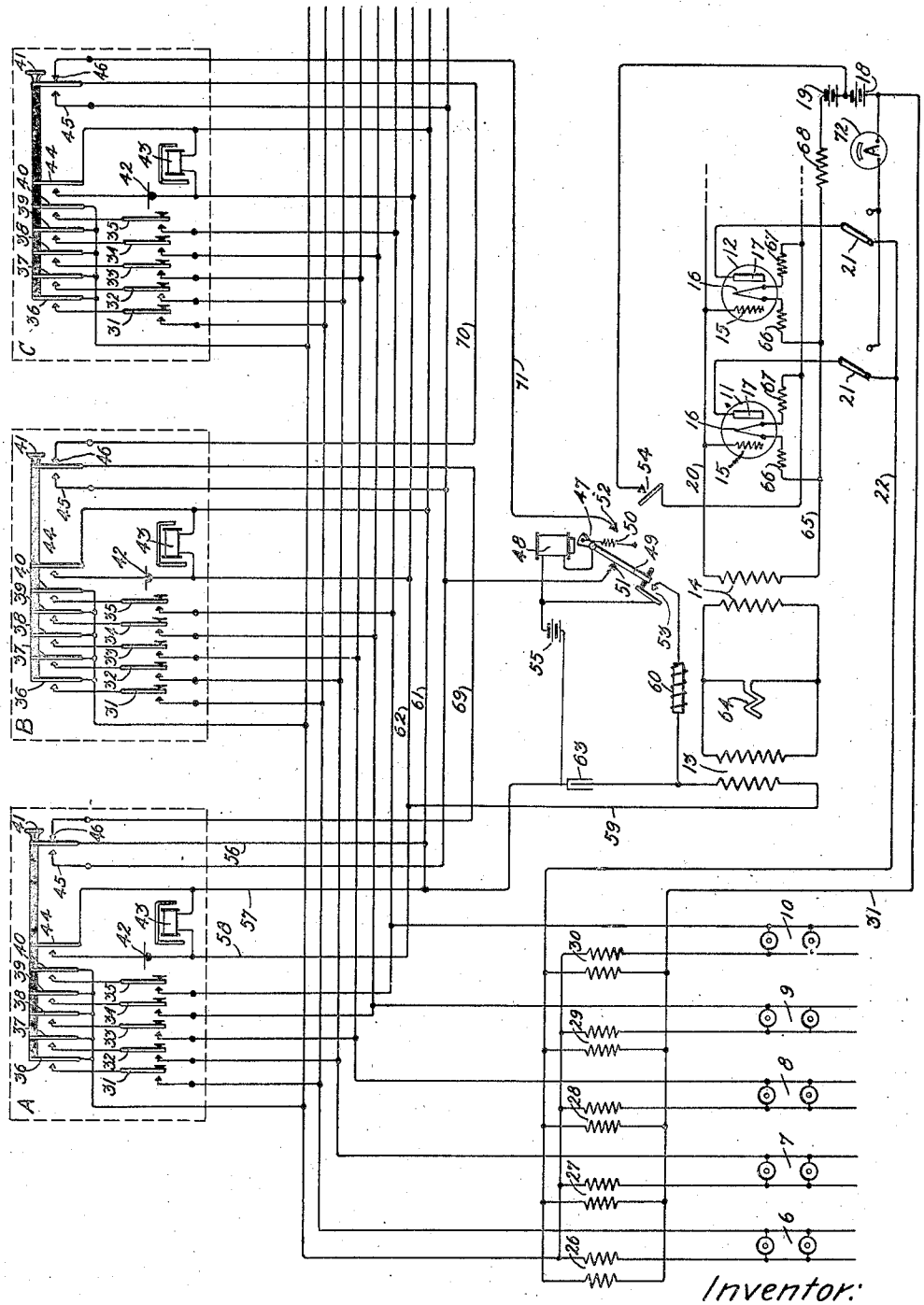
W. G. BRITTEN.

TELEPHONE SYSTEM.

APPLICATION FILED AUG. 19, 1918.

**1,356,256.** **Patented Oct. 19, 1920.**



# UNITED STATES PATENT OFFICE.

WILLIAM G. BRITTEN, OF WESTFIELD, NEW JERSEY, ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

## TELEPHONE SYSTEM.

1,356,256. Specification of Letters Patent. Patented Oct. 19, 1920.

Application filed August 19, 1918. Serial No. 250,518.

*To all whom it may concern:*

Be it known that I, WILLIAM G. BRITTEN, a citizen of the United States, residing at Westfield, in the county of Union, State of New Jersey, have invented certain new and useful Improvements in Telephone Systems, of which the following is a full, clear, concise, and exact description.

This invention relates to telephone systems and more particularly to telephone announcing systems having a plurality of transmitting stations.

The principal object of the present invention is to provide such a system wherein a transmitting station obtaining connection with a receiving station cannot be disconnected therefrom so long as it is transmitting, regardless of attempts of other transmitting stations to use the system. In accordance with a feature of the invention, to obtain this object electrically operated means are provided to restore the system to normal condition upon the disconnection of a transmitting station therefrom and means are provided at each transmitting station to maintain the operating circuit of the restoring means open until such station is disconnected from the system to prevent the completion of such circuit by other stations.

The accompanying drawing diagrammatically illustrates one embodiment of the invention as applied to a loud speaking telephone system. Three transmitting stations A, B and C have been illustrated, although obviously two transmitting stations could be provided or the system enlarged for use with more than three transmitting stations.

A plurality of groups 6, 7, 8, 9 and 10 of loud speaking receivers have been shown, and selective switching means are provided at each of the transmitting stations to associate any desired group or groups with such transmitting stations. The receiver groups may comprise any desired number of receivers and the number of receivers in any one group may be the same or different from the number in any other group or groups.

Any desired number of amplifiers such as 11 and 12 common to all the stations of the system are provided and inductively associated with the transmitter circuits of the stations through induction coils 13 and 14 common to the entire system. The amplifiers may be of any desired construction, but in the present instance have been illustrated as of the vacuum tube or audion amplifier type. Each amplifier comprises an input electrode or grid 15, a thermionic cathode or filament 16 and an output electrode or plate 17. The plate 17 is maintained positive with respect to the grid 15 by a source of direct current 18, and another source of direct current 19 is provided to effect the heating of the filament 16 upon the closure of the heating circuit therefor as hereinafter described. The amplifiers 11 and 12 are shown as connected in parallel relation. The input electrodes 15 are joined to a conductor 20 extending from the secondary of the induction coil 14 which serves as an input coil for the amplifiers, while the output electrodes or plates 17 are each connected to a switch 21 individual to the respective amplifiers. The switches 21 in their left-hand position as indicated on the drawing serve to connect the respective plates 17 in parallel to a common conductor 22 extending to the primary windings of a number of output induction coils 26, 27, 28, 29 and 30. The output coils 26 to 30 inclusive have their primary windings arranged in parallel relation between the common conductors 22 and 31 of the output circuit. The respective secondary windings of these output coils are arranged in receiving circuits individual to the respective receiving groups 6 to 10 inclusive. The receiving circuits are controlled by the group selecting keys 31 to 35 inclusive, respectively located at the transmitting stations, and selection of the desired receiver group or groups is accomplished by closing the proper selecting key or keys thereat. It will be noted that the respective selecting keys at the transmitting stations are multipled to each other and in order to prevent communication with an undesired receiver group the selecting key of which may have been left closed at another transmitting station, the receiver circuits each extend through normally open contacts 36, 37, 38, 39 and 40 respectively, which contacts are under the control of a key 41 individual to each transmitting station. The keys 41 are depressed to engage the contacts 36 to 40 thereat and each of these keys is maintained in this position so long as its respective transmitting station is in use. The receiver circuits are accordingly open

except during actuation of the talking keys 41 independent of the closure of one or more of the selecting keys 31 to 35 inclusive.

Each of the transmitting stations is provided with a transmitter 42 and signal 43 actuated to give a busy indication when any of the stations are in use. Normally open contacts 44 and 45 under the control of the keys 41 are provided at each station and closed upon movement of their respective key 41 to talking position; while a normally closed contact 46 is also provided at each station and disengaged upon movement of its respective key 41 to talking position.

It is desirable that systems of this kind be arranged so that no current will be used except during use of a transmitting station and this is accomplished in the system shown by the provision of a circuit controller 47, the operating circuit of which extends through contact 45 of the keys 41 at the transmitting stations. The circuit controller 47 may be of any suitable construction, but as shown comprises an electromagnet 48, a pivoted armature 49 and a spring 50 secured to the armature to aid in its movement. Momentary energization of the electromagnet 48 moves the armature 49 from either of the extreme positions in which it may be moved to a central position and the inertia of the armature, due to its movement, will serve to carry it by the central position, whereupon the spring 50 moves it to the extreme position opposite to that which it occupied prior to energization of the electromagnet. The armature in moving from either of its extreme positions opens the circuit of the electromagnet 48 at either the contact 51 or 52 according to the previous position of the armature and thereby prevents the electromagnet 48 from holding the armature 49 in central position under any circumstances. The controller 47 is shown in its normal position, and armature 49, in addition to controlling contacts 51 and 52, also closes contacts 53 and 54 when moved from its normal position to its opposite extreme position.

The normal condition of the system is diagrammatically shown on the drawing. To illustrate the operation, assume that station A desires to transmit certain information for reproduction by the receivers of groups 6 and 8 and 10. The party at station A first observes the condition of his signal 43 and if it indicates that the system is idle he then operates his selecting keys 31, 33 and 35 individual to receiver groups 6, 8 and 10 respectively. The switch 41 at station A is now moved to talking position, thereby engaging the contacts 36 to 40 inclusive, contacts 44 and 45 and at the same time disengaging the normally closed contact 46. The closure of contact 45 completes the operating circuit for the circuit controller 47; this circuit extending from one side of battery 55, conductor 56, contact 45, contact 51, armature 49 and winding of electromagnet 48 to the other side of battery. The energization of the electromagnet 48 moves the armature 49 to intermediate position, and the inertia thereof carrying the armature over its dead center, the spring 50 completes the movement thereof to its opposite extreme position. Upon the initial movement of the armature 49, the contact 51 is opened, effecting the deënergization of electromagnet 48 so that it does not retard the movement of the armature to its new position.

Contact 53 is also closed upon the movement of the armature and completes a circuit through which current is supplied to the transmitter 42 at station A; this circuit extending from one side of battery 55, conductor 57 at station A, contact 44 of key 41, transmitter 42 and the conductor 58 at station A, conductor 59, primary winding of induction coil 13, winding of retardation coil 60 and contact 53 to the other side of battery. The signals 43 at each of the transmitter stations are permanently bridged between the conductors 57 and 58 at their respective stations, and as the conductors 57 are multipled to a common conductor 61 and the conductors 58 are similarly multipled to a common conductor 62, the signals 43 will all assume their busy position upon the completion of the transmitter circuit at any of the transmitting stations. It will be noted that the bridge connection for the signals 43 is below the connection through which the circuit is completed for the respective transmitters 42 and that the transmitter circuit is normally open at the contact 44 of the respective keys 41. Accordingly, although all the signals will assume their busy position upon completion of the transmitter circuit at any station incident to the movement of the switch 41 thereat to talking position, only the transmitter 42 at such station will be included in circuit. Under the assumed conditions the transmitter 42 at station A is the only one the circuit of which is completed, although the signals 43 at stations A, B and C will all operate when the system is in use.

The armature 49 in the position opposite to that which it normally occupies closes contact 52, thus conditioning a circuit to restore the system to normal upon subsequent movement of the switch 41 at station A to normal position when the party thereat has finished talking. This circuit extends in series through the normally closed contacts 46 of all of the transmitting stations and inasmuch as the contact 46 at station A is open so long as that station is in use it is impossible to restore the system to normal condition, until the key 41 at station A is re-

stored to its normal or non-talking position. Accordingly the party at station A upon obtaining control of the system maintains control thereof independent of the operation of the keys 41 at other stations until he finishes talking and restores his switch 41 to normal position as previously explained. The same is also true of each of the other transmitting stations once they obtain control of the system and this arrangement furnishes a very desirable feature of the present invention.

The armature 49 in addition to closing contact 52 also closes contact 54, which in turn completes the energizing circuit of the amplifiers 11 and 12 and also a circuit through the primary windings of the induction coils 26 to 30 inclusive of the receiver groups 6 to 10 respectively, assuming that the switches 21 are in the position shown in the drawing. The receiver groups 6, 8 and 10 are thus operatively associated with station A, although groups 7 and 9 will be inactive since the circuits including the secondary windings of their respective coils 27 and 29 will be open at the selecting keys 32 and 34 respectively at station A and also at the contacts 37 and 39 of the keys 41 at the other transmitting station, even should the respective group selecting keys 32 or 34 be closed at any of such other transmitting stations, inasmuch as the keys 41 at such other stations would be in open or non-talking position.

The party at station A now delivers his message and the resulting current fluctuations developed by the transmitter 42 thereat pass through the primary winding of the induction coil 13 over a circuit extending from transmitter 42, contact 44, conductor 57 of station A, condenser 63, primary winding of induction coil 13, conductor 59, and conductor 58 at station A, to the transmitter 42 thereat. The condenser 63 permits the passage of these fluctuating currents, but prevents short-circuiting of the battery 55 upon the closure of contact 53, inasmuch as direct currents cannot flow through the condenser. Operating current to actuate the signals 43 at all of the transmitting stations and the transmitter 42 of the respective transmitting station in use, is thereby insured. The retardation coil 60 serves to impede the passage of the fluctuating currents to the battery 55 while providing a relatively free path for the passage of direct current from this battery to the signals 43 and to the transmitter 42 of station A.

The passage of the fluctuating currents through the primary winding of the coil 13 induces corresponding current fluctuations in the secondary winding thereof, which in turn pass through the primary winding of the input induction coil 14, likewise inducing corresponding current variations in the secondary winding of this latter coil. The circuit including the secondary winding of coil 13 and the primary winding of coil 14 in series is preferably shunted by a non-inductive resistance 64 designed to reduce the fluctuating currents supplied to the primary winding of the coil 14, within operating limits best suited to the system with which it may be used. If desired the coil 13 and resistance 64 may be omitted and the primary winding of the coil 14 connected directly in the transmitter circuit in the position occupied by the primary winding of the coil 13, but the arrangement shown in the drawing is to be preferred where amplifiers of the vacuum tube type are used.

The fluctuating currents developed in the secondary winding of the coil 14 vary the potential of the input electrodes or grids 15 and to those familiar with the operation of vacuum tube amplifiers, it will be evident that the potential difference between the grids 15 and the respective output electrodes or plates 17 is correspondingly varied. These changes of potential produce current fluctuations corresponding therewith but of increased amplitude in the output circuit passing through the primary windings of the coils 26 to 30 inclusive. The circuit for the input electrodes 15 may be considered as extending from the filaments 16 to their respective grids 15 in parallel, thence over conductor 20, secondary winding of input coil 14 and conductor 65 in series, thence in parallel through the resistances 66 to the respective filaments 16. The filament heating circuit extends from the positive side of battery 19 through contact 54, thence through resistances 67, filaments 16 and resistances 66 in parallel to conductor 65 and thence through a resistance 68 to the negative side of battery 19. Negative potential is also supplied to the grids 15 from battery 19 over a connection extending from the negative side of battery 19, through resistance 68, conductor 65, and secondary winding of input coil 14 to the grids 15. The resistances 66 are of relatively high value as compared to the resistance of the secondary winding of the coil 14 so that the grids are maintained at a relatively higher negative potential than the filaments 16 in order to control the flow of current between the filaments 16 and the output electrodes or plates 17 in accordance with the potential variations of the grids 15 under the influence of the current fluctuations developed in the secondary winding of the input coil 14. The resistances 67, which, if desired, may be made adjustable, serve to reduce the strength of heating current supplied to the filaments 16 to a proper operating value, while the resistance 68, which if desired may also be made adjustable, is used to still further con-

trol the potential of current supplied to the grids 15, and to the filaments 16.

The output circuit may be considered as extending from the filaments 16 to their respective plates 17 and switches 21 in parallel, thence over conductor 22, through the primary windings of the coils 26 to 30 inclusive in parallel, conductor 31, battery 18, contact 54, and the resistances 67 in parallel to the respective filaments 16. The fluctuating currents passing through the primary windings of the coils 26 to 30, inclusive, induce corresponding currents in the secondary windings thereof which operate the receivers of such groups as are operatively associated with the transmitting station in use. In the present case only the receivers of groups 6, 8 and 10 which are operatively associated with station A would be actuated.

As soon as the party at station A ceases talking, the key 41 thereat is released to its normal position, thus disengaging contacts 36 to 40 inclusive, 44 and 45, and engaging contact 46 thereof. The disengagement of contacts 36, 38 and 40 opens the circuits of receiver groups, 6, 8 and 10 respectively, and the disengagement of contact 44 opens the transmitter circuit previously traced. The engagement of contact 46 at station A completes the operating circuit to restore the circuit controller 47 to its normal position; this circuit extending from one side of battery 55, conductor 56, contact 46 at station A, conductor 69, contact 46 at station B, conductor 70, contact 46 at station C, conductor 71, contact 52, armature 49, and winding of electromagnet 48 to the other side of battery. The armature 49 is thereby moved to its initial position, disengaging the contact 52 to open the restoring circuit in a similar manner to that in which the contact 51 of the initial energizing circuit was opened on the initial operation of the circuit controller 47. Contact 54 is also opened in this movement and disconnects the batteries 18 and 19 from circuit. Immediately prior to the armature 49 reaching its initial position, it opens the contact 53, thus disconnecting battery from the signals 43, permitting them to return to their normal or non-busy position. Immediately thereafter the armature 49 closes contact 51 completing the restoration of the system to its normal condition and leaving it ready for subsequent operation.

In the above description it will be apparent that the busy condition of the signals while the station is in use by any one of the transmitting stations will indicate this fact to the other transmitting stations and will prevent their attempting to talk until after the restoration of the signals 43 to non-busy position indicating that the system is free for subsequent use.

However, even should another transmitting station start to depress the key 41 thereat, thus disengaging the contact 46 of such key, before observing that the signal 43 was in a busy position indicating that another station was using the system, the subsequent release of the key 41 and re-engagement of the contact 46 at the interrupting station would not operate the circuit controller 47 to restore the system to normal before the station which is using the system has finished talking, inasmuch as the operating circuit of the circuit controller 47 would be open at the contact 46 of the key 41 at the station first using the system until the party thereat finished talking and released his key 41 to normal position. Should the key 41 at the interrupting station be in talking position when the key at the first station is released, the interrupting station will be open and prevent completion of the restoring circuit until the interrupting station in turn finishes talking and restores his key to normal position. Under these conditions restoration of key 41 at the interrupting station will complete the restoring circuit for the circuit controller 47; thus effecting the restoration of the system to normal in the same manner as if the interrupting station had obtained initial control as described for station A.

It is often desirable to test the strength of current supplied to the filaments 16 and output electrodes or plates 17 of the individual amplifiers or to a parallel combination thereof. This is made possible in the present system by the provision of the switches 21 individual to each of the amplifiers 11 and 12. These switches are designed when in their left-hand position as shown in the drawing to connect the respective plates 17 to the conductor 22 of the output circuit, and when in the right-hand position to connect the respective plates to battery 18 of the output circuit through an ammeter 72. With the switch 21 of any of the amplifiers in its right-hand position and with the contact 54 closed, a circuit is completed extending from battery 18 through ammeter 72, switch 21, plate 17, filament 16 and resistance 67 of said amplifier, and contact 54 to the other side of battery. The ammeter reading under these conditions will indicate the strength of current between the filaments 16 and plate 17 of the amplifier being tested. The normal strength of current supplied to the filament and output electrode can thus be measured as well as changes in the current strength occurring between the filament and plate due to the variation of the potential of the input electrode or grid 15 during operation of the system. It will be obvious that the strength of current supplied to the filaments and plates of any parallel combination of amplifiers may be obtained in a similar manner

by moving the switches 21 of such amplifiers to their right-hand position to connect such amplifiers with the ammeter circuit; the switches 21 of the other amplifiers being moved to intermediate or open position under these circumstances.

What is claimed is:

1. A telephone system comprising a plurality of transmitting stations, a source of operating current common to the transmitting stations, a switch individual to the transmitting stations, switching means common to the transmitting stations and controlled by the individual switches to connect the source of operating current to and to disconnect it from its respective transmitting station, and means to prevent another transmitting station operating the switching means to disconnect the source of operating current from the first transmitting station while such first station is using the system.

2. A telephone system comprising a plurality of transmitting stations, a source of operating current common to the transmitting stations, a switch individual to the transmitting stations, switching means common to the transmitting stations and controlled by the individual switches to connect the source of operating current to and to disconnect it from the transmitting stations, and means so arranged that the first transmitting station effecting the operation of the switching means to connect operating current to said station prevents other transmitting stations effecting a disconnecting operation of the switching means so long as first station is using the system.

3. A telephone system comprising a plurality of transmitting stations, a transmitter at each station, a talking key at each station, a receiver, means actuated upon the movement of the key of one of the stations to talking position to operatively associate its respective transmitter with the receiver, electroresponsive means controlling the dissociation of a station associated with the receiver, an operating circuit for the electroresponsive means extending in serial relation through each of the stations, a normally closed contact at each of the stations serially included in the operating circuit, and means controlled by the movement of the key of a station to its talking position to disengage the closed contact thereat; whereby completion of the operating circuit is prevented while said station is talking.

4. A telephone system comprising a plurality of transmitting stations, a transmitter at each station, a talking key at each station, a receiver, means actuated upon the movement of the key of any station to talking position to operatively associate its respective transmitter with the receiver, electroresponsive means controlling the dissociation of any station associated with the receiver, an operating circuit for the electroresponsive means extending in serial relation through each of the stations, a normally closed contact at each of the stations serially included in the operating circuit, and means at each station controlled by the movement of the talking key thereat to its talking position to disengage its closed contact; whereby completion of the operating circuit is prevented while any of the stations are talking.

5. A telephone system comprising a plurality of transmitting stations, a transmitter at each station, a talking key at each station, a receiver, means actuated upon the movement of the key of one of the stations to talking position to operatively associate its respective transmitter with the receiver, electroresponsive means controlling the dissociation of a station associated with the receiver, an operating circuit for the electroresponsive means extending in serial relation through each of the stations, a normally closed contact at each of the stations serially included in the operating circuit, and means to disengage the closed contact of the station upon movement of its key to talking position and to engage such closed contact upon subsequent movement of its key to non-talking position; whereby the operating circuit is not completed while such station is talking but is completed upon subsequent movement of its key to non-talking position.

6. A telephone system comprising a plurality of transmitting stations, a transmitter at each station, a talking key at each station normally in non-talking position, a receiver, means actuated upon movement of the key of any of the stations to talking position to operatively associate its respective transmitter with the receiver, electroresponsive means to control the dissociation of any station associated with the receiver, an operating circuit for the electroresponsive means extending in serial relation through each of the stations, normally closed contacts at each station serially included in the operating circuit, and means to disengage the normally closed contact upon subsequent movement of its key to talking position; whereby the operating circuit is not completed while any of the stations are talking but is completed upon all of the keys assuming their non-talking position.

7. A telephone system comprising a plurality of transmitting stations, a transmitter at each station, a talking key at each station normally in non-talking position, a receiver, means actuated upon movement of the key of any of the stations to talking position to operatively associate its respective transmitter with the receiver, electroresponsive means to control the dissociation of any station associated with the receiver, an operat-

ing circuit for the electroresponsive means extending in serial relation through each of the stations, normally closed contacts at each station serially included in the operating circuit, and means carried by the key of each of the stations to disengage the normally closed contact thereat upon movement of its key to talking position; whereby the operating circuit is not completed while any of the stations are talking.

8. A telephone system comprising a plurality of transmitting stations, a transmitter at each station, a talking key at each station normally in non-talking position, a receiver, means actuated upon movement of the key of any of the stations to talking position to operatively associate its respective transmitter with the receiver, electroresponsive means to control the dissociation of any stations associated with the receiver, an operating circuit for the electroresponsive means extending in serial relation through each of the stations, normally closed contacts at each station serially included in the operating circuit, and means carried by the key of each of the stations to disengage the normally closed contact thereat upon movement of its key to talking position, and to reëngage such closed contact upon subsequent movement of its key to non-talking position; whereby the operating circuit is not completed while any of the stations are talking but is completed upon all of the keys assuming their non-talking position.

9. A telephone system comprising a plurality of transmitting stations, a transmitter at each station, a talking key at each station, a receiver, electroresponsive means to operatively associate the transmitter of any station with the receiver and to dissociate any associated station from the receiver, an initial operating circuit for the electroresponsive means completed upon movement of the key of a station to talking position to move such means from its normal position, a second operating circuit for the electroresponsive means to return such means to its normal position and extending in serial relation through each of the stations, normally closed contacts at each of the stations serially included in the second circuit, and means controlled by the movement of the key of a station to talking position to disengage the closed contact thereat; whereby completion of the second circuit is prevented while such station is talking.

10. A telephone system comprising a plurality of transmitting stations, a transmitter at each station, a talking key at each station, a receiver, electroresponsive means to operatively associate the transmitter of any station with the receiver and to dissociate any associated station from the receiver, an initial operating circuit for the electroresponsive means common to the stations including a normally closed contact and completed upon movement of the key of any station to its talking position to move such means from its normal position, a second operating circuit for the electroresponsive means to return such means to its normal position extending in serial relation through each of the stations and including a normally open contact therein, normally closed contacts at each of the stations serially included in the second circuit, the initial operation of the electroresponsive means serving to open the normally closed contact in the initial circuit and to close the normally open contact in the second circuit, and means controlled by the movement of the key of any station to talking position to disengage the normally closed contact thereat prior to the closure of the normally open contact in the second circuit; whereby closure of the initial and second circuits is prevented while any station is talking.

11. A telephone system comprising a plurality of transmitting stations, a transmitter at each station, a talking key at each station, a receiver, electroresponsive means to operatively associate the transmitter of any station with the receiver and to dissociate any associated station from the receiver, an initial operating circuit for the electroresponsive means completed upon movement of the key of any station to talking position to move such means from its normal position, a second operating circuit for the electroresponsive means to return such means to its normal position and extending in serial relation through each of the stations, normally closed contacts at each of the stations serially included in the second circuit, and means to disengage the normally closed contact of any station upon movement of its key to talking position and to reëngage such normally closed contact upon subsequent movement of its key to non-talking position; whereby the second operating circuit is not completed while any of the stations are talking but is completed upon all the keys assuming their non-talking positions.

In witness whereof, I hereunto subscribe my name this 12th day of August A. D., 1918.

WILLIAM G. BRITTEN.