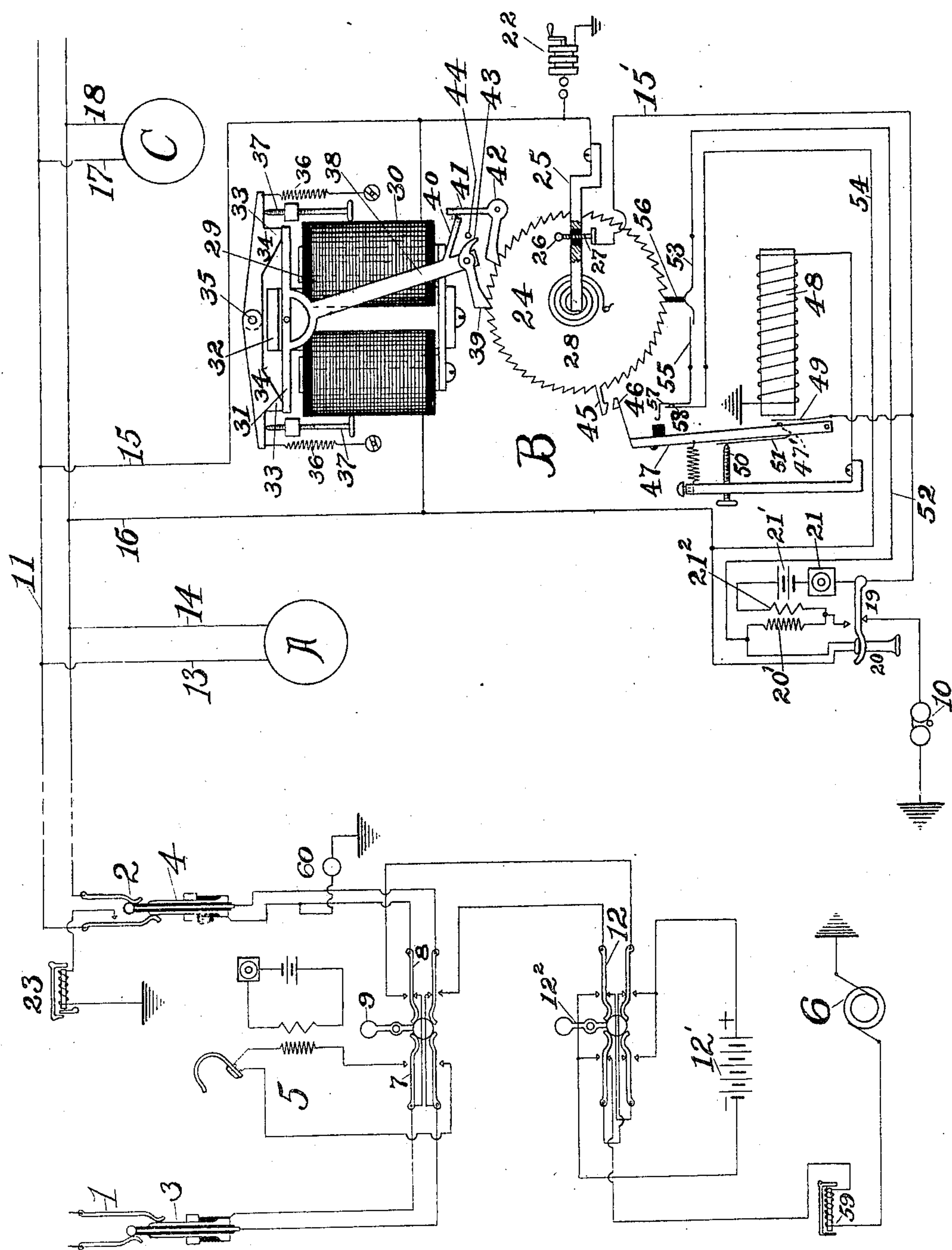


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E. A. BUELL.
TELEPHONY.

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TELEPHONY.

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To all whom it may concern:

Be it known that I, EDWARD A. BUELL, a citizen of Canada, residing at Dekalb, in the county of Dekalb and State of Illinois, have
5 invented a certain new and useful Improvement in Telephony, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

10 My invention relates to telephony, and particularly to party-line service, and has for its prime object the provision of means whereby central-exchange operators may determine which subscriber upon a party-line is "listen-
15 ing in" to conversation or is disturbing line conditions while conversation is being carried on between two subscribers who are properly connected and are entitled for the time being to the use of the line. In other words, the
20 invention provides means whereby eavesdroppers may be detected. This feature of my invention has been practiced in connection with selective signaling appliances, though it need not be limited to service including this
25 class of apparatus.

In practicing another feature of my invention I employ as an element of selective signaling apparatus an instrumentality for locking the switching mechanism controlled by
30 said selective signaling apparatus, said locking instrumentality being adapted for operation by the source of signaling-current that is impressed upon the line to operate the signal-bell at a selected station. This locking
35 instrumentality and its circuits are preferably so constructed and arranged that a momentary presence of the signaling-current through the electromagnet of the locking instrumentality is all that is required and used to form the
40 locking function, said electromagnet being immediately disconnected from the line after its operation, whereby a minimum amount of current is needed.

My invention has for its further object the
45 provision of an improved system whereby any substation of the party-line may signal the operator irrespective of the condition of use of the selective signaling apparatus. In the preferred embodiment of my invention
50 this result is accomplished by circuit arrangements whereby the subscribers in telephonic connection with the line do not have their conversation interrupted by the signal.

My invention has for its further object the improvement in mechanical construction of
55 certain parts of the selective mechanism.

One embodiment of my invention will be explained in connection with the accompanying drawing and will be particularly set forth in the following specification and claims. 60

The drawing illustrates one of several types of central-exchange apparatus that may be employed in practicing the invention, a party-line being shown as extending from the exchange and having provided thereon stations
65 equipped with the preferred construction and arrangement of my apparatus.

At the exchange I have indicated line-jacks 1 and 2 of normally independent telephone-lines, there being a cord connecting apparatus for uniting independent telephone-lines in conversation, such cord connecting apparatus including in the instance shown an answering-plug 3 and a connecting-plug 4, which cord-circuit has the usual associate apparatus in-
70 cluding, among other things, (not shown,) an operator's telephone outfit 5, an operator's ringing-generator 6, a listening-key 7, and a ringing selective key 8, there being provided a key-actuating lever 9, whereby the springs
80 of the listening-key may be pressed against the operator's telephone-terminals and whereby the springs of the ringing selective key may be removed from their normal contacts and brought into engagement with their alter-
85 nate contacts, one of which constitutes the ultimate terminal of the ringing-generator 6. In my present system I have indicated grounded signal receivers or bells 10 at the substations, which are connected with the sleeve
90 side of the party telephone-line 11. I have also provided at the exchange an additional switching mechanism 12, which may be employed for the purpose of connecting the battery 12' in circuit with the telephone-line,
95 at one time with the positive pole connected with the sleeve side of the telephone-line and at another time with the negative pole connected with the sleeve side of the telephone-line, whereby current may be sent over the tele-
100 phone-line first in one direction and then in another to operate the setting mechanism at each of the different stations, as will be more fully hereinafter set forth. While I have shown grounded bells 10, I do not wish to be
105 limited in all embodiments of my invention to

the use of grounded bells. I have indicated upon the party telephone-line three stations A, B, and C, though the number of stations connected with the line may be varied. The various stations are connected in multiple or bridge between the sides of the party-line, station A being included in such a bridge-path 13 14, while station B has a bridge-path 15 16 and station C has a bridge-path 17 18. I prefer the bridge arrangement, as the element of impedance is so largely removed, though I do not wish to be limited to such an arrangement. The apparatus at station B is illustrated in detail. The apparatus of the other stations is preferably similar thereto. At station B, I have illustrated as one type of substation outfit a gravity switch-hook 19, a telephone-receiver 20 to be supported thereby, and a transmitter 21 of any preferred form, which in the particular instance shown is adapted to be included in a closed local circuit with the battery 21' when the telephone switch-hook is relieved of the receiver, said local circuit also including the primary 21² of an induction-coil whose secondary 20' is in series with the telephone-receiver. All of these instrumentalities are well understood by those skilled in the art, the switch-hook serving, when in engagement with its normal contact through the agency of the telephone-receiver when supported, to include the signal-bell 10 in circuit and to cut out the telephone receiver and transmitter. I have indicated the well-known magneto-generator 22 at the substation B; but I do not wish to be limited to the use of magneto-generators at subscribers' stations. The grounded magneto-generator 22 when operated serves to release the shutter of the line-indicator 23, which in this particular instance is grounded and is normally in connection with the sleeve side of the party-line and the generator by way of the long spring of the line-jack 2 and the contact engaging said spring when said jack is free of a plug. In order that the current from the generator 22 may be sent in sufficient volume over the line to operate the line-indicator, the bell 10 is preferably made of very high resistance—for example, one thousand (1,000) ohms—which, however, is not too great to permit a fraction of the current to be diverted from the circuit containing the line-indicator through the bell to have the bell operated at the calling-station, said bell being in shunt relation with the generator. I have shown the side 15 to depend for its continuity upon a movable circuit-changing ratchet-wheel 24, which ratchet-wheel, in the particular embodiment of the invention herein shown, is provided with a mounting 25, with which it has electrical connection at its journal, the mounting 25 being illustrated in the form of a bracket, with which one section of the conductor 15 is connected. This section of the conductor 15

is thus connected with the wheel 24, as said wheel and bracket are in metallic connection. The wheel 24 has a metallic pin 26 mounted thereon and in electrical connection therewith, this pin 26 being normally maintained against a terminal or screw 27, that is carried by, but insulated from, the bracket 25, a coil-spring 28 normally maintaining the pin 26 and the screw 27 in contact. The screw 27 is connected with a continuation 15' of the conductor 15, which continuation 15' is connected with a switch-hook 19. When the apparatus is in normal condition, the conductor 15' and conductor 15 are in connection with each other, whereby the switch-hook 19 is connected with the sleeve side of the telephone-line, the bell 10 being connected with said side of the telephone-line when the switch-hook is depressed. When the switch-hook is elevated, the receiver 20 and secondary 20' are connected with the conductors 15 and 15', which latter conductors are connected through said receiver and secondary with the branch 16, connected with the tip side of the telephone-line. Thus in the normal condition of the apparatus the telephonic outfit at each substation may be used without the coöperation of any selective agency at such substation.

The instrumentality employed for operating the circuit-changing wheel 24 includes a polarized electromagnet 29, whose winding 30 is included in bridge between the conductors 15 and 16, said electromagnet furnishing sufficient impedance to prevent voice-currents from being shunted from the telephonic instruments. The combined resistance of the helices of this electromagnet may, for example, be of twenty-five hundred (2,500) ohms. The armature 31 of this electromagnet is of soft iron and is polarized by the permanent magnet 32. The armature rests against stops 33, that are provided upon the ends of rocking arms 34, which are desirably pivoted at their adjacent ends, being there preferably mounted upon a common shaft 35, upon which they may rotate. Springs 36 serve to maintain the outer ends of the arms 34 against adjustable stops 37. When the armature is rotated in one direction or the other under conditions to be hereinafter specified, one or the other of the arms 34 is caused to move against the retractile force of its associate spring 36. The armature 31 has attached rigidly thereto a tongue 38, upon the lower end of which is provided a pawl 39 in actuating relation with the teeth upon the wheel 24. This tongue 38 is also provided with a lateral projection 40, which, under conditions to be hereinafter specified, is adapted to engage an extension 41 of the locking dog or detent 42. By successive movements of the tongue 38 in a clockwise direction the wheel 24 is moved in a counter-clockwise direction, the dog 42 holding the wheel in any position to which it may

be placed. Upon a counter-clockwise movement of the tongue 38 the dog 42 is disengaged from the wheel 24 by the engagement of the parts 40 and 41, whereupon the spring 28 restores the wheel 24 to its normal position, in which position the pin 26 and the stop 27 are in engagement, these elements 26 and 27 serving to determine the normal position of the wheel 24. In order that the releasing operation may be effectively performed, the pawl 39 is provided with an extension 43, which upon the movement of the tongue 38 in a counter-clockwise direction is forced against a stationary pin 44, which permits the spring 28 to restore the wheel 24, the dog 42 having, as previously stated, been removed from engagement with said wheel. The helices of the magnet 29 are so disposed as to create or tend to create poles or magnetic regions of unlike sign. The armature of the magnet is desirably pivoted between the magnet-poles, the ends of the armature receiving definite polarity by reason of the permanent magnet 32. The cores of the helices are likewise of soft iron and are similarly polarized by the permanent magnet. When current is passed through the helices in one direction, the polarity of that portion of one core immediately opposed to the armature is increased and that of its companion is decreased, so that the armature is moved in one direction. When the current on the line is reversed, these polar conditions are reversed and the armature is caused to rotate in a reversed direction. The switching mechanism 12 is provided solely for the purpose of controlling the connection of the battery or other source of current 12' with the telephone-line, so that the direction of the current through the helices 30 may be reversed to secure the clockwise or the counter-clockwise movement of the tongue 38, as required.

An operator in selecting a station causes the tongue 38 thereat to move in a clockwise direction until the tongue 45, in metallic connection with the wheel 24, is placed with its stem or root in substantial alinement with the stem or root of the tongue 46, carried upon the armature 47 of an electromagnet 48, which, as will be hereinafter specified, is thereupon energized to effect interlocking engagement between the elements 45 and 46. This adjustment of the parts is effected at each of the two stations upon the party-line where two subscribers upon the same line desire to communicate. The tongues or catches 45 and 46 when in engagement are in electrical connection with the bracket 25, the conductor 15, the sleeve side of the telephone-line, and the generator 6 when the wedge of the lever 9 is moved toward the right and the lever 12² is in a central position. The said generator 6 has its connection continued from the catch 46 to the armature 47 in metallic contact therewith, the spring 49, the switch-hook 19 in connec-

tion therewith, and the grounded bell 10 at the station to be signaled, which signaling is accomplished by the aforesaid movement of the lower end of the lever 9 toward the right. The source of current 6, that is employed to operate the signal-bell 10 at a called station, also effects the energization of the magnet 48 to bring about connection of the bell 10 with the armature 47, and consequently the conductor 15. The winding of the magnet 48 is grounded and has its circuit complete when the parts 45 and 46 are brought in opposition, the opposing ends of these parts being in engagement to effect the inclusion of the magnet-winding 48 between its grounded terminal and the generator 6. This circuit may be traced from said grounded terminal to the back contact 50, the spring 51 upon the armature that is not removed from the back contact 50 until the opposing engaging ends of the elements 45 and 46 are slipped past each other to bring about their interlocking engagement, from said spring 51 to the armature 47, the tongue 46, the tongue 45, the wheel 24, the bracket 25, and thence by way of the conductor 15 and its connections to the generator 6. Thus the circuit of the generator 6 is initially closed by the resting contact of the free end of the tongue or catch 45 upon the free end of the tongue or catch 46, the lever 9 of course being in momentary position to complete this circuit at the exchange. The winding of the magnet 48, it is apparent, is only momentarily included in circuit with the generator 6, this momentary closure of the circuit, however, being sufficiently long to bring about the interlocking engagement of the parts 45 and 46, whereafter the magnet 48 has no further function at a properly-connected station, the magnet being thereupon cut out at the contacts 50 and 51. When the selectors are in their normal positions, the connection of the bell 10 with the conductor 15 is completed by way of the contacts 26 and 27. When the selectors at the various stations have been operated, however, this signaling-circuit is completed by way of the spring-contact 49 and the armature 47, the elements 45 and 46, the wheel 24, and the bracket 25, with which said wheel has metallic connection, the contacts 47 and 49 being in engagement when the parts 45 and 46 are interlocked. Though the contacts 26 and 27 are separated at unselected stations, there are conditions known to those skilled in the art in which the telephone receiver or instrument 20 will not effectively be disconnected from the telephone-line, and I therefore provide an arrangement under the control of the operator whereby said telephone receiver or instrument may be excluded most effectively from telephonic connection with the line. In the preferred embodiment of my invention there is included as a part of this arrangement a shunt about the receiver, which shunt includes a conductor 52, connected with a

spring 53, and a conductor 54, connected with the contact 55, for the said spring. The wheel 24 is provided with an insulating-pin 56, which in the normal condition of the apparatus effects a separation of the contacts 53 and 55 to thereby open the shunt about the telephone instrument 20, permitting the ordinary use of said telephone. When the wheels 24 of the selecting instruments on the party-line are actuated, as they all are when a station or stations upon the party-line are to be placed into communication with the agency of the selecting apparatus, the pins 56 are removed from engagement with the springs 53, whereupon the contacts 53 and 55 are brought together. This engagement of these contacts shunts the telephone appliance 20 at all stations except that station or stations which are to have telephonic connection with the party-line. At such station or stations that are to be telephonically connected with the telephone-line, the catches 45 and 46 being in interlocking engagement, the contact 57 is operated by the armature 47 and is separated from its companion contact 58, and as the contacts 57 and 58 are in series with the contacts 53 and 55 the stations where the contacts 57 and 58 are separated are permitted to have their telephone-receivers 20 in complete operative connection with the telephone-line. In order to prevent crossing of circuits, the contact 57 is separated from the armature 47 by insulation. As stated hitherto, the only circumstance in which the contacts 57 and 58 are separated is at the station or stations that are to be telephonically connected with the line. At the other stations where the contacts 45 and 46 are not interlocked and are not in position to be interlocked the contacts 57 and 58 remain in engagement, and as the contacts 53 and 55 are in engagement everywhere upon the line the shunt about the telephone instrument 20 is removed only at the stations where the contacts 57 and 58 are separated.

My means of detecting the location of the station where an eavesdropper is listening in comprises switching mechanism controlled by the subscriber, switching mechanism at the substation in a branch conductor leading to the substation from the main line controlled by the operator through the agency of electromagnetic mechanism and an indicator at the exchange jointly controlled by these switching mechanisms, whereby the operator may test a station to ascertain whether or not the telephonic apparatus thereat is in wrongful use. The switching mechanisms that I employ for this purpose are preferably those which exist in the apparatus already described, such mechanisms being preferably provided at each station upon the line. Such mechanisms include the telephone switch-hook, its normal contact that is grounded through the bell, and the contacts 45 and 46, spaced varying distances apart at the substations, these contacts 45 and 46

desirably cooperating with the contacts 47' and 49 to secure the desired results, though for testing purposes I do not wish to be limited to any particular instrumentality controlled by the operator acting in conjunction with the contacts 45 and 46 of the selective testing apparatus. The latter two contacts are those contacts which are controlled by the operator. The contact 19 and its normal contact are the contacts that are controlled by the subscriber. The latter contacts and the former are in series relation. Now in order that the operator may determine whether or not a subscriber is wrongfully using an instrument, she brings the contacts 47' and 49 into connection in the manner previously described, and thereupon moves the lower end of the lever to the right. If the switch-hook 19 at the station that should be idle is in engagement with its normal contact, the indicator 59 in circuit with the generator 6 will be continuously actuated (while the lever 9 is in proper position) to show the operator that the station she has chosen to investigate is in proper condition, whereupon the operator may try another station until she finds a station where the signal 59 fails continuously to respond. The signal or indicator 59 may be of any preferred form, the form and location of the indicator selected being simply shown for the sake of example.

While I prefer to employ the generator 6 as the source of testing-current, I do not wish to be limited to this source of current.

It is understood that in testing a station the contacts 45 and 46 are selectively brought into juxtaposition, as hitherto described, and then engaged by the magnet 48, whereafter the generator 6 is included in circuit to lock the parts 45 and 46 together in order that the test may be consummated. It is apparent that this test need only be applied when the party-line is in use as an ordinary party-line—that is, when subscribers are in communication without the aid of the selective apparatus—for it is apparent that when subscribers are brought into communication with the aid of the selective apparatus the telephone-receiver is shunted out of circuit in the manner heretofore specified at all unselected stations. It is understood, of course, that the contacts 45 and 46 are spaced varying distances apart at the different stations.

Ordinarily the selective switching mechanism is interposed between the substation signaling-generators and the main telephone-line. Such being the case it will be apparent that at unselected stations the generators will be disconnected from the line, so that at such unselected stations a subscriber would be absolutely prevented from signaling the operator. I directly connect the substation-generators 22 with the telephone-line, such a connection being illustrated at station B, where the generator is indicated in connection with the

branch 15 at a point between the switching device 26 27 and the telephone-line. By this arrangement not only is an unselected subscriber able to operate the signal 60 when the line is in use, but is also enabled to operate the said signal when the line is idle in case the operator has failed to disconnect her plugs when subscribers are through with their conversation.

10 In the preferred embodiment of the invention the indicator 60 is of high impedance, is grounded at the exchange, and is connected with one of the cord-strands and desirably acts as a clearing-out indicator also. Each
15 signaling-generator 22 is also grounded at the substation, but is normally disconnected from the line, as the said generator is of low resistance comparatively. When the generator is operated, it is by well-known automatic mechanism brought into connection with the line,
20 and thereby operates either the indicator 23 when the plug 4 is out or the indicator 60 when said plug is in. I prefer the ground arrangement of the generator 22, as thereby
25 any subscriber may signal the operator without interfering with the conversation that may be transpiring over the line. This grounded circuit, however, is not essential for the purpose of enabling the subscribers to signal the
30 exchange if no care is to be exercised against interfering with the telephonic currents.

It will be seen that I have provided a telephone system having a telephone-line extending from a plurality of substations to an exchange, a switching appliance at each of the
35 substations controlled by the subscriber thereat, a switching appliance at each of the substations selectively controlled by the operator, an electromagnet at each substation
40 for operating the latter appliance and connected with the line to receive current passing thereover, a conductor at each substation whose continuity is governed by these switching appliances and which is adapted for connection with the party-line thereby, a line-jack at the exchange, a cord connector at the exchange, a signal device at the exchange connected with the cord connector and having one terminal of its circuit at the exchange,
45 complemental terminals being provided by the aforesaid conductors adapted for connection by the party-line by said switching appliances, and a source of current adapted for inclusion in circuit with said signal, the cord
50 connector, the line-jack, the telephone-line, and the conductor connected with the telephone-line at a subscriber's station by said switching appliances.

60 It is obvious that changes may be made in the embodiment of my invention herein shown and particularly described without departing from the spirit of my invention, and I do not, therefore, wish to be limited to the precise apparatus illustrated; but,

Having thus described my invention, I claim 65 as new and desire to secure by Letters Patent—

1. The combination with a party-line extending from a plurality of substations to an exchange, of a switching appliance at each of the substations controlled by the subscriber 70 thereat, a switching appliance at each of the substations selectively controlled by the operator, an electromagnet at each substation for operating the latter appliance and connected with the line to receive current passing there- 75 over, a conductor at each substation whose continuity is governed by these switching appliances and which is adapted for connection with the party-line thereby, a line-jack at the exchange, a cord connector at the exchange, 80 a signal device at the exchange connected with the cord connector and having one terminal of its circuit at the exchange, complemental terminals being provided by the aforesaid conductors adapted for connection to the party- 85 line by said switching appliances, and a source of current adapted for inclusion in circuit with said signal, the cord connector, the line-jack, the telephone-line, and the conductor connected with the telephone-line at a subscriber's 90 station by said switching appliances, substantially as described.

2. The combination with a party telephone-line extending from a plurality of substations to an exchange, of step-by-step operating selective signaling apparatus at each of the substations, switching mechanism at the exchange for effecting operation of said selective signaling apparatus, locking mechanism at each of the substations for locking the selective apparatus thereat when properly set, a source of signaling-current, switching mechanism at the exchange, and circuit connections whereby the source of signaling-current may not only operate the signal-receiver of a selected 105 station, but will also operate the locking mechanism at the selected station to maintain the selective apparatus in the position to which it has been set, substantially as described.

3. The combination with a party telephone- 110 line extending from a plurality of substations to an exchange, of step-by-step operating selective signaling apparatus at each of the substations, switching mechanism at the exchange for effecting operation of said selective signaling apparatus, locking mechanism including a locking-magnet at each of the substations for locking the selective apparatus thereat when properly set, a source of signaling-current, switching mechanism at the exchange, 115 circuit connections whereby the source of signaling-current may not only operate the signal-receiver of a selected station, but will also operate the locking mechanism at the selected station to maintain the selective apparatus 120 in the position to which it has been set, interlocking catches between and forming part of the selective apparatus and locking mechanism.

ism, and a switching device controlled by the locking mechanism serving to exclude the locking-magnet from circuit when said catches are interlocked, substantially as described.

5 4. The combination with a party telephone-line extending from a plurality of substations to an exchange, of step-by-step-operating selective signaling apparatus at each of the substations, switching mechanism at the exchange for effecting operation of said selective
10 signaling apparatus, locking mechanism including a locking-magnet at each of the substations for locking the selective apparatus thereat when properly set, a source of current, switching mechanism at the exchange,
15 circuit connections, interlocking catches between and forming part of the selective apparatus and locking mechanism, and a switching device controlled by the locking mechanism
20 serving to exclude the locking-magnet from circuit when said catches are interlocked, substantially as described.

5. The combination with a party telephone-line extending from a plurality of substations
25 to an exchange, of step-by-step-operating selective signaling apparatus at each of the substations, switching mechanism at the exchange for effecting operation of said selective signaling apparatus, locking mechanism at
30 each of the substations controlled from the exchange for locking the selective apparatus thereat when properly set, a circuit at each station controlling the connection of the telephone with the line, and two switches included

in said circuit, one switch under the control 35 of the selective apparatus and normally placed in condition by said selective apparatus to enable the use of the telephone, and the other switch controlled by the locking mechanism and maintained at a selected station by the
40 locking mechanism thereat in a position to permit the use of the telephone, substantially as described.

6. The combination with a party telephone-line extending from a plurality of substations 45 to an exchange, of step-by-step-operating selective signaling apparatus at each of the substations, switching mechanism at the exchange for effecting operation of said selective signaling apparatus, locking mechanism at
50 each of the substations controlled from the exchange for locking the selective apparatus thereat when properly set, a shunt-circuit about the telephone at each substation, and two switches in said shunt-circuit, one switch
55 under the control of the selective apparatus and normally placed in condition by said selective apparatus to open the shunt, and the other switch, normally closed, controlled by the locking mechanism and maintained open
60 at a selected station by the locking mechanism thereat, substantially as described.

In witness whereof I hereunto subscribe my name this 19th day of September, A. D. 1904.

EDWARD A. BUELL.

Witnesses:

T. F. McDEMOTT,
A. W. FISK.