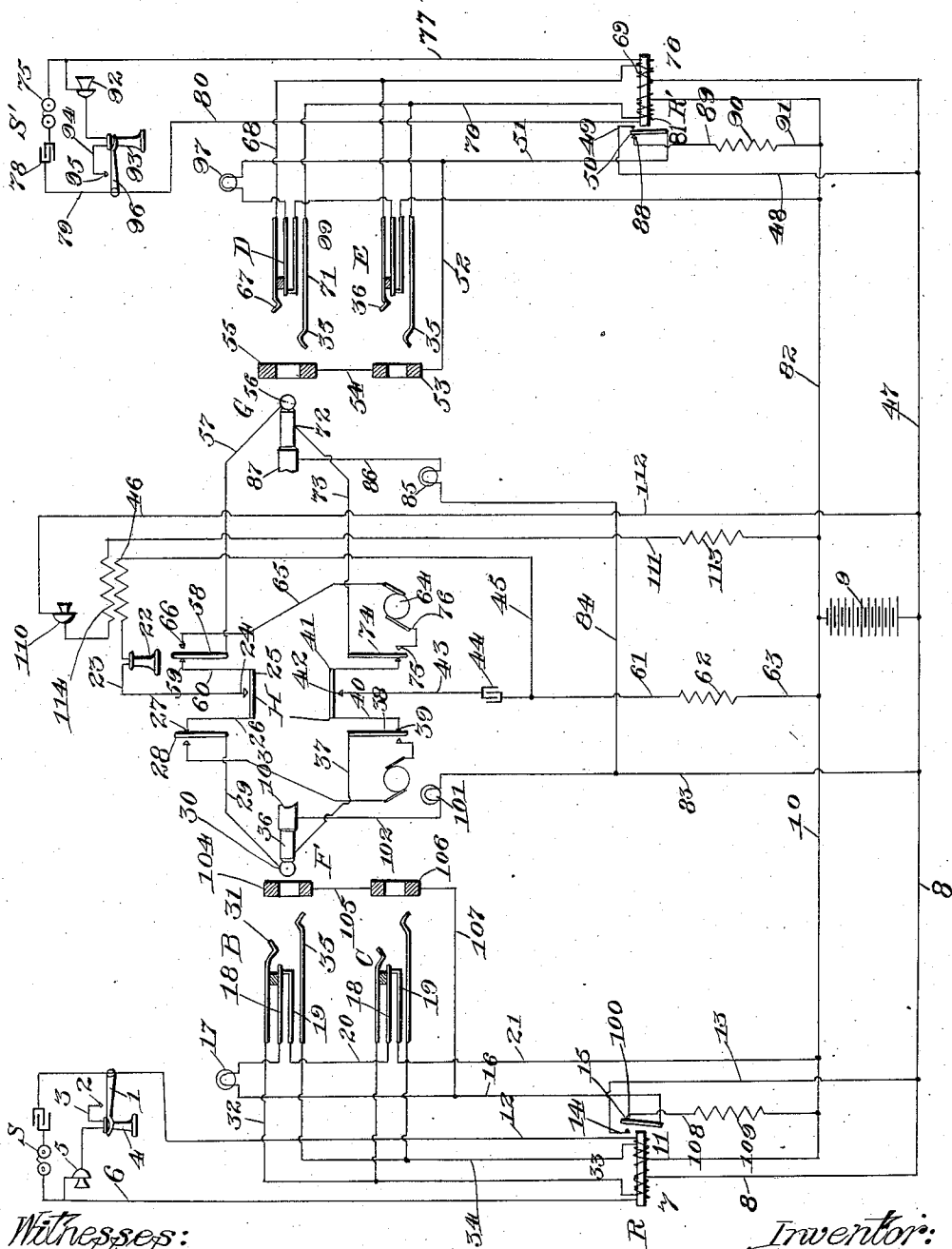


D. L. TEMPLE.
TELEPHONE SYSTEM.

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UNITED STATES PATENT OFFICE.

DAVID L. TEMPLE, OF LEWISTOWN, PENNSYLVANIA, ASSIGNOR, BY MESNE ASSIGNMENTS, TO STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, OF ROCHESTER, NEW YORK, A CORPORATION OF NEW YORK.

TELEPHONE SYSTEM.

1,028,635.

Specification of Letters Patent.

Patented June 4, 1912.

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To all whom it may concern:

Be it known that I, DAVID L. TEMPLE, a citizen of the United States of America, and resident of Lewistown, Mifflin county, Pennsylvania, have invented a certain new and useful Improvement in Telephone Systems, of which the following is a specification.

My invention relates to telephone systems in general, but more particularly to systems involving complete metallic circuits between the sub-stations and the central exchange, and particularly to systems of this character involving a centralized source of current supply. In systems of this character the sub-stations are usually connected with the central exchange by means of lines, each comprising two metallic limbs. These sub-station lines all terminate at the central exchange, and the switchboard apparatus at the central exchange involves an operator's connecting medium, commonly known as a cord circuit. Calling or line signals are located at the central exchange, whereby any one of the subscribers may attract the attention of the central operator, and each sub-station is also provided with a signal whereby the central operator may ring the sub-station signals when any two of the subscribers desire to be placed in communication. When the lines of the sub-stations are connected by the cord-circuit, a talking circuit is then established over which the subscribers may talk. The source of current supply, both for talking and signaling purposes, is located at the central exchange. In this way, all the current necessary to the operation of the various devices in the system is supplied from a common source located at the central station. It is also the practice in systems of this character to connect each substation line with a plurality of switchboards, and with this arrangement the system is of the type commonly known as the "multiple switchboard" system. In a system of this kind, each operator makes what is known as a "busy test" before connecting a calling subscriber with the sub-station called for. This test is usually made by touching the tip of the operator's calling plug to the test ring of the multiple jack. If the line of the sub-station called for is busy, this test causes a sudden flow of current from the test ring through the opera-

tor's receiver, producing a click which advises her that the line is busy. If no such click is produced, then the operator understands that the line called for is clear, and the connection between the two substations is then established by the insertion of the calling plug. It is also customary in a system of this kind to provide supervisory signals, whereby the central operator may know when the subscribers have finished talking. The arrangement is usually such that the hanging up of the receiver at one of the sub-stations will cause the supervisory signal allotted to such station to light up, thereby advising the operator that the subscribers are through talking, and that a disconnection can be made by removing the plugs of the cord circuit from the jacks of the two lines.

Generally stated, it is the object of my invention to provide a simple and highly efficient telephone system of this character.

A special object is to provide a circuit arrangement whereby the central operator may make a busy test regardless of whether a plug connection has been established or not.

Another object is to provide a simple and improved arrangement for enabling the central operator to mechanically break the line lamp signal circuit.

A further object is to provide an improved line relay for operating both the line and supervisory signals.

It is also an object of my invention to provide an improved circuit arrangement whereby the busy test can be made without producing an objectionable sound in the receiver at the sub-station with respect to which the test is made.

Another object is to provide an improved circuit arrangement whereby the answering plug of the cord circuit can be inserted in the jack and the line signal extinguished without breaking or changing the line circuit in a way that would be likely to produce a click or other objectionable sound in the receiver at the sub-station.

My invention also contemplates an improved and simplified circuit arrangement which obviates the necessity of locating either relays, resistance coils or condensers in the cord circuit. In this way my inven-

tion contemplates also a simplified arrangement whereby the cost of both installation and maintenance is reduced.

In addition to these, it is also an object of my invention to provide certain details and features of improvement tending to increase the general efficiency, and to render a telephone system of this character more serviceable and satisfactory in use.

To the foregoing and other useful ends, my invention consists in matters hereinafter set forth and claimed.

The accompanying drawing is a diagram illustrating a telephone system embodying the principles of my invention. It will be understood that in this diagram only two substations, together with line circuits and a single cord circuit, are shown, and that only such apparatus and devices are shown as are necessary to illustrate the invention.

The telephone system shown comprises the sub-station equipments S, S¹, the same being of any suitable known or approved construction consistent with the uses for which they are designed. Also, as shown in the diagram, the current both for signaling and talking purposes is supplied from a battery 9 at the central station. Line or calling signals 17 and 97 are mounted on the switch boards at the central station, and controlled by line relays R, R¹, which latter are in turn controlled by the ordinary hook-switches at the sub-station. These line relays are preferably repeating coils, one winding on each coil being connected with the line. Furthermore, each repeating coil winding, thus connected with the jacks, is excluded from all circuits or paths for battery current, no battery current whatever being allowed to pass through the tip and ring springs of the jacks. It will be seen, however, that battery current is allowed to pass through the third strand of the cord-circuit, and through the sleeve contacts of the plugs and jacks, for the purpose of lighting the supervisory lamps 85 and 101. It is evident, therefore, that the answering and multiple jacks B, C, D, E, connected with the subscribers' lines through the medium of the repeating coils, each comprises a pair of springs, of unequal length, and also a testing ring or thimble. The operator's cord circuit is provided with plugs F and G adapted for insertion in said jacks, and each having three contacts. In this way, the talking circuit is of the complete metallic type, while the third strand of the cord circuit is used merely to furnish battery current to the supervisory lamps.

It will be readily understood that the different devices and instruments may be constructed in any suitable or desired manner, it only being essential that each device or instrument be of the character or mode of

operation indicated, and capable of doing the work described.

The operator's talking set, and the generators for calling subscribers, are shown associated with the cord circuit and adapted to be bridged across the talking strands of the same by means of switch keys of any suitable construction.

Assuming that the subscriber at station S desires to be connected up with station S¹, the various operations and circuit connections which take place are as follows: The removal of the receiver 4 from the hook switch 1 operates to complete a circuit from the switch 1 through the contact point 2 and the conductor 3 to the receiver 4, thence through the transmitter 5 and the line conductor 6 to the primary 7 of the repeating coil relay R, through conductor 8 to battery 9, thence through conductor 10 to primary 11 of said repeating coil relay, and from the latter through line conductor 12 to the said hook switch. The energizing of the said relay causes its armature 15 to make contact with the contact point 14, and to thereby complete a local circuit including the battery 9, the conductors 8 and 13, the said contact point and armature 14 and 15, the conductor 16, line lamp 17, springs 18 and 19 of the jack B, conductor 20, springs 18 and 19 of the jack C, conductor 21, and the conductor or battery lead 10. The completion of this local circuit serves to light the line lamp 17. This attracts the attention of the central operator, and advises the latter that the subscriber at sub-station S desires connection with some other sub-station. The central operator then inserts the answering plug F of the cord circuit in the jack B, for example, thereby operating the jack springs 18 and 19, so as to break the circuit of the lamp 17. In this way, the insertion of the answering plug serves to mechanically break a local circuit and extinguish the line signal. The operator then presses the listening key H, so as to connect the receiver or head telephone 22 with the line of the calling subscriber. When this listening key is pressed, a line circuit is completed through the operator's receiver 22 and the conductor 23 to contact point 24, thence through key spring 25 and conductor 26 to contact point 27, through key spring 28 and cord strand 29 to the tip 30 of the answering plug, thence through tip spring 31 of the jack B, through conductor 32 to the secondary coil of the repeating coil relay R, through conductor 34 to ring contact spring 35, thence through ring contact 36 of the answering plug and the cord strand 37 to key spring 38, through the latter and the contact point 39 to the conductor 40, thence through key spring 41 to contact point 42, through conductor 43 and condenser 44, thence through conductor 45 and the sec-

ondary 46 of the induction coil. This places the central operator in communication with the calling subscriber, and the latter then states the number of the sub-station with which connection is desired. Assuming sub-station S^1 to be the one with which the calling subscriber desires connection, the operator then makes what is known as the "busy test" to ascertain whether or not the line of said station S^1 is busy. This test is made by touching the tip of the plug G to the testing ring 55 of the jack D. If the line to sub-station S^1 is clear, no click is produced in the operator's receiver or head telephone. However, should the plug of another cord circuit at this time be inserted in one of the multiple jacks of the line leading to sub-station S^1 , and should the receiver of this latter station be off the hook, then the touching of the plug tip to the testing ring operates to immediately complete a circuit from the battery 9 through the conductors 47 and 48 to the contact point 49, thence through the armature 50 and the conductors 51 and 52 to the testing ring 53 of the jack E, through the conductor 54 to the testing ring 55 of the jack D, thence through the tip contact 56 of the calling plug G, through the cord strand 57 to key spring 25, thence through contact point 24 and conductor 23 to the operator's receiver 22, thence through the secondary 46 of the induction coil and the conductors 45 and 61 to the resistance coil 62, thence through conductors 63 and 10 to the said battery. The sudden flow of current through this circuit produces a click in the operator's receiver advising her that the line of sub-station S^1 is in use. Should it be the case, however, that the plug of another cord circuit is in one of the jacks, and that the receiver at sub-station S^1 is hung up, then a test circuit is completed through the supervisory lamp and plug of said other cord circuit to the testing rings, which latter are all connected, thence through testing ring 55 to the tip 56 of the calling plug G, and thence through the operator's receiver and back to the battery. This, as in the previous case, causes a click in the operator's receiver, indicating that the tested line is in use. It may also happen that the receiver at sub-station S^1 is down, thereby closing the line circuit, while none of the calling plugs of the cord circuit have been inserted in any of the jacks with which this line is connected. In such case a test circuit is completed in the same manner as when a plug is in one of the jacks, and the click in the operator's receiver indicates that the line is closed. Thus in this way the circuit arrangement is such that the central operator can at all times make a test and ascertain whether or not the line is in use. Assuming now that the line of sub-station S^1 is not in use, the central operator then inserts the

calling plug G in the jack D and presses the ringing key in the cord circuit. This serves to complete a circuit from the generator 64 through conductor 65 and contact point 66 to key spring 58 of the ringing key, thence through cord strand 57 to plug tip 56, through jack spring 67 and the conductor 68 to the secondary 69 of the repeating coil relay R^1 , through conductor 70 and jack spring 71 to ring contact 72 of the plug, thence through the cord strand 73 to the spring 74 of the said ringing key, and thence through contact point 75 and conductor 76 to said generator.

The operation of the generator, and the consequent flow of generator current through the circuit just completed, operates to ring the bell 75 at the sub-station S^1 through the line circuit including the battery 9, the battery lead 47, the primary 76 of the repeating coil, the line conductor 77, the bell 75 and the condenser 78, the conductors 79 and 80, the other primary 81 of the repeating coil, and also the other lead 82 of the battery. This, as stated, operates to ring the bell at sub-station S^1 , and to indicate that the central operator has connected this sub-station with sub-station S. It will also be observed that the insertion of this calling plug in the jack of the line leading to the sub-station S^1 operates to close a supervisory circuit from the battery 9 through conductors 8, 83 and 84 to supervisory lamp 85, thence through conductor 86 and sleeve contact 87 to the testing ring 55, through conductor 54 and test ring 53 to conductor 52, thence through conductor 51 and armature 50 to contact point 88, thence through conductor 89, resistance 90 and conductors 91 and 82 to said battery. This, it will be observed, causes the supervisory lamp 85 to light up or glow, and the said lamp remains lighted until the subscriber at sub-station S^1 answers the call. When the subscriber at sub-station S^1 answers the call, a circuit is then completed from transmitter 92 through receiver 93 and conductor 94 to contact point 95, thence through hook switch 96 and line conductor 80 to the primary 81 of the repeating coil R^1 , thence through conductor 82 to battery 9, from the battery through conductor 47 to the primary 76 of said repeating coil, thence through line conductor 77 to the said transmitter 92. This serves to energize the relay R^1 , and to draw the armature 50 into contact with the contact point 49. This movement of the armature operates, it will be seen, to break the circuit through supervisory lamp 85, thereby extinguishing the latter and advising the central operator that the subscriber has answered the call. The contact established between the said armature and the contact 49 does not, however, light the lamp 97, as it will be seen that at this time the cir-

cuit for the latter is broken by reason of the springs 98 and 99 being separated, owing to the insertion of the plug G. With both the answering and calling plugs thus inserted, and with both receivers off the hooks at the sub-stations, the two subscribers are connected and a talking circuit is established through the lines and the cord circuit, it being observed that the repeating coils R and R¹ serve as medium of inductive connection between the lines and the jacks on the switchboards. Thus voice currents will traverse the line circuits, and will be inductively transmitted from one line to the cord circuit, and from the latter to the other line. In this way, the common battery 9 furnishes the current for operating all of the various signals, and also furnishes the current for the microphone transmitters at the sub-stations.

When the subscribers have finished their conversation and have hung up the receivers, the effect of so doing is as follows: Suppose the subscriber at sub-station S hangs up the receiver 4, the breaking of the line circuit, by reason of the switch 1 being drawn away from the contact 3, operates to deenergize the repeating coil relay R, and to thereby allow the armature 15 to resume its normal position. In its normal position the armature 15 is in contact with the contact point 100, and in such position a local circuit is completed from the battery 9 through the conductors 8 and 83 to the supervisory lamp 101, through the conductor 102 and the sleeve contact 103 of the plug F to the ring 104, thence through conductor 105 and ring 106 to conductor 107, through conductor 16 and armature 15 to contact point 100, thence through conductor 108 and the resistance 109 to battery lead 10, and thence back to the said battery 9. This, it will be observed, has the effect of lighting the supervisory lamp 101, and of indicating to the central operator that the subscriber at sub-station S is through talking. In a similar way, when the subscriber at sub-station S¹ hangs up the receiver 93, a circuit is completed which lights the supervisory lamp 85. This circuit, it will be observed, corresponds in character to the circuit which lights the lamp 101. Both subscribers having finished talking, the central operator then withdraws the plugs from the jacks, and in this way restores the system to its normal condition, so far as the two sub-stations are concerned.

It will be understood that the operator's talking set can be arranged in any suitable manner, as, for example, the transmitter 110 of this set can be connected with the battery through the medium of the conductors 111 and 112. The conductor 111 preferably includes a resistance 113, and also the primary 114 of the induction coil. It will also be understood that the resistance of the va-

rious relays and resistance coils can be regulated or adjusted to suit the conditions, and that such regulation or adjustment can be readily determined by those skilled in the art. Thus it will be seen that with the foregoing arrangement the system is simple and efficient, and at the same time characterized by all of the improved methods of operation. With the provision of the repeating coil relays in the lines, it will be seen that neither relays, condensers nor retardation coils are needed in the cord circuit, and that consequently a simplification of the system is secured which insures a substantial decrease both in the cost of installation and maintenance. The arrangement also involves, it will be observed, an improved and advantageous circuit arrangement for supplying the current directly to the line, rather than through the cord circuit. Furthermore, the busy test is thoroughly localized, thereby quieting the line and relieving the subscriber of any annoyance. As a further advantage, the circuit arrangement is such that the operator is always in a position to ascertain the correct condition of the line to any sub-station which may be called for. Again, the insertion of the answering plug in answering a call does not break an energized line circuit, and consequently such insertion of the plug does not cause any objectionable sound in the receiver at the sub-station from whence the call came. In addition, the system involves a simplified circuit arrangement which permits the line signal lamp circuit to be broken mechanically, rather than through the agency of relays or other electrical circuit breaking devices. It will also be seen that this method of extinguishing or restoring the line signal obviates the necessity of shunting out the lamp, and consequently insures a more economical use of the current. In fact, the system involves generally a simplified and improved arrangement of circuits tending to insure a high degree of efficiency with less apparatus and with simplified circuits, and having advantages which will be readily apparent to those skilled in the art.

What I claim as my invention is:

1. In a telephone system, the combination of a substation and a central station, suitable line connections between said stations, a central source of current supply permanently connected with said line, a repeating coil relay in the line, a local supervisory signal circuit normally open, a switch point included in said local circuit and controlled by the armature of said relay, a cord plug and a jack included in said local circuit, a resistance coil included in said local circuit and interposed between one pole of said source of current and a stationary contact of said relay, the said supervisory lamp being lighted when the plug is in the jack and the

armature released, and means for producing an audible call signal at any called subscriber's station.

2. In a telephone system, the combination
5 of a sub-station and a central station and suitable line connection between the same, a cord circuit and a jack at the central station, a repeating coil relay in the line, a source of current supply permanently connected with the line, a supervisory lamp associated with said cord circuit, and a local
10 circuit including said lamp and having a switch point controlled by said relay, said local circuit including the thimble or testing ring of the said jack, and said thimble or testing ring being connected with a movable contact of said relay.

3. In a telephone system, the combination
20 of a sub-station and a central station and suitable line connection between the same, a jack and a cord circuit at the central station, a central source of current supply permanently connected with the line, a repeating coil relay in the line, a line signal lamp associated with said jack, a local circuit including said line signal lamp and having a switch point controlled by said relay, a supervisory lamp associated with said cord
25 circuit, a local circuit including said supervisory lamp and having a switch point controlled by said relay and a resistance coil included in the local circuit of the supervisory lamp and interposed between the source of current and a stationary contact of said relay and means for producing an audible call signal at any called subscriber's station.

4. In a telephone system, the combination
40 of sub-stations and a central station and suitable line connection between the same, an operator's cord circuit having plugs, jacks coöperating with said plugs for establishing connection between the sub-stations, a source of current supply permanently connected with the sub-station lines, a repeating coil relay in each line, each repeating coil consisting of two primary coils, one in each side of the line, and of a secondary coil connected with both the tip and
50 ring contacts of a jack, said secondary coils being at all times free from battery current line signal lamps connected to the armature of said relay, and local circuits for the same, supervisory lamps associated with said cord circuit, local circuits for said supervisory lamps, all of said local circuits having switch points controlled by said relays.

5. In a telephone system, the combination
60 of a sub-station and a central station and suitable line connection between the same, a central source of current supply, a line lamp signal, a local circuit including said source of current supply and said line lamp signal, a relay for closing said local circuit, a jack electrically connected with

the line and provided with a test ring, a cord circuit having a plug, the armature of said relay being permanently connected with both the test ring and said lamp but said test ring being excluded from the circuit of said
70 lamp.

6. In a telephone system, the combination
of a sub-station and a central station and suitable line connection between the same, a central source of current supply, an operator's cord circuit provided with a plug, a
75 jack electrically connected with the line, line and supervisory lamps, suitable circuit connections for said lamps, a relay in the line, two contacts associated with the armature of said relay and included in circuit of said lamps, and a test ring permanently connected with said armature said test ring being excluded from the circuit of the line
80 lamp.

7. A telephone system comprising a supervisory signal, a line relay controlling said signal provided with a normally closed or back contact permanently connected with one pole of a centralized source of current, a jack for the line, and means for reversing the polarity of the testing contacts of the jack by the energization of said line relay when a subscriber calls.

8. In a telephone system, the combination
95 of lines, a two-way cord circuit, and repeating coils in the line circuits for inductively transmitting voice currents through the cord circuit, for excluding battery current from the talking strands thereof, and means for reversing the polarity of the testing contacts by the energizing of said coils, when the subscriber calls.

9. In a telephone system, the combination
105 of lines, a two-way cord circuit, repeating coils in the line circuits for inductively transmitting voice currents through the cord circuit, and for excluding battery current from the talking strands thereof, line lamp signals controlled by said repeating coils, and means for reversing the polarity of the testing contacts by the energizing of said coils, when the subscriber calls.

10. In a telephone system, the combination
115 of lines, a two-way cord circuit, repeating coils in the line circuits for inductively transmitting voice currents through the cord circuits, and for excluding battery current from the talking strands thereof, line lamp signals operated by the energizing of said repeating coils, a supervisory lamp signal operated by the deenergizing of said coils, and means for reversing the polarity of the testing contacts by the energizing of said coils, when the subscriber calls.

11. In a telephone system, the combination
125 of subscriber's lines, a battery permanently connected with the said lines, a two-way cord circuit, and repeating coils for connecting the lines with the cord circuit,

whereby battery current is excluded from the cord circuit, the voice currents are transmitted around the battery, and means for reversing the polarity of the testing contacts by the energizing of said coils, when the subscriber calls.

12. In a telephone system, including spring jacks and a cord circuit associated therewith, a line relay, a line signal and a contact of said jack connected to the armature of said relay, a supervisory signal energized over a circuit including said jack contact, and means whereby said relay controls both of said signals.

13. In a telephone system including spring jacks and a cord circuit associated therewith, a line relay, a line signal and a contact of said jack connected to the armature of said relay, a supervisory signal energized over a circuit including said jack contact, means whereby said relay controls both of said signals, and contacts in said jack for opening the circuit of said line signal when a plug is inserted in said jack.

14. In a telephone system including spring jacks, a cord circuit associated there-

with, a repeating coil relay having one winding connected to a subscriber's line and the other to the spring jacks, a line signal and a contact of said jack connected to the armature of said relay, a supervisory signal energized over a circuit including said jack contact, and means whereby said relay controls said signals.

15. In a telephone system including spring jacks, a cord circuit associated therewith, a repeating coil relay having one winding connected to a subscriber's line and the other to the spring jacks, a line signal and a contact of said jack connected to the armature of said relay, a supervisory signal energized over a circuit including said jack contact, means whereby said relay controls said signals, and contacts in said jack for opening the circuit of said line signal when a plug is inserted in said jack.

Signed by me at Lewistown, Pennsylvania, this 13th day of July, 1903.

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