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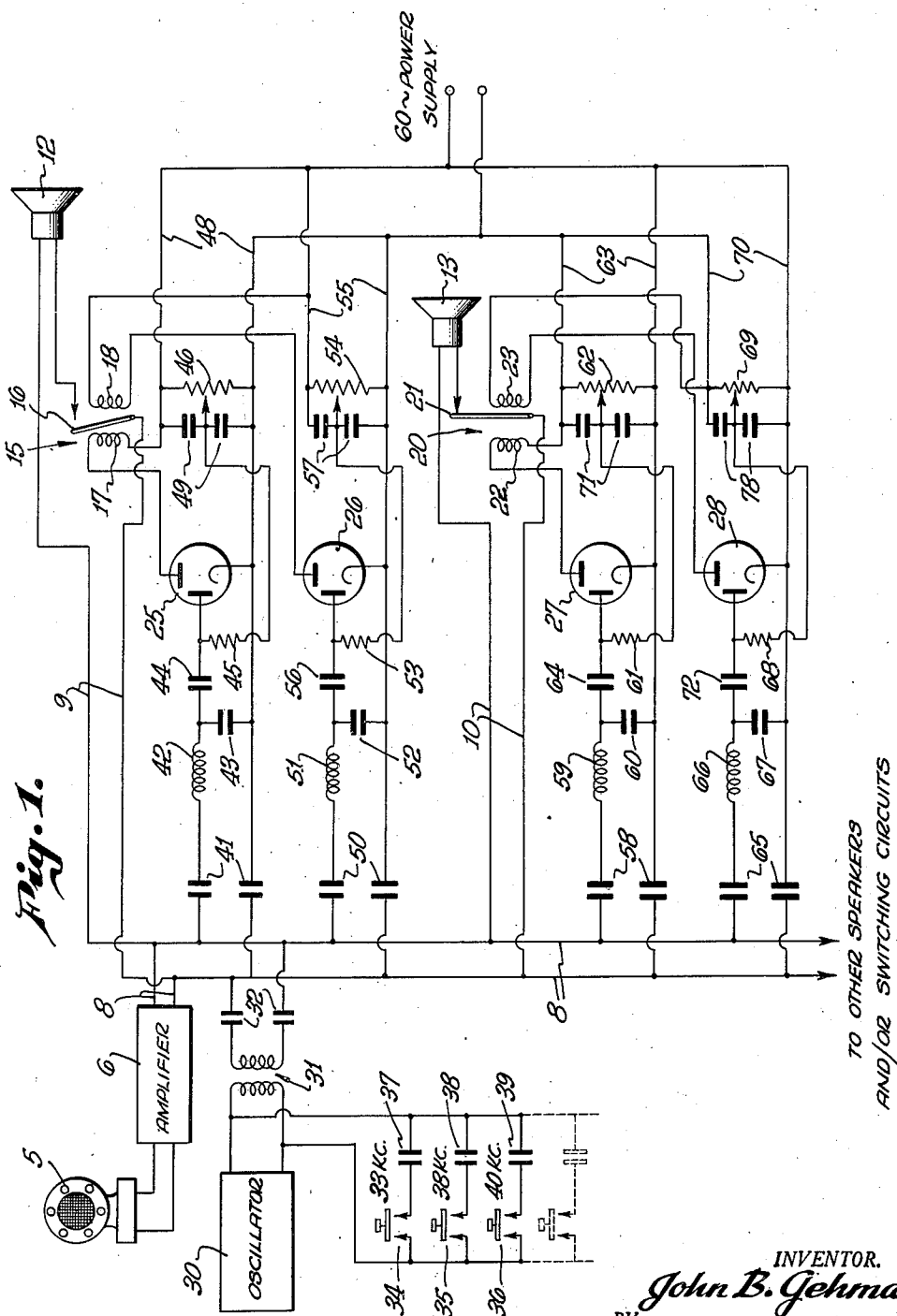
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2,427,850

SWITCHING METHOD AND SYSTEM

Filed March 17, 1945

3 Sheets-Sheet 1



TO OTHER SPEAKERS
AND/OR SWITCHING CIRCUITS

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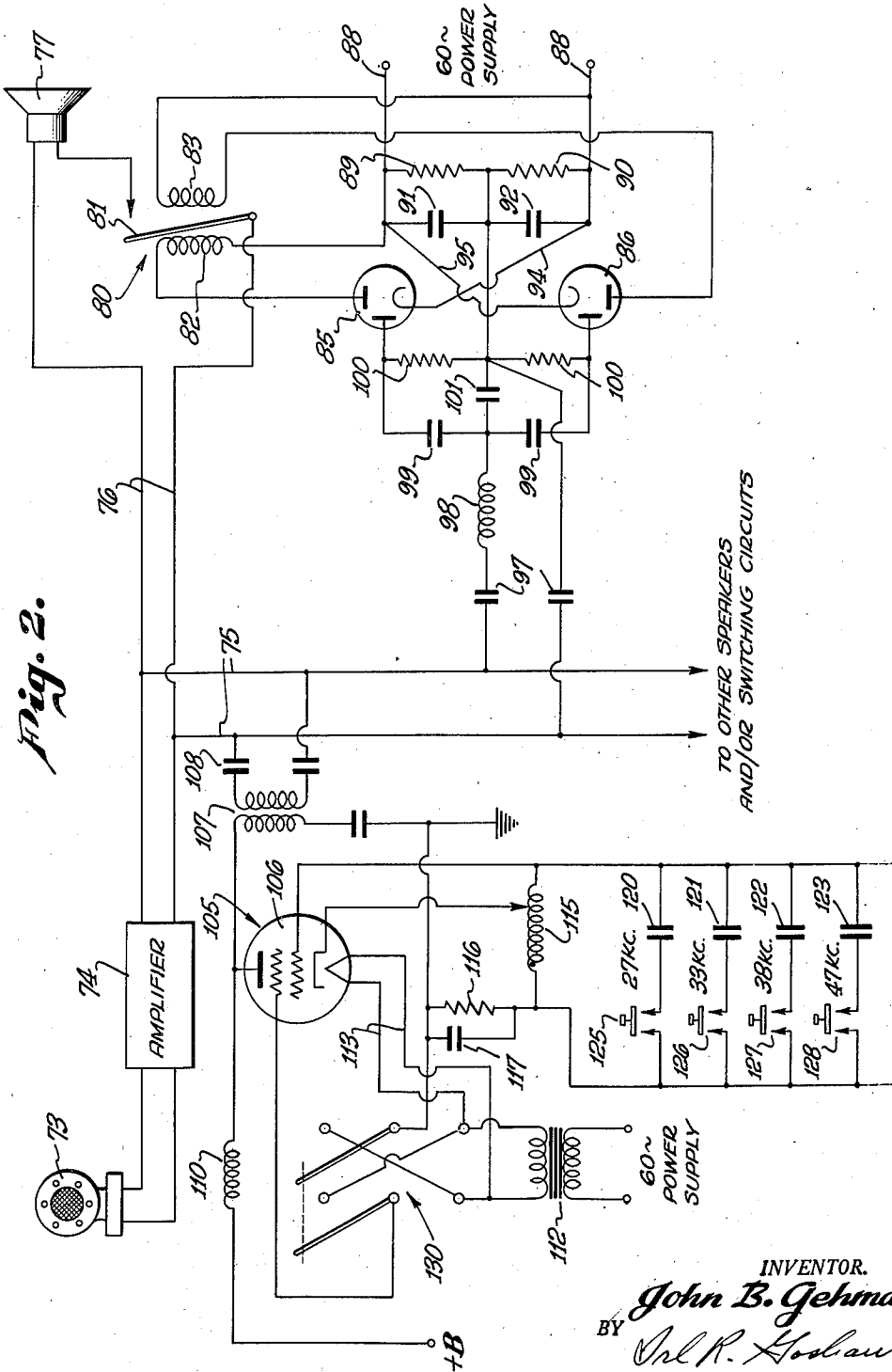
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SWITCHING METHOD AND SYSTEM

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3 Sheets-Sheet 2



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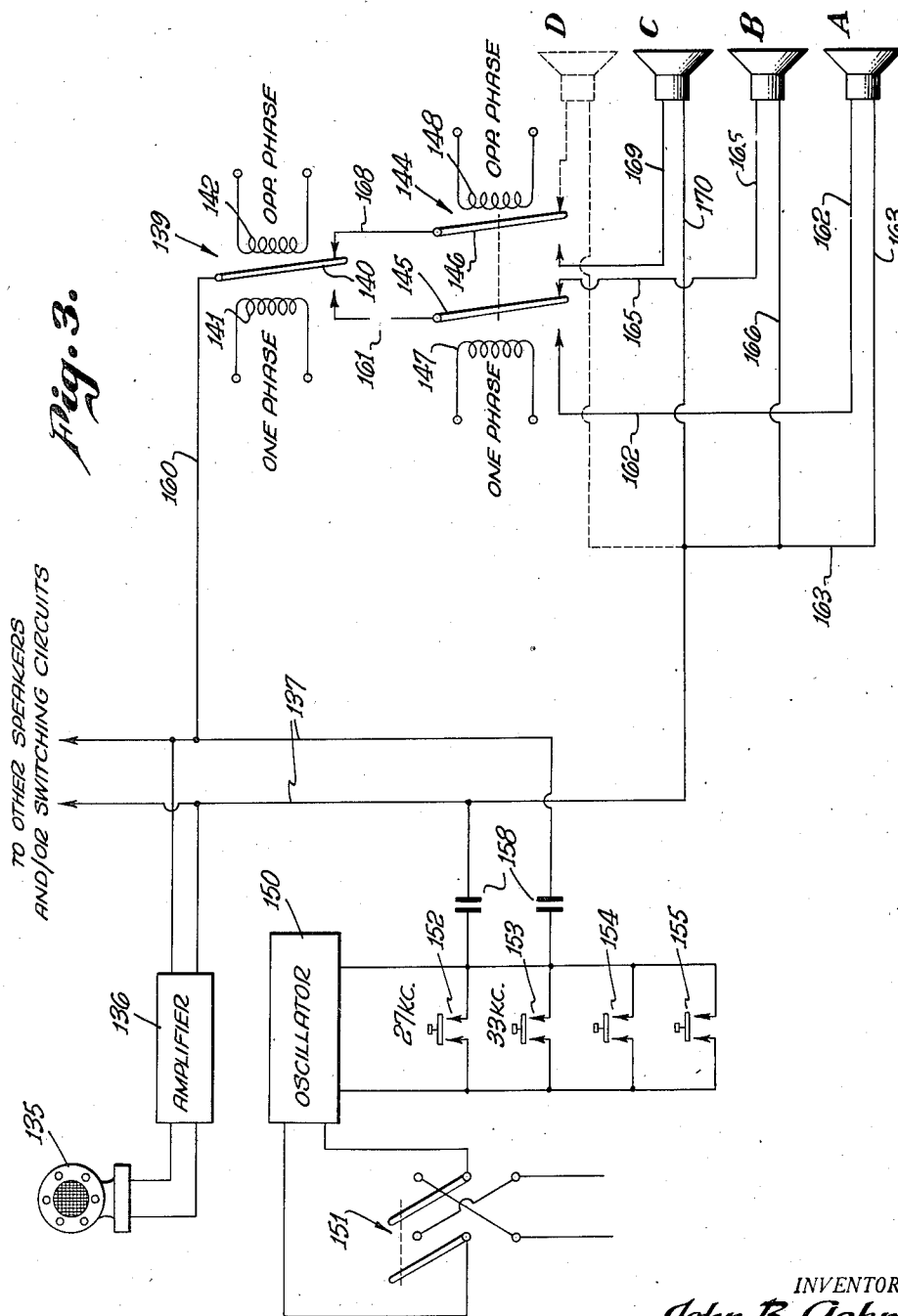
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SWITCHING METHOD AND SYSTEM

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3 Sheets-Sheet 3



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SWITCHING METHOD AND SYSTEM

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12 Claims. (Cl. 179—1)

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This invention relates to public address or announcing systems whereby the listening areas to be served by the system may be selected from a remote point.

Public address systems of the announcing type whereby one or more microphones may be connected to a main circuit or amplifier channel supplying a number of loud speakers located in various positions, such as different rooms or departments of a factory or office building, are well-known. Such systems employ one or more microphones, according to the points from which announcements originate, one or more amplifiers, according to the amount of power to be delivered, and various speakers located in different listening areas. Usually, the signal is given the proper amplification at or near the microphone, and the output of the amplifier distributed to the speakers over a main two wire circuit and branch circuits.

The present invention is directed to a switching arrangement whereby various loud speakers may be connected and disconnected to and from the main signal channel, the switching impulses being transmitted over the signal channel, but at frequencies above audibility or supersonic frequencies. Two types of switching circuits may be employed, one in which a certain oscillator frequency impulse connects a certain speaker to the line, and another frequency impulse disconnects the speaker from the line. Other frequencies will connect other speakers to the line, while all the speakers may be disconnected from the line with a common frequency and the selected speakers may then be reconnected as desired. The other modification utilizes one phase of a low frequency current, such as 60 cycles, modulating a supersonic carrier frequency for connecting a speaker to the line, while the other phase of the same modulating frequency disconnects the speaker from the line. By a series of relays, four speakers may be controlled by two oscillator carrier frequencies.

The principal object of the invention, therefore, is to facilitate the communication of intelligence from one or more central points to one or more listening points.

Another feature of the invention is to improve the flexibility of an announcing system employing a large number of loud speakers.

A further object of the invention is to provide an improved announcing system in which switching circuits are provided to connect and dis-

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nect any particular speaker to and from the signal channel.

A further object of the invention is to provide an improved announcing system in which the signal channel circuit is used to transmit switching signals for connecting and disconnecting the loud speakers to and from the signal channel.

A still further object of the invention is to provide an improved announcing system whereby a supersonic frequency impulse is superimposed on the signal channel to control the connecting and disconnecting of loud speakers.

A still further object of the invention is to provide a switching circuit for an announcing system whereby a high frequency carrier is modulated by a low frequency signal to perform switching operations.

Although the novel features which are believed to be characteristic of this invention will be pointed out with particularity in the appended claims, the manner of its organization and the mode of its operation will be better understood by referring to the following description read in conjunction with the accompanying drawings forming a part hereof, in which:

Fig. 1 is a schematic circuit diagram of one embodiment of the invention.

Fig. 2 is a schematic circuit diagram of another embodiment of the invention, and

Fig. 3 is a schematic diagram of a series arrangement of relay switches for use in either of the embodiments shown in Figs. 1 and 2.

Referring now to Fig. 1, a signal channel is shown composed of a microphone 5, an amplifier 6, main conductors 8, and branch conductors 9 and 10 feeding loud speakers 12 and 13, respectively. It is to be understood that one or more microphones and one or more amplifiers may be used, while other loud speakers and switching circuits may be connected to the main conductors 8, as indicated. In the lower conductor for the speaker 12, there is a mechanical relay 15 having an armature 16, a disconnect winding 17, and a connect winding 18, while in the lower conductor for speaker 13 is a similar mechanical relay 20 having an armature 21, a disconnect winding 22, and a connect winding 23. Thus, when coil 18 is energized, the armature 16 connects the loud speaker 12 to the signal channel, and when winding 17 is energized, the speaker 12 is disconnected. Similarly for speaker 13, the energization of coil 23 connects the speaker to the line, and the energization of coil 22 disconnects the speaker, it requiring only an impulse to swing the armature to

their respective positions, which are maintained until the next impulse is impressed on the relays.

The coils are energized from the output of gas vacuum tubes, a tube 25 controlling the energization of winding 17, and a tube 26 controlling the energization of winding 18, while a tube 27 performs the same function for winding 22 and a tube 28 for winding 23. The tubes 25, 26, 27, and 28 are of the trigger type; that is, when their grids are brought to a certain potential with respect to their cathode, current flow occurs between the anodes and cathodes, thus energizing the respective windings.

The tubes are triggered by energy supplied from an oscillator 30 connected to the main conductors 8 over a transformer 31 and a pair of blocking condensers 32. An indicated, the oscillator 30 may be tuned to three supersonic frequencies, such as 33, 38, or 40 kilocycles, these being sufficient for controlling the two speakers 12 and 13. If other speakers are on the line, other tuning elements may be added along with other switching circuits in the same manner as those shown for speakers 12 and 13. Switches 34, 35, and 36 in series with respective tuning condensers 37, 38, and 39, illustrate the tuning control of the oscillator, while the dotted lines show that further switches and tuning circuits may be added.

The tube 25 controlling the disconnect winding 17 is connected to the main channel conductors 8 over blocking condensers 41, a filter tuning inductance 42, a filter tuning condenser 43, and a grid blocking condenser 44. The elements 42—43 serve as a band pass type of filter which permits only one of the generated frequencies to be passed from the line 8 to the tube 25, such as the 40 kilocycle frequency. The grid of the tube 25 is positively biased over a grid leak resistor 45 from a potentiometer resistor 46, the anode of the tube 25 being energized from an alternating current source, such as 60 cycles, over conductors 48 during the positive half cycles of the A.-C. source. Condensers 49 are stabilizing condensers. To energize the winding 17, therefore, it is only necessary to close switch 36, the oscillator thus generating 40 kilocycles, which will be passed by the filter 42—43 to the tube 25. The change in bias produced by the 40 kilocycle impulse will permit current to flow through the winding 17 to move the armature 16 to the left and disconnect the speaker 12 from the line.

Tube 26 is connected to the line 8 over blocking condensers 50, a filter tuning inductance 51, a filter tuning condenser 52, and a grid blocking condenser 56. The tube 26 is biased over grid leak resistor 53 from a potentiometer resistor 54, the anode of the tube being energized over conductors 55 from the same 60 cycle power supply as that used for tube 25. Stabilizing condensers are shown at 57. Thus, a change of bias on tube 26 will permit current to flow through the winding 18 to move the armature 16 to the right to connect the speaker 12 to the line 8. The filter 51—52 in this instance is tuned to pass a 33 kilocycle impulse of supersonic frequencies which will be impressed on tube 26 when the switch 34 is closed, which results in the connecting of the speaker 12 to the line 8.

Referring now to the switching of speaker 13 to and from line 8, tube 27 is connected to the signal line 8 over blocking condensers 58, a filter inductance 59, a filter tuning condenser 60, and a grid blocking condenser 64. The tube 27 is biased over a grid leak resistor 61 from a potentiometer

resistor 62. The anode of the tube 27 is supplied from the 60 cycle power supply over conductors 63. Stabilizing condensers are shown at 71. The filter 59—60 in this instance is also tuned to pass a 40 kilocycle impulse, which, when received on tube 27 energizes the disconnect coil 22 to disconnect the speaker 13 from the line. Since filter 42—43 and filter 59—60 are both tuned to the 40 kilocycles, the closing of switch 36 will energize both tubes 25 and 27, and thus disconnect both speakers from the line simultaneously.

Tube 28 is similarly connected to the line 8 over blocking condensers 65, a filter tuning inductance 66, a filter tuning condenser 67, and a grid blocking condenser 72, while the grid of the tube 28 is biased over grid leak resistor 68 from a potentiometer 69, stabilizing condensers being shown at 78. The anode of the tube 28 is supplied from the 60 cycle power supply over conductors 70. The filter 66—67 is tuned to 38 kilocycles, and the winding 23 is energized when the switch 35 is closed. Thus, to control the connection and disconnection of the two speakers to and from the signal channel, switch 36 is closed to disconnect both speakers, and then either switch 34 or 35 or both may be closed to connect to the line whichever speaker is desired. A telltale may be located at the switches to indicate which speaker or speakers are connected to a line at any time. It is to be understood that other speakers may be similarly controlled by using a different supersonic frequency for each speaker to connect it to the line, while the same 40 kilocycles, or some other frequency, may be used to disconnect all the speakers.

Referring now to Fig. 2, an announcing channel is shown with a microphone 73, an amplifier 74, main conductors 75, and branch conductors 76 feeding a loud speaker 77. Other loud speakers and switching circuits may be connected to the main conductors 75, as indicated. In the lower of branch conductor 76 for speaker 77 is a mechanical relay 80 having an armature 81, a disconnect winding 82, and a connect winding 83, similar to the relays 15 and 20 shown in Fig. 1. For controlling the relay 80, a pair of gas tubes 85 and 86 are employed connected in push-pull arrangement. The anode supply for these tubes is from a 60 cycle power supply as indicated over conductors 88 through the two windings 82 and 83. Equal value positive bias resistors are shown at 89 and 90 with respective stabilizing bypass condensers 91 and 92, it being noted that the cathode of tube 85 is connected to the anode of tube 86 through relay winding 83, and the cathode of tube 86 is connected to the anode of tube 85 through relay winding 82 over conductors 94 and 95, respectively. The inputs of the tubes 85 and 86 are connected to the main conductors 75 over a pair of blocking condensers 97, a filter tuning inductance 98, a filter tuning condenser 101, grid blocking condensers 99, and grid leak resistors 100. Thus, the input of the tubes 85 and 86 are tuned to a predetermined supersonic frequency, the bias on each tube being adjusted so that it operates only over its positive half cycles.

The switching energy is supplied from an oscillator 105 which comprises a tube 106 connected to the line 75 over transformer 107 and condensers 108. Anode potential is supplied to the tube over an inductance 110, while the filament and cathode heating current is supplied from a 60 cycle power source over a transformer 112 and conductors 113. Other sources of phasing

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voltage may be used, although the simplest is the usual 60 cycle supply. An adjustable feedback inductance is shown at 115, a bias resistor being shown at 116 with its bypass condenser at 117. For tuning the oscillator to different frequencies, a plurality of condensers 120, 121, 122, and 123 are shown, any one of which may be connected into the circuit by the closing of respective switches 125, 126, 127, and 128. As indicated in the drawing, the closing of the switches will tune the oscillator to supersonic frequencies, such as 27, 33, 38, and 47 kilocycles. For instance, the closing of switch 125 will tune the oscillator so that a frequency of 27 kilocycles is impressed upon the line 75 and if the filter 98—101 is tuned to this frequency, the impulse will be transmitted to trigger either tube 85 or tube 86 in accordance with the position of double-pole double-throw switch 130 and the relative phasing of the 60 cycle current sources at 88 and 112. If one position of switch 130 triggers tube 85, the other position of the switch will trigger tube 86.

Explaining the operation of the circuit of Fig. 2, only one supersonic carrier frequency is used to operate the relay 80 in both directions. If it is desired to connect the speaker 77 to the line 75, the switch 125 is closed to generate a 27 kilocycle frequency which will be received by the tubes 85 and 86 if the filter 98—101 is tuned to this frequency. Now, with the switch 30 thrown to its upper position, the 27 kilocycle carrier frequency will be modulated in a certain phase by the 60 cycle frequency impressed upon the control grid of the tube. That is, the bias on the tube 106 is adjusted so that only the positive half of each cycle of the 60 cycle frequency controls the amplitude of the carrier when the switch 130 is thrown to its upper position, and only the negative half of each cycle of the 60 cycle frequency controls the amplitude of the carrier when the switch 130 is thrown to its lower position. Assuming the proper phase relationship exists between A—C sources at 112 and 88, the 27 kilocycle carrier will be modulated to cause the tube 86 to trigger to supply energy to winding 83, which will move the armature 81 to the right and connect speaker 77 to the line. With this phase relationship established, the closing of switch 130 in its lower position will modulate the carrier in the opposite phase and the tube 85 will be triggered to energize winding 82 and disconnect the speaker 77 from the line. Thus, the modification shown in Fig. 2 utilizes only a single carrier frequency for both connecting and disconnecting a speaker to and from the line, differentiating from the modification shown in Fig. 1, wherein one carrier frequency was used for connecting a speaker, and a second carrier frequency was used for disconnecting the same speaker.

With the systems shown in Figs. 1 and 2, multiple relay arrangements may be used for connecting and disconnecting a plurality of speakers by using a predetermined combination of several carrier frequencies as shown in Fig. 1, or two carrier frequencies and modulating said frequencies similarly to that shown in Fig. 2. In Fig. 3, a standard announcing channel is represented by a microphone 135, an amplifier 136, main line conductors 137, and a plurality of speakers A, B, and C with a speaker D shown in dotted lines. A single armature relay is shown at 139 with an armature 140, a winding 141, and a winding 142, while a double armature relay is shown at 144 with a first armature 145, a second armature 146,

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a winding 147, and a winding 148. The oscillator of Fig. 2 is shown diagrammatically at 150 with a control switch 151 and a plurality of key switches 152, 153, 154, and 155 to diagrammatically indicate multiple tuning of the oscillator 150. The oscillator is coupled to the line 137 by blocking condensers 158.

It may be assumed, for purposes of illustration, that the windings 141 and 142 are connected to gas tubes similar to tubes 85 and 86 in Fig. 2, while the windings 147 and 148 are similarly connected, although the input circuit for the tubes controlling windings 141 and 142 is tuned to one supersonic frequency, such as 27 kilocycles, while the input circuit for the tubes controlling windings 147 and 148 are tuned to a different supersonic frequency, such as 33 kilocycles. Winding 141 is energized when switch 151 is in its upper position, and switch 152 is closed, and winding 142 will be energized when switch 151 is in its lower position and switch 152 is closed. Similarly for windings 147 and 148 when switch 153 is closed.

To explain the operation of this circuit, if it is desired to connect only speaker A to conductors 137, key switch 152 is closed to generate a carrier frequency of 27 kilocycles. The switch 151 is then thrown to its upper position which will energize winding 141 and throw armature 140 to the left. Switch 152 is then opened and switch 153 is closed, which will energize winding 147 and move armatures 145 and 146 to the left, so that a circuit is now closed from the main line 137 over conductor 160, armature 140, conductor 161, armature 145, conductor 162, speaker A, and conductor 163 back to the main line conductors 137. To connect speaker B to the line, the switch 153 is closed and the switch 151 thrown to its lower position to actuate armatures 145 and 146 to the right, thus providing a circuit over conductor 160, armature 140, conductor 161, armature 145, conductor 165, speaker B, and conductor 166 back to the main channel.

To connect only speaker C to the line, the key 152 is closed with the switch 151 in its lower position to move armature 140 to the right, after which key 152 is opened. The switch 151 is then thrown to its upper position and the key 153 closed to move armatures 145 and 146 to their left-hand position to provide a circuit over conductor 160, armature 140, conductor 168, armature 146, conductor 169, speaker C, and conductor 170 back to the main channel. Thus, any one of speakers A, B, and C may be connected to the line as indicated above. If any one of the three speakers A, B, and C is to be disconnected, this may be accomplished by moving armatures 145 and 146 to the right with armature 140 in its right-hand position. In this position, all of speakers A, B, and C are disconnected, but, if desired, armature 146 may make an additional contact to connect a fourth speaker D to the line, as indicated by the dotted lines. Although only one combination of relays is shown, it is to be understood that other combinations may be arranged for connecting and disconnecting a plurality of speakers in any desired combination.

From the above description, a switching system is provided whereby a plurality of speakers at different locations remote from the controlling point may be connected and disconnected to an announcing or public address system at will, the connecting and disconnecting being accomplished during the actual transmission of signals over the channel, the same conductors being used for

both the transmission of the switching impulses and the announcing signal.

I claim as my invention:

1. In a communication system a source of signal currents, an amplifier for said currents, a plurality of reproducers connectable to said amplifier for reproducing said currents in different locations, and switching means for selectively connecting and disconnecting said reproducers from said amplifier, said means including a supersonic oscillator, means for connecting said oscillator to the output of said amplifier, and a plurality of relays selective to certain supersonic frequencies generated by said oscillator one of said supersonic frequencies connecting said reproducer to said amplifier and another of said supersonic frequencies disconnecting said reproducer from said amplifier.

2. In a communication system, a source of signal currents, an amplifier for said currents, a plurality of reproducers connectable to said amplifier for reproducing said currents in different locations, and switching means for selectively connecting and disconnecting said reproducers from said amplifier, said means including a supersonic oscillator, means for connecting said oscillator to the output of said amplifier, and a plurality of relays selective to certain supersonic frequencies generated by said oscillator for actuating said connecting means, said relays including gaseous vacuum tubes adapted to be energized by different supersonic frequencies.

3. In a communication system, a source of signal currents, an amplifier for said currents, a plurality of reproducers connectable to said amplifier for reproducing said currents in different locations, and switching means for selectively connecting and disconnecting said reproducers from said amplifier, said means including a supersonic oscillator, means for connecting said oscillator to the output of said amplifier, and a plurality of relays selective to certain supersonic frequencies generated by said oscillator for actuating said connecting means, certain of said relays controlling the disconnecting of said reproducers from said amplifier, said disconnecting relays being energized by a predetermined supersonic frequency generated by said oscillator, and other of said relays controlling the connecting of said reproducers to said amplifier, each of said connecting relays being energized by different individual supersonic frequencies generated by said oscillator.

4. A communication system comprising a source of signal currents, an amplifier for said currents, output conductors from said amplifier, a plurality of signal reproducers positioned at remote points from said amplifier and connected to said conductors, mechanical relays for connecting and disconnecting said reproducers to and from said conductors, a generator selectively tunable to a plurality of supersonic frequencies, means for connecting said oscillator to said conductors, a plurality of gaseous relays, and means for connecting said gaseous relays to said conductor, said last mentioned means including means for passing a predetermined band of frequencies, and means for energizing said gaseous relays to actuate said mechanical relays in accordance with the supersonic impulses received by said gaseous relays.

5. A communication system in accordance with claim 4, in which a gaseous relay is provided for each reproducer for controlling the

connecting of said reproducers to said conductors and a gaseous relay is provided for each reproducer for controlling the disconnecting of said reproducers from said conductors, said disconnecting relays being operable on the same supersonic frequency.

6. A communication system in accordance with claim 4, in which said oscillator frequency is adapted to be modulated in two phases, one of said gaseous relays being actuated by a supersonic frequency modulated in one phase and another gaseous relay being actuated by the same supersonic frequency modulated in the opposite phase to said first phase.

7. A communication system for selective coverage of a plurality of different listening areas comprising a source of signals, an amplifier for said signals, an output line from said amplifier to a plurality of listening areas, a plurality of speakers at said listening areas connectable to said line, a switching circuit connected to said line for connecting and disconnecting a respective speaker to and from said line, and a source of switching signals at a point remote from said speakers, said source of switching signals being connected to said line, and including an oscillator of supersonic frequencies and means for modulating said frequencies in two phases.

8. A communication system for selective coverage of a plurality of different listening areas comprising a source of signals, an amplifier for said signals, an output line from said amplifier to a plurality of listening areas, a plurality of speakers at said listening areas connectable to said line, a switching circuit connected to said line for connecting and disconnecting a respective speaker to and from said line, and a source of switching signals at a point remote from said speakers, said source of switching signals being connected to said line, said source of switching signals including an oscillator of supersonic frequencies, a low frequency source, and means for modulating said supersonic frequencies with the positive portions of said low frequency at one time and the negative portions of said low frequency at another time.

9. The method of selectively switching a plurality of speakers to and from a signal channel and over the signal channel conductors, comprising generating a plurality of switching signals each having a different supersonic frequency and impressing one of said supersonic frequencies on said channel in accordance with the speaker selected to be connected to said channel and impressing another of said supersonic frequencies on said channel to disconnect said selected speaker from said channel.

10. The method in accordance with claim 9, in which another one of said supersonic frequencies is impressed on said channel to disconnect all of said speakers from said channel.

11. The method in accordance with claim 9, in which each of said supersonic frequencies is modulated with the positive portions of a low frequency signal to connect a certain speaker to said channel and modulated with the negative portions of said low frequency signal to disconnect said speaker from said channel.

12. A switching system for a plurality of speakers connectable to a signal channel comprising a double contact relay, a quadruple contact relay, means for individually actuating said relays, a plurality of speakers connected to the contacts of said quadruple contact relays, and means for actuating each of said relays in two

directions to connect any one of said speakers to said channel at any certain time.

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