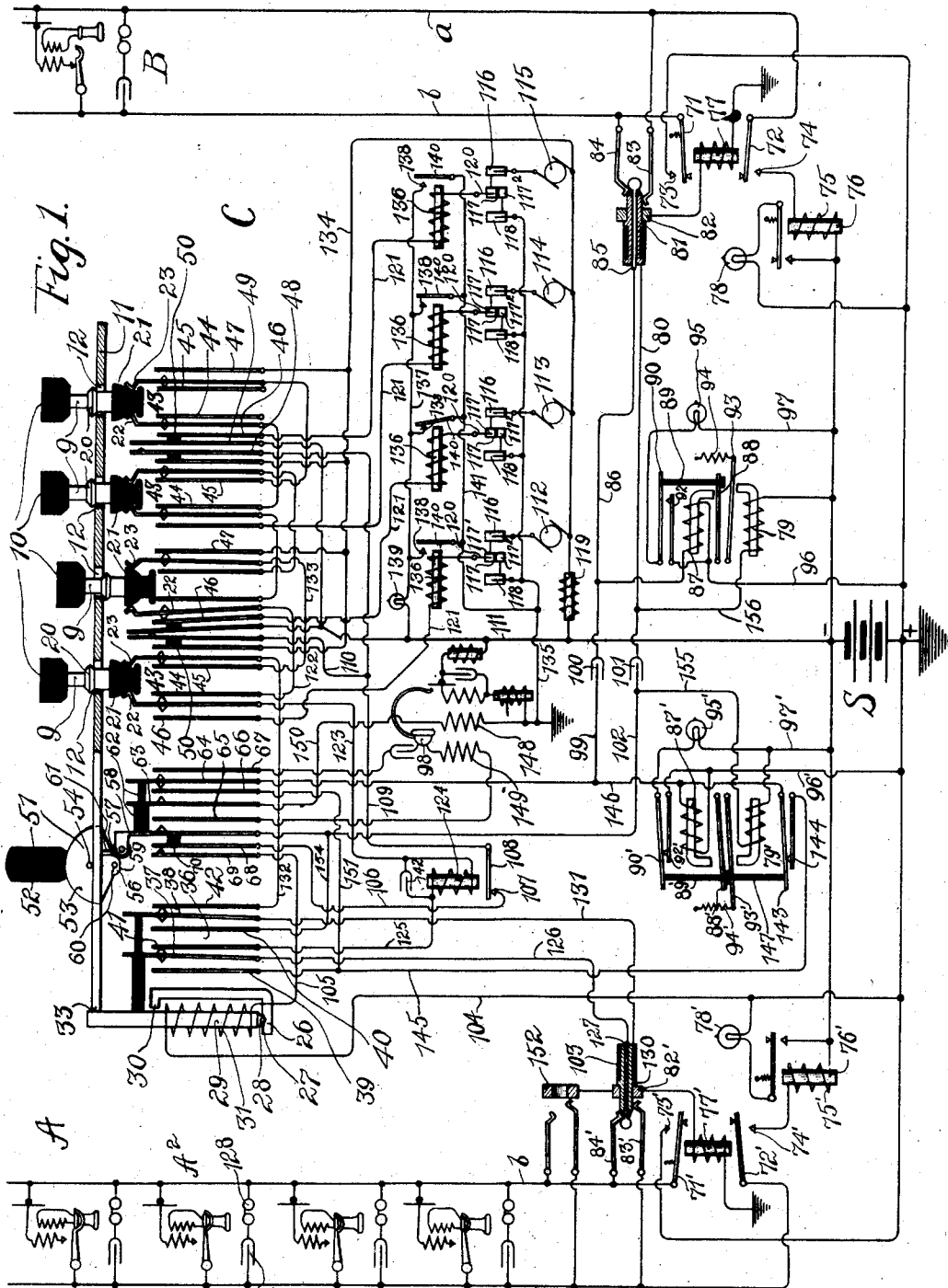


901,684.

Patented Oct. 20, 1908.

3 SHEETS—SHEET 1.



Witnesses:
Arthur H. Boettcher
Charles J. Schmidt

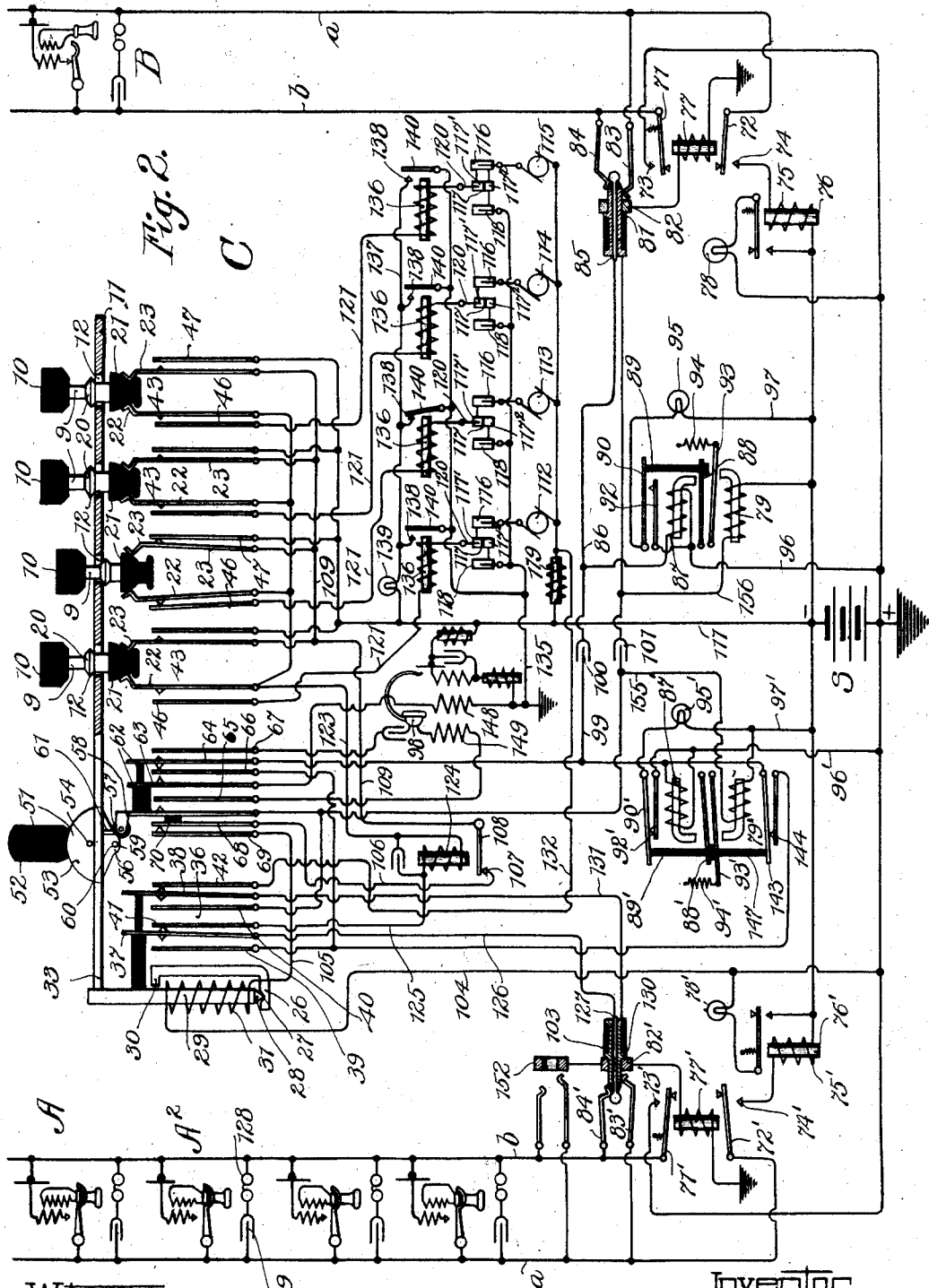
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M. S. CONNER.
 TELEPHONE EXCHANGE SYSTEM.
 APPLICATION FILED JULY 13, 1905.

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Patented Oct. 20, 1908.

3 SHEETS—SHEET 2.



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TELEPHONE EXCHANGE SYSTEM.
APPLICATION FILED JULY 13, 1905.

3 SHEETS—SHEET 3.



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UNITED STATES PATENT OFFICE

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TELEPHONE-EXCHANGE SYSTEM.

No. 901,684.

Specification of Letters Patent.

Patented Oct. 20, 1908.

Application filed July 13, 1905. Serial No. 269,465.

To all whom it may concern:

Be it known that I, MERRITT S. CONNER, 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 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 particularly to the central exchange apparatus and arrangement thereof for signaling party-line subscribers.

It is desirable in signaling a called subscriber on a party line that upon insertion of the calling plug and actuation of the selective apparatus that the proper signaling current is automatically connected with the line and is maintained in connection until the subscriber answers, whereupon the current flow is automatically discontinued and the selective apparatus at the central exchange restored to its normal condition.

The object of my invention is to provide improved apparatus and arrangement thereof and accessory parts for such a system of signaling. The selective switch mechanism and automatic controlling mechanism therefor are comprised in a unitary structure or key, which key, together with the signaling apparatus and circuits, forms the subject of my invention.

The key comprises a plurality of selective keys, each corresponding to a substation connected with the party-line. A locking bar is provided for the keys for holding them in their depressed position, and a controlling electromagnet serves to actuate the bar to lock the buttons of the keys in a depressed position. Each selective key is connected with a source of selective current, the signal receiving apparatus at a substation being adapted to respond to the current from only one of the sources. Upon insertion of the calling plug into the jack of the called line and upon depression of the proper selective button, a circuit will be closed through the controlling magnet upon engagement of contacts controlled by the depressed key. Energization of this controlling magnet causes actuation of a ringing key to connect the calling plug with the ringing sources and also causes actuation of the locking bar to lock

the depressed button. Signaling current will then flow from the corresponding source through the ringing key contacts and through the plug into the line to actuate the signal receiving apparatus at the desired substation. The circuit through which this ringing current flows includes the winding of a relay controlling contacts included in the circuit for the controlling magnet. The resistance in the ringing circuit, however, is normally very great on account of the high resistance bells at the substation and a condenser in series therewith, and the relay is not sufficiently energized to influence the contacts controlled thereby, and the controlling magnet will, therefore, remain energized to maintain connection of the signaling source with the line. When the subscriber, however, answers by removing his receiver from the hook, he greatly reduces the resistance through the substation, and enough current will now flow through the signaling circuit to energize the relay to actuate the contacts controlled thereby to open the circuit through the controlling magnet, whereupon the calling plug is disconnected from the signaling source and the locking bar released to allow return of the depressed button to its normal position with a consequent rupture of the ringing circuit. The called subscriber and the calling subscriber may now converse together in the ordinary manner.

My invention also includes other features of connection, arrangement and construction, which will best appear with reference to the accompanying drawings, in which

Figure 1 is a diagrammatic view showing a telephone exchange system in which my improved apparatus is incorporated. Fig. 2 shows a modified arrangement. Fig. 3 is a plan view of the key structure employed. Fig. 4 is a side elevation of the key structure. Fig. 5 is a sectional view thereof taken on line 5—5 of Fig. 4, and Fig. 6 is an end elevation of the key structure.

The key consists of the top supporting plate 1 and the lower supporting bar 2 from which extend the arms 3 and 4 secured to the underside of the top plate by the screws 5—5 as shown. These side bars or plates 3 and 4 are bent at right angles to the supporting bar 2 and form end walls for the insulating supporting base 6 in which are mounted the various springs of the switching mechanisms, a plate 7 being secured to the insulating base 6

over the springs to hold them securely in position therein. The top plate has a series of openings 8—8 through which extend the stems 9 of the actuating buttons 10. Below the supporting plate is the locking bar 11 of sheet material and U-shaped, as shown in Fig. 6. This locking bar is provided with openings 12—12 normally in register with the openings 8, said openings 12, however, being slightly larger. The right hand end of the locking bar has a groove 13 to form edges 14—14 which engage in notches 15 cut near the top of the end plate 4. The left hand end of the locking bar has the larger opening 16 and the slot 17 therethrough, the edges 18 engaging in the slots 19 cut at the top of the end plate 3, and the locking bar is thus slidable within these slots. The stem of each button is provided with an annular V-shaped cam or rim 20, and below said cam or rim is the actuating button 21 of insulating material for engaging the actuating springs 22 and 23. The rod or stem 24 extends downwardly from the actuating button and engages in the mounting base 6, a compression spring 25 encircling this stem between the base 6 and the actuating button and tending to hold the button in its upper normal position. The diameter of the openings 12 through the lock plate is equal to the diameter at the edge of the V-shaped cams, and when an opening 12 is directly below the cam of the corresponding button and the button is depressed, there will be no actuation of the locking bar. If an opening 12 is at either side of the cam, actuation of the button will cause lateral movement of the locking bar. If a button is depressed to carry the cam thereon below the edges of the corresponding opening in the locking bar and the locking bar is then moved laterally and held, the depressed button will be locked and prevented from being raised by its restoring spring. It will be seen, however, that if another button be depressed the locking bar must necessarily be moved to allow passage of the cam of the other button through the corresponding opening in the locking bar, and this, of course, will move the locking bar laterally, whereupon the first button will be released, the opening 12 corresponding to the first button having been moved upon actuation of the second button to allow passage therethrough of the cam of the first button.

To cause lateral motion of the locking bar to lock a depressed button, I employ electromagnetic mechanism consisting of the electromagnet frame or yoke 26 secured to the end plate 3, the lower leg thereof being provided with the pivot slot 27 in which pivots the V-shaped end 28 of the electromagnet core 29, said core when brought into engagement with the upper leg or pole 30 of the electromagnet frame serving to complete the magnetic circuit. Surrounding the core is

the energizing winding 31 whose leads 32 are suitably connected in circuit, which will be described when referring to Fig. 1. The bridge piece 33 at the left hand end of the locking bar is normally disposed in the path of the upper end of the core, and upon energization of the electromagnet this core end will be attracted toward the pole 30 and the locking bar will be moved toward the right to lock any button which may have been depressed. Upon deenergization of the electromagnet, the restoring spring of the depressed button will be sufficient to move the locking bar to its normal position as the button is moved upwardly and the V-shaped cam engages the edge of the corresponding opening 12 in the lock bar. The screw 34, passing loosely through the lower pole 26 and into the core end, serves to maintain the core within the pivot slot, and to prevent lateral swing of the core the wings 35—35 are provided, which rest against the sides of the upper pole 30. This electromagnet also directly controls the ringing switching mechanism 36, whose actuating springs 37 and 38 connected with the end of the electromagnet through the insulating stud 38' are adapted to engage either with the normal contact springs 39 and 40 or with the alternate contact springs 41 and 42 upon energization of the electromagnet. Each button is also associated with switching mechanism 43 consisting of the actuating springs 22 and 23 in engagement with the actuating button and adapted to normally engage the inner springs 44 and 45, and when the button is depressed to engage the alternate contact springs 46 and 47. A set of circuit closing springs 48 and 49 is provided for each two of the selective keys, the contact 48 being actuated upon actuation of the alternate contact spring 47 of the left hand button of the set through the insulating disk or washer 50, while the spring 49 is moved upon actuation of the alternate contact spring 46 of the right hand button of the set. Thus upon depression of either button of a set either the contact 48 or 49 will be moved to cause engagement of these contacts to close a circuit which will be described later with reference to Fig. 1. The contacts or springs 48 and 49 associated with the third and fourth buttons are connected upon actuation of either of these buttons.

A listening key 51 comprises the handle 52 and the cam plate 53 mounted on the pivot rod 54 passing through the top plate 1, this cam plate passing through the slot 55 in the top plate and through the slot 17 in the locking bar. The lower end 56 of the cam plate engages the roller 57 upon actuation of the listening key to remove the main actuating spring 58 of the listening key switching mechanism, this lower part 56 having a flat portion 59 which, after actuation of the listening

key, rests upon the top of the roller 57 so that the actuating spring exerts a pressure along a line extending through the centers of the roller and the listening key pivot, and the key after actuation will be locked. Extending from the side of the end 56 is a pin or post 60 adapted, after the key has been moved a distance toward its listening-in position, to strike the extension 61 from the locking bar, and, therefore, when the listening key is actuated, the locking bar will be moved laterally toward the right. Thus after the listening key has been moved to the listening-in position, actuation of a selective button will move the locking bar toward the left to cause restoration of the listening key on account of the engagement of the extension 61 with the post 60.

By means of the spacing stud 62 the actuating springs 63 and 64 are caused to move with the main actuating spring 58. The main actuating spring is normally free from contact, but upon actuation of the key engages the contact spring 65. The actuating spring 63 is normally free from contact, but upon actuation of the key engages the contact spring 66. The actuating spring 64 normally engages the contact spring 66, and upon actuation of the key engages the alternate contact 67. The contact spring 68 normally engages the associated spring 69, but upon actuation of the key, the spring 68 is carried out of engagement by means of the insulating connection 70 between the spring 68 and the main actuating spring.

Having thus described the general construction and arrangement of the key mechanism parts, I shall refer to Fig. 1 and describe a telephone exchange system in which a key of this kind is utilized in connection with controlling circuits and other apparatus.

I have shown a party line A and a single subscriber's line B extending from the central exchange C. The limbs *a* and *b* of line B terminate in the armatures 72 and 71, the armature 71 being normally in engagement with its contact 73 connected with the grounded positive side of the common battery S, while the armature 72 normally engages its contact 74 connected with the negative side of the battery S through the winding 75 of the indicating relay 76. In this drawing the subscriber on the line B has initiated a call by removing his receiver from the hook, whereupon central, after having plugged in the answering plug to ascertain the connection desired, has inserted the calling plug into the springjack of the line A and has actuated the second selective key, in correspondence with the request of the calling subscriber for connection with the substation A². Upon removal of the receiver at the calling substation a circuit is immediately closed from

the source S through the substation transmitter circuit and through the armatures of the cut off relay 77, this circuit, as before stated, also including the winding 75 of the indicating relay which, therefore, becomes energized and closes the local circuit through the indicating lamp 78 thus signaling the operator that a connection is desired. The operator in answer, having inserted the answering plug in the jack, causes closure of two circuits; one a local circuit from the negative side of the battery through the supervisory relay winding 79, through the sleeve strand 80, through the sleeve 81 of the answering plug, through the test thimble 82 and through the winding 77 of the cut-off relay to ground and thence to the grounded positive side of the battery. The other circuit closed upon insertion of the plug extends from the negative side of the battery through the winding 79, sleeve strand 80, sleeve 81, sleeve spring 83, line limb *a*, through the substation apparatus, through the line limb *b*, through the tip jack spring 84, through the tip member 85 of the plug, through the tip strand 86 and through the supervisory relay winding 87 to the positive side of the battery. Upon closure of the local circuit just traced, the indicating relay becomes energized to attract its armature whereby both line limbs are disconnected from direct engagement with the battery, and the indicating relay 75 being disconnected from circuit the indicating lamp controlled thereby is extinguished. The supervisory relay may be of a compound structure and arrangement as described in my Patent No. 799,146, Sept. 12, 1905. The armature 88 corresponding to the winding 87 is connected through an insulating stud 89 with the actuating spring 90, said spring 90 tending to engage with the contact spring 92. The armature 93 corresponding to the winding 79 is normally held in mechanical engagement against the armature 88 by the spring 94. Normally the spring 94 holds the spring 90 out of engagement with the contact spring 92, but upon current flow through the winding 79 the armature 93 becomes attracted away from mechanical engagement with the armature 88 and the spring 90 then moves into engagement with the spring 92 to cause closure of the local circuit including the supervisory lamp 95, this circuit including the conductors 96 and 97 leading to the positive and negative side of the battery respectively. The circuit through the substation telephonic apparatus, however, being closed, the winding 87 is energized and consequently the armature 88 is attracted to move the spring 90 away from the spring 92, whereupon the supervisory lamp 95 becomes extinguished, this being the well known condition of operation.

Upon being notified of the desired connection by illumination of the indicating lamp 78, the operator, after insertion of the answering plug in the jack, actuates the listening key 51 to connect her receiver 98 in a circuit which may be traced as follows: from the receiver to the alternate spring 67, to the actuating spring 64, to the calling tip strand 99, to the condenser 100, to the answering tip strand 86, through the plug, springjack and substation telephonic apparatus back to the answering sleeve strand 80, to the condenser 101, through the calling sleeve strand 102, and through the main actuating listening key spring 58, through the alternate contact spring 65 and back to the receiver. The condensers 100 and 101 render the cord circuit discontinuous to direct currents, but continuous to telephonic currents, this being for the well known purpose of providing independent supervision for the answering and calling studs of the cord circuit. After having ascertained from the calling subscriber that the subscriber at substation A² is desired, the operator inserts the calling plug 103 into the spring jack associated with the line A. Through a similar circuit as traced in connection with the apparatus connected with the line B the cut off relay associated with the line A is energized. (To render the description more clear, the reference characters applied to the cut off and indicating mechanism and the supervisory mechanism associated with the line A will be primed.) The second supervisory circuit controlled by the substation apparatus at the substation to be called is open and the relay winding 87' is not energized and consequently the springs 90' and 92' associated with said winding are in contact to close the circuit through the supervisory lamp 95'. The operator now presses the second key of the selective mechanism as shown, whereupon the following local circuit is established: from the positive side of the battery S through conductor 104, through the winding 31 of the controlling magnet, through the conductor 105, through the closed contacts 69 and 68, through the conductor 106, contact 107, armature 108, conductor 109, conductor 110, through the contacts 48 and 49 which will be closed, and through the conductor 111 to the negative side of the battery. Thus the controlling magnet immediately upon depression of a selective key becomes energized and, as before described, the cause of this is to move the locking bar 11 to lock the depressed key and also to move the actuating springs of the ringing switching mechanism to their alternate position to connect the calling plug with the signaling current mechanism.

I have here shown four selective keys corresponding to four substations and also four sources 112, 113, 114 and 115, each of a dif-

ferent kind of signaling current. These sources shown as generators may serve to produce currents of different frequencies which will actuate the corresponding signal receiving apparatus at the substation independently of each other, or these sources may produce currents of different harmonic properties, or other currents may be generated from these sources so that the current from one source when sent into the line will actuate only the signal receiving apparatus of the corresponding substation.

Associated with one terminal of each generator is a contact ring 116 and a contact ring 117 formed of two insulated segments 117' and 117², one of said segments being connected with the ring 116, the other segment being connected with a third contact ring 118, the third contact rings of the generators being all connected with ground or positive side of the battery, and the other terminal of each generator is connected with the negative side of the battery, which may be done through a common resistance or impedance 119. Upon energization of the controlling magnet and the consequent actuation of the ringing key, two circuits are alternately closed through the signal receiving apparatus at the substation to be called depending upon which of the segments 117' or 117² of the second ring 117 is connected with the collector brush 120. If this brush 120 is connected with the segments 117' as shown, current will flow as follows: from one terminal of the generator 113 to the ring 116, segment 117', brush 120, through the conductor 121, alternate spring 46 of the second selective key, actuating spring 22 of said key, conductor 122, through the engaging springs 44 and 22 of the first selective button, through the conductor 123, through the circuit controlling relay 124, conductor 125, through the contacting ringing springs 41 and 37, through conductor 126, through the tip member 127 of the calling plug, through the jack spring 84', through the line limb b, through the signal bell 128 at the desired substation A², through the condenser 129, back through the line limb a, through the sleeve spring 83', through the sleeve of the calling plug, through the conductor 131, through the contacting ringing key springs 38 and 42, through the conductor 132, through engaging springs 23 and 45 of the first selective key, through the conductor 133, through the engaging springs 23 and 47 of the depressed selective key, and through the conductor 134 to the other terminal of the generator 113. If the segment 117², however, is in contact with the brush 120, current will flow as follows: from the positive side of the battery to ground, thence to conductor 135, to the contact ring 118 associated with the generator 113, to the segment 117², to the brush 120, and from thence

to the same circuit through the various switch springs and through the substation signal receiving apparatus back to the conductor 134 and from thence through the impedance 119 and through conductor 111 to the negative side of the battery. This interrupted direct current is of such character as not to cause actuation of the signal bell at the called substation, which bell is responsive only to the current emanating from the generator 113 during the time that the segment 117' is connected with the ringing circuit, and thus the signal bell is interruptedly actuated. The currents from the battery and from the generator 113 both pass through the relay 124, but as the signal bells and the condenser at the substation are designed to offer a large resistance, this relay 124 will not be energized, and consequently the armature 108 will remain in engagement with the contact 107 to maintain closure of the local circuit through the controlling magnet winding 31. Upon receiving these signals, however, the called subscriber answers and removes his receiver from the hook, thereby offering a comparatively low resistance path between the line limbs and thus sufficiently reducing the resistance in the ringing circuit to allow energization of the relay 124 which thereupon causes disengagement of the armature 108 from its contact 107 to open the local circuit through the controlling magnet, the result being that the ringing key is released to disconnect the calling plug from the signaling apparatus and release of the locking bar to allow restoration of the second selective plug which was depressed. To indicate to the operator the working condition of the ringing circuit and also to assist in indicating when the called subscriber answers, a pilot relay 136 is included in each conductor 121, and the conductor 137 connected with each of the contacts 138 is connected with the negative side of the battery through the pilot lamp 139, the armatures 140 of the pilot relays being connected through the common conductor 141 with ground and thus with the positive side of the battery, and when the signaling current flows to the called substation, the corresponding pilot relay is energized to close circuit through the pilot lamp which remains illuminated until the subscriber answers. To assist in the transmission of the currents and in the control of the relay 124 a condenser 142 may be bridged about said relay.

It is sometimes desirable for the operator to listen-in while conversation is going on between connected subscribers. Unless provision is made, however, actuation of the listening key will open the tip strand circuit upon disconnection of the contacts 64 and 66. To prevent this additional contact springs 143 and 144 are provided for the supervisory relay mechanism associated with the calling

side of the cord circuit. The spring 144 connects with the switch spring 39 through the conductor 145, and the spring 143 connects with the calling tip strand of the cord circuit through the conductor 146. Immediately upon insertion of the calling plug in the spring jack, the winding 79' will be energized, as before described, and the armature 93' which has mechanical connection with the spring 143 through the stud 147 will be attracted to engage the spring 143 with the contact spring 144, and the tip strand circuit is continuous through the conductor 146, springs 143 and 144, conductor 145, through springs 39 and 37 of the calling key and conductor 126 to the tip member of the calling plug, this circuit being independent of the listening key contacts. This circuit just traced also enables the operator to listen-in independently on the calling plug side as well as on the answering plug side.

The local circuit including the winding of the controlling magnet also includes the normally closed contacts 68 and 69 associated with the listening key. Should the operator listen-in while ringing current is being applied, the actuation of the listening key will open the contacts 68 and 69 and cause de-energization of the controlling magnet which thereupon releases the locking bar to allow restoration of the depressed ringing key, whereupon the ringing circuit is interrupted.

To enable the operator to make a busy test, a test winding 148 is associated with the secondary winding 149 of the operator's set, one terminal of this winding being connected to ground and thus with the positive side of the battery, while the other terminal is connected through conductor 150 with the actuating spring 63 of the listening key. Upon actuation of the listening key the tip of the calling plug will be connected with the positive side of the battery through the conductor 126, springs 37 and 39, conductor 151, listening key springs 66 and 63, conductor 150 and through the test winding 148 to ground and positive side of the battery. To test, the operator touches one of the test thimbles 152 with the tip of the calling plug. If the plug at another board is inserted in the corresponding multiple jack, she will receive a click in the receiver notifying her that the line is busy, the test circuit in that case being continued from the test tip to the test thimble touched and through the other test thimbles to the sleeve of the busy plug to the sleeve conductor of the busy plug which may be either the calling or the answering plug of the busy cord circuit. If the busy plug is the calling plug the circuit will be continued from its sleeve through the conductor 131 of the busy cord circuit, through the ringing keys 38 and 40, through the conductor 154, through the sleeve strand 102, through conductor 155 and through the winding 79 of the

supervisory relay mechanism to the negative side of the battery. If the busy plug is an answering plug the circuit will be traced directly from the plug sleeve through the sleeve conductor 80 of the busy cord circuit and from thence through the conductor 156 and through the supervisory winding 79 to the negative side of the battery. If the called line, however, is not busy, the test thimbles thereof will not be charged and therefore there will be no noise or click in the operator's receiver.

In Fig. 2 I have shown a somewhat simplified arrangement of the selective key switching mechanism and circuits. Each key is here provided with only the actuating springs 22 and 23 and the alternate springs 46 and 47. Upon depression of the second selective key the local circuit through the controlling electromagnet will be as follows: from positive battery through conductor 104, through winding 31, through conductor 105, through contacts 69 and 68 of the listening key, through conductor 106, through contact 107 and armature 108, through conductor 109, through springs 23 and 47 of the second key and through conductor 111 to negative battery, the electromagnet causing actuation of the locking bar to lock the second key and to connect the ringing circuits with the calling plug at the ringing key 36. Signaling current from the generator 113 will alternately flow through the commutator ring 116 to the segment 117', pilot relay 136, conductor 121, springs 46 and 22 of the second key, conductor 123, winding of the relay 124, through the springs 41 and 37 of the ringing key, through the tip member of the plug, through signal receiving apparatus at the second substation, back to the sleeve member of the plug through conductor 131, springs 38 and 42 of the ringing key, and conductor 132 back to the generator, the signal receiving apparatus at the substation being thus actuated. As in the system shown in Fig. 1, direct current flows during contact of the brush 120 with the segment 117' through the following circuit: positive battery to ground, to the grounded conductor 135, through the ring 118, segment 117' and from there through the same circuit as traced by the ringing circuit through the conductor 132 and from there through the impedance winding 119 back to negative battery, the purpose of this direct current flow being, as before stated, for the purpose of providing current for the relay 124 to cause actuation thereof to open the local circuit should the subscriber not hang his telephone during the time that the brush 120 is not connected with the generator. The arrangement of all the other apparatus and the circuits therefor remain as in Fig. 1.

I thus provide a very efficient system and simple and compact apparatus therefor, whereby to call a desired subscriber it is only

necessary for the operator to insert the calling plug into the jack of the called line and to depress the selective key corresponding to the desired substation. The depressed key will be automatically electromagnetically locked to maintain connection with the line of the proper source of ringing current which flows intermittently through the signal receiving apparatus at the selective substation until the called subscriber answers, whereupon the central control of the electromagnetic locking mechanism is destroyed and the source of signaling current automatically disconnected from the line and without any assistance or attention from the operator.

As changes may readily be made in the arrangement and construction of the various parts, I do not wish to be limited to the exact disclosure herein shown, but

Having described my invention, I desire to secure by Letters Patent:

1. In a telephone exchange system, the combination with a telephone line extending from a central exchange to a plurality of party-line substations, a plurality of selective ringing keys at the central exchange, one corresponding to each substation, a controlling electromagnet associated with said keys, a source of signaling current, means adapted upon actuation of one of said selective keys for closing a circuit through said controlling electromagnet, mechanical means operated upon energization of said controlling electromagnet to lock said depressed key in its actuated position, and a second circuit closed upon depression of said selective key for causing signaling current to flow from said source into the line through signal receiving apparatus at the corresponding party-line substation.

2. In a telephone exchange system, the combination of a telephone line extending from a central exchange to a plurality of party-line substations, a plurality of selective ringing keys at the central exchange, one corresponding to each substation, a controlling electromagnet associated with said keys, a source of signaling current, means operated upon actuation of one of said selective keys for closing a circuit through said controlling electromagnet, means adapted upon energization of said controlling electromagnet for locking said depressed key in its actuated position, a second circuit closed upon depression of said selective key for causing signaling current to flow from said source into the line through signal receiving apparatus at the corresponding party-line substation, and means adapted upon actuation of the telephonic apparatus at the called substation for causing said electromagnet circuit to be opened whereby said actuated selective key is released and the ringing circuit opened.

3. In a telephone exchange system, the

combination with a telephone line extending from a central exchange to a plurality of party-line substations, a plurality of selective ringing keys at the central exchange, one corresponding to each substation, a controlling electromagnet associated with said keys, a source of signaling current, means adapted upon actuation of one of said selective keys for closing a circuit through said controlling electromagnet, means adapted upon energization of said controlling electromagnet for locking said depressed key in its actuated position, a second circuit closed upon depression of said selective key for causing signaling current to flow from said source into the line through signal receiving apparatus at the corresponding party-line substation, and electromagnetic means adapted upon actuation of telephonic apparatus at the called substation to open the circuit through said controlling electromagnet whereby said actuated selective key is released to cause opening of the ringing circuit.

4. In a telephone exchange system, the combination with a telephone line extending from a central exchange to a plurality of party-line substations, a plurality of selective ringing keys at the central exchange, one corresponding to each substation, a controlling electromagnet associated with said keys, a source of signaling current, means adapted upon actuation of one of said selective keys for closing a circuit through said controlling electromagnet, means adapted upon energization of said controlling electromagnet for locking said depressed key in its actuated position, a second circuit closed upon depression of said selective key for causing signaling current to flow from said source into the line through signal receiving apparatus at the corresponding party-line substation, and electromagnetic means controlled by the ringing circuit and adapted upon actuation of telephonic apparatus at the called substation to open the circuit through the controlling electromagnet whereby the actuated selective key is released to cause opening of the ringing circuit.

5. In a telephone exchange system, the combination with a telephone line extending from a central exchange and connecting with a plurality of party-line substations, of a plurality of selective keys at the central exchange, one corresponding to each substation, a controlling electromagnet associated with said selective keys, a local circuit including said controlling electromagnet and closed only upon actuation of one of said selective keys, means actuated upon current flow through the said electromagnet to cause the actuated selective key to be locked in position, a source of ringing current, and a circuit including said source of signaling current closed upon actuation of said selective key to send signaling current into the line through

the signal receiving apparatus at the desired substation; said signaling circuit being controlled by the circuit conditions at the called substation.

6. In a telephone exchange system, the combination with a telephone line extending from a central exchange and connecting with a plurality of party-line substations, of a plurality of manually operated selective signaling keys at the central exchange, one corresponding to each of the substations, a source of signaling current, a circuit closed to include said source and the signal receiving apparatus at a substation upon actuation of the corresponding selective key, electromagnetic means controlled upon actuation of the selective key to lock said key in its actuated position whereby said source is maintained in connection with the signal receiving apparatus, and means governed by the condition of the signaling circuit for controlling the electromagnetic mechanism to release the actuated selective key.

7. In a telephone exchange system, the combination with a telephone line extending from a central exchange and connecting with a plurality of party-line substations, of a plurality of manually operated selective signaling keys at the central exchange, one corresponding to each of the substations, a source of signaling current, a circuit closed to include said source and the signal receiving apparatus at a substation upon actuation of the corresponding selective key, electromagnetic means controlled upon actuation of the selective key to lock said key in its actuated position whereby said source is maintained in connection with the signal receiving apparatus, and electro-magnet means governed by the condition of the signaling circuit for controlling the electromagnetic mechanism to release the actuated selective key.

8. In a telephone exchange system, the combination with a telephone line leading from a central exchange and connecting with a plurality of party-line substations, of a plurality of selective keys, one corresponding to each substation, a source of signaling current at the exchange, actuation of one of said selective keys causing closure of a circuit through said source and connection thereof with the signal receiving apparatus at the corresponding substation, electromagnetic means associated with said keys, locking means controlled by the electromagnetic means, and a local circuit including said electromagnetic means; actuation of the selective key causing closure of said local circuit and actuation of the locking means for locking said key in its actuated position whereby said signaling circuit is maintained closed, said local circuit being controlled by the condition of said signaling circuit.

9. In a telephone exchange system, the combination with a telephone line leading

from a central exchange and connecting with a plurality of party-line substations, of a plurality of selective keys, one corresponding to each substation, a source of signaling current at the exchange, actuation of one of said selective keys causing closure of a circuit through said source and connection thereof with the signal receiving apparatus at the corresponding substation, electromagnetic means associated with said keys, locking means controlled by the electromagnetic means, and a local circuit including said electromagnetic means, actuation of the selective key causing closure of said local circuit and actuation of the locking means for locking said key in its actuated position whereby said signaling circuit is maintained closed, said local circuit being controlled by the resistance condition of the signaling circuit.

10. In a telephone exchange system, the combination with a telephone line leading from a central exchange and connecting with a plurality of party-line substations, of a plurality of selective keys, one corresponding to each substation, a source of signaling current at the exchange, actuation of one of said selective keys causing closure of a circuit through said source and connection thereof with the signal receiving apparatus at the corresponding substation, electromagnetic means associated with said keys, locking means controlled by the electromagnetic means, and a local circuit including said electromagnetic means, actuation of the selective key causing closure of said local circuit and actuation of the locking means for locking said key in its actuated position whereby said signaling circuit is maintained closed, said local circuit being controlled by the substation apparatus.

11. In a telephone exchange system, the combination with a telephone line leading from a central exchange and connecting with a substation, of a key at the central exchange, electromagnetic mechanism associated with said key, a local circuit closed through said electromagnetic mechanism upon actuation of said key, means whereby said key is locked in its actuated position upon closure of said local circuit, a source of ringing current connected with signal receiving apparatus at the substation upon actuation of said key, and means governed by said signaling circuit for controlling the local circuit through said electromagnetic mechanism.

12. In a telephone exchange system, the combination with a telephone line leading from a central exchange and connecting with a substation, of a key at the central exchange, electromagnetic mechanism associated with said key, a local circuit closed through said electromagnetic mechanism upon actuation of said key, means whereby said key is locked in its actuated position upon closure of said

local circuit, a source of ringing current connected with signal receiving apparatus at the substation upon actuation of said key, and electromagnetic means included in said signaling circuit for controlling said local circuit through the electromagnetic mechanism.

13. In a telephone exchange system, the combination with a telephone line extending from a central exchange and connecting with a substation, of switching mechanism at the central exchange, a source of signaling current, actuation of said switching mechanism causing connection of said source with signal receiving apparatus at the substation, and electromagnetic mechanism adapted upon actuation of said switching mechanism to cause mechanical locking of the switching mechanism in its actuated position whereby said source is maintained in connection with the substation, the circuit through said electromagnetic mechanism being controlled by the electrical condition of the signaling circuit.

14. In a telephone exchange system, the combination with a telephone line extending from a central exchange to a substation, of switching mechanism at the exchange associated with the line, a source of signaling current adapted to send signaling current into the line and through signal receiving apparatus at the substation upon actuation of said switching mechanism, a relay included in said circuit, a local circuit controlled by said relay, and electromagnetic mechanism included in said local circuit and adapted upon actuation of said switching mechanism to lock said switching mechanism in its actuated position whereby said source is maintained in connection with the substation, said signaling circuit upon closure thereof at the substation through the signal receiving apparatus being of too high resistance to allow actuation of said relay whereby said local circuit is unaffected, inclusion in circuit of telephonic apparatus at the substation, however, decreasing the resistance of the signaling circuit sufficiently to allow energization of said relay, whereby said local circuit is interrupted and said switching mechanism released to disconnect the source from the substation.

15. In a telephone exchange system, the combination with a telephone line extending from a central exchange to a substation, of switching mechanism at the central exchange connected with the line, a source of signaling current at the central exchange connected with the line and with the substation upon actuation of said switching mechanism, a relay in said signaling circuit, a local circuit controlled by said relay, and electromagnetic mechanism in said local circuit adapted upon actuation of said switching mechanism to lock said switching mechanism in its actuated position to maintain connection of said

source with the substation, the resistance condition of the signaling circuit when connected through the signal receiving apparatus only at the substation being such that said relay and the local circuit controlled thereby remain unaffected, the actuation of telephonic apparatus at the substation in response to the signal received changing the resistance conditions sufficiently to cause actuation of the relay to open the local circuit through the electromagnetic mechanism whereby said switching mechanism is released and the source of signaling current is connected from the substation.

16. In a telephone exchange system, the combination with a telephone line extending from a central exchange to a substation, of switching mechanism at the central exchange adapted upon actuation to close two circuits, one of said circuits including electromagnetic mechanism, means adapted upon actuation of said electromagnetic mechanism for locking the switching mechanism in its actuated position, a source of ringing current in the other circuit for sending signaling current through the line and to the substation, and electromagnetic mechanism associated with the second circuit for controlling the continuity of the first circuit, said second circuit electromagnetic mechanism being responsive upon change of the resistance conditions at the substation to open said first circuit.

17. In a telephone exchange system, the combination with a telephone line extending from a central exchange to a substation, of switching mechanism at the central exchange connected with the line and adapted upon actuation to close two circuits, a source of signaling current included in the first circuit to send signaling current through the line to the substation and primarily through the signal receiving apparatus thereat, electromagnetic mechanism included in the second circuit and adapted to cause said switching mechanism to be locked in its actuated position, and electromagnetic means in the first circuit controlling the continuity of the second circuit, the electrical conditions of the signaling circuit when continued through the signal receiving apparatus only at the substation being such that the electromagnetic means and the circuit controlled thereby remain unaffected, changes in the resistance at the substation upon actuation of substation apparatus in response to the signals received by the signal receiving apparatus causing said electromagnetic means to become responsive to open the second circuit whereby the switching mechanism is released to also disconnect the signal current source from circuit.

18. In a telephone exchange system, the combination with a telephone line extending from a central exchange to a substation, the path at the substation normally extending

only through signal receiving apparatus, switching mechanism at the central exchange connected with the line, a source of signaling current at the central exchange adapted upon actuation of said switching mechanism to be connected with the line to send signaling current through the signal receiving apparatus at the substation, electromagnetic mechanism at the central exchange for locking said switching mechanism in its actuated position to maintain connection of said signaling source with the substation, and additional electromagnetic mechanism included in the signaling circuit and controlling the circuit for energizing said electromagnetic mechanism, said additional electromagnetic mechanism being normally irresponsive but adapted upon actuation of telephonic apparatus at the substation to open the circuit through the first electromagnetic mechanism, whereby said switching mechanism is released and the source of signaling circuit disconnected from the substation.

19. In a telephone exchange system, the combination with a telephone line extending from a central exchange to a substation, of switching means at the exchange connected with the line, a source of signaling current connected with the line upon actuation of said switching mechanism, the signaling circuit being normally continuous at the substation only through the signal receiving apparatus thereat, a relay included in the signaling circuit normally irresponsive to current flow therethrough, a local circuit controlled by said relay, electromagnetic mechanism controlled by said local circuit, means for causing said electromagnetic mechanism to lock said switching mechanism in its actuated position, whereby said source is maintained in connection with the substation, and means adapted upon actuation of other apparatus at the substation for causing said relay to become responsive and to open the local circuit through said electromagnetic mechanism whereby said switching mechanism is released and the source of signaling current disconnected from the substation.

20. In a telephone exchange system, the combination with a telephone line extending from a central exchange to a substation, of switching mechanism at the central exchange connected with the line, a source of signaling current connected with the line upon actuation of said switching mechanism, the signaling circuit being normally continuous at the substation only through the signal receiving apparatus thereat, a relay included in the signaling circuit normally irresponsive to the current flow therethrough, a local circuit primarily controlled by said relay, an electromagnet having a winding included in said local circuit and having mechanical connection with said switching mechanism, said local circuit being secondarily controlled by

said switching mechanism to close said circuit and to cause energization of said electromagnet to cause said switching mechanism to be locked in its actuated position whereby said source is maintained in connection with the signal receiving apparatus at the substation, and means adapted upon actuation of the telephonic apparatus at the substation in response to actuations of the signal receiving apparatus for causing said relay to become responsive and to open said local circuit whereby said electromagnet becomes deenergized thereby to release the switching mechanism whereby said source is disconnected from the substation.

21. In a telephone exchange system, the combination with a telephone line extending from a central exchange to a substation, of a key at the central exchange connected with the line, a source of signaling current adapted for connection with the line upon actuation of said key, a relay included in the signaling circuit, the signaling circuit being normally continuous at the substation through a high resistance signal receiving circuit, whereby said relay is normally irresponsive, an electromagnet, a local circuit including the electromagnet winding and primarily controlled by said relay, said key having secondary control over said local circuit and adapted upon actuation to close the local circuit whereby said electromagnet becomes energized, and locking mechanism intervening between said electromagnet and said key whereby said key is locked in its actuated position when the electromagnet is energized, said relay upon actuation of the lower resistance telephonic apparatus at the central exchange becoming responsive to open the local circuit whereby the electromagnet becomes deenergized to release the key whereby the source of signaling current is disconnected.

22. In a telephone exchange system, the combination with a telephone line extending from a central exchange to a plurality of party-line substations, of a plurality of selective signaling keys, one corresponding to each substation, a source of selective current for each key, a main ringing key determining the connection of ringing current with the line, a common electromagnetic means associated with said selective keys and with said main ringing key, a circuit closed through said electromagnetic means upon actuation of one of said selective keys, whereby said main ringing key is actuated and the corresponding source of signaling current connected with the line to influence the signal receiving apparatus at the corresponding substation, means operable upon actuation of said electromagnetic mechanism for locking said key in its actuated position whereby said source is maintained in connection with the line, and additional electromagnetic means associated with the signaling circuit

and adapted upon actuation of the telephonic apparatus at the called substation to open the energized circuit for said first electromagnetic mechanism whereby said main ringing key and said actuated selective key are released to open the signaling circuit.

23. In a telephone exchange system, the combination with a telephone line extending from a central exchange to a plurality of party line substations, of a plurality of selective keys at the central exchange, one corresponding to each substation, a selective current source for each key, a main ringing key for determining the connection of signaling current with the line, an electromagnet, mechanism connecting said electromagnet with said main ringing key and with the selective keys, a relay in the main ringing circuit normally irresponsive to current flowing through the signal receiving apparatus only at the substation, a local circuit partly controlled by said relay and including the winding of said electromagnet, actuation of a selective key causing closure of said local circuit, means operable upon energization of the electromagnet for causing the mechanism controlled thereby to actuate the main ringing key to connect the corresponding source with the line and to lock the selective key in its actuated position to maintain connection of the source with the line, and means operable upon actuation of the telephonic apparatus at the called substation for causing said relay to become responsive to open the local circuit whereby the electromagnet becomes deenergized to allow the main ringing key and the selective key to return to their normal positions thereby to disconnect the source from the line.

24. In a telephone exchange system, the combination with a telephone line extending from a central exchange to a substation, of switching mechanism at the central exchange connected with the line, a source of signaling current adapted for connection with the line upon actuation of said switching mechanism, means for causing the current flow from said source to be intermittent, the ringing circuit being normally continuous only through the signal receiving apparatus at the substation, means for causing other current to flow through the signaling circuit when current from said source is not flowing, the signal receiving apparatus being responsive only to the current from said source, a relay in the signaling circuit normally irresponsive to the currents flowing through the signaling circuit, electromagnetic mechanism associated with the switching mechanism and controlled by said relay, said electromagnetic mechanism being connected in circuit upon actuation of said switching mechanism, means actuated by said electromagnetic mechanism for locking the switching mechanism in its actuated position to maintain

connection of the currents with the line, and means adapted upon actuation of the telephonic apparatus at the substation for causing said relay to become responsive to effect deenergization of the electromagnetic mechanism, whereby said switching mechanism is released and the signaling circuit disconnected from the line.

25. In a telephone exchange system, the combination with a telephone line extending from a central exchange to a substation, of switching mechanism at the exchange connected with the line, a source of signaling current at the central exchange, a source of other current at the central exchange, actuation of the switching mechanism causing connection with the line of the signaling circuit, means for alternately connecting said sources in the signaling circuit, the signal-receiving apparatus at the substation being responsive to only the current from said source of signaling current whereby said signal receiving apparatus will be intermittently actuated, a relay in the signaling circuit

normally irresponsive to either current flow, electromagnetic mechanism associated with said switching mechanism and controlled by said relay, actuation of the switching mechanism causing actuation of the electromagnetic mechanism to lock the switching mechanism in its actuated position whereby the signaling circuit is maintained in connection with the line, and means adapted upon actuation of the telephonic apparatus at the substation for causing said relay to become responsive to cause deenergization of the electromagnetic mechanism whereby said switching mechanism is released to disconnect the signaling current from the line.

In witness whereof, I hereunto subscribe my name this seventh day of July A. D., 1905.

MERRITT S. CONNER.

Witnesses:

E. A. HAWKINS,
W. W. KINSLEY.