J. H. SWANSON.

TELEPHONE LINE SELECTIVE SWITCH DEVICE.

APPLICATION FILED FEB. 21, 1907.

941,743. **Patented Nov. 30, 1909.**

2 SHEETS—SHEET 1.

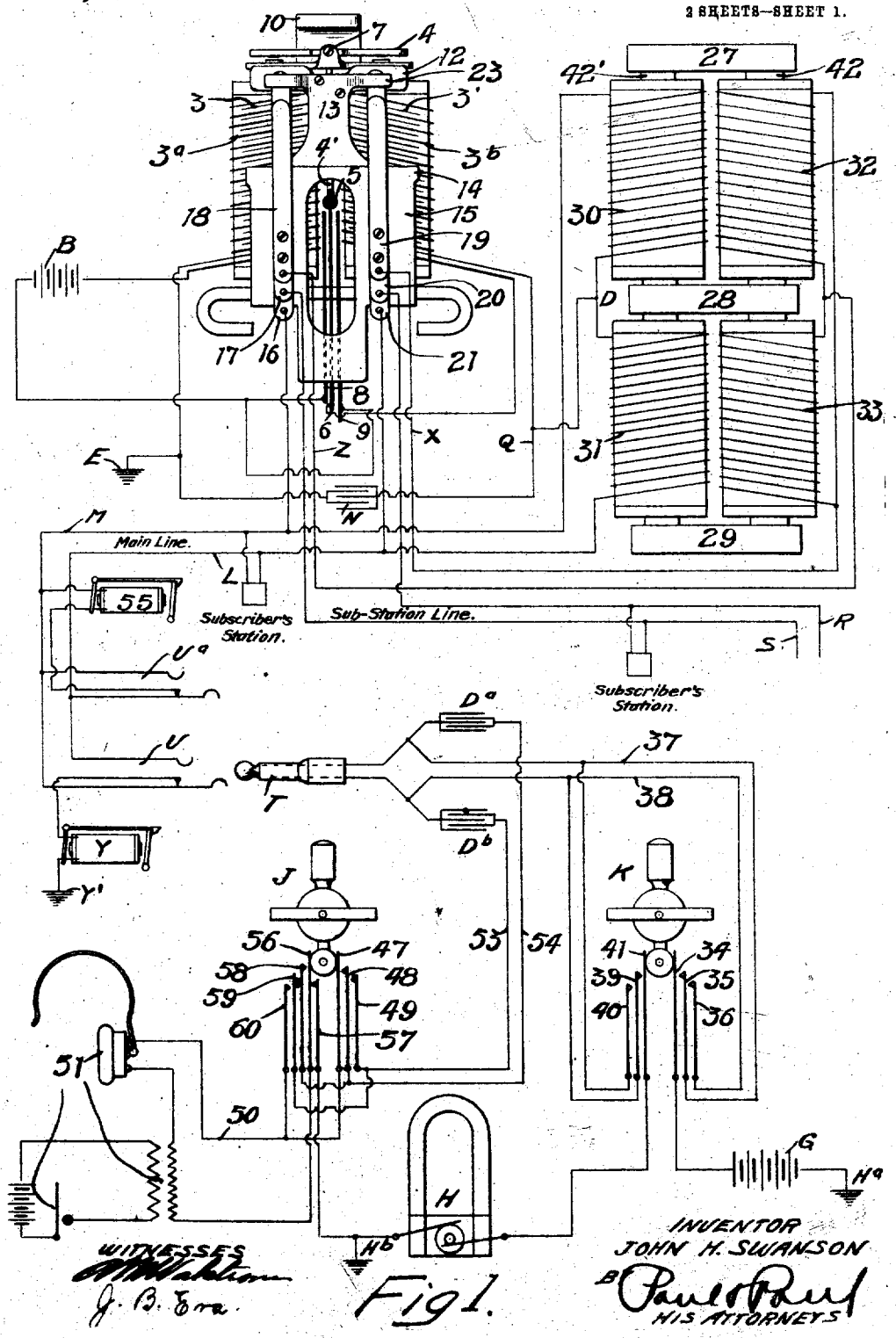

Fig 1.

WITNESSES

J. B. Tra.

INVENTOR

JOHN H. SWANSON

BY Paul & Paul

HIS ATTORNEYS

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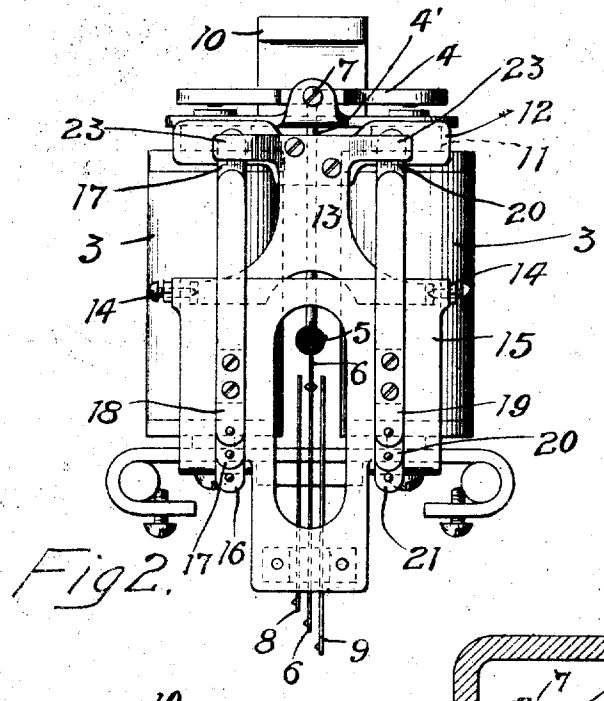

Fig 2.

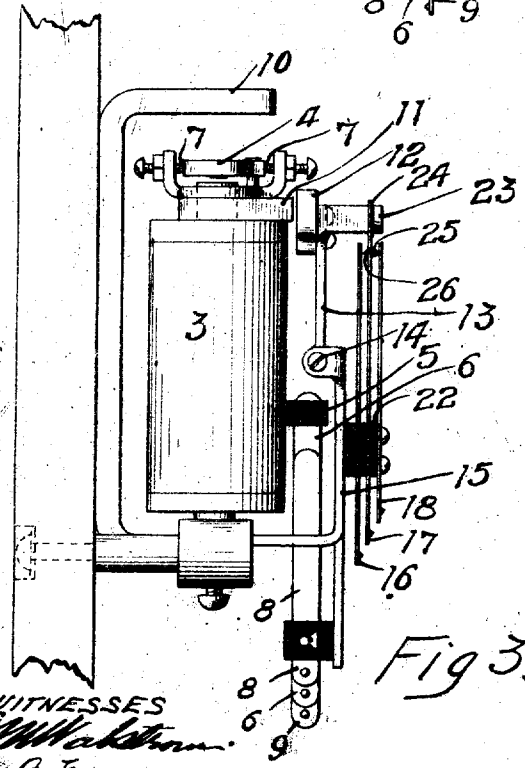

Fig 3.

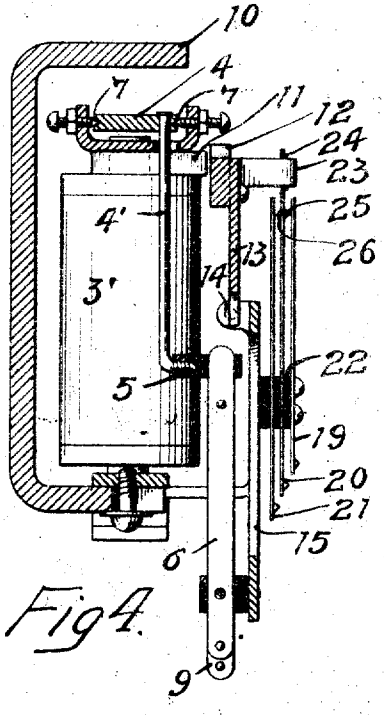

Fig 4.

WITNESSES

J. B. Em.

INVENTOR

JOHN H. SWANSON

BY Paul & Paul

HIS ATTORNEYS

UNITED STATES PATENT OFFICE.

JOHN H. SWANSON, OF BALDWIN, WISCONSIN, ASSIGNOR OF ONE-FOURTH TO T. F. ROBINSON, OF ST. PAUL, MINNESOTA.

TELEPHONE-LINE SELECTIVE SWITCH DEVICE.

941,743. Specification of Letters Patent. Patented Nov. 30, 1909.

Application filed February 21, 1907. Serial No. 358,534.

To all whom it may concern:

Be it known that I, JOHN H. SWANSON, of Baldwin, St. Croix county, Wisconsin, have invented certain new and useful Improvements in Telephone-Line Selective Switch Devices, of which the following is a specification.

In telephone systems a line, which I will designate as the main line, is connected to another line extending from the termination of the main line, the second line, for convenience being designated as the sub-station line. To illustrate, connected to and proceeding from a central telephone station is a line consisting of two metallic conductors having at the central station the usual means for receiving and answering telephone signals. The main telephone line proceeds to a distant point from the central station and has along its route a plurality of telephone stations connected to it in what is known as a bridged manner. At the termination of the main telephone line my invention is located, and connected to and proceeding from the terminal of the main line is a second line independent of the main line, consisting of two metallic conductors extending into an outlying territory. Sub-stations may be connected to these conductors in the usual way. It is assumed that the sub-station line is to be under the control of the central station as though directly connected to it by metallic conductors independent of the main line conductors. Heretofore it has been necessary to maintain at the sub-station or main line terminal an operator for the purpose of connecting or disconnecting the main telephone line and the sub-station line when telephone stations upon the main line desired to communicate with stations upon the sub-station line.

The object of my invention is to provide means whereby the expense of such an operator at the sub-station can be avoided and the supervision and control of the sub-station line be at all times under the central station operator, thereby providing for a perfect checking system where toll is charged between main line telephone stations and sub-line stations.

The invention is particularly adapted for rural or party farm telephone lines where it is used in developing outlying territory without the necessity of extending lines from such territory into the central station. It is understood that in rural telephone systems the party line is most generally used and that such systems are limited to the number of telephone stations capable of successful operation on one circuit and when the territory adjoining the central station is fully developed, that is, when all possible telephone users in the territory adjoining the central station have been supplied with telephones, the territory outlying beyond the radius of the central station territory can only be supplied with telephone service by the extension of other lines from the central station through the already developed territory contiguous to or adjoining the central station. Consequently the expense of supplying telephone service to a territory at a distance from the central station is much greater than to supply the territory adjoining a central telephone station.

By the use of my invention the expense of extending lines through an already developed territory is eliminated, the sub-station line being connected to the main line and the central station operator having communication at all times with the sub-station lines without the necessity of an operator at the main line terminal.

The invention consists generally in various constructions and combinations, all as hereinafter described and particularly pointed out in the claims.

In the accompanying drawings, forming part of this specification, Figure 1 is a diagrammatic view of a telephone system embodying my invention. Fig. 2 is a front view of the switch device at the sub-station. Fig. 3 is a side view of the same. Fig. 4 is a sectional view vertically between the cores of the magnet.

For convenience in manufacturing, I utilize the electromagnets 3 and 3′ of an ordinary polarized telephone bell having the usual windings which I will hereinafter designate as the primary windings, and outer windings 3^a and 3^b of a heavier wire hereinafter referred to as the secondary windings.

4 is a soft iron armature, which I will designate for convenience of description as the primary armature, having a rod 4′ with its end bent at an angle to the main portion

and carrying an insulating post 5 having a slot to receive a contact spring 6. The armature 4 is pivoted at 7 and swings back and forth carrying with it the rod 4′ and moving the contact spring 6 toward springs 8 or 9. A permanent magnet 10 charges the soft iron armature 4 with a polarity of magnetism opposite to itself and thereby causes this armature to be alternately attracted and repelled by magnetism produced in the cores of the electromagnets 3 and 3′ when a current of electricity is passed through them. The armature 4 is dependent for its direction of movement upon the polarity of magnetism in the magnets 3 and 3′ with respect to itself, that is, if the permanent magnet maintains in the armature 4 a positive polarity, a positive polarity in electromagnet 3 would repel the armature 4 and a negative polarity in electromagnet 3′ would attract the armature 4. When the polarity in the electromagnets is reversed, a reverse action will take place in the armature 4 and it will move in the opposite direction. Thus it will be understood the rod 4′ controlling contact spring 6 can be moved in either direction toward springs 8 or 9 by the application of electricity to the electromagnets 3 and 3′.

12 is a second armature, designated for convenience the secondary armature, extending across the two poles of the electromagnets 3 and 3′.

11 are pole pieces connected with the magnets 3 and 3′ to conduct the magnetic flux at an angle with the cores and attract the armature 12. This armature is of steel or hardened iron and adapted to retain any magnetic charge when attracted by the pole pieces 11, as usual with magnets of this kind. The armature 12 is held directly in front of the pole pieces by a support 13 which is pivoted at 14 on a plate 15. Contact springs 16, 17, 18, 19, 20 and 21 are mounted in insulating blocks 22 on the plate 15. The support 13 has arms 23 arranged to contact with insulating blocks 24 on the springs 17 and 20, whereby the said springs will be moved when the support is oscillated. The springs 17 and 20 have contact points 25 and 26 and the tension of the springs normally holds these points in engagement with the springs 18 and 19, and the armature 12 away from the pole pieces 11. When the electromagnets 3 and 3′ are energized they attract the armature 12 and move springs 17 and 20 into engagement with springs 16 and 21 and hold the armature and springs in that position.

27, 28 and 29 in Fig. 1, represent the armatures of an induction coil having four independent windings 30, 31, 32 and 33. A local battery circuit B at the switch device furnishes a current of sufficient strength to attract the steel armature 12.

The local battery in circuit B connected with 3^a and 3^b and contact springs 8, 8 and 9, supplies a current of sufficient strength to attract the steel armature 12 to the pole pieces 11 and thereby gives the said armature an initial charge of magnetism when the battery circuit is closed. The purpose of the attraction of the steel armature to the pole pieces 11 is to bend contact springs 17 and 20 and thereby break contact with springs 18 and 19 and open the circuit between lines R and S and conductors X and Z, and to make contact between springs 17 and 16 and 20 and 21 and close the circuit between lines R and S, and M and L. The steel armature upon being attracted to the pole pieces closes the magnetic field in electromagnets 3 and 3′ and thereby deprives the primary armature 4 of magnetic influence, which through the action of the contact spring 6 is restored to a neutral position with respect to the electromagnets, and opens the circuit through the battery B. The initial charge of magnetism in the steel armature causes it to adhere to the pole pieces and maintain contact between springs 17 and 16 and 20 and 21 after the battery B circuit has been broken. Nor is its electrical equilibrium disturbed. When a disconnection of any connected line is desired, the method used in my device is an extremely simple one, employing as I do a well known principle; that an alternating current of electricity when present in an electromagnet coil will de-magnetize a permanent magnet within its field of magnetic flux.

In my system of operating the said switch device, I use an alternating current of electricity, such as is ordinarily used for the purpose of ringing polarized telephone bells in telephony. By this means, I simplify the operation of my apparatus, as no special devices are necessary at the central station, other than are found in any telephone central station.

The secondary windings, or the outer coils 3^a and 3^b are of a size of wire proportionate to the exciting current used, and in ordinary practice, I find that a coil of about 10 ohms resistance is the best suited for an open circuit battery of about 3 volts.

The primary windings of magnets 3 and 3′ are of resistance of about 200 ohms, suitable for a current of electricity flowing through the main lines M and L and through coils 30 and 31, and through magnets 3 and 3′ to earth at E, or in other words, of about equal resistance with coils 30 and 31.

The high resistance primary windings and low resistance secondary windings 3^a and 3^b upon electromagnets 3 and 3′ are wound in the same direction on the cores of the magnets and do not interfere in their action with the cores or with the steel armature 12 so that when the armature is attracted to the pole pieces 11 as described, its initial charge

of magnetism is not dissipated by a second current passing through the primary or secondary windings and having the same polarity. Thus it will be understood a current of electricity applied to the lines M and L at the central station for the purpose of operating the relay at the sub-station will produce in the magnets 3 and 3′ magnetism of a polarity in the same direction as the magnetism produced by the local battery circuit B, and when an alternating current of slightly weaker influence than the current used for operating the polarized relay is passed through the windings the steel armature will be demagnetized and released from the pole pieces 11.

When a suitable direct current of electricity is applied to the main line at the central station to operate the relay in the desired direction, a current of electricity flows through coils 30 and 31 and unites at D, and thence passes through magnets 3 and 3′ to ground at E. This current of itself would not be sufficient to operate the switch device, that is, to attract the steel armature 12, but as soon as the contact springs 6 and 8 or 9 make contact by the operation of the polarized relay, and thereby close the local battery circuit which includes in it the electromagnet windings 3^a and 3^b, the battery current flowing through these windings in the same direction as in the primary windings of electromagnets 3 and 3′ augments the magnetism in said cores and attracts the steel armature 12 and retains it in that condition as hereinbefore set forth. The secondary or steel armature 12 upon being attracted by the pole pieces 11 closes the magnetic field of force in the electromagnets and thereby deprives the primary armature 4 of magnetic influence. The primary armature is immediately restored to its normal position by the spring 6 and opens the local battery circuit.

As the operating current flowing in the main line and through the primary windings of electromagnets 3 and 3′ is in the same direction upon these cores, it will be understood that it does not interfere with the operation of the switch device to close circuit connected to the contact springs 16, 17, 18, 19, 20 and 21. I have found in practice that the opening of the line connections, last named, may be effected not alone by an alternating current of electricity applied to the main operating line in which the switch device is operated, but may be accomplished by the application of a direct current of electricity to the main operating line in the opposite direction as to its polarity to that of the initial charge or first impulse applied for the purpose of closing the line circuits. But this second impulse, of course, must be of very short duration for two reasons, First, it must be of too short a duration to make the polarized relay operable to close the battery circuits, and secondly, it must be of sufficient duration to repel the steel armature away from the electromagnet cores and no more. However, this latter method of release, while it is possible, I have found is not so simple and effective as the use of the alternating current.

The principles involved in my device may be used in apparatus slightly different from the one I herein describe, and I do not wish to be understood as confining myself to this exact type of instrument, nor to the exact combination of circuits as here shown. In fact, the greatest utility of my invention is in the fact that it is adaptable to greatly varying conditions and to a great number of combinations of line switching.

A central station equipment necessary for controlling the current used for operating my device, is illustrated, having a source of direct current G and a source of alternating current H, and cams J and K or other suitable means for applying the direct and alternating current to the main operating line M and L, proceeding to the sub-station switch device.

When it is desired to connect the main operating line M and L to an independent line R and S, proceeding from the said sub-station and independent of the first said main operating line, plug T is inserted in jack V. A direct current of electricity is applied to the main line conductors with one polarity of the said current and the opposite polarity to ground at H^a by movement of cam K to the left. When this cam is operated in this manner, contact springs 34, 35 and 36 are connected to the main line conductors through conductors 37 and 38, plug T and jack V and the source of direct current G. The main line conductors are thereby made to receive a current of electricity of negative polarity which flows equally over each of the said conductors through contact with spring 34 which is connected to the negative pole of the source of electricity at the central station, the other pole G being grounded at H^a. The current flows over the main lines in the manner described, thence through coils 30 and 31 and through magnets 3 and 3′ to the earth at E. This current energizes electromagnets in the polarized relay in the well-known manner, and closes the local battery circuits by contact springs 6 and 8 or 6 and 9 coming in contact as hereinbefore described; the direction of its movement being dependent upon the polarity of the permanent magnet 10 with respect to the polarity of the electromagnets 3 and 3′, influencing armature 4 in the well known manner.

It will be understood that contact springs 6 and 8 and 9 normally maintain an open local battery circuit and are only closed

when the polarized relay is operated to do so by a current in the main line conductors, as described. When the contact spring 6 comes in contact with contact spring 8 or 9 it closes the local battery circuit B and current flows through the windings 3^a and 3^b, energizing the cores. The steel armature 12 is thereby attracted to the pole pieces 11 on said cores and retained in that condition until acted upon by an alternating current in the primary windings of electromagnets 4 and 3′, applied at the central station in a like manner as the direct current.

The action of the alternating current in the switch device causes the steel armature 12 to be demagnetized and thereby be released from the pole piece 11 whereupon the armature will be withdrawn by the contact springs 17 and 20 and the circuits opened between the main line M and L, lines R and S, contact springs 16 and 21, and closed through conductors X and Z. When the secondary or steel armature is in this position it maintains the connection between the independent line R—S and induction coil winding 32—33 through contact springs 17, 18, 19 and 20, and the central station may signal or call stations on the independent line or lines, thus connected to the main operating line through the said induction coil by operating the cam K to the right. The alternating current of electricity from source H flows through contact springs 41, 39 and 40 through conductors 37 and 38 to line M—L through plug T and jack V, thence through coils 30 and 31 and through the relay, thence to earth at E. This induces electricity in the coils 32 and 33 in the well known manner and causes an alternating current of electricity to flow in conductors X and Z and through contact springs, 17, 18, 19 and 20, to which is connected line R—S or the independent line proceeding from the sub-station.

When my invention is used in a system as herein described, it is necessary in order that the independent line R—S may signal central station, that a means for receiving the signals at the central station be provided. This means consists of the ordinary switchboard drop at the central station, illustrated at Y, which is here shown as connected with one side of the main line M and thence to earth at Y′. It is necessary that the winding of this signal device should be of high, self-inductive resistance so as to not unbalance the electrical equilibrium in the main operating line.

The central station receives the telephone signals from the sub-station line over main line conductor M and the earth for return circuit on line drop Y at the central station. When a station on the sub-station line R—S operates the alternating current generator (not shown) for the purpose of calling the central station, the induction coil windings 32 and 33 included in line R—S, induces a current of electricity in the secondary windings of 30 and 31 of opposite polarity to the sub-station line current when present in windings 32 and 33. The induced current in the secondary windings 30 and 31 flows through main line conductors M and L to the central station. The induced current in the secondary windings 30 and 31 flows through main line conductors M and L to the central station where winding in line drop Y is connected in circuit with the circuit M. The current flows through the said winding in line drop Y to the earth at Y′. From point E at the sub-station the circuit is completed through relay windings 3 and 3′ by conductor Q at point D in the induction coil. The central station operator upon observing the call answers by inserting plug T into spring jack V and by operating cam J to the left places the operator's set 51 in communication with the sub-station line acting as one conductor and the earth at H^b and E as its return circuits in the manner described.

When a station connected with the sub-station R—S desires to communicate with any station connected with main line M—L, it signals the central station in the manner set forth and informs the operator who thereupon calls the desired station upon the main line M—L in the usual and well known manner, that is, by the application of a suitable alternating current of electricity to the main line conductors M—L. When the station called has answered, the central operator proceeds to place the sub-station line R—S and the main line M—L in direct communication by the application of a direct current of electricity to the main line conductors M—L. This is accomplished by operating the cam K toward the left. The source of direct current G at the central station is grounded at H^a, the direct current flows through contact springs 34, 35, and 36 through conductors 37 and 38, plug T and spring jacks V connected with main line conductors M—L. This direct current should be of somewhat higher voltage and amperage than the current used for ringing on the main line, as the relay at the switch device is adjusted to close the local battery circuit upon the application of the direct current, but to remain unaffected by the alternating current used in ringing stations on the main line. The direct current when thus applied to the line M—L operates the relay at the telephone line switch device and closes the local battery circuit through springs 6, 8 and 9 in the manner heretofore described, thereby cutting off the repeating coil at the telephone line switch device when the main line M—L is placed in direct connection or contact with the sub-station line R—S, whereupon a station on line R—S may talk

to a station on main line M—L and when the stations are through with their conversation, the act of ringing off effects the release of the secondary armature from the pole pieces 11, and thereby restores the connections between the repeating coil, the main line M—L and substation line R—S.

When a station on line M—L desires to call the central station it may do so by ringing with the telephone generator (not shown) upon the said line, which ring will be received on line drop 55. The central operator proceeds to answer by the insertion of plug T into either jack V or V^a, and operates the cam J to the right in the manner hereinbefore described, or the call may be answered with any other plug and cord-set in the switch-board wired in the ordinary way, by the insertion of such plug into jack V^a.

I have omitted details not absolutely necessary to the performance of the purpose to which this device is designed; as for instance, the sub-stations or telephones connected with line M—L or stations upon R—S, are not shown, their mode of operation not being different from the ordinary magneto-system of telephony.

I claim as my invention:—

1. The combination, with a central station lines, of a polarized relay having primary and secondary windings, said primary windings being in circuit with said central lines, a normally open local circuit having a suitable source of electrical energy and connected with said secondary windings, means whereby said local circuit will be closed when said relay is energized by the passage of a current through said primary windings, sub-station lines, and means whereby the closing of said local circuit will close the circuit between the said central and sub-station lines and maintain such circuit after said local circuit is opened, substantially as described.

2. The combination, with a central station lines, of a polarized relay having primary and secondary windings, said primary windings being of greater resistance than said secondary windings and in circuit with said central station lines, a normally open local circuit connected with said secondary windings, means whereby said local circuit will be closed when said relay is energized, sub-station lines, means whereby the closing of said local circuit will establish a circuit between said central and sub-station lines, and said means maintaining such circuit after said local circuit is opened and until an alternating current is passed through said primary windings.

3. The combination, with a central station lines, of a polarized relay having primary and secondary windings, said primary windings being in circuit with said central station lines, a normally open local circuit connected with said secondary windings a primary armature arranged to be attracted when a current is passed through said primary windings, means actuated by the movement of said primary armature for closing said local circuit, a secondary armature normally unaffected by the passing of a current through said primary windings but attracted when said current is augmented by the closing of the circuit through said secondary windings, sub-station lines, and means actuated by the movement of said secondary armature for establishing a connection between said central station lines and said sub-station lines, and said secondary armature being adapted to deprive said primary armature of magnetic influence whereby upon the attraction of said secondary armature said primary armature will return to its normal position and said local circuit will be opened without effecting the connection between said main lines and said sub-station lines, substantially as described.

4. The combination, with a central station lines, of a polarized relay having primary and secondary windings, said primary windings being in circuit with said central station lines, a normally open local circuit connected with said secondary windings, a soft iron armature arranged to be attracted when a current is passed through said primary windings and having means, when attracted, for closing said local circuit, a steel armature normally unaffected by the passage of a current through said primary windings but attracted when a current is passed through said secondary windings by the closing of said local circuit, sub-station lines, and means controlled by the movement of said steel armature for establishing a connection between said central station lines and said sub-station lines, and said steel armature being adapted to deprive the said soft iron armature of its magnetic influence and allow it to return to its normal position and open said local circuit, and said steel armature remaining in its attracted position until released by the passage of an alternating current through said primary windings, substantially as described.

5. In a polarized relay having primary and secondary windings, a soft iron armature normally attracted by the passage of a current through said primary windings, a steel armature unaffected normally by the passage of a current through said primary windings, a local circuit connected with said secondary windings and closed by the movement of said soft iron armature, the passage of a current through said secondary windings augmenting the magnetism of said relay sufficiently to attract said steel armature, and said steel armature depriving, when attracted, said soft iron armature of its mag-

netic influence, whereby when said steel armature is attracted, said soft iron armature will be released and will return to its normal position and open said local circuit, substantially as described.

6. In a telephone system, the combination with a central station lines, of a polarized relay having primary and secondary windings, said primary windings being in circuit with said central station lines, a normally open local circuit connected with said secondary windings, an armature arranged to close said local circuit when a current is passed through said primary windings, an induction coil in circuit with said central station lines, sub-station lines, and means for establishing a connection between either of said sub-station lines and either of said main lines when said local circuit is closed, and said connection continuing after the opening of said local circuit by the return of said armature to its normal position, substantially as described.

7. In a telephone system, the combination, with a central station line, of a relay having primary and secondary windings, said primary windings being in circuit with said central station lines, a normally open local circuit having a suitable source of electrical energy and connected with said secondary windings, means whereby said local circuit will be closed when said relay is energized by the passage of a current through said primary windings, sub-station lines, and means whereby the closing of said local circuit will close the circuit between the said central and sub-station lines and maintain such circuit after said local circuit is opened.

8. In a telephone system, the combination, with the central station lines, of sub-station circuits normally disconnected from said central station lines, a normally open local circuit provided at the sub-station, means within control of the operator at the central station for closing said local circuit, and means whereby the closing of said local circuit will close the circuit between the said central station lines and sub-station circuits, substantially as described and said means maintaining said circuit after said local circuit is opened.

9. In a telephone system, the combination, with a central station lines, of sub-station lines, a normally open local circuit provided at the sub-station, means within control of the operator at central station for closing said local circuit, means whereby the closing of said local circuit will close the circuit between the said central and sub-station lines, and said means maintaining such circuit after said local circuit is opened and until an alternating current is passed through said local circuit closing means.

10. In a telephone system, the combination, with a central station line, of a normally open local circuit, a sub-station circuit normally disconnected from said central station line, and having a subscriber's station and means within control of the operator at the central station for closing said local circuit and connecting or disconnecting said central line and said sub-station circuit, to connect a subscriber's station on said sub-station circuit with the central line, without the presence of an operator at the sub-station.

In witness whereof, I have hereunto set my hand this 13th day of February 1907.

JOHN H. SWANSON.

Witnesses:
RICHARD PAUL,
J. B. ERA.

Correction in Letters Patent No. 941,743.

It is hereby certified that in Letters Patent No. 941,743, granted November 30, 1909, upon the application of John H. Swanson, of Baldwin, Wisconsin, for an improvement in "Telephone-Line Selective Switch Devices," an error appears requiring correction, as follows: In the grant and printed head of the specification it is stated that said Swanson assigned one-fourth of his interest in said invention to T. F. Robinson, whereas it should have been stated that said Swanson assigned *one-half to T. F. Robinson*, as shown by the record of assignments in this office; and that the said Letters Patent should be read with this correction therein, that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 28th day of December, A. D., 1909.

[SEAL.]

E. B. MOORE,
Commissioner of Patents.

netic influence, whereby when said steel armature is attracted, said soft iron armature will be released and will return to its normal position and open said local circuit, substantially as described.

6. In a telephone system, the combination with a central station lines, of a polarized relay having primary and secondary windings, said primary windings being in circuit with said central station lines, a normally open local circuit connected with said secondary windings, an armature arranged to close said local circuit when a current is passed through said primary windings, an induction coil in circuit with said central station lines, sub-station lines, and means for establishing a connection between either of said sub-station lines and either of said main lines when said local circuit is closed, and said connection continuing after the opening of said local circuit by the return of said armature to its normal position, substantially as described.

7. In a telephone system, the combination, with a central station line, of a relay having primary and secondary windings, said primary windings being in circuit with said central station lines, a normally open local circuit having a suitable source of electrical energy and connected with said secondary windings, means whereby said local circuit will be closed when said relay is energized by the passage of a current through said primary windings, sub-station lines, and means whereby the closing of said local circuit will close the circuit between the said central and sub-station lines and maintain such circuit after said local circuit is opened.

8. In a telephone system, the combination, with the central station lines, of sub-station circuits normally disconnected from said central station lines, a normally open local circuit provided at the sub-station, means within control of the operator at the central station for closing said local circuit, and means whereby the closing of said local circuit will close the circuit between the said central station lines and sub-station circuits, substantially as described and said means maintaining said circuit after said local circuit is opened.

9. In a telephone system, the combination, with a central station lines, of sub-station lines, a normally open local circuit provided at the sub-station, means within control of the operator at central station for closing said local circuit, means whereby the closing of said local circuit will close the circuit between the said central and sub-station lines, and said means maintaining such circuit after said local circuit is opened and until an alternating current is passed through said local circuit closing means.

10. In a telephone system, the combination, with a central station line, of a normally open local circuit, a sub-station circuit normally disconnected from said central station line, and having a subscriber's station and means within control of the operator at the central station for closing said local circuit and connecting or disconnecting said central line and said sub-station circuit, to connect a subscriber's station on said sub-station circuit with the central line, without the presence of an operator at the sub-station.

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