(No Model.)

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TELEPHONE SWITCHING APPARATUS AND CIRCUIT.

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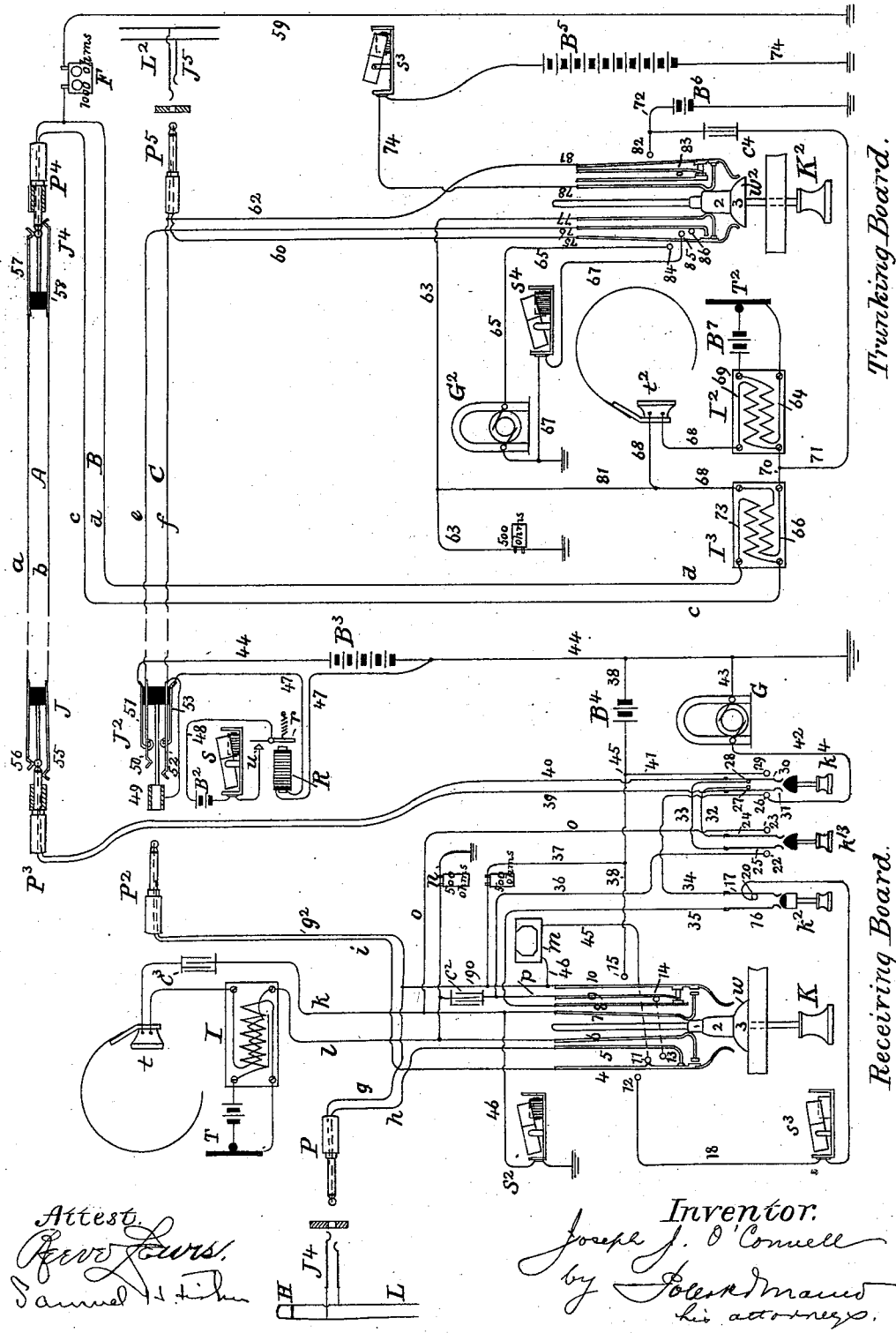

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TELEPHONE SWITCHING APPARATUS AND CIRCUIT.

SPECIFICATION forming part of Letters Patent No. 533,015, dated January 22, 1895.

Application filed May 1, 1894. Serial No. 509,684. (No model.)

To all whom it may concern:

Be it known that I, JOSEPH JOHN O'CONNELL, residing at Chicago, in the county of Cook and State of Illinois, have invented certain Improvements in Telephone Switching Apparatus and Circuits, of which the following is a specification.

This invention relates to telephone circuits and particularly to the interconnection of substation lines converging to one central station with the substation lines centering at other substations by means of multiple switchboards located at the said central stations which are connected together by trunk circuits.

In large cities the substation circuits are divided into groups each of which is provided with its own central station, and the said central stations are connected with each other by trunk circuits. Owing to the increased utilization of telephonic service, and the consequent increase of the trunking between the central stations, it is becoming more and more essential that the trunk conductors, whereby one substation is connected to another, shall be so arranged and fitted that not only shall the connections be completed in the quickest possible time, but also, that when conversation is finished between two connected substations their lines shall be disconnected as promptly as possible, in order that they may be in a condition to be utilized by the other substations, and so that the best service may be given to all of the substations.

To this end my invention consists in a combination of apparatus at each central station associated with the multiple switchboards there, comprising trunk and order circuits and switching and signal apparatus, by means of which first, the ordinary operations of answering a call from a substation and looping or linking the same to a substation at another or distant switchboard will automatically notify all the operators to whose tables or sections the trunk circuit used is multipled or extended that the said trunk is in use or busy; second, at the same time the trunking operator at the distant switchboard will be notified that a connection is wanted by a particular trunk terminating there; third, when a connection is made by the trunking operator from the trunk terminal to the substation line called for, an indication of the fact is made at the table of the receiving or first operator; fourth, when the conversation is concluded and the clearing out annunciator so indicates at the receiving board, and the connections are then taken down, there, the trunking operator is automatically notified thereof, and, fifth, when the trunking operator disconnects the trunk terminal from the called substation line and said trunk is not in use, an indication of the fact is made at all the switchboard sections, at the receiving central station to which the said trunk terminal is multipled, and the circuits are returned to the normal condition, all of which I will now proceed to describe and claim.

The drawing which illustrates the invention shows the circuits and apparatus at the table of a receiving switch-board operator, and at the table of a trunking board operator each located at separate telephone central stations with an order and a trunk circuit extending between them, all in their normal or quiescent condition of which the following is a description:

At the receiving board L represents a substation circuit and J^4 the open terminal answering spring jack therefor.

P is the answering plug and P^2 the connecting plug of a looping or linking pair.

I is an induction coil.

T is the operator's telephone transmitter and *t* the receiving telephone.

K is the principal switch or key by means of which the operators' telephones are switched into the plug cords and the several operations are supervised, as is particularly set forth in Patent No. 430,747, granted to me June 24, 1890. It consists of the wedge or plunger *w* and the several springs 4, 5, 6, 7, 8, 9 and 10 and contacts 11, 12, 13, 14 and 15. The spring 4 is connected with the wire *i* and to the tip of the plug P^2, the spring 5 being connected to the tip of the plug P, and the spring 10 is connected by conductors *g* and g^2 to the sleeves of the plugs P and P^2 respectively. Springs 6 and 7 are connected by wires *l* and *k* to the secondary of induction coil I and to operator's telphone receiver *t*, a condenser c^3 being connected to prevent passage of straight

battery currents. A clearing out annunciator m is bridged in between the spring 10 and contact 11, and by means of spring 4 between plug cord conductors g and i. A five hundred ohm resistance is placed in a ground branch n from the wire l, and a condenser c^2 is placed in a wire p from the spring o to the branch n. The contact 15 is connected by wire 38 to test battery B^4 and to ground by wire 44. A branch wire 37 extends from wire 90 to wire 38 and includes a five hundred ohm resistance coil. The contact 12 is connected by wire 18 to contact 20 of key k^2 and includes a signal s^3 to indicate the reception of a generator current at a distant station, and spring 8 of key K is connected by wire 35 with spring 16 of key k^2, the spring 17 being connected by wire 34 with contact 26 of key k^4 and from thence by wire 42 to ground through the generator G. The wire p is connected by wire 36 to contact 22 of key k^3, its opposite contact 23 being connected by wire O to conductor k. Spring 25 of key k^3 is connected by wire 33 with contact 28 of key k^4 and spring 24 by wire 32 to contact 27. Spring 31 of key k^4 is connected by conductor 39 to the tip of order circuit plug P^3 and the spring 30 by the other conductor 40 to the sleeve of the said plug.

A is an order trunk the conductors of which a b are respectively connected to the springs 56 and 55 of the springjack J on the receiving board, and to the springs 57 and 58 of the jack J^4 on the trunking board.

J^2 is a four pointed contact spring jack forming the terminal of an out trunk C from the receiving board to the trunking board; the conductor e thereof extending from the spring 50 to spring 76 of key switch K^2 and the conductor f extending from the spring 52 to the sleeve of trunk plug P^5 with a branch 62 to the spring 81 of the key K^2. Test ring 49 is connected by wire 54 to the spring 52. Springs 51 and 53 are in contact with the inner surface of the springs 50 and 52 and the former extends to ground by wire 44 through the battery B^3 and the latter goes to ground by wire 47 through the helices of relay R. The armature r of relay R is adapted to mechanically close a local circuit 48 when its spring pulls it to press against its back contact u, and causes the busy signal s to be displayed, the helices of which are then energized by the battery B^2.

At the trunking board, K^2 is the principal switch or key by means of which the operator conducts the operations there. Its spring 75 is connected by wire 60 with the tip of plug P^5. Spring 77 is grounded by wire 63 which includes a resistance of five hundred ohms. Spring 78 is grounded through the order signal s^3 and battery B^5 by wire 74. The contact 84 is grounded through generator G^2 by wire 65, and contact 85 is grounded through disconnecting signal s^4 by wire 67. P^4 is the connecting plug of the order circuit B, the tip and sleeve of which are connected by conductors c and d with one side 73 of the repeating coil I^3, the other side of said coil 66 being connected by wires 68 and 70 to one side 69 of repeating coil I^2 including the operator's telephone t^2 with a branch 81 to ground. The primary 64 of coil I^2 includes transmitting telephone T^2 and battery B^7. A branch wire 71 connects between the sides 66 and 69 of coils I^3 and I^2 and extends to the wire 72, which wire connects contact 82 with ground and includes test battery B^6.

A grounded branch 59 connects with conductor d of circuit B, and includes a one-thousand ohm call bell F by means of which the receiving operator may signal the trunking board. L^2 indicates the conductors of a substation and J^5 the springjack therefor upon the section of the multiple board represented.

As before stated, the circuits are represented in their normal condition. At the receiving board the key switch K is withdrawn, the loop plugs P and P^2 are disconnected, the plug P^3 is inserted in the order trunk A, and the signals s^2 and s are not displayed. At the trunking board the wedge w^2 of key switch K^2 is pushed in so that the springs 75 and 77 and springs 78 and 81 are respectively brought into contact, the signal s^4 being in an open branch by reason of the separation of its contact 85 from the spring 75; the signal s^3 not being displayed as an order signal as there is a circuit from ground by wire 74, battery B^5, signal s^3, wire 74, springs 78 and 81, wire 62, conductor f, springs 52 and 53, wire 47, relay R attracting the armature r and opening the local circuit 48, and wires 47 and 44 to ground. At the receiving board the signal s^2 is not displayed as it is on an open grounded circuit, and the signal s is not displayed because its circuit 48 is opened by the armature r as just described.

The operation is as follows: A call comes in on circuit L from a substation and the line annunciator H indicates the fact to the operator at the receiving board, who pushes in the wedge w of switch key K until its part 2 forces the springs 6 and 4 and 7 and 10 together, which act connects the telephones T and t in circuit with the plugs P and P^2 through their cord conductors. The answering plug P is inserted into the terminals of the answering jack J^4, thus completing the circuit between the substation and the operator in a manner well understood. The number of the substation wanted having been ascertained to be at another or distant multiple switchboard a test is made to see if the connecting out-trunk circuit C is busy at any other section of the switchboard or not. This is done by touching the tip of plug P^2 to the ring 49 of the spring jack J^2. At the same time the wedge w of key K is forced inward until the spring 10 comes in contact with the contact pin 15 thus establishing a circuit from plug P^2, conductor i, springs 4 and 6, wire l, through the telephone t, wire k, springs 7 and 10, contact 15, wire 38, and test battery B^4 to ground.

The trunk not being engaged the plug P^2 is inserted into the jack J^2. The plug tip raises the spring 50 to rest thereon separating it from the spring 51, and the spring 52 is raised to rest upon the plug sleeve and is separated from the spring 53, and the conductor *i* is connected to conductor *e* and the conductor g^2 with the conductor *f* of the trunk C. The effect of the insertion of the plug P^2 into jack J^2 is to cause all the busy or line-in-use signals *s* to be displayed at the several sections of the switchboard as the circuit from ground by wire 74, including battery B^5, springs 78 and 81, wire 62, conductor *f*, springs 52 and 53, wire 47, including relay R, to ground, is broken by the separation of the springs 52 and 53. Consequently the spring of armature *r* closes the local circuit 48 by pressing the same to its back contact *u*, bringing the battery B^2 into operation and energizing the helices of the signal *s*. At the same time the order signal s^3 at the trunking board is displayed to indicate to the operator there that a connection is desired from trunk circuit C; and the signal s^2 is displayed because a circuit is made from ground *via* wires 46, and *k*, springs 7 and 10, wire 90, conductor g^2, sleeve of plug P^2, spring 52 of jack J^2, conductor *f*, wire 62, springs 81 and 78, wire 74, helices of order signal s^2, and battery B^5 to ground. The receiving operator gives the order to the trunking board operator over the order circuit A by pressing the key k^3 and forcing the springs 25 and 24 against their respective contacts 22 and 23 which loops the order circuit A to the receiving operators' telephones as will be seen by tracing from repeating coil I^3 by conductor *d*, sleeve of plug P^4, spring 58 of jack J^4, conductor *b*, spring 55 of jack J, sleeve of plug P^3, conductor 40, spring 30, wire 33, spring 25, wire 36, condenser c^2, wires *n* and *l*, telephone *t*, wires *k* and O, spring 24, wire 32, spring 31, conductor 39, tip of plug P^3, spring 56 of jack J, conductor *a*, spring 57 of jack J^4, tip of plug P^4 and conductor *c* to coil I^3. After the trunking operator has received the order, the line called for is tested by touching the tip of the trunk plug P^5 to the test ring of the called jack J^5 in the usual manner, and finding the line disengaged inserts the plug into the jack and pressing in the wedge w^2 of the key K so that the spring 75 touches the contact 84, rings the substation, a circuit being formed from ground *via* generator G^2, wire 65, spring 75, wire 60, and by tip of plug P^5 to the line L^2. After ringing, the wedge w^2 is drawn out. This movement removes the operators' telephones from the circuit, and leaves the two substations connected together through the trunk circuit C and looping plugs P^2 and P; and legs to the circuit the disconnection signal s^4 at the trunking board, and resets the O. K. or "all right" signal s^2 at the receiving operator's board to give notice there that the connection had been made with the called for line, and also resets the order signal s^3. The circuits from jacks J^4 to J^5 are traced as follows: from tip of plug P, conductor *h*, springs 5 and 4, conductor *i*, tip of plug P^2, spring 50 of jack J^2, conductor *e*, springs 76 and 75, conductor 60 to tip of plug P^5, returning by sleeve of plug P^5, conductor *f*, spring 52 of jack J^2, sleeve of plug P^2, conductors g^2 and *g*, to sleeve of plug P. The disconnecting signal s^4 is legged to the spring 75 and so to the conductor 60 when the wedge w^2 is pushed inward by the contact 84 coming into contact with the said spring. The O. K. signal s^2 and the order signal s^3 are reset by the opening of the circuit in which they are included by the separation of the springs 78 and 81. When the conversation is concluded, either substation rings off which causes the clearing out annunciator *m* to display its shutter, whereupon the receiving operator withdraws the plugs P and P^2 from their jacks J^4 and J^2. This act closes the springs 50 and 51, and springs 52 and 53 respectively of the jack J^2, thus making a circuit from ground *via* wire 44, springs 51 and 50, conductor *e*, springs 76 and 75, contact 85, wire 67, through disconnecting signal s^4 to ground, and sets or displays the said signal to notify the trunking operator that the lines are disconnected at the receiving board, and of the duty of disconnecting the trunk from the substation line. The operator then pushes in the wedge w^2 of key K^2, which act resets the signal s^4 by separating the spring 75 from the contact 85 and also closes the circuit of the battery B^5 at the springs 78 and 81, and at the same time resets the busy signals *s* at all the receiving boards, to indicate that the trunk C is not busy, this being accomplished by the attraction of the relay armature *r* by its helices and the opening of the local circuit 48, as previously described.

The receiving operator can tell at a glance if the connection at the trunk board has not been taken down as the busy signal *s* will not disappear until the trunk operator has attended to this duty, and the chances that the trunk circuit and the substation line will be held up are greatly reduced.

I claim—

1. In a trunking system between two central stations a trunk circuit extending between each station provided with switching and looping apparatus at the receiving and trunking terminals thereof; and signals at the receiving terminal normally indicating that the circuit is not in use, and an order signal at the trunking terminal normally not displayed the said signals being controlled by a source of electricity at the trunking terminal; whereby upon looping a substation line to the trunk terminal at the receiving switchboard, the signals there are changed to indicate that the trunk circuit is busy, and at the same time the order signal is displayed at the trunking switchboard.

2. In a trunking system between two switchboards a trunk circuit extending between each station provided with switching

and looping apparatus at the receiving and trunking terminals thereof, and a signal at the receiving board operated by a source of electricity at the trunking board to indicate that the called substation line has been connected to the trunk circuit; switching devices at the receiving board whereby the circuit of said signal is closed and the signal itself set or displayed by the connection of the looping apparatus to the trunk terminal at said receiving board; and switching apparatus at the trunking board whereby the circuit of said signal is opened and the signal reset when the looping apparatus at said trunking board is connected to the called line, substantially as described.

3. In a trunking system between two central stations, a trunk circuit extending between each station provided with switching and looping apparatus at the receiving and trunking terminals thereof, and a disconnecting signal at the trunking terminal; means whereby said signal is legged to one side of the talking circuit when the trunking operator connects the trunk circuit with the called line; and means whereby upon the disconnection of the looping apparatus at the receiving board the circuit of said signal is completed through a source of current at the receiving board, substantially as described.

4. In a trunking system between two central stations a trunk circuit extending between each station provided with switching and looping apparatus at the receiving and trunking terminals thereof, and a disconnecting signal at the trunking terminal operated by a source of electricity at the receiving terminal, and busy signals at the receiving board operated by a source of electricity at the trunking board, whereby upon the withdrawal of the looping apparatus from the trunk circuit terminal at the receiving board, the disconnecting signal will be displayed and the busy signals will be reset to indicate line not in use.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 25th day of April, 1894.

JOSEPH JOHN O'CONNELL.

Witnesses:
ALFRED A. THOMAS,
A. B. RAYMOND.