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# UNITED STATES PATENT OFFICE.

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## FRAUD-DETECTING TELEPHONE TOLL SYSTEM.

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Specification of Letters Patent.

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*To all whom it may concern:*

Be it known that I, VOLNEY D. COUSINS, residing at 440 Thirty-eighth street, Oakland, in the county of Alameda and State of California, have invented certain Improvements in Fraud-Detecting Telephone Toll Systems, of which the following is a specification.

This invention concerns telephone systems in which the prepayment or registration of a toll is necessary to obtain the desired connection. This is customarily effected by the deposit of a coin of the proper denomination in a box at the calling substation, thus grounding the line through the resistance of the coin box magnet and operating the line relay to light the line lamp. The users of the telephone sometimes seek to evade payment by connecting a ground to the line independently of the coin box. By my invention means are provided for both detecting this fraud and preventing communication between the calling party and the operator until the call has been regularly initiated. By this improved system positive signals are given the operator of the fact that a subscriber has legitimately made a call and of the abandonment of efforts to otherwise obtain a connection.

In the accompanying drawing is shown diagrammatically one arrangement for carrying out the invention.

At A appears a telephone substation, this including in addition to the usual equipment a toll apparatus C, which in the present instance consists of a coin box of the well-known type having a collect and refund magnet M and contacts 10 by which one side of the line may be grounded by the cooperation of the approved coin or token. The substation A is united by line conductors L and L' to a jack j at a central station D, there being here connected to the line the line relay r and lamp o and the cut-off relay r'. At D are provided a suitable number of special cord or connecting circuits adapted in accordance with my invention for use in switching lines over which the receipt of fraudulent calls is anticipated. One of these cord circuits c is illustrated. From its plug p for cooperation with the jack j, the tip and ring conductors l and l' of the cord may be extended through the front contacts of a 75 ohm marginal relay R and windings of the repeating coil I to

24 volt central station battery B<sup>0</sup>. As this invention directly involves only the answering end of the cord circuit, a portion of the calling end is omitted, and of the other usual cord elements attention will merely be called to the answering supervisory relay R<sup>0</sup> and the operator's listening key K, which are associated with the circuit in the well-known manner, though the key K has an extra contact 10'.

By way of the back contacts of relay R, 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<sup>2</sup> and through the 233 ohm winding of a relay R<sup>3</sup> 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<sup>2</sup> at their front contacts close a circuit for a relay R<sup>4</sup> from a 24 volt grounded battery B<sup>2</sup> 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<sup>2</sup>. Relay R<sup>4</sup> controls at its back contact the 40 ohm shunt s of the answering supervisory lamp O, this shunt being independently under the control of the front contact of the answering supervisory relay R<sup>0</sup>. In addition to its usual function, the lamp O is thus caused to serve as a detecting signal. The winding of relay R receives current through the front contacts of relays R' and R<sup>2</sup>, the special contact 10' of listening key K and a 200 ohm resistance s' in parallel with the winding of relay R<sup>4</sup>. Included in the sleeve conductor l<sup>2</sup> of the cord circuit c in series with the supervisory lamp O is the 80 ohm winding of a relay R<sup>5</sup>. This relay, energized from 24 volt battery B<sup>3</sup> through the winding of the cut-off relay r' of the calling line when the operator places the plug p in jack j, governs at its front contact a locking circuit for relay R and the shunt of the supervisory lamp O which also passes through the front contact of relay R<sup>3</sup> and the back contact of relay R<sup>4</sup>.

The ground used in the irregular operation of the line signal is naturally of low resistance, and to enable detecting relays R' and R<sup>2</sup> controlling the supervisory lamp O



through the agency of relay  $R^4$  to discriminate between this and the normal ground through resistance of the coin box magnet  $M$ , the circuit is so arranged that the polarized relay  $R'$  is energized only when the resistance of the ground at the substation exceeds approximately 116 ohms and the receiver is removed from its hook. Under such conditions current flows from central 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.

It will first be assumed that the subscriber at  $A$  makes a call in the prescribed manner—by taking down the receiver and closing the toll device 10 by supplying the approved coin to the box  $C$ , and that pursuant to the illumination of the line lamp  $o$  the operator at the central station  $D$  responds by inserting the plug  $p$  of the special cord circuit  $c$  in the jack  $j$ . A path for current from battery  $B^3$  is now completed through the answering supervisory lamp  $O$ , winding of relay  $R^5$ , the sleeve strand  $l^2$  of the cord and sleeve contacts of the plug  $p$  and jack  $j$  and the winding of the cut-off relay  $r'$  of the calling line. The lamp  $O$  lights and relays  $R^5$  and  $r'$  are energized, the latter performing its customary function. Current also flows from batteries  $B$  and  $B'$  in series through contact 10 of the coin box, winding of magnet  $M$ , the hook switch and the substation circuit, conductor  $L'$  of the line, ring contacts of the jack  $j$  and plug  $p$ , ring strand  $l'$  of the cord, back contact 11 of relay  $R$ , conductor 8, winding of relay  $R^3$  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  $R'$ , conductor 9, back contact 15 of relay  $R$ , the tip strand  $l$  of the cord, the tip contacts of the plug and jack, conductor  $L$ , and back through the substation circuit and  $L'$  side of the line, as previously traced. To this current relays  $R'$  and  $R^3$  respond. 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 relay  $R^4$  through conductor 16, front contact 17 of relay  $R^2$ , front contact 19 of

relay  $R'$  and conductor 20. At its back contact 18 relay  $R^4$  opens the 40 ohm shunt of lamp  $O$  which would otherwise exist through resistance  $s$ , conductor 21, contact 18, conductor 22, front contact 23 of relay  $R^3$ , back contact 24 of relay  $R$  and front contact 25 of relay  $R^5$ . The lamp therefore remains illuminated, contrary to the standard practice, and furnishes the operator a positive indication that the call has been made in a legitimate manner. The operator then throws the listening key  $K$ , connecting her set to the talking strands of the cord and closing contact 10'. This results in the energization of relay  $R$  by way of conductor 26, resistance  $s'$ , contact 10', conductors 27 and 16, front contacts 17 and 19 of relays  $R^2$  and  $R'$ , respectively, and conductor 20 to batteries  $B$  and  $B'$  in series, and also to battery  $B^2$  through a path in parallel from the point 28 and including the winding of relay  $R^4$ . Relay  $R$  operates, and at its front contact 29 locks itself through the contact 25 of relay  $R^5$ . At its back contacts 11 and 15 it disconnects the conductors 8 and 9 from the cord strands  $l$  and  $l'$  and thus cuts off the detecting relays  $R'$  and  $R^2$  from the talking circuit. At the front contacts 30 and 31 the talking strands of the cord are connected through to the repeating coil  $I$  and battery  $B^0$ , and the operator may receive the subscriber's order. The answering supervisory relay  $R^0$  completes the shunt of the lamp  $O$  at its front contact and said lamp is thereby extinguished. The conduct of the remainder of the call presents nothing worthy of note in the present connection.

Considering now the unauthorized or fraudulent calling conditions, any method of procedure other than both removing the receiver from its hook and grounding the line through a resistance of a value between the limits previously specified will fail to energize either relay  $R'$  or  $R^2$ , thus leaving a gap in the circuit of relay  $R^4$  governing the shunt previously traced for the supervisory lamp  $O$ .  $R^4$  consequently remains unenergized with its back contact 18 closed. If the subscriber merely takes down the receiver without supplying a coin to the box  $C$ , after the operator has plugged into the jack  $j$  with the plug  $p$  there is a circuit from battery  $B$  through winding 14 of relay  $R^2$ , winding of relay  $R'$ , conductor 9, contact 15 of relay  $R$ , cord strand  $l$ , tip contacts of the plug and jack, conductor  $L$  of the line, the substation circuit, conductor  $L'$ , ring contacts of the jack and plug, cord strand  $l'$ , contact 11 of relay  $R$ , conductor 8, winding of relay  $R^3$  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 of relay  $R^2$ . This causes the same current to



pass through both windings, preventing the energization of the differential relay. When the receiver is off the hook, and a low resistance ground is applied to the line conductors at the substation, the differential relay is energized by the passage of current through its winding 14 as already explained in connection with the normal operation of the system. In this case, however, due to the diminished resistance to ground at the substation, the resultant current from batteries B and B' flows over the conductor L from said ground to the central station. This is the wrong direction to operate the polarized relay. Again relay R<sup>4</sup> is not operated and its contact 18 remains closed.

Of the contacts other than 18 which have a part in completing the continuity of the shunt for the lamp O, back contact 24 is closed because its relay R is not energized until the listening key K is thrown, while in both the above described abnormal conditions the front contacts 23 and 25 of relays R<sup>3</sup> and R<sup>5</sup>, respectively, are also closed. Relay R<sup>5</sup> operates whenever the plug of the answering cord is in the jack of the calling line, and, with the line and cord thus joined, relay R<sup>3</sup> is energized when the substation hook switch is closed, this being the only time at which the illumination of the line lamp will cause the operator to answer. Therefore, the shunt of the supervisory lamp is complete and said lamp remains dark, informing the operator of the irregularity of the call. Had the listening key K been thrown when the operator answered the irregular call by plugging into the jack of the calling line, there would be a circuit from 24 volt battery B<sup>2</sup> passing through the winding of relay R<sup>4</sup>, conductor 27, contact 10' of the key K, conductor 26, resistance s' and winding of relay R. To the resulting current relay R does not respond. Relay R<sup>4</sup> operates, however, and at contact 18 severs the shunt of the lamp O. The lighting of this lamp when the listening key is actuated indicates to the operator that the call has been made improperly.

Upon the operator observing, either from the non-illumination of the supervisory lamp in the normal position of the listening key or its illumination in the actuated position, that the subscriber has not satisfied the toll requirements, she may with the listening key normal hold the calling line by retaining the plug in the jack until the subscriber has returned the receiver to its hook, or supplied the required coin to the box C. In the first instance the circuit of relay R<sup>3</sup> is opened at the substation hook switch, and in retracting its armature this relay breaks the shunt of the supervisory lamp at contact 23 so that it lights. If, instead, the contact 10 of the box C is closed by a coin, the energization of the detecting relays R'

and R<sup>2</sup> operates relay R<sup>4</sup>, which breaks the front contact 18 and the lamp also lights. Upon the display of this signal, the operator throws the listening key. The withdrawal of the signal shows that the call has been legitimately made, while if it persists, the operator is made aware that the attempt to call has been abandoned. It should be noted that failing to make the call properly the subscriber cannot communicate with the operator, since the circuit for relay R, the energization of which connects the cord strands through to the operator's listening key, is by way of the front contacts of the detecting relays R' and R<sup>2</sup>, and these remain inert when a call is irregularly initiated.

Whatever the character of the call, the various relays whose energization has been described will have been released, either by the hanging up of the receiver at substation A or the return of the key K to normal, except R and R<sup>5</sup>. The circuit of relay R<sup>5</sup> is opened when the operator withdraws the plug p from the jack j in response to the illumination of the lamp O. This severs the locking circuit of relay R, and the retraction of its armatures completes the restoration of the apparatus.

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 as my invention:

1. In a telephone toll system, the combination with a central station, a substation and a line connecting the stations, of a toll device at the substation, a signal at the central station, and means including said signal for detecting attempts to simulate the effect of the toll device.

2. In a telephone toll system, the combination with a central station, a substation and a line connecting the stations, of a toll device at the substation, a supervisory signal at the central station, and means including said signal for detecting attempts to simulate the effect of the toll device.

3. In a telephone toll system, the combination with a central station, a substation and a line connecting the stations, of a toll device at the substation, a signal at the central station operable legitimately by the toll device and fraudulently independently of said device, and means whereby the legitimate and fraudulent operation differently affect the signal.

4. In a telephone toll system, the combination with a central station, a substation and a line connecting the stations, of a toll device at the substation, a signal at the central station operable legitimately by the toll device and fraudulently independently



of said device, and means including an operator-controlled device whereby the legitimate and fraudulent operation differently affect the signal.

5 5. In a telephone toll system, the combination with a central station, a substation and a line connecting the stations, of a toll device at the substation, a connecting circuit at the central station for switching the line and  
10 a disconnection signal in the connecting circuit controlled by the substation switch hook and by the toll device.

6. In a telephone toll system, the combination with a central station, a substation and  
15 a line connecting the stations, of a toll device at the substation, a connecting circuit at the central station for switching the line, and a supervisory signal in the connecting circuit controlled by the substation switch  
20 hook, said signal also being controlled jointly by the switch hook and toll device in a different manner from its control by the switch hook.

7. In a telephone toll system, the combination with a central station, a substation  
25 provided with a toll device adapted to be grounded through different resistances and a line connecting the stations, of a signal at the central station operable by said ground  
30 connections, and means whereby such ground connections affect the signal differently.

8. In a telephone toll system, the combination with a central station, a substation  
35 provided with a toll device adapted to be grounded through different resistances and a line connecting the stations, of a signal at the central station operable by said ground connections, and means including an operator's key whereby such ground connections affect the signal differently.  
40

9. In a telephone toll system, the combination with a central station, a substation and  
45 a line connecting the stations, of a signal at the central station operable by ground connections of different resistances at the substation, and means including a listening key whereby such ground connections affect the signal differently.

50 10. A telephone line, a toll device connected thereto, a switching circuit for the line, a signal in the switching circuit, and means controlling the display of the signal and including a plurality of relays governed  
55 by the toll device.

11. A telephone line and its substation, a toll device connected to the line at the substation, a switching circuit for the line, a  
60 signal in the switching circuit, and means controlling the display of the signal and including a relay governed by the toll device and a relay governed by the substation switch hook.

65 12. A telephone line, a toll device connected thereto, a switching circuit for the

line, a signal in the switching circuit, and means controlling the display of the signal and including a relay governed by the toll device and a relay governed by the connection between the line and switching circuit. 70

13. A telephone line, a toll device connected thereto, a switching circuit for the line, a signal in the switching circuit, and means controlling the display of the signal and including an operator's key and a plurality of relays one of which is governed by the toll device. 75

14. A telephone central station, a substation and a line connecting the stations, a toll device connected to the line at the substation, a cord circuit for switching the line, a supervisory lamp in the cord circuit, a shunt for the supervisory lamp, and a relay controlled by the toll device for governing the shunt. 80 85

15. A telephone central station, a substation and a line connecting the stations, a toll device connected to the line at the substation, a cord circuit for switching the line, a supervisory lamp and an operator's key  
90 in the cord circuit, a shunt for the supervisory lamp extending through contacts of the key, and a relay controlled by the toll device for governing the shunt.

16. A telephone central station, a substation and a line connecting the stations, a toll device connected to the line at the substation, a cord circuit for switching the line, a supervisory lamp and an operator's key in the cord circuit, a shunt for the supervisory  
100 lamp extending through contacts of the key when said key is actuated, and a relay controlled by the toll device for governing the shunt.

17. A telephone line and its substation, a toll device at the substation, a connecting circuit for switching the line, a signal, and means controlled by the toll device for governing the signal and the continuity of the connecting circuit. 105 110

18. A telephone line and its substation, a toll device at the substation, a connecting circuit for switching the line, an operator's telephone set, a signal, means including said signal for detecting attempts to simulate the effect of the toll device, and means controlled by the detecting means for uniting the operator's set to the substation line. 115

19. A telephone line and its substation, a toll device at the substation, a connecting circuit for switching the line, an operator's telephone set, a signal, means including said signal for detecting attempts to simulate the effect of the toll device, and means controlled by the detecting means for uniting the operator's set to the substation line and disconnecting the detecting means therefrom. 120 125

20. A telephone line and its substation, a toll device at the substation, a connecting 130



circuit for switching the line, an operator's telephone set, a signal, means including said signal for detecting attempts to simulate the effect of the toll device, means controlled  
 5 by the detecting means for uniting the operator's set to the substation line and disconnecting the detecting means therefrom, and means depending upon the connection of the line and connecting circuit for locking  
 10 said uniting means independently of the detecting means.

21. A telephone toll system comprising a telephone line and its substation, a toll device at the substation, a cord circuit which  
 15 may be united with the line, an operator's set associated with the cord circuit, toll detecting relays in the cord circuit, and a relay controlled by said detecting relays and governing the connection of the operator's tele-  
 20 phone to the line.

22. A telephone toll system comprising a telephone line and its substation, a toll device at the substation, a cord circuit which may be united with the line, an operator's  
 25 set associated with the cord circuit, toll detecting relays in the cord circuit, and a relay controlled by said detecting relays and governing the connection of said detecting relays to the line.

30 23. A telephone toll system comprising a

telephone line and its substation, a toll device at the substation, a cord circuit which may be united with the line, an operator's set associated with the cord circuit, toll detecting relays in the cord circuit, and a relay  
 35 controlled by said detecting relays and governing the connection of the operator's telephone and the detecting relays to the line.

24. A telephone toll system comprising a telephone line and its substation, a toll de-  
 40 vice at the substation, a cord circuit which may be united with the line, an operator's set associated with the cord circuit, toll detecting relays in the cord circuit, a relay controlled by said detecting relays and gov-  
 45 erning the connection of said detecting relays to the line, a relay having its winding in a strand of the cord circuit, and a locking circuit for the connection governing relay extending through a contact of the cord  
 50 strand relay.

In testimony whereof, I have signed my name to this specification in the presence of two subscribing witnesses, this 23 day of February 1916.

VOLNEY D. COUSINS.

Witnesses:

C. W. LINDER,  
 A. J. REED.