

(No Model.)

3 Sheets—Sheet 1.

C. F. DANFORTH.

TELEPHONE AND TELEGRAPH SWITCH BOARD.

No. 251,098.

Patented Dec. 20, 1881.

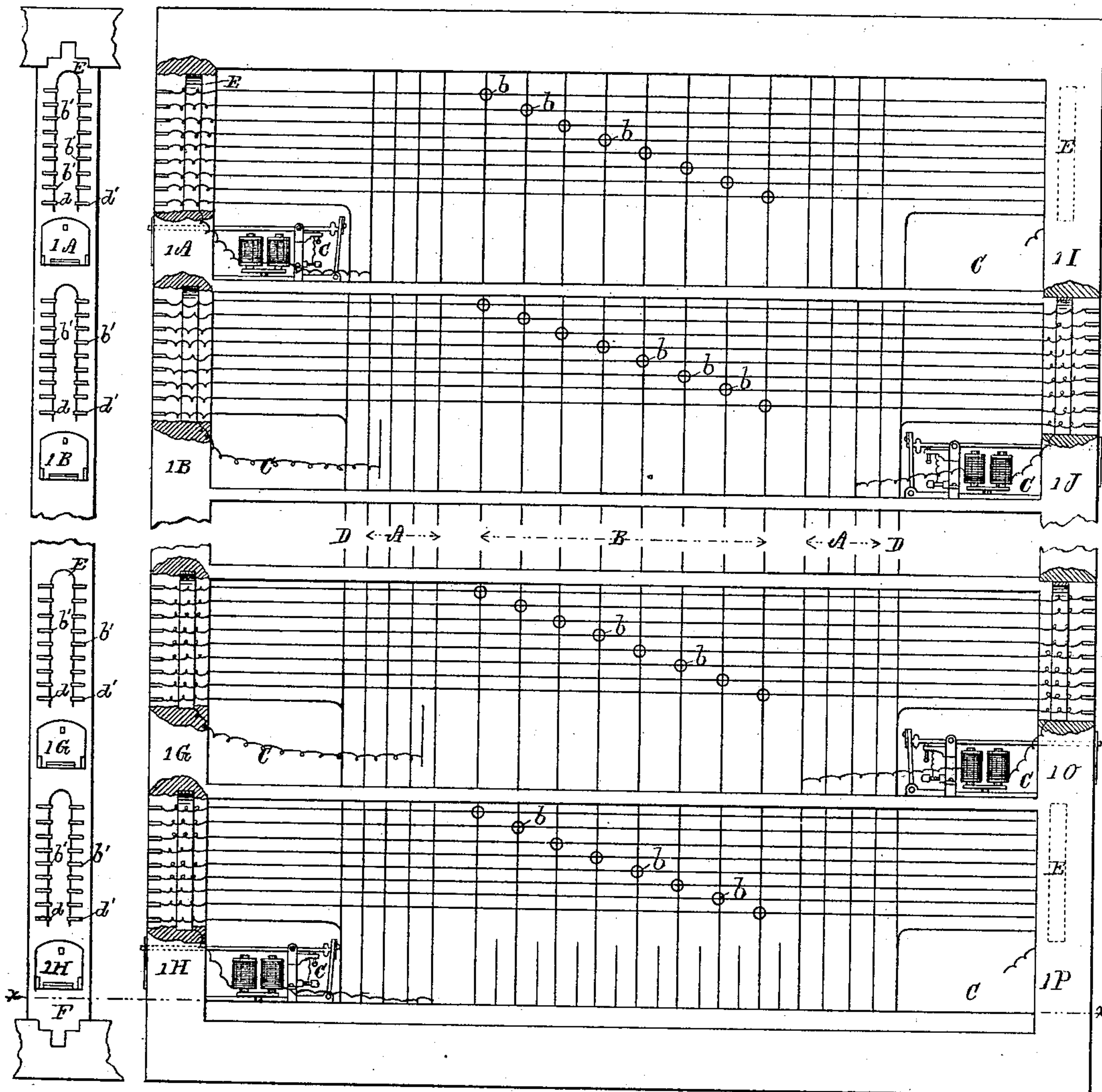


Fig. 2.

Fig. 1.

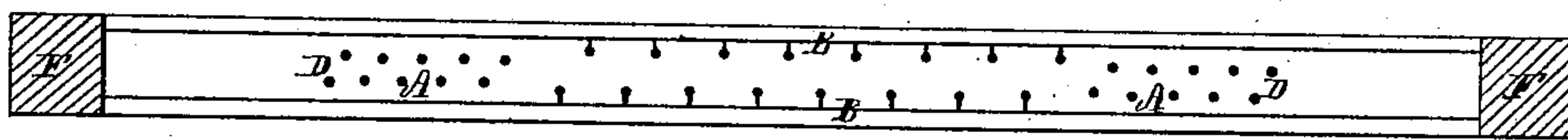


Fig. 3.

Witnesses-
G. B. Maynard
L. N. Holler

Inventor
Charles Francis Danforth
by J. E. Maynard
his atty

(No Model.)

3 Sheets—Sheet 2.

C. F. DANFORTH.
TELEPHONE AND TELEGRAPH SWITCH BOARD.
No. 251,098. Patented Dec. 20, 1881.

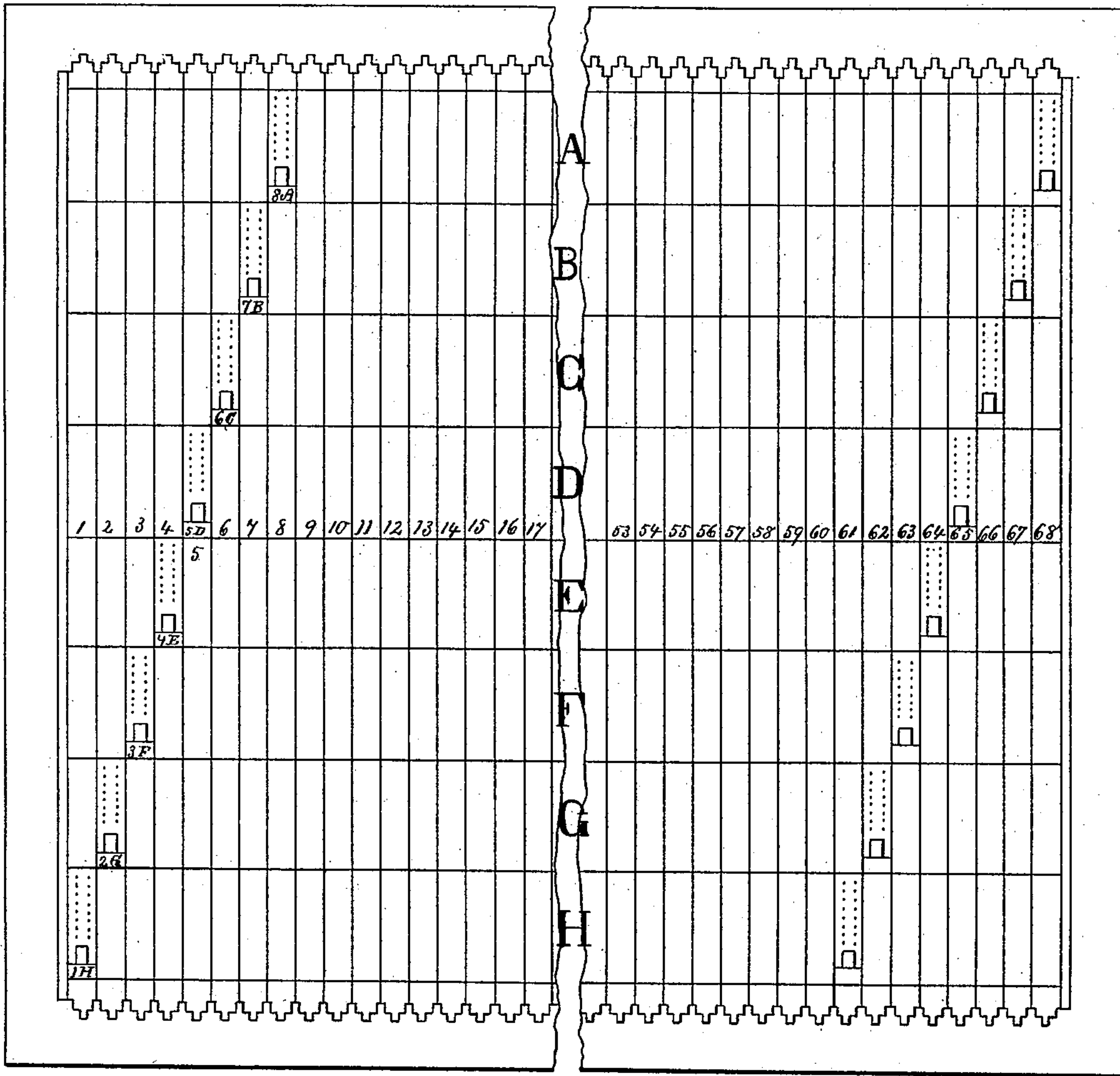


Fig. 4

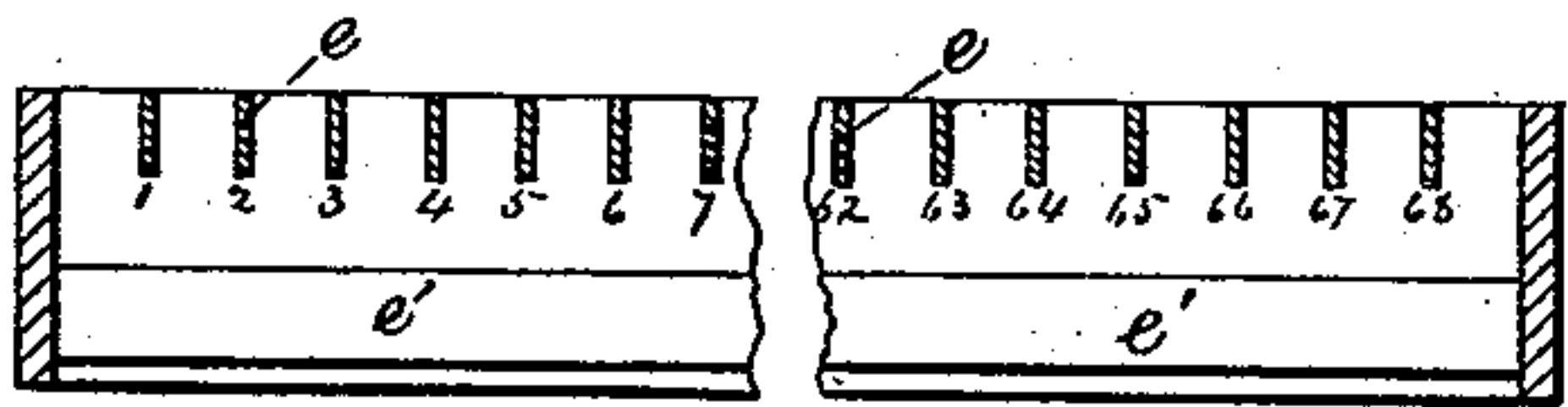


Fig. 5

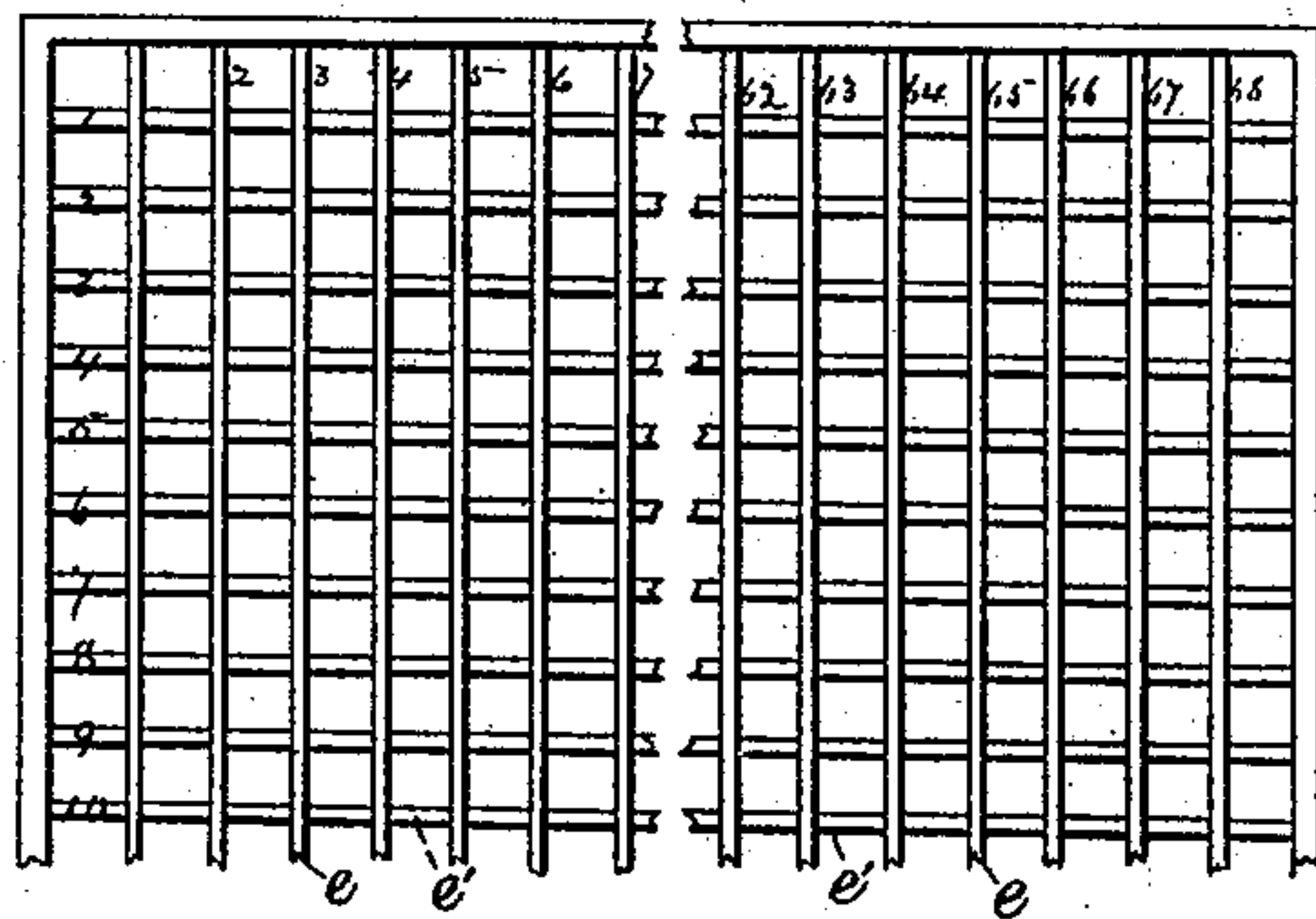


Fig. 6

Witnesses—
G. B. Maynard
L. W. Keller.

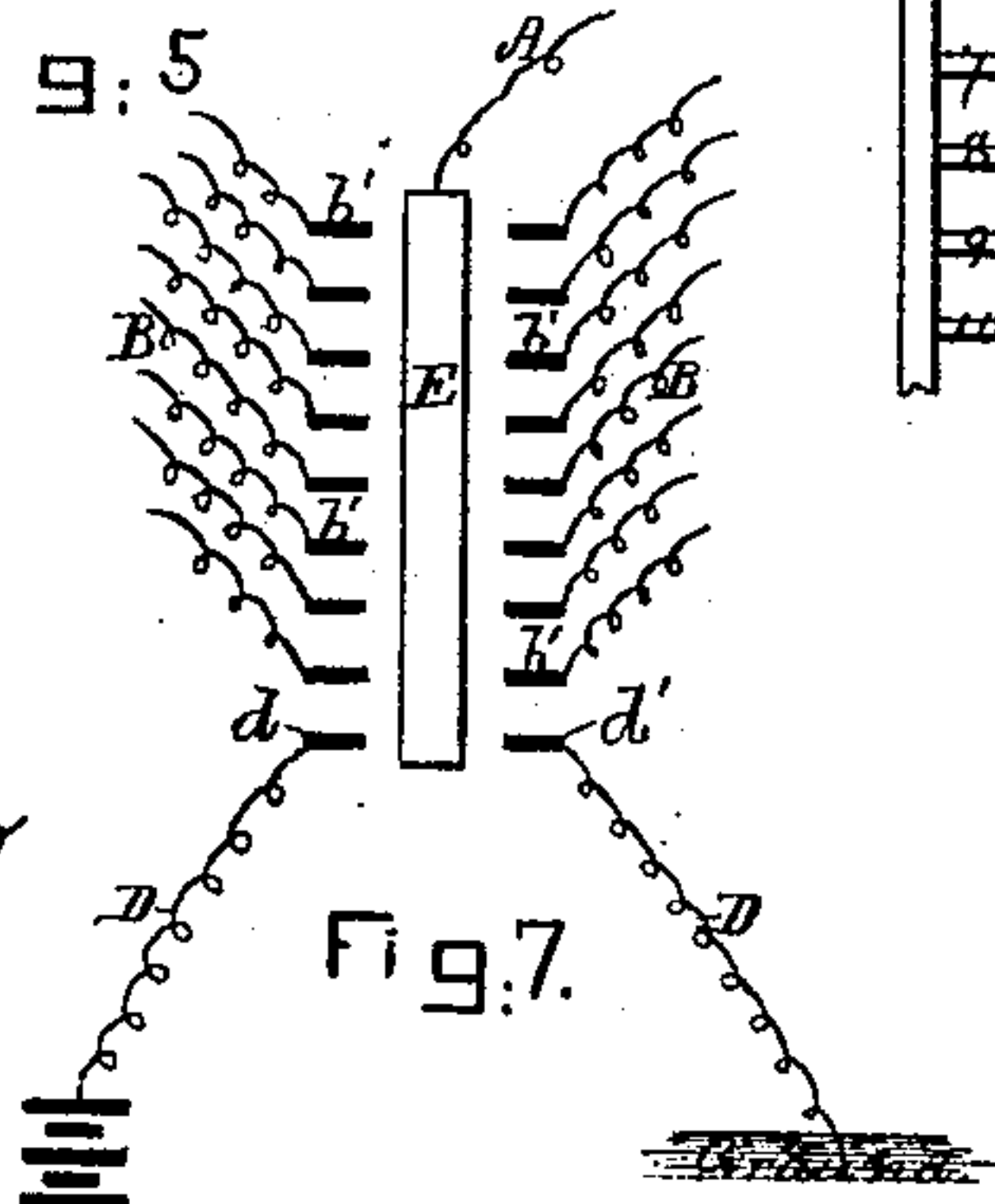


Fig. 7

Inventor
Charles Francis Danforth
by J. E. Maynard
Att'y.

(No Model.)

3 Sheets—Sheet 3.

C. F. DANFORTH.
TELEPHONE AND TELEGRAPH SWITCH BOARD.
No. 251,098. Patented Dec. 20, 1881.

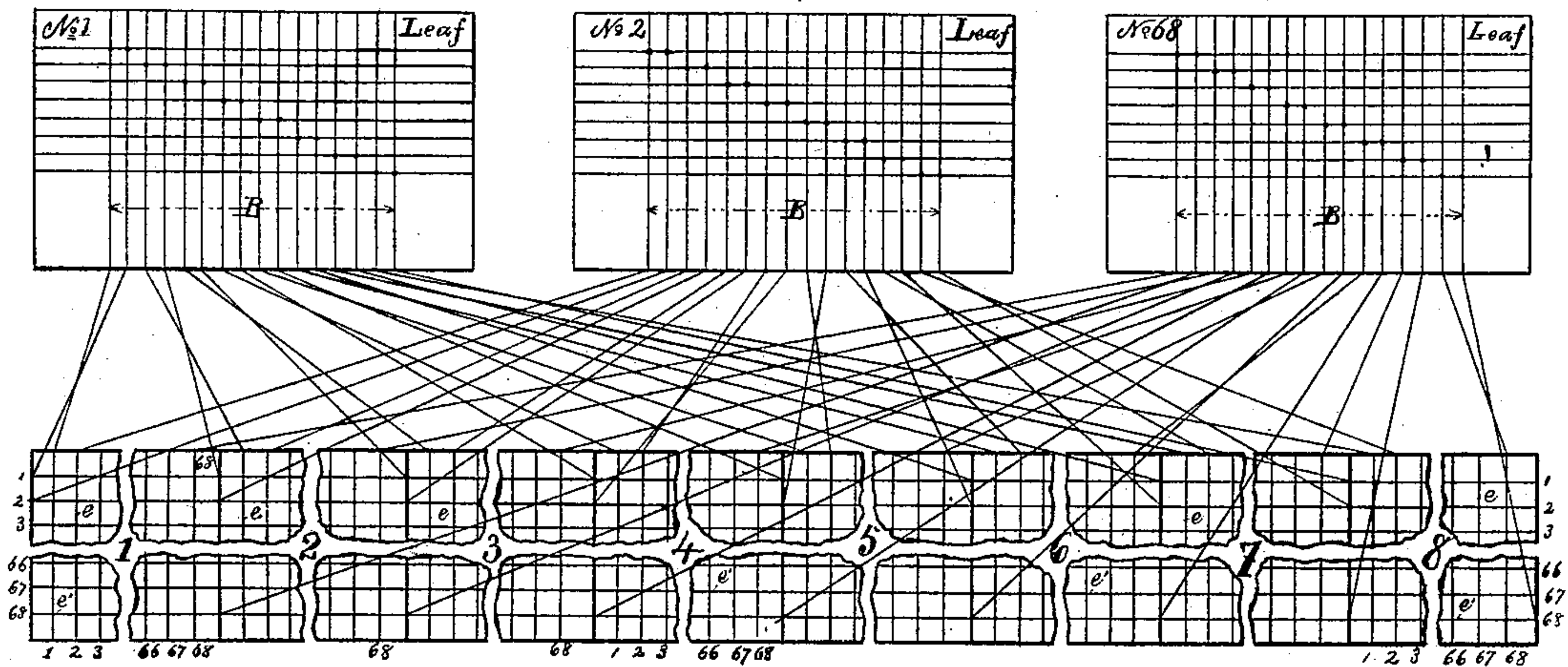


Fig. 8.

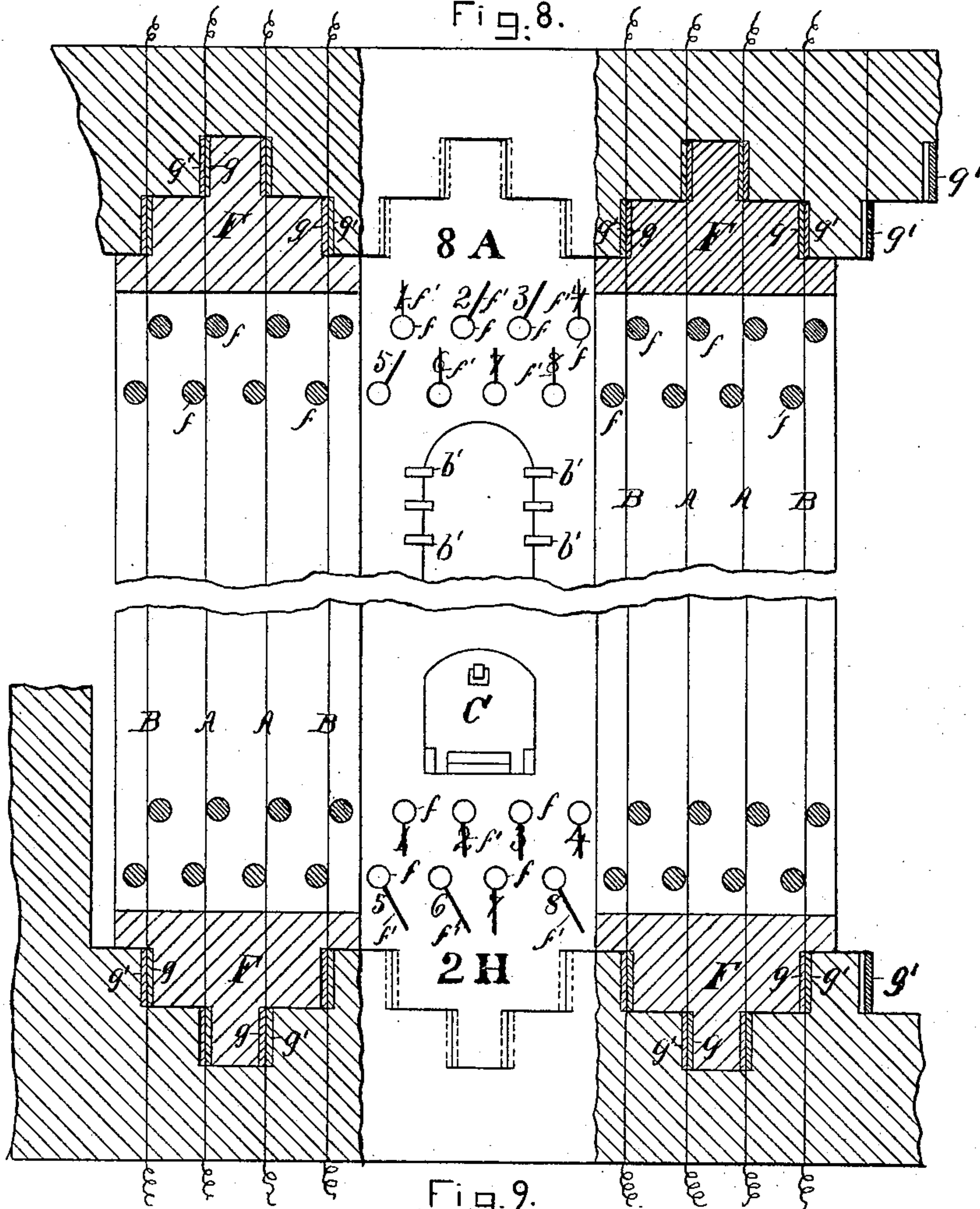


Fig. 9.

Witnesses:
Wm. Pittel.
John A. Snow

Inventor:
Charles Francis Danforth
by J. E. Magnader his atty.

UNITED STATES PATENT OFFICE.

CHARLES F. DANFORTH, OF CHELSEA, MASSACHUSETTS,

TELEPHONE AND TELEGRAPH SWITCH-BOARD.

SPECIFICATION forming part of Letters Patent No. 251,098, dated December 20, 1881.

Application filed May 18, 1881. (No model.)

To all whom it may concern:

Be it known that I, CHARLES FRANCIS DANFORTH, a citizen of the United States, residing at Chelsea, in the county of Suffolk and State of Massachusetts, have invented a new and useful Improvement in Telephonic Exchange Systems, of which the following is a specification.

My invention relates to a telephonic or telegraphic exchange system in which any one of the subscribers may be placed in communication with any other one.

The object of my invention is to connect any one of a large number of circuits with any other. This has heretofore been accomplished in a variety of ways, some such system being in practical use in many places in this country; but my improved system is wholly new in one particular, and differs in many other minor respects from all others known to me.

The main novelty of my system resides in the use of a series of connecting-wires with each circuit-wire, as hereinafter more fully explained; and the minor features of my invention consist in the grouping together of a number of circuit-wires with a corresponding number of connecting-wires, as more fully explained below; and in the means for connecting together any two of the connecting-wires, and thereby connecting together the two circuit-wires which are connected with those connecting-wires.

In my improved system, as shown in the drawings and now to be explained, each circuit-wire terminates in an insulated metal bar, and sixteen other insulated metal bars are arranged about the circuit wire bar, so that either one of the sixteen can be readily connected to the circuit-wire bar by a plug or other like contrivance, as will be well understood by all skilled in this art. Sixteen connecting-wires terminate each in one of these sixteen metal bars, the purpose being to make it easy to connect the circuit-wire to either one of these sixteen connecting-wires. (See the diagram Figure 7.) This series of connecting-wires so combined with each circuit-wire that the circuit-wire can be connected with either one of the connecting-wires is not only the main novelty of my invention, but is the main feature upon which my system is based. With this multi-

plicity of connecting-wires for each circuit-wire, it becomes easy to so arrange insulated crossing strips of metal, each a continuation of one of the connecting-wires, that any two of these crossing strips may be readily connected, and as the circuit-wire may be readily connected with either one of the connecting-wires, it will be clear that all that is necessary to connect together any two circuit-wires will be to connect one of them with one of the connecting-wires and the other with another connecting-wire and then connect together these two connecting-wires by connecting the crossing strips which are continuations of these connecting-wires. On this simple basis any number of circuit-wires can be practically managed by means of a device which is not over-complicated, not likely to get out of order, and easily understood and used by operatives of average skill.

I will now proceed to describe the preferred form of this device; but it will be obvious that it is susceptible of numerous modifications, although in all the underlying principle must be the use of a multiplicity of connecting-wires for each circuit-wire.

In the drawings, Fig. 1 is a side view of one of the leaves, showing the arrangement of the subscribers' wires A, connecting-wires B, drop-signals C, and ground and battery wires D. Fig. 2 is a front view of either end of a leaf, showing the metallic plates b' and $d d'$, in which the horizontal connecting-wires B and battery and ground wires D terminate, and the U-shaped metallic pieces E, in which subscribers' wires terminate, one wire to each piece. Fig. 3 is a section on line $x x$, Figs. 1 and 2, showing the positions of the different wires. Fig. 4 is a front view of one side of a set of leaves, the opposite side being exactly the same. Fig. 5 is a section through one of the switch-boards. Fig. 6 is a plan of one of the switch-boards. Fig. 7 is a diagram for illustration. Fig. 8 is a diagram showing the electrical connections of the leaves with the switch-boards. Fig. 9 is an end view of the upper portion of one leaf and the lower portion of another, showing the indicators, and section through two leaves, showing the manner of making electrical connections at top or bottom with circuit and connecting wires.

Each subscriber has a wire and a signal-drop, the drops being numbered and lettered as hereinafter stated. Each subscriber's wire—that is, each circuit-wire—must be capable of ready connection with any one of a number of connecting-wires—for example, as illustrated in the diagram Fig. 7, where A represents a circuit-wire and B sixteen connecting-wires, the circuit-wire terminating in a metal bar, E, and each connecting-wire in a metal bar, *b'*. A number of such wires and drops (in this instance sixteen of each) form a leaf, and a number of leaves (in this instance sixty-eight) form a set, so that a set of leaves contains one thousand and eighty-eight circuit-wires and drops, arranged in sixteen rows, eight on each side and sixty-eight in each row. The rows are lettered from A to H on one side and from I to P on the other. The leaves are numbered from 1 to 68 on both ends, the same numbers being on the opposite ends of the same leaf, and the ends of the leaves form the sides of a set. A subscriber is thus known by his row and number, as 17A 57G, &c., on one side and 30K 19N, &c., on the other side. There will be an operator on each side of a set of leaves. The leaves are all exactly alike, and a description of one will answer for all.

F is the frame, made of wood or other suitable material; A, the subscribers' wires, which may enter from top or bottom, sixteen in number, arranged on each side, near the signal-drops C, in groups of eight, four on each end, only being fully shown in Fig. 1, but all of them in Fig. 3. The connecting-wires B are also sixteen in number, each one extending from top to bottom and from side to side of the leaf, or consisting of vertical and horizontal wires in metallic contact at their points of crossing *b*. The connecting-wires terminate in metallic plates *b'* let into the frame F, and have their connections at the top and bottom of the frame F, as will be described farther on. The ground and battery wires D at each side are connected to metallic plates *d d'*, similar to those of the connecting-wires B.

E is a metallic U-shaped strip of metal let into the frame F, out of contact with the metallic plates *b'*, *d*, and *d'* and wires B, but which can be connected with either of the metallic plates *b' d d'* by a suitable plug.

When not in use each subscriber's wire is connected to the ground-wire through the drop C, strip E, and plug to plate *d'*. If 1A desires to communicate, he completes the circuit, by any well-known contrivance at his office, through his drop C, strip E, and plug, to plate *d'*, which plate is connected with ground by ground-wire D. This causes his signal to drop and notify the operator, who removes the plug from *d'* and plugs plate *d* to strip E of 1A, thus connecting the battery which is connected to plate *d* by wire D with the circuit-wire of 1A. The operator then, after having signaled 1A, removes the plug from plate *d*. He then connects strip E of 1A with his telephone and notifies 1A, who replies "Connect with 1P." The

operator then removes his telephone-plug and plugs 1A's wire to any disengaged connecting-wire by plugging plate *b'* to strip E of 1A and notifies the operator on the other side of the section, who rings up 1P, and on receiving an answer removes the plug from *d'* of 1P's strip E and plugs 1P's strip E to the plate *b'* corresponding to the plate *b'* to which the wire of 1A is plugged, and completes the connection. The connection of a subscriber in one leaf with a subscriber in another leaf is effected by means of the connecting-wires and switch-boards, as I will now describe.

Fig. 1 shows a section through a part of the switch-board, and Fig. 6 a plan thereof.

The switch-board is composed of metallic strips *e e'*, crossing at right angles, the total number of strips being the same as the number of subscribers' or connecting wires, (the two latter being always the same,) and are placed half running in one direction and half in the other, separated from each other, but capable of being connected at their points of crossing by plugs. The board is divided into eight parts, each part containing one hundred and thirty-six strips—sixty-eight upper, *e*, and sixty-eight lower, *e'*. The strips are numbered from 1 to 68 in each part, so that there are an upper and lower strip in each part with the same number. For convenience in locating, I make each part a separate board and number the boards from 1 to 8, and place four on each side of the set of leaves, in reach of the operators. The strips are designated by number, position, and number of board—as No. 1 upper strip in No. 1 board, No. 2 lower strip in No. 4 board, &c. The sixteen connecting-wires in each leaf are carried to the eight boards in the following manner, (see Fig. 8, in which the wires from leaves 1, 2, and 68 are shown connected to their corresponding strips in each of the eight boards:) The two wires connected to the two upper metallic plates *b'* in each subscriber's part in No. 1 leaf are carried to the upper and lower No. 1 strip in No. 1 board. The two connected with the next lower metallic plates *b'* in each subscriber's part in No. 1 leaf are carried to the upper and lower No. 1 strips in No. 2 board, from third pair of metallic plates *b'* to No. 3 board, and so on for the eight pairs of metallic plates *b'* in No. 1 leaf. The wires that connect with the right-hand metallic plates *b'* are carried to the upper strips, *e*, and those that connect with the left-hand metallic plates *b'* to the lower strips, *e'*, in the switch-boards, reference being had always to the same end of the leaf. From No. 2 leaf they are carried in the same manner to the upper and lower No. 2 strips in each of the eight boards, and so on for the sixty-eight leaves, so that each one of the sixteen connecting-wires from each of the sixty-eight leaves composing the set is connected to its corresponding metallic plate *b'* in each of the subscribers' parts in its leaf, and to its corresponding strip in one of the eight boards. The connections of the strips in the boards with

connecting-wires from the different leaves or groups must be made by plugs, so as to leave the strips free to be connected with connecting-wires from other similar sets when required; and any two wires from different leaves—one from each leaf—may be brought into electrical communication by joining their corresponding strips at any one of their points of crossing in any one of the boards by a suitable plug.

Various devices may be used for indicating at a glance what plates *b'* are disconnected, and consequently what strips in the switch-boards should be plugged together. A simple device is shown in Fig. 9, in which the upper end of the eighth leaf and the lower end of the second leaf are shown with indicators for this purpose. All leaves have the same at top and bottom, eight in each place. The top ones refer to the upper strips, *e*, and the bottom ones to the lower strips, *e'*, in the switch-boards, and the numbers show the number of the board. Wooden rods *f* extend through the leaf and project slightly at each end, and carry suitable pins, *f'*, the pins on each rod being in the same plane. Near each rod are numbers from 1 to 8, the same number being near each end of the same rod, so that when the pin *f'* on one end of a rod is made to cover a number the pin on the other end covers a similar number. When the operator on either side of a set connects a plate, *b'*, he immediately covers a corresponding number with a pin, *f'*, thus covering a similar number and notifying the operator on the other side that such a plate with its connecting wire and strip in the switch-board is in use, for upper plates *b'* covering 1, for next lower 2, for next 3, and so on—on upper end for right side and on lower end for left side. The uncovered numbers show the number of a board in which a strip corresponding in number to number of leaf on which the uncovered number is is not in use.

In Fig. 9 the upper part of No. 8 leaf shows 2, 3, and 5 uncovered, thus indicating that No. 8 upper strips in Nos. 2, 3, and 5 boards are not in use. The lower part of No. 2 leaf shows 5, 6, and 8 uncovered, showing that No. 2 lower strips in Nos. 5, 6, and 8 boards are not in use; and thus it is known that No. 8 leaf and No. 2 leaf can be connected in No. 5 board. For instance, to connect 8A with 2G, find in any one of the eight boards where a No. 8 strip, upper or lower, not in use crosses a No. 2 strip, upper or lower, not in use, insert a plug at their point of crossing, and connect the corresponding metallic plate *b'* in 8A's part to his wire and in 2G's part to his wire. For instance, if the point of crossing should be in No. 5 board, 8A upper and 2G lower, the right-hand metallic plate *b'* in fifth pair from the top in 8A's part should be connected with his wire and the left-hand metallic plate *b'*, fifth pair from the top in 2G's part, connected with his wire. Then the connection between 8A and 2G will be established, through their

circuit-wires, plates E, plugs, to metallic plates *b'*, connecting-wires, and strips in the board, and the line ready for use. If the point of crossing should be in No. 8 board, 8A lower and 2G upper, the left hand lower or eighth row metallic plate *b'* in 8A's part would be connected to his wire, and the right-hand lower or eighth row metallic plate *b'* in 2G's part would be connected to his wire, and the connection completed as above, and so on for any other board.

Leaves and corresponding strips can be added to a set to any desired extent; but I prefer to make a separate set of leaves and switch boards for, say, every ten hundred and eighty-eight wires.

Separate sets of leaves may be connected by extending the connecting-wires from one to the others and making the requisite contacts by plugs; but I prefer to connect the opposite ends of the strips in the boards by wires from one set to another, and plugs so that any board may be used by any one of a number of sets of sixty-eight leaves. The top and bottom of each leaf are notched, as shown in Figs. 2 and 4. These notches fit into corresponding grooves in the supporting-frame, so that each leaf can be inserted or withdrawn, the electrical contact being made, when the leaf is in its place, by metallic plates secured to the ends of each wire in the leaf and to the ends of the corresponding wires above or below, as shown in Fig. 9, in which metallic plates *g* are shown attached to the wires in the leaf and embedded in the top and bottom pieces of the leaf-frame F. Similar plates, *g'*, are embedded in the top and bottom of the frame that supports the leaves, and are attached to the circuit and connecting wires, so that when a leaf is in place the plates *g* come in contact with the plates *g'* and make the electrical connection of their corresponding wires.

I do not claim as my invention the method herein described for connecting the subscribers' wires in one group by means of the metallic plates *b'*, arranged adjacent to and for plugging connection with the metal bar E, as this may be accomplished in other ways, the object of my invention being to provide a device for connecting the wires of one group with those of any other, so that any subscriber in any one of the groups may be put in communication with any disengaged subscriber at any time, so that it may be possible for one half of the subscribers to communicate with the other half at the same time.

I claim as my invention and desire to secure by Letters Patent—

1. In a telegraphic or telephonic exchange system in which the subscribers' wires are arranged in groups of equal number, the device above described for connecting the wires of any one group with the wires of any other group, consisting of a switch board divided into half as many divisions or separate boards as there are subscribers' wires in one group,

each of these divisions or boards containing
twice as many metallic strips as there are
groups, these strips being divided into two
equal parts, crossing each other, so that any
5 one of them may be electrically connected with
any other, and any two strips so connected ar-
ranged to be electrically connected by plugs
to the wires in their corresponding groups, for
the purposes set forth.

10 2. In a telephonic exchange system, the com-
bination of a number of groups of subscribers'
wires, annunciators, ground and battery con-
nections, and telephones with a switch board

containing as many metallic strips as there are
subscribers' wires in all the groups, each sub- 15
scriber's wire having plug-connection with two
strips crossing each other in different parts
of the board half as many times as there are
subscribers' wires in one group, these strips
arranged to be electrically connected at any of 20
their crossing - points, substantially as de-
scribed, and for the purposes set forth.

CHARLES FRANCIS DANFORTH.

Witnesses:

CYRUS T. CLARK,
HENRY P. HALL.