H. M. BASCOM.

TELEPHONE TOLL SYSTEM.

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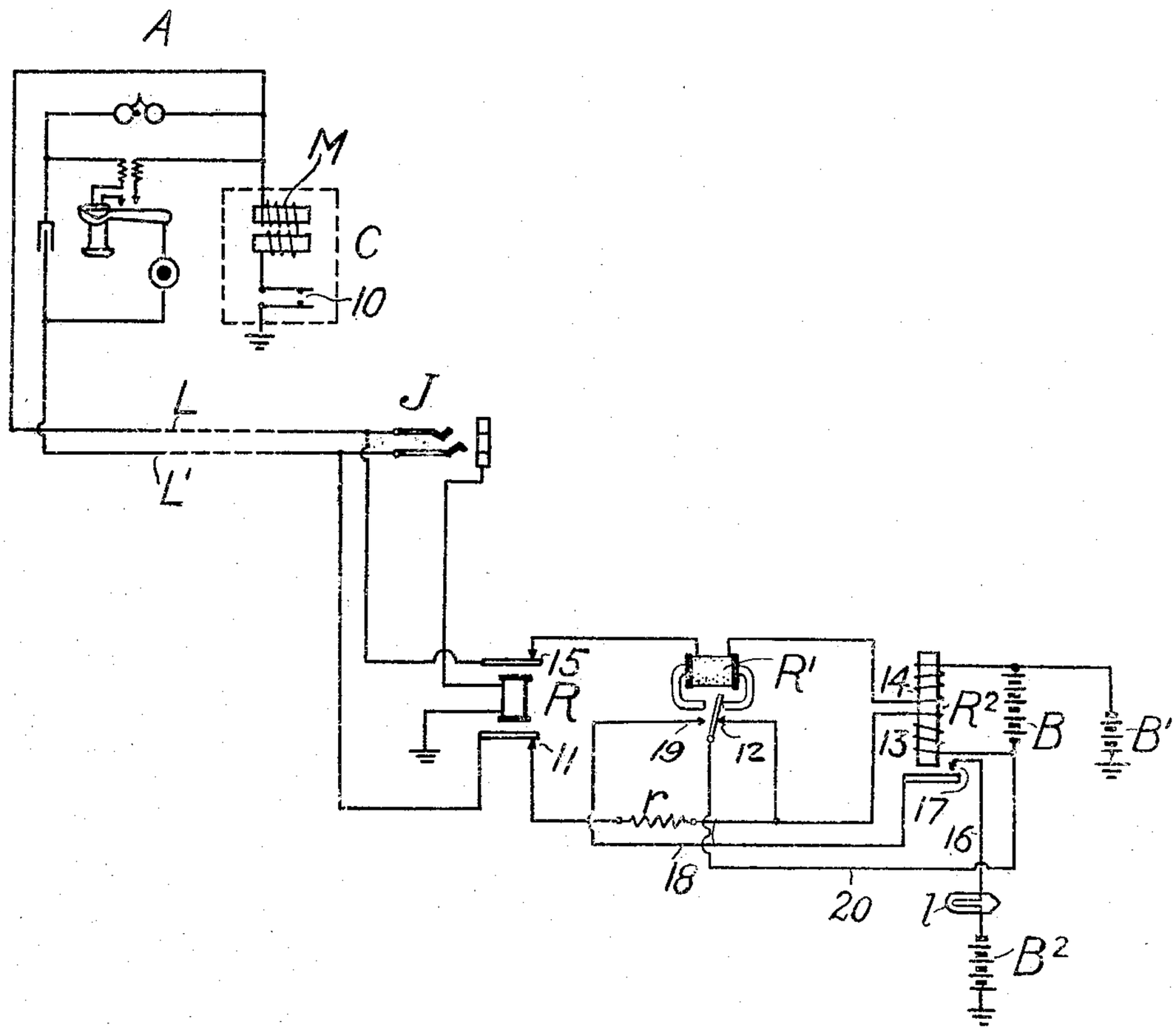
1,215,331. Patented Feb. 13, 1917.



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UNITED STATES PATENT OFFICE.

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TELEPHONE TOLL SYSTEM.

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Application filed September 30, 1915. Serial No. 53,313.

To all whom it may concern:

Be it known that I, HENRY M. BASCOM, residing at Brooklyn, in the county of Kings and State of New York, have invented certain Improvements in Telephone Toll Systems, of which the following is a specification.

It is common in telephone toll systems to make the display of a signal at the central station, as the line lamp, dependent upon the operation of contacts at a substation in the satisfaction by the subscriber of a toll charge, which may be through the deposit of a coin or the actuation of a register, and the consequent connection of the line to ground. It is found, however, that this deposit or registration is sometimes avoided by the subscriber by placing a ground upon the substation circuit independently of the contacts of the toll apparatus. The present invention provides means for so modifying the action of this illicit ground, as by preventing the display of the central station signal or causing its display in a peculiar manner, that it usually will be ineffective in obtaining the desired result. More specifically the invention consists in controlling a signal by relays responsive to currents of different characteristics both of which relays will be energized to complete the normal signal circuit only when the substation line is grounded in the approved manner.

The drawing illustrates diagrammatically a prepayment substation line and its central station equipment arranged according to one embodiment of the invention.

From a substation A line conductors L and L′ extend respectively to the tip and ring contacts of a jack J at the central station. To the sleeve contacts of the jack the winding of the usual cut off relay R is connected, and by way of the back contacts of said relay the tip conductor L and ring conductor L′ are joined to the positive and negative poles of a 32 volt battery B, passing respectively through the 420 ohm winding of a polarized relay R′ and one 200 ohm winding of a differential relay R^2, and through a 233 ohm resistance r and the other 200 ohm winding of the differential relay. The positive terminal of the battery B is grounded through a 16 volt battery B′. Relays R′ and R^2 at their front contacts close the circuit for a line signal l from a 24 volt grounded battery B^2 to the negative terminal of the batteries B and B′ in series. At the back contact of relay R′ a short circuit is completed for the ring conductor winding of the differential relay R^2.

At the substation A is the usual equipment and a toll apparatus, the latter being here illustrated conventionally as a prepayment coin box C provided with a 1000 ohm deposit and refund magnet M, and contacts 10 adapted to be closed by the weight of the approved coin between time of insertion by the subscriber and its final disposition as a result of the energization of the magnet.

The ground used in the irregular operation of the central office signal is naturally of low resistance, and to enable the relays R′ and R^2 controlling the line lamp to discriminate between this and the normal ground through the resistance of the coin box magnet, the circuit is so arranged that the polarized relay R′ is energized only when the resistance of the ground at the substation exceeds approximately 150 ohms and the receiver is removed from its hook. Under such conditions either an intermittent or a continuing current flows from the central station to the substation over the conductor L of the line in the direction for which the relay R′ is polarized to respond. Moreover, the differential relay is so organized that it operates only when the currents in the two windings are unequal, due to a resistance to ground at the substation of less than about 5000 ohms.

When the subscriber makes a call in the prescribed manner—by taking down the receiver and closing the contacts 10 by supplying the appropriate coin to the box C— current flows from batteries B and B′ in series through said contacts, winding of magnet M, the hook switch and the substation circuit, conductor L′ of the line, back contact 11 of cut off relay R, resistance r and the back contact 12 of relay R′, which places a short circuit upon the winding 13 of relay R^2. There is also a resultant current due to the batteries B and B′ in

opposition, which leaving the central station traverses the winding 14 of relay R^2, the winding of polarized relay R′, back contact 15 of cut off relay R^2, conductor L and back through the substation circuit and L′ side of the line, as previously traced. To this current relay R′ responds. The differential relay R^2 also attracts its armature, and although the opening of contact 12 removes the short circuit and permits current to flow in its winding 13, the difference between the current strengths in its two windings due to the resistance to ground at the substation is such that the relay remains operated. The batteries B, B′ and B^2 now supply a resultant potential of 24 volts to the line lamp *l* through the conductor 16, front contact 17 of relay R^2, conductor 18, front contact 19 of relay R′ and conductor 20. The lamp by its illumination furnishes a signal for the subscriber's operator and the call proceeds in the usual manner, the energization of relay R upon the insertion of the answering plug of the standard cord circuit in the jack J disconnecting the relays R′, R^2 and the associated equipment from the line.

Considering now the abnormal or unauthorized calling conditions, if the subscriber takes down the receiver without supplying a coin to the box C there is a circuit from battery B through winding 14 of relay R^2, winding of relay R′, contact 15 of relay R, conductor L, the substation circuit, conductor L′, contact 11 of relay R, resistance *r* and back contact 12 of relay R′. The last named relay is operated by current in this direction and at once breaks the short circuit upon the winding 13 of relay R^2. This causes the same current to pass through both windings, preventing the energization of the differential relay. The circuit of the lamp *l* is consequently open at contact 17, and the operator receives no signal. If with the receiver upon its hook the conductor L is grounded, current from the battery B′, flowing by way of said ground, traverses conductor L, the winding of the polarized relay and the winding 14 of the differential relay. Although the latter is energized, the polarized relay does not respond to current in this direction and the line lamp is unaffected. With the ground upon the conductor L′ neither of the contacts 17 or 19 is closed, since neither of the lamp-controlling relays has a winding in the path for current from batteries B and B′ in series. When the receiver is off the hook and a low resistance to ground is applied to the line conductors at the substation, such ground will prevent the display of the central station signal. Assuming the case of the voltages and resistances given by way of illustration, and line and other resistances are neglected for the sake of simplicity, the system as explained above provides for the production of the condition of zero current in conductor L, under two conditions, one when a resistance *r* only is in conductor L′ and the other when the several resistances *r* and winding 13 are both included. In the first instance when *r* is 233 ohms, the illicit insertion of a ground resistance of 116 ohms results in zero current in L, and in the second instance when *r* and the winding 13 are 433 ohms, an insertion of 216 ohms to ground results in zero current in conductor L. When an illicit resistance less than 116 ohms is inserted to ground, the current flows from the substation to the central station through polarized relay R′ and fails to operate it, and the circuit of the line lamp is open at contact 19. The insertion of an illicit resistance to ground above 116 ohms, for example one of approximately 150 ohms, as given above, causes current to flow through relay R′ from the central station to the substation. Current in this direction operates relay R′ which attracts its armature and opens at its back contact 12 the short circuit 20, thereby introducing into branch L′ the resistance of winding 13. The series resistance in branch L′ now becomes 433 ohms which establishes the higher value of the ground resistance to wit, 216 ohms, for zero current in L. Since the assumed illicit resistance to ground is about 150 ohms, which is less than 216 ohms, the current now starts flowing from the substation to the central station. Under these conditions the polarized relay R′ releases its armature which will vibrate but will not close its contact 19 for sufficient time to give a line signal. It will be seen that, to signal the operator, the normal method of removing the receiver and grounding the line through a considerable resistance must be followed.

It will be understood that the arrangement and voltages of batteries and resistances of the different elements as hereinbefore stated are for a particular application of my invention only, and that they may be widely varied.

I claim:—

1. In a telephone toll system, the combination with a central station, a substation and a line connecting the stations, of contacts at the substation operable in the satisfaction of a toll charge, a signal situated at the central station and capable of actuation independently of the substation contacts, and means normally under the influence of the substation contacts for modifying such independent actuation of the signal.

2. In a telephone toll system, the combination with a central station, a substation and a line connecting the stations, of con-

tacts at the substation operable in the satisfaction of a toll charge, a signal situated at the central station and capable of actuation independently of the substation contacts, relay mechanism at the central station for modifying such independent actuation of the signal, and a normal circuit for the relay mechanism including the substation contacts.

3. In a telephone toll system, the combination with a central station, a substation and a line connecting the stations, of contacts at the substation operable in the satisfaction of a toll charge, a signal situated at the central station and capable of actuation independently of the substation contacts, and means normally under the influence of the substation contacts and responsive to current of different characteristics for modifying such independent actuation of the signal.

4. In a telephone toll system, the combination with a central station, a substation and a line connecting the stations, of contacts at the substation operable in the satisfaction of a toll charge, a signal situated at the central station and capable of actuation independently of the substation contacts, and means normally under the influence of the substation contacts and responsive to current of a definite direction for modifying such independent actuation of the signal.

5. In a telephone system, the combination with a central station, a substation and a line connecting the stations, of a toll apparatus at the substation, a signal at the central station, controlling means for the signal, and means for discriminating in the control of the signal between the operation of the toll apparatus and attempts to simulate its normal operation.

6. In a telephone system, the combination with a central station, a substation and a line connecting the stations, of a signal at the central station, a circuit including the line and a ground connection at the substation, controlling means for the signal, and a device contained in the circuit and being adapted in its operation to discriminate between ground connections of different electrical characteristics.

7. In a telephone system, the combination with a central station, a substation and a line connecting the stations, of a line signal at the central station, a circuit including the line and a ground connection at the substation, controlling means for the signal, and a device contained in the circuit and being adapted in its operation to discriminate between ground connections of different electrical characteristics.

8. In a telephone system, the combination with a central station, a substation and a line connecting the stations, of a signal at the central station, a circuit including the line and a ground connection at the substation, and controlling means for the signal including a polarized device contained in the circuit and being adapted in its operation to discriminate between ground connections of different characteristics.

9. In a telephone system, the combination with a central station, a substation and a line connecting the stations, of a signal at the central station, a circuit including the line and a ground connection at the substation, and controlling means for the signal including a polarized device contained in the circuit and being adapted in its operation to discriminate between ground connections of different resistances.

10. In a telephone system, the combination with a central station, a substation and a line connecting the stations, of a signal at the central station, a circuit including the line and a ground connection at the substation, and a polarized relay and a differential relay having their windings included in the circuit and controlling the signal at their contacts.

11. In a telephone system, the combination with a central station, a substation and a line connecting the stations, of a polarized relay having its winding connected to one side of the line, a differential relay with its windings connected to both sides of the line, and a signal controlled at the front contacts of both relays.

12. In a telephone system, the combination with a central station, a substation provided with the coin box having ground contacts and a line connecting the central and substations, of a polarized relay having its winding connected to one side of the line, a differential relay with its windings connected to both sides of the line, a battery joined in series with the opposite sides of the line, a battery connected from one side of the first-named battery to ground, and a signal controlled at the contacts of the relays.

13. The combination with a toll apparatus and a signal therefor, of a circuit including a ground connection, controlling means for the signal included in the circuit, and a source of electrical energy connected to the circuit to supply current thereto in different directions depending upon the character of the ground connection.

14. The combination with a toll apparatus and a signal therefor, of a circuit including the toll apparatus and a ground connection, controlling means for the signal including a polarized relay having its windings in the circuit, and a divided battery connected to the circuit supplying current to the polarized relay in different directions depending upon the character of the ground connection.

15. The combination with a toll apparatus and a signal therefor, of a circuit including the toll apparatus, controlling means for the signal including a polarized relay and a differential relay having their windings included in the circuit.

In testimony whereof, I have signed my name to this specification in the presence of two subscribing witnesses, this 27th day of September, 1915.

HENRY M. BASCOM.

Witnesses:

WILLIAM H. HORNER,

RICHARD A. HAISLY.