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Aug. 10, 1943. R. H. CAMPBELL 2,326,617

COMMUNICATION SYSTEM

Filed Jan. 16, 1942 3 Sheets-Sheet 1

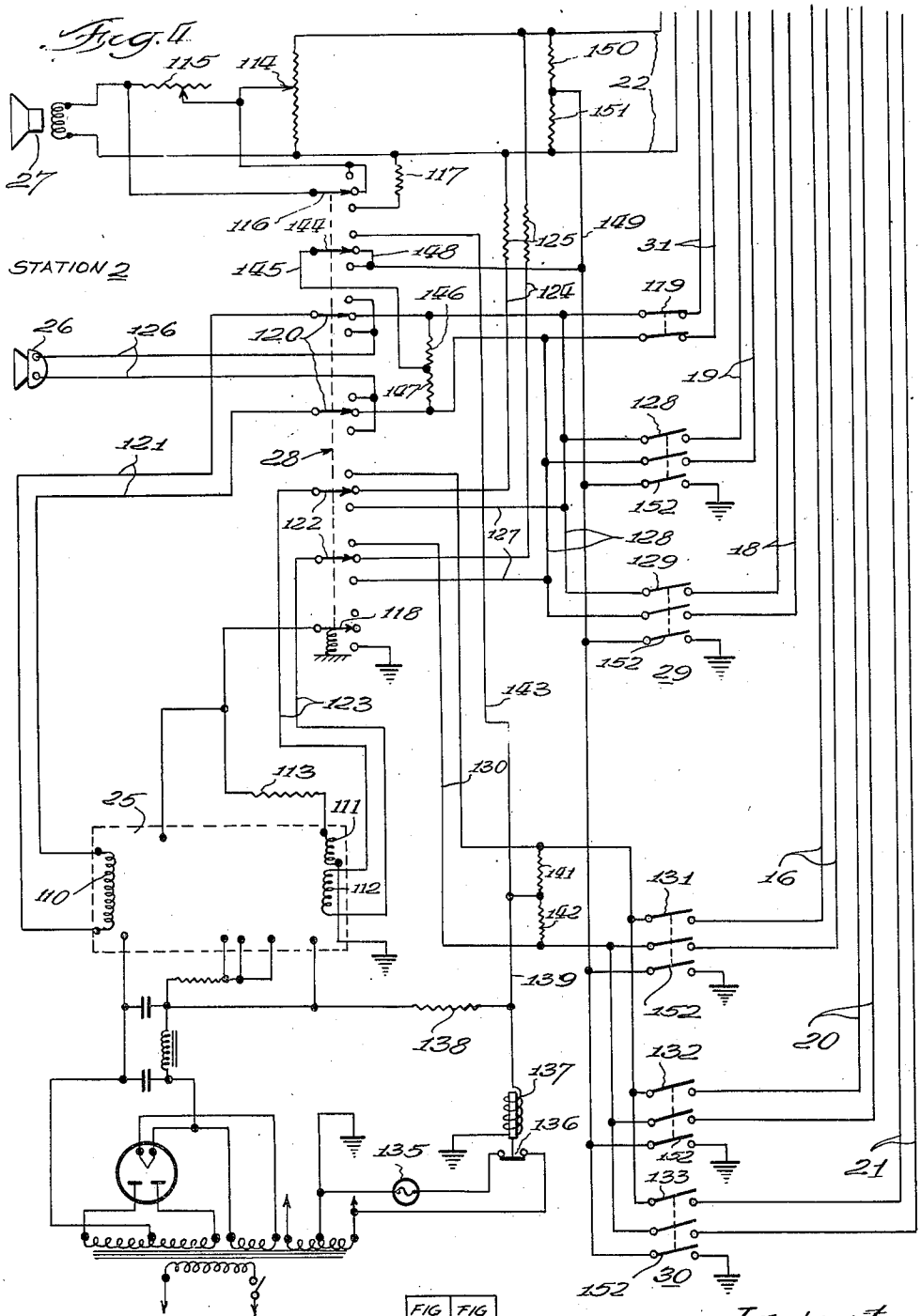



FIG 2 | FIG 3 | FIG 4

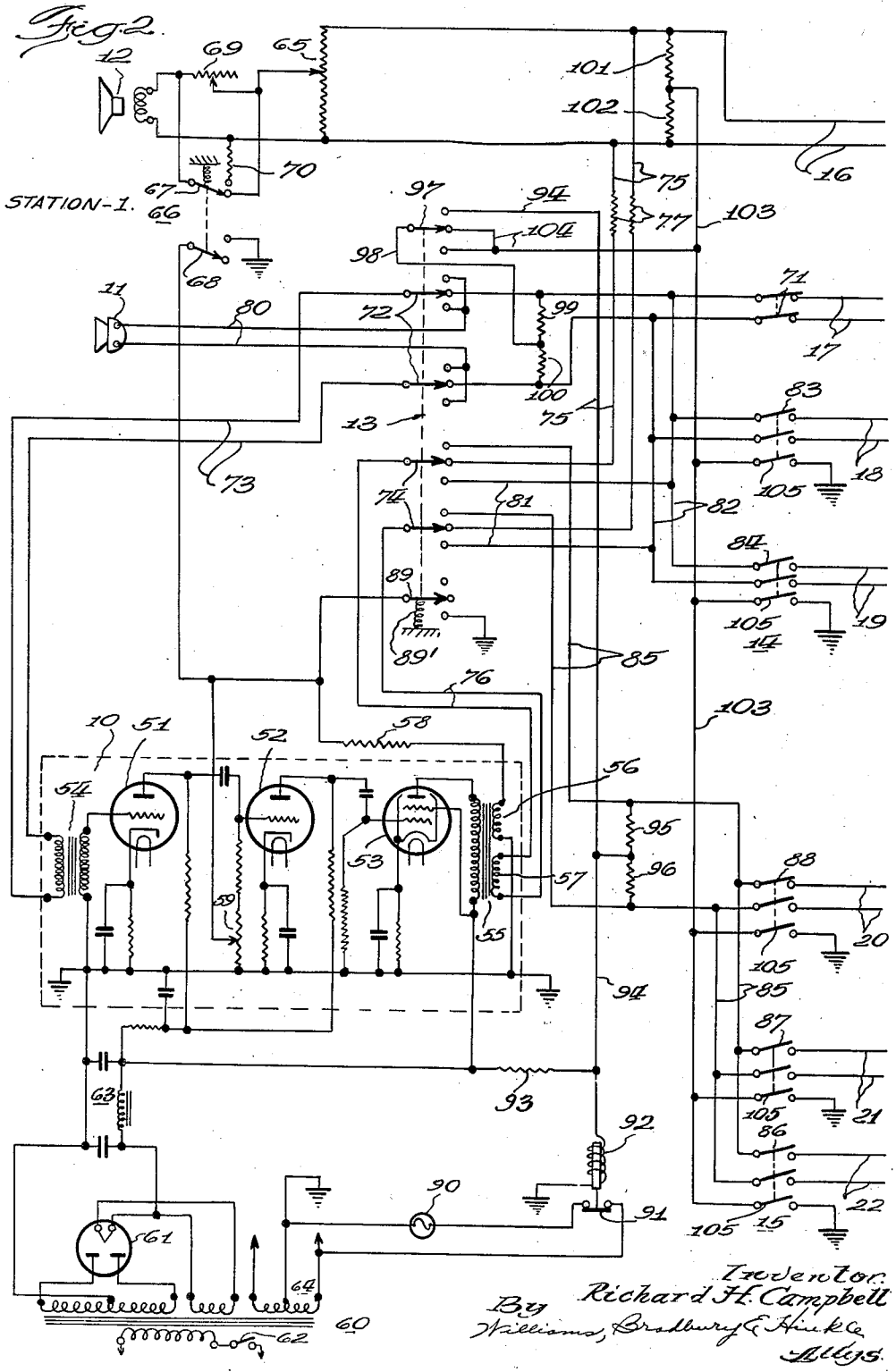
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COMMUNICATION SYSTEM

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Fig. 2.



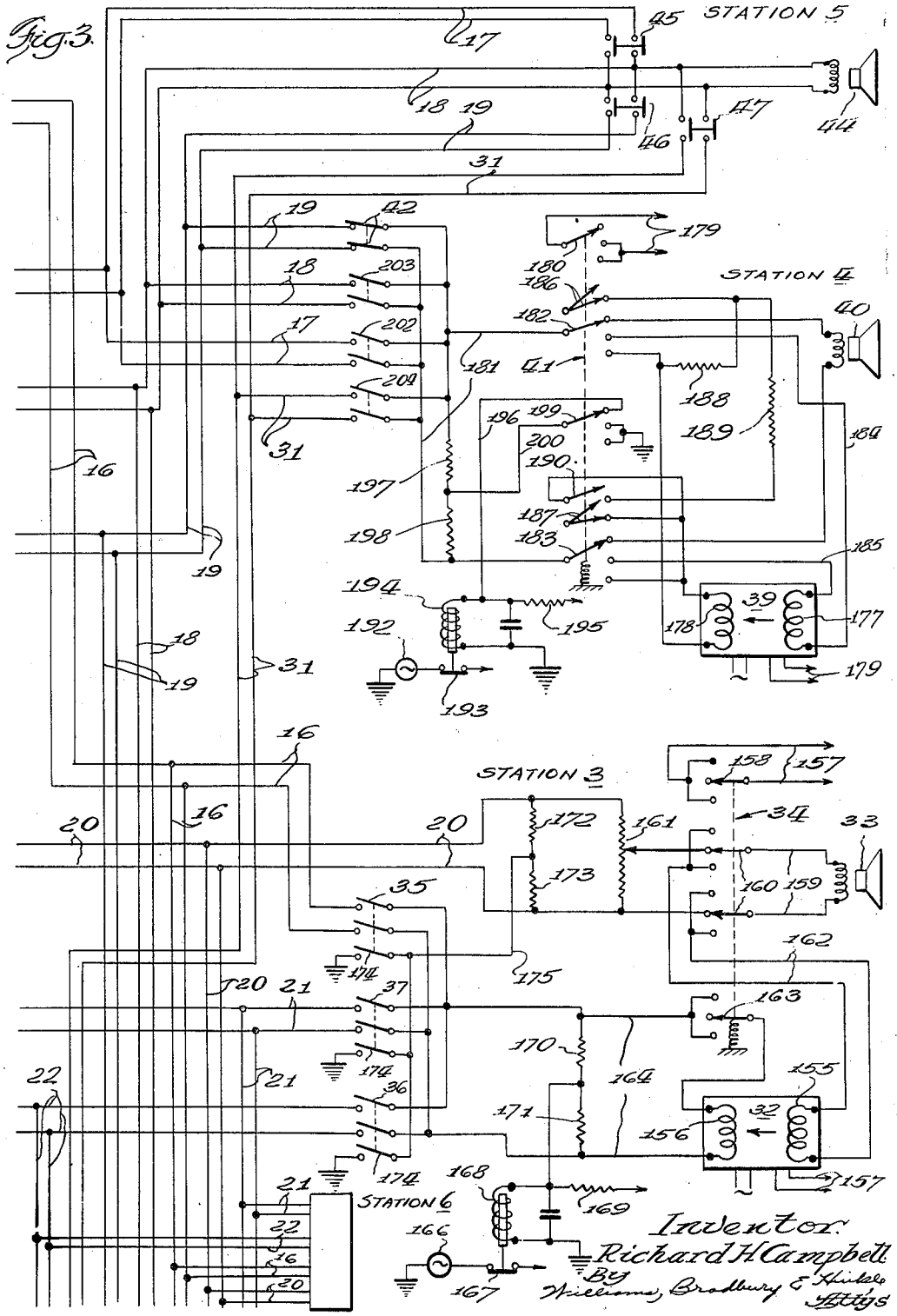

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Fig. 3.



Patented Aug. 10, 1943

2,326,617

# UNITED STATES PATENT OFFICE

2,326,617

## COMMUNICATION SYSTEM

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Application January 16, 1942, Serial No. 426,979

23 Claims. (Cl. 179—1)

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

Different requirements in various installations have resulted in the development of a number of different types of intercommunicating units and systems. Probably the simplest type is a system comprising a central or master station and a number of sub-stations, the former being provided with an amplifier, a loudspeaker, a station selector switch or switches, and a communication direction control switch, and the latter simply with loudspeakers. The commmunication 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 sub-station loudspeakers to the output and input of the amplifier so that communication may be carried on between the master and sub-stations 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 only.

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 communication direction control switch 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.

A fourth type of system is made up of a number of stations each provided with a receiver, a microphone, an amplifier to the input of which the microphone is connected, and station selector switches for connecting the output of the amplifier to interstation circuits and receivers of other stations. In this type of system communication between stations is carried on in separate channels, each of which includes a microphone, an amplifier at one station, and a receiver at another station, so that no communication direction control switch is necessary. These systems may also include substations having loudspeakers only which may be selectively connected to the output of an amplifier so that they can receive from but cannot transmit to master stations.

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. In this respect the present invention is an improvement over the invention described and claimed in my contemporaneously filed application Serial No. 426,978, disclosing units and a system for use with systems or units of the first three types referred to above.

A further object of the present invention is to provide a new and improved busy signalling arrangement, whereby a calling station may readily determine whether or not a called station is busy. In this respect the present invention is an improvement over the arrangements disclosed and claimed in Letters Patents Nos. 2,269,141, 2,269,142 and 2,269,143 granted to me on Jan. 6, 1942.

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 illustrates how the remaining figures, that is, Figs. 2 to 4, inclusive, are combined to form a unified system;

Fig. 2 is a diagrammatic representation of a portion of the system and illustrates in diagrammatic form a unit constructed in accordance with the present invention;

Fig. 3 is a similar representation of a portion of the system including various forms of units heretofore used; and

Fig. 4 is a view similar to Fig. 2 of a slightly modified form of unit constructed in accordance with the present invention.

Referring now to the drawings, the communication system illustrated therein is shown to consist of six stations, numbered 1 to 6, inclusive, stations 1 and 2 being shown in Figs. 2 and 4, respectively, and the remaining stations in Fig. 3.

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 number of switches whereby it may call the executive and certain of the sub-executive stations, and it will be referred to hereinafter as a "subordinate" station. Station 6, which has not been illustrated in detail, is a station of the executive type and may have a unit corresponding in construction and arrangement with the units disclosed and claimed in my co-pending application Serial No. 343,390 filed July 1, 1940.

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 microphone 11, a loudspeaker 12, a multi-position communication control switch indicated generally by the reference character 13, and two groups of station selector switches 14 and 15, respectively. The loudspeaker 12 is permanently connected to an interstation circuit 16 individual to station 1 for the reception of calls from other executive stations and from sub-executive stations of the type of station 3. In the normal position of the communication control switch 13, the position in which it is indicated, the loudspeaker is also connected to the output of the amplifier for reception from sub-executive stations of the type of station 4 and from subordinate stations of the type of station 5. Calls from the two latter types of stations are received over another interstation circuit 17 individual to station 1. Circuit 17 is normally connected to the input of the amplifier, as will be described hereinafter. The output of the amplifier is adapted selectively to be connected by station selector switches to interstation circuits 18, 19, 20, 21 and 22 individual to stations 5, 4, 3, 6 and 2, respectively.

The apparatus at station 2 is very similar to that at station 1, as will appear hereinafter. It includes an amplifier 25, a microphone 26, a loudspeaker 27, a communication control switch 28, and two groups of station selector switches 29 and 30. Loudspeaker 12 is permanently connected to the interstation circuit 22 individual to station 2 for the reception of calls from other executive stations and from sub-executive stations of the type of station 3. In the normal position of the communication control switch 28, the position in which it is indicated, the loudspeaker is also connected to the output of the amplifier for reception from sub-executive stations of the type of station 4 and from subordinate stations of the type of station 5. Calls from the two latter types of stations are received over another interstation circuit 31 individual to station 2. Circuit 31 is normally connected to the input of the amplifier, as will be described hereinafter. The output of the amplifier adapted selectively to be connected by station selector switches to interstation circuits 16, 18, 19, 20, and 21, individual to stations 1, 5, 4, 3, 6, and 1, respectively.

The apparatus at station 3 includes an amplifier 32, a loudspeaker 33 utilizable both as a receiver and as a microphone, and a combined amplifier power and communication direction control switch 34. In the normal position of the switch, the amplifier is rendered inoperative and loudspeaker 33 is connected to the interstation circuit individual to station 3 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 of the latter is connected to the selected station or stations through selector switches 35, 36 and 37 individual to stations 1, 2 and 6, respectively, in a manner to be described in greater detail hereinafter.

The apparatus at station 4 includes an amplifier 39, a loudspeaker 40 utilizable both as a receiver and as a microphone, and a combined amplifier power and communication direction control switch 41. In the normal position of the switch, the amplifier is rendered inoperative and the loudspeaker is connected to the interstation circuit 19 individual to station 4 through the switch and through a normally closed selector switch 42. In one displaced position of the communication control switch, the amplifier is rendered operative and the loudspeaker is connected to the output of the amplifier and the selected interstation circuit or circuits are connected to the input of the amplifier, and in a second displaced position, the amplifier is again rendered operative but the connections of the interstation circuit and loudspeaker to the amplifier are reversed.

The apparatus at station 5 includes a loudspeaker 44, utilizable both as a receiver and as a microphone, permanently connected to the interstation circuit 18 individual to station 5. The station also includes normally open switches 45, 46 and 47 for connecting the loudspeaker to the interstation circuits 17, 19 and 31 individual to stations 1, 4 and 2, respectively, whereby station 5 may call the latter.

The apparatus at station 6, which has not been illustrated in detail, includes a loudspeaker (not shown) connected to the interstation circuit 21 individual to station 6 and a number of station selector switches (also not shown) for connecting the output of the amplifier (not shown) at station 6 to the interstation circuits 16, 20 and 22 individual to stations 1, 3 and 2, respectively.

Returning now to Fig. 1 and station 1, it may be noted that the amplifier is of the inverse feedback type and comprises three stages of amplification provided by tubes 51, 52 and 53. The amplifier comprises also an input transformer 54 and an output transformer 55 having two secondary windings 56 and 57, the first of which is utilized to provide inverse feedback and the second of which is used in the usual manner for the transmission of amplified signals. The winding 56 has one terminal connected to ground and its other terminal connected to the input of tube 52 through a resistor 58, which may have a value of about 10,000 ohms, and through an adjustable connection 59 providing means for adjusting the gain of the amplifier, as hereinafter more fully described.

The amplifier is supplied with power from a suitable alternating current source through a transformer 60 and a full wave rectifier 61. Power is supplied to the primary of the transformer from any suitable source whenever a switch 62 is closed. This switch may be part of the volume control switch to be described hereinafter. The power supply circuit may be of any well-known type and it is believed sufficient for the purpose of this description to state that it comprises the

usual filter 63 through which the "B" supply is obtained, and that the amplifier tubes are of the indirectly-heated cathode type, the cathode heaters of which are supplied with current from a separate secondary winding 64, the center tap of which is grounded.

The loudspeaker 12 is permanently connected to the interstation circuit 16 individual to station 1 through a volume control indicated by reference character 65 and which may be made as a part of the power switch 62 heretofore referred to. The loudspeaker is normally conditioned for reception at high volume, and the reception volume may be decreased simultaneously with an increase in the amplifier gain by means of a high volume switch 66. The switch consists of a pair of switch blades 67 and 68, the former of which normally short circuits an adjustable resistor 69 and the latter of which is normally in circuit opening position. When the switch 66 is operated to its high volume position for the purpose of calling another station at high volume, switch blade 67 is operated to remove the short circuit from around resistor 69 and to place a resistor 70 in parallel with the loudspeaker voice coil. At the same time switch blade 68 connects to ground a point between resistor 58 and the adjustable connection or potentiometer 59, thereby to remove the negative feedback to the second stage of the amplifier and thus increase the gain of the amplifier.

The communication control switch 13 normally occupies a position connecting the secondary circuit 17 individual to station 1 to the input of the amplifier and the loudspeaker 12 to the output of the amplifier. The interstation circuit 17 is connected to the input through a normally closed selector switch 71 individual to station 1, a pair of switch blades 72 and a circuit 73 leading to the primary winding of the input transformer 54. Loudspeaker 12 is connected to the amplifier output through a pair of switch blades 74 and a circuit comprising the pairs of conductors 75 and 76, the former of which are connected to circuit 16 and the latter of which are connected to the secondary winding 57 of the amplifier output transformer. Conductors 75 have interposed therein the resistors 77 in order to prevent the output transformer winding 57 from partially short-circuiting the voice coil of loudspeaker 12. In other words, the resistors enable messages coming in over interstation circuit 16 better to be heard on the loudspeaker. This arrangement for preventing partial short-circuiting of the loudspeaker by the secondary winding of the amplifier output transformer is disclosed and claimed in my copending application Serial No. 426,978, filed contemporaneously herewith.

Communication control switch 13 is operable to a first displaced position to connect the microphone 11 to the input of the amplifier 10 and to connect the output of the amplifier to the first group of selector switches 14 and to a second displaced position to connect the output to the second group of selector switches 15. When operated into the first (lower) of the displaced positions, the microphone is connected to the input of the amplifier through a circuit comprising the conductors 80, switch blades 72 in their lowermost positions, and circuit 73. At this time the amplifier output is connected to the first group of selector switches 14 through the circuit 76, switch blades 74 in their lowermost positions, and a circuit including branch circuits 81 and 82 the latter of which is connected to the selector switch 71 individual to station 1, a selector switch 83 for connecting the output of the amplifier to the circuit 18 individual to station 5, and a selector switch 84 for connecting the output to the circuit 19 individual to station 4. In the lowermost position of the communication control switch, the negative feedback circuit is grounded by switch blade 89 to increase the amplifier gain.

In the second (upper) displaced position, the microphone is connected to the input of the amplifier through circuit 60, switch blades 72 in their uppermost positions, and circuit 73. At this time the output of the amplifier is connected to the second group of selector switches 15 through circuit 76, switch blades 74 in their uppermost positions, and an output circuit 85. Circuit 85 may selectively be connected to one or more of stations 2, 3 and 6 through selector swtches 86, 87 and 88, respectively. Switch 13 is biased by a spring 89' to return from its lower to its middle position.

The apparatus at station 1 also includes a busy signalling arrangement embodying the principles of the invention disclosed and claimed in the Patent No. 2,269,141, heretofore referred to, and including improvements rendering it practicable in a system of the type displosed herein. This arrangement includes a pilot light 90 normally connected to a portion of the secondary winding 94 of the power transformer 60 by a switch 91 held in its closed position by a solenoid 92. The solenoid 92 has one terminal grounded and the other connected to the amplifier "B" supply through a high resistance resistor 93. The solenoid is also connected to the interstation circuits in such manner that when a busy station is selected, it is deenergized sufficiently for switch 91 to open by its being connected to ground through resistors and thereby partially short-circuited. When switch 91 is opened in this manner, light 90 is extinguished to give an indication that the selected station is busy.

The connection of the solenoid to the interstation circuits is effected through a conductor 94 connected to a point between two equal value resistors 95 and 96 connected in series across circuit 85. Conductor 94 also leads to the communication control switch 13, whereby it is connected by switch blade 97, when the latter is in its uppermost position, as it is when a station is being selected, and conductor 98 to a point between another pair of equal value resistors 99 and 100 connected in series across circuit 17. The busy signalling arrangement includes also a pair of equal value resistors 101 and 102 connected in series across interstation circuit 18 and a connection from a point therebetween to all the selector switches except switch 71 through a conductor 103. The point between the resistors is connected by conductor 104 to contacts associated with switch blade 97. Each of the selector switches, with exception of selector switch 71 which is individual to station 1, is provided with a switch blade 105 for connecting to ground the point between resistors 101 and 104 whenever any of the selector switches is closed to select another station. The switch blades 105 also connect to ground the point between resistors 99 and 100 when the communication control switch is in its middle or lower positions.

The apparatus at station 2 corresponds identically with that at station 1, except that the latter is provided with a different arrangement for controlling the reception volume and amplifier gain, the control being effected by the com-

munication control switch rather than conjointly by the communication control switch and a high volume switch. However, in order that a better understanding may be had of the operation of the system as a whole, it is deemed desirable briefly to describe the apparatus at station 2.

The amplifier 25 corresponds in construction to the amplifier 10 and is provided with an input transformer having a primary winding 110 and an output transformer having two secondary windings 111 and 112, the former being utilized to provide inverse feedback through a resistor 113. The amplifier power supply corresponds identically with that at station 1, and since it is not directly related to the manner in which communication is carried on between stations, it will not be described further.

The loudspeaker 27 is permanently connected to interstation circuit 22 individual to station 2 through a volume control indicated by reference character 114. The loudspeaker 27 is connected for reception at high volume whenever the communication control switch 28 is in its normal or middle position and when it is in its uppermost position. In both of these positions the resistor 115 is short-circuited by switch blade 116 forming part of the communication control switch. In the lowermost position of the latter, the switch blade 116 removes the short circuit from about resistor 115 and connects a resistor 117 in parallel with the voice coil of loudspeaker 27. In the lowermost position of the communication control switch, the inverse feedback is removed from the amplifier as a result of the grounding of the feedback circuit by switch blade 118 forming part of the communication control switch.

The communication control switch normally occupies a position connecting circuit 31 individual to station 2 to the input of the amplifier and the loudspeaker 27 to the output of the amplifier. Interstation circuit 31 is connected to the input through a normally closed selector switch 119 individual to station 2, a pair of switch blades 120, and a circuit 121 leading to the primary winding 110 of the amplifier. Loudspeaker 27 is connected to the amplifier output through a pair of switch blades 122 interconnecting circuits 123 and 124, the former of which is connected to circuit 22 and the latter to the secondary winding 112 of the output transformer. The conductors of circuit 124 have interposed therein the resistors 125 in order to prevent the output transformer winding 112 from partially short-circuiting the voice coil of loudspeaker 27.

The communication control switch 28 is operable to a first displaced position to connect the microphone 26 to the input of amplifier 25 and to connect the output of the amplifier to the first group of selector switches 29 and into a second displaced position to connect the output to the second group of selector switches 30. When operated into the first (lower) of these displaced positions, the microphone is connected to the input of the amplifier through circuit 126, switch blades 120 in their lowermost positions, and circuit 121. At the same time the amplifier output is connected to the first group of selector switches 29 through circuit 123, switch blades 122 in their lowermost positions, and a circuit including the branch circuits 127 and 128 the latter being connected to the selector switch 119 individual to station 2, a selector switch 128 for connecting the output of the amplifier to the circuit 19 individual to station 4, and a selector switch 129 for connecting the output to the circuit 13 individual to station 5. In the second (upper) of the two displaced positions of the communication control switch, the microphone is connected to the input of the amplifier through circuit 126, switch blades 120 in their uppermost positions, and circuit 121. At this time the output of the amplifier is connected to the second group of selector switches through circuit 123 and circuit 130. This output circuit may be selectively connected to one or more of stations 1, 3 and 6 through selector switches 131, 132 and 133, respectively.

The busy signalling arrangement at station 2 includes the pilot light 135 normally energized by a circuit including the switch 136 held in closed position by a solenoid 137 normally supplied with sufficient energy to operate and hold the switch 136 in its closed position through a circuit including resistor 138 leading to the "B" supply. One terminal of the solenoid is grounded and the other connected by a conductor 139 to a point between resistors 141 and 142 connected in series across circuit 130. The other terminal is also connected to the communication control switch by a conductor 143. In the uppermost position of the communication control switch the conductor 143 is connected by switch blade 144 and conductor 145 to a point between resistors 146 and 147 connected in series across circuit 31. In the middle and lowermost positions of the communication control switch the point between resistors 146 and 147 is connected by a conductor 148 to a conductor 149. Conductor 149 is connected to a point between resistors 150 and 151 connected in series across circuit 22 and it is adapted to be connected to ground by switch blades 152 operable simultaneously with the station selector switches.

The apparatus at station 3 includes the amplifier 32 having an input transformer with a primary winding 155 and an output transformer with a secondary winding 156. The amplifier is conditioned for instantaneous operation whenever the "B" supply circuit including conductors 157 are connected by switch blade 158, as they are whenever the communication control switch 34 is operated into either of its displaced positions. In the normal position the "B" supply is cut off and the loudspeaker 33 connected to the circuit 20, individual to station 3, through circuit 159, switch blades 160 and volume control 161. The loudspeaker is connected to the input of the amplifier whenever the communication control switch is operated into either of its displaced positions through circuit 162, and the amplifier output is simultaneously connected by switch blade 163 and circuit 164 to the selector switches 35, 36 and 37.

The busy signalling arrangement at station 3 includes a light 166 normally supplied with energy through a switch 167 held in closed position by a solenoid 168 supplied with energy from the "B" supply through a circuit including resistor 169. One terminal of the solenoid is grounded and the other connected to a point between resistors 170 and 171 connected in series across circuit 164. The arrangement includes also a pair of resistors 172 and 173 connected in series across circuit 20 and switches 174 operable with the selector switches to ground the point between the resistors through conductor 175.

The apparatus at station 4 includes the amplifier 39 having an input transformer with a primary winding 177 and an output transformer having a secondary winding 178. The amplifier is

normally inoperative, but is conditioned to be rendered operative whenever the "B" supply circuit, including conductors 179, is completed by the switch blade 180 in its intermediate or lowermost positions. In the normal and indicated position of the communication control switch 41, the loudspeaker 40 is connected to circuit 19 individual to station 4 through circuit 181 and switch blades 182 and 183. In the intermediate position of the communication control switch, the loudspeaker is connected to the output of the amplifier and circuit 181 to the input of the amplifier. Circuit 181 is connected to the input through switch blades 182 and 183 and conductors 184 and 185. The loudspeaker 40 is connected to the output by two pairs of switch blades 186 and 187. At this time resistors 188 and 189 are connected in series-parallel relationship to the speaker to decrease the reception volume, the resistor 189 being connected in parallel to the speaker by a switch blade 190. In the lowermost position of the communication control switch, the loudspeaker is connected to the input of the amplifier by the pairs of switch blades 186 and 187, the former connecting one terminal of the voice coil of the speaker to conductor 184 and the latter connecting the other terminal to conductor 185. The output of the amplifier is connected to circuit 181 by switch blades 182 and 183.

The busy signalling arrangement at station 4 includes the light 192 and switch 193 held in closed position by a solenoid 194 normally supplied with sufficient energy to operate and maintain the switch in closed position from the "B" supply through resistor 195. One terminal of the solenoid is grounded and the other connected by a conductor 196 to the communication control switch. In the normal position of the communication control switch, conductor 196 is connected to a point between resistors 197 and 198 connected in series across circuit 181 by switch blade 199 and conductor 200. In the middle and lowermost positions of the communication control switch, the point between resistors 197 and 198 is connected to ground by the switch blade 199. The circuit 181 may be connected to circuits 17, 19 and 31 individual to stations 1, 5 and 2, respectively, by selector switches 202, 203 and 204, respectively.

The apparatus at stations 5 and 6 has already been described in sufficient detail to permit an understanding of the operation thereof.

Before the system is placed in operation, the units at stations 1, 2 and 6 are adjusted to prevent excessive feedback during operation in accordance with the principles disclosed and claimed in my copending application Serial No. 343,390. In brief, this method consists in connecting the output of the amplifier to the receiver circuit. For instance, the secondary winding 57 of the output transformer of the amplifier 10 at station 1 would be connected to circuit 16. The volume control 65 is then adjusted to its maximum position, and the volume control 59 adjusted to a point just below that at which feedback from the output to the input is sufficient to cause the amplifier to go into an oscillatory condition. Then, with the communication control switch 13 in its lower position, the resistor 69 is adjusted to a point just at that at which the feedback is sufficient to cause the amplifier to go into an oscillatory condition. The unit at station 2 is somewhat similarly adjusted, the volume control corresponding to 59 being adjusted, with the volume control 114 in its maximum volume position, with the talk-listen switch in its indicated position, and then the resistor 115 being adjusted with the talk-listen switch in its lowermost position. The normal reception volume at station 2 is higher than at station 1 because resistor 115 at station 2 is adjusted when the loudspeaker 27 is conditioned for reception at low volume, whereas resistor 69 at station 1 is adjusted when loudspeaker 12 is conditioned for reception at high volume or when there is more acoustic feedback to the microphone.

It is believed that the operation of the units and of the system of this 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*

In order to render operative the amplifier at station 1, the power switch 62 is closed. As a result, the amplifier is supplied with power and the solenoid 92 is energized as it is connected across the "B" supply through resistor 93. Switch 91 is closed and light 99 supplied with energy to indicate that power is supplied to the amplifier. The operator at station 1 desiring to communicate with station 2 first operates the communication control switch 13 to its uppermost position to connect microphone 11 to the input of the amplifier and to direct the output of the amplifier to the second group 15 of the selector switches. Selector switch 86 is then closed to connect the output of the amplifier to circuit 22 individual to station 2, and likewise to connect to ground the point between resistors 191 and 192 connected to circuit 16 individual to station 1. Switch blade 97 of the communication control switch also connects the point between resistors 93 and 199 to the ungrounded terminal of solenoid 92. Then, if station 2 is not busy, the solenoid 92 remains ungrounded for the time being to give an indication to the operator at station 1 that station 2 is not busy.

In responding to a call the operator at station 2 operates the power switch thereat to render operative the amplifier, although it should be mentioned that the amplifiers are usually operative. The operator also moves the communication control switch 23 to its uppermost position to connect the microphone 26 to the input of the amplifier and to connect the output of the amplifier to circuit 130. He also closes the selector switch 131 to connect the output of the amplifier to circuit 16 individual to station 1. Closing of the selector switch connects to ground the point between resistors 150 and 151, while movement of the communication control switch to its uppermost position connects the point between resistors 146 and 147 to the ungrounded terminal of solenoid 137. When the two stations are connected for intercommunication in the manner described, the solenoids at both stations are partly grounded, thereby to extinguish the pilot lights 99 and 135 at the two stations, respectively. Solenoid 92 at station 1 is grounded through a circuit including conductor 94, the resistors 95 and 96, circuit 85, selector switch 86, interstation circuit 22, resistors 150 and 151, conductor 149, and the switch 152 associated with selector switch 131. The solenoid 137 at station 2 is similarly grounded through conductor 139, resistors 141 and 142, selector switch 131, interstation circuit 16, re-

sistors 101 and 102, conductor 103, and switch blade 105 of selector switch 86.

Communication is now carried on between the two stations, the communication from station 1 to station 2 extending through the microphone and amplifier at station 1 to the loudspeaker at station 2 and in the opposite direction from the microphone and amplifier at station 2 through the speaker at station 1.

In case the operator at station 2 finds it difficult to hear the operator at station 1, he can so advise the latter and the latter may then operate the high volume switch 66 in order to increase the gain of the amplifier. If this is done the amplifier gain is increased by grounding the inverse feedback circuit by switch 68 and simultaneously decreasing the volume of reception of loudspeaker 12. By doing this, the feedback is maintained at the same level to prevent undesired howling. It is obvious, of course, that, if desired, the apparatus at station 2 could be identical with that at station 1. In this event, if high volume switches at both stations were depressed, the overall feedback would remain the same because the receiver volumes at both stations would be decreased in the same relation as the amplifier gains were increased.

It may be noted that when station 1 initially calls station 2, the communication control switch at the latter is in its intermediate position wherein the secondary winding 112 of the output transformer is also connected across circuit 22. However, this winding is prevented from short circuiting the loudspeaker to any substantial extent by the resistors 125, each of which may have a value approximately one-half the impedance of the loudspeaker voice coil and of the secondary winding amplifier output transformer. For instance, the loudspeaker 27 and secondary winding 112 may have an impedance of about 50 ohms and the resistors 125 each a value of about 25 ohms.

The busy signalling arrangement described is such that if the operators at either stations 3 or 4 should select either of stations 1 or 2, then the signal light at the former would be extinguished.

In the event station 3 should select station 1 as by closure of selector switch 35, then the solenoid 168 at station 3 is partially short circuited as it is grounded through resistors 170 and 171, circuit 164, selector switch 135, interstation circuit 16, resistors 101 and 102, conductor 103, and switch blade 105 of selector switch 86 at station 1.

In the event station 3 selects station 2, the solenoid 169 is similarly grounded through the selector switch 36 and the interstation circuit 22 individual to station 2, which is grounded through conductor 149 and switch blade 152 at station 2.

In the event station 4 selects station 1 while stations 1 and 2 are communicating with each other, then the solenoid 194 at the former is grounded through a circuit including conductor 195, switch blade 199 in its uppermost position, conductor 200, resistors 197 and 198, circuit 181, selector switch 202, interstation circuit 17, normally closed selector switch 171 at station 1, resistors 99 and 100, conductor 98, switch blade 97 in its uppermost position, and conductor 94, which, it may be recalled, is grounded through a circuit previously described.

When station 2 calls station 1, the selection of stations and communication between stations as well as the operation of the busy signal circuits correspond with that described above, except that the operator at station 2 performs the functions performed by the operator at station 1, and the latter performs the functions performed by the operator at station 2.

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

In the event the operator at station 1 desires to call station 3, he first operates the communication control switch 13 to its uppermost position thereby to change the circuits as already described, and then closes selector switch 88. If station 3 is not busy, solenoid 92 remains energized thereby indicating that station 3 is not busy. The operator at station 1 then calls station 3, which receives the call through loudspeaker 33 which is connected to the output of amplifier 10 through communication control switch blades 74, selector switch 32, and interstation circuit 20. To respond to the call, the operator at station 3 closes selector switch 35 individual to station 1 and operates the communication control switch to its lowermost position. When the selector switch is closed, the solenoids at the two stations are grounded in substantially the same manner as when stations 1 and 2 were placed in communication with each other, i. e., solenoid 92 at station 1 is grounded through the switch blade 74 of selector switch 35 at station 3 and solenoid 168 at station 3 is grounded through the switch blade 105 of selector switch 88 at station 1.

In order to receive a call, the communication control switch 34 at station 3 must be in its middle position, and in order to send a call in the opposite direction, the communication control switch must be in one or the other of its displaced positions, at which time the loudspeaker is connected to the input of the amplifier and the output of the amplifier is connected to interstation circuit 16 individual to station 1 by the lowermost blade 163 of the communication control switch and selector switch 35. The operator at station 1 need not operate the communication control switch thereat.

The operator at station 1 may talk to the operator at station 3 at increased volume simply by closing the high volume switch 66. There is no danger of feedback when stations 1 and 3 are communicating with each other inasmuch as there is no feedback path, the loudspeaker 33 being alternately used as a microphone and receiver.

When stations 1 and 3 are communicating with each other, then in case either of stations 2 or 4 selects one of the two stations first mentioned, it will receive a busy signal. In the event station 2 selects station 1 as by closure of selector switch 131, then the solenoid 137 is grounded through conductor 139, resistors 141 and 142, interstation circuit 16, resistors 101 and 102, conductor 103, and switch blade 105 associated with selector switch 88 at station 1. In the event station 2 selects station 3 as by closure of selector switch 32, then solenoid 157 is grounded through a circuit including conductor 139, resistors 141 and 142, selector switch 132, interstation circuit 20, resistors 172 and 173, conductor 175 and switch blade 174 associated with selector switch 35.

Station 3 can select station 1 simply by closing selector switch 35. In the event station 1 is not busy, the solenoid 168 remains energized until the operator at station 1 closes selector switch 88. The operator at station 3 then calls station

1 by operating the communication control switch 36 to either of its displaced positions, and the call will be heard by the operator at station 1 through loudspeaker 12.

The mode of operation between stations 2 and 3 is substantially the same as between stations 1 and 3. It is believed, therefore, that further description thereof is unnecessary.

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

In the event station 1 desires to call station 4, the communication control switch 13 is first operated into its uppermost position in order to ascertain whether or not station 4 is busy, although thereafter the communication control switch is operated between its middle and lowermost positions, as will be described.

To select station 4, the communication control switch is operated to its uppermost position, as already stated, and selector switch 34 closed. It is assumed, first, that station 4 is not busy and, therefore, solenoid 32 remains energized. Upon ascertaining that station 4 is not busy, the operator at station 1 operates the communication control switch to its lowermost position, at which time the microphone 11 is connected to the input of the amplifier and the output of the amplifier is connected to loudspeaker 40 at station 4 through switch blades 74 of the communication control switch in their lowermost positions, circuits 81 and 82, selector switch 34, interstation circuit 19, selector switch 42 at station 4, circuit 181, and switch blades 182 and 183.

For station 4 to answer a call, the operator at station 4 need do nothing but the operation at station 1 must return the communication control switch thereat to its middle position, thereby connecting the loudspeaker 12 to the output of the amplifier through circuit 76, switch blades 74 in their middle positions, circuits 75 (including resistors 77), and circuit 19. In the middle position the loudspeaker 40 at station 4 is connected to the input of the amplifier through a circuit including interstation circuit 19, selector switch 34, circuit 82, switch blades 72, and circuit 73.

It may be well to mention that if the operator at station 4 desired to do so, he could close selector switch 202 inividual to station 1, but this would have no effect on the circuits except to connect circuits 17 and 19 in parallel.

In the event the operator at station 1 desires to talk to station 4 at high volume, the high volume switch at station 1 is operated.

While stations 1 and 4 are in communication with each other, then stations 2 and 3 receive busy signals if they select station 1 and station 2 also receives a busy signal in case it selects station 4.

Station 2 obtains a busy signal upon selecting station 1 because the solenoid 137 thereat is grounded through a circuit including conductor 139, resistors 141 and 142, selector switch 131 individual to station 1, interstation circuit 16, resistors 101 and 102, conductor 103, and switch blade 105 associated with selector switch 84.

In the event station 2 selects station 4, it receives a busy signal as solenoid 137 is grounded through a circuit including conductor 139, conductor 143, switch blade 134 in its uppermost position (in which position a station of the type of station 4 is selected), conductor 145, resistors 146 and 147, selector switch 128 individual to station 4, interstation circuit 19, selector switch 34 at station 1, resistors 99 and 100, conductor 98, switch blade 97 in either its middle or lowermost position, conductor 104, conductor 103, and switch blade 105 associated with selector switch 84.

In the event station 3 selects station 1, then station 3 receives a busy signal as the solenoid 168 is grounded through a circuit including resistors 170 and 171, circuit 164, selector switch 35, interstation circuit 16, resistors 101 and 102 at station 1, conductor 103, and switch blade 105 associated with selector switch 84.

When station 4 desires to call station 1, it is necessary for the operator at the former only to close selector switch 202 individual to station 1. This effects the connection of the loudspeaker 40 at station 2 to the input of the amplifier 10 at station 1 through interstation circuit 17 individual to station 1. Thereafter, the direction of communication is controlled by the operation of communication control switch 13 at station 1 between its middle and lowermost positions, as described above. When stations 1 and 4 are in communication with each other, the other stations selecting either receive busy signals, as described above.

Communication between stations 2 and 4 is carried on in a manner corresponding to that described above in connection with stations 1 and 4, so that further description is deemed unnecessary.

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

For station 1 to call station 5, the operator at the former station closes selector switch 83 individual to station 5 and operates the communication control switch 13 to its lowermost position. When these operations are effected, microphone 11 at station 1 is connected to the input of amplifier 10 and the output of the amplifier is connected through switch blades 74, the communication control switch and selector switch 83 to interstation circuit 18 individual to station 5 and to which loudspeaker 44 is permanently connected. Communication in the opposite direction is effected simply by releasing communication control switch 13 to return it to its middle position.

When station 1 is in communication with station 5, then stations 2 and 4 receive busy signals in the event they select either of stations 1 or 5, and station 3 receives a busy signal in case it selects station 1. In the event station 2 selects station 1, solenoid 137 at station 2 is grounded through a circuit including conductor 139, resistors 141 and 142, selector switch 131, interstation circuit 16, resistors 101 and 102 at station 1, conductor 103, and the switch blade 105 associated with selector switch 83. If station 2 selects station 5, which it does with its communication control switch 28 in its uppermost position, solenoid 137 at station 2 is grounded through a circuit including conductor 139, conductor 143, switch blade 144 in its uppermost position, conductor 145, resistors 146 and 147, selector switch 129 individual to station 5, interstation circuit 18, selector switch 83 at station 1, resistors 99 and 100, conductor 98, switch blade 97 in either its middle or lowermost position, conductors 104 and 103, and switch blade 105 associated with station 5.

In the event station 3 selects station 1 when the latter is in communication with station 5, then solenoid 168 at station 3 is grounded through a circuit including resistors 170 and 171, circuit

164, selector switch 35, interstation circuit 16, resistors 101 and 102 at station 1, conductor 103, and switch blade 105 associated with selector switch 83.

In the event station 4 selects station 1, then solenoid 194 is grounded through a circuit including conductor 196, switch base 199, conductor 200, resistors 197 and 198, circuit 181, selector switch 202, interstation circuit 17, selector switch 71 at station 1, resistors 99 and 100, conductor 98, communication control switch 97 in its middle or lowermost positions, conductors 104 and 103, and switch blade 105 associated with selector switch 83.

In the event station 4 selects station 5, solenoid 194 is grounded through a circuit including conductor 196, switch blade 199, conductor 200, resistors 197 and 198, circuit 181, selector switch 203 individual to station 5, interstation circuit 18, selector switch 83 at station 1, circuit 82, resistors 99 and 100, conductor 98, switch blade 97 in its middle or lowermost position, conductors 104 and 103, and switch blade 105 associated with selector switch 83.

For the operator at station 5 to call station 1, switch 45 at the former station is closed, thereby to connect the loudspeaker 44 to interstation circuit 17 individual to station 1, which in the normal position of the communication control switch at station 1 is connected to the input of the amplifier. In responding, the operator at station 1 preferably closes selector switch 83 individual to station 5, while the operator at station 5 preferably releases switch 45. Thereafter, the communication between stations 1 and 5 is carried on as described above and the other stations will obtain busy signals, also as described above, in case they select either stations 1 or 5.

Communication between stations 2 and 5 is carried on in the same manner as between stations 1 and 5, and further description thereof is deemed unnecessary.

5. *Communication between stations 4 and 5*

For station 4 to call station 5, the operator at station 4 closes selector switch 203 individual to station 5. If station 5 is not communicating with stations 1 or 2, then solenoid 194 at station 4 remains energized to indicate that station 5 is not busy. Thereafter, the operator at station 4 operates communication control switch 41 to its lowermost position to connect the loudspeaker 40 at station 4 to the input of the amplifier and to connect the output of the amplifier to the loudspeaker at station 4 through a circuit including circuit 181 at station 4, selector switch 203, and interstation circuit 18. To reverse the direction of communication, the communication control switch 41 is released to return it to its middle position, thereby to reverse the connections of the loudspeakers 40 and 44 to the amplifier.

When stations 4 and 5 are communicating with each other then in case either of stations 1 or 2 selects either of stations 4 or 5, they receive busy signals. In the event station 1 selects station 4, which it does with the communication control switch in its uppermost position, then solenoid 92 is grounded through a circuit including conductor 94, switch blade 97 in its uppermost position, conductor 98, resistors 99 and 100, circuit 82, selector switch 84, interstation circuit 19, circuit 181, resistors 197 and 198, conductor 200, and switch blade 199 in either its middle or lowermost position, in which positions the switch blade is when station 4 is communicating with station 5.

In the event station 1 selects station 5, the solenoid 92 at station 1 is grounded through the above described circuit at station 1 to circuit 82, and thence through selector switch 83 individual to station 5, interstation circuit 18, selector switch 203 at station 4, circuit 181, resistors 197 and 198, conductor 200, and switch blade 199 in its middle or lowermost positions.

In the event station 2 selects either of stations 4 or 5 with its communication control switch 28 in its uppermost position, then the solenoid 137 thereat is grounded through circuits similar to those described above in conjunction with the selection of either of these two stations by station 1. In brief, when station 4 is selected by station 2 the ground circuit extends through interstation circuit 19, and when station 5 is selected, the ground circuit extends through interstation circuit 18.

In order for station 5 to call station 4, the communication control switch at the latter has to be left in its middle position, at which time the circuit 181 is connected to the input of the amplifier and the loudspeaker at station 4 is connected to the output. When station 4 is conditioned for reception of calls from station 5 in this manner, then station 5 may call station 4 by closing switch 46. Closure of this switch connects loudspeaker 44 to interstation circuit 19 individual to station 4, which circuit is normally connected by selector switch 42 at station 4 to circuit 181 and consequently to the input of the amplifier.

In responding to a call, the operator at station 4 preferably closes selector switch 203, individual to station 5, and the operator at station 5 releases switch 46, although this is not essential, as all that the closure of switch 203 does is to place interstation circuit 18 in parallel to interstation circuit 19. Thereafter, the operator at station 4 operates the communication control switch thereat between its middle and lowermost positions alternately to listen and talk to station 4. When the two stations are in communication in this manner, stations 1 and 2 receive busy signals upon selecting either of them, as described above.

6. *Communications between station 6 and stations 1, 2 and 3*

Station 6, it will be remembered, has a loudspeaker connected to circuit 21 individual to station 6, and a microphone connected to the input of an amplifier, the output of which may be selectively connected by selector switches to circuits 16, 20 and 22 individual to stations 1, 3 and 2, respectively. For station 1 to call station 6, the operator at station 1 operates communication control switch 13 to its uppermost position and closes selector switch 87, thereby to connect microphone 11 to the input of amplifier 10 and the output of the amplifier to the interstation circuit 21 individual to station 6. To respond to a call, the operator at station 6 closes the selector switch thereat to connect the amplifier output to interstation circuit 16 to which the loudspeaker at station 1 is connected. Thereafter, communication is carried on between the stations without any further manipulation of switches, just as in the case when stations 1, 2 and 3 are communicating with each other. Stations 2 and 3 will not receive any busy signal when selecting station 6 when the latter is in communication with sta-

tion 1 but will receive signals upon selecting station 4, as will station 4 upon selecting station 1, in a manner heretofore described.

Station 6 can call station 1 simply by closing the selector switch connecting the output of the amplifier thereat to interstation circuit 16. Upon receipt of the call, the operator at station 1 moves communication control switch 13 to its uppermost position and closes selector switch 37, after which communication is carried on without further manipulation of switches.

The operation when either of stations 2 or 5 calls the other corresponds to the operation when station 1 calls station 6.

The procedure when station 3 calls station 6 is the same as when station 3 calls either of stations 1 or 2, except, of course, the operator at station 6 does not have to manipulate any communication control switch, none being provided.

For station 6 to call station 3, it is necessary only for the operator at station 6 to close the proper selector switch. In responding, the operator at station 3 likewise has to close the proper selector switch and then manipulate communication control switch 34 from its middle to either of its displaced positions, as described above.

While the present invention has been described in connection with a preferred embodiment thereof, it should be apparent to those skilled in the art that the principles are not limited to the specific embodiment or to the particular number of various types of units illustrated.

What I claim as new and desire to secure by United States Letters Patent is:

1. In an intercommunicating system, the combination including, a plurality of stations each having a microphone, a loudspeaker, an amplifier, communication control switch means, a plurality of communication circuits between stations, each of said communication circuits constituting an individual reception circuit for a particular station, a circuit at each station connecting the loudspeaker thereat to the reception circuit individual thereto, a transmission circuit, station selector switch means for connecting said transmission circuit to communication circuits individual to other stations, and means including circuit associated with said communication control switch means for connecting said microphone to the amplifier input and the amplifier output to said transmission circuit.

2. In an intercommunicating system, the combination including, one or more stations of a first type each having a microphone, a loudspeaker, an amplifier, a multi-position communication control switch, a plurality of communication circuits between stations, each of said communication circuits constituting an individual reception circuit for a particular station, a circuit at each station connecting the loudspeaker thereat to the reception circuit individual thereto, a transmission circuit, station selector switch means for connecting said transmission circuit to communication circuits individual to other stations, one or more stations of a second type, communication circuits from one or more stations of the first type to one or more stations of the second type, said circuits being utilizable for both reception and transmission, and means including circuits controlled by said communication control switch for disconnecting said microphone and connecting one of said last mentioned communication circuits to the amplifier input and the amplifier output to said loudspeaker.

3. In an intercommunicating system, the combination including, one or more stations of a first type each having a microphone, a loudspeaker, an amplifier, and a multi-position communication control switch having a normal position and two displaced positions, a plurality of communication circuits between stations, each of said communication circuits constituting an individual reception circuit for a particular station, a circuit at each station connecting the loudspeaker thereat to the reception circuit individual thereto, a transmission circuit, station selector switch means for connecting said transmission circuit to communication circuits individual to other stations, one or more stations of a second type, communication circuits from one or more stations of the first type to one or more stations of the second type, said circuits being utilizable for both reception and transmission, and means at each station of the first type including said communication control switch and circuits controlled thereby for disconnecting said microphone and connecting said last mentioned communication circuit to the amplifier input and the amplifier output to said loudspeaker in the normal position of said switch, for connecting said microphone to the amplifier input in both displaced positions, and for connecting said transmission circuit to the amplifier output in one of said displaced positions and said last mentioned communication circuit to the amplifier output in the other displaced position of said switch.

4. In an intercommunicating system, the combination including, one or more stations of a first type each having a microphone, a loudspeaker, an amplifier, and a multiposition communication control switch, a plurality of communication circuits between stations, each constituting an individual reception circuit for a particular station, a circuit at each station connecting the loudspeaker thereat to the reception circuit individual thereto, one or more stations of a second type having an amplifier, a loudspeaker utilizable both as a microphone and a receiver, reception circuits individual to stations of the second type extending to one or more stations of the first type, and circuits connecting the circuits individual to the stations of the first type to said stations of the second type, each of the stations of the second type having means including a communication control switch normally connecting the loudspeaker to its reception circuit and operable to connect the loudspeaker to the amplifier input and the amplifier output to the reception circuits individual to said stations of the first type, and said stations of the first type having a transmission circuit, station selector switch means for connecting said transmission circuit to the reception circuits individual to both types of stations, and communication control switches normally connecting the reception circuits individual thereto to said loudspeaker and operable to a position to connect said microphone to the amplifier input and the amplifier output to said transmission circuit.

5. An intercommunicating system, including in combination, one or more stations of a first type each having an amplifier, a microphone, a loudspeaker, a first circuit utilizable both for reception and transmission, a reception circuit, a transmission circuit, and means including a communication control switch and circuits controlled thereby for normally connecting said loudspeaker to both said first and reception circuits

and operable into two displaced positions wherein said microphone is connected to the amplifier input and in one of which the amplifier output is connected to said first circuit and in the other of which the output is connected to said transmission circuit; one or more stations of a type having a circuit utilizable for both reception and transmission, a loudspeaker utilizable both as a microphone and a receiver, an amplifier and means including a communication control switch and circuits controlled thereby normally connecting said loudspeaker to said circuit and operable to connect said loudspeaker to the amplifier output or input and simultaneously to connect the amplifier input or output to said circuit; and one or more stations of a third type each having a reception circuit, a transmission circuit, an amplifier, a loudspeaker utilizable both as a microphone and a receiver and means including a communication control switch and circuits controlled thereby normally connecting said loudspeaker to said reception circuit and operable to connect said loudspeaker to the amplifier input and the amplifier output to said transmission circuit; and interstation circuits between the stations including circuits individual to each station to which the loudspeakers are normally connected.

6. In an intercommunicating system, the combination including, one or more stations of a first type each having a microphone, a loudspeaker, an amplifier normally operable at a predetermined gain and communication control switch means, one or more stations of a second type, communication circuits between stations of the two types utilizable for both reception and transmission, and means at stations of the first type including said communication control switch means and circuits controlled thereby for connecting said microphone to the amplifier input and the amplifier output to an interstation circuit and simultaneously increasing the gain of said amplifier.

7. In an intercommunicating system, the combination including, one or more stations of a first type each having a microphone, a loudspeaker, an amplifier operable at high and low gain, a multi-position communication control switch having a normal position and another position, one or more stations of a second type, communication circuits from one or more stations of the first type to one or more stations of the second type, said circuits being utilizable for both reception and transmission, and means including said communication control switch and circuits controlled thereby operable in said normal position to condition said amplifier for operation at low gain, to disconnect said microphone and to connect one of said last mentioned communication circuits to the amplifier input and the amplifier output to said loudspeaker, and operable in said other position to condition said amplifier for operation at high gain and to connect said microphone to the amplifier input and said communication circuit to the amplifier output.

8. In an intercommunicating system, the combination including, one or more stations of a first type each having a microphone, a loudspeaker, an amplifier operable at high and low gain, and a multi-position communication control switch having a normal position and two displaced positions, a plurality of communication circuits between stations, each of said communication circuits constituting an individual reception circuit for a particular station, a circuit at each station connecting the loudspeaker thereat to the reception circuit individual thereto, a transmission circuit, station selector switch means for connecting said transmission circuit to communication circuits individual to other stations, one or more stations of a second type, communication circuits from one or more stations of the first type to one or more stations of the second type, said circuits being utilizable for both reception and transmission, and means at each station of the first type including said communication control switch and circuits controlled thereby for conditioning said amplifier for operation at low gain, for disconnecting said microphone and for connecting said last mentioned communication circuit to the amplifier input and the amplifier output to said loudspeaker in the normal position of said switch, for connecting said microphone to the amplifier input in both displaced positions, and for connecting said transmission circuit to the amplifier output in one of said displaced positions and for connecting said last mentioned communication circuit to the amplifier output and conditioning said amplifier for operation at high gain in the other displaced position of said switch.

9. In an intercommunicating system, the combination including, one or more stations of a first type each having a microphone, a loudspeaker normally conditioned for reception at high volume, an amplifier normally operable at low gain and operable also at high gain, a manually operable two position switch associated with said loudspeaker and amplifier for simultaneously decreasing the loudspeaker reception volume and increasing the amplifier gain, and a multi-position communication control switch having a normal position and two displaced positions, a plurality of communication circuits between stations, each of said communication circuits constituting an individual reception circuit for a particular station, a circuit at each station connecting the loudspeaker thereat to the reception circuit individual thereto, a transmission circuit, station selector switch means for connecting said transmission circuit to communication circuits individual to other stations, one or more stations of a second type, communication circuits from one or more stations of the first type to one or more stations of the second type, said circuits being utilizable for both reception and transmission, and means at each station of the first type including said communication control switch and circuits controlled thereby for conditioning said amplifier for operation at low gain, for disconnecting said microphone and for connecting said last mentioned communication circuit to the amplifier input and the amplifier output to said loudspeaker in the normal position of said switch, for connecting said microphone to the amplifier input in both displaced positions, and for connecting said transmission circuit to the amplifier output in one of said displaced positions and for connecting said last mentioned communication circuit to the amplifier output and conditioning said amplifier for operation at high gain in the other displaced position of said switch.

10. In an intercommunicating system, the combination including, one or more stations of a first type each having a microphone, a loudspeaker operable at high and low reception volume, an amplifier operable at high and low gain, and a multi-position communication control switch having a normal position and two displaced posi-

tions, a plurality of communication circuits between stations, each of said communication circuits constituting an individual reception circuit for a particular station, a circuit at each station connecting the loudspeaker thereat to the reception circuit individual thereto, a transmission circuit, station selector switch means for connecting said transmission circuit to communication circuits individual to other stations, one or more stations of a second type, communication circuits from one or more stations of the first type to one or more stations of the second type, said circuits being utilizable for both reception and transmission, and means at each station of the first type including said communication control switch and circuits controlled thereby for conditioning said amplifier for operation at low gain and said loudspeaker at high reception volume, for disconnecting said microphone and for connecting said last mentioned communication circuit to the amplifier input and the amplifier output to said loudspeaker in the normal position of said switch, for connecting said microphone to the amplifier input in both displaced positions, and for connecting said transmission circuit to the amplifier output in one of said displaced positions and for connecting said last mentioned communication circuit to the amplifier output and conditioning said loudspeaker at low reception volume and said amplifier for operation at high gain in the other displaced position of said switch.

11. In an intercommunicating system, the combination including a plurality of stations each having a microphone, a loudspeaker, an amplifier, communication control switch means, a plurality of communication circuits between stations, each of said communication circuits constituting an individual reception circuit for a particular station, a circuit at each station connecting the loudspeaker thereat to the reception circuit individual thereto, a transmission circuit, station selector switch means for connecting said transmission circuit to communication circuits individual to other stations, grounding switches associated with said selector switch means, signal means, signal controlling means, a circuit connecting said controlling means to said transmission circuit, and means including circuits associated with said communication control switch means for connecting said microphone to the amplifier input and the amplifier output to said transmission circuit and for connecting said signal controlling means to said grounding switch means.

12. In an intercommunicating system, the combination including, one or more stations of a first type each having a microphone, a loudspeaker, an amplifier, and a multi-position communication control switch having a normal position and two displaced positions, a plurality of communication circuits between stations, each of said communication circuits constituting an individual reception circuit for a particular station, a circuit at each station connecting the loudspeaker thereat to the reception circuit individual thereto, a transmission circuit, station selector switch means for connecting said transmission circuit to communication circuits individual to other stations, signal means, signal controlling means, a circuit permanently connecting said signal controlling means to said transmission circuit, one or more stations of a second type, communication circuits from one or more stations of the first type to one or more stations of the second type, said circuits being utilizable for both reception and transmission, and one being individual to each station of the first type and the others individual to stations of the second type, station selector switch means at stations of the first type for connecting the two-way communication circuit thereat to the circuits individual to stations of the second type, grounding switches associated with both said station selector switch means, a circuit connecting said grounding switch means to said reception circuit, and means at each station of the first type including said communication control switch and circuits controlled thereby so constructed and arranged that in a normal position of the switch said microphone is disconnected and said loudspeaker is connected to said reception circuit and to the amplifier output and the amplifier input is connected to said two-way communication circuit, and wherein said signal controlling means is disconnected from said grounding switch means and the latter are connected to said reception circuit and two-way communication circuit; that said microphone is connected to the amplifier input in both displaced positions; and that said transmission circuit is connected to the amplifier output and said signal controlling means to said two-way communication circuit in one of said displaced positions; and that in said other displaced position said two-way communication circuit is connected to the amplifier output and said signal controlling means and grounding switches are connected as in the normal position of said switch.

13. An intercommunicating system, including in combination, one or more stations of a first type each having an amplifier, a microphone, a loudspeaker, a first circuit utilizable both for reception and transmission, a reception circuit, a transmission circuit, and means including a communication control switch and circuits controlled thereby for normally connecting said loudspeaker to both said first and reception circuits and operable into two displaced positions wherein said microphone is connected to the amplifier input and in one of which the amplifier output is connected to said first circuit and in the other of which the output is connected to said transmission circuit; one or more stations of a type having a circuit utilizable for both reception and transmission, a loudspeaker utilizable both as a microphone and a receiver, an amplifier and means including a communication control switch and circuits controlled thereby normally connecting said loudspeaker to said circuit and operable to connect said loudspeaker to the amplifier output or input and simultaneously to connect the amplifier input or output to said circuit; and one or more stations of a third type each having a reception circuit, a transmission circuit, an amplifier, a loudspeaker utilizable both as a microphone and a receiver and means including a communication control switch and circuits controlled thereby normally connecting said loudspeaker to said reception circuit and operable to connect said loudspeaker to the amplifier input and the amplifier output to said transmission circuit; interstation circuits between the stations including circuits individual to each station to which the loudspeakers are normally connected; station selector means, signal means and normally energized signal controlling means at each station, and means at the stations constructed and arranged to ground signal controlling means at stations in communication with each other,

whereby when a station calls a station communicating with another, the signal controlling means at the calling station is grounded to indicate the so called station is busy.

14. A unit for use in an intercommunicating system, including in combination, a microphone, a loudspeaker, an amplifier, communication control switch means, a reception circuit connected to the loudspeaker, a transmission circuit, and means including circuits controlled by said communication control switch means for connecting said microphone to the amplifier input and the amplifier output to said transmission circuit.

15. A unit for use in an intercommunicating system, including in combination, a microphone, a loudspeaker, an amplifier, and a multi-position communication control switch, a reception circuit connected to said loudspeaker, a transmission circuit, a circuit utilizable for both reception and transmission, and means including circuits controlled by said communication control switch for disconnecting said microphone from the amplifier input and for connecting said last mentioned circuit to the amplifier input and the amplifier output to said loudspeaker.

16. A unit for use in an intercommunicating system, including in combination, a microphone, a loudspeaker, an amplifier, a multi-position communication control switch having a normal position and two displaced positions, a reception circuit connected to said loudspeaker, a transmission circuit, a circuit utilizable for both reception and transmission, and means including said communication control switch and circuits controlled thereby for disconnecting said microphone from the amplifier input and for connecting said last mentioned circuit to the amplifier input and the amplifier output to said loudspeaker in the normal position of said switch, for connecting said microphone to the amplifier input in both displaced positions, and for connecting said transmission circuit to the amplifier output in one of said displaced positions, and for connecting said last mentioned communication circuit to the amplifier output in the other displaced position of said switch.

17. A unit for use in an intercommunicating system, including in combination, a microphone, a loudspeaker, an amplifier having gain control means and normally operable at a predetermined gain, communication control switch means, a communication circuit utilizable for both reception and transmission, and means including said communication control switch means and circuits controlled thereby for connecting said microphone to the amplifier input and the amplifier output to said communication circuit and simultaneously increasing the gain of said amplifier.

18. A unit for use in an intercommunicating system, including in combination, a microphone, a loudspeaker, an amplifier operable at high and low gain, a multi-position communication control switch having a normal position and another position, a communication circuit utilizable for both reception and transmission, and means including said communication control switch and circuits controlled thereby operable in said normal position to condition said amplifier for operation at low gain, to disconnect said microphone and to connect said communication circuit to the amplifier input and the amplifier output to said loudspeaker, and operable in said other position to condition said amplifier for operation at high gain and to connect said microphone to the amplifier input and said communication circuit to the amplifier output.

19. A unit for use in an intercommunicating system, including in combination, a microphone, a loudspeaker, an amplifier operable at high and low gain, a multi-position communication control switch having a normal position and two displaced positions, a reception circuit connected to said loudspeaker, a transmission circuit, a circuit utilizable for both reception and transmission, and means including said communication control switch and circuits controlled thereby for conditioning said amplifier for operation at low gain, for disconnecting said microphone and for connecting said last mentioned circuit to the amplifier input and the amplifier output to said loudspeaker in the normal position of said switch, for connecting said microphone to the amplifier input in both displaced positions, and for connecting said transmission circuit to the amplifier output in one of said displaced positions and for connecting said last mentioned circuit to the amplifier output and conditioning said amplifier for operation at high gain in the other displaced position of said switch.

20. A unit for use in an intercommunicating system, including in combination, a microphone, a loudspeaker normally conditioned for reception at high volume, an amplifier normally operable at high gain and operable also at low gain, a manually operable two position switch associated with said loudspeaker and amplifier for simultaneously decreasing the loudspeaker reception volume and increasing the amplifier gain, a multi-position communication control switch having a normal position and two displaced positions, a reception circuit connected to said loudspeaker, a transmission circuit, a circuit utilizable for both reception and transmission, and means including said communication control switch and circuits controlled thereby for conditioning said amplifier for operation at low gain, for disconnecting said microphone and for connecting said last mentioned circuit to the amplifier input and the amplifier output to said loudspeaker in the normal position of said switch, for connecting said microphone to the amplifier input in both displaced positions, and for connecting said transmission circuit to the amplifier output in one of said displaced positions and for connecting said last mentioned circuit to the amplifier output and conditioning said amplifier for operation at high gain in the other displaced position of said switch.

21. A unit for use in an intercommunicating system, including in combination, a microphone, a loudspeaker operable at high and low reception volume, an amplifier operable at high and low gain, a multi-position communication control switch having a normal position and two displaced positions, a reception circuit connected to said loudspeaker, a transmission circuit, a circuit utilizable for both reception and transmission, and means at each station of the first type including said communication control switch and circuits controlled thereby for conditioning said amplifier for operation at low gain and said loudspeaker at high reception volume, for disconnecting said microphone and for connecting said last mentioned communication circuit to the amplifier input and the amplifier output to said loudspeaker in the normal position of said switch, for connecting said microphone to the amplifier input in both displaced positions, and for connecting said transmission circuit to the am-

plifier output in one of said displaced positions and for connecting said last mentioned communication circuit to the amplifier output and conditioning said loudspeaker for reception at low reception volume and said amplifier for operation at high gain in the other displaced position of said switch.

22. A unit for use in an intercommunicating system, including in combination, a microphone, a loudspeaker, an amplifier, communication control switch means, a reception circuit, a circuit at each station connecting the loudspeaker thereat to the reception circuit individual thereto, a transmission circuit, station selector switch means for connecting said transmission circuit to circuits adapted to be connected to other units, grounded switches associated with said selector switch means, signal means, signal controlling means, a circuit connecting said controlling means to said transmission circuit, and means including circuits associated with said communication control switch means for connetcing said microphone to the amplifier input and the amplifier output to said transmission circuit, and for connecting said signal controlling means to said grounding switch means.

23. A unit for use in an intercommunicating system, including in combination, a microphone, a loudspeaker, an amplifier, a multi-position communication control switch having a normal position and two displaced positions, a reception circuit connected to said loudspeaker, a transmission circuit, station selector switch means for connecting said transmission circuit to communication circuits, signal means, signal controlling means, a circuit permanently connecting said signal controlling means to said transmission circuit, a conmmunication utilizable for both reception and transmission, station selector switch means for connecting the two-way communication circuit to communication circuits, grounding switches associated with both said station selector switch means, a circuit connecting said grounding switch means to said reception circuit, and means including said communication control switch and circuits controlled thereby to constructed and arranged that in a normal position of the switch said microphone is disconnected and said loudspeaker is connected to said reception circuit and to the amplifier output and the amplifier input is connected to said two-way communication circuit, and wherein said signal controlling means is disconnected from said grounding switch means and the latter are connected to said reception circuit and two-way communication circuit; that said microphone is connected to the amplifier input in both displaced positions; and that said transmission circuit is connected to the amplifier output and said signal controlling means to said two-way communication circuit in one of said displaced positions; and that in said other displaced position said two-way communication circuit is connected to the amplifier output and said signal controlling means and grounding switches are connected as in the normal position of said switch.

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