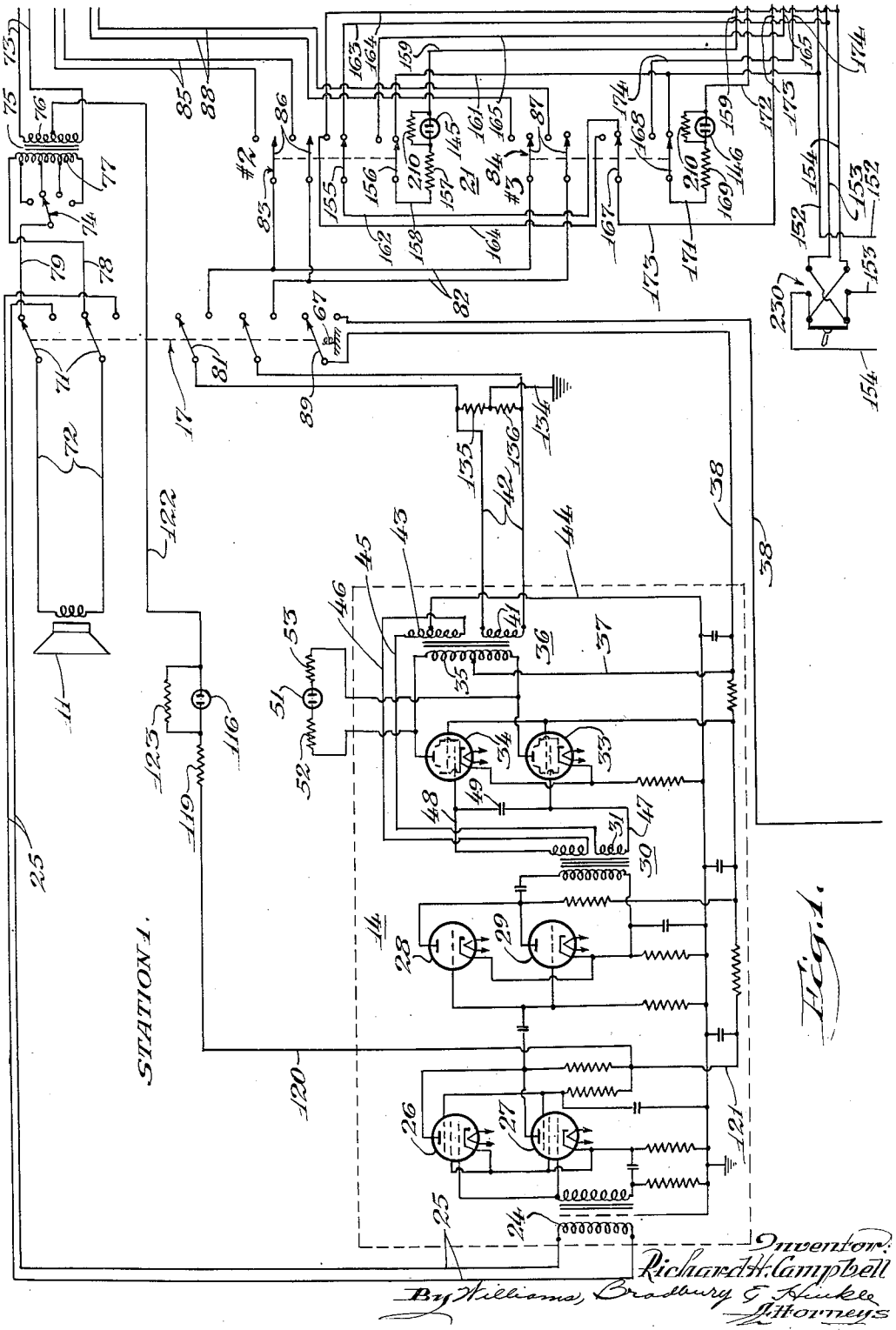
April 18, 1944. R. H. CAMPBELL 2,347,079

COMMUNICATION SYSTEM

Filed Sept. 7, 1942 4 Sheets-Sheet 1



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COMMUNICATION SYSTEM

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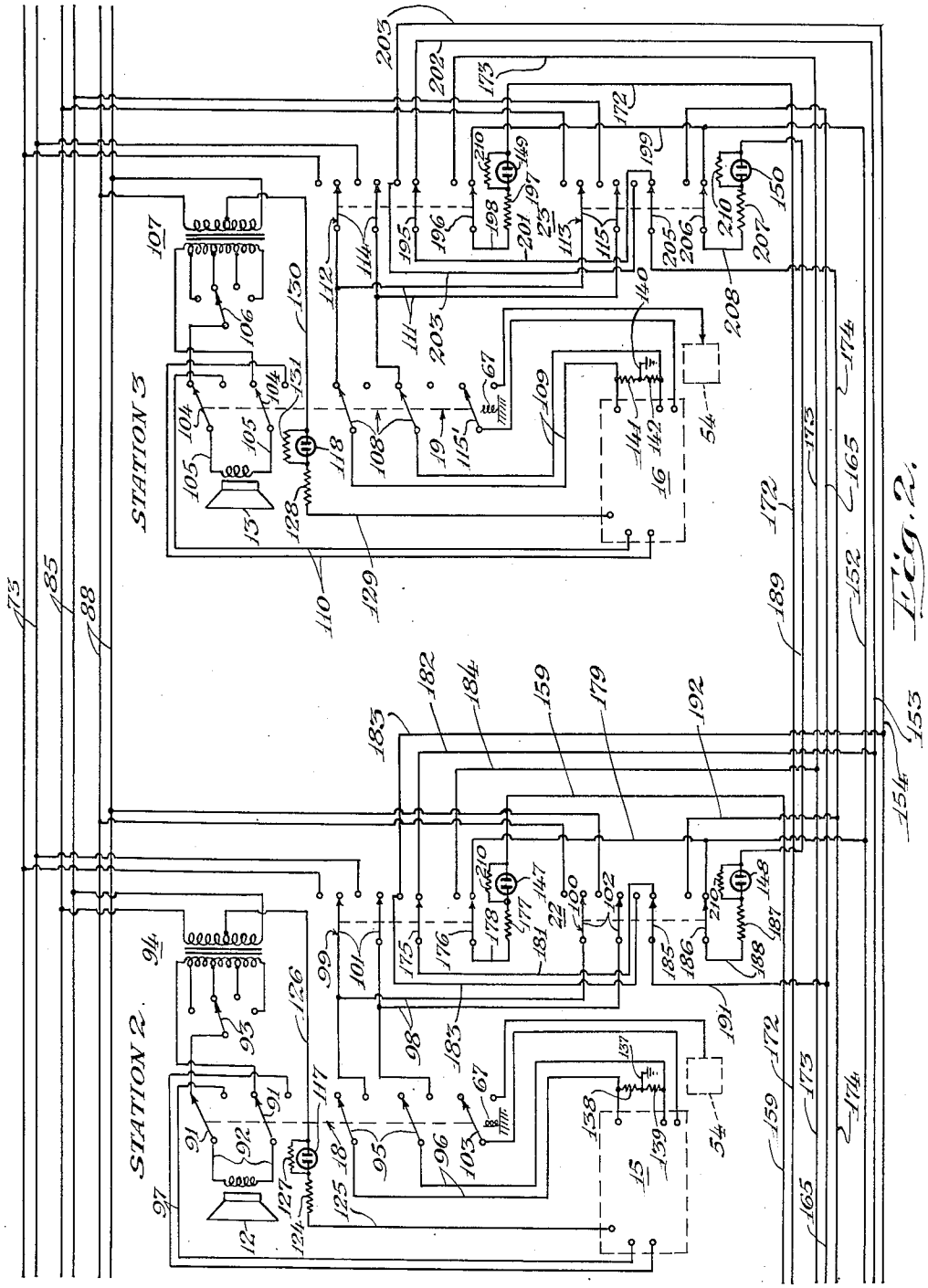


Fig. 2.

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COMMUNICATION SYSTEM

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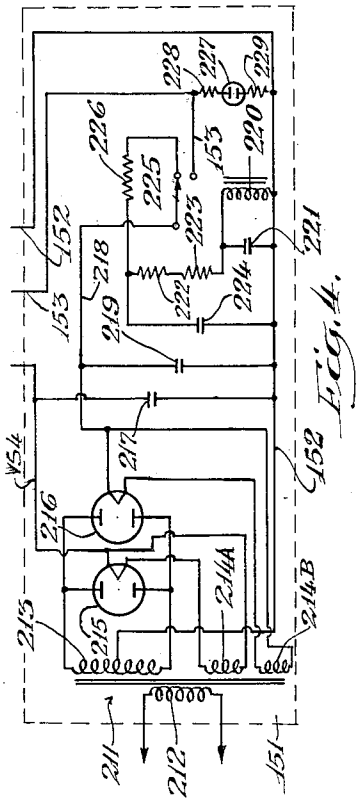


Fig. 4.

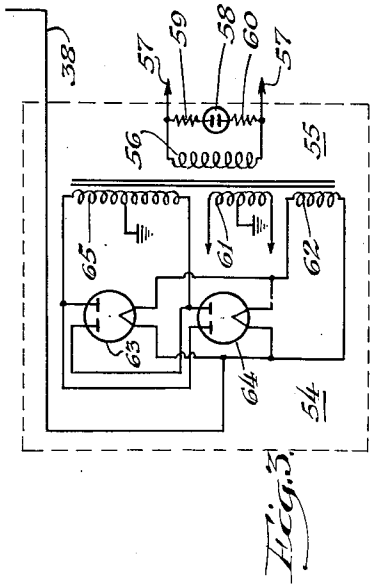


Fig. 3.

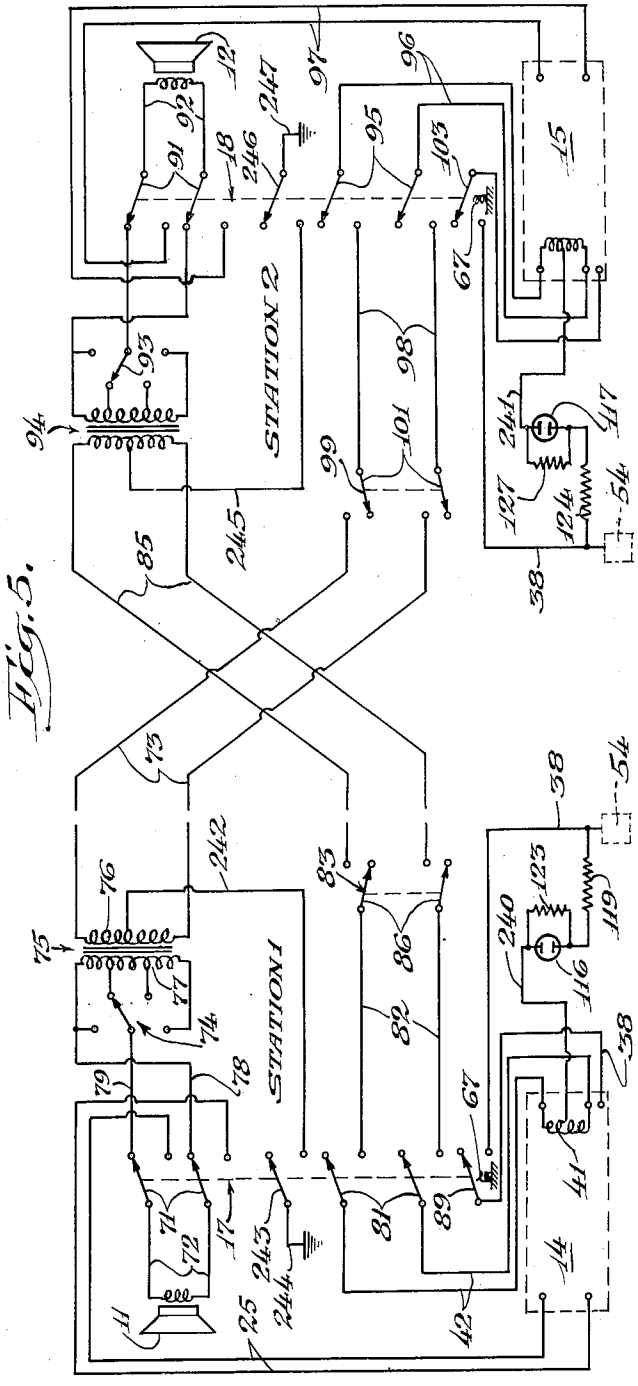


Fig. 5.

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COMMUNICATION SYSTEM

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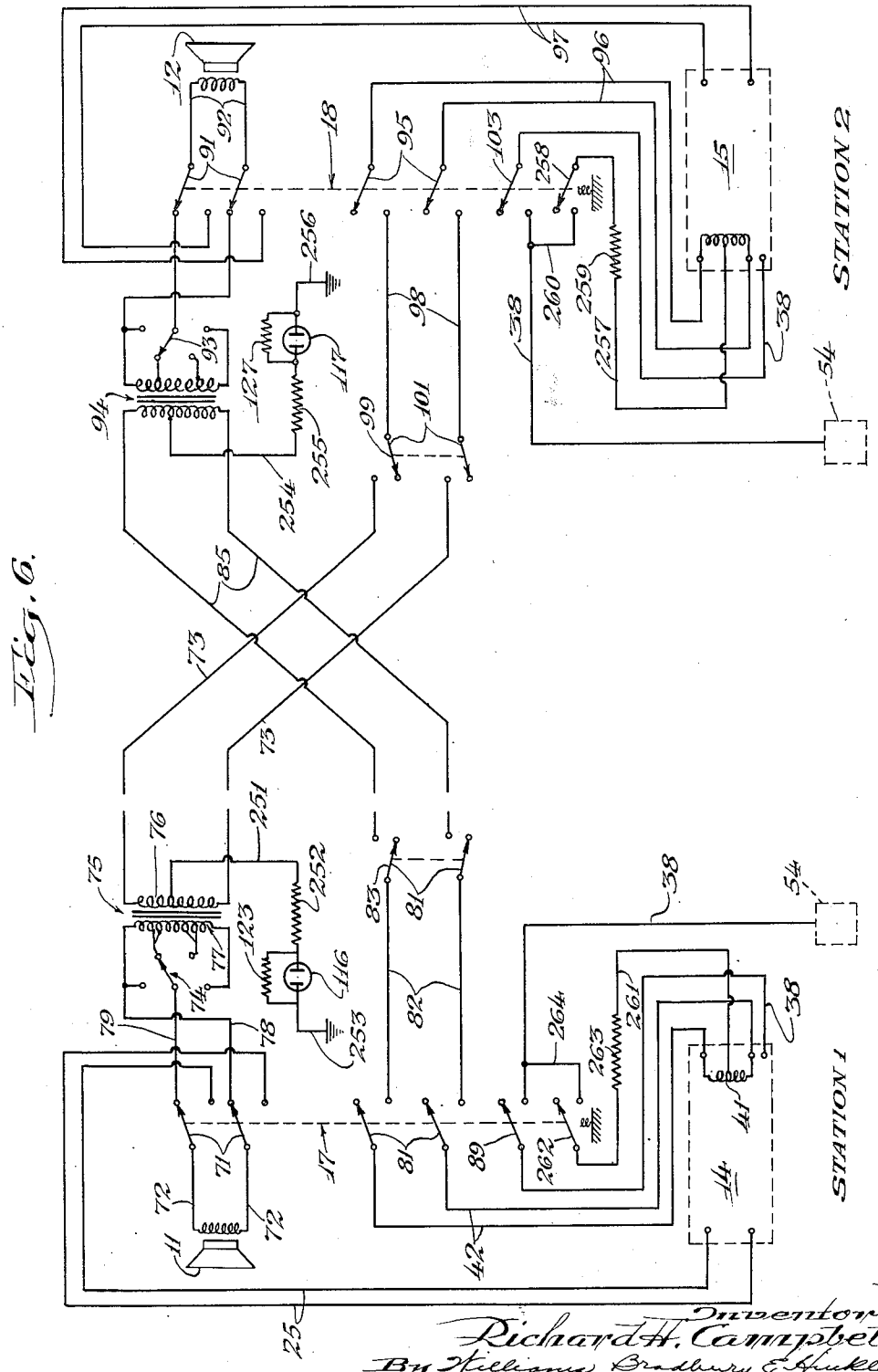


Fig. 6.

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UNITED STATES PATENT OFFICE

2,347,079

COMMUNICATION SYSTEM

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Application September 7, 1942, Serial No. 457,549

65 Claims. (Cl. 179—37)

The present invention relates to intercommunicating systems and particularly to the provision of new and improved circuit arrangements enabling an operator at one station to indicate to an operator at another station that he is desirous of interrupting or "breaking in" on the operator at another station when the latter is talking to the former. The invention also relates to the provision of new and improved circuit arrangements for enabling an operator at one station to signal an operator at another that it is desired to communicate with him.

In intercommunicating systems and particularly intercommunicating systems of the loudspeaker type, there has been developed a type of system wherein a "talk-listen" switch is utilized to condition a station either for transmission or reception. In some systems, alternate operation of switches at two stations between their talk and listen positions is required in order for communication to be carried on between the two stations. In other systems, the direction of communication is controlled by the operation of a switch at one station between its two positions. In systems of these types, it may happen that the operator at a station conditioned for reception desires to interrupt transmission by the station conditioned for transmission. Heretofore, this has not been possible and it is, therefore, one of the primary objects of the present invention to provide an arrangement whereby a station conditioned for reception may signal a station conditioned for transmission that it is desired to interrupt or break in on the latter.

Another of the primary objects of the present invention is to provide communication systems with signaling arrangements whereby one station can signal another that it is desired to communicate therewith and wherein the called station is given a first distinctive signal that another station desires to communicate therewith in the event the called station is not busy and given another and different distinctive signal in the event the called station is busy.

A further object of the present invention is to provide communication systems with signaling arrangements whereby the calling station is given distinctive signals of the character aforesaid as to whether or not the called station is busy or not busy.

A further object of the present invention is to provide a communicating system with signaling arrangements of the character aforesaid in which the distinctive signals given in the called and calling stations in response to the busy or not busy condition of a called station may be reversed.

A further object of the present invention is to provide improved signal supply voltage arrangements.

Another object of the present invention is to provide an improved amplifier for use with intercommunicating systems of the loudspeaker type.

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 schematic representation of one station of an intercommunicating system provided with apparatus constructed and arranged in accordance with the present invention;

Fig. 2 is a similar representation of a further portion of the system, this portion including two additional stations provided with the same equipment as station 1 illustrated in Fig. 1;

Fig. 3 is a schematic representation of the power pack for supplying power to the amplifier located at station 1;

Fig. 4 is a schematic representation of a voltage supply arrangement for supplying the signaling voltages utilized to provide distinctive signals at the called and calling stations dependent upon whether or not the called station is busy or not busy;

Fig. 5 is a schematic representation of a modified form of circuit arrangement for enabling one station to signal another that it is desired to break in on transmission from the other station; and

Fig. 6 is a view similar to Fig. 5 of a further modification.

Referring now to the drawings and more particularly to Figs. 1, 2, 3, and 4, it may be well perhaps to mention that these four figures illustrate a complete three-station communication system embodying the present invention. Space requirements prevent disclosure of the system on a single sheet of drawings, but the system as a whole may be conveniently noted if Fig. 2 is placed to the right of Fig. 1 and Figs. 3 and 4 below Fig. 1.

The system has been illustrated as including three stations although additional stations could be readily added to the system in a manner that will become apparent after the system has been described in detail. The three stations of the system have been indicated by reference characters 1, 2, and 3. Each of the stations is provided with translating devices capable of being utilized both as microphones and loudspeakers such as the loudspeakers 11 and 12 and 13 which may be of the well known permanent magnet type. The stations are also provided with amplifiers 14, 15, and 16, communication direction control switches 17, 18, and 19, and station selector switches indicated generally by reference characters 21, 22, and 23, all respectively.

The amplifiers are all of identical construction and therefore only the amplifier 14 at station 1 has been illustrated in detail. While the ampli-

fiers may be of any well known type, the amplifiers illustrated are of the negative feedback type and are constructed and arranged in accordance with one of the features of this invention to give an output that is considerably above the output obtained with conventional amplifiers.

The amplifier 14 includes input transformer 24 to the primary winding of which are connected the amplifier input conductors 25. The secondary winding of transformer 24 is connected to the tubes 26 and 27 (of the 6SJ7 type) which are arranged in parallel so that in the event one of the tubes fails for any reason whatever, the amplifier will remain operative. The output of the tubes 26 and 27 is supplied to tubes 28 and 29 (of the 6J5 type) which are also connected in parallel. The output of tubes 28 and 29 is supplied to the primary winding of an interstage coupling transformer 30, the secondary of which comprises two windings 31 and 32 connected in push-pull arrangement with the power tubes 33 and 34 (of the 6V6GT type). The anodes of the two tubes are connected to the primary winding 35 of an output transformer 36 and the midpoint of the primary winding is connected by a conductor 37 to a conductor 38 through which the supply of B voltage is led to the amplifier. It may be well to note at this point that the heaters of the various amplifier tubes are continuously supplied with power but that B or plate voltage is not supplied to them except when the communication control switch 17 is in its lowermost or talk position as will be described in greater detail hereinafter.

The output transformer 36 includes a first secondary winding 41 to the terminals of which are connected a pair of output conductors 42. The transformer also includes a second secondary winding 43, the midpoint of which is grounded to the chassis of the amplifier by a conductor 44 and the opposite terminals of which are connected by conductors 45 and 46 to adjacent terminals of windings 31 and 32 of the interstate coupling transformer 30. The other terminals of the latter are connected by conductors 47 and 48 to the grids of tubes 33 and 34, respectively. The grids of the two tubes are connected through a condenser 49, the purpose of which will now be described.

The output transformer secondary winding 43 is utilized as a source of negative feedback for the push-pull connected power output stage of the amplifier. As frequencies of about 15,000 cycles may be shifted in phase enough to cause a positive instead of negative feedback and thus produce an undesirable oscillation, the condenser 49 is used to bypass or reduce these higher frequencies enough to prevent excessive positive feedback which might otherwise produce oscillation. When the condenser is used, the amplifier can be adjusted to operate as a Class AB–2 amplifier. The amplifier thus draws grid current at high volume, that is, when the audio signal voltage applied to the grids of tubes 33 and 34 exceeds the normal grid bias voltage. The grid return circuit including conductors 45 and 46 is of low resistance and, consequently, the power output obtainable from the amplifier output stage is considerably increased. A further advantage of the amplifier circuit arrangement is to balance the grid current flowing through the secondary winding 43 so that it does not deleteriously affect the nature of the amplifier output.

The amplifier also includes a volume indicator in the nature of a neon tube 51 connected across the primary winding 35 in series with the high value (50,000 to 100,000 ohms) resistors 52 and 53, which prevent direct shorting of the amplifier B supply in the event the tube or socket should ground to the chassis. Should such grounding take place, one of the resistors would probably be destroyed but the power transformer and rectifier tube saved.

The amplifier is supplied with power through a power pack indicated generally by reference character 54 and illustrated in Fig. 3. The power pack includes a transformer 55, the primary winding 56 of which is connected to a suitable source of alternating current through conductors 57. A pilot light in the form of a neon tube 58 is connected across conductors 47 through the resistors 59 and 60. The transformer is provided with three secondary windings, the first 61 of which is utilized as a source of power for the cathode heaters of the amplifier tubes. A secondary winding 62 is used as a source of filament heating current for the rectifier tubes 63 and 64, and a third winding 65 is utilized as a source of anode voltage for the rectifier tubes, which, it may be noted, are connected in conventional manner for full wave rectification. The B supply line 38 is connected to the filaments of the tubes 63 and 64 in customary manner. Each of the amplifiers 15 and 16 has a similar power pack associated with it and indicated in each case by the reference character 54.

The communication control switches 17, 18, and 19 are operable between a listen position, in which they are indicated, to a talk position which is a lower position. The switches are preferably biased from their talk to their listen positions by springs 67. In the listen positions of the switches, the loudspeakers at the respective stations are connected to an interstation conductor individual thereto and in the talk positions the loudspeakers are connected to the inputs of the amplifiers and the outputs of the amplifiers are connected to the selector switches and thence through operated selector switches to the interstation circuits individual to other stations.

Referring now to Fig. 1 and station 1, it may be noted that the communication control switch 17 includes a pair of switch blades 71 connected directly through the pair of conductors 72 to the voice coil of loudspeaker 11. In the indicated position of the switch 17, the loudspeaker is connected to an interstation circuit individual to station 1 and including a pair of conductors 73 through the switch blades 71, through an adjustable volume control 74 and a transformer 75. The primary winding 76 of the transformer has two terminals connected to the conductors 73. One terminal of the secondary winding 77 of the transformer is connected by conductor 78 to a contact associated with the lowermost switch blade 71, while the movable contact 74 of the volume control is connected by conductor 79 to a contact associated with the other of switch blades 71. Volume control is effected by moving the contact 74 to vary the effective portion of the secondary winding 77.

In the indicated position of switch 17, the amplifier output conductors 42 are open circuited by the pair of switch blades 81 to which they are connected.

In the lowermost position of the communication control switch, the loudspeaker 11 is connected to the amplifier input through the switch blades 71 in their lowermost positions and the input conductors 25. At this time, the amplifier

output conductors 42 are connected through switch blades 81 (in their lowermost positions) to an output circuit 82 leading to the station selector switches 21 through which the amplifier output may be supplied to interstation circuits individual to the other stations of the system. In the system herein illustrated, there are but two other such stations and therefore two station selector switches have been illustrated. These are the switches 83 and 84 individual to stations 2 and 3, respectively.

When it is desired to communicate with station 2, station selector switch 83 is operated from its indicated lowermost position to a displaced position wherein the output circuit 82 is connected to an interstation circuit 85 individual to station 2, this connection being made through switch blades 86. When it is desired to communicate with station 3, the station selector switch 84 is operated so that the switch blades 87 thereof connect the output circuit 82 to the interstation circuit 88 individual to station 3. The station selector switches have also associated therewith additional circuits controlled thereby for signaling called stations, and also station 1, in a distinctive manner dependent upon whether or not the called station is busy or not busy, as will be described in detail hereinafter.

The communication control switch 17 includes an additional switch blade 89 operable into a circuit closing position to supply B voltage to the amplifier. The switch blade 89 breaks the B supply line 38 when the switch 17 is in its uppermost or listen position and completes the circuit when it is in its lowermost or talk position.

Referring now to Fig. 2 and station 2, it may be noted that the communication control switch 18 includes a pair of switch blades 91 connected through conductors 92 to the voice coil of loudspeaker 12. In the indicated position of switch 18, the loudspeaker is connected to interstation circuit 85 individual to station 2 through a volume control 93 and transformer 94. At this time, the switch blades 95 of switch 17 open circuit the amplifier output to which they are connected through conductors 96.

In the lowermost position of the communication control switch, loudspeaker 12 is connected to the amplifier input through switch blades 91 and the conductors 97. The amplifier output conductors 96 are at the same time connected to an output circuit 98 leading to a station selector switch 99 individual to station 1 and a station selector switch 100 individual to station 3. When the station selector switch 99 is closed, the output circuit 98 is connected through switch blades 101 to the interstation circuit 73 individual to station 1 and when station selector switch 100 is closed, the output circuit is connected through switch blades 102 to interstation circuit 88 individual to station 3.

The communication control switch includes also a switch blade 103 adapted when switch 18 is in its lowermost position to complete the B supply circuit for the amplifier 15.

The communication control switch 19 at station 3 includes a pair of switch blades 104 connected through conductors 105 to the voice coil of loudspeaker 13. In the indicated position of switch 19, the loudspeaker is connected to the interstation circuit 88 individual to station 3 through volume control 106 and transformer 107. At this time, the switch blades 108 of switch 19 open circuit the amplifier output to which they are connected through conductors 109.

In the lowermost position of the communication control switch, loudspeaker 13 is connected to the amplifier input through switch blades 103 and input conductors 110. The amplifier output conductors 109 are at the same time connected to an output circuit 111 leading to a station selector switch 112 individual to station 1 and a station selector switch 113 individual to station 2. When station selector switch 112 is closed, the output circuit 110 is connected through switch blades 114 to interstation circuit 73 individual to station 1 and when switch 113 is closed, circuit 111 is connected through switch blades 115 to interstation circuit 85 individual to station 2. The switch 19 also includes a switch blade 115' adapted to complete the B supply connection to the amplifier in the talk position of the switch.

Communication between any two stations of the system is carried on by alternate operation of the communication control switches at the two stations between their indicated and lowermost positions, i. e., between their listen and talk positions, provided of course that the station selector switches at the two stations have been closed to complete the interstation circuits between them. Suppose, for instance, that station 1 is communicating with station 2 (station selector switches 83 and 99 having been closed), and that the operator at station 1 is talking to the operator at station 2, then if the operator at station 2 desires to break-in on the operator at station 1, he cannot do so even though he operates the communication control switch 18 thereat to its talk position. The reason for this is that under these conditions the loudspeakers at both stations would be connected to the inputs of the amplifiers thereat and no loudspeakers would be connected to the outputs of the amplifiers.

One of the important features of the present invention is to provide a signaling arrangement whereby under the conditions mentioned above, an indication is given at a station conditioned for talking that the listening station desires to interrupt or break in. It is preferred that the signal be given as by the lighting of a lamp and consequently the various stations have been provided with signaling means consisting of neon tubes that are adapted to be lighted to indicate the break-in. These neon tubes are indicated by the reference characters 116, 117, and 118 (of the type NE17 manufactured by the General Electric Company), at stations 1, 2, and 3, respectively. The tube 116 has one terminal connected through a voltage limiting resistor 119 and conductor 120 to a source of direct current voltage which may be the conductor 121 through which plate voltage is supplied to tubes 26 and 27 of the amplifier. The other terminal of tube 116 is connected by a conductor 122 to the midpoint of the primary winding 76 of transformer 75. The tube is shunted by a resistor 123 having a value of about 100,000 ohms and the purpose of which is to decrease the voltage across the tube terminals so that it will not be lit as a result of resistance leakage and capacity between the interstation line 73 and ground, to which the negative side of the B voltage is connected.

In similar manner, one terminal of tube 117 at station 2 is connected through resistor 124 and conductor 125 to a source of direct current voltage while the other terminal is connected by conductor 126 to the midpoint of the primary winding of transformer 94. Tube 117 is bridged by the resistor 127.

The tube 118 at station 3 is likewise connected through resistor 128 and conductor 129 to a

source of direct current voltage and by conductor 130 to the midpoint of the primary winding of transformer 106. The tube 116 is also bridged by the resistor 131.

The break in circuit arrangement also includes a ground connection at each station. At station 1, the ground connection 134 is made to the midpoint of a pair of resistors 135 and 136 connected across the amplifier output conductors 42. At station 2, the ground connection 137 is made at the midpoint of resistors 138 and 139 connected across the amplifier output conductors 96. At station 3, the ground connection 140 is made at the midpoint of resistors 141 and 142 connected across the amplifier output conductors 109.

The arrangement of the neon tube break-in signals is such that when the talk-listen switches at two stations in communication with each other are both in their listen positions, or that at one station is in its listen position and that at the other in its talk position, the neon tubes are not lit. However, when both the switches are in their talk positions, thus indicating that the station conditioned for reception desires to interrupt or break in on the station conditioned for transmission, then the tubes at both stations are lit.

When the talk-listen switches are in their listen or indicated positions, then the neon tubes are not supplied with voltage since no plate voltage is supplied to the amplifiers as the plate supply controlling switch blades 89, 103, and 155 at the three stations are in circuit opening positions. When the talk-listen switch at one station is in its talk position (for instance, switch 17 at station 1) and the talk-listen switch at another station (for instance, switch 18 at station 2) is in its listen position then, while the B supply voltage is connected to tube 116 at station 1, there is no complete energizing circuit for this tube because the switch blades 95 at station 2, through which the energizing circuit for the tube is completed to ground, are in circuit opening position.

When both of the switches 17 and 18 are in their talk positions, which positions they would occupy when the operator at station 2 desires to interrupt the operator at station 1, then the tubes 116 and 117 at stations 1 and 2 are both lit. The energizing circuit for tube 116 extends from the B supply conductor 38 at station 1, conductors 121, 120 and resistor 119 to one terminal of tube 116. The other terminal of the tube is connected to ground through conductor 122, primary winding 76 of transformer 75 at station 1, interstation circuit 73, the station selector switch blades 101 at station 2, switch blades 95, conductors 96, resistors 138 and 139 and the ground connection 137 at station 2. The various ground connections at the stations may be connected to a single conductor or to shielding around a multiple conductor cable. The energizing circuit for tube 117 at station 2 extends from the B supply at that station through conductor 125 and resistor 124 to one terminal of the tube, and the other terminal of the tube is connected to ground through conductor 126, the midpoint of the primary winding of transformer 94 at station 2, interstation circuit 85, switch blades 86, switch blades 81, resistors 135 and 136, and the ground connection 134 at station 1. The operator at station 1 is thereupon advised by the lighting of tube 116 that the operator at station 2 desires to break in.

In the event station 2 had been transmitting to station 1, and the operator at the latter desired to break in, then both of the talk-listen switches would again be operated to their talk positions, with the results described above, namely, that both tubes 116 and 117 at the two stations would be lit.

Inasmuch as the apparatus at station 3 corresponds to that at stations 1 and 2, the desire to break in is indicated in the same way if station 3 is communicating with either one of the other stations.

One of the advantages of the described signaling arrangement is that it does not require any additional interstation conductors other than those utilized in the communication system. Furthermore, the connection of the tubes to the midpoints of the transformers and of the ground connections to the midpoints of resistors in the amplifier output circuits provides a balanced circuit arrangement to eliminate undesirable consequences that might otherwise result from the use of the communication circuits for signaling purposes.

Another of the important features of the present invention resides in the provision of signaling arrangements whereby a signal of a first distinctive character is actuated at both the calling and called stations upon the selection of a station that is not busy and a signal of another characteristic is actuated at both stations in the event the selected station is busy. In the instant embodiment, the first of the signals of distinctive characteristic is a flashing signal light and the second is a steady light.

Each of the stations is provided with a light source, preferably a neon tube (preferably of the same type as the tubes 116 to 118) for each of the stations in the system. Thus station 1 is provided with tubes 145 and 146 corresponding to stations 2 and 3, respectively; station 2 is provided with tubes 147 and 148 corresponding to stations 1 and 3, respectively, and station 3 is provided with tubes 149 and 150 corresponding to stations 1 and 2, respectively.

Upon the selection of one station by another, the tubes corresponding to the two stations are supplied with either a periodic or steady voltage dependent upon whether or not the called station is not busy or busy. These two voltages are supplied from a centrally located signal voltage supply source 151 (see Fig. 4) which will be described in detail hereinafter. From an inspection of this Fig. 4, it will be noted that three conductors 152, 153, and 154 lead from the supply source 151 to all stations of the system. The conductor 152 is a common conductor, conductor 153 is a conductor supplying the periodic voltage, and conductor 154 is a conductor supplying the steady signal voltage.

The station condition responsive signaling arrangement is controlled in response to the positions of the station selector switches at the various stations. Referring now first to station 1, it may be noted that the station 2 selector switch 83 thereat includes switch blades 155 and 156 operable simultaneously with the switch blades 86. The neon tube 145 is connected to switch blade 156 through a resistor 157 and conductor 158. The other terminal of the tube is connected by a conductor 159 to the corresponding terminal of the tube 147 at station 2.

In the unactuated position of selector switch 83, switch blade 156 completes a circuit to a branch conductor 161 connected to the common conductor 152 and switch blade 155 interconnects

conductors 162 and 163. The latter is a branch conductor leading to the conductor 153 through which the periodic voltage is supplied to the system, and the former leads to a contact associated with selector switch 84, as will be described shortly.

In the actuated position of selector switch 83, the signal circuit controlling switch blades 155 and 156 are moved upwardly. In this position, switch blade 155 interconnects the aforesaid conductor 162 and a branch conductor 164 leading to the source of steady signal voltage, that is, conductor 154, and switch blade 156 interconnects conductor 158 and a conductor 165 leading to both stations 2 and 3.

Station selector switch 84 at station 1 includes switch blades 167 and 168 operable simultaneously with the switch blades 87. The neon tube 146 is connected to switch blade 168 through a resistor 169 and conductor 171. The other terminal of the tube is connected by a conductor 172 to the corresponding terminal of tube 149 at station 3. In the unactuated position of selector switch 84, switch blade 168 completes a circuit to branch conductor 161 and the common conductor 152, while switch blade 167 interconnects the previously referred to conductor 162 and a conductor 173 leading to both stations 2 and 3. In the actuated position of selector switch 84, the switch blade 167 interconnects conductors 164 and 173 and switch blade 168 interconnects conductors 171 and a conductor 174 leading to both stations 2 and 3.

The signal circuit controlling arrangement at station 2 is similar to that at station 1. The station selector switch 99 includes a pair of switch blades 175 and 176, operable simultaneously with the switch blades 101. The neon tube 147 is connected to switch blade 176 through resistor 177 and conductor 178. The other terminal of the tube is connected to the previously referred to conductor 159. In the unactuated position of selector switch 99, switch blade 176 completes the circuit to a branch conductor 179 leading to the common conductor 152 and switch blade 175 interconnects conductors 181 and 182. The latter is a branch conductor leading to the flashing voltage supplying conductor 153, and the former leads to a contact associated with selector switch 100. In the actuated position of selector switch 99, the signal circuit controlling switch blades 175 and 176 are moved upwardly. In this position, switch blade 175 interconnects the conductor 181 and a branch conductor 183 leading to the steady voltage supplying conductor 154, and switch blade 176 interconnects conductors 178 and 184, the latter of which is connected to the conductor 173, which leads to both stations 1 and 3.

Station selector switch 100 includes the switch blades 185 and 186, operable simultaneously with switch blades 102. The neon tube is connected through resistor 187 and conductor 188 to switch blade 186. The other terminal of the tube is connected by a conductor 189 to the corresponding terminal of tube 150 at station 3. In the unactuated position of selector switch 100, switch blade 186 completes a circuit from conductor 188 to the branch conductor 179 leading to the common conductor 152 and switch blade 185 interconnects branch conductor 181 and a conductor 191 which is connected to the conductor 165 leading to the other stations of the system. In the actuated position of selector switch 100, switch blades 185 and 186 are moved upwardly. In this position, blade 185 interconnects conductors 191 and the branch conductor 183 connected to the steady voltage supply line 154 and blade 186 interconnects conductors 188 and a branch conductor 192 connected to the conductor 174.

At station 3, the station selector switch 112 includes switch blades 195 and 196 operable simultaneously with switch blades 114. The neon tube 149 is connected to switch blade 196 through a resistor 197 and conductor 198. The other terminal of the tube is connected by conductor 122 to the corresponding terminal of tube 146 at station 1. In the unactuated position of selector switch 112, switch blade 196 completes a circuit from conductor 198 to a branch conductor 199 leading to the common conductor 152 and switch blade 195 interconnects conductors 201 and 202, the latter of which is a branch conductor leading to the periodic voltage supplying conductor 153, and the former of which leads to selector switch 113. In the actuated position of selector switch 112, switch blades 195 and 196 are moved upwardly to a position wherein blade 195 interconnects conductor 201 and the branch conductor 203 leading to the steady voltage supplying line 154 and blade 196 interconnects conductors 173 and 198.

The station selector switch 113 at station 3 includes the switch blades 205 and 206 operable simultaneously with switch blades 115. The neon tube 150 is connected to switch blade 206 through a resistor 207 and conductor 208 and its other terminal is connected to the conductor 189 connected to the corresponding terminal of tube 148 at station 2. In the unactuated position of selector switch 113, switch blade 206 completes the circuit from conductor 208 to the branch conductor 199 connected to the common conductor 152 and switch blade 205 interconnects conductors 174 and 201. In the actuated position of selector switch 113, switch blades 205 and 206 are moved upwardly to positions wherein the former interconnects conductors 174 and 203 and the latter interconnects conductors 208 and 165.

In order to prevent excessive voltage drop across the neon tubes when signal voltage is applied thereto, due to the capacity between the wires of the signaling arrangement, each of the tubes is bridged by a resistor 210. These resistors may have a value of about 100,000 ohms, whereas the resistors 167, 169, etc., in series with the tubes, may have a value of about 10,000 ohms. The resistors 210 also enable radio frequency voltages, which may be induced in the wires because of high power radios utilized on ships, to leak out. If this were not done, these induced voltages might be sufficient to light the tubes and give erroneous signals.

The signal voltage supply means 151 illustrated in Fig. 4, to which reference is now had, includes a transformer 211 having a primary winding 212 and three secondary windings 213, 214A and 214B. The primary winding may be connected to a suitable source of alternating current voltage. Secondary winding 213 is connected to the plates of a pair of rectifier tubes 215 and 216 arranged for full wave rectification and the filaments of which are independently connected to the secondary windings 214A and 214B. The output of tube 215 is supplied to the steady voltage conductor 154, across which and the common conductor is connected a condenser 217. The output of the other tube 216 is supplied to a conductor 218, across which and the common conductor is connected a condenser 219, and the

conductor 218 is periodically connected to the conductor 153.

The periodic voltage is supplied to conductor 153 by a novel arrangement including a relay 220 having a condenser 221 connected in shunt thereto. A pair of resistors 222 and 223 are connected in series with the parallel connected relay and condenser. This series-parallel circuit is in turn shunted by a condenser 224. The relay 220 operates a two-position switch blade 225 adapted in its indicated position (to which it is suitably biased) to connect conductor 218 to the relay circuit through a resistor 226. When the relay winding is energized sufficiently, the switch blade 225 is actuated to connect conductor 218 to the conductor 153 through which, it may be remembered, a periodic voltage is supplied to the signal circuit.

A neon pilot light 227 is connected across conductors 153 and 152 in series with resistors 228 and 229 to give an indication that the voltage supply means is operating.

When the switch blade 225 occupies its indicated position, a steady direct current voltage obtained from conductor 218 is utilized to charge condensers 221 and 224 and to energize relay 220. The condenser 224 is charged to a higher voltage than condenser 221 by reason of the resistors 222 and 223 being located in circuit with condenser 221. As the condensers are charged, an increasing voltage is supplied to the relay winding 220 until it becomes energized sufficiently to move switch blade 225 to disconnect conductor 154 from the relay circuit and to connect it to conductor 153. When this occurs, the relay winding remains energized and continues to pull switch blade 225 downwardly because of the discharge of condensers 221 and 224 through the winding. Condenser 221 discharges rapidly, but condenser 224, which is charged to a higher voltage, discharges more slowly because of the series resistors 222 and 223. Consequently, switch blade 225 is held in its lowermost position until the bias applied thereto overcomes the diminishing force applied to it by the decreased current flowing through the winding.

The described arrangement is very advantageous in that the ratio of the time voltage is supplied to conductor 153 to the time that no voltage is supplied to the conductor is relatively independent of the power required to move switch blade 225 because the energization of the relay is increased to effect operation of the switch blade in the event the latter tends to stick. If the blade tends to stick, then the condensers 221 and 224 are charged for a slightly longer time and consequently the energization of the relay is increased so that more power is available for movement of the switch blade. Furthermore, the ratio is independent of the load (the number of neon tubes energized) as condensers 221 and 224 are entirely disconnected from the load circuit when the switch blade 225 is moved from its indicated position, and the discharge is through the relay winding and not through the load which may be variable.

In order to vary the ratio of the lengths of time that the switch blade remains in its two operated positions, the circuit constants of the elements in circuit with the relay winding as well as the resistance of the relay winding itself may be varied. To increase the length of time that the switch blade remains in its actuated position, the condenser capacities may be increased so that the condensers discharge for a longer period of time. In addition, the resistances of resistors 222 and 223 or of the relay winding itself may be increased.

Excellent results have been obtained with an arrangement wherein the conductor 218 has a voltage of about 200 volts, the relay winding 220 has resistance of about 5,000 ohms, and resistors 222, 223, and 226 have resistances of about 5,000 ohms, and the condensers 221 and 224 a capacity of about 4 microfarads. When thus arranged, the neon tubes, when supplied with the periodic voltage, flash about 4 times per second and the ratio of the period of illumination to the period of darkness is about 60 to 40.

If it is desired to reverse the character of the distinctive signals given at the various stations upon the selection of a busy or a not busy station, a reversing switch 230 (see Fig. 1) may be provided whereby the connection of conductors 153 and 154 may be reversed. In the indicated position of the switch 230, conductor 154 is supplied with a steady voltage whereas conductor 153 is periodically supplied with voltage. When the switch 230 is operated to its other position, conductor 153 is supplied with a steady voltage and conductor 154 is periodically supplied with voltage.

Another advantage of the arrangement is that the steady voltage applied to conductor 154 from rectifier tube 215 is substantially independent of the load connected across the periodic voltage supply conductor 153. Thus, a change in load in either circuit is reflected into the other circuit only by a slight voltage drop across the transformer itself. This would not be the case if the steady voltage was taken from the same rectifier as the periodic voltage.

In operation of the system, it is contemplated that the amplifiers of the various stations will be conditioned for immediate operation as by the connection of the power pack transformers 55 to suitable source of alternating current. When thus connected, the operators at the various stations will be apprised of the operative condition of the amplifiers by the glowing of the neon tubes 58. The signal voltage supplying means 151 also has its transformer 211 connected to a suitable source of alternating current so that the steady and periodic signaling voltages will be at all times supplied to the conductors 154 and 153. The neon tube 227 which is connected to the periodic voltage supplying conductor 153 thus flashes periodically to indicate that the voltage supplying means is operating.

Under normal conditions, i. e., when none of the stations in the system is in use, the communication control switches 17, 18, and 19 are in their uppermost indicated positions so that the loudspeakers 11, 12, and 13 are connected through their associated volume controls and transformers to the interstation circuits 73, 85, and 88 individual to the three stations. The amplifier output circuits are opened by the communication control switches and no plate voltage is supplied to the amplifiers although the heaters of the various amplifier tubes are supplied with current to make the amplifiers ready for instantaneous operation. The break-in signaling tubes 116, 117, and 118 at the stations are deenergized. The various station selector switches are also in their unactuated positions and the signaling tubes 145 to 150 are deenergized, the pairs of tubes 145 and 147, 146 and 149, and 148 and 150, each being connected in series to the common conductor 152. The tubes 145 and 147 are connected in series to the com-

mon conductor through a circuit including the branch conductor 161 at station 1, switch blade 157, conductor 158, resistor 157, the tube 145, interstation conductor 159, the tube 147 at station 2, resistor 177, conductor 178, switch blade 176, and the branch conductor 179 at station 2 which is also connected to conductor 152. Tubes 146 and 149 are similarly connected to the common conductor through a circuit including the branch conductor 161 at station 1, switch blade 168, conductor 171, resistor 169, the tube 146, interstation conductor 172, the tube 149 at station 3, resistor 197, conductor 198, switch blade 196, and branch conductor 199 at station 3. Tubes 148 and 150 are connected to the common conductor through the circuit including branch conductor 179 at station 2, switch blade 186, conductor 188, resistor 187, and the tube 148 at station 2, interstation conductor 189, the tube 150 at station 3, resistor 207, conductor 208, switch blade 206, and the branch conductor 199.

Assuming first that the operator at station 1 desires to communicate with the operator at station 2 and that the latter station is not busy, then the operator at station 1 actuates selector switch 83 and a flashing signal is produced at both the calling station 1 and the called station 2. The operator at station 1 is thereupon advised that station 2 is not busy and the operator at the latter station is apprised by the flashing signal light that another station desires to communicate therewith. A flashing signal is supplied at both stations by the connection of the tubes 145 and 147 at stations 1 and 2, respectively, to the conductor 153 which, it may be remembered, is supplied with a periodic or intermittent voltage. The energizing circuit for the two tubes is as follows: conductor 152 at station 2, branch conductor 179, switch blade 176 (which is in its indicated position as selector switch 99 has not yet been actuated) conductor 178, resistor 177, tube 147, interstation conductor 159, tube 145 at station 1, resistor 157, conductor 158, switch blade 156 in its uppermost position, interstation conductor 165, conductor 191 at station 2, switch blade 185 in its unactuated position, conductor 181, switch blade 175 in its unactuated position, and branch conductor 183 which is connected to conductor 153 at station 2.

At this time, the operator at station 2 is apprised of a call by the flashing of a signal light and if the operator at station 1 desires, he can also call the operator at station 2 by using the intercommunicating apparatus. In doing this, it is necessary for the operator at station 1 simply to operate the communication control switch 17 thereat to its lowermost or talk position. When this is done, the loudspeaker 11 at station 1 is connected to the input of the amplifier 14 and the output of the amplifier is connected to loudspeaker 12 at station 2 through the switch blades 81 of switch 17 at station 1, the actuated station selector switch blades 86 and the interstation circuit 85 individual to station 2 and to which loudspeaker 12 is normally connected through its associated volume control 93 and transformer 94. Thus if the operator at station 2 hears the call, he can respond thereto, but if he is not where he can hear the call, the station selector switch at station 1 can be left in its actuated position so that the signal light at station 1 will flash periodically until the operator at station 2 responds.

In order for the operator at station 2 to reply to a call from station 1, it is necessary for the former first to actuate selector switch 99. When the station selector switches 83 and 99 at stations 1 and 2 have both been actuated, the tubes 145 and 147 are both deenergized. The tubes are connected in series to the steady voltage supplying conductor 154, but there is no circuit to the common conductor, and the tubes are deenergized. The circuit connections of the two tubes at this time are as follows: conductor 154 at station 2, conductor 183, switch blade 175 in its uppermost position, conductor 181, switch blade 185 in its unactuated position, conductor 191, interstation conductor 165, switch blade 156 at station 2 in its uppermost position, conductor 158, resistor 157, tube 145, interstation conductor 159, tube 147 at station 2, resistor 177, conductor 178, switch blade 176 in its uppermost position, conductor 184, interstation conductor 173, switch blade 167 at station 1 in its unactuated position, conductor 162, switch blade 155 in its uppermost position, and branch conductor 164 leading to conductor 154 at station 1.

After the station selector switches at stations 1 and 2 have been operated as described above, then communication between the two stations may be carried on by the alternate operation of the communication control switches 17 and 18 between their talk and listen positions. In the event one of the stations is conditioned for transmitting to the other by the operation of its switch to its talk position and the operator at the other station desires to break in on the one, then all that is necessary is for the operator at the other station to actuate the switch thereat to its talk position. Both the switches are thereupon operated into their talk positions with the result that the break-in signal tubes 116 and 117 at the two stations are energized in a manner heretofore described in detail.

It will now be assumed that stations 1 and 2 are in communication with each other as described above and that station 3 selects one of the two stations, for instance, station 2. To select station 2, the operator at station 3 actuates station selector switch 113, whereupon tubes 148 and 150 at stations 2 and 3 are supplied with a steady voltage and thus glow steadily to indicate to the operator at station 3 that station 2 is busy and to indicate to the operator at station 2 that station 3 desires to communicate therewith. At this time, tubes 148 and 150 are connected in series across conductors 152 and 154, the circuit being as follows: conductor 152 at station 2, branch conductor 179, switch blade 186 in its unactuated position, conductor 188, resistor 187, tube 148, interstation conductor 189, tube 150 at station 3, resistor 207, conductor 208, switch blade 206 in its actuated position, interstation conductor 165, conductor 191 at station 2, switch blade 185 in its unactuated position, conductor 181, switch blade 175 in its uppermost position, and conductor 183 which is connected to the steady voltage supplying conductor 154.

At this time, the operator at station 2 has the option of continuing to communicate with station 1 or to communicate with station 3. Should the operator at station 2 decide to communicate with station 3 for any reason whatever, as such, for instance, as a belief that the call from station 3 is of an urgent or emergency character, then the operator at station 2 can return to its unactuated position the number 1 station selector switch 83, and operate the station 3 selector switch 84. If this is done, the tubes 148 and 150 at stations

2 and 3 are extinguished, whereas tubes 145 and 147 at stations 1 and 2 will be supplied with a steady voltage and glow continuously. Thus the operator at station 1 is advised of the changeover in the status of station 2, namely, that this station has selected some other station for communication. The tubes 148 and 150 at stations 2 and 3 are connected to the steady voltage supplying conductor 154 but not to the common conductor and are consequently deenergized. This circuit connection is as follows: conductor 154 at station 2, conductor 183, switch blade 185 in its uppermost position, conductor 191, interstation conductor 165, switch blade 206 at station 3 in its uppermost position, conductor 208, resistor 207, tube 150, interstation conductor 189, tube 148 at station 2, resistor 187, conductor 188, switch blade 186 in its uppermost position, conductor 192, interstation conductor 174, switch blade 205 at station 3 in its uppermost position, and conductor 203 which is connected to conductor 154.

Remembering now that station selector switch 99 at station 2 has been returned to its indicated position, then the circuit whereby tubes 145 and 147 at stations 1 and 2 are supplied with a steady voltage upon station 2 giving precedence to station 3 over station 1, is as follows: conductor 152 at station 2, conductor 179, switch blade 176 in its lowermost position, conductor 176, resistor 177, tube 147, interstation conductor 159, tube 145 at station 1, resistor 157, conductor 158, switch blade 156 in its uppermost position, interstation conductor 165, conductor 191 at station 2, switch blade 185 in its uppermost position, and conductor 183 which is connected to conductor 154 at station 2.

In the event two stations of the system select a third at approximately the same time, and prior to the third having responded to a call from one of the two, then both neon tubes at the third station and the tubes corresponding to the third station at the two other stations are all supplied with periodic voltage to give flashing signals. Tubes 145 and 147 at stations 1 and 2 are connected in series across the common conductor 152 and the periodic voltage supplying conductor 153 in the manner heretofore described in conjunction with the selection of station 2 by station 1. The tubes 148 and 150 at stations 2 and 3 are connected across the common conductor and conductor 153 through a circuit that is as follows: conductor 152 at station 2, conductor 179, switch blade 186 in its unactuated position, conductor 188, resistor 187, tube 148, interstation conductor 189, tube 150 at station 3, resistor 207, conductor 208, switch blade 206 in its uppermost position, interstation conductor 165, conductor 191 at station 2, switch blade 185 in its unactuated position, conductor 181, switch blade 175 in its unactuated position, and conductor 182 which is connected to conductor 153.

Under the above circumstances, the called station (station 2) has the option of communicating with either one of stations 1 or 2. Assuming, first, that station 2 selects station 1 by the operation of selector switch 99, then tubes 145 and 147 at stations 1 and 2 are extinguished and tubes 148 and 150 are connected across the common conductor and the steady voltage supplying conductor 154 so that the latter tubes glow continuously. The circuit connections existing at this time are the same as those heretofore described in conjunction with the conditions existing at the time stations 1 and 2 are communicating with each other and station 3 selects station 2.

Assuming, now, that station 2 selects station 3 and not station 1, then tubes 148 and 150 at stations 2 and 3 are extinguished while tubes 145 and 147 at stations 1 and 2 glow continuously. The circuit conditions existing at this time are the same as those previously described in conjunction with the situation wherein stations 1 and 2 were communicating, station 3 called station 2 and station 2 gave precedence to station 3 over station 1.

A conference between all of the stations of the system may also be arranged. In this event, the station desiring to arrange the conference can call the other stations of the system and the operators at the other stations can then operate all the station selector switches thereat to connect the communication circuits for conference purposes.

Assuming that station 1 desires to arrange the conference, then the operator at station 1 operates the station selector switches 83 and 84 corresponding to stations 2 and 3. Tubes 145 and 146 at station 1 and also tube 147 at station 2 and tube 149 at station 3 are thereupon supplied with periodic voltage in a manner heretofore described, and the enumerated tubes thus flash on and off. The operators at stations 2 and 3 then first operate selector switches 99 and 112 conditioning the respective stations for communication with station 1. The operator at station 1 then operates the communication control switch 17 thereat to its talk position and informs the operators at stations 2 and 3 of the desire to arrange a conference. The operators at the called stations thereupon operate selector switches 100 and 113, respectively, with the net result that all the station selector switches in the system are closed. At this time, the tubes 145 to 150 are all extinguished inasmuch as the tubes are all disconnected from the common conductor 152. After the circuits have been arranged for the conference, the stations can individually transmit to the other stations by operation of the communication control switches thereat to their talk positions, the communication control switches at the other stations being in their listen positions.

In a system comprising more than three stations, if less than all of the stations are arranged for a conference, any other station selecting one of the conferring stations will be given a signal that the called station is busy in the same manner that the third station of the specific embodiment illustrated is given a signal upon the selection of a busy station.

In Fig. 5 there is illustrated a modified circuit arrangement for enabling one station to signal another of a desire to break in upon the transmission from the other station to said one station. The circuit arrangement of this figure corresponds closely to that previously described except for the connections of the break-in signal tubes 116 and 117 at stations 1 and 2, and like elements in this figure have been indicated by the reference characters previously used. The tube 116 at station 1 is connected directly to the B supply conductor 38 through resistor 119 and to the midpoint of the output transformer secondary winding 41 of amplifier 14 by a conductor 240. The tube 117 at station 2 is similarly connected to the B supply conductor 38 at that station through resistor 124 and to the midpoint of the secondary winding of the output transformer of amplifier 15 by conductor 241. The energizing circuit for tube 117 at station 2 is completed at station 1

through a conductor 242 leading from the midpoint of the primary winding 76 of transformer 75 to a contact associated with a switch blade 243 forming part of and operable with the remaining switch blades of the communication control switch 17. The switch blade is grounded by a conductor 244. The energizing circuit for tube 116 at station 1 is completed through a similar circuit arrangement at station 2 including a conductor 245 leading from the midpoint of the primary winding of transformer 94 to a contact associated with switch blade 246 forming part of and operable simultaneously with the remaining switch blades of communication control switch 18. The switch blade is grounded by conductor 247.

The operation of the arrangement illustrated in Fig. 5 is the same as that of the previous embodiment. When the communication control switches at the two stations are in their uppermost or listen positions, the tubes 116 and 117 are both deenergized. When the two stations have been placed in communicating relationship with each other by the closure of the station selector switches 83 and 99, then the tubes remain deenergized when the communication control switch at one station is in its listen position and the communication control switch at the other is in its talk position. When both switches are in their talk positions, as is the case when a station conditioned for reception desires to interrupt a station conditioned for transmission, then the energizing circuits for the two tubes are completed simultaneously. The energizing circuit for tube 116 at station 1 is completed across the B supply at that station, the circuit extending from the B supply conductor 38 through resistor 119 to the tube 116 and thence to ground through conductor 240, the midpoint of secondary winding 41 of amplifier 14, the output conductors 42, switch blades 81 of switch 17, the output circuit 82, switch blades 86 in their closed positions, interstation circuit 85, the midpoint of the primary winding of transformer 94 at station 2, conductor 245, switch blade 246 in its lowermost position, and the ground connection 247. The energizing circuit for tube 117 at station 2 is similarly completed from the B supply conductor 38 at that station to ground as follows: conductor 124, tube 117, conductor 241, midpoint of the secondary winding of the output transformer of amplifier 15, output conductors 96, switch blades 95, the output circuit 98, switch blades 101, interstation circuit 73, midpoint of primary winding 76 at station 1, conductor 242, switch blade 243 in its lowermost position, and the ground connection 244.

The modification of the invention illustrated in Fig. 6 differs somewhat from those previously described in that the neon tube at a station conditioned for reception from another station conditioned for transmission is energized while the tube at the station conditioned for transmission is not energized until the station conditioned for reception operates the communication control switch thereat to condition it for transmission.

Referring now to Fig. 6, in which elements corresponding to those previously described are indicated by like reference characters, it may be noted that the tube 116 at station 1 is connected to the midpoint of the primary winding of the transformer 75 through conductor 251 and resistor 252 and to ground by a conductor 253. In like manner, the tube 117 at station 2 is connected to the midpoint of the primary winding of transformer 94 by conductor 254 and resistor 255 and to ground by a conductor 256. The energizing circuit for tube 116 at station 1 is completed through a circuit at station 2 including a conductor 257 leading from the midpoint of secondary winding of the output transformer of amplifier 15 to a switch blade 258 through a resistor 259. The switch blade 258 forms part of the communication control switch 18 and is adapted when the latter is in its talk position to complete a circuit to the B supply conductor 38 through a branch conductor 260. The energizing circuit for tube 117 at station 2 is similarly completed at station 1 through a conductor 261 leading from the midpoint of the secondary winding 41 of amplifier 15 to switch blade 262 through a resistor 263. The switch blade 262 forms part of the communication control switch 17 and is adapted to complete a circuit to the B supply line 38 when the switch 17 is in its talk position through a branch conductor 264.

After stations 1 and 2 have been placed in communication with each other by the closure of the station selector switches 83 and 99, then with both the communication control switches 17 and 18 in their listen positions, both tubes 116 and 117 are deenergized. When the switch 17 at station 1 is in its talk position and switch 18 at station 2 is in its listen position, tube 117 at station 2 is energized through a circuit including the interstation conductors 84 individual to station 2 and the switch blade 262 in its circuit closing position wherein it connects the B supply line 38 to the interstation circuit. When the switch 17 is in its listen position and switch 18 in its talk position, tube 116 at station 1 is energized through a similar circuit including the interstation circuit 73 individual to station 1 and switch blade 258 in circuit closing position.

When one of the stations desires to interrupt the other station conditioned for transmission, it is necessary only to operate the communication control switch thereat to its talk position. When this is done, the neon tube at the station originally conditioned for transmission is energized to give an indication to the operator thereat that the other station desires to interrupt or break in on the transmission.

It may be well again to note that while only a comparatively few stations have been illustrated in the description of the various embodiments of the invention, it should be understood that the number of stations may be increased as required by the needs of the particular installation. While the invention has been disclosed in conjunction with the specific details of preferred embodiments thereof, it should be understood that such 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 of the type comprising a station having a communication direction control switch operable to condition the station for reception or transmission and a second station, the combination including, break in signal means at the first station, and means including signal means control circuits and a switch at the second station controlling said circuits so constructed and arranged that the signal means at the first station can be operated from the second station when the first is conditioned for transmission and the second for reception for providing a signal at the station

conditioned for transmission that it is desired to break in on the transmission from the station.

2. In an intercommunicating system of the type comprising a first station having a communication direction control switch operable to condition the station for reception or transmission and a second station, the combination including, break in signal means at the first station, and means including a switch at the second station for operating said signal means when the communication direction control switch at the first station conditions that station for transmission, thereby to indicate a desire to break in on the transmission from the first station.

3. In an intercommunicating system of the type comprising a first station having a communication direction control switch operable to condition the station for reception or transmission, a second station and a communication circuit between the stations, the combination including, signal means at the first station, and means including said communication circuit and a switch at the second station for operating said signal means when the communication direction control switch at the first station conditions that station for transmission, thereby to indicate a desire to break in on the transmission from the first station.

4. In an intercommunicating system of the type including a first station having a communication direction control switch operable to condition the station for reception or transmission and a second station, the combination including, signal means at said first station, signal controlling means at said first station for conditioning said signal means for operation when said communication direction control switch conditions said station for transmission, and means including signal controlling means at the second station for operating said signal means when said first station is conditioned for transmission.

5. In an intercommunicating system of the type including a first station having a communication direction control switch operable to condition the station for reception or transmission and a second station, the combination including, signal means at said first station, switch means at said first station operable simultaneously with said communication direction control switch for conditioning said signal means for operation when said communication direction control switch is operated to condition said station for transmission, and means including switch means at the second station for operating said signal means when said first station is conditioned for transmission.

6. In an intercommunicating system of the type including a first station having a communication direction control switch operable to condition the station for reception or transmission and a second station, the combination including, a signal light at said first station, a source of power for said light, switch means at said first station operable simultaneously with said communication direction control switch for partly completing the connection of said light to said source of power when said communication direction control switch is operated to condition said station for transmission, and means including switch means at the second station for completing the connection of said light to said source of power when said first station is conditioned for transmission.

7. In an intercommunicating system of the type comprising a pair of stations each having a communication direction control switch operable to condition the station for reception or transmission, the combination including, break in signal means at each station, and means including a switch at each station for operating the signal means at another when the communication direction control switch at said other station conditions said other station for transmission, thereby to indicate a desire to break in on the transmission from said other station.

8. In an intercommunicating system of the type comprising a pair of stations each having a communication direction control switch operable to condition the station for reception and transmission, the combination including, signal means at each station, signal controlling means at each station for conditioning the signal means at that station for operation when the communication control switch thereat conditions the station for transmission, and signal controlling means at each station operable when the station is conditioned for transmission for operating the signal means at the other station when the signal means at the other station is conditioned for operation.

9. In an intercommunicating system of the type comprising a pair of stations each having a communication direction control switch operable to condition the station for reception and transmission, the combination including, signal means at each station, signal controlling means at each station operable simultaneously with the communication direction control switch thereat for conditioning the signal means at that station for operation when the communication control switch thereat conditions the station for transmission, and signal controlling means at each station operable simultaneously with the communication direction control switch thereat and operable when the station is conditioned for transmission for operating the signal means at the other station when the signal means at the other station is conditioned for operation.

10. In an intercommunicating system of the type comprising a pair of interconnected stations having communication direction control switches alternately operable to condition the stations for reception and transmission, the combination including, signal means at each station, and means including signal means control circuits and switch means operable simultaneously with the communication direction control switches controlling said circuits so constructed and arranged that the signal means at a station conditioned for transmission can be operated from a station conditioned for reception upon operation of the communication direction control switch at the latter station to condition it for transmission for providing a signal that it is desired to break in on the transmission from the station.

11. In an intercommunicating system of the type comprising a pair of stations having communication direction control switches alternately operable between talk and listen positions for providing two way communication between the stations, the combination including signal means at each station, and signal controlling means at each station operable simultaneously with the communication control switch thereat so constructed and arranged that the signal means at a station conditioned for transmission is operated when the communication direction control switch at the other station is operated to condition the other station for transmission.

12. In an intercommunicating system of the type comprising a pair of stations interconnected by a pair of interstation circuits and having communication direction control switches alternately operable between talk and listen positions for providing alternate two way communication between the stations in opposite directions over said interstation circuits, the combination including, signal means at one station associated with one of said circuits, signal means at the other station associated with the other of said circuits, and signal controlling means at each station operable simultaneously with the communication control switch thereat so constructed and arranged that the signal means at a station conditioned for transmission is operated when the communication direction control switch at the other station is operated to condition the other station for transmission.

13. In an intercommunicating system of the type comprising a pair of stations having communication direction control switches alternately operable between talk and listen positions for providing two way communication between the stations, the combination including, a signal light at each station, a source of power at each station, and signal controlling means at each station operable simultaneously with the communication control switch thereat so constructed and arranged that the light at a station conditioned for transmission is connected to a source of power and energized when the communication direction control switch at the other station is operated to condition the other station for transmission.

14. In an intercommunicating system of the type comprising a pair of stations interconnected by a communication circuit and having communication direction control switches alternately operable between talk and listen positions for providing two way communication between the stations, the combination including, signal means at each station connected to said communication circuit in balanced manner, and signal controlling means at each station connected in balanced manner to said communication circuit and operable simultaneously with the communication control switch thereat so constructed and arranged that the signal means at a station conditioned for transmission is operated through said communication circuit when the communication direction control switch at the other station is operated to condition the other station for transmission.

15. In an intercommunicating system of the type comprising a pair of stations interconnected by a pair of interstation circuits and having communication direction control switches alternately operable between talk and listen positions for providing alternate two way communication between the stations in opposite directions over said interstation circuits, the combination including, a signal light at each station connected in balanced manner to one of said circuits, a source of power at each station, and signal controlling means at each station operable simultaneously with the communication control switch thereat for conditioning the signal light at the station for connection to a source of power when the communication direction control switch conditions the station for transmission, and means including signal controlling means at each station connected in balanced manner to a communication circuit and operable simultaneously with the communication direction control switch thereat for completing the connection of the light at the other station to a source of power.

16. In an intercommunicating system of the type comprising two or more stations adapted to be connected by a pair of interstation circuits and a common conductor and each having an amplifier, a loudspeaker utilizable both as a receiver and a transmitter, station selector means, and a communication direction control switch operable to condition the station for reception over one of said circuits by connection of the loudspeaker thereto or for transmission over the other by connection of the loudspeaker to the input of the amplifier and of the output thereto through the station selector means, whereby two way communication can be carried on between two stations by alternate operation of the switches thereat, including in combination, a transformer in the reception circuit at each station having a primary winding connected to said one circuit thereat and a secondary winding adapted to be connected to the loudspeaker through said communication direction control switch when the latter conditions the station for reception, a signal light at each station having one terminal connected to the mid point of the primary winding of the transformer at that station, a source of power at each station, switch means operable with the communication direction control switch at each station for partly completing the connection of the light at the station to the source of power thereat by connecting the other terminal of the light to the source when the communication direction control switch conditions the station for transmission, a pair of resistors connected across the amplifier output at each station, a connection from between the resistors to said common conductor, and other switch means forming part of and operable with the communication direction control switch at each station for completing the connection of the light at the other station to the source of power at the other station through said common conductor and transmission circuit when the communication direction control switch conditions the station for transmission, whereby the signals at both stations are connected to their respective sources of power when both stations are conditioned for transmission.

17. In an intercommunicating system of the type comprising two or more stations adapted to be connected by a pair of interstation circuits and each having a communication direction control switch operable to condition the station for reception over one of said circuits or for transmission over the other, whereby two way communication can be carried on between two stations by alternate operation of the switches thereat, including in combination, a signal light at each station connected to the reception circuit for that station, a source of power at each station, switch means operable with the communication direction control switch at each station for partly completing the connection of the light at the station to the source of power thereat when the communication direction control switch conditions the station for transmission, and other switch means operable with the communication direction control switch at each station for completing the connection of the light at the other station to the source of power at the other station through said transmission circuit when the communication direction con-

trol switch conditions the station for transmission, whereby the signals at both stations are connected to their respective sources of power when both stations are conditioned for transmission.

18. In an intercommunicating system of the type comprising two or more stations adapted to be connected by a pair of interstation circuits and a common conductor and each having a communication direction control switch operable to condition the station for reception over one of said circuits or for transmission over the other, whereby two way communication can be carried on between two stations by alternate operation of the switches thereat, including in combination, a transformer in the reception circuit at each station, a signal light at each station connected to the mid point of the primary winding of the transformer at that station, a source of power at each station, switch means operable with the communication direction control switch at each station for partly completing the connection of the light at the station to the source of power thereat when the communication direction control switch conditions the station for transmission, a pair of resistors connected across the transmission circuit at each station, a connection from between the resistors to said common conductor, and other switch means forming part of and operable with the communication direction control switch at each station for completing the connection of the light at the other station to the source of power at the other station through said common conductor when the communication direction control switch conditions the station for transmission, whereby the lights at both stations are connected to their respective sources of power when both stations are conditioned for transmission.

19. In an intercommunicating system of the type comprising two or more stations adapted to be connected by a pair of interstation circuits and each having a communication direction control switch operable to condition the station for reception over one of said circuits for transmission over the other, whereby two way communication can be carried on between two stations by alternate operation of the switches thereat, including in combination, a source of power at each station, a signal light at each station having one terminal connected to the source of power at that station, switch means operable with the communication direction control switch at each station for connecting the other terminal of the light at the station to said other circuit when the communication direction control switch conditions the station for transmission over said other circuit, and other switch means operable with the communication direction control switch at each station for completing the connection of the light at the other station to the source of power at the other station through said one circuit when the communication direction control switch conditions the station for transmission, whereby the signals at both stations are connected at their source of power when both stations are conditioned for transmission.

20. In an intercommunicating system of the type comprising two or more stations adapted to be connected by a pair of interstation circuits and a common conductor and each having a communication direction control switch operable to condition the station for reception over one of said circuits or for transmission over the other, whereby two way communication can be carried on between two stations by alternate operation of the switches thereat, including in combination, a source of power at each station, a transformer in the reception circuit at each station, a connection from the mid point of the primary winding of the transformer at each station to the communication direction control switch, switch means operable with the communication direction control switch at each station for connecting the common conductor to said connection when the communication direction control switch conditions the station for transmission, a signal light at each station having one terminal connected to the source of power thereat, and other switch means forming part of and operable with the communication direction control switch at each station for connecting the other terminal of the light at the station to the transmission circuit thereat and thereby completing the connection of the light at the other station to the source of power at the other station when the communication direction control switch conditions the station for transmission, whereby the lights at both stations are connected to their respective sources of power when both stations are conditioned for transmission.

21. In an intercommunicating system of the type comprising two or more stations adapted to be connected by a pair of interstation circuits and a common conductor and each having an amplifier, a loudspeaker utilizable both as a receiver and a transmitter, station selector means, and a communication direction control switch operable to condition the station for reception over one of said circuits by connection of the loudspeaker thereto or for transmission over the other by connection of the loudspeaker to the input of the amplifier and of the output thereto through the station selector means, whereby two way communication can be carried on between two stations by alternate operation of the switches thereat, including in combination, a transformer in the reception circuit at each station having a primary winding connected to said one circuit thereat and a secondary winding adapted to be connected to the loudspeaker through said communication direction control switch when the latter conditions the station for reception, a connection at each station from the mid point of the primary winding of the transformer at that station to the communication direction control switch, switch means operable with the communication direction control switch at each station for connecting the connection at the station to the common conductor when the communication direction control switch conditions the station for transmission, a signal light at each station having one terminal connected to the source of power and its other terminal to the amplifier output circuit, and other switch means forming part of and operable with the communication direction control switch at each station for completing the connection of the light at the other station to the source of power at the other station through said common conductor and transmission circuit when the communication direction control switch conditions the station for transmission, whereby the signals at both stations are connected to their respective sources of power when both stations are conditioned for transmission.

22. In an intercommunicating system of the type comprising two or more stations adapted to

be connected by a pair of interstation circuits and a common conductor and each having a communication direction control switch operable to condition the station for reception over one of said circuits for transmission over the other, whereby two way communication can be carried on between two stations by alternate operation of the switches thereat, including in combination, a signal light at each station connected to the reception circuit for that station and to the common conductor, a source of power at each station, switch means operable with the communication direction control switch at each station for connecting the light at the other station to the source of power at the station through the transmission circuit and common conductor when the communication direction control switch conditions the station for transmission, whereby the signal light at a station conditioned for transmission may be connected to a source of power upon operation of the communication direction control switch at a station conditioned for reception to condition the latter station for reception.

23. In an intercommunicating system of the type comprising two or more stations adapted to be connected by a pair of interstation circuits and a common conductor and each having a communication direction control switch operable to condition the station for reception over one of said circuits or for transmission over the other, whereby two way communication can be carried on between two stations by alternate operation of the switches thereat, including in combination, a transformer in the reception circuit at each station, a signal light at each station connected to the mid point of the primary winding of the transformer at that station and to the common conductor, a source of power at each station, and switch means forming part of and operable with the communication direction control switch at each station for connecting the light at the other station to the source of power at the station through said transmission circuit common conductor when the communication direction control switch conditions the station for transmission, whereby the signal light at a station conditioned for reception is connected to the source of power at a station conditioned for transmission and a station conditioned for reception from one conditioned for transmission can signal the latter by conditioning the station for transmission.

24. In an intercommunicating system of the type comprising two or more stations adapted to be connected by a pair of interstation circuits and a common conductor and each having an amplifier, a loudspeaker utilizable both as a receiver and a transmitter, station selector means, and a communication direction control switch operable to condition the station for reception over one of said circuits by connection of the loudspeaker thereto or for transmission over the other by connection of the loudspeaker to the input of the amplifier and of the output thereto through the station selector means, whereby two way communication can be carried on between two stations by alternate operation of the switches thereat, including in combination, a transformer in the reception circuit at each station having a primary winding connected to said one circuit thereat and a secondary winding adapted to be connected to the loudspeaker through said communication direction control switch when the latter conditions the station for reception, a signal light at each station connected across the mid point of the primary winding of the transformer at that station and the common conductor, a source of power at each station, switch means operable with the communication direction control switch at each station for connecting the source of power thereat to the transmission circuit when the communication direction control switch conditions the station for transmission, whereby the signal light at a station conditioned for reception is connected to the source of power at a station conditioned for transmission and a station conditioned for reception from one conditioned for transmission can signal the latter by conditioning the station for transmission.

25. In a multiple station intercommunicating system of the loudspeaker type comprising a plurality of stations, any two of which can be placed in communication with each other over two interstation circuits, each of which is utilized for communication in one direction only, and each station having a communication direction control switch operable to condition the station for reception or transmission, the combination including, signal means at each station, and means including switch means operable simultaneously with said communication direction control switches and circuits controlled thereby for operating the signal means at a station conditioned for transmission from a station conditioned for reception upon operation of the communication direction control switch at the station conditioned for reception to condition that station for transmission.

26. In a multiple station intercommunicating system of the loudspeaker type comprising a plurality of stations, any two of which can be placed in communication with each other over two interstation circuits and each having a communication direction control switch operable to condition the station for reception or transmission, the combination including, signal means at each station, and means including switch means operable simultaneously with said communication direction control switches and circuits controlled thereby for operating the signal means at a station conditioned for transmission from a station conditioned for reception upon operation of the communication direction control switch at the station conditioned for reception to condition that station for transmission.

27. In a multiple station intercommunicating system, the combination including, signal means at each station, station selector switches at each station, means including circuits between stations controlling the signal means and controlled by the station selector switches for effecting operation of said signal means to produce different distinctive signals at both selected and selecting stations when a station selects another dependent upon whether or not a station selector switch has been operated at the selected station.

28. In a multiple station intercommunicating system, the combination including, signal means at each station, switch means at each station corresponding to other stations of the system, means including circuits between stations controlling the signal means and controlled by said switch means for effecting operation of said signal means to produce different distinctive signals at the station at which switch means is operated and the station corresponding to the operated switch means dependent upon whether or not switch means has been operated at the latter station.

29. In a multiple station intercommunicating system, the combination including, signal lights at each station corresponding to other stations in the system, switch means at each station corresponding to other stations of the system, means including circuits between stations controlling the signal lights and controlled by said switch means for selectively effecting steady or periodic energization of said signal lights to produce different distinctive signals at the station at which switch means is operated and the station corresponding to the operated switch means dependent upon whether or not switch means has been operated at the latter station.

30. In a multiple station intercommunicating system, the combination including, signal lights at each station corresponding to other stations in the system, station selector switches at each station corresponding to other stations of the system, means including circuits between stations controlling the signal lights and light circuit controlling switches operable with said selector switches for selectively effecting steady or periodic energization of said signal lights to produce different distinctive signals at the station at which a selector switch is operated and the station corresponding to the operated selector switch dependent upon whether or not a selector switch has been operated at the latter station.

31. In a multiple station intercommunicating system, the combination including, signal lights at each station corresponding to other stations in the system, station selector switches at each station corresponding to other stations of the system, a source of steady voltage, a source of periodic voltage, means including circuits between stations controlling the signal lights and light circuit controlling switches operable with said selector switches for selectively connecting said signal lights to said periodic or steady voltage sources to produce different distinctive signals at the station at which a selector switch is operated and the station corresponding to the operated selector switch dependent upon whether or not a selector switch has been operated at the latter station.

32. In a multiple station intercommunicating system, the combination including, neon tubes at each station corresponding to other stations of the system, station selector switches at each station corresponding to other stations of the system, a source of steady voltage, a first conductor leading therefrom to all stations, a source of periodic voltage, a second conductor leading therefrom to all stations, a common conductor connected to both voltage sources and leading to all stations, and means operable conjointly with said selector switches for producing a flashing of tubes at both a selecting and selected station if no selector switches are operated at the selected station and a steady glow of the tubes in the event a selector switch has been operated at the selected station, said means including conductors connecting in series the tubes at each pair of stations corresponding to said stations, a pair of switches operable with each selector switch, the first of said switches being connected to a terminal of its associated tube and operable when the selector switch is not operated to connect the tube to the common conductor and when the selector switch is operated to connect the tube to a conductor leading to a second of said pair of switches associated with the selector switches at other stations corresponding thereto, the second of said pair of switches at each station being connected in series to said last mentioned conductor and operable when the selector switch is not operated to connect said last mentioned conductor to said second conductor through other corresponding switches at the station and when the selector switch is operated to connect said last mentioned conductor to said first conductor.

33. In a multiple station intercommunicating system, the combination including, signal means at each station, station selector switch means at each station individual to other stations of the system, means including circuits between stations controlling the signal means and controlled by said switch means for effecting operation of said signal means to produce a periodic signal or another signal at the station at which switch means is operated dependent upon whether or not switch means has been operated at the station corresponding to the operated switch means.

34. In a multiple station intercommunicating system, the combination including, neon tubes at each station corresponding to other stations of the system, station selector switches at each station corresponding to other stations of the system, a source of steady voltage, a first conductor leading therefrom to all stations, a source of periodic voltage, a second conductor leading therefrom to all stations, a common conductor connected to both voltage sources and leading to all stations, and means operable conjointly with said selector switches for producing a flashing of a tube at a selecting station if no selector switches are operated at the selected station and a steady glow of the tube in the event a selector switch has been operated at the selected station, said means including conductors connecting the tubes at each station to the stations corresponding thereto, a pair of switches operable with each selector switch, a first of said switches being connected to a terminal of its associated tube and operable when the selector switch is not operated to connect the tube to the common conductor and when the selector switch is operated to connect the tube to a conductor leading to a second of said pair of switches associated with the selector switches at other stations corresponding thereto, the second of said pair of switches at each station being connected in series to said last mentioned conductor and operable when the selector switch is not operated to connect said last mentioned conductor to said second conductor through other corresponding switches at the station and when the selector switch is operated to connect said last mentioned conductor to said first conductor.

35. In a multiple station intercommunicating system, the combination including, signal means at each station, switch means at each station corresponding to other stations of the system, means including circuits between stations controlling the signal means and controlled by said switch means for effecting operation of said signal means to produce a periodic signal or another signal at the station corresponding to the operated switch means dependent upon whether or not switch means has been operated at the latter station.

36. In a multiple station intercommunicating system, the combination including, neon tubes at each station corresponding to other stations of the system, station selector switches at each station corresponding to other stations of the

system, a source of steady voltage, a first conductor leading therefrom to all stations, a source of periodic voltage, a second conductor leading therefrom to all stations, a common conductor connected to both voltage sources and leading to all stations, and means operable conjointly with said selector switches for producing a flashing of a tube at a selected station if no selector switches are operated at the selected station and a steady glow of the tube in the event a selector switch has been operated at the selected station, said means including a conductor connecting the tubes at each station to corresponding stations, a pair of switches operable with each selector switch, a first of said switches being connected to a terminal of its associated tube and operable when the selector switch is not operated to connect the tube to the common conductor and when the selector switch is operated to connect the tube to a conductor leading to a second of said pair of switches associated with the selector switches at other stations corresponding thereto, the second of said pair of switches at each station being connected in series to said last mentioned conductor and operable when the selector switch is not operated to connect said last mentioned conductor to said second conductor through other corresponding switches at the station and when the selector switch is operated to connect said last mentioned conductor to said first conductor.

37. In a multiple station intercommunicating system, the combination including, signal means at each station, switch means at each station corresponding to other stations of the system, means including circuits between stations controlling the signal means and controlled by said switch means for effecting operation of said signal means to produce signals at the station at which switch means is operated and the station corresponding to the operated switch means at which switch means has not been operated and for returning said signals to non-operated condition upon operation of the switch means corresponding to the first station at said corresponding station.

38. In a multiple station intercommunicating system, the combination including, signal lights at each station corresponding to other stations in the system, station selector switches at each station corresponding to other stations of the system, a source of periodic voltage, means including circuits between stations controlling the signal lights and light circuit controlling switches operable with said selector switches for selectively connecting said signal lights to said periodic voltage source to produce distinctive signals at the station at which a selector switch is operated and the station corresponding to the operated selector switch at which a selector switch has not been operated and for disconnecting said lights from said source of periodic voltage upon operation of the selector switch corresponding to said first station at said corresponding station.

39. In a multiple station intercommunicating system, the combination including, signal means at each station, switch means at each station corresponding to other stations of the system, means including circuits between stations controlling the signal means and controlled by said switch means for effecting operation of said signal means to produce a distinctive signal at the station at which switch means is operated and the station corresponding to the operated switch means and at which switch means has not been operated and for returning said signal means to non-operated condition upon operation of the switch means corresponding to the first station at said corresponding station, and means including said circuits and switch means for effecting operation of the signal means to produce other distinctive signals at a third station selecting one of the two first mentioned stations and said one of the two first mentioned stations upon the operation of the switch means at said third station corresponding to said one station.

40. In a multiple station intercommunicating system, the combination including, signal lights at each station corresponding to other stations in the system, station selector switches at each station corresponding to other stations of the system, a source of steady voltage, a source of periodic voltage, means including circuits between stations controlling the signal lights and light circuit controlling switches operable with said selector switches for connecting said signal lights to said periodic voltage source to produce distinctive signals at the station at which a selector switch is operated and the station corresponding to the operated selector switch at which a selector switch has not been operated and for disconnecting said signal lights from said periodic voltage source upon operation of the selector switch corresponding to said first station at said corresponding station, and means including said circuits and light circuit controlling switches for connecting signal lights at a third station and one of said two first mentioned stations to said source of steady voltage upon operation at said third station of a selector switch corresponding to said one station.

41. In a multiple station intercommunicating system, the combination including, signal lights at each station corresponding to other stations in the system, and means including switch means at each station corresponding to other stations in the system and controlling the signal lights at other stations for producing flashing of the signal lights at the other station when switch means at said other stations occupy predetermined positions.

42. In a multiple station intercommunicating system, the combination including, signal lights at each station corresponding to other stations in the system, and means including switch means at each station corresponding to other stations in the system and controlling the signal lights at other stations for producing flashing of the signal lights at the other stations in response to the operation of the switch means at the station in the event no switch means have been operated at said other stations.

43. In a multiple station intercommunicating system, the combination including, signal lights at each station corresponding to other stations in the system, and means including switch means at each station corresponding to other stations in the system and controlling the signal lights at other stations for producing flashing of the signal lights at the other stations in response to the operation of the switch means at the station in the event switch means have been operated at said other stations.

44. In a multiple station intercommunicating system, the combination including, signal lights at each station corresponding to other stations in the system, and means including switch means at each station corresponding to other stations in the system and controlling the signal lights for producing flashing of the signal lights at each

station in response to the operation of the switch means thereat when the switch means at stations corresponding to the operated switch means occupy predetermined positions.

45. In a multiple station intercommunicating system, the combination including, signal lights at each station corresponding to other stations in the system, and means including switch means at each station corresponding to other stations in the system and controlling the signal lights for producing flashing of the signal lights at each station in response to the operation of the switch means thereat when the switch means at stations corresponding to the operated switch means have been operated.

46. In a multiple station intercommunicating system, the combination including, signal lights at each station corresponding to other stations in the system, and means including switch means at each station corresponding to other stations in the system and controlling the signal lights for producing flashing of the signal lights at each station in response to the operation of the switch means thereat when the switch means at stations corresponding to the operated switch means have not been operated.

47. In a multiple station intercommunicating system, the combination including, signal lights at each station corresponding to other stations in the system, and means including switch means at each station for controlling signal lights at that and at other stations for producing flashing of the signal lights at that and at other stations corresponding to operated switch means when the switch means at the other stations corresponding to the operated switch means occupy predetermined positions.

48. In a multiple station intercommunicating system, the combination including, signal lights at each station corresponding to the other stations in the system, and means including switch means at each station for controlling signal lights at that and at other stations for producing flashing of the signal lights at that and at other stations corresponding to operated switch means when the switch means at the other stations corresponding to the operated switch means have not been operated.

49. In a multiple station intercommunicating system, the combination including, signal lights at each station corresponding to other stations in the system, and means including switch means at each station for controlling signal lights at that and at other stations for producing flashing of the signal lights at that and at other stations corresponding to operated switch means when the switch means at the other stations corresponding to the operated switch means have been operated.

50. In a multiple station intercommunicating system, the combination including, signal means at each station, station selector switches at each station, means including circuits between stations controlling the signal means and controlled by the station selector switches for effecting operation of said signal means to produce different distinctive signals at both selected and selecting stations when a station selects another dependent upon whether or not a station selector switch has been operated at the selected station, and means for reversing the natures of the distinctive signals produced in response to the selection of a station at which a selector switch has or has not been operated.

51. In a multiple station intercommunicating system, the combination including, signal lights at each station, station selector switches at each station, means including circuits between stations controlling the signal means and controlled by the station selector switches for effecting operation of said signal means to produce steady glow or flashing of signal lights at both selected and selecting stations when a station selects another dependent upon whether or not a station selector switch has been operated at the selected station, and means for reversing the nature of the signals produced upon selection of a station at which a selector switch has or has not been operated.

52. A periodic voltage supply system, including in combination, a source of voltage, a voltage output conductor, switch means operable alternately to connect said conductor to and to disconnect said conductor from said source, and means including a relay having a winding energized from said voltage source through said switch means when the latter disconnects said output conductor from said voltage source for periodically operating said switch means.

53. A periodic voltage supply system, including in combination, a source of voltage, a voltage output conductor, switch means operable between two positions alternately to connect said conductor to said source and to disconnect said conductor from said source, and means including a relay having a winding adapted to be energized from said voltage source through said switch means when the latter disconnects said output conductor from said voltage source for periodically operating said switch means between its two positions.

54. A periodic voltage supply system, including in combination, a source of voltage, a voltage output conductor, a relay having a winding, a switch blade connected to said source of voltage and operable in one position to connect said source to said conductor and to disconnect said relay winding from said source and in another position to disconnect said source from said conductor and to connect said source to said relay winding, and means including a condenser associated with said relay winding for determining the lengths of time the switch blade is in its two positions.

55. A periodic voltage supply system, including in combination, a source of voltage, a voltage output conductor, a relay having a winding, a switch blade connected to said source of voltage operable in one position to connect said source to said conductor and disconnect said relay winding from said source and in another position to disconnect said source from said conductor and to connect said source to said relay winding, and means including a condenser in circuit with said relay winding and charged when said winding is connected to said source and discharged when said winding is disconnected from the source for determining the lengths of time the switch blade is in its two positions.

56. A periodic voltage supply system, including in combination, a source of voltage, a voltage output conductor, a relay having a winding, a switch means operable in one position to connect said source to said conductor and to disconnect said winding from said source and in another position to disconnect said source from said conductor and to connect said source to said relay winding, and means including a condenser-resistor network in circuit with said relay winding and through which said relay winding is energized and discharging through said winding when the winding is disconnected from said source for determining the

lengths of time the switch means is in its said two positions.

57. In apparatus of the type described, the combination including, an input transformer having a pair of secondary windings, an output transformer having a primary winding and a pair of secondary windings, one of said last mentioned pair of windings constituting a source of inverse feedback voltage and the other an amplifier output winding, a pair of tubes having their anodes connected to the said primary winding and their grids connected to opposite end terminals of the secondary windings of the input transformer, and connections from the terminals of said one of the pair of output transformer secondary windings to adjacent terminals of the secondary windings of the input transformer.

58. In apparatus of the type described, the combination including, an input transformer having a pair of secondary windings, an output transformer having a primary winding and a pair of secondary windings, one of said last mentioned pair of windings constituting a source of inverse feed-back voltage and the other an amplifier output winding, a pair of tubes having their anodes connected to the said primary winding and their grids connected to opposite end terminals of the secondary windings of the input transformer, connections from the terminals of said one of the pair of output transformer secondary windings to adjacent terminals of the secondary windings of the input transformer, and a condenser adapted to bypass frequencies above about 15,000 cycles per second connected across the grids of said tubes.

59. In apparatus of the type described, the combination including, an input transformer having a pair of secondary windings, an output transformer having a primary winding and a pair of secondary windings, one of said last mentioned pair of windings constituting a source of inverse feed-back voltage and the other an amplifier output winding, a pair of tubes having their anodes connected to the said primary winding and their grids connected to opposite end terminals of the secondary windings of the input transformer, connections from the terminals of said one of the pair of output transformer secondary windings to adjacent terminals of the secondary windings of the input transformer, and a connection from the midpoint of said one secondary winding to cathode circuits of said tubes.

60. In apparatus of the type described, the combination including, an input transformer having a pair of secondary windings, an output transformer having a primary winding and a pair of secondary windings, one of said last mentioned pair of windings constituting a source of inverse feed-back voltage and the other an amplifier output winding, a pair of tubes having their anodes connected to the said primary winding and their grids connected to opposite end terminals of the secondary windings of the input transformer, connections from the terminals of said one of the pair of output transformer secondary windings to adjacent terminals of the secondary windings of the input transformer, a connection from the midpoint of said one secondary winding to cathode circuits of said tubes, and a condenser adapted to bypass frequencies above about 15,000 cycles per second connected across the grids of said tubes.

61. In an intercommunicating system of the type comprising a pair of stations each having a communication direction control switch operable to condition the station for reception or transmission, the combination including, neon tube signal lights at each station, means including a switch at each station and interstation circuits controlled thereby for energizing the tubes at another station when the communication direction control switch at said other station conditions said other station for transmission, thereby to indicate a desire to break in on the transmission from said other station, and resistance means connected in shunt to each of said tubes.

62. In a multiple station intercommunicating system, the combination including, neon tube signal lights at each station corresponding to other stations in the system, switch means at each station corresponding to other stations of the system, means including circuits between stations controlling the signal tubes and controlled by said switch means for selectively effecting steady or periodic energization of said signal lights to produce different distinctive signals at the station at which switch means is operated and the station corresponding to the operated switch means dependent upon whether or not switch means has been operated at the latter station, and resistance means connected in shunt with each of said tubes.

63. A voltage supply system for providing steady and periodic signal voltages, including in combination, rectifying means comprising a single transformer and a pair of rectifiers providing independent output voltages, a steady signal voltage supplying conductor connected to one of said rectifiers, an output conductor, switch means operable alternately to connect said conductor to and to disconnect said conductor from the other of said rectifiers, whereby a voltage is periodically supplied to said conductor, and means including a relay having a winding energized from the other of said rectifiers through said switch means when the latter disconnects said output conductor from said other rectifier for periodically operating said switch means.

64. In a multiple station intercommunicating system, the combination including, signal means at each station, station selector switches at each station, means including circuits between stations controlling the signal means and controlled by the station selector switches for effecting operation of said signal means to produce identical distinctive signals at both the selected and selecting stations when a station selects a busy station and to produce identical signals different from said first mentioned signals when a station selects another that is not busy.

65. In a multiple station intercommunicating system, the combination including, signal means at each station, station selector switch means at each station corresponding to the other stations in the system, and means including the station selector switch means at each station for effecting periodic energization of the signal means at other stations when the switch means is in a position connecting the station to another station.

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