A set of stereo headphones contains a radio receiver, having an audio output circuit which drives speakers of the headphones. During operation of the receiver, the speakers are connected in series to provide a monaural sound reproduction of a received radio signal. A stereo input jack, adapted to mate with a stereo plug, is mounted directly to the headphones to receive a stereo signal having right and left channel components applied from an external stereo signal source through the plug. When the stereo plug is mated with the input jack, a switch mounted to the jack is actuated to disconnect the two speakers from the audio output circuit of the receiver and connect the same to the terminals of the input jack to provide sound reproduction of the right and left channel components of the stereo signal. An ornamental cover is provided to enclose a battery mounted in the headphones. The cover is secured to the headphones with a manually operable latch mechanism permitting the cover to be easily removed for replacement of the battery.

14 Claims, 6 Drawing Figures
COMBINATION RADIO RECEIVER AND STEREO HEADPHONES

FIELD OF THE INVENTION

The present invention relates generally to a combination battery powered radio receiver and stereo head- phone unit and more particularly to the combination including a novel switch means for automatically converting the unit between operation with the receiver and operation with an external source of stereo signals, and means for providing easy replacement of the battery.

BACKGROUND OF THE INVENTION

In stereophonic reproduction, two channels, i.e., right and left, contain audio signal components which are amplified to drive right and left speakers, respectively, to produce a "three-dimensional" sound effect. The stereo signals are generally derived either from a recording medium, such as a magnetic tape or vinyl recording, or from a stereo broadcast signal received in a radio receiver designed for stereo signal reception.

While large speakers are still probably the most commonly used sound reproducers incorporated in a typical stereo system, stereo headphones are becoming increasingly popular for several reasons. Because the coupling of sound between the headphone speakers and the ears of the user is far superior to that achieved in floor or bookshelf speakers, the quality of sound reproduction is generally quite good and a relatively inexpensive set of headphones often compares in sound reproduction quality to that of an expensive set of speakers. Also, because stereo headphones are applied directly to the ears of the user, the reproduced stereo sound is not generally affected by the acoustic properties of the room containing the stereo equipment, a relatively important factor which must be considered when conventional speakers are used. In addition, because external noises are substantially blocked by the acoustic seal between the headphones and the ears, the user can listen to the stereo sound without being disturbed by environmental noises and because the stereo sound is confined to the ears of the user, other persons in proximity to the user are not disturbed.

With the advent of the transistor, radio receivers are now produced which are extremely compact and efficient. A typical portable transistorized radio receiver is generally powered by a battery contained inside a case of the receiver and provides an audio output from a small speaker contained within the case. In order to confine the audio output of the receiver to the ears of the user, a small earphone is often provided as an accessory with the receiver. However, the earphone is inconvenient to use and lacks the high quality of sound reproduction and acoustic isolation usually found in a set of stereo headphones.

In order to combine the portability of a portable radio receiver with the high quality sound reproduction and acoustic isolation qualities of a set of stereo headphones, it has been herebefore proposed to provide a unit including one of a monaural or a stereo radio receiver directly inside the headphones. The audio output circuit of the radio receiver is connected to the speakers of the headphones and a battery contained within the headphones is used as a source of power for the receiver. The units having speakers responsive to a monaural receiver are connected either in parallel or series to provide a monaural sound reproduction of the broadcast material, while speakers of the units including a stereo receiver are separately driven by the two stereo channels. There is no presently existing headphone receiver unit capable of both internally generated monaural and remotely generated stereo signal operation.

While the above described arrangement performs generally satisfactorily, it has the disadvantage of combining the use of the headphone set to operation with the monaural or stereo radio receiver contained therein. Often, the headphone used in conjunction with the built-in receiver is itself suitable for application in a stereo system; however, no convenient means has been heretofore provided for selectively converting the headphones for operation with an existing stereo system.

Another disadvantage of the combined headphone and receiver unit of the prior art is that defective battery replacement requires the cumbersome and inconvenient removal of a cover portion of the headphones, generally by using a tool to remove at least one screw from the cover. Frequently batteries become defective when the user is away from home and an appropriate tool is often not immediately available.

OBJECTS AND BRIEF DESCRIPTION OF THE INVENTION

Accordingly, it is one object of the present invention to provide a new and improved combination stereo headphone and radio receiver unit.

It is another object of the present invention to provide a new and improved combination stereo headphone and radio receiver unit for selectively reproducing a received radio signal or a stereo signal generated from an external source.

It is yet another object of the present invention to provide an entertainment apparatus which economically combines the portability of a radio wave receiver with the high quality audio reproduction of a set of stereo headphones.

It is an additional object of the present invention to provide a new and improved combination stereo headphone and monaural radio receiver unit which is automatically switched from one configuration to the other merely by inserting or removing a stereo plug into or out of a stereo input jack mounted to the unit.

It is a further object of the present invention to provide a new and improved combination stereo headphone and radio receiver unit having a battery cover which is easily removed.

In accordance with one preferred embodiment of the present invention, a combined stereo headphone and monaural radio receiver unit is provided having a receptacle and a switch mounted to the unit for enabling the headphone to be automatically switched from a monaural configuration responsive to the receiver to a stereo configuration responsive to a remote stereo source coupled through a jack included in the receptacle. A battery for powering the receiver is contained in the headphone and enclosed by an ornamental cover which is easily removed.

During operation of the unit with the radio receiver, the two speakers of the headphone are connected to be driven by the audio output circuit of the receiver. Alternatively, for operation of the unit with an external source of stereo signals, a stereo input jack is mounted
directly to the headphone to receive the stereo signal from a stereo plug wired to a source of stereo signals. When the stereo plug is mated with the input jack, a switch incorporated in the jack is mechanically actuated by the plug to disconnect the speakers from the audio output circuit of the receiver and connect the same to the contacts of the input jack. Since the switch is mounted to the headphone jack and automatically actuated when the stereo plug is inserted, no external switching operation is required of the user for converting the unit from monaural operation with the built-in receiver to stereo operation with the external signal source.

The unit includes two muffs which are positioned to cover the ears of the user. A cavity is formed in one of the muffs to house a battery which powers the radio receiver and an ornamental cover is provided over the muff to enclose the battery. An arm actuated latch releasably secures the cover and muff together so that the cover is easily removable for replacing the battery.

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

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a perspective view of a headset unit according to the present invention;

FIG. 2 is a top view of one muff containing a radio receiver with a speaker support separated from the receiver to expose the receiver and a speaker;

FIG. 3 is a top view of a second muff with the speaker support separated therefrom to expose the underside of a battery cavity, an input jack, a switch and a speaker;

FIG. 4 is a sectional view of the second muff taken along the line 4—4 in FIG. 3;

FIG. 5 is a detailed view of the cover latching mechanism of the muff shown in FIGS. 3 and 4; and

FIG. 6 is a schematic diagram of the radio receiver circuit.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. 1 is a perspective view of an entertainment unit 10 including a combined stereo headphone and monaural radio receiver. The headphone is a conventional type including a pair of muffs 12, 14 connected together by a resilient headband 15 for positioning the muffs over the ears of a user. Ornamental covers 16 and 18 are respectively provided to partially enclose the exposed surfaces of the muffs 12 and 14. While the covers 16 and 18 have the appearance of a football helmet in FIG. 1, it is understood that any other suitable configuration can be used.

The muff 12 contains a monaural radio receiver 20, preferably of a transistorized printed circuit type, and includes a bowl shaped enclosure 22 covered by a lid 24 which supports a speaker 26 that faces an ear of a user when the unit 10 is worn. A combination on-off and volume control 28 and a tuner control 30 of the receiver 20 extend outside the enclosure 22 to permit adjustment of the receiver while the unit 10 is worn.

The other muff 14 (FIG. 3) similarly includes an enclosure 32 and a lid 34 which supports a speaker 36. A cavity 38, formed on an exposed surface of enclosure 32, houses a battery 40 shown more clearly in FIG. 4. Battery 40 is maintained against a cushion 58 in the cavity 38 by a pair of ribs or projections 55 integrally formed to the cover 18.

Of particular importance to the present invention is a stereo input jack 42 having a switch 46 mounted thereto connected to the enclosure 32 by screws 44. An actuator portion 50 of the switch 46 is disposed adjacent the input jack 42 and is adapted to be pushed upwardly by a stereo plug 48 as the plug and jack are mated when operation of the unit 10 with an externally provided stereo signal is desired.

The switch 46 is a conventional triple pole, double throw momentary slide switch having the actuator 50 biased downwardly by a spring 52 within the switch. The actuator 50 electrically switches three ganged sections S1, S2, and S3 (not shown but illustrated schematically in FIG. 6) of the switch 46 which connects to the input jack 42, the radio receiver 20 and the speakers 26 and 36 through the terminals 54, as will be described in more detail infra. For present purposes it is sufficient to state that when the stereo plug 48 and jack 42 are not mated, the actuator 50 is maintained in a downward position by the spring 52 to connect speakers 26 and 36 for monaural operation with the receiver 20. Alternatively when the stereo plug 42 and the input jack 48 are mated, the actuator 50 is forced upwardly by the plug to convert the unit 10 so that speakers 26 and 36 are driven by separate channels of a stereo signal applied to the input jack via the stereo plug.

The ornamental cover 18 is secured to the enclosure 32 with a latch 59, shown in detail in FIG. 5. The latch 59 is formed of a key-shaped lug 60 secured to an operating arm 62 by a screw 64 extending through a stand-off 66. As the arm 62 is manually rotated about screw 64, both the stand-off 66 and the lug 60 rotate correspondingly by means of the coupling of the screw 64. A receiving portion or island 68 formed on the enclosure 32 contains a keyhole shaped slot or aperture 70 with a rim 72 adapted to receive the lug 60 of the latch assembly. The rim 72 receives and supports the stand-off 66 as the lug 60 and slot 70 are mated by bringing together the cover 18 and enclosure 32 with the lug and slot in mutual alignment, and the stand-off spaces the ornamental cover from the enclosure. The island 68 is hollow so that the lug 60, when inserted into the slot 70 and rotated clockwise with the arm 62, becomes latched therein and removable until the lug is rotated counterclockwise in alignment with the slot 70.

Thus, in operation, the ornamental cover 18 enclosing the battery 40 is easily latched to the enclosure 32 by the user's aligning the cover with the enclosure, the lug 60 extending into the keyhole slot 70. Thereafter, arm 62 is manually rotated clockwise to cause the lug 60 to be latched within the hollowed out portion of the island 68. When a battery is to be inspected or replaced the user merely rotates the arm 62 counterclockwise to realign the lug 60 with the slot 70 to remove the cover 18.

The operation of the unit 10 will now be described referring to the schematic diagram of FIG. 6. A receiver circuit 56 is powered by the battery 40 connected in series with an SPS control 74 incorporated in the control 28 in FIG. 2. When the switch 74 is closed corresponding to the receiver circuit 56 being "on", the negative terminal of the battery is connected to the common lead or ground 76 of the receiver circuit.
through the $S_1$ section of the switch 46, discussed in more detail following a brief description of the receiver circuit.

The receiver circuit is a standard monaural, a.m. superheterodyne type and a detailed description thereof is not necessary to an understanding of the invention. However, the receiver includes a combination radio frequency amplifier and mixer stage 78 for amplifying a radio signal received by an antenna 80 and converting the signal to an intermediate frequency for further amplification. The antenna 80 is preferably a conventional loop wound on a ferrite rod mounted directly on the printed circuit substrate 20 of the receiver in FIG. 2. Intermediate frequency amplifier 82 amplifies the converted signal and drives detector circuit 84 which demodulates the intermediate frequency signal to provide a monaural audio frequency signal suitable for driving the speakers 26 and 36 following power amplification.

An audio driver stage 86 applies the audio output signal of the detector 84 to a standard push-pull amplifier stage 88. The push-pull amplifier stage 88 is a typical class-B complimentary transistor type including compensating diodes 90 and 92 for minimizing crossover distortion caused by transistor mismatch or by discontinuities in the change over point between half cycles of the amplified audio waveform. The output terminal 98 of the amplifier 88 is applied across the two speakers 26 and 36, connected in series to each other for monaural operation in response to the receiver output.

The input jack 42 shown most clearly in FIG. 4 contains electrical terminals 96l, 96r and 96g which correspond to the left and right channels, and ground, respectively, of an external stereo signal source, such as derived from phonograph, tape playback system or stereophonic f.m. receiver. When the stereo plug 48 is mated with the jack 42, the jack terminals 96l, 96r and 96g make contact with corresponding terminals in the plug. More specifically, during operation of the unit 10 with an external stereo signal, that is, when the plug 48 and jack 42 are mated, the terminal 96l of the jack receives the left channel component of the externally applied stereo signal, the terminal 96r receives the right channel component and the terminal 96g receives the common or ground line of the stereo signal source.

When the unit is operated with the built-in receiver 56, that is, when the stereo plug 48 is not mated with the stereo jack 42 on the unit 10, the speakers 26 and 36 are connected in series with each other between the output 98 of the audio amplifier 88 and the B+ line 94 (positive terminal of the battery 40) through switch contacts $h-j$ and $e-f$ in sections $S_2$ and $S_3$ of the switch 46. It is understood that when the plug 48 and jack 42 are not mated, the sections $S_1$, $S_2$, and $S_3$ of the switch 46 are maintained in the positions shown in FIG. 6 by the action of the spring 52 against the actuator 50 in FIG. 4. However, when the actuator 50 is upwardly displaced by the insertion of the plug 48, the ganged sections $S_1$, $S_2$, and $S_3$ are switched, i.e., the terminals $b$ and $c$ in section $S_1$ become bridged simultaneously with the terminals $d$ and $e$ in section $S_2$ and the terminals $g$ and $h$ in section $S_3$.

The speakers 26 and 36 are each nominally 8 ohms and although a mismatch occurs between the series connected speakers (16 ohms) and the output of the push-pull amplifier circuit 88 (approximately 8 ohms), the output power of the class-B push-pull amplifier 88 is more than adequate to drive the speakers 26 and 36, and the audio system performs satisfactorily. The volume of the sound reproduced by the speakers 26 and 36 is adjusted with the volume control 28 and the frequency of the signals is adjusted by variable tuned circuits 100 and 102 forming the tuner 30.

It is not necessary to turn off the receiver circuit by manually opening the switch 74 with the control 28 when the unit 10 is operated with an external source of stereo signals because the negative terminal of the battery is automatically disconnected from the power supply ground terminal 76 of the receiver circuit 56 by the switching of the switch section 81 from the terminals $a-b$ to the terminals $b-c$ when the stereo plug and jack are mated.

As mentioned above, when the stereo plug 48 is inserted into the stereo input jack 42 mounted to the enclosure 32, the ganged portions $S_1$, $S_2$, and $S_3$ of the switch 46 simultaneously switch to bridge across the terminals $b-c$, $d-e$ and $g-h$, respectively. Following the schematic diagram of FIG. 6, it can readily be seen that when the plug and jack are mated, a connection from the stereo jack contact 96g to a lead of each speaker 26 and 36 is provided through the connections of the switch section 81 across the terminals $b-c$ and of the switch section 82 across the contacts $d-e$. The remaining lead 106 of the speaker 26 is connected to the stereo jack contact 96r through the connection of switch section 82 across the contacts $g-h$ and the remaining lead 108 of the speaker 36 is directly connected to the input jack terminal 96l. Accordingly, when the stereo plug 48 and input jack 42 are mated, the speakers 26 and 36 are connected to the input jack contacts 96g, 96r, and 96l to receive a stereo signal applied thereto.

That is, the left channel signal component of the stereo signal applied between the contacts 96l and 96g of the stereo plug 48 is connected to the left channel speaker 26, and similarly, the right channel signal component applied between the input jack contacts 96r and 96g is connected to the right channel speaker 36. During operation with an external stereo signal, the electrical connection 110 remaining between the audio output 98 and the speaker 36 has no effect on either the receiver circuit or the speakers since, except for the lead 110, the speakers are completely disconnected from the receiver circuit.

Obviously, numerous modifications and variations of the present invention are possible in light of the above teachings. For example, without departing from the spirit of the invention, the headphone could be of a quadraphonic type including four speakers and four corresponding input channel contacts in the input jack. As another variation, the radio receiver could be either an a.m. or f.m. type and the speakers could be connected together in parallel. Further, both muffs can contain the latching mechanism of FIG. 5, e.g., the cover 16 can be releasable and the receiver 20 displaced to expose a cavity in the muff 12 for storing a spare battery or other item. It is therefore understood that within the scope of the appended claims, the invention may be practiced otherwise than specifically described herein.

What is claimed is:

1. An entertainment unit including a set of headphones alternatively responsive to a monaural signal source and a stereo signal source, there being means connectable to the set of headphones for supplying a
stereo signal from the stereo source to the headphones, comprising:

- first and second speakers contained in said set of headphones;
- monaural radio receiver contained in said set of headphones for providing a monaural audio signal;
- stereo signal input means mounted to said set of headphones for receiving a stereo signal from said source external to said set of headphones, said stereo signal having first and second channel signal components; and
- switching means actuated by said means for supplying the stereo signal, said switching means mounted to said set of headphones and connected to each of said speakers, said input means and said receiver for selectively connecting either (a) both said speakers to be driven by said monaural audio signal to provide a monaural sound reproduction of a signal received by said receiver or (b) said first and second speakers to be respectively driven by the first and second channel components to provide a stereo sound reproduction of said stereo signal.

2. The unit of claim 1 wherein said stereo signal input means includes a stereo jack for receiving a stereo plug and said switching means includes an electrical switch mounted to said jack, said switch including means for changing the speaker connections to selectively provide connections for (a) or (b) in response to said stereo plug being inserted into and withdrawn from the jack.

3. The unit of claim 2 wherein the set of headphones includes means for carrying a battery, said receiver including d.c. power supply terminals connectable to terminals of the battery while connection (a) is established and means for disconnecting the receiver from one of the power supply terminals in response to the plug being inserted into the jack.

4. The unit of claim 1 wherein the set of headphones includes means for carrying a battery, said receiver including d.c. power supply terminals, means for connecting the power supply terminals to terminals of the battery while connection (a) is established, and means for disconnecting one of the receiver power supply terminals from the battery terminals while connection (b) is established.

5. The unit of claim 1 wherein one of said headphones includes an outer surface having a cavity formed therein for receiving a battery for powering said receiver, and a cover for at least partially covering said outer surface.

6. The unit of claim 5 further including latching means for selectively securing said cover to said one headphone and releasing said cover to expose said battery in said cavity.

7. The unit of claim 6 wherein said latching means includes a rotatable lug mounted to said cover, and said outer surface includes a receiving slot, said lug and slot being relatively positioned for mutual engagement.

8. An entertainment unit comprising in combination:

- a set of headphones including first and second speakers;
- a radio receiver contained in said set of headphones for driving said speakers, one of said headphones having an outer surface with a cavity formed therein for receiving a battery for powering the receiver;
- a cover for at least partially enclosing said outer surface of said one headphone; and
- latching means for releasably securing said cover to said one headphone, wherein said latching means includes a lug mounted to said cover, and said outer surface includes an aperture, said lug and aperture being relatively positioned for mutual engagement, said lug being selectively engageable and disengageable with said aperture; and
- spacing means for maintaining a portion of said cover spaced apart a predetermined distance from said outer surface outside of said one headphone when said lug is engaged with said aperture.

9. The entertainment unit of claim 8 further including an arm secured to said lug for rotation therewith and accessible externally of said cover, said latching means being operable with said arm.

10. The entertainment unit of claim 8 further including a stand-off disposed between said lug and said cover, and a rim formed in said aperture for supporting said stand-off, whereby said cover and said outer surface of said headphone are spaced apart.

11. The entertainment unit of claim 8 wherein said cover includes at least one projection extending toward the cavity for maintaining said battery within said cavity.

12. The entertainment unit of claim 11 further including a cushion disposed within said cavity for cushioning the battery, a space being provided between said projection and said cushion for receiving the battery.

13. The entertainment unit of claim 8 wherein said spacing means includes an island formed on said outer surface, said aperture being formed in said island to receive said lug.

14. An entertainment unit including a set of headphones alternatively responsive to an external signal source and an external stereo signal source, there being means connectable to the set of headphones for supplying a stereo signal from the external stereo signal source to the headphones, comprising:

- first and second speakers contained in said set of headphones;
- said internal signal source comprising a radio receiver contained in said set of headphones for providing an audio signal;
- stereo signal input means mounted to said set of headphones for receiving a stereo signal from said source external to said set of headphones, via said connectable means said stereo signal having first and second channel signal components;
- switching means actuated by said means for supplying the stereo signal, said switching means mounted to said set of headphones and connected to each of said speakers, said input means and said receiver for selectively connecting said speakers to be driven by either (a) the audio signal generated by said radio receiver or (b) the stereo signal generated by said external stereo signal source;
- said set of headphones including means for carrying a battery for powering said radio receiver, said receiver including d.c. power supply terminals; and
- said switching means further connecting the power supply terminals to terminals of the battery while connection (a) is established, and disconnecting one of the power supply terminals from the battery terminals while connection (b) is established.