Voice Switched Microphone Control System

Inventor: Max Vernon Mathews, New Providence, N.J.
Assignee: Bell Telephone Laboratories, Incorporated, Murray Hill, N.J.
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Primary Examiner—Kathleen H. Claffy
Assistant Examiner—Douglas W. Olms
Attorney—R. J. Guenther et al.

Abstract

Voice activated control apparatus selectively connects one of a plurality of microphones to an audio line and inhibits all other microphones from capturing the line while the initial connection is maintained. Each microphone is connected to an associated speech detector and relay. In response to voice signals from a microphone, the associated speech detector activates a relay which connects the microphone to the line and generates a signal which inhibits the other relays. Other users cannot interrupt the present speaker because their relays remain inhibited as long as the speaker continues. The same circuitry can accommodate any number of microphones.

1 Claim, 1 Drawing Figure
VOICE SWITCHED MICROPHONE CONTROL SYSTEM

FIELD OF THE INVENTION

This invention relates to audio systems and, more specifically, to systems for selectively connecting speech circuits to an audio line in response to voice signals.

BACKGROUND OF THE INVENTION

In classrooms and auditoriums it has been customary to employ a number of microphones in various locations within the room in order that questions and comments by members of the audience may be heard by others. The voice signals input into the microphones are amplified and conveyed through loud speakers to the immediate audience. If desired, the signals may also be transmitted to select individuals via the telephone system, or to the public at large via the broadcast media.

In such systems, difficulties arise when more than one user speaks at the same time. Since all the microphones have equal access to a central amplifying system, more than one set of voice signals is concurrently amplified. Thus, an unintelligible combination of speech is often transmitted to the audience. To avoid this difficulty, human monitors are often employed to insure that only one member of the audience is afforded access to a microphone at a given time.

In order to overcome this problem, other systems employ sophisticated speech detectors and complicated logical gating arrangements to first determine which microphones are being used and then to selectively connect one of these microphones to the audio line. The selection is made by comparing signal strengths in a centralized logic arrangement. The microphone used by the loudest talker is connected to the line. Such systems are a great improvement over those previously used since the speech of a single user rather than from a multitude of users is conveyed to the audience at a given time. However, since the loudest user gains access to the audio line even if he interrupts one who is presently talking, there is a great tendency for an anxious questioner to interrupt the present user before he has concluded his discussion. It is conceivable that a shouting match might develop when several users, each wishing to be heard, speak successively louder in order to capture the system's output.

Furthermore, since these systems are fairly complex, they are not as flexible as prior systems since the central logic has to be altered when a microphone is added to the system. Such alterations require adding additional logic.

It is an object of this invention to selectively connect a microphone to an audio line in response to voice signals and to inhibit all other microphones from capturing the line as long as the present speaker continues to speak.

It is a further object of this invention to connect or disconnect any number of microphones from the system without either interrupting system operation or requiring an alteration in system logic.

SUMMARY OF THE INVENTION

The present invention stems from the recognition that by decentralizing the decision making apparatus the versatility of simpler microphone systems is retained while gaining an additional inhibiting feature. Each microphone is connected to an associated device which autonomously determines whether to connect that microphone to the audio line given the information specifying whether one of the other microphones is presently connected to the line.

In accordance with one illustrative embodiment of the principles of this invention, control apparatus selectively connects one of a plurality of microphones to an audio line and inhibits all other microphones from capturing the line while the initial connection is maintained. Each microphone is connected to an associated speech detector and relay. The microphone, speech detector and relay form a self-contained module which may be plugged in or out of a single cable without interfering with the operation of the other modules.

When a user speaks into his microphone, the associated speech detector detects the speech and activates the associated relay. The relay connects the microphone to the audio line and grounds a control line which inhibits the other relays. As long as the user continues talking, his microphone remains connected to the audio line and the other relays are deactivated by the grounded control line. When the user completes his talk, his microphone is disconnected from the audio line and the ground is removed from the control line. Other users are then able to capture the audio line. The speech detectors have a built-in time delay to bridge the pauses between spoken words.

GENERAL DESCRIPTION

The single FIGURE is a schematic block diagram of an illustrative microphone control system embodying the principles of this invention. When spoken into, each of the microphones $M_1, \ldots, M_N$ bids for access to the audio line $10$. When a microphone is subsequently connected to the audio line, the voice signals input into the microphone are conveyed to amplifier $11$ which amplifies the signals for transmission and subsequent conversion to audible speech. The other microphones are inhibited from capturing the audio line while the initial connection is maintained.

Each of microphones $M$ is connected to an associated speech detector $SD_1, \ldots, SD_M$. Each of speech detectors $SD$ comprises filters for distinguishing voice frequencies and a logical arrangement for outputting a predetermined positive voltage over its respective output line $A_1, \ldots, A_N$ when it detects speech. When no speech is detected, each of the speech detectors grounds its respective output lead $A$. To allow for pauses which occur in normal speech, each of the speech detectors has sufficient hysteresis so that the output signals remain at the positive voltage during gap between words.

Bus $1$ which houses control line $14$, audio line $10$, power line $12$, and ground line $15$ may be a single cable with access ports at conveniently spaced distances. Each of the microphone units $MU_1, \ldots, MU_N$ preferably is a self-contained module which may be easily plugged in or out of bus $1$. The bus may be positioned along an
arbitrary path in a room and the microphone units plugged in where they are needed.

It should be noted that the Figure employs a type of notation referred to as "detached contact" in which an "X" represents a normally open contact of a relay, and a bar, shown intersecting a conductor at right angles, represents a normally closed contact of a relay; "normally" referring to the unoperated condition of the relay.

**SPECIFIC DESCRIPTION**

The operation of the control system shown in the Figure is best understood by considering three illustrative cases. In the first case, voice signals are input into one of the microphones at a time and when all of the microphones are disconnected from the audio line. In the second situation, a microphone user attempts to access the line while another microphone remains connected to the line. Finally, a microphone connected to the line is disconnected when voice signals are no longer input into the microphone.

Turning now to the first situation, all of the microphones M are disconnected from audio line 10. Since speech is not detected by any of the speech detectors SD, output leads A are all at ground potential. Current flows from power source 13 over power line 12 through each of the resistors R1, ... Rn and through each of the diodes D1, ... Dn to ground (via output leads A). Diodes D are forward biased and each of the points X1, ... Xn is at a voltage equal to the voltage drop across its respective diode D (nearly about 0.7 volts). Diodes DA1, ... DAn are substantially not in conduction and control line 14 floats.

The user of microphone M1 wishing to capture the audio line speaks into his microphone. Speech detector SD1, in response to the voice signals places a positive potential on the previously grounded lead A1. The positive potential reverse biases diodes D1. The current from resistor R1 flows through relay winding W1 activating the relay. Relay contact W1 - B closes connecting microphone M1 to audio line 10 via line L1. Contacts W1 - A also operate both disconnecting diode DA1 from control line 14 and grounding control line 14. As long as speech detector SD1 detects speech from microphone M1, a positive potential is conveyed over lead A1, and relay W1 remains operative.

While control line 14 remains grounded by relay W1, the other relays W2, ... Wn are inhibited from operating. Current flows through resistors R2, ... Rn through forward biased diodes DAn, ... DAr to ground control line 14. Thus points X2, ... Xn are slightly above ground potential and insufficient current flows through relay windings W2, ... Wn to activate these relays.

Now consider the second situation which illustrates the inhibiting feature of the control system. The user of microphone M2 speaks into his microphone and attempts to interrupt the user of microphone M1 who has previously captured audio line 10. Speech detector SD2 in response to the voice signals from microphone M2 places a positive potential on lead A2 reverse biasing diode D2. Relay W2 does not operate because point X2 still remains just above ground potential because diode DA2 is forward biased through relay contact W1-A to grounded control line 14. Control line 14 remains grounded by the continuing activation of relay W1 in response to speech signals from microphone M1. Thus, as long as control line 14 remains grounded in response to voice signals from a microphone, all the other microphones are inhibited from capturing audio line 10 since their associated relays are inhibited from operating.

In the third case, the user of microphone M1 completes talking and thereby relinquishes his grasp over audio line 10. Speech detector SD1, when it no longer detects voice signals from microphone M1, grounds lead A1. Diode Dl goes into forward conduction, the voltage at point X1 drops, and relay W1 deactivates due to insufficient current through relay winding W1. Relay contacts W1-A and W1-B return to their normal positions. Relay contact W1-B opens disconnecting microphone M1 from audio line 10. Control line 14 floats when contact W1-A disconnects the ground from the line. Now each of the users of microphone M is afforded an equal opportunity to access audio line 10.

What is claimed is:

1. A voice activated switching system for selectively connecting one of a plurality of speech circuits to an output line and for inhibiting the connection of all others of said speech circuits to the line while the connection is maintained, which comprises:
   a plurality of circuits for conveying speech,
   a speech detector associated with each of said circuits for generating a first signal coincident with speech signals applied from that one of said speech circuits associated therewith,
   an output line for conveying speech,
   generating means for developing control signals,
   switching means associated with each of said speech circuits and its associated speech detector wherein each of said switching means is deactivated by control signals and activated, in the absence of said control signals, by said first signal generated by said associated speech detector,
   a control line connected to each of said switching means for conveying control signals, and
   switching contacts associated with each of said switching means which when activated by said associated switching means connect with associated speech circuit to said output line, disconnect said associated switching means from said control line, and connect said generating means to said control line.