

(No Model.)

3 Sheets—Sheet 1.

**E. J. HALL.**  
**CENTRAL OFFICE APPARATUS AND CIRCUIT FOR TELEPHONE EXCHANGES.**

No. 495,087.

Patented Apr. 11, 1893.

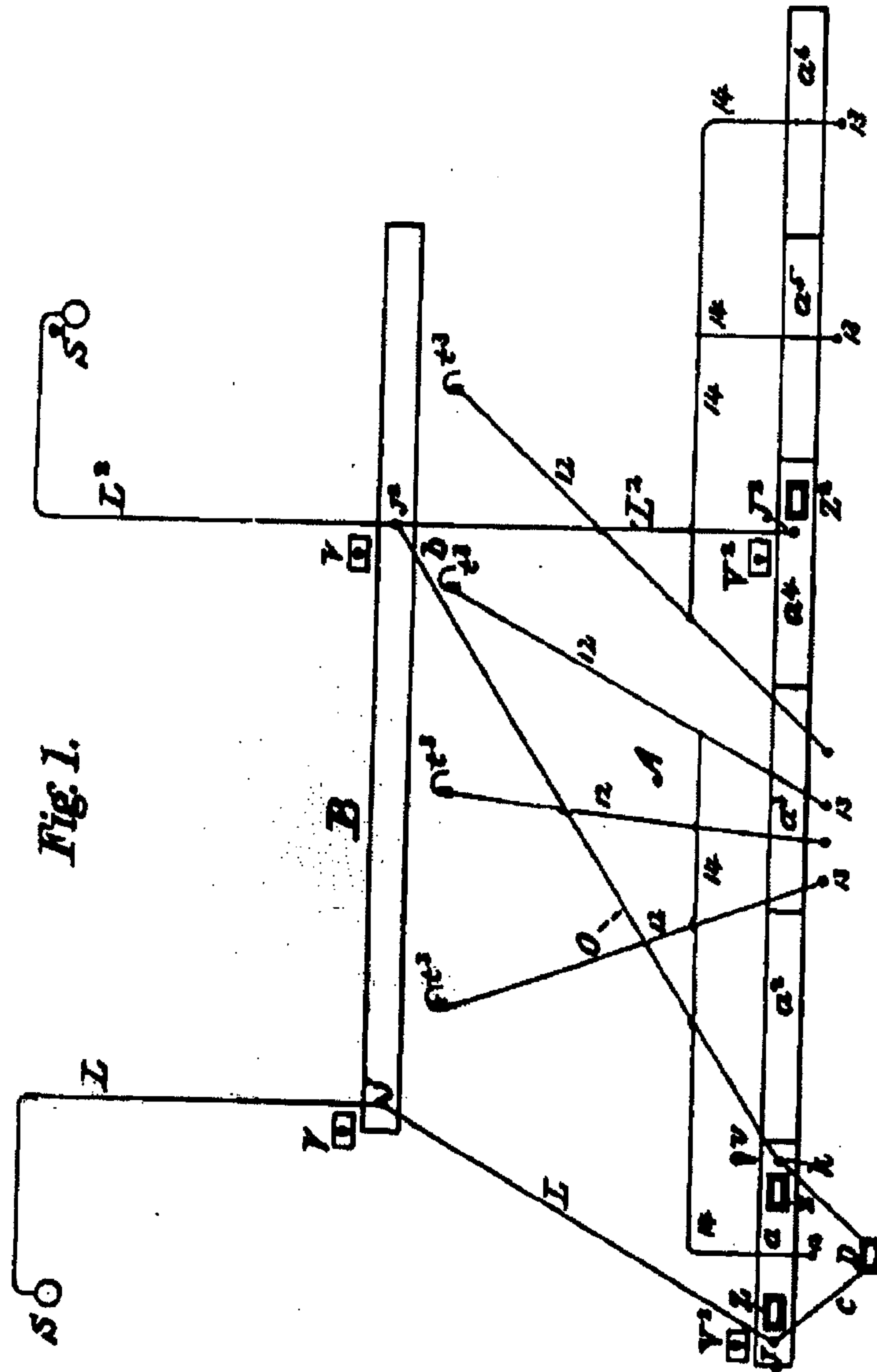


Fig. 1.

Witnesses.  
*Reverend James*  
*Arthur C. C.*

Inventor.  
*Edward J. Hall*  
by *Blair M. M.*  
his attorney.

(No Model.)

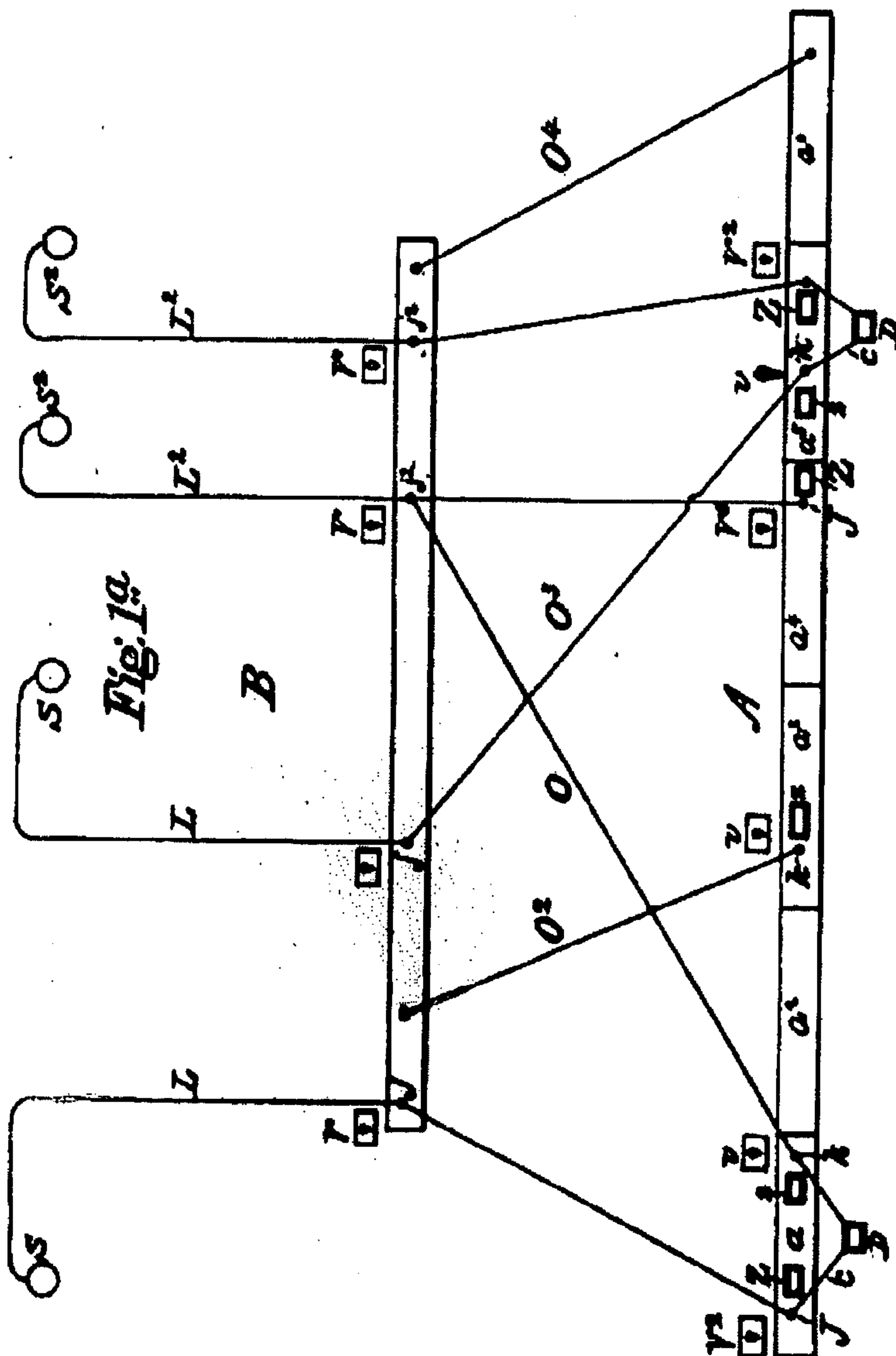
3 Sheets—Sheet 2.

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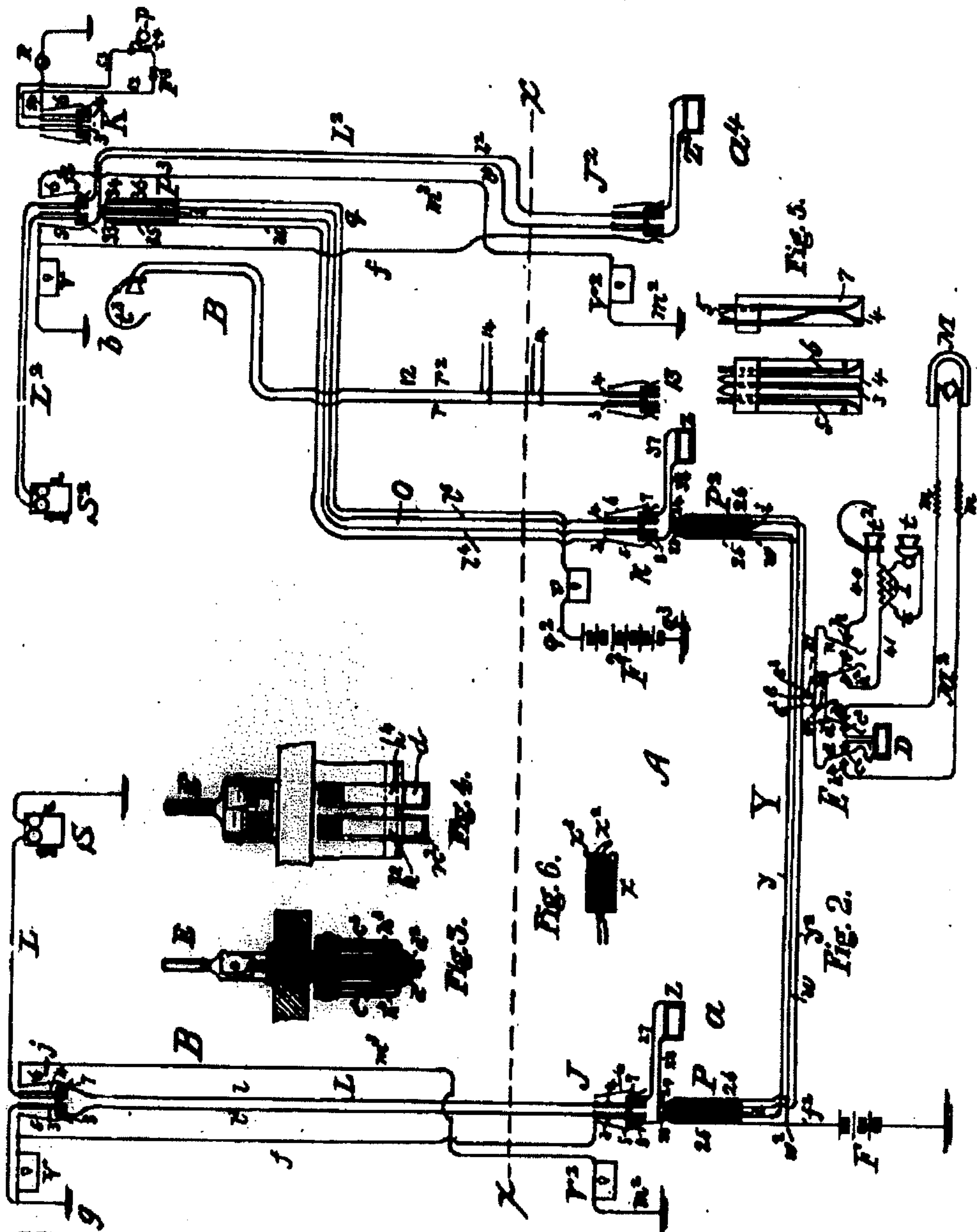
Witnesses.  
Burr Lewis  
Arthur H. Cook

Inventor.  
Edward J. Hall  
by Mark Mansel  
his attorney.

(No Model.)

3 Sheets—Sheet 2.

E. J. HALL.  
CENTRAL OFFICE APPARATUS AND CIRCUIT FOR TELEPHONE EXCHANGES.  
No. 495,087.  
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Witnesses.  
*Benjamin*  
*Arthur H. East*

Inventor:  
*Edward J. Hall*  
by *Wm. D. Munn*  
his attorney.



# UNITED STATES PATENT OFFICE.

EDWARD J. HALL, OF MORRIS, NEW JERSEY, ASSIGNOR TO THE AMERICAN  
TELEPHONE AND TELEGRAPH COMPANY, OF NEW YORK.

CENTRAL-OFFICE APPARATUS AND CIRCUIT FOR TELEPHONE-EXCHANGES.

SPECIFICATION forming part of Letters Patent No. 495,087, dated April 11, 1893.

Application filed October 13, 1892. Serial No. 448,762. (No model.)

*To all whom it may concern:*

Be it known that I, EDWARD J. HALL, residing at Morris township, in the county of Morris and State of New Jersey, have invented certain Improvements in Central-Office Apparatus and Circuits for Telephone-Exchanges, of which the following is a specification.

This invention relates to apparatus for telephone exchange central stations by means of which the entire work of the said central station including the receiving sending and answering of call signals; the connection of main circuits for through communication; the reception of disconnecting signals and the announcement of busy lines is accomplished.

Its object is the performance of these several and other essential sub-operations, all tending to the grand result of giving satisfactory telephone service with great efficiency, with speed, and with greater economy than heretofore has been feasible. To this end it comprises a division of the main switch board into two distinct portions, one where calls are uniformly received and answered, containing the terminals of the lines with their springjacks or other circuit connections, the annunciator drops and connecting appliances; and another on which all circuits are represented by circuit connections such as springjacks, and at which connections resulting from calls received at the first portion are effected with any desired circuit. The first portion is preferably subdivided into operator's sections to each of which a given number of circuits may be assigned, and where such circuits have their calls answered and their connections with others initiated; for this reason it is hereinafter referred to as a "sectional switchboard," while by reason of the special location of its jacks and drops in the main circuits, it is also distinguished by being called the "terminal switchboard," or "terminal board," and it is moreover properly entitled the "answering board" because all calls are there answered. The second portion is not so subdivided, but is homogeneous in construction, and has a springjack for all entering lines, and because it is especially arranged to make the required connection with the second circuit, I term it the "connecting switchboard," or the "connecting board." Each en-

tering substation circuit passes first to the connecting board springjack, and thence to a springjack and an annunciator at the terminal board.

The invention also comprises the combination of such a divided switchboard, with trunk conductors extending between the two parts thereof, both main circuits and trunk conductors being provided with independent and double track electric signals (preferably visual) whereby the operator at any connecting point of either of such circuits or conductors may be promptly apprised of connections or disconnections occurring at its complementary or corresponding connecting point, and is therefore enabled to know whether such line or trunk is or is not already occupied at some other point in the office. Also, the combination of the above named organizations with office instruction circuits; with main and trunk disconnection signals; with suitable devices whereby both the terminal board operator, and the calling substation operator may simultaneously be informed that a circuit called for at the connecting board is already busy, if such be the case; and other arrangements and detailed constructions all of which are specifically pointed out in the claims appended to this specification.

In the drawings forming a part of this specification Figure 1 is a diagram representing the relative arrangement of the switchboards, with their principal circuits. Figure 1<sup>a</sup> is a similar diagram, showing especially the arrangement of trunk conductors. Fig. 2 is a diagram showing two main circuits complete together with an office trunk; an instruction circuit; and the full outfit of visual signals which I purpose to employ, illustrating the mode of connecting a circuit whose call has been received on the terminal switchboard, with a second circuit at the connecting switchboard. Figs. 3 and 4 are respectively side and vertical section elevations of a three way cam key which is convenient for use in determining the connection with any link connection of any section, the call generator, the operator's telephone, or the disconnecting drop. Fig. 5 shows in plan and section, a compound or double circuit spring jack adapted for use in association with the switchboard



circuits and trunk conductors. Fig. 6, is a detail in elevation of the visual indicator.

Considering first, Figs. 1 and 1<sup>a</sup>, A is the terminal switchboard subdivided into sections *a*, *a*<sup>2</sup>, *a*<sup>3</sup>, &c.; and B is the connecting switchboard. Any number of substation lines may converge to the central station, but for perspicuity I have in Figs. 1 and 2 of the several drawings shown but two; and that number is sufficient for explanatory purposes, since no further principle of operation is involved in the addition of others. L and L<sup>2</sup> represent these two circuits which extend respectively from substations S and S<sup>2</sup>; L passing the spring jack *j* at the connecting board, and its jack J at section *a* of the terminal board successively, and normally connecting them with its regular call annunciator drop Z; while L<sup>2</sup> in the same way, passes its jacks *j*<sup>2</sup>, J<sup>2</sup> and reaches its call drop Z<sup>2</sup>. From each terminal section *a*, one or more trunk conductors as O in Fig. 1, and O, O<sup>2</sup>, O<sup>3</sup>, O<sup>4</sup> in Fig. 1<sup>a</sup>, are extended to suitable points in front of, and adjacent to, the connecting switchboards B, and are at both of their ends provided (as will be hereinafter more particularly specified) with suitable connection devices whereby at the terminal board end, they may be united with any main circuit so as to form an extension of such main circuit to a point at the connecting board near to the jack of the line wanted there, and whereby at the said connecting board they may form a conveniently manipulated union with such line. At each terminal section *a* is also the usual number of link connectors consisting each of flexible conductors having at each end a connecting plug adapted to be thrust into springjacks, and by these, connections may be made between any two line jacks J, if the call be for a circuit terminating on the same or the immediately adjacent section on either side; or between any line jack J, and a trunk jack *k*, for connections which are to be made through the connecting board. These links *c* are shown in Figs. 1 and 1<sup>a</sup>, and a disconnecting drop D is shown as being included in circuit therewith.

I place at the connecting board springjack of each main circuit a visual signal indicator V, which becomes operative whenever a plug is inserted in the terminal board jack of such circuit, and at each of the latter jacks is a similar visual signal indicator V<sup>2</sup> responsive to the placing of a connecting plug in the corresponding connecting board jack of the same line. The trunk conductors also are at their terminal boards provided each with a similar indicator *v* to denote a connection or disconnection effected at their other end; and are likewise provided at their terminal board ends with an annunciator drop Z from which they are disconnected when in use, but which on the withdrawal of the terminal board plug resumes its connection so that upon it, should a main circuit not be promptly disconnected from its trunk at the

connecting board, the calls of said line may be received.

From suitable springjacks 13 at the terminal board sections, order or instruction telephone circuits 12 extend to operators' telephones *t*<sup>3</sup> worn or used by the operators at the connecting board. One such circuit to each connecting board operator will ordinarily be sufficient, and the several stem circuits 12 may have branches 14 to the springjacks 13 at each section, the said circuits being normally open in each springjack until the section operator's telephone circuit plug is inserted in said jack. The terminal and connecting boards may be in the same room, or otherwise, as preferred.

The foregoing description generally outlines the essentials of my invention and referring to Figs. 2 to 6, I will now proceed to specify its details of construction and operation. Two main circuits only are indicated in the diagram, as all are arranged and worked in the same way, and to delineate a greater number would, would simply complicate without further elucidating the drawing. The diagram, Fig. 2, then represents two main circuits L and L<sup>2</sup> extending respectively from telephone stations S and S<sup>2</sup> to the central station where each passes through a springjack *j* *j*<sup>2</sup> on the connecting board B, to a second springjack J or J<sup>2</sup> on the terminal board: circuit L however terminating at section *a*, and circuit L<sup>2</sup> at section *a*<sup>4</sup>. The connecting and terminal switchboard portions of the apparatus are shown as being separated by the median line *x x*. Since metallic circuits are rapidly coming into general use, I have shown L<sup>2</sup> as a metallic circuit. L is an earth completed circuit, but after reaching the terminal board, it is extended backwardly and is grounded at *g*, after its extension also passes through the jack *j* at the connecting board. All of the springjacks used in this system may be made alike, although they may be connected differently.

Any well known form of four contact springjack may be employed, and the plug intended for use therewith, must also of course have four contacts, or be adapted to control four contacts. Fig. 5 illustrates in plan and side view a form which I have found convenient, and which also is the form indicated in Fig. 2. It comprises two horizontally disposed contact springs 3 and 4 pressing normally against resting or anvil contacts 8 and 7; and two other contact springs 5 and 6 also placed horizontally but edgewise, so that their flat surfaces oppose the edges of the former. These have no normal contacts, but so long as the jack is at rest, may form discontinuous portions of a circuit. The several plug connectors shown, P, P<sup>2</sup>, and P<sup>3</sup>, may all also be of like construction, and have four insulated conducting surfaces mounted on a suitable non-conducting stem *i*, and each adapted to register and make contact with some one of the jack springs. Thus when



the plug is inserted in its jack, the conducting surfaces 23 and 24, make contact with the main line jacksprings 3 and 4 respectively, while the surfaces 25 and 26 connect with the local jack springs 5 and 6 respectively. Moreover, when the plug is thrust into the jack, its action in addition to making the said contacts, is to sever the normal contact of the springs 3 and 4 with their respective anvils 8 and 7, and thus to break the normal circuit, and to form a new circuit continuation through the said conducting surfaces 23 and 24, and such conductors as may lead therefrom. Tracing main circuit I, I find that leaving station S, it passes by main line L to the central station, and there leads first to the connecting board B, where it connects with spring 4 of jack *j*. Thence by resting contact 7 and conductor 1 to jack J at the terminal board, from spring 4 to contact 7 thereof; thence to resting contact 8 of the second spring of said jack, by way of the call annunciator drop Z and its connecting wires 27 and 28; and from said contact 8 to its spring 3 and by way of conductor 1' to the second resting contact and springs 8 and 3 of jack *j* at the connecting board and thence to earth at *g*. The main circuit L<sup>3</sup> may in like manner be traced, the only difference being that the return conductor instead of being grounded, is extended back completely to station S<sup>2</sup> forming a metallic circuit. For distinction, the two conductors thereof, extending between the two switchboards are marked l<sup>2</sup> and l<sup>3</sup> respectively.

As already stated, a series of office trunk conductors extend between the terminal board sections and different points on the connecting board. But one such trunk is shown, that being sufficient to indicate the arrangement. O represents the said trunk which has a terminal plug P<sup>3</sup> at its connecting board end, and a terminal spring jack *k* connecting normally by wires 37 and 38 with a drop *z* at its terminal board end. It being assumed that all main circuits so far as they extend through the central office apparatus are metallic, the trunk necessary is also formed with two conductors l<sup>4</sup> and l<sup>5</sup>; l<sup>4</sup> joining the spring 3 of the jack *k* with the surface 33 of the plug P<sup>3</sup>, and l<sup>5</sup> uniting the spring 4 with the surface 34 of said plug.

Each answering or terminal board section is provided with the usual outfit of a number of double plug link connections Y, whereby the jacks of any two circuits or conductors may be united to constitute a continuous line of conduction. Each of these comprises for metallic circuits two flexible main line conductors *y* and *y*<sup>2</sup> each united at its ends to independent contact surfaces upon the terminal plugs; the plugs P P<sup>2</sup> are hereinbefore described, and in the present instance an additional conductor *w* is associated with the main line connecting link conductors for a purpose presently to be disclosed. The conductor *y* joins the contact surfaces 23 while

conductor *y*<sup>2</sup> joins the surfaces 24 of the two plugs P and P<sup>2</sup> of each pair, there being shown to avoid confusion one link connection Y only. It will now be clear that the said plugs P P<sup>2</sup> may respectively be placed within any two springjacks J, respectively located at the same or adjacent terminal board sections, and that when so placed, the circuits represented by such jacks will be connected to form a compound circuit through the link connection Y. Not only so, but it is also evident that one of the plugs P being inserted in a line jack J and its associate in a trunk conductor jack *k*, the plug terminal P<sup>3</sup> of said trunk becomes the extended terminal of the line represented by said jack J, and may be inserted in any connection board jack *j*<sup>2</sup>, thereby establishing a through connection between the stations S and S<sup>2</sup> of the two lines L and L<sup>2</sup> concerned, by way of the terminal board jack J of L, the link connection Y, and the trunk conductor II.

Any of the well known keyboard systems of connecting the operator's call and telephonic apparatus may be arranged at each terminal section in connection with the several pairs of connection cords and plugs; I prefer however to provide for each section a loop circuit M<sup>2</sup> extending from a call generator M; and transmitting and receiving telephones *t* and *t*<sup>2</sup>, common to all of the connection links of said section; and with a disconnecting or clearing out drop D and a three way cam switch for each individual link connection. The generator loop M<sup>2</sup> extends from the generator M which may be common to the entire switchboard, to two terminal contacts h<sup>3</sup> and h<sup>4</sup> in each cam switch; an electro-magnetic resistance or retardation coil *m*, being included in each loop conductor for a purpose to which reference will hereinafter be made. The disconnecting drop D is provided with a conductor *c* having terminal contacts c<sup>2</sup> and c<sup>3</sup>. The transmitting telephone *t* is usually in a local battery circuit, and connects with its main loop including the receiver *t*<sup>2</sup> through an induction coil I; the loop conductors 40 and 41 being branched to terminal contacts h and h<sup>2</sup> in each cam switch of a terminal switchboard section. The three way cam switch E, by means of which any of these appliances may be connected with the link connection Y, and thereby with any main telephone circuits which may be attached thereto, is shown in Figs. 3 and 4; since it is not claimed as forming part of this invention, it is not necessary to describe it specifically. Fig. 3 shows however the disconnecting drop contacts c<sup>2</sup> and c<sup>3</sup>, the generator terminals h<sup>3</sup> and h<sup>4</sup>, and the main line terminals *d* and *d*<sup>2</sup> which may be placed in contact with either of the two former, alternatively.

It is not desirable at any time to introduce any of the keyboard appliances directly into a compound talking circuit; and the switch conductors are therefore arranged, so that whenever any two lines are united by the



link connection, if any of the appliances of the operator are to be used thereon, they are connected in bridge circuit between the two main conductors  $y$  and  $y^2$ . To this end, the two principal conductors 37 and 38 of the cam switch lead from points  $e$  and  $e^2$  on the link conductors  $y$  and  $y^2$  respectively, and at the points  $e^3$  and  $e^4$  branch to two sets of contacts. One of the pairs of branches ends in terminals  $n$  and  $n^2$  which may connect with the telephone loop; and the other ends in terminals  $d$  and  $d^2$  which connect alternatively with the disconnecting drop or generator loop. In the normal position of the cam lever which is upright, the telephone and generator loops are both open, but the disconnecting drop  $D$  is in circuit between the conductors  $y$  and  $y^2$  through the contacts  $d$ ,  $c^2$ , and  $d^2$ ,  $c^3$ . In the second position of the cam when depressed to one side in which a call is to be sent to line, the telephone and disconnecting drop loops are both open, and the generator is connected between the conductors  $y$  and  $y^2$  through the contacts  $d$ ,  $h^4$  and  $d^2$ ,  $h^3$ , the original contacts of  $d$  and  $d^2$  with  $c^2$  and  $c^3$  having been forced apart by the descending spindle and wedge, which projects downwardly under the influence of the cam, as shown in Fig. 3. But if the cam be turned reversely into its third position, the telephone loop being controlled by a second spindle will be closed in bridge circuit with the main conductors  $y$  and  $y^2$  through the contacts  $n$ ,  $h$ ,  $n^2$ ,  $h^2$ , without opening the circuit of the disconnecting drop, the impedance of this, being sufficient to prevent any short circuiting of the telephonic currents.

Although it is true that while the connection link  $Y$  is employed at both ends in uniting two main circuits, the telephone loop (should it be connected) is indeed bridged between its two conductors, or in other words is in derived circuit with the two said circuits, it is also true that when one of the plugs  $P$  only of such link is in use, as in answering a call, the other plug remaining unused, the telephones although connected in the same way, are yet in direct circuit with the said plug, the alternative route through the second plug being for the present discontinuous. When answering calls therefore, the answering end of the connection link  $Y$  is in fact itself the telephone loop, and the answering plug, the plug terminal of such loop.

The instruction or order circuits 12, extend between each section of the terminal board and the several operators' telephones at the connecting board. Their general arrangement has already been described. This also is here shown as being a metallic circuit, the two conductors thereof,  $r$  and  $r^2$  both extending from the head telephone  $t^3$  of the connecting board to a spring jack 13 at a section  $a$  of the terminal board. To indicate that said order circuit passes likewise to other sections, the rudimentary branches 14 are shown, connecting with the conductors of circuit 12. Being

common to a plurality of sections, it is necessary that this circuit shall not be normally closed in any of its springjacks 13, and accordingly it will be seen that though the jack shown has all the elements of the other jacks of the system, the spring contacts 3 and 4 of the main telephone circuit are the only ones which are attached to circuit conductors; the others serving merely as plug guides whereby it becomes possible to employ the same plug connector  $P$  in association with this jack to give an order, as will thereafter be used to connect with the trunk jack  $k$ . By means of these order circuits the operations at the connecting board are readily kept under the control of the operator at the terminal board, and they are constantly employed for the transmission of orders relating to the connection of given trunk terminal plugs with desired lines.

There being two springjacks for each main circuit located at two different switchboards, it is essential that some efficient means be provided whereby it may promptly and certainly be known at either springjack when a connection or a disconnection has been made at the other, or in other words, whereby the engaged or disengaged condition of a circuit at either switchboard may be determined at the other by a glance. And though not essential, it is desirable also that means should be provided at each connection board jack for promptly apprising the operator there, that a trunk conductor which has been in use, and which is plugged to said jack, is now disconnected, and that such plug therefore should now be withdrawn. These requirements are met by the system of visual signals shown, in which a suitable visual indicator is closely associated with each connecting board springjack  $j$ , and is operated first, by placing a connecting plug in the corresponding or complementary jack  $J$  of the same telephone circuit at the terminal board; and second by placing the terminal plug of any trunk conductor in the connecting board jack  $j$ . A form of visual indicator which I have found well adapted for this purpose, is the self-restoring annunciator for which Letters Patent of the United States No. 481,120 were granted to Frank A. Pickernell, August 16, 1892; or, if desired an ordinary incandescent lamp may be employed, as indicated at the trunk signal of section  $a$  in Fig. 1, and at section  $a^5$  in Fig. 1<sup>a</sup>. The former device I have illustrated in Fig. 6 of this specification, and it consists simply of a short electro-magnet  $x$  which can be included in an electric circuit, and whose core has a curved tapering projection  $x^2$ , extending through a hole in the shutter armature  $x^3$ . When current is passed through the coil, the shutter is drawn up, and when the current ceases, it is permitted to fall; in the first case announcing a connection, and in the latter a disconnection. Such an indicator  $V$  placed beside its jack at the connecting board has one of its coil terminals



connected with the earth or with a return conductor, and the other attached to a conductor  $f$  forming part of a normally open signaling circuit which extends to the terminal section, and there is united to the contact spring 5 of the corresponding line jack J, which spring forms normally the open end of the circuit, and also a circuit closer.

The plugs P of the several plug and cord connectors at each terminal section, each carry, as previously explained, a conducting surface 25 arranged to register and connect with the circuit closing spring of the jack J, and the said surface is in constant connection through conductor  $f^2$ , with one pole of a source or generator of electricity F, such as a battery, the other pole of which connects with the return terminal of the indicator V of the connecting board jack, shown as the earth through the said return conductor with which that terminal connects. Thus when the plug P is thrust into the jack J to answer a call, the circuit closer of the signal circuit becomes operative, and the indicator V is actuated, announcing at the connecting board that such a plug insertion has been made, and that the connecting board jack is blocked until the reverse operation of said indicator which, occurring on the withdrawal of said plug, and the consequent opening of the said circuit, indicates that the main circuit is once more at liberty. The same connecting board indicator V subserves the second purpose also. It exhibits its block signal whenever the plug terminal of a trunk conductor is inserted in its associated jack, provided that a connection is made at the terminal board with the jack of said trunk; consequently should a plug be found in a jack at said connecting board the block signal having disappeared, it is at once known that the terminal board end of said trunk has been disconnected, and that the plug end thereof should also be withdrawn.

It will be seen that each visual indicator V at the connecting board in addition to its connections which have already been described, has also a branch connection to spring contact 5 of its own jack  $j$  or  $j^2$ . This spring has no further connection until a trunk plug is placed in the jack; but the contact surface 35 of such plug is united through a conductor  $u$ , associated with the trunk conductor throughout its length, to the normally unconnected contact spring 5 of the trunk jack  $k$ .

The plug  $P^2$  of each connection link Y is during a connection inserted in the jack  $k$ , and its contact surface 25, registers and makes contact with the said spring 5 thereof. The said contact surface 25 as well as the opposite one 26 is electrically united to a local circuit conductor  $w$  which may mechanically be arranged in the same flexible cord as includes the main link conductors  $y$  and  $y^2$ , and which branches from the battery conductor  $f^2$  at the point  $w^2$ . The whole then may be regarded as a local automatic signal circuit open at

two points, namely at the connecting board jack, and at the trunk board jack, so that the block signal is established in the indicator V when both circuit closers are operated, and disappears when the plug is withdrawn from the trunk jack, thus indicating that the trunk plug should also be withdrawn from the line jack. In like manner each terminal board spring jack J has its protecting signal  $V^2$  to indicate the use or disuse of its line at the connecting board by a trunk plug.

The indicator  $V^2$  has one of its terminals connected by the wire  $m^2$  with a suitable return conductor shown as the earth; and its remaining terminal is united directly by a conductor  $m^3$  with the spring contact 6 of the jack  $j$  of its own main circuit at the connecting board. Here the signal circuit is normally open, and the said spring 6 serves as the circuit closer operated by the insertion of the trunk plug  $P^2$ . The contact surface 36 of said plug is united by a second associate conductor  $q$  of the trunk conductors to a trunk conductor visual indicator  $v$  of the same class as the others, and through that by conductor  $q^2$  with the battery  $F^2$  and by conductor  $q^3$  to the return or earth. The act of introducing the trunk plug  $P^2$  into a jack  $j$  closes this signal circuit and causes the indicators  $V^2$  and  $v$  both to set at their block position, showing at the jack J that its circuit is in use at the connecting board, and showing at trunk jack  $k$  that the order given over the order circuit to connect a given trunk plug to a given circuit has been complied with; while upon the withdrawal of said plug, one section of the terminal switchboard receives the signal "clear line" and the other receives the signal "clear trunk." But should the connecting board end of the trunk fail to be promptly disconnected after the withdrawal of the plug  $P^2$  from the jack  $k$ , the trunk annunciator drop  $z$  becomes temporarily the call receiving drop of the line connected at said connecting board so that the service of such line is not neglected. A complete double track system of automatic busy signals is thus provided.

One electrical generator alone, such as a secondary battery is, if desired, sufficient for all the visual signals, there being no special reason for two, save that of facility of delineation. The trunk signal  $v$  also has a subsidiary function as will presently appear. At the connecting board B, is arranged an apparatus whereby should a called for line be found to be already occupied, the fact may readily and promptly be made known to the terminal board operator who transferred the call; and, if desired, also to the substation at which such call originated; and in practice it would be preferable to have several such appliances.

K is an auxiliary jack made like the others, and having electrical conductors attached to but three of its spring contacts viz: 3, 4 and 6. Contact 6 is adapted to register and con-



nect with conducting surface 36 of plug  $P^1$ , and thereby to be brought into circuit with battery  $F^2$ . It is united to the return conductor of said battery by the wire 50 through a revolving or vibratory circuit breaker R which may be kept in motion by suitable mechanism (not shown) or which in a manner well understood may be organized to start its motion as soon as current passes through it.

To indicate the busy condition of the line wanted, the plug  $P^2$  is inserted in the jack K and its battery conductor including the indicator  $v$  at the other end, is thus brought into circuit with the intermittent circuit breaker R, the current is intermitted through the said indicator which is thereby caused to flutter in response to the action of said circuit breaker, and the terminal board operator is thus visually informed that the line wanted is occupied. It is sometimes desirable that the calling substation should also receive a similar automatic notification, and I accomplish this by uniting the main spring contacts 3 and 4 of the jack K which register with the main circuit conducting surfaces 33 and 34 of the plug, to a loop circuit extending through conductors 52 and 53 in which is included any convenient form of battery signal transmitter, and a battery  $F^3$ . This signal may be of the same class as the circuit breaker B, or it may be an ordinary buzzer; in an organization which has been constructed, I have however employed in this loop, a telephone transmitter  $t$ , and have mounted the same in close juxtaposition to a phonograph  $p$ , which may be in constant operation, and arranged to repeat continuously into such transmitter the word "busy," "busy." Any such signal is however transmitted over the several circuit conductors, from the trunk plug to the substation and is received in the telephone or upon the bell there, and the signal being heard, therein, automatically notifies the attendant that the line of the station called for is engaged with another connection. These devices however considered by themselves constitute the subject matter of another application for Letters Patent filed of even date herewith by myself, conjointly with Frank A. Pickernell for an improvement in busy signals for telephone circuits, Serial No. 448,767, and, except as elements of a combination are therefore not claimed herein.

The operation may generally be described as follows: Station S signals the central station in the usual manner. Its circuit L as already stated is through a spring jack  $j$  located on the connecting board, extending thence to the corresponding or complementary spring-jack J at the terminal board A, section  $a$ , and then to the terminal drop Z. The operator at the terminal board inserts the answering plug P of any connector  $c$  into the jack J and receives the call. This plug is for the present the terminal of the telephone loop, the three way cam being properly turned; and the instructions of the substation are therefore prop-

erly received and answered. But the insertion of the plug in the jack J is an occupation of the circuit, and to forestall an interruption, by an attempt to connect with the said circuit at its connecting board jack while such occupation continues, the operators at the said connecting board are to be informed that the circuit of station S is busy and the springjack  $j$  therefore blocked. This is done by providing that the insertion of the plug at J shall close a local circuit in which is located the signal receiver V located in close proximity to the jack  $j$ . The setting of this signal operates to prevent the connection of circuit L at the jack  $j$  of connecting board B, with the circuit of any other customer calling for station S, which connection otherwise might take place and interfere with the service. A similar electric visual indicator  $V^2$  protecting the springjack J at the terminal board A is not required to become operative, as the presence of the plug in the jack there, shows at once the line to be busy; and it does not become operative because no plug has been placed in springjack  $j$  to close its circuit. The operator at the terminal section  $a$ , having received the call from station S, finds that a connection with some other station, say  $S^2$ , is desired. If the circuits of station S and  $S^2$  should happen to be represented on the same or adjacent terminal boards, they may be at once connected directly with the regular link connection or pair of switchboard cords Y in the ordinary way, and in that case the circuit  $L^2$  being connected through the connecting board to the terminal board, in the same manner as is circuit L, the insertion of the plug in its terminal board jack would operate the visual signal V at its connecting board jack and would protect the connection from interference there, also in the same manner as in the case of circuit L. But the circuit  $L^2$  of station  $S^2$  as indicated in the drawing, is terminated at a remote terminal section  $a^4$ , and must be reached through the connecting board. The operator therefore inserts the second plug  $P^2$  of the pair in the springjack 13 of the ordering or instruction circuit 12, extending from said springjack by branch 14 and main 12 to the head telephone of a switching operator stationed at some point  $b$  at the connecting board near to the line wanted. Over this, the said connecting board operator is instructed to connect line  $L^2$  of station  $S^2$  with the office trunk conductor O, extending between the terminal board section  $a$  to the point  $b$  at the connecting board. The second plug of the link connection Y would now be inserted in the jack  $k$  of the specified trunk as shown, and at the connecting board the plug terminal of said trunk would be inserted in the jack  $j^2$  of line  $L^2$  of station  $S^2$ . This last plug connection automatically operates the visual indicator  $v$  at the terminal board end of the office trunk, and also severs the end of line  $L^2$  which extends to the terminal board  $a^4$  and actuates the visual indicator  $V^2$  of said line as so-



ciated with its terminal board jack, thereby indicating to the operators at that and adjacent sections  $a^8$  and  $a^5$  that the line of station  $S^2$  is busy. It also, in co-operation with the connection at the springjack end of the trunk sets the visual signal  $V$  at the connecting board jack  $j^2$  to serve as a trunk disconnection signal. If line  $L^2$  should on the reception of the order for its connection be found at the connecting board to be already busy, the operator there would automatically signal the fact to the answering operator and also to the calling station, by inserting the trunk plug  $P$  in the busy spring jack  $K$ , thereby connecting the main line  $L$  and the trunk signal circuits to automatic devices, sending preconcerted busy signals, by means of the hereinbefore described apparatus connected with said busy jack. Further than the loop connection of the call generator  $M$  with the three way cam switch, I have not shown any special call key device for signaling substation  $S^2$  over its line  $L^2$ , but any of the ordinary and well known call key devices may readily be subjoined to or substituted for said cam switch and loop in a manner well understood.

In connection with the cam  $E$ , I show that the generator loop includes two graduating electromagnetic resistances, and in practice I have found it feasible to so arrange such resistance and retardation coils, that a regular alternating current generator adapted to efficiently ring the ordinary polarized telephone bell will not produce any material sound in a telephone included in the same circuit; the alternating currents being so graduated, and their crests so rounded, that they do not act upon the telephone while continuing to efficiently operate bells. I call a generator so arranged a graduated generator and as the same is described and claimed in a separate application for Letters Patent filed by myself and Frank A. Pickernell as joint inventors, contemporaneously herewith and entitled an improvement in signaling apparatus and circuits, Serial No. 448,766, no claim is made herein for the same.

In the use of this apparatus after the order has been given to the connecting board operator to connect a given trunk with the line wanted, the cam  $E$  is turned to the generator side and so left, while other calls are being answered on other cord connections. As soon therefore as the connection is made at the connecting board, the bell at the desired station being connected with the generator, will ring continuously until the attendant there takes down his telephone and begins to talk. But when that is done, though the generator connection continues, the two persons talking at the two connected stations are not disturbed thereby, because their telephones do not respond to the graduated call currents. The ringing however does not long continue, for the operator after having attended to other calls, returns to this connection and finding

the signal  $v$  set, knows that the connection has properly been completed and reverses the cam lever, so as to disconnect the generator and bridge the disconnecting drop across the circuit. By this automatic ringing feature much time is saved, as the operator is enabled to attend to other work, while it is going on. On the conclusion of the communication either or both stations may ring off as usual, and the disconnecting drop  $D$  is operated. The operator withdraws the plugs  $P$  and  $P^2$  from the jacks  $J$  and  $k$ . The withdrawal of  $P$  opens the local circuit of signal  $V$  of line  $L$  and removing said signal liberates the jack  $j$  and restores the normal circuit of  $L$ . The withdrawal of  $P^2$  opens the local circuit of signal  $V$  of  $L^2$ , and removing the said signal, notifies the connecting board operator that the trunk plug  $P^2$  should be withdrawn from jack  $j^2$ . Until that plug is removed and circuit  $L^2$  thereby set at liberty the signal  $v$  at the trunk jack  $k$  and  $V^2$  at the terminal board jack of said circuit  $L^2$  remain set, but the station  $S^2$  can still signal the central station through the trunk drop  $z$ . And finally, the trunk plug  $P^2$  having been withdrawn from the connecting board jack  $j^2$ , the local signal circuit of  $v$  is opened, restoring that signal to its normal state, and declaring the trunk conductor to be at liberty; the signal  $V^2$  at the terminal board end of circuit  $L^2$  being in the same local circuit is also restored indicating the liberty of said main circuit  $L^2$ , and the normal state of said main circuit is resumed.

I have now fully described the invention and its operation and claim—

1. In a telephone exchange, the combination of a terminal switchboard; a connecting switchboard; springjack connections on the connecting switchboard; a second series of spring-jacks, and a series of call receiving annunciators on the terminal switchboard; and a series of circuits converging from substations to a central station where said switchboards are located, and each passing successively through a springjack at the connecting switchboard, and a springjack and call receiving device at the terminal switchboard; the connecting board being located between the terminal board and the substation, substantially as described.

2. The combination in a telephone exchange system, of a series of substation circuits converging to a central station; with a divided switchboard, consisting first of a connecting switchboard provided with springjack connections, one for each circuit, and second a terminal or answering switchboard at which are located other springjack connections, and call receiving annunciators, one for each circuit, and means for transmitting outgoing calls; the connecting switchboard springjack of each circuit being located at a point thereon, external to the terminal switchboard devices, or between the same and the substation, substantially as described.

3. The combination, substantially as here-



inbefore described, of an outer or connecting switchboard fitted with springjack connections, one for each line; an inner or terminal switchboard fitted also with springjack connections, one for each line; a series of substation circuits passing through the connecting board and terminal board springjacks successively; a plug connector forming the terminal of an operator's telephone circuit, located at the terminal board, and adapted to fit in the springjacks thereof for the purpose of answering calls; a visual signal associated with each springjack on the connecting board to indicate whether the circuit of such jack is busy; and a circuit changer associated with the corresponding springjack on the terminal board, controlling the said visual signal, the said circuit changer being arranged to be operated by the act of making a connection or disconnection, by inserting the said plug connector into the said corresponding springjack, for the purposes specified.

4. The combination in a telephone central station apparatus, of an inner or terminal switchboard divided into operators' sections; an outer or connecting switchboard containing springjack connections; a series of telephone substation circuits entering the central station each passing through a single connecting board jack to a jack on that one of the terminal boards at which is located its call annunciator; a series of office trunk conductors, extended from each terminal board to the connecting board, the terminal board end of each being provided with a spring jack, and the connecting board end with a flexible conductor and plug, whereby the said trunks are adapted to serve as extensions through which a calling circuit at its terminal board may connect at the connection board with called circuits terminating at other sections; a series of double plug and cord connectors at each terminal section for uniting the main circuit jacks to the office trunk jacks; and an order or instruction circuit extended from the several terminal board sections to an operator's telephone at the connecting switchboard, substantially as and for the purposes specified.

5. The combination in a telephone central station, of an inner or terminal switchboard, divided into operators' sections containing a given number of springjacks or plug sockets, each section being provided with independent operating and supervisory apparatus; an outer or connecting switchboard having a springjack or plug socket for each entering circuit; a series of telephone circuits extended from substations, each passing first through one of the connecting board jacks, and from thence inwardly to a jack at some one of the terminal boards; an office trunk conductor extended from each terminal board section to the connecting board, and adapted to serve as an extension circuit through which a circuit terminating in such terminal board section may connect with circuits terminating in other sections, at their respective connecting-board

jacks; a series of link connectors at each terminal board section, each comprising a pair of jack plugs and flexible conductors uniting them; and an order or instruction circuit extended from each terminal board section to an operator's telephone at the connecting board, substantially as described.

6. In a telephone exchange, the combination, substantially as hereinbefore described, of a connecting switchboard; a sectional terminal switchboard; and a series of incoming substation lines, each connecting with a springjack at the terminal switchboard after passing through a similar spring jack or plug-receiving connection on the connecting switchboard; with a series of plug and cord connectors containing double main circuit conductors at each terminal switchboard section for the purpose of connecting any two circuits together through their respective jack connections; three independent appliance circuit loops at each terminal board section, including respectively the operators' telephones, the call sending generator, and the disconnecting signal device; and a three way cam switch for each of the said plug and cord connectors, in a bridge circuit between the said two main conductors thereof, controlling the connection therewith of the said appliance loops, for the purposes specified.

7. In a telephone central office system, a divided switch apparatus comprising a terminal switchboard formed in sections, at which calls are answered and transmitted, and connections initiated, each section being provided with springjacks and annunciators for a given number of main circuits; and a homogeneous switchboard at which connections are made with circuits called for, the said switchboard being fitted with springjacks only, one for each entering main circuit, each located on its circuit at a point outside of the terminal board jack of the same circuit; in combination with a series of office trunk conductors extending from springjacks at each terminal section, to flexible conductors and plugs located at one or more points of the said homogeneous switchboard; a series of double-plug and flexible cord link connectors at each terminal section for making connections between the main circuit and office trunk jacks; telephones and call receiving and sending appliances adapted by suitable switches (one for each cord) to be connected in derived circuit with the said link connectors; and instruction or order circuits, extending between a springjack at each answering or terminal section, to which the operator may plug in and connect his telephones to an operator's telephone at the connecting switchboard, substantially as described.

8. In a telephone central station switching apparatus the combination with a terminal switchboard at which calls are answered; a connecting switchboard at which the connection with a desired line may be made; a series of substation lines, each passing through



an intermediate springjack on the connecting board to a terminal springjack and call annunciator at the terminal board; a series of conductors extended between the said switchboards to connect a calling line on the terminal board with a called line on the connecting board, each normally closed through a springjack and an annunciator at the terminal board, and normally discontinuous in a connecting plug at the connecting board; and a series of double plug and cord connectors at the terminal board, the terminal plugs of each being adapted to fit the substation and trunk line jacks respectively, and thereupon to unite said lines, and disconnect their respective annunciators; substantially as described.

9. The combination in a telephone central office system of a divided switching apparatus, comprising a terminal switchboard formed in sections at which calls are answered and transmitted, each section being provided with answering springjacks and annunciators for a given number of main circuits; a non-sectional connecting switchboard having a springjack for each main circuit, at which connections with called lines are completed; cord connectors fitted at each end with connecting plugs, located at the terminal board sections; and a series of office trunk conductors extending from an equal number of springjacks to flexible conductors and plug terminals located suitably near the jacks of the connecting board, and adapted to connect with said jacks; with a double track system of visual electric signals, the said signals comprising an indicator, located in proximity to each springjack of each main circuit and included in the normally open local circuit of a suitable source of electricity, and an automatic circuit closer therefor mounted in the remaining or corresponding springjack of the same line, adapted to be operated by the insertion of a plug into or its withdrawal from such corresponding springjack; whereby the use of any main circuit at either terminal or connecting board is automatically indicated at the other.

10. The combination in a telephone central office system, with a divided switching apparatus comprising a terminal switchboard formed in sections, at which calls are answered and transmitted, each section being provided with answering jacks and annunciators for a given number of main circuits; a non-sectional connecting switchboard having a springjack for each main circuit at which connections with called lines are completed; a series of substation or main circuits, each connected with one jack on each board; a series of office trunk conductors extending between the several terminal board sections and the connecting board, and adapted to connect the jacks of one to those of the other; and detachable link connectors at the terminal sections for uniting the main circuit jacks to the office trunks; of an automatic visual electric signal associated with each springjack of each cir-

cuit; and means for automatically operating the indicator at either jack of said circuit, by making a connection or disconnection at the other.

11. The combination in a telephone central office system of a divided switching apparatus comprising a terminal switchboard formed in sections at which calls are answered and transmitted, each section being provided with answering springjacks and annunciators for a given number of main circuits; a non-sectional connecting switchboard having a springjack for each main circuit, at which connections with called lines are completed, cord connectors fitted at each end with connecting plugs located at the terminal board sections, and a series of office trunk conductors extending from an equal number of springjacks at the terminal sections to flexible conductors and plug terminals located near the jacks of the connecting board, and adapted to connect with said jacks; with a system of visual electric signals to indicate at each switchboard the condition at the other, of a given circuit; the said signals comprising an indicator associated with each springjack of each main circuit, and included together with a suitable source of electricity in a normally open local circuit, and a circuit closer for said local circuit controlling said indicator mounted within the remaining or corresponding springjack of said line, and adapted to be operated when a plug is inserted in said jack; substantially as described.

12. A central office system of circuits and apparatus comprising the following elements in combination, an outer or connecting switchboard fitted with springjack or plug socket circuit connections; a sectional inner, or terminal switchboard fitted similarly with springjack or plug socket connections; a series of telephone circuits extending from substations to the central station, each passing successively first through a springjack on the connecting board, second through a springjack on some one of the terminal board sections, and through a call receiving device at the latter; an independent series of loop connectors having plug terminals at each terminal board section whereby the springjacks of any two lines terminating on the same or on adjacent terminal sections may be united; a visual electric signal associated with each circuit springjack on the connecting board to indicate whether such circuit is busy; and a circuit changer actuating each such visual signal associated with the corresponding springjack on the terminal board, and adapted to be operated by the insertion and withdrawal of the connector plug, whereby the connection and subsequent disconnection of any two lines at the terminal board is enabled to set and remove the busy signal of both at their respective connecting boards, substantially as described.

13. In a central telephone station apparatus, the combination of two switch-boards at which



are located the terminal connection devices of main-line circuits, a series of trunk-lines extending between the two boards, having each a plug terminal at one end and a spring-jack at the other, a visual signal at the latter terminal, a circuit including said signal and including also a circuit controller, the latter being associated with the plug terminal, and being actuated whenever a connection is made thereby with any of the terminal connection devices, substantially as described.

14. The combination with the two switchboards at which are located the terminal connection-devices or spring jacks of the main-circuits, of a trunk conductor extending between the two switch boards, a visual signal located at one terminal of said trunk conductor, a circuit including said signal and also including a generator, said circuit being normally open at the other terminal of the trunk-conductor, and a circuit-closer at the latter terminal operated automatically by the act of making a connection thereat, so that the circuit of said signal and its generator remains closed so long as said connection is established, substantially as described.

15. In a telephone central station apparatus a series of substation main circuits, each passing successively through two springjacks or like connection devices located on different switchboards; and a series of office trunk conductors extending from one of the said switchboards where each said trunk has a spring-jack terminal, to the other where each has a plug terminal; combined with a visual signal indicator located at each springjack of the said main circuits and trunk conductors, each adapted to respond to connections or disconnections made at the other jack of such main circuits, and at the plug end of such trunk conductors respectively, by means of circuit closing contacts electrically connecting with said indicators, and operated by the act of making such connections and disconnections.

16. In a telephone central office system, a divided switching apparatus comprising a terminal or answering switchboard formed in sections to which a determinate number of substation circuits are assigned; a non-sectional connecting switchboard on which all substation main circuits are represented by a plug socket or jack; a series of such main circuits connected serially with the connecting board and with some one section of the terminal board; office trunk conductors extending from the sections of terminal board, to different points at the connecting board and having at one end a springjack connection and at the other a plug connector; and means, as indicated, at each terminal section, for electrically connecting any main circuit jack with any trunk conductorjack, combined with a system of visual signals to indicate at each switchboard the use or disuse of a given circuit at the other board, the said signals consisting of an electrical indicator associated with each springjack of all main circuits, and

means for automatically operating the same at either jack of any circuit by inserting a plug in or withdrawing it from the remaining jack of such circuit; and an auxiliary system of visual signals associated with each office trunk conductor, and comprising an electric indicator located at the end or ends thereof, and a circuit controller therefor at the opposite end thereof, arranged to be actuated by any electric connection or disconnection made at such opposite end, whereby such use or disuse of either end, may be indicated at the other; all substantially as hereinbefore described.

17. In a telephone central office switching apparatus, the combination with a series of main circuits, and a series of trunk conductors, each of both series being furnished with a pair of connection devices, whereby it may be connected with others; of a series of normally open signal circuits extending each between the two members of a pair of the said connection devices; a visual signal indicator in such circuits located at each connection device of each pair, and a circuit closer for each such circuit and indicator, located and associated with the remaining connection device of the said pair, and adapted to be actuated by each connection or disconnection made therewith; whereby such connections or disconnections of main circuits made by either member of a pair of connection devices are enabled simultaneously to make or break its associated signal circuit, and to automatically announce themselves at the other member of said pair.

18. The combination of a telephone central office switchboard apparatus in which each substation circuit is provided with connection devices such as springjacks, one at each of two independent switchboards, said apparatus also including a series of office trunk conductors extending between the said two independent switchboards for the purpose of connecting a jack of a given circuit at one of the switchboards with a jack of a second circuit at the other switchboard, each trunk conductor being fitted at both ends with suitable connection devices; and a system of automatic visual electric signals operated by means of local signaling circuits for the purpose of indicating at either connection device of the said substation circuits and trunk conductors the engagement or disengagement of the other connection device thereof, each signal consisting of an electric indicator associated with each of the said connection devices, and adapted to respond to connections and disconnections made at the other connection device of each such circuit or conductor; substantially as described.

19. The combination of a telephone switchboard apparatus in which each substation circuit is provided with two connection devices such as springjacks, one at each of two independent switchboards, said apparatus also including a series of office trunk conduct-



ors fitted at both ends with suitable connection devices extending between the said two independent switchboards for the purpose of connecting a jack of a given circuit at one of the switchboards with a jack of a second circuit at the other switchboard; and an automatic and double track visual electric signal for each substation circuit and trunk conductor, the said signal comprising an electric indicator associated with each connection device, a circuit controller therefor associated with the remaining or complementary connecting device of the same circuit or trunk conductor; a local circuit including the said signal and governed by the said circuit controller; and means for automatically operating the said circuit controller whenever the connection device with which it is associated is brought into, or put out of use; whereby the engagement or disengagement of any circuit or trunk conductor at either connecting device is caused to automatically announce itself at the other, substantially as described.

20. In a telephone central station switching apparatus, the combination with two switchboards, one serving as an answering or terminal board, and being formed into a number of operators' sections, and the other serving as a connecting board at which the connection of the desired circuit is made; an answering telephone loop terminated in a suitable plug connector located at each section of said answering board; and office trunk conductors extending between the said two switchboards whereby a calling line answered at any section of the terminal board may be temporarily extended to any desired part of the connection board; of a series of order or instruction circuits, each extending from an operator's telephone at the connecting switchboard, to the terminal switchboard, where it divides into normally discontinuous branches, terminating at the several operators' terminal sections in sockets adapted to receive the plug of said telephone loop, substantially as described.

21. The combination of a main telephone substation circuit; a springjack or plug socket therefor, having main and local circuit contacts included therein, and located at a terminal switchboard at which calls are received and transmitted; a second springjack included in said circuit at a point between the first and the substation, and located at a connecting or intermediate switchboard; a visual signal such as a glow lamp or self restoring annunciator, associated with the latter at the said connecting board; a local circuit conductor extending from the said signal to the local contacts of the terminal board springjack where its circuit is normally open; a plug connector adapted to be inserted in said springjack and provided with main and local contact pieces adapted to register and connect with those of said jack; and an electrical generator having one pole connected with the local contact piece of said plug and the

other connecting with a return conductor of the said visual signal and adapted upon the insertion of said plug to close its own circuit through said visual signal; whereby the insertion of a plug at any springjack at the terminal switchboard is indicated at the connecting board jack of the same line.

22. In combination with an office trunk conductor extending between an answering or terminal switchboard, and a connection completing switchboard; a system of visual signals comprising a normally open signal circuit, a source of electricity therefor, two alternative circuit closers therefor at the connecting board, one completing the circuit directly and thereby producing therein a steady current, and the other completing the said circuit through a vibrator or current varying device, and thereby producing a varying current therein, and a visual indicator, such as an incandescent lamp, or a selfrestoring annunciator included in the said signal circuit at the answering board, and adapted to give distinctive signals in response to the said circuit closers respectively; substantially as described.

23. In combination with a telephone substation circuit; a switchboard with which such circuit is connected, and where its calls may be answered; an independent switchboard at which other substation circuits are represented by suitable connection devices; and an office trunk conductor extending between the said switchboards and adapted to interconnect the circuit at the first switchboard with any desired circuit at the independent switchboard; of a telephone apparatus at the substation of the said first circuit; a visual indicator at the first switchboard terminal of the said office trunk; and a compound busy signal transmitter located at the independent switchboard terminal of said trunk, organized to transmit busy signals adapted to manifest themselves audibly in said substation apparatus, and visually in said indicator at the said trunk terminal; whereby the busy condition of a desired circuit may be indicated simultaneously at the calling substation and at the switchboard connected therewith.

24. In a system of central telephone station apparatus, the combination with a series of substation or main circuits; an answering switchboard having a springjack for each circuit; a second or connecting switchboard also having a springjack for each circuit; and office trunk conductors extending between the said two switchboards; of an office signaling circuit and an electrical generator therefor associated with each trunk, provided at the connecting board terminal thereof with an absolute circuit closer operated by connecting the said terminal with a desired line, and a current varying circuit closer, operated by connecting the said terminal with a special springjack, whereby steady or vibratory currents are alternatively caused to circulate in the said signaling circuit; and at the answer-



ing board terminal thereof, with a visual indicator adapted to respond with a distinctive signal to either current and to indicate alternatively thereby at the answering board, that connection is made with the circuit wanted, or that said circuit is busy.

25. In combination with an office trunk conductor extending between an answering or terminal switchboard, and a connection completing switchboard comprising a series of suitable springjacks, one for each main circuit; and a busy signal springjack located at such connecting switchboard; a system of visual signals for indicating at the said answering board the progress of a connection at the connecting board, said system consisting of a signal circuit extending in association with said trunk between said switchboards, and being normally open at the connection board; a source of electricity therefor; two alternative circuit closers therefor at the connecting board, one located upon each main circuit springjack adapted to complete the signal circuit directly, and to establish a steady current therein when the trunk conductor is connected with said main circuit jack; and the other located upon the busy signal jack and adapted to complete the said signaling circuit through a vibrator; a buzzer or a current varying device, and thus to produce a varying current therein when the said trunk conductor is connected with said busy signal jack; and a visual signal indicator included in the said signal circuit at the answering board, and adapted to give distinctive signals in response to, and corresponding with the said circuit closers respectively, substantially as described.

26. In combination with a main telephone circuit extending from an outstation through an answering switchboard to an independent switchboard at which are located the connection devices of other main circuits, with which said circuit may be connected for through communication; and an audible signal receiving instrument such as a telephone included therein at such outstation; a local signaling circuit extending in association with said main circuit from the said answering switchboard to the said independent switchboard; a visual indicator included therein at said answering switchboard; and a compound busy signal transmitter at said independent switchboard, provided with individual transmitting devices for the said main and local circuits respectively, and adapted to be connected with said circuits and thereby to simultaneously operate said audible and visual signal receivers, each over its own circuit; substantially as and for the purposes specified.

27. In a telephone exchange system, the combination of a series of main circuits, extending from substations to a central station where each passes successively through two springjacks; a homogeneous connecting switchboard at which the first springjack of each main circuit is placed; a sectional terminal

switchboard on which the inner springjack of all lines are placed; a series of office trunk conductors, each extending from a springjack at some one of the terminal board sections to the connecting board, and being there provided with a flexible cord and plug terminal whereby connection may be made between a calling line at a terminal board and a called line at the connecting board; a series of link connections at each terminal board section, consisting each of flexible conductors with a plug connector at both ends, whereby any main circuit jack may be connected with any other, or with any trunk conductor jack; a busy signal springjack at the connecting switchboard, provided with the spring terminals of two independent arbitrary signal electrotomes or other signal transmitting devices; and an automatic signal circuit associated with each trunk conductor and comprising an electric generator, a visual indicator located at the terminal board, an electric conductor extending from said indicator to a contact surface on the trunk conductor plug terminal at the connecting board; and return conductors connected respectively with an auxiliary springcontact in the line jacks at said board, and with the spring terminal of one of the busy jack signal transmitters, the said contacts being adapted to register with the plug contact surface of said signal circuit, and the terminals of the remaining busy jack signal transmitter being adapted to register and connect with the contact surface of the trunk conductor proper, whereby the said plug when inserted in a main circuit jack at the connecting board, is enabled to connect the said circuit through the trunk with any other main circuit united with the said trunk at the terminal board and to establish at said terminal board a steady signal indicating the occupancy of said trunk; and when inserted in the busy signal jack to send an arbitrary busy signal over a main circuit connected at the terminal board with said trunk to the substitution of such line, and establish a fluttering or other distinctive signal at said terminal board indicating that the line called for is busy, substantially as described.

28. A telephone central office system, comprising in a single organization, an outer or connecting switchboard; an inner or terminal sectional switchboard; a series of main circuits extending from telephone substations, all passing first through a springjack on the connecting board, and each continuing thence to a duplicate springjack on a given section of the terminal board; a series of office trunk conductors, extending from each terminal section to different points on the connecting board, each being provided with a springjack normally closed through an annunciator at the terminal board and ending in a connecting plug at the connecting board; a series of double plug connecting cords at each terminal board section, for uniting the jacks of different circuits or for uniting a circuit jack with



a trunk jack; telephones and signal appliances for each terminal section adapted to be alternatively connected in derived circuit with any of the said cords by means of a three  
5 way switch; a series of order or instruction circuits, each extending from an operator's telephone at the connecting board, and branching to telephone connections at the several terminal sections; a visual signal at the spring-  
10 jack of each line at either switchboard, the circuit of which is closed by the insertion of a plug in the jack of the same line at the other switchboard; an auxiliary visual signal at the terminal board end of each office trunk,  
15 controlled by a circuit closer operated by inserting the plug terminal of said trunk at its connecting board end in any main circuit springjack; and two independent arbitrary

busy signal transmitters, located at the connecting board, and connected with a common  
20 busy signal springjack adapted to receive the plug terminal of the trunk conductors, for the purpose of transmitting independent busy signals to the said auxiliary visual trunk signal; and to a substation connected with the  
25 terminal section end of said trunk conductor; all substantially as and for the purposes specified.

In testimony whereof I have signed my name to this specification, in the presence of  
30 two subscribing witnesses, this 20th day of September, 1892.

EDWARD J. HALL.

Witnesses:

THOS. D. LOCKWOOD,  
JOHN C. FREY.