

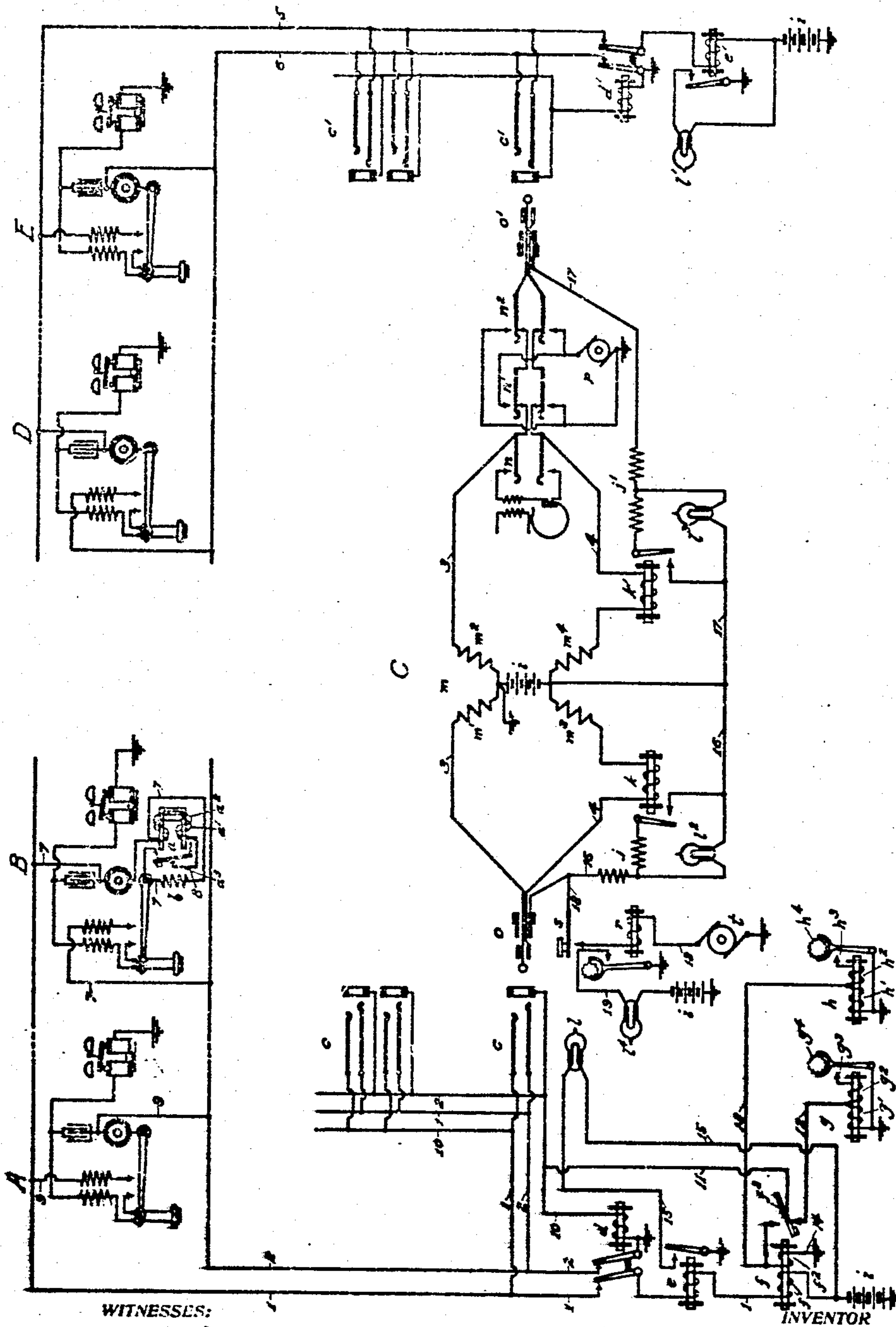
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J. L. McQUARRIE.

MEASURED SERVICE SYSTEM FOR TELEPHONE LINES.

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UNITED STATES PATENT OFFICE.

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MEASURED-SERVICE SYSTEM FOR TELEPHONE-LINES.

No. 869,450.

Specification of Letters Patent.

Patented Oct. 29, 1907.

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To all whom it may concern:

Be it known that I, JAMES L. McQUARRIE, a citizen of the United States, residing at Oak Park, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Measured-Service Systems for Telephone-Lines, of which the following is a specification.

My invention relates to the measurement of telephonic service, and has more particularly to do with the selective registration of telephonic calls originating in any one of a number of subscribers' stations connected with and served by a single telephone line.

Where charges for telephonic service are based upon the number of calls made by a subscriber, and several subscribers' stations are served by the same telephone line, it becomes necessary, in order correctly to apportion the charges among the various subscribers, to provide for ascertaining at which one of the several stations of the line each call originates, so that it may be entered up or charged against that station; and, when the identity of the calling station has been determined, it is desirable to provide suitable registering mechanism associated with the line for enabling the calls of the different stations to be separately recorded and totaled.

In the system of a prior patent, 766,192, issued to me August 2, 1904, these requirements are met by associating a connection register for each station with the line at the central office, and providing means at each station for automatically determining the operation of the register corresponding with that station in the act of initiating a call, the registration being effected by means associated with the cord circuit through the agency of which the call is answered. Such a system has the advantage of insuring against the call being charged to the wrong station through the error of the operator or through the subscriber misinforming her as to his identity, and, it is to a system having these general characteristics and advantageous features that the invention of my present application relates.

In accordance with the embodiment of my invention herein described and illustrated I determine the selection and operative connection with the line of the connection register at the central office corresponding with a particular substation, by means of a current controlling device included in the bridge of the line at one of the substations which includes the telephone and is controlled by the telephone switch hook. The current controlling device which I prefer to employ is a high resistance, or like current reducing means, which, by its inclusion in the telephone bridge, reduces the current flow in the line when the telephone is taken for use to the point where it is insufficient to actuate register selecting mechanism provided at the central office, while sufficient to display the calling signal, the non-

operation of the selecting mechanism leaving the register corresponding with the calling station in operative relation with the line; while the current when the other station calls is adapted to be sufficient to operate the selecting mechanism, as well as the calling signal, and thus serve to disconnect the first register and operatively associate another register with the line.

To prevent the current reducing device included in the telephone bridge at the substation from interfering with efficient telephonic transmission, I prefer to associate with it mechanism which operates, after the device has performed its function, to neutralize it, or remove it from the telephonic circuit.

I will describe my invention more particularly by reference to the accompanying drawing, which is a diagrammatic representation of a telephone line equipped in accordance with my invention extending from two stations to a central office, and there adapted for connection with another telephone line through the medium of a connecting cord circuit.

As illustrated, the telephone line may extend in two limbs 1, 2 from two stations A, B to the central office C where it is connected with the spring jacks or connection terminals c, and has a normally closed extension through the contacts of a cut-off relay d to the poles of a central battery i, the winding of a line relay e and one winding of a selecting relay f being included in the extension of limb 1. One of the poles of the central battery, in the present instance that associated with limb 2 of the line, may be connected with earth or a return conductor, in accordance with the usual practice.

I have shown a number of batteries marked i associated with different parts of the circuit, for convenience of illustration; but it will be understood that these may be, and in practice ordinarily are, one and the same battery.

Associated with the line at the central office are a number of connection registers which may correspond in number with the stations connected with the line. In the present instance two designated g and h are shown, one for station A and one for station B. The representation of the connection registers herein is merely a diagrammatic one, the registers shown being of a type familiar in the art, and comprising an electromagnet adapted to effect the advance of a counting train, indicated at g¹ and h¹, by means of step-by-step mechanism operated by the armature of magnet. In the type shown in the present instance, the magnet of each register is provided with two windings g', g² and h', h², respectively, the windings g' and h' being adapted to effect the primary actuation of the registers, while windings g², h², respectively, are closed in contacts g², h² when the registers are actuated to retain the register mechanism in its operated position.

The circuit by means of which the connection registers g and h are actuated is associated with the connection terminals c of the line, and in the present instance is a branch 11 of conductor 10 which is connected to the test sleeves or thimbles of the jacks and extends to earth through the winding of cut-off relay d . Conductor 11 has two branches 12 and 13 in which the windings g^1 and h^1 , respectively, of the two connection registers g and h are included, the two branches being adapted to be closed alternatively in the switch contacts f^3 of the selecting relay f . Branch 12 including the winding of connection register g is normally completed in the resting switch contacts of relay f , and is therefore in operative relation with the connection terminals of the line. When the armature of relay f is attracted branch 12 is interrupted and branch 13 containing the winding of connection register h is completed instead, a part of the current which may be flowing in conductor 11 being diverted to earth through conductor 14, which includes a winding f^2 of the relay f , thus serving to maintain the relay actuated and the circuit of branch 13 closed so long as current is supplied through conductor 11.

Winding f^2 of selecting relay f , as has been heretofore mentioned, is included together with the winding of line relay e in one limb of the line circuit, so as to be traversed by current flowing in the line. The windings are so proportioned, however, to the parts that they are adapted to energize that a predetermined flow of current will cause both to actuate their associated mechanism, while less than the predetermined flow will cause the operation of the line relay but fail to operate the selecting relay. This result may be effected in any convenient manner, as by varying the turns and resistance of the winding, or by regulating the adjustment of the armatures. I also find it convenient to make the selecting relay f of a type that is rendered sluggish in its response to the energizing current, as by providing an armature of relatively large mass pivoted before the magnet in a peculiar way, as shown. This is to prevent the response of the relay to momentary impulses of current caused by accidental closures of the circuit in the course of making connection.

A line signal, shown in the present instance as a miniature incandescent lamp, l is associated with the answering jack of the line, in accordance with the usual practice, and is included in a conductor 15 extending between the poles of the central battery i and controlled in a normally open contact of line relay e . The connection of the line relay with the line, and consequently the illumination of lamp l , is controlled in contacts of the usual cut-off relay d included in conductor 10 connected with the test sleeves of the connection terminal c .

In order to bring about the actuation of register selecting relay f when a call is established at one of the stations of the line, and not when the call is made from the other station, I provide at one of the stations, in the present instance station B, a peculiar organization of circuits and apparatus which causes a different electrical condition of the line circuit when substation B calls from that when substation A calls.

As has heretofore been stated, the winding and the moving parts of relay f are so adjusted that the circuit is actuated only by current flow of a predetermined value

in the line circuit, any flow less than the predetermined amount not affecting the relay. I therefore, in order to cause relay f automatically to distinguish between the stations calling, provide an organization at substation B which serves to reduce below the predetermined value the current flowing in the line when the telephone at that station is taken for use; while, no such provision being made at substation A, the act of taking the telephone for use at that station creates a condition of normal current flow in the line which is so regulated as to be sufficient to actuate relay f .

The equipment at substation A comprises the usual telephone transmitter, induction coil and condenser arranged in a bridge 9 of the line, together with the usual bell included in a grounded branch to earth or a return conductor from one limb, in the present instance limb 2, of the line. The equipment of substation B includes like parts arranged in like manner in a bridge 7, together with a bell in a branch from limb 1 of the line; and in addition comprises the current reducing apparatus which will be particularly described. This, in the present instance, consists of a relay a having a low resistance winding a^1 and a high resistance winding a^2 , together with a resistance coil b interposed in the bridge 7 of the line with the telephone apparatus heretofore mentioned. The resistance of the winding a^1 may conveniently be 12 ohms (preferably shunted with a non-inductive resistance of 100 ohms,—not shown), the winding a^2 may have a resistance of 1000 ohms, and the resistance of the coil b may be 2500 ohms. The relay has normally separated contact members a^3 which control a conductor 8 adapted to complete a short circuit about the high resistance winding a^2 and the resistance coil b when the relay is energized, the low resistance winding a^1 being allowed to remain in circuit in order to maintain the energization of the relay. As is indicated diagrammatically, the relay a is preferably polarized in order that it may be responsive only to current flowing in a certain direction in the line, so that it may more conveniently be controlled from the central office.

The line with which I have assumed the line extending from substations A B is to be connected, extends from substations D E in two limbs 5 and 6 to connection terminals c^1 and the usual line signal apparatus at the central office. The line signal apparatus is represented in the present instance as comprising a line relay e' controlling a line signal or lamp l' , and controlled in turn by the usual cut-off relay d' . Current for the actuation of the relay and the signal is derived from the central battery i . The telephone lines are adapted to be connected together, in the present instance, by a connecting cord circuit terminating in an answering plug o and a calling plug o' arranged for insertion in the connection terminals of the two lines. The connecting circuit proper extends in two conductors 3 and 4 between the tip and ring contacts, respectively, of the plugs o o' , windings m^1 m^2 and m^3 m^4 of a repeating coil m being preferably included in the conductors 3 and 4, respectively, while between the windings of the repeating coil is a bridge of the circuit including the central battery i .

It will be noted that the line circuit 1 2 and the connecting cord circuit 3 4 are so arranged that the direction of the current flow in the line will be reversed

when connection is made with it by the insertion of a connecting cord plug in any of its jacks; thus, while limb 1 of the line is normally connected with the negative or free pole of the central battery and limb 2 is connected with the positive pole or earthed pole, when plug *o* is inserted in one of the jacks of the line, limb 1 comes into connection with the positive pole, while limb 2 is connected to the negative pole. This is for the purpose of bringing about the actuation of the polarized relay *a* at substation B to short circuit its high resistance winding and the resistance coil *b* when connection is made with the line.

The connecting cord circuit is equipped in the usual manner with a listening key *n* for enabling the operator to bring her telephone apparatus into association with the circuit, and with ringing keys *n*¹ *n*² arranged to apply current from generator *p* to one or the other of the limbs of the line to ring selectively either the station D or station E. The circuit is also provided with supervisory relays *k* *k*¹ connected in the answering half and the calling half, respectively, of the cord circuit, and controlling supervisory signals or lamps *P* *P*¹, respectively, through the medium of resistances *j* *j*¹ included in the signal strands 16 and 17 respectively, of the answering and calling cords.

To enable the operator to actuate the particular connection register which is automatically selected and brought into operative relation with the line by means of the apparatus heretofore described, I provide actuating means associated with the cord circuit, comprising, in the present instance, a suitable source of current *t* adapted when applied thereto to energize the connection registers, and a switch or key *s* for applying current from the source *t* through the medium of conductor 18 to the sleeve or body of answering plug *o* and thence by way of the sleeve or thimble of the jack and its associated conductors to one or the other of the registers.

In accordance with well known practice, I include in conductor 18 an electro-magnetic service meter *r*, common to all the cords in the operator's position, to register the total of all the separate registrations which may be made by the individual registers of the lines terminating on that position; and associate therewith a pilot lamp *P*¹ having its actuating circuit 19 completed to light the lamp upon the operation of the register *r*. The current which flows from the battery *i* to the body of the plug *o* by way of the third strand 16 of the answering cord and thence to conductors 10 and 11 and either 12 or 13 when the answering plug is inserted in one of the jacks *c* while sufficient to bring about the actuation of cut-off relay *d*, and to maintain relay *f* operated when the circuit through its locking winding is once closed, is insufficient of itself to actuate the connection register *g* or *h* to which it is applied. But when current from the source *t* is applied to the system of conductors by the operation of switch or key *s* or when the current is increased to the requisite amount in any other manner, whichever connection register is in connection with conductors 16 10 and 11 is actuated, and, upon being actuated, closes its circuit *g*² or *h*², as the case may be, thus locking itself in its actuated position. At the same time the flow of current from source *t* actuates the common register which, in turn, closes the circuit of and illuminates pilot lamp *P*¹, thus indicating to the operator that the registration has been made.

The operation of the system of my invention is as follows: Assume that the subscriber at station A wishes to be put in communication with the subscriber at station D. He first takes his telephone from its hook, which completes the circuit of the line through bridge 9 to permit current to flow from the central battery by way of the winding of the line relay *r* and the winding *f*¹ of the selecting relay *f*. This actuates the line relay to close the circuit and effect the illumination of line lamp *L*, and the resistance interposed by the transmitter and induction coil to the flow of current through the bridge 9 at the substation being slight, sufficient current flows over the circuit of the line to cause the actuation of relay *f*. When the relay *f* attracts its armature normally closed branch 12 through the winding of connection register *g* is interrupted, and branch 13 through connection register *h* is closed in its stead, while at the same time branch 14 containing the locking winding *f*² of relay *f* is brought into operative connection with the test sleeves of the jacks *c*. The operator, upon observing the illumination of lamp *L*, inserts the answering plug *o* of the pair of cords into the associated jack, thus extending conductors 1 2 of the line to conductors 3 4 of the cord circuit, and at the same time causing current from the central battery *i* to flow by way of conductor 16 of the cord circuit to the test sleeve of the jack in which the plug is inserted, and thence by way of the conductors 10, 11, 13, and 11 to the cut-off relay *d*, the locking winding *f*² of the selecting relay *f* and the winding *h*¹ of the connection register *h*. The cut-off relay is thereupon actuated to disconnect the normal extension of the line through the line relay and selecting relay to the central battery, while the locking winding *f*² of the selecting relay *f* is energized to keep the armature of that relay from falling back, now that the flow of current through winding *f*¹ has been interrupted. A portion of the current flows through winding *h*¹ of connection register *h* but, as has been heretofore stated, this is insufficient to cause the register to operate. When the operator, by means of her listening key *n* has learned that the subscriber wishes connection with substation D she depresses ringing key *n*¹, which applies ringing currents to limb 5 of the line to ring the bell at that substation. If the subscriber does not respond no charge ordinarily is made. If he does respond, however, and communication with the calling subscriber is had, the operator registers a charge against the calling subscriber by depressing switch or key *s* associated with the connecting cords. The depression of this key completes the circuit extending from the source of current *t* to the connection register *h*, corresponding with substation A, by way of conductor 18, the body of the answering plug and the sleeve of the jack in which it is inserted, conductors 10 and 11, the alternative contact of selecting relay *f* and conductor 13, the current also passing through the winding of the operator's register *r*. The current which is thus caused to flow is such as to actuate connection register *h*, the register being maintained in its operated position during the rest of the time that the plug remains in the jack by the action of locking winding *h*². The current flow that actuates register *h* also causes the operation of the operator's register *r*, which, in operating, brings about the illumination of lamp *P*¹, and thus indicates to the operator that the call has been recorded. Supervision of the connection

tion is had in the usual manner through the medium of supervisory lamps L^2 and L^3 , and when the connection is taken down all the apparatus is restored to its normal condition.

- 5 When the call is from substation B, the subscriber in taking his telephone from its hook completes the bridge 7 of the line, which, however, in this case, includes in addition to the transmitter and induction coil, the windings of relay a and the resistance coil b , the resistance thus interposed to the passage of current from the battery reducing it to less than the amount required for the actuation of selecting relay f . The result is that while line relay e , which is more sensitive, is actuated to cause the display of line signal l , relay f is not operated to switch its locking winding f^2 , and the register h into connection with the spring jacks of the line. Instead the normal connection of register g with the test sleeves of the jacks is uninterrupted, so that when the operator responds to the line signal by inserting the answering plug of the pair of cords into the answering jack of the line, selecting relay f is disconnected, and register g left in position to be operated by an application of actuating current from generator t to the sleeve of the jack, in the manner described in connection with the call originating in substation A.

- 25 The office of the high resistance included in bridge 7 at substation B ends with the prevention of the operation of selecting relay f , and after connection is made with the line it is desirable that resistance be removed or neutralized in order to prevent it from interfering with the proper transmission of telephonic currents, and the proper supply of current for the operation of the substation transmitter. This is effected in the present instance, as has hereinbefore been described, by employing the polarized relay a adapted to respond only to current flowing in one direction, and organizing the circuits at the central office to cause a reversal in the direction of current flow when connection is made with the line. The consequence is that when the operator, in responding to the line signal l , inserts the answering plug o into jack c , relay a is actuated, and, in closing its contacts, completes conductor 8, which short circuits high resistance winding a^2 and resistance coil b , only low resistance winding a^1 remaining in circuit to maintain the energization of the relay. The same action takes place whether it be an answering plug or a calling plug that is inserted into a jack of the line, and consequently the high resistance at substation b is operative only when it is required in initiating a call to control the actuation of selecting relay f , and is thereafter removed from the circuit.

- Although particularly useful in connection with two conductor or metallic circuit telephone lines, wherein it enables the earth or return connection at the substation for the operation of the register selecting mechanism to be dispensed with, my invention is also applicable to single conductor or so called "grounded" lines, and, in fact, provides a particularly convenient method of securing automatic selective registration in connection with such lines.

- It is also obvious that my invention may be practiced and its advantageous features realized in embodiments employing other than the specific mechanism provided in the present instance for reducing or controlling the current flow in the metallic circuit of

the line and for selectively responding to the same to govern the association of the registers with the line; and it therefore is not to be considered as being limited to the particular arrangement disclosed.

I claim:

1. The combination with a telephone line extending in two limbs from a plurality of substations to a central office, of means thereat for making connection with said line, a connection register associated with said line at the central office, electrically actuated mechanism for bringing said register into operative relation with the line, an actuating circuit for said mechanism adapted to be completed at said substations in the act of taking the telephone for use, and controlling means in a non-grounded bridge between the limbs of the line at one of said substations adapted to prevent the operation of said mechanism when the telephone is taken for use at said substation. 70
2. The combination with a telephone line extending in two limbs from two substations to a central office, of a bridge of the line at each substation and a telephone switch for controlling the same, a connection register associated with the line at the central office, electrically actuated mechanism for bringing said register into operative relation with the line, said mechanism being controlled in said substation telephone switches, and means included in the bridge of the line at one of said substations adapted to prevent the actuation of said mechanism when the switch at said substation is closed. 85
3. The combination with a telephone line extending in two limbs from two substations to a central office, of a non-grounded bridge at each substation closed in the use of the telephone thereat, a connection register associated with the line at the central office, and normally in operative relation therewith, an electrically actuated mechanism adapted to render said register inoperative, an actuating circuit for said mechanism closed in said bridges of the line at the substations, and means included in the bridge at one of said substations adapted to prevent the actuation of said mechanism when the bridge at said substation is closed. 95
4. The combination with a telephone line extending from two substations to a connection terminal at a central office, of a bridge of the line at each substation containing the telephone apparatus and controlled by the telephone switch, means for making connection with the line at the central office connection terminal, a connection register associated with the line at the central office, means for operating the connection register associated with the aforesaid connecting means, electrically actuated mechanism adapted to render said connection register responsive or irresponsive to the aforesaid operating means depending upon the actuated or non-actuated condition of said mechanism, an actuating circuit for said mechanism adapted to be completed in the aforesaid bridges of the line at the substations, and a device interposed in the bridge of the line at one of said substations adapted to prevent the actuation of said mechanism when said bridge is closed. 110
5. The combination with a telephone line extending from a plurality of substations to a connection terminal at a central office, a bridge of the line including the telephone apparatus and controlled in the telephone switch at each of said substations, means for making connection with the line at the central office terminal, a connection register normally operatively associated with the connection terminal of the line at the central office, means for actuating said register associated with said connecting means, electrically actuated mechanism adapted to render said connection register inoperative, said mechanism being adapted to respond only to a predetermined current flow therethrough, an actuating circuit for said mechanism adapted to be completed in the aforesaid bridges of the line at the substations thereof, a high resistance interposed in the bridge at one of the substations adapted to reduce the current flow below the predetermined amount to prevent the actuation of said mechanism and thereby maintain the connection register in an operative condition, a relay at said substation adapted to short-circuit said 125

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resistance, and means made operative in completing connection with the line at the central office terminal thereof for actuating said relay.

6. The combination with a telephone line extending from a plurality of substations to a connection terminal at a central office, of means for making connection with the line at the terminal thereof, a bridge of the line at each substation completed in taking the telephone for use, electrically actuated connection register mechanism associated with the line at the central office, said mechanism being adapted to respond selectively in accordance with the quantity of current flow in the line, a device interposed in the bridge of the line at one of said substations adapted to alter the current flow in the line to control the operation of said selective mechanism, an electrically actuated switch at said substation adapted to neutralize the aforesaid interposed device, and means made operative in completing connection with the line at the central office adapted to effect the actuation of said neutralizing switch.

7. The combination with a telephone line extending from a plurality of substations to a connection terminal at a central office, of means for making connection with the line at said terminal, a bridge of the line at each substation including the telephone apparatus and controlled in the telephone switch, electrically operated connection register mechanism associated with the line at the central office, said mechanism being adapted for selective actuation the selective response of said mechanism depending upon the quantity of current flowing in the line, a resistance interposed in the bridge of the line at one of said substations adapted to alter the current flow in the line when the bridge is closed to control said selective mechanism, a relay adapted when actuated to neutralize said resistance, and means made operative in the act of completing connection with the line at the central office adapted to actuate said relay.

8. The combination with a telephone line extending from a plurality of substations to a central office, of means for making connection with the line at the central office, connection registers associated with the line at the central office, one for each of said substations, electrically actuated mechanism adapted to select and operatively associate with the line one or another of said connection registers, a device at one of said substations adapted to control the actuation of said selecting mechanism, neutralizing means for said device, an electrically actuated switch adapted to disconnect the aforesaid selecting mechanism from the line, and means made operative in the act of making connection with the line for actuating said neutralizing means and said electrically actuated switch, whereby the aforesaid device at the substation is rendered inert and said selecting mechanism is disconnected from the line.

9. The combination with a telephone line extending from a plurality of substations to a connection terminal at a central office, of means for making connection with the line at said terminal, a bridge at each of said substations including the telephone apparatus and controlled by the telephone switch, a device included in the bridge at one of the substations adapted to modify the current flowing in the line, electrically actuated mechanism connected with the line at the central office selectively responsive to the quantity of current flow in the line, a plurality of connection registers at the central office, one for each of said substations, adapted to be selected and operatively associated with the line by said selecting mechanism, and means made operative in the act of making connection adapted to neutralize said modifying device in the substation bridge.

10. The combination with a telephone line extending from a plurality of substations to a central office, of a bridge of the line at each of said substations including the telephone apparatus and controlled in the telephone switch, a resistance interposed in said bridge, a polarized relay having a winding interposed in said bridge, a short circuit of said resistance adapted to be closed in contacts of said relay when the relay is actuated, a connection register associated with the line at the central office, electrically actuated mechanism selectively responsive to the quantity of current flow in the line, said mechanism being

adapted to control the operative relation of said register with the line, means for making connection with the line at the central office, and means made operative in the act of making connection adapted to bring about a reversal of current flow in the line to actuate said polarized relay at the substation.

11. The combination with a telephone line extending to a connection terminal at a central office, of two connection registers associated with the line at the central office, mechanism adapted to operatively connect said connection registers with the line alternatively, an electro-magnet connected together with a source of current in the circuit of the line, and being responsive only to a predetermined flow of current in the line, line signal apparatus connected with the line and adapted to respond to less current flow therein than that to which said register controlling mechanism is adapted to respond, and means associated with said telephone line adapted to determine the flow of current therein to operate both said register controlling magnet and said line signal apparatus, or said line signal apparatus alone, whereby the operative relation of said connection registers with the line is controlled.

12. The combination with a telephone line extending from a plurality of substations to a central office, of two connection registers and a line signal associated with the line at the central office, electrically actuated mechanism adapted alternatively to operatively associate said connection registers with the line, electrically actuated mechanism adapted to effect the operation of said line signal, an actuating circuit for said connection register controlling and signal operating mechanism adapted to be completed in the use of the telephone at any one said substations, said signal operating mechanism being responsive to a smaller flow of current in the line than that to which said register controlling mechanism is responsive, and means at one of said substations for reducing the current flow in the line to a quantity sufficient to operate said signal controlling mechanism without operating said register controlling mechanism.

13. The combination with a telephone line extending to a connection terminal at a central office, of two connection registers and a line signal associated with the line at the central office, electrically actuated mechanism adapted alternatively to bring said connection registers into operative relation with said connection terminal, means for actuating said registers made operative in completing connection with the line at the terminal thereof, electrically actuated mechanism for operating said line signal, said signal actuating mechanism and the aforesaid register controlling mechanism being connected with the line and adapted to respond to current flow therein, said signal actuating mechanism being adapted to respond to a smaller current flow in the line than that to which the register controlling mechanism is adapted to respond, means connected with the line for determining a current flow therein sufficient to operate both mechanisms, and other means associated with the line for determining a current flow sufficient to operate the signal controlling mechanism but insufficient to operate the register controlling mechanism.

14. The combination with a telephone line extending from two substations to a central office, of a connection register and a line signal associated with the line at the central office, mechanism adapted to control the operative relation of said connection register with the line, electrically actuated mechanism adapted to control the operation of said line signal, said register controlling and said signal controlling mechanisms having their circuits connected with the line and being adapted to respond to current flow therein, said signal controlling mechanism being arranged to respond to a smaller current than that to which the register controlling mechanism is arranged to respond, means associated with the line adapted to determine a current flow sufficient to actuate both mechanisms, and other means associated with the line adapted to determine a current flow sufficient to operate the signal controlling mechanism but insufficient to operate the register controlling mechanism.

15. The combination with a telephone line extending in two limbs from two substations to a connection terminal at a central office, of two connection registers, one for each

of said substations, electrically actuated mechanism for operatively associating either of said registers with said terminal, and means in a non-grounded bridge of said line at one of the substations for controlling the operation of said mechanism to place in operative relation with the line the particular register associated with said substation.

16. The combination with a telephone line extending from two substations to a connection terminal at a central office, of two connection registers at the central office, one for each of said substations, one of said connection registers being normally in operative relation with said connection terminal, electrically actuated mechanism adapted to render said last mentioned register inoperative and bring the other register into operative relation with said terminal, and controlling means in a non-grounded bridge of the line at one of said substations adapted to control the operation of said electrically actuated mechanism.

17. The combination with a telephone line extending in two limbs from two substations to a central office, of means for establishing connection with the line at the central office, two connection registers at the central office, one for each of said substations, one of said connection registers being normally operatively associated with the line, electrically actuated mechanism for rendering inoperative said connection register and operatively associating the other register with the line, and controlling means in a non-grounded bridge between the two limbs of the line at one of said substations for determining the operation of said electrically actuated mechanism, to select and operatively associate with the line the particular register corresponding to said substation.

18. The combination with a telephone line extending in two limbs from a plurality of substations to a central office, of means thereat for making connection with said line, a connection register associated with said line at the central office, electrically actuated mechanism for controlling the operative relation of said register with the line, and means in a non-grounded bridge between the limbs of the line at one of said substations adapted to control the operation of said electrically actuated mechanism.

19. The combination with a telephone line extending in two limbs from a plurality of substations to a central office, of means thereat for making connection with said line, a connection register associated with said line at the central office, electrically actuated mechanism for bringing said register into operative relation with the line, controlling means in a non-grounded bridge between the limbs of the line at one of said substations adapted to determine the operation of said electrically actuated mechanism, and actuating means for said connection register operatively associated therewith in making connection with the line.

20. The combination with a telephone line extending from two substations to a central office, of means thereat for completing connection with said line, a connection reg-

ister at the central office, a relay adapted to be operated upon a predetermined flow of current therethrough to operatively associate said connection register with the line, the winding of said relay being included with a source of current in the circuit of said line, means at one of said substations made operative upon taking the telephone for use for producing in the circuit the predetermined current for actuating said relay and operatively connecting said connection register with the line, and means at the other station made operative in taking the telephone for use adapted to prevent the predetermined current flow through said relay.

21. The combination with a telephone line extending from two substations to a central office, of means thereat for making connection with said line, a connection register at the central office normally operatively associated with said line, a relay having switch contacts adapted upon the actuation of said relay to destroy the operative relation of said register with the line, the winding of said relay being included with a source of current in the circuit of the line, said relay being adapted to require a predetermined current flow for its actuation, means made operative upon taking the telephone for use at one of said substations for producing in the line the predetermined current flow for said relay, and means made operative in taking the telephone for use at the other substation for limiting the current flow in the line to a quantity less than sufficient for operation of said relay.

22. The combination with a telephone line extending from a plurality of substations to a connection terminal at a central office, of means thereat for making connection with said line, a connection register associated with said line at the central office, a relay having switch contacts adapted to bring said connection register into operative relation with the connection terminal of said line, said relay being included, together with a source of current in the circuit of said line and being adapted to require a predetermined current flow for its operation, bridges of the line at said substations controlled in the telephone switches thereat, a device included in the bridge at one of said substations for reducing the current flow below the predetermined amount so that the aforesaid relay will not be operated when the telephone at that station is taken for use, the current flow through the bridge at the other substation being adapted to be sufficient to actuate said relay, and electrically actuated mechanism at the first mentioned substation responsive to the aforesaid connecting means at the central office, and adapted to render inoperative said current reducing device.

JAMES L. McQUARRIE.

Witnesses:

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