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TONE GENERATOR WITH DIRECTIVITY CUES

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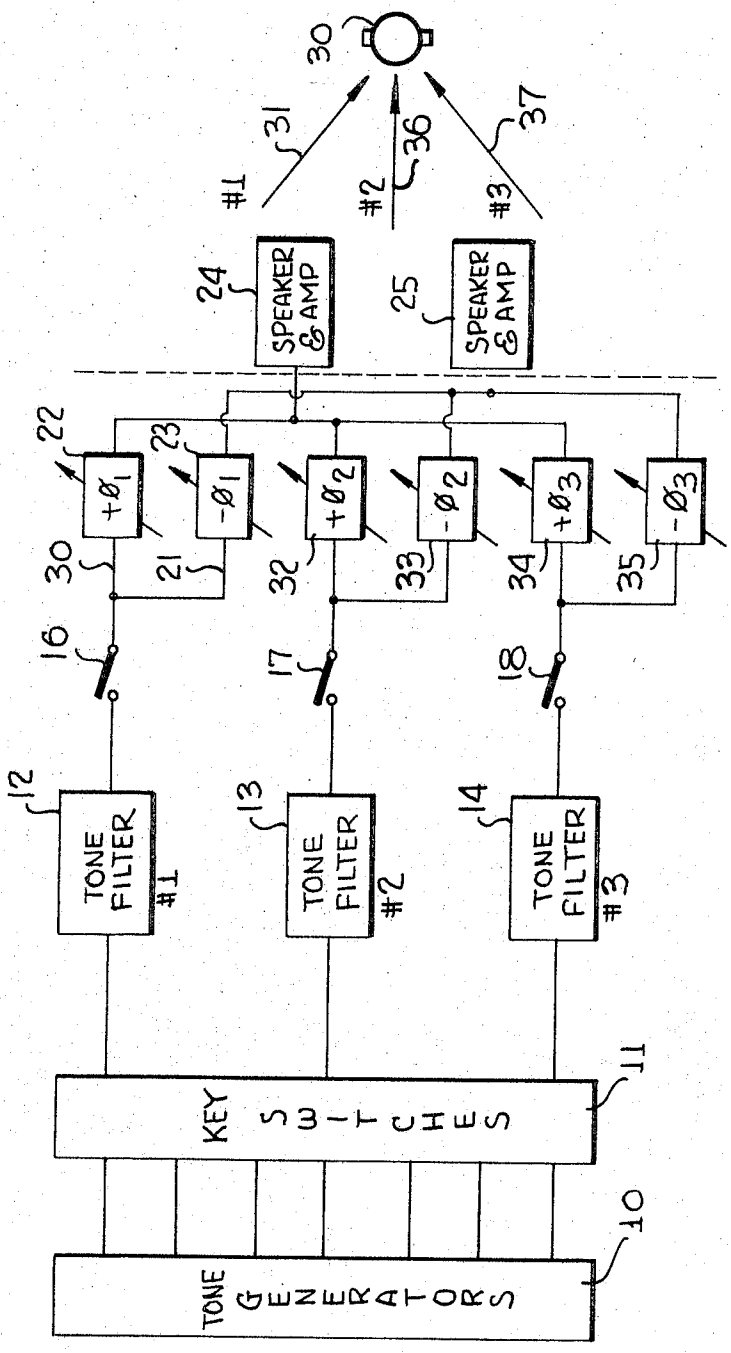

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TONE GENERATOR WITH DIRECTIVITY CUES

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The present invention relates generally to electronic organs and more particularly to systems for radiating different voices as if they originated from different directions, by means of only two speakers.

Current practice in acoustic radiation of organ music is to employ a single speaker, or if several speakers are employed these are sub-divided on a frequency basis, or additional speakers are employed for special effects, such as reverberation.

It is generally considered good practice in respect to electronic organ practice to simulate pipe organs in every possible respect. In the latter case different voices orginate in different locations. To accomplish this result for electronic music, following past techniques, requires a separate speaker and power amplifier for each voice which has a different direction of origin.

The last mentioned solution is uneconomic of both equipment and space. Many organs have twenty or more voices, and to provide different apparent sources, for all or most of these would involve a great deal of equipment.

It is a feature of the present invention to provide apparently different directions of origin for many or all voices of an electric organ, by means of only two speakers for all the voices. This is accomplished by introducing direction cues into the music, the cues being arranged to provide the requisite directivities. It is well known that the human being determines direction from which a sound originates by sensing phase and amplitude differences among the frequency components of the sound. These differences are called cues. The human mind is capable, on the basis of these cues, of computing direction of apparent origin of sound. Once computed, the human mind is capable of excluding from the scope of its attention all sounds divergent from the computed directions.

Use is made of the facts presented in the preceding paragraph, by imparting to each separate voice of an electric organ, in two separate channels, two separate phases (and amplitudes, if desired). These are selected so as to provide apparent directivity for each voice, and the directivities are selected to simulate the derivatives of corresponding voices in pipe organs.

The above and still further objects, features and advantages of the present invention will become apparent upon consideration of the following detailed description one specific embodiment thereof, especially when taken in conjunction with the accompanying drawings, wherein:

The single figure of the drawing is a block diagram of a simplified system according to the invention.

In the single figure, **10** represent tone generators of an organ. These may be independent sinusoidal generators, or frequency divider chains, or the like, the invention not depending on the character of the tone generators. Tone generators are selected by key switches **11**, as the organ is played, and the selected tones applied to a set of tone form ing filters, as **12, 13, 14**, each having a different voice. The outputs of the filters are selected by switches **16, 17, 18**, respectively. The system as described to this point, briefly, is completely conventional and is descriptive of most commercial organs, as the Lowrie, the Conn, the Baldwin, the Allen, etc.

In accordance with the present invention, tone deriving from tone filter **12** is divided into two channels, **20, 21**. The channels are provided with phase shifters **22, 23**, of which one may provide a delay and the other an advance. The outputs of the phase shifters may be applied to separate speakers **24, 25** which are space separated by any convenient amount.

By properly selecting the phases, or more basically the relative phase delays in the channels, the voice provided by filter **12** may be caused to appear, to the listener **30**, to originate from a direction **31**.

The filters **13, 14** may be connected to the same speakers **24, 25**, via other phase shift networks **32, 33** and **34, 35**, designed to provide directivities **36, 37** respectively.

Amplitude cues may also be provided by including suitable attenuation in the phase shifters. Many simple phase shifters are known, as RC networks, bridges, T-networks, and the like, so that attenuation is inherently provided in the phase shift network, and attenuation should be given to so designing the network that amplitude transfer functions exist, or at least do not oppose, phase transfer functions in providing cues.

The phase shift networks **22, 23, 32, 33, 34, 35** may be made adjustable, to enable variation of apparent directivities to suit various organ installations, according to the mood of the designer or installer, the mood of the musician.

While I have described and illustrated one specific embodiment of my invention, it will be clear that variations of the details of construction which are specifically illustrated and described may be resorted to without departing from the true spirit and scope of the invention as defined in the appended claims.

What I claim is:

1. An organ system comprising a tone generator, key switches for selecting tones from said tone generator, and tone forming filters in cascade with said key switches, the combination of a pair of space separated loudspeakers, coupled at will to any of said tone forming filters and means for imparting different directivity cues to tones passing between said tone forming filters and said pair of loudspeakers for each of said tones forming filters, whereby different voices of the organ system may be caused to have different apparent directivities as sensed by listeners.

2. The combination according to claim **1** wherein said means comprises a pair of phase shifters for each of said tone forming filters and coupled thereto, one of said pair of phase shifters being coupled to one of said pair of space separated loudspeakers and the other of said pair of phase shifters being coupled to the other of said space separated loudspeakers.

3. The combination according to claim **2** wherein each of said pair of phase shifters is selectively variable so that phase relations between the tone coupled to said one of said space separated loudspeakers and the tone coupled to the other of said spaced separated loudspeakers may be selected, whereby the apparent directivity of said tone may be selectively controlled.

4. The combination according to claim **3** wherein said phase shifters have a range of phase shift ranging from phase advance to phase delay whereby phase advance may be applied to one of said space separated loudspeakers and phase delay may be applied to the other of said spaced separated loudspeakers.

5. The combination according to claim **3** wherein said phase shifters include attenuators.

6. An organ system, comprising a tone generator, a first loudspeaker, a second loudspeaker, said loudspeakers being separated spatially sufficiently to provide stereophonic directional effects to a listener, means for directing tones generated by said tone generator to said speakers via separate channel pairs, and means for imparting to the tones in the separate channel pairs diverse characteristics pertaining to directional cues.

7. The combination according to claim **6** wherein is provided different tone forming filter means connected in cascade with different ones of said channel pairs.

8. The combination according to claim 6 wherein is provided means for imparting to each of said channel pairs only selected ones of said tones fewer than the total tones within the capability of said tone generator.

9. In a sound system,
a source of wide band audio signals,
means applying said audio signals existing in predominantly diverse parts of the audio spectrum into at least three different channels,
a pair of loudspeakers spatially separated sufficiently that stereophonic effects are evident to the listener, and
means for imparting diverse directivity cues to tones passing from each of said at least three different channels to said pair of loudspeakers.

10. In an electric organ system,
a tone generator system providing a wide band of audio signals in response to actuation of playing keys,
means for separating said audio signals into at least three diverse separate channels on a frequency basis,
only two loudspeakers spatially separated sufficiently that stereophonic effects are evident to the listener, and
means for imparting diverse directivity cues to signals passing from each of said at least three diverse separate channels to said only two loudspeakers.

11. In a sound system,
a source of wide band audio band representing music,
means for deriving at least three audio sub-bands from said audio band in separate channels,
a pair of loudspeakers separated sufficiently that stereophonic effects are evident to the listener, and
means for imparting diverse directivity cues to each of the different ones of said at least three sub-bands in said separate channels in passing from said first mentioned means to said pair of loudspeakers, whereby said different sub-bands have different apparent activities as sensed by said listener.

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