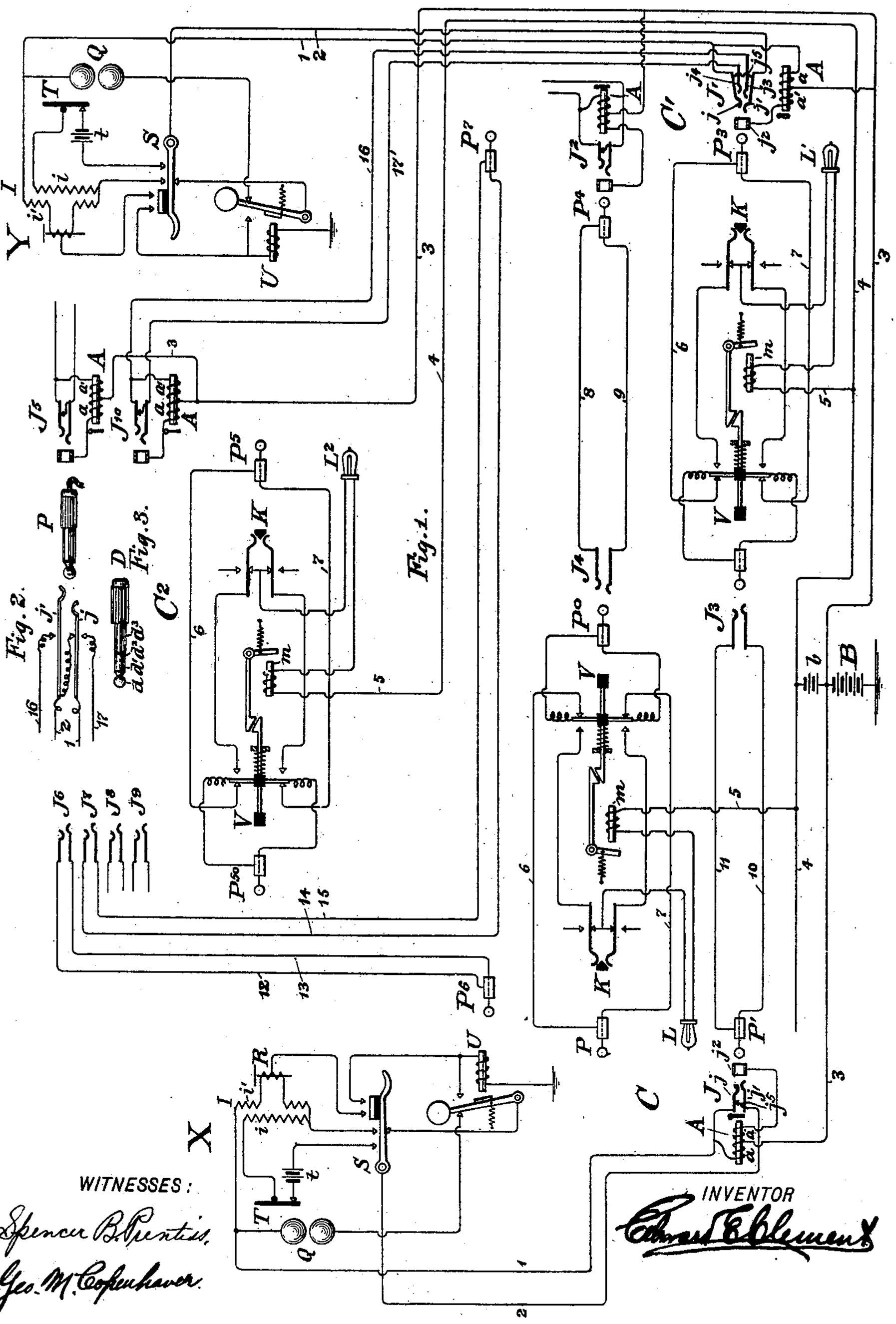
No. 646,683. Patented Apr. 3, 1900.

E. E. CLEMENT.

TELEPHONE EXCHANGE SYSTEM.

(Application filed Apr. 21, 1899.)

(No Model.)



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TELEPHONE-EXCHANGE SYSTEM.

SPECIFICATION forming part of Letters Patent No. 646,683, dated April 3, 1900.

Application filed April 21, 1899. Serial No. 713,884. (No model.)

To all whom it may concern:

Be it known that I, EDWARD E. CLEMENT, a citizen of the United States, residing in Washington, in the District of Columbia, have invented a certain new and useful Improvement in Telephone-Exchange Systems, of which the following is a specification, reference being had to the accompanying drawings, forming a part hereof, in which the same letters and figures of reference point out the same parts throughout.

My invention relates to telephone-exchange systems in which part or all of the interconnections between subscribers are effected through the agency of trunk or transfer lines. In such systems, which are now coming more and more into use, while the general arrangement is very flexible and admirably adapted for the rearrangement of lines and adjustment to the demands of business, still there frequently comes a time when the operator or operators at a given board will be swamped with business coming on lines which it is desirable to keep upon the same section. Of course if the lines could well be separated from each other the simplest cure for such a condition would be to put some of the busy lines upon other board-sections where the business was not so heavy and so balance things. This cannot always be done, however, and it is the purpose of my invention to provide a means whereby relief may be afforded to overtaxed operators and the work transferred to other operators without the necessity of changing the line connections.

Stated in broad terms, my invention consists in providing lines which are known to be in constant use with multiple extensions, each passing to some other board-section than that on which the main-line terminal is located. These multiple extensions are normally disconnected from the line, so that the operator upon the section carrying the main-line terminal has control of the line under all ordinary conditions and indeed always retains control so far as outgoing calls are concerned; but in times of rush when a large number of signals come in succession I provide the operator with means to connect the multiple extension of any given line, and the extremity of the multiple extension being a duplicate in every respect of the extremity of the main line with its terminal devices the operator before whom the extension terminates can proceed as with an original call. I preferably provide special boards for the reception of the extension-terminals, so that during the hours when business is contracted the operators thereat may be removed without detriment to the general service. Such a special board I term a "relief-board," and obviously when no line is plugged to it it can well remain idle, being entirely disconnected, except by the trunk-lines which extend from it to other board-sections and of course are open unless in use.

My invention is illustrated in the drawings forming a part hereof, wherein—

Figure 1 is a diagrammatic representation of a system operating on principles fully set forth in my prior application, Serial No. 713,881, filed April 21, 1899, and shows the present invention applied thereto. It is not to be supposed that this is the only system in which the present invention can be used, however, as, on the contrary, it is applicable to any system, but more particularly those in which centralized batteries supply the current for signaling in as well as out.

In the drawings, X and Y are two subscribers' stations, each connected to the central station by line-wires 1 and 2. At each station X and Y, I provide the usual transmitter T, receiver R, induction-coil I, ringer Q, and switch-hook S. The switch-hook S and the relay U combine when the line is in disuse to connect line-wires with the ringer-circuit. When the switch-hook rises upon the removal of the telephone-receiver, the line-circuit is disconnected from the ringer-circuit and connected to the talking set and also to ground through the magnet of the relay U. At the same time the local circuit through the transmitter T, battery t, and primary winding of the induction-coil is closed. At the central station each line is connected to a spring-jack J J′, the latter containing springs $j\,j'$ for the line and a third contact conveniently shown as a thimble j^2. Connected from the line-wire 1 across to the thimble j^2 are the continuous windings $a\ a'$ of an annunciator A, from the middle point of which a

wire 3 is led to the main battery B and ground. The jack-springs are normally connected together through an anvil j^5.

The principle of operation of the jacks, annunciators, and calling devices, &c., is as follows: Normally the winding a of the line-annunciator A is in series through the spring-jack with the line-wires in parallel and there is no ground on either line-wire at the subscriber's station. When a subscriber calls, by taking his receiver from the hook he immediately puts on a ground connection from the middle point of his receiver-windings through the magnet of the relay U, and thereafter current continues to flow over the path thus provided from the battery B until final disconnection. When the answering-plug P is inserted in the jack, the thimble j^2 is connected through the sleeve of the plug to the spring j' before the springs j and j' are separated. Thus the coils $a\,a'$ of line-relay A are brought into a bridge across the line-wires and current from battery B passes through both windings a and a', thus neutralizing the magnetism of the core and permitting the signal to be retired. This condition of the line-relay continues until the subscribers clear out. It will be observed that when the relay U first draws up its armature it not only holds it up as long as the hook is up, but it also closes a branch from its own circuit to the down contact of the hook S. When the subscriber hangs his telephone-receiver on the hook after finishing his conversation, the line-wire 1 is disconnected from the ground-circuit of the relay U, while the line-wire 2 is immediately connected to the branch from the down contact of the hook to the armature of relay U, and current then flows from battery B over the single line-wire 2 to and through the relay U by way of its armature, thus holding the armature still attracted. This flow of current through one winding of the line-relay a' causes the display of the line-signal as a clearing-out signal. When the operator withdraws the plug from the jack, the connection between the thimble j^2 and the spring j' is broken for a moment before the springs j and j' are again allowed to come together. This momentary break permits the armature of relay U to start to retract, and the subsequent closure between the springs of the jack has no effect in stopping it, the ground being removed and the armature falling back to again complete the circuit through the bell Q. Thus the line-relay A again becomes deënergized and remains so until the next call.

I have shown in Fig. 1 portions of the apparatus located at each of three different switchboard-sections, (indicated by the letters C C′ C².) The sections C and C′ constitute answering and connecting sections. The section or board C² is an answering-section only and is what I have referred to above as the "relief-board." Each section C, C′, and C² is provided with connecting plugs and cords, together with apparatus therefor of the type described in my application referred to and consisting of a plunger-switch V, a detent device therefor with its magnet m, and a ringing-key K. A supervisory signal L is provided also for each cord-circuit. The cord-conductors in each case are Nos. 6 and 7; but the connecting-plugs, while they all have the reference-letter P, have different exponents appended thereto for convenient reference. Suitable trunk-lines 8 9 and 10 11 extend between sections C and C′, the trunk-line 8 9 having a jack J^4 at the section C and a plug P^4 at the section C′, the trunk-line 10 11, on the other hand, having a jack J^3 at the section C′ and a plug P′ at the section C. By means of these trunk-lines and their cord-circuits the operators at these two sections may trunk or transfer calls between their respective board-sections in both directions. At the section C², however, which I shall call hereinafter the "relief-board," there are outgoing trunks only—that is to say, the relief-board is provided with trunk-jacks J^6, J^7, J^8, and J^9, connected, respectively, by conductors 12 13 14 15 and others (not shown) to plugs P^6, P^7, &c., at all the regular board-sections; but there are no incoming trunk-plugs at the relief-board. Instead of incoming trunk-plugs the relief-board is fitted with regular line-terminal devices consisting of drops and jacks in every way similar to the line drops and jacks at all the other boards. Only two of these are shown, the annunciators being lettered A and having the divided coils $a\,a'$, with their middle points connected by wire 3 to the main battery B, and the jacks being lettered J^5 and J^{10}. The jack J^5 has a broken circuit only in the drawings, the jack J^{10} being shown with its connection complete through wire 16 17 to jack J′ of subscriber Y. Subscriber Y's line is supposed to be a very busy one, and is therefore among those which are connected to the relief-board. The wires 16 17 terminate in springs j^3 and j^4 in the jack J′ and constitute a normally-disconnected extension of Y's line-wires 1 and 2. The insertion of the ordinary plug P^3 in the jack J′ to answer a call or to make a connection does not affect the springs j^3 and j^4, because the ordinary plugs are too short or are not of the right shape to reach the springs. If, however, a proper plug, such as the plug D, (shown in Fig. 3,) be inserted in the jack J′, the springs j and j^3 and j' and j^4 become connected, so that the line-wire 1 is prolonged through the wire 16 to the short spring of the jack J^{10} and the line-wire 2 is prolonged to the long spring of said jack through wire 17. This will be better understood by referring to Fig. 3. It will be observed that the plug D is longer than an ordinary plug, such as is shown at P in Fig. 2, and that the plug D has four contacts d, d', d^2, and d^3. Of these d and d^3 are connected and d' d^2 are connected, the last two being, in fact, a metal ring slipped upon the tube which constitutes the part d^3, but insulated therefrom. This plug D has no cord-

conductors ordinarily connected to it, although if it be considered desirable for the operator to listen in on lines which have been prolonged to the relief-board such a cord may be connected in the ordinary way and provided with a listening-key.

In Fig. 2 I have shown a different method of connecting wires 16 17 in the jack J′. Here the wires 16 17 are connected to terminal-contacts on opposite sides of the line-springs *j j*, said contacts being at such a distance from the springs that the insertion of an ordinary plug would not force the springs far enough apart to touch the contacts. A plug having a larger shank and head than usual, however, would spread the said springs a sufficient distance to force them into contact with the terminals and wires 16 and 17.

Any details not specifically referred to in this description will become perfectly clear from the statement of operation of the system, which is as follows: Suppose that subscriber X desires to communicate with subscriber Y. He removes his receiver R from the hook S, which thereupon rises, closing a circuit from battery B, through wire 3 and coil *a*, to wire 1, and through the jack, by connection j^5, to wire 2, by both wires to the subscriber's station, through the secondary *i′* and the receiver R to the relay U and ground, and thence back to the battery. The relay U and the magnet A simultaneously attract their armatures, the subscriber being thus apprised of the continuity of the circuit and the operator of the existence of a call. The operator inserts the plug P in the jack J, and ascertaining the number desired to be that of Y, whose line is on another board, she inserts the plug P^0 in the jack J^4, and at the same time passes the order to the operator at section C′ over ordinary instruction-circuits. (Not shown.) She also depresses the plunger V. This severs the cord-circuit 6 7 and puts the plug P^0 in direct connection with a supervisory signal L, the magnet *m*, and, by way of wire 5, with the battery *b*, through its bus-bar 4. It will be observed that the bus-bar 3, to which the other pole of this battery is connected, is also connected to the battery B and to all the line-annunciators. The operator at section C′ immediately lifts the plug P^4 and inserts it in the jack J′ of the wanted line. As soon as this is done the lamp L or equivalent signal receives current from battery *b*, through the wire 5, from the bus-bar 4, the cord and truck circuits, the jack-springs and windings *a a′*, and back through the bus-bar 3. This apprises the answering-operator of the completion of the connection, whereupon she uses the ringing-key K. When subscriber Y answers, he puts a ground, including the relay U, on his line-wires, and current from main battery B is immediately added to that from battery *b*, through the bus-bar 4, the wire 5, magnet *m*, lamp L, cord and trunk circuits, and line-wires. This current is heavy enough to operate the magnet *m* and cause it to release the plunger V, when the circuits are immediately recompleted for conversation and the lamp and magnet disconnected. When the subscribers have finished their conversation and both have hung up their telephones, current from battery B passes from the bus-bar 3 to the winding *a′*, to the ring j^2, the spring *j′* of each jack and line-wire 2, through the switch S, armature of relay U, and the relay to ground. The line-annunciators both again become active, and both operators are notified to clear out. This is the ordinary operation of the system during times when there is no rush of business. Suppose now that it is about half-past eleven in the morning when the operators are at their busiest and Y desires to converse with X. He removes his telephone-receiver from the hook, causing his annunciator A to display its signal. The operator at section C′ is engaged for the instant with some one else, so without giving any thought to the connection she picks up a dummy plug, such as D in Fig. 3, and inserts it in the jack J′. The portion d^3 of the plug D connects the ring j^2 to the spring *j′* and restores the annunciator. This is the end of that operator's connection with that line until they clear out. Observe, however, that the line has been prolonged through springs j^3 and j^4 and conductors 16 17 to the relief-board, and that the annunciator A of the line 16 17 at said board is ready to receive a signal. Current immediately passes from battery B through bus-bar 3 to the winding *a′* of that annunciator and thence out to Y's station. The operator C^2, perceiving the signal, inserts the plug P^5 in the jack J^{10}, and thenceforth the same steps are taken that I have described with regard to the answering of X's call at the section C. In order to reach X, the operator C^2 uses the plug P^{50} in connection with the jack J^6, and the operator C inserts the plug P^6 in the jack J, whereupon the operator C^2 sees the lamp L^2 glow and rings as before. When subscriber X answers, the lamp goes out and the circuits are complete from Y's station to section C′, thence to section C^2, thence to section C, and thence to station X. When both of the subscribers hang up their receivers, the annunciators A at all three jacks J, J′, and J^{10} become active to display their signals, whereupon all three operators withdraw their plugs and everything resumes its normal condition.

In exchanges where the business becomes heavy at times, but does not warrant the provision of conductors 16 17 and a jack and drop on the relief-board for every busy line, these conductors 16 17 may terminate in an ordinary plug at the section C′, and the relief annunciator and jack thereby become available for any line into whose jack J^2, for instance, the extension-plug should be inserted. In such case, however, the operator at section C^2 would find it necessary to ask the number of the subscriber calling as well as of the subscriber called if she wishes to

keep a record of the same. The numbers of pairs of conductors 16 17 leading to the relief-board might be reduced thereby, however, although the direct extension for each line, as shown, is undoubtedly preferable.

Having described my invention, what I claim, and desire to secure by Letters Patent of the United States, is—

1. In a telephone-exchange system, a central station, subscribers' stations and line-circuits interconnecting the two, a switchboard at the central station divided into sections, an answering and connecting jack and an annunciator permanently connected to each line-circuit at one section of the switchboard, an answering-jack and a signal for each of one or more lines located at another section of the switchboard, circuit connections from the answering-jack to the answering and connecting jack, and means at the latter jack to continue such circuit connections to the subscriber's line, whereby the subscriber may either call or be called ordinarily upon one section of the switchboard but upon occasion may have his line prolonged for the purpose of answering his calls to another section of the switchboard, substantially as described.

2. In a telephone-exchange system, a central station and a multisection switchboard therein, a subscriber's station and a line-circuit connecting the same with said central station and terminating in a spring-jack upon said switchboard, a line-annunciator associated with said jack, a similar jack and annunciator located upon another section of the switchboard, and having conductors extending to but normally disconnected from the line-circuit wires at the first-named spring-jack, and means in said jack for connecting said conductors to the line-circuit, whereby the subscriber's call will become apparent and may be answered at the other section of the switchboard, substantially as described.

3. In a telephone-exchange system, a central station and a switchboard thereat, a subscriber's station and line-conductors passing therefrom to the central station, two jacks upon said board corresponding to said line, and a signal at the first jack permanently connected to the line, the second jack being normally disconnected therefrom, and means associated with the first jack for bringing the second jack into connection with the line conductors, substantially as described.

4. In a telephone-exchange system, a central office and a switchboard thereat, a subscriber's station and a line extending from said station to the switchboard, a line-signal upon one part of the switchboard permanently connected to line and also to a source of current, a second similar line-signal located upon a different part of the switchboard and also connected to the said source of current but not with the line, means associated with the first signal for bringing the second signal into connection with the line and terminal connective devices associated with said signals, substantially as described.

5. In a telephone-exchange system, a switchboard having several sections, one or more of said sections being used as "relief-sections," a subscriber's line, and a jack therefor; together with a line-signal permanently connected thereto, located at one section, a normally-disconnected extension of the line from said jack to a similar jack and signal, at the relief-section, and means associated with the permanently-connected jack for bringing the relief jack and signal into connection with the line, substantially as described.

6. In a telephone-exchange system, a central-station switchboard divided into sections, one or more of said sections constituting "relief-sections," a subscriber's line terminating at one section of the board and a jack and signal thereat permanently connected to the line, a normally-disconnected extension of the line passing to the relief-section and there provided with a line jack and signal similar to the first, and means for connecting the extension to the line, substantially as described.

7. In a telephone-exchange system, a central-station switchboard divided into ordinary and relief sections, subscribers' lines, and terminal devices and signals therefor permanently connected to them at the ordinary switchboard-sections, other similar terminal devices located at the relief-section, for one or more of the lines, normally disconnected therefrom but adapted to be connected thereto through the ordinary board-sections, incoming and outgoing trunk-lines extending between each two ordinary sections, and outgoing trunks only from each relief-section to all the ordinary sections, substantially as described.

In testimony whereof I have hereunto set my hand, in the presence of two witnesses, this 20th day of April, 1899.

EDWARD E. CLEMENT.

Witnesses:
SPENCER B. PRENTISS,
W. BERTRAND ACKER.