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K. KONZELMANN ET AL

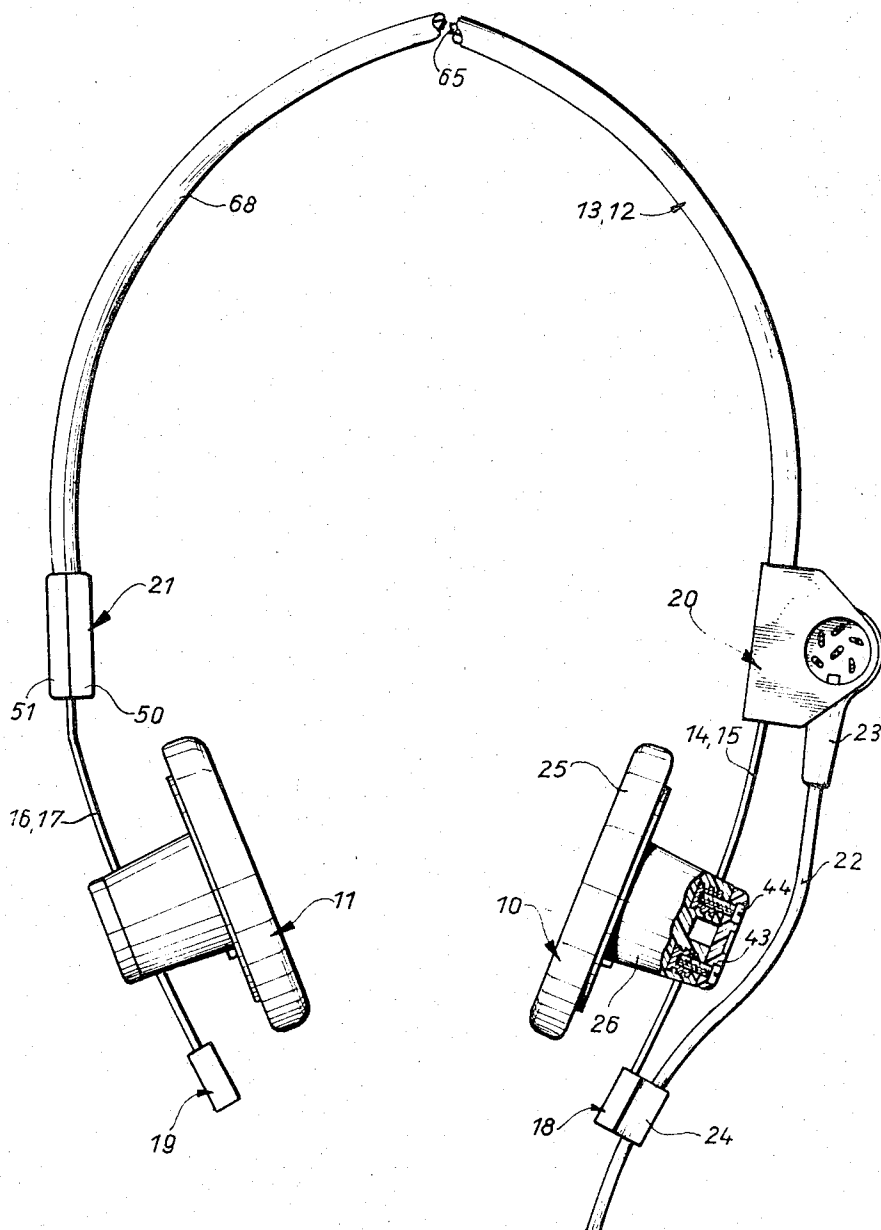
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EARPHONE CONSTRUCTION

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3 Sheets-Sheet 1

Fig. 1



Inventors

Kurt Konzelmann  
Ernst Döge  
Klaus Wischgoll

By: Lawrence E. Lautscher  
ATTORNEY

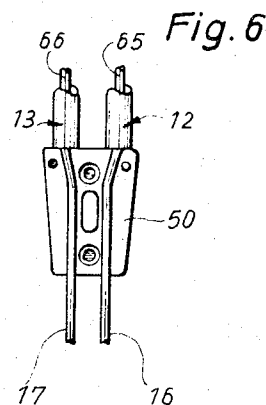
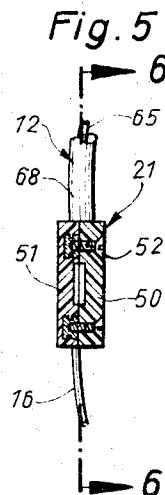
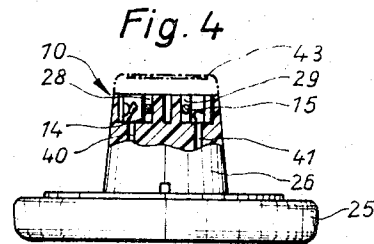
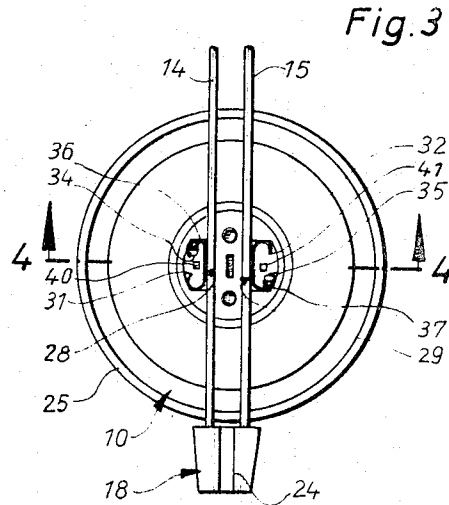
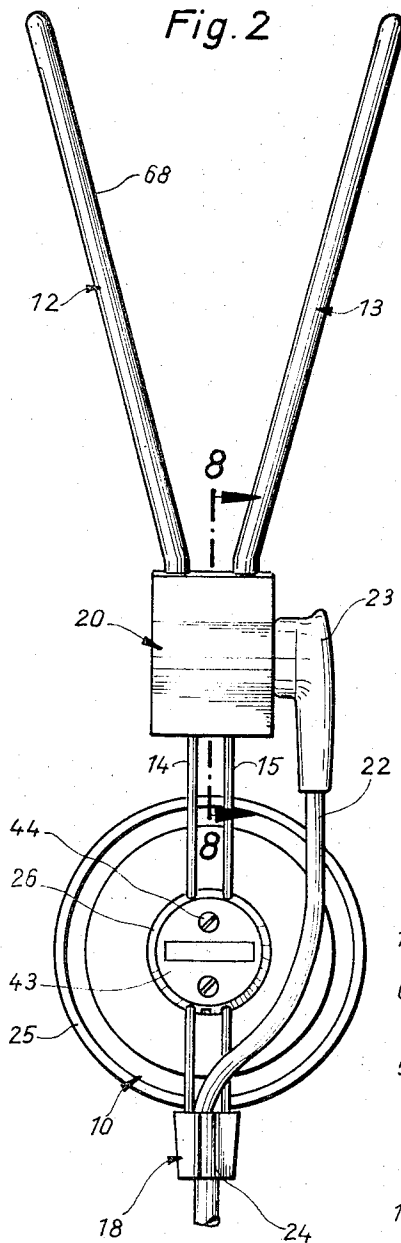
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*Inventors*

Kurt Konzelmann  
Ernst Doege  
Klaus Wueggoll  
By: Lawrence E. Aufseher  
ATTORNEY

Dec. 5, 1967

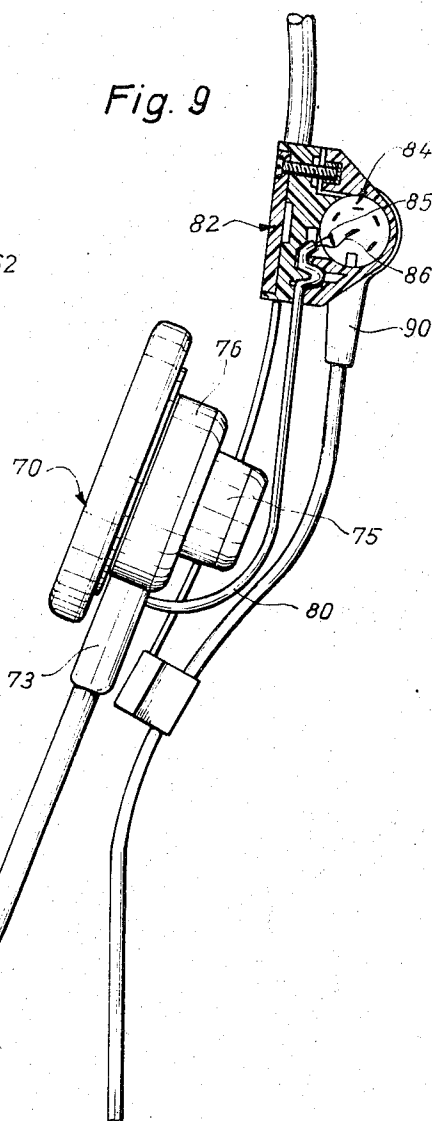
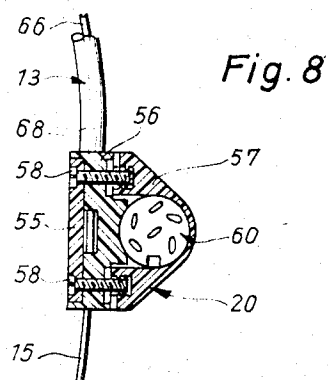
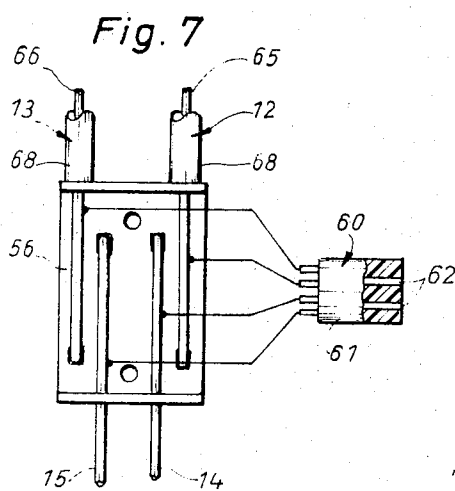
K. KONZELMANN ET AL.

3,356,797

## EARPHONE CONSTRUCTION

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*Inventors:*

Kurt Konzelmann

Ernst Doege

Klaus Wischgoll

३५:

Lawrence E. Laubscher  
ATTORNEY

ATTORNEY

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## EARPHONE CONSTRUCTION

Kurt Konzelmann, Heilbronn-Bockingen, and Ernst Doege and Klaus Wischgoll, Heilbronn, Germany, assignors to Eugen Beyer Elektrotechnische Fabrik, Heilbronn, Germany, a German firm

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## ABSTRACT OF THE DISCLOSURE

Headphone apparatus including harness means for mounting at least one earpiece on the head of a user, characterized in that the harness means includes for each earpiece a pair of parallel bare conductive rod portions upon which the earpiece is slidably mounted and through which electrical energy is conducted from cable means to the earpiece terminals, respectively.

This invention relates generally to a headphone apparatus the earpieces of which may be adjusted in accordance with the head size of the user, and more particularly to a headphone apparatus wherein the earpieces are slidably mounted on conductive slide rods through which electrical energy is conducted to the earpiece terminals.

Headphone devices have been disclosed in the prior art including a harness for mounting one or two earpieces on the head of a user. Generally the harness includes a plurality of resilient, generally U-shaped straps the ends of which are connected with each earpiece. Normally the earpieces are adjustably mounted on the harness so that the size of the headphone set may be varied in accordance with the size of the user's head. In general, the means for supplying electrical energy to the two earpieces includes a cable that is bifurcated at one end to define two pairs of leads of unequal lengths the free ends of which are connected directly with the earpieces, respectively. Consequently, the conventional headphone wiring arrangements are relatively complicated and are often uncomfortable to the user. Furthermore, owing to the physical location and arrangement of the wiring means, the exposed cables and leads are subject to damage, wear, and short circuiting.

The present invention was developed to provide an improved adjustable headphone apparatus that avoids the above and other drawbacks of the known devices. In accordance with the invention the earpiece wiring means are so designed as to avoid hindrance to the user and yet to supply electrical energy to the earpieces in a safe, positive and reliable manner.

A primary object of the invention is to provide a headphone apparatus including a pair of mutually-insulated conductive slide rod members upon which an earpiece is slidably mounted. The invention is characterized in that the means for supplying electrical energy from a pair of cable conductors to the two terminals of the earpiece include at least portions of the lengths of the conductive slide rods. As a consequence of this novel construction, a single cable may be connected with the headphone apparatus at any convenient location relative to the user's head. In the case of a headphone apparatus including only a single earpiece, the cable may be designed for connection with either end of the harness as desired. Thus, when only a single earpiece is provided, the cable may be connected with the free end of the harness, and the bow pieces of the harness may be utilized as conductive

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elements for conducting electrical energy to the conductive slide rods upon which the earpiece is slidably mounted.

In the case of a headphone set including two earpieces, the single cable, which includes four or more conductors, is connected at a given point on the harness as desired. At one end of the harness, one pair of the cable conductors is connected with the pair of conductive slide rods to supply electrical energy to the respective terminals of the earpiece slidably mounted thereon. Electrical energy is conducted from another pair of cable conductors to the terminals of the other earpiece via conductive bow pieces of the harness and the conductive slide members upon which said other earpiece is slidably mounted. By means of this arrangement and by the use of suitable cable connector means, it is quite easy to connect the two earpieces in series or in parallel, as desired, or to switch the entire electrical energy between one or the other of the earpieces.

In accordance with the invention, the two terminals of each earpiece are connected with the two bare, parallel conductive slide rods upon which the earpiece is slidably mounted by means of two spring contacts that are resiliently biased in continuous electrical engagement with the slide rods, respectively. Consequently, the electrical connection between the cable conductors and the earpiece terminals is assured in a positive manner for all positions of adjustment of each earpiece on the harness.

For adjustably mounting the earpieces on the harness, each earpiece includes a body member the rear surface of which contains a pair of parallel grooves that slidably receive the conductive slide rods. A cover is removably connected with the rear surface of the body member to maintain the slide rods in the grooves. The aforementioned spring contacts are mounted in recesses in the walls of the respective grooves and are biased in continuous electrical contact with the associated slide rods. Preferably the springs have such a tension and are so arranged as to produce a biasing pressure that frictionally resists sliding movement of the earpiece on the rods. This resistance to the sliding movement of the earpiece on the slide rods may be controlled by the longitudinal configuration of the grooves relative to that of the slide rods. Preferably the contact springs are formed of a corrosion-resistant material affording good spring tension (for example, a copper-beryllium alloy).

As the acoustic system requires vent holes in the earpieces, these vent holes are preferably arranged in communication at one end with the groove recesses that contain the contact springs. This construction offers the advantage that the vent holes may be utilized, at least in part, as passages for receiving the electrical leads that connect the earpiece terminals with the associated contact springs.

In order to retain the slide rods in rigid parallel spaced insulated relationship and to cover the ends thereof, insulated end pieces are mounted on the lower free ends of the slide rods. One of these insulated end pieces may be provided with cable clamp means for clamping an intermediate portion of the cable to the harness.

In addition to the use of the two conductive slide rods for conducting electrical energy to the earpiece terminals, the harness may include a pair of generally U-shaped electrically-conductive mutually-insulated bow pieces that are electrically connected at one end with one pair of slide rods, respectively. Since these bow pieces span the head of the user, they are preferably covered with a layer of soft insulating material (for example, a soft plastic such as polyvinyl chloride).

According to another feature of the invention, spacer means are provided that rigidly secure the adjacent ends

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of the harness bow pieces in insulated, spaced relation. At one end of the harness, the bow pieces are electrically connected with the slide rods, and consequently when the bow pieces and slide rods are of integral construction, the spacer means may engage the connected ends of the slide rod. At the other end of the harness, the spacer means rigidly connect the ends of the harness bow pieces and the adjacent ends of the slide rods in spaced mutually-insulated relation.

According to a further feature of the invention, the means for supplying energy from the cable conductors to the earpiece terminals include a separable multi-contact electrical connector a first part (preferably the plug) of which is secured to the cable end and a second part (preferably the socket) of which is mounted on one of the spacer means. In order to electrically connect the earpieces in series or parallel as desired, the second connector part is mounted on that spacer means which supports the ends of the two harness bow pieces and the ends of the adjacent slide rods in spaced mutually-insulated relation. The connector part that is secured to the spacer means is preferably a multi-contact socket the body portion of which is formed of a synthetic plastic insulating material.

The headphone apparatus may further include a lip microphone that is connected with one of the earpieces by swivel means. In this case the cable includes an additional pair of conductors that are connected with the microphone terminals via an additional pair of contacts on the multi-contact connector means.

The invention offers the advantage that the earpieces may be connected in series or in parallel, and also that the cable may be easily disconnected to permit connection of the headphone set to the various cables of other equipment. The desired connections may be achieved solely by plugging in appropriate male connectors as desired, and the leads may be marked so that the operator can easily determine what switching connections are to be achieved. Incorrect connections are avoided by use of connector parts having conventional orientation guide means that permit connection only when the plug is properly oriented with the socket.

As indicated above, at the end of the harness remote from the cable-connected end, the adjacent ends of the harness bow pieces are electrically connected with the corresponding slide rods and may be formed integrally therewith. In some instances it may be desirable to utilize spacer means at this end of the harness that are of unitary, non-separable construction and to utilize spacer means at the cable end of the harness that consists of separable sections. This arrangement offers the advantage that the harness bow pieces can be separated only at the cable end of the harness.

Other objects and advantages of the invention will become apparent from a study of the following specification when considered in conjunction with the accompanying drawing, in which:

FIGURE 1 is a partially sectioned front elevational view of the headphone apparatus;

FIGURE 2 is an end elevational view of the apparatus of FIGURE 1;

FIGURE 3 is a detailed elevational view of the earpiece of FIGURE 2 with the cover element removed;

FIGURE 4 is a bottom view of the earpiece that is partially sectioned along line 4—4 in FIGURE 3;

FIGURE 5 is a vertical sectional view of the left-hand spacer means of FIGURE 1;

FIGURE 6 is a sectional view taken along line 6—6 of FIGURE 5;

FIGURE 7 is a somewhat diagrammatic view of the manner in which the right-hand spacer means support the ends of the bow piece and slide rod elements, the electrical connections of these elements with the female socket connector being illustrated schematically;

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FIGURE 8 is a vertical sectional view of the right-hand spacer means taken along line 8—8 of FIGURE 1; and

FIGURE 9 is a partially sectioned detailed front elevational view of an embodiment of the invention including microphone means connected with the headset.

Referring first to FIGURE 1, the headphone apparatus includes right and left earpieces 10 and 11 that are slidably mounted upon pairs of slide rods 14, 15 and 16, 17, respectively. These pairs of right and left slide rods are connected, respectively, with the ends of a head harness including a pair of generally U-shaped bow pieces 12 and 13. Right and left spacer means 20 and 21 rigidly support the ends of slide rods 14, 15 and 16, 17, respectively, in spaced electrically-isolated relation. The right-hand slide rods 14 and 15, which are parallel and slightly bowed, constitute bare electrical conductors that are supported at their upper ends by the spacer means 20. At their lower ends the slide rods 14, 15 and 16, 17 are supported in spaced, electrically-isolated relationship by right and left end pieces 18 and 19, respectively. The right-hand end piece 18 includes also a cable clamp 24 that supports an intermediate portion of a multi-conductor cable 22 that terminates at its free end in a multi-contact bayonet plug connector 23.

The right and left earpieces 10 and 11 are of identical construction and consequently only the right-hand earpiece need be described.

The earpiece 10 includes a conventional two-terminal ear cup portion 25 connected at one end with a body member 26 the rear surface of which contains a pair of parallel grooves or channels 28 and 29 that slidably receive the right-hand slide rods 14 and 15, respectively. The walls of grooves 28 and 29 are provided with recesses that contain spring contacts 31 and 32 which are so mounted between the recess walls and the slide rods as to be biased (by their inherent resiliency) into continuous electrical engagement with the slide rods 14 and 15, respectively. The spring contacts 31 and 32 are electrically connected with the terminals of the ear cup 25 by means of conductors 34 and 35 that extend at least partially through air vent holes 36 and 37, respectively, which are contained in the earpiece and communicate at one end with the recesses in which the spring contacts are mounted. The earpiece 10 contains an additional pair of air vent passages 40 and 41 as shown in FIGURES 3 and 4. A cover member 43 is removably connected with the body member 26 by means of screws 44 and serves to maintain the slide rods 14 and 15 in the grooves 28 and 29. The body member 26 and the cover 43 are formed of a suitable electrical insulating material.

Referring now to FIGURES 5 and 6, the left-hand spacer means 21 includes a pair of separable sections 50 and 51 that are connected with each other by screws 52. Contained in the adjacent surfaces of sections 50 and 51 are a pair of opposed grooves that define passages which receive the upper ends of the pair of left slide rods 16 and 17. As shown in FIGURE 6, and as will be described in greater detail below, the slide rods 16 and 17 are preferably integral with the conductive central members 65 and 66 of the harness bow pieces 12 and 13, respectively. However, as will be apparent from the discussion presented below with regard to the right-hand spacer means 20, in the alternative, the left slide rods 16 and 17 could be separate from the conductors 65 and 66 of the bow pieces 12 and 13, respectively, in which case the spacer means 21 would include means for electrically connecting the ends of slide rods 16 and 17 with the conductors 65 and 66, respectively.

Referring now to FIGURES 7 and 8, the right-hand spacer means 20 includes separable base, retainer, and cap sections 55, 56 and 57, respectively, that are rigidly connected by screws 58. A female bayonet multi-contact connector part 60 is clamped between the retainer and cap sections as shown in FIGURE 8. As shown in FIGURE 7

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the ends of the slide rods 14 and 15 and the conductors 65 and 66 of the harness bow pieces 12 and 13, respectively, are retained in spaced parallel electrically-isolated relationship by the retainer section 56. The extremities of the elements 14, 15, 65 and 66 are bent at right angles and extend downwardly and terminate in corresponding recesses provided in the retainer section 56, whereby longitudinal displacement of the conductive elements relative to section 56 is prevented.

The female bayonet socket 60 includes a plurality of spaced contacts 62 arranged in a cylindrical body 61. Four of the contacts are connected with the conductors 14, 15, 65 and 66 as shown schematically in FIGURE 7. The sections 55, 56 and 57 and the connector body 61 are formed of a suitable electrical insulating material (preferably a synthetic plastic material). The cable connector 23 of FIGURE 1 is provided with a plurality of male bayonet prongs that are inserted in the connector 60 in engagement with the respective contacts 62.

According to a specific advantage of the invention, by appropriate connections of the cable conductors to the male bayonet prongs of connector 23 (or of the leads to the female connector contacts), it is possible to electrically connect the earpieces 10 and 11 in series or in parallel, or to completely disconnect either of the earpieces.

Through the use of appropriate cables and connectors, a manufacturer or user of the apparatus may achieve a desired headphone and cable connection arrangement. Consequently the manufacturer may adapt the headphone apparatus for use with many types of conventional cables provided on various electrical apparatus.

The harness bow pieces 12 and 13 comprise conductive elements 65 and 66 that are covered with a layer 68 of a soft insulating material (for example, polyvinyl chloride). Through the use of such a material, the harness conductors 65 and 66 are insulated from the head of the user. Furthermore the insulation 68 and the spacer means 20, 21 serve to electrically isolate the conductors 65 and 66 from each other.

Referring now to the embodiment of FIGURE 9 a lip microphone 71 is connected with the right-hand earphone 70 by means of a rigid support 72 that is rotatably connected with a swivel member 73 carried by a sleeve 76 which is rotatably mounted on the earpiece body member 75. As in the embodiment of FIGURE 1, the earpiece 70 is slidably mounted upon a pair of conductive slide rods. In this embodiment the cable includes at least six conductors four of which are connected with the respective earpiece slide rods in accordance with the embodiment of FIGURE 1. The remaining two cable conductors are connected with the terminals of microphone 71 via an additional two male prongs on the connector part 90, corresponding contacts on the female connector part 84, the conductors 85 and 86 of a flexible cable 80, and conductor means contained within sleeve 73 and rigid support 72. Thus, in the embodiment of FIGURE 9 each of the connector parts 84 and 90 includes at least six contacts.

While in accordance with the provisions of the patent statutes the preferred form and embodiments of the invention have been illustrated and described, it will be apparent to those skilled in the art that various changes and modifications may be made in the apparatus described without deviating from the invention set forth in the following claims.

What is claimed is:

1. Headphone apparatus, comprising  
a headphone earpiece including a pair of electrical terminals;

harness means adapted to mount said earpiece on the head of a user, said harness means including a pair of electrically-conductive mutually-insulated parallel bare slide rods upon which said earpiece is slidably mounted;

cable means including a pair of electrical conductors; and

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circuit means including at least portions of the lengths of said conductive elements for electrically connecting said conductors with said earpiece terminals, respectively.

2. Apparatus as defined in claim 1 wherein said earpiece includes a pair of separable sections one of which contains a pair of parallel grooves slidably receiving said slide rods, the other of said earpiece sections comprising a cover element for retaining said slide rods in said grooves.

3. Apparatus as defined in claim 2 wherein said circuit means for electrically connecting said conductors with said earpiece terminals includes a pair of spring contacts mounted in said grooves in continuous electrical engagement with said slide rods, respectively.

4. Apparatus as defined in claim 3 wherein at least one of said spring contacts is resiliently biased into frictional contact with the associated slide rod with such force as to resist, by frictional resistance, sliding movement of said earpiece on said slide rods.

5. Apparatus as defined in claim 4 wherein each of said contact springs consists of a copper-beryllium alloy.

6. Apparatus as defined in claim 3 wherein said earpiece contains at least one acoustic air vent passage communicating at one end with said groove adjacent the contact spring therein.

7. Apparatus as defined in claim 6 wherein said circuit means for connecting said conductors with said earpiece terminals includes a pair of conductive leads extending at least partially through said vent holes, respectively, and electrically connecting said spring contacts with said terminals, respectively.

8. Apparatus as defined in claim 1 wherein said harness means includes insulated spacer means rigidly supporting the ends of said slide rods in spaced mutually-isolated relationship.

9. Apparatus as defined in claim 8 wherein said harness means includes a pair of generally U-shaped resilient bow pieces, said bow pieces being adapted to span the head of the user of the apparatus.

10. Apparatus as defined in claim 9 wherein said bow pieces are electrically conductive, and further including a layer of insulating material electrically insulating said bow pieces.

11. Apparatus as defined in claim 10 wherein said bow pieces are rigidly connected at one end with said spacer means.

12. Apparatus as defined in claim 11 wherein the ends of said bow pieces are electrically isolated from each other.

13. Apparatus as defined in claim 11 wherein said bow pieces are in electrical communication with said slide rods, respectively.

14. Apparatus as defined in claim 13, wherein said slide rods are integral with said bow pieces, respectively.

15. Headphone apparatus, comprising  
first and second headphone earpieces each including a pair of electrical terminals;

harness means adapted to mount said earpieces on the head of a user, said harness means including first and second pairs of parallel bare electrically-conductive slide rods upon which said first and second earpieces are slidably mounted, respectively, a pair of generally U-shaped resilient electrically-conductive bow pieces each of which is covered with a layer of insulation, said first pair of slide rods being electrically connected at one end with the ends of said bow pieces, respectively, first spacer means rigidly supporting the ends of said first pair of slide rods in electrically insulated spaced relation, second spacer means rigidly supporting the other ends of said bow pieces and one end of each of said second pair of slide rods in electrically insulated spaced relation;

cable means including at least four conductors; and  
circuit means for electrically connecting said conduc-

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tors with said earpiece terminals, respectively, comprising means including spring contacts carried by said earpieces in electrical contact with said slide rods, respectively, for electrically connecting the terminals of said first earpiece with said first slide rods and the terminals of said second earpiece with said second slide rods, respectively, and means electrically connecting a first pair of said conductors with said other ends of said bow pieces, respectively, and a second pair of said conductors with said second pair of slide rods, respectively.

16. Apparatus as defined in claim 15 wherein said connector means includes a pair of multi-contact separable elements a first one of which is secured to said second spacer means.

17. Apparatus as defined in claim 16 wherein said cable means includes an additional pair of conductors, and further including a microphone having a pair of terminals, carrier means supporting said microphone from said second earpiece, and circuit means including

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said first connector element for electrically connecting said additional pair of conductors with said microphone contacts, respectively.

18. Apparatus as defined in claim 16 wherein the other one of said separable connector elements comprises a multi-contact plug, and means connecting said conductors with the contacts of the plug respectively, whereby said earpieces may be electrically connected in series or in parallel.

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WILLIAM C. COOPER, *Primary Examiner*.