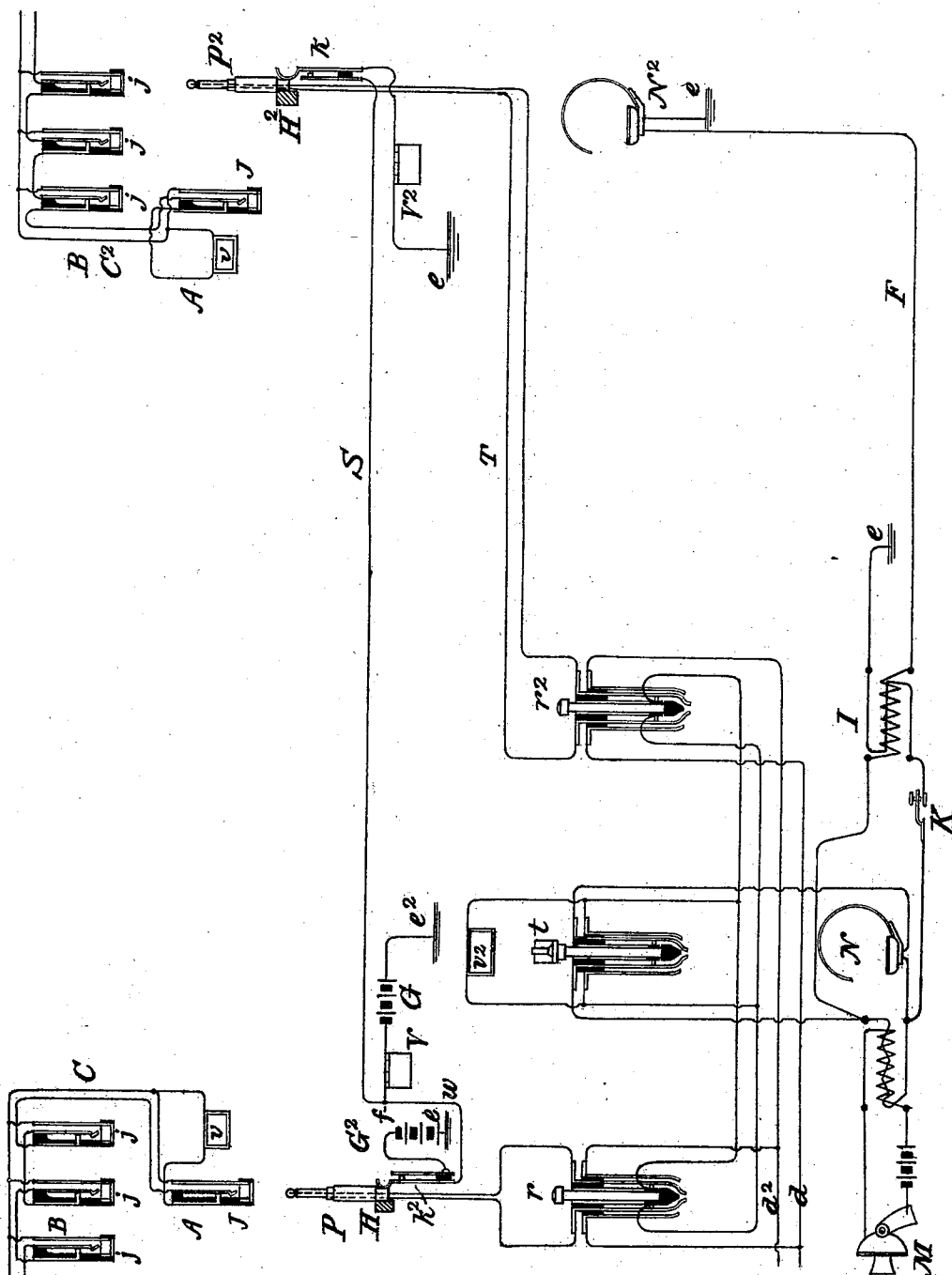


(No Model.)

F. A. PICKERNELL.
ELECTRIC SWITCHBOARD SIGNAL.

No. 503,252.

Patented Aug. 15, 1893.



Attest.

Rev. J. M. Copenhaver.

Inventor.

Frank A. Pickernell,
by *Edw. M. Mauro,*
his attorneys.

UNITED STATES PATENT OFFICE.

FRANK A. PICKERNELL, OF NEWARK, NEW JERSEY, ASSIGNOR TO THE
AMERICAN TELEPHONE AND TELEGRAPH COMPANY, OF NEW YORK.

ELECTRIC SWITCHBOARD-SIGNAL.

SPECIFICATION forming part of Letters Patent No. 503,252, dated August 15, 1893.

Application filed May 15, 1893. Serial No. 474,320. (No model.)

To all whom it may concern:

Be it known that I, FRANK A. PICKERNELL, residing at Newark, in the county of Essex and State of New Jersey, have invented certain Improvements in Electric Switchboard-Signals, of which the following is a specification.

This invention relates to automatic electric signals, and particularly to their operation in connection with different switchboards or with different parts of the same switchboard, whereby a perfect understanding tending to prompt operation may be maintained between operators.

It comprises an electric signaling circuit which has a permanently attached branch and an annunciator or other signal preferably of the well known self-restoring order and of relatively high resistance at one station, and a similar annunciator of lower resistance at another station. A suitable source of current supply, conveniently a voltaic battery is included at the first station between the annunciator and the return conductor, and a similar generator of substantially equal strength is connected in the branch circuit (which is attached to the main on the other side of the said annunciator) and the two generators present like poles to the main conductor. The effect of this is that as long as the main circuit is open, and the branch closed, the two generators are connected in opposition to one another, and each neutralizes the effect of the other on the high resistance visual signal which thus is placed between the said like poles. If the main circuit be now closed and the branch be opened, the generator in the main circuit will send a current through said circuit and although both annunciators are serially in circuit that only which has the higher resistance will respond and display its signal; it being well understood that a current that will efficiently operate two serially connected electro-magnetic devices of equal resistance will, when the devices differ materially in resistance, actuate that of the higher resistance only, for the reason that this higher resistance weakens the current to such a degree that the comparatively few turns of the low resistance magnet cannot efficiently

magnetize their cores, while the high resistance magnet in virtue of its numerous convolutions, or in other words its greater number of current turns round the core, utilizes the current though so weakened in a highly advantageous way, and thereby remains highly efficient. But if, while the main circuit remains closed, the branch be also closed, the branch generator now reinforces the current over the main circuit, and the said current thus strengthened is enabled to operate the low resistance annunciator also, causing the same to display its signal. It follows of course that when the normal conditions are reinstated the main circuit being opened and the branch closed, the annunciators, assuming them to be of the self restoring class, will automatically withdraw their signals and that the said withdrawal equally with the display can be understood also as a signal having any determined significance. In the branch is placed a circuit controller, circuit changer or key which normally maintains the said branch closed; and at the other station in the main signaling circuit is placed a like circuit changer which normally maintains the said circuit open. The two generators are therefore normally opposed to one another through the coils of the high resistance signal, and since the terminals of said magnet are thus at the same potential, it remains inoperative though in a closed circuit, and the arrangement may be accurately described by stating that the two generators are in parallel with each other as respects their relation to the main line; and that the branch when closed constitutes a derived circuit including an auxiliary generator, which shunts the main line generator, and the high resistance signal indicator.

The invention comprises also the association of such a signaling circuit with a trunk line or conductor extending between two co-ordinate telephone switchboards, and when so associated, the signals may of course conveniently aid in the intelligent co-operative manipulation of such switchboards. This is especially the case when calls are received on one switchboard which may be called the "answering board" and connections made on the other, which may therefore be entitled the

"connection board." Of course the circuit changers may be arranged for manual operation if desired, and since the first action of that which is normally closed is to break its circuit, it may properly be considered as a "circuit breaker," while on the same grounds that which acts in the first place to close its circuit, may with propriety be entitled a "circuit closer." They are preferably however in a manner well understood, placed in such mechanical relation to the terminal plugs of the trunk telephone conductor that they are automatically actuated, and the requisite signals automatically transmitted by the manipulation of the said plugs in making connections and disconnections; and to this end the circuit breaker is so mounted in the resting socket of one of the plugs that the withdrawal of said plug from said socket actuates the same to break, while the replacement of the plug actuates it again to close the branch circuit; while on a similar but reversed plan the circuit closer is actuated by the withdrawal of its plug to close, and by the replacement of the said plug once more to break the main signaling circuit. Instead of placing these circuit changers in the resting sockets, they may of course be placed in the working sockets or springjacks of the plugs as shown in Letters Patent of the United States granted to Edward J. Hall, April 11, 1893, No. 495,087. The main application of the invention then is to provide automatically operated visual signals between two distant operators, whereby the first operator may know that a connection ordered has been made at the switchboard of the other; whereby the second operator may promptly be instructed to disconnect; and whereby a disconnection made, may at once announce itself to both operators.

A difficulty or defect in practice has heretofore been that the operator giving a connection order has had no means of knowing that the connection ordered has been made at the other switchboard; or that a disconnection order properly and duly transmitted, has been obeyed. This defect is entirely remedied by my invention, which enables any operator giving an order for a connection to be made, to see that it is done promptly, and also to note whether disconnections are promptly made.

I am aware that it is not broadly new to arrange automatic signals between telephone operators; but so far as I am aware, it is new to employ two automatic visual signals upon one circuit, one of which gives the signal when a connection is duly completed at the connection board, and the other giving a signal to take down the connection, while both give signals that the connection has been taken down by the act of resuming their normal condition; and also to construct such a signaling circuit as is described herein.

The drawing which accompanies this specification is a conventional diagram, showing symbolically the electrical connections and apparatus herein described and claimed.

In it, A and B are two switchboards which may be any distance apart, or more specifically A may represent an answering switchboard, and B a connecting switchboard in the same office.

At A is the answering jack J, and the call annunciator v of the several incoming circuits, and at B are the multiple connecting jacks j of such circuits; two circuits alone C and C² being represented.

T is a double wire trunk conductor extending between the said switchboards and provided at A with flexible extension cords (not shown) and with a terminal plug P placed when not in use in a resting socket H, but adapted to be withdrawn therefrom and inserted in the answering jack J for the purposes of answering a call, and of establishing the initial portion of a connection desired. The other end of the trunk line is similarly provided with a plug P² which rests when not in use, in the socket H², and which is adapted to complete a connection called for, by being inserted in the nearest connecting jack j of the circuit wanted.

S is a signaling circuit associated with such trunk, and extending between the said two switchboards, and provided at A with the visual signal V preferably some one of the many forms of self-setting annunciator; and at B with a signal V² of like character. These annunciators differ however in resistance, V having a resistance considerably higher than that of V²; it is to be understood however that such difference in resistance is to be brought about by winding V with finer wire than V², and with a great many more turns or convolutions.

F represents an instruction circuit extending between the two switchboards and connecting at B with the operator's telephone N², while at A it has a connection by means of the repeating induction coil I, and controlled by the key or button K with the telephone circuit of the operator.

The signaling circuit and the instruction circuit are both shown as having terminal earth connections e , but it is of course to be understood that they may have, if desired either a special common return conductor, or may be provided each with an independent return conductor. The trunk conductor is provided at A also with the usual and ordinary call keys r and r^2 , whereby the circuit in either direction may be connected with call generator mains d and d^2 ; and also with the regular disconnecting annunciator v^2 , and the telephone key t , whereby the operators' telephones M and N, may be bridged across the circuit for purposes of supervision. The signaling circuit S leads through a spring key or circuit controller k preferably mounted in the seat or resting socket of the plug P² at switchboard B, and so constructed that its points are held apart and the circuit thus maintained open when the said plug is in place; while on the withdrawal of the plug

to make a connection the points of the key are brought into contact, and the circuit thereby closed, may be traced from e , through the relatively low resistance annunciator V^2 , circuit closer k , main conductor S , point f , high resistance annunciator V , the battery G or any equivalent source of current, to the return conductor at e^2 . At the point f , a branch or derived circuit conductor w including a second or auxiliary source of current G^2 substantially equal in strength to the first, is attached to the main conductor, and it is so arranged that the poles presented by both sources to the said main conductor are of like sign. The branch w is likewise provided with a key or circuit controller k^2 which is mounted in the seat or resting socket of the plug P of the trunk conductor, so that the manipulation of the said plug may actuate it; this key however is so constructed that its contacts are held together by the presence of the plug, and are permitted to separate when the plug is withdrawn for use; thus while the branch is closed when the trunk line is at rest, it is opened when the trunk is in operation. This key therefore in the first instance is a circuit-breaker.

It is obvious that instead of mounting the circuit changers in the resting sockets, they can be readily mounted in the springjacks, but in that event the action of both would require to be reversed, so that the insertion of plug P^2 in its jack would close the main, while the insertion of plug P in its jack would open the branch circuit.

During the normal or resting condition of the signal circuit S , the two batteries G and G^2 oppose each other through the high resistance signal V , which therefore remains unaffected; but when the plug P is removed from its socket the branch circuit is opened at k^2 , and battery G^2 is completely disconnected. When under these conditions the plug P^2 is withdrawn from its socket or the circuit controller k otherwise actuated, the signal circuit is completed as already described, through both high and low resistance signals, and the battery G , whereupon the high resistance signal only is operated. When now the plug P is replaced or the circuit controller k^2 otherwise actuated to close the branch circuit w , the circuit of the auxiliary battery G^2 is completed through k^2 , w , f , S , k , and V^2 to e , and the low resistance signal V^2 will respond and display itself. By reason of the opposition offered by the battery G and the high resistance of the signal V , little of the current of the battery G^2 will pass through them; and its major part will pass to the signal circuit direct for the purpose above stated. When therefore the said main circuit is closed at k , the two batteries are practically connected in parallel thereto, and the current of one, reinforces that of the other; and it may properly be stated that the battery G^2 shunts the battery G and the signal V .

In operating such a signal circuit in connection with two such switchboards as are shown, the *modus operandi* of a complete operation is as follows: The customer sends his call and the shutter v falls at the answering board A ; the operator at the answering board A lifts the plug P from its socket H , and in doing so automatically opens the branch w . The plug P is inserted into the answering jack J , and connection is made between the operator and the subscriber. The operator receiving the order presses the key k which closes the instruction circuit between his telephones, and the telephone N^2 of the connecting board operator, and instructs the said operator to connect the circuit called for with a given trunk terminal, the trunk named being of course that whose plug P has already been connected with the calling line. The operator at the connecting board B , takes up the plug P^2 forming the remaining terminal of said trunk from its socket, thereby closing the contact k , and inserts it into the jack j of the circuit called for. The act of taking up the plug P^2 by closing the key k , operates the signal V , and thus notifies the first operator that his order is carried out, so that he may proceed to ring up the station desired, and put the two stations into communication by means of the ringing keys r r^2 and telephone key t . When the two substations concerned have concluded their conversation, one or both ring off, and operate the disconnecting signal v^2 . The operator at board A disconnects by withdrawing the plug P from the jack J , and by returning it to its socket. In doing this, the points of the circuit controller k^2 are brought into contact, the branch w is closed, and the current from the generator G^2 flows over the line and operates the low resistance annunciator V^2 which displays its signal, indicating to the connecting board operator that the conversation is over, and that he should disconnect. This signal remains in view until its instructions are complied with. The plug P^2 is then removed from the jack j effecting completely the disconnection, and being replaced in its socket actuates the circuit changer k to once more open the circuit and reinstate the normal condition of the signal circuit. This being done, both signals V and V^2 (which having once been displayed, remain in view, until the plug is restored to its socket) return to their passive position, thereby indicating to the operators at both switchboards that the disconnection has been made.

The invention and its operation having now been fully and clearly described, I claim—

1. The combination of an electric circuit; a high resistance and a low resistance signal included therein; a source of current also included therein; a normally closed branch or derived circuit shunting the said high resistance signal and the said source of current, and including an independent and equal source of current, so connected that the two sources

oppose each other through the said signal, as long as the said branch is closed; and circuit controllers in the signal and branch circuits respectively, controlling the continuity thereof, and thereby the operation of said signals; substantially as described.

2. The combination in a reciprocal signaling system, of a main signaling circuit extending between two stations and divided at one of the said stations into two normally closed terminal branches containing respectively independent and equal electrical generators, having like poles to line, and thereby opposed in the said branches; a self setting annunciator of relatively high resistance in one of the said branches; a circuit controller in the other, normally maintaining the continuity thereof; a self setting annunciator of relatively low resistance and a second circuit controller in the main signaling circuit at the other station, the latter maintaining the same normally open; the high resistance annunciator in the branch circuit alone being caused to give its signal when the other branch is opened, and the main circuit closed; both annunciators being made responsive to the closure of both branch and main circuit; and both being withdrawn or adapted to reset their signals when the main circuit is opened, and the branch closed, by their respective circuit controllers; substantially as specified.

3. The combination of a main signaling circuit extending between two stations and containing an electrical generator and a key or circuit controller; a relatively high resistance annunciator at one station, and a relatively low resistance annunciator at the other, whereby when the said key is closed the high resistance annunciator alone is enabled to respond; with a branch circuit at the first named station including a second key or circuit controller, and an independent and substantially equal generator having the same pole to line as the first, and thereby acting in opposition to and adapted to neutralize the effect of the first upon the said high resistance annunciator when the main circuit key is open, and the second key closed, but adapted to energize and actuate the low resistance annunciator when the main circuit key is closed; substantially as described and for the purposes specified.

4. The combination of two switchboards, or of two switchboard sections; with a reciprocal signaling circuit extending between them provided at one of the said switchboards with a relatively high resistance annunciator, and at the other with a relatively low resistance annunciator, the former maintained normally inert by being connected between two equal and opposed batteries, and the latter by being on open circuit; keys or circuit controllers at both switchboards, one controlling the continuity of the signaling circuit and adapted when alone closed to actuate the high resistance annunciator only; and the other con-

trolling the connections of one of the said equal batteries, whereby when both keys are closed, the low resistance annunciator also may be actuated, substantially as described.

5. The combination of two telephone switchboards; a trunk conductor extended between them having a terminal plug at each; two circuit changers actuated by the manipulation of said plugs respectively; a main signaling circuit between the said two switchboards; two annunciators of differing resistance serially connected in the main signaling circuit one at each of the said switchboards; a branch circuit permanently connected with the said main signaling circuit at a point thereon between the two annunciators; and two equal batteries connected in parallel with each other and included in the said main and branch signaling circuits respectively, with like poles to the said main circuit, but on opposite sides of the relatively high resistance annunciator; whereby the signals may be displayed or withdrawn, to indicate the use or disuse of the trunk conductor plugs, substantially as described.

6. The combination of a trunk conductor extending between two switchboards or sections of switchboards and terminating at each in a connecting plug or its equivalent, and sockets for the said plugs; of a reciprocal signaling circuit therefor, having a relatively low resistance annunciator at one of the said switchboards; an energizing battery; a normally closed branch; an independent and equal battery in said branch and in parallel with the first; and a relatively high resistance annunciator interposed between the like poles of the said two batteries at the other switchboard; and main line and branch keys or circuit controllers the former normally closed, and the latter normally open, so mounted in the said sockets respectively that they are operated by the withdrawal or replacement of the said plugs, and thereby enabled to operate one or both of the said annunciators to give and restore their signals as desired, substantially as specified herein.

7. The combination of an answering switchboard; a connection making switchboard; a trunk line extending from one to the other, and having a connecting plug, and a resting socket therefor at each end; an associated signaling circuit also extending between the said two switchboards; visual signal indicators as indicated herein connected therewith, one at each switchboard; and an energizing battery therefor; a key controlling the continuity of said circuit mounted in the resting socket of the connection board plug, and held open thereby; and a second key controlling the connection of a normally closed branch including an auxiliary battery connected in parallel with the first, mounted in the resting socket of the call receiving board plug and normally held closed thereby; whereby the visual signal indicator at the answering board

is enabled to become operative regardless of the position of the answering board plug, whenever the connecting board plug is absent from its socket, while the indicator at the connecting board can only become operative when the answering board plug only is in its socket; and whereby both signals are automatically withdrawn, when both plugs are replaced, substantially as specified herein.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 9th day of May, 1893.

FRANK A. PICKERNELL.

Witnesses:

ALFRED E. HOLCOMB,
EDWARD W. BELL.