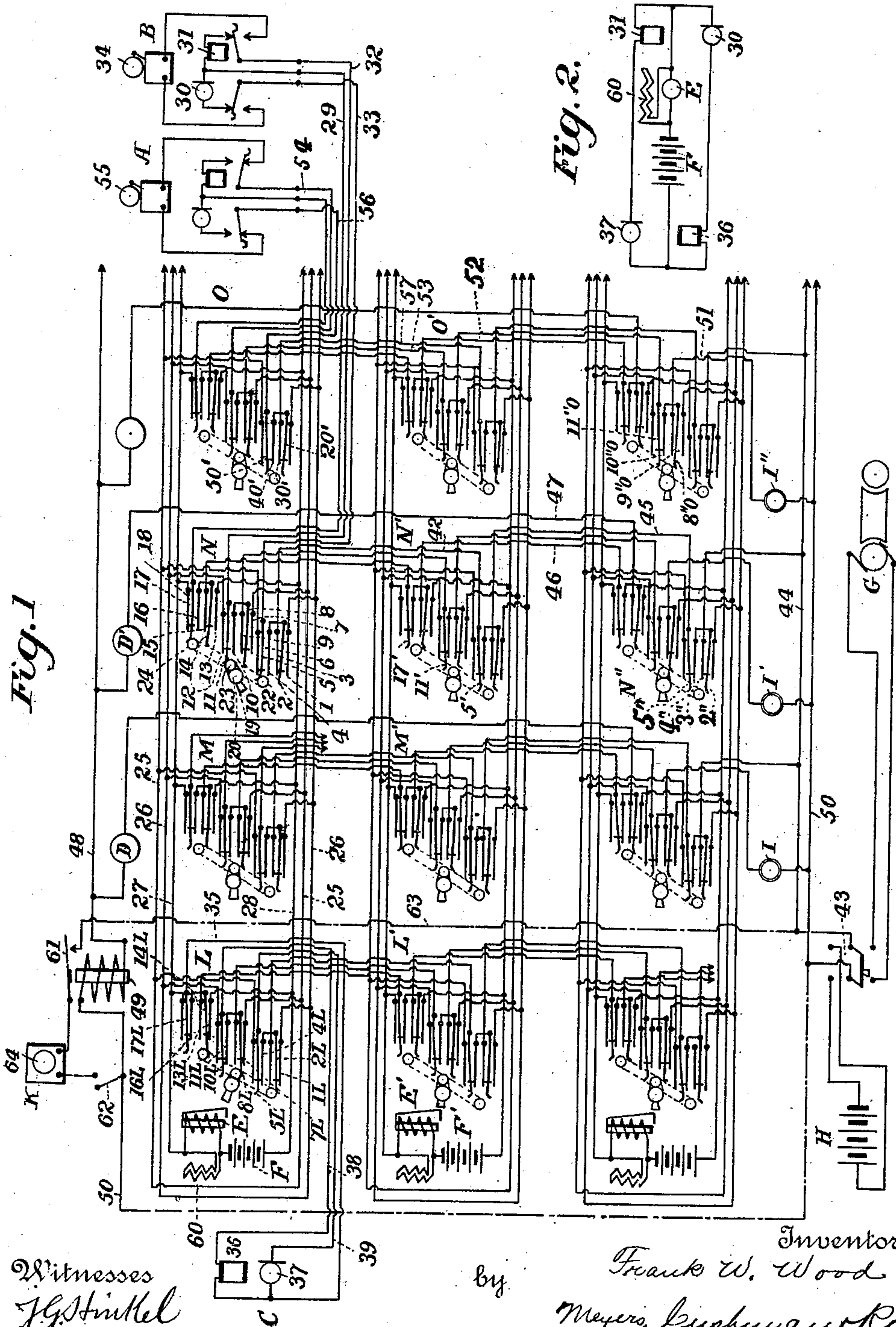


F. W. WOOD.
TELEPHONE SYSTEM.
APPLICATION FILED JULY 8, 1906.

914,690.

Patented Mar. 9, 1909.



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TELEPHONE SYSTEM.

No. 914,690.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, FRANK W. WOOD, a citizen of the United States, residing at Newport News, in the county of Warwick and State of Virginia, have invented new and useful Improvements in Telephone Systems, of which the following is a specification.

This invention relates to telephone systems and its object is to improve systems of the character described as can be best set forth in connection with the accompanying drawings of which—

Figure 1 is a diagram of the connections and apparatus of sufficient of a telephone system to illustrate the application of the invention, and Fig. 2 is a simplified diagram showing the relative connections of stations in talking communication.

Referring to the drawings, the system comprises a plurality of telephone sets A, B etc., each comprising a transmitter, receiver, signal and appurtenant apparatus and connections as will be hereinafter referred to, and a central switchboard with apparatus for effecting desired connections and promoting communication between the stations including an operator's set C, line drops D, D' etc., clearing-out drops E, E' etc., talking batteries F, F' etc., a ringing generator G or ringing battery H, means as push buttons I, I' etc., for closing the ringing circuits, an auxiliary central signal K as will be hereinafter referred to, key switches L, L' etc., M, M' etc., N, N' etc., O, O' etc., for effecting connections as hereinafter described.

The mechanical construction and arrangement of the central switchboard and apparatus is not shown or described in this application as it forms the subject matter of a separate application and is unnecessary to an understanding of the invention claimed herein, the diagrammatic drawings and description thereof forming a part of this application being sufficient for that purpose.

Each of the key switches is like every other and therefore a description of one will apply to each. The key switch N, for instance, comprises 18 contacts, 1 to 18 inclusive. Contacts 2 and 4 are permanently connected together as are also contacts 8 and 10, and 14 and 16 respectively. Contacts 2 and 3, 4 and 5, 8 and 9, 10 and 11, 14 and 15, 16 and 17 are normally in contact in respective pairs. To operate the switch contacts a key 19 pivoted at 20 is provided. To the key is

pivoted a member 21 carrying bars 22, 23 and 24 adapted when moved in one direction from normal respectively to engage with contacts 5, 11 and 17, break their respective contacts with contacts 4, 10 and 16 and move them into contact respectively with contacts 6, 12 and 18, the connections then being as illustrated at N. The movement of the key in the other direction from normal operates to remove the contacts 2, 8 and 18 respectively from contact with contacts 3, 9 and 15 and bring them into connection with contacts 1, 7 and 13 respectively as illustrated by switch L. The normal position is illustrated by switch M. The device for actuating the contacts is suitably insulated to prevent the formation of a circuit through it.

It will be observed that the key switches are arranged in sets of parallel rows at right angles to each other as rows containing L, M etc., and L', M' etc., are parallel as are also rows containing L, L' etc., and M, M' etc., but the row containing L, L' etc., and parallel rows are at right angles to the row containing L, M etc., and parallel rows. To facilitate the description, one set of rows may be considered vertical and the other horizontal. Let it be considered that the row containing L, L' etc., and parallel rows are vertical. The apparatus and connections of each of the horizontal rows are the same as every other one and therefore a description of one will apply to each of the others. Taking the top row (L, M etc.,) as an instance therefore, a conductor 25 connects together contact 6 and all the corresponding contacts of the other switches of the row and connects them with the contact 7 and the corresponding contacts of the other switches in the row. A conductor 26 connects contact 12 and analogous contacts of the other switches of the row together and to contact 1 and analogous contacts of the other switches of the row. The talking battery F has one terminal connected with one terminal of the clearing-out drop E and the free terminals are connected, one with a conductor 27 which is also connected with the contact 18 and the corresponding contacts of the row and the other with a conductor 28 which is also connected with contact 13 and the corresponding contacts in the row.

To a switch, as N, of each vertical row is connected a telephone set as B, a conductor 29 connecting contact 17 with the junction

of the transmitter 30 and receiver 31, a conductor 32 connecting contact 11 with a contact controlled by the receiver hook and a conductor 33 connecting the contact 5 with another contact controlled by the receiver. In the diagram, for the sake of clearness, two hooks are apparently shown. It will be understood, however, that there is but one hook and that the illustration is intended to show that there are two separate connections controlled by the hook. One of the connections, when the hook is down, connecting conductor 32 with one terminal of the bell 34 and the other connection connecting conductor 32 with the other terminal of the bell. When the hook has risen, conductors 32 and 33 are respectively connected with receiver 31 and transmitter 30. In a similar manner set A is connected with switch O. To one of the switches of one of the vertical rows is connected the operator's set C. Thus conductor 35 connects contact 17^L with the junction of the receiver 36 and transmitter 37, conductor 38 connects contact 11^L with a terminal of the receiver and conductor 39 connects contact 5^L with a terminal of the transmitter.

Contact 15 of switch N is connected by conductor 40 with contact 17' of switch N', contact 9 is connected by conductor 41 with contact 11' and contact 3 is connected by conductor 42 with contact 5'. In a similar manner switch N' is connected with switch N'' so that all the switches in the vertical row are connected as indicated and in a similar manner the switches of each vertical row are connected.

The operation of the apparatus and the circuits employed may be now set forth. Suppose that a person at one telephone set as B, desires to converse with some one at another point as at A. The receiver is lifted from the hook at B when the following circuit may be traced: from battery H (assuming that the switch 43 is thrown upward) through conductor 44, contacts 2'', 3'', 4'' and 5'' of switch N'', conductor 45, similar contacts of switch N', conductor 42, contacts 2, 3, 4 and 5 (it being assumed that all the switches are in normal position), conductor 33, transmitter 30, conductor 29, contacts 17, 16, 15 and 14, conductor 40, similar contacts of switch N', conductor 46, similar contacts of switch N'', conductor 47, line drop D', conductor 48, relay 49, (hereinafter referred to) conductor 50 to the other terminal of the battery H. The line drop which may be of any well known self-restoring type is now energized and signals the operator that a call has been made. Thereupon the operator actuates one of the switches, as N, in the vertical row corresponding to the line drop actuated. In this case the handle of the switch is thrown down, bringing the switch into position as shown. The operator also throws the switch,

as L, in the vertical row corresponding to the operator's set and in the horizontal row with the switch previously thrown, in the opposite direction from that in which the switch N was moved, the switch L being then in the position shown. Circuits may now be traced as follows: from the junction of the operator's receiver 36 and transmitter 37, through the receiver 36, conductor 38, contacts 11^L, 10^L, 8^L and 7^L, conductor 25, contacts 6 and 5 of switch N, conductor 33, transmitter 30 at set B, conductor 29, contacts 17 and 18, conductor 27, clearing-out drop E, talking battery F, conductor 28, and contacts 13^L, 14^L, 16^L and 17^L to the junction of the receiver 36 and transmitter 37. Circuit may also be traced from the said junction through the transmitter 37, conductor 39, contacts 5^L, 4^L, 2^L and 1^L, conductor 26, contacts 11 and 12, conductor 32, receiver 31, conductor 29, contacts 17 and 18, conductor 27, drop E, battery F, conductor 28 and contacts 13^L, 14^L, 16^L and 17^L to the aforesaid junction. The operator's instrument and that at station B are now connected as shown in Fig. 2 from which it will be seen that the receiver of one and transmitter of the other are connected in series in one branch, the remaining receiver and transmitter are connected in another branch and that the two said branches are connected in multiple across a third branch containing the talking battery and clearing-out drop connected in series. This arrangement is conducive to loud talking, and the clearing-out drop, which may be of a well known type, is energized, thus indicating that the line is in use. Conversation can now be carried on between the station and operator and upon the latter ascertaining what station is wanted as, for instance, A, the ringing button I'' corresponding to station A is pushed thereby closing a circuit as follows: from one terminal of battery H through conductor 50, button I'', conductor 51, contacts 8''0, 9''0, 10''0 and 11''0, conductor 52, similar contacts of switch O', conductor 53, similar contacts of switch O, conductor 54, bell 55 (the receiver being on the hook) conductor 56, contacts 50', 40', 30' and 20', conductor 57, similar contacts at switch O', similar contacts at switch O'' and conductor 44 to the other terminal of battery H. The circuit being thus completed through the bell 55, it will ring and attract the attention of a person at station A, who will respond in the usual manner by removing the receiver from the hook. A switch, as O, in the vertical row corresponding to the station and in the same horizontal row as the switch (N) already thrown, is thrown by the operator in the opposite direction to that in which N occupies. The operator also brings his switch (L) to normal thus disconnecting his set. Circuits may now be traced through the two connected

stations A and B, similar to those already traced between the operator's set and that at station B. Conversation may be carried on and upon its conclusion and the hanging up of the receivers, the talking circuits will be broken and indication of this fact conveyed to the operator by the restoration of the clearing-out drop which takes place automatically upon its deenergization. Upon such a signal the operator restores the key switches concerned to their normal positions.

In order that the coil of the clearing-out drop E, which is in the talking circuit, may not interfere, by its induction, with the transmission of talking currents, means is provided for neutralizing the effect of the inductance of the coil. This may consist of a non-inductive resistance 60 connected across the coil of the drop, although other means of neutralizing the inductance may be employed. The non-inductive resistance may be conveniently formed by winding a coil of the required resistance with half its turns reversely wound on the other half. It should be of suitable ohmic resistance to shunt sufficient of the steady current into the drop coil to actuate the drop but at the same time to act as a short circuit about the drop coil for the rapidly varying talking currents which are greatly opposed by the inductance of the drop coil. By throwing the switch 43 downwardly the generator G may be connected to the ringing circuit in place of the battery H which, if a storage battery, may be then charged.

The relay 49 before referred to as being in the circuit with the line drop is energized when a call is made and attracts its armature 61 and, if the switch 62 is closed, closes a circuit from the battery H through conductor 63, bell 64 and conductor 50, thereby ringing the bell in addition to throwing the drop. This is of service to attract the operator's attention to a call especially when the drop is obscured as at night. The bell can be cut by opening the switch 52.

From reference to the foregoing and the drawings it will be apparent that there is a vertical row of switches corresponding to each "out" station and that there is a line drop and ringing button corresponding to each vertical row and its station, also a vertical row of switches corresponding to the operator's set. This reference will also make evident that the switches of each vertical row are connected one directly with its corresponding telephone set, to this switch which is directly connected with the telephone set is connected another switch and with the last mentioned switch still another switch is connected and so on. In other words, the switches corresponding to a given telephone set are connected in *seriatim* with the set. It will also be seen that there is a

battery adapted to supply current in common to connected stations and a clearing-out drop corresponding to each horizontal row. The conductors corresponding to the horizontal row for connecting two stations are common to all the switches of the horizontal row and therefore when conversation is being carried on between any two stations through those conductors and by the use of its corresponding talking battery, in order to avoid interference it is necessary to employ the conductors and common battery of some other horizontal row for joining any other two stations desiring conversation. Upon the throwing of a switch in one of the horizontal rows to establish a connection the connection between that switch and others below it in its vertical row that is, other switches not between the switch in question and the telephone set to which it corresponds, is broken in a manner as before indicated and therefore subsequent throwing of another switch cannot operate to interfere with the conversation through the connections already established. It will be noted also that the circuit of the line drop corresponding to each vertical row is completed through the contacts of each and all the switches of its vertical row when those switches are all in normal positions and therefore the throwing of any one of the switches to establish a connection operates to deenergize the drop which restores itself to normal position. It will further be observed that the calling circuit of each "out" station is completed through contacts of each and all of the switches of its vertical row when they are in normal position and therefore the throwing of any one of the switches opens the calling circuit to the station.

From the foregoing it will be evident that when a horizontal row is occupied by having stations connected through two of its switches that the clearing-out drop corresponding to the row will be displayed. When therefore a call is received at the central station the operator by glancing at the line drops can ascertain the vertical row corresponding to the calling station and by running his eye down along the clearing-out drops until he comes to a horizontal row which is not in use he throws switches in that row as before indicated in connection with the top-most horizontal row and stations A and B with results as also indicated. It will now be apparent that there must be horizontal rows of switches equal in number to the number of conversations it is desired to carry on simultaneously and as before observed there must be a vertical row of switches for each station. In the apparatus illustrated there are four vertical rows and three horizontal rows and therefore this system provides for three "out" stations and an operator's set

and the number of horizontal rows is sufficient to enable the carrying on of three simultaneous conversations providing sufficient "out" instruments and corresponding
 5 vertical rows of switches to render this number of conversations possible are provided. It will be seen that the system might be extended indefinitely by adding stations and vertical rows and horizontal rows.

10 While the invention has been illustrated in what is considered its best structure and arrangement it may be embodied in other structures or arrangements and should not therefore be limited to the structure or arrangement shown.

15 What I claim is:—

1. In a telephone system, the combination with a plurality of telephone sets, each comprising a receiver and a transmitter, of a
 20 clearing-out drop, a source of electrical energy, and means for connecting the receiver of one set and the transmitter of another in series in one branch circuit, the said source and drop in another branch circuit and the
 25 other transmitter and receiver of the said sets in series in another branch circuit, the said branch circuits containing the receivers and transmitters being connected in multiple across the branch containing the said source and drop.

30 2. In a telephone system, the combination with a plurality of telephone sets, each comprising a receiver and a transmitter, of a clearing-out drop, a source of electrical energy, means for connecting the receiver of
 35 one set and the transmitter of another in series in one branch circuit, the said source and drop in another branch circuit and the other transmitter and receiver of the said sets in
 40 series in another branch circuit, the said branch circuits containing the receivers and transmitters being connected in multiple across the branch containing the said source and drop, and a non-inductive resistance
 45 connected in shunt with said drop.

3. In a telephone system, the combination with a plurality of telephone sets, each comprising a receiver and a transmitter, of a
 50 clearing-out drop, a source of electrical energy, and means at a central point for connecting the receiver of one set and the transmitter of another in series in one branch circuit, the said source and drop in another
 55 branch circuit and the other transmitter and receiver of the connected sets in series in another branch circuit, the said branches containing the receivers and transmitters being connected in multiple across the branch containing the said source and drop.

60 4. In a telephone system, the combination with a plurality of telephone sets, each comprising a receiver and a transmitter, of a clearing-out drop, a source of electrical energy, means at a central point for connect-
 65 ing the receiver of one set and the transmitter

of another in series in one branch circuit, the said source and drop in another branch circuit and the other transmitter and receiver of the connected sets in series in another
 70 branch circuit, the said branches containing the receivers and transmitters being connected in multiple across the branch containing the said source and drop, and a non-inductive resistance connected in shunt with
 75 said drop.

5. In a telephone system, the combination with a plurality of telephone sets, each comprising a receiver and a transmitter, of a clearing-out drop, a source of electrical energy, means for connecting the receiver of
 80 any one of said sets in series with the transmitter of any other of said sets in one branch circuit, the remaining transmitter and receiver of the connected sets in another branch circuit, the said source and drop in
 85 another branch circuit, the said branches containing the receivers and transmitters being connected in multiple across the branch containing the said source and drop.

6. In a telephone system, the combination 90 with a plurality of telephone sets each comprising a receiver and a transmitter, of a clearing-out drop, a source of electrical energy, means at a central point for connecting the receiver of any one of said sets in series
 95 with the transmitter of any other of said sets in one branch circuit, the remaining transmitter and receiver of the connected sets in another branch circuit, the said source and drop in another branch circuit, the said
 100 branches containing the receivers and transmitters being connected in multiple across the branch containing the said source and drop.

7. In a telephone system, the combination 105 with a plurality of telephone sets each comprising a receiver and a transmitter, of a clearing-out drop, a source of electrical energy, means for connecting the receiver of any one of said sets in series with the trans-
 110 mitter of any other of said sets in one branch circuit, the remaining transmitter and receiver of the connected sets in another branch circuit, the said source and drop in another branch circuit, the said branches
 115 containing the receivers and transmitters being connected in multiple across the branch containing the said source and drop, and a non-inductive resistance connected in shunt with said drop.
 120

8. In a telephone system, the combination with a plurality of telephone sets, of a plurality of rows of switches, one row corresponding to each of said sets, each of said
 125 switches being adapted to establish conversational connections for its set, the contacts of all switches in one row being normally connected in series and a line-drop corresponding to each telephone set and common
 130 to all of the said row of switches correspond-

ing to that set, the circuit of the line-drop being completed through all of the said switches corresponding to its telephone set, each of said switches being adapted to break the circuit of said line-drop when the switch is moved from its normal position.

9. In a telephone system, the combination with a plurality of telephone sets each comprising a signal, of a plurality of switches corresponding to each set and having interconnected contacts, each of said switches being adapted to establish conversational connections, of a source of current, a circuit adapted to be closed through said source of current, the signal of any telephone set and all of the switches corresponding to that set, the contacts of said switches being connected in series and each of said switches being adapted to close said circuit when they are in normal position and to open said circuit when a switch is moved from its normal position.

10. In a telephone system, the combination with a plurality of telephone sets having the usual receiver hooks, a switch corresponding to each of said telephone sets, conductors common to said switches and adapted to connect the same to place the said sets in communication and a clearing-out drop common to said switches, said clearing out drop being controlled by the receiver hooks of said telephone sets.

11. In a telephone system, the combination with a plurality of telephone sets having the usual receiver hooks, a switch corresponding to each of said telephone sets, conductors common to said switches and adapted to connect the same to place the said sets in communication and a clearing-out drop and a source of current common to said switches, said clearing out drop being controlled by the receiver hooks of said telephone sets.

12. In a telephone system, the combination with a plurality of telephone sets, of a plurality of switches corresponding to each set, all of said switches being arranged in rows, each row comprising a switch corresponding to each of said telephone sets, a group of conductors corresponding to each row and common to the switches thereof, the said conductors of a row being adapted to connect any two switches of the row to place their corresponding telephone sets in com-

munication and a source of current corresponding to each of said rows and common to the switches thereof.

13. In a telephone system, the combination with a plurality of telephone sets, of a plurality of switches corresponding to each set all of said switches being arranged in rows, each row comprising a switch corresponding to each of said telephone sets, a group of conductors corresponding to each row and common to the switches thereof, the said conductors of a row being adapted to connect any two switches of the row to place their corresponding telephone sets in communication and a clearing-out drop corresponding to each of said rows and common to the switches thereof.

14. In a telephone system, the combination with a plurality of telephone sets, of a plurality of switches corresponding to each set all of said switches being arranged in rows, each row comprising a switch corresponding to each of said telephone sets, a group of conductors corresponding to each row and common to the switches thereof, the said conductors of a row being adapted to connect any two switches of the row to place their corresponding telephone sets in communication and a source of current and a clearing-out drop corresponding to each of said rows and common to the switches thereof.

15. In a telephone system, the combination with a plurality of telephone sets, of a plurality of switches corresponding to each of said telephone sets, said switches being arranged in rows, each row containing a switch corresponding to each of the said telephone sets, a set of conductors corresponding to each of said rows and adapted to connect any two switches of the row to place their corresponding telephone sets in communication, a source of current and a clearing-out drop corresponding to each of said rows and common to the switches therein and a line-drop for each of said telephone sets and common to its switches.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

FRANK W. WOOD.

Witnesses:

J. E. WARREN,
E. W. HOUSE.