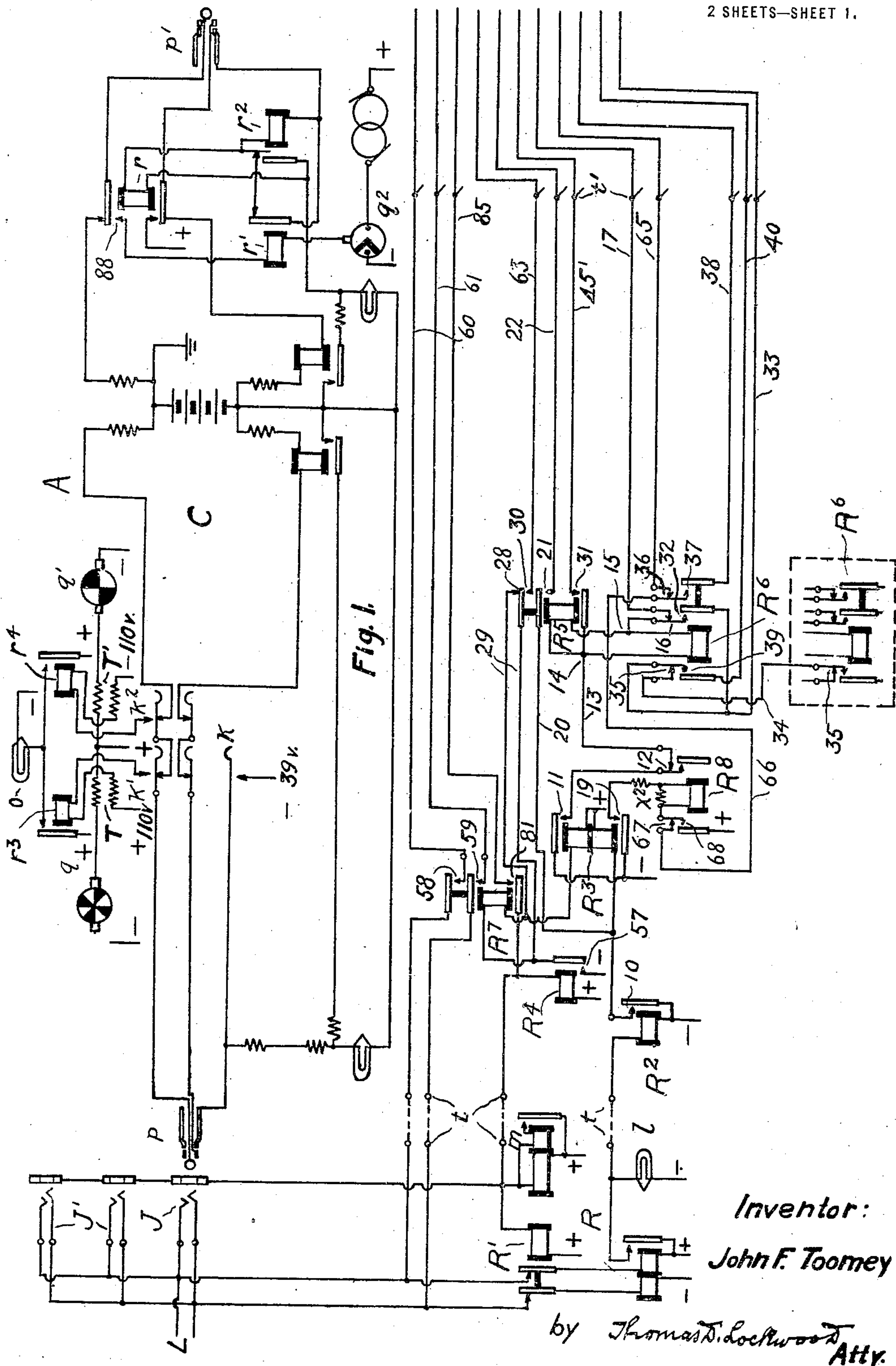


J. F. TOOMEY.
SYSTEM FOR OBSERVING TELEPHONE SERVICE.
APPLICATION FILED JAN. 22, 1916.

1,245,402.

Patented Nov. 6, 1917.

2 SHEETS—SHEET 1.



Inventor:
John F. Toomey

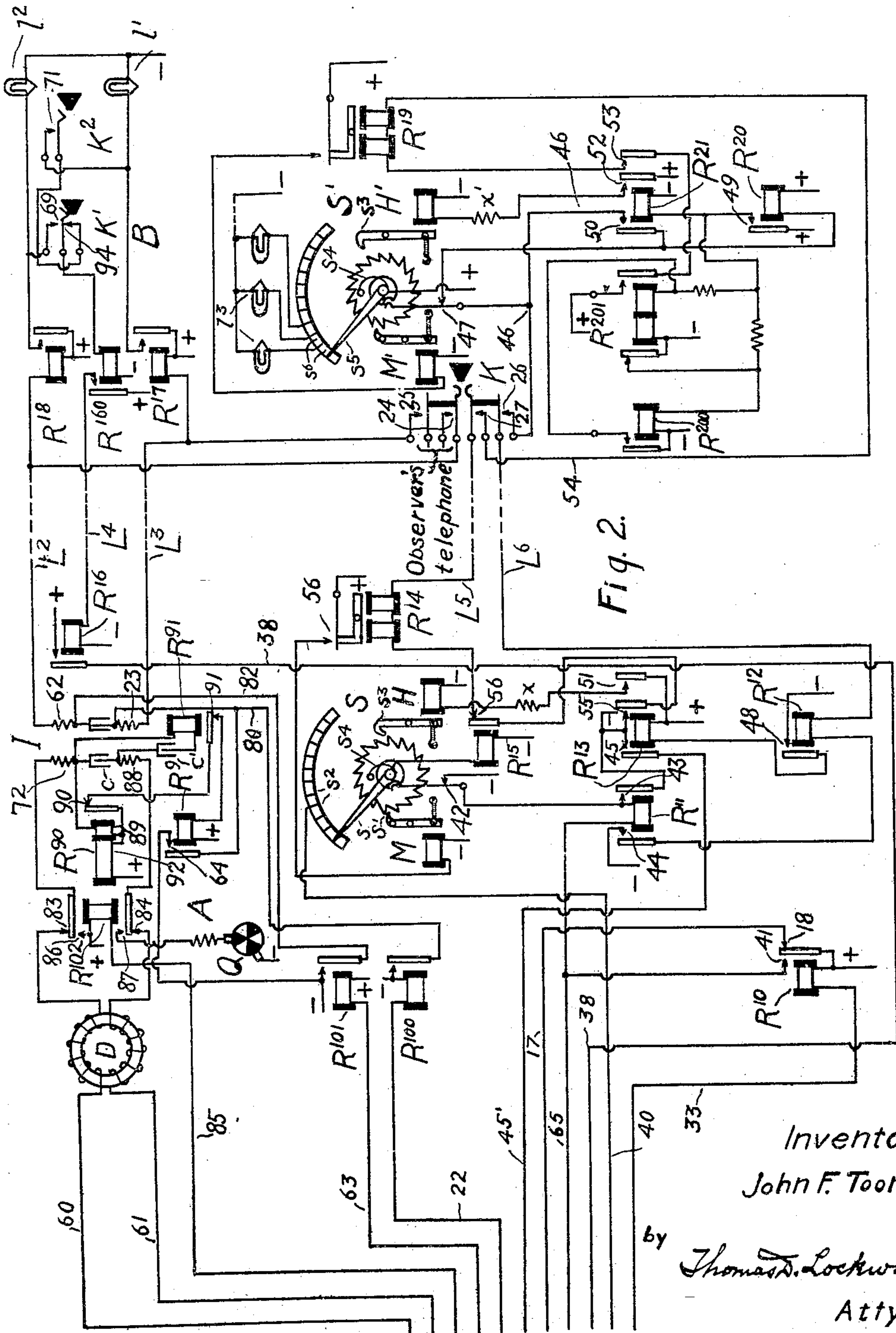
by Thomas D. Lockwood
Att'y.

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Atty.

UNITED STATES PATENT OFFICE.

JOHN F. TOOMEY, OF NEW YORK, N. Y., ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

SYSTEM FOR OBSERVING TELEPHONE SERVICE.

1,245,402.

Specification of Letters Patent.

Patented Nov. 6, 1917.

Application filed January 22, 1916. Serial No. 73,648.

To all whom it may concern:

Be it known that I, JOHN F. TOOMEY, residing at New York, in the county of New York and State of New York, have invented certain Improvements in Systems for Observing Telephone Service, of which the following is a specification.

My invention relates to systems for observing the conduct of operators in the performance of their duties in connection with a group of telephone lines. It is specially directed to means in such a system for informing an observer of acts connected with toll devices, as in collecting and refunding coins deposited at coin box substations and in recording calls upon a message register, to means for preventing disturbances in the observing circuit from being transmitted to the observed operator and to the adaptation of observing systems for use with machine ringing apparatus.

In the accompanying drawings, Figure 1 shows the equipment individual to one of a plurality of substation lines, the service of which is to be observed, together with an operator's cord circuit for coöperation with said line; and Fig. 2 illustrates the apparatus common to all the lines of the observed group and individual to the observing trunk.

A line L of a group under observation appears terminating at an answering jack J and multiple jacks 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 and the latter having in parallel with it the service meter or message register m . At some convenient point, as the distributing frame, there may be temporarily connected to the substation line, as is indicated at the terminals t , a service observing line provided with the initiating relays R^2 and R^3 , 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 R^3 may also be effected by an

operator's initiating relay R^4 which is in parallel with the cut-off relay. When the secondary initiating relay R^3 is energized in either of the ways mentioned, it causes the trunk-seizing relays R^5 , R^6 and R^7 to become active, this bringing about the coöperation of the line and disengaged trunk. A sluggish lock-out relay R^8 , when energized as a result of the trunk being in use, prevents this appropriation of the trunk by the relays R^5 , R^6 and R^7 . 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, L^2 , L^3 , L^4 , L^5 and L^6 , lead through to the distant observing station, which may be at another office B . Of these trunk conductors, L^2 and L^3 are talking and the remainder controlling conductors. In the talking conductors is the customary repeating coil I and a retardation coil D , the latter preventing the trunk from absorbing an undue amount of energy from the line, and thus reducing transmission, and also tending to shield the line against inductive disturbances originating in the trunk.

At the office A , individual to the trunk and therefore common to the lines under observation, is a subscriber's relay R^9 operated by current over the observed line when the receiver is removed from its hook, this circuit being through the back contacts of quick-acting relays R^{90} and R^{91} . Relay R^{90} is joined to the tip side of the trunk between the winding 72 of a repeating coil I and the usual condenser c . Relay R^{91} is in parallel with condenser c , and has in series with it a condenser c' so that it is operated only by ringing current. Associated with the relays just mentioned are also a trunk relay R^{10} which determines whether the trunk-seizing or lock-out relays shall receive current, repeating relays R^{100} , R^{101} which interrupt the direct conductive continuity of certain of the local conductors of the observing trunk for reasons which will appear when the operation of the system is described in detail, a register relay R^{102} , an indication initiating relay R^{11} putting into effect the identification of the observed line, and indicator controller relays R^{12} and R^{13} .

Relay R^{102} responds to the relatively high voltage employed to actuate the register m and connects to the trunk an interrupter Q or other signaling means for indicating to the observer that the operator has registered a call. Relays R^{12} and R^{13} , acting in succession in consequence of the operation of relay R^{11} , govern the holding magnet H , and through the stepping relay R^{14} 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 well known step-by-step automatic selector, in which a brush s is moved by ratchet mechanism s' over fixed contacts s^2 under the influence of the motor magnet M . A pawl s^3 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 s^4 returns the brush to normal. A test relay R^{15} 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 opposite ends of the trunk are observation limiting relays R^{160} , 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.

The operator's position at central station A is equipped with a suitable number of cord circuits, the essential portions of one of which are illustrated at C in Fig. 1. Considering only the elements which more intimately concern the present invention, there are the plugs p and p' for respectively coöperating with the answering jack J of an observed calling line and the multiple jacks J' of an observed called line. A key k joins to the cord circuit a source of current of a voltage higher than the talking battery, say 39 volts, to actuate the message register m . Coin collect and refund keys k' and k^2 open the cord conductors and respectively apply positive and negative high voltage current, which may be 110 volts, to the answering end of the cord to direct a coin deposited by a subscriber, either to the till of the coin box or to the refund chute. There is superimposed upon this steady current from both sources by means of the transformers T and T' , intermittent current produced by interrupters q and q' so arranged that they send out characteristic tones serving to indicate the application of the collecting and refunding current to the calling line. An operator's coin collect and refund signal o is controlled by relays r^3 and r^4 , having their windings in series with the secondary wind-

ings of the transformers T and T' , respectively. The cord circuit is equipped with the customary machine ringing apparatus which automatically transmits alternating current to the called line when the plug p' is inserted in one of its jacks. This apparatus comprises an interrupter q^2 through which alternating and direct current are alternately made available for ringing and tripping purposes through the agency of a ringing relay r and tripping and locking relays r' and r^2 .

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} operated through front contacts of the repeating relays R^{100} and R^{101} , respectively. Relay R^{17} under the influence of relays R^2 and R^9 and relay R^{18} 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 the brush s^5 is movable into engagement with a series of contacts s^6 joined to a like series of lamps l^3 , respectively corresponding to 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, which may consist of the self-interrupting relays R^{200} and R^{201} , furnishes the stepping impulses to both stepping relays. The observer is provided with keys K , K' and K^2 . The first when actuated joins the operator'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 keys K' and K^2 , when closed, respectively permit either an originating or a terminating call to be observed.

Considering the operation of the system in detail and assuming the contacts of the keys K' and K^2 to be open 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 secondary initiating relay

R³. Further assuming that there is no line of this group under observation and that the resting contacts of the lock-out relay R⁸ are therefore closed, there is a circuit from contact 11 of relay R³ through contact 12 of lock-out relay R⁸ and conductor 13 to the point 14, then in parallel through the windings of the trunk-seizing relays R⁵ and R⁶ to a point 15, on by way of contact 16 of relay R⁶, the lead 17 of the service observing line and through the back contact 18 of trunk relay R¹⁰. The front contact 19 of relay R³ 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 R¹⁷, there being first a circuit through the front contact 10 of relay R², conductor 20, front contact 21 of relay R⁵, lead 22, and winding of repeating relay R¹⁰⁰. This closing its front contact provides a second circuit on by way of conductor 80, winding 23 of the trunk repeating coil I, trunk conductor L³ and winding of relay R¹⁷, the attracted armature of this subscriber's signal relay supplying current to the lamp L'. 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 L² and L³ 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 R⁵ removes a short circuit 29 from the windings of relay R⁷, preparing it for operation. At front contact 30 of this relay a path for current to control the operator's signal relay R¹⁸ through repeating relay R¹⁰¹ is made ready, this, however, awaiting the energization of the operator's relay R⁴. Contact 31 of relay R⁵ joins to the point 14 in the parallel circuit of relays R⁵ and R⁶ an armature of controller relay R¹³, through which later battery may be applied independently of the connection through contact 12 of the lock-out relay R⁸. When relay R⁶ operated simultaneously with relay R⁵, it locked this pair of relays through contact 32, lead 33 and winding of trunk relay R¹⁰ 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 R⁶ of the group in series, but as this relation does not directly concern the present invention, it will not be further considered. Resting contact 36 of relay R⁶ in the path between the front contact of trunk relay R¹⁰ and the winding of lock-out relay R⁸ is opened, this not being used when the trunk is idle, and said relay R⁸ is joined at front contact 37

to lead 38 and the armature of observation limiting relay R¹⁶. This allows the keys K' and K² when operated to exercise their control. At contact 35 of relay R⁶ 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 s² 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 R¹⁰ to said contact.

When trunk relay R¹⁰ receives current through the locking circuit of relays R⁵ and R⁶, as already described, it operates and at its contact 41 completes a circuit through the winding of the indication initiating relay R¹¹ and the normal contact 42 of the indicator controller S. Relay R¹¹ 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 R¹², trunk conductor L⁶, 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 R²⁰. The front contacts 48 and 49 of relays R¹² and R²⁰ thereupon cause the energization of the secondary indicator controller and indicator relays R¹³ and R²¹, respectively. At contact 49 the pulsator relays R²⁰⁰ and R²⁰¹ are likewise started in operation. Front contact 50 of relay R²¹ by short circuiting contact 47 provides for the continued energization of relay R²⁰ after the indicator leaves its normal position. Contacts 51 and 52 of relays R¹³ and R²¹ close local circuits through resistances ω and ω' for the holding magnets H and H', which apply the pawls s³ of the indicator controller and indicator to the ratchet mechanism. There is also a circuit from the pulsator relays R²⁰⁰ and R²⁰¹ through front contact 53 of relay R²¹, indicator stepping relay R¹⁹, conductor 54, contact 27 of key K, trunk conductor L⁵, controller stepping relay R¹⁴, back contact 56 of test relay R¹⁵ and front contact 55 of relay R¹³. The relays R¹⁴ and R¹⁹ 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 brushes s and s⁵ in synchronism until the former touches the contact s² belonging to the line which is connected with the trunk. Current thereupon flows through the winding of relay R¹⁵, brush s, contact s², lead 40 of the service observing line, contact 39 of relay R⁶, lead 33 and winding of relay R¹⁰. Test relay R¹⁵ severs the stepping circuit at contact 56 stopping both the indi-

cator controller and indicator. The brush of the latter supplies current to the lamp l^3 corresponding to the line which is connected to the trunk, the illumination of said lamp informing the observer what line is under observation.

In addition to rendering the holding magnet 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 maintained 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 p of cord circuit C 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 up to this time 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. Contact 81 joins register relay R^{102} in parallel with the cut-off relay and therefore with the register m , but being marginal relay R^{102} remains inert. The contact 57 also supplies current to the repeating relay R^{101} through lead 63 and contact 30 of relay R^5 . Relay R^{101} thereupon causes the energization of the operator's signal relay R^{18} by way of trunk conductor L^2 , winding 62 of the repeating coil I and conductor 82. This displays the operator's signal l^2 and the observer thereby knows that the operator has answered. The release of relay R^2 would also cause the retraction of the armature of relay R^{100} and 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 back contacts of relays R^{90} and R^{91} , winding 89 of the latter, the winding 72 of repeating coil I, lead

60, winding of the coil D, 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 C with which the operator has answered. Repeating relay R^{101} , and also relay R^{100} previously referred to in connection with the display of the subscriber's signal l' , assist in preventing various disturbances incident to the operation of the system, chiefly those induced in conductors of the service observing line and trunk from adjacent conductors, from being transmitted over the line and cord to the observed operator. These relays completely interrupt the direct connection between talking conductors L^2 and L^3 in which are included the windings of the signal relays R^{17} and R^{18} and the apparatus of the service observing line which control the operation of the last named relays, the relays R^{100} and R^{101} repeating effects from one section on the line to another and into the trunk. Because of this, no current variations in the leads 22 and 63 not strong enough to energize and deenergize the repeating relays can influence the trunk conductors L^2 and L^3 . Moreover, because of the location of relays R^{100} and R^{101} , permitting the conductors 80 and 82 to be of equal lengths and run together, and since there is no apparatus included in these conductors, their impedances may be kept equal. Consequently, any currents induced in the trunk conductors L^2 and L^3 , tending in their flow to ground through the front contacts of relays R^{100} and R^{101} to be transmitted back through repeating coil I over the observed line, will neutralize one another's effects in the windings 23 and 62 of the coil, and will not reach the observed operator.

If the substation line, the service of which is being observed, is provided with a prepayment coin box, the operator having determined whether or not connection can be obtained will depress either the key k' or k^2 in the cord circuit C. The one actuated, in addition to either collecting or refunding the deposited coin, will cause the tone produced by the interrupter q or q' to pass through the tip contacts of plug p and jack J, contact 58 of trunk-seizing relay R^7 , service observing lead 60, a winding of retardation coil D, back contact 83 of register relay R^{102} , winding 72 of repeating coil I and the windings of relay R^{90} in series. This will induce a like tone in the repeating coil winding 62 which will be communicated over the service observing trunk to the observer's telephone. The observer will thereby be informed of the time and character of the act. If, instead, the substation calling and under observation were given measured service, the operator when the wanted connection was obtained would close the contacts of the register key k . The current from the

volt source then flows through the sleeve contacts of the plug *p* and jack *J* and is of sufficient strength to actuate the register *m*. It also energizes relay R^{102} by way of front contact 81 of relay R^7 and conductor 85. Contacts 83 and 84 of register relay R^{102} open the talking conductors of the trunk and at contacts 86 and 87 connect the interrupter *Q* in circuit with the windings 72 and 88 of the repeating coil *I*. Intermittent current induced in the associated windings of the coil is communicated to the observer's telephone so she knows that the call has been recorded.

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 R^4 . The latter breaking its contact 57 releases in turn relays R^{101} and R^{18} and the operator's signal *l*² ceases to glow. The opening of contact 57 also releases relays R^3 and R^7 . The former severs the originating circuit of the relays R^5 and R^6 at contact 11, though these relays are still held up by relay R^{13} over lead 45'. When the observer frees the key *K*, it deprives the relays R^{12} and R^{20} of current by the interruption of their circuit at contact 26 and they break the circuits of relays R^{13} and R^{21} . 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 R^{15} falls off when the brush of the indicator controller leaves the contact joined to lead 40. The opening of contact 45 of relay R^{13} releases relays R^5 and R^6 , and the latter breaks the circuit of trunk relay R^{10} which releases relay R^{11} . 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 *J'*. Under such conditions the cut-off relay R^7 and the relay R^4 in parallel are first operated. Contact 57 is closed by relay R^4 and relays R^3 and R^7 receive current in series, the former through its upper winding. For a time relay R^7 remains inert because of the presence of the short circuit 29. As a result of the making of contact 11 of relay R^3 , trunk relays R^5 and R^6 are energized, and the display of the operator's signal *l*² follows the closure of contact 30 of relay R^5 and operation of re-

lays R^{101} and R^{18} . The opening of contact 28 of relay R^5 removes the short circuit from relay R^7 , which completes the talking leads. This, it will be noted, follows the energization of relays R^5 and R^6 , 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 R^6 renders trunk relay R^{10} active, and when the observer throws the key *K* the various relays of the indicator controller and indicator will be energized and the lamp *l*³ of the called line will be lighted by the indicator. Relay R^9 responds to the closure of the substation switch hook when the called subscriber answers, and operating relay R^{17} lights the subscriber's lamp *l'* at the observing desk. The description of the release of the apparatus for an originating call is applicable to the present case.

The calling end of the cord used in the previous connection having machine ringing equipment, as has been described, with the winding of the subscriber's relay R^9 united directly to the trunk without interposed means for preventing such an effect, the low impedance path thereby offered to ground would allow the operation of relay r' in the cord and the premature disconnection of ringing current from the called line. The circuit of this relay r' would be through interrupter *q*², contact 88 of ringing relay r , tip contacts of the plug *p'* and jack *J'*, contact 58 of relay R^7 , service observing lead 60, winding of the retardation coil *D*, contact 83 of relay R^{102} , winding 72 of the repeating coil *I* and the winding of relay R^9 to ground. In the circuit of the present invention, however, during the silent interval, the direct tripping current flowing by way of low resistance winding 89 of relay R^{90} , contact 90 of said relay, contact 91 of relay R^{91} and winding of relay R^9 operates relay R^{90} , severing the low impedance path previously traced at contact 90, so that the tripping relay is not energized. Relay R^{90} maintains the attraction of its armature by current through its high resistance locking winding 92. This is not sufficient to operate the tripping relay. During the ringing interval the relay R^{91} in parallel with the condenser *c* receives the alternating ringing current, which traverses the condenser *c*. Relay R^{91} attracts its armature and by opening contact 91 breaks the circuit of the tripping relay. Interference with the action of the machine ringing apparatus by the connection of the observing system is therefore entirely avoided.

The relay R^{90} also performs a function in connection with the operation of the coin box similar to that for the ringing apparatus. Were the path through relay R^9 left unbroken when 110 volt current is applied to the tip side of the line to actuate the coin

box mechanism, it would constitute a low impedance connection for it and for the relays r^3 and r^4 controlling the coin box signal ϕ which would interfere with their operation. With the observing circuit as here organized, this current as just described energizes relay R^{90} to open this low impedance connection at contact 90 and substitute the holding connection of high impedance which will not affect either the coin box or its signal relays.

In either an originating or terminating call, if the observing trunk had already been connected to a line when the subscriber on line L called or is called, the trunk relay R^{10} would be found energized. Therefore, upon the operation of relay R^3 associated with line L, instead of a circuit through back contact 18 for energizing the trunk-seizing relays R^5 and R^6 there would be a circuit through front contact 41 by way of lead 65, resting contact 36 of relay R^6 , conductor 66, resting contact 67 and winding of lock-out relay R^8 , resistance α^2 and front contact 19 of relay R^3 . Relay R^8 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 R^8 breaks the originating circuit for the trunk-seizing relays R^5 and R^6 . Consequently, the line is locked off the trunk until a new call is made and the trunk is found idle. Since relay R^8 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.

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 actuated, joining the winding of relay R^{100} in parallel with the operator's signal l^2 at contact 69 and at contact 94 disconnecting such relay from the key K^2 . Now when the subscriber upon a line of the 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 R^{18} as hereinbefore described, there is closed at the front contact a path for relay R^{100} through contact 69 of key K' . Relay R^{100} over trunk conductor L^4 energizes the observation limiting relay R^{16} . Relay R^{16} attracts its armature and completes a circuit for the lock-out relay R^8 , this passing through conductor 38, front contact 37 of relay R^6 , lead 66, resting contact 67 of relay R^8 , winding of said relay, resistance α^2 , and front contact 19 of relay R^3 . Relay R^8 locks itself

through 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 relay R^{101} and therefore from the operator's lamp l^2 before the latter has time to glow, so the observer receives 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 a busy trunk.

If the call had instead originated upon the line, the operation proceeds as though the key K' were in its normal position until the operator in answering inserts the plug 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, 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 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^{10} closes its front contact upon the response of the operator and the energization of the operator's signal relay R^{18} and relay R^{100} , 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^2 would be thrown to close contact 71. The effect is similar to that just described, in the present instance the relay R^{100} being operated by the subscriber's signal relay R^{17} in parallel with the lamp l' through contact 94 of key K' . This causes the relay R^8 to lock out all originating calls. Upon a terminating call, if the observer 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 relays R^{100} and R^{16} and the line which seized the trunk will be disconnected 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.

Having thus described my invention, I claim:

1. The combination with a line the service of which is to be observed, of a service observing system comprising observation controlling electro-mechanisms, conductors connecting the line and observing station, conductors for uniting the electro-mechanisms with one another and with the line, one of the conductors being in sections, and means for repeating electrical impulses from one of the sections to another, said means being responsive to the currents peculiar to service observation and irresponsive to disturbing currents.

2. The combination with a line the service of which is to be observed, of a service observing system comprising observation controlling electro-mechanisms, trunk conductors connecting the line and observing station, local conductors for uniting the electro-mechanisms with one another and with the trunk conductors and line, one of the local conductors being in sections, and means for repeating electrical impulses from one of the sections to another, said means being responsive to the currents peculiar to service observation and irresponsive to disturbing currents.

3. 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 station, conductors for uniting the electro-mechanisms with one another and with the trunk conductors and line, one of the conductors being in sections, and electro-mechanical means for repeating electrical impulses from one of the sections to another, said means being energized by the currents peculiar to service observation and irresponsive to disturbing currents.

4. 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 station, conductors for uniting the electro-mechanisms with one another and with the trunk conductors and line, one of the conductors being in sections, and a relay having its winding included in one of the sections and its contacts in another of the sections.

5. The combination with a line the service of which is to be observed, of a service observing system comprising observation controlling electro-mechanisms, trunk conductors connecting the line and observing station and including talking conductors, local conductors uniting the electro-mechanisms with the talking conductors, and repeating apparatus included in said local conductors.

6. 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 station and including talking conductors, a local conductor uniting one of the electro-mechanisms with a talking conductor and being in sections, and a relay having its winding in one section and its contacts in another section.

7. 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 station and including talking conductors, a local conductor uniting one of the electro-mechanisms with a talking conductor and being in sections, and repeating means between the sections interrupting their conductive continuity, the sections of the conductors between the repeating means and talking conductors being of substantially equal impedance.

8. In a service observing system, a central station at which is an operator's position, an observed line terminating at said position, a toll apparatus associated with the line, an observing station adapted to be connected with said line, and means depending upon the operation of the toll apparatus for producing a signal at the observing station.

9. In a service observing system, a central station at which is an operator's position, an observed line terminating at said position, a toll apparatus associated with the line, an observing station adapted to be connected with said line, and tone generating means controlled with the toll apparatus for producing a signal at the observing station.

10. In a service observing system, a central station at which is an operator's position, an observed line terminating at said position, a toll apparatus associated with the line, an observing station adapted to be connected to said line, a connecting circuit for the line, means included in the connecting circuit for controlling the toll apparatus, and means dependent upon the actuation of the controlling means for producing a signal at the observing station.

11. In a service observing system, a central station at which is an operator's position, an observed line terminating at said position, a register connected therewith, a service observing station adapted to be connected with said line, and means for producing a signal at the observing station upon the operation of the register.

12. In a service observing system, an observed line, a register connected therewith, a service observing station, a trunk joining the line and service observing station, means for producing a signal at the observ-

ing station, and controlling means for the signal associated with the trunk, said controlling means being operated in the operation of the register.

5 13. In a service observing system, an observed line, a register connected therewith, a service observing station, a trunk joining the line and service observing station, means for producing a signal at the observing station, controlling means for the signal associated with the trunk, and means for joining the line and trunk, said means also connecting the register and controlling means and the controlling means being operable in the operation of the register.

10 14. In a service observing system, an observed line, a register connected therewith, a service observing station, a trunk joining the line and service observing station, means for producing a signal at the observing station, and a relay energized with the register and thereupon opening the trunk and connecting the signal producing means to the observing station.

15 15. In a service observing system, an observed line, a register connected therewith, a service observing station, a trunk joining the line and service observing station, a relay energized with the register and controlling the continuity of the trunk at its back contacts, and a source of tone connected to the observing station through the front contacts of the relay.

20 16. In a service observing system, a central station at which is an operator's position, an observed line terminating at said position, a coin collecting apparatus connected with the line, an observing station adapted to be connected with said line, means for controlling the disposition of a coin and means under the influence of the controlling means for producing a signal at the observing station.

25 17. In a service observing system, a central station at which is an operator's position, an observed line terminating at said position, a coin collecting apparatus connected with the line, an observing station adapted to be connected with said line, controlling means for causing a coin supplied to the apparatus to be deposited or refunded, and a plurality of signaling means for indicating at the observing station the operation of the controlling means.

30 18. In a service observing system, an observed line, a prepayment coin box associated therewith, a connecting circuit having deposit and refund keys, said keys applying current of different characteristics to the line in the operation of the coin box, an observing station, and means at the observing station for transforming the currents into distinguishable signals.

35 19. In a service observing system, an observed line, a prepayment coin box associ-

ated therewith, a connecting circuit having deposit and refund keys, sources of depositing and refunding current for the coin box connected through the keys, means for superposing different tone producing currents upon the depositing and refunding current, an observing station, and means for communicating the different tone producing currents to the observer.

40 20. The combination with a service observing station and a line to be observed, of a trunk connecting the line and station, observation controlling apparatus, a path for current through the observation controlling apparatus joined to a conductor of the trunk, and means for opening said path when currents possessing particular characteristics are applied to the line.

45 21. The combination with a service observing station and a line to be observed, of a trunk connecting the line and station, observation controlling apparatus, a path for current through the observation controlling apparatus joined to a conductor of the trunk, and means responsive to current of relatively high voltage for opening the path.

50 22. The combination with a service observing station and a line to be observed, of a trunk connecting the line and station, observation controlling apparatus, a path for current through the observation controlling apparatus joined to a conductor of the trunk and a plurality of instrumentalities responsive to current of different characteristics to open the path.

55 23. The combination with a service observing station and a line to be observed, of a trunk connecting the line and station, observation controlling apparatus, a path for current through the observation controlling apparatus joined to a conductor of the trunk, and a plurality of instrumentalities responsive to alternating and direct current to open the path.

60 24. The combination with a service observing station and a line to be observed, of a trunk connecting the line and station, observation controlling apparatus, a path for current through the observation controlling apparatus joined to a conductor of the trunk, and a relay having its winding connected to the trunk and a contact in said path.

65 25. The combination with a service observing station and a line to be observed, of a trunk connecting the line and station, observation controlling apparatus, a path for current through the observation controlling apparatus joined to a conductor of the trunk, and a relay having a low resistance winding and a high resistance locking winding, the low resistance winding being included with the relay contacts in said path.

70 26. The combination with a service observing station and a line to be observed, of

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a trunk connecting the line and station, observation controlling apparatus, a path for current through the observation controlling apparatus joined to a conductor of the trunk, and means responsive to alternating current for opening the path.

In testimony whereof, I have signed my

name to this specification in the presence of two subscribing witnesses, this 18th day of January, 1916.

JOHN F. TOOMEY.

Witnesses:

ALFRED KAUFMANN,
STANLEY FAIRCHILD.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."