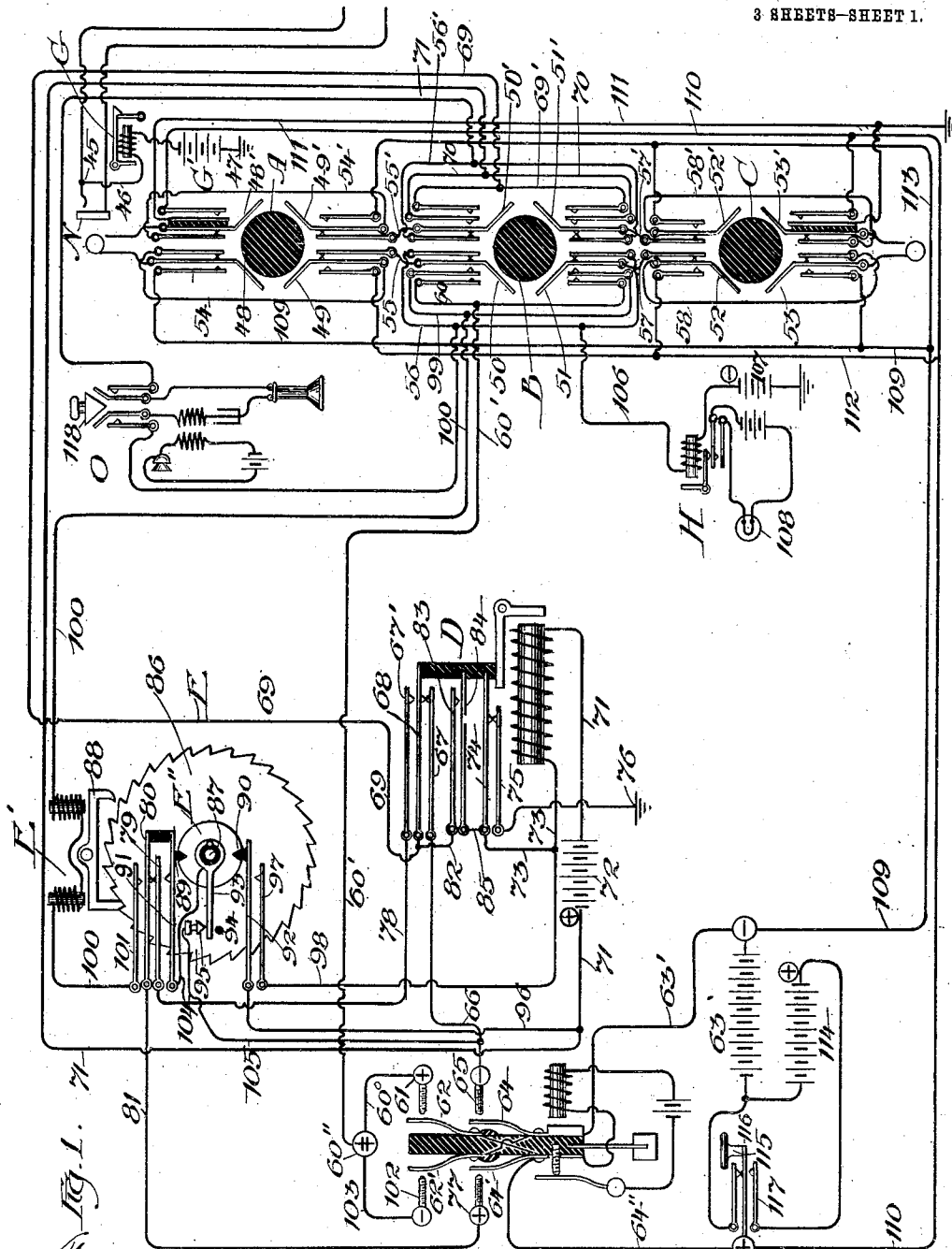


C. A. SOANS & A. H. GRAVES.
 PARTY LINE TELEPHONE.
 APPLICATION FILED MAR. 4, 1907.

978,951.

Patented Dec. 20, 1910.

3 SHEETS—SHEET 1.



Witnesses:

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 Frank L. Delknap

Inventors:

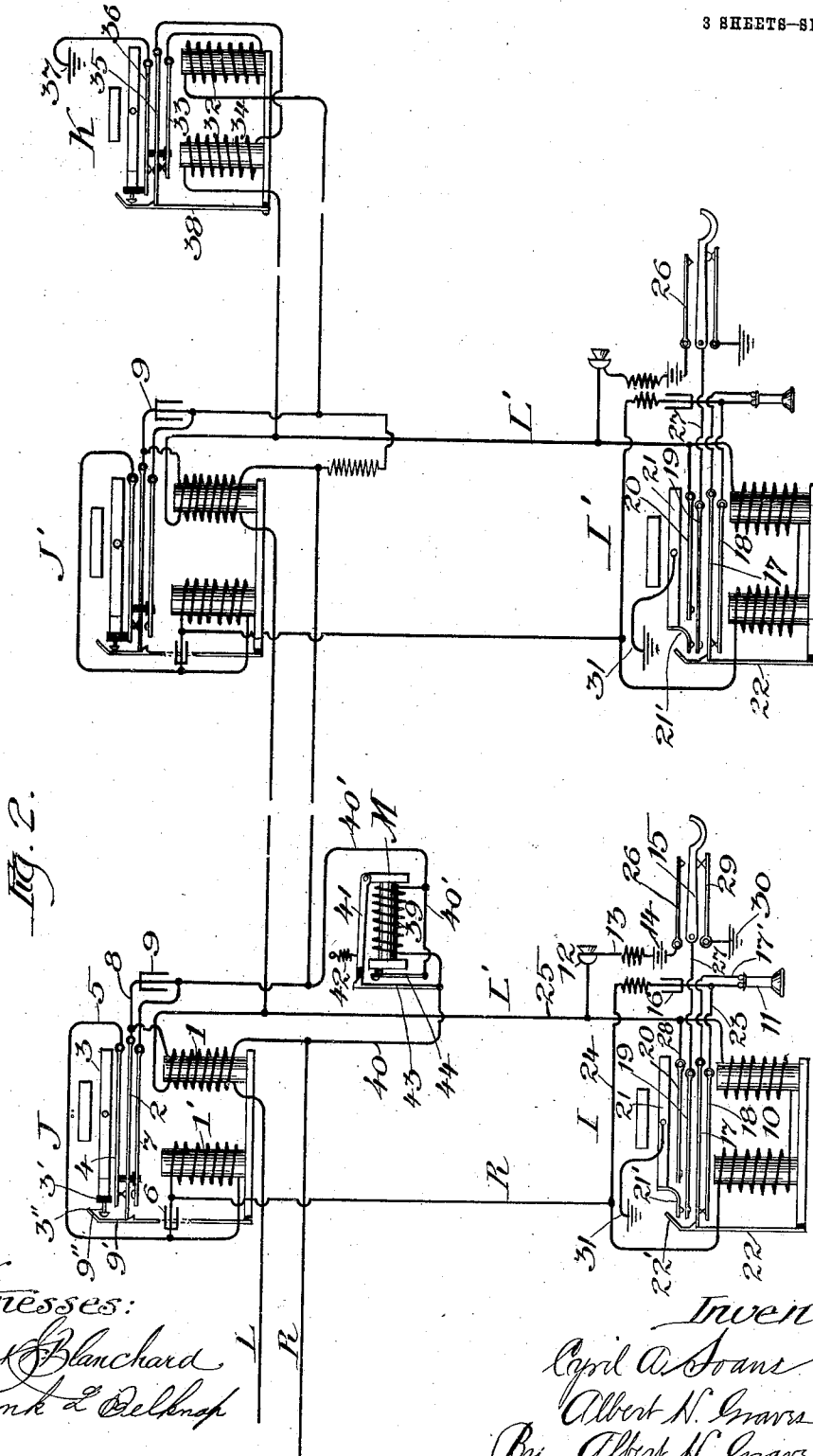
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 By Albert H. Graves,
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3 SHEETS—SHEET 2.



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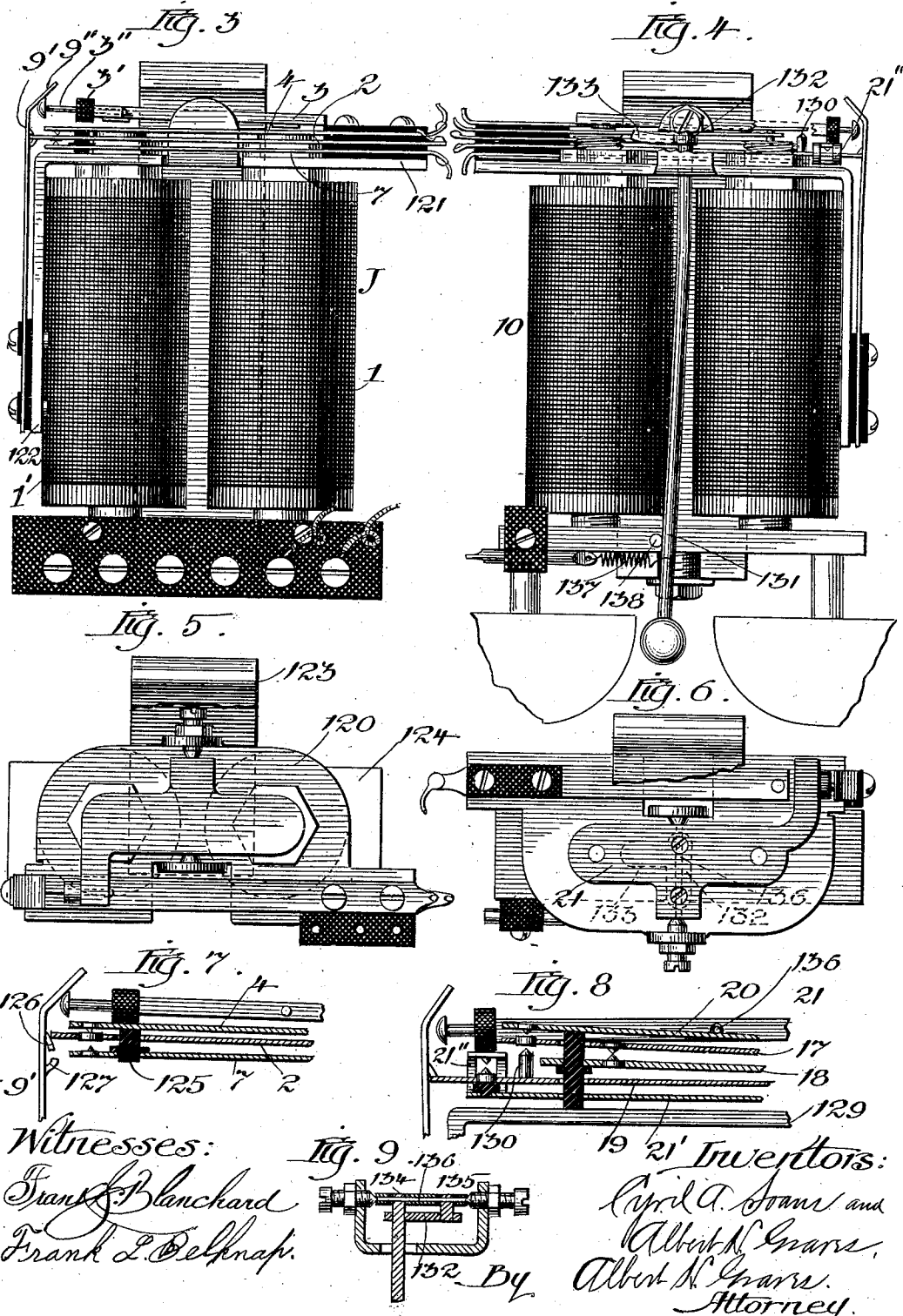
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3 SHEETS—SHEET 3.



UNITED STATES PATENT OFFICE.

CYRIL A. SOANS AND ALBERT H. GRAVES, OF CHICAGO, ILLINOIS, ASSIGNORS, BY
MESNE ASSIGNMENTS, TO HOMER ROBERTS TELEPHONE CO., A CORPORATION OF
WEST VIRGINIA.

PARTY-LINE TELEPHONE.

978,951.

Specification of Letters Patent.

Patented Dec. 20, 1910.

Application filed March 4, 1907. Serial No. 360,352.

To all whom it may concern:

Be it known that we, CYRIL A. SOANS, a citizen of the Kingdom of Great Britain, residing at Chicago, in the county of Cook and State of Illinois, and ALBERT H. GRAVES, a citizen of the United States, residing at said Chicago, Illinois, have invented certain new and useful Improvements in Party-Line Telephones, of which the following is a specification.

This invention relates to improvements in party-line telephones, and refers more specifically to systems of that character commonly designated as lock-out systems.

Among the salient objects of the invention are to so organize and construct the sub-station apparatus and circuits that the main or selecting relay of each sub-station may be located at the juncture of the drop wires with the main line wires and the telephone set proper arranged at the ends of the drop wires or at any desired distance from said relay, thereby avoiding the necessity of "looping in" more than a single pair of drop wires; to so organize a system of that character in which one of the line wires is in sections which are built up or united from station to station, that the building up of the line (in so far as mechanical operation is concerned) depends only upon the proper operation of a single relay at each sub-station, thereby minimizing the interdependency of the several stations; to provide in a system of the general character last mentioned, in conjunction with each instrument which normally operates to build up the sectional line an emergency relay whose function is to act as a substitute for the main relay in case the latter becomes inoperative; to provide in a party-line telephone system a line construction which while normally sectional as regards direct current is nevertheless continuous as regards alternating, *i. e.*, talking current; to provide in conjunction with a line construction characterized as last mentioned, improved means for placing a plurality of subscribers upon the same line in talking connection with each other; to provide improved means whereby any subscriber's telephone set which has been given talking connection may be restored locally, *i. e.*, without restoring the entire line, thereby enabling the exchange operator to answer calls progressively over

the entire length of the line as distinguished from commencing at the initial end after disposing of each talking connection; to provide a system so organized that the simple act by a subscriber of removing the receiver from the switch-hook both sends in a call for connection and "sets" the station for automatic selection by the exchange operator, but nevertheless in case the subscriber abandons the call and returns the receiver to the switch-hook, the set condition of his station is eliminated; to provide in a system organized in general as last mentioned, means whereby upon the automatic location and selection of a calling sub-station, and without further move on the part of the exchange operator; to provide in a system of the general character described improved means for automatically arresting the building up of the sectional line and thereby locating a calling station; to provide an improved polarized relay or magnet and associated switch contacts whereby said contacts may be latched or locked in one position by sending current through the magnet of one polarity, and the same contacts released or restored by sending current of opposite polarity through the magnet; to provide in a party-line system of the general character described a system of calling in signals and a system of clearing out or supervisory signals, both signal systems being to all practical intents entirely independent of each other and non-interfering; and in general to provide simplified and improved mechanism, circuits and coöperative arrangements in systems of the general character referred to.

To the above ends the invention consists in the matters hereinafter described and more particularly pointed out in the appended claims.

The invention will be readily understood from the following description, reference being had to the accompanying drawings forming a part thereof and in which—

Figures 1 and 2 taken together show diagrammatically a preferred embodiment of the system; Fig. 3 is a front elevation of one of the selecting relays; Fig. 4 is a similar elevation of one of the ringers, parts being broken away to expose other parts in rear thereof; Figs. 5 and 6 are plan views of the selecting relay and ringer, respectively, the

upper end of the biasing bar being broken away in each instance; Fig. 7 is a fragmentary detail, partly in section, of the contact group of the selecting relay; Fig. 8 is a similar detail of the contact group of the ringer; Fig. 9 is a sectional detail through the armature of the ringer showing the connection of the clapper therewith.

Referring to the drawings, Fig. 1 shows the central station equipment, and Fig. 2 the sub-station equipment and line wires.

A, B and C, respectively, designate keys interposed in the cord circuit at the exchange, D designates as a whole a controlling relay, E an automatic impulse counter or selector, F a pole changer, G a line drop, and H a supervisory signal set. In the external part of the system I and I', respectively, designate the telephone sets proper, J and J', respectively, corresponding main selecting relays, which for convenience of description will be hereinafter designated pole relays, K a grounding instrument at the end of the line (hereinafter termed the grounder), and M an emergency relay which is operatively associated with one of the pole relays.

Describing first the external circuits and sub-station apparatus, L and R designate the main lines, and L' and R' the drop wires. At the juncture of each pair of drop wires with the main lines is located a pole relay, as J, this instrument being constructed in general similarly to an ordinary polarized magnet, comprising the usual pair of spools, heel piece, armature and biasing bar, all as hereinafter more specifically described. The windings of this instrument are, however, peculiar in that they are so arranged that the windings of one spool are included in both the right and left main lines, while the winding of the other spool is electrically connected with one of the drop wires.

Tracing the circuits through this instrument, line wire L extends to and includes one winding of spool 1, thence extends beyond unbrokenly to the next sub-station. The right main line also extends to and includes one winding of the spool 1, being wound upon the latter in the same direction as is the left hand line, extends thence to and is connected with the switch-spring 2 of a group of contact springs controlled by the armature 3 of the relay. Normally the switch-spring rests in contact with an upper spring 4, and from the latter a conductor 5 leads to and includes the winding of the spool 1' and thence extends to the telephone set proper as the right drop wire R'. A condenser 6 is interposed in a conductor as a shunt across the winding of the spool 1'. The right main line is normally in sections extending from station to station, and the lower spring 7 of the group referred to is connected with the initial end of the suc-

ceeding section of said right main wire. A shunt conductor 8 connects the switch-spring 2 with the contact spring 7, and a condenser 9 is interposed in this shunt. Switch-spring 2 is depressed into engagement with lower spring 7 by the downward movement of one end of the armature 3, the latter being provided with an insulating bushing 3' mounted upon an extension or stem 3'' which engages the group. A spring-latch 9' engages and holds the switch-spring depressed, and this latch is provided at its upper end with an inclined cam extension 9'' which is engaged by the extension 3'' in the upward movement of that end of the armature to trip off the latch and release the switch-spring.

The telephone set proper comprises a polarized ringer 10, receiver 11, transmitter 12, induction coil 13, battery 14, switch-hook 15, condenser 16, and certain contact springs, described in connection with the circuits.

The spools of the ringer 10 are wound in the usual manner, the windings thereof being directly included in the drop wires R, L', which drop wires form with the windings of the ringer an unbroken loop through the telephone set.

17, 18, 19 and 20 designate a group of contact springs controlled and operated by the armature 21 of the ringer. The switch-spring 17 of this group is normally held in contact with the bottom spring 18 by a spring-latch 22 which is provided at its upper end with a cam extension 22' adapted to be engaged by a contact extension 21' carried by the armature, upon the upward movement of the latter, whereupon the switch-spring 17, which has a normal upward tension, is released, and rises so as to close contact between 17 and 19 and 19 and 20. The return of the switch-spring to normal latched engagement with latch 22 is effected by the downward movement of the same end of the armature which effects the release on its upward movement.

The receiver 11 is included in a loop conductor 23 which connects the springs 17 and 18 and is therefore normally short circuited. A conductor 24 connected with the right drop wire extends thence through condenser 16, secondary winding of the induction coil 13, to and through the receiver, and by conductor 23 to switch-spring 18. The transmitter, primary and local battery are included in a conductor 25 extending from the left drop wire to a top spring 26 which co-operates with the switch-hook. A conductor 27 connecting the switch-hook with spring 19 forms another part of the primary circuit, and a conductor 28 connecting spring 20 with the left drop wire completes the primary circuit. A bottom spring 29 contacts with the switch-hook when the latter is depressed, and this spring is connected

to ground as indicated at 30. The armature 21 of the ringer is also connected to ground, as indicated by conductor 31.

The pole relays, the telephone sets proper and the circuits are, or should ordinarily be, exactly identical at each sub-station, with the exception that electrically-beyond the last pole relay a grounder instrument is provided, which will now be described: In so far as mechanical construction is concerned, this grounder K is or may be identical with one of the pole relays, as J or J'. The windings of the spools, however, are both alike and wound in the same direction. The right-hand main line extends to and includes the winding of spool 32 and thence extends to and is connected with the lower contact spring 33. Similarly the left-hand main wire includes the windings of the spool 34 and extends thence to and is connected with the switch-spring 35. The top spring 36 is connected to ground as indicated at 37. The normal position of the grounder is with the switch-spring held down by the latch-spring 38 in contact with bottom spring 33, thus closing the circuit between the right and left main lines through the windings of the magnet.

There is shown associated with the pole relay J an emergency relay M. This instrument is not essential to the working of the system, and is omitted at the sub-station of which the pole relay J' forms a part. Describing this relay, it comprises an ordinary, non-polarized magnet spool 39 wound extremely high and having its windings included in a shunt wire 40, 40', which extends from the right main line on one side of the pole relay to the right main line on the other side thereof. Magnet M has an armature 41 normally held retracted by a spring 42 having considerable tension, and in its retracted position this armature holds back a contact spring 43 which is adapted when released to engage a cooperating spring 44. These two springs are connected with the shunt wire 40, 40', respectively, in such manner as to cut out or short circuit the windings of the instrument when the magnet is energized and spring 43 released to close with spring 44. The end of spring 43 is hook-shaped so as to hook over the end of the armature 41 and hold the latter in closed position when it has been once energized. The instrument must be restored manually and its function is to completely cut out the pole relay with which it is associated, when an emergency demands, *i. e.* when the pole relay fails to operate properly.

The system is operated by sending pulsating current of one polarity for building up the line, pulsating current of opposite polarity for operating the ringer of the station selected, and ground to ground current for restoring, for automatically arresting the

building up of the sectional line, and for signaling purposes.

Describing now the central station equipment, the two main line wires terminate in an ordinary spring-jack N, the tip-spring of which normally engages a contact 45 with which is connected a conductor 46 which includes the windings of an ordinary drop G, battery G' and ground 47. In the cord circuit are interposed the three double-throw keys A, B and C, each operating a group of springs whichever direction it is moved. The switch-springs as 48, 48', 49, 49', 50, 50', 51, 51', 52, 52' and 53, 53', normally rest in engagement with corresponding inner springs, and these inner springs and switch-springs are interconnected by conductors, as 54, 54', 55, 55', 56, 56', 57, 57' and 58, 58' in such manner that whenever either key is moved in either direction it opens the series connections at each side which extend through the three keys, but normally the two line wire circuits are extended uninterruptedly through the series of keys.

The central key B is the key which is operated in building up the line and either locating a party calling in for connection or selecting and ringing the bell of a subscriber called for. Shifting this key in one direction throws current on one end of the cord, and in the opposite direction sends current over the opposite end of the cord. To give connection to a party calling in, the sub-station is so organized that upon removing the switch-hook a flash-ground is established from the substation in question through the grounded drop G of the corresponding jack; the bottom spring 29 of the switch-hook being to this end arranged to follow the switch-hook until it engages top spring 26 and for a short period thereafter during the upward movement of the switch-hook. Upon observing the shutter of the drop fall, the operator plugs in and moves the running-selecting key B, thus establishing circuit connections with the pole changer F as follows: from the tip of the plug to switch-spring 50, through the two cooperating outer springs to conductor 60, to conductor 60' and to the plus-or-minus binding post 60'' of the pole changer, thence by conductor 60'' to the plus contact 61 on one side of the pole changer arm, through the corresponding spring 62 of the pole changer (when closed on that side) to the positive side of the battery 63, from the opposite side of the battery to the other spring 64 on the same side of the pole changer arm, thence to contact 65 and from there by conductor 66 to the front spring 67 of a relay D, which spring is normally closed with a switch-spring 68 of the relay. From the latter spring a conductor 69 leads back to the conductor 69' of the key, and which is connected with the outer spring of the group operated by the switch-spring 50'.

Switch-spring 50' is connected with the sleeve of the corresponding end of the cord. Each movement of the pole changer arm which closes this circuit will, therefore, send an impulse of one polarity over the external or line circuit as long as the running-selecting key is held over.

Assuming that the second station is the one from which the subscriber has called in, the first impulse going over the external circuit described will flow through the selecting relay J in the direction to draw down the left hand end of its armature, thus placing the switch spring 2 into latched engagement with latch 9'. A space bushing interposed between the members 4 and 7 of this group of springs will prevent spring 2 from contacting with spring 7 during this movement. Upon the dying away of the impulse, however, armature 3 will return to its normal position, relieving the pressure from spring 4 and the space bushing controlled by the latter, whereupon spring 7 will rise into contact with switch spring 2. This peculiar operation of the spring group effects the building up of the right hand sectional line without permitting any part of the building up impulse to flow on to the succeeding station. The same impulse which operates relay J will also flow through the ringer 10 at that station, but inasmuch as its switch spring is normally in latched position and its armature moves in the latching-up direction, such movement will be ineffective. The clapper of the ringer will not strike a blow when its armature is moved in this direction because of the peculiar connection of the clapper-stem with the armature, as will hereinafter appear.

The next impulse sent to line will tend to repeat at the second station the same movements just described as having occurred at the first station. However, the subscriber by removing his receiver, and permitting the switch-hook to rise, has partially established a grounding connection which comes into operation and is effective as follows: as the left end of the armature 21 of the ringer at station I' starts to close it encounters spring 19 and thus establishes a ground connection from the grounded armature through spring 19, conductor 27, switch-hook and top spring 26, and that part of the primary circuit connected with the drop line L', thence through the ringer and relay at that station to the right main line, and over the latter to the right-hand side of key B. From switch spring 50' of this key the circuit is through a cooperating outer spring to conductor 70 and thence by a conductor 71 to an auxiliary battery 72, and to and through the windings of the relay D, thence by conductor 73 to one of the switch springs 74 of said relay, normally closed with a bottom spring 75, and through the latter to ground at 76. The es-

tablishment of this grounded circuit instantly actuates relay D, which is in practice so organized as to act quickly, and the operation of this relay results in transposing the circuit connections of the line wires with the main battery, which, of course, arrests the further movement in one direction of the armature of the ringer at station I' and of the armature of the relay J'. In this connection it should be noted that the armatures 21 of the ringers are unrestrained in their initial movements and therefore move during the earliest part of the impulse, whereas the armatures of the relays J, J', etc., have comparatively heavy loads to overcome in the resistance of their respective spring groups before the latching-up movement is effected, and it follows that the reversing relay D has ample time to effect the reversal of the circuit before the particular pole relay concerned, as J', can operate.

The reversal of circuits referred to, as accomplished by relay D, is effected by changing the connection of conductor 69 from contact 65 of the pole changer over to a contact 77 thereof on the opposite side, this being done by the movement of switch spring 68 of relay D away from spring 67 and into contact with top spring 67'. From 67' a conductor 78 leads to a spring 79 of the impulse counter, which normally engages a cooperating switch spring 80, and from the latter a conductor 81 leads to the said contact 77. With this contact a spring 64' of the pole changer coöperates, and the latter spring is connected by conductor 64'' with the positive side of the battery 63. Inasmuch as the left side of the main line is connected through key B with the plus-or-minus contact 60'' of the pole changer, no change in this connection is necessary to effect the reversal being described.

The result of the operation of relay D is to arrest the building-up of the line at that station which has signaled in, and by changing the polarity of the circuit through the ringer, cause the latter to ring. The ringer will, of course, continue to operate as long as the key B is held over.

The first ringing stroke of the ringer at station I' places the local circuit in talking condition as follows: upon the up-movement of member 21' of the armature, the latch 22 is tripped off, whereupon switch spring 17 separates from short-circuiting spring 18 and closes with springs 19 and 20. This establishes the talking circuit,—the primary from the left drop wire through the transmitter, primary, battery, spring 26 and switch-hook, to springs 19 and 20, and thence by conductor 28 back to the left drop wire, and the secondary circuit, from the left drop wire through 28 to springs 20, 19 and 17, from the latter over conductor 17' to the receiver, and from the other side of the latter

back through condenser 16, secondary winding of the induction coil and conductor 24 to the right drop wire.

It should be noted that relay D when it operates closes a holding circuit through itself which remains unbroken until key B is returned to normal. This circuit is from battery 72, over 71 to outer springs of key B, back over conductors 69 and 82 to springs 83 and 84 of the relay, (now closed) and by 85, 73 and 71, to and through the windings of the relay and to battery.

The operation of selecting a called-for party is effected by plugging into the jack of the party wanted and using the same key B described, but this operation involves also the use of the impulse counter E. This instrument comprises an escapement wheel 86 and circular cam E'' mounted fixedly upon a main shaft 87 which is spring returned; the escapement wheel being controlled by an armature 88 actuated by a magnet E' forming a part of this instrument. The impulse counter is set by grasping a thumb-nut (not shown) mounted upon the end of the main shaft and rotating the escapement wheel against the action of its spring as many steps or ratchet notches as the number of impulses to be counted out. The circular cam coöperates with and controls two groups of contact springs through the medium of cam projections 89 and 90 respectively mounted on springs 91 and 92. In the normal position, these wipers 89 and 90 engage diametrically opposed notches in the periphery of the cam, but whenever the cam is rotated out of its normal position the wipers ride out of the notches and upon the periphery of the cam, and in so doing change the circuits through the groups of contact springs controlled thereby, as will appear in connection with the tracing of the circuits. It may be noted at this point that when the impulse counter reaches its zero position the circuits are automatically restored to normal by the movement of the wipers 89 and 90 into the notches of the cam E''.

The mechanism is so organized that after the impulse counter has been set for a predetermined count, and the key B held over, impulses from one side of the pole changer pass to line or over an external circuit, and impulses from the opposite side of the pole changer pass through the magnet E' of the impulse counter and actuate the escapement. It is essential that no fragmentary impulse should be sent over the external circuit as otherwise certainty of selection would be impossible. To this end the external circuit is arranged to pass through a conducting arm 93 frictionally mounted upon, but insulated from, the main shaft of the impulse counter and extended at its free end between an insulating stop 94 and a contact 95, through which latter the external cir-

cuit also passes. Normally arm 93 engages contact 95 and closes the circuit. Upon the initial setting movement of the impulse counter, however, the arm 93 is moved away from contact 95 slightly and arrested by stop 94. The first impulse after the key B has been closed, if it happens to be from that side of the pole changer which is connected with the external circuit, would be ineffective because of the interruption of the circuit between arm 93 and stop 95. The next impulse of opposite polarity would pass over the local circuit and operate the escapement, thereby closing the external circuit, and thereafter the impulses would go alternately over the external and local circuits.

The operation of building up the line from station to station while selecting a called party is precisely the same as in the case of answering a calling party, until the requisite number of impulses have been counted out by the impulse counter, and thereupon the arrival of the latter at normal automatically reverses the circuits and rings the bell of the selected station.

Before tracing the circuits through the impulse counter it may be noted that as soon as the latter instrument is moved from normal in setting it, it closes a circuit through the reversing relay D so that the latter is held in what may be termed its reversed position during the entire act of selecting a called-for party. This holding circuit is from battery 72 over conductors 71 and 96 to spring 92 of the impulse counter, from the latter to contact spring 97, and thence by conductor 98 to conductors 73 and 71 which extend through the windings of the relay D and back to the opposite side of the battery.

The local circuit established through the impulse counter by closing key B is from the intermediate one of the two outer springs engaged by switch spring 50 over conductors 99 and 100, to and through magnet E', to top spring 101, at this time closed with switch spring 80. From the latter over conductor 81, contact 77, pole changer spring 64', conductor 64'', to the positive side of battery 63. From the opposite side of the battery by conductor 63', to pole changer spring 62', contact 102, conductor 103, to plus-or-minus terminal 60'', and thence over conductors 60' and 60 back to the outer spring of the pair operated by switch spring 50.

The exchange end of the external circuit may be traced from the outer spring of the pair actuated by switch spring 50', over conductors 69' and 69, to switch spring 68 of relay D now closed with top spring 67', from the latter over conductor 78, to spring 79 of the impulse counter, now closed with spring 91, from the latter over conductor 104, to arm 93 now closed with contact 95, from the latter over conductor 105, to contact 65 of the

pole changer, thence through spring 64 and conductor 63' to the main battery, and from the opposite side of the latter over 64'', to spring 62, contact 61 and conductor 60', to the plus-or-minus contact 60''. From the latter the circuit is over conductors 60' and 60, to the left side of the master-key, and so out to the left-hand main line. The external circuit is, of course, out over one main line and back over the other.

The automatic reversal at the end of the predetermined count which rings the bell of the subscriber called, is accomplished by the return of the impulse counter to normal thereby changing that part of the external circuit which theretofore extended through conductor 78 and springs 79 and 91, to springs 79 and 80, and conductor 81 to contact 77 at the opposite side of the pole changer; the circuit from 77 through the battery and back to contact 102 of the pole changer and the plus-or-minus contact 60'' complete that part of the circuit which is reversed.

After a party has been given talking connections, has finished his conversation, and hangs up his receiver, the clearing-out signal H at "Central" is operated. By depressing his switch-hook, when any party has talking connection, he establishes a ground circuit from 30 to the bottom spring 29 of his switch-hook, thence through the switch-hook, conductor 27, springs 19 and 20, and conductor 28 to the left main line. From the left main line the circuit at "Central" is from the inner spring, now in contact with switch spring 50 of key B, over conductor 56 to a branch conductor 106, which extends through lamp relay H, and battery 107 to ground. The closing of relay H closes a local lamp circuit and illuminates the supervisory or clearing lamp 108. The restoring of the lines which have been in use is now in order, and is accomplished as follows: the restoration of any line with which the cord circuit is connected is accomplished by sending a grounded circuit from ground at "Central" over the left main line to a ground established at the extreme end of this line, and before this latter ground can be established it is necessary to build up the sectional line to reach the grounder K which, as hereinbefore described, is similar to one of the relays J or J' and is operated by precisely the same kind of a selecting impulse. The impulse which reaches and operates this instrument K moves the latch-engaging end of its armature upwardly, thereby tripping off the latch and permitting switch spring 35 to close with grounding spring 36. This places the line in condition for restoring. To restore, the operator moves key A or C, as the case may be, in a direction away from key B. This closes the circuit from the tip

side of the cord through switch spring 48, outer spring engaging the latter, conductor 109, with negative side of main battery 63, from the other side of the battery back over the conductor 110 to the two outer springs actuated by spring 48', that one next to spring 48' being insulated therefrom. From the insulated spring a conductor 111 leads to ground. The placing of the left line direct to ground through the main battery secures an impulse of any desired duration, so that the several relays in series in this circuit are operated with certainty. Those spools which act as restoring magnets and which are included in this restoring circuit are the spools 1 of the several selecting relays J, J', etc., and the spool 34 of the grounder. The latter spool, it will be noted, is energized in such manner as to restore the grounder to its normal, *i. e.* latched condition. The master-key consisting of the three keys A, B and C, is symmetrical in so far as its connections are concerned, and accordingly the operations on either end of the key are alike both as to locating and selecting the calling-in subscriber, selecting a called subscriber, and restoring.

It has been stated that before restoring it is necessary to build up the line to the grounder K. Inasmuch as it would be an unfair distribution of service, particularly in the case of party-lines having a large number of sub-stations, to restore the whole line and commence at the station nearest "Central" always after each conversation, means are provided whereby the exchange operator, upon receiving the signal to restore, may locally restore the single subscriber who was given talking connections, then proceed farther along the line and pick up and give talking connections to the next subscriber in order, who may have set his station for a connection by removing his receiver, as hereinbefore described. Local restoring is accomplished by sending a single metallic circuit impulse through the ringer of the subscriber who has been rung on and in the proper direction to restore that instrument, *viz*: in a direction opposite that of the ringing current. This local clearing is accomplished by closing either key A or C in a direction toward B, and, as will be seen by the circuits now to be traced, this closes the main battery direct to the external line without passing through the pole changer and without establishing grounds. Assuming key A has been operated for local clearing, the circuit from the tip side of the line is from switch spring 49 and cooperating outer spring over a conductor 112 to 110 and the positive side of the battery, and from the opposite side back over conductors 109 and 113 to the outer spring which cooperates with switch spring 49'; the latter being, of course, connected to the

sleeve side of the main line. The closing of this circuit moves the armature of the ringer in the direction to latch the switch spring 17, and, by closing with bottom spring 18, short circuits the receiver, thereby disabling the talking circuit.

It is often necessary to place two parties on the same line in talking connection with each other. This is accomplished as follows: the party who calls in is located and rung on as usual, whereupon he gives his order for the party wanted. If the party wanted be between his station and "Central" the operator asks him to hang up his receiver for a moment, thus establishing a ground at his station, whereupon she operates the restoring key, and, of course, restores the line, without, however, disabling his talking connections because the restoring circuit flows to ground at 30 without passing through the windings of his ringer. Thereupon she simply sets the impulse counter for the number of the intermediate station desired and calls that subscriber. The two then are in talking connection; the condensers 9 being in series with and bridging (for talking purposes) the interrupted right-hand line between the station nearest "Central" and the other station.

In case the party to be called should be located farther from "Central" than the party calling, the operation of putting the two together would be changed to the extent of first locally restoring the calling subscriber's station, then, with the impulse counter selecting the farther subscriber, immediately restoring without local clearing and then calling the original subscriber with the impulse counter.

The function of the emergency relay M, shown as located at station J, has been hereinbefore referred to. It is a feature of the present system that failure of any part of the subscriber's set proper to operate properly does not interfere with the proper operation of the selecting relay controlling that station, so that the sub-stations are not in any sense interdependent so long as the selecting relays operate properly. Failure of a selecting relay may be due either to a bad contact between its normally closed springs 2 and 4, or to an interruption of the bridging loop formed by the drop wires. Either of these conditions would prevent the magnet of the selecting relay operating. Inasmuch, however, as the left line extends uninterruptedly to and through the next selecting relay, at which instrument the bridging connection to the right line will be intact, it follows that sufficient current can be forced through the emergency relay M, which is bridged across the interruption of the right main line, by simply putting on enough voltage at the exchange to operate said emergency relay notwithstanding the

fact that it is extremely high wound and heavily tensioned. To this end, there is provided at "Central" an auxiliary battery 114, and auxiliary key 115 whereby the auxiliary battery may be added to the main battery 63. The connections are, as clearly shown in the diagram, such that by simply pressing the switch spring 116 of the key into contact with the bottom spring 117 the two batteries are placed in series. The voltage of battery 114 will be such that added to that of the main battery it will operate the emergency relay M, and inasmuch as the closing of the latter causes it to remain permanently closed, and thus cuts out the particular sub-station to which it pertains, it will be obvious that any disabled station may be readily cut out, and the line thus made available for the rest of the subscribers.

The exchange operator's listening set is shown at O and is arranged in a usual manner; the listening key of the set being designated 118.

Describing now the principal selecting instruments employed at the sub-station, viz: the selecting or pole relay and the combined ringer and relay, and referring first to Figs. 3, 5 and 7 wherein the pole relay is shown, 1 and 1' designate the spools, 3 the armature, 2, 4 and 7 the several springs of the contact group, 9' the latch, 9'' the cam portion of the latch, 3'' the member which coöperates with the cam, and 3' an insulating bushing which engages and actuates the group of springs. The armature is pivoted, as usual, between a pair of upstanding ears forming part of a yoke plate designated as a whole 120. The yoke has a horizontal extension at its right-hand end 121 to which the group of springs is attached, and at its opposite end a down-turned extension 122 to which the latch is attached. The biasing bar 123 is connected at its lower end to a heel-piece 124 (Fig. 5) and at its opposite end overhangs the central portion of the armature in the usual manner.

An insulating bushing 125 is seated immovably in contact spring 7, extends freely through an opening in spring 2 and engages the under side of spring 4, as shown clearly in Fig. 7. It follows that during the depression of spring 4, that spring and the switch spring 2 remain in contact until the latter has been engaged with the latch and the pressure upon spring 4 relieved, whereupon the tension of spring 7 causes it to rise into contact with the switch spring; the bushing lifting spring 4 out of contact.

Below the overhanging lip or notch member 126 of the latch member 9' at a distance slightly in excess of the thickness of the switch spring is thrown out an integral stop 127; this stop member standing outwardly sufficiently beyond the member 126 to posi-

tively arrest the downward movement of the latch spring under the action of the armature. The function of this stop is to prevent sparking between the switch spring 2 and overlying spring 4, which would otherwise occur at the end of the down-stroke of the armature.

Describing the ringer, this instrument is in general like the pole relay, and most of the parts thereof have been described in connection with the description of circuits therethrough; corresponding parts being similarly designated by the reference numerals. Describing the contact group, however, somewhat more specifically, the numbers thereof are shown in normal position in Fig. 8, wherein it will be seen that the arrangement is somewhat different from that shown diagrammatically but nevertheless corresponding springs are correspondingly designated. That is to say, springs 17 and 18 are normally closed with each other and short-circuit the receiver; a pair of grounding springs are shown in this group to avoid using "frame" as any part of the circuit, and accordingly switch spring 19 serves as one of the grounding springs, and a bottom spring 21' corresponds to the part similarly designated in the diagram. This bottom spring is provided with an extension 21'' which is bent outwardly around the edge of the spring 19 and returns so as to overhang the latter; the return portion carrying the contact point and forming that part with which the bushing of the armature engages in depressing the group. An insulating bushing 128 rests at its lower end upon the yoke frame 129 of the ringer and extends upwardly through all of the members of the spring group, except the uppermost. Spring 18 rests upon a ledge or annular shoulder upon the bushing and is to all intents immovable. Accordingly when spring 19 is unlatched it rises, and in so doing a stud 130 carried thereby encounters spring 17 and forces it upwardly into contact with top spring 20, at the same time opening the contact between 17 and 18. Bottom spring 21' has an upwardly following tension which keeps the grounding contacts separated at all times, except during the time the pressure of the armature is upon the group. In short, in the normal position, contact is closed between 17 and 18 only, and in the talking circuit position contact is closed between springs 19, 17 and 20 only.

The clapper stem 131 of the armature is rigidly connected with a pivot bracket 132 (shown in plan view in Fig. 6), which pivot bracket is provided with a laterally extending arm 133 (see Fig. 4) which rests close to the under side of the armature. The pivot bracket is pivotally connected to the armature by two studs 134 and 135 which extend into suitable apertures in the arma-

ture; a pivot pin 136 being extended through the armature and these studs. In practice an extension of the clapper stem forms the stud 134. This connection pivots the clapper to the armature in such manner that the armature is free to move in one direction, viz: in the direction to depress its spring group, without moving the clapper, but upon movement in the opposite direction the armature engages the arm 133 and oscillates the clapper positively. A coiled contractile spring 137 normally holds the loosely pivoted clapper against a stop stud 138. The operation of these parts has been fully set forth in connection with the description of the diagram.

While we have herein shown a preferred embodiment of the several features of the invention, yet the invention is not to be understood as limited, in its broader aspect, to details of either construction or arrangement.

We claim as our invention:

1. In combination, an uninterrupted main line wire extending through a plurality of sub-stations, a companion main line wire likewise extending through said sub-stations, means practically sectionalizing one of said line wires, as regards direct current of normal operating potential, at each sub-station, a bridging loop conductor normally connecting said main wires at each sub-station, a selecting relay at the juncture of the main wires and loop, and a subscriber's telephone set associated with said loop and connected to the main wires solely through the two limbs of said loop.

2. In combination, an uninterrupted main line wire extending through a plurality of sub-stations, a companion main line wire likewise extending through said sub-stations, means practically sectionalizing one of said line wires, as regards direct current of normal operating potential, at each sub-station, a bridging loop conductor normally connecting said main line wires at each sub-station, a selecting relay at the juncture of the main wires and loop and included in said bridging loop conductor, contact devices operated by said selecting relay for building up said sectionalized line wire, as regards direct current of normal operating potential, and a subscriber's telephone set associated with said loop and connected to the main wires solely through the two limbs of said loop.

3. In combination, an uninterrupted main line wire extending through a plurality of sub-stations, a companion main line wire likewise extending through said sub-stations, means practically sectionalizing one of said line wires, as regards direct current of normal operating potential, at each sub-station, a bridging loop conductor normally connecting said main wires at each sub-station, a

selecting relay at the juncture of the main wires and loop, and having a winding included in series in said loop, switching contact devices operable by said relay for disabling the direct current circuit through said loop and establishing a direct current circuit from one section of the sectionalized line to the next, a condenser bridge across the winding of said relay included in said bridging loop, and a subscriber's telephone set associated with said loop.

4. In combination, an uninterrupted main line wire extending through a plurality of sub-stations, a companion main line wire likewise extending through said sub-stations, means practically sectionalizing one of said line wires, as regards direct current of normal operating potential, at each sub-station, a bridging loop conductor normally connecting said main wires at each sub-station, a selecting relay at the juncture of said main wires and loop, and having a winding included in series in said loop, switching contact devices operable by said relay for disabling the direct current circuit through said loop and establishing a direct current circuit from one section of the sectionalized line to the next, a condenser bridge across the winding of said relay included in said bridging loop, and a subscriber's telephone set associated with said loop, and means, operable from a central station, for restoring the several selecting relays to normal.

5. In combination, an uninterrupted main line wire extending through a plurality of sub-stations, a companion main line wire likewise extending through said sub-stations, means practically sectionalizing one of said line wires, as regards direct current of normal operating potential, at each sub-station, a bridging loop conductor normally connecting said main wires at each sub-station, a selecting relay at the juncture of the main wires with said bridging loop, having two magnet windings, one of which is included in one of said main line wires and the other included in said bridging loop conductor, contacts operable by said selecting relay for building up said sectionalized main line wire, as regards direct current of normal operating potential, a subscriber's telephone set associated with said bridging loop, and means for establishing a restoring ground to ground circuit from a central station through the windings of the several relays included in said main line to ground at a point beyond said relays.

6. In combination, an uninterrupted main line wire extending through a plurality of sub-stations, a companion main line wire likewise extending through said sub-stations, means practically sectionalizing one of said line wires, as regards direct current of normal operating potential, at each sub-station, a bridging loop conductor normally con-

necting said main wires at each sub-station, a selecting relay at the juncture of the main wires with said loop, said relay comprising two windings on one magnet core, both of which are included in the main line wires, and a third winding upon a second core, included in said bridging loop, an armature forming a member of said relay, movable in one direction when current is sent through the bridging loop winding and movable in an opposite direction when current is sent through one of the windings included in a main line, contacts operable by said relay for effecting the building up of said sectionalized main line as regards direct current, a subscriber's telephone set associated with said bridging loop, and means for establishing a restoring circuit from ground at a central station through the several operated selecting relays to ground at a station beyond.

7. In combination, an uninterrupted main line wire extending through a plurality of sub-stations, a companion main line wire likewise extending through said sub-stations, means practically sectionalizing one of said line wires, as regards direct current of normal operating potential, at each sub-station, a bridging loop conductor normally connecting said main wires at each sub-station, a polarized selecting relay at the juncture of the main wires and loop, switching contacts operable by said relay to build up the sectionalized line wire, as regards direct current when said relay is actuated by current of one polarity, means actuated by said relay for restoring said switching contacts when operated by current of opposite polarity, and a subscriber's telephone set controlled by said selecting relay.

8. In a party-line telephone apparatus, an uninterrupted main line wire extending through a plurality of sub-stations, a companion main line wire likewise extending through said sub-stations, means practically sectionalizing one of said line wires, as regards direct current of normal operating potential, at each sub-station, a drop wire connected with one of said main wires at each sub-station, a subscriber's telephone set associated with said drop wire, and a selecting relay at the juncture of the main wire with said drop wire, said relay comprising a polarized magnet and its armature, a switch spring, one or more cooperating contacts, a latch arranged to cooperate with said switch spring, and operative connections between the armature and said latch, whereby movement of the armature in one direction moves the switch spring into latched engagement and movement of the armature in the opposite direction trips off the latch.

9. In a party-line telephone system, the combination with a central station, a plu-

5 rality of subscribers' telephone sets arranged at different sub-stations, a pair of line wires extending from "Central" through the several sub-stations and means for successively and progressively establishing link circuits from the central station through the successive sub-stations, of means for automatically arresting the progressive establishment of said link circuits
 10 comprising manually operable means at each of the sub-stations for partially establishing a ground connection, electrically-actuated means, operable from the central station, for completing said ground connection at the sub-station, and automatic means
 15 operable by the establishment of said ground circuit for arresting the progressive closing of said link circuits.

20 10. In a party-line telephone system, the combination with a central station, a plurality of subscribers' telephone sets arranged at different sub-stations, a pair of line wires extending from "Central" through the several sub-stations and means for successively
 25 and progressively effecting a selection by establishing return circuits from the central station through the successive sub-stations, of means for automatically arresting the progressive establishment of said return circuits,
 30 comprising manually operable means for partially establishing an alternative return circuit from each sub-station, electrically-actuated means for completing said alternative return circuit, and automatic means
 35 brought into operation by the establishment of said alternative return circuit for arresting the progressive selection of stations.

40 11. In a party-line telephone system, the combination with a central station, a plurality of subscribers' telephone sets arranged at different sub-stations, a pair of line wires extending from "Central" through the several sub-stations and means for successively and progressively effecting a selection by establishing return circuits from the central station through the successive sub-stations, of means for automatically arresting the progressive establishment of said return circuits,
 45 comprising manually operable means for partially establishing an alternative return circuit from each sub-station, electrically-actuated means for completing said alternative return circuit, and automatic means
 50 brought into operation by the establishment of said alternative return circuit for arresting the progressive selection of stations, said means comprising a relay at the central station included in said alternative circuit and switching contacts controlled by said relay
 55 which in turn control the source of operating current.

60 12. In a party-line telephone system, the combination with a central station, a plurality of subscribers' telephone sets arranged at
 65 different sub-stations, a pair of line wires

extending from "Central" through the several sub-stations and means for successively and progressively effecting a selection by establishing return circuits from the central station through the successive sub-stations, 70
 of means for automatically arresting the progressive establishment of said return circuits, comprising manually operable means for partially establishing an alternative return circuit from each sub-station, electrically-actuated means for completing said
 75 alternative return circuit, and automatic means brought into operation by the establishment of said alternative return circuit for arresting the progressive selection of stations, said means comprising a relay at the central station included in said alternative circuit and switching contacts operable by said relay and operating to reverse the polarity of the operating current flowing to line. 85

85 13. In a party-line telephone system, the combination with a central station, a plurality of subscribers' telephone sets arranged at different sub-stations, a pair of line wires extending from "Central" through the several sub-stations, one of said line wires being sectionalized as regards direct current of normal operating potential, and means for successively and progressively establishing link circuits from the central station through
 90 the successive sub-stations comprising a selecting relay associated with each sub-station for building up said sectional line, a second relay associated with each sub-station for arresting operation of the corresponding
 95 selecting relay, manually operable means for partially establishing an alternative return circuit from each sub-station, cooperative means operated by said second relay for completing the establishment of said alternative return circuit, a relay at the central station, and means operable by said latter relay and operating to deprive the selecting relay of building-up current. 105

110 14. In a party-line telephone system, the combination with a central station, a plurality of subscribers' telephone sets arranged at different sub-stations, a pair of line wires extending from "Central" through the several sub-stations, one of said line wires being
 115 sectionalized as regards direct current of normal operating potential, and means for successively and progressively establishing link circuits from the central station through the successive sub-stations comprising a selecting relay associated with each sub-station for building up said sectional line, a second relay associated with each sub-station for arresting operation of the corresponding selecting relay, manually operable
 120 means for partially establishing a grounded return circuit from each sub-station, cooperative means operated by said second relay for completing the establishment of said grounded return circuit, a 125
 130

relay at the central station, and means operable by said latter relay and operating to deprive the selecting relay of building-up current.

15. In a party-line telephone system, the combination with a central station, a plurality of subscribers' telephone sets arranged at different sub-stations, a pair of line wires extending from "Central" through the several sub-stations, one of said line wires being sectionalized as regards direct current of normal operating potential, and means for successively and progressively establishing link circuits from the central station through the successive sub-stations comprising a selecting relay associated with each sub-station for building up said sectional line, a second relay associated with each sub-station for arresting operation of the corresponding selecting relay, manually operable means for partially establishing an alternative return circuit from each sub-station, coöperative means operated by said second relay for completing the establishment of said alternative return circuit, a relay at the central station, and means operable by said latter relay and operating to deprive the selecting relay of building-up current, a ringer relay associated with each sub-station for arresting operation of the corresponding selecting relay, said ringer relay comprising a polarized magnet and its armature, a clapper operatively connected to move positively with the armature in one direction and to remain inactive during movement of the armature in the opposite direction, and a group of switching contacts operable by said armature, manually operable means for partially establishing a grounded return circuit from each sub-station, circuit connections through the group of contacts controlled by said ringer for completing the establishment of said grounded return circuit, a relay at the central station included in said grounded circuit, and means operable by said latter relay for reversing the polarity of the operating current flowing to line whereby the selecting relay is prevented from performing its building-up function and the ringer relay is operated in the ringing direction.

16. In a party-line telephone system, a central station and a plurality of sub-stations, a line wire extending through said sub-stations, a plurality of condensers connected in series in said wire, one corresponding to each sub-station except the last, direct current return circuit connections from each sub-station to the central station, an electromagnetic selecting mechanism at each sub-station interposed in said line wire and controllable through the several return circuit connections.

17. In a party-line telephone system, a line wire extending through a plurality of sub-

stations, corresponding condensers associated with said line wire at each sub-station and normally interposed in series in said line wire and electromagnetic station selecting mechanism arranged in shunt relation to the condensers at each sub-station.

18. In a telephone system, a normally continuous line wire and a companion sectionalized line wire comprising sections extending from the central station to the first sub-station, and from sub-station to sub-station beyond, means acting to balance said lines electrically under induction due to high frequency current comprising a condenser interposed and normally connected in series between the contiguous ends of each of the several sections of said sectionalized wire and selective mechanism interposed in said sectionalized wire.

19. In a party-line telephone system, a line wire extending through a plurality of sub-stations, condensers interposed in series in said line wire whereby it is sectionalized, as regards direct current, lock-out mechanism controlling the talking circuit at each sub-station, mechanism for building up said line wire around the condensers, and mechanism for restoring the apparatus to normal.

20. In a party-line telephone system, a pair of line wires extending through a plurality of sub-stations, condensers interposed in series in one of said line wires, whereby it is sectionalized as regards direct current, and relay mechanism at each sub-station interposed in the same wire with the condensers.

21. In a party-line telephone system, a pair of line wires extending through a plurality of sub-stations, condensers interposed in series in one of said line wires, whereby it is sectionalized as regards direct current, mechanism for building up said sectionalized line wire past each condenser, lock-out mechanism at each sub-station, and means for restoring parts of the sectionalized line wire to normal independently of the restoration of said lock-out mechanism.

22. In a party-line telephone system, a pair of line wires extending from a central station through a plurality of sub-stations, condensers interposed in series in one of said line wires, whereby it is sectionalized as regards direct current, a relay associated with each condenser operable to build up said sectionalized line wire past the condenser, lock-out mechanism at each sub-station operable independently of said building-up relays, and means operable from the central station for restoring the sectionalized line from "Central" through any desired number of sub-stations.

23. In a party-line telephone system, a pair of line wires extending through a plurality of sub-stations, condensers normally interposed in series in one line, whereby it

is sectionalized as regards direct current at each sub-station, lock-out mechanism at each sub-station, and means for establishing a full metallic uninterrupted talking circuit from "Central" through one sub-station and a talking circuit through one or more of the said line condensers as to another more remote station.

24. In a party-line telephone system, a pair of line wires extending from a central station through a plurality of sub-stations, one of said line wires being sectionalized as regards direct current, a selecting relay corresponding to each sub-station and operable to build up the sectional line past said station, a subscriber's telephone set and associated lock-out mechanism at each sub-station, said lock-out mechanism being operable independently of the corresponding selecting relay, and mechanism organized to restore a given lock-out mechanism independently of or without restoring lock-out relays, whereby the progressive building up of the line may be continued from any intermediate station after the subscriber last connected in has been locked out.

25. In a party-line telephone system, a pair of line wires extending through a plurality of sub-stations, one of said line wires being divided into sections corresponding to the sub-stations, as regards direct current, selecting relays corresponding to the several sub-stations and operable to build up said sectional line, and lock-out mechanism at each sub-station including a polarized relay operable independently of the corresponding selecting relay, each selecting relay comprising two windings arranged to inductively oppose each other when said relay is included in a metallic link circuit and said polarized relay being arranged in a bridging loop extending across the two main lines, whereby the latter relay may be operated independently of the selecting relays.

26. In a party-line telephone system, a pair of line wires extending through a plurality of sub-stations, one of said line wires being divided and of sections corresponding to the several stations, a selecting relay corresponding to each sub-station, the magnet whereof comprises two windings, one included in each of the main line wires, a bridging loop and a lock-out mechanism at each sub-station, said lock-out mechanism comprising a relay, the windings whereof are included in the bridging loop, means for sending current over a metallic link circuit including the two main line wires and bridging loop, and means for establishing a circuit from ground at "Central" through one of the main lines to ground at a point beyond one or more of said selecting relays, whereby the latter operate to restore the sectionalized line to normal.

27. In a party-line telephone system, the combination of a pair of line wires extending through a plurality of sub-stations, one of said line wires being normally separated into sections corresponding to the stations, a normally closed bridging loop at each sub-station, a selecting relay at each sub-station operable to build up said sectional line, and an emergency relay arranged in a high resistance shunt bridging the gap between the contiguous ends of the sectional line, inoperative under normal selecting current but responsive to current of greater power and operable to complete a circuit of lower resistance across the same gap.

28. In a party-line telephone system, a main line comprising a pair of line wires extending from "Central" through a plurality of sub-stations, a branch circuit wire leading from the main line at a sub-station, lock-out mechanism included in said branch circuit wire, and an emergency relay located at the juncture of the branch and main lines, inoperative under normal current and operable under abnormal current, and controlling switch contacts operable to throw said lock-out mechanism out of operative connection with the main line.

29. In a party-line telephone system, the combination of a pair of line wires extending through a plurality of sub-stations, one of said line wires being normally separated into sections corresponding to the stations, a normally closed bridging loop at each sub-station, a selecting relay at each sub-station operable to build up said sectional line, and an emergency relay arranged in a high resistance shunt bridging the gap between the contiguous ends of the sectional line, inoperative under normal selecting current but responsive to current of greater flow and operable to complete a circuit of lower resistance across the same gap, said relay comprising switching contacts and means operating to hold the switching contacts controlled thereby permanently closed after operation.

30. In a party-line lock-out system, the combination with a subscriber's telephone set, of a station selecting relay, an associated local circuit controlling relay, a local battery circuit, contacts operable by said latter relay for partially completing said local battery circuit, and other contacts, manually operable, for completing the establishment of said local battery circuit.

31. In a party-line lock-out system, the combination with a subscriber's telephone set, of a station selecting relay, an associated local circuit controlling relay, a local battery transmitter circuit, an associated receiver circuit, contacts operable by said local-circuit controlling relay for partially closing the local battery circuit and placing in operative condition the receiver circuit,

and other, manually operable, contacts for completing said local battery transmitter circuit.

32. In a party-line lock-out system, the
5 combination with a subscriber's telephone set, of a station-selecting relay, an associated local-circuit-controlling relay, a local battery transmitter circuit, an associated receiver circuit, contacts operable by said local-circuit-controlling relay for partially

closing the transmitter circuit, and switch-hook contacts operable to complete said local battery transmitter circuit when the switch-hook is released and rises.

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