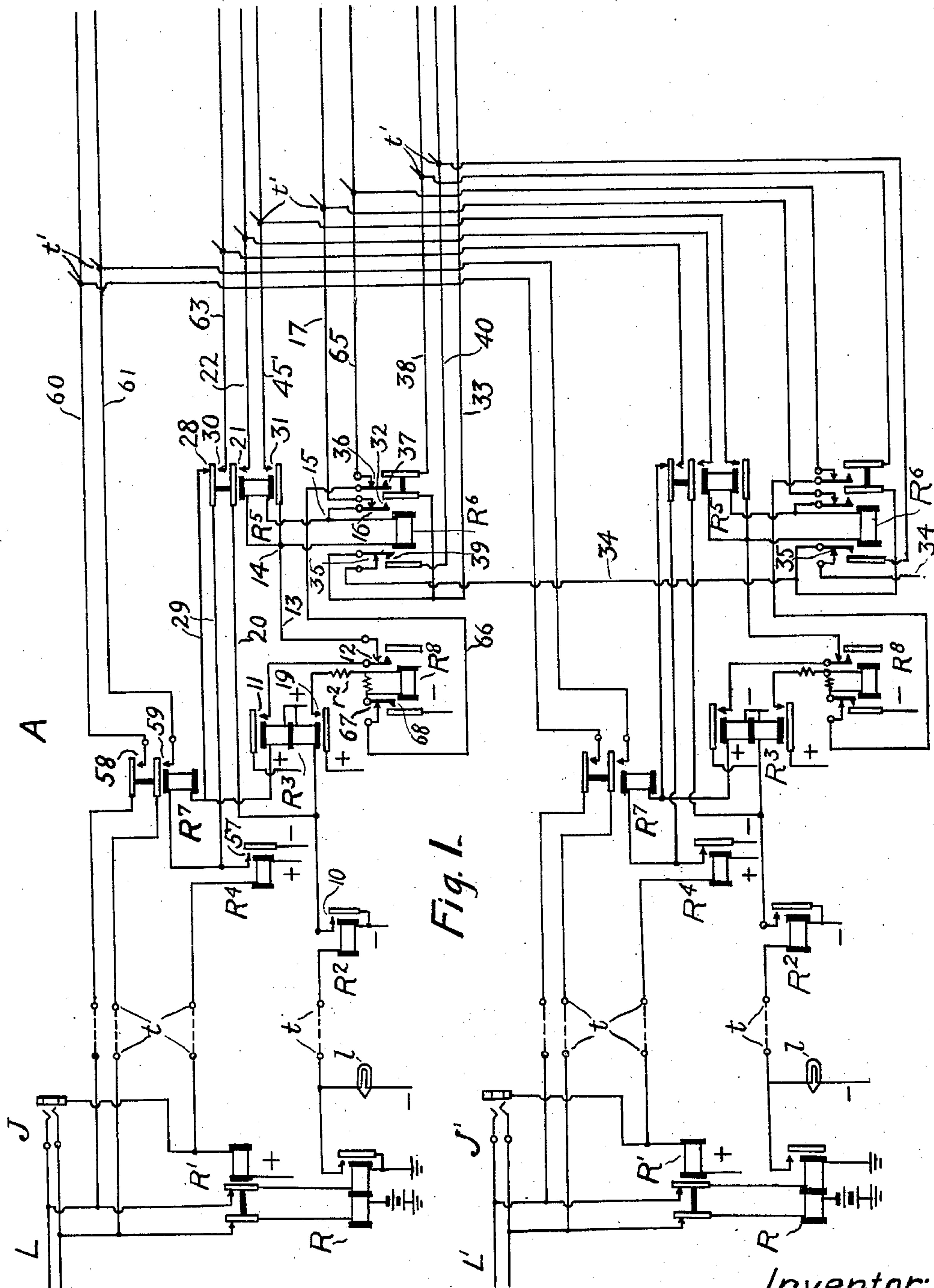


E. C. MOLINA.
 TELEPHONE SERVICE OBSERVING SYSTEM.
 APPLICATION FILED DEC. 1, 1915.

1,245,490.

Patented Nov. 6, 1917.
 2 SHEETS—SHEET 1.

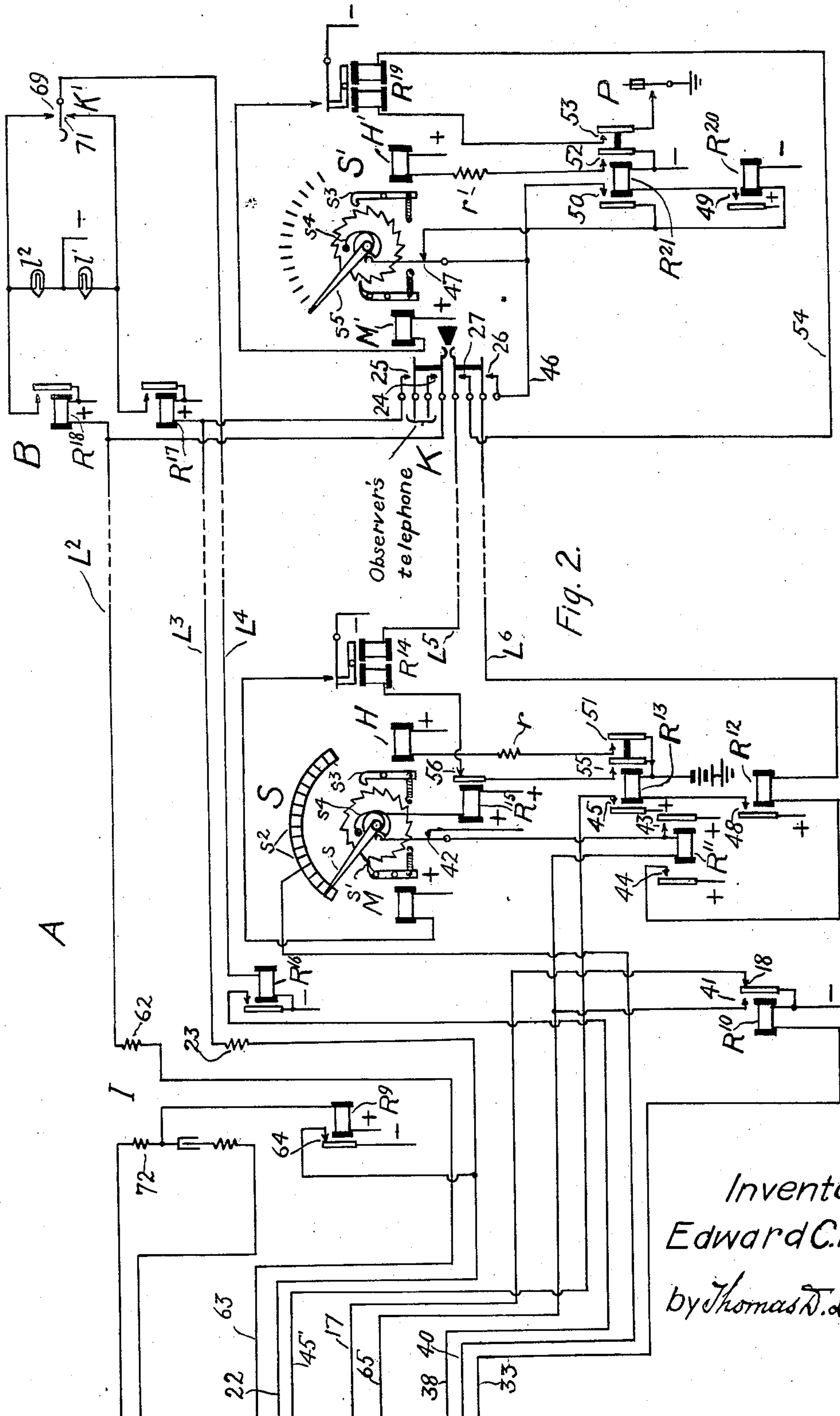


Inventor:
 Edward C. Molina
 by Thomas D. Lockwood
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Att'y.

UNITED STATES PATENT OFFICE.

EDWARD C. MOLINA, OF EAST ORANGE, NEW JERSEY, ASSIGNOR TO AMERICAN
TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

TELEPHONE-SERVICE-OBSERVING SYSTEM.

1,245,490.

Specification of Letters Patent.

Patented Nov. 6, 1917.

Application filed December 1, 1915. Serial No. 64,489.

To all whom it may concern:

Be it known that I, EDWARD C. MOLINA, residing at East Orange, in the county of Essex and State of New Jersey, have invented certain Improvements in Telephone-Service-Observing Systems, of which the following is a specification.

To determine the character of service being rendered telephone subscribers, it is desirable that an observer situated, for example, at one office or central station of a multi-office district shall be informed as to the various details of the calls of groups of subscribers at the same or other offices; such as the time at which a subscriber removes the receiver from its hook to initiate a call, the time of the operator's response by plugging into the answering jack, the conversation between the subscriber and operator, the hanging up of the receiver at the substation and the withdrawal of the plug from the jack. All this should be accomplished for a considerable number of subscribers with the use of as few trunks as possible for connecting the lines under observation and the observer's station. The present invention provides such information in a simple and effective manner, and with but one trunk for each observed group.

In the accompanying drawings, Figure 1 shows the equipment individual to two substation lines the service upon which is to be observed, this being according to a particular embodiment of the invention; while Fig. 2 illustrates the apparatus common to all the lines of the observed group and individual to the observing trunk.

As the equipment belonging to an observed group of lines and the corresponding trunk is of the same character for all, that of but two lines of the group with their trunk is shown and will be described. These two substation lines L and L' appear terminating at their respective answering jacks J and J' at a central station A. Considering now the apparatus associated with the line L as typical of all the lines of the group, it has the usual line relay R and cut-off relay R', the former controlling the line lamp L. At some convenient point, as the distributing frame, there may be temporarily connected to the substation line, as is indicated at the terminal t, a service observing line provided with the initiating relays R² and R³, which, energized successively as

a result of the actuation of the line relay, start a train of operations leading to the connection of the line to the observing trunk if the latter is not already joined to a line of the group, or its being locked out therefrom if the trunk is busy. The energization of relay R³ may also be effected by an operator's initiating relay R⁴ which is in parallel with the cut-off relay. When the secondary initiating relay R³ is energized in either of the ways mentioned, it causes the trunk-seizing relays R⁵, R⁶ and R⁷ to become active, this bringing about the co-operation of the line and disengaged trunk. A sluggish lock-out relay R⁸, when energized as a result of the trunk being in use, prevents this appropriation of the trunk by the relays R⁵, R⁶ and R⁷. At t' the conductors of the various service observing lines of the group are multiplied to the conductors of the service observing trunk, five of which conductors, L², L³, L⁴, L⁵ and L⁶, lead through to the distant observing station, which may be at another office B. Of these trunk conductors, L² and L³ are talking and the remainder controlling conductors.

At the office A, individual to the trunk and therefore common to the lines under observation, are a subscriber's relay R⁹ operated by current over the observed line when the receiver is removed from its hook, a trunk relay R¹⁰ which determines whether the trunk-seizing or lock-out relays shall receive current, an indication initiating relay R¹¹ putting into effect the identification of the observed line, and indicator controller relays R¹² and R¹³. The last mentioned relays, acting in succession in consequence of the operation of relay R¹¹, govern the holding magnet H, and through the stepping relay R¹⁴ the motor magnet M of an indicator controller S, which, as will later more clearly appear, controls the operation of identifying the line under observation. This device S may consist of the wellknown step-by-step automatic selector, in which a brush s is moved by ratchet mechanism s' over fixed contacts s² under the influence of the motor magnet M. A pawl s³ actuated by the holding magnet H retains the brush in the position to which it is advanced, and when this pawl is withdrawn, a spring s⁴ returns the brush to normal. A test relay R¹⁵ responds through

the brush s to an active condition of a particular terminal s^2 and stops the advance of the operation by opening the stepping circuit. Associated with this end of the trunk is an observation limiting relay R^{16} , the action of which, governed from the observer's station, determines whether an originating call, or one beginning with the closure of the hook switch at a substation, or a terminating call, started by insertion by the operator of the calling plug of a cord circuit in the jack of a called line, or both, shall be observed.

At the observing end of the trunk at station B is a subscriber's signal relay R^{17} and an operator's signal relay R^{18} . The former under the influence of relays R^2 and R^3 and the latter governed by relay R^4 control lamps or other signals l' and l^2 , respectively showing by their illumination or non-illumination whether the hook switch at the substation of the observed line is closed or open, and whether or not an operator has plugged into a jack of the line. There is also at the observing station an indicator S' which may be practically identical with the controller S , except that in the present embodiment of the invention there is substituted for the brush s' a pointer or indicating arm s^5 , movable into registration with the numbers or other designations of all the lines of the observed group associated with the trunk. This indicator has a holding magnet H' , motor magnet M' and stepping relay R^{19} corresponding to the like devices of the indicator controller, with relays R^{20} and R^{21} performing generally similar functions to the relays R^{12} and R^{13} . A suitable pulsator P furnishes the stepping impulses to both stepping relays. The observer is provided with two keys K and K' . The former when actuated joins the observer's receiving telephone to the line and controls certain relays of the indicating circuit and, through controller relays R^{12} and R^{13} over the trunk, the lock-out relay R^8 . The key K' when in its central position with the contacts open permits either an originating or a terminating call to be observed. When upon its upper contact the observed calls are limited to originating calls and when upon its lower contact to terminating.

Considering the operation of the system in detail and assuming the key K' to be in its central position and a call to originate upon the substation line L , the closure of the line circuit at the substation incident to the subscriber taking down the receiver causes the energization of the line relay R , which at its front contact supplies current to illuminate the line lamp l and also gives a circuit in parallel therewith through the winding of primary initiating relay R^2 , and this in turn through its contact 10 completes a circuit through the lower winding of the sec-

ondary initiating relay R^3 . Further assuming that there is no line of this group under observation and that the resting contacts of the lock-out relay R^8 are therefore closed, there is a circuit from contact 11 of relay R^3 through contact 12 of lock-out relay R^8 and conductor 13 to the point 14, then in parallel through the windings of the trunk-seizing relays R^5 and R^6 to a point 15, on by way of contact 16 of relay R^6 , the lead 17 of the service observing line and through the back contact 18 of trunk relay R^{10} . The front contact 19 of relay R^3 closes one break in the circuit of the lock-out relay, whereby it would be operated in case the trunk were in use. This will more clearly appear later. The subscriber's lamp l' at the observing station is now lighted as a consequence of the energization of relay R^{17} over the following circuit—front contact 10 of relay R^2 , conductor 20, front contact 21 of relay R^5 , lead 22, winding 23 of the trunk repeating coil L , trunk conductor L^3 and winding of relay R^{17} ; the attracted armature of this subscriber's relay supplying current to the lamp. The observer therefore is made aware that a call is awaiting observation upon the trunk and may depress her key K to unite her receiver to the talking conductors L^2 and L^3 at the contacts 24 and 25, and also making contacts 26 and 27 for purposes which will hereinafter be described.

By opening contact 28 relay R^5 removes a short circuit 29 from the winding of relay R^7 , preparing it for operation. At front contact 30 of this relay a path for current to the operator's signal relay R^{18} is made ready, awaiting the energization of the operator's relay R^4 . Contact 31 of relay R^5 joins to the point 14 in the parallel circuit of relays R^5 and R^6 a front contact of controller relay R^{13} , through which latter battery may be applied independently of the connection through contact 12 of the lock-out relay R^8 . When relay R^6 operated simultaneously with relay R^5 , it locked this pair of relays through contact 32, lead 33 and winding of trunk relay R^{10} independently of the path through the back contact of the last named relay. This lead 33 normally, or when the trunk is not in use, is extended by conductor 34 through the resting contacts 35 of all the relays R^6 of the group in series, so that the relay R^6 of any line of the group may, when the relays R^6 of the associated lines are deenergized, complete at contact 32 the energizing circuit for trunk relay R^{10} . Resting contact 36 of relay R^6 in the path between the front contact of trunk relay R^{10} and the winding of lock-out relay R^8 is opened, this not being used when the trunk is idle, and said relay R^8 is joined at front contact 37 to lead 38 and the front contact of observation limiting relay R^{16} . This allows the key K' when operated to ex-

ercise its control. At contact 35 of relay R^6 the connection between lead 33 and its extension 34 is broken, and there is substituted at front contact 39 a connection with a lead 40 extending to a contact s^2 of the indicator controller S, said contact being individual to the line which has seized the trunk. Battery is thus applied through the winding of relay R^{10} to said contact.

When trunk relay R^{10} receives current through the locking circuit of relays R^5 and R^6 , as already described, it operates and at its contact 41 completes a circuit through the winding of the indication initiating relay R^{11} and the normal contact 42 of the indicator controller S. Relay R^{11} attracts its armatures and at contact 43 locks itself independently of the controller contact 42, which will be opened as soon as the controller begins its advance. At contact 44 there is now a circuit by way of the winding of the primary controller relay R^{12} , trunk conductor L^6 , contact 26 of key K, closed by the observer after the subscriber's lamp L' lighted, conductor 46, through the normal contact 47 of indicator S' and the winding of the primary indicator relay R^{20} . The front contacts 48 and 49 of relays R^{12} and R^{20} thereupon cause the energization of the secondary indicator controller and indicator relays R^{13} and R^{21} , respectively. Front contact 50 of relay R^{21} by short circuiting contact 47 provides for the continued energization of relay R^{20} after the indicator leaves its normal position. Contacts 51 and 52 of relays R^{13} and R^{21} close local circuits through resistances r and r' for the holding magnets H and H', which apply the pawls s^3 of the indicator controller and indicator of the ratchet mechanism. There is also a circuit from the pulsator P at the observing station through front contact 53 of relay R^{21} , indicator stepping relay R^{19} , conductor 54, contact 27 of key K, trunk conductor L^5 , controller stepping relay R^{14} , back contact 56 of test relay R^{15} and front contact 55 of relay R^{13} . The relays R^{14} and R^{19} responding to the impulses make and break the local circuits of the motor magnets M and M', so that the indicator controller and indicator move forward the brush s and pointer s^5 in synchronism until the former touches the contact s^2 belonging to the line which is connected with the trunk. Current thereupon flows through the winding of relay R^{15} , brush s , contact s^2 , lead 40 of the service observing line, contact 39 of relay R^6 , lead 33 and winding of relay R^{10} . Test relay R^{15} severs the stepping circuit at contact 56 stopping both the indicator controller and indicator. The pointer of the latter stands at the designation of the line which is connected to the trunk, informing the observer what line is under observation.

In addition to rendering the holding mag-

net of the indicator controller active and closing a gap in the stepping circuit, relay R^{13} at contact 45 through lead 45' gives a battery connection for the circuit of the parallel relays R^5 and R^6 from the point 14, so that as long as relay R^{13} is held energized by relay R^{12} through the closure of the contact 26 at the observer's depressed key K, the trunk will be held regardless of the condition of the relays R^3 and R^8 , the contacts of which are included in the original energizing path.

After the line lamp L lighted, the subscriber's operator inserted the answering plug of a cord circuit in the jack J, energizing the cut-off relay R' in the well known manner. The operator's relay R^4 receives current in parallel with this, and closing contact 57 provides for the continued energization of relay R^3 by current through its upper winding after the path through the lower winding has been broken at contact 10 by the release of relay R^2 , which is deenergized when the cut-off relay opens the circuit of the line relay. The circuit through the upper winding of relay R^3 includes the winding of relay R^7 . This operates and at contacts 58 and 59 closes through the talking leads 60 and 61 of the service observing line to the corresponding trunk conductors L^2 and L^3 , so that the observer may listen in. The talking leads having previously been maintained open, clicks and other disturbances produced by the action of the various apparatus associated, inductively or otherwise, with the observing trunk will not get back into the line which is being observed. The contact 57 also supplies current to the operator's signal relay R^{18} by way of trunk conductor L^2 , winding 62 of the repeating coil, lead 63 and contact 30 of relay R^5 . Relay R^{18} causes the display of the operator's signal L^2 and the observer thereby knows that the operator has answered. The release of relay R^2 would also extinguish the subscriber's signal L' , but the control of this is now transferred to relay R^9 , the front contact 64 of which supplies current to conductor L^3 . The energizing circuit of relay R^9 is through the winding of repeating coil I, lead 60, contact 58 of relay R^7 , tip side of the line, the substation circuit and the ring side of the line to battery at the cord with which the operator has answered. Having been informed of the number of the line by the indicator, with the indications furnished by the lamps L' and L^2 and with her telephone the operator can follow and record the various details of the call.

When at the close of the conversation the subscriber returns the receiver to its hook, the opening of the substation circuit releases the relay R^9 . This deenergizes relay R^{17} and the subscriber's lamp L' is extinguished.

The withdrawal of the plug from the jack J by the subscriber's operator in response to the supervisory signal in the cord leads to the deenergization of the cut-off relay and opens the circuit of relay R⁴. The latter breaking its contact 57 releases relay R¹⁸ and the operator's signal $\mathcal{L}^2$ ceases to glow. The opening of contact 57 also releases relays R³ and R⁷. The former severs the originating circuit of the relays R⁵ and R⁶ at contact 11, though these relays are still held up by relay R¹³ over lead 45'. When the observer frees the key K, it deprives the relays R¹² and R²⁰ of current by the interruption of their circuit at contact 26 and they break the circuits of relays R¹³ and R²¹. These last named relays deenergize the holding magnets H and H' and the indicator controller and indicator are returned to normal by their springs. Relay R¹⁵ falls off when the brush of the indicator controller leaves the contact joined to lead 40. The opening of contact 45 of relay R¹³ releases relays R⁵ and R⁶, and the latter breaks the circuit of trunk relay R¹⁰ which releases relay R¹¹. The observing system is now ready to take up another call.

The call upon the line of the observed group might have been terminating instead of originating. That is, another subscriber may call for a line of the group, and therefore the first operation in connection with it is the insertion of a calling plug in one of its multiple jacks. Under such conditions the cut-off relay R' and the relay R⁴ in parallel are first operated. Contact 57 is closed by relay R⁴ and relays R³ and R⁷ receive current in series, the former through its upper winding. For a time R⁷ remains inert because of the presence of the short circuit 29. As a result of the making of contact 11 of relay R³, trunk relays R⁵ and R⁶ are energized, and the display of the operator's signal $\mathcal{L}^2$ follows the closure of contact 30 of relay R⁵. The opening of contact 28 of relay R⁵ removes the short circuit from relay R⁷, which completes the talking leads. This, it will be noted, follows the energization of relays R⁵ and R⁶, so that the line is protected against sounds incident to their action and the operator will be less liable to be made aware that she is being observed. Relay R⁶ renders trunk relay R¹⁰ active, and when the observer throws the key K the various relays of the indicator controller and indicator will be energized and the number of the called line will appear upon the indicator. Relay R⁹ responds to the closure of the substation switch hook when the called subscriber answers and operating relay R¹⁷ lights the subscriber's lamp $\mathcal{L}'$ at the observing desk. The description of the release of the apparatus for an originating call is applicable to the present case.

In either an originating or terminating

call, if the observing trunk had already been connected to a line, as L', when the subscriber on line L called or is called, the trunk relay R¹⁰ would be found energized. Therefore, upon the operation of relay R³ associated with line L, instead of a circuit through back contact 18 for energizing the trunk-seizing relays R⁵ and R⁶ there would be a circuit through front contact 41 by way of lead 65, resting contact 36 of relay R⁶, conductor 66, resting contact 67 and winding of lock-out relay R⁸, resistance r^2 and front contact 19 of relay R³. Relay R⁸ opening contact 67 locks up through contact 68, so that it will remain energized regardless of the condition of the trunk relay. At contact 12 relay R⁸ breaks the originating circuit for the trunk seizing relays R⁵ and R⁶. Consequently the line is locked off the trunk until a new call is made and the trunk is found idle. Since relay R⁸ is slow to release, and since its continued energization is through a chain of relays, a sufficient time interval is given so that it will not release if the subscriber endeavors to attract the attention of the operator by making and breaking the contacts of the switch hook. The proper maintenance of the lock-out is thus assured.

If two subscribers of the observed group, say upon lines L and L', call simultaneously, the relays R⁶ of both the service observing lines associated therewith will operate together, but this relay of line L, which is nearest in the series to the lead 33 and trunk relay R¹⁰, in making contact 39 through which said trunk relay is energized opens contact 35 and this disconnects conductor 34 and the apparatus of line L' and all other lines of the group from said relay. Being cut off from the battery connection at the trunk relay, the trunk-seizing relays of line L' retract their armatures. It will therefore be seen that the line of the group which is nearest the relay R¹⁰ in the series through conductors 33 and 34 will always be joined to the trunk in such cases and that there will be no interference.

It may be desired only to observe one class of calls, say those originated by the subscribers upon lines under observation. In such case the key K' is closed upon the contact 69. Now when the subscriber upon the line of a group is called and the operator plugs into the jack of the line, this being what has been previously designated as a terminating call, upon the energization of the operator's signal relay R¹⁸ as hereinbefore described, there is closed at the front contact a path in parallel with the operator's lamp $\mathcal{L}^2$ through contact 69 of key K', trunk conductor L⁴ and winding of observation limiting relay R¹⁶. Relay R¹⁶ attracts its armature and completes a circuit for the lock-out relay R⁸, this passing through con-

ductor 38, front contact 37 of relay R^6 , lead 66, resting contact 67 of relay R^8 , winding of said relay, resistance r^2 and front contact 19 of relay R^3 . Relay R^8 locks itself through
 5 contact 68 and opens at contact 12 the circuit of the trunk-seizing relays R^5 and R^6 . The former at contact 30 cuts off the current from the operator's lamp L^2 before it has time to glow, so the observer receives
 10 no signal. At contact 28 relay R^5 applies the short circuit 29 to relay R^7 , and this is deenergized. The line is now held locked off the trunk until the call is completed, as in the case of an attempted connection with
 15 a busy trunk.

If the call had instead originated upon the line, the operation proceeds as though the key K' were in its central position until the operator in answering inserts the plug
 20 in the jack of the calling line. This, provided the observer is occupied with some other line or for any reason fails to take up the call by depressing her key K , operates the relays R^{16} and R^8 as just described,
 25 and the consequent release of the trunk-seizing relays R^5 , R^6 and R^7 deenergizes the relays whose circuits are dependent upon them, extinguishing the lamp L' and placing the trunk in a condition to take up another call. But if after seeing the illumination of the subscriber's lamp L' and before the operator answers the observer had closed the contacts of the key K , the indicator controller relay R^{12} would be operated
 30 through key contact 26 and the secondary relay R^{13} in turn energized. At its contact 45 the latter closes the holding path for relays R^5 and R^6 from point 14 by way of contact 31 of relay R^5 and lead 45'. Consequently, when relay R^{16} closes its front
 40 contact upon the response of the operator and the energization of the operator's signal relay R^{18} , although it operates the lock-out relay R^8 , this produces no effect because the holding path maintains the trunk-seizing relays actuated.

Were terminating calls only to be observed, the key K' would be closed upon contact 71. The effect is similar to that just
 50 described, in the present instance the observation limiting relay R^{16} being operated by the subscriber's signal relay R^{17} in parallel with the lamp L' . This causes the relay R^8 to lock-out all originating calls. Upon a terminating call, if the observer
 55 does not depress the key K before the subscriber removes the receiver from its hook in response to the passage of ringing current over the line following the plugging in with the calling end of a cord circuit by the operator, the attraction of the armature of the subscriber's signal relay R^{17} will lead to the operation of relay R^{16} and the line which seized the trunk will be disconnected
 60 therefrom. On the other hand, the closure

of contact 26 of key K gives the holding path for the trunk-seizing relays through conductor 45' which allows the call to be observed to its completion.

I claim as my invention:

1. The combination with a central station and a service observing station, of a group of substation lines to be observed terminating at the central station, a trunk connecting the central station and service observing station, and automatic means for connecting to the trunk one at a time the lines put into use. 70 75
2. The combination with a central station and a service observing station, of a group of substation lines to be observed terminating at the central station, a trunk connecting the central station and service observing station, and means controlled by conditions produced in the lines for connecting to the trunk one at a time the lines put into use. 80 85
3. The combination with a central station and a service observing station, of a group of substation lines to be observed terminating at the central station, a trunk connecting the central station and service observing station, and means for connecting a line to the trunk upon the initiation of a call upon the line by a subscriber or the connection with said line by an operator. 90 95
4. The combination with a central station and a service observing station, of a group of substation lines to be observed terminating at the central station, a trunk connecting the central station and service observing station, means for connecting to the trunk a line put into use, and means for preventing other lines of the group from obtaining access to the trunk while the first line is connected thereto. 100 105
5. The combination with a central station and a service observing station, of a group of substation lines to be observed terminating at the central station, a trunk connecting the central station and service observing station, means controlled by conditions produced in the lines for connecting to the trunk a line put into use, and means responsive to the connection for preventing other lines of the group from obtaining access to the trunk while the first line is connected thereto. 110 115
6. The combination with a central station and a service observing station, of a group of substation lines to be observed terminating at the central station, a trunk connecting the central station and service observing station, and relays for connecting to the trunk one at a time the lines put into use. 120 125
7. The combination with a central station and a service observing station, of a group of substation lines to be observed terminating at the central station, a trunk connecting the central station and service observing 130

station, and automatic means for connecting to the trunk one at a time the lines put into use and consisting of relays individual to each line of the group and relays common to the group.

8. The combination with a central station and a service observing station, of a group of substation lines to be observed terminating at the central station, a trunk connecting the central station and service observing station, and automatic means for connecting to the trunk one at a time the lines put into use and consisting of relays individual to each line of the group and relays common to the group and associated with the trunk.

9. In a service-observing system, a subscriber's operator's position, a group of lines to be observed each terminating at said position, an observing station, a trunk for connecting said position and station, a trunk-seizing relay associated with each line, a trunk relay common to the group of lines and energized by the trunk-seizing relay, and a relay controlled by the trunk relay for preventing the seizure of the trunk.

10. In a service-observing system, a subscriber's operator's position, a group of lines to be observed each terminating at said position, an observing station, a trunk for connecting said position and station, a trunk-seizing relay associated with each line, a trunk relay common to the group of lines and energized by the trunk-seizing relay, and a relay controlled by the trunk relay for opening the circuit of the trunk-seizing relay.

11. In a service observing system, a group of lines to be observed, a trunk, a trunk-seizing relay associated with each line, a lock-out relay for preventing the seizure of the trunk, and a manually controlled relay common to the group of lines for controlling both the trunk-seizing relay and the lock-out relay.

12. In a service observing system, a group of lines to be observed, a trunk, a trunk-seizing relay associated with each line, a lock-out relay for preventing the seizure of the trunk, and a relay common to the group of lines for controlling the trunk-seizing relay at its back contact and the lock-out relay at its front contact.

13. A service-observing station, a service-observing trunk terminating at the station, a subscriber's operator's position adapted to be connected to said trunk, a line to be observed terminating at said position, there being talking conductors and controlling conductors belonging to the line and trunk, and means dependent upon the putting of the line into use for connecting the controlling conductors of the line and trunk and thereafter connecting the talking conductors.

14. A service-observing station, a service-

observing trunk terminating at the station, a subscriber's operator's position adapted to be connected to said trunk, a line to be observed, a plurality of trunk-seizing devices adapted to successively perform steps in connecting the line and trunk and associated with the line, and a plurality of means for operating said devices at different times.

15. A service observing trunk, a line to be observed, a plurality of trunk-seizing relays individual to the line, means for energizing a plurality of relays simultaneously, and means for thereafter energizing another of said relays.

16. A service observing trunk, a line to be observed, a plurality of trunk-seizing relays individual to the line, means for energizing one of said relays, and means dependent upon the operation of said relay for energizing another of the relays.

17. A service observing trunk, a line to be observed, there being talking conductors and controlling conductors belonging to the line and trunk, a plurality of trunk-seizing relays associated with the line, means dependent upon the putting of the line into use for energizing a relay to connect controlling conductors of the line and trunk, and means governed by said energized relay for causing the energization of another relay to connect the talking conductors.

18. The combination with a line the service of which is to be observed, of a service observing system comprising observation controlling electro-mechanisms, service observing trunk conductors connecting the line and observing system, conductors for uniting the electro-mechanisms with one another and with the trunk conductors and line, and means associated with the conductors for preventing disturbances from being communicated therethrough to the observed line.

19. The combination with a line the service of which is to be observed, of a service observing system comprising observation controlling electro-mechanisms, service observing trunk conductors connecting the line and observing system, conductors for uniting the electro-mechanisms with one another and with the trunk conductors and line, and means associated with the trunk conductors for preventing disturbances from being communicated therethrough to the observed line.

20. The combination with a line the service of which is to be observed, of a service observing system comprising observation controlling electro-mechanisms, service observing trunk conductors connecting the line and observing system, conductors for uniting the electro-mechanisms with one another and with the trunk conductors and line, and means for interrupting the conductive continuity of the conductors where-

by disturbances are prevented from being communicated through the trunk conductors to the observed line.

21. In a service observing system, a group of lines to be observed, an observing trunk, electro-mechanisms for connecting any one of the lines to the trunk for observation and for enabling such observation to be made, and means for preventing sounds from being applied to the line through the service observing instrumentalities.

22. In a service observing system, a group of lines to be observed, an observing trunk, electro-mechanisms for connecting any one of the lines to the trunk for observation and for enabling such observation to be made, and means for preventing sounds produced in the operation of the electro-mechanisms from being applied to the line.

23. In a service observing system, an observing station, a group of lines to be observed, a trunk extending from the observing station to the group of lines, means operable as the lines are put into use upon the initiation of a call upon a line by a subscriber or by the connection with said line by an operator for connecting them to the trunk for observation, and means for preventing the simultaneous connection of lines to the trunk.

24. In a service observing system, an observing station, a group of lines to be observed, a trunk extending from the observing station to the group of lines, electro-responsive means operable to effect the connection of a line with the trunk, and a circuit for said means extending through the equipment of a plurality of lines, said circuit being opened at said means upon the connection of the trunk with one of the lines of the group.

25. In a service observing system, an observing station, a group of lines to be observed, a trunk extending from the observing station to the group of lines, electro-responsive means associated with each line of the group for connecting it with the trunk, and a circuit for said means extending through the apparatus of a plurality of lines of the group, said circuit being opened at said means upon the connection with the trunk of one of the lines of the group.

26. In a service observing system, an observing station, a group of lines to be observed, a trunk extending from the observing station to the group of lines, electro-responsive means associated with each line of the group for connecting it with the trunk, and a locking circuit for said means extending through the apparatus of a plurality of lines of the group, said circuit being opened upon the connection with the trunk of one of the lines of the group.

27. In a service observing system, an observing station, a group of lines to be ob-

served, a trunk extending from the observing station to the group of lines, electro-responsive means associated with each line of the group and with the trunk for connecting such line with the trunk, and a circuit for said means extending through the apparatus of a plurality of lines of the group, said circuit being opened upon the connection with the trunk of one of the lines of the group.

28. In a service observing system, an observing station, a group of lines to be observed, a trunk extending from the observing station to the group of lines, a trunk-seizing relay associated with each line, a trunk relay common to the group of lines and governing the operation of the trunk-seizing relay, and an energizing circuit for the trunk relay extending through contacts belonging to the trunk-seizing relays of a plurality of lines of the group.

29. In a service observing system, an observing station, a group of lines to be observed, a trunk extending from the observing station to the group of lines, a trunk-seizing relay associated with each line, a trunk relay common to the group of lines and governing the operation of the trunk-seizing relay, and an energizing circuit for the trunk relay and a locking circuit for the trunk-seizing relays controlled by a plurality of the trunk-seizing relays.

30. In a service observing system, a plurality of substation lines to be observed and their individual equipment, a service observing line adapted for temporary association with each substation line to be observed and having apparatus under the control of the substation line equipment, a service observing station provided with service observing apparatus, and a trunk multiplied to the service observing lines and connected to the service observing apparatus at the observing station.

31. In a service observing system, a plurality of substation lines to be observed and their individual equipment, a service observing line adapted for temporary association with each substation line to be observed and having apparatus under the control of the substation line equipment, a service observing station provided with service observing apparatus, a trunk multiplied to the service observing lines and connected to the service observing apparatus at the observing station, and apparatus in the trunk cooperating with that of the service observing lines in the control of the service observing apparatus.

32. In a service observing system, a plurality of substation lines to be observed and their individual equipment, a service observing line adapted for temporary association with each substation line to be observed and having apparatus under the control of the substation line equipment, a service observ-

ing station provided with service observing apparatus, a trunk multiplied to the service observing lines and connected to the service observing apparatus at the observing station, and apparatus in the trunk cooperating with that of the service observing station in the control of the service observing apparatus.

33. In a service observing system, a plurality of substation lines to be observed and their individual equipment, a service observing line adapted for temporary association with each substation line to be observed and having apparatus under the control of the substation line equipment, a service observing station provided with service observing apparatus, a trunk multiplied to the service observing lines and connected to the service observing apparatus at the observing station, and apparatus in the trunk cooperating with that of the service observing lines and of the service observing station in the control of the service observing apparatus.

34. In combination, a subscriber's operator's position, a group of lines terminating in said position, a service-observing station, a trunk for connecting said position and the service-observing station, automatic means responding to acts of the subscriber and the operator for connecting the lines to the trunk one at a time as they are put into use, and a signal at the observing station dependent in its operation upon the condition of the connected line.

35. In combination, a subscriber's operator's position, a group of lines terminating in said position, a service-observing station, a trunk for connecting said position and the service-observing station, automatic means responding to acts of the subscriber and the operator for connecting the lines to the trunk one at a time as they are put into use, and a signal at the observing station dependent in its operation upon connection with the line by an operator.

36. The combination with a group of telephone lines extending from substations to a central station, of a service observing station, a trunk terminating at the service observing station, automatic means for connecting the lines to the trunk one at a time as they are put into use, and a signal at the observing station dependent in its operation upon the condition of the line at the substation.

37. The combination with a group of telephone lines extending from substations to a central station, of a service observing station, a trunk terminating at the service observing station, automatic means for connecting the lines to the trunk one at a time as they are put into use, and signals at the observing station dependent in their operation upon the condition of a line at the sub-

station and connection with said line by an operator.

38. The combination with a group of telephone lines extending from substations to a central station, of a service observing station, a trunk terminating at the service observing station, automatic means for connecting the trunk to a line of the group to be observed, a signal at the observing station, and an electro-mechanism situated at the central station and responsive to the condition of the line to both control the trunk connecting means and the signal.

39. The combination with a group of telephone lines extending from substations to a central station and each having a line relay, of a service observing station, a trunk terminating at the service observing station, automatic means for connecting the trunk to a line of the group to be observed, a signal relay joined to the trunk at the observing station, a signal controlled thereby, and a relay governed by the line relay and governing the connecting means and signal relay.

40. The combination with a group of telephone lines extending from substations to a central station and each having a cut-off relay, of a service observing station, a trunk terminating at the service observing station, automatic means for connecting the trunk to a line of the group to be observed, a signal relay joined to the trunk at the observing station, a signal controlled thereby, and a relay governed with the cut-off relay and governing the connecting means and signal relay.

41. The combination with a group of telephone lines extending from substations to a central station, of a service observing station, a trunk terminating at the service observing station, automatic means for connecting the trunk to a line of the group to be observed, a signal at the observing station, and an electro-mechanism situated at the central station and being common to the group of lines, said electro-mechanism being responsive to the condition of the line to control the signal.

42. The combination with a group of telephone lines extending from substations to a central station and each having a line relay, of a service observing station, a trunk terminating at the service observing station, automatic means for connecting the trunk to a line of the group to be observed, a signal relay joined to the trunk at the observing station, a signal controlled thereby, a relay governed by the line relay and governing the signal relay, and a relay common to the group of lines for also governing said signal relay.

43. The combination with a telephone line having a line relay, of a service observing station, a trunk terminating at the service

observing station, a relay for connecting the line to the trunk, a signal relay joined to the trunk at the observing station, a signal controlled thereby, and a relay governed by the line relay and governing the signal relay.

44. The combination with a telephone line having a cut-off relay, of a service observing station, a trunk terminating at the service observing station, a relay for connecting the line to the trunk, a signal relay joined to the trunk at the observing station, a signal controlled thereby, and a relay operable with the cut-off relay and governing the signal relay.

45. The combination with a telephone line having a line relay and a cut-off relay, of a service observing station, a trunk terminating at the service observing station, a relay for connecting the line to the trunk, signal relays joined to the trunk at the observing station, signals controlled thereby, and relays operable with the line and cut-off relays and governing the signal relays.

46. A service observing station, lines to be observed, connections between the lines and observing station, a plurality of signals at the observing station respectively responsive to different line conditions, and means under the control of the station observer for limiting the operation to one class of line conditions.

47. A service observing station, lines to be observed, connections between the lines and observing station, a plurality of signals at the observing station respectively responsive to different line conditions, and means under the control of the station observer including a device normally acting to display a signal for limiting the operation to one class of line conditions.

48. A service observing station, lines to be observed, connections between the lines and observing station, a subscriber's signal and an operator's signal at the observing station, relays under the influence of different line conditions for respectively controlling the signals, a key, and a relay controlled by said key for rendering the signal relays ineffective.

49. A service observing station, lines to be observed, connections between the lines and observing station, a subscriber's signal and an operator's signal at the observing station, relays under the influence of different line conditions for respectively controlling the signals, a key, and a relay controlled by said key and by the signal relays for rendering said signal relays ineffective.

50. A service observing station, lines to be observed, a trunk terminating at the observing station, trunk-seizing means for connecting each line to the trunk, lock-out means for preventing the trunk-seizing means from making a connection, a plurality of signals

at the observing station respectively responsive to different line conditions, manual controlling means therefor, and means operable upon the actuation of the controlling means for governing the lock-out means.

51. A service observing station, lines to be observed, a trunk terminating at the observing station, trunk-seizing means for connecting each line to the trunk, lock-out means for preventing the trunk-seizing means from making a connection, a plurality of signals at the observing station respectively responsive to different line conditions, manual controlling means therefor, and observation limiting means operable upon the actuation of the controlling means for governing the lock-out means.

52. A service observing station, lines to be observed, a trunk terminating at the observing station, trunk-seizing means for connecting each line to the trunk, lock-out means for preventing the trunk-seizing means from making a connection, and means controlled by the observer for rendering the lock-out means ineffective.

53. A service observing station, lines to be observed, a trunk terminating at the observing station, trunk-seizing means for connecting each line to the trunk, lock-out means for preventing the trunk-seizing means from making a connection, and means including contacts of an observer's key for rendering the lock-out means ineffective.

54. A service observing station, lines to be observed, a trunk terminating at the observing station, a trunk-seizing relay for connecting each line to the trunk, a lock-out relay energized to prevent the operation of the trunk-seizing relay, an operating circuit for the trunk-seizing relay extending through normal contacts of the lock-out relay, and a branch circuit for completing said operating circuit independently of the lock-out relay.

55. A service observing station, lines to be observed, a trunk terminating at the observing station, a trunk-seizing relay for connecting each line to the trunk, a lock-out relay energized to prevent the operation of the trunk-seizing relay, an operating circuit for the trunk-seizing relay extending through normal contacts of the lock-out relay, a branch circuit for completing said operating circuit independently of the lock-out relay, and an observer's key for controlling said branch circuit.

56. A service observing station, a trunk terminating thereat, a group of lines to be observed, automatic means for connecting any one of the lines to the trunk, automatic means controlled in the operation of the connecting means for indicating which of the lines is thus connected, and a manual device at the observing station for initiating the operation of said indicating means.

57. A service observing station, a trunk

terminating thereat, a group of lines, any one of which may be connected to the trunk for observation, a line indicator at the observing station, an indicator controller at the other extremity of the trunk, means operable in the connection of a line to the trunk to govern the indicator controller, said indicator controller governing the indicator, and a key-controlled energizing circuit including both indicator and controller.

58. A service observing station, a trunk terminating thereat, a group of lines to be observed, means for connecting any one of the lines to the trunk, a controlling electro-mechanism associated with the lines at one extremity of the trunk and being movable to a point determined by the line connected therewith, and an indicating electro-mechanism situated at the observing end of the trunk and controlled in its movement by the first named electro-mechanism.

59. A service observing station, a trunk terminating thereat, a group of lines to be observed, means for connecting any one of the lines to the trunk, a controlling electro-mechanism associated with the lines at one extremity of the trunk and being movable to a point determined by the line connected therewith, and an indicating electro-mechanism situated at the observing end of the trunk and movable in synchronism with the first named electro-mechanism.

60. A service observing station, a trunk terminating thereat, a group of lines to be observed, means for connecting any one of the lines to the trunk, a controlling electro-mechanism associated with the lines at one extremity of the trunk and being movable to a point determined by the line connected therewith, an indicating electro-mechanism situated at the observing end of the trunk and movable in synchronism with the first named electro-mechanism, an observer's key, and an energizing circuit for the electro-mechanisms passing through contacts of the observer's key.

61. A service observing station, a trunk terminating thereat, a group of lines to be observed, means for connecting any one of the lines to the trunk, a controlling electro-mechanism associated with the lines at one extremity of the trunk and being movable

to a point determined by the line connected therewith, an indicating electro-mechanism situated at the observing end of the trunk and movable in synchronism with the first named electro-mechanism, an observer's key, and a circuit preparing the electro-mechanisms for operation passing through contacts of the key.

62. In a service observing system, a central station at which is a subscriber's operator's position, a group of substation lines terminating at said position, a service observing line adapted for temporary association with each substation line to be observed, a service observing station, a service observing trunk, automatic means at the central station for connecting any one of the service observing lines to the trunk, and automatic means associated with the trunk at the service observing station for indicating which of the lines is thus connected.

63. In a service observing system, a central station at which is a subscriber's operator's position, a group of substation lines terminating at said position, a service observing station, a service observing trunk, automatic means at the central station for connecting any one of the substation lines through said trunk to the service observing station, and automatic means associated with the trunk at the service observing station for indicating which of the lines is thus connected.

64. In a service observing system, a central station at which is a subscriber's operator's position, a group of substation lines terminating at said position, a service observing station, a service observing trunk, means at the central station for connecting any one of the substation lines through said trunk to the service observing station, and automatic means associated with the trunk at the service observing station for indicating which of the lines is thus connected.

In testimony whereof, I have signed my name to this specification in the presence of two subscribing witnesses, this seventeenth day of November, 1915.

EDWARD C. MOLINA.

Witnesses:

WILLIAM H. HERNER,
CHAS. C. FRITZ.