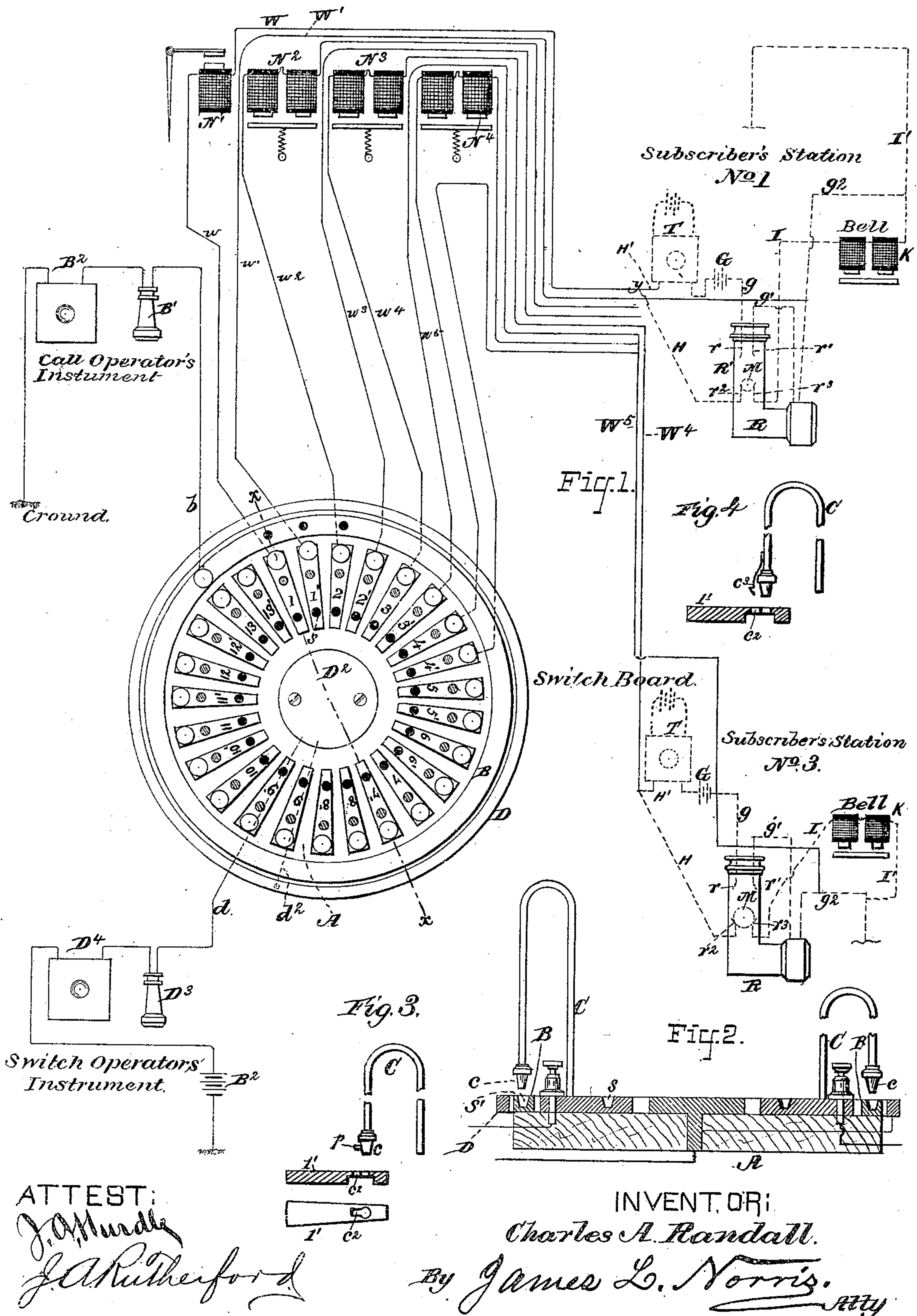


(No Model.)

C. A. RANDALL.
TELEPHONE EXCHANGE SYSTEM.
No. 270,556.
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UNITED STATES PATENT OFFICE.

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TELEPHONE-EXCHANGE SYSTEM.

SPECIFICATION forming part of Letters Patent No. 270,556, dated January 9, 1883.

Application filed October 17, 1882. (No model.)

To all whom it may concern:

Be it known that I, CHARLES A. RANDALL, a citizen of the United States, residing at New York, in the county and State of New York, have invented new and useful Improvements in Telephone-Exchange Systems, of which the following is a specification.

This invention relates to a telephone-exchange system in which each subscriber's station is connected with a central office by two line-wires, its object being to provide a complete metallic circuit for subscribers when connected for conversation by telephone, and to utilize one line-wire of each subscriber for calling and conversation with the central office.

The invention consists in certain novel combinations of line-wires and apparatus at a central office and subscribers' stations, as will be fully hereinafter described.

In the accompanying drawings, Figure 1 is a diagram illustrating the apparatus at the central office and two subscribers' stations connected therewith. Fig. 2 is a diametric section of the switch-board on line *xx* of Fig. 1, and Figs. 3 and 4 are modifications of the connector and socketed connections therefor.

The devices at the central office and subscriber's station resemble in construction those described and shown in an application for Letters Patent filed heretofore by me, but differ therefrom in certain features, adapting them to the system described in the present application.

The letter A indicates the non-conducting base of the switch-board, which may be made of wood or other suitable material. It has arranged upon its front a central metallic plate, *D*², which, by a wire, *d*, is connected with a receiving-telephone, *D*³, which is connected with a transmitter, *D*⁴, which is connected in turn with the ground through a battery, *B*².

In a circle around the central plate, *D*, on the switch-board are arranged a series of individually-insulated metallic plates, indicated by the numbers 1 1', 2 2', 3 3', 4 4', &c. These plates are connected with the central-office terminals of the subscribers' lines, respectively, those designated by simple numbers, as 1, being connected with the lines used for calling, and normally kept in connection with the calling-operator's instruments at the central office,

while those designated by numbers marked thus 1', as 1', are connected with the line-wires, which are normally left open and only used when placed in electrical connection with the other wires for the purpose of completing metallic circuits. Each of these switch-board terminal plates is provided with a plug-socket, *S*, and each of the calling-wire terminal plates 1 2 3 4, &c., is provided also with an attached connector, *C*, each connector being provided with a plug, *c*, which fits all the sockets of the board. The connector *C* is made of a metallic spring strip or wire doubled in the form of a letter *U*, and has one leg in swiveling connection with the block, while the other leg is slightly shorter and provided with a plug of such size that it will be held by friction in any of the switch-board plug-sockets. The connector may be constructed to be held in place by a spring-catch or a projecting pin, so that a special movement will be required—such as depressing the spring-catch or turning the connecting-plug to the right or left—to remove the connector, thus preventing the removal of the connector and breaking the circuit by accident. When constructed in the manner mentioned the apertures in the terminal pieces and in the ring *B* will have to conform thereto, as in Figs. 3 and 4.

In Fig. 3 the connector *C*¹ has a pin, *c*¹, projecting from the plug, and the terminal plate 1' has a slot, *c*², extending from its socket, and its wall undercut to permit the plug to be turned laterally to engage the pin with the catch thus formed.

In Fig. 4 the connector *C*² is provided with a spring-catch, *c*³, which will take under a shoulder formed in the terminal plate. The ring *B* will have its sockets also modified as those of the terminal plates. The connector may be easily flexed, so that its plug may be inserted to form the connections hereinafter described, and it will resume its normal shape and position when the plug is released. The precise shape of the connector is not material, the main object being to have it of such shape and resilience that it will stand out from the board and resume its position when left free after use, so that it will not become entangled with other connectors.

Outside of the circle of terminal plates is

arranged a metal ring, B, which is provided with a plug-socket, S', opposite each of the calling-wire terminal plates, and said ring is connected by a wire, b, with a call-operator's receiving-telephone, B', which is connected with a transmitter, B², in the usual manner, and the transmitter is connected with the ground.

Surrounding the ring B, and insulated therefrom, is another metallic ring, D, which is connected with the central plate, D², by a wire, d². (Indicated by a dotted line.)

The several calling-wire terminal blocks, 1 2 3 4, &c., are respectively connected with the coils of magnets N' N² N³ N⁴ and so on, these coils being also included in the subscribers' lines when the complete metallic circuits are established for the purpose of indicating to the switch-board operator when the lines to which they are connected are in use, and thereby obviate the necessity of his connecting his telephone with any line in order to ascertain if it be in use or if conversation has been discontinued over two lines which have been connected. If any line is in use the magnet connected in that line will attract its armature, owing to its being, when connected, in circuit with the subscriber's battery, as will presently appear.

The letters w w' w² w³ w⁴ w⁵, &c., indicate the terminals of the lines connecting with the terminal plates of the switch-board. The wire w connects the terminal plate 1 with one terminal of the coils of indicating-magnet N', the other terminal of said coils being connected with the subscriber's calling-wire W, leading to "subscriber's station No. 1," which is so marked on the drawings. At the subscriber's station the line W divides at the point marked y, one branch, H, leading to the receiver R, and connected therewith in a manner presently to be described, while the other branch, H', leads through the transmitter T and connects with one pole of the station-battery G, from the other pole of which a wire, g, leads to the receiver.

The receiver R has attached to its case a laterally-projecting tube, R', of insulating material, within which are two pairs of metallic and preferably elastic fingers, r r' and r² r³, the pair of fingers r r' projecting toward the middle of the tube from the opposite end. In the space between the ends of the two pairs of fingers is a loose metallic ball, M, and when the tube R' extends upward with respect to the case of the receiver, as shown in the figure, the metallic ball M will rest upon and electrically connect the fingers r² r³; but if the tube R' be reversed the ball will rest upon and connect the fingers r r'.

The branch H of the calling-line wire connects with the finger r², and from the finger r³ a wire, I, connects with one terminal of the coils of the bell-magnet K, from the other terminal of which a wire, I', leads to ground.

When the receiver R and tube R' are in the

position shown in the drawings, which is their normal position when hung up and not in use, it will be observed that the line-wire W is connected to ground through branch H, finger r², ball M, finger r³, wire I, bell-magnet coils, and wire I', so that the subscriber may receive a call through his bell when a current is sent over his line-wire.

The wire g, which connects with the branch H' through battery G and transmitter T, is connected with the finger r, while from a finger, r', a wire, g', leads to one terminal of the coil of the receiver-magnet, (not shown,) and from the other terminal of said coil a wire, g², connects with wire I', and through it to ground. It will be seen that if the position of the receiver be reversed from that shown in the drawings, as before described, the ball M will connect the fingers r and r', and the line W will be connected to ground through branch H', the transmitter T, battery G, wire g, finger r, ball M, finger r', wire g', receiver-coil, wire g², and a part of wire I', the station apparatus being thus in condition for holding conversation with the central office or calling. At the same time the bell-magnet will be cut out of circuit, as the fingers r² and r³ are not connected. At this time, also, the current from the battery G traverses the calling-wire and charges the magnet N at the central office, which, by its action upon its armature, gives notice to the switch-board operator that the line is in use.

At the central office the plugs c of the connectors C are kept normally in the sockets S', behind their respective plates 1 2 3 4, &c. The line-wire W', which is normally open, leads from the switch-board terminal plate 1' to the subscriber's station, and there connects with the wire g², between the receiver-coil and the ground. When a subscriber—say, for instance, subscriber No. 1—wishes to communicate with another subscriber—say subscriber No. 3—the first puts his apparatus in condition for use, as just described, the circuit being completed from his battery over his line-wire W, coils of magnet N', terminal plate 1 at switch-board, its connector C, metallic ring B, wire b, and through the call-operator's instrument to ground. He then informs the call-operator with whom he wishes to communicate, and the call-operator thereupon directs the switch-board operator to connect subscribers' lines 1 and 3. The switch-board operator then first calls up subscriber No. 3. This he does by removing the plug of the connector C of terminal plate 3 from its socket in ring B, and placing said plug in contact with the central plate, D², or ring D, thus connecting the subscriber's line No. 3 with the ground through the connector C, plate D² or ring D, wire d, the switch-operator's instruments, and battery B². The current of battery B² flows over the line No. 3 and rings the bell at the subscriber's station. When the subscriber No. 3 replies, and signifies through the switch-board operator's instrument that he is ready, the switch-

board operator proceeds to connect the two subscribers in a complete metallic circuit. This he does by first disconnecting the connection of plate 1 from the ring B and connecting it with plate 3', and then connecting the connector of plate 3 with plate 1'. By now following the conductors it will be found that the circuit leads from, say, battery G at station No. 1, through the transmitter T over branch H', calling-line wire W, plate 1 at switch-board, and its connector to plate 3', and thence over line-wire W⁵, to station No. 3, and said line being there connected in the same manner that line W' is connected at station No. 1, the circuit is continued over wires $g^2 g' r' M r g$, through the station battery and transmitter, and over branch H' of calling-line W⁴, and thence over the said line W⁴ to the central office, and then over plate 3 and its connector to plate 1', thence back to station No. 1, and over the wires $g^2 g' r' M r g$ at that station to the opposite pole of the battery G from which it started.

It will be understood that in the above description of the complete metallic circuit the receivers at the stations are supposed to be in a position the reverse of that shown in the drawings, and the fingers r' and r' therefore connected by the ball M. There are various other arrangements of the connections by which a normally-grounded calling-wire and a normally-open circuit-wire may be combined so as to form a metallic circuit for a talking-circuit without departing from the spirit of my invention.

Instead of making the connections as heretofore described, the return-wire may be connected with the subscriber's transmitter in such manner that by means of an automatically-operating switch the impulses of the transmitter can be sent alternately over the calling and talking wires, combined substantially as in the apparatus described in the Patent No. 252,256, granted to J. H. Rogers, January 10, 1882.

The central-office call-operator's instruments may be constantly in the circuit between the switch-board and ground; or by a suitable

switching device it may be "cut out" when not in use, and a bell "cut in" to give him notice of a call.

Having thus described my invention, what I claim is—

1. In a telephone-exchange system, the combination, with the two line-wires connecting each subscriber's station with the central office, of a central-office switch-board having a separate metallic terminal plate for each line-wire, each of said terminal plates having a plug-socket and an attached flexible connection carrying a connecting-plug, substantially as described.

2. In a telephone-exchange system, the combination, with the two line-wires connecting each subscriber's station with the central office, of a transmitter and battery connected in one of said wires, a receiving instrument at each station, having separate terminals connected with said wires, respectively, one of said terminals being connected with one line through the secondary coil of the transmitter, and said battery and the other terminal being connected to the other line-wire and also to ground through the magnet-coil of the receiver, and an automatic shunting device arranged to connect said terminals when the receiver is held in position for use and to break connection between the same when hung or held in a different position, substantially as described.

3. The switch-board having the terminal plates arranged in a circle, in combination with a series of subscriber's circuits, each composed of two line-wires, the two terminal plates of each circuit being side by side, and each provided with a plug-socket and a flexible connector carrying a plug, substantially as described.

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

C. A. RANDALL.

Witnesses:

F. A. KINSMAN,
WM. THARP.