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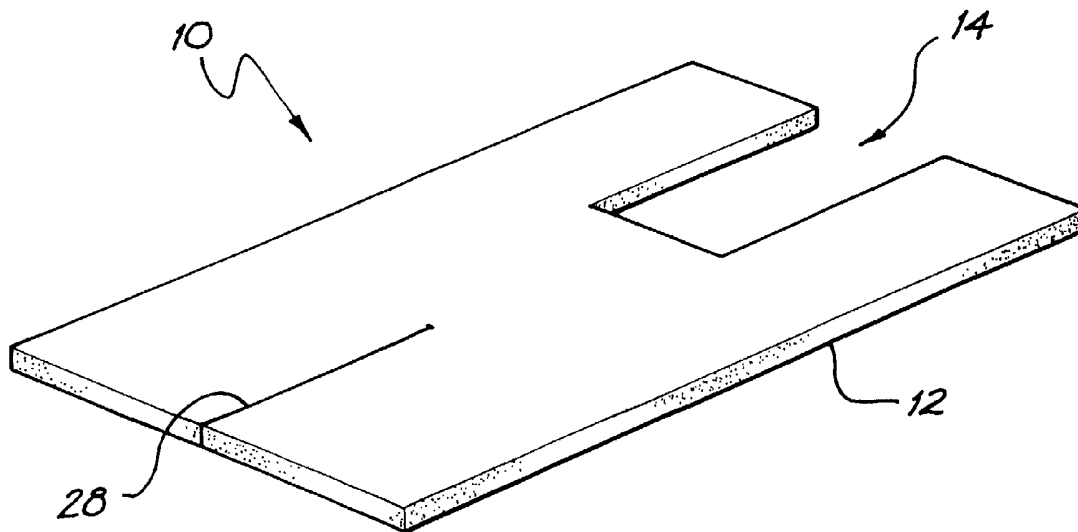
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- (71) Applicant (for all designated States except US): **AUCKLAND UNISERVICES LIMITED** [NZ/NZ]; Level 10, 70 Symonds Street, Auckland (NZ).
- (72) Inventor; and
- (75) Inventor/Applicant (for US only): **TONKIN, Shirley, Lyford** [NZ/NZ]; c/-Auckland Uniservices Limited, Level 10, 70 Symonds Street, Auckland (NZ).
- (74) Agent: **FB RICE & CO**; 605 Darling Street, Balmain, NSW 2041 (AU).
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(54) Title: A DEVICE FOR SUPPORTING AN INFANT



(57) Abstract: A device (10) for supporting an infant includes a support member (12) for supporting at least a torso of the infant substantially in a plane. A receiving formation (14) is defined by the support member (12) for receiving a rear part of a head of the infant so that the rear part of the head of the infant lies behind the plane.

"A device for supporting an infant"

Field of the Invention

This invention relates to the supporting of an infant. More particularly, the invention relates to a device for supporting an infant and to a method of supporting an
5 infant. The invention extends still further to a holder including the device.

Background to the Invention

Infant car seats have improved over recent years as a result of much research and experimentation. This research has been primarily focused towards the safety of
10 the occupant in the event of an impact arising from an accident resulting in a sudden deceleration of the body of the infant. Means of restraining the occupant during such an impact have been improved including improved anchoring of the seat and the prevention of the occupant from pressing against the seat belt by the use of rear facing infant seats.

15 However, the designs of most, if not all, commercially available infant car seats do not take into account differences between the anatomy of an infant and that of an adult. These differences have been observed during research into the causes of sudden infant death syndrome and are capable of causing death to an infant by events not related to motor vehicle accidents.

20 The anatomy of the head, jaw and neck of a human infant can give rise to potentially life threatening oxygen desaturation when the infant is improperly restrained in a sloping position, such as in a car seat. The size of the infant head relative to the infant body, the short neck of the infant and the weak, undeveloped neck muscles allow the infant's head to flex forward. As a result, the infant's chin impinges
25 on its chest and this promotes postero-cranial movement of a lower jaw of the infant. The infant lower jaw has far greater movement than an adult lower jaw. As a result, when an infant lower jaw is pushed upward or backward, the tongue is carried backward with it making a partial or complete occlusion of the airway within the pharynx. During such occlusion, a negative inspiratory pressure may be induced in the
30 pharyngeal region by the infant attempting to inhale. This may amplify the effect by pulling back on the tongue, providing further sealing. The consequences of this mobility of the infant lower jaw appears to be unknown to designers of infant car seats as no commercially available products of which the Applicant is aware contain features to allow for them.

35 Some products of which the Applicant is aware restrict movement of the infant's head. These devices appear to have the opposite effect to that intended, by not having

taken due consideration of the anatomy of the infant and actually may increase the amount of postero-cranial movement of the lower jaw of the infant. This type of device has been shown not to improve oxygenation.

- 5 While the invention has particular application in the field of infant car seats, where the infant may be unattended for some time, the invention is equally applicable to any holder for an infant where the infant is supported in a sloping position such as a stroller or pram, a carry cot, a bouncinette, or the like.

Summary of the Invention

According to a first aspect of the invention, there is provided a device for supporting an infant, the device including:

a support member for supporting at least a torso of the infant substantially in a plane; and

a receiving formation defined by the support member for receiving a rear part of a head of the infant so that the rear part of the head of the infant lies behind the plane.

The support member may be of a resiliently flexible material. More particularly, the support member may be of a foam material.

In one embodiment of the invention, the receiving formation may be defined by a slot at an operatively upper part of the support member. In another embodiment of the invention, the receiving formation may be defined by a recessed region at an operatively upper part of the support member. If desired and particularly in the case of the second embodiment of the invention, the support member may be a laminate of different layers of foam material.

The support member may include a covering member to impart an attractive appearance to the support member. The covering member may be of a washable material and, preferably, the material is a waterproof material.

The invention extends also to an infant holder including a device as described above.

The device may be in the form of a removable insert.

The holder may be a car seat. However, the holder may also be a stroller or pram, a carry cot, a bouncinette, or the like

According to a second aspect of the invention, there is provided a method of supporting an infant, the method including the steps of:

supporting at least a torso of the infant substantially in a plane; and

arranging a head of the infant so that a rear part of the head of the infant lies behind the plane.

The method may include arranging the head of the infant in such a position that a lower jaw of the infant does not impinge on the chest of the infant.

Still further, the method may include supporting the infant in an infant holder which may, in a preferred embodiment of the invention be an infant car seat.

According to a third aspect of the invention, there is provided an infant car seat which includes

a holder; and

- 5 a support member arranged in the holder for supporting at least a torso of the infant substantially in a plane, the support member defining a receiving formation for receiving a rear part of a head of the infant so that the rear part of the head of the infant lies behind the plane.

The support member may be in the form of a removable insert.

The support member may be of a resiliently flexible material.

In one embodiment of the invention, the receiving formation may be defined by a slot at an operatively upper part of the support member. In another embodiment of the invention, the receiving formation may be defined by a recessed region at an operatively upper part of the support member.

Preferably, the support member includes a covering member.

Brief Description of the Drawings

- 10 The invention is now described by way of example with reference to the accompanying drawings in which:

Figure 1 shows a schematic, three dimensional view of a device, in accordance with a first embodiment of a first aspect of the invention, for supporting an infant;

- 15 Figure 2 shows a schematic, three dimensional view of a device, in accordance with a second embodiment of the first aspect of the invention, for supporting an infant;

Figure 3 shows a schematic side view of the device, in use, in a holder in accordance with yet a further aspect of the invention;

- 20 Figures 4a and 4b show, respectively, an infant's head in a normal position with an unobstructed airway and with the head of the infant forced forwardly causing a closure of the airway;

Figure 5 shows a graph of upper airway size along a set of positions of the airway with and without the device of Figures 1 or 2 in place; and

Figures 6a and 6b show chart tracings of various parameters with the device of Figures 1 or 2 in place and without the device in place, respectively.

Detailed Description of Embodiments of the Invention

Referring initially to Figures 1 and 2 of the drawings, a device, in accordance with embodiments of a first aspect of the invention, for supporting an infant is illustrated and is designated generally by the reference numeral 10.

5 The device 10 comprises a support member or body 12 of a resiliently flexible material. More particularly, the body 12 is of a foam material. The support member 12 defines a receiving formation 14 at an operatively upper region of the support member 12.

The support member 12 is of a sufficiently dense material to support at least a
10 torso 16 (Figure 3) of an infant 18 substantially in a plane. The receiving formation 14 defined by the support member 12 receives a rear part 20 of a head 22 of the infant 18 so that the rear part 20 of the head 22 of the infant 18 lies behind the plane defined by the support member 12, as will be described in greater detail below.

In the embodiment of the invention illustrated in Figure 1 of the drawings, the
15 support member 12 is of a single layer of foam material and the receiving formation 14 is in the form of a slot defined in the operatively top region of the support member 12.

In the embodiment of the invention illustrated in Figure 2 of the drawings, the support member 12 is a laminate comprising two layers 24, 26 of foam material. The layers 24 and 26 may be of different densities or, instead, could be of the same density.
20 In this embodiment of the invention, the receiving formation 14 is in the form of a recess with the layer 26 defining a cushion behind the recess for the rear part 20 of the infant's head 22.

It will be appreciated that, in the case of both embodiments, the support member 12 is covered by a covering (not shown) of a suitable material to provide an attractive
25 appearance to the device 10. The covering is also, preferably, waterproof.

A slot 28 is defined in an operatively lower region of the support member 12 through which webbing of a restraining belt (not shown) can pass for restraining the infant in position in a holder 30 (Figure 2).

The Applicant has conducted extensive research into cot death known as sudden
30 infant death syndrome or SIDS, over a number of years. This has led to a hypothesis that the difference in anatomy between a newborn infant and an adult or older child could contribute to SIDS or other potentially life threatening events.

In the case of an infant, the head 22 is much larger in proportion to the body than in the case of an adult. Also, the neck of the infant is short, the neck muscles of
35 the infant are undeveloped and the infant is unable to support the head in an upright position. Still further, an infant's lower jaw effectively "floats" relative to the cranium

due to lack of development and consequent flexibility of the temporomandibular joints. Another major difference is that a spine of the infant 18 is much straighter and, as a result, the spinal cord of the infant enters the skull through the foramen magnum at almost 90°. This causes the rear part 20 of the head 22, more particularly, an occipital bone of the skull, to protrude rearwardly to a far greater extent than in an older person.

As a result, when an infant is placed on a substantially flat surface, the surface bears on the occipital bone of the skull 22 urging the head of the infant forward as shown in Figure 4b of the drawings.

Also, as shown in Figures 4a and 4b of the drawings, the temporomandibular joints between the lower jaw 32 and the temporal bones of the skull of the infant 18 have not yet been fully formed resulting in extreme mobility of the lower jaw 32 relative to the skull. As a result, when the infant's head 22 is forced forwardly as shown in Figure 4b of the drawings, the neck of the infant will flex and the lower jaw 32 will impinge on the chest of the infant. This forces the lower jaw 32 backwards and/or upwards and the tongue, which is contained in the lower jaw 32, is pushed backwards and/or upwards. In part, this pushes the soft palate into the pharyngeal airway and, in part, the tongue may occlude the pharynx directly.

The Applicant's research also indicates that the relative laxity of a joint capsule of each of the temporomandibular joints and the ligament of the joint can cause this effect. In addition, lowered muscle tone such as may occur when the infant is tired, sleeping or is suffering from hypoxia may also play a part.

The problem is compounded due to the fact that an attempt by the infant to inhale causes a low pressure region to develop behind the tongue in the pharyngeal region causing the tongue to seal further in the pharynx. The infant 18 is unable to cry out under the circumstances because air cannot pass to the larynx.

The Applicant conducted various tests on a number of individuals. In particular, a test using 17 premature birth infants who were at an age of 34 to 36 weeks when they were due to leave hospital was conducted in an ethically approved and carefully monitored trial. Each infant 18 was tested for 60 minutes during which time the infant was allowed to relax and sleep either with or without the device 10 of the embodiments of the invention illustrated in Figures 1 or 2. Each infant 18 undergoing the test was placed in a holder 30, more particularly, an infant car seat of the type illustrated schematically in Figure 3 of the drawings. A backrest 36 of the holder 30 was arranged at an angle of approximately 40° to the horizontal. Each infant was physiologically monitored to measure the parameters shown in Figures 6a and 6b of the drawings.

Measurements from inspiratory radiographs from each of the 17 infants were measured with and without the device in place at various positions of the airway of each infant 18. This is shown in Figure 5 of the drawings where the solid circles illustrate the device 10 in place and the open circles indicate the device 10 being
5 omitted from the holder 30.

The results of the test showed, with statistical significance, that an adverse effect on airway radiological profile occurred in 14 out of 17 infants in the trial when the holder 30 did not include the device 10. In particular, oxygen saturation (pO_2) measurements confirmed that a physiologically significant effect occurs in most infants
10 as shown in Figures 6a and 6b of the drawings.

Also, as shown in Figures 6a and 6b of the drawings, polygraph recordings were taken of various parameters of the infants. In the case of Figure 6a, the measurements were taken while the infant was supported on the device 10 in the holder 30. In the case of Figure 6b of the drawings, the infant was resting directly on the backrest 36 of
15 the holder 30 without the device 10 being in place. This resulted in the infant's head 22 being forced forwardly as shown in dotted lines in Figure 3 of the drawings.

The parameters measured were heart rate, chest impedance (chest Z), airflow and oxygen saturation (pO_2). The chest impedance indicates breathing movement. In Figure 6a, ie with the device 10 in place in the holder 30, oxygen saturation remains
20 acceptable at over 85% throughout the test. The other parameters such as heart rate, breathing (as measured by chest impedance) and airflow remain stable. In contrast, when the device 10 is omitted from the holder 30, a number of the parameters are erratic. In addition, it is to be noted that oxygen saturation goes through two unacceptably low episodes and there are also episodic, serious drops in heart rate.

Hence, it is readily apparent that, with the provision of the device 10 in place in
25 a holder 30, oxygen saturation and related parameters of the infant 18 are greatly improved in comparison with the situation without the device 10 in place. The Applicant is of the view that this should inhibit the occurrence of potentially life threatening episodes when an infant is held in a holder 30 such as an infant car seat, or
30 the like.

It will be appreciated by persons skilled in the art that numerous variations and/or modifications may be made to the invention as shown in the specific embodiments without departing from the spirit or scope of the invention as broadly described. The present embodiments are, therefore, to be considered in all respects as
35 illustrative and not restrictive.

CLAIMS:

1. A device for supporting an infant, the device including:
a support member for supporting at least a torso of the infant substantially in a plane; and
a receiving formation defined by the support member for receiving a rear part of a head of the infant so that the rear part of the head of the infant lies behind the plane.
2. The device of claim 1 in which the support member is of a resiliently flexible material.
3. The device of claim 1 or claim 2 in which the receiving formation is defined by a slot at an operatively upper part of the support member.
4. The device of claim 1 or claim 2 in which the receiving formation is defined by a recessed region at an operatively upper part of the support member.
5. The device of any one of claims 1 to 4 in which the support member includes a covering member.
6. An infant holder including a device as claimed in any one of the preceding claims.
7. The holder of claim 6 in which the device is in the form of a removable insert.
8. A method of supporting an infant, the method including the steps of:
supporting at least a torso of the infant substantially in a plane; and
arranging a head of the infant so that a rear part of the head of the infant lies behind the plane.
9. The method of claim 8 which includes arranging the head of the infant in such a position that a lower jaw of the infant does not impinge on the chest of the infant.
10. The method of claim 8 or claim 9 which includes supporting the infant in an infant holder.
11. An infant car seat which includes

a holder; and

a support member arranged in the holder for supporting at least a torso of the infant substantially in a plane, the support member defining a receiving formation for receiving a rear part of a head of the infant so that the rear part of the head of the infant
5 lies behind the plane.

12. The car seat of claim 11 in which the support member is in the form of a removable insert.

13. The car seat of claim 11 or claim 12 in which the support member is of a resiliently flexible material.

14. The car seat of any one of claims 11 to 13 in which the receiving formation is defined by a slot at an operatively upper part of the support member.

15. The car seat of any one of claims 11 to 13 in which the receiving formation is defined by a recessed region at an operatively upper part of the support member.

16. The car seat of any one of claims 11 to 15 in which the support member includes a covering member.

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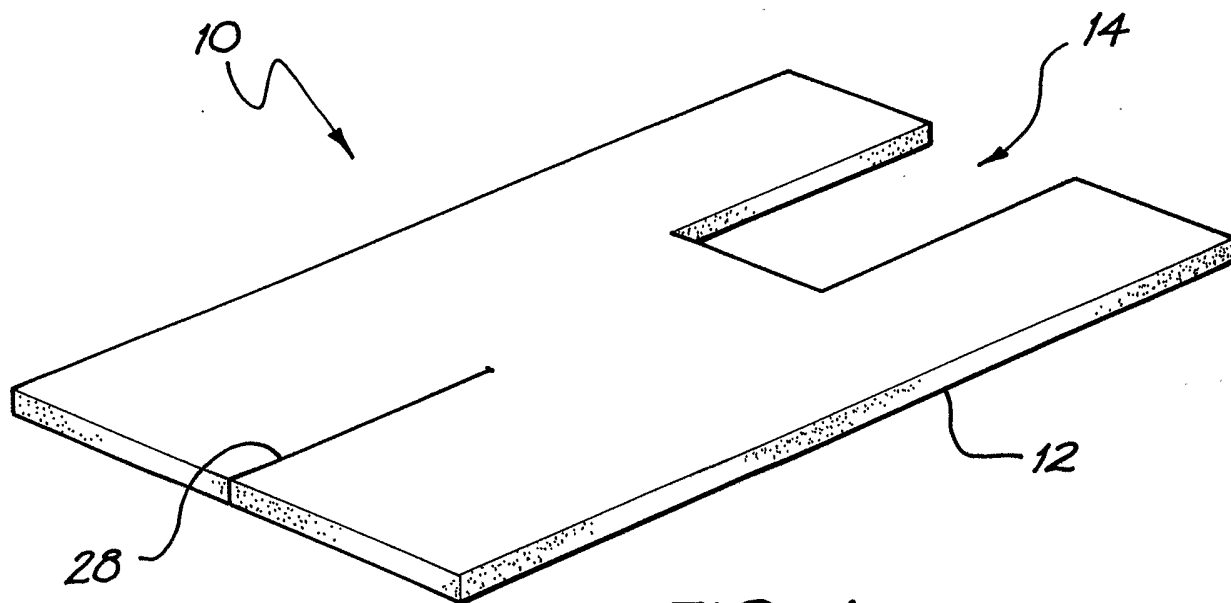


FIG. 1

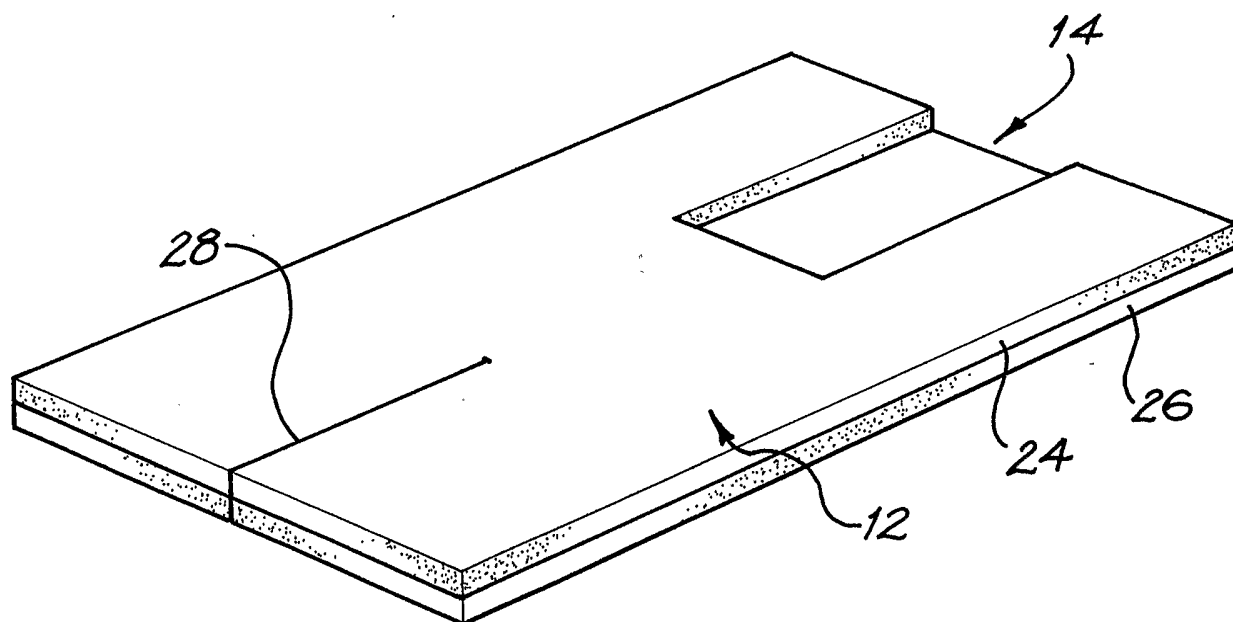


FIG. 2

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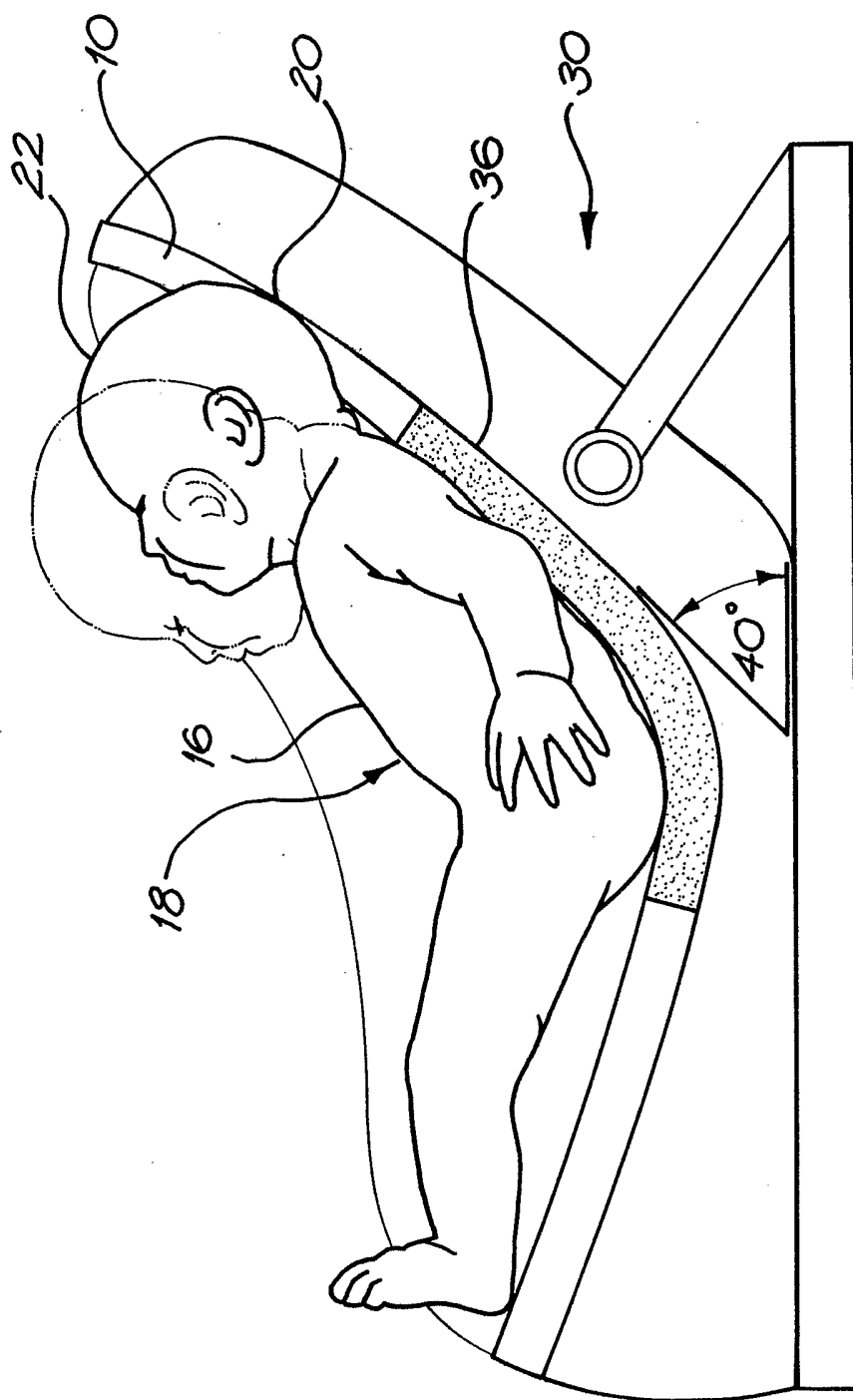


FIG. 3

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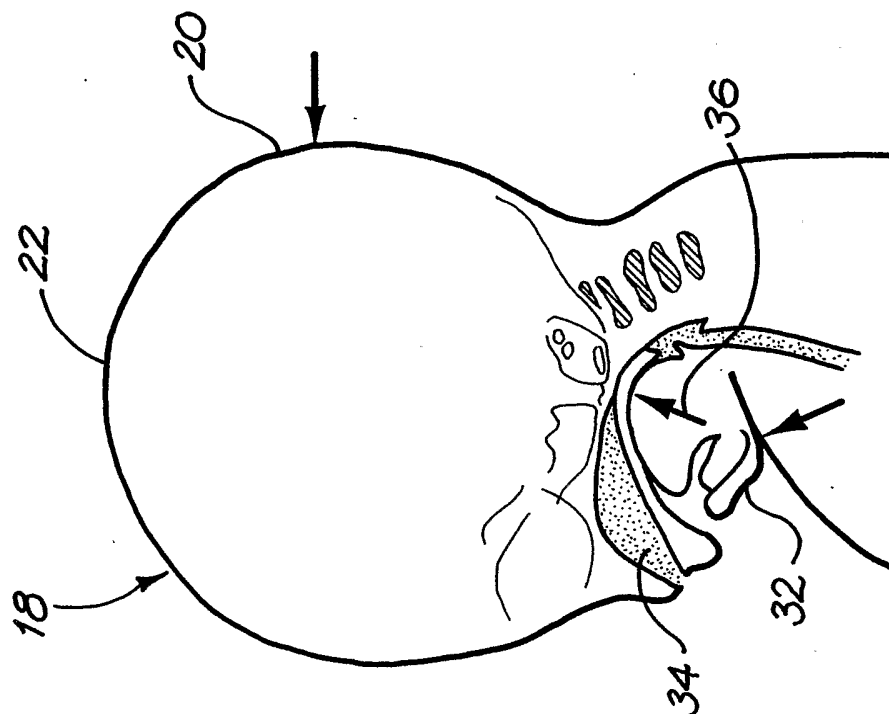


FIG. 4b



FIG. 4a

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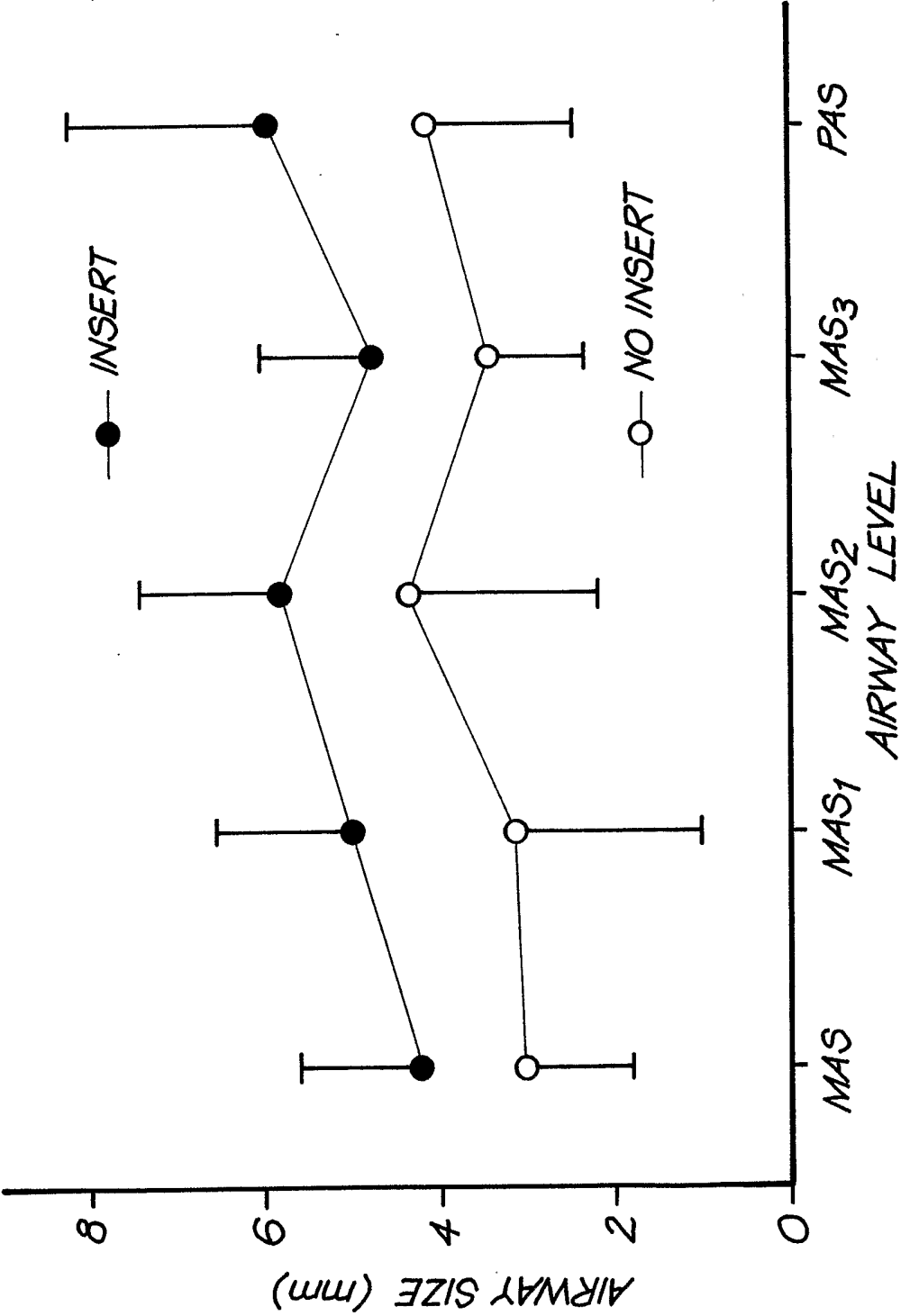


FIG. 5

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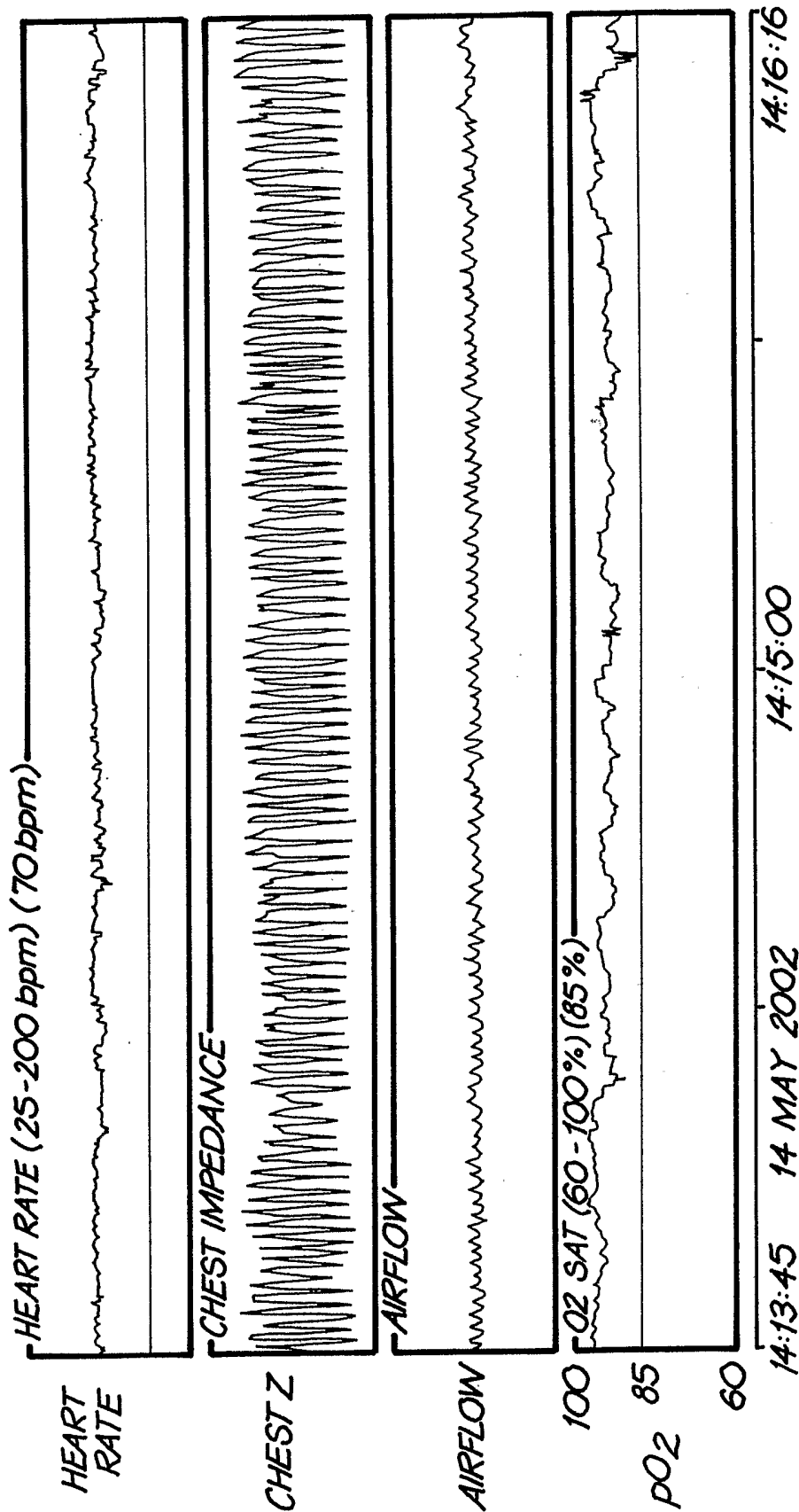


FIG. 6a

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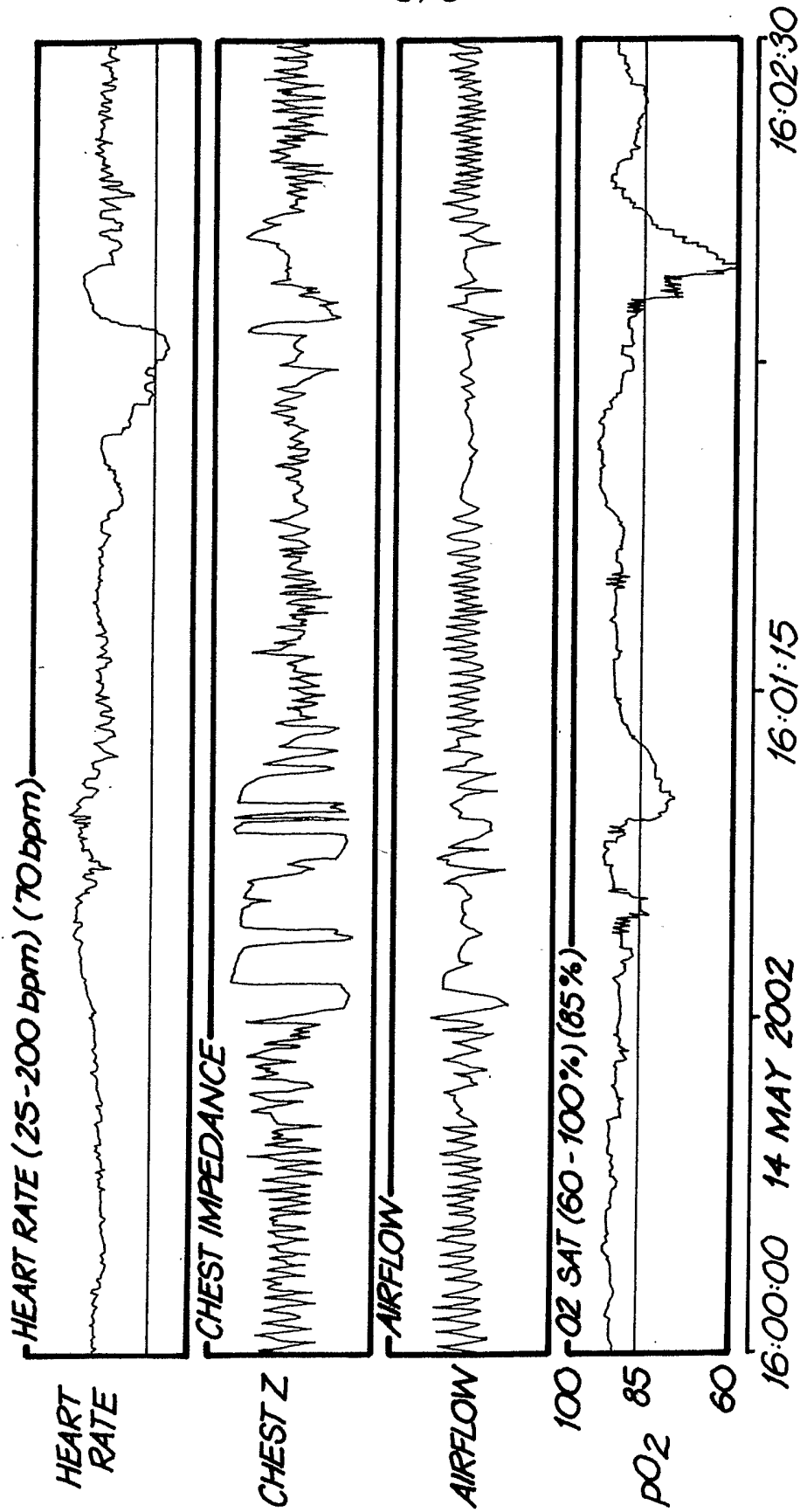


FIG. 6b

INTERNATIONAL SEARCH REPORT

International application No.

PCT/NZ03/00177

A. CLASSIFICATION OF SUBJECT MATTER				
Int. Cl. ⁷ : A47D 13/02; B60N 2/26; A 47C 16/00				
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)				
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 practicable, search terms used) DWPI: IPC B60N/IC, A47C/IC, A47D/IC, A47G/IC and key words INFANT, BABY etc., LOCATE, SEAT etc., HEAD, NECK etc.				
C. DOCUMENTS CONSIDERED TO BE RELEVANT				
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.		
X	US 4825487 A (EBERL) 2 May 1989 Whole document	1-16		
X	WO 01/00064 A (SPROG LIMITED) 4 January 2001 Whole document	1-16		
X	FR 2324282 A (INSTITUT EUROPEEN DE RECHERCHES ET D'APPLICATIONS MEDICALES (I.E.R.A.M.) S.A.R.L.) 15 April 1977 Whole document	1-16		
X	US 6321403 B1 (MATTHEWS) 27 November 2001 Whole document	1-16		
☐ Further documents are listed in the continuation of Box C ☒ See patent family annex				
<table style="width: 100%; border: none;"> <tr> <td style="width: 50%; vertical-align: top;"> * Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed </td> <td style="width: 50%; vertical-align: top;"> "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family </td> </tr> </table>			* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family			
Date of the actual completion of the international search 25 September 2003		Date of mailing of the international search report 29 SEP 2003		
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustalia.gov.au Facsimile No. (02) 6285 3929		Authorized officer L. DESECAR Telephone No : (02) 6283 2381		

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/NZ03/00177

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
US	4825487	CA	1257016	DE	3502003	EP	188739
		JP	61170463				
FR	2324282	NONE					
US	6321403	AU	200185354	CA	2389606	WO	200221978
WO	01/00064	AU	55513/00	EP	1202654	GR	9914694
							END OF ANNEX