ABSTRACT

A stereophonic device that includes headphones for receiving at least four channels of information to provide a full panorama of sound. The speakers in each of the earpieces of the headphone are arranged in side-by-side spaced relation. A jack for connecting multi-channel headphones to a suitable source has means permitting capacitive coupling between the channels connecting the source to the speakers.

13 Claims, 10 Drawing Figures
STEREOPHONIC TRANSDUCER ARRANGEMENT


This invention relates to stereophonic devices and more particularly to a stereophonic headphone and a multichannel jack permitting capacitive coupling between the channels.

Stereophonic headphones have been in use for many years. They have been developed to a high degree of sophistication and are capable of faithfully transducing electronic signals into sounds that are virtually identical to those that would be heard if the listener were in the presence of the sound source itself. However, as more fully explained in the above-noted patent application, stereophonic headphones suffer from the characteristic of causing the listener to perceive the sound as emanating from the center of his head. Thus, while stereophonic headphones produce differential left-right characteristics, they are not capable of producing a true panorama of sound. Thus, it is the purpose of the present invention to provide stereophonic headphones which are capable of producing the effect of a true panorama of sound as set forth in the above-noted patent application, and at the same time presenting an arrangement of elements which is useful in designing a highly stylized and uniquely appearing device.

Additionally, jacks known heretofore for connecting stereophonic headphones to an audio signal source have been rather simple, crude devices. By this it is meant that the jacks comprised a simple means for completing a circuit to each of the speakers in the headphone set. The most familiar type of jack is the "plug-in" type, wherein an elongated member attached to the headphone is inserted into a recess in the audio signal source to complete a circuit to a particular speaker. When more than one speaker is utilized a gang of such projecting members and recesses have been employed.

The prior art type of jacks have failed to provide an opportunity for a listener to control the separation of signals into the various channels. Such a device would be particularly suitable for stereophonic headphones of the type utilizing two or more speakers adjacent to each ear of the listener. The capability of intermixing the sound in adjacent channels is particularly desirable in order to enhance the stereophonic characteristics of the headphones and to more completely realize the desired panorama of sound.

Generally, the invention relates to stereophonic headphones for a four-channel system, comprising a support, first and second enclosures to be positioned over the ears of the listener carried by said support, each of said enclosures including an inside wall to lie adjacent an ear and an outside wall faced outwardly from said inside wall, said inside walls having an opening for the emission of sound into the ear of a listener, at least two audio transducers in each of said enclosures for transducing electronic signals into sound, each of said audio transducers being supported in said enclosures in spaced relation from said inside wall and in spaced, substantially side-by-side relation to each other, and baffle means interposed between said audio transducers in each of said enclosures.

Furthermore, the invention also includes, generally, a jack for completing at least two circuits between an audio signal source and an audio signal receiver comprising a housing, first and second adjacent, spaced elements supported by said housing in side-by-side relation, said first and second elements corresponding to said first and second circuits and being electrically connected to a signal source, a carrier adapted to be removably connected to said housing, first and second adjacent spaced members supported by said carrier in side-by-side relation, said first and second members being aligned with and contacting said first and second elements respectively when said carrier is connected to said housing to thereby complete said first and second circuits between said signal source and said signal receiver, and dielectric means supported by said carrier for axial movement into the space between said first and second adjacent members so that current variations in each of said circuits cause corresponding current variations in the adjacent circuit.

Accordingly, it is an object of the present invention to provide a new and improved stereophonic headphone.

It is a further object of this invention to provide a new and improved jack for connecting an audio signal source and an audio signal receiver wherein means are provided for permitting the signals in adjacent channels to influence each other.

Other objects and advantages of the invention will appear herein.

For the purposes of illustrating the invention, there are shown in the drawings forms which are presently preferred; it being understood, however, that this invention is not limited to the precise arrangements and instrumentalities shown.

FIG. 1 is a plan view of headphones constructed in accordance with the present invention.

FIG. 2 is a sectional view taken along line 2-2 of FIG. 1.

FIG. 3 is a sectional view taken along line 3-3 of FIG. 1.

FIG. 4 is a sectional view taken along line 4-4 of FIG. 1.

FIG. 4a is a perspective view of a jack constructed in accordance with the present invention mounted in a housing.

FIG. 5 is a sectional view taken along lines 5-5 of FIG. 4a, showing the plan of a jack constructed in accordance with the present invention.

FIG. 6 is a partial sectional view taken along line 6-6 of FIG. 5.

FIG. 7 is a partial sectional view taken along line 7-7 of FIG. 5.

FIG. 8 is a sectional view taken along line 8-8 of FIG. 5.

FIG. 9 is a partial sectional view taken along line 8-8 of FIG. 5.

Referring now to the drawings in detail, wherein like numerals indicate like elements, there is shown in FIG. 1 a pair of stereophonic headphones designated generally at 10.

As shown, the headphones 10 include first and second housing 12 and 14 which are pivotally mounted on a support bracket 16. The bracket which may be made of any conventional material is preferably provided with a closed conduit 18 through which suitable interconnection conductors between the headphones can be
threaded. Additionally, if desired, the side of the bracket adjacent the head of the wearer may have a layer of foamed plastic 19. The housings 12 and 14 may be connected to the bracket by suitable pins 24 and 26. The housings 12 and 14 and the bracket 16 are preferably made of the same material to promote uniformity of design and color. Additionally, to further complement this uniformity the inwardly facing portions of the housings 12 and 14 are made of the same foamed plastic as appears on the bracket. The outer portions of the housing are generally elongated hollow members having outer walls 23 and inner walls 24 that define an open space 25 therebetween. Mounted in space 25 are a pair of audio transducers 26 and 28. The transducers are supported on inner wall 24 in spaced longitudinal relation to each other. Each audio transducer takes the form of a 1-inch or 1 and 1/2 inch speaker. Such speakers are available on the market and hence, need not be described in detail. Of course, better quality speakers are preferable in order to obtain a more faithful audio reproduction of the electronic signal.

As best seen in FIGS. 1 and 3, audio transducers 26 and 28 are in side-by-side spaced relation to each other. It is to be noted that for the purposes of achieving a unique design of the headphones the speakers are placed so that their centers are aligned with bracket 16. This arrangement permits the bracket to be worn across the back of the head, rather than over the head.

The aforementioned opening through which sound emanates is defined by louvers 32 which are centrally positioned in wall 24. The louvers are preferably disposed horizontally. Additionally, it should be noted that the foamed plastic connected to the inside wall 24 completely covers that wall with the exception of an opening 34 immediately overlying the louvers 32. The louvers are mounted so that vibration due to resonance is substantially eliminated. A preferred manner of achieving this is by coating the louvers with cloth. In this regard it should be noted that the perimeter defined by opening 34 is sufficiently large so that the ear of a listener is completely enveloped thereby. That is, sound emanates directly from the louvered openings directly into the ear without being transmitted through the foamed plastic. It is important to minimize the contact between the foamed plastic and the listener’s ear since it is possible for the foam to conduct the sound from the speakers to the ear.

As thus positioned within the housings 12 and 14, the audio transducers 26 and 38 carry a sound pattern which provides a full panorama effect to the listener. In other words, to the listener, the sound seems to be directed at him along a continuum extending fully from his left side to his right side.

To further increase the stereo separation between paired speakers within each housing 12 and 14 a suitable sound divider is provided. A preferred form of divider is a generally V-shaped member 36, having its base fixed to the outside walls 23 and its apex adjacent the louvers 32. The points of connection of the membrane to the outside wall can be spaced from each other a greater or lesser distance so that the generally V-shaped configuration of the membrane can be set to a preferred distance. If desired, the membrane may be made of a stretchable plastic material so that the listener may adjust it.

In operation, each audio transducer is connected to one track of a four track stereophonic system. Such a system may include a four track tape or some other means for generating four distinct electronic signals, each being representative of a particular microphone position for recording sounds generated over measurable distance; e.g., an orchestra or a chorus. As thus positioned within the headphone 10, the transducers generate an effect perceived by the listener as a full panorama of sound and aiming him in all directions. It is not entirely understood why this positioning of the audio transducers produces a panorama of sound. While it had been believed that only those arrangements of audio transducers disclosed and claimed in the above-noted patent application could produce this panorama of sound, it has been found that the arrangement of speakers disclosed herein has surprisingly achieved the same effect.

Referring now to FIG. 4a, a jack 50 particularly suited for connecting stereo headphones, such as those described herein and in the above-noted patent application, to an audio signal source is illustrated.

The jack 50 is shown to comprise a suitable housing 52 which receives a carrier 54 in a cavity 56 therein. The carrier is connected by a conduit 50 to a plurality of speakers which may be arranged in a headphone of the type described.

Referring now to FIG. 5, the interior of the housing which may be an audio amplifier or the like includes a plurality of conductor elements 57 which are connected at their ends to a plurality of wires 58. It is to be noted that for an eight channel system there will be eight wires and eight elements. A common ground connection is made through a metal chassis defined by walls 64. Not shown is a plastic enencasement for the chassis. Since this jack is designed principally to be utilized with a transducing system comprising eight audio transducers, eight such elements 57 are shown. A four channel system would have four elements. The elements are seen to be supported within the interior of housing 52 with their end sticking out slightly past the front wall of the housing.

Each of the elements is connected to an electric circuit by the wires 58 in the interior of the housing. The opposite ends of each element have substantially flat faces 59 which function as contacts in a manner which will be explained.

The carrier 54 may comprise a generally box-like structure having an open end. It comprises spaced top and bottom walls 61 and 62, which support an end wall 63, and opposed side walls 64. Suitable channel members 65, each of which corresponds to one of the aforementioned elements 57, are supported from the top wall 61 of the carrier by suitable support brackets 66. Each of the channel members 65 has a suitable contact face 67 which is substantially parallel to, and positioned for abutting contact with corresponding contact surface 59 on elements 57. A suitable wire 68 extends from the opposite end of each of the channel members 65. All of the wires 68 converge and are carried by the aforementioned conduit 55 to a plurality of audio transducers.

The carrier is adapted to be releasably installed in opening 56 in the face of the housing 52. This is achieved by virtue of the fact that the side walls 64 on the carrier support resilient arms 74 (FIGS. 5 and 9), which support opposed, outwardly directed cylinders.
of magnetizable material 76. The cylinders of magnetizable material are adapted to be received in corresponding opposing spaced recesses 79 in the housing. Normally, the resilience of arms 74 is sufficient to keep the cylinders within the recesses and the carrier locked in position in the housing. However, it may be desirable under some circumstances to provide an auxiliary attachment means. Provision is made for such attachment by the utilization of means for energizing the magnetizable cylinders 76. Such a means comprises energizable coils 80 wrapped around each of the cylindrical recesses 79. The coils may be connected to a circuit 82 which is completed by an external switch, or by any other suitable means. It should be apparent that upon completion of the circuits to the energizable coils the cylinders will be locked in their respective recesses and the carrier will not be removable from the housing. Obviously, the deenergization of circuit 82 will permit the resilient arms to be squeezed inwardly and the carrier released.

Additionally means are provided for permitting the signals transmitted by each of the circuits to influence the next adjacent circuit so that the sounds created by the respective audio transducers can be intermingled. It is well known law of physics that changes in the electric field can be capacitively coupled from a conductor to an adjacent conductor. This law has been utilized advantageously in the subject device to achieve a certain degree of intermixing of adjacent audio signals. While the elements comprising each of the circuits could be spaced rather close together to achieve this desired mixing effect, such an arrangement would be undesirable since the degree of mixing could not be controlled. Thus, the subject device implements the law by having the aforementioned channel members 65 spaced from each other a distance that precludes any substantial interaction therebetween. However, interaction in a selective fashion is achieved by the positioning of elements that are comprised of a suitable electric field supporting resistive material which may be selectively interposed between adjacent channel members 65. The electric field supported by the resistive material is useful in achieving the above-noted interaction.

As best seen in FIGS. 5, 7 and 8, the resistive material is generally in the shape of elongated substantially rectangular, flat bars 84 which are mounted on a slide bar 86. The slide bar which is disposed transversely of the carrier is wider than the distance between the aforementioned side walls 64 so that it extends outwardly on either side through slots 87. If desired, the slide bar may have enlarged ends 88 to facilitate grasping.

Referring to FIGS. 7 and 8 it can be seen that the resistive members 84 are disposed between adjacent channel members 65 and are higher than those channel members so that uniform interrelation of those members is achieved.

Each bar 84 is comprised of a plurality of sections, each having a different degree of resistivity. Preferably, each bar is comprised of four sections with the section on the right (FIG. 8) having the highest degree of resistivity and the section on the left having the lowest. Additionally, it should be noted with respect to FIG. 8 that the carrier is of sufficient length so that when the slide bar 86 is at the end of slot 87 the resistive members are disposed axially of channel members 65. In this position they do not cause any interaction between adjacent channel members. However, it is apparent that when slide bar 86 is moved to the right (FIG. 9) the resistive members move into the spaces between adjacent channel members and influence the relationship therebetween. Thus, by selectively moving slide bar along slot 87, the degree of mixing of sound signals transmitted by the adjacent channel members can be adjusted to suit the listener.

While the invention has been described with reference to particular embodiments thereof, it should be apparent that many other embodiments and forms of the invention would be obvious to those skilled in the art in view of the foregoing description. Thus, the scope of the invention should not be limited by the description of a particular embodiment set forth above, but rather only by the scope of the claims amended hereto.

1. Stereophonic headphones for a four channel system comprising a support, first and second enclosures to be positioned over the ears of a listener carried by said support, each of said enclosures including an inside wall to lie adjacent an ear and an outside wall spaced outwardly from said inside walls, said inside walls having an opening for the emission of sound into the ear of the listener, two audio transducers in each of said enclosures for transducing electronic signals into sound, each of said audio transducers being supported in said enclosure laterally displaced with respect to each other, said support being adapted to position said first and second enclosures over the ears of the listener with said transducers being in a front to back relation with respect to the head of the listener, and baffle means interposed between said audio transducers in each of said enclosures to provide stereo sound separation between each transducer within each of said enclosures.

2. Stereophonic headphones in accordance with claim 1 wherein a layer of foam is provided on said inside wall, said layer having an aperture overlying said opening.

3. Stereophonic headphones as defined in claim 2 wherein said opening includes a plurality of louvres and said layer overlies a portion of said louvres.

4. Stereophonic headphones in accordance with claim 1 including means to selectively mix the signals applied to the transducers.

5. Stereophonic headphones for a four channel system comprising a support, first and second enclosures to be positioned over the ears of a listener carried by said support, each of said enclosures including an inside wall to lie adjacent an ear and an outside wall spaced outwardly from said inside walls, said inside walls having an opening for the emission of sound into the ear at least two audio transducers in each of said enclosures for transducing electronic signals into sound, each of said audio transducers being supported in said enclosures in spaced relation from said outside wall and being laterally displaced with respect to each other, and baffle means interposed between said audio transducers in each of said enclosures to acoustic enhance the separation of said audio transducers.

6. Stereophonic headphones as defined in claim 5 wherein each of said audio transducers in said enclosures is supported by said inside wall.

7. Stereophonic headphones for a four channel system comprising a support, first and second enclosures to be positioned over the ears of a listener carried by said support, each of said enclosures including an in-
side wall to lie adjacent an ear and an outside wall spaced outwardly from said inside wall, said inside walls having an opening for the emission of sound into the ear of the listener, at least two audio transducers in each of said enclosures for transducing electronic signals into sound, each of said audio transducers being supported in said enclosure laterally displaced with respect to each other, and said support being adapted to position said first and second enclosures over the ear of the listener with said transducers being in a front to back relation with respect to the head of the listener, a plurality of means for applying signals to each of said transducers, and means for coupling a predetermined portion of the electronic signal in at least a first one of said signal applying means into at least a second one of said signal applying means.

8. Stereophonic headphones in accordance with claim 7, including means to selectively mix the signals applied to more than two of the transducers.

9. Stereophonic headphones for a four channel system comprising a support, first and second enclosures to be positioned over the ears of a listener carried by said support, each of said enclosures including an inside wall to lie adjacent an ear and an outside wall spaced outwardly from said inside wall, said inside walls having an opening for the emission of sound into the ear of the listener, two audio transducers in each of said enclosures for transducing electronic signals into sound, each of said audio transducers being supported in said enclosure in spaced relation from said outside wall and being displaced laterally with respect to each other, said support being adapted to position said first and second enclosures over the ear of the listener with said transducers being in a front to back relation with respect to the head of the listener, and acoustic separation means interposed between said audio transducers in each of said enclosures.

10. The headphones of claim 5, wherein said baffle means comprises a member in each of said enclosures fixed to said outside wall and being expandable toward said inside wall.

11. The headphones of claim 7 further characterized in that said coupling means is also for coupling into said one circuit a predetermined portion of the signal in another of said circuits.

12. Stereophonic headphone assembly comprising: a. first and second enclosures, b. at least two transducers in each enclosure, c. a plurality of means for applying signals to respective ones of said transducers, and d. means for coupling the signal in at least one of said circuits to another one thereof.

13. A headphone assembly for use with four electrical signals containing sound information corresponding to predetermined spatial positions comprising: a. at least first and second transducer mounting means adapted to be positioned respectively in close proximity to the ears of a wearer, b. at least two sets of electro-acoustic transducers, each set comprising two transducers mounted to a corresponding one of said mounting means, c. means for applying predetermined portions of one of said signals to a predetermined one or ones of said transducers, d. means for applying predetermined portions of another of said signals to at least one of said transducers, and e. means for applying predetermined portions of said third and fourth signals to a predetermined one or ones of said transducers.

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