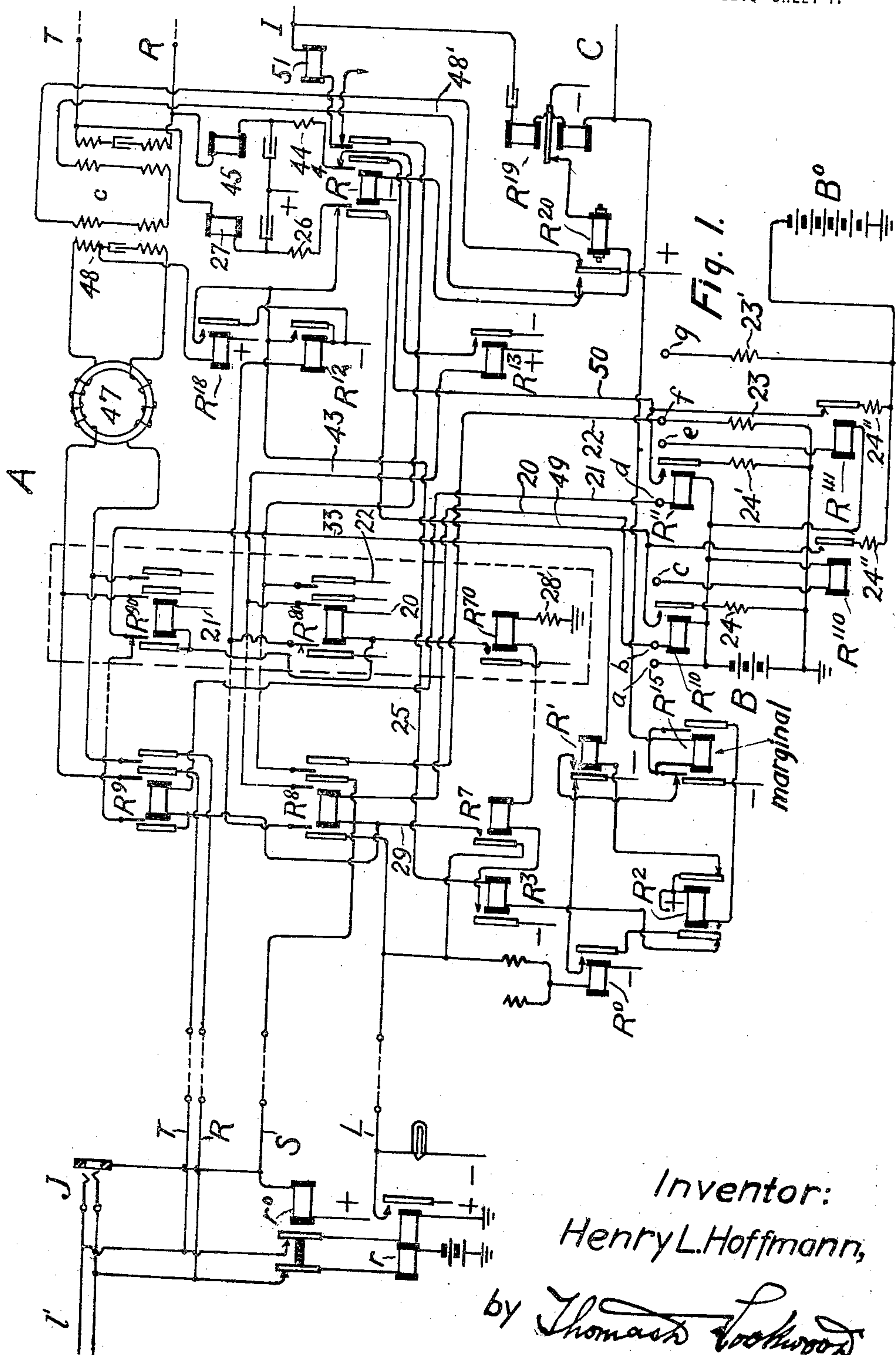


1,245,341.

H. L. HOFFMANN.
SERVICE OBSERVING SYSTEM.
APPLICATION FILED JULY 12, 1916.

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

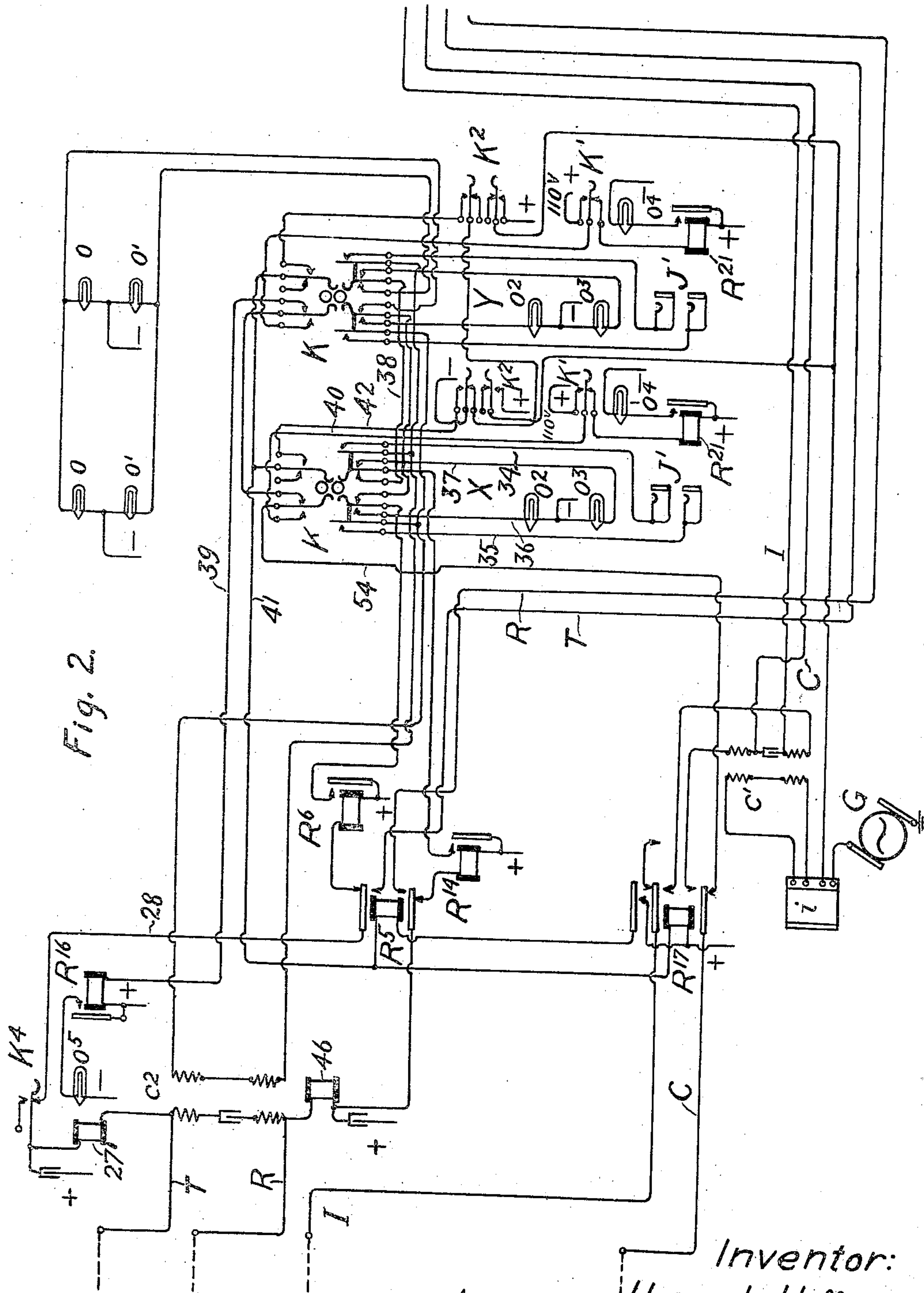


Inventor:
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Atty.

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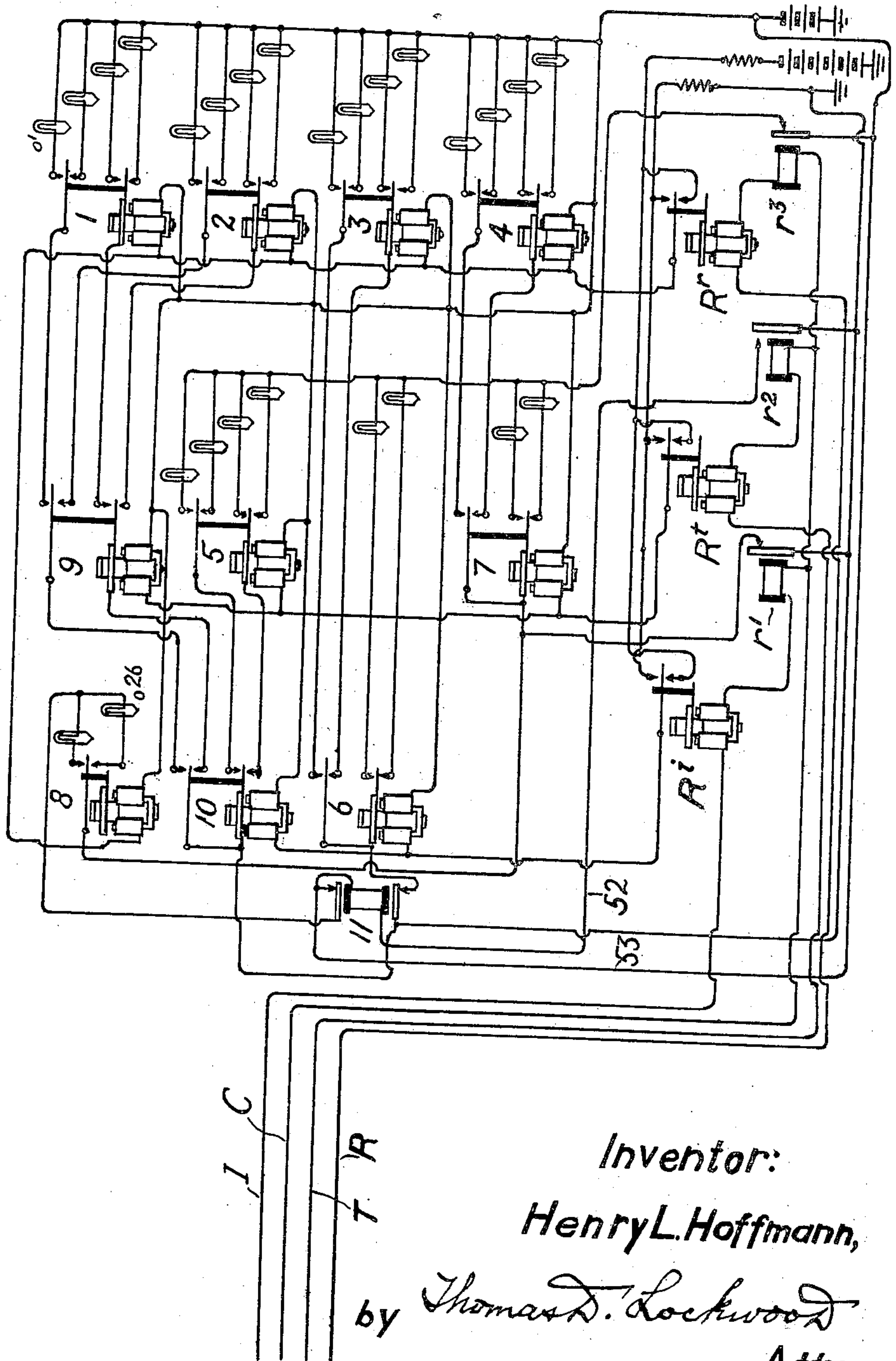
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3 SHEETS—SHEET 3.

Fig. 3.



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UNITED STATES PATENT OFFICE.

HENRY L. HOFFMANN, OF ST. LOUIS, MISSOURI, ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, OF BOSTON, MASSACHUSETTS, A CORPORATION OF NEW YORK.

SERVICE-OBSERVING SYSTEM.

1,245,341.

Specification of Letters Patent.

Patented Nov. 6, 1917.

Application filed July 12, 1916. Serial No. 108,943.

To all whom it may concern:

Be it known that I HENRY L. HOFFMANN, residing at St. Louis, in the city of St. Louis and State of Missouri, have invented certain
5 Improvements in Service-Observing Systems, of which the following is a specification.

In systems as heretofore organized for observing the service upon telephone lines, as
10 illustrated for example in the application of John F. Toomey, filed January 22, 1916, Serial No. 73,648, it has been customary to operate the apparatus for furnishing an identification of the line under observation
15 during the time that the service indicating signals were in use. This has made it necessary to have at least five conductors in the trunk joining the group of observed lines and the observer's positions. By the present
20 invention, I operate the system over a trunk containing but four conductors with considerable resulting economy, this being accomplished by so placing the identifying apparatus under the control of the observer
25 that it can be caused to act at any time during the connection of an observed line to the trunk. I also arrange the line identifying means in such a manner that it can be made effective for a plurality of observers,
30 and provide means to indicate to the observers the connection between the observed line and the trunk.

In the accompanying drawings, Figure 1 shows diagrammatically the central station
35 equipment of a substation line, the service of which is to be observed, together with the outgoing end of a service observing trunk and the associated apparatus; Fig. 2 similarly illustrates the equipment at the incoming extremity of the trunk at a plurality of
40 observers' positions; and Fig. 3 is a diagrammatic representation of line identifying apparatus which may be used in connection with my invention. To show the entire circuit, the sheets should be placed end to end
45 in the order of the figure numbers.

Referring to Fig. 1, a substation line L' terminates at its answering jack J at central station A and has there connected to it
50 the usual line relay r and cut-off relay r^o . For uniting the group of observed lines, of which L' is one, to the positions of the observers, of which two are indicated at X and Y (Fig. 2) and which may be located
55 at a distant central station, an observing

trunk is provided having tip and ring conductors T and R, respectively, over which not only voice currents are transmitted to the observers but also both service indicating currents and line identifying currents. 60 The other conductors I and C of the trunk are employed for the purpose of line identification, that last-named furnishing a common return. At the central station A, associated with the outgoing end of the trunk 65 and common to the observed lines of the group, are relays $R^o, R^1, R^2, R^3, R^4, R^{12}, R^{13}, R^{15}, R^{18}, R^{19}, R^{20}$. Of these relay R^{15} is marginal, being designed to operate upon 110 volt current, while relay R^{19} is operable 70 by alternating current only and is bridged across the trunk conductors I and C. The conductors T and R of the trunk are connected at the central station A through a repeating coil c having intermediate wind- 75 ings included in a loop normally closed at the front contact of relay R^{20} , which is sluggish and is held normally energized through the back contact of relay R^{19} . To the leads 20, 21 and 22, of which there is 80 a set individual to each observed line, are multiplied through the terminals a, b, c, d, e, f and g in different combinations for the different lines the windings of relays R^{10}, R^{11}, R^{110} and R^{111} , resistances 23, 23' and 85 24-volt battery B. The opposite extremities of the windings of these relays are multiplied to battery B, while the armatures of R^{10} and R^{11} are joined through resistances 24 and 24' to the opposite pole of the bat- 90 tery. Resistance 23 is connected directly to said pole. The armatures of relays R^{110} and R^{111} are united through resistances 24'', together with resistance 23', to the free pole of 48-volt battery B^o . The relays R^{10}, R^{11}, R^{110} and R^{111} with the resistances 23, 23', 95 24, 24' and 24'' and batteries B and B^o furnish identification controlling means for the lines. In addition to the relays previously mentioned there are associated with 100 the trunk three series of relays, of which the first in each, R^7, R^8 and R^9 are individual to the line L' while R^{70}, R^{80} and R^{90} , shown as inclosed in a dotted rectangle, may be considered as belonging to the last 105 line of the group under observation, it being convenient with a system arranged as hereinafter described to observe the service of twenty-six substation lines. The complete connections for these relays R^{70}, R^{80} and R^{90} 110

and those between them and the relays R^7 , R^8 and R^9 in each of the three series are not illustrated, but correspond to those for the line V' .

5 With the incoming end of the trunk (Fig. 2) are associated relays R^5 , R^6 , R^{14} , R^{16} and R^{17} . There is also a relay R^{21} for each observing position. An interrupter i may be operated from a generator G to apply alternating current through a repeating coil c' to the trunk conductors I and C . A repeating coil c^2 inductively unites the talking conductors T and R at this extremity of the trunk.

15 At each of the observing positions X and Y is a key K , which when actuated by the observer serves to transfer the display of subscriber's and operator's service indicating signals, shown as lamps O and O' which are illuminated at all the observing positions in response to the acts of the subscriber and operator, to corresponding signals O^2 and O^3 individual to her position. These keys also connect the position equipment to the trunk, this including a head telephone for the observer connected to the jack J' , a line identifying key K^2 , a release key K' and a guard signal O^4 controlled by the relay R^{21} . A second guard signal O^5 , visible at all the observing positions, is governed by the relay R^{16} . A night key K^4 may be opened and there locked to disconnect the observing equipment from the trunk when the observing positions are unoccupied.

Common to the observing positions is some suitable indicating apparatus, such as appears in Fig. 3, in which some one of a bank of twenty-six lamps o^1 to o^{26} , inclusive, is illuminated to show the observers which of the group of lines under observation is at the time joined to the observing trunk. The identifying apparatus is brought into action by the relays R^{17} and R^5 controlled by the key K^2 of any observer, and then has under the influence of the identification controlling means at the opposite extremity of the trunk a set of selecting relays R^1 , R^4 , R^7 , r^1 , r^2 and r^3 , the first three of which are polarized. These relays, energized in various combinations, in turn energize a group of polarized relays 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10 and a neutral relay 11, and for each group, the armatures of which are thus attracted, a path is closed to supply current to a particular one of the lamps o^1 to o^{26} .

The functions of the various pieces of apparatus, as far as they concern this invention, will appear in the following description of operation of the system: When a call is originated on a substation line under observation, as V' , the line relay r operates, lighting the line lamp and energizing in parallel therewith the relay R^9 of the service observing trunk. Relay R^9 through its

front contact closes a path from battery through the back contacts of relays R^1 and R^2 , the winding of relay R^3 , conductor 25, back contact of relay R^4 , resistance 26, retardation coil 27, conductor T of the trunk, retardation coil 27', night key K^4 , conductor 28, upper back contact of relay R^5 and the winding of relay R^6 , causing relays R^3 and R^6 to attract their armatures. The operation of relay R^6 closes a circuit through normal contacts of the keys K in series and in parallel through the subscriber's signals O at the various service observing positions, as X and Y , at which the trunk is multiplied lighting all of them, thus serving to notify the observers that a call has been originated. The energization of relay R^3 applies battery to the windings of the series of relays R^7 to R^{10} associated with the observed lines, operating them through resistance 28'. These relays, as is shown by R^7 , connect relays R^8 and R^9 and the others of each set through conductor 29 to the corresponding leads L of the lines to which they belong. The line V' on which the call originated will have battery connected to its lead L at the line relay r , thus giving a circuit for the corresponding relays R^8 and R^9 by way of conductors 20 and 21 in series respectively with relays R^{10} and R^{11} . Relay R^8 at its left-hand front contact gives a path for current from lead L to relay R^{12} , which attracts its armature connecting battery to conductor T of the trunk. This short circuits and releases relay R^3 , which breaks the circuit of relay R^7 and the companion relays of the set causing their deenergization. The release of these relays prevents the appropriation of the trunk by other lines until an observer has released it from line V' . Relay R^8 at its middle front contact connects the lead S of the substation line V' to the winding of the relay R^{13} , preparing a path for transmitting the operator's signal to the observers. At its right-hand front contact relay R^8 joins lead 22 to the right-hand armature of relay R^4 , for a purpose which will be explained later. Relay R^9 at its right hand and middle front contact closes the ring and tip leads R and T from the substation line to the corresponding conductors of the service observing trunk. At its left-hand front contact relay R^9 provides a locking circuit for itself and relay R^8 , in series through the resting contacts of the set of relays to which R^9 belongs, conductor 33, winding of relay R^1 and the back contact of relay R^2 . Relay R^1 , holding open a break in the circuit of relay R^3 , renders it impossible for the latter to cause the connection of another calling line with the trunk. A disengaged observer, as at position X , upon noticing the subscriber's signal O connects her equipment to the service observing trunk by operating key K . This joins her

telephone receiver to the conductors R and T by way of conductors 34 and 35, transfers the subscriber's signal to the signal O^2 at her position, and by uniting conductor 37 to the front contact of relay R^{14} prepares for the display of the operator's signal O^3 at the observing position X, instead of the operator's trunk signal O' which would receive current over conductor 38. It also transfers the conductor C of the trunk from conductor 39 and the guard relay R^{16} to release key K' through conductor 40 and connects the winding of relay R^{17} through conductors 41 and 42 to the indicating key K^2 .

When the A operator answers the call upon line L' by connecting the usual A cord circuit to the jack J, battery is applied through the sleeve strand of the cord to the sleeve lead of the substation line, operating the cut-off relay r^0 and relay R^{13} of the service observing trunk in parallel with said cut-off relay by way of the middle front contact of relay R^8 and conductor 43. There is now a circuit through the front contact of relay R^{13} , the middle normal contact of relay R^4 , resistance 44, retardation coil 45, conductor R of the trunk, retardation coil 46, lower back contact of relay R^5 and the winding of relay R^{14} , operating the latter, which in turn lights the operator's signal O^3 at position X through conductor 37, as previously indicated. In addition, current is supplied from the A cord through the subscriber's line to conductor T of the service observing trunk, middle front contact of relay R^9 , upper winding of retardation coil 47, winding 48 of repeating coil c and the winding of relay R^{18} . This relay R^{18} thereupon connects battery to the tip conductor of the trunk and conductor 28 to hold relay R^6 and consequently the subscriber's signal O^2 at position X operated. Since relay R^{18} receives its energizing current through the subscriber's set, both it and the subscriber's signal O^2 respond to the movement of the subscriber's switch hook. Similarly the operator's signal O^3 follows the operator's plug under the influence of relay R^{13} . These service indicating operations, it will be noted, are controlled over the talking conductors T and R of the trunk.

When the observer wishes to identify the line which is under observation, she may actuate the indicating key K^2 . This operates relay R^{17} through a contact of key K and conductors 41 and 42. Relay R^{17} at its lower and middle front contacts connects the conductors I and C of the trunk through the secondary windings of repeating coil c' to the corresponding leads of the indicating apparatus. At its upper front contact relay R^{17} connects the winding of relay R^5 in parallel with its own winding. Relay R^5 , thus energized, joins conductors R and T

of the trunk to the leads R and T of the indicating apparatus. Key K^2 also closes a circuit including generator G and interrupter i , setting the latter in operation. High frequency current now passes from the interrupter through the windings of the repeating coil c' over conductors C and I of the trunk to relay R^{19} , which at its back contact breaks the circuit of normally operated relay R^{20} . The release of relay R^{20} opens at its front contact the loop 48' including the intermediate windings of the repeating coil c , thus preventing any clicks or disturbances, which would warn the operator that she was being observed, from being transmitted back over the trunk during the operation of the line identifying apparatus. At its back contact relay R^{20} causes the energization of relay R^4 . The latter disconnects conductors T and R of the trunk from their service indicating circuits, and unites them through conductors 49 and 50 and the front contacts of relays R^{10} and R^{11} , respectively, to the resistances 24 and 24'. Relay R^4 also connects conductor I through the right-hand front contact of relay R^8 and conductor 22 to resistance 23.

There are now three circuits established from the identification controlling apparatus through the trunk apparatus to the line identifying apparatus: (1) resistance 24, front contact of relay R^{10} , conductor 49, left-hand front contact of relay R^4 , resistance 26, retardation coil 27, conductor T of the trunk, retardation coil 27', key K^4 , conductor 28, upper front contact of relay R^5 , lead T of the indicating apparatus, windings of relays R^t and r^2 , back over the lead and trunk conductor C, secondary winding of the repeating coil c' , lower front contact of relay R^{17} , winding and left-hand normal contact of relay R^{15} and front contact of relay R^1 ; (2) resistance 24', front contact of relay R^{11} , conductor 50, middle front contact of relay R^4 , resistance 44, retardation coil 45, conductor R of the trunk, retardation coil 46, lower front contact of relay R^5 , lead R of the indicating circuit, relays R^r and r^3 and back over the conductor C as just described; and (3) resistance 23, conductor 22, right-hand front contact of relay R^8 , right-hand front contact of relay R^4 , retardation coil 51, conductor I of the trunk, middle front contact of relay R^{17} , secondary winding of repeating coil c' , lead I of the indicating apparatus, relays R^i and r^1 and back over conductor C. With these connections current flows from the central station A over the trunk conductors T, R and I to the service observing positions and back over conductor C to the central station in the right direction to operate the polarized selecting relays R^i , R^t , R^r in the identifying apparatus in such a direction as to make their upper contacts. Selecting relays r^1 ,

r^2 and r^3 of the indicating apparatus also operate. With this combination of selecting relays energized there are circuits which cause the polarized relays 1 to 10, inclusive, to close their upper contacts. Relay 11 is also operated over conductors 52 and 53 by way of the front contact of relay r^2 . With these identifying relays energized lamp o' , and that only, receives current through contacts of relays 1, 9 and 10, identifying line number 1 as under observation. If another observed line were connected to the trunk, the leads 20, 21 and 22 of said line would be connected to the identification controlling means in a different manner so that another combination of the polarized relays of the line identifying apparatus would operate, selecting the corresponding lamp. For these line identifying operations the talking and service indicating conductors T and R have been employed, together with the other two conductors I and C of the trunk.

When the observer has finished the observation, she releases the line by actuating key K' , which connects 110-volt current over conductors 40 and 54, lower back contact of relay R^{17} , conductor C, the winding and left-hand normal contact of relay R^{15} and the front contact of relay R^1 . Relay R^{15} , which is responsive only to 110 volts, is energized, locking itself at its left-hand front contact to hold operated after relay R^1 is released, and providing a circuit through its right-hand front contact for relay R^2 . The latter at its right-hand back contact opens the locking circuit of relays R^1 , R^8 and R^9 , releasing them. Relay R^2 at its left-hand back contact opens the circuit of relay R^3 , thus preventing a signal from coming in during the operation of release, and at its front contact connects the armature of relay R^0 and the winding of relay R^2 . Thus, if a call had originated on some other line just before the observer had released, relay R^2 would remain locked up until the call had been answered and the observer would receive no indication of this call.

If, having taken up the call and completed the observation, the observer fails to restore key K and to release the line connected to the trunk by actuating the key K' , relay R^{21} is energized through the normal contact of key K' , make contact of the observer's key K and break contacts of the other keys K, and on over the release circuit including conductor 54, lower back contact of relay R^{17} , conductor C, winding and left-hand normal contact of relay R^{15} and front contact of relay R^1 . Relay R^{21} at its front contact supplies current to the guard lamp O^4 , the resulting lighting of which indicates to the observer her oversight. When, a line having been connected to the observing trunk, no observer takes up the call, there is a circuit for relay R^{16} after the call has

been completed, by way of conductor 39, normal contacts of the keys K in series and then through conductor 54 and the release circuit as just indicated. Relay R^{16} is energized and causes the illumination of guard lamp O^5 . This shows the observers that a key K' should be operated to release the line from the trunk.

I claim:

1. The combination with a telephone line the service of which is to be observed, of a service observing position, conductors connecting the telephone line and observing position, service indicating means and line identifying means at the observing position, means joined to the connecting conductors for controlling the service indicating means, and means joined to the same conductors for controlling the line identifying means.

2. The combination with a group of telephone lines the service of which is to be observed, of a service observing position, a trunk for connecting any line of the group with the observing position, means at the observing position for indicating the character of the service and for identifying the line under observation, and means joined to the same trunk conductors for controlling the indicating and identifying means.

3. The combination with a telephone line the service of which is to be observed, of a service observing position, conductors connecting the telephone line and observing position, service indicating means and line identifying means at the observing position, means joined to the connecting conductors for controlling the service indicating means, means joined to the same conductors for controlling the line identifying means, and means operable at the observing position for rendering either of the controlling means effective.

4. The combination with a group of telephone lines the service of which is to be observed, of a service observing position, a trunk for connecting any line of the group with the observing position, means at the observing position for indicating the character of the service and for identifying the line under observation, means joined to the same trunk conductors for controlling the indicating and identifying means, and a manually operable device at the observing position for determining which of the controlling means shall act.

5. The combination with a substation line the service of which is to be observed, of a service observing position, two talking conductors joining the line and observing position, service indicating signals at the observing position, controlling means therefor connected to separate talking conductors, and line identifying means connected to both talking conductors.

6. The combination with a group of tele-

phone lines the service of which is to be observed, of a service observing position, a trunk including four conductors joining the lines and observing position, service indicating signals and line identifying signals at the observing position, controlling means for the signals at opposite ends of the trunk, the service indicating signal controlling means being normally connected to two of the conductors, and means for temporarily connecting the line identifying signal controlling means to the four conductors.

7. The combination with a group of telephone lines the service of which is to be observed, of a service observing position, a trunk including four conductors joining the lines and observing position, service indicating signals and line identifying signals at the observing position, controlling means for the signals at opposite ends of the trunk, the service indicating signal controlling means being normally connected to two of the conductors, and means governed over the other two conductors for temporarily connecting the line identifying signal controlling means to the four conductors.

8. The combination with a group of telephone lines the service of which is to be observed, of a service observing position, a trunk joining the lines and observing position, service indicating and line identifying signals at the observing position, independent controlling means for the signals at opposite ends of the trunk, and means governed from the observing position for rendering the corresponding controlling means effective at both ends of the trunk.

9. The combination with a group of telephone lines the service of which is to be observed, of a service observing position, a trunk joining the lines and observing position, service indicating and line identifying signals at the observing position, independent controlling means for the signals at opposite ends of the trunk, a relay at each end of the trunk governing the respective signal controlling means at its opposite contacts, and means operable by the observer for governing the relays.

10. The combination with a group of telephone lines the service of which is to be observed, of a service observing position, a trunk joining the lines and observing position, service indicating and line identifying signals at the observing position, controlling means for the signals at the end of the trunk distant from the observing position, and an alternating current relay bridged across conductors of the trunk at the distant end for governing the connection of the signal controlling means thereto.

11. The combination with a group of telephone lines the service of which is to be observed, of a service observing position, a trunk joining the lines and observing posi-

tion, service indicating and line identifying signals at the observing position, plural controlling means for the signals, and means for determining which of the signal controlling means shall be effective, said determining means also serving to prevent the communication of disturbances from the observing position to the observed line.

12. The combination with a group of telephone lines the service of which is to be observed, of a service observing position, a trunk joining the lines and observing position, service indicating and line identifying signals at the observing position, plural controlling means for the signals, and a relay for determining which of the signal controlling means shall be effective and for governing the continuity of the trunk.

13. In a telephone service observing system, a group of lines under observation, a plurality of observers' positions, a trunk connecting the lines and positions, a line identifying apparatus common to all the observing positions, and means at each observing position for governing the operation of the line identifying apparatus.

14. In a telephone service observing system, a group of lines under observation, a plurality of observers' positions, a trunk connecting the lines and positions, a line identifying apparatus common to all the observing positions, and manually operable means at each observing position for connecting the identifying apparatus to the trunk.

15. In a service observing system, an observed line, an observing trunk, means for connecting the line and trunk, release means therefor, and means for indicating the condition of the release means.

16. In a service observing system, an observed line, an observing trunk, means for connecting the line and trunk, release means therefor, and a plurality of signals for indicating different conditions of the release means.

17. In a service observing system, an observed line, an observing trunk, means for connecting the line and trunk, release means therefor including a release circuit, and a signal controlled over the release circuit.

18. In a service observing system, an observed line, an observing trunk means for connecting the line and trunk, release means therefor including a release key, and a signal controlled in contacts of the release key.

19. In a service observing system, an observed line, an observing trunk, means for connecting the line and trunk, release means therefor, observer's equipment, means for connecting said equipment to the trunk, and a guard signal controlled by the equipment connecting means.

20. In a service observing system, an observed line, an observing trunk, means for

connecting the line and trunk, release means therefor, observer's equipment, means for connecting said equipment to the trunk, and a signal controlled by the release means and equipment connecting means.

21. In a service observing system, an observed line, an observing trunk, means for connecting the line and trunk, release means therefor including a release circuit, observer's equipment, a key for connecting the equipment to the trunk, and a signal controlled by the key over the release circuit.

22. In a service observing system, an observed line, an observing trunk, means for connecting the line and trunk, release means therefor including a release key, observer's equipment, a key for connecting the equipment to the trunk, and a signal controlled by the release and equipment keys.

23. In a service observing system, an observed line, an observing trunk, means for connecting the line and trunk, release means

therefor including a release circuit, observer's equipment, a key for connecting the equipment to the trunk, and a plurality of signals each controlled by the equipment key over the release circuit.

24. In a service observing system, an observed line, an observing trunk, means for connecting the line and trunk, release means therefor including a release key, observer's equipment, a key for connecting the equipment to the trunk, and a signal controlled through a make contact of one key and a break contact of the other key.

In testimony whereof, I have signed my name to this specification in the presence of two subscribing witnesses, this sixth day of July, 1916.

HENRY L. HOFFMANN.

Witnesses:

A. C. HOFFMEISTER,
J. A. CALLAHAN.

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