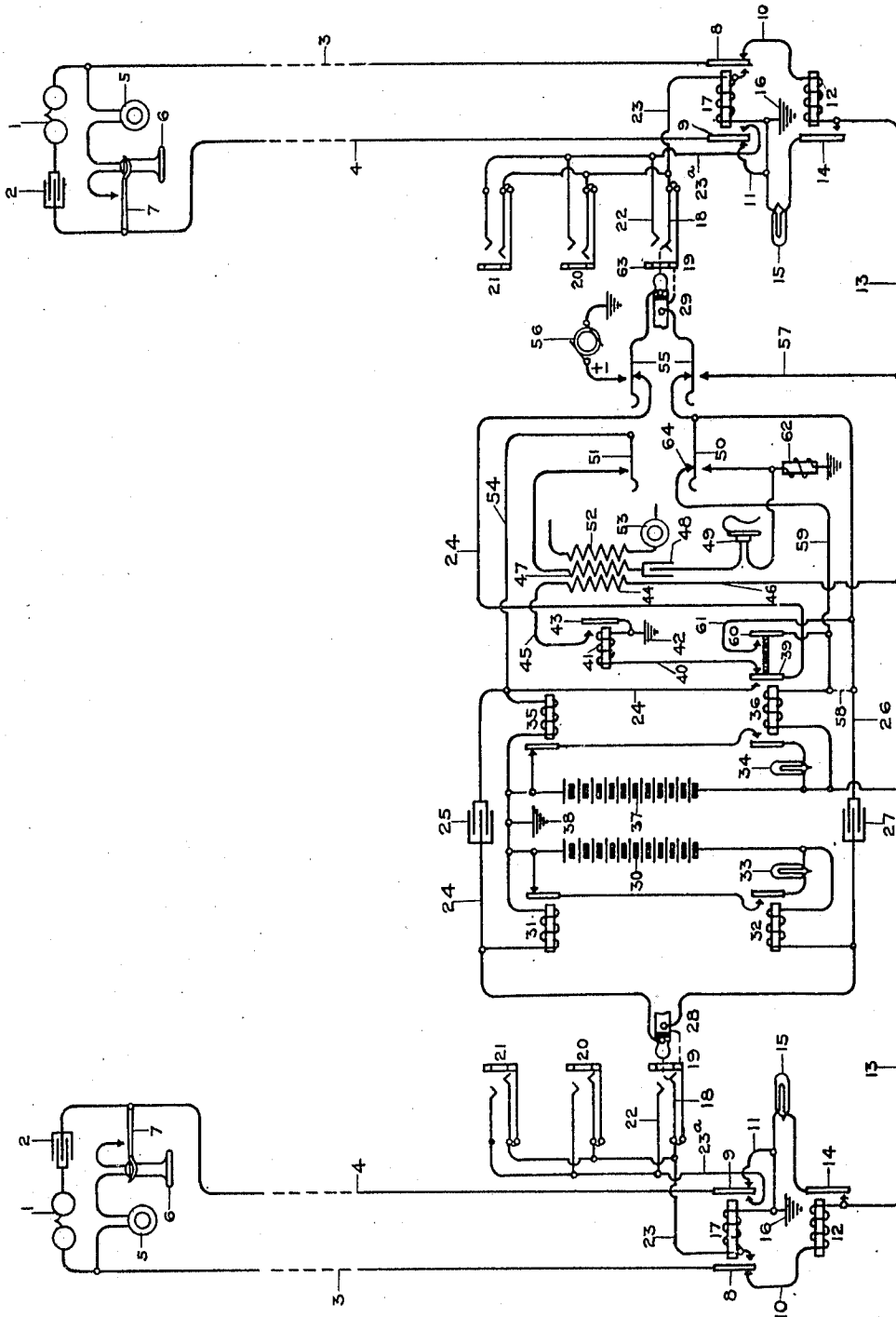


A. H. WEISS.
TELEPHONE SYSTEM.
APPLICATION FILED JULY 24, 1905.

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TELEPHONE SYSTEM.

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Specification of Letters Patent. Patented Mar. 29, 1910.

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To all whom it may concern:

Be it known that I, ALFRED H. WEISS, a citizen of the United States of America, and resident of Chicago, county of Cook, and State of Illinois, have invented a new and useful Improvement in Telephone Systems, of which the following is a specification.

My invention relates to telephone systems and more particularly to improvements upon the type of cord circuit shown and described in the application of Francis W. Dunbar, filed March 22, 1901, Serial Number 52,315.

The cord circuit shown and described in the above application in its individual capacity I do not claim as my invention. It is desired, however, to use such a cord circuit in connection with a three contact jack, that is, a jack having contact springs connected with the respective line conductors so as to give a spring contact upon both the tip and sleeve of the plug, the sleeve of the jack being used for testing purposes only.

My invention has for its objects the provision of means whereby a cord circuit of the type described in the above application may be used with a jack having three contacts as above described, without objectionable results, as hereinafter described.

I have illustrated in the accompanying drawing a cord circuit embodying my improvements and two telephone lines extending to the central office.

The substation apparatus shown consists of a call bell 1 and condenser 2 in a permanent bridge of the line conductors 3 and 4 and a transmitter 5 and receiver 6 in a bridge of said conductors, the continuity of which is normally broken by the switch hook 7. Any subscriber's common battery outfit may be used in lieu of that above described. The limbs of the telephone lines terminate in contact springs 8 and 9, said springs being normally in contact with conductors 10 and 11, respectively, the conductor 10 including the winding of the line relay 12, said winding being connected with the battery by means of conductor 13. The contact spring 14 of the line relay 12 is adapted to connect the line lamp 15 to the ground 16 when said relay is energized. One side of the winding of the cut-off relay 17 is connected with the ground 16 and the other side of said winding is connected by means of conductor 23 with the sleeve

spring 18 of the jack 19. Multiple jacks 20 and 21 are shown in the usual manner. The tip springs 22 of the jacks are connected by conductor 23^a with a front contact of the cut-off relay 17, said relay being provided with a similar contact point adapted to engage the line spring 8.

The same apparatus as that above described is shown in connection with both the line circuits and the same reference numerals have been used to indicate like parts.

The cord circuit consists of a tip strand 24 containing the condenser 25 and a sleeve strand 26 containing a similar condenser 27, said strands extending between the tip and sleeve contacts respectively of the answering plug 28 and calling plug 29. A battery 30 is bridged between the tip and sleeve strands of the cord circuit, said bridge containing the windings of the supervising relays 31 and 32, said relays being adapted to control the circuit of the supervisory lamp 33 through the action of their normally-closed and normally-open contacts as shown. The supervisory lamp 34 is adapted to be similarly controlled by means of the normally-closed and normally-open contacts of the supervisory relays 35 and 36, said relays receiving current from the battery 37. One pole of each of said batteries is grounded at 38. A contact spring 39 is provided for the supervisory relay 36, said spring being adapted to unite the normally-separated tip strand 24 of the cord circuit when said relay is energized, said contact spring being normally connected by a conductor 40 with a high resistance and high impedance test relay 41, the opposite side of the winding of said relay being grounded at 42. The contact spring 43 of test relay 41 is adapted to connect with a tertiary winding 44 of the operator's induction coil by means of conductor 45 when said relay is energized, said winding being connected with the battery lead 13 by means of a conductor 46. The secondary winding 47 of said induction coil, a condenser 48 and receiver 49 are connected in series between the springs 50 and 51 of a suitable listening key. The primary winding 52 and transmitter 53 may be connected with the battery 37 or any other suitable source of current. The spring 51 of the listening key is connected to the tip strand of the cord circuit by means of a conductor 54. A ringing key 55 is adapted to

connect a ringing generator 56 with the tip side of the line in calling a subscriber, a conductor 57 preferably extending from the conductor 13 to the opposite contact of said key.

The operation of the system as thus far described is as follows: Assuming that the subscriber at the station shown upon the left hand side of the figure desires a connection with the other station shown, he removes his receiver from the telephone hook, which closes a path for current from the battery 37 over battery lead 13, the winding of line relay 12, conductor 10, spring 8 of the cut-off relay 17, line conductor 3, through the substation apparatus, line conductor 4, contact spring 9 of the cut-off relay and conductor 11 to ground and back to the battery. This current energizes the line relay which attracts its armature 14, closing a path for current through the lamp 15 as shown. The operator observing the signal inserts the plug 28 in the answering jack 19, current flowing from the battery 30 through the supervisory relay 32, sleeve contacts of the plug and jack, conductor 23 and the winding of cut-off relay 17 to ground. This energizes the cut-off relay which attracts its contact springs 8 and 9, effacing the line signal and connecting the external limbs of the telephone line with the tip and sleeve contacts of the jack. Part of the current above traced then flows through the contact spring 8, conductor 3, through the substation apparatus, line conductor 4, spring 9, conductor 23^a, tip contacts of the plug and jack, and the winding of the supervisory relay 31 to battery. It will be seen that this circuit places the operator's telephone in condition for conversation with the calling subscriber when the listening key is thrown, the voice currents being propagated through the condensers 25 and 27. It will also be noted that as both supervisory relays 31 and 32 are energized the signal 33 remains inert, the circuit of said signal being closed at the contacts of relay 32, and open at the contacts of relay 31.

Upon learning the number of the subscriber desired the operator tests the condition of the line in the usual manner by touching the tip of the calling plug to the sleeve of a multiple jack of the desired line. If the line is busy the testing terminal will be raised to a potential above that of the ground, due to the connection of a multiple of said terminal with the sleeve of a plug at another section of the switchboard, as described with reference to the answering plug 28, and current will therefore flow from the testing terminal of the jack tested to the tip of the plug and over tip conductor 24 through the contact spring 39 of the supervisory relay 36, conductor 40 and the

winding of the test relay 41 to ground at 42. The energization of the test relay will close a path for battery over the common lead 13, conductor 46, tertiary winding 44 of the operator's induction coil, conductor 45 and contact spring 43 of the test relay to ground, the last mentioned circuit as the line is tested creating the usual inductive click in the operator's receiver, thus notifying her that the line is busy. Any desirable method of testing the condition of the called line may be substituted in lieu of the above without affecting the present invention.

In case the line is found idle the plug 29 is inserted in the jack, current flowing from the battery 37 through the winding of the supervisory relay 36, the closed contacts of the listening and ringing keys, sleeve contacts of the calling plug and jack, conductor 23, winding of the cut-off relay 17 to ground 16 and back to the battery. The cut-off relay responds to this current attracting its armatures 8 and 9, thus connecting the limbs of the telephone line with the contacts of the jack. It will be noted also that the above current will energize the supervisory relay 36, thus closing the circuit of the signal 34 which will be lighted, the circuit of said signal being normally closed at the contacts of the supervisory relay 35 until the called subscriber removes his receiver from its hook. The operator will now depress the ringing key 55 which will close a path for calling current from the generator 56 over the tip contacts at the calling plug and jack, contact spring 9 of the cut-off relay 17, line conductor 4, condenser 2 and the winding of the ringer 1 at the substation, line conductor 3, contact spring 8 and winding of the cut-off relay 17 to ground and back to the generator. When the cord circuit is severed at the ringing key in calling the subscriber the cut-off relay 17 is maintained actuated by current from the battery 37 over the battery lead 13, conductor 57, contact of the ringing key 55, sleeve contacts of the plug and jack, conductor 23 and the winding of the cut-off relay 17 to ground. Upon the response of the called subscriber a path for current will be closed from the battery 37 through the winding of the supervisory relay 36, contacts of the listening and ringing keys, sleeve contacts of the plug and jack, conductor 23, contact spring 8, line conductor 3, through the substation apparatus, line conductor 4, contact spring 9 of the cut-off relay, conductor 23^a, tip contacts of the plug and jack, tip conductor 24 and the contact spring 39 of the supervisory relay 36, and the winding of the supervisory relay 35 to battery. It will be seen that this current will break the continuity of the circuit of the supervisory signal 34 at the contacts of the relay 35, which will extinguish the signal, thus notifying the operator that

the called subscriber has responded. As the supervisory relays 31 and 35 are in the path of current to the substations as above described, when either subscriber hangs up his receiver at the termination of the conversation said relays will be deenergized and the circuits of the supervisory signals 33 and 34 will be closed, thus giving the operator the signal for disconnection, upon noticing which the operator will remove the plugs from the jacks, thus restoring all parts to normal condition.

My invention consists of improvements in systems of the type above described, which enables such a system to be used with jacks having three contacts as shown, without producing a loud click in the operator's receiver when the plug is inserted in the jack. My invention also provides means for maintaining connection with the lines when a plug is withdrawn from and inserted in the jack during a connection for conversation, in order to give the subscriber a better connection. I have illustrated one means of accomplishing these results and in the form shown instead of connecting the winding of the supervisory relay 36 directly to the sleeve strand 26 of the cord circuit in the usual manner as shown by the dotted line 58, I connect said winding by means of conductor 59 to the contact spring 50 of the listening key, said contact being normally closed. I also provide an additional contact spring 60 adapted to move with but insulated from the contact spring 39 of the supervisory relay 36, said contact spring when said relay is actuated being adapted to form electrical connection with the conductor 61 connected with the sleeve strand 26 of the cord circuit. I also leg a resistance 62 to ground from the normally-open contact of the listening key 50, as shown.

When a system of the above type is used with a three contact jack as shown, and with the above-described contact spring 60, conductor 61, and resistance 62 omitted, and with the winding of the supervisory relay 36 connected directly with the sleeve strand 26 of the cord circuit in the usual manner, as indicated by the dotted line 58, a loud click is produced in the operator's receiver and in the receiver of the calling subscriber when the calling plug is inserted in the jack, which click results in the following manner: Assuming the operator touches the tip of the calling plug to the test terminal of the jack with her listening key thrown to the listening position for the purpose of ascertaining the idle or busy condition of the line; immediately upon failing to receive a busy signal she inserts the plug into the jack, without releasing her key from the listening position, after which the key is operated to ring the desired subscriber. In three-contact multiple jacks it is necessary to mount

the tip and sleeve springs 22 and 18 of the jack in such close relation that it is almost impossible to insert the plug 29 without the tip thereof engaging the sleeve spring 18 of the jack. In entering the jack, therefore, the tip of the plug would make and break contact with the sleeve spring 18, at the same time that the sleeve of the plug is in contact with the test ring 63.

I have indicated the above contacts by dotted lines in connection with the calling plug and jack. The listening key being thrown, as above stated, the insertion of the plug would close a path for current from the battery 37 through the winding of the supervisory relay 36, conductor 58 indicated by the dotted line, sleeve strand 26 of the cord circuit, sleeve contact of the plug, testing ring 63 and sleeve spring 18 of the jack, the tip of the plug, tip strand 24 of the cord circuit, contact spring 39 of supervisory relay 36, tip strand 24, and the winding of the supervisory relay 35, back to the battery. This circuit would be completed by the contact of the tip of the plug with the sleeve spring 18 of the jack during the operation of inserting the plug therein and would be immediately broken by the complete insertion of the plug. The supervisory relay 35 would thus be momentarily energized, which would cause an inductive click in the operator's receiver over the following path: from the winding of said relay over conductor 54, contact 51 of the listening key, secondary winding 47 of the induction coil, condenser 48, head receiver 49, contact 50 of the listening key, sleeve strand 26, dotted line conductor 58 and the winding of relay 36 to the battery 37. This induced discharge of the relay 35 would also produce a click in the receiver of the calling subscriber, which may be traced over the following path: from the relay 35 through the condenser 25, tip strand 24, tip contacts of the answering plug and jack, conductor 23^a, spring 9 of the cut-off relay 17, line conductor 4, through the subscriber's receiver and transmitter, line conductor 3, contact spring 8 of the cut-off relay, and the winding of said relay to the ground 16.

It will be noted that by connecting the winding of the supervisory relay 36 with a normally-closed contact 50 of the listening key instead of connecting same directly with the sleeve strand 26 of the cord circuit in the usual manner, as indicated by the dotted line 58, the above inductive click in the operator's receiver and in the receiver of the calling subscriber, is prevented, the circuit being broken at the contact point 64 as long as the listening key is thrown to listening position. There is no battery, therefore, upon the sleeve of the plug during the operation of inserting the same in the jack and consequently no flow of cur-

rent will result from the engagement of the tip of the plug with the sleeve spring 18 of the jack and the relay 35 will not be energized. Current will not be admitted to the sleeve contacts of the plug and jack until the plug has been entirely inserted therein and the listening key released from the listening position and thrown to the ringing position to call the desired subscriber. Assuming now that a connection is established with a subscriber and the subscriber signals the operator and requests a better connection for any reason, the operator would have her key thrown to listening position to ascertain the wishes of the subscriber, and with her listening key in this position would withdraw and reinsert the plug in the jack. Under such circumstances the supervisory relay 36 is maintained actuated when the plug is thus momentarily withdrawn from the jack over a locking circuit comprising the spring contact 60 of said relay, conductor 61, cord strand 26, listening key contact 50, and resistance 62 to ground. This locking circuit provides a path for current for the cut-off relay 17 when the plug is reinserted in the jack, which may be traced from the battery 37 through supervisory relay 36, contact 60, conductor 61, sleeve strand 26, ringing key 55, sleeve contacts of the plug and jack, conductor 23, and the winding of cut-off relay 17 to ground. The connection will thus be at once reestablished with the subscriber and the operator may inquire if the connection is satisfactory. It will be noted that when the listening key is thrown to listening position the path for current through the supervisory relay 36 over conductor 59 is broken at contact point 64. It will therefore be seen that the above locking circuit provides a path for current by means of which the cut-off relay may be energized as soon as the plug is re-inserted in the jack and while the listening key is thrown to listening position.

It will be understood that my invention is not limited to the details of the circuit arrangements shown for accomplishing the above results, but contemplates in its broad aspects any suitable means for accomplishing said results, and I do not wish to limit myself to such details further than is defined in the appended claims.

What I claim as new and desire to secure by Letters Patent is:

1. In a telephone system, the combination with a pair of telephone lines, of spring jacks at the central office having a spring contact for each limb of said lines, a cord circuit having tip and sleeve strands terminating in suitable plugs and adapted to form electrical connection with the contacts of said jacks, a battery associated with the cord circuit, a supervisory signal, a pair of re-

lays adapted to control the circuit of said signal through their normally-closed and normally-open contacts, a suitable listening key for connecting the operator's telephone set with the line, and means for opening the path of current from said battery to the sleeve of the calling plug when said listening key is thrown to listening position, substantially as described.

2. In a telephone system, the combination with a pair of telephone lines, of spring jacks at the central office having a spring contact for each limb of said lines, a cord circuit having tip and sleeve strands terminating in suitable plugs and adapted to form electrical connection with the contacts of said jacks, a battery associated with the cord circuit, a supervisory signal, a pair of relays adapted to control the circuit of said signal through their normally-closed and normally-open contacts, a suitable listening key for connecting the operator's telephone set with the line, one of said relays being in the path of current from said battery to the sleeve of the calling plug, and means for breaking the continuity of said path when the listening key is thrown to listening position, substantially as described.

3. In a telephone system, the combination with a pair of telephone lines, of spring jacks at the central office having a spring contact for each limb of said lines, a cord circuit having tip and sleeve strands terminating in suitable plugs and adapted to form electrical connection with the contacts of said jacks, a battery associated with the cord circuit, a supervisory signal, a pair of relays adapted to control the circuit of said signal through their normally-closed and normally-open contacts, a suitable listening key for connecting the operator's telephone set with the line, one of said relays being in the path of current from said battery to the sleeve of the calling plug, said circuit including a contact of said listening key, substantially as described.

4. In a telephone system, the combination with a pair of telephone lines, of spring jacks at the central office having a spring contact for each limb of said lines, a cord circuit having tip and sleeve strands terminating in suitable plugs and adapted to form electrical connection with the contacts of said jacks, a battery associated with the cord circuit, a supervisory signal, a pair of relays adapted to control the circuit of said signal through their normally-closed and normally-open contacts, a suitable listening key for connecting the operator's telephone set with the line, one of said relays being in the path of current from said battery to the sleeve of the calling plug, and a locking circuit for said relay, completed when a connection is established with the line, substantially as described.

5. In a telephone system, the combination with a pair of telephone lines, of spring jacks at the central office having a spring contact for each limb of said lines, a cord circuit having tip and sleeve strands terminating in suitable plugs and adapted to form electrical connection with the contacts of said jacks, a battery associated with the cord circuit, a supervisory signal, a pair of relays adapted to control the circuit of said signal through their normally-closed and normally-open contacts, a suitable listening key for connecting the operator's telephone set with the line, one of said relays being in the path of current from said battery to the sleeve of the calling plug, and a locking circuit for said relay, completed when a connection is established with the line, said locking circuit including a normally-open contact of said listening key, substantially as described.

6. In a telephone system, the combination with a pair of telephone lines, of spring jacks at the central office having a spring contact for each limb of said lines, a cord circuit having tip and sleeve strands terminating in suitable plugs and adapted to form electrical connection with the contacts of said jacks, a battery associated with the cord circuit, a supervisory signal, a pair of relays adapted to control the circuit of said signal through their normally-closed and normally-open contacts, a suitable listening key for connecting the operator's telephone set with the line, one of said relays being in the path of current from said battery to the sleeve of the calling plug, and a locking circuit for said relay, completed when a connection is established with the line, said locking circuit including a pair of normally-open contacts of said relay, a portion of the sleeve strand of the cord circuit and a normally-open contact of said listening key, substantially as described.

7. In a telephone system, the combination with a pair of telephone lines, of spring jacks at the central office having a spring contact for each limb of said lines, a cord circuit having tip and sleeve strands terminating in suitable plugs and adapted to form electrical connection with the contacts of said jacks, a battery associated with the cord circuit, a supervisory signal, a pair of relays adapted to control the circuit of said signal through their normally-closed and normally-open contacts, a suitable listening key for connecting the operator's telephone set with the line, one of said relays being in the path of current from said battery to the sleeve of the plug, and means after a connection has been established with the line for breaking the continuity of said path, and for closing a locking circuit for said relay, substantially as described.

8. In a telephone system, the combination

with a pair of telephone lines, of spring jacks at the central office having a spring contact for each limb of said lines, a cord circuit having tip and sleeve strands terminating in suitable plugs and adapted to form electrical connection with the contacts of said jacks, a battery associated with the cord circuit, a supervisory signal, a pair of relays adapted to control the circuit of said signal through their normally-closed and normally-open contacts, a suitable listening key for connecting the operator's telephone set with the line, one of said relays being in the path of current from said battery to the sleeve of the plug, and means operated in moving said listening key to the listening position, after a connection has been established with the line, for breaking the continuity of said path, and for closing a short circuit for said relay, substantially as described.

9. In a telephone system, the combination with a telephone line extending in two metallic limbs from a substation to a central office, of a three-point spring jack for said line having its sleeve and one spring contact short-circuited, a two conductor cord circuit adapted to connect said line with another for conversation, a source of current associated with the cord circuit and adapted to energize the transmitter of the line over the two cord conductors during conversation, and means to prevent current from said source from being shunted through the contacts of the jack by a short circuit of the tip and sleeve of the calling plug during its insertion in a jack, substantially as described.

10. In a telephone system, the combination with a line terminal at the central office, of a pair of spring contacts for said line terminal, and a sleeve contact permanently connected with one of said spring contacts, a cord circuit adapted to be connected with said line terminal, a source of current associated with said cord circuit and adapted to have its terminals connected through the cord strands to the two spring contacts of said line terminal during conversation, a two-point plug adapted for insertion in said line terminal and connected to said cord circuit, and means to prevent the current from said source from being shunted through the contacts of said line terminal during the insertion of said plug, substantially as described.

11. In a telephone system, the combination with a telephone line extending in two metallic limbs from a substation to a central office, of a three-point spring jack for said line having its sleeve and one spring contact short circuited, of a two conductor cord circuit adapted to connect said line with another for conversation, a source of current associated with the cord circuit and adapted to energize the transmitter of said line over the two cord conductors during conversation,

and means to prevent excess current from flowing in said cord circuit by the short circuiting of the tip and sleeve contacts of the calling plug during its insertion in a jack, substantially as described.

12. In a telephone system, the combination with a line terminal at the central office, of a pair of spring contacts for said line terminal, and a sleeve contact permanently connected with one of said spring contacts, a cord circuit adapted to be connected with said line terminal, a source of current associated with said cord circuit and adapted to have its terminals connected through the cord strands to the two spring contacts of said line terminal during conversation, a two-point plug adapted for insertion in said line terminal and connected to said cord circuit, and means to prevent excess current from flowing in said cord circuit by the shunting of the tip and sleeve contacts of the plug while being inserted in a jack, substantially as described.

13. In a telephone system, the combination with a cord circuit, of a listening key associated with the cord circuit, a testing strand, a relay operated over the sleeve con-

ductor of the cord circuit controlling contacts of said testing strand, the coil of said relay being normally connected with the sleeve strand of the cord circuit through contacts of the operator's listening key, and a pair of contacts carried by the relay adapted to complete a shunt about said contacts of the listening key when the relay is actuated, substantially as described.

14. In a telephone system, the combination with a cord circuit, a source of current, a supervisory relay connected between a pole of said source and the sleeve strand of said cord circuit by contacts of the operator's listening key, and a pair of contacts carried by said relay adapted to close a shunt about the contacts of the operator's listening key when the relay is actuated, substantially as described.

Signed by me at Chicago, county of Cook and State of Illinois, in the presence of two witnesses.

ALFRED H. WEISS.

Witnesses:

CURTIS B. CAMP,
E. F. GRIER.