S. A. SOUTHER.

PARTY LINE TELEPHONE SYSTEM.

APPLICATION FILED OCT. 22, 1908.

1,002,878.

Patented Sept. 12, 1911.

3 SHEETS—SHEET 1.

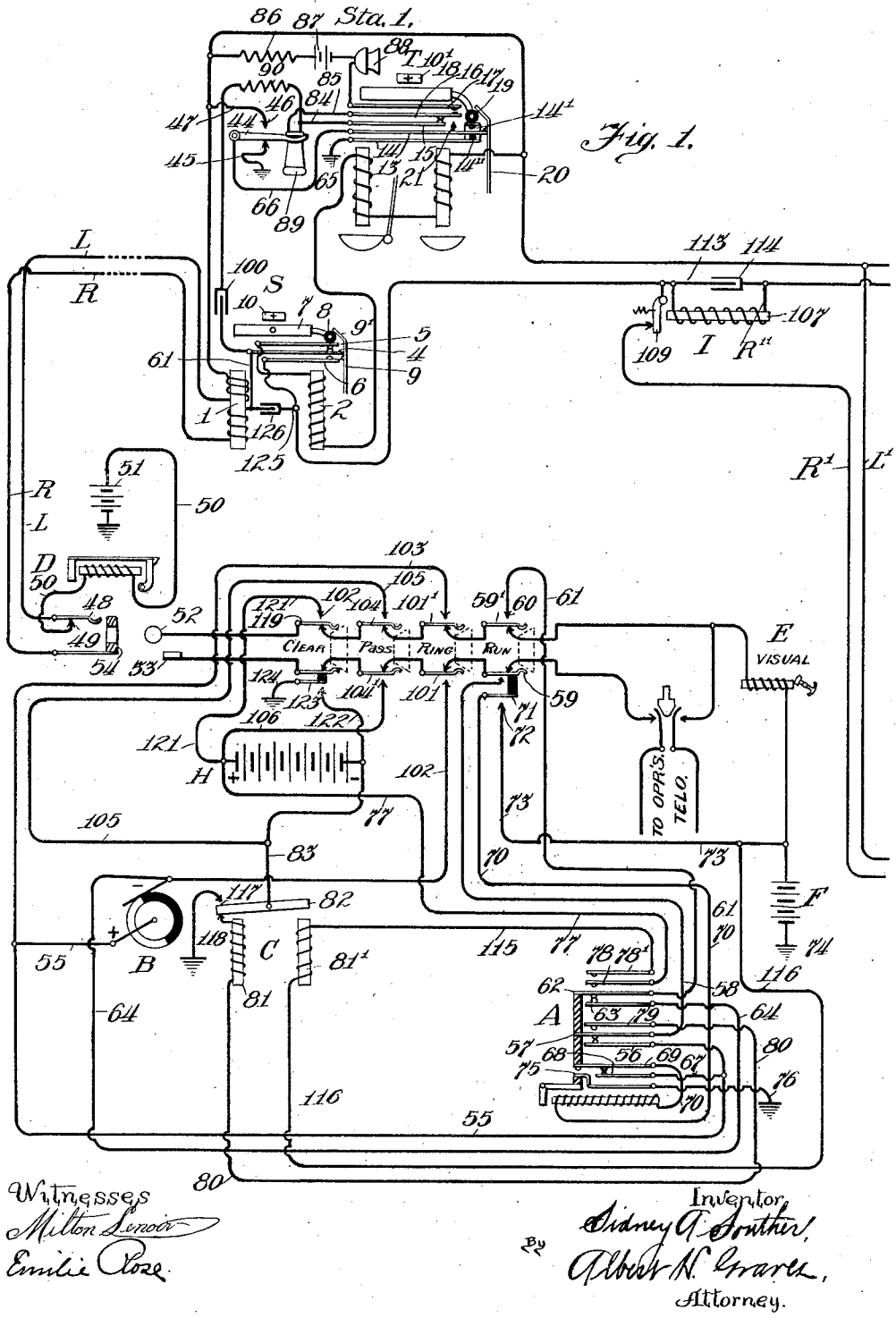

Fig. 1.

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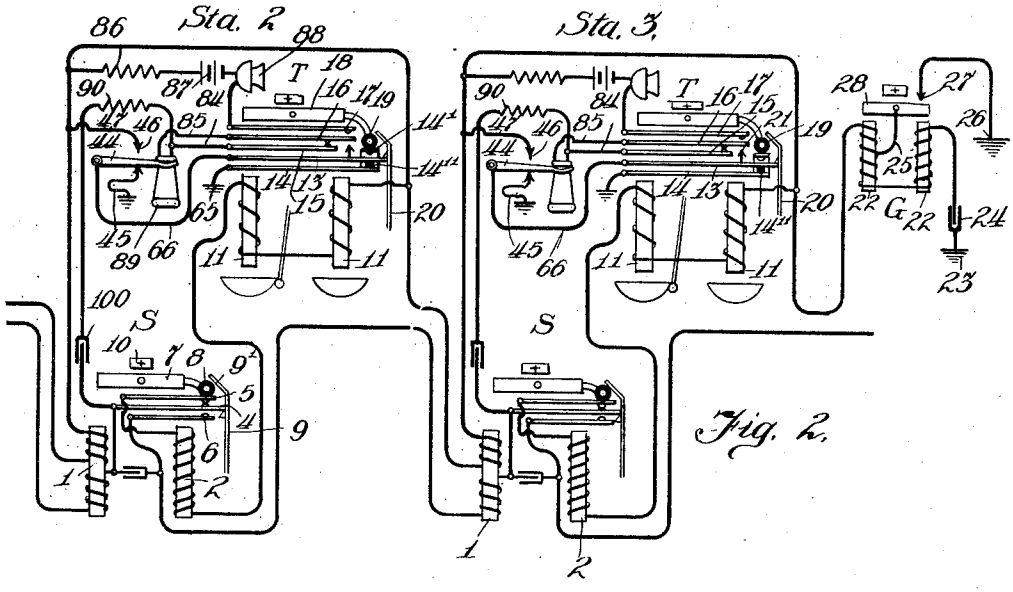
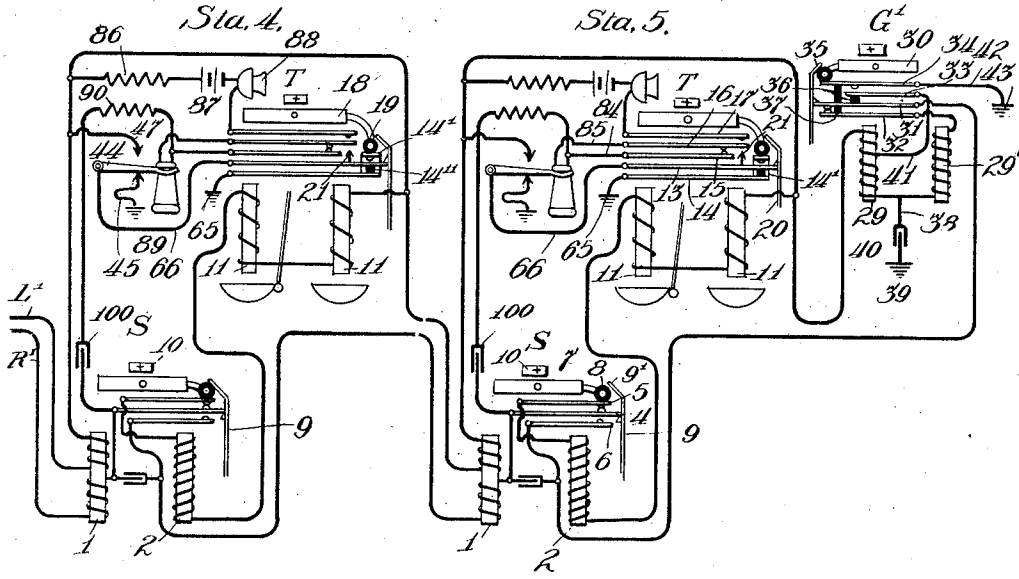


Fig. 2.



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3 SHEETS—SHEET 3.

Fig. 4

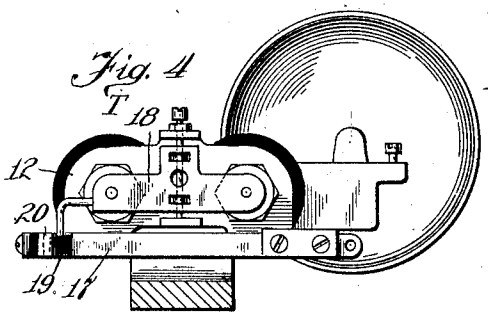


Fig. 3.

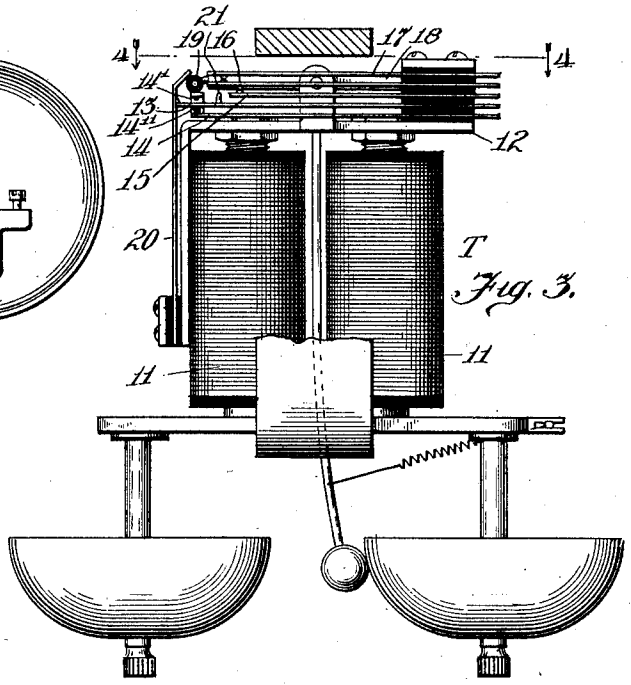


Fig. 5

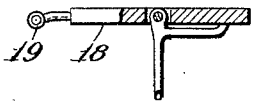


Fig. 6.

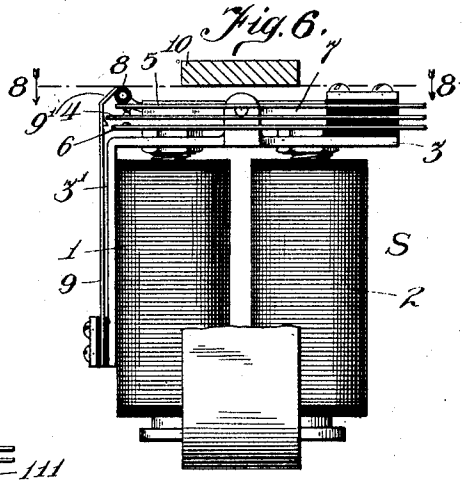


Fig. 7.

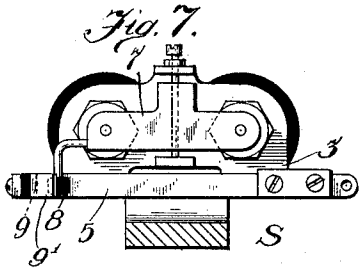
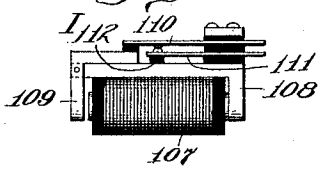


Fig. 8.



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UNITED STATES PATENT OFFICE.

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PARTY-LINE TELEPHONE SYSTEM.

1,002,878. Specification of Letters Patent. **Patented Sept. 12, 1911.**

Application filed October 22, 1908. Serial No. 458,927.

To all whom it may concern:

Be it known that I, SIDNEY A. SOUTHER, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Party-Line Telephone Systems, of which the following is a specification.

This invention relates to improvements in party-line telephone systems, and refers more specifically to a system in which the stations are arranged on branching lines and nevertheless selected serially.

The salient object of the invention is to provide a system so organized as to enable the several stations to be successively selected by the successive extension of a link circuit, those stations on what may be regarded as the main line being first selected and then the stations on one or more branches selected in due order; to provide in a party-line system characterized by the employment of one or more sectional lines, means for establishing branches reaching out to sub-stations remote from the main line in the same general manner as is commonly practiced in bridging systems but nevertheless without departing from the characteristic features of a sectional party-line; to provide a system so organized that the selection of the sub-stations upon branches follows successively and automatically after the main line stations have been passed, precisely as though the stations on the branch line or lines were upon the main line; to provide a system of the character above stated which is characterized by simplicity of construction and reliability of operation, and in general to provide an improved system of the character referred to.

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

In the accompanying drawings—Figures 1 and 2 taken together show a preferred embodiment of the system diagrammatically; the necessary parts of a central exchange and one cord circuit and five sub-stations being shown; Fig. 3 is a view of a polarized lock-out relay, the biasing magnet being partly broken away and partly shown in section; Fig. 4 is a view of the device shown in Fig. 3, taken on line 4—4 of the latter, and looking downwardly; Fig. 5 is a sectional detail showing the connection of the clapper stem with the armature of the selecting relay; Fig. 6 is a view of a polarized lock-out relay with part of the biasing magnet broken out and shown partly in section; Fig. 7 is a horizontal sectional view of the device shown in Fig. 6, taken on line 8—8 of the latter figure, and looking downwardly; Fig. 8 is a view of the branch line relay, seen in side elevation.

In the embodiment of the invention illustrated, the two main limbs of the party-line are metallic, one being continuous and the other sectional, the several sections corresponding to the reaches between stations. The end of each section of the interrupted line is normally connected across to the opposite continuous line, a selector relay being included in each such connection, having for its function to disconnect the sectional line terminating at its station and connected on to the next section so as to successively extend the metallic link circuit from station to station.

If the selector relay be arranged in the same cabinet with the talking set or telephone set proper, it follows that both main lines must be looped in from the external poles or other wire supports, and obviously where the sub-station is located more or less remote from the main course of the line the looping in or carrying of both wires both to and from the main course involves considerable expense. This is avoided in the present system.

Referring to Figs. 1 and 2, at the exchange station A designates a relay, hereinafter termed the "pick-up relay", B a source of pulsating current, indicated as a generator, C a restoring or clearing relay, D a line drop, E a supervisory signal, F a signal battery and H the main operating battery. The several switchboard keys are designated respectively "run," "ring," "pass" and "clear;" these legends corresponding to the functions performed by the respective keys.

At the several sub-stations, S designates as a whole the selecting relay and T the lock-out relay. At the end of the main line is an automatic grounding relay G, and at the end of the branch line a second somewhat differently constructed automatic grounding relay G'.

Describing first the external apparatus, the magnet of each selector relay S has two

differently wound spools, 1 and 2; the former being included in both main limbs L and R of the telephone line and so wound that current flowing out on one limb and back on the other neutralizes or produces no inductive effect on the spool. The spool 2 has a single ordinary winding.

Upon the yoke 3 of the selector magnet is mounted a group of three springs,—a switch-spring 4, a back contact spring 5 and a front contact spring 6. The armature 7 is pivoted upon the yoke as usual, and carries an arm having an insulating button 8 adapted to engage and depress springs 4 and 5. A spring latch 9 suitably mounted upon a down-turned extension 3′ of the yoke, engages and holds depressed the switch-spring 4, and upon the return of the armature 7 the back-spring 5 opens away from spring 4. The magnet of relay S is polarized, being provided with the usual permanent magnet 10. In order to restore the spring group to normal, current is sent through the magnet in a direction to lift the end of the armature carrying the button 8, which latter in rising engages an inclined cam portion 9′ of the latch-spring and trips the latter off.

The lock-out relay T is organized in general like the relay S. Its two spools 11 are alike, having similar windings, connected as usual in series. This instrument is also polarized, being provided with a permanent magnet 10′. Upon the yoke 12 of this instrument is mounted a group of five springs,—a switch-spring 13, a grounding-spring 14, an intermediate short circuiting spring 15 and two upper talking circuit springs 16 and 17, respectively. The grounding-spring is provided at its movable end with a lateral arm or extension 14′ which is bent upwardly around and in position to overlie the end of the switch-spring; said overlying portion carrying a contact point which is adapted to engage the switch-spring. Between the under side of the switch-spring and the grounding spring is interposed an insulation 14″, which is desirably mounted on the grounding spring.

The armature 18 of the instrument carries an arm and insulating button 19, which latter in its downward movement engages the part 14′ of the grounding spring and depresses the latter into contact with the switch-spring 13, and thereafter, if the movement is continued, forces the switch-spring into latching engagement with the spring-latch 20, constructed and mounted in a manner similar to the spring 9 of the selecting relay described.

Both springs 13 and 14 are tensioned to rise when released from the latch, and spring 13 carries an extension contact 21, which, when the spring is permitted to rise, closes with spring 16, lifts the latter out of engagement with spring 15 and forces it into engagement with spring 17. The lock-out relay is shown in normal position. After being latched by current of one polarity therethrough, it is tripped off by a reversal of current therethrough, substantially as described in connection with the selector relay.

Describing the grounder G, the function of this instrument is to establish a ground connection at the end of the main line, when it is desired to restore the intermediate stations to normal. This grounder comprises a polarized magnet, the two spools of which are wound to a relatively high resistance, and the circuit extends from this high winding to ground at 23 through a condenser 24. A branch conductor 25 is connected with an intermediate part of the windings of the magnet and leads to ground at 26 through a contact 27 controlled by the armature 28 of the grounder; this path of current when closed serving to short circuit the chief part of the resistance of the grounder.

The grounder G′ is a polarized instrument organized in general like the selector relay hereinbefore described, and its function is also to establish a ground connection at the end of the branch line for clearing or restoring intermediate instruments. It comprises high wound magnet spools 29, an armature 30, a group of four springs comprising a switch-spring 31, a front spring 32 and a pair of top springs 33 and 34, respectively, and a spring-latch 35. The instrument is shown in normal position, *i. e.* with its switch-spring latched down and springs 31 and 32 in contact. Insulation blocks 36 and 37 interposed between these springs cause them to move downwardly together when depressed by the armature 30. Springs 31 and 34 are tied together by the insulation 36, and upon being unlatched rise together, opening away from spring 32 and forcing spring 33 into engagement with spring 34. A conductor 38 leads from the connection of the windings of the two spools to ground at 39 through a condenser 40. A shunt conductor 41 leads from an intermediate portion of the windings of spool 29 to spring 33, and a conductor 42 leads from grounding spring 34 to ground at 43.

Describing the operations and concerned mechanism somewhat in the order in which such operations are likely to occur in practice, the subscriber at any sub-station desiring connection, lifts his receiver from the switch-hook 44, and in so doing establishes a momentary or "flash" ground from his station to "central," through the grounded spring 45 which is arranged to follow the switch-hook in its upward movement until shortly after the latter has encountered the

top contact 46, but opens the grounded circuit before the switch-hook reaches its upward limit. This circuit is from grounded spring 45 to the left line over 47, through one winding of each intervening magnet spool 1, to the jack-spring 48, thence through normally closed contact 49, over conductor 50 through the drop magnet to drop battery 51 and to ground. This throws the shutter of the drop. Thereupon the operator inserts the cord plug, the tip 52 engaging tip spring 48 and opening the drop circuit, and the sleeve contact 53 engaging the sleeve ring 54.

The operator now closes running key, and in so doing sends pulsating current from the generator to line over a circuit traced as follows: from positive side of generator B over 55 to springs 56, 57, of relay A, thence over 58 to spring 59 of running key thence over the right side of the cord, the right main line, through included winding of spool 1 of the first selector relay, over 61 to switch spring 4 of this relay, to top spring 5, thence through windings of spool 2 of the relay, over 60 to and through windings of lock-out relay to left main line. The left main line includes the other winding of spool 1 of the selector relay, and at "central" the circuit is over the left side of the cord circuit to running key spring 59′ to contact 60, thence over 61 to springs 62, 63, of relay A, thence over 64 to negative side of generator, thus completing the metallic circuit.

The first pulsation which goes to line from the generator energizes spool 2 of the selector relay, draws down the armature and latches switch-spring 4, and so opens the bridging connection as to that station and extends the line or link circuit to the next station. This same impulse energizes the lock-out relay and pulls down the engaging end of its armature, but since this mechanism is already latched down this movement is ineffectual. In precisely the same manner any number of intervening stations may be passed, a station being passed for each pulsation of the generator. As soon, however, as the link circuit is extended to the station at which the subscriber has called in from, a condition is there found which results in automatically arresting the further extension of the link. It will be noted that each switch-hook 44 is connected to the switch-spring 13 of the corresponding lock-out relay, so that when the receiver is removed and the switch-hook rises it partially establishes a grounding connection to the left line, which grounding connection is completed whenever the armature 18 of the lock-out relay depresses the grounding spring sufficiently to close contact with the switch-spring. The adjustment between these contacts is close, and inasmuch as the armature has little mechanical work to perform, except to bring these springs together during its initial movement, it follows that the left line is grounded during an early part of the impulse sent to line. The establishment of the ground at the "set" station energizes a circuit which operates relay A, the latter operates to remove the generator connections from line and closes the main battery H to line in such manner as to reverse the metallic circuit flow, thus arresting the building up or extending of the line and picking up the "set" station. Tracing this grounded pick-up or arresting circuit, and starting at the sub-station, the circuit is from ground at 65 through springs 14, 13, conductor 66, switch-hook 44, top spring 46 and conductor 47 to left main line. At "central" the circuit is from tip side of the cord circuit to running key spring 59′ and thence to the negative side of the generator, as before described. From the opposite side of the generator, over 55 to a branch 67, thence through springs 68, 69, conductor 70 to and through the windings of relay A and to an insulated contact spring 71 attached to and moving with the spring 59 of the running key. Spring 71 is now engaged with contact 72, and from thence the circuit is over 73 to battery F and to ground at 74 at the opposite side of said battery. This energizes relay A and the armature of the latter in closing changes the positions of its three switch-springs 62, 57 and 69; these being connected to move in unison as shown. During the initial movement of the armature of this relay, a grounding spring 75 is brought into contact with switch-spring 69 thereof, thus establishing the holding circuit of said relay which extends from the grounding spring 75 over 76 to ground; the remainder of the circuit from spring 68 to and through the battery F being as before described.

During the further closing movement of the armature, switch-springs 57 and 62 open from springs 56 and 63, respectively, and engaging other springs take off the generator and close the main battery H to line. The circuit so established may be traced as follows: from positive side of battery H over 77, to springs 78, 62, and thence to tip spring of the running key over 61. At the sub-station the circuit is through the bridging connections hereinbefore described to the right main line and thence back to "central." At "central" the circuit continues from sleeve spring of the running key over 58 to springs 57 and 79, thence over 80 to and through one spool 81 of relay C, through the armature 82 of the latter and over conductor 83 to the negative side of the battery, thus completing this battery circuit, which, it will be observed, is of opposite polarity from the pulsations theretofore sent to line

by the generator. It may also be noted that the current flow of this circuit through the spool of relay C maintains the armature of the latter closed, as shown.

At the sub-station the direction of current flow through the lock-out relay lifts the actuating end of the armature of the latter and trips off the latch, thus opening a short circuit over conductors 84, 85, which includes the receiver and establishing the talking circuit. The talking circuit may be traced from left through primary 86, battery 87, transmitter 88 to top spring 17, to springs 16 and 13 (the latter through contact 21), over 66 to switch-hook and back to left through contact 46 and conductor 47. The secondary circuit is at the same time established from left as before through primary, etc., to spring 16, to receiver 89, to primary 90, to condenser 100 and over conductor 61 to right.

The same movement of the armature of the lock-out which trips off the latch and establishes the circuits described throws the clapper of the instrument against its gong and thus taps the gong once, so notifying the subscriber that his connection is completed. Should it be necessary to ring the subscriber's bell to call him to the 'phone, as for example when he has put in a call and it is not answered immediately, then the operator simply closes the ringing key, thereupon closing the generator to line through the springs of the ringing key 101 and 101′; the former being connected to the negative side of the generator by conductor 102 and the latter to the opposite side by conductor 103.

In practice, after a subscriber has had talking connections, it is usual to first lock out his station and then to run on down the line with a view of picking up and giving talking connections to any waiting station between the subscriber last served and the end of the line.

The locking out of a connected station without restoring the rest of the line is accomplished by closing the pass-key once; it being obvious that the station which has been given talking connections cannot be passed with the running key because of the partially established ground at that station which would operate the pick-up relay and prevent passing. That is to say, if the subscriber has neglected or refuses to hang up his receiver there is a partially established ground through the switch-hook and switch-spring, and if he does hang up properly there is nevertheless a partially established ground through the primary circuit, local battery, transmitter and group of engaging springs.

Closing the pass-key establishes a circuit from pass-key spring 104 over conductor 105 to the negative side of the battery, and from the positive side of the latter over 106 to spring 104′. The circuit thus established operates both the lock-out relay and the selector relay at the station then in circuit, thus restoring the lock-out to normal, and, as soon as the pass-key is open and the selector relay be energized, the line is extended to the next station. The further running down the line is then accomplished by the use of the running key. In this connection it may be noted that the operator can pass as many stations as she desires, one at a time, by simply operating the pass-key in the manner described, and this method is resorted to when the operator wishes to select any station to complete connection with another party, as for example, some party on another line.

Describing, now, the chief feature of improvement of the present system, viz: the apparatus which controls the branch line circuit, I designates as a whole a relay, the windings of which are included in a section R″ of one of the main lines. This relay I may be of any usual or suitable type. As shown herein, it comprises in addition to the usual spool 107 the angular heel piece 108, angular armature 109 and a pair of contact springs or strips 110 and 111. The spring 111 rests against an insulation block 112 and has no movement. Spring 110 normally engages 111 and at the same time acts upon the armature to hold the latter in open position in an obvious manner.

The two branch lines R′ and L′ are connected across the main lines in bridging relation, and one of these lines, the line R′ in the present instance, includes the two springs 110 111 of the relay, from which it follows that whenever current is flowing over the main line and through relay I, the right limb of the branch line is open. Relay I is made to respond quickly so that the branch line circuit is opened promptly. A shunt 113 extends across the windings of relay I, and within this shunt is arranged a condenser 114 which, of course, permits talking current to flow through the right main line past the relay without substantial interference, but compels the direct current flow to pass through the windings of the relay. The sub-stations, of which there may be any desired number, upon branch lines are or may be precisely like those upon the main lines.

It will be obvious from the foregoing that as soon as all the stations between relay I and "central" have been passed, thereafter every impulse on the main line will operate relay I and thus be confined to the main line until the last station on the main line has been passed. Thereupon, the main line being open at its termination as regards a metallic circuit, no current can flow through relay I and further impulses and

operating current will pass out over the branch line, operating the mechanism on the latter precisely as though it were a part of the main line.

The two grounders G and G′ are so organized that they will each pick up and establish a direct current ground connection whenever an impulse of sufficient potential is sent therethrough to operate through their high windings and condenser connections. Grounder G′ is furthermore connected in a close metallic circuit across the main lines, and its spools wound in such direction that when the running pulsations arrive at the instrument its armature trips off the latch and establishes a direct current ground through the branch circuit 41, etc. The establishment of this ground brings into operation the relay A, which in turn throws the main battery onto the left line and establishes a grounded circuit of sufficient potential and in the right direction to not only restore all sub-stations on the branch line and between the junction of the branch line with the main line and "central", but also brings into operation the grounder G, establishes a direct ground at that point over the left main line and thus restores those sub-stations between the junction of the main line with the branch lines and the end of the former. The circuit so established is from ground 43 at grounder G′ over 42, springs 34, 33, left main line to left running key spring, over 61 to springs 62, 63, of relay A, over 64 to negative side of generator, from positive side of the latter over 55 to and through 67, to spring 69, 68, of relay A, over 70 to and through windings of relay A to spring 71 of running key, to back contact 72, over 73 to battery F and to ground at 74. This circuit energizes relay A, which in closing places battery H to line as follows: from left running key spring over 61 to relay springs 62, 78 and 78′, from the latter over 115 to and through spool 81′ of grounding relay C, over 116 to battery F and to ground at 74. This circuit draws down the corresponding end of armature 82 of relay C and closes a ground through contact 117 and conductor 118. The main battery circuit is now from left through spring 59′, over 61 to springs 62, 78, from the latter over 77 to positive side of battery H and from the negative side of said battery over 83, armature 82, contact 117 and conductor 118 to ground. This latter circuit is the one which effects the clearing of both main and branch lines, as hereinbefore described.

It is often desirable to restore a part of the main line without first running through the entire series of stations. This is accomplished by throwing the positive side of the main battery direct to the left main line through the restoring key, which, of course, operates the restoring magnets of all sub-stations precisely as last above described. The circuit so established is from left through restoring key spring 119, contact 120, conductor 121 to battery, and from battery over 122 to insulated spring 123 of the restoring key and from the latter over 124 to ground.

Both grounders G and G′ respond to this main battery, and the two lines are cleared over their respective left limbs in parallel. This clearing operation is ordinarily employed for placing two or more parties on the same line in talking communication. To accomplish this, the operator, upon receiving the order from the calling subscriber, if connection with a station more remote from "central" is wanted, simply runs on down the line to the station wanted, and then, without operating the pass-key and therefore without restoring the sub-station last called, operates the restoring key, thus restoring all intermediate selector relays. She then proceeds to run over the line to the party who first called and gives him talking connections, whereupon the two are in talking connection with each other over a metallic circuit through the condenser shunts 125 and condenser 126 which bridge the gaps between the sectional lines at each sub-station.

To give a connection with a party nearer "central" than the calling party, the operator simply restores the line without passing the station of the calling subscriber, and then runs past the intervening stations to the subscriber wanted, thus establishing the same circuit conditions as last above described.

While it has been necessary to describe the construction and operation of the complete telephone system herein shown, yet it is to be understood that that feature of the invention residing in the provision of the branch line controlling relay, is not by any means limited to the specific system herein described, but on the contrary is claimed not only in combination with this particular system but generically.

I claim as my invention:

1. In an electric station selecting system, the combination with a central station of a pair of main line wires and one or more stations thereon, a pair of branch line wires bridged upon said main line wires and one or more stations thereon and means controlling selection of the branch line stations, comprising a relay magnet having its winding included in series in one of said main lines, and contacts controlled by the armature of said relay operating upon each energization of the relay to open one limb of the branch line.

2. In an electric selecting system, a pair of continuous main line wires, a relay mag-

net in one of said wires, a condenser arranged in the shunt extending across the winding of said magnet, a pair of branch lines bridged on said main lines, and contacts controlled by the armature of said relay, whereby one of said branch lines is held open whenever said relay magnet is energized.

3. In an electric station selecting system, the combination with a main operating station and source of current supply, of a main line wire extending through one or more sub-stations, a branch line wire connected to said main wire and extending through one or more additional sub-stations, a relay magnet having its windings included in said main line wire, contacts controlled by the armature of said relay and operating to hold open said branch line whenever said relay is energized, and means operable from the central station for disabling that part of the main line beyond the branch line relay as regards current flow therethrough whereby said branch line relay remains inoperative and the current is diverted to the branch line.

4. In an electric selecting system, a main line wire, a relay magnet in said main line wire, a condenser arranged in a shunt on said main wire extending across the winding of said relay magnet, a branch wire connected to said main wire, and contacts controlled by the armature of said relay and operated to hold open said branch wire whenever said magnet is energized.

5. In an electric station selecting system, the combination of a continuous main line and a branch line connecting to said main line at a point remote from the operating station, one or more stations on the main line beyond the point of juncture of the two lines, one or more stations on the branch line, a relay magnet located at the juncture of said lines having its winding included in one conductor of said main line, a self-returning armature operable by said relay, and contacts controlled by the armature of said relay and operable to hold open said branch line whenever said magnet is energized.

6. In combination with a pair of main circuit conductors, a relay magnet included in series in one of said conductors, a condenser shunt extending across the windings of said magnet, means in said shunt for forcing direct current through said relay magnet, branch line conductors connected in bridged relation to said main circuit conductors, a self-returning armature operable by said relay magnet, contacts governing the continuity of one of said branch line conductors and operable by said armature, and means for opening the main line circuit beyond said relay magnet, whereby the latter is rendered inoperative, and operating current directed over the branch line circuit.

7. In an electric selecting system, a central station, a pair of main line wires, a plurality of sub-stations thereon, electro-magnetic selecting mechanism at said several sub-stations for successively extending a link-circuit from the central station through each of the sub-stations, a relay magnet having its winding included in one of said main line wires, a pair of branch line wires connected in bridged relation with said main wires, a self-returning armature operable by said relay magnet, normally closed contacts governing the continuity of one of said branch lines, one or more sub-stations on said branch lines, means for establishing and maintaining an interruption of said link-circuit at a point electrically beyond said relay, whereby the latter remains inoperative and operating current flows over said branch lines, and electro-magnetic means for restoring the main line mechanism to normal.

8. In an electric station selecting system, the combination of a continuous main line and a branch line connecting to said main line at an intermediate point thereof remote from the operating station, one or more sub-stations on the main line between the operating station and the point of connection of the branch line with the main line, a plurality of sub-stations on the main line at a point beyond the junction of the branch line with the main line, one or more sub-stations on the branch line, a relay located at the juncture of said lines and having its winding included in one conductor of said main line, contacts controlled by said relay and operable upon current flow through said relay to disconnect said branch line from the main line when said relay is energized, and means operable from the operating station for disabling that part of the main line beyond the juncture of the branch line therewith as regards current flow through the main line whereby said relay remains inoperative and the current is diverted to the branch line.

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