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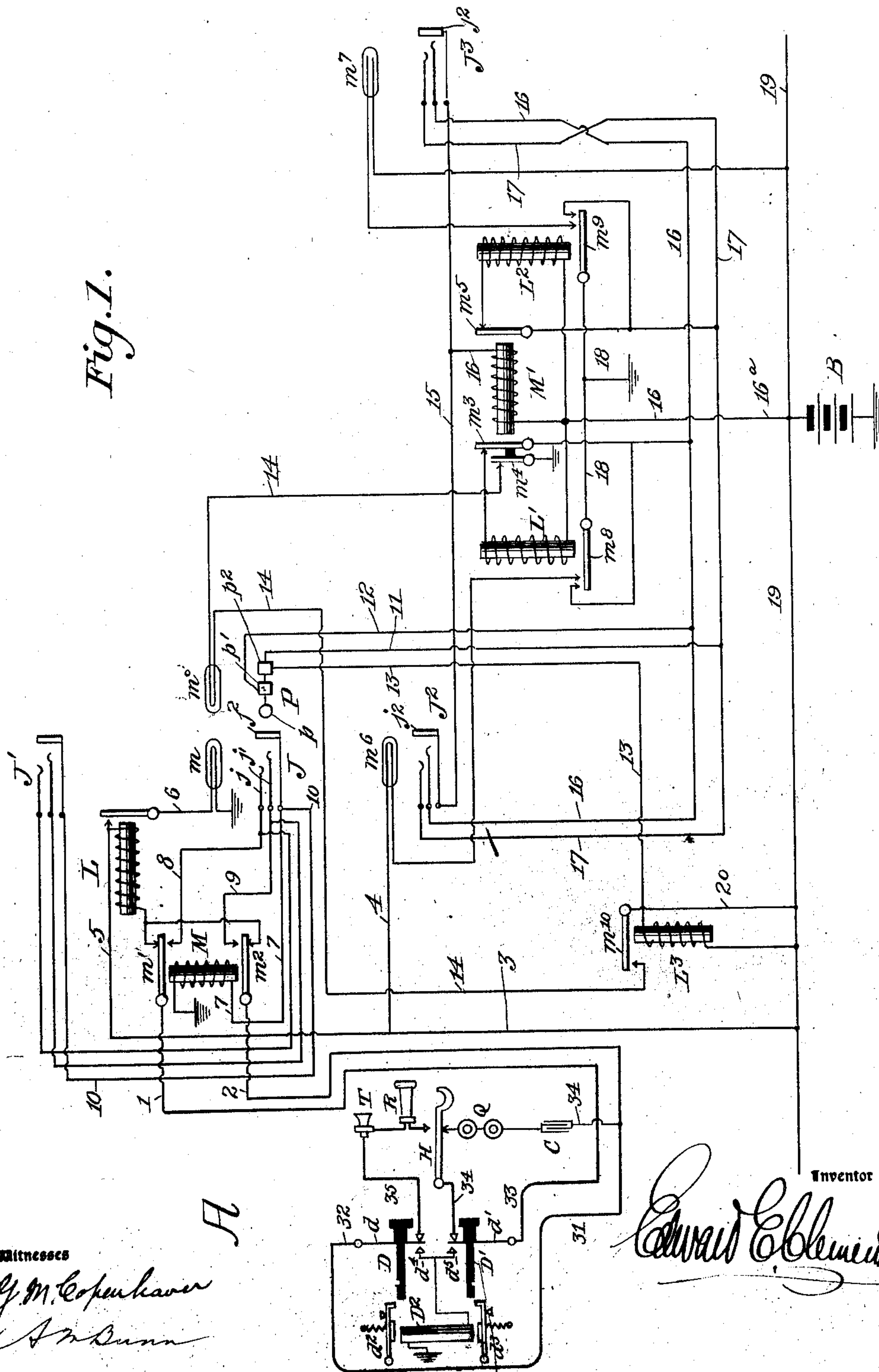
PATENTED APR. 16, 1907.

E. E. CLEMENT.
TELEPHONE EXCHANGE SYSTEM.

APPLICATION FILED MAR. 20, 1905.

2 SHEETS-SHEET 1.

Fig. 1.



Witnesses

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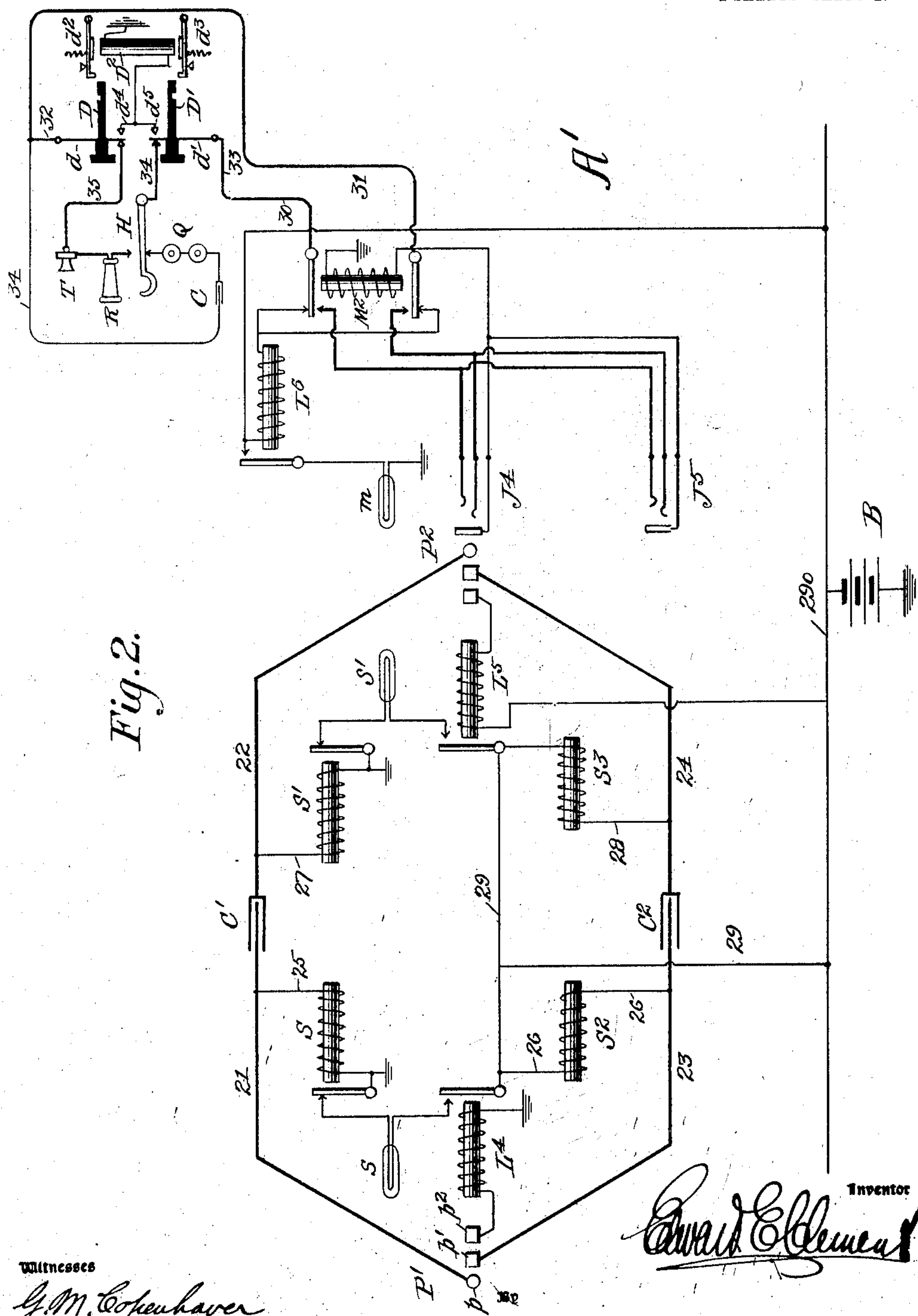
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2 SHEETS—SHEET 2.

**WITNESSES**

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UNITED STATES PATENT OFFICE.

EDWARD E. CLEMENT, OF WASHINGTON, DISTRICT OF COLUMBIA.

TELEPHONE-EXCHANGE SYSTEM.

No. 850,344.

Specification of Letters Patent.

Patented April 16, 1907.

Application filed March 20, 1905. Serial No. 251,047.

To all whom it may concern:

Be it known that I, EDWARD E. CLEMENT, a citizen of the United States, residing at Washington, in the District of Columbia, have invented certain new and useful Improvements in Telephone-Exchange Systems, of which the following is a specification, reference being had therein to the accompanying drawings.

My invention relates to telephone systems, and has for its object to simplify and reduce the expense of large systems, especially those in which multiple switchboards are employed, while increasing their efficiency.

My invention may be briefly stated as a divided multiple system, in which the lines have but one signal, and that is not controlled in any way by complicated means, such as polarized magnets and the like. The main switchboard at the central office is divided into two or more divisions, each of which is a complete multiple board in itself, with a full complement of answering and multiple jacks for the lines which are represented in its extent. The answering-jacks, line-relays, or annunciators, and line lamps or shutters are the same as in ordinary use and need not be of any special type. In fact, my invention is applicable to any type of switchboard and apparatus and to any circuit. I have shown it as applied to a common-battery circuit having a two-wire cord and a three-wire jack connection of the most advanced type now known in service; but it may be applied with equal facility to any type or any variety of system without sacrifice of its essential features.

Between the divisions of the main board trunk-lines extend. Each trunk is multiplied to all the divisions and has a terminal plug or jack at some one division. Each trunk has for every one of its multiple jacks a signal, such as a lamp, controlled by a magnet so connected that the particular magnet and the particular signal desired can be selected by a subscriber when calling. Each subscriber's line is of course represented on some one of the divisions in all its sections, but not on the other divisions. For calls on that division connections are made direct, but for those on others they are trunked. The method of this trunking the calls is of the essence of my invention. Every call is trunked—that is, when a line-signal is displayed a trunk-plug is first inserted in the line-jack without any other step being taken, and the subscriber's

predetermined selective signal then determines whether the trunk-signal shall be displayed at the home division or some other division and at which. The trunk-signals are treated by the operators as the calling-signals of subscribers to be answered and further attended to, and hence after inserting a plug in a trunk-jack in response to a call-signal in connection therewith the operator proceeds to get the number wanted, to test the jack of the wanted line, and to complete the connection. This she can do, for the call has come to the division where the wanted subscriber has a connection in a multiple jack for each section therein.

At the subscriber's station the apparatus is very simple. I have shown it as a pair of push-buttons with a retaining-magnet which when a button is depressed holds it in and the other button out until the call is finally extended to the operator required and there answered. The special calling apparatus and push-buttons are then cut out automatically, so that nothing remains in the circuit except the ordinary common-battery telephone. By means which I shall not specifically claim herein the number of divisions can be increased to ten. Assuming ten thousand subscribers as the unit of allowance for one board, ten divisions would give a full size of one hundred thousand subscribers in one exchange or group of exchanges, which would take care of all but the very largest exchanges now in operation. By "exchange" in this connection I do not mean one interconnecting center within four walls, but any correlated group of centers, which together interchange business, and thereby combine to serve a specified group of subscribers under one control. Thus there may be ten exchanges in the narrower sense, constituting ten divisions according to my present invention, scattered through different parts of a city, but all commonly controlled and working under the same rules and orders. In such case the calls may be trunked, as herein set forth, with manifest advantage and with the same ease and certainty of operation as if the divisions were under one roof and the boards side by side. If the exchanges individually be very widely separated—say more than twenty-five hundred feet apart—a combination of trunk-wires may be required to save the three-wire extensions, only as many triplets being run in the cables as will be required for actual

use at once, allowing for "peak" hours and for spares. This, however, as well as the other problems I have mentioned above, need not be discussed at length herein, as they will be fully treated in other specifications.

My present invention is illustrated as to one embodiment in the accompanying drawings, wherein—

Figure 1 is a diagram showing a subscriber's station connected to one division of a divided multiple switchboard, and the trunk-terminal circuits thereat, as well as a trunk extension to another division. Fig. 2 is a similar and symmetrical diagram made as a continuation of the first, showing the operators' cord-circuits and a second subscriber's line and station outfit, these appertaining to a second division of the switchboard.

Referring to the drawings, A, in Fig. 1, and A', in Fig. 2, are subscribers' stations, each provided with the usual talking set of a common battery system and each provided, also, with selective mechanism by which the divisions of the exchange may be differentiated. As all this at each station is the same I shall describe that at station A alone.

At station A, T is the transmitter, R the receiver, H the switch-hook, C the condenser, Q the ringer, all of usual or any desired type.

D and D' are two push-buttons, (shown of insulating material as to heads and shanks,) although the latter may obviously be of metal and in practice would be so. Each button has a contact-spring d or d' , normally back on a fixed contact, these two fixed contacts being in the circuit 34 35 of the talking set, so that when either button is pressed the talking-circuit is broken. I have not chosen to complicate this diagram by showing anything but the essentials; but in practice I may, and preferably will, make a number of changes entirely within the scope of my invention, which will do away with the disagreeable click in the receiver. Each button when pushed in is adapted to be held in by a latch controlled by a magnet D^2 . For the button D this latch is shown as a toe on the end of the armature-lever d^2 , and for the button D' it is shown as a similar toe on the armature-lever d'^2 . Both armatures are controlled by the one magnet D^2 and of course may be the same armature. Each latch holds its button when pushed in and also prevents its being so pushed in if the armature is up before the pushing is essayed. This prevents tampering with the signal after it is set. When the button D is pressed, it grounds the side 2 of line through the magnet D^2 , and when the button D' is pushed it similarly grounds the side 1 of line through the same magnet, each, as I have stated, opening the talking-circuit and leaving the other side of line ungrounded. At the cen-

tral-office end of the line it passes to the contact-terminals m' and m^2 of the cut-off relay M. Thence normally both sides of line pass to the magnet L of the line-relay, controlling the signal m in the local circuit 6 5 3 from battery B. Hence no matter which side of line is grounded at the substation the line-relay L will get current through the relay D^2 and line.

Each line has a terminal answering-jack J and multiple jacks J'. Each jack has the line-terminal springs j j' and a thimble j^2 . The thimbles are all connected together by wire 10 and through wire 7 to the cut-off relay M and ground. To cooperate with the line-jacks, I preferably provide only the trunk-plugs P for answering purposes, and in practice it is desirable to have the answering-jacks J and the trunk-plugs P before one set of operators, whose sole duty is to stick plugs and withdraw them according to the signals, the trunk-jacks J² J³ and the cord-circuits (shown in Fig. 2) being before another set of operators, who correspond to the present subscribers' operators. The plug P has a tip, ring, and sleeve p p' p^2 , the tip and ring forming terminals of the main trunk-wires 11 12 and the sleeve the terminal of the relay-wire 13 passing to relay L³ and battery. The wires 11 12 have extensions 16 17 passing to both divisions of the switchboard, (which in this case is supposed to be a two-division board.) At each division these trunk-wires terminate in an answering-jack J² or J³, having springs similar to those of the line-jacks, and thimbles j^2 , connected together by wire 15 and thence by a branch 16 to the trunk cut-off relay M' and battery. The relay L³ controls, through its armature m^{10} , the circuit 20 14 m^4 of the lamp m^0 , which is at once the supervisory and clearing-out signal of the trunk. The armature m^4 is controlled by the trunk cut-off relay M', whose other contacts m^3 m^5 control the circuits of the trunk signal-relays L' L². Of these the former is connected from the trunk-wire 16 through the cut-off contacts m^3 to the battery by wire 16 and the latter, L², is similarly connected from the wire 17 through the cut-off contacts m^5 to the wire 16 and battery. The grounding of either side of the line will therefore energize one of these relays. For a purpose presently to be referred to the wires 16 and 17 are reversed between the jacks J² J³ and to one side of the connections of the relays L' L²—in this case on the side toward the jack J³. Cooperating with this trunk-circuit and with the line-circuit described I may employ the cord-circuit shown in Fig. 2. Here the plugs P' P² are connected by the cord conductors 21 22 23 24, conductively separated by the condensers C' C². Upon each side of the condensers a bridge is formed across the cord including the battery B, this being shown, in the one case, at 25 26

and in the other at 27 28, the bridge containing the supervisory relay S and the choke-coil S^2 , while the second contains similar pieces of apparatus S' S'^2 . The supervisory relays, respectively, control the two supervisory lamps s s' , whose circuits, open when the plugs are idle, are closed in use by the relays L^4 L^5 , connected to the sleeves of the respective plugs.

The operation of my invention thus described is as follows: Subscriber A, desiring to converse with subscriber A', ascertains that the number of the latter is such that he is in a different division from his caller. If we assume A to be in the A division and A' to be in the B division, (which may be the marks on the buttons,) the caller would then press his B button. In doing so he closes the following circuit: ground, relay D^2 , contact d^5 , d' , 33, L, 5, 3, 19, B. Both the line-relay and the relay D^2 pull up, the button D' (which we have called the B button) is retained in its depressed position, and the lever d^2 is drawn up behind the other button to prevent its being depressed. The operator in Fig. 1, perceiving the line-lamp m to light, inserts a plug P, whereupon circuit through the cut-off relay is formed as follows: ground to relay M, 7, j^2 , p^2 , 13, L^3 , 19, B. The cut-off relay then acts, and at the same time the potential of the test rings or thimbles j^2 is raised for test purposes. The cut-off relay draws in its armature connections so that they make contact with the terminals of wires 8 and 9 before they break with the terminals leading to the relay L. The reason for this is that there must be no break in the flow of battery-current to line until the answering operator finally makes connection. The line-circuit 1 2 is now continued through the trunk-wires 16 17 to the multiple jacks J^2 J^3 in the two divisions of the board. The ground remaining on the wire 1 at the subscriber's station, current flows through the relay L^2 by the following path: ground at the substation to relay D^2 , contact d^5 , d' , 33, 1, m' , 8, j , p , 11, m^5 , L^2 , 16, 19, B. The relay L^2 therefore pulls up and lights the lamp m' at the B board. The operator at that board, using the cord-circuit shown in Fig. 2, answers the call and handles the connection exactly the same as if she were dealing with the subscriber's line direct. As soon as she inserts the plug P', however, in the jack J^3 she closes circuit through the trunk cut-off relay M' by the following path: ground to relay L^4 , p^2 , j^2 , of jack J^3 , 15, 16, M', 16, 19, B. This relay then pulls up, as well as the relay L^4 , the lamp-relays L' L^2 , which were previously bridged across the trunk, being thereby removed and the lamp darkened. At the same time the lamp m'' , which lighted when the plug P was first inserted, is put out, which indicates to the first operator that the call is being attended to. Continued burn-

ing of this lamp would mean probable trouble with the trunk, and another trunk would be substituted promptly therefor.

Detailed description of the operation of the parts in Fig. 2 is thought to be unnecessary, so I will merely refer to the reason for reversing the conductors 16 17 on jack J^3 . It will be observed that the battery B, in accordance with standard practice, has its positive terminal grounded. If both trunk-jacks were directly connected to line, this would bring the ground on one side or the other, according to the jack selected. If the cord-circuits are uniformly connected to battery—that is, with the sleeve side always to the live side of battery for test purposes—the result would be that the two grounds, one at central and the other at the substation, would both come on the same side of line for one jack J^2 , but would come on opposite sides of the line and battery for the other jack J^3 . The result of this would be that for all connections on jack J^3 the relay D^2 at the substation would never let go. Hence I simply reverse the conductors 16 17, as shown, and thus bring the two grounds always on the same side of battery after the operator's plug P' is in any trunk-jack. The test is of course unnecessary to consider, as the trunk-jacks are only answering-jacks. It would be all right, however, in any case, provided the relay M' were grounded instead of to battery and the relay L^4 to battery instead of grounded. This is a mere reversal of connections, which is always understood where necessary.

It will be apparent that while I have thus described a two-button substation and a two-division switchboard the same may be made four or eight or sixteen by any suitable method, and I contemplate all such changes as within the scope of the appended claims.

I am aware that sundry changes may be made in the apparatus and circuits I have described without departing from the spirit of my invention, and I wish it distinctly understood that all such changes are well within the scope and purview of my claims.

The essential feature of my present invention is the provision of trunk-lines between separate multiple boards or separate exchanges, the trunk-lines containing selective apparatus by which the subscriber may differentiate, so as to select the particular exchange or division of the switchboard upon which his wanted correspondent has a terminal and can be reached.

My invention has been described as applied to manual multiple switchboards only; but it may obviously be applied to automatic or semi-automatic systems and to transfer-boards as well and without change in essence. Such application I consider within the skill of any telephone-engineer well informed in his profession.

Having thus fully described my invention,

what I claim, and desire to secure by Letters Patent, is—

1. In a telephone-exchange system, a plurality of subscribers' lines and substations, a central-office switchboard for interconnecting the same arranged in several divisions or parts, multiple terminals for each line in some one of the switchboard-divisions only, one of said terminals being provided with a signal and serving as an answering-terminal, the other terminals for each line being distributed upon different portions of its division, trunk-lines containing selective apparatus extending unbroken between said divisions, boards, or exchanges and means by which a subscriber may affect said selective apparatus and differentiate so as to manifest a particular trunk-signal at the particular division upon which a terminal of the line wanted is to be found and no other, substantially as described.

2. In a telephone-exchange system, a subscriber's line, a controlling-relay, means at the substation for grounding one side or the other of the line through the controlling-relay, a line-signal at the central office displayed in response to the subscriber's act in calling, a trunk-line extending to multiple terminals at a plurality of switchboard divisions or exchanges, selective relays connected to said trunk-line, means to supply current thereto and to the line, and signals to designate a particular division or exchange wanted, controlled by said relays, and responsive to the grounding of a subscriber's line, substantially as described.

3. In a telephone-exchange system, a plurality of subscribers' lines, a central office, a plurality of central-office switchboards each containing answering-terminals and multiple terminals for a particular group of said lines, a telephone set at a subscriber's station and a signaling set thereat comprising a circuit-closer and a retaining-magnet therefor, a line-signal device normally connected to the line at central and associated with the answering-terminal thereof, together with trunk-lines extending between the switchboards, and each provided with a connective terminal upon each board, signals associated with the said trunk-line terminals, one for each, and circuit-closing devices for said signals normally connected to the trunk to be affected by the subscriber's circuit-closing device so as to display the particular signal desired upon a particular board of the set, containing one or more multiple terminals of the line wanted, substantially as described.

4. In a telephone-exchange system, a central service-bureau divided into a plurality of switchboards or exchanges, subscribers' lines each terminating at one division only; trunk-lines less in number than the number of subscribers' lines and extending between the several exchanges or divisions, each trunk-line

having connective terminals at two or more of said exchanges or divisions; a plurality of selective relays connected to opposite sides of each trunk-line, with means to supply current thereto and to the lines, and signals associated with the trunk-terminals and controlled by said relays; together with circuit-controlling devices at each subscriber's station arranged to cooperate with and affect said relays; whereby a subscriber may signal his own division for a connection, and being trunked may selectively signal an operator at the division or exchange in which a line wanted is terminated, substantially as described.

5. In a telephone-exchange system, a divided switchboard and subscribers' lines each terminating in one division, each line composed of two wires both normally connected to a line-annunciator at the terminal division; a pair of circuit-closers and a locking-magnet therefor at the subscriber's station, whereby one side or the other of the line may be held grounded at will and the line-signal thereby set; a trunk-line between the divisions having two wires each connected to a generator and ground through suitable relays, trunk-terminal signals at the different divisions controlled by said relays; and operator's connective circuits in each division; the whole so arranged that when a calling subscriber is trunked his line-signal is disabled and the trunk-relays brought under the control of the line to set one of the trunk-signals at the predetermined division; and means whereby an operator at the desired division may complete the connection between the trunk-terminal and the line of the wanted subscriber, and in so doing may disable the trunk-signals, and in finally breaking the connection may actuate a trunk disconnect-signal at the calling-subscriber's division, substantially as described.

6. In a telephone-exchange system, a plurality of subscribers' stations, a central station, and a plurality of switchboard devices each containing terminals for a particular group of the subscribers' lines, a plurality of trunk-lines extending between the switchboard divisions, a common battery supplying current for the lines and trunks, a plurality of terminals and associated signals for the trunks, the same being distributed on the several boards or divisions, and a controlling-magnet for each signal connected between the battery and one or the other side of the trunk, together with means at a subscriber's station for determining the flow of current from said battery through one or the other side of the trunk, and the corresponding signal-controlling magnet, substantially as described.

7. In a telephone-exchange system a plurality of subscribers' lines and stations, a plurality of central-office switchboards with answering and multiple terminals upon each

board for a particular group of subscribers' lines, trunk-lines extending unbroken between the boards, each trunk having terminals upon more than one of the switchboards, a trunk-signal associated with each terminal, and a controlling-magnet therefor, a plurality of separate circuits composed in part of the members of the trunk, and means at a subscriber's station to complete one or another of said circuits at will, so as to display a desired signal, substantially as described.

8. In a telephone-exchange system, a subscriber's station having selective devices, and a central switchboard divided into distinct parts, together with trunk-lines normally extending unbroken to all the parts, and means whereby the subscriber may set a signal therethrough on any division of the switchboard, substantially as described.

9. In a telephone-exchange system, a subscriber's line, a talking set therefor at the subscriber's station, and a signaling set comprising a circuit-closer and a retaining-magnet therefor, a line-signal device normally connected to the line at central, and a terminal connective device, together with a trunk-line extending unbroken to more than one division of the exchange or system, and provided with a connective terminal at each, signals associated with said trunk-line, one for each terminal, and circuit-closing devices for said signals normally connected to the

trunk to be effected by the subscriber's circuit-closing device so as to close the circuit of any particular signal desired, so as to select a particular division of the switchboard, substantially as described.

10. In a telephone-exchange system a plurality of subscribers' lines and a plurality of central-office-switchboard divisions, with line-circuits extending from the subscribers' stations to the said switchboards, each line terminating upon less than the full number of boards, a number of line extensions or trunk-lines passing unbroken between the several switchboards, each having multiple terminals on the said boards and signals associated therewith, all of said trunks being normally disconnected from the lines, a calling-signal for each line, and means for connecting a line when calling to an extension or trunk, together with means at the subscriber's station for actuating one or the other of the signals associated with said trunk, according to the particular board upon which the line of the wanted subscriber terminates, substantially as described.

In testimony whereof I have affixed my signature in presence of two witnesses.

EDWARD E. CLEMENT.

Witnesses:

H. M. STERLING,

G. M. COPENHAVEN.