

No. 688,673.

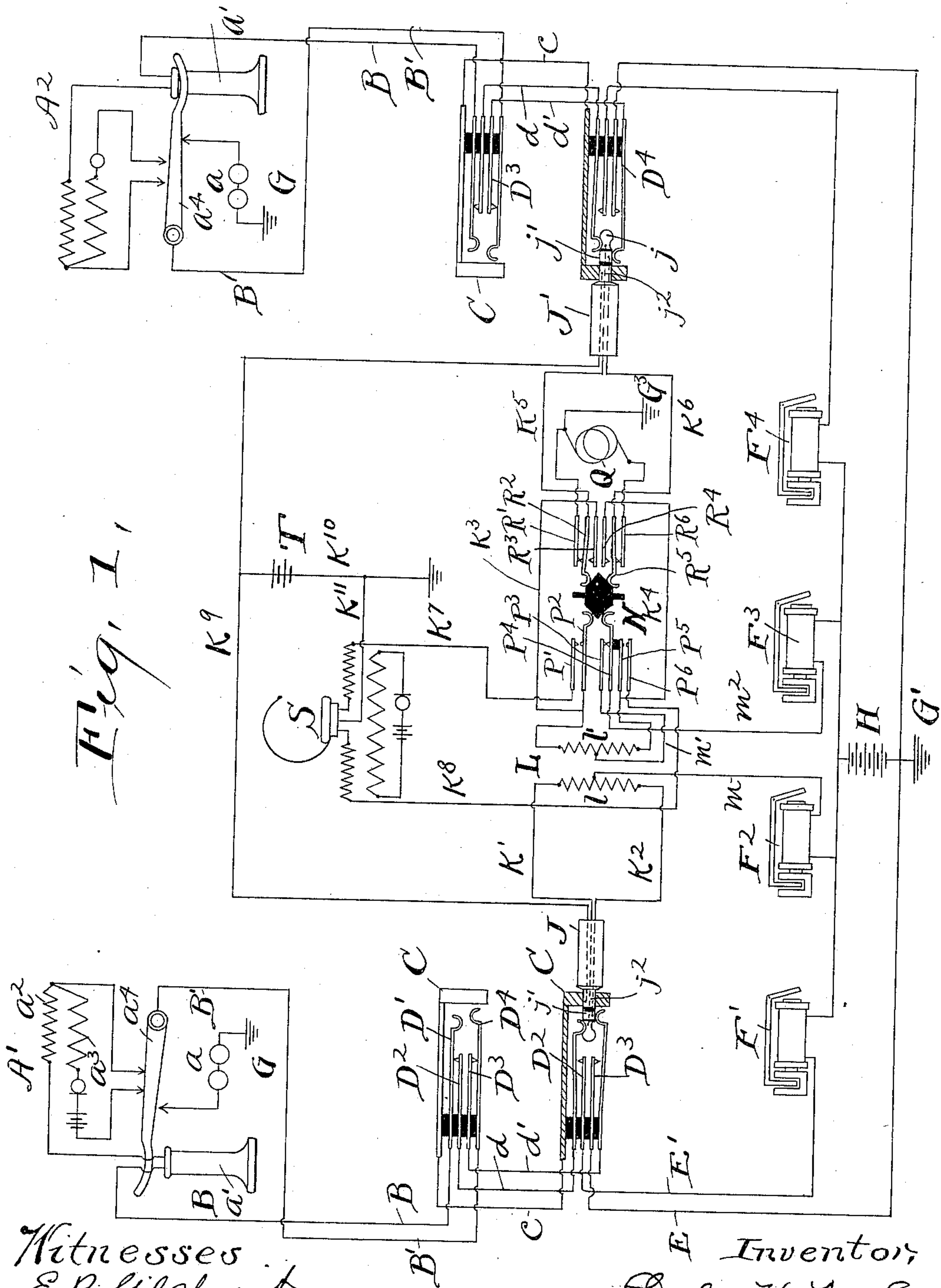
Patented Dec. 10, 1901.

C. H. NORTH.  
TELEPHONE SYSTEM.

(Application filed May 17, 1900.)

(No Model.)

3 Sheets—Sheet I.



Witnesses  
E. B. Gilchrist  
F. D. Ammen

Inventor  
Charles H. North  
By His Attorneys,  
Thurston & Bates.

**No. 688,673.**

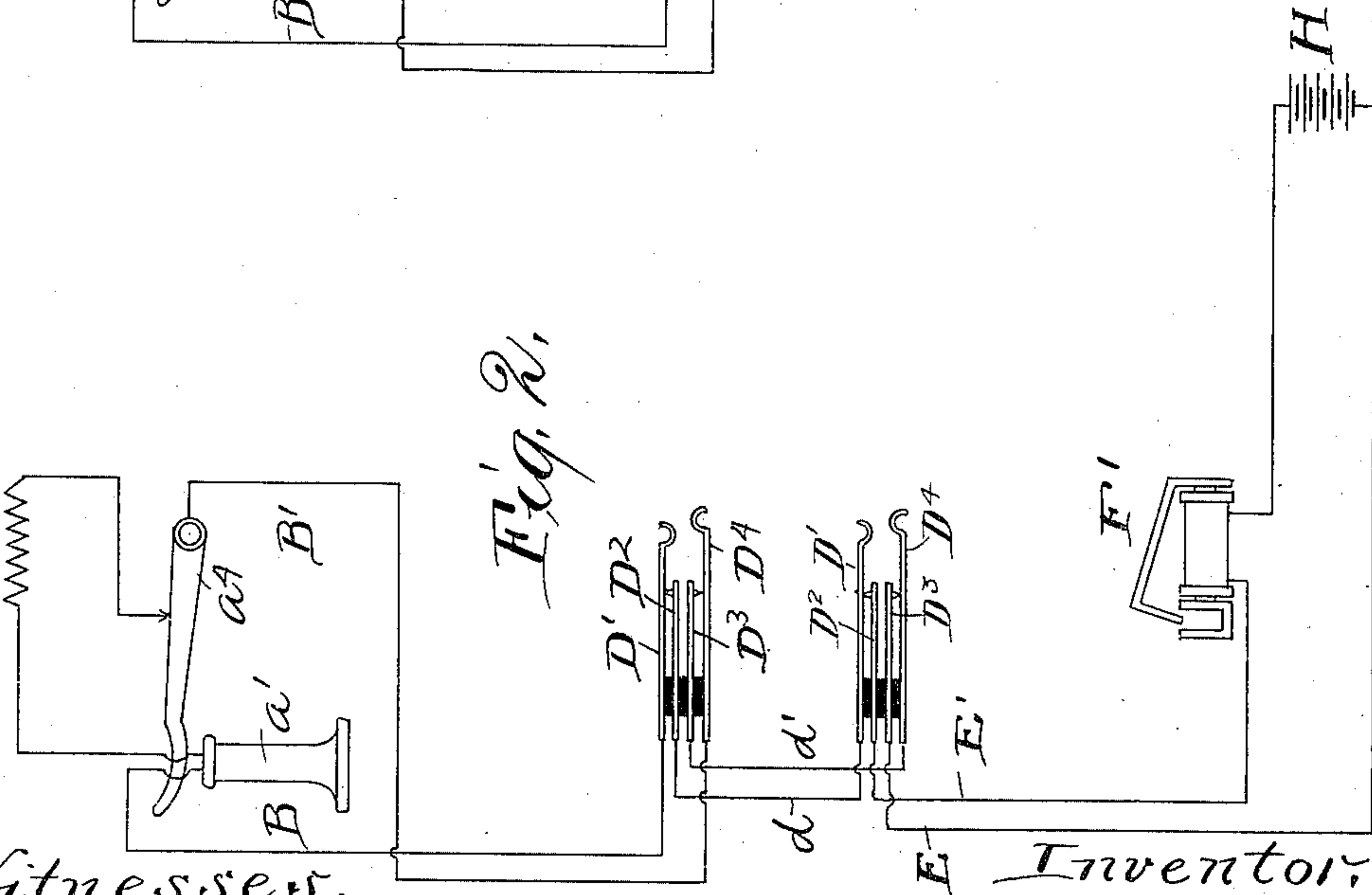
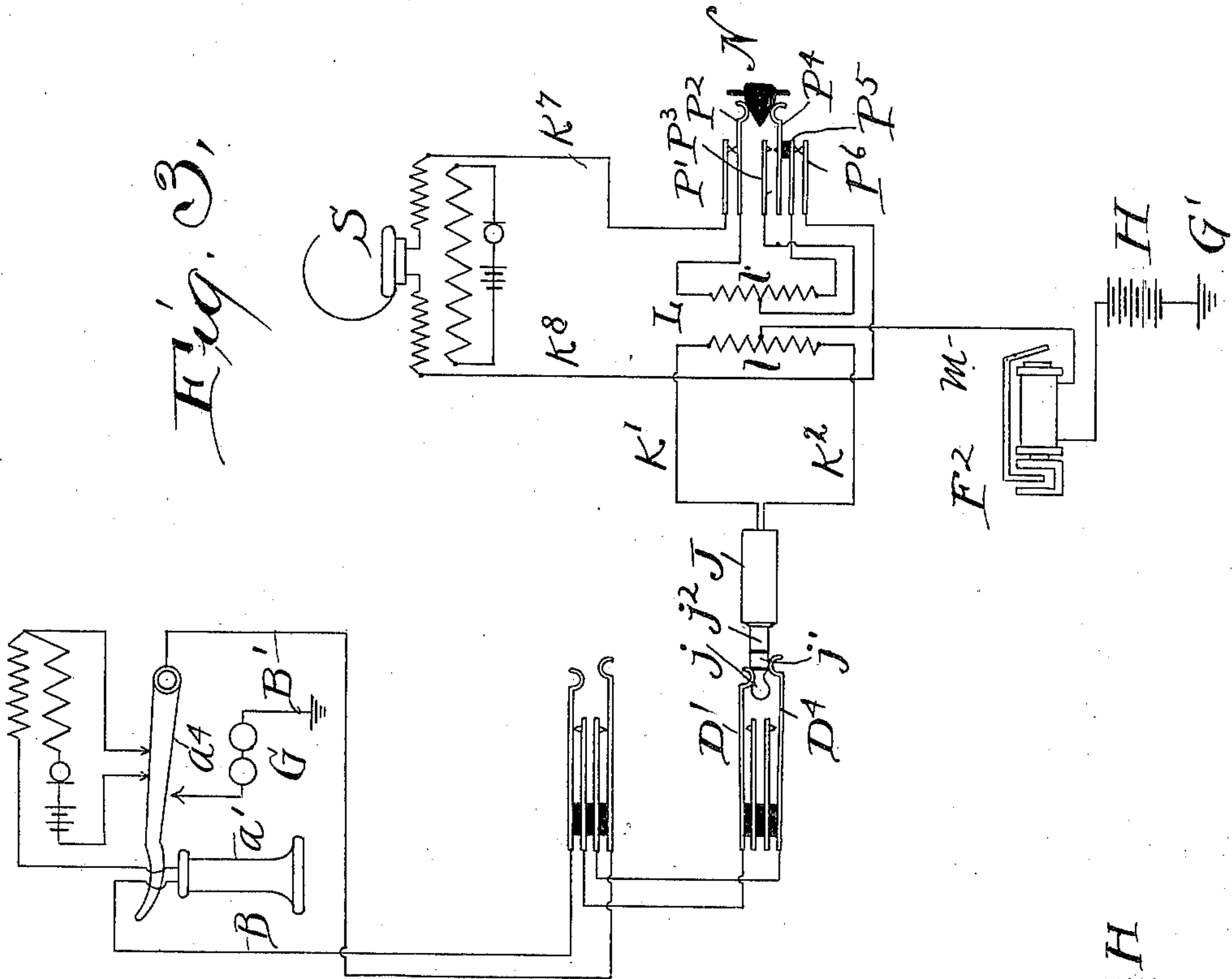
Patented Dec. 10, 1901.

**C. H. NORTH.**  
**TELEPHONE SYSTEM.**

(Application filed May 17, 1900.)

(No Model.)

**3 Sheets—Sheet 2.**



Witnesses,  
E. B. Gilchrist  
F. D. Ammen

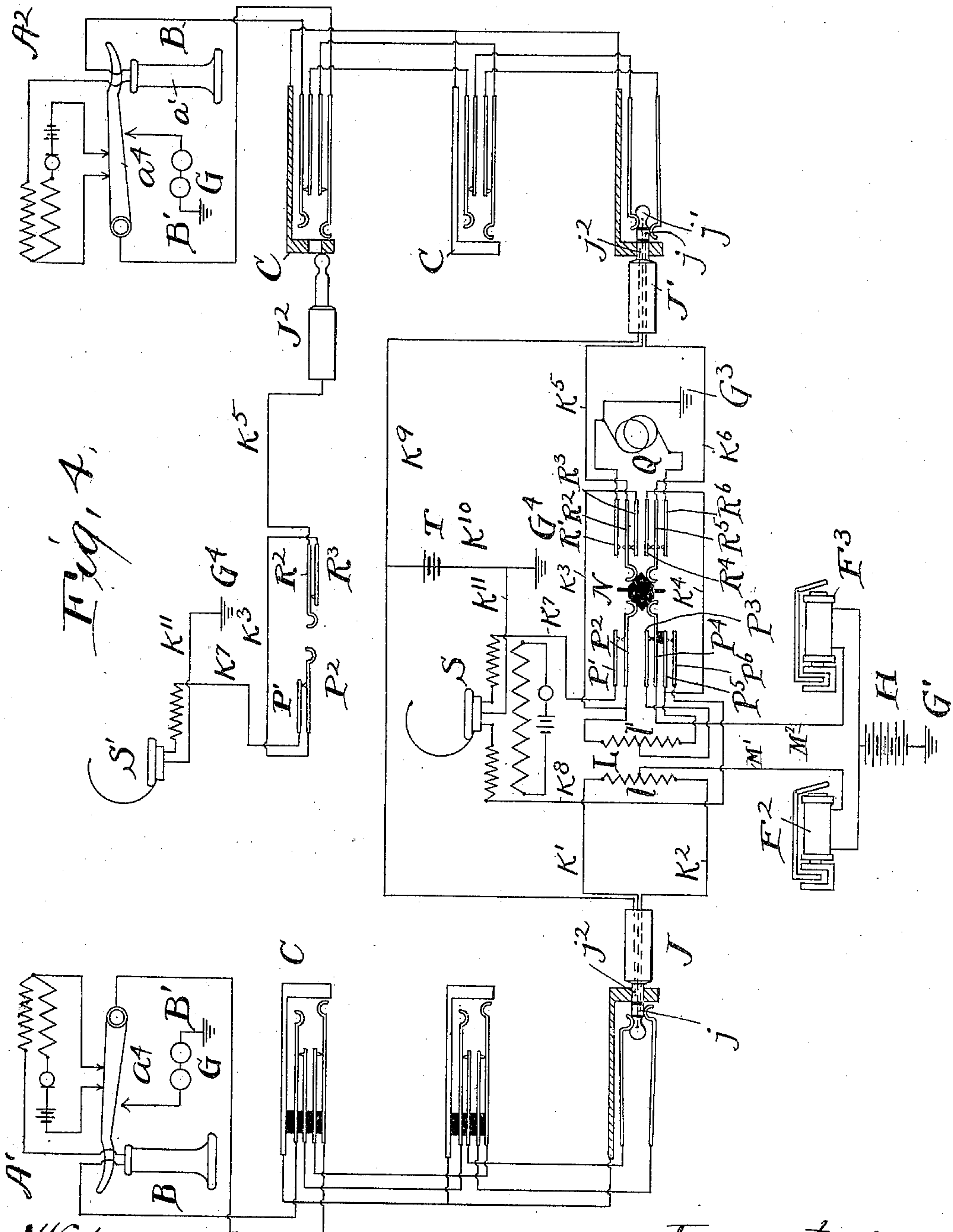
Inventor:  
Charles H. North.  
By his Attorneys,  
Thurston & Bates.

C. H. NORTH.  
TELEPHONE SYSTEM.

(Application filed May 17, 1900.)

(No Model.)

3 Sheets—Sheet 3.



Witnesses,  
E. B. Gilchrist  
F. D. Ammen

Inventor,  
Charles H. North,  
By his Attorneys  
Thurston & Bates.



# UNITED STATES PATENT OFFICE.

CHARLES H. NORTH, OF CLEVELAND, OHIO, ASSIGNOR TO THE NORTH ELECTRIC COMPANY, OF CLEVELAND, OHIO, A CORPORATION OF OHIO.

## TELEPHONE SYSTEM.

SPECIFICATION forming part of Letters Patent No. 688,673, dated December 10, 1901.

Application filed May 17, 1900. Serial No. 16,986. (No model.)

*To all whom it may concern:*

Be it known that I, CHARLES H. NORTH, a citizen of the United States, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented a certain new and useful Improvement in Telephone Systems, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings.

The object of my invention is to simplify and cheapen telephone-exchange systems and at the same time render them more efficient in service. I obviate the necessity of using condensers or repeating-coils in the subscribers' lines, placing a repeating-coil simply in each operator's cord-circuit, which are about one-tenth as numerous as subscribers' lines.

My invention provides in a complete installation subscribers' sets with complete metallic circuits—i. e., having metallic individual or common return—and at the exchange subscribers' line-signals, supervisory signals, a ringing-generator, an operator's talking set, and suitable connections for a busy test, all arranged in a simple and satisfactory form, as hereinafter more fully set out.

The invention may thus be conveniently summarized as consisting of the combinations of elements in a telephone system, as herein-after described and claimed.

The drawings are diagrams disclosing my invention.

Figure 1 illustrates a complete installation with calling and supervisory signals, a multiple switchboard, and an operator's cord-circuit with ringing and talking apparatus. The condition of the parts in this figure is that when the exchange operator has just connected two subscribers and is in the act of ringing up the called subscriber. The remaining figures are all abstractions of Fig. 1 and represent the portions of the system in use at different periods of telephoning. Thus Fig. 2 represents a subscriber calling the exchange. Fig. 3 shows the parts in use when the exchange plugs in and answers, and Fig. 4 shows the condition when the subscribers are talking and another exchange operator tests the line and finds it busy.

I will refer to the calling subscriber as A<sup>1</sup> and the called subscriber as A<sup>2</sup>. The subscribers'

lines and connections are of course similar, each consisting of the subscriber's instrument and two metallic lines B B', leading therefrom.

The subscriber's instrument includes the bell *a*, connected at one side with the ground G and adapted to be connected when the instrument is out of use with the line B', the receiver *a'*, permanently in the line B, the secondary coil *a*<sup>2</sup> of the transmitter, also in the line B, the primary circuit of the transmitter, (designated *a*<sup>3</sup>,) and the receiving-hook *a*<sup>4</sup>, which acts as or operates the switch. When the receiver is on the hook, the line B is disconnected and the ground is connected through the bell with the line B'. When the receiver is removed from the hook, the latter rises by a spring, as is usual, and the line B' becomes thereby connected with the line B through the secondary coil *a*<sup>2</sup> and the receiver *a'*, while the primary circuit is closed through its own battery and the grounded bell is disconnected.

At the switchboard I provide a series of jacks. These jacks have bushings C, all of which representing the same subscriber are permanently connected together by the lines in the different parts of the multiple switchboard. In proximity to these bushings are the spring members D' D<sup>2</sup> D<sup>3</sup> D<sup>4</sup>. Of these the two outer members D' D<sup>4</sup> on the first jack are terminals of the subscribers' lines B B'. The two inner springs D<sup>2</sup> D<sup>3</sup> are connected by local lines *d d'* with the outer spring members D' D<sup>4</sup> of the next jack, the inner springs of this jack being connected with the outer springs of the next jack, and so on. The two inner springs D<sup>2</sup> D<sup>3</sup> are normally in contact with the two outer springs by means of the elasticity of the latter. The last jack in the line is the one in the section of the switchboard in charge of the subscriber's exchange operator, and the two inner springs D<sup>2</sup> D<sup>3</sup> of his jack are terminals of the lines E E', the former of which leads directly to the ground G' and the latter of which leads to the subscriber's line-signal F' and through the main battery H to the line E and the ground.

The line-signal F' and the other signals herein shown are indicated as gravity-drops, which should be understood to illustrate any approved form of electrically-operated signal. The signal F<sup>4</sup> represents the line-signal of the



subscriber  $A^2$ , and the signals  $F^2$   $F^3$  are the supervisory signals of the cord-circuits connecting the subscribers  $A'$  and  $A^2$ , respectively.

5 The remainder of the apparatus can best be described in connection with the different operations.

When the subscriber  $A'$  wishes the exchange, he removes his receiver from its hook. This places the parts in the condition shown in Fig. 2, the ground  $G$  at the subscriber's instrument being disconnected and the two lines  $B$   $B'$  being connected together by the hook, and thus forming a continuous circuit successively through the line-signal  $F'$  and the main battery  $H$ . This energizes the line-signal, and the exchange operator is thereby notified. Now, as shown in Fig. 3, the exchange operator inserts in the subscriber's jack the plug  $J$  of that end of her cord-line which is used for the calling subscriber. This plug includes the tip  $j$  and the ring  $j'$ , which are terminals of two lines  $K'$   $K^2$ , which lead from the ends of the half  $l$  of the repeating-coil  $L$ . The plug also carries a sleeve  $j^2$ , which is the terminal of a line  $K^3$ , leading through a battery to the ground for use in the busy test, as hereinafter described. When the plug  $J$  is inserted in the subscriber's jack, the tip  $j$  engages with the spring member  $D'$  and the ring  $j'$  with the spring member  $D^4$ . This forces apart these spring members, entirely disconnecting the corresponding spring members  $D^2$   $D^3$  on lines  $E$   $E'$  and the calling-signal  $F'$ , while a complete metallic circuit is established through the subscriber's receiver and transmitter and the half  $l$  of the repeating-coil  $L$ . The other half  $l'$  of the repeating-coil is connected with the cord-lines  $K^3$   $K^4$ , which lead through the ringing-switch to the plug  $J'$ , as hereinafter explained. In order to bridge in the subscriber's talking set, branches extend from these two lines to the spring members  $P^2$   $P^5$  of the talking-set switch. In the drawings there is shown a triple-acting switch  $N$ , which normally leaves the plug  $J'$  connected with the two lines  $K^3$   $K^4$  of this half of the repeating-coil (via the lines  $K^5$   $K^6$ ) and leaves the operator's talking set and the ringing mechanism disconnected. As soon as the exchange operator has plugged in she presses the switch  $N$  toward the left, as shown in Fig. 3, forcing apart the spring members  $P^2$   $P^4$ , which the switch engages, thus causing the former to contact with the switch member  $P'$ , which leads through the line  $K^7$  to one side of the operator's talking set  $S$ , and forcing the switch member  $P^5$  from the repeating-coil into engagement with the switch member  $P^6$ , connected to the line  $K^8$  from the other side of the operator's talking set. The operator is thereby placed on a complete metallic circuit through the repeating-coil, and she is able to converse with the calling subscriber and asks the number wanted. The operator being bridged in the cord-line, as stated, and having ascertained the number

wanted, tests the jack corresponding to that number to find if the line is busy. This test consists of touching the tip  $j$  of the plug  $J'$  to the bushing  $C$  of the jack. Though the bushings of corresponding jacks are all connected together throughout the switchboard, they are normally disconnected from the rest of the apparatus, wherefore it is apparent that if none of these jacks is in use there will be no effect from the operator's touching the plug  $J'$  of her cord-line to one of the bushings. She does this, and receiving no click in her instrument (as she would, as hereinafter explained, if the line were busy) she inserts the plug  $J'$  into the jack and presses the switch or key  $N$  in the opposite direction, cutting herself out and connecting the generator with the called subscriber's bell to ring him. The condition of the parts during the ringing operation is as shown in Fig. 1. The circuit is established from the ground  $G^3$  through a generator  $Q$ , to the spring-terminal  $R^6$ , to the terminal  $R^5$ , (which the switch  $N$  causes to engage therewith,) through the cord-line  $K^6$ , to the ring  $j'$  of the plug  $J'$ , and from thence through the springs  $D^4$ , connections  $d'$ , and springs  $D^3$  of the successive jacks to the line  $B'$ , and thence through the switch  $a^4$  and the bell  $a$  to the ground  $G$ . After this ringing operation the operator allows the key to return to its intermediate position, leaving her free to attend to other subscribers. This operation disconnects the spring members  $R'$  and  $R^6$ , leading from the generator, and connects the spring members  $R^2$   $R^5$ , leading from the cord-lines  $K^5$   $K^6$ , with the spring members  $R^3$   $R^4$  of the cord-lines  $K^3$   $K^4$ . This connects the two lines  $B$   $B'$  of the called subscriber  $A^2$  through the half  $l'$  of the repeating-coil, leaving his instrument in condition to talk with the calling subscriber as soon as he removes the receiver from the hook and completes the connection between the lines  $B$   $B'$  at his instrument. Immediately upon the exchange operator ceasing to ring the called subscriber the latter's supervisory signal is energized at the exchange and remains so until he removes his receiver from the hook in responding. This is accomplished as follows: The hook  $a^4$  being down, the line from the ground through the bell is connected with the line  $B'$ , while a line  $m'$  from the neutral point of the half  $l'$  of the repeating-coil leads to the switch-point  $P^3$ , which in this position is connected with the switch-point  $P^4$ , from which the line  $m^2$  leads through the supervisory signal  $F^3$  and the main battery  $H$  to the ground. This signal thus remains energized as long as the hook is down. If the called subscriber does not respond promptly, the exchange operator rings him again. As soon as he does respond and removes his receiver the hook  $a^4$  rises, disconnecting the ground  $G$ , and the supervisory signal  $F^3$  becomes deenergized and the exchange operator is apprised of the condition. As soon as either subscriber hangs up his instrument his



supervisory signal is energized, this signal  $F^2$  of the subscriber A' being on a similar line  $m$  from the repeating-coil to the main battery. The exchange operator thus knows when to disconnect the subscriber and is constantly advised of the condition of the connected lines.

Returning now to the busy test, if when the subscribers are talking, as shown in Fig. 4, another operator wishing to use one of the same lines touches the tip of her plug  $J^2$  to the bushing C of another jack of one of these subscribers' lines the following condition takes place: The bushings being all connected together they are all connected through the sleeve  $j^2$  of the plug  $J'$  in use with the line  $K^9$ , which leads through a battery T to the ground  $G^4$ . These bushings are thus all grounded through a battery whenever any of them are in use. Now when the tip of the plug  $J^2$  is touched to one of the bushings the line is completed to the ground through the receiver  $S'$  of the testing operator's set via the cord-line  $K^5$ , the spring members  $R^2 R^3$ , the cord  $K^3$ , the spring members  $P' P^2$ , the line  $K^7$ , through one of the magnets of the receiver  $S'$ , and thence via the line  $K''$  to the ground. The line  $K''$  is connected to the operator's head-phone, between the two magnets thereof, which is the neutral point—that is, the point from which the resistance of both the outgoing and returning circuits is substantially equal—so that the grounds  $G^4$  will not throw the head-phone out of balance in normal operation. The testing operator therefore receives a click through one-half of her receiver  $S'$ , due to the bushings being grounded at one point through a battery T. She therefore knows that the line is busy, as without this grounding through some other operator's cord-circuit there would be no click.

Having described my invention, I claim—

1. In a telephone system, a subscriber's instrument, a ground connection adapted to be established thereat, two conductors of the subscriber's line, and a multiple switchboard having jacks with which said conductors are connected, combined with an exchange operator's cord-line which includes a repeating-coil, a three-part plug, two conductors leading to the repeating-coil from the parts of said plug which are adapted to be connected at the jack with the subscriber's two lines, a supervisory signal and a source of current-supply at the exchange, a line leading independently of said plug from said two cord-lines through said supervisory signal and source of current to the ground, and a third line in the operator's cord-line leading from the plug and adapted for use in making a busy test, substantially as described.

2. In a telephone system, the combination of a repeating-coil, an operator's local talking set including a receiver and transmitter, a plug, a pair of lines leading from said plug and adapted to be connected with the repeating-coil, a switch adapted to bridge the oper-

ator's talking set across said lines, a supervisory signal, a connection therefrom to said cord-line, said switch being arranged to open said connection when the operator's talking set is bridged in, substantially as described.

3. In a telephone system, the combination of a ringing-generator, a repeating-coil, an operator's local talking set including a receiver and transmitter, a plug, a pair of lines leading from said plug, switch mechanism adapted to connect said lines with the repeating-coil or break the connection thereto and connect one of them with the ringing-generator, and in the former case adapted to bridge the operator's talking set across said lines, a connection leading from said cord-line to the ground, a supervisory signal and a source of current in said connection, said connection being broken when the operator's talking set is bridged in, substantially as described.

4. The combination, with the two wires of a subscriber's metallic line, of an operator's cord-line containing two plugs, a repeating-coil, a pair of lines leading from each plug, and each pair adapted to form a part of a continuous circuit respectively through a primary or secondary of the repeating-coil, a pair of supervisory signals, a source of current, lines leading from the two parts of the cord-line through said supervisory signals and source of current to the ground, an exchange operator's local talking set, including a receiver and transmitter, switching mechanism for bridging it across one of the pair of cord-lines, and means for disconnecting the line from one of the latter cord-lines through the supervisory signal when the exchange operator's instrument is so bridged, substantially as described.

5. In a telephone system, a subscriber's cord-line, containing two plugs each of which is the terminal of three lines, a repeating-coil, two of the lines from each plug being adapted to cooperate respectively through the primary or secondary of said repeating-coil, and the other line leading from each plug through a battery to the ground, spring-jacks of a multiple switchboard having spring members with which the terminals of the lines leading to the repeating-coil are adapted to engage, and having bushings which the said line leading to the ground is adapted to engage, all of the bushings in different parts of the switchboard corresponding to the same subscriber's line being connected together, combined with the two wires of a subscriber's metallic line leading to the spring members of said jacks, and an exchange operator's local talking set adapted to be bridged across a pair of lines from the repeating-coil to one of said plugs and being itself connected with the ground, substantially as described.

6. In a telephone system, in combination, an exchange operator's cord-line including two plugs, a repeating-coil, and lines leading from each plug and adapted to be connected



with the repeating-coil, a source of current for calling purposes, an exchange operator's talking set, suitable switching mechanism adapted to connect either said source of current or the operator's talking set in the cord-line, a ground connection from the operator's talking set, a switchboard including spring-jacks, different jacks corresponding to the same subscriber's line having their bushings connected together, and a line connected by the plug with the bushing of the jack in which the plug is inserted, said line leading through a source of current to the ground, substantially as described.

7. In a telephone system, an exchange operator's cord-line including a repeating-coil, a plug, a pair of conductors leading from the plug, means adapted to connect said conductors with the repeating-coil, an operator's local set including a receiver and transmitter, means for bridging it across said pair of conductors, a line leading from the neutral point of the receiver of said local set to the ground, a supervisory signal, a line leading from said cord-line through the supervisory signal to the ground, switching mechanism for bridging in the operator's local set, said mechanism operating automatically to disconnect said supervisory signal, spring-jacks with which the plug is adapted to engage, said jacks having the bushings, the bushings in different parts of the switchboard corresponding to the subscriber's line being connected together, and means operated by the plug for grounding said bushings when the plug is inserted, substantially as described.

8. The combination with a subscriber's instrument and his two metallic lines, of jacks at the switchboard having pairs of resilient terminals normally in contact and in series circuit with said two lines, a line-signal at the switchboard, a source of current, a line

through said signal and source of current grounded intermediately and having both its ends connected to resilient terminals in the last jack in said series circuit, an operator's cord-line having a plug adapted to be inserted in said last jack, the terminals whereof are thereby disconnected, a line leading from said cord-circuit through said source of current to the ground, a supervisory signal in said last-mentioned line, and means at the subscriber's instrument for connecting one of his lines with the ground, substantially as described.

9. In a telephone system, the combination with a subscriber's two metallic lines, a set of jacks at the switchboard, each of which includes a bushing, all of the bushings in different sections of the board corresponding to the same subscriber's line being connected together, a plug adapted to be inserted in such bushing and having a sleeve adapted to engage therewith, said plug carrying an insulated ring and tip, said jack including four spring members one of which is engaged by the ring, and another by the tip of said plug when inserted, whereby they are moved out of contact with the other two spring members, said other two spring members of one jack being connected with the spring members which are moved by the plug in the next jack, an operator's cord-line including three conductors connected respectively with said sleeve, ring and tip, and an operator's local receiver adapted to be bridged across the two conductors leading to the ring and tip and connected with the other conductor, substantially as described.

In testimony whereof I hereunto affix my signature in the presence of two witnesses.

CHARLES H. NORTH.

Witnesses:

ALBERT H. BATES,  
H. M. WISE.