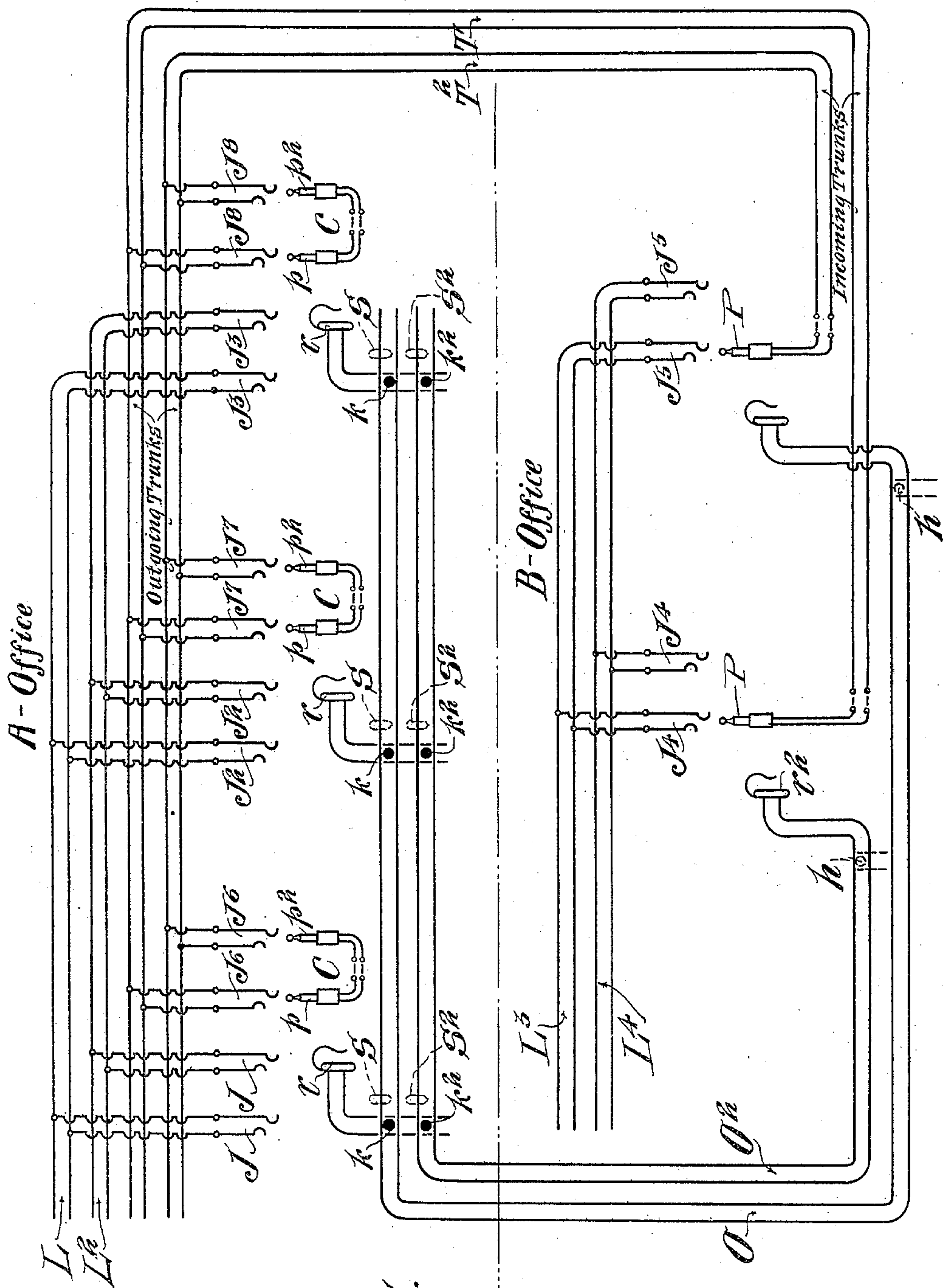


No. 838,749.

PATENTED DEC. 18, 1906.

H. L. REBER.  
TELEPHONE SYSTEM.  
APPLICATION FILED MAR. 29, 1905.

2 SHEETS—SHEET 1.



Witnesses.

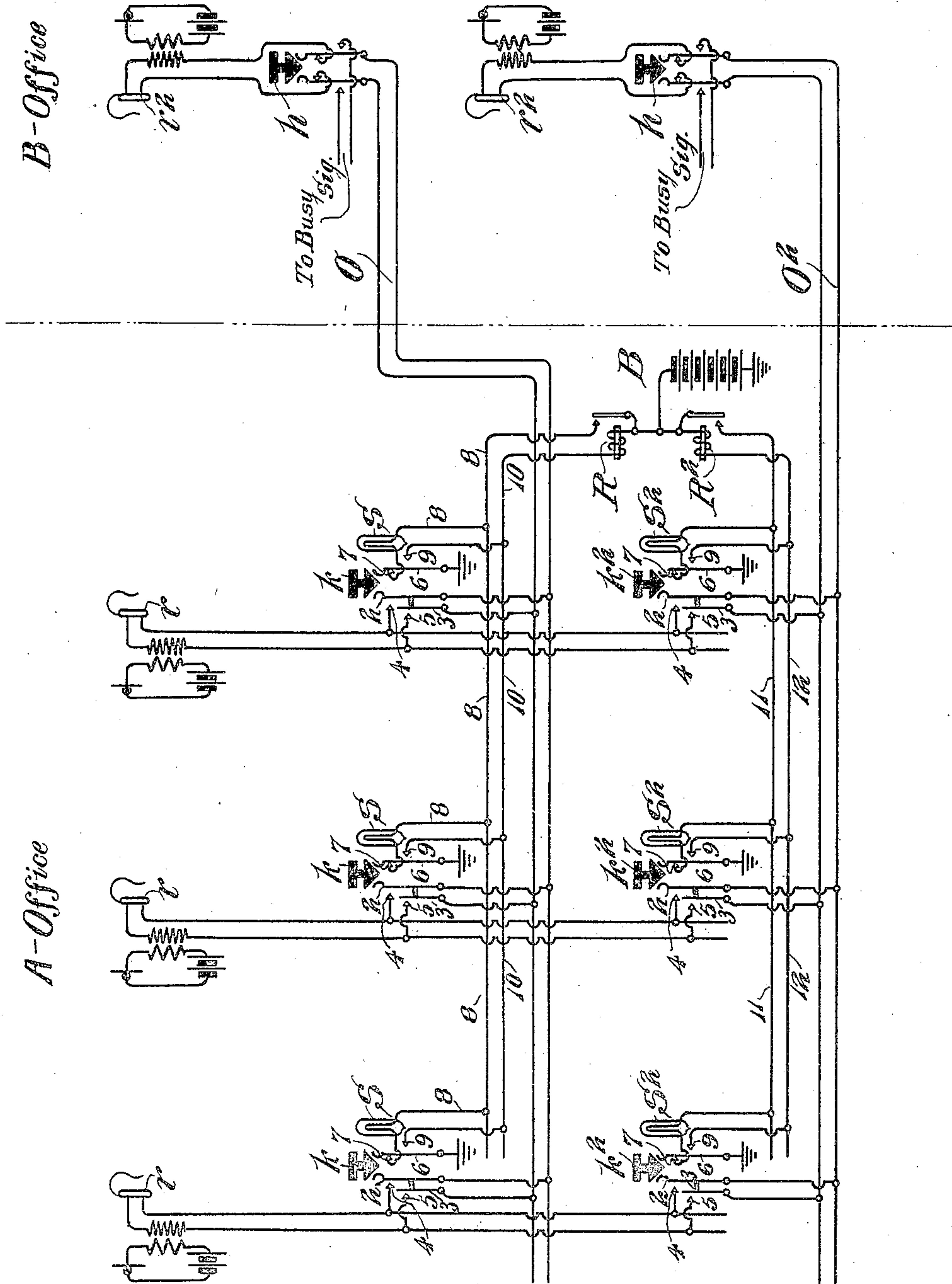
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Fig. 1.

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2 SHEETS—SHEET 2.



Witnesses.  
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Fig. 2.

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# UNITED STATES PATENT OFFICE.

HENRY LINTON REBER, OF ST. LOUIS, MISSOURI.

## TELEPHONE SYSTEM.

No. 838,749.

Specification of Letters Patent.

Patented Dec. 18, 1906.

Application filed March 29, 1905. Serial No. 252,655.

*To all whom it may concern:*

Be it known that I, HENRY LINTON REBER, a citizen of the United States, residing at St. Louis, in the State of Missouri, have invented new and useful Improvements in Telephone Systems, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to improvements in those features of telephone-exchanges which are involved in making trunking connections between the various central offices or switchboards of the exchange, my object in general being to provide means for improving the service by quickening the same and rendering it more certain and satisfactory than heretofore and to reduce the equipment, as well as the number of operators required.

In the exchanges of our larger cities the greatest number of calls is for trunking connections, this in some instances rising as high as seventy-five per cent., and at the same time such connections are the most difficult to make and the most liable to errors, due to the fact that at least two sets of operators are involved in initiating and completing such connections, with the consequent necessity for communication back and forth between them and the liability for mistakes. It is apparent, therefore, that any improvement which results in the betterment of this class of service in the respects mentioned, particularly those of increasing the speed, is most desirable, and this is true even though only a small fraction of a second per call is gained, since in the aggregate the saving in time is large. It is evident also that an increased speed of establishing such connections results in a less number of operators, since each can do more work and handle a greater number of calls, and a smaller amount of equipment is necessary, since the periods of delay between conversations are reduced.

In the larger exchanges, as is well known, it is common to provide several central offices each in itself having a large multiple switchboard, and these offices are connected together by trunk-circuits to extend the talking-circuits through from one switchboard to the other. In addition the operators are provided with circuits independent of the trunk-circuits, commonly known as "order-wires" or "order-wire circuits," to enable them to communicate with each other

for the purpose of properly establishing the talking connections between the subscribers of the different switchboards. In the ordinary arrangement of such large multiple switchboards the multiple jacks are distributed before the operators in the upper part of the board and the answering-jacks of the subscribers' lines are placed upon the lower portion of the board. The trunk-circuits terminate at one office in multiple jacks distributed throughout the switchboard before the operators, these jacks being usually placed between the subscribers' answering and multiple jacks, and at the other office they terminate in connecting cords and plugs, which are usually placed upon separate sections of the switchboard, known as the "incoming-trunk" section, and upon which sections the subscribers' lines of that office are extended through to multiple jacks arranged similarly to the corresponding jacks in the ordinary multiple sections. These trunk-circuits are designated as "outgoing trunks" at the first switchboard or office, where they are provided with multiple jacks, and as "incoming trunks" at the other switchboard or office, at which they terminate in connecting-plugs. The first office is often spoken of as the "A" office, and the second office as the "B" office, and the corresponding operators are termed "A" operators and "B" operators. This arrangement of the apparatus for establishing through communications between widely-separated subscribers and central offices is the result of years of experience and has proven the best for satisfactory and quick service. The terms thus applied to the offices, apparatus, and operators are the result of this arrangement of the trunks and the method of handling the trunking connections, since calls are first received by the A operators at the A office, are then transmitted to the B operators at the B office, and by the latter are completed by connecting the incoming-trunk circuits with the proper telephone-line circuits at said office. Such connections therefore may be said to be initiated at the A office and completed at the B office. In order that these two sets of operators may expeditiously perform their work with as few mistakes and as little confusion as possible, a prescribed code of communication between them is followed, that usually employed in large or busy offices being as follows: As soon as an A operator receives an order from a call-



ing subscriber for a connection with a party whose line appears upon a different switchboard she communicates with the B operator at the said board and informs her of the line wanted. The B operator immediately informs the A operator of the proper trunk to be used for the connection and immediately completes the connection by inserting the plug of the trunk which has been designated into the jack of the called line. The A operator at once establishes the connection between the calling subscriber's line and the trunk through the medium of her cord-circuit. These acts thus serve to establish a complete talking-circuit for the subscribers. In this connection I have omitted the steps of testing the condition of the wanted line and calling the subscriber, since these may be carried out in any well-known manner.

For convenience and speed in establishing communications between the two sets of operators each order-wire terminates in the receiver of a B operator having in charge a certain number of incoming trunks. At the A office these order-wires extend before all of the operators, and each is provided with suitable switches or keys, known as "order-keys," to enable her to readily connect her head-telephone with any of the order-wires. Thus when an A operator wishes to communicate with a B operator she depresses an order-key to connect her telephone with the order-wire leading directly to the B operator's telephone. These order-keys are usually placed in a row or strip upon the key-shelf of the switchboard at each operator's position. The operators are therefore required to listen-in upon the order-wires—that is, to connect their head-telephones with the order-wires and listen for a moment to determine whether or not the B operators are engaged. If after thus listening an order-wire is found to be busy, a second key is depressed, and so on until an idle B operator is found to take charge of and complete the connection at the B board. This results in delay, since the calling subscriber is waiting for the completion of his connection and is frequently the cause of mistakes on account of the A operator's failure to listen long enough, and which results in a confusion of orders and the establishment of wrong connections.

The object of my invention is to provide means for enabling the A operators to select the idle B operators without delay and confusion. In carrying out my invention I provide means for indicating to the A operators the idle or busy condition of the order-wires, whereby any A operator is enabled to immediately select an order-wire and communicate with a B operator who is idle and free to at once complete the connection.

In one form of the invention a signal is provided in association with each order-key, so that under some conditions of use a glance is

sufficient to enable the A operators to immediately put themselves in communication with an idle B operator. Under other conditions of use the signal may be received by the A operators only by listening-in, but under such circumstances is received instantly upon depressing the order-key. As a result of this arrangement the connection for conversation between the telephone-lines of the two boards is more speedily accomplished, the operators are enabled to do more work, and consequently a less number is required, and the number of trunk-circuits and order-wires, as well as switchboard equipment, may be reduced, since they are enabled to handle more calls than in former arrangements.

The invention is conventionally illustrated in the accompanying drawings, in which the same reference characters are used throughout to indicate the like parts, and in which—

Figure 1 is a diagram of a telephone-exchange, indicating the apparatus and circuits ordinarily involved in trunking connections; and Fig. 2 is a diagram of the order-wire circuits only involved in such an exchange and showing in detail the invention applied thereto.

Referring to Fig. 1, L and L<sup>2</sup> indicate two subscribers' lines terminating upon the multiple switchboard at the A office, and L<sup>3</sup> and L<sup>4</sup> indicate multiple sections of telephone-line circuits terminating upon the incoming-trunk section of the B office. T and T<sup>2</sup> indicate the trunk-circuits extending between the A and B offices, and O and O<sup>2</sup> indicate the order-wire circuits extending between the same offices. The lines L and L<sup>2</sup> are each furnished with an answering-jack J and multiple jacks, such as J<sup>2</sup> and J<sup>3</sup>, in any number upon the various sections of the multiple switchboard at the A office. In like manner the telephone-lines L<sup>3</sup> and L<sup>4</sup> are each provided with multiple spring-jacks J<sup>4</sup> and J<sup>5</sup> upon the incoming-trunk section of the switchboard at the B office. The trunks T and T<sup>2</sup> at the A office, where they are termed "outgoing trunks," are furnished with similar multiple spring-jacks J<sup>6</sup>, J<sup>7</sup>, and J<sup>8</sup> upon the various sections of the switchboard, and at the B office, where they are known as "incoming trunks," they are provided with cords and connecting-plugs P upon the incoming-trunk sections. Cord-circuits C are provided in any number at the various sections and operators' positions of the multiple switchboard at the A office to enable the operators to establish connections for conversational purposes between the various subscribers' lines and between the subscribers' lines and the outgoing trunks. At the A office the order-wires O and O<sup>2</sup> extend past the various operators' positions, each operator being provided with a strip of order-keys k k<sup>2</sup> to enable her to readily con-



nect her head-receiver  $r$  with any of the said order-wires, while at the B office said order-wires terminate in the head-receivers  $r^2$  of the B operators at the incoming-trunk sections, one terminating in one operator's receiver and the other in another. It will be understood that this diagram is intended merely to conventionally illustrate the usual exchange arrangement so far as the same enters into my invention without reference to the details of the various parts or the illustration of the features not directly concerned in the said invention, and, while but three sections and three operators' positions of the multiple switchboard are indicated and but two sections and two operators' positions at the B office are shown, that in practice these may comprise as many sections and positions as desired, and that many more trunks would be assigned to each incoming operator than is shown in the diagram. The means for signaling in connection with the lines, cord-circuits, and trunk-circuits are entirely omitted, as not entering into the present matter, and for the same reason no attempt has been made to illustrate either a common battery or magneto-exchange, although as a matter of fact the larger exchanges to-day are nearly all of the common-battery type.

In the ordinary operation of the system a call coming in over the line  $L$  is received at the first section and the operator inserts the answering-plug  $p$  of one of her cord-circuits  $C$  into the answering-jack  $J$  of the calling-line and connects her head-telephone therewith by means of the usual listening-key to receive the order from the calling subscriber. Upon finding that a connection is wanted with a line terminating at the B office—for instance, with the line  $L^3$ —the operator depresses one of the order-keys  $k$  or  $k^2$  to connect her head-telephone with one of the order-wires  $O$  or  $O^2$  to thus put herself in communication with the corresponding B operator at the said other office. At the same time she informs the latter operator that a certain line is wanted, and the B operator immediately informs the A operator to use a certain trunk, at the same time picking up the connecting-plug of the trunk designated and, if necessary, testing the condition of the wanted line and, if idle, inserting the plug into the multiple jack of the line  $L^3$  on her section of the switchboard. If the A operator has depressed order-key  $k^2$ , she has connected her telephone with the operator at the first incoming-trunk section at the B office, and the plug  $P$  of the trunk  $T$  is taken up by the latter operator and inserted in the jack  $J^4$  of the wanted line  $L^3$ . Meanwhile the A operator has inserted the plug  $p^2$  of the cord-circuit with which she answered the call of the subscriber into the jack  $J^6$  of the trunk  $T$ . The through talk-

ing-circuit between the two switchboards and the two subscribers' lines is thus established.

It is evident that the A operator is unable to tell before depressing one of the order-keys and listening-in whether or not the B operator is busy, and hence may be required to take sufficient time to listen-in to this extent on several of the order-wires before finding an unengaged B operator. My invention is designed to obviate the delay this caused by the A operator in selecting an idle B operator and to provide means whereby such delays are largely eliminated and the operators are enabled to immediately select the idle B operators. One means for accomplishing this is indicated more clearly in Fig. 2, in which the trunk-circuits and subscribers' lines are omitted for the sake of clearness. In this figure it will be seen that the order-wires  $O$  and  $O^2$  extend from the A office at the left to the B office at the right. At the latter office they terminate in the head-receivers  $r^2$  of the operators, while at the former office they pass successively through the various operators' positions. The head-telephones  $r$  of the A operators are adapted to be connected with the order-wires through the medium of the order-keys  $k$   $k^2$ , which when depressed connect their springs 2 and 3, joined to the said order-wires, with their contacts 4 and 5, which are connected with the said head-receivers of the operators. Each of these keys has an additional spring 6 connected with ground, the normal contact 7 of which spring is connected upon one side with a suitable signal  $S$ , which may be in the form of a small incandescent lamp, the opposite terminal of which signal is connected with a common conductor 8, leading from one of the normally open contacts of a relay  $R$ , the other of which contacts is joined to the live pole of a battery  $B$ . The alternate or normally open contact 9 of each of said keys is connected through a second common lead 10 with one terminal of the winding of the relay  $R$ , the other terminal of which is likewise joined to the live pole of the battery  $B$ . Associated with the keys  $k^2$  throughout the series of operators' positions are similar signals  $S^2$ , which are connected in a manner similar to the keys  $k$  with the leads 11 and 12, extending from the relay  $R^2$ , connected, like the relay  $R$ , to the battery  $B$ . It will be observed that normally the said signals  $S$  and  $S^2$  are connected upon one side to ground by means of the closed contacts 6 and 7 of the order-keys  $k$   $k^2$ , &c. When the corresponding relay  $R$  or  $R^2$  is operated, therefore, said lamps receive current from battery  $B$  and are lighted. These relays are operated whenever any order-key associated with their signaling-circuit is depressed. For instance, depressing any of the keys  $k$  serves to disconnect the spring 6 from the contact 7 and to connect it with the con-



tact 9. This has the effect of grounding the conductor 10 and permitting a flow of current from the battery B, through the winding of the relay R and over the conductor 10, and through the grounded spring 6 of the depressed key, which results in the energization of said relay R, thereby lighting all the lamps S associated with the other order-keys  $k$  of the same order-wire. These lamps on being lighted indicate to the operators at the other positions that the said order-wire is in use and that the B operator with which it is connected is engaged. It will be unnecessary, therefore, for them to even listen-in upon said order-wire, and when desiring a connection with the B operators they have only to depress any of the order-keys in connection with which the signals are not shown. The depression of any key  $k^2$  likewise operates relay  $R^2$  and lights the lamps or operates the signals  $S^2$  associated with the other keys  $k^2$ . These signals  $S$   $S^2$  may be placed in the switchboard immediately at the sides of the corresponding keys, in the keys, or in any other desired location and may be lamps, as shown, or annunciators, or any desired type. In case the invention be applied to a common-battery exchange the battery B may be one of the main batteries at the A office.

If for any reason a B operator is unable to attend to the calls coming in over her order-wire, a key  $h$  is provided therein which when operated disconnects the same from her head-telephone and connects it with some device arranged to impress thereon a distinctive current or signal, such as the ordinary busy signal device found in most large exchanges or a phonographic device. This when so connected serves to give the A operators a distinctive signal in their receivers whenever they depress an order-key. They are thus notified that the order-wire is not in use at the B office. Obviously any other signaling means might be employed in place of this busy signal. The signals  $S$   $S^2$ , &c., might be operated from the B office also, but the arrangement shown is preferred. It is evident that with this arrangement the selection of the B operator is hastened, since the busy signal is at once given and the A operator does not need to pause for any length of time to determine the condition of the circuit, but, on the contrary, is at once informed of such condition. This key  $h$  at the B office may be made use of in case order-wires from different offices are connected with the same B operator and the work at times becomes too heavy for the B operators to handle. Then the keys  $h$  in the order-wires extending to some of the offices may be operated to prevent so many calls from coming in, thereby enabling the operators to satisfactorily handle the calls from the other offices. Again, it may be desired during certain times of the day to relieve some of the B operators entirely be-

cause a less number can do the work, and in such cases the keys  $h$  may be depressed. The signals  $S$  and  $S^2$  and busy-signal keys  $h$  are likewise indicated in dotted lines in Fig. 1.

It is thus apparent that the invention results in increasing the speed with which trunking connections may be established, reduces the liability for errors, and decreases the number of operators employed, as well as the number of trunk-circuits, order-wires, and switchboard equipment required. While only one specific means has been shown and described for accomplishing these results, it is evident that the invention is in no wise so limited, for obviously many variations and modifications may be made therein without departing from the scope or principle of the same. Hence I do not wish to be limited to the specific form so shown and described.

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

1. In a telephone-exchange system, the combination with an A switchboard and a B switchboard, of trunk-circuits extending between said switchboards, operators' devices at each switchboard to enable conversational connections to be established between the lines of said switchboards through the medium of said trunk-circuits, order-wire circuits also extending between the said switchboards and having multiple terminals at the A board, to provide means for communication between the A and B operators, and means associated with the order-wire circuits to enable the operators to instantly pick out the idle B operators.

2. In a telephone-exchange system, the combination with an A switchboard and a B switchboard, of trunk-circuits extending between said switchboards, operators' devices at each switchboard to enable conversational connections to be established between the lines of said switchboards through the medium of said trunk-circuits, order-wire circuits multiplied at the A board also extending between the said switchboards to provide means for communication between the A and B operators, and indicating means associated with the order-wire circuits to enable the operators to instantly select the idle B operators.

3. In a telephone-exchange system, the combination with an A switchboard and a B switchboard, of trunk-circuits extending between said switchboards, operators' devices at each switchboard to enable conversational connections to be established between the lines of said switchboards through the medium of said trunk-circuits, order-wire circuits also extending between the said switchboards to provide means for communication between the A and B operators, said order-circuits extending before a plurality of A operators, and means associated with the order-



wire circuits to indicate to the A operators the idle or busy condition of the B operators.

4. In a telephone-exchange system, the combination with an A switchboard and a B switchboard, of trunk-circuits extending between said switchboards, operators' devices at each switchboard to enable conversational connections to be established between the lines of said switchboards through the medium of said trunk-circuits, order-wire circuits each having a plurality of A terminals also extending between the said switchboards to provide means for communication between the A and B operators, and means associated with the order-wire circuits whereby the A operators are enabled to select the idle B operators without the necessity of listening in.

5. In a telephone-exchange system, the combination with an A switchboard and a B switchboard, of trunk-circuits extending between said switchboards, operators' devices at each switchboard to enable conversational connections to be established between the lines of said switchboards through the medium of said trunk-circuits, order-wire circuits having a plurality of A terminals also extending between the said switchboards to provide means for communication between the A and B operators, and busy-signaling means associated with said order-wires to inform the A operators of the idle or busy condition of said wires.

6. In a telephone-exchange system, the combination with an A switchboard and a B switchboard, of trunk-circuits extending between said switchboards, operators' devices at each switchboard to enable conversational connections to be established between the lines of said switchboards through the medium of said trunk-circuits, order-wire circuits passing before a plurality of A operators also extending between the said switchboards to provide means for communication between the A and B operators, and means associated with the order-wire circuits to indicate to the A operators the idle or busy condition of said order-wires.

7. In a telephone-exchange system, the combination with an A switchboard and a B switchboard, of trunk-circuits extending between said switchboards, operators' devices at each switchboard to enable conversational connections to be established between the lines of said switchboards through the medium of said trunk-circuits, order-wire circuits passing through a plurality of A operators' positions and also extending between the said switchboards to provide means for communication between the A and B operators, and means associated with said order-wires to indicate their idle or busy condition.

8. In a telephone-exchange system, the combination with an A switchboard and a B switchboard, of trunk-circuits extending be-

tween said switchboards, operators' devices at each switchboard to enable conversational connections to be established between the lines of said switchboards through the medium of said trunk-circuits, order-wire circuits also extending between the said switchboards to provide means for communication between the A and B operators, said order-wires passing before the various operators at the A board and connected each with an operator's telephone at the B board, order-keys before the operators at the A board to enable them to connect their telephones with any of the order-wires, and busy signals for said order-wires whereby whenever one is in use the fact is indicated at the various positions, substantially as described.

9. In a telephone-exchange system, the combination with an A switchboard and a B switchboard, of trunk-circuits extending between said switchboards, operators' devices at each switchboard to enable conversational connections to be established between the lines of said switchboards through the medium of said trunk-circuits, order-wire circuits also extending between the said switchboards to provide means for communication between the A and B operators, said order-wires passing before the various operators at the A board and connected each with an operator's telephone at the B board, order-keys before the operators at the A board to enable them to connect their telephones with any of the order-wires, and busy signals for the said order-wires whereby whenever an order-key is operated at one position, the corresponding signals are given at the other positions, substantially as described.

10. In a telephone-exchange system, the combination with an A switchboard and a B switchboard, of trunk-circuits extending between said switchboards, operators' devices at each switchboard to enable conversational connections to be established between the lines of said switchboards through the medium of said trunk-circuits, order-wire circuits also extending between the said switchboards to provide means for communication between the A and B operators, said order-wires passing before the various operators at the A board and connected each with an operator's telephone at the B board, order-keys before the operators at the A board to enable them to connect their telephones with any of the order-wires, and busy signals for said order-wires at each position, whereby whenever an order-key is depressed the corresponding signals at each of the other positions are operated, substantially as described.

11. In a telephone-exchange system, the combination with an A switchboard and a B switchboard, of trunk-circuits extending between said switchboards, operators' devices at each switchboard to enable conversational



connections to be established between the lines of said switchboards through the medium of said trunk-circuits, order-wire circuits also extending between the said switchboards to provide means for communication  
 5 between the A and B operators, said order-wires passing before the various operators at the A board and connected each with an operator's telephone at the B board, order-keys  
 10 before the operators at the A board to enable them to connect their telephones with any of the order-wires, and means associated with the order-wire circuits whereby whenever an order-wire is in use or not in condition for use  
 15 a busy-signaling indication is given at the A switchboard.

12. In a telephone-exchange system, the combination with an A switchboard and a B switchboard, of trunk-circuits extending between  
 20 said switchboards, operators' devices at each switchboard to enable conversational connections to be established between the lines of said switchboards through the medium of said trunk-circuits, order-wire circuits also extending between the said switchboards to provide means for communication  
 25 between the A and B operators, said order-wires passing before the various operators at the A board and connected each with an operator's telephone at the B board, order-keys before the operators at the A board to enable them to connect their telephones with any of the order-wires, and means whereby when an order-wire is thrown out  
 30 of use at the B office a distinctive signal is made possible to the operators at the A office.

13. In a telephone-exchange system, the combination with an A switchboard and a B  
 40 switchboard, of trunk-circuits extending between these boards, operators' devices at the boards to connect the lines thereof with said trunk-circuits, order-wires between the boards to permit communication between  
 45 the operators, and means at the B board to place said order-wires in condition to distinctively test busy, substantially as described.

14. In a telephone-exchange system, the combination with branch exchanges, of a  
 50 multiple switchboard at one of the branch exchanges, trunk-circuits extending from said switchboard to the other branch exchange, said trunk-circuits extending through a plurality of operators' positions at said  
 55 multiple board, connecting means at each branch exchange to connect said trunks with the subscribers' lines, order-wire circuits extending between the branch exchanges and passing through the operators' positions at  
 60 said multiple board, means to enable the operators at the multiple board to connect

their telephones with any of said order-circuits, and means whereby when one of the operators at the multiple board has connected her telephone with one of the order-  
 65 wire circuits, said circuit indicates "busy" at the other operators' positions at such board.

15. In a telephone-exchange system, the combination with branch exchanges, of a  
 70 multiple switchboard at one of the branch exchanges, trunk-circuits extending from said switchboard to the other branch exchanges, said trunk-circuits extending through a plurality of operators' positions at  
 75 said multiple board, connecting means at each branch exchange to connect said trunks with the subscribers' lines, order-wire circuits extending between the branch exchanges and passing through the operators'  
 80 positions at said multiple board, operators' listening-keys at each operator's position at the multiple board to enable the operators to connect their telephones with any of said order-circuits, signals associated with said  
 85 order-keys, and means whereby when one of the order-keys is depressed at the operator's position to connect her telephone with an order-circuit, the signals associated with the order-keys for that same order-circuit at the  
 90 other operators' positions are operated to indicate that the said order-circuit is busy.

16. In a telephone-exchange system, the combination with branch exchanges, of a  
 95 multiple switchboard at one of the branch exchanges, trunk-circuits extending from said switchboard to the other branch exchanges, said trunk-circuits extending through a plurality of operators' positions at said  
 100 multiple board, connecting means at each branch exchange to connect said trunks with the subscribers' lines, order-wire circuits extending between the branch exchanges and passing through the operators' positions at  
 105 said multiple board, a signaling-circuit associated with each order-wire circuit in the multiple board, operators' listening-keys at the multiple board to enable the operators to connect their telephone with said order-wire circuits, a signal for each order-key connected with the corresponding signaling-circuit, and means whereby the depression of any listening-key operates the signals associated with the other order-keys of the  
 110 same order-circuit.  
 115

In witness whereof I have hereunto subscribed my name in the presence of two witnesses.

H. LINTON REBER.

Witnesses:

JAMES HARRISON,  
 JOHN M. STUART.