

June 17, 1941.

L. C. CAVANAUGH ET AL

2,245,756

COMMUNICATING SYSTEM

Filed April 28, 1939

2 Sheets-Sheet 1

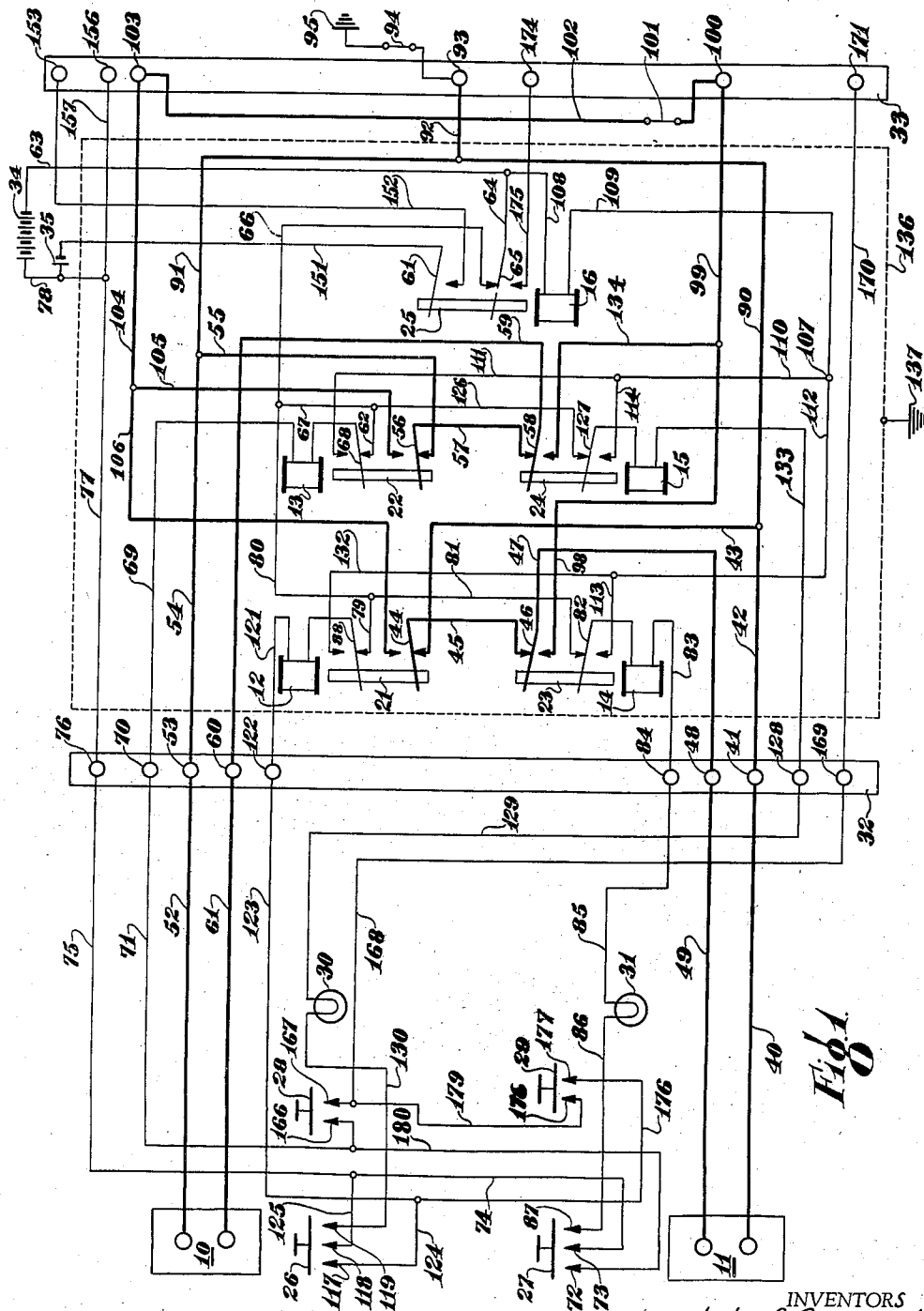


Fig. 1

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ATTORNEYS

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2 Sheets-Sheet 2

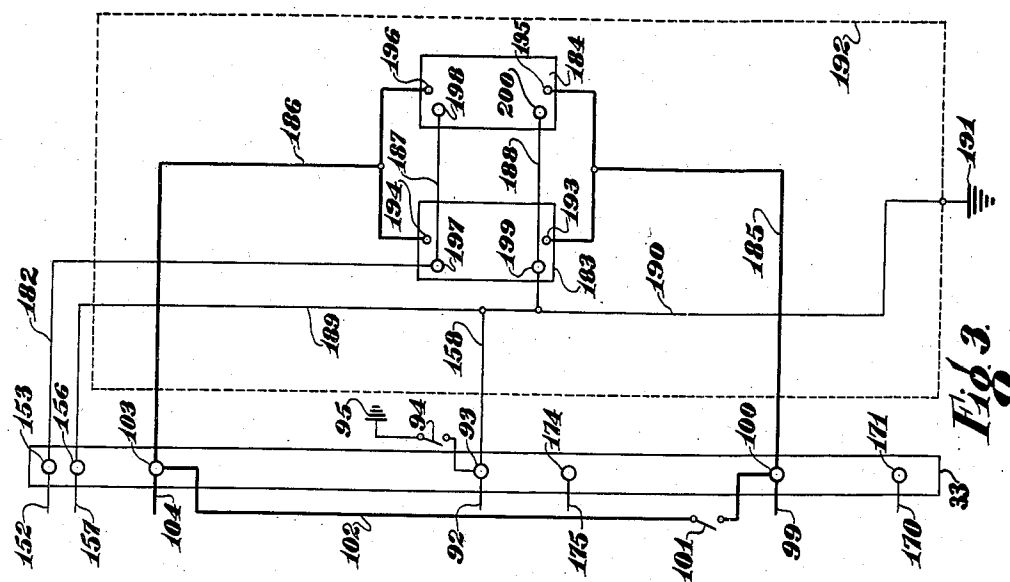


Fig. 3.

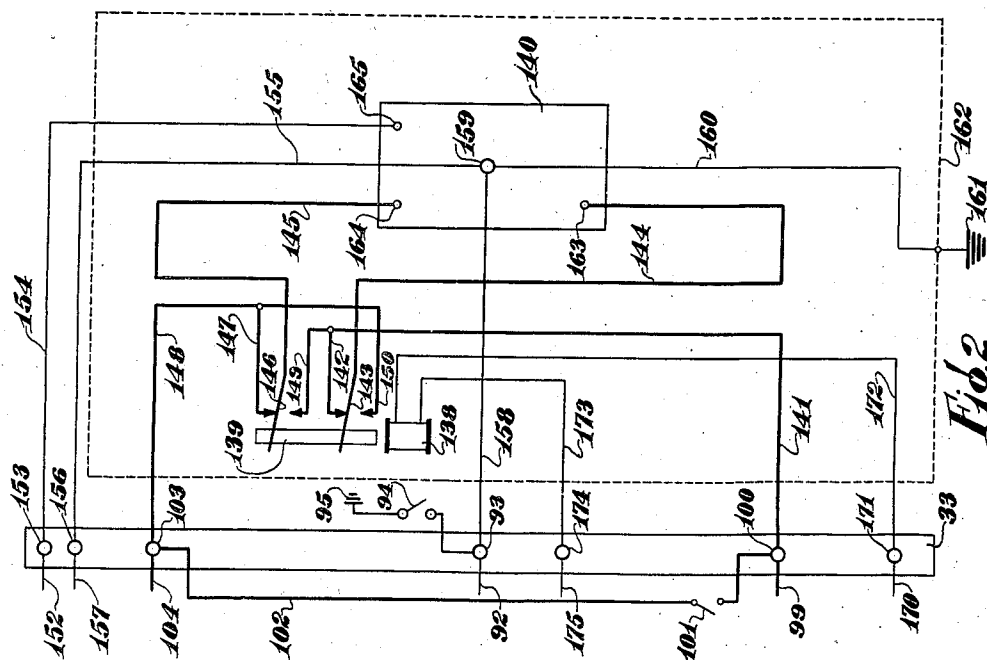


Fig. 2.

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## UNITED STATES PATENT OFFICE

2,245,756

## COMMUNICATING SYSTEM

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Application April 28, 1939, Serial No. 270,602

17 Claims. (Cl. 179—39)

Our invention relates to acoustic devices comprising a plurality of stations capable of sending and receiving sound, but more particularly to intercommunicating telephonic or radio systems in which each of a plurality of stations can send to, or receive from, another station the voice of the person without the possibility of the other stations interrupting the conversation.

Heretofore intercommunicating systems have been made in which a plurality of stations were wired to permit sending and receiving at each of the stations but there was a possibility that during a two-way conversation any of the other stations in the system could cut in thereby causing a disagreeable interruption.

One of the objects of our invention is to eliminate the above mentioned disadvantage by providing an intercommunicating system comprised of a plurality of stations each of which can send to and receive from any other station in the system but which, when two stations are in conversation, automatically prevents any other station from interrupting.

Another object of our invention is to provide an intercommunicating system which has no bells or buzzers.

A still further object of our invention is to provide a wiring system which will enable the expensive and bulky parts of an intercommunicating system to be combined and placed in a central out-of-the-way unit thereby reducing the size of the desk units and reducing the cost of the system.

Another object of our invention is to provide combined sending and receiving apparatus in a unit and to provide a minimum of simple controls to control the unit.

Another object of our invention is to provide a wiring system for an intercommunicating system whereby each sending and receiving unit may, upon initiating a call, become a central or master station.

A further object of our invention is to reduce the number of manual operations necessary to carry on a conversation over an intercommunicating system.

Another object of our invention is to provide an intercommunicating system which has selective relays common to all sending and receiving units.

In an electrical intercommunicating system some space must be provided for the necessary parts and it is an object of our invention to provide a wiring system which will enable many of those parts to be placed in a convenient central out-of-the-way location thereby reducing the size

of the sending and receiving units which usually are in a prominent place, as upon an office desk.

Another object of our invention is to provide an intercommunicating system having a plurality of voice transmitting lines all of which are short circuited out when the system is at rest.

Another object of our invention is to provide for breaking the short circuit on the line of the calling party and on the line of the called party but on no other line when a party initiates a call.

Another object of our invention is to furnish an intercommunicating system having a plurality of normally disconnected transmitting and receiving stations and to provide for selectively connecting any pair of stations in the system and, upon the connection of a pair of stations, to prevent any other station in the system from interrupting the established connection.

Another object of our invention is to furnish a plurality of normally disconnected transmitting stations and to provide for connecting any station to any other station and, by establishing that connection, preventing any other station from initiating a call while that connection exists.

Another object of our invention is to provide an intercommunicating system having a plurality of stations capable of initiating a call and a one-way-amplifier and to cause the current to flow through the one-way-amplifier in the correct direction by the selecting ability of a relay.

Another object of our invention is to provide an intercommunicating system having a plurality of stations each capable of sending and receiving signals in which the originator of a call need not operate a switch to control his apparatus to determine whether he is to send or to receive.

Another object of our invention is to provide an intercommunicating system having a plurality of stations each capable of sending and receiving vocal or other signals in which the receiver of the call operates a switch thereby controlling a relay which causes his vocal or other signal to enter a one-way-amplifier in the proper direction to be transmitted to the party originating the call.

Still another object of our invention is to provide an intercommunicating system having a plurality of signal sending and receiving stations and to allow any one station to initiate a call but once that initiating station is connected to the called station, to prevent any other station from initiating a call until the first connection is broken and, upon blocking out all other stations,

to connect a one-way-amplifier to a current supply source to allow the connected parties to send and receive signals.

A further object of our invention is to provide an intercommunicating system which has a two-way-amplifier.

Other objects and a fuller understanding of our invention may be had by referring to the following description and claims, taken in conjunction with the accompanying drawings, in which:

Figure 1 is a circuit diagram of my invention;

Figure 2 is a circuit diagram which when combined with Figure 1 constitutes another embodiment of my invention using a pole changer relay; and

Figure 3 is a circuit diagram which when combined with Figure 1 constituted another embodiment of my invention showing a two-way amplifier.

With reference to Figure 1 of the drawings, one embodiment of our invention may comprise a plurality of station devices 10 and 11, a plurality of selective relays 12, 13, 14 and 15, an interlocking relay 16, and station control push-button switches 26 and 27.

While we have illustrated but two station devices 10 and 11, it is to be clearly understood that our invention may comprise a larger number of station devices. Each of the station devices are arranged to be of the same construction and may be of the type which serves both as the transmitting and receiving unit, thus eliminating the necessity of utilizing one device for transmitting the sound and another device for receiving the sound. In the embodiment in Figure 1, the station devices are constructed of such parts that they serve as a self-contained unit for sending and receiving sound without aid of auxiliary amplifiers in the sound transmitting circuits.

The illustrated relays may be of any suitable type and may comprise a plurality of movable contacts operated by a single armature. The system is arranged to be energized by means of batteries 34 and 35 but it is to be understood that any other suitable source of electrical energy may be provided. The plurality of relays may be assembled in a suitable box or other container and placed in some out-of-the-way place in a closet or store room of an office or in any other suitable location. The station devices 10 and 11 may be conveniently positioned near the person using the system. Thus, for example, in an office system the stations 10 and 11 may be positioned upon office desks in separate rooms or upon near-by locations convenient for the use of the persons. The push buttons 26 and 27, while shown separated from the station devices 10 and 11 respectively, may be mounted in the boxes which contain the sending and receiving devices. The push buttons 28 and 29, which are utilized in connection with the embodiment shown in Figure 2 of my invention, may likewise be mounted in the boxes or containers which house the sending and receiving devices 10 and 11. The lamps 30 and 31 may be arranged to be incorporated in the container or housing for the station devices 10 and 11, respectively. The conductors which lead from the station devices and the associated push button switches and lamps may be connected to a plurality of terminals mounted upon a suitable input terminal block 32, which may be positioned near or embodied in the relay assembly unit which is positioned in some out-of-the-way place. The relay assembly unit may also comprise an out-

put terminal block 33 having a plurality of terminals to which the conductors may be connected.

In describing the operation of our system, let us first assume that the system is at rest, which is the position shown in Figure 1 of the drawings. In this position, the station devices 10 and 11 are connected in a shorted circuit. The shorted circuit for the station device 10 may be traced as follows: Beginning with the upper terminal of the station device 10 the shorted circuit extends through conductor 52, terminal 53, conductors 54 and 55, movable contact 56 of the relay 13, conductor 57, movable contact 58 of the relay 15, conductor 59, terminal 60, and conductor 61 to the lower terminal of the station device 10. The shorted circuit for the station device 11 may be traced as follows: Beginning with the lower terminal of the station device 11 the shorted circuit extends through conductor 40, terminal 41, conductors 42 and 43, movable contact 44 of the relay 12, conductor 45, movable contact 46 of the relay 14, conductor 47, terminal 48, and conductor 49 to the upper contact of the station device 11.

Now let it be assumed that the person at the station device 11 desires to communicate with the person at the station device 10. Under this assumption, it is only necessary for the person at station 11 to depress the push button switch 27 and close contacts 72, 73 and 87. The depressing of the push button switch 27 establishes control circuits for energizing the selective relays 13 and 14, which in turn establish electrical contacts for establishing a transmitting communicating circuit between the station device 11 and the station device 10. The control circuit for energizing the selective relay 13 may be traced as follows: Beginning with the battery 34 current flows through conductors 63 and 64, movable contact 65 of the relay 16, conductors 66, 67, and 62, movable contact 68, the winding of the relay 13, conductor 69, terminal 70, conductor 71, contacts 72 and 73 bridged by the depressed push button switch 27, conductors 74 and 75, terminal 76, and conductors 77 and 78 to the opposite sides of the battery 34. The current for energizing the selective relay 14 may be traced from the battery 34 to the energized conductor 66, as previously explained, through conductors 80 and 81, movable contact 82, the coil of the selective relay 14, conductor 83, terminal 84, conductor 85, the lamp 31, conductor 86, and contacts 87 and 73 bridged by the depressed push button switch 27 and from the contact 73 back to the opposite side of the battery 34 as previously traced for the circuit which energized the relay 13. The energization of the selective relays 13 and 14 from the battery 34 by depressing the switch push button 27 causes the armatures 22 and 23 to be actuated which shifts the movable contacts to the opposite set of stationary contacts. The actuation of the movable contacts to the opposite set of stationary contacts upon the relays 13 and 14, establishes a transmitting communicating circuit between the station device 11 and the station device 10. One side of the transmitting communicating circuit between the station device 11 and the station device 10 may be traced as follows: Beginning with the lower terminal of the station device 11 communicating current flows through conductor 40, terminal 41, conductors 42, 43, 44 and 45, terminal 53 and conductor 52 to the upper terminal of the station device 10. The circuit thus traced may be connected to a ground 95 through conductor 92, ter-

minal 93 and a switch 94. The other side of the communicating circuit between the station device 11 and the station device 10 may be traced as follows: Beginning with the upper terminal of the station device 11 communicating current flows through the conductor 49, terminal 48, conductor 47, movable contact 46, conductors 98 and 99, terminal 100, switch 101, conductor 102, terminal 103, conductors 104 and 105, movable contact 56, conductor 57, movable contact 58 of the relay 15, conductor 59, terminal 60 and conductor 61 to the lower terminal of the station device 10. The establishment of the transmitting communicating circuit between the station device 11 and the station device 10 permits the persons to communicate back-and-forth with each other.

As previously explained, our system is not limited to two station devices but may include any number of such devices. When other station devices are connected in our system, additional selective relays are employed with circuit connections passing through them in the same manner as the circuit connections pass through the illustrated relays for the station devices 10 and 11. In other words, for each additional station device added to our system, two additional selective relays of the same type as illustrated need be added.

We provide in the embodiment of our invention an interlocking relay 16 which prevents a subsequently operated station device from interfering or interrupting the selected transmitting communicating circuit established by a prior operated station device such, for example, the station device 10, nor any newly added station device, can not take the control away from the station device 11, so long as the push button switch 27 is depressed. The manner in which we provide for excluding other station devices from interfering with the selected transmitting communicating circuit established by the selective relays, is by energizing the interlocking relay 16 upon the closing of the contacts of the operated selective relays which establish the transmitting communicating circuit between two of the stations. Thus, for example, when the selective relays 13 and 14 are energized, a circuit is established for energizing the coil of the interlocking relay 16. The circuit for energizing the interlocking relay 16 may be traced as follows: Beginning with the battery 34 current flows through conductors 63 and 108, the relay winding of the relay 16, conductor 109 to a connection 107 at which point the current divides part going through the contacts of the relay 13 and part going through the contacts of the relay 14. The current which flows through the contacts of the relay 13 may be traced from the connection 107 through conductors 110 and 111, movable contact 68, the winding of the relay 13, conductor 69, terminal 70, conductor 71, the contacts 72 and 73 bridged by the depressed push button switch 27, conductors 74 and 75, terminal 76, and conductors 77 and 78 to the other side of the battery 34. The path of current flowing from the connection 107 through the contacts of the relay 14 may be described as follows: conductors 112 and 113, movable contact 82 of the relay 14, the winding of the relay 14, conductor 83, terminal 84, conductor 85, lamp 31, conductor 86 to the contacts 87 and 73 and from there the current flows back to the opposite side of the battery 34 as previously described. Upon the energization of the interlocking relay 16, the armature 25 causes the

movable contacts 61 and 65 to be shifted to the opposite side. The shifting of the movable contact 65 to the opposite stationary contact prevents the battery 34 from being connected in circuit relation with the selective relays 12 and 15, even though the push button switch 26 may be depressed by the person at the station device 10. In other words, when the person at the station device 11 depresses the push button switch 27 and selectively energizes the relays 13 and 14, after which the interlocking relay 16 is immediately energized, then the person at the station device 10 can not, by depressing the push button switch 26, take the control away from the station device 11 by interrupting the selected communicating transmitting circuit. In this manner, the interlocking relay 16 excludes a subsequently operated station from interfering with the selected and established circuits effected by the operation of a prior station device. The interlocking relay 16 also prevents any additional station devices to our system from interfering with the selected and established transmitting communicating circuit when once established by a person at another station device.

The purpose of the lamps 30 and 31 is to indicate to the operator at each of the station devices, as to whether or not another station has been established a transmitting communicating circuit. Thus, for example, should the operator at the station device 11 have control of the system and should the operator at the station device 10 depress the push button switch 26, the lamp 30 would fail to light since the connection is broken from the battery 34 at the movable contact 65. Therefore, when a person depresses a push button switch at a station and the lamp does not light then this is an indication that some other station has control of the system.

When the operator at station device 11 finishes his conversation with the operator at the station device 10 he merely releases the push button switch 27. Upon the releasing of the push button switch 27 the system is again at rest. Now, should the person at the station device 10, at some later time, desire to communicate with the person at the station device 11 then the person at the station device 10 merely depresses the push button switch 26 bridging the contacts 117, 118 and 119 establishing circuits from the battery 34 for energizing the selective relays 12 and 15, which establishes a transmitting communicating circuit from the station device 10 to the station device 11. The control circuit for energizing the selective relay 12 may be traced as follows: Beginning with the battery 34 current flows through the conductors 63 and 64, movable contact 65, conductors 66, 80 and 79, movable contact 88, the winding of the selective relay 12, conductor 121, terminal 122, conductors 123 and 124, the contacts 117 and 118 bridged by the depressed push button switch 26, conductors 125 and 75, terminal 76, and conductors 77 and 78 to the other side of the battery 34. The circuit for energizing the selective relay 15 may be described as follows: Beginning at the battery 34 to energized conductor 63, as previously explained, current flows through conductors 67 and 126, movable contact 127 of the relay 15, the winding of the relay 15, conductor 133, terminal 128, conductor 129, lamp 30, and conductor 130 to the contact 119 to the common contact 118 and from there the current flows back through the common circuit as previously described to the opposite side of the battery 34. The energiza-

tion of the selective relays 12 and 15 establish a communicating transmitting circuit from the station device 10 to the station device 11. The circuit from the upper terminal of the station device 10 to the lower terminal of the station device 11 is the same as previously described. The circuit between the lower terminal of the station device 10 and the upper terminal of the station device 11 may be traced as follows: Beginning with the lower terminal of the station device 10, the circuit extends through conductor 61, terminal 60, conductor 59, movable contact 58, the conductors 134, conductor 99, terminal 100, switch 101, conductor 102, terminal 103, conductor 104, conductor 105, movable contact 44, conductor 45, movable contact 46, conductor 47, terminal 48, conductor 49 to the upper terminal of the station device 11. Upon the establishment of the transmitting communicating circuit through the relays 12 and 15, as just described, the person at the station device 10 and the person at the station device 11 may communicate with each other. Upon the energization of the selective relays 12 and 15 and upon the actuation of the armatures 21 and 24, a circuit is established for energizing the interlocking relay 16 which prevents the person at station 11, by depressing the push button switch 27, as well as a person at any additionally added stations from interfering with the circuit established by the person at the station 10. The circuit for energizing the interlocking relay 16 by the closing of the contacts of the selective relays 12 and 15 may be described as follows: Beginning with the battery 34 current flows through the conductors 63 and 103, the winding of the relay 15, and conductor 109 to the connection 107, at which point the current divides, one path extending through conductors 110 and 114, movable contact 127 of the relay 15, the winding of the relay 15, conductor 133, terminal 128, conductor 129, lamp 30, conductor 130, the contacts 119 and 118 bridged by the depressed push button switch 26, conductors 125 and 75, terminal 76 and conductors 77 and 78 to the opposite side of the battery 34. Beginning with the connection 107, the other path extends through conductors 112 and 132, movable contact 88, the winding of the relay 12, conductor 121, terminal 122, conductors 123 and 124, contacts 117 and 113 bridged by the depressed push button switch 25 and from the common contact 118 the current flows through the common circuit to the opposite side of the battery, as previously described. Upon the energization of the interlocking relay 16, the battery 34 is prevented from being connected in circuit relation with the selective relays 13 and 14, even though the operator at station 11 may depress the push button switch 27. Also, the depressing of the push button switches at any additionally added stations would prevent them from interfering with the established communicating transmitting circuit between the station 10 and the station 11, so long as the operator at the station 10 retained the push button 26 depressed.

Since the selective relays for the subsequently operated stations can not be energized when a station has control and since the de-energized selective relays short circuit the station devices not in use, then it is impossible for a subsequently operated station device to cause interference with the prior selected station devices. The selective relays 12, 13, 14 and 15 and the interlocking relay 16 may be surrounded by a shield 136 which is

connected to a ground 137 to eliminate static interferences in the communicating system.

As explained before, in the embodiment shown in Figure 1, the station devices 10 and 11 produce sufficient communicating transmitting energy to enable communication to be carried on therebetween without the employment of a centralized amplifying device. In Figure 2, we have illustrated an embodiment which, when combined with the embodiment in Figure 1, comprises a complete communicating system having a centralized amplifier 140. The output terminal block 33 in Figure 2 is a duplication of the terminal block in Figure 1, but the switches 101 and 94 are in their open position. Thus, for example, the communicating current from the station device 11, instead of flowing through the switch 101 as explained in Figure 1, is caused to flow, in Figure 2, from terminal 100 through conductors 141 and 142, movable contact 143, and conductor 144 to the input terminal 163 of the amplifier 140, and from the amplifier the amplified current flows from the output terminal 164 through conductor 145, movable contact 146, and conductors 147 and 148 to terminal 103 and from there to the station device 10 as previously explained. The opening of the switch 94, in Figure 2, causes the terminal 93 to be grounded through conductor 158, terminal 159 of the amplifier and conductor 160 to a ground 161 which is also connected to a shield 162 which eliminates static interferences in the equipment shown in Figure 2. The amplifier 140 is a one-way amplifier, in that the communicating current must enter the amplifier through the input terminal 163 and leave the amplifier through the terminal 164. In order that communication may be carried on between the station device 10 and the station device 11 in both directions with a one-way amplifier 140, we have employed a pole changer relay 138 which provides for directing the incoming communicating current from either of the two station devices 10 or 11 into the input terminal 163 of the amplifier 140. The pole changer relay 138 is arranged to be energized by circuits established either by depressing the push button switch 28 at the station device 10 or by depressing the push button switch 29 at the station device 11. Thus, for example, should station device 11 have control of the communicating system and desire to carry on a conversation with the person at the station device 10, then under this condition, the push button switch 27 is depressed and communicating current from the station 11 upon reaching the terminal 100, as previously described, flows through conductors 141 and 142, movable contact 143, conductor 144 to the input terminal 163 and from the amplifier 140, the amplified current flows from the output terminal 164 through conductor 145, movable contact 146, and conductors 147 and 148 to the terminal 103 which is connected to the station device 10, as previously described. In order that the person at the station device 10 may communicate back to the person at the station device 11, it is necessary to depress the push button switch 28 which energizes the pole changer relay 138 and causes the armature 139 to move the movable contacts 143 and 146 to the opposite set of stationary contacts. Under the energized position of the pole changer relay 138, communicating current from the station device 10 upon reaching the terminal 103, as previously described, flows through conductors 143 and 150, movable contact 143, conductor 144 to the input

terminal 163 of the one-way amplifier 140 and from the amplifier the amplified current flows from the output terminal 164 through conductor 145, movable contact 145, and conductors 149 and 141 to the terminal 100 and from there to the station device 11, as previously explained. When the person at the station device 10 has finished his message he releases the push button switch 28, after which the person at the station device 11 may communicate with the person at the station 10. The person at station device 11, for example, cannot take the control away from the person at station device 10 by depressing the push button switch 29 and thus the person at station 11 cannot communicate with the person at station device 10, until the person at station 10 releases the push button switch 28. The same conditions prevail with any newly added station devices. In the event that the person at the station 10 should have control of the system by the prior depressing of the push button switch 26, then it is necessary for the person at the station device 11 to depress the push button switch 29 to energize the pole changer relay 138 to establish circuit for causing the communicating current to flow in the input terminal 163 of the amplifier 140. The circuit for energizing the pole changer relay 138 upon the depressing of the push button switch 28 may be traced as follows: Beginning with the battery 34 current flows through the conductors 63 and 64, movable contact 65, conductor 175, terminal 174, conductor 173, the coil of the relay 138, conductor 172, terminal 171, conductor 170, terminal 169, conductor 168, contacts 167 and 166 bridged by the push button switch 29, conductor 189, contacts 72 and 73 bridged by the push button switch 27, conductors 74 and 75, terminal 76, and conductors 77 and 78 to the battery 34. The circuit for energizing the pole changer relay 138 upon the closing of the push button switch 29 may be traced as follows: Beginning with the energized terminal 174, current flows through conductor 173, the coil of the pole changer relay 138, conductor 172, terminal 171, conductor 170, the terminal 169, conductors 168 and 179, contacts 178 and 177 bridged by the depressed push button switch 29, conductor 176 and 124, contact 117 and 118 bridged by the push button switch 26, conductors 125 and 75, terminal 76, and the conductor 77 and 78 to the battery 34.

The energization of the interlocking relay 16 also controls the filament to the amplifier 140. Thus, when the interlocking relay 16 is energized current from the filament battery 35 flows through conductor 151, movable contact 61, conductor 152, terminal 153, and conductor 154 to the filament terminal 165 of the amplifier 140 and from the amplifier the filament current flows from the terminal 159 through conductor 155, terminal 156, and conductors 157 and 78 to the opposite side of the filament battery 35. In this manner the amplifier 140 is de-energized until the interlocking relay 16 is energized by the closing of the contacts of the selective relays of our system.

In Figure 3, we show an arrangement of a two-way amplifier 183 and 184 which obviates the necessity of the pole changer relay 138. Thus, for example, communicating current from station device 11 which flows from the terminal 109 through the conductor 185 enters the input terminal 195 of the amplifier 184 and the amplified current leaves the output terminal 196 and flows through conductor 186 to the terminal 103. The

communicating current from station device 10 upon reaching the terminal 103 flows through conductor 136 and to the input terminal 194 of the amplifying device 183 and the amplified current flows from the output terminal 193 through the conductor 185 and to the terminal 100 which is connected to the station device 11. Therefore, communication may be carried on between the station devices 10 and 11 without the operation of the push button switches 28 and 29. The filament terminals 197 and 198 of the amplifiers 183 and 184 are inter-connected together by conductor 187 and both are connected to the filament battery 35 through a conductor 182 leading to the energized terminal 153. The ground terminals 199 and 200 of the amplifiers 183 and 184 are connected together by conductor 188 and both are connected through the conductor 189 to the other energized terminal 156 from the filament battery 35. Both of the ground terminals 199 and 200 are connected to a ground 191 through a conductor 190 which is also connected to a shield 192 to the ground. The object of the shield is to eliminate static interferences in the equipment. In the embodiment of Figure 3, as just described, the amplifier 184 has the property of amplifying the communicating current from the station 11 to the station 10 and the amplifier 183 has the property of amplifying the communicating current from the station 10 to the station 11 and each have the property of selecting its own directional current.

In our system each station device 10 and 11, and the additional station devices which may be added thereto, upon initiating a call become a central or master station and prevents any other station in the system from interrupting the established communicating connection. In addition, our system is completely de-energized when at rest and thus uses a minimum of electrical energy.

While we have described our invention with a certain degree of particularity, it is understood that the present disclosure has been made only by way of example and that numerous changes in the details of construction and the combination and arrangement of parts may be resorted to without departing from the spirit and scope of the invention as hereinafter claimed.

We claim as our invention:

1. An electrical transmission system comprising, in combination, a plurality of station devices, each capable of sending and receiving sound, transmission circuit connections interconnecting the station devices with each other, selective relay means for selecting and establishing a transmission circuit connection between at least two of said station devices, control circuit connections for governing the selective relay means, a switch associated with each station device for selecting and establishing control circuit connections to govern the selection of the selective relay means and the establishment of a transmission circuit connection between at least two of said station devices, and an interlocking relay means controlled by the selective relay means, said interlocking relay means governing the control circuit connections to prevent the subsequent actuation of a switch at one of said station devices from interrupting a selected transmission circuit connection established by the prior actuation of a switch at another station device, and amplifying means for amplifying the selected transmission circuit in each of two directions and means for governing the operation of the ampli-

fy ing means in accord with the interlocking relay.

2. An electrical transmission system comprising, in combination, a plurality of station devices, each capable of sending and receiving sound, transmission circuit connections interconnecting the station devices with each other, selective relay means for selecting and establishing a transmission circuit connection between at least two of said station devices, control circuit connections for governing the selective relay means, a switch associated with each station device for selecting and establishing control circuit connections to govern the selection of the selective relay means and the establishment of a transmission circuit connection between at least two of said station devices, an interlocking relay means controlled by the selective relay means, said interlocking relay means governing the control circuit connections to prevent the subsequent actuation of a switch at one of said station devices from interrupting a selected transmission circuit connection established by the prior actuation of a switch at another station device, a two-way amplifying means included in the selected transmission circuit connection, and means for causing the interlocking relay to govern the operation of the amplifying means.

3. An electrical transmission system comprising, in combination, a plurality of station devices, each capable of sending and receiving sound, transmission circuit connections interconnecting the station devices with each other, selective relay means for selecting and establishing a transmission circuit connection between at least two of said station devices, control circuit connections for governing the selective relay means, a switch associated with each station device for selecting and establishing control circuit connections to govern the selection of the selective relay means and the establishment of a transmission circuit connection between at least two of said station devices, an interlocking relay means controlled by the selective relay means, said interlocking relay means governing the control circuit connections to prevent the subsequent actuation of a switch at one of said station devices from interrupting a selected transmission circuit connection established by the prior actuation of a switch at another station device, amplifying means included in the selected transmission circuit connection, and means for causing the interlocking relay to govern the operation of the amplifying means.

4. An electrical transmission system comprising, in combination, a plurality of station devices, each capable of sending and receiving sound, transmission circuit connections interconnecting the station devices with each other, selective relay means for selecting and establishing a transmission circuit connection between at least two of said station devices, control circuit connections for governing the selective relay means, a switch associated with each station device for selecting and establishing control circuit connections to govern the selection of the selective relay means and the establishment of a transmission circuit connection between at least two of said station devices, an interlocking relay means controlled by the selective relay means, said interlocking relay means governing the control circuit connections to prevent the subsequent actuation of a switch at one of said station devices from interrupting a selected transmission circuit connection established by the prior actuation of a switch at an-

other station device, one-way amplifying means having input and output terminal means included in the selected transmission circuit connection, pole changing relay means for establishing the selected transmission circuit connection through the amplifying means in a direction to cause the current flowing in the selected transmission circuit connection to enter the amplifying means through the input terminal means and leave through the output terminal means, and means located at each station to govern the pole changing relay means.

5. An electrical transmission system comprising, in combination, a plurality of station devices, each capable of sending and receiving sound, transmission circuit connections interconnecting the station devices with each other, selective relay means for selecting and establishing a transmission circuit connection between at least two of said station devices, control circuit connections for governing the selective relay means, a switch associated with each station device for selecting and establishing control circuit connections to govern the selection of the selective relay means and the establishment of a transmission circuit connection between at least two of said station devices, an interlocking relay means controlled by the selective relay means, said interlocking relay means governing the control circuit connections to prevent the subsequent actuation of a switch at one of said station devices from interrupting a selected transmission circuit connection established by the prior actuation of a switch at another station device, one-way amplifying means having input and output terminal means included in the selected transmission circuit connection, pole changing relay means for establishing the selected transmission circuit connection through the amplifying means in a direction to cause the current flowing in the selected transmission circuit connection to enter the amplifying means through the input terminal means and leave through the output terminal means, means located at each station to govern the pole changing relay means, and means for causing the interlocking relay means to govern the operation of the amplifying means.

6. In an apparatus of the character described, the combination of a central exchange comprising selective relay means and interlocking relay means and a plurality of station devices capable of sending and receiving sound through said central exchange, each of said station devices being normally in a shorted circuit, and means at said central station adapted to select and break the short circuit upon at least two of said station devices and establish a transmitting circuit between the said selected station devices, said means at said central station upon establishing the selected transmitting circuit preventing a second transmitting circuit from being made while said selected transmitting circuit is established.

7. In an electrical system, the combination of a plurality of station devices, each capable of sending sound to and receiving sound from any other station device in the system, each of said station devices being normally in a shorted circuit, means located at each station device for establishing a circuit connection between a station device and another station device and breaking the shorted circuits of said connected station devices, and a central exchange for causing the circuit connection established to exclude all other station devices from establishing subsequent cir-

cuit connections in the system until the prior circuit is interrupted.

8. An electrical system comprising, in combination a central exchange, a plurality of station devices capable of sending and receiving sound, each of said station devices being normally in a shorted circuit, a sound transmitting circuit connected to each of said station devices including a two-way amplifying means through said central exchange, a selecting control circuit connected to each of said station devices, means located at each of said station devices for selecting the control circuit to connect said transmitting circuit to any other station device through said central exchange and locking out all other selecting control circuits at the central exchange to prevent all the other station devices in the circuit from being connected to the selected stations, and means for breaking the shorted circuits of said selected and connected station devices.

9. In an electrical system of the character described, the combination of a plurality of stations including a first and a second station normally located in shorted circuits and adapted to send and receive signals, each of said stations being normally in a shorted circuit, circuit connections including switch means associated with said first station for connecting said first station to said second station by breaking each of the shorted circuits and by establishing a transmitting circuit between them to permit said first station to send signals to said second station, a one-way amplifier adapted to normally receive current from the first station and amplify same for the second station, and means associated with said second station for directing current from the second station through said one-way amplifier in the proper direction and amplify same for said first station.

10. In an apparatus of the character described, the combination of a plurality of station devices capable of sending and receiving sound, each of said station devices being normally in a shorted circuit, a central exchange, relays at said central exchange for breaking said shorted circuits and establishing a signal transmitting circuit between said station devices, and a one-way-repeater at said central exchange, said relays also acting to direct the flow of current from said station devices through said one-way-repeater in one direction, and to prevent the establishment of any other signal transmitting circuit while one circuit is made.

11. An electrical system comprising, in combination, a central exchange, a plurality of station devices capable of sending and receiving sound, each of said station devices being normally in a shorted circuit, a sound transmitting circuit including means for amplifying in two directions connected through said central exchange to each of said station devices, a selecting control circuit connected through said central exchange to each of said station devices for breaking said shorted circuit and establishing two selected stations in said sound transmitting circuit and for locking out all other selecting control circuits at the central exchange to prevent all the other station devices in the circuit from being connected to the selected stations.

12. In an electrical system of the character described, the combination of a plurality of stations including a first and a second station adapted to send and receive signals, each of said stations being normally in a shorted circuit, circuit connections including switch means associated with said first station for connecting said first station to

said second station by breaking each of the shorted circuits and by establishing a transmitting circuit between them to permit said first station to send signals to said second station, a one-way amplifier adapted normally to receive current from the first station and amplify same for the second station, and means associated with said second station for directing current from the second station through said one-way amplifier in the proper direction and amplify same for said first station, said switch means also operating means to prevent the subsequent actuation of a switch at one of the other of said plurality of stations from interrupting the circuit between the said first and second stations.

13. In an electrical system of the character described, the combination of a plurality of stations including a first and a second station adapted to send and receive signals, each of said stations being normally in a shorted circuit, circuit connections including switch means associated with said first station for connecting said first station to said second station by breaking each of the shorted circuits and by establishing a transmitting circuit between them to permit said first station to send signals to said second station, amplifying means included in the transmitting circuit and means for causing said switch means to govern the operation of the amplifying means.

14. In an electrical system of the character described, the combination of a plurality of stations including a first and a second station adapted to send and receive signals, each of said stations being normally in a shorted circuit, circuit connections including switch means associated with said first station for connecting said first station to said second station by breaking each of the shorted circuits and by establishing a transmitting circuit between them to permit said first station to send signals to said second station, a two way amplifying means included in said transmission circuit and means for causing said switch to govern the operation of the amplifying means.

15. An electrical system comprising, in combination, a plurality of station devices normally in shorted circuits, a plurality of relay means located at a central exchange spaced from said station devices, a sound transmitting circuit including means for amplifying in two directions connected through said central exchange to each of said station devices, a selecting control circuit connected to said relay means and to said station devices for actuating said relays to break said shorted circuit and establish two selected stations in said sound transmitting circuit, the actuation of said relay means locking out all unselected control circuits at the central exchange to prevent the unselected station devices from interrupting the selected station devices.

16. An electrical transmission system comprising, in combination, a plurality of station devices normally in shorted circuits, transmission circuit connections interconnecting the plurality of station devices with each other, first relay means for establishing a transmission circuit between two selected station devices and breaking the shorted circuits of said selected and connected station devices, second relay means for preventing the interruption of the established transmission circuit, amplifying means in said transmission circuit, and means for causing said second relay means to govern the operation of the amplifying means.

17. In an electrical system, the combination of

a plurality of station devices, each capable of sending sound to and receiving sound from any other station device in the system, each of said station devices being normally in a shorted circuit, means located at each station device for governing the establishment of a circuit connection between a station device and another station device and the breaking of the shorted circuit of said connected station devices, a central exchange

5 having means for causing the circuit connection established to exclude all other station devices from establishing subsequent circuit connections in the system until the prior circuit is interrupted and grounded shielding means around the said central station to reduce the static interference in the said system.

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