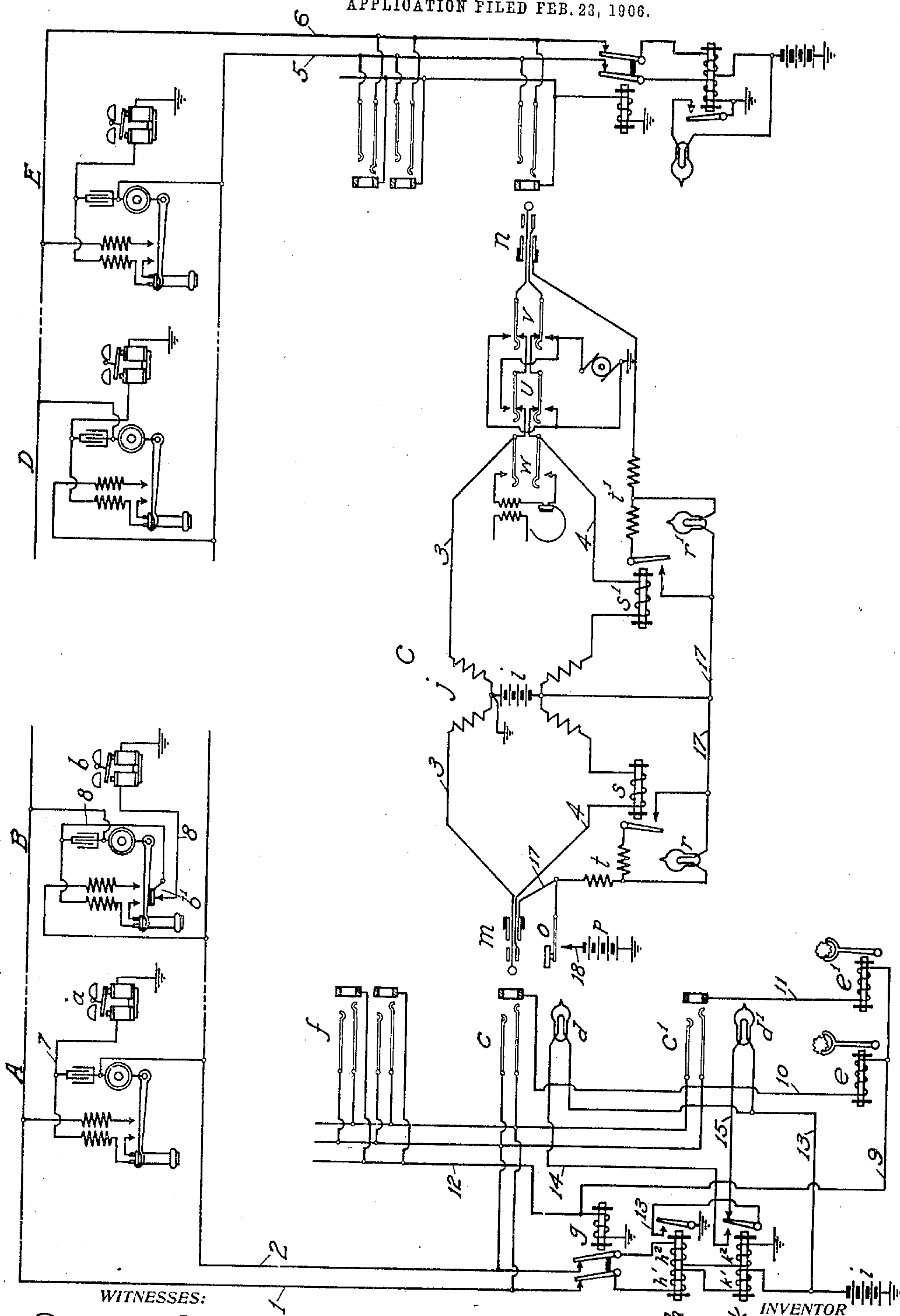


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J. L. McQUARRIE.  
MEASURED SERVICE SYSTEM FOR TELEPHONE LINES.

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WITNESSES:

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# UNITED STATES PATENT OFFICE.

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## MEASURED-SERVICE SYSTEM FOR TELEPHONE-LINES.

No. 869,449.

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 its object is to provide a system wherein messages transmitted over a single telephone line may be registered selectively, the object being more particularly to provide for the separate registration of messages originating with different subscribers, stations connected with the same line, in order that the charges for the telephone service may be properly apportioned among the different subscribers. To this end I associate with each line suitable mechanism for registering the conversations or calls passing over the line, the mechanism being adapted to be selectively actuated to make a separate record of the messages in each of the classes into which the conversations or calls may be divided. Where the messages to be separately recorded are those which originate in a number of subscribers' stations connected with the same line, I provide the line at the central office with a signaling device, or devices, capable of giving distinctive signals each corresponding with the particular station originating the call, and with connecting means so adapted to the rest of the organization that in making connection with the line in response to a particular signal the registering mechanism is adapted for its selective actuation corresponding with the station to which the particular signal relates.

In the preferred form of my invention instead of extending the line to a single connection terminal at the central office, and providing switch mechanism selectively controlled from the various substations for placing a particular connection register in operative relation with the connection terminal when a certain substation calls, I provide a number of connection terminals, which may correspond to the number of subscribers' stations associated with the line, and a selectively controlled signal for each terminal, together with a connection register corresponding with the substation whose call the associated signal is adapted to indicate; so that a particular connection register is automatically brought into operative relation with the means for operating it in the act of responding to the signal of the station to which the register corresponds.

I will describe my invention more particularly by reference to the accompanying drawing, which represents a telephone line extending from two substations to a central office, and there adapted for connection

through a connecting cord circuit with another telephone line, the system being organized and equipped for the selective registration of calls originating in the two stations, in accordance with my invention.

The telephone line extends in two limbs 1 and 2 from the substations A and B to the central office, where it is connected with the appropriate switch springs of two answering jacks *c* and *c'*, and the usual multiple jacks *f*, which constitute the connection terminals by means of which connection is made with the line. The conductors 1 2 of the line extend through the normally closed contacts of a cut-off relay *g*, the windings *h'* and *h''* of a line relay *h*, and the windings *k'* and *k''* of a differentially wound signal-controlling relay *k* to the poles of a central battery *i*. One pole of the battery *i* may, in accordance with the usual practice, be connected with earth or a return conductor; and although for convenience in illustration several batteries marked *i* are shown, it will be understood that they may be one and the same battery.

Each of the answering jacks *c c'* has associated with it a signal *d d'*, respectively, the jacks with their associated signals being, if desired, mounted on widely separated portions of the switchboard. The signals may be of any desired character, the commonly used lamp signals being shown in the present instance. Electrically associated with the answering jacks and signals are the connection registers or service meters *e e'*, register *e* being associated with jack *c* and signal *d*, while register *e'* is associated with the jack *c'* and lamp *d'*. The service meters are preferably located at some point distant from the switchboard, although each is electrically connected with and thus identified with its associated jack, or connection terminal, and signal.

Each signal corresponds with a particular substation of the party line, and is adapted to be selectively operated in the use of a telephone at the corresponding station through the medium of the relays *h* and *k* and the circuits which they control. The signals are connected in parallel branches 14 15 of an actuating circuit 13 extending between the poles of the central battery *i*. The undivided portion of this circuit is normally open in switch contacts of the line relay *h*, the two windings of which are connected one in each limb 1 2 of the line in such a manner that their effects upon the closure of the line circuit reinforce each other. The parallel branches 14 15 of the lamp actuating circuit are controlled in switch contacts of the differential relay *k*, whose two windings are connected one in each limb 1 2 of the line circuit in such a manner that their effects oppose and neutralize each other when the currents flowing in both windings are equal. The switch members of the relay *k* comprise an arm adapted to move between two con-



tacts, and arranged to complete the circuit through one of said signals in one of its positions and the circuit through the other signal in its alternative position. In the present instance the circuit through the signal  $d'$  is closed, subject to the control of line relay  $h$ , in the normal or retracted position of the switch.

As indicated in the foregoing, one or the other of the signals  $d$   $d'$  will be operated whenever the line relay is actuated, which one depending upon whether the differential relay is in the retracted position which it occupies when the current flow in its windings is equal, or whether it is in the attracted position it assumes when the current flow in its windings is unequal. To determine the operation or non-operation of the differential relay, I make use of an organization of apparatus and circuits at the substations which brings about a substantially equal flow of current in the two limbs of the line when a call is made from one of the stations, and an unequal flow when a call is made from the other station. As shown in the present instance, I organize the circuits and apparatus at one substation so that the metallic line circuit is connected to earth or a return conductor through the medium of the telephone bell at that substation when the telephone is taken for use, while at the other substation no such branch connection is completed in the use of the telephone. Both substations have the usual equipment of apparatus, comprising in each case a telephone transmitter, a receiver, a switch hook upon which the receiver normally rests, a telephone bell, an induction coil and a condenser. The telephone bells  $a$  and  $b$  at the substations A and B are included in conductors 7 and 8, respectively, which extend to earth or a return conductor from a point in the local circuit of each substation which is permanently connected with one of the limbs,—limb 2 at station A, and limb 1 at station B—of said telephone line through the substation condenser, the condenser serving normally to prevent the flow of direct current through the bell, while permitting the passage of alternating ringing current flowing out over one or the other limb. The point in the local circuit to which each substation bell is directly connected, while normally disconnected from the line with respect to direct currents, is placed in continuous connection with both limbs of the line by the closure of the switch contacts of the hook when the telephone at the associated station is taken for use. At one of the stations, however, I provide additional switch hook contacts which open the connection through the telephone bell to earth when the telephone is lifted. Such contacts are, in the present instance, provided at substation B and are designated  $b'$ . The result of this arrangement is that when the telephone is removed from the hook at substation B, the limbs of the line are connected together through the substation apparatus in a metallic circuit free from earth connection, while when the telephone is taken for use at substation A, that portion of the local circuit from which the bell  $a$  is connected to earth by way of conductor 7 is brought into direct connection with both limbs of the metallic circuit in the closure of the switch hook contacts, and a portion of the current flowing out over limb 1 of the metallic circuit is diverted to earth, and does not return over limb 2, thus unbalancing the flow in the two windings of the differential relay  $k$ .

As hereinbefore indicated, the connection registers

$e$   $e'$  are associated one with each of the answering jacks  $c$   $c'$ , the particular jack used in responding to a call being determined by the particular signal operated, under the control of differential relay  $k$ , in initiating the call. The association of the registers with their corresponding jacks is effected through the medium of conductors 10 and 11 which extend from the sleeves of answering jacks  $c$  and  $c'$ , respectively, through the windings of registers  $e$  and  $e'$ , respectively, to conductor 9, which is connected with one pole,—preferably the earthed pole—of the central battery  $i$  through the winding of cut-off relay  $g$ , whose contacts control the continuity of line conductors 1 2. The sleeves of the multiple jacks  $f$  are connected directly with the winding of cut-off relay  $g$  by conductor 12.

For completing connection between the telephone line equipped with the connection registers and any other line in exchange, I provide a well known form of connecting cord circuit which comprises in the present instance an answering plug  $m$  and a calling plug  $n$  connected by way of conductors 3 and 4, each conductor preferably including two of the windings of a repeating coil  $j$ , with the central battery  $i$  connected in a bridge of the conductors between the windings of the repeating coil. The connecting circuit also includes the usual ringing keys  $u$  and  $v$  for applying suitable ringing current to the called line to signal the substations thereof, and a listening key  $w$  by means of which the operator is enabled to place her telephonic apparatus in communication with the connecting circuit.

Associated with the telephonic connecting strands of the cord circuit is a third conductor 17, which extends from the free pole of the central battery to the sleeves or bodies of the connecting plugs which are adapted to engage the sleeves of the jacks in which the plugs are inserted. This conductor 17 includes supervisory signals  $r$  and  $r'$  associated with the answering and calling plugs, and under the control, respectively, of answering supervisory relay  $s$  and calling supervisory relay  $s'$  included in conductor 4 of the connecting cord circuit; it also includes resistances  $t$   $t'$ , which cooperate with the supervisory relays in the control of the supervisory signals. In connection with the connecting cord circuit I provide means for effecting the actuation of the connection register associated with the jack or connection terminal of the line with which connection is made. This, in the present instance, comprises a battery  $p$  or other suitable source of current, which may be the central battery, and a key or switch  $o$  by means of which current from this source is applied to the answering plug of the cord circuit. One pole of the battery  $p$  is preferably connected to earth or a return conductor, while the other pole is connected by way of conductor 18 with the switch or key  $o$  from which the circuit extends by way of conductor 17 to the sleeve of the answering plug, and thence over conductor 10 or 11, depending upon the particular answering jack with which connection is made, through the winding of the associated register, and to earth or the return conductor by way of conductor 9 and the winding of cut-off relay  $g$ .

The line extending to stations D and E, with which, for the sake of illustration, it is assumed that the line extending to stations A and B is to be connected, requires no particular description, as the apparatus with



which it is equipped and its circuit organization are well known in the art. It is sufficient to state that it extends in two limbs 5 and 6 from substations D and E, equipped with the usual telephonic communication and signaling apparatus, to the connection terminals or jacks on the central office switchboard, and to the central battery *i* through the contacts of a cut-off relay and the windings of a line relay, the usual line signal device and signal controlling circuits being provided.

10 In the operation of my system, the subscriber at either substation, in removing his telephone from its hook to initiate a call, completes the metallic circuit of limbs 1 2 of the line in the contacts of the telephone switch, thus permitting current from the central bat-  
 15 tery *i* to flow in the circuit and energize line relay *h*. If it is the telephone at substation B that has been taken for use, the current from the central battery will flow out over limb 1 and back over limb 2 in equal quantities, the path to earth by the way of conductor  
 20 8 being interrupted; and therefore, while actuating line relay *h*, the current will produce effects in the windings of differential relay *k* which will neutralize each other, and that relay will not be operated. If, however, it is at substation A that the telephone is taken  
 25 for use, a circuit is closed from the metallic circuit to earth by way of conductor 7 and telephone bell *a*, with the result that the current which passes out over conductor 1 is divided between this path and the re-  
 30 turn path by way of conductor 2, and does not flow equally over the two limbs of the line. Thus, in addition to actuating the line relay *h*, the current, by producing unequal effects in the windings of differen-  
 35 tial relay *k*, actuates the latter relay also. When the line relay *h* alone is actuated by the use of the tele- phone at station B, the signal circuit is completed by  
 40 way of the normal resting contact of the differential relay *k* to illuminate line lamp *d'*, while when both re- lays are actuated by the use of the telephone at station  
 45 A, the signal circuit is completed by way of the alter- native contact of the differential relay to illuminate the line lamp *d*. Upon observing the illumination of  
 50 either lamp the operator inserts the answering plug *m* of a pair of connecting cords into the associated jack, and, upon learning with what station connection is de-  
 55 sired, inserts the calling plug *n* of the pair into the cor- responding jack, and applies ringing current to signal the station. In the insertion of the answering plug  
 60 into the jack associated with the signal which has been displayed the cut-off relay *g* is actuated to sever the extension of line 1 2 through the line relay *h* and differ-  
 65 ential relay *k*, and battery *p* and switch or key *o* are operatively associated with the circuit of the register corresponding with the signal displayed, and, there-  
 fore, with the particular substation calling. If it is substation A that is calling, signal *d* is illuminated, connection is made with answering jack *c*, and connec-  
 tion register *e* is placed under the control of the oper-  
 ator's register-operating key *o*. If on the other hand it is station B that calls, line lamp *d'* is illuminated,  
 the answering plug is inserted in answering jack *c'* and connection register *e'* is brought under the control of the registering key *o*. When, therefore, during the course of the connection it is desired to operate the register and thus charge the service against the station  
 calling, it is merely necessary for the operator to de-

press key *o*, upon which current flows through the reg-  
 ister associated with the line whose calling signal has been answered, and the charge is made.

For the sake of clearness I have illustrated the two windings of the differential relay *k* as if they were on  
 70 opposite ends of the magnet, but it will be understood that, in accordance with the usual practice, they may be superposed, or "twin wound", to insure more per-  
 75 fect neutralization of their effects.

I claim:

1. The combination with a telephone line extending from a plurality of substations to a plurality of connection terminals at a central office, of signal mechanism at the central office adapted to give a plurality of signal indica-  
 80 tions corresponding with said substations, means at each of said substations adapted to control the operation of said signal mechanism to produce the signal corresponding with said station, a connection register operatively associated with one of said terminals, and means for actuating said connection register brought into operative relation there-  
 85 with in making connection with the line at the associated terminal.

2. The combination with a telephone line extending from two substations to two connection terminals at a central office, of signal mechanism at the central office adapted to produce two signal indications, each corre-  
 90 sponding with a particular substation, means at each of said substations adapted to control the operation of said signal mechanism to produce the particular signal indica-  
 95 tion corresponding with said substation, two connection registers associated one with each of said connection ter-  
 minals, and means for actuating said connection registers brought into operative relation with one or the other of said registers in making connection with the line at one or  
 100 the other of said terminals.

3. The combination with a telephone line extending from two substations to two connection terminals at a central office, of signal mechanism at the central office adapted to give two signal indications, each correspond-  
 105 ing with a particular substation, means at each of said substations adapted to control the operation of said signal mechanism to produce the particular indication corre-  
 110 sponding with said substation, two registering devices at the central office, one for each of said substations, electro-  
 magnetic mechanism operatively connected with said connection terminals for selectively actuating said regis-  
 115 tering devices, and means for actuating said electro-mag-  
 netic mechanism to operate one or the other of said regis-  
 tering devices made operative in completing connection with the line at the corresponding connection terminal.

4. The combination with a telephone line extending from a plurality of substations to a central office, of signal mechanism at the central office adapted to give a plurality of signal indications corresponding with the substations of the line, means at each of said substations adapted to control the operation of said signal mechanism to give the particular indication corresponding with said substation, a plurality of connection devices for completing connection with the line, said connection devices corresponding with the substations of the line, registering devices at the central office corresponding with said substations, electro-  
 120 magnetic mechanism for selectively actuating said regis-  
 125 tering devices, and means for actuating said electro-mag-  
 netic mechanism to operate a particular registering device made operative in completing connection with the line through the medium of the corresponding connection de-  
 130 vice.

5. The combination with a telephone line extending from a plurality of substations to a plurality of connection terminals at a central office, means at the central office for establishing connection with the line at said connection terminals, a connection register operatively associated with one of said terminals, signals associated one with each of said terminals and corresponding with the substations of the line, means selectively controlled from each of said substations for operating the particular signal cor-  
 135 responding to said station, and means made operative in  
 140



establishing connection with the line at the aforesaid terminal for actuating said associated connection register.

6. The combination with a telephone line extending from a plurality of substations to a plurality of connection terminals at a central office, of a signal associated with each of said connection terminals, electrically actuated switch mechanism for effecting the actuation of said signals, means made operative in taking the telephone for use at each of said substations for causing the selective actuation of said switch mechanism to operate a particular one of said signals, a connection register associated with one of said connection terminals, and actuating means for said connection register brought into operative relation therewith in establishing connection with the line at the terminal associated with said register.

7. The combination with a telephone line extending from a plurality of substations to a plurality of connection terminals at a central office, of a signal associated with each of said connection terminals, electrically actuated mechanism for effecting the selective operation of said signals, means at each of said substations adapted to control the operation of said selective mechanism, a connection register operatively associated with one of said terminals, and actuating means brought into operative relation with the connection register in making connection with the line at the associated terminal.

8. The combination with a telephone line extending from a plurality of substations to a plurality of connection terminals at a central office, of a signal associated with each of said terminals, electrically actuated mechanism adapted to effect the selective operation of one of said signals, controlling means at one of said substations automatically operated when the telephone is taken for use at such station and adapted to bring about the selective operation of said mechanism to display the aforesaid signal, a connection register operatively connected with the connection terminal associated with said selective signal, and means for actuating said connection register brought into operative relation therewith in completing connection with the line at the associated connection terminal.

9. The combination with a telephone line extending to two connection terminals at a central office, of a signal and a connection register associated with each terminal, means associated with the line for effecting the selective operation of said signals, means for making connection with the line at either terminal in response to the associated signal, and means made operative in completing connection at either terminal for effecting the actuation of the associated connection register.

10. The combination with a telephone line extending to two connection terminals, of a connection register associated with each terminal, means for completing connection with either terminal, and means adapted to actuate either connection register placed in operative relation therewith in making connection with the associated connection terminal.

11. The combination with a telephone line extending to two connection terminals, of connection registers associated one with each of said terminals, a connecting circuit adapted to complete connection with said line at either of its terminals, and means for operating said connection registers associated with the connecting circuit, and brought into operative relation with one or the other of said registers in the act of completing connection with its connection terminal.

12. The combination with a telephone line extending from two substations to two connection terminals at a central office, a signal and a connection register associated with each of said terminals, each connection terminal with its associated signal and connection register corresponding to a particular one of said substations, means controlled at each substation for causing the operation of the corresponding signal, a connecting device for completing connection with the line in response to said signal, and means made operative in completing connection with either terminal of the line for actuating the associated connection register.

13. The combination with a telephone line extending from a plurality of substations to a plurality of connection terminals at a central office, of a line signal and a

connection register associated with each of said connection terminals, means controlled at each of the substations for actuating the one of said signals corresponding to such substation, a connecting circuit adapted to be closed in any one of said connection terminals in response to its associated signal to connect the aforesaid line with another line, a source of current for actuating said connection registers, and a switch associated with said connecting circuit adapted to apply said current to the circuit to actuate the register associated with the terminal with which connection is made.

14. The combination with a telephone line extending from two substations to two connection terminals at a central office, of a line signal and a connection register associated with each of said terminals, electro-magnetic controlling mechanism connected with the line at the central office and adapted selectively to actuate said line signals, switch mechanism at each of said substations adapted in the use of the telephone automatically to actuate said controlling mechanism to operate a particular one of said line signals, means for making connection with the line at either of its terminals in response to the associated signal, and means made operative in completing connection at either terminal for actuating the associated connecting register.

15. The combination with a telephone line extending from two substations to two connection terminals at a central office, of a signal associated with each terminal, electro-magnetic switch mechanism at the central office for selectively actuating said signals, means at each substation for controlling the actuation of said switch mechanism to operate a particular one of said signals, two connection registers associated one with each of said connection terminals, means for making connection with the line at either of said terminals, and an actuating circuit for each of said connection registers independent of said switch mechanism, and adapted to be completed in contacts of the associated connection terminal in making connection with the line.

16. The combination with a telephone line extending from two substations to two spring-jacks at a central office, of a signal associated with each spring-jack, an actuating circuit for said signals comprising two branches and an undivided portion, each of said branches including one of said signals, a line relay connected with the line at a central office and arranged to control the undivided portion of said actuating circuit, a second relay arranged to close the branches of said actuating circuit alternatively, means controlled in the use of the telephone at one of the substations for actuating both the line relay and the second relay to operate one of said signals, means controlled in the use of the telephone at the other substation for actuating the line relay alone to operate the other of said signals, a connection register associated with each connection terminal and its signal, a connecting circuit for completing connection with the line at either of the terminals, a source of current for operating the connection registers, and a key associated with said connecting circuit for applying said current to the register associated with the terminal with which connection is made.

17. The combination with a telephone line extending from a plurality of substations to a central office, of signal mechanism at the central office adapted to give a plurality of signal indications corresponding with the substations of the line, means at each of said substations adapted to control the operation of said signal mechanism to give the particular indication corresponding with said substation, a plurality of connection devices for completing connection with the line, said connection devices corresponding with the substations of the line, a registering device at the central office corresponding with one of said substations, electro-magnetic mechanism for actuating said registering device, and means for energizing said electro-magnetic mechanism to operate said registering device, said means being made operative in completing connection with the line through the medium of one of said connection devices.

18. The combination with a telephone line extending from a plurality of substations to a central office, of a plurality of signals associated with said telephone line at



the central office, each of said signals corresponding with one of the substations of the line, electrically-actuated mechanism for selectively operating said signals, means at each of said substations adapted to control the operation of said selective mechanism, a connection register corresponding with one of said substations and operatively associated with the line at the central office, a plurality of connection devices for completing connection with the line in response to the various signals, and actuating means brought into operative relation with said connection register in making connection with the line through the medium of the connection device corresponding with the signal of the substation with which the connection register is associated.

19. The combination with a telephone line extending to a central office, of two signals associated with the line at the central office, means associated with the line for effecting the selective operation of said signals, two connection devices, one for each signal, through which connection may be made with the line in response to the associated

signal, two connection registers at the central office, one associated with each signal and its corresponding substation, and means made operative in completing connection with the line through the medium of either connection device for effecting the actuation of the corresponding connection register.

20. The combination with a telephone line extending to two connection terminals, of a registering device associated with each terminal, means for completing connection with the line at either terminal, electro-magnetic mechanism for selectively actuating said registering devices, and means for actuating said electro-magnetic mechanism to operate a particular registering device, said means being made operative in completing connection with the line through the medium of the corresponding connection terminal.

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