

No. 767,033.

PATENTED AUG. 9, 1904.

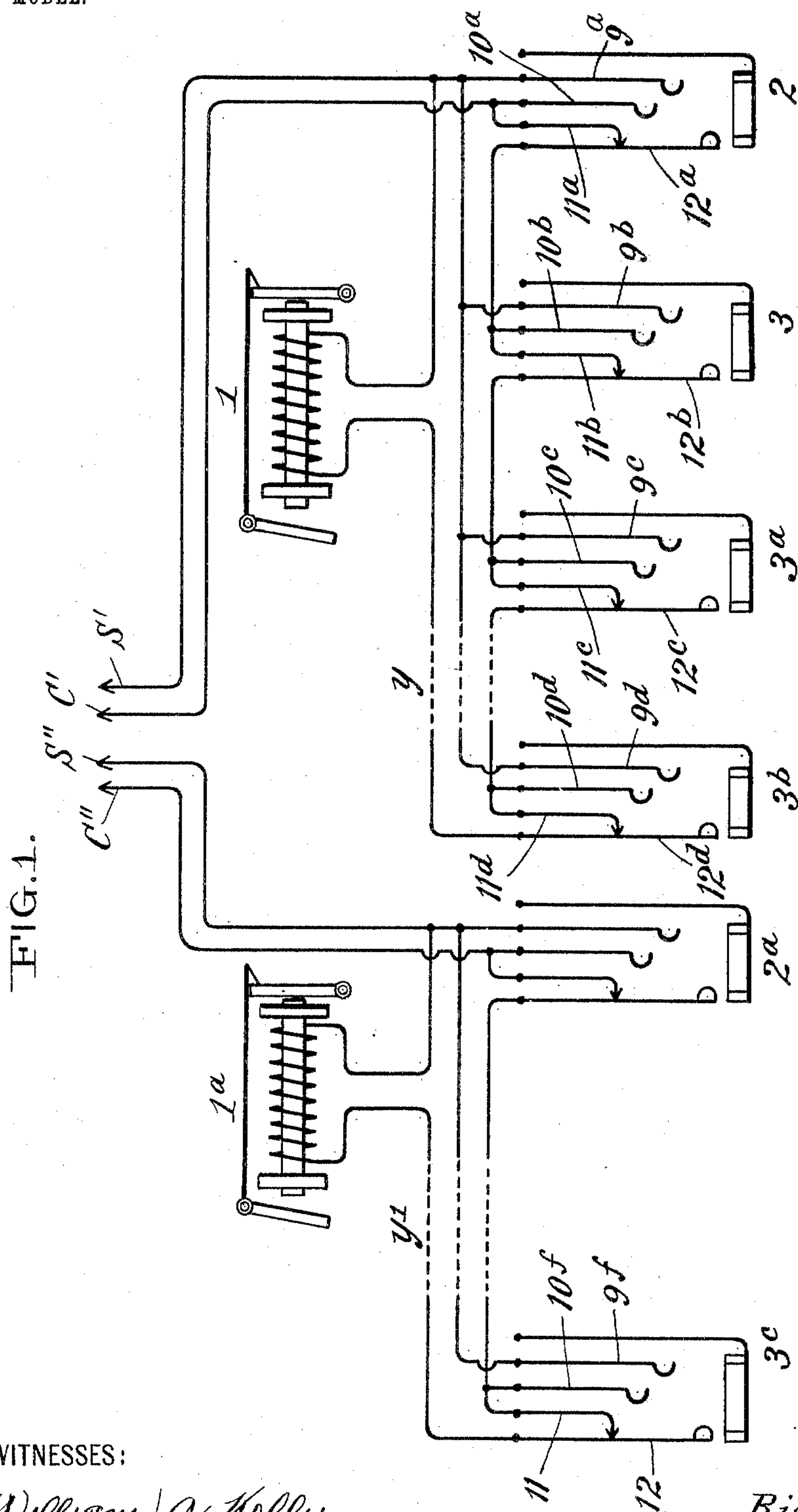
R. M. BEARD.

TELEPHONE CENTRAL EXCHANGE INSTALLMENT.

APPLICATION FILED DEC. 15, 1903.

NO MODEL.

3 SHEETS—SHEET 1.



WITNESSES:

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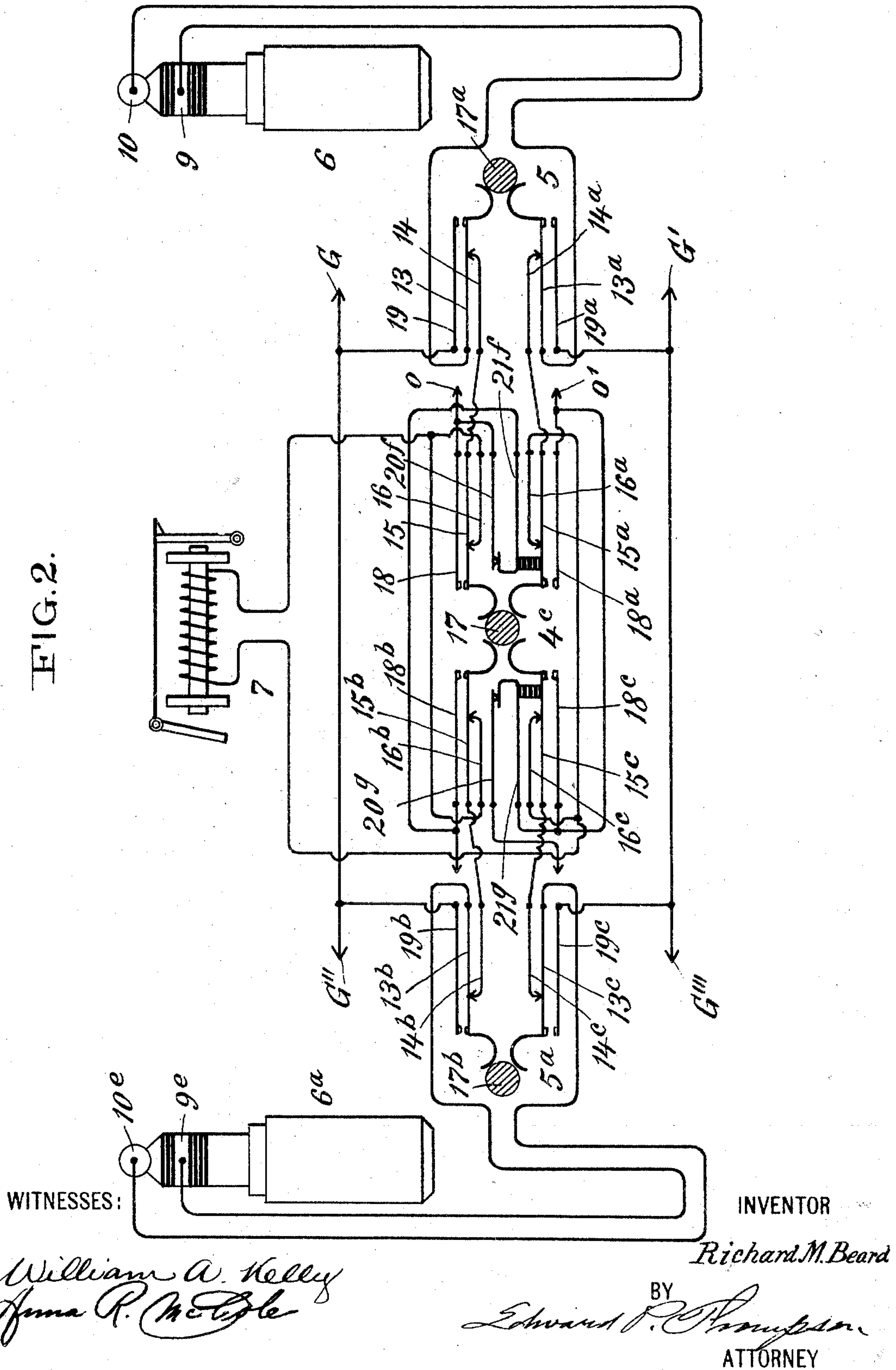
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3 SHEETS—SHEET 2.

FIG. 2.



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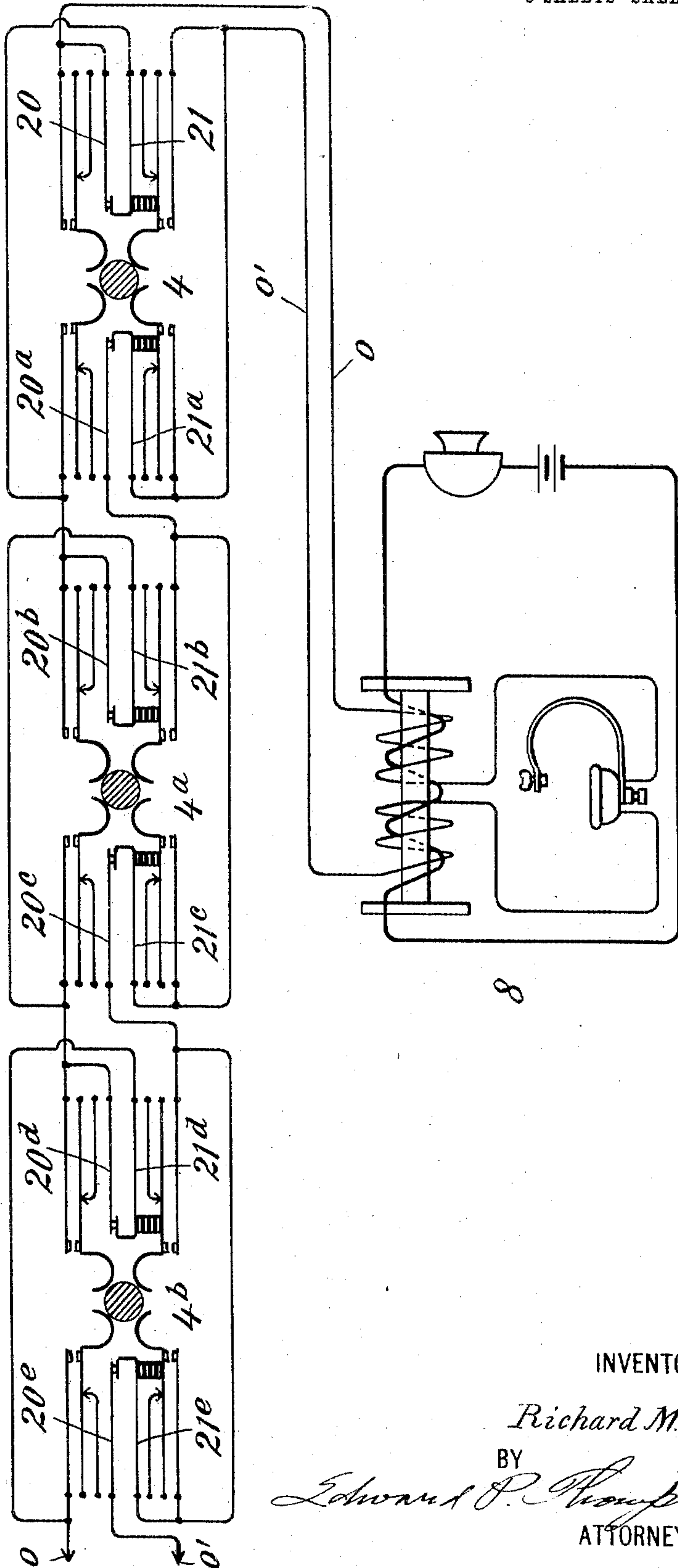
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3 SHEETS—SHEET 3.

FIG. 3.



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# UNITED STATES PATENT OFFICE.

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## TELEPHONE CENTRAL-EXCHANGE INSTALMENT.

SPECIFICATION forming part of Letters Patent No. 767,033, dated August 9, 1904.

Application filed December 15, 1903. Serial No. 185,231. (No model.)

*To all whom it may concern:*

Be it known that I, RICHARD M. BEARD, a citizen of the United States of America, and a resident of New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Telephone Central - Exchange Instalments, of which the following is a specification.

My invention relates generally to telephone systems, and specifically to a secret system of telephonic communication whereby when any two subscribers' telephones are connected together for talking no third subscriber or central-exchange operator is able through any manipulation of his telephone apparatus or switching devices to listen in while the two subscribers are in communication. No complicated or unusual mechanism is needed in my system, privacy being secured through the disposition of circuits, and the number of subscribers which can be supplied is practically unlimited.

I have found that the public telephones, as well as the systems of intercommunication from one department to another in present use in the banking-houses, stock-exchanges, brokers' offices, and other important places of business in large cities are by reason of securing no privacy to telephonic conversations not adapted to meet the requirements. Moreover, in smaller towns and villages the annoyance caused by central-exchange operators listening to the conversations of subscribers has been considerable.

My system is especially designed to meet the demands of parties requiring absolutely private telephonic communication and is equally adapted to fill all the other requirements of telephone traffic.

The general organization comprising my invention consists of telephone and signaling apparatus located at the subscribers' telephones and at the central exchanges, wires connecting the central exchanges with each other, other wires connecting the central ex-

changes with the subscribers' telephones, and switching apparatus located at the central exchanges by which the central-exchange operator can have talking connection with one subscriber only at a time.

The disposition of the local circuits and apparatus in the central exchanges is as follows: The individual visual signal for indicating the subscriber's call is tapped directly onto one side of the subscriber's line and makes connection with the other side of the line through the jack-springs when no plug is in the answering or any of the multiple jacks. The answering-jack and multiple jacks are so connected together through their contacts that when a plug is in any of the jacks the line is open to every jack occurring after it in the multiple. On the keyboard the keys for each pair of cords are arranged in a separate group consisting of one two-way-listening-key and two signaling-keys, so that when all of the keys are in the normal position the cords are connected together, but when either of the signaling-buttons is pressed the cord to which it corresponds is disconnected from the other cord and the listening-key and the generator contact-springs are placed in circuit with it and when the lever of the listening-key is thrown the one way or the other from the normal position the cords are disconnected from each other and the operator's telephone is connected with the one cord or the other, according to the position of the lever, and all the other apparatus and circuits are arranged in the manner usually employed in central exchanges.

In installations having more than one central exchange the exchanges are connected by trunk-lines, as in common practice.

In the accompanying drawings some of the apparatus—as, for example, the transmitter and receiver—is shown as exterior elevations; but most of it is represented diagrammatically and typically.

Figure 1 shows two different subscribers' lines terminating in the spring-jacks and line-



signals at the central exchange. Fig. 2 is a diagram of the cord-circuit and keyboard-wiring at the central exchange. Fig. 3 illustrates the method of connecting the wires from the operator's telephone to the listening-keys at the central exchange.

In Fig. 1,  $C' S'$  and  $C'' S''$  are respectively two subscribers' lines. 1 is the line-signal, and 2 is the answering-jack for subscriber's line  $C' S'$ , while 3,  $3^a$ , and  $3^b$  are the multiple jacks,  $3^b$  being the last in the multiple.  $1^a$  is the line-signal, and  $2^a$  is the answering-jack for subscriber's line  $C'' S''$ , and  $3^c$  is the last multiple jack. There may be no multiple jacks, or there may be any number of them, according to the number of operators' positions, which are omitted from the drawings, as indicated by the dotted lines  $y$  and  $y'$ .

In Fig. 2,  $4^c$  is the two-way listening-key, while 5 and  $5^a$  are respectively the signaling-keys for the plugs 6 and  $6^a$ . For the sake of clearness the cords are omitted from the drawings, and the pair of wires from each signaling-key is represented as leading directly to the ring and tip contacts of the respective plugs. 7 is the clearing-out signal for the pair of plugs 6 and  $6^a$ . The two wires, of which  $G G''$  and  $G' G'''$  are respective sections, are common wires which multiple to every signaling-key on the keyboard and are the two sides of a generator-circuit which supplies the current for signaling.  $o$  and  $o'$  are the two sides of a circuit to the operator's telephone, which is fully illustrated in Fig. 3.

In Fig. 3, 4,  $4^a$ , and  $4^b$  are three listening-keys, and 8 is the operator's telephone.  $o$  is one side of the operator's telephone-circuit, and  $o'$  is the other side. The wire  $o$  is connected to one side of the key 4 and is connected to the next key  $4^a$  through the contacts 20 and 21, which are normally closed, and is again connected to the key  $4^b$  through the contacts  $20^b$  and  $21^b$ , which are normally closed, while the wire  $o'$  is connected to the side of the key 4 opposite to the side which the wire  $o$  is connected to and to the next key  $4^a$  through the contacts  $20^a$  and  $21^a$ , which are normally closed, and is again connected to the key  $4^b$  through the contacts  $20^c$  and  $21^c$ , which are normally closed, and so on, the method of connecting the operator's telephone-wires to the listening-keys being to connect them to each succeeding key through a normally closed pair of contacts on the preceding key in the multiple. The key  $4^c$  in Fig. 2 may be considered as the fourth key in the multiple of three listening-keys, (shown in Fig. 3,) for if the key  $4^c$  in Fig. 2 were placed so that  $o$  and  $o'$  in Fig. 2 coincided with  $o$  and  $o'$  in Fig. 3 the key  $4^c$  would be connected as the fourth key in the multiple. (Shown in Fig. 3.)

Now let it be assumed that a subscriber desires to call and talk with another subscriber to which he has no direct line, but with whom

he can get a connection through the central exchange in which the line  $C' S'$  terminates, and let us suppose that the subscriber's line is the continuation of the line  $C' S'$  and proceed to trace the line  $C' S'$  in Fig. 1.  $S'$ , one side of line  $C' S'$ , terminates in the spring  $9^a$  of the answering-jack 2 and multiples to the corresponding spring in each of the multiple jacks 3,  $3^a$ , and  $3^b$ . Each of these springs is normally out of contact. The wire  $S'$  is also tapped to one side of the drop-signal 1, which is located at the same operator's position with the answering-jack 2.  $C'$ , the other side of the line  $C' S'$ , terminates in the springs  $10^a$  and  $11^a$  of the answering-jack 2. The spring  $11^a$  is normally in contact with the spring  $12^a$ , from which a wire connects to springs  $10^b$  and  $11^b$  in multiple jack 3. The spring  $11^b$  is normally in contact with spring  $12^b$ , from which a wire connects to springs  $10^c$  and  $11^c$  in multiple jack  $3^a$ . The spring  $11^c$  is normally in contact with spring  $12^c$ , from which a wire connects to springs  $10^d$  and  $11^d$  in the last multiple jack  $3^b$ , and the spring  $11^b$  is normally in contact with the spring  $12^d$ , from which a wire connects to the other side of drop 1, so the line  $C' S'$  is normally closed through the drop 1, and when the signaling-current passes through the winding of the drop 1 it operates to show the number of the subscriber calling.

Let it be assumed that the group of keys 5,  $4^c$ , and  $5^a$  and the pair of plugs 6 and  $6^a$  and clearing-out signal 7 corresponding to it, which is shown in Fig. 2, is located in the keyboard of the operator's position at which the jack 2 and the drop 1 (shown in Fig. 1) is located, and that the operator inserts the plug 6 (shown in Fig. 2) in the answering-jack 2 (shown in Fig. 1) to answer the subscriber calling. 9 and 10, the ring and tip contacts of the plug 6 (shown in Fig. 2) make contact, respectively, with the springs  $9^a$  and  $10^a$  of the jack 2, (shown in Fig. 1,) and the circuit to the drop 1 and also the circuit to all of the other jacks in the multiple is opened by the plug in the jack 2 forcing the spring  $12^a$  out of contact with the spring  $11^a$ . Continuing to trace the circuit in Fig. 2, the wires from the contacts 9 and 10 of the plug 6 respectively connect to the springs 13 and  $13^a$  of the signaling-key 5, which springs are normally in contact with the springs 14 and  $14^a$ , from which wires connect each spring, respectively, to the springs 15 and  $15^a$  of the listening-key  $4^c$ . The springs 15 and  $15^a$  of the key  $4^c$  are normally in contact, respectively, with springs 16 and  $16^a$ , from which wires connect, respectively, to springs  $16^b$  and  $16^c$ . Springs  $16^b$  and  $16^c$  are normally in contact, respectively, with springs  $15^b$  and  $15^c$ , from which wires connect each spring, respectively, to the springs  $14^b$  and  $14^c$  of the signaling-key  $5^a$ . The springs  $14^b$  and  $14^c$  of the key  $5^a$  are normally in contact, respectively, with the springs  $13^b$  and  $13^c$ ,



from which wires connect, respectively, to 9° and 10° the ring and tip contacts of the plug 6<sup>a</sup>. So 9 and 10, the ring and tip contacts of the plug 6, are normally connected, respectively, with 9° and 10°, the ring and tip contacts of the plug 6<sup>a</sup>—i. e., they are connected when the keys 5, 4°, and 5<sup>a</sup> are all in normal position.

When the operator inserts the plug 6 in the answering-jack of the subscriber calling, he throws the listening-key 4° into the position to listen on plug 6, in which position the wedge 17 is forced in between the springs 15 and 15<sup>a</sup> far enough to cause them to break contact with the springs 16 and 16<sup>a</sup> and to make contact, respectively, with the springs 18 and 18<sup>a</sup>. The springs 18 and 18<sup>a</sup> are tapped, respectively, to the wires *o* and *o'*, the two sides of the circuit to the operator's telephone set, and the operator is then in talking-circuit with the party calling. As soon as the operator learns what subscriber the party calling wants to be connected with he inserts the other plug 6<sup>a</sup> in the jack installed at his position the number of which corresponds to the number of the desired subscriber. If the line terminates in an answering-jack and drop located at his position, he inserts the plug 6<sup>a</sup> in the answering-jack; otherwise the operator inserts the plug 6<sup>a</sup> in the multiple jack installed at his position to connect the desired subscriber. To signal him, the operator throws the signaling-key 5<sup>a</sup> into the position to signal on plug 6<sup>a</sup>, in which position the wedge 17<sup>b</sup> is forced in between the springs 13<sup>b</sup> and 13<sup>c</sup> far enough to cause them to break contact with springs 14<sup>b</sup> and 14<sup>c</sup> and to make contact with springs 19<sup>b</sup> and 19<sup>c</sup>, which are tapped, respectively, to G G'' and G' G''', the two sides of the circuit to the signaling-generator, and then restores the key to the normal position.

If we assume that the multiple jack 3° (shown in Fig. 1) is the jack installed at the position which corresponds to the number of the desired subscriber and is the jack in which the plug 6<sup>a</sup> (shown in Fig. 2) is inserted, we may continue to trace the circuit in Fig. 1. To the spring 9<sup>f</sup>, in contact with the ring of the plug, a wire is connected, which is tapped to S'', one side of the line C'' S'', and to the spring 10<sup>f</sup> in contact with the tip of the plug a wire is connected which is tapped to C'', the other side of the desired subscriber's line C'' S''. The plug in the jack 3° also operates to cut the drop 1<sup>a</sup> out of circuit with the line C'' S'' by separating the contacts 11 and 12.

Returning again to Fig. 2, after signaling on plug 6<sup>a</sup> the operator may listen on the same plug. When the key 4° is in position to listen on plug 6<sup>a</sup>, the wedge 17 is forced in between the springs 15<sup>b</sup> and 15<sup>c</sup> far enough to cause them to break contact with the springs 16<sup>b</sup> and 16<sup>c</sup> and to make contact with springs 18<sup>b</sup> and 18<sup>c</sup>, thus placing the operator's telephone-wires *o* and *o'* in circuit, respectively,

with 9° and 10°, the ring and tip contacts of plug 6<sup>a</sup>.

If the operator has occasion to signal back to the subscriber calling on the plug 6, he may do so by operating the signaling-key 5 in the same manner the signaling-key 5<sup>a</sup> was operated.

It will be seen that when either signaling-key is in position to signal on the plug to which it corresponds the circuit to the other plug and keys is broken, and when the listening-key is in position for the operator to listen on one of the plugs the circuit to the other plug is open, so the operator can listen on but one plug at a time, and when listening on either plug the connection between the two subscribers is broken. All keys in the group connected with a busy pair of cords must remain in normal position until the two subscribers connected finish talking. When the two subscribers finish, each gives a signal which operates the clearing-out-signal drop 7, and the two plugs may then be removed from the jacks.

It may here be explained that the wiring between the listening-keys, as illustrated in Fig. 3, prevents the operator from using a plug from one set to answer a subscriber and a plug from another set to call the subscriber called for, connecting the two by listening on the two plugs at the same time. When the listening-key 4° (shown in Fig. 2) is thrown into position to listen on plug 6, contact is broken between the springs 20<sup>f</sup> and 21<sup>f</sup>, which are otherwise in contact, and when in position to listen on plug 6<sup>a</sup> contact is broken between the springs 20<sup>g</sup> and 21<sup>g</sup>, which are otherwise in contact. Similar springs are installed on every listening-key at the position, and by tracing the connections as illustrated in Fig. 3 it will be seen that when any key is thrown into listening position one of the operator's telephone-wires is opened to every key occurring after it in the multiple.

As the listening-keys 4, 4<sup>a</sup>, 4<sup>b</sup>, and 4<sup>c</sup> are all in multiple on the circuit *o o'* of the operator's telephone 8, they will all be located at one operator's desk and constitute that operator's set, and there may yet be other additional similar listening-keys in the multiple of each set, four only being shown. The connections and arrangement of the listening-keys shown in Fig. 3 are in all respects similar to those shown in Fig. 2, the adjuncts of each listening-key consisting of the signaling-keys 5 and 5<sup>2</sup>, the plugs 6 and 6<sup>a</sup>, and the clearing-out signal 7, as shown in Fig. 2, being omitted from Fig. 3 for the sake of space and clearness. There is a set of apparatus like that shown in Figs. 2 and 3 located at each operator's position; but as all of these sets are alike it is only necessary to show one.

Electricians will readily understand how common battery and other modern improve-



ments may be used in connection with my system without altering the method of connecting the jacks and the listening-keys in the central exchange. Also the plugs 6 and 6<sup>a</sup>,  
 5 with their attached cords, may be omitted and the subscriber's lines connected up in other well-known ways to the listening-keys. In short, many of the details in my system may be altered as conditions require in any special  
 10 installation, the operation being in any case to secure absolute privacy to telephonic conversations.

I claim as my invention—

1. A telephone central-exchange instalment  
 15 consisting of the combination of an operator's telephone-circuit; pairs of means for detachably connecting together any two subscribers' lines, and the two means of a pair normally connected with each other; a signaling-key  
 20 for each means; and a device for disconnecting the two means of a pair from each other and simultaneously connecting the operator's telephone-circuit to either one of the said means while maintaining it disconnected from  
 25 the other.

2. A telephone central-exchange instalment consisting of the combination of an operator's telephone-circuit; twin wire cords arranged in pairs and the cords of each pair normally  
 30 connected with each other; a double contact-plug in which each cord terminates; a signaling-key for each cord; and a device for disconnecting the two cords of a pair from each other and simultaneously connecting the op-  
 35 erator's telephone to either one of the cords while maintaining it disconnected from the other, said device consisting of a two-way listening-key, two of whose terminals on one side are connected to one of said cords through  
 40 one of said signaling-keys, two to the other cord through the other side of the listening-key and the other signaling-key, and the remaining two to the operator's telephone-circuit, and the terminals on the other side of the  
 45 listening-key being likewise disposed and connected with reference to the other cord.

3. A telephone central-exchange instalment consisting of the combination of an operator's telephone-circuit; twin wire cords arranged  
 50 in pairs and the cords of each pair normally connected with each other; a double contact-plug in which each cord terminates; a signaling-key for each cord; and a device for disconnecting the two cords of a pair from each  
 55 other and simultaneously connecting the operator's telephone to either one of the cords while maintaining it disconnected from the other, said device consisting of a two-way listening-key, two of whose terminals on one  
 60 side are connected to one of said cords through one of said signaling-keys, two to the other cord through the other side of the listening-key and the other signaling-key, and the remaining two to the operator's telephone-cir-

cuit, and the terminals on the other side of 65 the listening-key being likewise disposed and connected with reference to the other cord, and a wedge for controlling the connections of all of the said terminals.

4. A telephone central-exchange instalment 70 consisting of the combination of an operator's telephone-circuit; twin wire cords arranged in pairs and the cords of each pair normally connected with each other; a double contact-plug in which each cord terminates; a set of 75 multiple jacks in which each subscriber's line terminates respectively, the said jacks being so connected together through their contacts that when a said plug is in any one of the jacks the line is open to every jack occurring after 80 it in the multiple; a signaling-key for each cord; and a device for disconnecting the two cords of a pair from each other and simultaneously connecting the operator's telephone to either one of the cords while maintaining 85 it disconnected from the other, said device consisting of a two-way listening-key, two of whose terminals on one side are connected to one of said cords through one of said signaling-keys, two to the other cord through the 90 other side of the listening-key and the other signaling-key, and the remaining two to the operator's telephone-circuit, and the terminals on the other side of the listening-key being likewise disposed and connected with refer- 95 ence to the other cord, and a wedge for controlling the connections of all of the said terminals.

5. A telephone central-exchange instalment consisting of the combination of an operator's 100 telephone-circuit; twin wire cords arranged in pairs and the cords of each pair normally connected with each other; a double contact-plug in which each cord terminates; a set of multiple jacks in which each subscriber's line 105 terminates respectively, each of said jacks having a double pair of contacts, one of said contacts in one pair being connected directly to one side of the subscriber's line and the other contact of the same pair being connected 110 through the preceding jacks to the other side of the subscriber's line, the second pair of contacts connecting each jack with the one following in the multiple, and the second pair of contacts adapted to be opened by one of said plugs 115 when the first pair is closed through the same; a signaling-key for each cord; and a device for disconnecting the two cords of a pair from each other and simultaneously connecting the operator's telephone to either one of the cords 120 while maintaining it disconnected from the other, said device consisting of a two-way listening-key, two of whose terminals on one side are connected to one of said cords through one of said signaling-keys, two to the other 125 cord through the other side of the listening-key and the other signaling-key, and the remaining two to the operator's telephone-cir-



cuit, and the terminals on the other side of the listening-key being likewise disposed and connected with reference to the other cord.

6. A telephone central-exchange instalment  
 5 consisting of the combination of an operator's telephone-circuit; twin wire cords arranged in pairs and the cords of each pair normally connected with each other; a double contact-plug  
 10 in which each cord terminates; a set of multiple jacks in which each subscriber's line terminates respectively, each of said jacks having a double pair of contacts, one of said contacts in one pair being connected directly to  
 15 one side of the subscriber's line and the other contact of the same pair being connected through the preceding jacks to the other side of the subscriber's line, the second pair of contacts connecting each jack with the one following in the multiple, and the second pair of contacts adapted to be opened by one of said plugs  
 20 when the first pair is closed through the same; a signaling-key for each cord; and a device for disconnecting the two cords of a pair from each other and simultaneously connecting the  
 25 operator's telephone to either one of the cords while maintaining it disconnected from the other, said device consisting of a two-way listening-key, two of whose terminals on one side are connected to one of said cords through  
 30 one of said signaling-keys, two to the other cord through the other side of the listening-key and the other signaling-key, and the remaining two to the operator's telephone-circuit, and the terminals on the other side of  
 35 the listening-key being likewise disposed and connected with reference to the other cord, and a wedge for controlling the connections of all of the said terminals.

7. A telephone central-exchange instalment  
 40 consisting of the combination of an operator's telephone-circuit; twin wire cords arranged in pairs and the cords of each pair normally connected with each other; a double contact-plug in which each cord terminates; a signaling-  
 45 key for each cord; a device for disconnecting the two cords of a pair from each other and simultaneously connecting the operator's telephone to either one of the cords while maintaining it disconnected from the other, said  
 50 device consisting of a two-way listening-key, two of whose terminals on one side are connected to one of said cords through one of said signaling-keys, two to the other cord through the other side of the listening-key and the  
 55 other signaling-key, and the remaining two to the operator's telephone-circuit, and the terminals on the other side of the listening-key being likewise disposed and connected with reference to the other cord; and other  
 60 listening-keys like the first named and to each of which said operator's circuit is multiplied, and means adapted when any key is thrown into listening position to open one of the operator's telephone-wires to every key occurring  
 65 after it in the multiple.

8. A telephone central-exchange instalment consisting of the combination of an operator's telephone-circuit; twin wire cords arranged in pairs and the cords of each pair normally connected with each other; a double contact-plug  
 70 in which each cord terminates; a set of multiple jacks in which each subscriber's line terminates respectively, each of said jacks having a double pair of contacts, one of said contacts in one pair being connected directly to  
 75 one side of the subscriber's line and the other contact of the same pair being connected through the preceding jacks to the other side of the subscriber's line, the second pair of contacts connecting each jack with the one following in the multiple, and the second pair of  
 80 contacts adapted to be opened by one of said plugs when the first pair is closed through the same; a signaling-key for each cord; a device for disconnecting the two cords of a pair from  
 85 each other and simultaneously connecting the operator's telephone to either one of the cords while maintaining it disconnected from the other, said device consisting of a two-way listening-key, two of whose terminals on one  
 90 side are connected to one of said cords through one of said signaling-keys, two to the other cord through the other side of the listening-key and the other signaling-key, and the remaining two to the operator's telephone-circuit, and the terminals on the other side of  
 95 the listening-key being likewise disposed and connected with reference to the other cord; and other listening-keys like the first named and to each of which said operator's circuit is multiplied, and means adapted when any key is thrown into listening position to open one of the operator's telephone-wires to every key occurring after it in the multiple.

9. A telephone central-exchange instalment  
 105 consisting of the combination of an operator's telephone-circuit; twin wire cords arranged in pairs and the cords of each pair normally connected with each other; a double contact-plug in which each cord terminates; a signaling-  
 110 key for each cord; a device for disconnecting the two cords of a pair from each other and simultaneously connecting the operator's telephone to either one of the cords while maintaining it disconnected from the  
 115 other, said device consisting of a two-way listening key, two of whose terminals on one side are connected to one of said cords through one of said signaling-keys, two to the other cord through the other side of the listening-  
 120 key and the other signaling-key, and the remaining two to the operator's telephone-circuit, and the terminals on the other side of the listening-key being likewise disposed and connected with reference to the other cord,  
 125 and a wedge for controlling the connections of all of the said terminals; other listening-keys like the first named and to each of which said operator's circuit is multiplied; and a normally closed pair of contacts on one side  
 130



of each of said listening-keys and through which one of the wires to the operator's telephone is connected to the succeeding listening-key in the multiple, and a similar normally closed pair of contacts on the other side of each of said listening-keys and through which the other wire of the operator's telephone is connected to the other side of the said succeeding listening-key, said two pairs of contacts being controlled by said wedge.

10. A telephone central-exchange installment consisting of the combination of an operator's telephone-circuit; twin wire cords arranged in pairs and the cords of each pair normally connected with each other; a double contact-plug in which each cord terminates; a set of multiple jacks in which each subscriber's line terminates respectively, each of said jacks having a double pair of contacts, one of said contacts in one pair being connected directly to one side of the subscriber's line and the other contact of the same pair being connected through the preceding jacks to the other side of the subscriber's line, the second pair of contacts connecting each jack with the one following in the multiple, and the second pair of contacts adapted to be opened by one of said plugs when the first pair is closed through the same; a signaling-key for each cord; a device for disconnecting the two cords of a pair from each other and simultaneously connecting the operator's telephone to either one of the cords while maintaining it disconnected from the other, said device consisting of a two-way listening-key, two of whose terminals on one side are connected to one of said cords through one of said signaling-keys, two to the other cord through the other side of the listening-key and the other signaling-key, and the remaining two to the operator's circuit, and the terminals on the other side of the listening-key being likewise disposed and connected with reference to the other cord, and a wedge for controlling the connections of all of the said terminals; other listening-keys like the first named and to each of which said operator's circuit is multiplied; and a normally closed pair of contacts on one side of each of said listening-keys and through which one of the wires to the operator's telephone is connected to the succeeding listening-key in the multiple, and a similar normally closed pair of contacts on the other side of each of said listening-keys and through which the other wire of the operator's telephone is connected to the other side of the said succeeding listening-key, said last-named two pairs of contacts being controlled by said wedge.

11. A telephone central-exchange installment consisting of the combination of an operator's telephone-circuit; two pairs of wires and each pair of said wires normally electrically connected with the other pair; a connecting means in which each pair of said wires

terminates; a signaling-key for each of said pairs of wires; and a device for disconnecting the two pairs of wires from each other and simultaneously connecting the operator's telephone to either one of the pairs of wires while maintaining it disconnected from the other pair.

12. A telephone central-exchange installment consisting of the combination of an operator's telephone-circuit; terminal means in which the subscribers' lines terminate; two pairs of wires and each pair of said wires normally electrically connected with the other pair; a connecting means in which each pair of said wires terminates, each of said connecting means being adapted to engage one of said terminal means; a signaling-key for each of said pairs of wires; and a device for disconnecting the two pairs of wires from each other and simultaneously connecting the operator's telephone to either one of the pairs of wires while maintaining it disconnected from the other pair.

13. A telephone central-exchange installment consisting of the combination of an operator's telephone-circuit; two pairs of wires and each pair of said wires normally electrically connected with the other pair; a connecting means in which each pair of said wires terminates; a signaling-key for each of said pairs of wires; and a device for disconnecting the two pairs of wires from each other and simultaneously connecting the operator's telephone to either one of the pairs of wires while maintaining it disconnected from the other pair, said device consisting of a two-way listening-key, two of whose terminals on one side are connected to one of said pairs of wires through one of said signaling-keys, two to the other pair of wires through the other side of the listening-key and the other signaling-key, and the remaining two to the operator's telephone-circuit, and the terminals on the other side of the listening-key being likewise disposed and connected with reference to the other pair of wires.

14. A telephone central-exchange installment consisting of the combination of an operator's telephone-circuit; terminal means in which the subscribers' lines terminate; two pairs of wires and each pair of said wires normally electrically connected with the other pair; a connecting means in which each pair of said wires terminates, each of said connecting means being adapted to engage one of said terminal means; a signaling-key for each of said pairs of wires; and a device for disconnecting the two pairs of wires from each other and simultaneously connecting the operator's telephone to either one of the pairs of wires while maintaining it disconnected from the other pair, said device consisting of a two-way listening-key, two of whose terminals on one side are connected to one of said pairs of wires through one of said signaling-keys, two to the



other pair of wires through the other side of the listening-key and the other signaling-key, and the remaining two to the operator's telephone-circuit, and the terminals on the other side of the listening-key being likewise disposed and connected with reference to the other pair of wires.

15. A telephone central-exchange installation consisting of the combination of an operator's telephone-circuit; terminal means in which the subscribers' lines terminate; two pairs of wires and each pair of said wires normally electrically connected with the other pair; a connecting means in which each pair of said wires terminates, each of said connecting means being adapted to engage one of said terminal means; a signaling-key for each of said pairs of wires; and a device for disconnecting the two pairs of wires from each other and simultaneously connecting the operator's telephone to either one of the pairs of wires while maintaining it disconnected from the other pair, said device consisting of a two-way listening-key, two of whose terminals on one side are connected to one of said pairs of wires through one of said signaling-keys, two to the other pair of wires through the other side of the listening-key and the other signaling-key, and the remaining two to the operator's telephone-circuit, and the terminals on the other side of the listening-key being likewise disposed and connected with reference to the other pair of wires, and a wedge for controlling the connections of all of the said terminals of the listening-key.

16. A telephone central-exchange installation consisting of the combination of an operator's telephone-circuit; two pairs of wires and each pair of said wires normally electrically connected with the other pair; a connecting means in which each pair of said wires terminates; a signaling-key for each of said pairs of wires; a device for disconnecting the two pairs of wires from each other and simultaneously connecting the operator's telephone to either one of the pairs of wires while maintaining it disconnected from the other pair; other said devices, signaling-keys, wires and connecting means like the first named and likewise arranged and to each of which said devices said operator's circuit is multiplied; and mechanism adapted when any key is thrown into listening position to open one side of the operator's telephone-circuit to every one of said listening-keys occurring after it in the multiple.

17. A telephone central-exchange installation consisting of the combination of an operator's telephone-circuit; two pairs of wires and each pair of said wires normally electrically connected with the other pair; a connecting means in which each pair of said wires terminates; a signaling-key for each of said pairs of wires; a device for disconnecting the two pairs of wires from each other and simultaneously connecting the operator's telephone to either one of the pairs of wires while maintaining it disconnected from the other pair; other said devices, signaling-keys, wires and connecting means like the first named and

taneously connecting the operator's telephone to either one of the pairs of wires while maintaining it disconnected from the other pair; other said devices, signaling-keys, wires and connecting means like the first named and likewise arranged and to each of which said devices said operator's circuit is multiplied; mechanism adapted when any key is thrown into listening position to open one side of the operator's telephone-circuit to every one of said listening-keys occurring after it in the multiple; and terminal means in which the subscribers' lines terminate, each of said connecting means being adapted to engage one of said terminal means.

18. A telephone central-exchange installation consisting of the combination of an operator's telephone-circuit; two pairs of wires and each pair of said wires normally electrically connected with the other pair; a connecting means in which each pair of said wires terminates; a signaling-key for each of said pairs of wires; a device for disconnecting the two pairs of wires from each other and simultaneously connecting the operator's telephone to either one of the pairs of wires while maintaining it disconnected from the other pair, said device consisting of a two-way listening-key, two of whose terminals on one side are connected to one of said pairs of wires through one of said signaling-keys, two to the other pair of wires through the other side of the listening-key and the other signaling-key, and the remaining two to the operator's telephone-circuit, and the terminals on the other side of the listening-key being likewise disposed and connected with reference to the other pair of wires; other listening-keys, signaling-keys, wires and connecting means like the first named and likewise arranged and to each of which said listening-keys said operator's circuit is multiplied; and a normally closed pair of contacts on one side of each of said listening-keys and through which one of the wires to the operator's telephone is connected to the succeeding listening-key in the multiple, and a similar normally closed pair of contacts on the other side of each of said listening-keys and through which the other side of the operator's telephone is connected to the other side of the said succeeding listening-key.

19. A telephone central-exchange installation consisting of the combination of an operator's telephone-circuit; two pairs of wires and each pair of said wires normally electrically connected with the other pair; a connecting means in which each pair of said wires terminates; a signaling-key for each of said pairs of wires; a device for disconnecting the two pairs of wires from each other and simultaneously connecting the operator's telephone to either one of the pairs of wires while maintaining it disconnected from the other pair; other said devices, signaling-keys, wires and connecting means like the first named and



likewise arranged and to each of which said devices said operator's circuit is multiplied; mechanism adapted when any key is thrown into listening position to open one side of the operator's telephone-circuit to every one of said listening-keys occurring after it in the multiple; a plurality of groups of elements like the above named, one being located at each operator's position; and terminal means in which the subscribers' lines terminate, each of said connecting means being adapted to engage one of said terminal means.

20. A telephone central-exchange installation consisting of the combination of an operator's telephone-circuit; two pairs of wires and each pair of said wires normally electrically connected with the other pair; a connecting means in which each pair of said wires terminates; a signaling-key for each of said pairs of wires; a device for disconnecting the two pairs of wires from each other and simultaneously connecting the operator's telephone to either one of the pairs of wires while maintaining it disconnected from the other pair, said device consisting of a two-way listening-key, two of whose terminals on one side are connected to one of said pairs of wires through one of said signaling-keys, two to the other pair of wires through the other side of the listening-key and the other signaling-key, and the remaining two to the operator's telephone-circuit, and the terminals on the other side of the listening-key being likewise disposed and connected with reference to the other pair of wires; other listening-keys, signaling-keys, wires and connecting means like the first named and likewise arranged and to each of which said listening-keys said operator's circuit is multiplied; a normally closed pair of contacts on one side of each of said listening-keys and through which one of the wires to the operator's telephone is connected to the succeeding listening-key in the multiple, and a similar normally closed pair of contacts on the other side of each of said listening-keys and through which the other side of the operator's telephone is connected to the other side of the said succeeding listening-key; a plurality of groups of elements like the above named, one being located at each operator's position; a set of multiple jacks in which each subscriber's line terminates respectively, each of said jacks having a double pair of contacts, one of said contacts in one pair being connected directly to one side of the subscriber's line and the other contact of the same pair being connected through the preceding jacks of the multiple to the other side of the subscriber's line, the second pair of contacts connecting each jack with the one following in the multiple, and the said second pair of contacts adapted to be opened by one of said connecting means when the first-named pair is closed through the same said connecting means.

21. A telephone central-exchange instal-

ment consisting of the combination of an operator's telephone-circuit; two pairs of wires and each pair of said wires normally electrically connected with the other pair; a connecting means in which each pair of said wires terminates; a signaling-key for each of said pairs of wires; a device for disconnecting the two pairs of wires from each other and simultaneously connecting the operator's telephone to either one of the pairs of wires while maintaining it disconnected from the other pair, said device consisting of a two-way listening-key, two of whose terminals on one side are connected to one of said pairs of wires through one of said signaling-keys, two to the other pair of wires through the other side of the listening-key and the other signaling-key, and the remaining two to the operator's telephone-circuit, and the terminals on the other side of the listening-key being likewise disposed and connected with reference to the other pair of wires, and a wedge for controlling the connections of all of the said terminals of the listening-key; other listening-keys, signaling-keys, wires and connecting means like the first named and likewise arranged and to each of which said listening-keys said operator's circuit is multiplied; a normally closed pair of contacts on one side of each of said listening-keys and through which one of the wires to the operator's telephone is connected to the succeeding listening-key in the multiple, and a similar normally closed pair of contacts on the other side of each of said listening-keys and through which the other side of the operator's telephone is connected to the other side of the said succeeding listening-key, said two pairs of contacts being controlled by said wedge and said wedge adapted to open either one or the other of said contacts whenever said listening-key is thrown to listening position; a plurality of groups of elements like the above named, one being located at each operator's position; a set of multiple jacks in which each subscriber's line terminates respectively, each of said jacks having a double pair of contacts, one of said contacts in one pair being connected directly to one side of the subscriber's line and the other contact of the same pair being connected through preceding jacks of the multiple to the other side of the subscriber's line, the second pair of contacts connecting each jack with the one following in the multiple, and the said second pair of contacts adapted to be opened by one of said connecting means when the first-named pair is closed through the same said connecting means.

22. A telephone central-exchange installation consisting of the combination of an operator's telephone-circuit; two pairs of wires and each pair of said wires normally electrically connected with the other pair; a signaling-key for each of said pairs of wires; and a device for disconnecting the two pairs of



wires from each other and simultaneously connecting the operator's telephone to either one of the pairs of wires while maintaining it disconnected from the other pair.

5 23. A telephone central-exchange installation consisting of the combination of an operator's telephone-circuit; two pairs of wires and each pair of said wires normally electrically connected with the other pair; a signaling-key for each of said pairs of wires; and  
10 a device for disconnecting the two pairs of wires from each other and simultaneously connecting the operator's telephone to either one of the pairs of wires while maintaining it disconnected from the other pair, said device consisting of a two-way listening-key, two of  
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whose terminals on one side are connected to one of said pairs of wires through one of said signaling-keys, two to the other pair of wires through the other side of the listening-key and 20 the other signaling-key, and the remaining two to the operator's telephone-circuit, and the terminals on the other side of the listening-key being likewise disposed and connected with reference to the other pair of wires. 25

In testimony whereof I have hereunto subscribed my hand and affixed my seal this the 5th day of December, 1903.

RICHARD M. BEARD. [L. s.]

Witnesses:

L. E. HICKS,

EDWARD P. THOMPSON.