(No Model.)

T. N. VAIL.

ELECTRICAL SWITCH BOARD FOR METALLIC CIRCUITS.

No. 261,187. Patented July 18, 1882.

Fig. 1.

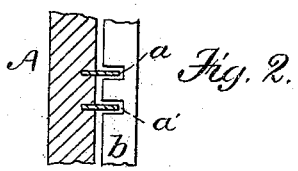


Fig. 2.

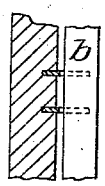
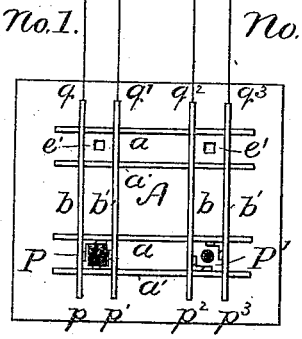


Fig. 3.



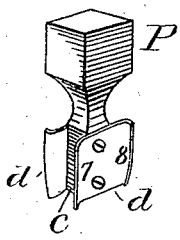
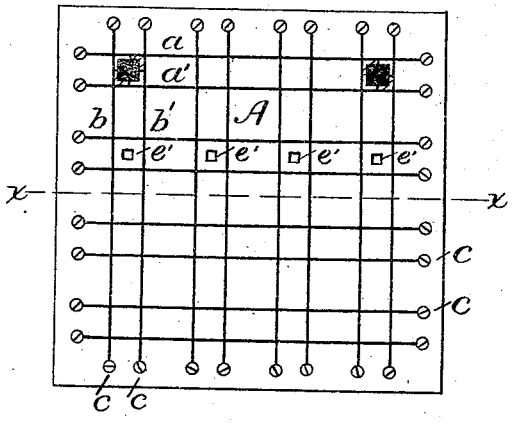


Fig. 6.

Fig. 4.



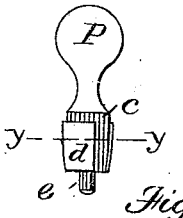


Fig. 7.

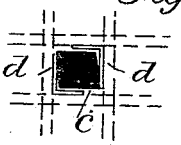


Fig. 8.

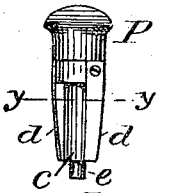


Fig. 9.

Fig. 10.

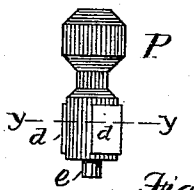


Fig. 11.

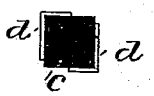


Fig. 12.

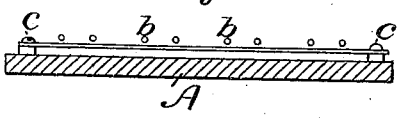


Fig. 5.

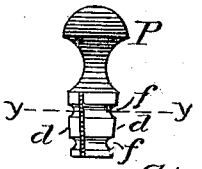


Fig. 13.

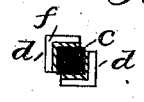


Fig. 14.

Attest.

Fred Bartlett

Geo. Willis Pierce.

Inventor.

Theo. Vail

UNITED STATES PATENT OFFICE.

THEODORE N. VAIL, OF BOSTON, MASSACHUSETTS.

ELECTRICAL SWITCH-BOARD FOR METALLIC CIRCUITS.

SPECIFICATION forming part of Letters Patent No. 261,187, dated July 18, 1882.

Application filed April 28, 1882. (No model.)

To all whom it may concern:

Be it known that I, THEO. N. VAIL, of Boston, in the county of Suffolk and State of Massachusetts, have invented certain Improvements in Electrical Switch-Boards for Metallic Circuits, of which the following is a specification.

My invention relates to improvements in electric switch-boards, whereby special arrangements of circuits may be made and operated, and the connection, disconnection, and interchanging of metallic circuits and loops conveniently and quickly effected.

It has been known from the earliest introduction of the speaking-telephone that when each circuit is composed of but one wire connecting any two points it is often strongly influenced by electrical vibrations and disturbances received by electrical induction from other and parallel conducting-wires conveying telegraphic or other strong electrical currents, and sometimes, if the wires are of considerable length, the telephonic messages traversing one wire are from the same cause repeated on adjacent wires. It is often found that these disturbing inductive influences cause such a confusion of sounds that the telephonic articulations cannot be understood; and in the latter case, in which the telephonic currents are induced from one wire to another, it is obvious that all privacy of communication is destroyed. As a remedy for this objectionable feature in telephonic intercommunication, it has been proposed to employ a metallic return-circuit for each conducting-wire, instead of using a single wire terminating at the earth at each of the two distant points connected by the line. Such an arrangement is described and shown in the English patent of L. D. B. Gordon, No. 2,089, of the date September 15, 1855, in which the return-circuit runs parallel with but is insulated from the outgoing wire, and the proximity of the two wires to one another and with reference to neighboring wires is such that disturbing effects in one of the wires will be neutralized and counteracted by the disturbing effects simultaneously produced in the other and complementary return-circuit; but it has been found very difficult in practice to operate metallic or looped circuits arranged as described satisfactorily and with celerity in central-office or telephone-exchange systems, inasmuch as, instead of merely having to provide for the cross-connection of two central-office terminals, we have to provide for the simultaneous interconnection or disposition of four line-terminals; and to accomplish this in a convenient and expeditious manner is the object of my invention, which consists in the combination of a series of metallic circuits or loops with a switch-board adapted for the rapid and simple interchanging of such circuits, in a switch-board providing for such interconnection of metallic circuit-lines, and in the combination, with a switch-board arranged for the reception of metallic circuit-lines, of a connecting-plug which is fitted with two separate conducting surfaces or plates, and adapted thereby at each insertion to make contact with and between four connecting switch-board conducting bars, plates, or strips.

In the accompanying drawings, which illustrate my invention, Figure 1 is a diagrammatic view of a switch-board in which the transverse conducting-strips are represented by bars, and shows two metallic circuit-lines connecting with sub-stations. Figs. 2 and 3 are sections showing arrangement of cross-rods. Fig. 4 represents a board embodying the same principle, but constructed simply of two series of wires stretched tightly at right angles to one another. Fig. 5 is a cross-section of the said wire board on line *x x*. Fig. 6 is a perspective view of a connecting-plug adapted for use in the switch-board shown in Fig. 1. Figs. 7, and 8, and 9, and 10 are respectively elevation and cross-section views of other varieties of plug for the same board. Figs. 11, 12, 13, and 14 are similar views of plugs adapted for use with the wire switch-board shown in Figs. 4 and 5.

A in either board is a base board or frame of wood, upon which, in Fig. 1, are ranged two series of conducting bars, strips, or plates, *a* and *b*, which can conveniently be made of brass or any similar metal or alloy. They are usually, although not necessarily, arranged at right angles to one another, and each bar of the series *b* is so fixed in the base-board, as shown in Figs. 2 and 3, as to cross over the bars of the other series, *a*, without touching any of them. I connect the bars of one series, preferably those shown as vertical, *b*, to the wires entering from the line-wires, and I leave

those crossing transversely normally insulated from any other conducting-body whatsoever.

At the point *q* of each upright metallic bar *b*, I connect the respective line-wires 1, 2, 3, and 4 of the circuits No. 1 and No. 2, and my circuits and apparatus are so constructed and arranged that the same circuit, No. 1, leading out by wire 1 from switch-bar *b* to the distant sub-station S, instead of being there terminated at an earth-plate, is, after passing through the sub-station apparatus, returned to the central-station switch-board A, by a second or return wire, 2, which is connected, as shown, to the second upright strip, *b'*, at the point *q'*, thus forming in each circuit so constructed an absolute metallic circuit or loop from the central station to the sub-station and return. Each circuit is connected with the switch-board in a similar manner, and in each case it will therefore be seen that after the lines are connected with the upright bars of the switch-board the lower extremity, *p*, of each bar forms the virtual terminal of its respective circuit-wire.

In practice the pair of terminals *p* pertaining to each line will be connected with an indicating device—such as an annunciator—the wire 1 thus being connected with one wire of the annunciator-helix and the wire 2 with the other. As, however, this forms no part of my invention, it is not shown in the drawings.

For the convenient operation of circuits constructed as hereinbefore described, the conducting-bars, both vertical and horizontal, are arranged in pairs, *b b'*, *a a'*, and thus at the intersecting point of the two series a species of plug-socket is formed, having four separate metallic sides as its linear boundaries, two of which, *b* and *b'*, are connected with the two ends of the line-circuit, and the other two, *a* and *a'*, are insulated from any other conductor, and thus are enabled to serve as connecting-links when a plug specially conformed, as hereinafter described, is inserted within the plug-socket formed by the intersection of the vertical and horizontal bars.

Fig. 4 is a board constructed upon the same general principle of metallic circuits, and shows four pairs of vertical metallic conductors *b b'*, which in this case are wires tightly drawn over the surface of the board, as shown in Fig. 5. Four pairs of horizontal conducting-wires *a a'* are also shown, which likewise are tightly stretched under the vertical series. The line-wires are connected in a precisely similar manner to those of Fig. 1, and, as in Fig. 1, the connecting plug-socket is formed by the intersection of one pair of the vertical conductors with one pair of the horizontal conductors. A plug of special character is obviously requisite in connection with this board, and it is also obvious that in a board such as that shown in Fig. 1, fitted with comparatively-rigid conducting-bars, the conducting-surfaces of the connecting-plug must possess a certain degree of elasticity or resiliency in order to adapt itself to a perfect fit in the plug-socket. If, on the contrary, a board of similar characteristics to that delineated in Fig. 4 be employed, possessing permanent conductors of a spring-like or elastic nature, the rigidity must be in the plugs, which may then be composed of two conducting-surfaces insulated from one another by a base of non-conducting material, which may also be extended to serve as a handle.

I have in Figs. 6, 7, 8, 9, and 10 shown several plugs which are well adapted for use in connection with the switch shown in Fig. 1.

Fig. 6 shows a plug, P, the handle of which may be formed of hard rubber or similar non-conducting material. Curved plates of metal, *d d*, are placed on two of the opposite sides of the nucleus *c*, and fastened on with small screws. This plug is to be inserted in its socket diagonally, and is then held firmly, as only when so placed is there sufficient space for its insertion, and when once inserted it cannot turn round, the plates *d* being wider than any one side of the plug-socket.

The plug shown in Figs. 7 and 8 also has a handle, P, and non-conducting nucleus *c*, and for its conducting-surfaces is provided with metallic angle-plates *d*, which are attached by one side only to the nucleus, so as to impart sufficient resiliency to them to produce a firm contact upon the sides of the plug-socket. This variety is shown as inserted in the socket formed by the intersection of the horizontal bars *a a'* and the vertical bars *b b'* of the wires 1 and 2 in Fig. 1 and on a large scale in Fig. 8, where the switch-bars are represented by dotted lines. A square pin, *e*, is shown as extending from the inner end of the non-conducting portion of the plug. This, when the plug is inserted, fits in a square hole, *e'*, in the base-board A, and serves as a guide for the proper insertion of the plug, in order that one of its angle-plates *d* may always be brought into contact with one vertical and one horizontal conducting-bar of each pair and the other angle-plate into contact with the other vertical and horizontal bars of the pair.

Figs. 9 and 10 show still another variety of connecting-plug, the conducting-plates *d* of which have their corners rounded, as more clearly shown in the sectional view in Fig. 10. The pin *e* is also affixed to this plug and adapted for insertion in the hole *e'*.

The plugs shown in Figs. 11 and 13 and in cross-section in Figs. 12 and 14 are made especially adapted for use with the board shown in Figs. 4 and 5. Fig. 13, besides being fitted with angle-plates for conducting-surfaces, is provided with grooves *f*, which, when the plug is inserted in any of the squares formed by the intersection of a vertical and horizontal pair, clasp the wires which in this board represent the conducting-bars, and thus make a good electrical contact. Figs. 11 and 12 simply show two angle-plates *d*, rigidly fixed upon the non-conducting portion of the plug.

In all the figures it will be seen that the plugs are squared and are adapted to fit square sockets, and that the contact-plates are so arranged as to be cut by one of the diagonals

of the square socket when inserted. They will thus connect the strips adjacent to their respective ends of the said diagonal. The arrangement may for convenience be termed "the diagonal arrangement of the contact-plates."

When two circuits are connected together by means of my switch-board, as shown in Fig. 1, it will be observed that the operation is complex. Starting from the central station—for example, from the point *q*—the interconnected circuit is over the wire 1 of No. 1 circuit to sub-station S, thence back to central station *via* line-wire No. 2 to q', line-strip b', through plug P to cross-strip a', plug P′, upright strip b to q^2, line 3 of No. 2 circuit to sub-station S′, returning *via* line 4 to q^3, upright strip b', upper conducting-plate of plug P′, cross-strip *a*, upper plate of plug P, and to upright strip *b*, back to the starting-point *q* on line 1 of No. 1 circuit, thus completing a continuous metallic circuit.

It has prior to my invention been customary to use for the cross-connection of two loops, as described, four plugs, one for the crossing-point of each upright strip with its corresponding horizontal strip. For example, strip *b* of No. 1 would be fixed by a single connecting-plug to the horizontal bar *a* and strip b' of circuit No. 1 to horizontal bar a', No. 2 being similarly connected. It is clear, therefore, that both time and apparatus are advantageously minimized by the use of my invention, inasmuch as two plugs are in each interconnection dispensed with, and the time which would be lost by the act of inserting them is saved.

When the board shown in Fig. 4 is employed the wires which form the conducting-strips, being tightly stretched over the board, will be readily pushed slightly to either side upon the insertion of the plug, and when the said plug is fully inserted will close tightly upon it, producing a good electrical contact.

I do not in this specification confine myself to switch-boards of any special method of construction, as the essence of my invention lies in the arrangement of certain well-known instrumentalities in such a manner that the insertion of two plugs shall interconnect the two wire-terminals of one metallic circuit or loop with the two terminals of any other similar loop, so as to produce a continuous circuit composed of the said two loops, whereby a sub-station located at any part of one of the said loops is placed in direct electrical connection with a sub-station at any part of the other loop through the central-station switch-board. It is evident, therefore, that any switch-board in which the intersecting conducting-strips or their equivalents are arranged in pairs can be used to carry out my invention.

I claim—

1. The combination, in a telephone-exchange system, with a series of metallic circuits or loop-lines, of a switch-board having strips, bars, or plates arranged in pairs, and plugs or connectors for establishing the connection of the loop-lines with each other through said strips, bars, or plates, the latter extending across the switch-board, and being for their continuity independent of the plugs or connectors, substantially as described.

2. In a switch-board, the two sets or series of intersecting insulated strips arranged in pairs, in combination with plugs or connectors for connecting the strips of any pair with the strips of an intersecting pair, the said strips being electrically continuous independent of the plugs or connectors, substantially as described.

3. In an electrical switch-board or commutator, the conducting strips or bars, arranged in pairs, each pair permanently connected with the two ends of a metallic or loop circuit, and the connecting bars or strips, also arranged in pairs, and disposed transversely with reference to the line-strips, in combination with the plug-connector provided with separate contact-plates, each adapted to make contact simultaneously with one line-strip and one connecting-strip, the connecting strips or bars of a pair having normally no electrical connection with each other, for the purposes set forth.

4. A switch-board consisting of a series of conducting line-strips or their equivalents, arranged in pairs for the reception of both ends of a line-circuit, a transverse series of connecting-strips, or equivalents therefor, also arranged in pairs, each pair crossing each pair of line-strips in such a manner as to form by each intersection a hole or plug-socket having for its linear boundary a portion of each of the four intersecting strips, and a plug or circuit connector furnished with two contact-plates insulated from one another by the non-conducting portion of the plug, and placed oppositely to one another, whereby when the said plug is inserted each one of the pair of line-strips is respectively connected with one of the pair of connecting or cross strips, substantially as and for the purpose described.

5. The combination, in a telephone-exchange system, of a compound signaling-circuit composed of two metallic circuits or loops, each normally forming a main line, two pairs of switch-board conducting bars, plates, or strips, each pair permanently connected with the two terminals of its own line, a pair of switch-board connecting bars or strips crossing transversely both pairs of line-strips, but normally insulated therefrom and without electrical connection with each other, and a plug-connector constructed, substantially as described, with two separate conducting-surfaces thereon, and adapted for insertion in the plug-sockets produced by the intersection of the transverse pair of strips with the two pair of line-strips, as and for the purpose specified.

6. In an electrical switch-board, plug-sockets formed by the intersection of continuous line strips, bars, plates, or wires, arranged in

pairs, with continuous transverse connecting-conductors of like character, likewise arranged in pairs, as and for the purpose specified.

7. In a switch-board, strips, bars, or plates arranged to leave one or more square sockets between them, in combination with plugs adapted to fit said sockets, and having contact-pieces arranged as indicated, so that when inserted they connect adjacent strips, bars, or plates, substantially as described.

8. A switch-plug adapted for insertion in a square socket, and having contact-plates diagonally arranged so as to connect the conductors or adjacent sides of the square sockets, substantially as described.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 25th day of April, 1882.

THEO. N. VAIL.

Witnesses:

FRED BARTLEET,

GEO. WILLIS PIERCE.