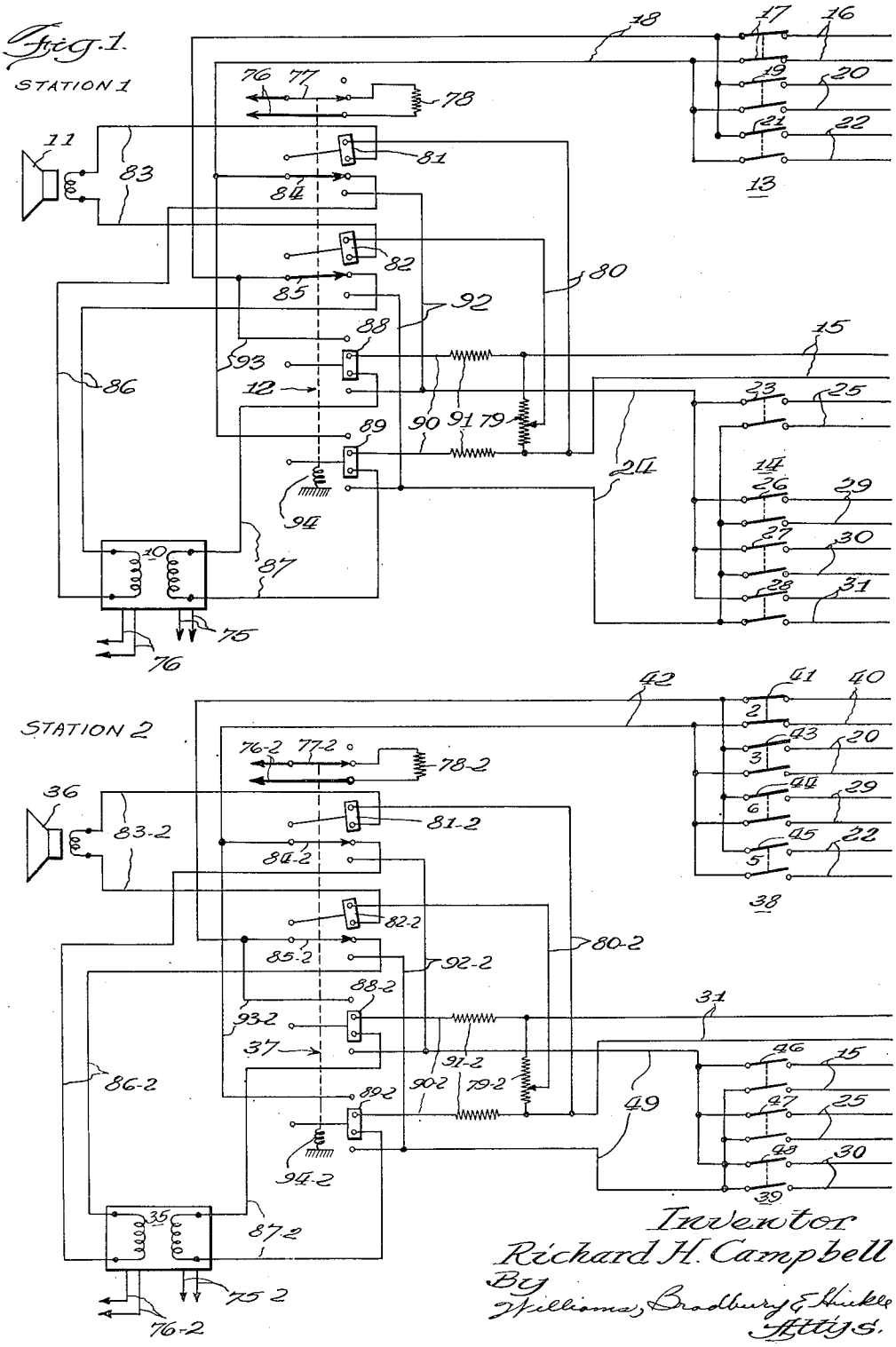
Aug. 10, 1943. R. H. CAMPBELL 2,326,616

COMMUNICATION SYSTEM

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COMMUNICATION SYSTEM

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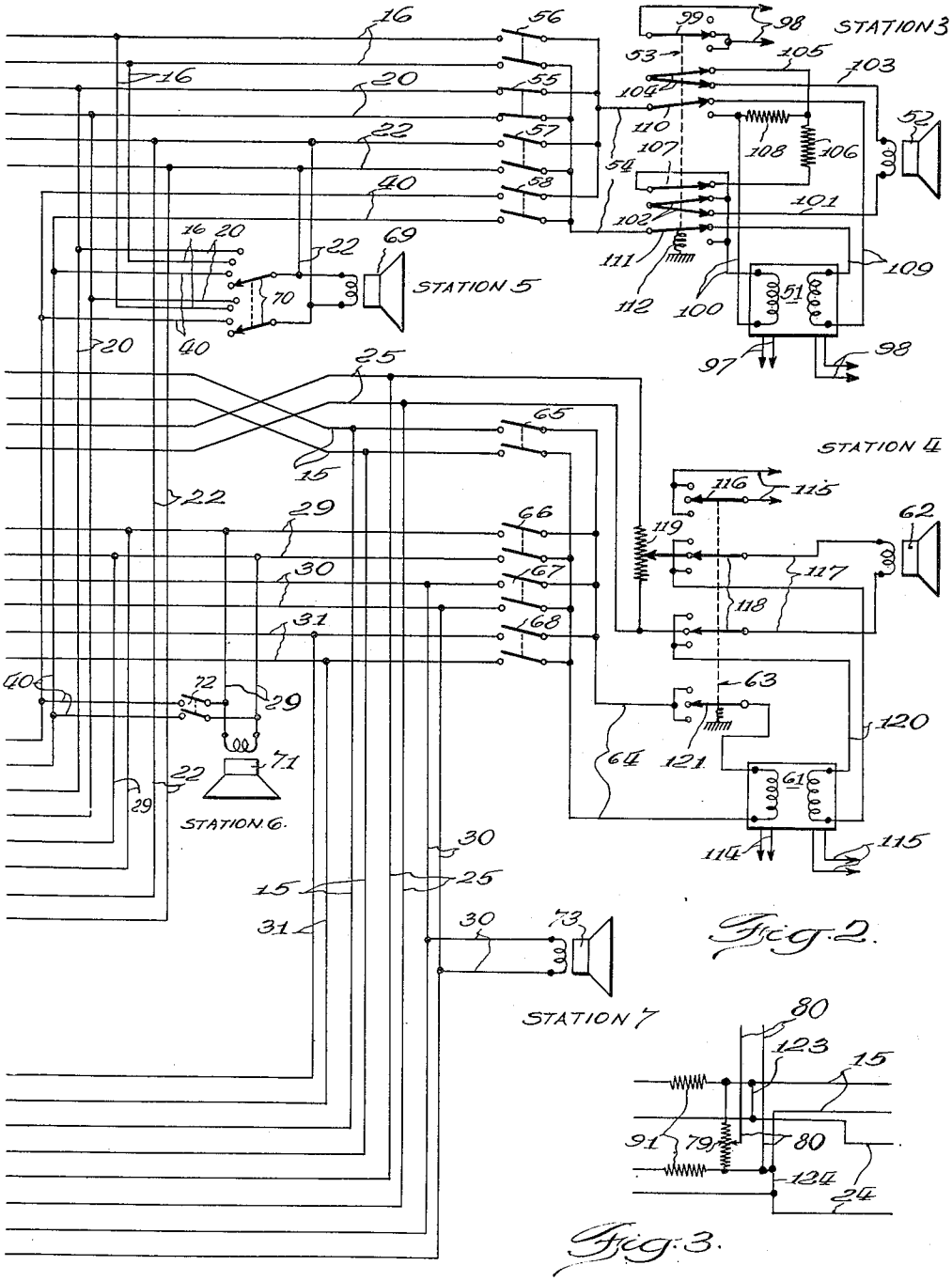


Fig. 2.

Fig. 3.

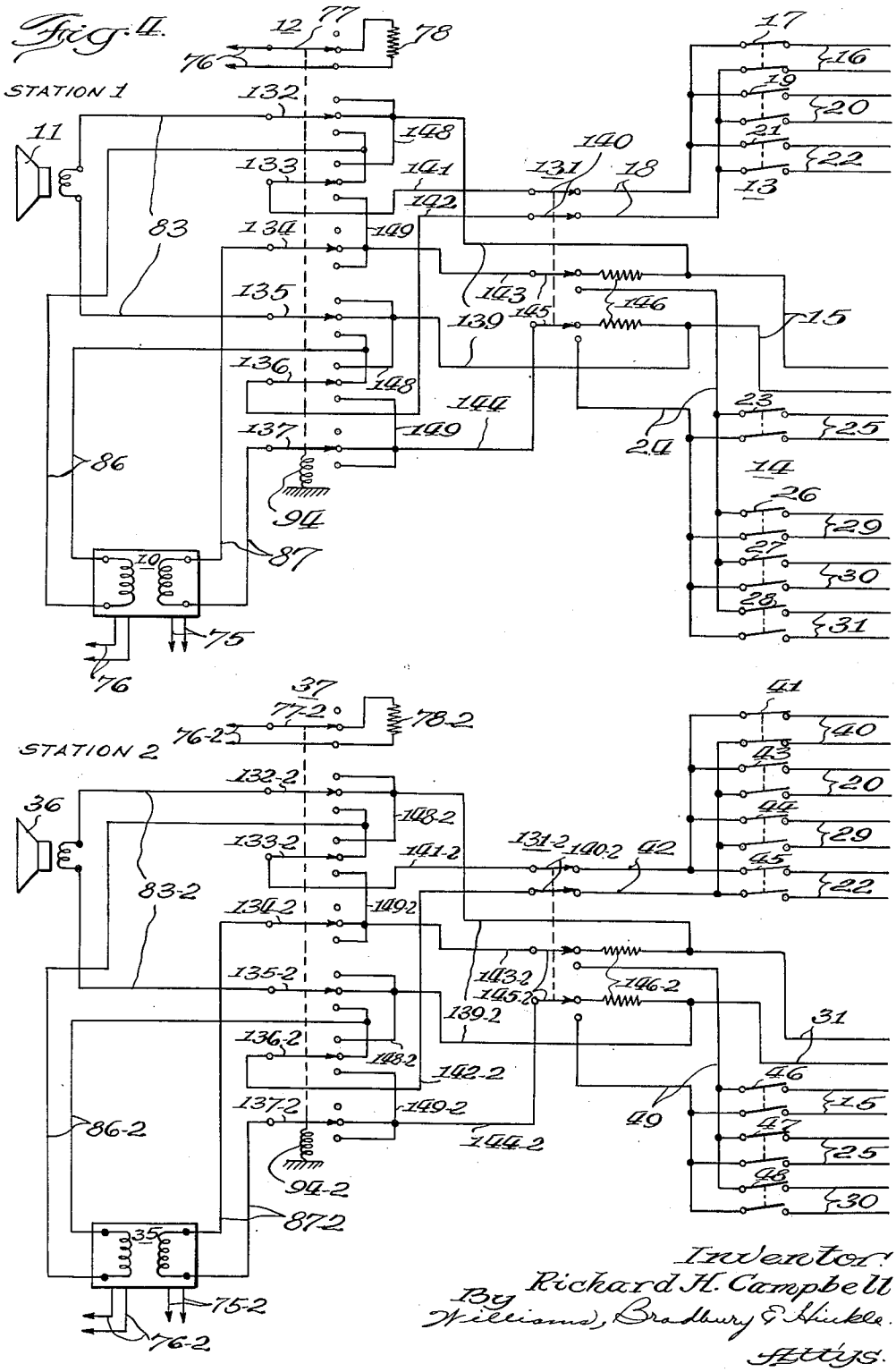
Inventor.
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Aug. 10, 1943. R. H. CAMPBELL 2,326,616

COMMUNICATION SYSTEM

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Fig. 4.



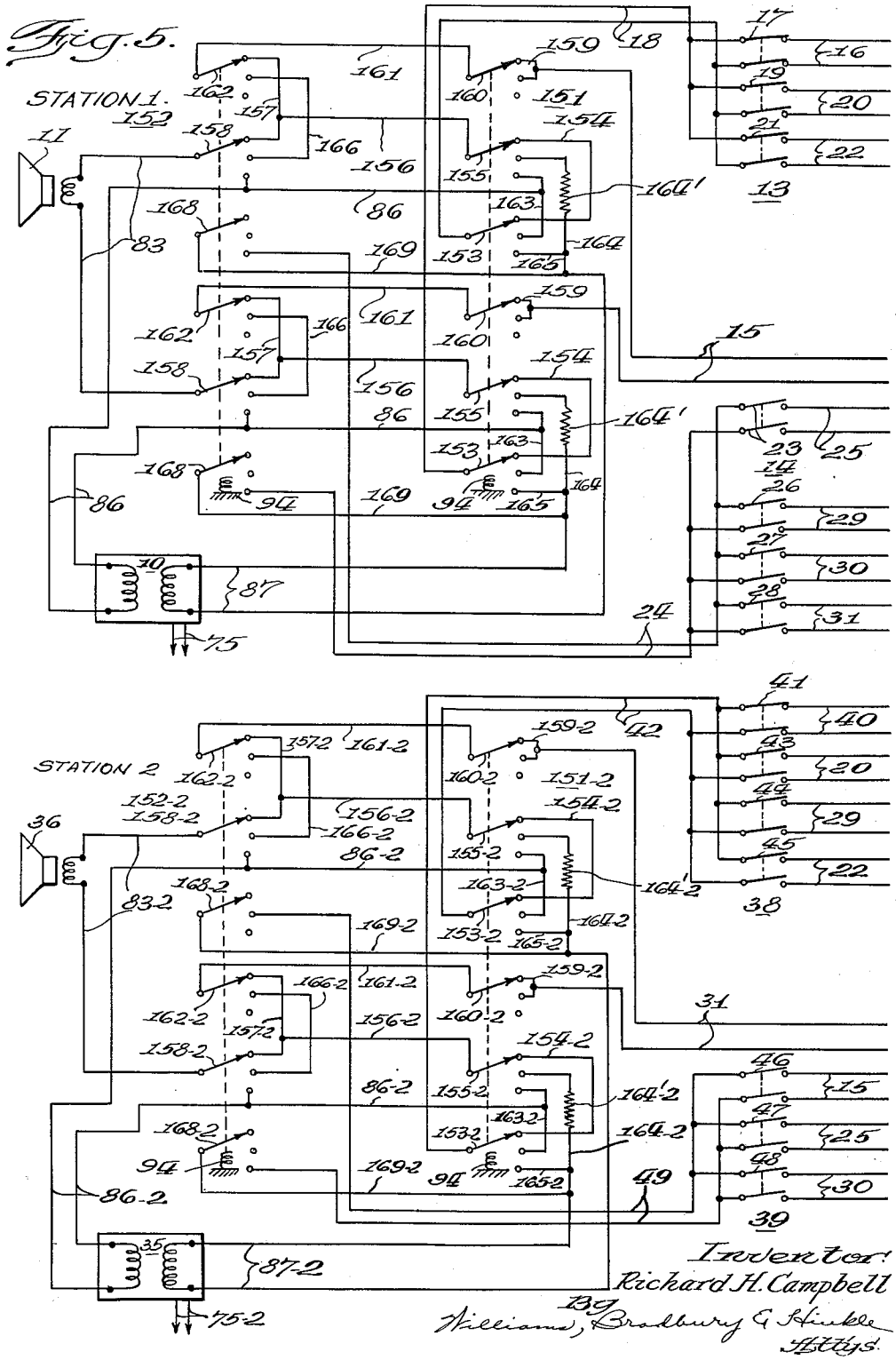
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Fig. 5.



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COMMUNICATION SYSTEM

Richard H. Campbell, Racine, Wis., assignor to Webster Electric Company, Racine, Wis., a corporation of Delaware

Application January 16, 1942, Serial No. 426,978

26 Claims. (Cl. 179—1)

The present invention relates to communication systems and more particularly to intercommunicating systems of the loudspeaking type.

Different requirements in various installations have resulted in the development of a number of types of intercommunicating systems. Probably the simplest type is a system comprising a central or master station and a number of substations, the former being provided with an amplifier, a loudspeaker adapted to be utilized also as a microphone, a station selector switch or switches, and a communication direction control switch, and the latter simply with loudspeakers adapted also to be utilized as microphones. The communication direction control switch is operable selectively to connect the loudspeaker at the master station to the input and output of the amplifier and simultaneously to connect the selected substation loudspeakers to the output and input of the amplifier so that communication may be carried on between the master and substations alternately in opposite directions.

A second type of system comprises a plurality of master stations, each provided with a loudspeaker, an amplifier, a station selector switch or switches, and a communication direction control switch normally connecting the loudspeaker to an interstation circuit for reception of calls from other stations and operable into a first displaced position in which the interstation line is connected to the input of the amplifier and the loudspeaker to the output for reception through the amplifier, and operable also into a second displaced position in which the interstation circuit is connected to the output and the loudspeaker to the input of the amplifier for transmission through the amplifier. Systems of this type may also include substations provided with loudspeakers and switches for connecting the loudspeakers to the amplifier input when the communication control switches are in an alternate normal position, which position is the first of the two displaced positions referred to above.

A third type of system also includes a number of master stations, each provided with a loudspeaker, an amplifier, a station selector switch or switches, and a communication direction control switch. The latter normally connects the loudspeaker to an interstation circuit individual to that station for the reception of calls and is operable into a displaced position wherein the loudspeaker is connected to the input of the amplifier and the output of the amplifier is connected to a selected interstation circuit individual to another station.

It is an object of the present invention to provide a new and improved intercommunicating unit which may be used in conjunction with other similar units to provide a new and improved system, and which units and system may be operated with and include, respectively, the various types of prior art units referred to above.

Another and more specific object of the present invention is to provide a new and improved unit of the type mentioned, in which the loudspeaker is connected to both the output of the amplifier and to an interstation circuit individual thereto for reception of calls from two different types of stations, and in which means are provided for enabling calls coming in over the interstation circuit readily to be heard through the loudspeaker.

Other objects and advantages of the present invention will become apparent from the ensuing description, in the course of which reference is had to the accompanying drawings, in which:

Fig. 1 is a diagrammatic representation of a portion of the system of the present invention, which portion includes two units constructed in accordance with the invention;

Fig. 2 is a diagrammatic representation of another portion of the system, including various forms of units heretofore used. Figs. 1 and 2, when placed alongside each other, represent a unified system;

Fig. 3 is a fragmentary diagrammatic representation of a modification of the units of Fig. 1;

Fig. 4 is a view similar to Fig. 1 of a modification of the invention. When this figure is placed alongside Fig. 3, the result is a complete system; and

Fig. 5 is a view similar to Fig. 1 of a further modification of the invention. When this figure is placed alongside Fig. 2, the result is a complete system.

Referring now to the drawings, and more particularly to Figs. 1 and 2, the communication system illustrated therein is shown to consist of seven stations, numbered 1 to 7, inclusive, stations 1 and 2 being shown in Fig. 1 and the remaining stations in Fig. 2. Stations 1 and 2 have units embodying the present invention, and in order to simplify the following description, these two stations will be referred to as "executive" stations. Stations 3 and 4 each include a master type of prior art unit and will be referred to hereinafter as "sub-executive" stations. Station 5 includes a speaker and a selector switch whereby the executive stations and one of the sub-executive stations may be called therefrom,

and it will be referred to hereinafter as a "subordinate" station. Station 6 is a station similar similar to station 5, having but one switch whereby it may call one of the executive stations, and station 7 is a station similar to stations 5 and 6, but having no switches for originating calls.

Before considering the details of the circuit arrangement and operation of the system as a whole and of the various units, it may be well briefly to describe the main elements located at each of the stations.

Station 1 includes an amplifier 10, a loudspeaker 11 utilizable both as a microphone and as a receiver, a multi-position communication direction control switch indicated generally by the reference character 12, and two groups of station selector switches 13 and 14. In the normal and indicated position of the communication control switch 12, loudspeaker 11 is connected to an interstation circuit 15 for the reception of calls from other executive stations and from sub-executive stations of the type of station 4. In the normal position of the communication control switch, the loudspeaker is also connected to the output of the amplifier for reception of calls from sub-executive stations of the type of station 3 and from subordinate stations of the type of station 5. Calls from the two latter types of stations are received over an interstation circuit 16 individual to station 1 which is connected to the amplifier input through a normally closed selector switch 17, a circuit 18, the communication control switch and circuits to be described in detail hereinafter. The first group 13 of selector switches includes also a selector switch 19 for connecting circuit 18 to an interstation circuit 20 individual to station 3, and a selector switch 21 for connecting circuit 18 to a circuit 22 individual to station 5. The second group 14 of selector switches includes selector switch 23 for connecting an amplifier output circuit 24 to an interstation circuit 25 individual to station 4, and selector switches 26, 27 and 28 for connecting circuit 24 to interstation circuits 29, 30 and 31 individual to stations 6, 7 and 2, respectively.

The unit at station 2 corresponds to that at station 1. It includes an amplifier 35, a loudspeaker 36 utilizable both as a microphone and as a receiver, a multi-position communication direction control switch indicated generally by the reference character 37, and two groups of station selector switches 38 and 39. In the normal and indicated position of the communication control switch, loudspeaker 11 is connected to the interstation circuit 31 for the reception of calls from other executive stations and from sub-executive stations of the type of station 4. In the normal position of the communication control switch, the loudspeaker is also connected to the output of the amplifier for reception of calls from sub-executive stations of the type of station 3 and from subordinate stations of the type of stations 5 and 6. Calls from the two latter types of stations are received over an interstation circuit 40 individual to station 2, which is connected to the amplifier input through a normally closed selector switch 41, a circuit 42, the communication control switch and circuits to be described in detail hereinafter.

The first group 38 of selector switches includes selector switches 43, 44 and 45 for connecting the circuit 42 to the interstation circuits 20, 29 and 22, individual to stations 3, 6 and 15, respectively. The second group 39 of selector switches includes selector switches 46, 47 and 48 for connecting an amplifier output circuit 49 to interstation circuits 15, 25 and 30, individual to stations 1, 4 and 7, respectively.

The apparatus at station 3 includes an amplifier 51, a loudspeaker 52 utilizable both as a receiver and as a microphone, and a communication direction control switch 53. In the normal and indicated position of the switch, the amplifier is operative, the loudspeaker 52 is connected to the output of the amplifier, and a circuit 54 connected to all of the selector switches is connected to the input of the amplifier. The selector switches include a normally closed switch 55 for connecting circuit 54 to the interstation circuit 20 individual to station 3, and selector switches 56, 57 and 58 for connecting circuit 54 to the interstation circuits 16, 22 and 40, individual to stations 1, 5 and 2, respectively.

The apparatus at station 4 includes an amplifier 61, a loudspeaker 62 utilizable both as a receiver and as a microphone, and a communication direction control switch 63. In the normal position of the switch the amplifier is rendered inoperative and the loudspeaker 62 is connected to the interstation circuit 25 individual to station 4 for the reception of calls from other stations. In the displaced positions of the switch, the amplifier is rendered operative and the loudspeaker is connected to the input of the amplifier and the output circuit 64 of the latter is connected to a selected station or stations through selector switches 65, 66, 67 and 68, individual to stations 1, 6, 7 and 2, respectively.

The apparatus at station 5 includes a loudspeaker 69, utilizable both as a receiver and as a microphone, connected directly to interstation circuit 22 individual to station 5. The station also includes a selector switch 70 operable to connect the loudspeaker to interstation circuits 16, 20 and 40, individual to stations 1, 3 and 2, respectively, whereby station 5 may call the enumerated stations.

The apparatus at station 6 includes a loudspeaker 71 permanently connected to interstation circuit 29 individual to station 6 and a normally open switch 72 operable to connect the loudspeaker to interstation circuit 40 individual to station 2, whereby the latter may be called by station 6.

Station 7 includes a loudspeaker 73 permanently connected to interstation circuit 30 individual to station 7.

Returning now to Fig. 1 and station 1, the amplifier 10 may be of any suitable type having input and output connections, and it may be supplied with power through a pair of conductors 75. It is conditioned for instantaneous operation upon completion of the "B" supply circuit, which circuit is completed through conductors 76 and switch blade 77 forming part of the communication control switch. In the normal position of the switch, the "B" supply circuit is completed through a resistor 78, so that the amplifier is operated at reduced "B" potential for the reception of calls from stations of the type of 3 and 5. The feature of rendering the amplifier normally operative with reduced "B" potential is disclosed and claimed in my copending application Serial No. 364,133, filed November 4, 1940 (now Patent No. 2,280,280, granted April 21, 1942) and assigned to the assignee of this application. When the communication control switch is operated to its uppermost position, the "B"

supply circuit is broken and the amplifier thus rendered inoperative. When the communication control switch is operated to its lowermost position, the resistor 78 is removed from the "B" supply circuit to increase the "B" voltage.

As previously indicated, station 1 is conditioned for reception of calls from other stations when the communication control switch is in its middle and indicated position. At this time interstation circuit 15 is connected to the loudspeaker 11 and interstation circuit 16 is connected to the input of the amplifier and the output of the amplifier is connected to the loudspeaker. Interstation circuit 15 is connected to the loudspeaker through a potentiometer 79, circuit 80, switch segments 81 and 82 of the communication control switch, and circuit 83. Interstation circuit 16 is connected to the amplifier input through the previously mentioned normally closed selector switch 17, circuit 18, switch blades 84 and 85, and the amplifier input circuit 86. The output of the amplifier is connected to the loudspeaker through the output circuit 87, switch segments 88 and 89, circuit 90 including resistors 91, and thence through the previously mentioned potentiometer 79, circuit 80, switch segments 81 and 82, and circuit 83.

Resistors 91 are utilized to prevent the secondary winding of the amplifier output transformer (not shown) from short-circuiting the interstation circuit 15 and loudspeaker to any substantial extent in order that calls coming in over interstation circuit 15 will be heard. Resistors 91 may have values equal to one-half the impedance of the loudspeaker voice coil and the secondary winding—e. g., impedances of 25 ohms as compared to 50 ohms. These resistors also serve to reduce the volume when listening and prevent excessive distortion due to the nonlinearity and rectification of the plate load of the tube feeding the output transformer.

Station 1 is conditioned for transmitting messages through the amplifier thereat when the communication control switch 12 is operated to its lowermost position. When this is done, the loudspeaker 11 is connected to the input of the amplifier and the output of the amplifier is connected to circuits 18 and 24. Loudspeaker 11 is connected to the input of the amplifier through circuit 33, switch segments 81 and 82, and the input circuit 86. The amplifier output circuit 87 is connected to circuit 18 through switch segments 88 and 89, circuits 24 and 92, and switch blades 84 and 85. Circuit 24 is connected to the amplifier output circuit 87 directly by the switch segments 88 and 89.

While the middle position of the communication control switch is its preferred normal position, the switch may be operated to its uppermost position for another normal position. In this other normal position, station 1 is conditioned for the reception of calls from other stations provided with amplifiers by reason of loudspeaker 11 being connected to interstation circuits 15 and 16. The loudspeaker is connected to circuit 15 through resistors 91, circuit 90, switch segments 88 and 89, circuit 93, switch blades 84 and 85, and circuit 83. Interstation circuit 16 is connected to the loudspeaker through normally closed selector switch 17, circuit 18, switch blades 84 and 85, and circuit 83.

The communication control switch is so constructed and arranged that it remains in either its middle or uppermost position when operated thereinto but is returned by a spring 94 from its lowermost to its middle position.

The apparatus at station 2 corresponds identically with that at station 1 and, consequently, it is not deemed necessary to describe it in detail. The corresponding circuit elements at station 2 have, however, been indicated by adding the suffix 2 to the various numbers.

The apparatus at station 3 includes the amplifier 61 supplied with power through circuit 97 and conditioned for instantaneous operation upon completion of the "B" supply circuit. The "B" supply circuit is completed through a circuit 98 by a switch blade 99 forming part of the communication control switch 53. In the normal position of the switch, as already indicated, the "B" supply circuit is completed, the loudspeaker 52 is connected to the output, and the circuit 54 is connected to the input of the amplifier. The loudspeaker 52 is connected to one side of the output circuit 100 through conductor 101 and switch elements 102 and to the other side of the output circuit 100 through conductor 103, switch elements 104, conductor 105, resistor 106, and switch element 107. At the same time the resistor 108 is connected in parallel with the voice coil of the loudspeaker. The circuit 54 is connected to the input circuit 109 directly through switch elements 110 and 111.

When the switch is operated to its lower position, loudspeaker 52 is connected to the input of the amplifier, while circuit 54 is connected to the output. Loudspeaker 52 is connected to one side of the input circuit 109 through conductor 101 and switch elements 102 and to the other side through conductor 103 and switch elements 104. Circuit 54 is connected directly to the output circuit 100 by switch elements 110 and 111. In this position the "B" supply circuit is completed as before. The switch is preferably provided with a spring 112 for returning it from its down to its middle position.

In the up position of the communication control switch 53, which may be an alternate normal position, the "B" supply circuit is broken up by switch blade 99 and the loudspeaker 52 is connected directly to circuit 54 by means of switch blades 110 and 111. In this position, station 3 may be called only by stations provided with amplifiers.

The amplifier 61 at station 4 is supplied with power through circuit 115 and is conditioned for instantaneous operation upon completion of the "B" supply circuit 115 by switch blade 116. The communication control switch is normally in its intermediate position, at which time the "B" supply circuit is broken and loudspeaker 62 is connected to interstation circuit 25 individual to station 4 through circuit 117, switch blades 118, and potentiometer 119. In both displaced positions of the communication control switch, the "B" supply circuit is completed and the loudspeaker connected to the amplifier input and circuit 64 connected to the output. Loudspeaker 62 is connected to the amplifier input circuit 120 through circuit 117 and switch blades 118, and circuit 64 is connected to the amplifier output by switch blade 121.

It is believed that the apparatus at stations 5, 6 and 7 has already been described in sufficient detail, so that further amplification is not necessary and that the operation thereof will be apparent from the following description of the operation of the system as a whole. It is

believed further that the operation of the units and of the systems of the present invention may be understood best by considering the modes of operation when stations of the various types communicate with each other, and the following portion of the specification has been based on this assumption.

(1). Communication between stations 1 and 2

The mode of communication between stations 1 and 2 will be considered first when the communication control switches at the two stations are in their preferred normal positions, in which they are indicated. When the communication control switches are in these positions, either of the stations may call the other.

It is assumed, first, that station 1 calls station 2. To do this, the operator at station 1 closes selector switch 28 and operates communication control switch 12 to its lowermost position. In this position the loudspeaker 11 is connected to the input of amplifier 10 and the output of the amplifier is connected to circuit 24, and thence through the closed selector switch and the interstation circuit 31 individual to station 2 to loudspeaker 36 at station 2, the circuit 31 being connected to the loudspeaker through circuit 80—2, switch segments 81—2 and 82—2, and circuit 83—2. The amplified output from station 1 is thus supplied to loudspeaker 36 at station 2 and in part is dissipated in the output transformer of amplifier 35 at station 2, but, as already pointed out, the part so dissipated is decreased by placing resistors 91—2 between the amplifier output and the potentiometer 79—2.

To respond to a call from station 1, the operator at station 2 closes selector switch 46, thereby connecting output circuit 49 to interstation circuit 15 individual to station 1 and operating switch 37 to its lowermost position, and the operator at station 1, in order to receive, must release the communication control switch 12 thereat so that it returns to its middle position. Thus, alternate two-way communication is possible by alternate operation of the communication control switches 12 and 37 at stations 1 and 2.

In case station 2 calls station 1, the foregoing operation is repeated with the operator at each station performing the operation previously performed by the other.

The alternate normal positions of the communication control switches at stations 1 and 2 are their uppermost positions. When the switches are in these positions, the loudspeakers at the two stations are connected only to interstation circuits. Assuming now that the communication control switches are in their uppermost positions, then station 1 can call station 2 by closing selector switch 28 and operating the communication control switch thereat to its lowermost position. This connects loudspeaker 11 to the input of amplifier 10 and the output of the latter to loudspeaker 36 at station 2 through interstation circuit 31 individual to station 2, resistors 91—2, circuit 90—2, switch segments 88—2 and 89—2, circuit 93—2, switch blades 84—2 and 85—2, and circuit 83—2. To respond to a call, the operator at station 2 closes selector switch 46, individual to station 1, and thereafter the communication control switches at the two stations are alternately operated between their middle and lowermost positions, as heretofore described.

The operation, when station 2 calls station 1, corresponds to the above except that the operator at each station performs the operation previously performed by the other.

(2). Communication between station 3 and stations 1 and 2

Inasmuch as stations 1 and 2 are identical, it is believed that it will be sufficient to obtain an understanding of the present invention if communication between stations 1 and 3 alone is described. Station 1 can call station 3 by closing selector switch 19 to connect circuit 18 to interstation circuit 20 individual to station 3 and by operating switch 12 to its uppermost position. This connects loudspeaker 11 to interstation circuit 20 and thence through amplifier 51 to loudspeaker 52 at station 3, it being remembered that with the communication control switch at the latter in its normal position, circuit 54 is connected to the input of the amplifier and the output of the amplifier is connected to the loudspeaker 52. Thereafter, the direction of communication is controlled by the operator at station 3, the communication control switch 53 being operated to its middle position for station 3 to receive and to its down position for station 3 to talk.

In the event the communication control switch at station 3 is in its second alternate normal position, that is, in its up position, then the operator at station 1 can call station 3 by closing selector switch 19 and operating the communication control switch 12 to its lowermost position. This connects loudspeaker 11 to the input of amplifier 10 and the output of the latter is connected to loudspeaker 52 through interstation circuit 20 and switch blades 110 and 111 at station 3. The direction of communication is reversed by releasing communication control switch 12 so that it returns to its middle position.

Station 3 can call station 1 when the communication control switch at the latter is in its indicated normal position by closing selector switch 56 and operating communication control switch 53 to its uppermost position. Loudspeaker 52 is thus connected to the input of amplifier 10 at station 1 through switch blades 110 and 111, circuit 54, switch 56, and interstation circuit 16. When called, the operator at station 1 can reverse the direction of communication by operating the communication control switch thereat to its lowermost position. Thus, communication in opposite directions is carried on under the control of communication control switch 12.

Station 3 can call station 1 when the communication control switch at the latter is in its second normal position, that is, in its uppermost position. Under these conditions, station 1 is called by closure of selector switch 56 and operation of communication control switch 53 at station 3 to its lowermost position. To receive an answer from station 1, the communication control switch at station 3 must be returned to its middle position.

(3). Communication between station 4 and stations 1 and 2

Communication between station 4 and stations 1 and 2 is carried on in a manner similar to that between stations 1 and 2. For station 1 to call station 4, it is necessary for the operator at station 1 to close selector switch 23 and to operate

switch 12 into its lowermost position. This connects loudspeaker 11 to the input of amplifier 10 and the output of the latter to circuit 24, selector switch 23, interstation circuit 25, and thence to loudspeaker 62 at station 4 through switch blades 118. To reply, the operator at station 4 closes selector switch 65 and operates the communication control switch 63 to its lowermost position, and in order for the operator at station 1 to receive the reply, the communication control switch 12 thereat must be released to return to its middle position. For two-way communication, it is necessary for the operators at the two stations alternately to operate the communication control switches between their lowermost and middle positions.

For the operator at station 4 to call station 1, it is necessary for him to close selector switch 65 and operate switch 63 to its lowermost position, and to answer, the operator at station 1 must close selector switch 23 and operate the communication control switch 12 thereat.

In case the communication control switch 12 at station 1 is left in its uppermost normal position, station 4 may call station 1 in the same manner. Thereafter, however, station 1 has to operate switch 12 between its middle and lowermost positions after receiving an initial call.

(4). Communication between station 5 and stations 1 and 2 and station 3

Station 1 can call station 5 by closing selector switch 21 and operating communication control switch 12 to its lowermost position. This connects loudspeaker 11 to the input of the amplifier and loudspeaker 69 to the output of the amplifier through interstation circuit 22 and the selector switch 21. To receive from station 4, the communication control switch 12 is released to its middle position.

Station 5 can call station 1 by operation of the selector switch 70 to complete a circuit from the loudspeaker to interstation circuit 16. This interstation circuit is connected to the input of the amplifier through the normally closed selector switch 17, circuit 18, switch blades 84 and 85, and circuit 86. To respond, the operator at station 1 preferably closes selector switch 21 and thereafter operates the communication control switch between its middle and lowermost positions. When station 5 calls station 1, communication between the two stations may be carried on over the interstation circuit 16 individual to station 1 or with this circuit connected in parallel with the interstation circuit 22 individual to station 5, which circuit is connected in this manner by closure of selector switch 21 at station 1.

Communication between stations 2 and 5 is carried on in the same manner as between stations 1 and 5, except, of course, for the operation of the proper selector switches, and when station 5 calls station 2 by operation of selector switch 70 to connect loudspeaker 69 to interstation circuit 40 individual to station 2.

Station 5 can also call station 3 when the communication control switch 53 at the latter is in its indicated normal position. To call station 3, the operator at station 5 moves selector switch 70 to connect loudspeaker 69 to interstation circuit 20 individual to station 3. This intersection circuit is connected to the input of amplifier 61 and the output of this amplifier is connected to loudspeaker 52. To answer a call, the operator at station 3 may, if he desires, close selector switch 57 individual to station 5 so that the operator at station 5 may, if he desires, return selector switch 70 to its normal off position. Thereafter, the direction of communication is controlled by the operator at station 3, the communication control switch being operated alternately between its middle and lowermost positions.

(5). Communication between station 6 and stations 1 and 2 and station 4

Station 6 can call station 2 when the communication control switch at the latter is in its indicated normal position by closing selector switch 72. This connects loudspeaker 71 to interstation circuit 40, individual to station 2, which it may be recalled is connected to the input of amplifier 35. To answer, the operator at station 2 may close selector switch 44 individual to station 6, so that the operator at station 6 may, if he desires, open switch 72. Thereafter, communication between the two stations is carried on by alternate operation of communication control switch 37 at station 2 between its middle and lowermost positions.

Stations 1 and 4 may transmit to, but not receive from, station 6. In order for stations 1 and 4 to be placed in communication with station 6, it is necessary that the proper selector switches at these two stations be closed. For station 1 to call station 6, selector switch 26 has to be closed, and for station 4 to call station 6, selector switch 66 must be closed. Then, when the communication control switches at stations 1 and 2 are operated into their lowermost positions, loudspeaker 71 at station 6 will be connected to the output of the amplifiers at stations 1 and 4.

(6). Communication between station 7 and stations 1 and 2 and station 4

Stations 1, 2 and 4 may transmit to, but not receive from station 7. To transmit to station 7, the operators at any of stations 1, 2 and 4 simply close the proper selector switches, that is, selector switch 27 at station 1, selector switch 48 at station 2, and selector switch 27 at station 4.

In Fig. 3 there is illustrated an arrangement whereby stations 1 and 2 may be placed in communication with each other by operation of the proper selector switch at the calling station. The arrangement has been illustrated in conjunction with a portion of the apparatus at station 1. The modification consists in connecting circuit 15, which is individual to station 1, to circuit 24 which is connected to the output of amplifier 10 at station 1 when the communication control switch is in its lowermost position. This connection is made by jumpers 123 and 124. Similar jumpers may be provided at station 2 and also at stations similar to station 4. Then when the called station selector switch is closed at the calling station, the two stations are conditioned for two-way communication by alternate operation of the communication control switches thereat between their middle and lowermost positions.

Assume, for instance, that station 1 desires to communicate with station 2. Then, selector switch 28 at station 1 is closed. To call station 2, the operator operates the communication control switch to its lowermost position, thereby to connect loudspeaker 11 to the input of the amplifier and to connect the output of the amplifier to circuit 24, selector switch 28, and interstation circuit 31. Interstation circuit 31 is connected to loudspeaker 36 through the circuit 80—2, switch segments 81—2 and 82—2, and circuit

83—2. To answer, the operator at station 2 operates communication control switch 37 to its lowermost position after the operator at station 1 releases communication control switch 12 to return the latter to its middle position. Loudspeaker 36 is thus connected to the input of the amplifier 35 and the output of the latter is connected to interstation circuit 31 through jumpers corresponding to jumpers 123 and 124 at station 2, and interstation circuit 31 is connected to loudspeaker 11 at station 1 through selector switch 28, circuit 24, jumpers 123 and 124, the potentiometer 79, circuit 80, switch segments 81 and 82, and circuit 83. This circuit may be utilized where secrecy of communication between stations is not necessary.

A modified form of unit which may be used in conjunction with other similar units or with the various types of prior art units referred to above is illustrated diagrammatically in Fig. 4, to which reference will now be had. In Fig. 4, stations 1 and 2 are illustrated as having identical equipment, which equipment corresponds in part to that illustrated in Fig. 1. The corresponding parts have been indicated by like reference characters.

Referring now more particularly to the equipment at station 1, it will be noted that the communication direction control switch 12 differs from that shown in Fig. 1 and that the station has been provided also with a group selector switch indicated generally by the reference character 131.

The communication direction control switch 12, like that of the embodiment of Fig. 1, has two normal positions, although its preferred normal position is the middle position in which it is illustrated. The group selector switch 131 normally occupies the position in which it is indicated. In this position it connects station 1 for the reception of calls from various outlying stations and in its displaced position it conditions the station for reception of calls from other similar stations or from sub-executive stations of the character of station 4 having access to interstation circuit 15.

The communication direction control switch 12 includes the amplifier "B" supply controlling switch 77 and a plurality of circuit controlling switch blades 132 to 137, inclusive. In the indicated position of the switch, the loudspeaker 11 is connected to interstation circuit 15 for the reception of calls from other executive stations and from sub-executive stations of the type of station 4. This connection extends through conductors 83, switch blades 132 and 135 and conductors 139. At the same time the station is conditioned for the reception of calls from sub-executive stations of the type of station 3 and from certain of the subordinate stations as the interstation circuit 18 through which these stations may call station 1 is connected to the input of amplifier 10 and the output of the amplifier is connected to loudspeaker 11. Interstation circuit 18 is connected to the input of the amplifier through a pair of switch blades 140 forming part of the previously referred to group selector switch 131, a pair of conductors 141 and 142 leading to switch blades 133 and 136, respectively, and the amplifier input conductors 86. The output of the amplifier is connected to loudspeaker 11 through the output conductors 87, switch blades 134 and 137, conductors 143 and 144, a second pair of switch blades 145 forming part of the group selector switch 131, a pair of resistors 146 and conductors 139 leading to switch blades 132 and 135 which are connected to the loudspeaker.

The resistors 146 perform the same function as performed by the resistors 91 in the embodiment of Fig. 1, i. e., they prevent the output transformer of the amplifier from short-circuiting signals sent to station 1 over the interstation circuit 15.

The alternative normal position of the communication direction control switch at station 1 is its uppermost position in which the amplifier 10 is rendered inoperative by disconnection of its "B" supply. In this position of the switch the loudspeaker 11 is connected directly to circuits 15 and 18 for the reception of calls from other stations in the system. The loudspeaker is connected to circuit 15 through conductors 83, switch blades 132 and 135 in their uppermost position and conductors 139. The loudspeaker is connected to circuit 18 through conductors 83, switch blades 132 and 135 in their uppermost positions, a pair of branch conductors 148, switch blades 133 and 136 in their uppermost positions, the pair of conductors 141 and 142 and switch blades 140. In this position of the communication control switch, station 1 is conditioned for the reception of calls from other stations provided with amplifiers.

When the communication direction control switch is operated to its lowermost position, the loudspeaker is connected to the input of the amplifier and the output of the amplifier is connected either to circuit 18 or circuit 24, depending upon the position of the group selector switch 131. In the indicated position of the latter, the output of the amplifier is connected to circuit 18 for the transmission of messages to stations connected to interstation circuits 16, 20 and 22 (that is, to stations 3 and 5) through conductors 87, switch blades 134 and 137 in their lowermost positions, the pair of branch conductors 149 (which are also connected to conductors 143 and 144), switch blades 133 and 136 in their lowermost positions, the pair of conductors 141 and 142 and switch blades 140. At this time the output of the amplifier is also connected to interstation circuit 15 through conductors 143 and 144, the switch blades 145 and resistors 146; but since interstation circuit 15 is normally not connected to the amplifiers or loudspeakers at any of the other stations, this connection has no deleterious effect on the operation.

When the group selector switch 131 is operated to its displaced position, circuit 18 is disconnected from the communication switch and circuit 24 is connected to the conductors 143 and 144 directly through the switch blades 145. The latter also break the circuit 15 through resistors 146 so that the output of the amplifier goes only to circuit 24 and thence through the station selector switches to the selected station.

The apparatus at station 2 corresponds identically with that at station 1, as indicated heretofore, and in view of this the various elements have been indicated by like reference characters with the suffix 2 and further description thereof is not deemed necessary in view of the following description of the operation of the system as a whole. The system as a whole is disclosed in Figs. 4 and 2, and more particularly when the former is placed to the left of the latter.

(1). Communication between stations 1 and 2

The mode of communication between stations 1 and 2 will be considered first when the communication direction control switches are in their

indicated preferred normal positions, at which time either of the stations may call the other. It is assumed that station 1 calls station 2. To do this, the operator at station 1 moves group selector switch 131 to its displaced position to connect switches 145 to circuit 24 and closes station selector switch 28 and operates switch 12 to its lowermost position. In this position the loudspeaker 11 is connected to the input of amplifier 10, and the output of the latter is connected to circuit 24 and thence through switch 28 and interstation circuit 31, individual to station 2, to loudspeaker 36 at station 2, the circuit 31 being connected to the loudspeaker 36 through circuit 139—2, switch blades 132—2 and 135—2, and circuit 83—2. The amplifier output from station 1 is thus supplied to loudspeaker 36 at station 2 and in part is dissipated in the output transformer of amplifier 35, but, as already pointed out, the part so dissipated is decreased by placing resistors 146—2 between the amplifier output and circuit 31.

To respond to a call from station 1, the operator at station 2 closes the station selector switch 46, thereby connecting circuit 49 to interstation circuit 15 individual to station 1, operating group selector switch 131—2 to its displaced position to connect the amplifier output to circuit 49, and finally operating switch 37 to its lowermost position. The operator at station 1, in order to receive, must release the communication control switch 12 thereat so as to return it to its middle position. Thus, alternate two-way communication is possible by alternate operation of the communication control switches 12 and 37 at stations 1 and 2 after the respective station selector switches have been closed and the group selector switches 131 operated to their displaced positions.

When the communication direction control switches at stations 1 and 2 are in their upper or alternate normal positions, then station 1 can call station 2 in the manner described above, i. e., by operating switch 131 to its displaced position, closing selector switch 28 and operating switch 12 to its lowermost position. Loudspeaker 11 is thus connected to the input of amplifier 10, and the output of the latter is connected to loudspeaker 36 at station 2 through interstation circuit 31, conductors 139—2, switch blades 132—2 and 135—2 in their uppermost positions and conductors 83—2. At this time amplifier 35 is inoperative and both its input and output circuits are broken. To respond, the operator at station 2 operates switch 131—2 to its displaced position, closes selector switch 46 and operates switch 37 to its lowermost position. To receive the response, the operator at station 1 releases switch 12 allowing it to return to its middle position and thereafter, as previously, alternate two-way communication is carried on by operation of switches 12 and 37 between middle and lowermost positions.

In case station 2 calls station 1, the foregoing operations are repeated, with the operator at each station performing the operation previously performed by the other.

(2). *Communication between station 3 and stations 1 and 2*

Inasmuch as stations 1 and 2 are identical, it is believed that it will be sufficient to describe communication between stations 1 and 3. Station 1 can call station 3 when the communication control switch at the latter is in its indicated position, conditioning the loudspeaker 52 thereat for reception through its associated amplifier 51 by closing station selector switch 19 to connect circuit 18 to interstation circuit 20 individual to station 3, by leaving switch 131 in its indicated position and operating switch 12 to its uppermost position. This connects loudspeaker 11 to interstation circuit 21, and thence through amplifier 51 to loudspeaker 52 at station 3. In this position of switch 12, the amplifier 10 at station 1 is rendered inoperative. Thereafter, the direction of communication is controlled by the operator at station 3, the communication direction control switch 53 being operated between its middle and lowermost positions to condition station 3 for reception and transmission, respectively.

In the event the communication control switch at station 3 is in its second alternate normal position, that is, in its up position, then the operator at station 1 can call station 3 by closing station selector switch 19 and operating switch 12 to its lowermost position. This connects loudspeaker 11 to the input of amplifier 10 and the output of the latter is connected to loudspeaker 52 through interstation circuit 20 and switch blades 110 and 111 at station 3. The direction of communication is reversed by releasing switch 12 to return it to its middle position.

Station 3 can call station 1 when the communication control switch at the latter is in its indicated normal position by closing selector switch 56 and operating communication control switch 53 to its uppermost position. Loudspeaker 52 is thus connected to the input of amplifier 10 at station 1 through interstation circuit 16 and the normally closed switch 17, switches 140 and the input circuit 86. The output of the amplifier 10 is connected to loudspeaker 11 through a circuit previously described and including the output conductors 87, resistors 146 and circuit 139. When called, the operator at station 1 can reverse the direction of communication by operating the communication control switch thereat to its lowermost position, thereby reversing the connections of the interstation circuit and loudspeaker 11 to the amplifier.

Station 3 can also call station 1 when the communication control switch at the latter is in its second normal position, that is, in its uppermost position. Under these conditions, station 1 is called by closure of selector switch 56 and operation of communication control switch 53 at station 3 to its lowermost position. To receive an answer from station 1, the communication control switch at station 3 must be returned to its middle position.

In the event the selector switch 131 is in its displaced position, then station 3, as well as any other stations connected to or adapted to be connected to interstation circuit 16, cannot call station 1 because the circuit 18 is disconnected by switches 140 from the communication control switch.

(3). *Communication between station 4 and stations 1 and 2*

Communication between station 4 and stations 1 and 2 is carried on in a manner similar to that between stations 1 and 2. For station 1 to call station 4, it is necessary for the operator at the former to close selector switch 23 and operate switch 131 to its displaced position and switch 12 into its lowermost position. Inasmuch as loudspeaker 62 at station 4 is normally connected to interstation circuit 25, it may be seen that when

the switches at station 1 are operated as indicated, then station 1 can call station 2 through amplifier 10 at the former. To reply, the operator at station 4 closes selector switch 65 and operates communication control switch 63 to its lowermost position, and in order for the operator at station 1 to receive the reply, the communication control switch thereat must be released to return to its middle position. For two-way communication, it is thereafter necessary for the operators at the two stations alternately to operate the communication control switches between their lowermost and middle positions, although it is possible for the operator at station 1 to operate the communication control switch thereat alternately between its uppermost and lowermost positions.

For the operator at station 4 to call station 1, it is necessary for him to close selector switch 65 and operate switch 63 to its lowermost positions, and to answer, the operator at station 1 must close selector switch 23 and operate the communication control switch thereat.

In case the communication control switch at station 1 is left in its uppermost or alternate normal position, station 4 may call station 1 in the same manner. Thereafter, however, station 1 preferably operates switch 12 between its middle and lowermost positions for two-way communication, although, as stated above, it is possible to operate switch 12 alternately between its uppermost and lowermost positions.

(4). Communication between station 5 and stations 1 and 2

Station 1 can call station 5 by closing station selector switch 21 and operating communication control switch 12 to its lowermost position. This connects loudspeaker 11 to the input of the amplifier and loudspeaker 69 to the output of the amplifier through interstation circuit 22, selector switch 21, and switch blades 140. To receive from station 4, the communication control switch is released to return to its middle position.

Station 5 can call station 1 when switches 131 and 12 at station 1 are in their indicated positions by operation of selector switch 70 to complete a circuit from the loudspeaker to interstation circuit 16, which, it may be remembered, is individual to station 1. This interstation circuit is connected to the input of amplifier 10 through a circuit including circuit 18, switch blades 140, and switch blades 133 and 136. To respond, the operator at station 1 preferably closes selector switch 21 and thereafter operates the communication control switch between its middle and lowermost positions. When station 5 calls station 1, communication may be carried on between the two stations over interstation circuit 16 individual to station 1 or with this circuit connected in parallel with interstation circuit 22 individual to station 5, which circuit is connected in this manner by closure of selector switch 21 at station 1.

Communication between stations 2 and 5 is carried on in the same manner as between stations 1 and 5, except, of course, for operation of the proper selector switches at the two stations.

(5). Communication between station 6 and stations 1 and 2

Station 6 can call station 2 when the communication control switch 37 and selector switch 131–2 at the latter are in their indicated positions upon closure of selector switch 72. This connects loudspeaker 71 to interstation circuit 41 individual to station 2, which, it may be recalled, is connected to the input of amplifier 35. To answer, the operator at station 2 may close selector switch 44 individual to station 6 so that the operator at station 6 may, if he desires, open switch 72. Thereafter, communication between the two stations is carried on by alternate operation of switch 37 at station 2 between its middle and lowermost positions.

Station 1 may transmit to, but not receive from, station 6, inasmuch as no provision is made for station 6 to call station 1. Station 6, however, being connected to its interstation circuit 29, may be called by station 1 upon closure of station selector switch 26 at the latter and upon operation of selector switch 131 to its displaced position and of communication control switch 12 to its lowermost position.

(6). Communication between station 7 and stations 1 and 2

Stations 1 and 2 may transmit to, but not receive from, station 7. To transmit, the operators at stations 1 and 2 simply close the proper selector switches, that is, selector switch 27 at station 1 and selector switch 48 at station 2, and operate the selector switches 131 to their displaced positions and the communication control switches to their lowermost positions.

From the foregoing it may be noted that the modes of communication between stations 5 and 3 and between 4 and 6 and 7 have not been described. The reason for this is that they correspond to those previously described.

A further modified form of unit which may be used in conjunction with other similar units or with various types of prior art units is illustrated in Fig. 5. In this figure stations 1 and 2 are illustrated as having identical equipment, which equipment corresponds in part to that illustrated in Fig. 1. The corresponding parts have been indicated by like reference characters.

Referring more particularly to the equipment at station 1, it may be noted that it differs from the previously described embodiments in that two communication direction control switches 151 and 152 are provided. The first of these is utilized for communication between station 1 and stations connected to group 13 of station selector switches and the latter for communication between station 1 and stations connected to group 14 of station selector switches. The switches are of the three-position type and are both normally in their uppermost positions, in which they are indicated. Switch 151 may, if desired, be utilized with its middle position as an alternative normal position. Both switches are returned from their lowermost positions to their middle positions by springs 94.

In the indicated normal positions of the switches the loudspeaker 11 at station 1 is connected for reception from other stations provided with amplifiers, it being connected to the interstation circuit 16 individual to station 1 through the normally closed station selector switch 17 and circuit 18, and also to the other interstation circuit 15 individual to station 1. Circuit 18 is connected to the loudspeaker through a pair of switch blades 153 forming part of switch 151, a pair of conductors 154, a second pair of switch blades 155 also forming part of switch 151, a pair of conductors 156, a pair of branched conductors 157, a pair of switch blades 158 forming

part of switch 152 and conductors 83. Circuit 15 is connected to loudspeaker 11 through a pair of branched conductors 159, a pair of switch blades 160 forming part of switch 151, a pair of conductors 161, a pair of switch blades 162 forming part of switch 152, the previously mentioned conductors 157, switch blades 158 and circuit 83. In the indicated positions of switches 151 and 152 both the input and output circuits 86 and 87, respectively, of the amplifier are open.

Switches 151 and 152 are both operable from their uppermost positions to middle and lowermost positions. When switch 151 is operated to its middle position, circuit 18 is connected to the input of the amplifier (which is normally operative) and loudspeaker 11 to the output. Circuit 18 is connected to the input through switch blades 153 in their middle positions, a pair of branched conductors 163 and the input circuit 86. Loudspeaker 11 is connected to the output of the amplifier through circuit 83, switch blades 158, conductors 157 and 156, switch blades 155 in their middle positions and the pair of conductors 164 which are connected to amplifier output circuit 86. Conductors 164 are each provided with resistors 164' corresponding to resistors 91 and 146 of the previously described embodiments.

When switch 151 is operated to its lowermost position, circuit 18 is connected to the output of the amplifier and loudspeaker 11 to the input. Circuit 18 is connected to the output through switch blades 153, and the pair of conductors 165. Loudspeaker 11 is connected to the amplifier input through circuit 83, switch blades 158, circuits 157 and 156, switch blades 155 in their lowermost positions, the pair of conductors 163 and the input circuit 86.

When switch 152 is operated to its middle position with switch 151 in its uppermost position, then circuit 15 is connected to loudspeaker 11 and when operated to its lowermost position loudspeaker 11 is connected to the input of the amplifier and the output is connected to circuit 34 and the group 14 of station selector switches. In the middle position of the switch, circuit 15 is connected to the loudspeaker 11 through the pair of conductors 159, switch blades 160, conductors 161, switch blades 162, conductors 166, switch blades 158 and circuit 83. In the lowermost position loudspeaker 11 is connected to the input of the amplifier through circuit 83 and switch blades 158 and input circuit 86. In this position of switch 152, circuit 24 is connected to the output of the amplifier through a pair of switch blades 168 forming part of switch 152 and a pair of conductors 169 connected to the output circuit 87.

The apparatus at station 2 corresponds with that at station 1, the corresponding elements being indicated by like reference characters with the suffix 2. The system as a whole is disclosed in Figs. 5 and 2, and more particularly when the former is placed to the left of the latter.

(1). Communication between stations 1 and 2

The mode of communication between stations 1 and 2 will be considered first when the communication direction control switches are in their indicated normal positions, at which time either station may call the other. It is assumed station 1 calls station 2. The operator at station closes station selector switch 28 and operates switch 152 to its lowermost position. In this position loudspeaker 11 is connected to the input of amplifier 10 and the output of the latter is connected to circuit 24 and thence through switch 28 and interstation circuit 31 individual to station 2, to the loudspeaker 36 at station 2, circuit 31 being connected to the loudspeaker through circuit 159—2, switch blades 160—2, circuit 161—2, switch blades 162—2, circuit 157—2, switch blades 158—2 and circuit 83—2. The amplifier output at station 2 is open circuited at this time.

To respond to the call, the operator at station 2 closes station selector switch 46, thereby connecting circuit 49 to interstation circuit 15 individual to station 1 and operates switch 152—2 to its lowermost position. The operator at station 1, in order to receive, must release switch 152 to return it to its middle position wherein loudspeaker 11 is connected to circuit 15 through a circuit that remains the same as described above except conductors 166 are substituted for conductors 157, thus disconnecting circuit 18 from loudspeaker 11. Thereafter, communication in opposite directions is carried on by alternate operation of switches 151 and 152—2 between their middle and lowermost positions.

When the switches 151 and 151—2 are in their alternative normal positions, communication between stations 1 and 2 is carried on in the manner described above, the only difference being that circuits 15 and 31 are connected to switch blades 160 and 160—2 through the other branches of conductors 159 and 159—2. Circuits 18 and 42, however, are connected to the inputs of the amplifiers 10 and 35, respectively, so that to avoid interruptions by calls from stations connected to circuits 18 and 42, the selector switches of groups 13 and 38 should be opened.

In case station 2 calls station 1, the foregoing operations are repeated, with the operator at each station performing the operations previously performed by the other.

(2). Communication between station 3 and stations 1 and 2

Inasmuch as stations 1 and 2 are identical, it is believed that it will be sufficient to describe communication between stations 1 and 3. Station 1 can call station 3 when the communication control switch at the latter is in its indicated position, conditioning the loudspeaker at station 3 for reception through amplifier 51, by closing station selector switch 19 to connect circuit 18 to interstation circuit 20 individual to station 3. This connects loudspeaker 11 to interstation circuit 20 and thence through amplifier 51 to loudspeaker 52 at station 3. Thereafter, the direction of communication is controlled by the operator at station 3, communication direction control switch 53 being operated between its middle and lowermost positions to condition station 3 for reception and transmission, respectively.

In the event communication direction control switch at station 3 is in its second alternative normal position, that is, in its up position, then the operator at station 1 can call station 3 by closing station selector switch 19 and operating switch 151 to its lowermost position. This connects loudspeaker 11 to the input of amplifier 10 and the output of the latter is connected to loudspeaker 52 through interstation circuit 20 and switch blades 110 and 111 at station 3. The direction of communication is reversed by releasing switch 151 to return it to its middle position.

Station 3 can call station 1 when the communication control switch at the latter is in its indicated normal position by closing station se-

lector switch 56 and operating communication control switch 53 to its lowermost position. Loudspeaker 52 is thus connected to the input of amplifier 51 and the output of the latter is connected to loudspeaker 11 through interstation circuit 16 and the normally closed switch 17 at station 1. The direction of communication is controlled by the operator at station 3 by moving switch 53 between its middle and lowermost positions.

Station 3 can also call station 1 when the communication control switch 151 at the latter is in its middle position, at which time loudspeaker 11 is connected to the output of amplifier 10 through resistors 164' and circuit 18 is connected to the input of amplifier 10. The operator at station 3 merely operates the communication control switch 33 to its uppermost position, thus connecting loudspeaker 52 to interstation circuit 16 through station selector switch 56 corresponding to station 1. The direction of communication is controlled by the operator at station 1.

(3). *Communication between station 4 and stations 1 and 2*

Communication between station 4 and stations 1 and 2 is carried on in a manner similar to that between stations 1 and 2. For station 1 to call station 4 it is necessary for the operator at the former to close selector switch 23 and operate communication direction control switch 152 to its lowermost position. This connects loudspeaker 11 to the input of the amplifier and the output of the amplifier is connected to circuit 24 and thence through interstation circuit 25 to loudspeaker 62 at station 4. To reply, the operator at station 4 closes station selector switch 65 and operates communication direction control switch 63 to either its lowermost or uppermost position. In order for the operator at station 1 to receive the reply, the switch 152 thereat is returned to its middle position. Thus, for two-way communication, it is necessary for the operators at the two stations alternately to operate the switches between their lowermost and middle positions.

For the operator at station 4 to call station 1, it is necessary for him to close selector switch 65 and operate switch 63 to its lowermost position and to answer. The operator at station 1 must close selector switch and operate the communication control switch thereat.

In the event switch 151 at station 1 is left in its alternate normal position to condition that station for reception of calls from stations not provided with amplifiers, then station 4 can call station 1 in the manner described above. At this time interstation circuit 15 is connected in parallel to the loudspeaker and to the output transformer of amplifier 10. The connection to the latter is through resistors 164', so that only part of the energy is dissipated in the output transformer.

(4). *Communication between station 5 and stations 1 and 2*

Station 1 can call station 5 by closing station selection switch 21 and operating communication direction control switch 151 to its lowermost position. This connects loud speaker 11 to the input of the amplifier and loudspeaker 69 at station 9 to the output of the amplifier through interstation circuit 22. To receive from station 4, the communication control switch 151 is released to return to its middle position.

Station 5, which is not provided with an amplifier, can call station 1 only when switch 151 at the latter is in its alternate normal position wherein circuit 18 is connected to the input of the amplifier and loudspeaker 11 is connected to the output of the amplifier. Direction of communication is reversed by alternately operating switch 151 between its middle and lowermost positions. As before, communication between the two stations may be carried on over interstation circuit 16 individual to station 1 or interstation circuit 22 individual to station 5.

Communication between stations 2 and 5 is carried on in the same manner as between stations 1 and 5, except, of course, for operation of the proper selector switches at the two stations.

(5). *Communication between station 6 and stations 1 and 2*

Station 2 can call station 6 by closing selector switch 44 and operating switch 151—2 to its lowermost position. To receive from station 6, the switch 151—2 is released to return it to its middle position.

Station 6 can call station 2 when switch 151—2 at the latter is in its middle position by the operator at station 6 closing switch 72.

Station 1 may transmit to but not receive from station 6, inasmuch as no provision is made for station 6 to call station 1. Station 6, however, being connected to interstation circuit 29, may be called by station 1 upon closure of station selector 26 at the latter and upon operation of switch 152 to its lowermost position.

(6). *Communication between station 7 and stations 1 and 2*

Stations 1 and 2 may transmit to but not receive from station 7. To transmit, the operators at the two stations simply close the proper selector switches and operate communication control switches 152 and 152—2 to their lowermost positions.

The modes of communication between stations 5 and 3 and between 4 and 6 and 7 have not been described, as they correspond to those previously described.

Although the present invention has been disclosed in connection with the specific details of preferred embodiments thereof, it should be understood the details are not intended to be limitative of the invention except in so far as set forth in the accompanying claims.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. In an intercommunicating system, the combination including, a plurality of stations each having a loudspeaker utilizable both as a microphone and a receiver, an amplifier, and communication direction control switch means, a plurality of communication circuits between stations, each of said stations having one of said circuits as its individual circuit for reception from other stations, each of said stations also having a transmission circuit and station selector switch means for connecting the station to the individual circuits of other stations, means including circuits controlled by said communication direction control switch means at the respective stations for connecting the loudspeaker to the amplifier output and to the circuit individual to the station, and resistance means in the amplifier output circuit between the output and the point of

connection of the loudspeaker to said individual circuit.

2. In a multiple station intercommunication system, the combination including; one or more stations of a first type including a loudspeaker utilizable both as a microphone and receiver, an amplifier, an interstation circuit, and a communication direction control switch operable in a first position to connect the loudspeaker to the interstation circuit, in a second position to connect the loudspeaker to the amplifier input and the interstation circuit to the output of the amplifier, and in a third position to reverse the connections of the interstation circuit and loudspeaker to the amplifier; one or more stations of a second type including a loudspeaker utilizable both as a microphone and receiver, an amplifier a first interstation circuit individual thereto leading to other stations, and a communication direction control switch operable in one position to connect the loudspeaker to the circuit individual thereto and in a second position to connect the loudspeaker to the amplifier input and the amplifier output to interstation circuits individual to other stations; and one or more stations of a third type having a first interstation circuit connected to interstation circuits of the first type of station, second and third interstation circuits leading to other similar stations and stations of the second type, said second circuit being individual to the station, and communication direction controlling switch means operable to connect said loudspeaker to said first and second interstation circuits, whereby stations of said first and second type may call stations of the third type.

3. In an intercommunicating system, the combination including, a plurality of stations of a first type having interstation circuits individual thereto, a plurality of stations of a second type, each including a loudspeaker utilizable both as a microphone and a receiver, communication direction control switch means, a pair of interstation circuits individual thereto leading to other stations, one of said circuits being utilized for reception and the other for transmission between it and other similar stations, a third circuit connectable to interstation circuits of stations of the first type, and means including said communication direction controlling switch means for connecting the loudspeaker to both said one circuit and said third circuit, whereby said station may be called by stations of either type.

4. In a multiple station intercommunication system, the combination including; one or more stations of a first type including a loudspeaker utilizable both as a microphone and receiver, an amplifier, an interstation circuit, and a communication direction control switch operable in a first position to connect the loudspeaker to the interstation circuit, in a second position to connect the loudspeaker to the amplifier input and the interstation circuit to the output of the amplifier and in a third position to reverse the connections of the interstation circuit and loudspeaker to the amplifier; one or more stations of a second type including a loudspeaker utilizable both as a microphone and receiver, an amplifier, a first interstation circuit individual thereto leading to other stations, and a communication direction control switch operable in one position to connect the loudspeaker to the circuit individual thereto and in a second position to connect the loudspeaker to the amplifier input and the amplifier output to interstation circuit individual to other stations; and one or more stations of a third type having a first interstation circuit connected to interstation circuits of the first type of station, second and third interstation circuits leading to other similar stations and stations of the second type, said second circuit being individual to the station, and communication controlling switch means operable (1) to connect said loudspeaker to said first and second interstation circuits, (2) to connect said first interstation circuit to the input of the amplifier and said loudspeaker to the output of the amplifier and to said second interstation circuit, and (3) to connect said loudspeaker to the amplifier input and the amplifier output to said first or third interstation circuits.

5. In an intercommunicating system, the combination including, a plurality of stations each having a loudspeaker utilizable both as a microphone and a receiver, an amplifier, and a single multiple position communication direction control switch, a plurality of communication circuits between stations, each of said stations having one of said circuits as its individual circuit for reception from other stations, each of said stations also having station selector switch means for connecting the station to the individual circuits of other stations, means including circuits controlled by said communication direction control switches at the respective stations for connecting the loudspeaker to the amplifier output and to the circuit individual to the station, and resistance means in the amplifier output circuit between the output and the point of connection of the loudspeaker to said individual circuit.

6. In an intercommunicating system, the combination including, a plurality of stations of a first type having interstation circuits individual thereto, a plurality of stations of a second type each including an amplifier, a loudspeaker utilizable both as a microphone and a receiver, a multiple position communication direction control switch, a first circuit adapted to be connected to said interstation circuits, a second circuit individual thereto and leading to other stations of the second type, a transmission circuit, circuits individual to other stations of the second type, selector switch means for connecting the transmission circuit to the circuits individual to said other stations, and means including circuits controlled by said control switch for connecting (1) the first circuit to the amplifier input and the loudspeaker to the amplifier output and to said second circuit, in one position of said control switch, (2) the loudspeaker to both said first and second circuits, in a second position of said control switch, and (3) the loudspeaker to the amplifier input and the amplifier output to said first circuit and said transmission circuit, in a third position of said switch.

7. In an intercommunicating system, the combination including, a plurality of stations of a first type having interstation circuits individual thereto, a plurality of stations of a second type each including an amplifier, a loudspeaker utilizable both as a microphone and a receiver, a multiple position communication direction control switch, a first circuit adapted to be connected to said interstation circuits, a second circuit individual thereto and leading to other stations of the second type, said second circuit including resistance means, a transmission circuit, circuits individual to other stations of the second type, selector switch means for connecting the transmission circuit to the circuits individual to said other stations, and means including circuits con-

trolled by said control switch for connecting (1) the first circuit to the amplifier input and the loudspeaker to said second circuit and to the amplifier output through said resistance means, in one position of said control switch, (2) the loudspeaker to both said first and second circuits, in a second position of said control switch, and (3) the loudspeaker to the amplifier input and the amplifier output to said first circuit and said transmission circuit, in a third position of said switch.

8. In an intercommunicating system, a combination including a plurality of stations each having loudspeakers utilizable both as a microphone and a receiver, an amplifier, and communication direction control switch means, a plurality of communication circuits between stations, each of said stations having one of said circuits as its individual circuit for reception from other stations, each of said stations also having a transmission circuit and station selector switch means for connecting the transmission circuit to the individual circuits of the other stations, a jumper circuit connecting the circuit individual to the station to said transmission circuit, and means including circuits controlled by said communication direction control switch means at the respective stations for connecting the loudspeaker to the amplifier output and to the circuit individual to the station.

9. In an intercommunicating system, the combination including, a plurality of stations of a first type, a plurality of stations of a second type, each of the latter having a loudspeaker utilizable both as a microphone and a receiver, a circuit extending to stations of the first type utilizable for both reception and transmission, a circuit individual thereto utilizable for reception and extending to other similar stations, a circuit adapted to be utilized for transmission, station selector switch means for connecting said transmission circuit to circuits individual to other stations, an amplifier, a communication direction control switch, and means including selector switch means and circuits controlled thereby for connecting the circuit extending to stations of the first type to the amplifier input and the loudspeaker to the amplifier output.

10. In an intercommunicating system, the combination including, a plurality of stations of a first type, a plurality of stations of a second type, each of the latter having a loudspeaker utilizable both as a microphone and a receiver, a circuit extending to stations of the first type utilizable for both reception and transmission, a circuit individual thereto utilizable for reception and extending to other similar stations, a circuit adapted to be utilized for transmission, station selector switch means for connecting said circuit to circuits individual to other stations, an amplifier, a multiple position communication direction control switch, and means including a two-position selector switch and circuits controlled thereby and by said control switch for connecting, in one position of said selector switch, the circuit extending to stations of the first type to the amplifier input, the loudspeaker to the amplifier output and to the circuit individual to said station, and for connecting, in the other position of said selector switch, said transmission circuit to the amplifier output and breaking said circuit extending to stations of the first type.

11. In an intercommunicating system, the combination including, a plurality of stations of a first type, a plurality of stations of a second type, each of the latter having a loudspeaker utilizable both as a microphone and a receiver, a circuit extending to stations of the first type utilizable for both reception and transmission, a circuit individual thereto utilizable for reception and extending to other similar stations, a circuit adapted to be utilized for transmission, station selector switch means for connecting said circuit to circuits individual to other stations, an amplifier, a multiple position communication direction control switch, resistance means, a two-position selector switch, and circuits controlled by said control switch and selector switch so constructed and arranged that in one position of said selector switch the control switch is operable (1) in one position to connect said loudspeaker to said first mentioned circuit and to the circuit individual to the station, (2) in a second position to connect said loudspeaker to the circuit individual to the station and to the amplifier output through said resistance means and to connect said first mentioned circuit to the amplifier input, and (3) in a third position to connect the loudspeaker to the amplifier input and the amplifier output to said first circuit; and that in the other position of said selector switch the control switch is operable in said first two positions to connect said loudspeaker to the circuit individual to the station and in said third position to connect said loudspeaker to the amplifier input and the amplifier output to said transmission circuit.

12. An intercommunicating system, including in combination, one or more stations of a first type, a plurality of stations of a second type, and communication circuits between stations of the second type and between stations of the second type and stations of the first type, each of the stations of the second type having a pair of communication direction controlling switches, one for controlling communication therebetween and stations of the first type and the other for controlling communication with stations of the second type.

13. An intercommunicating system, including in combination, one or more stations of a first type, a plurality of stations of a second type, a communication circuit utilizable for both reception and transmission between stations of the second type and stations of the first type, and a pair of communication circuits between stations of the second type, one utilizable for reception and the other for transmission, each of the stations of the second type having a loudspeaker utilizable both as a microphone and a receiver, an amplifier, a pair of multiple position communication direction control switches, and circuits controlled thereby, said switches and circuits being so constructed and arranged that when both switches occupy one position, the loudspeaker is connected to said first communication circuit and to said reception circuit, one of said switches being operable to another position to connect the loudspeaker to the amplifier input and the amplifier output to said first circuit, and the other of said switches being operable to another position to connect the loudspeaker to the amplifier input and the amplifier output to said transmission circuit.

14. An intercommunicating system, including in combination, one or more stations of a first type, a plurality of stations of a second type, and a communication circuit utilizable for both reception and transmission between stations of

the second type and stations of the first type, and a pair of communication circuits between stations of the second type, one utilizable for reception and the other for transmission, each of the stations of the second type having a loudspeaker utilizable both as a microphone and a receiver, an amplifier, resistance means, a pair of multiple position communication direction control switches, and circuits controlled thereby, said switches and circuits being so constructed and arranged that when both switches occupy one position, the loudspeaker is connected to said first communication circuit and to said reception circuit, each of said switches being operable to another position to connect the loudspeaker to the amplifier input and the amplifier output to either said first circuit or said transmission circuit, one of said switches being operable to a third position wherein said loudspeaker is connected to said reception circuit and to the amplifier output through said resistance means and said first circuit is connected to the amplifier input, and the other of said switches being operable to a third position wherein said reception circuit is connected to said loudspeaker.

15. A unit for use in intercommunicating system, including in combination a loudspeaker utilizable both as a microphone and a receiver, an amplifier, and communication direction control switch means, an individual circuit adapted for reception from other units, selector switch means adapted to connect the unit to the individual circuits of other units, means including circuits controlled by said communication direction control switch means for connecting the loudspeaker to the amplifier output and to said individual circuit, and resistance means in the amplifier output circuit between the output and the point of connection of the loudspeaker to said individual circuit.

16. A unit for use in an intercommunicating system, including in combination, an amplifier, a loudspeaker utilizable both as a microphone and a receiver, communication direction control switch means, a pair of interstation circuits individual thereto, one of said circuits being utilizable for reception and the other for transmission, a third circuit utilizable for both reception and transmission, and means including communication direction controlling switch means for connecting the loudspeaker to said one circuit and said third circuit.

17. A unit for use in an intercommunicating system, including in combination, a loudspeaker utilizable both as a microphone and a receiver, an amplifier, and a single multiple position communication direction control switch, a reception circuit individual thereto, station selector switch means adapted to connect the unit to the individual circuits of other units, means including circuits controlled by said communication directoin control switch for connecting the loudspeaker to the amplifier output and to the circuit individual to the unit, and resistance means in the amplifier output circuit between the output and the point of connection of the loudspeaker to said individual circuit.

18. A unit for use in an intercommunicating system, including in combination, an amplifier, a loudspeaker utilizable both as a microphone and a receiver, a multiple position communication direction control switch, a first circuit adapted to be utilized for transmission and reception, a second circuit individual to the unit and adapted to be used for reception, a transmission circuit, and means including circuits controlled by said control switch for connecting (1) the first circuit to the amplifier input and the loudspeaker to the amplifier output and to said second circuit, in one position of said control switch, (2) the loudspeaker to both said first and second circuits, in a second position of said control switch, and (3) the loudspeaker to the amplifier input and the amplifier output to said first circuit and said transmission circuit, in a third position of said switch.

19. A unit for use in an intercommunicating system, including in combination, an amplifier, a loudspeaker utilizable both as a microphone and a receiver, a multiple position communication direction control switch, a first circuit adapted to be utilized for both transmission and reception, a second circuit individual to the unit and adapted to be utilized for reception, said circuit including resistance means, a transmission circuit, and means including circuits controlled by said control switch for connecting (1) the first circuit to the amplifier input and the loudspeaker to said second circuit and to the amplifier output through said resistance means, in one position of said control switch, (2) the loudspeaker to both said first and second circuits, in a second position of said control switch, and (3) the loudspeaker to the amplifier input and the amplifier output to said first circuit and said transmission circuit, in a third position of said switch.

20. A unit for use in an intercommunicating system, including in combination, a loudspeaker utilizable both as a microphone and a receiver, an amplifier and communication direction control switch means, a circuit individual to the unit, a transmission circuit and unit selector switch means for connecting the transmission circuit to the circuits leading to the other units, a jumper circuit connecting the circuit individual to the unit to said transmission circuit, and means including circuits controlled by said communication direction control switch means for connecting the loudspeaker to the amplifier output and to the circuit individual to the unit.

21. A unit for use in an intercommunicating system, including in combination, a loudspeaker utilizable both as a microphone and a receiver, a circuit adapted to be utilized for both reception and transmission, a circuit individual to the unit utilizable for reception and adapted to be extended to other similar units, a circuit adapted to be utilized for transmission, station selector switch means for connecting said transmission circuit to circuits individual to other units, an amplifier, a communication direction control switch, and means including selector switch means and circuits controlled thereby for connecting the first mentioned circuit to the amplifier input and the loudspeaker to the amplifier output.

22. A unit for use in an intercommunicating system, including in combination, a loudspeaker utilizable both as a microphone and a receiver, a circuit utilizable for both reception and transmission, a circuit individual to said unit utilizable for reception, a circuit adapted to be utilized for transmission, unit selector switch means for connecting said circuit to circuits individual to other stations, an amplifier, a multiple position communication direction control switch, and means including a two-position selector switch and circuits controlled thereby and by said con-

trol switch for connecting, in one position of said selector switch, the first mentioned circuit to the amplifier input, the loudspeaker to the amplifier output and to the circuit individual to said unit, and for connecting, in the other position of said selector switch, said transmission circuit to the amplifier output and breaking said first mentioned circuit.

23. A unit for use in an intercommunicating system, including in combination, a first communication circuit adapted to be used for reception and transmission, a second circuit adapted to be used for reception, a third circuit adapted to be used for transmission, and a pair of communication direction controlling switches, one for controlling communication over said first circuit and the other for controlling communication over said second and third circuits.

24. A unit for use in an intercommunicating system, including in combination, a communication circuit utilizable for both reception and transmission, a pair of communication circuits, one utilizable for reception and the other for transmission, a loudspeaker utilizable both as a microphone and a receiver, an amplifier, a pair of multiple position communication direction control switches, and circuits controlled thereby, said switches and circuits being so constructed and arranged that when both switches occupy one position, the loudspeaker is connected to said first communication circuit and to said reception circuit, one of said switches being operable to another position to connect the loudspeaker to the amplifier input and the amplifier output to said first circuit, and the other of said switches being operable to another position to connect the loudspeaker to the amplifier input and the amplifier output to said transmission circuit.

25. A unit for use in an intercommunicating system, including in combination, a communication circuit utilizable for both reception and transmission, and a pair of communication circuits, one utilizable for reception and the other for transmission, a loudspeaker utilizable both as a microphone and a receiver, an amplifier, resistance means, a pair of multiple position communication direction control switches, and circuits controlled thereby, said switches and circuits being so constructed and arranged that when both switches occupy one position, the loudspeaker is connected to said first communication circuit and to said reception circuit, each of said switches being operable to another position to connect the loudspeaker to the amplifier input and the amplifier output to either said first circuit or said transmission circuit, one of said switches being operable to a third position wherein said loudspeaker is connected to said reception circuit and to the amplifier output through said resistance means and said first circuit is connected to the amplifier input, and the other of said switches being operable to a third position wherein said reception circuit is connected to said loudspeaker.

26. A unit for use in an intercommunicating system, including in combination, a loud speaker utilizable both as a microphone and a receiver, a circuit utilizable for both reception and transmission, a circuit individual to said unit utilizable for reception, a circuit adapted to be utilized for transmission, unit selector switch means for connecting said circuit to circuits individual to other stations, an amplifier, a multiple position communication direction control switch, resistance means, a two-position selector switch, and circuits controlled by said control switch and selector switch so constructed and arranged that in one position of said selector switch the control switch is operable (1) in one position to connect said loud speaker to said first mentioned circuit and to the circuit individual to the unit, (2) in a second position to connect said loud speaker to the circuit individual to the unit and to the amplifier output through said resistance means and to connect said first mentioned circuit to the amplifier input, and (3) in a third position to connect the loud speaker to the amplifier input and the amplifier output to said first circuit; and that in the other position of said selector switch the control switch is operable in said first two positions to connect said loud speaker to the circuit individual to the unit and in said third position to connect the loud speaker to the amplifier input and the amplifier output to said transmission circuit.

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