at the central exchange, a supervisory relay and a supervisory signal at the central exchange, means upon connection of the cord circuit
 25 with the line for causing closure of a circuit primarily including said source of current, said supervisory lamp and all the windings of the supervisory relay, the resistance of
 30 said circuit being too great to allow actuation of the supervisory signal, there being sufficient current flow to allow actuation of the supervisory relay, and means upon ac-
 35 tuation of the supervisory relay for short circuiting part of the winding thereof where-
 upon sufficient current may flow through the circuit to actuate the supervisory signal.

3. In a telephone exchange system, the combination with a telephone line leading
 40 from a central exchange to a substation, of a cord circuit and a source of current at the central exchange, a supervisory relay and a supervisory signal at the central exchange, means upon connection of the cord circuit
 45 with the line for causing closure of a circuit primarily including said source of current, said supervisory lamp and all the windings of the supervisory relay, the resistance of said
 50 circuit being too great to allow actuation of the supervisory signal, there being sufficient current flow to allow actuation of the super-
 55 visory relay, means upon actuation of the supervisory relay for short circuiting part of the winding thereof whereupon sufficient current may flow through the circuit to ac-
 60 tuate the supervisory signal, and means upon actuation of substation apparatus for removing said short circuit and substituting there-
 for a short circuit path which causes the supervisory signal to become inert.

4. In a telephone exchange system, the combination with a telephone line leading
 from a central exchange to a substation, of a cord circuit and a source of current at the
 central exchange, a supervisory relay and a

supervisory lamp at the central exchange, 65
 means operable when the cord circuit is connected with the line to call the substa-
 tion for closing a circuit including said source of current, said supervisory lamp and all
 the winding of the supervisory relay, the 70
 resistance of said circuit with all the winding included being too great to allow sufficient
 current flow to illuminate the supervisory lamp, the current flow being normally suffi-
 75 cient to actuate the supervisory relay, a short circuit path connected with an intermediary
 point of the supervisory relay winding upon actuation of said relay and with one terminal
 of said source to render ineffective one part
 of the relay winding and to allow sufficient 80
 current flow through the circuit to illuminate the supervisory lamp, and means upon actu-
 ation of substation apparatus in response to the call from the central station for causing
 said short circuit to be connected with the 85
 other terminal of said source whereby said source is prevented from supplying current
 flow to illuminate the supervisory lamp.

5. In a telephone exchange system, the combination with a telephone line leading 90
 from a central exchange to a substation, of a cord circuit and a source of current at the
 central exchange, a supervisory relay and a supervisory lamp at the central exchange,
 means operable when the cord circuit is con- 95
 nected with the line to call the substation for closing a circuit including said source of cur-
 rent, said supervisory lamp and all the wind-
 100 ing of the supervisory relay, the resistance of said circuit with all the winding included
 being too great to allow sufficient current flow to illuminate the supervisory lamp, the
 current flow being normally sufficient to actuate the supervisory relay, a short circuit
 path connected with an intermediary point 105
 of the supervisory relay winding upon actua-
 tion of said relay and with one terminal of
 said source to render ineffective one part
 of the relay winding and to allow sufficient
 110 current flow through the circuit to illuminate the supervisory lamp, and means upon actua-
 tion of substation apparatus in response to the call from the central station for causing
 said short circuit to be connected with the
 other terminal of said source, whereby sub- 115
 stantially all the current flow from said source will pass through the part of the relay
 winding before short circuited, whereby said
 relay remains in its actuated condition and
 the supervisory lamp extinguished. 120

6. In a telephone exchange system, the combination with a telephone line leading
 from a central exchange to a substation, of a cord circuit and a source of current at the
 central exchange, a supervisory relay and a 125
 supervisory lamp at the central exchange, means operable upon connection of the cord
 circuit with the line to call the substation to

close a circuit including said source of current, said supervisory lamp and primarily all the winding of the supervisory relay, whereby the resistance of the circuit will be too great to allow illumination of the supervisory lamp, there being, however, sufficient current flow to cause actuation of the relay, means adapted upon actuation of the supervisory relay to close a short circuit path about part of the relay winding whereby sufficient current may flow to illuminate the supervisory lamp, and means adapted upon actuation of substation apparatus to open the short circuit to allow the winding part to again become effective and to short circuit the remaining part of the winding and the supervisory lamp.

7. In a telephone exchange system, the combination with a telephone line leading from a central exchange to a substation, of a source of current and a cord circuit at the central exchange, a supervisory relay and a supervisory lamp at the central exchange, a line relay at the central exchange, means adapted upon connection of the cord circuit with the line to call the substation to close a circuit including said source of current, the supervisory lamp and primarily all the winding of the supervisory relay, whereby the resistance is too great in said circuit to allow illumination of the lamp, the current flow, however, being sufficient to actuate the supervisory relay, and a short circuit closed upon actuation of the supervisory relay to render part of the relay winding ineffective to allow sufficient current flow to illuminate the supervisory lamp, actuation of substation apparatus causing operation of the line relay, operation of the line relay causing opening of the short circuit about the winding part and closure of another circuit about the remainder of the winding and the supervisory lamp, whereby said lamp is extinguished.

8. In a telephone exchange system, the combination with a telephone line extending from a central exchange to a substation, of a source of current and a cord circuit at the central exchange, a supervisory relay and a supervisory lamp at the central exchange, a line relay and a line lamp at the central exchange, actuation of substation apparatus causing operation of the line relay to connect the line lamp in circuit, means adapted upon connection of the cord circuit with the line in response to the actuation of the line signal to close a circuit including said source of current, the supervisory lamp and primarily all the winding of the supervisory relay, the current flow through said circuit with all the winding effective being insufficient to illuminate the supervisory lamp but sufficient to cause actuation of the supervisory relay, actuation of said relay

causing disconnection of the line lamp and causing completion of a short circuit path for preventing illumination of the supervisory lamp, restoration of substation apparatus and the line relay causing opening of said short circuit and thereby illumination of the supervisory lamp.

9. In a telephone exchange system the combination with a telephone line leading from a central exchange to a substation, of a cord circuit and a source of current at the central exchange, a supervisory relay and a supervisory lamp associated with the cord circuit, a line relay and a line lamp at the central exchange, said line relay being controlled by substation apparatus, connection of the cord circuit with the line causing closure of a circuit including said source of current, the supervisory lamp and primarily all the winding of the supervisory relay, the current flow through said circuit with all the winding included being insufficient to illuminate the supervisory lamp but sufficient to cause actuation of the supervisory relay, actuation of the supervisory relay causing closure of a short circuit about part of the supervisory relay winding when the line relay is inert, whereby sufficient current may flow to illuminate the supervisory lamp, actuation of the supervisory relay when the line relay is actuated causing closure of a short circuit for shunting the current flow from the supervisory lamp, whereby said lamp becomes extinguished.

10. In a telephone exchange system, the combination with a telephone line leading from a central exchange to a substation, of a cord circuit and a source of current at the exchange, a supervisory relay and a supervisory signal at the central exchange, a line relay at the central exchange, armature mechanism for the supervisory and line relays, connection of the cord circuit with the line causing closure of a circuit including the supervisory signal and all the winding of the supervisory relay whereby to prevent operation of the supervisory signal, said armature mechanism when in one position causing short-circuiting of part of the supervisory relay winding to allow operation of the supervisory signal, and when in another position upon operation of the line relay being adapted to close a shunt path about the supervisory signal to prevent illumination thereof.

11. In a telephone exchange system, the combination of a telephone line leading from a substation to a central exchange, a cord circuit and a source of current at the central exchange, a supervisory relay and a supervisory signal at the central exchange, a line relay, an armature for the supervisory relay, and an armature for the line relay, connection of the cord circuit with the line causing

closure of a circuit including the supervisory
signal and primarily enough of the supervi-
sory relay windings to prevent illumination
of the supervisory signal, said armatures
5 being in position when the line relay is inert
to render part of the supervisory relay wind-
ing ineffective to allow operation of the su-
pervisory signal, and the line relay armature
upon energization of the line relay being

adapted to close a path about the super- 10
visory signal to prevent operation thereof.

In witness whereof, I hereunto subscribe
my name this 18th day of May, A. D., 1906.

SAMUEL B. FOWLER.

Witnesses:

BESSE M. BEGANE,

CHARLES E. THOMPSON.