



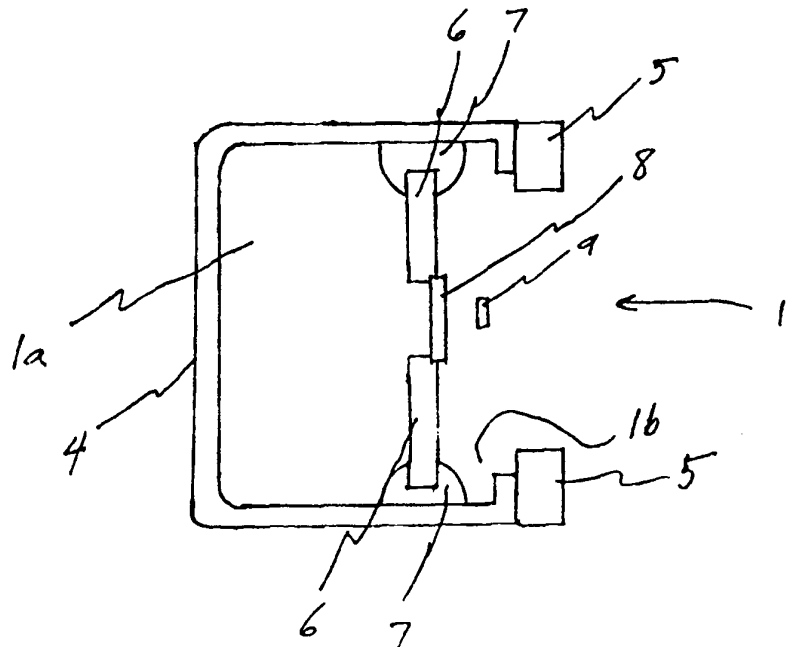
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<p>(21) International Application Number: PCT/US94/00849 (22) International Filing Date: 28 January 1994 (28.01.94) (30) Priority Data: 08/011,427 29 January 1993 (29.01.93) US (71) Applicant: ACTIVE NOISE AND VIBRATION TECHNOLOGIES, INC. [US/US]; 4824 South 40th Street, Phoenix, AZ 85040 (US). (72) Inventor: JONES, Owen; Water Run Cottage, Mill Lane, Chattisham, Ipswich, Suffolk IP8 3PX (GB). (74) Agents: LECHTER, Michael, A. et al.; Streich Lang, 2100 First Interstate Bank Plaza, 100 West Washington, Phoenix, AZ 85003-1897 (US).</p>		<p>(81) Designated States: AU, CA, FI, JP, KR, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). Published With international search report.</p>

(54) Title: EARPIECE FOR ACTIVE NOISE CANCELLING HEADSET

(57) Abstract

An earpiece (1) for active noise cancellation is disclosed. A headset embodying the earpiece, and a handset of a conventional telephone embodying the earpiece are also disclosed. The earpiece includes an outer shell (4); a baffle (6) including a compliant seal (7) for extending across the inside of the shell to define a closed volume (1a) therein; and a sound producer (8) such as a speaker mounted on the baffle for directing anti-noise sound towards the user's ear.



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EARPIECE FOR ACTIVE NOISE CANCELLING HEADSET**FIELD OF THE INVENTION**

The present invention relates to an earpiece for active noise cancellation, and a headset or telephone handset including such an earpiece.

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BACKGROUND OF THE INVENTION

A conventional ear defender provides a high degree of high frequency passive attenuation by means of a combination of the mass of the shell and the compliance of the air enclosed by the shell. These elements form a second order low pass filter such that the higher the mass and the larger the enclosed volume, the higher the degree of attenuation.

In a conventional active ear defender, as described in European Patent Application No. 333411, an earphone is mounted on an annular baffle, rigidly fixed inside the shell. The baffle is sealed to the inner surface of the shell and the earphone is mounted across the opening in the baffle to define a sealed volume in the shell. At high frequencies, the air volume behind the earphone is isolated from that in front of the earphone and is thereby prevented from contributing to the attenuation at the ear. Thus, a normal active ear defender gives poorer high frequency attenuation than a passive ear defender of the same size and weight. Typically, a passive ear defender might give 40 to 45 dB attenuation above 1 kHz, whereas an active ear defender gives only 30 dB. Furthermore, there is a tendency for active ear defenders to enhance higher frequency noise.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide an improved earpiece for active noise cancellation headset and a headset for active ear defense.

It is another object of the present invention to provide an improved earpiece for an active noise cancellation telephone handset and a telephone handset for active ear defense.

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According to a first aspect of the present invention, there is provided an earpiece for an active noise cancellation, comprising: a shell covering or holding to a user's ear; a baffle extending across the inside of the shell to define a closed volume therein; and a sound producer mounted on the baffle for directing anti-noise sound towards the user's ear. The baffle is sufficiently compliant to enhance passive attenuation of sound having a frequency above 200 Hz.

Active noise cancellation for the range of frequencies above 200 Hz where the enhancement of passive attenuation needs to occur will depend on various factors including the bandwidth of the active noise cancelling system employing the earpiece, and the detailed structure of the earpiece. Thus, for instance, it is envisaged that the enhancement may not occur below 300 Hz.

Preferably, the baffle comprises a stiff baffle plate and a compliant seal for connecting the baffle plate to the shell. Alternatively, the baffle plate itself may be formed of suitably flexible resilient material.

Preferably, the sound producer includes a moving sound producing diaphragm structure, and the resonant frequency of the baffle is below that of the diaphragm structure in use.

One or more microphones may be associated with the earpiece as required by the active noise control system employed.

The shell may form part of a telephone handset.

According to a second aspect of the present invention, there is provided a headset for active ear defense, comprising: first and second earpieces for respective ears of the user, and a headband coupling earpieces, wherein each earpiece comprises a shell for holding to one of the user's ears; baffle means extending across the shell to define a closed volume therein; and a sound producer mounted on the baffle for directing anti-noise sound towards the user's ear, wherein the baffle is sufficiently compliant to enhance passive attenuation of a sound having a frequency above 200 Hz.

According to a third aspect of the present invention, there is provided an active noise cancelling system, comprising an earpiece, a shell for covering or holding to a user's ear, a

baffle means extending across the shell to define a closed volume therein, a sound producer mounted on the baffle, and a microphone, wherein the baffle means is sufficiently compliant to enhance passive attenuation of a sound having frequency
5 above 200 Hz, and an electronic controller for producing signals to drive the sound producer to produce cancelling sound in response to the output of the microphone.

Such a system is applicable to a single earpiece handset of a conventional telephone or other headset. A system having two
10 earpieces for a headset is also disclosed.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows a headset according to the present invention;
Figure 2 shows a cross-sectional view of an earpiece
15 according to the present invention; and
Figure 3 shows a telephone handset according to the present invention.

DESCRIPTION OF AN EMBODIMENT

20 An embodiment of the present invention will now be described, by way of example, with reference to the accompanying drawings.

Referring to Figure 1, an active ear defender is shown comprising a pair of earpieces 1 coupled by a headband 2. An
25 electronic control unit 3 monitors the sound in the earpieces and sends drive signals to a sound producer (not shown) mounted in each earpiece to produce cancelling sound. The cancelling sound destructively interferes with incident noise to achieve quieting in the earpieces 1. A suitable electronic control
30 unit 3 is disclosed in PCT Application No. GB92/01399.

Referring to Figure 2, the earpiece 1 is shown comprising a cup-shaped shell 4, having a radially inwardly extending lip 4a, an annular cushion 5 supported on the lip 4a, a rigid
35 annular baffle plate 6, supported by an annular compliant seal 7 affixed to the inner surface of the shell 4, a small speaker or earphone 8 (hereinafter referred to as an earphone) mounted on the baffle plate 6 across the central opening

therein and a microphone 9 located on the ear side of the baffle plate 6. The compliant seal 7 preferably comprises a ring of elastomeric material and is provided with a groove on its inwardly directed surface for receiving the peripheral edge of the baffle plate 6. The baffle plate 6 and the earphone 8 divide the volume within the shell 4 into a closed rear volume 1a and an open front volume 1b. The diaphragm of the earphone is open on the one side to the closed volume 1a and on the other side to the open volume 1b.

10 The compliance of the compliant seal 7 is selected such that the resonant frequency of the baffle plate 6 on the compliant seal 7 is between that of the shell 1, when being worn as shown in Figure 1, and that of the diaphragm and diaphragm mounted components of the earphone 8, against when the earpiece is being worn as shown in Figure 1.

The resonant frequency of the diaphragm and diaphragm mounted components of the earphone 8 is typically 700 Hz to 1000 Hz in use. In the present invention, the compliance of the compliant seal 7 and the mass of the baffle plate 6 are selected to give a preferred resonant frequency for the baffle plate 6 and seal 7 of between, typically, 200 Hz and 300 Hz. It should be noted that the resonant frequency is not limited to this range, and other ranges may be employed, without departing from the scope of the invention.

25 If the resonant frequency of the baffle plate 6 and seal 7 is too low, the baffle plate 6 will move significantly in response to movement of the diaphragm of the earphone 8. This creates an acoustic short which limits the sound pressure that can be achieved in the open volume 1b of the earpiece 1.

30 Referring to Figure 3, wherein like numbers indicate the same structure as in Figure 2, a telephone handset is shown, which includes a body 10 with a microphone 11 mounted at one end, and an earpiece shell structure 12 at the other end. The earpiece shell structure 12 defines a volume which is divided into a sealed rear chamber 12a and a front chamber 12b by a compliantly mounted baffle plate 6. The front chamber 12b is open to atmosphere through a plurality of holes 13. Although

the invention is described with reference to a handset, the invention may be embodied in other telephone headsets, such as "hands free" headsets.

Referring to both Figs. 2 and 3, it should be noted the compliance of the seal 7 provides extra acoustic isolation between the diaphragm of the earphone 8 and the shell 4, 12. It is anticipated that this extra acoustic isolation may be achieved in other ways, for example, by use of a flexibly resilient baffle plate sealed directly to the shell 4, 12. Such an embodiment may be practiced within the scope of this invention.

As can be appreciated with a system as described above, an active ear defender can be constructed to give a total attenuation level of 40 to 45 dB from 200 Hz upwards which represents a significant and surprising improvement over the prior art.

Although the invention has been described in detail with particular reference to a preferred embodiment thereof, it should be understood that the invention is capable of other and different embodiments, and its details are capable of modifications in various obvious respects. As is readily apparent to those skilled in the art, variations and modifications can be affected while remaining within the spirit and scope of the invention. Accordingly, the foregoing disclosure, description, and figures are for illustrative purposes only, and do not in any way limit the invention, which is defined only by the claims.

CLAIMS

1 1. An active noise cancellation earpiece assembly,
2 comprising:
3 a shell having a concave interior;
4 a baffle extending across said concave interior of said
5 shell to define a closed volume therein; and
6 a sound producer mounted on said baffle for generating anti-
7 noise, wherein said baffle is sufficiently compliant to enhance
8 passive attenuation of sound having a frequency above a
9 selected threshold.

1 2. An earpiece assembly according to claim 1, wherein said
2 baffle includes:
3 a rigid baffle plate; and
4 a resilient seal for connecting said baffle plate to said
5 shell.

3 3. An earpiece assembly according to claim 1, wherein said
sound producer includes a moving sound producing diaphragm
structure, and wherein the resonant frequency of said baffle is
below that of said diaphragm structure.

4 4. An earpiece assembly according to claim 1, including
a microphone positioned in the propagation path of said anti-
noise generated by said sound producer.

1 5. A headset for active ear defense, comprising:
2 first and second earpieces for respective ears of a user,
3 wherein each of said earpieces comprises:
4 a shell;
5 a baffle extending across said shell to define a closed
6 volume therein, wherein said baffle is sufficiently
7 compliant to enhance passive attenuation of sound at
8 frequencies above 200 Hz; and
9 a sound producer mounted on said baffle for generating
10 anti-noise within said shell; and

11 a headband coupling said earpieces.

6. A headset according to claim 5, wherein said baffle comprises:

- a rigid baffle plate; and
- a resilient seal coupling said baffle plate to said shell.

7. A headset according to claim 5, wherein the sound producer includes a moving sound producing diaphragm structure, and wherein the resonant frequency of said baffle is below that of said diaphragm structure.

8. A headset according to claim 5, wherein each earpiece includes a microphone positioned in the propagation path of said anti-noise generated by said sound producer.

1 9. An active noise cancellation earpiece, comprising:
2 a shell;
3 a baffle extending across said shell to define a closed
4 volume therein, wherein said baffle is sufficiently compliant
5 to enhance passive attenuation of sound having a frequency
6 above 200 Hz;
7 a sound producer mounted on said baffle;
8 a microphone mounted within said shell; and
9 an electronic controller for producing signals to drive said
10 sound producer to produce anti-noise in response to sound
11 detected by said microphone.

10. An earpiece according to claim 9, wherein said baffle comprises:

- a rigid baffle plate; and
- a resilient seal coupling said baffle plate to said shell.

11. An earpiece according to claim 9, wherein said sound producer includes a moving sound producing diaphragm structure, and wherein the resonant frequency of said baffle is below that of said diaphragm structure.

1 12. An active noise cancelling system, comprising:
2 a shell;
3 a baffle extending across said shell to define a closed
4 volume therein, wherein said baffle is sufficiently compliant
5 to enhance passive attenuation of sound at frequencies above
6 200 Hz;
7 a sound producer mounted on said baffle;
8 a microphone mounted in the propagation path of sound
9 produced by said sound producer; and
10 an electronic controller for producing signals to drive said
11 sound producer to produce anti-noise in response to sound
12 detected by said microphone.

13. A system according to claim 12, wherein said baffle
comprises:

 a rigid baffle plate; and
 a compliant seal coupling said baffle plate to said shell.

14. A system according to claim 12, wherein said sound
producer includes a moving sound producing diaphragm structure,
and wherein the resonant frequency of said baffle is below that
of said diaphragm structure.

15. The earpiece assembly of claim 1, wherein said earpiece
further comprises a telephone handset attached to said shell.

16. The earpiece assembly of claim 9, wherein said earpiece
further comprises a telephone handset attached to said shell.

17. The earpiece assembly of claim 12, wherein said
earpiece further comprises a telephone handset attached to said
shell.

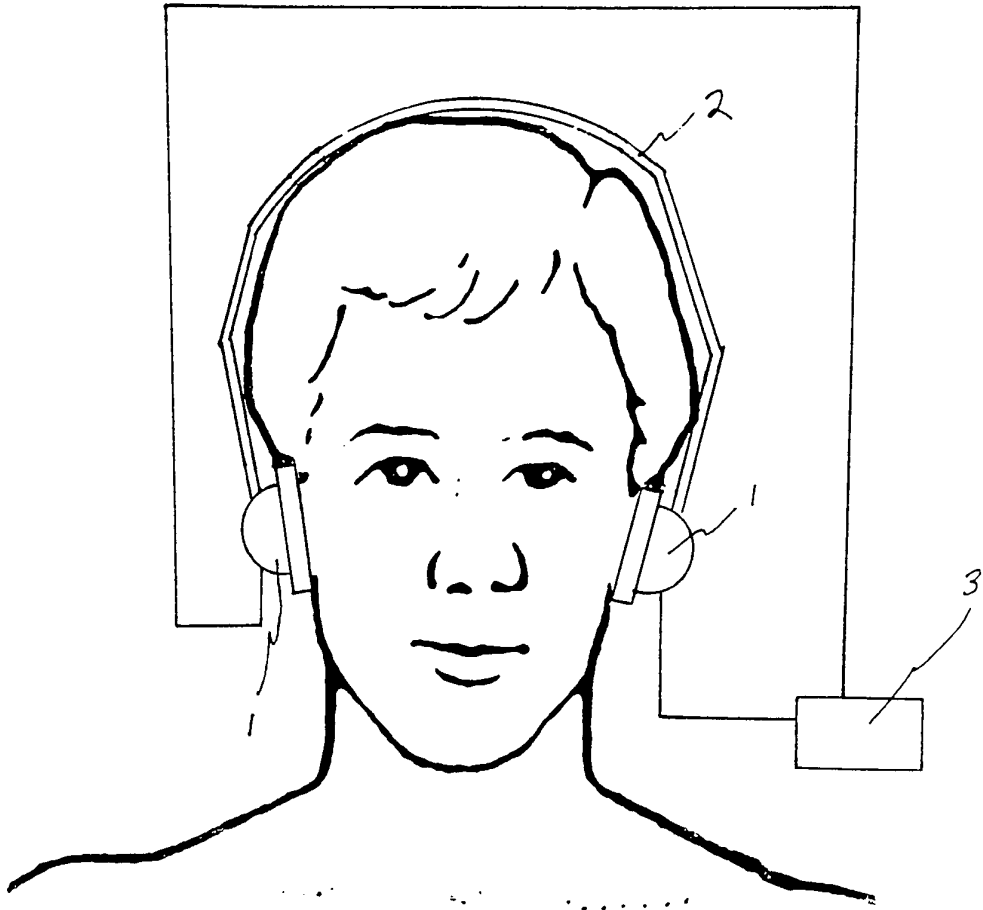


FIG. 1

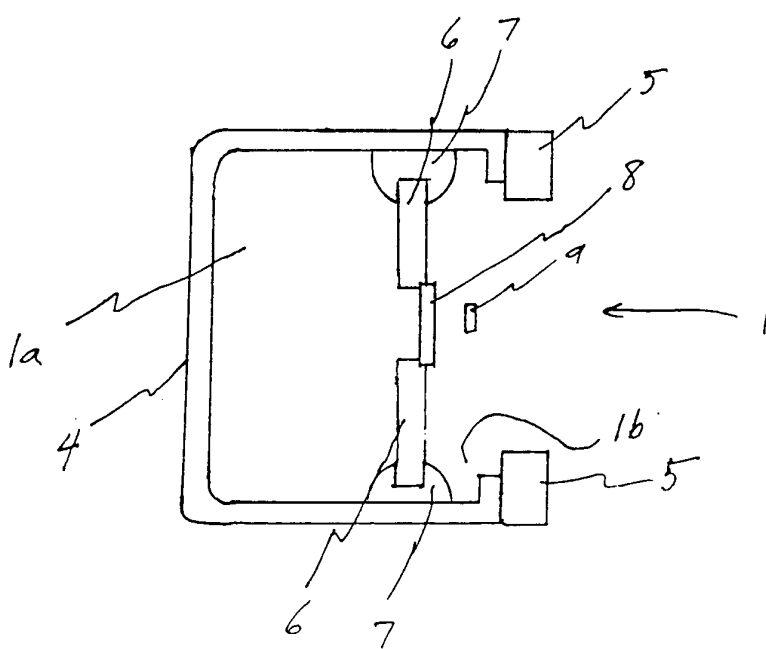


FIG. 2

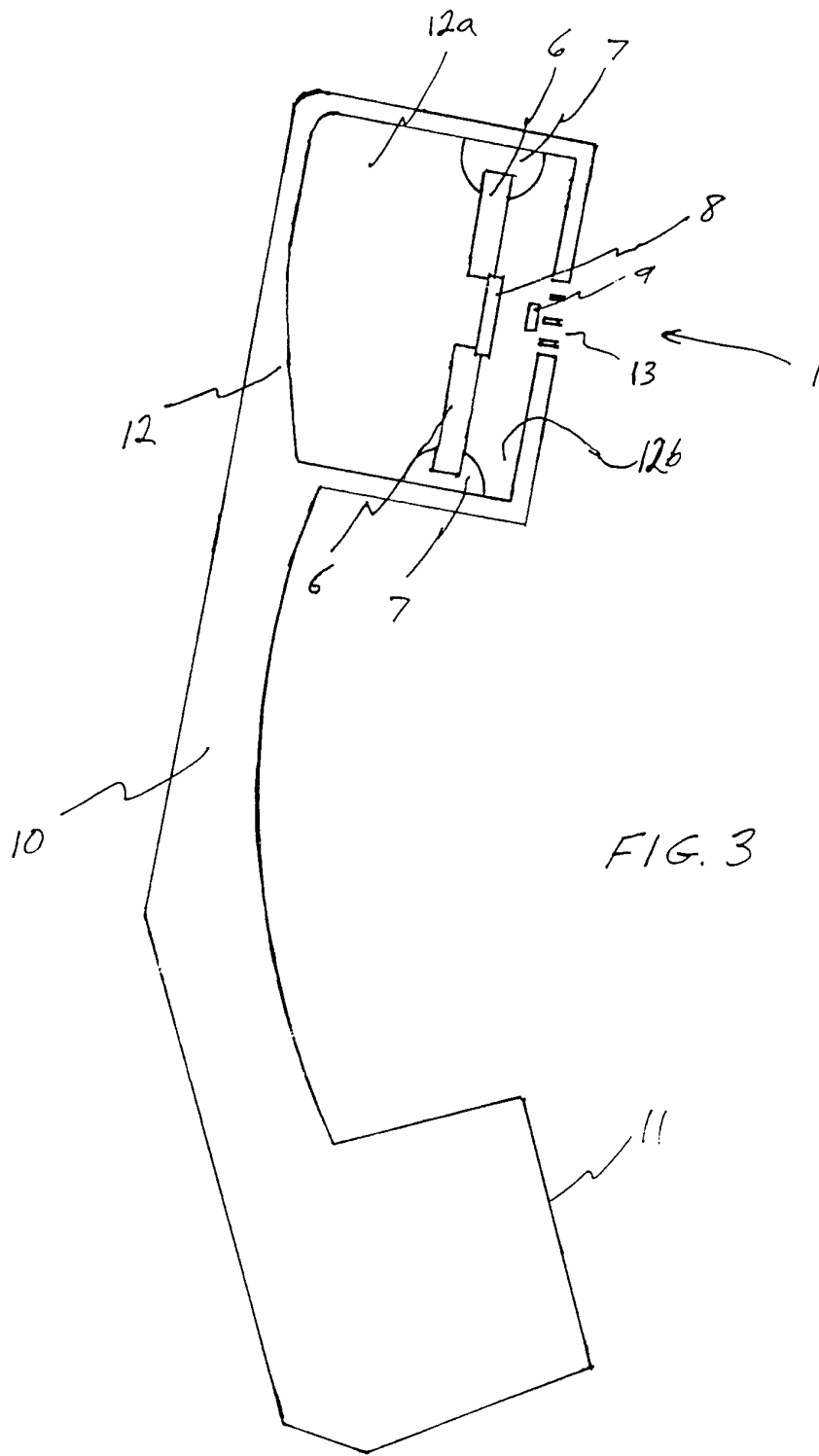


FIG. 3

INTERNATIONAL SEARCH REPORT

 Internat Application No
 PCT/US 94/00849

A. CLASSIFICATION OF SUBJECT MATTER IPC 5 G10K11/16 H04M1/19		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols) IPC 5 G10K H04M A61F		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practical, search terms used)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JOURNAL OF THE ACOUSTICAL SOCIETY OF AMERICA, vol.34, no.9, September 1962, NEW YORK US pages 1233 - 1246 EDGAR SHAW ET AL. 'Acoustics of circumaural earphones' see the whole document ---	1
P,A	GB,A,2 265 790 (POLURAL LIMITED) 6 October 1993 see page 6, line 1 - line 10; figure 2 ---	1
A	WO,A,89 00746 (PLESSEYS OVERSEAS LIMITED) 26 January 1989 --- -/--	
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	SOVIET PATENTS ABSTRACTS Week 9240, Derwent Publications Ltd., London, GB; AN 92-329384 'Anti-noise earphones' & SU,A,1 697 798 (KIEV POLY) 15 December 1991 see abstract -----	1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 94/00849

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB-A-2265790	06-10-93	NONE	
WO-A-8900746	26-01-89	AU-B- 608041	21-03-91
		AU-A- 2071688	13-02-89
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