(No Model.) 3 Sheets—Sheet 1.

D. M. MUNRO.

SWITCHBOARD.

No. 560,275. Patented May 19, 1896.

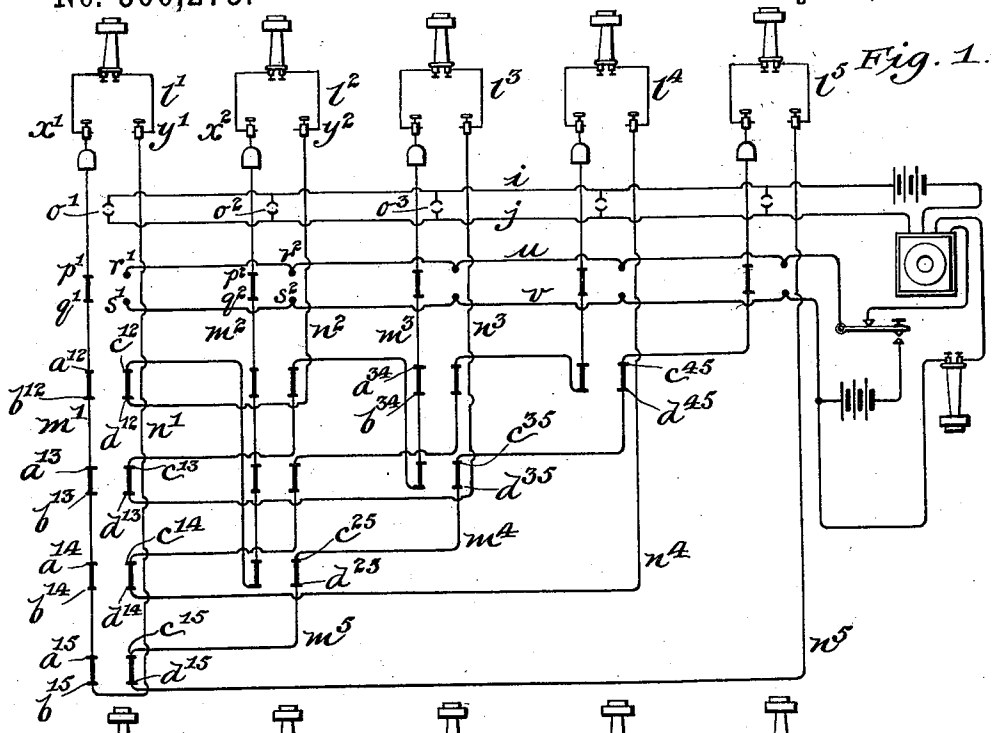


Fig. 1.

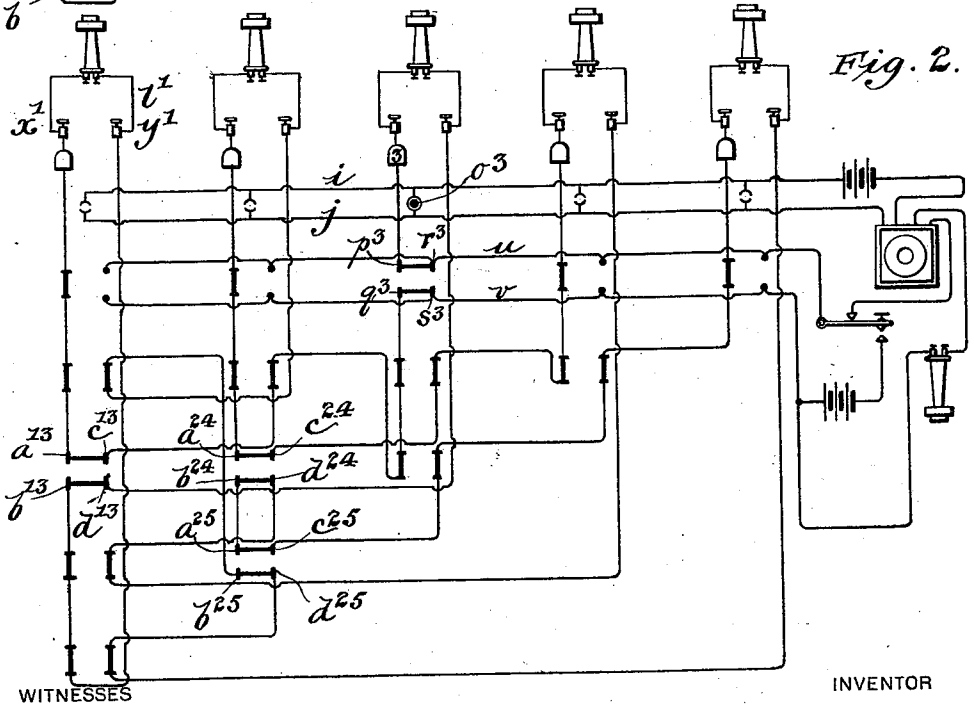


Fig. 2.

WITNESSES

Severance.

O. F. Johnson

INVENTOR

David M. Munro

By Francis M. Wright

Atty.

(No Model.) 3 Sheets—Sheet 2.

D. M. MUNRO

SWITCHBOARD.

No. 560,275. Patented May 19, 1896.

Fig. 3.

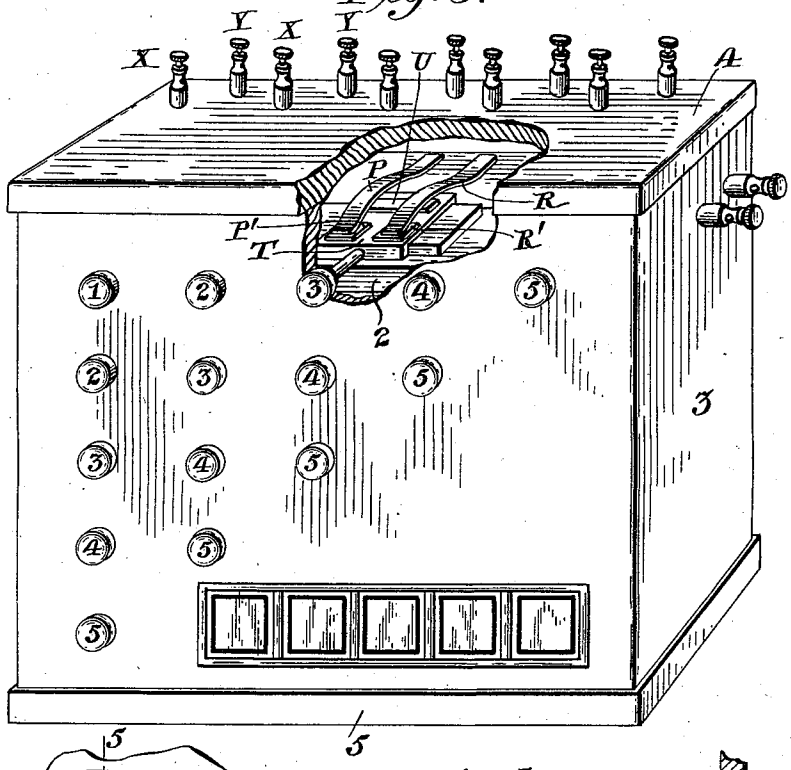


Fig. 4.

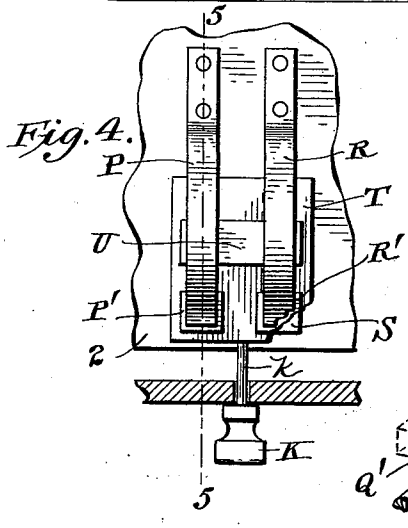


Fig. 5.

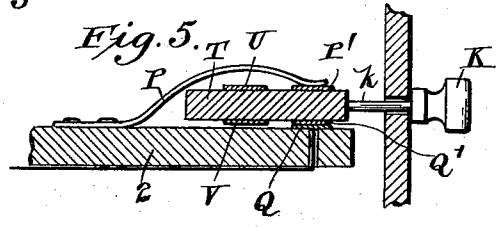


Fig. 6.

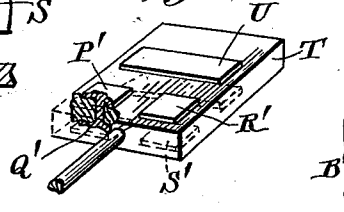
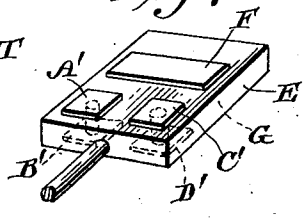


Fig. 7.



WITNESSES

Geverance.
O. F. Johnson

INVENTOR

David M. Munro
By Francis M. Wright
Atty.

(No Model.) 3 Sheets—Sheet 3.

D. M. MUNRO.

SWITCHBOARD.

No. 560,275. Patented May 19, 1896.

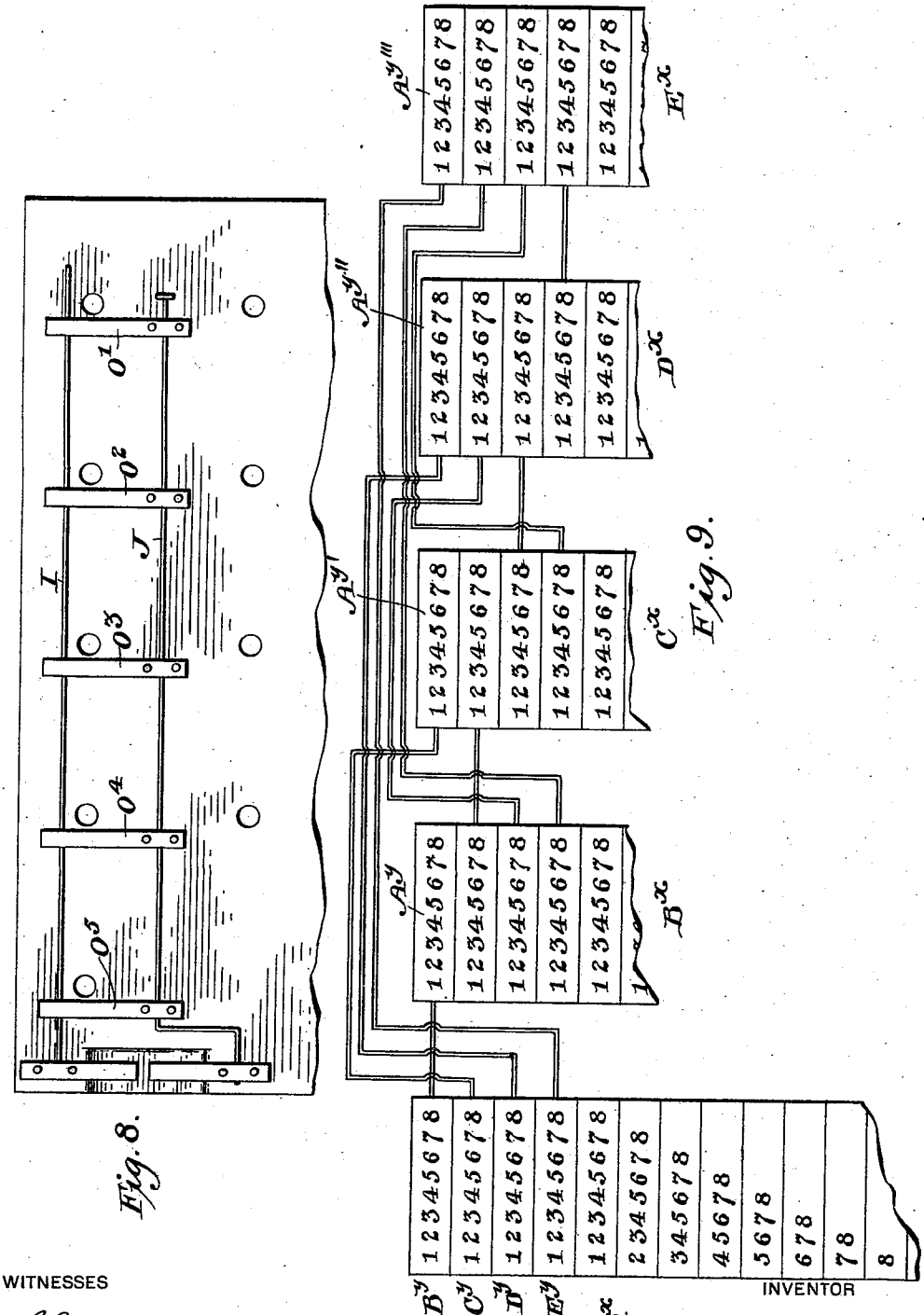


Fig. 8.

Fig. 9.

WITNESSES

C. Severance.
O. F. Johnson

David M. Munro
By Francis M. Wright
Atty.

UNITED STATES PATENT OFFICE.

DAVID M. MUNRO, OF GAITHERSBURG, MARYLAND.

SWITCHBOARD.

SPECIFICATION forming part of Letters Patent No. 560,275, dated May 19, 1896.

Application filed February 26, 1896. Serial No. 580,786. (No model.)

To all whom it may concern:

Be it known that I, DAVID M. MUNRO, a citizen of the United States, residing at Gaithersburg, in the county of Montgomery and State of Maryland, have invented a new and useful Improvement in Switchboards, of which the following is a specification.

My invention relates to improvements in switchboards for the central stations of telephonic and telegraphic systems, the object of my invention being to provide a switchboard by means of which the different subscribers' lines can be connected in a more convenient and speedy manner than with those at present in general use.

The most common class of switchboards now used is that whereby the subscribers' lines are electrically connected by means of terminal plugs joined by a flexible conducting-cord. The objection to this arrangement is the great liability of the numerous cords to become broken by repeated bending. One of the objects of my invention is to dispense with these flexible cords and to provide means whereby any two subscribers' circuits can be electrically connected or disconnected merely by sliding out or in a single switch-plug.

A further object of my invention is to provide a switchboard in which not only two subscribers' lines, but three, four, or any number up to the entire series can be brought into a continuous circuit and the subscribers into mutual communication with each other.

A further object of my invention is to provide means whereby at the central station of a large exchange where several switchboards are required a subscriber's line on any one switchboard can be rapidly and conveniently connected with any line on any other switchboard.

In the drawings, Figure 1 is a diagrammatic representation of the electrical connections of the switchboard as they appear when none of the subscribers' circuits have been joined, while Fig. 2 is a similar diagram illustrating the connections when subscribers are brought into communication with each other. Fig. 3 is a perspective view of my improved switchboard, a portion being broken away to show a switch-plug and its contacts. Fig. 4 is a plan view, on an enlarged scale, of a portion of one of the shelves, showing more clearly the structure of the plug. Fig. 5 is a section of the same on the line 5 5, Fig. 4. Fig. 6 is a perspective view of one of the plugs in the upper row detached. Fig. 7 is a similar view of one of the plugs in a lower row. Fig. 8 is a rear view of the top board of the front wall of the switchboard, which is opposite to the top shelf thereof; and Fig. 9 is a diagrammatic view of the connections for a multiple switchboard arranged according to my improved system.

Before describing the specific mechanism of my improved switchboard I will first explain the principles embodied in its construction.

In the diagram, figures $1'$ 1^2 1^3 1^4 1^5 represent metallic subscribers' lines of a telephonic-exchange system, each circuit being brought into connection with the switchboard by two terminals x' y' x^2 y^2, &c. I have selected five such lines as being a sufficient number to illustrate the nature of my invention; but it will be readily seen that the invention is equally applicable to any number of lines however large.

Each subscriber's circuit is normally completed on the switchboard by a loop, as m' n' m^2 n^2, &c., and in these loops are the usual annunciator-drops. Premising that in the diagram the thin lines represent permanent metallic lines or wires, while the thick short lines represent bridges or switch connections that may be broken, it will be observed that the first portion m of each of said loops comprises a number of wire connections between contact-points alternated by bridges between said points, while the second or return portions n consist each of a single uninterrupted line-wire back to the terminals y.

Of the bridges in the portions m of the loops it is to be observed that the first series p' q' p^2 q^2, &c., are to be broken when it is desired to include in any one of the subscriber's lines the receiver, transmitter, and signaling instrument of the attendant at the central station. To these instruments proceed two lines u v through contact-points r' s' r^2 s^2, &c., which are adjacent to the pairs of contacts p q, the line u passing through the points r adjacent to the points p, and v passing through points s adjacent to q. In order to close the battery or primary circuit of the central-at-

tendant's transmitter, there are also provided two lines $i\,j$, having bridges $o'\,o^2$, &c., which may be closed by a plug. If now any subscriber—as, for instance, No. 3—is communicating to the central station, the attendant thereat, being apprised of the fact by the corresponding annunciator-drop, will close the bridge o^3 and will at the same time break the connection $p^3\,q^3$ and close $p^3\,r^3\,q^3\,s^3$. The central telephone will then be included in No. 3 circuit.

In addition to the contacts for including the instruments at the central telephone each loop-line $m\,n$, or, in particular, the portion m thereof, contains a series of pairs of contacts for connecting the subscriber's line corresponding to that loop with the other lines of the system, there being as many pairs as there are remaining lines—in other words, the number of such pairs of contacts in each loop-line is one less than the total number of subscribers. These bridges or pairs of contact-points are represented in the diagram by the letters $a\,b$ or by the letters $c\,d$, the former being used to denote in any loop a bridge which must be broken to introduce a subscriber's circuit of a higher number than the circuit of said loop, while the letters $c\,d$ represent a bridge for introducing a circuit of a lower number than that of the loop. Thus the first loop $m'\,n'$ contains the bridges $a^{12}\,b^{12}$ $a^{13}\,b^{13}\,a^{14}\,b^{14}\,a^{15}\,b^{15}$ for connecting with lines of higher numbers, while the loop $m^5\,n^5$ contains the bridges $c^{45}\,d^{45}\,c^{35}\,d^{35}\,c^{25}\,d^{25}\,c^{15}\,d^{15}$ for connecting with lines of lower numbers. These loops and the bridges therein are so disposed that the bridge $a\,b$ for connecting with a line of a higher number is placed in proximity to the corresponding bridge $c\,d$ of the latter line for connecting with the former line, as shown in the diagram.

Now suppose it is required to connect No. 1 subscriber with No. 3. All that is necessary is to break the connections $a^{13}\,b^{13}$ and $c^{13}\,d^{13}$ and join a^{13} with c^{13} and $b^{13}\,d^{13}$. The completed circuit of the two lines thus joined is shown in Fig. 2.

An important feature of my invention is that when two subscribers' lines are connected each line is introduced into the other at two adjacent or successive points on the same wire of the latter and takes the place of a bridge in said line. From this it follows that not only two local lines, but three, four, or any number of the lines, can be brought into simultaneous communication with each other. This I have also illustrated in Fig. 2, where it is seen that line 4 is connected with line 2 at the points $a^{24}\,c^{24}\,b^{24}\,d^{24}$, while line 5 is brought into the same circuit by connecting $a^{25}\,c^{25}\,b^{25}$ d^{25}. It will readily be seen that with this system all the lines can be brought into the same circuit, if desired.

I will now describe the specific apparatus which I have devised for operating the foregoing system of exchanges.

My improved switchboard, as illustrated in Fig. 3, comprises a vertical series of horizontal shelves or boards 2, supported by side walls 3, the whole being formed into a suitable framework by a top 4 and base 5. Upon the top 4 of the switchboard are placed the terminals X Y of the subscribers' circuits, in pairs. Upon the first shelf, which I call the "attendant's shelf," are arranged the contacts for switching the central-attendant's instruments into any one of the subscribers' circuits. This switching device for each circuit comprises, first, a pair of spring-jacks P R, of which P is connected with the terminal X, while R is connected with a wire to the central instruments, as has been explained and illustrated diagrammatically in Fig. 1; next, a pair of contact-plates Q S, located on the upper side of the telephone-shelf, underneath the spring ends of the jacks P R, the circuits from the plates Q S being such as are shown in Fig. 1 in relation to the points q s—that is, from Q the line proceeds to contact-points on the lower shelves and thence back to the other terminal of the subscriber's circuit, while the line from S goes to the central telephone. Next there is provided a switch-plug T of insulating material, having at its front end, on its upper side, contact-plates P′ R′, which normally lie beneath and in contact with the ends of the spring-jacks P R, and on its lower side contact-plates Q′ S′, which are normally in contact with the plates Q S. The plates P′ Q′ are connected through the plug, while the plates R′ S′ are insulated from each other. Thus in the normal position of the switch-plug the circuit is from the terminal X through spring-jack P, plate P′, plate Q′, plate Q, loop-line of the switchboard, (and other subscribers' lines if connected up,) and back to the terminals Y, as is illustrated in lines 1 2 4 5 of Fig. 2, while the central-telephone circuit is cut out. Now on the rear end of the switch-plug are located bridge-plates—U on the upper surface and V on the lower surface—insulated from each other and of such dimensions as that when the switch-plug is pulled out or forward the bridge-plate V shall contact with the ends of both of the spring-jacks P R, while the plate V will bridge the plates Q S. The effect of this will be to throw the central telephone into the subscriber's circuit, as illustrated in line 3 of Fig. 2, said telephone-line taking the place of the bridge P P′ Q′ Q, which will be broken.

Upon the rear surface of the front wall of the switchboard illustrated in Fig. 8 are carried two lines I J to the battery or primary circuit of the central transmitting instrument, normally open, but adapted to be closed across the wires I J by means of any one of the spring-plates $O'\,O^2$, &c., one end of each of which is permanently connected to the wire J, while the other end of any spring-plate, as O^3, is brought into contact with the wire I when its switch-plug T is drawn forward, its end pressing against the plate O^3 and causing

it to make contact with the wire I. Thus the same operation which throws the central instruments into the subscriber's circuit will also close the primary circuit of the transmitter. The shelves below the first support the switches and contacts for connecting the different subscribers' circuits. In general the arrangement is similar to the above-described devices for including the central telephone. Thus there are spring-jacks similar to the spring-jacks P R and contact-plates on the shelves similar to the contact-plates Q S. The switch-plugs E have bridge-plates F G like the bridges U V and upper and lower contact-plates A′ C′ B′ D′ like the plates P′ R′ Q′ S′, with this sole difference, that while the plates R′ S′ were insulated from each other the plates C′ D′ are electrically connected through the insulating-plug. The circuits from these jacks and plates are such as are shown diagrammatically in Fig. 1 proceeding from the points *a b c d*. It will now readily be seen that while in the normal position of the switch-plugs the circuits will be as shown in Fig. 1, the effect of pulling out any plug so as to bring the upper and lower bridge-plates F G into operation will be to put two subscribers' lines into communication with each other, as illustrated diagrammatically in Fig. 2.

To pull out the plugs, there are provided knobs or handles K, secured to the plugs by rods *k*, passing through apertures in the front wall 6 of the switchboard. The knobs K of any row are numbered in order, as "1," "2," "3," "4," &c., "2," "3," "4," "5," &c., "3," "4," &c., and they are similarly numbered in the columns. The knobs of the first row indicate by their numbers that by pulling the knob of a certain number the central telephone will be included in the subscriber's circuit of that number.

In the lower rows the number on a knob indicates that by pulling the knob the subscriber's circuit of that number will be connected with the circuit having the same number as the column in which the knob is situated.

The operation then is as follows: The central attendant, having been apprised by the drop that a subscriber, say No. 1, desires to communicate with another subscriber, pulls out switch-plug 1, which will have the effect of including in No. 1 circuit the central-attendant's instruments and of closing the central battery-circuit. The central attendant then communicates with subscriber No. 1 and learns that he desires to talk with, say, No. 3. The attendant thereupon pushes in plug 1 and pulls out plug 3 in the first row, in order to signal to No. 3, and having done so pulls out plug 3 in the first column. This will place subscribers 1 and 3 in communication with each other, the central attendant being in the same circuit. As soon as the attendant is satisfied that subscribers 1 and 3 are talking with each other he will push in plug 3 in the first row, which leaves subscribers 1 and 3 in communication by means of plug No. 3 in the first column, the central-attendant's circuit being cut out.

Supposing that more than two subscribers, as Nos. 2, 4, and 5, should desire to communicate simultaneously with each other, this can be made possible by pulling out plugs 4 and 5 in column No. 2. It may also be done by pulling out plug 4 in column 2 and plug 5 in column 4.

It will also readily be seen that all the subscribers can be put on the same circuit by pulling out plugs 2, 3, 4, and 5 in column 1.

The annunciator-drops for the different subscribers can be conveniently placed in the vacant triangular space in the right-hand lower corner of the switchboard, as shown in Fig. 3.

In case the number of subscribers is too large for a single switchboard a number of such switchboards can be used, slightly modified to connect them with each other. This is illustrated diagrammatically in Fig. 9, which shows five sections A^x B^x C^x D^x E^x, each of eight subscribers. These sections of a multiple switchboard differ from the single switchboard described above in that in the upper part of each, above the shelf or row of plugs for throwing in the central-attendant's instruments, are four shelves precisely like the attendant's shelf or row. Thus section A^x has the four rows B^y C^y D^y E^y. Each row, as B^y, and the connections and switch-plugs thereof, is precisely like the attendant's row or shelf on the section A^x, except that the pair of wires corresponding to those which in the central-attendant's row go to the attendant's instruments now go to the row marked A^y on section B^x. Similarly the wires from the row C^y go to the row $A^{y'}$ on section C, and so on. Supposing then that subscriber No. 6 on section A^x desires to communicate with subscriber No 3 on section D^x, the attendant will first pull out plug 6 in row D^y in section A^x, and will then himself or another attendant pull out plug 3 in row $A^{y''}$ in section D^x. No. 6 in section A^x and No. 3 in section D^x will then be in communication with each other.

Having thus fully described my invention, what I claim is—

1. In a switchboard, a series of loop-lines connected to pairs of terminals of subscribers' wires, each loop-line comprising a number of pairs of contact-points, and bridges for said points, a pair of such points on one loop being arranged in proximity to a pair of such points on another loop, whereby, when said bridges are broken, and said contact-points are connected across from one loop to the other, said loops are brought into a single circuit, substantially as described.

2. In a switchboard, a series of loop-lines connected to the respective terminals of the subscribers' lines, each loop-line comprising a number of pairs of contact-points, one pair for each of the other loop-lines, and bridges for said points, each pair of such points hav-

ing in proximity thereto one of the pairs on another loop, whereby, when said bridges are broken, and said contact-points are connected across from one loop to the other, said loops are brought into a single circuit, substantially as described.

3. In a switchboard, a series of loop-lines connected to pairs of terminals of subscribers' lines, each loop-line comprising a number of pairs of contact-points, and bridges for said points, a pair of such points on one loop being in proximity to a pair of such points on another loop, in combination with a switch-plug which simultaneously breaks said bridges, and connects the contact-points on one loop with those on the other, whereby said loops are brought into a single circuit, substantially as described.

4. In a switchboard, a series of loop-lines connected to the respective terminals of the subscribers' lines, each loop-line comprising a number of pairs of contact-points, one pair for each of the other loop-lines, and bridges for said points, each pair of such points having in proximity thereto one of the pairs on another loop, in combination with switches which simultaneously break said bridges and connect the contact-points on one loop with those on another, whereby said loops are brought into a single circuit, substantially as described.

5. In a switchboard, a series of loop-lines connected to the respective terminals of the subscribers' lines, and forming normally-closed circuits therewith, each loop-line comprising a number of pairs of contact-points, one pair for each of the other loop-lines, each pair of such points having in proximity thereto one of the pairs on another loop, in combination with switches, each switch, in its normal position, closing two pairs of contact-points on different lines adjacent to each other, and, when operated, opening said pairs, and connecting the contact-points thereof across from one line to the other, substantially as described.

6. In a switchboard, a series of loop-lines connected to the respective terminals of the subscribers' lines and forming normally-closed circuits therewith, each loop-line comprising a series of normally-closed bridges adapted to be broken for connecting with the lines of a higher number, followed by a series of similar bridges for connecting with lines of a lower number, the two bridges on two loops for connecting the corresponding lines being placed in proximity to each other, substantially as described.

7. In a switchboard, in combination with the pair of spring-jacks, and the pair of contact-plates, either spring-jack and its corresponding contact-plate being connected to the terminals of one of two subscribers' lines, forming a broken loop between said terminals, the switch-plug having the upper and lower connected contact-plates normally contacting with said jacks and corresponding contact-plates for simultaneously bridging said broken loops, and having upper and lower bridge-plates adapted to bridge, the one the spring-jacks, and the other the contact-plates, when said switch-plug is operated, substantially as described.

8. In a switchboard, a series of loops connected to the pairs of terminals of the subscribers' circuits, each loop having a series of bridges, each bridge being adjacent to a bridge on one of the other loops, and independently-operated switches whereby any one, or more, or all of said other loops can be substituted for the bridge, adjacent thereto, on the single loop, and be brought into a single continuous circuit therewith, substantially as described.

9. In a switchboard, a series of loops connected to the pairs of terminals of the subscribers' circuits, each loop having a bridge, a series of pairs of contacts, one adjacent to each bridge, two lines, normally open, proceeding to the central-attendant's instruments, and passing through opposite contacts of the pairs, two other lines, normally open, to the battery-circuit of the central-attendant's transmitter, and a switch for each loop which simultaneously breaks the bridge and connects its ends to the contacts of the adjacent pair, thus throwing the central-attendant's instruments into the subscriber's line, and closes the battery-circuit, substantially as described.

10. A switchboard forming a section of a multiple switchboard, comprising a series of loops, one for each subscriber's circuit of said section, each loop having therein a bridge for connecting with another section of the multiple switchboard, said bridges in the several loops having adjacent thereto pairs of contact-points, the opposite points of the pairs being connected by wires to the other switchboard of the section, and means for breaking any one of the bridges and connecting its ends with the adjacent contact-points whereby said loop is placed in communication with the other section of the switchboard, substantially as described.

11. A section of a multiple switchboard having rows of switch-plugs, there being for each row a pair of open wires to one of the other sections, the switch-plugs of said rows forming columns, one column for each subscriber's circuit of said section, the switch-plugs of the same column normally forming bridges in the subscriber's circuit of said column, any switch-plug on being moved from its normal position breaking the bridge and making contacts with the pair of open wires to the corresponding other section of the multiple switchboard, substantially as described.

In witness whereof I have hereunto set my hand in the presence of two witnesses.

DAVID M. MUNRO.

Witnesses:
FRANCIS M. WRIGHT,
R. M. ELLIOTT.