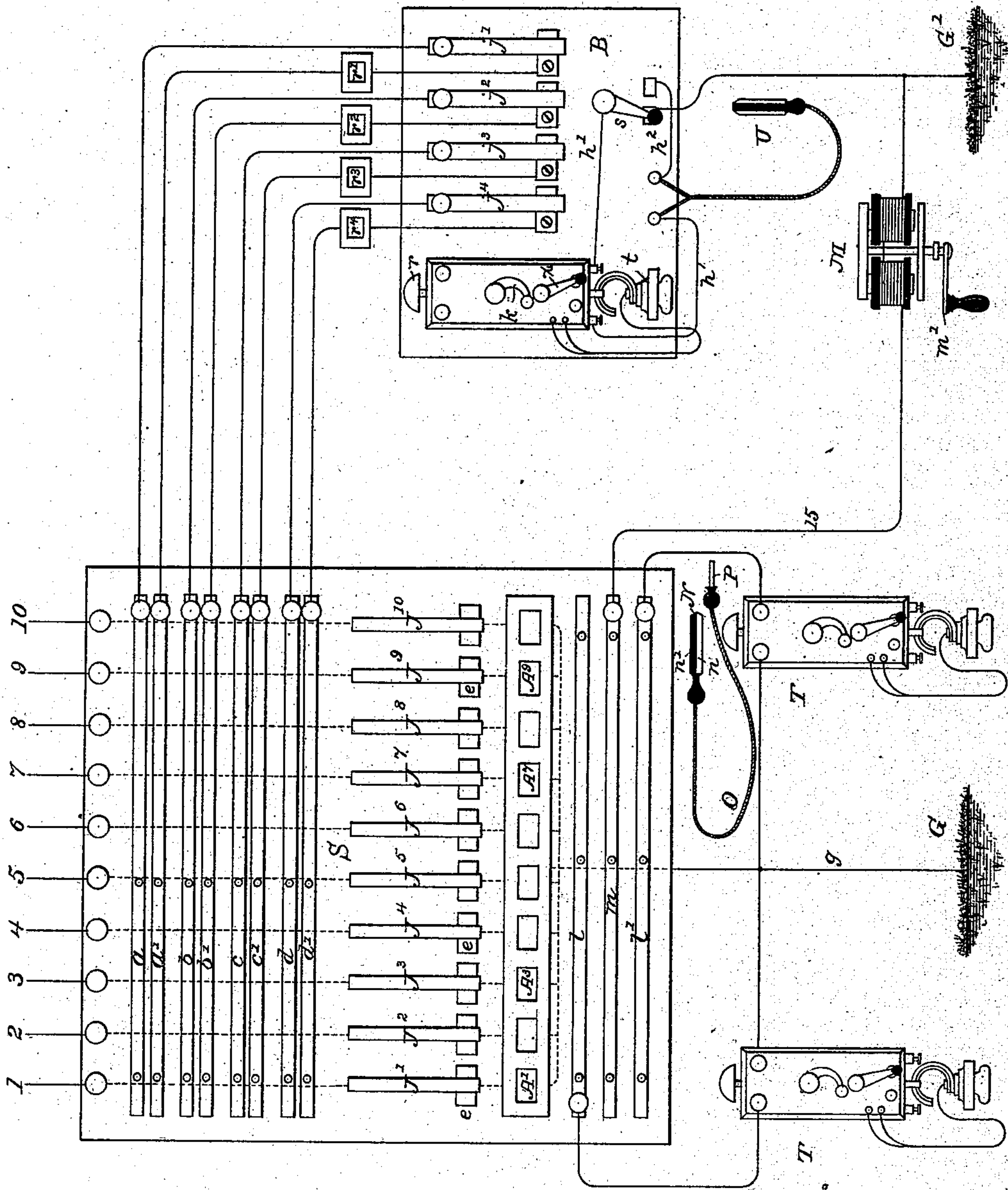


(No Model.)

H. H. ELDRED.
TELEPHONE EXCHANGE.

No. 382,518.

Patented May 8, 1888.



WITNESSES,

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TELEPHONE-EXCHANGE.

SPECIFICATION forming part of Letters Patent No. 382,518, dated May 8, 1888.

Application filed March 7, 1884. Serial No. 123,381. (No model.)

To all whom it may concern:

Be it known that I, HORACE HAMLINE ELDRED, a citizen of the United States, formerly a resident of New York city, but now residing in Boston, Massachusetts, have invented a new and useful Improvement in Telephone-Exchanges, of which the following is a specification.

My invention relates to an organization of electric circuits and apparatus, usually termed a "district telephone" or "exchange system," which consists of a number of separate lines or circuits, each of which is so arranged as to connect one or more subscribers' instruments, hereinafter termed "sub-stations," directly with a district exchange or connecting-office. This arrangement enables any sub-station in the system to be placed in direct telephonic connection with any other sub-station in the same system through the exchange office by making the necessary circuit connections at the latter point. The organization and operation of such a system are clearly shown and described in my application Serial No. 11,759, filed June 12, 1880.

The subject-matter herein claimed consists in the combination, as hereinafter set forth, of a series of subscribers' lines converging to a common switch-board, switch apparatus adapted for temporarily connecting any two of said lines, switching and calling mechanism mounted on an operator's table and in a loop connected with said switching mechanism, and indicators to notify the table-operator of connections made on the switch-board with the loop-lines on the table.

The accompanying drawing shows in theoretical diagram so much of my improved telephone-exchange as is necessary to illustrate the invention herein claimed.

I have shown, in illustration of my invention, a central exchange-station having nine independent lines radiating therefrom, which extend to or connect with a like number of different sub-stations. The apparatus at the several sub-stations is constructed and arranged in a well-known manner, and consists of apparatus for transmitting and receiving calls and signals and a transmitting and re-

ceiving telephone with the necessary switches, which telephones may be separate, or combined in one instrument, as found most convenient in any particular case. The apparatus at each sub-station is connected in the usual manner with the earth and also by means of a line-wire with the central station, as hereinbefore stated. In the drawing these different sub-station lines are seen entering the switch S at the central station, and are designated, respectively, by numbers, as 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10. The switch-board S is provided with a series of spring-jacks, J' J², &c., one to each sub-station line, the construction of which is well known, and therefore requires no special description. Each spring-jack normally presses firmly against a separate insulated metallic plate, as shown at *eee*, each of which plates is connected by a wire (shown by a dotted line) to a corresponding annunciator or visual electro-magnetic signal or annunciator, A' A², &c. After passing through these all the wires are joined together and connected with a common wire, *g*, leading to the earth at G.

The means which I prefer to employ for coupling or connecting the different lines together in pairs for direct communication are similar to those described in a pending application filed by me on or about the 9th day of June, 1880, Serial No. 11,389, patented August 19, 1884, as No. 303,714, and are as follows: A flexible insulated conductor, O, is provided with a wedge-shaped terminal, N, at one extremity, which terminal has one conducting-face, *n*, and one non-conducting face, *n'*. The construction of this terminal and the manner in which it is designed to be inserted into the spring-jack are well known. It may be remarked, however, by way of explanation that when the terminal N is inserted into a spring-jack, with its conducting-face *n* uppermost, the previously-existing connection between the line-wire and the annunciator and earth is interrupted, and the line-wire is at the same time placed in connection through the conducting-face *n* of the terminal N with the conductor O. If the terminal N be withdrawn from the spring-jack, the line is automatically

restored to its normal connection with the annunciator and the earth. The opposite extremity of the flexible conducting-cord O terminates in a tapering metallic peg, P, which is adapted to be inserted with a twisting motion into one of a number of suitable holes provided for that purpose in the horizontal metallic bars $a a' b b' c c' d d'$ upon the upper part of the switch-board S, as shown in the figures. These bars are insulated from each other and are placed, preferably, above the spring-jacks, as shown in the drawing. They are arranged in pairs, each pair, as $a a'$, being connected by wires with one of another series of spring-jacks, j', j'', j''' , and j^4 , mounted upon an operator's table, B, separate from the switch-board S, which may be placed in any convenient part of the same room. Thus the bar a' is connected with one side of the spring-jack j' by a wire, which also passes through a visual signal or annunciator, r' . This signal is actuated by an electro-magnet in a well-known manner whenever the magnet is traversed by an electric current. The other side of the spring-jack is connected directly with the bar a by a return-wire, as shown. Thus each one of the spring-jacks upon the table B is included, together with its annunciator, in a loop-conductor, the terminals of which are formed by one of the pairs of bars upon the switch-board.

Upon or beside the operator's table B is placed an apparatus for the use of the operator in receiving and transmitting calls, signals, or alarms, which may consist of a magneto-generator operated by a crank, k , and a bell, r , actuated by an electro-magnet. A telephone transmitter and receiver, t , fitted with the usual switch, automatic or otherwise, for throwing either the signaling or the speaking apparatus into the circuit at pleasure, is also provided. This apparatus is placed in a looped wire or circuit, one leg, h , of which terminates in one side of a double-faced terminal wedge, U, while the other leg, h' , goes to the lever of a switch, s , on the operator's table B. When the switch s is moved to the right, it completes the loop through the wire h'' to the remaining side of the wedge U; but when turned to the left, as shown in the figure, which is its normal position, it connects the leg h' of the loop directly to the earth at G' .

Upon the same switch-board S, with the spring-jacks below the annunciators, are placed a number of parallel metallic conducting bars or strips, $l l' m$. The bar m is connected by means of a wire, 15, with a signal-transmitting apparatus, M, which is preferably kept constantly in operation. I have shown an ordinary magneto-generator which may be rotated by a crank, m' , turned by hand, or, preferably, by power. As the other terminal of its coils is connected to the earth at G' , its action is to transmit a series of rapid, alternate, positive, and negative impulses through any conductor which is made to form a connection between the insulated bar m and the earth. The func-

tion of this device will be hereinafter explained.

The strips $l l'$ are each connected with a transmitting and receiving telephone, T, provided with the usual signaling apparatus, from both of which telephones a wire leads to the earth at G. Thus it will be understood that each of these instruments is placed in a normally-disconnected earth-circuit, terminating in the insulated bars l and l' . The number of these instruments required in connection with any particular switch-board will depend upon the number of separate lines entering the exchange, as will be hereinafter shown.

The manner in which my improved system is operated will be understood from the following explanation: At the central station one attendant is stationed at the switch S, who is termed the "switchman," and one at the disconnecting-table, who is termed an "operator." Where the number of lines is very great, additional switchmen and operators may be employed, as required. If now the sub-station upon line 1 desires to be connected with the sub-station upon line 9, for example, the subscriber at that point transmits an electrical impulse by means of his signaling apparatus to the central station, which actuates the visual signal A' and then passes directly to the earth at G. The switchman at the central station at once takes a flexible conductor, O, and inserts its terminal N into the spring-jack J', which disconnects the line-wire 1 from the annunciator and the earth, as hereinbefore explained, and places it in connection with the metallic peg P at the other end of the flexible conductor. He next touches the peg P to the bar m , which completes the circuit through the wire 15 and signal-transmitter M to the earth at G' , which operation causes the pulsations which are constantly being sent out from the transmitter to pass over the line to sub-station and actuate the alarm or signal at that point in response to the call which has previously been sent in. The switchman takes the same peg P and inserts it with a twisting motion into a hole in one of the bars l or l' , which operation puts the operator at the telephone T into direct communication with the sub-station. The operator converses with the subscriber and ascertains that he wishes to be connected with number 9. He then calls out or hands a ticket to the switchman with the two numbers (as 1 and 9) written on it, who upon receiving it immediately completes the connection by changing the peg P from the bar l or l' to the bar a . The switchman then, taking another flexible conductor precisely similar to O with its wedge terminal and peg, inserts the pin in the bar a' and touches the wedge-block to the bar m . This places the spring-jack j' at table B in circuit with the call-generator M, and causes the annunciator r' to drop, and then the switchman immediately plugs the switch to the spring-jack J⁹, which connects the lines of the two subscribers. The operator at the table,

having his attention thus called, inserts his telephone *t* and signaling apparatus *k* into the united circuit by placing wedge *U* in the spring-jack *j'*, and calls up the second sub-station on line 9 and puts the two in correspondence. He then restores the annunciator to its normal position, in which it is ready to act as a disconnecting-signal. When the two subscribers have finished their conversation, they announce the fact by sending an impulse from one sub-station or the other, which actuates the visual signal *r'*, whereupon the switchman is notified by the table-operator to disconnect the united lines and restore them to their normal relations.

The number of pairs of connecting-bars, as *a a' b b'*, &c., that will be required, will depend upon the number of lines entering the exchange and the proportion of them which will ordinarily require to be coupled to either at any one time, and the same is true of the number of telephones *T T* and their attachments. The object of the arrangements which have been described is, generally speaking, to subdivide the labor of answering calls, connecting and disconnecting lines, &c., among a number of different attendants, so that the service may be rendered as expeditious as possible where a very large number of lines are assembled together. Thus under the organization described the table-operator calls the subscriber wanted, puts the calling-subscriber in connection with him, and removes his plug *U*, so as to be ready for the next call while the two last connected are still talking. When notified by the falling of the annunciator-drop that they are through talking, he notifies the switchman to disconnect, and replaces his annunciator-drop ready for the next signal. Under the organization shown the annunciator thus serves both to notify the table-operator of connections to be made on his table, and also acts as a disconnecting-signal.

I have described as part of the above operation the putting of an operator at the telephone *T* into communication with a calling-subscriber, who directs the switchman to make the necessary connections with the table-operator; but in practice I frequently dispensed with this intermediate operator, the switchman, when the call came in, making the connection directly with the table-operator who conversed with the subscriber, ascertained and called up the party wanted, and made the necessary connections, as above described, thus dispensing with the services of an intermediate operator.

Under this method of operation the circuit-connections were as follows: Beginning at the ground *G'*, through battery or generator *M*, wire 15, bar *m*, face *n*, plug *N*, flexible cord *O*, plug *P*, loop-strap *d'*, annunciator *r'*, base of spring-jack *j'*, double-faced plug *U*, through its cord and wire into magneto-machine *k*, thence by wire *h''* and three-point switch *s* back to ground *G'*. When a signal came in over

one of the lines, say No. 1, the switchman took the round plug *P* and inserted it in the strap *d'* of the switch-board, and then touched the conducting-face *n* of the flat plug at the other end of the conducting-cord *O* upon the strap *m*, which caused the annunciator *r'* on the operator's table to drop, thus calling the operator's attention, who immediately restored the annunciator to its normal condition. While the switchman was thus using these plugs the situation at the operator's table was as follows: The double plug *U* was inserted in the spring-jack *j'*, and the three-point switch *s* was upon the ground connection. The switchman then withdrew his plug from contact with the strap *m* and inserted it under the spring-jack *J'*, with the insulated face down. The table-operator then moved the switch *x* of the magneto-machine to the right, put the hand-telephone to the ear, and spoke through the other telephone to the subscriber. Ascertaining from the subscriber on line 1 the party with whom he wished to make connection, the table-operator gave the two numbers to the switchman on a ticket. He then, taking another pair of plugs united by a flexible cord, inserted the flat plug under the spring-jack *J'* of the second line and inserted the round plug in the upper strap, *d*, of the pair of loop-straps already used. The table-operator then turned the three-point switch *s* to the right, thus cutting off the ground and placing the telephones and magneto by a loop in the circuit between the two subscribers. He then rang his magneto-bell, notifying both parties that the connection had been made, and talked with either of them if necessary. Finding all right he pulled the double plug out from the spring-jack and left the parties to themselves. When the subscribers were through talking, they rang down the annunciator *r'* between them. The operator then, by ticket, directed the switchman to draw the plugs from the spring-jacks and loop-straps at the switch-board. As soon as the double plug was withdrawn from the spring-jack it was inserted in the one next on the right and the switch-connections restored to their normal condition for the proper reception of another signal. The switchman also habitually used the pair of straps next above those first used, which corresponded with the ones in which the operator had inserted the plug, so that everything was in readiness for the next signal.

I disclaim in this application the subject-matter claimed in my respective applications No. 11,389, filed June 9, 1880, patented August 14, 1884, as No. 303,714, and No. 11,759, filed June 12, 1880, limiting the claim in this application to the specific subject-matter set forth in the claim.

Having thus fully described my invention, what I claim as new, and desire to secure by Letters Patent, is—

The combination, substantially as hereinbefore set forth, of a series of subscribers' lines

5 converging to a common switch-board, switch apparatus adapted for temporarily connecting any two of said lines, switching and calling mechanism mounted on an operator's table and in a loop connected with said switching mechanism, and indicators to notify the table-operator of connections made on the switch-board with the loop-lines on the table.

In testimony whereof I have hereunto subscribed my name this 5th day of March, A. D. 1884.

HORACE HAMLINE ELDRED.

Witnesses:

PHILIP S. STONE,
V. M. BERTHOLD.