

(No Model.)

T. SPENCER.

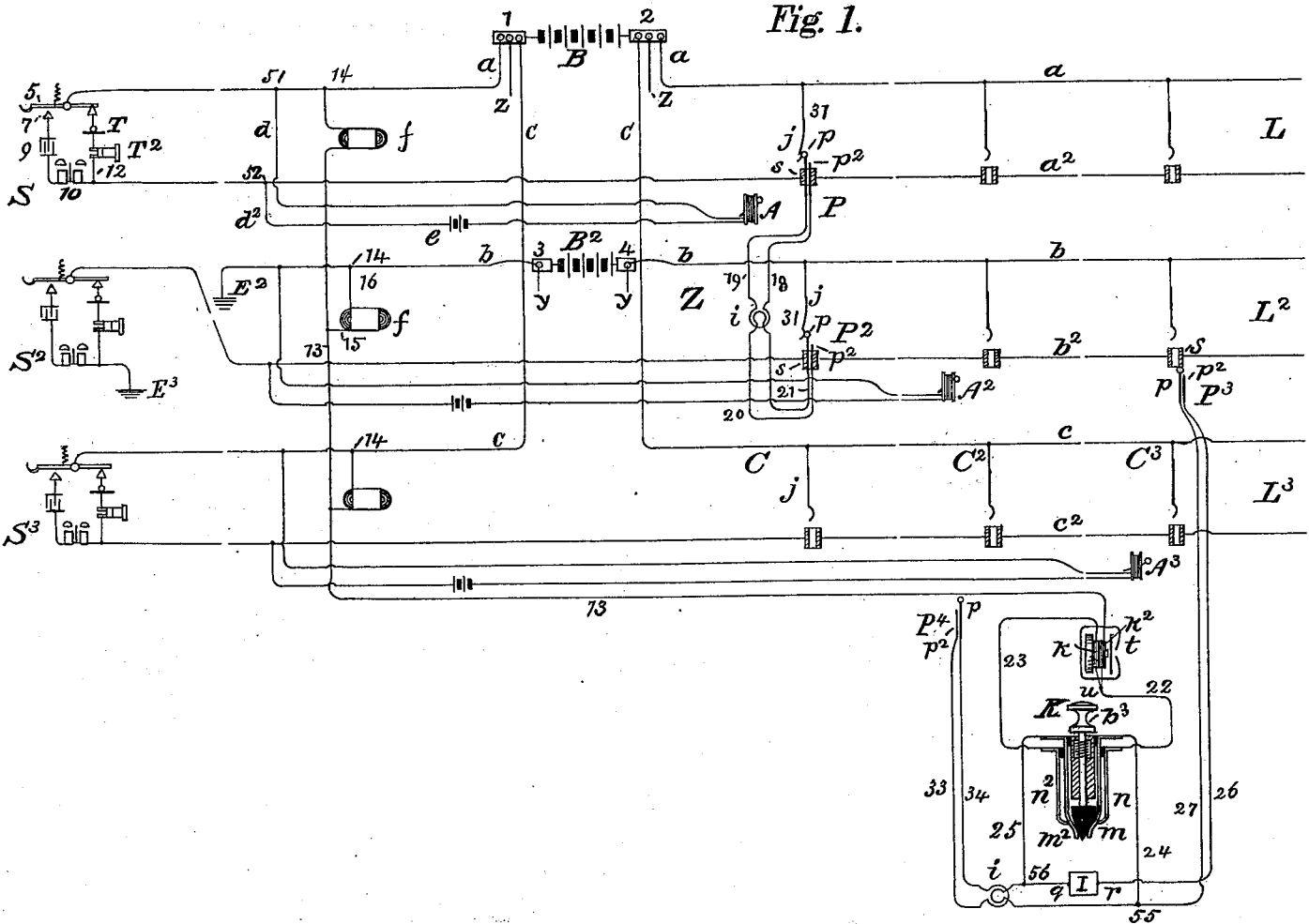
2 Sheets—Sheet 1.

TEST AND SIGNAL CIRCUIT AND APPLIANCE.

No. 507,565.

Patented Oct. 31, 1893.

Fig. 1.



Witnesses.

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(No Model.)

2 Sheets—Sheet 2.

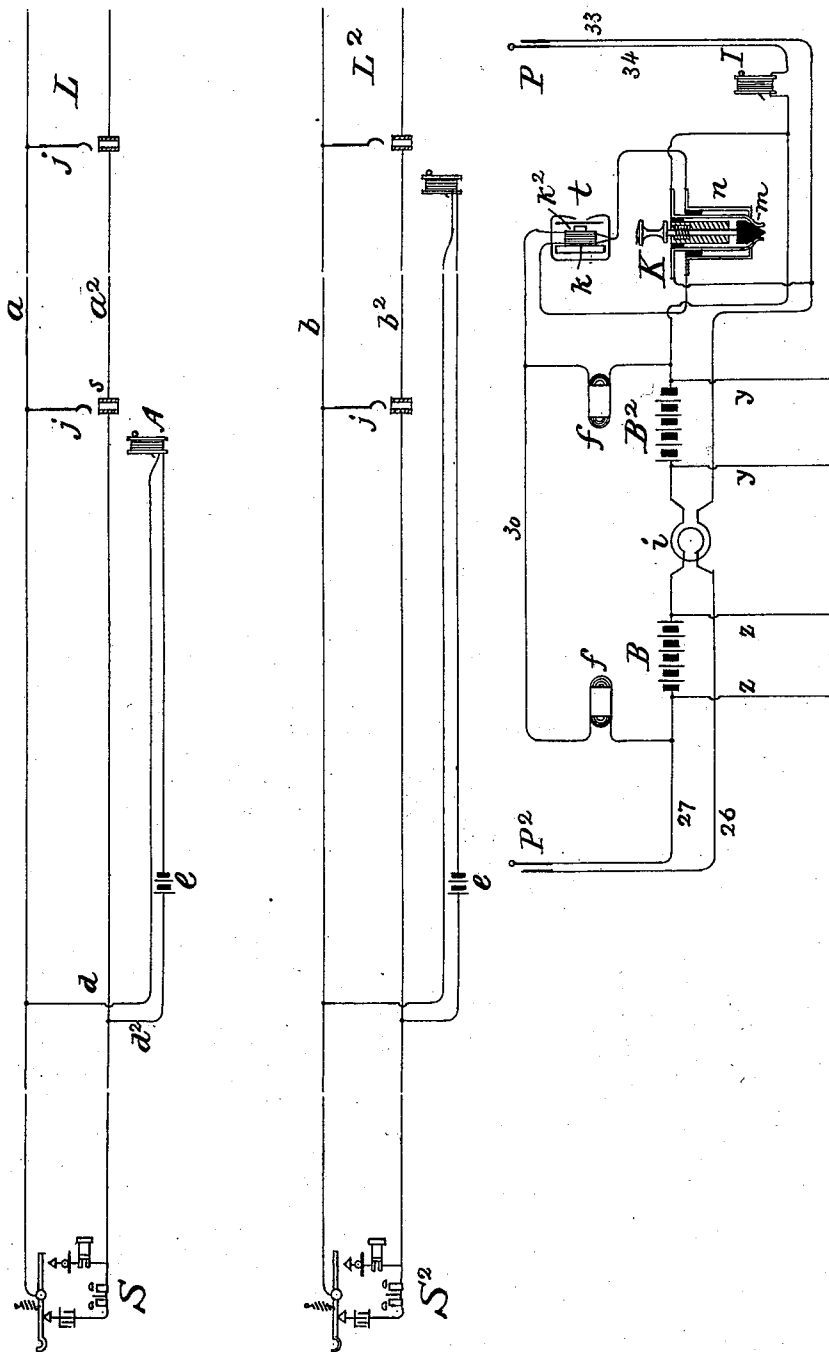
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TEST AND SIGNAL CIRCUIT AND APPLIANCE.

No. 507,565.

Patented Oct. 31, 1893.

Fig. 2.



Witnesses.
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TEST AND SIGNAL CIRCUIT AND APPLIANCE.

SPECIFICATION forming part of Letters Patent No. 507,565, dated October 31, 1893.

Application filed November 19, 1892. Serial No. 452,549. (No model.)

To all whom it may concern:

Be it known that I, THEODORE SPENCER, residing at Cambridge, in the county of Middlesex and State of Massachusetts, have invented certain Improvements in Test and Signal Circuits and Appliances, of which the following is a specification.

This invention relates to telephonic intercommunication. It is frequently desirable to centralize the vitalizing batteries of substation telephone transmitters at the central station, as generally indicated in and claimed by United States Patent No. 252,986, granted to George L. Anders, January 31, 1882; and in doing this to arrange that a battery so centralized, may be common to and capable of being utilized simultaneously by a number of main telephone circuits. Such an arrangement which can readily be made efficient, and under many conditions is very economical, is disclosed in United States Patent No. 447,220, granted February 24, 1891, to Anthony C. White.

In the practical construction and operation of organizations embodying the above mentioned features, it is found convenient and useful to introduce an induction coil between the two portions of the switchboard connecting cord or link connection as substantially disclosed in United States Patent No. 335,436, granted February 2, 1886, to Thomas B. Doolittle, and to relatively dispose the connections and circuits so that in the case of any two circuits connected for intercommunication through the medium of such a compound link connection and interposed induction coil, each of the said two main circuits concerned, shall include a battery or equivalent source of electrical energy, and one of the helices of the induction coil; such an organization in fact as is described in United States Patent No. 474,323, granted May 3, 1892, to Hammond V. Hayes. An arrangement of this kind in which either the same or two distinct batteries may be used, is advantageous, because it divides the total compound telephone circuit into two distinct conductively complete sections and thereby secures a higher degree of immunity from circuit or battery troubles, and because also it tends to provide a greater uniformity of service, and therefore a better service; for the reasons that each

transmitter is required (even though the generator be common to both circuits) to vary the current of its own circuit and generator only; and that its variations can be propagated through the intermediation of the induction coil to the corresponding circuit, where they will be manifested in the receiver. In the practical operation of large telephonic central stations on these principles, it is obviously desirable that they shall be associated with a multiple switchboard, and it is equally obvious that so associated, a satisfactory and efficient busy test or signal becomes essential. To provide such a satisfactory busy test or signal, is one of the objects of this invention. When the multiple switchboard employed is of the "branch terminal" type, in which the plug sockets instead of containing separable contacts in series one pair at each switchboard section, comprise normally discontinuous contact springs forming parallel branch connections, one at each section, as described in United States Patent No. 463,544, granted November 17, 1891, to Frank A. Pickernell, it furthermore becomes necessary to so devise or arrange instrumentalities, or means, which during the act of sending an outgoing call signal over any main circuit shall enable the said call to be transmitted without operating the line or call annunciator of such circuit which may be located at some other section of the switchboard, a signal or response from which might be regarded by the operator there, as an incoming call signal. To prevent the occurrence of such false calls in multiple switchboards operated upon the common centralized battery or generator system, is a second object of this invention.

Though not essential, it is highly advantageous to associate with multiple switchboards embodying the principles outlined above, some simple and efficient means whereby the call or line annunciator having given its call signal, may be automatically reset. To provide such a means is the third object of my invention, and I find that it can be attained by the application to the circuit indicating a call, of the same means as I employ in connection with a called circuit for the prevention of false call signals.

To attain these objects, the invention embraces several features, to wit: a novel and

improved busy test apparatus and circuit for a multiple switchboard; the combination with a multiple switchboard adapted for the inter-connection of telephone main circuits whose substation transmitters are provided with current from a centralized and preferably common source of electrical energy, of a busy test apparatus and circuit which depends for its operation upon the connection or non-connection of the said source with the line tested; a multiple switchboard in which the battery power for the substation transmitters of the several circuits centering in such switchboard may be supplied to any such circuit by the act of making a central office connection therewith, associated or combined with a busy test apparatus and circuit, enabled by a special construction (which may include an electromagnetic or other resistance) to receive for any main circuit its signaling current from the transmitter battery of such main circuit; and the combination in a branch terminal multiple switchboard of a polarized call annunciator or similar signal receiving instrument for each main circuit responsive to currents of given direction; a source of calling current in normally open circuit with each such annunciator; and a suitable circuit closer at each substation adapted when operated to permit an electrical current of suitable direction to pass through and actuate the annunciator, which thus is caused to give the call; with a stronger source of current arranged to be included in the main circuit by the act of making a connection therewith at the central station, either to answer a call, or to send an outgoing call for a desired line, which stronger source is thereupon caused to transmit a current of opposite direction and greater strength to that of the calling current through the said annunciator, which under the first condition resets the annunciator that has given the call, and which under the second condition prevents the annunciator from responding to outgoing calls.

In the drawings which accompany and constitute a part of this specification, Figure 1 is a diagram illustrating the several features mentioned above; and Fig. 2 is a diagram of a modified arrangement wherein the transmitter vitalizing batteries are included in the circuit of the connecting cords, instead of being placed in normally open circuit with one side of the main circuits.

Referring first to Fig. 1, L and L³ are metallic telephone circuits extending between substations S and S³ respectively, each to a central station Z where they are represented by springjacks or plugsockets j, one for each line, at the several sections C, C² and C³ of the switchboard. The calls sent from substation S, are arranged to be answered by the attendant at the switchboard section C; its call annunciator A, being for that purpose located at such switchboard section; and in like manner as shown the call annunciator A³ of

circuit L³ is located at section C³. It must however be understood that in practice the main circuits entering the central station, while represented by plugsockets on each switchboard section so as to be readily accessible for connections desired by other circuits having their calls answered on the said boards, each have their call annunciators placed at some one section, the annunciators of the whole being equitably divided between the several sections.

L² is an earth completed main telephone circuit, extending between another substation S² and the central station, having plugsockets similar to those of circuits L and L³. Like these also, it has a double conductor through the switchboard, as otherwise it would not be fitted for inter-connection with metallic circuits, and the said conductor is earthed at E². Its calls are to be answered at switchboard section C², and accordingly, its call annunciator A² is there placed.

The two conductors of circuit L are respectively marked a, a²; those of L² are marked b b², and those of L³, c and c²; and the spaces or gaps left in the lines representing the several conductors, are intended simply to indicate indefinite lengths of conductor. As shown, the conductors a, b and c are branched to the spring contacts of the springjacks j, and the conductors a² b² and c² are branched to the conducting frame pieces or sockets of the said jacks; which thus are formed into normally incomplete bridges between their circuit conductors. A plug connector P, formed with two conducting contacts, namely a tip conductor p, and a stem conductor p³ insulated from one another, will therefore when thrust into any socket make a connection by the said tip p with the spring 31 and by the said stem with the socket frame; and any extension conductors united with the tip and stem (in practice the conductors of a flexible cord) will be connected with the circuit concerned. At the substations, one of the line conductors terminates in the automatic switch lever 5, which when the receiving telephone T² is in place on the end thereof, rests on the contact 7, continuing the circuit through the condenser 9, call bell 10 and thence to the return conductor or earth. The condenser as described in Letters Patent No. 474,323 is so proportioned, that the bell 10 can readily be rung through it, by alternating currents, although it affords no passage to steady currents, the circuit thus while the telephone is in place, being open. The telephone being removed from its support, the switchbar retracted by a suitable spring, disconnects the condenser branch, and closes the circuit of the main line through the branch 12 telephone T² and transmitter T, and return conductor or earth. At the central station, the switchboard extensions of each circuit are normally discontinuous branches, and in that branch of each to which the spring contacts of the plugsockets are united, but at a point thereof

outside of all the said plugsockets is included a main battery B or B² which may be common to a number of main circuits; although as indicated by the drawings, it is preferable that batteries for metallic circuits shall not also be required to serve earth completed circuits. Accordingly, I have shown the battery B as being connected with the two metallic circuits L and L³; while the earth completed circuit has a different battery B². The batteries B B², as indicated may have their poles connected to omnibus bars 1 and 2, and 3 and 4, from which connections *a*, *b*, *c*, *y*, *z*, lead to such circuits as are to be supplied with current; one battery being as before stated, common to a number of circuits. There being normally no continuity between the two branch connections of the circuit at the switchboards, it is evident that the batteries B B² are normally on open circuit so far as their connection with any given line is concerned; but it is manifest that if by any means the spring and frame of any plugsocket can be united, the substation telephone at the same time being displaced, the circuit will be closed and the current of the battery will circulate through the transmitting and receiving telephones T, T².

In order that incoming calls may be received at the central station, I provide a polarized or deflecting coil annunciator for each circuit, these being marked A, A² A³. Such an annunciator is looped as at *d* *d*², from the two conductors of each circuit at the points 51 and 52, and in the circuit of such loop is a battery *e*; which (all circuits being normally open) can of course serve many lines; it is however to be especially observed that this battery is so connected that when the circuit of the transmitter battery B is closed by the insertion of the plug, the two will oppose each other in the annunciator loop *d* *d*² and that since the electromotive force of the battery B is the greater, its current will overpower that of *e*.

The resistance and self induction of the coils of the annunciator A are in a manner well understood, so proportioned that though the loop *d* *d*² thereof is a permanently closed bridge between the two conductors of the talking circuit, no short-circuiting of the battery B will supervene; nor will conversation be interfered with.

As indicated by the partially obscured condition of the signal disk in the annunciators A and A² of the drawings, the signal is ordinarily not displayed. If a current of suitable direction pass through the coils of said annunciators, the signal disk will be displayed as shown at A³ and this constitutes the call signal. Such a current is developed by the small battery *e* when working alone; and when its circuit is closed and the call sent by the removal of the telephone from its support at the substation. To answer a call, the central station attendant inserts one of the plugs of a pair in a socket of the calling line,

and the two sides of the line circuit are then united through the central station telephones. Having received the instructions of the substation thus answered, and obtained therefrom the number of the line wanted, the second plug of the pair is inserted in a socket of the said second line (provided upon applying the busy test such line be found at liberty) and an outgoing call signal is sent in the usual manner. The second station having been signaled the two lines concerned are united as shown, by means of the plugs P and P² and their associated conductors 18 and 19 and 20 and 21; these however in the present instance not being continuously conductive, but connected through an induction coil *i*, the conduits 18 and 19 of plug P being connected with one, and the conductors 20 and 21 with the other helix of said coil. By this means, it is evident that the current in each of two circuits so connected will when operated by the current varying transmitter T, act inductively upon the other, and thereby operate the distant receiver.

The talking circuit between stations S and S² will be readily traced on Fig. 1. Beginning at station S its circuit proceeds by line *a*, bar 1, battery B, bar 2, branch 31, tip *p* of plug P, wire 19, one coil of inductorium *i*, wire 18, stem conductor *p*², socket *s*, and return conductor *a*² to station S. The circuit of station S² is completed from earth E² at said station by line *b*, bar 3, battery B², bar 4, branch 31 of line *b*, tip *p* of plug P², wire 21, the other coil of inductorium *i*, wire 20, stem *p*² of plug P², return conductor *b*², through the telephone branch at station S² and finally to earth at E².

In each of the three cases considered, in which calling, called, or connected circuits are closed in different ways through the plug conductors, the presence of the plug in the jack operates to close the circuit of the battery B, first, through the main circuit and substation instruments; and second, through the calling annunciator loop. The drawings illustrate the connections of the latter circuit in the third case mentioned, and we may readily trace them, beginning at plate 1, battery B, and proceeding by plate 2, switchboard conductor *a*, jack spring 31, plug tip *p*, cord conductor 19, induction coil helix, cord conductor 18, plug stem *p*², socket-frame *s*, switchboard conductor *a*², point 52, wire *d*², battery *e*, annunciator A, wire *d*, point 51, and then over conductor *a* to the starting point. The batteries B and *e* as before stated, are reversed with respect to each other in this circuit, the smaller *e*, being overpowered by the larger B, and the displayed signal being therefore reset by an opposite deflection. The other two cases, exhibit essentially the same circuit connections, the only difference being that telephones, or other appliances are also included in the call circuit. But in each case, an effect is had upon the polar annunciator A. Being organized to operate and give the

signal with a given direction of current developed by battery e , in the first case the action is that a resultant current of opposite direction passes through its coils, and that the signal having been displayed is automatically replaced or restored. In the second case, the plug being inserted in a socket of the second circuit as an operation preliminary to that of sending the outgoing call, the connection of the vitalizing battery B or B² in opposition to the annunciator battery e , causes a resultant current through the annunciator coil, of such a direction as to tend to deflect the armature or needle reversely; and thereby prevents a false call. This is useful when the call is to be sent from a switchboard section, different from that where the said annunciator is located. Were the battery arranged to coincide in polarity with the battery e , it would be impossible to insert a plug in the socket of any line, without operating the annunciator at its appropriate section. In the third case, where the two lines concerned are fully connected, it is obvious that the battery e of each is overpowered by the battery B and that therefore the annunciators of neither will display the call signal.

The two circuits L and L² are shown as being united at the central station for through communication by means of the plugs P and P² and their connecting cords, the looped conductors of the said two cords however having no conductive connection, but being inductively united through the induction coil i . Thus, while voice currents have free communication between the two circuits so connected, or in other words, while telephonic variations are freely propagated, the battery currents circulating in either have no access to the other, and the circuit of the battery is closed on each line through its own helix of the induction coil and by the insertion of the plug, which thus is a circuit closer. For facility of illustration, none of the regular key board or supervisory apparatus is shown in association with the conductors of these plugs P, P², although in practice they are employed, as usual. A second plug and cord connection link is also shown and is assumed to be one of a series located at the switchboard section C³; there being of course a similar series at each section to make such connections as are called for. With this, I have shown the usual telephone loop key, the supervisory telephones whose connection is controlled thereby, and the disconnecting annunciator, but I have not considered it necessary to show the ringing keys.

P³ and P⁴ are the terminal loop plug connectors each having exactly as in the former set a tip contact p , and a stem contact surface p^2 together with the usual nonconducting handle. The induction coil i as in the instance before described, is interposed between the two plugs, the conductors 26 and 27 of plug P forming a loop through one helix, and the conductors 33 and 34 of the other

plug P² forming a loop through the other helix of said induction coil.

The operator's telephones are conventionally represented by the telephone t , which is in a normally discontinuous bridge controlled by the loop key K between the two plug conductors 26 and 27. The button b^3 of the key is shown as being depressed to connect the telephone, and the circuit of the loop is from the junction point 55 on the tip cord conductor 27, to the point 56 on the stem conductor 26, by way of wire 25, contact spring m^2 , outer spring n^2 , wire 23, telephone coil k , wire 22, springs n m and wire 24. When the key is undepressed, the said bridge circuit is open between the two sets of contact springs m and n , m^2 and n^2 . In practice a disconnecting annunciator I is looped at the points q and r in the stem conductor 26 of the answering plug this being preferably of the same construction as the line drops A; that is to say, being a polarized galvanometer annunciator. From the battery side of each main circuit, at a point 14 external to the connection of the main battery, a testing branch conductor is led, these branches being bunched into a common conductor 13, which is united to one terminal of an auxiliary coil k^2 in the several operators' telephones, the other terminal of the said auxiliary coil being united at any desired point u , to the tip conductor of the answering plug P³, which is therefore also a test plug. These appliances constitute the busy test apparatus and circuit; and in the figure, the act of applying such test to the circuit L² at the switchboard section C³ is shown.

When any line is already in use, a connecting plug must certainly be inserted in some one of its plug sockets. In the drawing for example, a plug is seen to be inserted in the socket of circuit L² at section C. The plug inserting operation therefore connects all of the plugsockets of that line with the terminal or pole 4 of battery B², by means of a line of conduction to be traced as follows: pole 4, conductor b , socket spring 31 of the jack j at C, plug tip p , conductor 21, induction coil i , conductor 20, plugstem p^2 , socket frame s and main conductor b^2 ; and thereby closes one gap in the test circuit of the battery B² which includes the auxiliary telephone coil. The other pole of the said battery B² connects with one terminal of the auxiliary telephone coil k^2 , by way of the poleplate 3, conductor b , junction point 14, wires 16 15 and 13. The remaining terminal of the auxiliary telephone coil connects with any convenient point u on the conductor which terminates in the answering plug tip p . If it be desired that the auxiliary coil connection shall be controlled by the loop key K, as would ordinarily be the case, the junction point u will be, as shown, at some point between the coil, and the contact m n ; but if the connection with said plug tip is for any reason to be permanent, the said junction point may be lo-

cated between the said tip *p* and the contact *m n*. The test circuit being traceable, and the test applied as described above, it is evident that a current from the battery *B*² will be directed through the auxiliary coil of the telephone, provided the line be busy, producing a distinct click in the said telephone, which is held to the ear of the testing operator, the circuit of said current being from one pole of the battery to the other, by way of pole plate 4, conductor *b*, jackspring 31, tip *p*, conductor 21, induction coil helix *i*, conductor 20, stem conductor *p*², socket frame *s*, conductor *b*², socket frame *s* at section C³, tip *p* of plug P³, conductor 27, junction point 55, wire 24, contact spring *m*, outer contact spring *n*, wire 22, auxiliary coil *k*² of telephone *t*, wire 13, wires 15 and 16, point 14, conductor *b* of the main circuit L² and pole plate 3. If on the contrary, the tested circuit be at liberty, no sound will be heard in the telephone at the moment of applying the plug tip to the socket frame, because the test circuit will not have theretofore been made continuous between the spring and frame of any other socket of the same line, and consequently the potential of the remaining socket frames of the same line will be at its normal condition.

In some cases, such for example where the telephone circuits supplied by the battery *B*³ are of considerable length and require a strong battery it is desirable to subdue the effect produced by the derived current upon the telephone and to moderate the loudness of the audible signal due thereto. This is done by introducing a suitable resistance or retardation coil *f* into the test circuit as shown; if a simple resistance coil be employed, it should be of much higher real resistance, than is required for a retardation coil or electro magnetic resistance. I have found a retardation coil having a real resistance of four hundred ohms, and an apparent resistance to telephone currents of ten thousand ohms to answer well; and this may be placed as shown in the individual test branch of each main circuit in the common conductor leading to the several operators' telephones; or in the circuit of the auxiliary coil of each telephone at pleasure.

In the modification indicated by Fig. 2, two metallic circuits L and L² are shown. The direct circuit of a single pair of connection plugs P P² also is shown, as is also the bridge connection of the operators' telephones and the auxiliary test coil thereof. Instead however of connecting the vitalizing batteries for the transmitters in the normally discontinuous spring-jack conductor of the several main circuits, they are introduced into the circuit of the conductor connecting the plugs with the interposed induction coil. There is however no change in the circuits in virtue of this change in the position of the battery; the electrical connections being identical. It is sometimes advantageous to interpose the

disconnecting annunciator I as shown in Fig. 2 in the circuit of the conductor 34 leading from the tip of the answering plug to the loop key, instead of placing it in the stem conductor thereof. In that case it can, if desired, serve also as a visual busy test signal, it being in that portion of the circuit of the plug tip which is common to the main circuit and the busy test derived circuit.

Having now fully described the invention and its mode of operation, I claim—

1. The combination in a multiple switchboard of a series of main telephone circuits each having two switchboard conductors; a series of springjacks for each circuit, each having a spring contact terminal, and a socket contact terminal normally in a separated relation, but each series being branched to the said main circuit conductors respectively; a main circuit transmitter battery common to a number of circuits included in the circuit of the main line conductor branching to the spring contact terminals but normally on open circuit; a series of link connections at each switchboard section, each composed of two terminal loop plugs, an interposed induction coil, and a loop circuit from the two plugs to the two induction coil helices respectively; the said plugs being adapted to be inserted in the said springjacks, and thereby to inductively unite any two main circuits, to close each of the circuits through the said battery and one of the induction coil helices, and to connect the socket terminal of each spring jack with the spring terminal thereof, and with one pole of the battery through the said helix; with a busy test apparatus comprising the socket contact terminals of the said springjacks of the main circuits; an electro magnetic signaling instrument; a branch circuit extending from the other pole of the said main circuit transmitter battery to one terminal of said signaling instrument; and a test plug with a conducting tip, adapted to be applied to the said socket terminals, and having a flexible conductor uniting the said tip to the remaining terminal of said signaling instrument, substantially as described.

2. In a multiple switchboard a busy test circuit and apparatus comprising a series of double conductor spring-jacks or plug sockets for each main circuit, each containing a spring contact branched from one main circuit conductor, and a frame contact branched from the other main line conductor of the same circuit; a main circuit transmitter battery or other generator having one pole connected with the said spring contacts: means for uniting the said two contacts electrically by the act of making a main circuit connection and for thereby connecting the said battery pole with the several other socket frame pieces of said main circuit; a test circuit conductor extending from the remaining pole of said transmitter battery to a contact piece mounted on the tip of a test plug; and an electro-magnetic

signaling instrument included in the circuit of said test conductor, and adapted to become operative and give the busy signal when the test circuit is closed by the application of the tip of the test plug to the frame of a spring-jack of a line in use, substantially as described.

3. In a multiple switchboard, a busy test circuit and apparatus, comprising a series of double conductor spring jacks or plug sockets for each main circuit, each containing a spring contact branched from one main circuit conductor, and a frame contact branched from the other main circuit conductor, the said two contacts being normally separated; a main circuit transmitter battery having one pole connected with the series of spring contacts; a main circuit connection plug adapted to fit said sockets to unite said spring and frame contacts, and thereby to unite said battery to all other frame contacts of said main circuit; a test circuit conductor extending from the remaining pole of said transmitter battery to a contact piece mounted on the tip of a testing plug which tip contact piece to make this test is adapted to be brought into contact with the jackframe of a line to be tested; and a telephone included in the test circuit so formed, and organized to produce an audible signal when a line already in use is tested, substantially as described.

4. The combination of a series of spring jacks or plug sockets interposed in a multiple switchboard in parallel branches between the two conductors of a main telephone circuit, and each comprising a socket or frame contact piece and a spring contact piece normally separated or insulated from each other, the several spring contacts being branched from one and the several socket contacts being branched from the other of said main circuit conductors; a transmitter battery for the said main circuit having one of its poles connected with said spring contacts; a loop plug, and a closed loop connected therewith, adapted to fit the said springjack and to electrically unite the two contacts thereof, and thereby to change the potential of the frame contacts of the remaining jacks of the same series: a test circuit conductor branched from the other pole of said transmitter battery to the conducting tip of a test plug whereby the test circuit may be closed by applying the said conducting tip to the frame piece of a jack of a busy circuit; and a telephone having an inducing coil included in circuit with said branch conductor, and thereby organized to produce an audible signal when the said test is closed substantially as described.

5. The combination with a multiple switchboard, a series of main telephone circuits connected therewith each provided with a number of normally open plug sockets or spring-jacks interposed between its two conductors or sides, and a centralized source of current which may be common to a number of said main circuits, and which has one pole in nor-

mal connection with the spring contacts, but disconnected from the conducting frame pieces of said springjack; of a busy test apparatus consisting of a test plug having a conducting piece to be placed in contact with the frame piece of a springjack whose line is to be tested; means as indicated for altering the potential of the frame pieces of a busy line, or for connecting such frame pieces with the said source of current when a connection is made with any springjack of the same series; an electromagnetic testing instrument such as a telephone; and a test circuit branch conductor extending from the other pole of said source of current, through the said instrument to the conducting piece of said test plug, substantially as and for the purposes described.

6. The combination of a number of series of multiple switchboard springjack connections, each springjack having a spring contact piece and a socket or frame contact piece in a separated relation, the said separated contact pieces of the springjacks of each series constituting respectively the disunited terminals of a main telephone circuit, and also of a busy test circuit; a main circuit transmitter battery or generator included in and forming a portion of both of the said normally open circuits; a circuit closing plug adapted to fit said springjacks to unite the separated contacts thereof, and thereby to close the main line circuit through said generator, and to connect with said generator the socket contact pieces of the remaining springjacks of the same series, whereby each is made a terminal of the test circuit; an electromagnetic signal instrument included in the said test circuit; and a test plug forming the complementary terminal of said test circuit which may be finally closed by the application of said plug to any of the said remaining frame contact pieces; substantially as described.

7. The combination in a multiple switchboard, of a number of substation telephone circuits; a series of springjacks for each circuit, each springjack having a spring terminal and a socket terminal, normally in a separated relation; a normally open centralized transmitter battery supplying current for said circuits, and connection cords fitted with terminal plugs adapted to be inserted in said springjacks, and thereupon to unite the circuits concerned, and also to electrically connect the two springjack terminals, thereby closing the circuit of the main circuits through the battery, and connecting the socket terminals of the other springjacks of the same circuit with one pole of said battery; with a test plug having a conducting tip; a branch conductor for each main circuit uniting the remaining pole of said battery with said conducting tip; and an electro magnetic testing instrument such as a telephone interposed in the circuit of said branch conductor substantially as described.

8. The combination, substantially as here-
 inbefore described, in a multiple switchboard,
 of a number of substation telephone circuits;
 a series of springjacks for each circuit, each
 5 springjack having a spring terminal and a
 socket terminal normally in a separated re-
 lation; a normally open or disconnected cen-
 tralized transmitter battery supplying cur-
 rent for said circuits; and terminal loop plugs
 10 fitted with flexible conductor attachments
 adapted to be inserted in said springjacks and
 thereupon to unite the circuits concerned, and
 to electrically connect the two springjack
 terminals, thereby closing the circuit of the
 15 main circuits through the battery, and con-
 necting the socket terminals of the other
 springjacks of the same circuit with one pole
 of said battery; with a test plug having a con-
 ducting tip, a branch conductor for each main
 20 circuit, uniting the remaining pole of said bat-
 tery with the tip of said test plug; an electro-
 magnetic or other resistance, and a signal re-
 ceiving instrument such as a telephone inter-
 posed in the circuit of said branch conductor;
 25 substantially as described.

9. In a branch terminal multiple switch-
 board, the combination of a main telephone
 circuit extending between a central station
 and a substation; a polarized call annunciator
 30 in such circuit at the central station, respon-
 sive to currents of uniform direction; a source
 of calling current in normally open circuit
 with said annunciator; and a suitable circuit
 closer at the substation, adapted to close the
 35 circuit of said source through said annun-
 ciator in such direction as to give the signal;
 with a stronger source of current adapted to
 be included in the main circuit by the act of
 making a connection at the central station
 40 with said circuit, and thereupon to direct
 through said annunciator a current of greater
 strength, and opposite direction, whereby the
 said annunciator if operated, may be reset,
 and otherwise may be prevented from oper-
 45 ating, substantially as described.

10. The combination substantially as here-
 inbefore described, of an open main circuit;
 a polarized signal instrument included there-
 in; a circuit closer therefor; a battery also in-
 50 cluded therein, and arranged on the operation
 of said circuit closer to direct a current of
 electricity through said instrument of proper
 direction to actuate the same; with a nor-
 mally discontinuous loop of said circuit, shunt-
 55 ing the said battery and the polarized signal-
 ing instrument, a circuit closer therefor; and
 a second battery of higher electro-motive force
 included in said loop, the said second battery
 being so arranged that upon the closure of
 60 said loop by the operation of its circuit closer,
 it will oppose the smaller battery and cause
 a resultant current of opposite direction to
 flow through the helices of the polarized sig-
 nal instrument, thereby acting to prevent the
 65 operation of the signal, or to reset the same,
 if already given.

11. The combination of a series of main

telephone circuits each having direct and re-
 turn conductors extending through the sec-
 tions of a multiple switchboard; an interposed
 series of springjacks for each main circuit in
 70 parallel branches thereof constituting nor-
 mally incomplete bridge connections between
 said conductors; a normally incomplete busy
 test circuit for each main circuit at each
 75 switchboard section, including a conductor
 extending from a point on the said direct main
 circuit conductor external to the outermost
 springjack branch, and branching to test plugs
 at the several sections through the operator's
 80 telephone at such section, the several spring-
 jack branches of the series being common to
 both main and test circuits; a main line trans-
 mitter battery included in the said direct main
 circuit conductor between the junction point
 85 of the busy test branch and the outermost
 springjack, and being thereby made common
 to the said main and test circuits, but having
 its circuits normally incomplete in said
 springjacks; and circuit closing plug con-
 90 nectors at each switchboard section adapted
 to be inserted in the said springjacks, and
 thereby to complete the bridge connection
 thereof, to close the main line circuit through
 the said battery, and to connect with said
 95 battery the return conductor side of the re-
 maining springjacks of the series; substan-
 tially as described and for the purposes set
 forth.

12. A series of springjacks on a multiple
 switchboard whose frame contact pieces and
 spring contact pieces are normally in a sepa-
 rated relation; conductors representing re-
 spectively the direct and return conductors
 of a main telephone circuit, one branching to
 105 all of the spring contacts, and the other to all
 of the frame contacts of a series of spring-
 jacks; a main circuit transmitter battery in-
 terposed in the spring branching conductor
 at a point outside of the outermost springjack;
 110 a circuit closing plug for said springjacks
 adapted to be inserted therein and to electri-
 cally unite the separated contacts thereof, for
 the purpose of closing the main circuit through
 the battery, and of connecting one pole of
 115 said battery to all other frame contact pieces
 of the same series of springjacks; and means
 for testing for the presence of the said battery
 connection at any of the several springjack
 frames consisting of a conductor branched
 120 from the other pole of said battery to one ter-
 minal of the operator's telephone, and a mov-
 able conductor and testing plug for placing
 the other terminal of said telephone in con-
 tact with any of the said springjack frames,
 125 substantially as described.

In testimony whereof I have signed my
 name to this specification, in the presence of
 two subscribing witnesses, this 11th day of
 November, 1892.

THEODORE SPENCER.

Witnesses:

GEO. WILLIS PIERCE,
 FRANK C. LOCKWOOD.