Nov. 4, 1958 H. P. ROTH 2,858,544

NOISE ATTENUATING DEVICE

Filed May 4, 1956

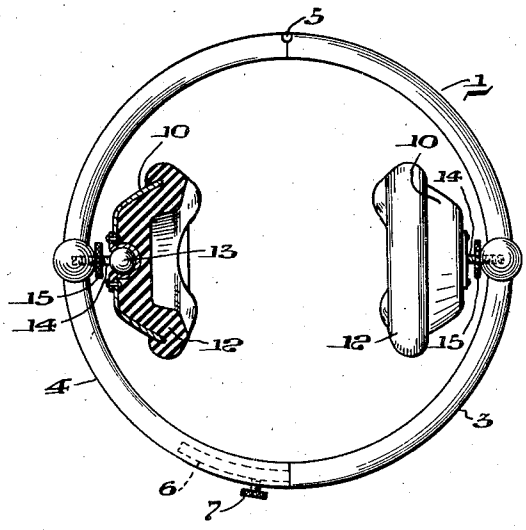

Fig. 1.

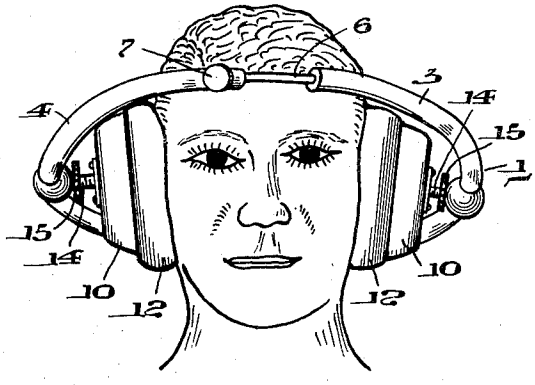

Fig. 2

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United States Patent Office 2,858,544 Patented Nov. 4, 1958

2,858,544

NOISE ATTENUATING DEVICE

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Application May 4, 1956, Serial No. 582,694

7 Claims. (Cl. 2—209)

This invention relates to a noise attenuating device for insulating the human ear from high intensity ambient noise by means of cups or covers worn over the ears, so as to reduce the acoustic energy which enters the ear canal, or otherwise reaches the sensory portion of the auditory apparatus.

In environments subjected to high intensity ambient noise, it is necessary to protect the human ear with some noise attenuating device. Such devices are frequently associated with some sort of earphone, and their primary purpose is to reduce the intensity of the external noise relative to the acoustic intensity of the "signal" emitted by the earphone to the point that the ratio of the latter to the intensity of the external noise, or the "signal-to-noise ratio," permits adequate reception of intelligible communication signals.

Since the development of the jet engine, and other devices which generate a very high intensity sound in spaces occupied by human beings, the need has existed of further improving the attenuation of such sound so that verbal communication would be more intelligible. It has also become increasingly important to reduce the intensity of the sound reaching the human auditory apparatus to the point where, considering the duration of exposure, permanent damage to hearing may be eliminated and temporary hearing loss minimized or prevented.

A conspicuous characteristic of jet engines and other recently-developed devices which generate loud noises for long periods is that if the acoustic energy is analyzed on a frequency basis, a considerable proportion of this energy is found in the lower portion of the audible acoustic spectrum, i. e., in the frequency octaves below about 600 cycles per second. This is an important aspect of the problem, since attenuation of sound energy in this lower frequency region is much more difficult than in the higher frequencies.

One of the important factors, and in some respects a dominant one, in insulating the human ear from external noise is the completeness and uniformity of the closure between the edge of the ear covering cup or pad and the sides of the wearer's head. That closure must be so tight that it not only will provide an effective seal, but will also restrain any movement of the cup or pad in response to the driving forces of sound pressure variations. Such a tight and uniform closure cannot be obtained by conventional noise protective devices, in which the cups or pads depend from a head-supported member and rely on spring or elastic pressure, which may be supplemented by a chin strap, to press the cups against the head.

In addition to the effectiveness of the seal between the edge of the ear cover and the head, the degree of sound attenuation is also affected by other factors, including the mechanical rigidity of the structure of the ear cover; the acoustical damping inherent in the material of which the structure is composed, or which is contributed by interior or exterior coatings or other means; and the nature of the mechanical restraint afforded the cover both by the

padding material between the cup and the head and by the member which holds the cover against the head.

It is accordingly among the objects of this invention to provide a noise attenuating device using cup-like structures covering the ears, in which the cups are held against the sides of the wearer's head by a member having a high degree of rigidity, in which the pressure of the cups against the side of the head may be varied to suit the wearer and the noise level of his environment, and in which that pressure is applied in a direction substantially normal to the sides of the wearer's head and can be maintained uniformly for an indefinite period.

Further objects are to provide a noise attenuating device of the type referred to that may be supported solely by the clamping pressure of the ear covers against the wearer's head, that is adjustable to all sizes and shapes of heads, and that can be easily put on and taken off.

The foregoing and other objects will be apparent from the following description of the invention in connection with the attached drawings, in which

Fig. 1 is a plan view of the device, partly in section; and

Fig. 2 is a perspective view of the device supported on the wearer's head.

In accordance with this invention, compressible sound absorbing ear pads supported in rigid or semi-rigid ear cups are adjustably mounted on opposite sides of a rigid frame and extend radially inward therefrom. Adjusting means are provided for applying positive radial pressure to the center of the ear cups to force the ear pads against the sides of the wearer's head around the ears. The frame preferably includes two rigid sections adjustably but rigidly connected. In use, the frame need not touch the wearer's head at any point, and the entire device may be supported solely by the clamping pressure of the ear pads against the head.

Referring to the drawings, the frame there shown is a head encircling halo member 1, preferably circular or elliptical in shape, that includes two rigid sections 3 and 4, which are pivotally connected at the rear by a hinge 5 and are adjustably connected at the front. While the adjustable connection may be obtained in a variety of ways, the form shown in the drawings includes a rod 6 mounted on the front end of one of the frame sections and adapted to be telescopically received in the other frame section and clamped therein by a set screw 7. This construction is facilitated by making the frame sections of metal tubes formed into the desired curved shape.

Approximately at the midpoint of each frame section is mounted a rigid or semi-rigid ear cup 10, which supports an ear pad 12 of sound absorbing material having the additional property of delayed or damped resilience, such as is possessed by certain types of di-isocyanate foams. Since the ear cups do not fully enclose the ear pads and the edges of the cups are overlapped by the pads, the cups do not contact the wearer's head. Preferably, the edges of the cup are contoured to fit the wearer's head, particularly the depression behind the jawbone below the ear, so that the cushioning pad between the edge of the cup and the wearer's head may be of substantially uniform thickness. To accommodate various shapes and sizes of human heads, each ear cup is adjustably mounted on its frame section, as by a ball and socket joint 13 on the base of the cup and by a threaded stud 14 extending from the base and threadably received in the frame section. The ball and socket joint permits each ear cup not only to be rotated about its supporting stud, but also to be inclined at the desired angle thereto, so that the ear pad will properly fit around the wearer's ear against the side of his head. The threaded stud 14, which can be manually turned by the knurled disc 15, provides an additional means for radially adjust-

ing the ear pads within the halo frame 1 and, in conjunction with the telescoping connection at the front of the frame, permits a wide range of adjustment in the radial pressure of the ear pads against the sides of the head.

In using this sound attenuating device, the set screw 7 on the front of the frame is loosened, and the frame is opened up sufficiently to permit the device to be placed over the wearer's head with the ear pads fitting over and around his ears. The frame is then closed, clamping the ear pads against the wearer's head; and the set screw 7 is tightened when the desired pressure is obtained. Further adjustment in the pressure of the ear pads can be made by turning the threaded studs 14, until the maximum pressure consistent with comfort is reached. It will be noted that the entire device becomes a substantially rigid assembly when clamped on the wearer's head and is self supporting thereon. Moreover, the halo frame can be rotated about its transverse axis defined by the studs 14, so that it can be tilted up in front at an angle that will not interfere with the wearer's vision, there being sufficient friction in the ball and socket joint to keep the frame from tilting of its own accord.

Because of the rigidity of the assembly in its clamped position on the wearer's head, and because of the adjustable support for the ear pads, it is possible with this device to seal the area around the wearer's ears more effectively and uniformly than can be obtained in any conventional noise protective headgear. As a result, far greater sound attenuation can be obtained with this device than by these conventional devices. In addition, this invention provides a minimum of head-engaging elements, thereby promoting greater comfort in use. There is no helmet or other head-supported member above the wearer's ears; there is no chin strap, which so frequently causes discomfort to the wearer without obtaining the necessary pressure of the ear pads against the wearer's ears. In the present invention, the radial pressure forcing the ear pads into contact with the wearer's head is applied approximately to the center of the ear cups and will be uniformly distributed around the periphery of the ear pads to provide a tight seal at all points around the wearer's ears and will maintain that seal without change for an indefinite time. Moreover, this device can be quickly put on and taken off with a minimum of adjustment, so that it is not only comfortable, but convenient to use by persons frequently passing in and out of areas having a high level of ambient noise. If desired, one or both of the ear pads may be provided with ear phones in the conventional manner, so that personnel wearing this device can communicate orally with others.

It is a further advantage of the rigid support described herein that it reduces the vibration or movement of the ear cups themselves in response to the driving forces of sound pressure variations created by ambient noise source. Such induced vibrations of the ear cups tend to generate corresponding pressure variations in the air enclosed within the ear cups, regardless of the excellence of the acoustic seal between those cups and the wearer's head.

While the rigid support illustrated in the drawings is in the form of a halo frame, it will be understood that the support may take other forms, such as, for example, a caliper-shaped frame in which the rigid sections may be adjustably joined at one end and in which sufficient friction or other locking means at the joint may be provided to maintain the assembly substantially rigid.

According to the provisions of the patent statutes, I have explained the principle of my invention and have illustrated and described what I now consider to represent its best embodiment. However, I desire to have it understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically illustrated and described.

I claim:

1. A noise attenuating device, comprising two rigid and substantially inflexible curved frame sections with an end of one section hingedly connected to an end of the other section and the other end of each section adjustably connected together to form a continuous frame in the form of a closed curve that is adapted to encircle completely the wearer's head and to be spaced therefrom at all points, an ear cup rotatably and pivotally mounted on each frame section near the mid-point thereof and extending radially inward therefrom, and an ear pad of resilient sound absorbing material supported by each ear cup, the ear pads alone being adapted to engage the sides of the wearer's head and to support the device thereon.

2. A noise attenuating device in accordance with claim 1, in which each ear cup is mounted on its frame section through a ball and socket joint.

3. A noise attenuating device in accordance with claim 1, in which the adjustably connected ends of the frame sections are connected by a telescopic joint provided with means for locking the joint.

4. A noise attenuating device comprising a substantially circular frame adapted to encircle completely the wearer's head and to be spaced therefrom at all points, the frame including two substantially semicircular rigid and inflexible sections with an end of one section hingedly connected to an end of the other section and means for adjustably connecting the other ends of the sections for varying the transverse diameter of the frame, a stud mounted on each frame section adjacent the mid-point thereof and extending radially inward therefrom, a rigid ear cup rotatably and pivotally mounted on the inner end of each stud, and an ear pad of resilient sound absorbing material secured to each ear cup, the ear pads alone being adapted to engage the sides of the wearer's head and to support the device thereon.

5. A noise attenuating device in accordance with claim 4, in which each stud is threadably mounted on its supporting frame section to permit radial movement of the stud relative to the frame.

6. A noise attenuating device comprising a substantially circular frame adapted to encircle completely the wearer's head and to be spaced therefrom at all points, the frame consisting of two rigid and substantially inflexible curved side sections hingedly joined at the back of the frame and adjustably connected at the front of the frame, an ear cup rotatably and pivotally mounted on each frame section near the mid-point thereof and extending radially inward therefrom, and an ear pad of resilient sound absorbing material supported by each ear cup, the ear pads alone being adapted to engage the sides of the wearer's head and to support the device thereon.

7. A noise attenuating device in accordance with claim 6, in which each side section is formed of tubular material and is connected to the other section at the front of the frame by an adjustable telescopic joint provided with locking means.

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