Title: ARTIFICIAL AIRWAY DEVICE

Abstract: The invention relates to an artificial airway device (1) to facilitate lung ventilation of a patient, comprising an airway tube (2) and a mask (3) carried at one end of the airway tube, the mask (3) having a distal end (4) and a proximal end (5) and a peripheral formation (6) capable of forming a seal around the circumference of the laryngeal inlet, the peripheral formation (6) surrounding a hollow interior space or lumen (7) of the mask (3) and the bore of the airway tube (2) opening into the lumen (7) of the mask, the airway tube including support means (44) such that the cross sectional area of the bore is substantially maintained upon application of pressure by the patient’s teeth, whilst allowing local deformation of the tube at the point of tooth contact.
Published:

Designated States (unless otherwise indicated, for every Mund of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG) — with international search report (Art. 21(3))
ARTIFICIAL AIRWAY DEVICE

The present invention relates to an artificial airway device.

Artificial airway devices such as the laryngeal mask airway device are well known devices useful for establishing airways in unconscious patients. In its most basic form, a laryngeal mask airway device consists of an airway tube and a mask carried at one end of the airway tube, the mask having a peripheral formation often known as a "cuff" which is capable of conforming to and of fitting within, the actual and potential space behind the larynx of the patient so as to form a seal around the laryngeal inlet. The cuff can be inflatable, and in most variants it surrounds a hollow interior space or lumen of the mask, the at least one airway tube opening into the lumen. U.S. Patent No. 4,509,514 is one of the many publications that describe laryngeal mask airway devices such as this. Such devices have been in use for many years and offer an alternative to the older, even better known endotracheal tube. For at least seventy years, endotracheal tubes comprising a long slender tube with an inflatable balloon disposed at the tube's distal end have been used for establishing airways in unconscious patients. In operation, the endotracheal tube's distal end is inserted through the mouth of the patient, past the patient's trachea. Once so positioned, the balloon is inflated so as to form a seal with the interior lining of the trachea. After this seal is established, positive pressure may be applied to the tube's proximal end to ventilate the patient's lungs. Also, the seal between the balloon and the inner lining of the trachea protects the lungs from aspiration (e.g., the seal prevents material regurgitated from the stomach from being aspirated into the patient's lungs).

In contrast to the endotracheal tube, it is relatively easy to insert a laryngeal mask airway device into a patient and thereby establish an airway. Also, the laryngeal mask airway device is a "forgiving" device in that even if it is inserted improperly, it still tends to establish an airway. Accordingly, the laryngeal mask airway device is often thought of as a "life saving" device. Also, the laryngeal mask airway device may be inserted with only relatively minor manipulation of the patient's head, neck and jaw. Further, the laryngeal mask airway device provides ventilation of the patient's lungs without requiring contact with the sensitive inner lining of the trachea and the size of the airway established is typically significantly larger than
the size of the airway established with an endotracheal tube. Also, the laryngeal mask airway
device does not interfere with coughing to the same extent as endotracheal tubes. Largely due
to these advantages, the laryngeal mask airway device has enjoyed increasing popularity in
recent years.

U.S. Patent Nos. 5,303,697 and 6,079,409 describe examples of prior art devices that may be
referred to as "intubating laryngeal mask airway devices." The intubating device has the
added advantage that it is useful for facilitating insertion of an endotracheal tube. After an
intubating laryngeal mask airway device has been located in the patient, the device can act as
a guide for a subsequently inserted endotracheal tube. Use of the laryngeal mask airway
device in this fashion facilitates what is commonly known as "blind insertion" of the
endotracheal tube. Only minor movements of the patient's head, neck and jaw are required to
insert the intubating laryngeal mask airway device, and once the device has been located in
the patient, the endotracheal tube may be inserted with virtually no additional movements of
the patient. This stands in contrast to the relatively large motions of the patient's head, neck
and jaw that would be required if the endotracheal tube were inserted without the assistance of
the intubating laryngeal mask airway device. Furthermore, these devices permit single-
handed insertion from any user position without moving the head and neck of the patient from
a neutral position, and can also be put in place without inserting fingers in the patient's mouth.

Finally, it is believed that they are unique in being devices which are airway devices in their
own right, enabling ventilatory control and patient oxygenation to be continuous during
intubation attempts, thereby lessening the likelihood of desaturation.

Artificial airway devices of the character indicated are exemplified by the disclosures of US
5,297,547; U.S. Pat. No. 5,303,697; and by the disclosure of UK Patent 2,205,499.

Furthermore, devices with additional provision for gastric-discharge drainage are exemplified
by EP 0 794 807; U.S. Pat. No. 4,995,388 (Figs. 7 to 10); U.S. Pat. No. 5,241,956; and U.S.
Pat. No. 5,355,879 and commonly known as gastro-laryngeal masks. These masks make
provision for airway assurance to the patient who is at risk from vomiting or regurgitation of
stomach contents whilst unconscious. From a reading of these prior art documents it will be
appreciated that gastro-Iaryngeal masks present numerous and often conflicting requirements of design and manufacture to achieve designs that do not sacrifice any of the benefits of the more simpler designs described above.

Thus, in general, laryngeal mask airway devices aim to provide an airway tube of such cross-section as to assure more than ample ventilation of the lungs. Designs with provision for gastric drainage have been characterized by relatively complex internal connections and cross-sections calculated to serve in difficult situations where substantial solids could be present in a gastric discharge. As a result, the provision of a gastric discharge opening at the distal end of the mask applicable for direct service of the hypopharynx has resulted in a tendency for such masks to become bulky and unduly stiff, thus making for difficulty in properly inserting the mask. Undue bulk and stiffness run contrary to the requirement for distal flexibility for tracking the posterior curvature of the patient's anatomy on insertion, in such manner as to reliably avoid traumatic encounter. Moreover, manufacturing is made much more difficult and costly and the risks of device failure may be increased.

Problems such as these can be especially acute in devices formed from relatively rigid materials, like PVC, as opposed to the more traditional Liquid Silicon Rubber (LSR). In general, devices formed from materials such as PVC are attractive because they are cheaper to make, and can be offered economically as "single-use" devices. However, there are material differences in PVC and PVC adhesives, such as increased durometer hardness as compared to LSR, which affect how devices perform in use. For example, it has been observed that for a given volume of air, an LSR cuff will expand to a larger size than a comparable PVC cuff. This superior elasticity allows the LSR cuff to provide an anatomically superior seal with reduced mucosal pressure. To close the performance gap, the PVC cuff must be of reduced wall thickness. However, a PVC cuff of reduced wall thickness, deflated and prepared for insertion, will suffer from poor flexural response as the transfer of insertion force through the airway tube to cuff distal tip cannot be adequately absorbed. The cuff assembly must deflate to a thickness that preserves flexural performance i.e. resists epiglottic downfolding, but inflate so that a cuff wall thickness of less than or equal to 0.4mm creates a satisfactory seal. And where mask backplates are formed from PVC, as well as cuffs, the fact that the increased durometer hardness of PVC is inversely proportional to flexural performance (hysteresis)
means that the flexural performance of the device in terms of reaction, response and recovery on deformation is inferior to a comparable LSR device.

A problem experienced in the early days of the laryngeal mask was crushing and even puncture of the airway tube due to biting or abrasion by the patient's teeth. It will be remembered that the airway tube passes out through the patient's mouth between the teeth, usually in line with the incisors. This problem was addressed by the present inventor by providing an airway tube of flattened as opposed to circular section. Such an airway tube is illustrated in the drawings accompanying this application. A flattened section tube is less likely to contact the patient's teeth because it requires less clearance between the teeth and can be made to provide the same or a greater cross-sectional area for gas flow as a circular section tube.

A further expedient devised by the present inventor to prevent crushing and puncturing is the bite block. Bite blocks are now commonly used in laryngeal masks of all types. A bite block is a part of the device that is disposed to sit between the patient's teeth when the device is in place that is designed to be resistant to crushing and puncturing by the teeth. A bite block can be made by increasing the thickness of the wall of the airway tube, by forming the relevant section of the tube from a harder material, and by adding a reinforcement inside and or outside of the material of the airway tube. Although all of these expedients help prevent crushing and puncturing of the tube, they also to a greater or lesser extent increase the likelihood of damage to a patient's teeth by the device, particularly the airway tube, which can be particularly traumatic to a patient. It is an object of the present invention to seek to mitigate problems such as this.

According to the invention there is provided an artificial airway device to facilitate lung ventilation of a patient, comprising an airway tube and a mask carried at one end of the airway tube, the mask having a distal end and a proximal end and a peripheral formation capable of forming a seal around the circumference of the laryngeal inlet, the peripheral formation surrounding a hollow interior space or lumen of the mask and the bore of the airway tube opening into the lumen of the mask, the airway tube including support means such that the cross sectional area of the bore is substantially maintained upon application of
pressure by the patient’s teeth, whilst allowing local deformation of the tube at the point of tooth contact. In this way, the invention provides a device that has an airway tube that is resistant to crushing and puncture whilst also guarding against damage to a patient’s teeth.

The support means may comprise an insert within the airway tube. The insert may comprise a wall disposed to contact and support the airway tube, the wall including a cut away portion disposed at a point that in use will be in line with the direction of biting of the patient’s teeth.

As an alternative, the support means may comprise an external sleeve of the airway tube. The sleeve may comprise a wall disposed to contact and support the airway tube, the wall including a cut away portion disposed at a point that in use will be in line with the direction of biting of the patient’s teeth.

The peripheral formation may be inflatable, such as for example an inflatable cuff.

It is preferred that the mask describes a substantially convex curve, from the proximal to distal end. It is further preferred that the mask body comprises a plate, the plate having a dorsal side and a ventral side, the dorsal side being substantially smooth and having a convex curvature across its width. It is also preferred that the dorsal surface of the airway tube corresponds in curvature to the curvature across the width of the plate. All of these expedients assist in making insertion of the mask easier.

The airway tube preferably comprises a relatively more rigid material than the mask body. Both the airway tube and the mask body preferably comprise a plastics material.

The invention will further be described by way of example and with reference to the following drawings, in which,

Figure 1 is an underplan, or ventral view of a device according to the invention;

Figure 2 is an exploded view of a part of the device of Figure 1;
Figure 3 is a perspective ventral view of the mask of the device of Figure 1;

Figure 4 is a front end view of the mask shown in Figure 3 in a first position;

Figure 5 is a front end view of the mask shown in Figure 3 in a second position;

Figure 6 is a side view of the device of Figure 1; and

Figure 7 is a plan, or dorsal view of the device of Figure 1.

Referring now to the drawings, there is illustrated an artificial airway device 1 to facilitate lung ventilation of a patient, comprising an airway tube 2 and a mask 3 carried at one end of the airway tube, the mask 3 having a distal end 4 and a proximal end 5 and a peripheral formation 6 capable of forming a seal around the circumference of the laryngeal inlet, the peripheral formation 6 surrounding a hollow interior space or lumen 7 of the mask 3 and the bore of the airway tube 2 opening into the lumen 7 of the mask, the airway tube including support means 44 such that the cross sectional area of the bore is substantially maintained upon application of pressure by the patient’s teeth, whilst allowing local deformation of the tube at the point of tooth contact.

As can be seen from the drawings, the device 1, in terms of overall appearance is somewhat similar to prior art devices, in that it consists of the basic parts which make up most if not all laryngeal mask airway devices, i.e. an airway tube 2 and mask 3. The mask 3 includes two components, a body part 11 often referred to as a backplate (shown in Figures 6 and 7), and a peripheral formation 6 which here takes the form of an inflatable cuff with an inflation line 12.

For the purposes of description it is convenient to assign reference names to areas of the device 1 (as opposed to its constituent parts) and accordingly with reference to Figures 6 and 7, the device 1 has a dorsal side 14, a ventral side 15, a proximal end 16 (in a sense that this is the end nearest the user rather than the patient) a distal end 17 and right and left sides 18 and 19.
Referring firstly to the airway tube 2, in the illustrated embodiment the tube 2 comprises a relatively rigid PVC material such as a shore 90A Colorite PVC moulded into an appropriately anatomically shaped curve. The tube 2 has some flexibility such that if it is bent it will return to its original shape. Although it is resiliency deformable in this way, it is also sufficiently rigid to enable it to assist in insertion of the device 1 into a patient, acting as a handle and guide for positioning the mask. The airway tube 2 does not have a circular cross-section as in many prior devices, but instead is compressed in the dorsal/ventral direction which assists in correct insertion of the device 1, helps prevent kinking, and assists in comfortable positioning for the patient as the shape generally mimics the shape of the natural airway. In this embodiment each side 18, 19 of the airway tube 2 also includes a groove or channel 20 extending for most of the tube's length from the proximal to distal ends. These grooves 20 further assist in preventing crushing or kinking of the airway tube 2. Internally the grooves 20 form ridges along the inner surfaces of the sides 18 and 19, but this not essential to their operation.

A further feature of the airway tube 2 is oesophageal drain tube 41. This drain tube 41 is located within airway tube 2, extending centrally through it from the proximal end to the distal end, and in this embodiment it is disposed in contact with the inner surface of the dorsal wall 2b of the airway tube 2, and bounded on each side by raised, smooth walls (not shown) which form a shallow channel through which it runs. At the proximal end of the airway tube 2, the drain tube 41 exits the airway tube 2 via branch 42a of a bifurcated connector 42, to which a suction line may be attached. Bifurcated connector 42 also allows for connection of the airway tube to a gas supply via branch 42b. Here it is formed from a relatively rigid plastics material (when compared with the airway tube 2) to enable easy connection of air lines and suction. Referring to Figure 2, connector 42 comprises a hollow somewhat flattened, conical connector body 43 defining an atrium having branches 42a and 42b extending from its narrower, proximal end. Conical body 43 includes a circumferential flange 42c from which extends tab 42d in a direction generally normal to the longitudinal axis of the connector.

Referring to Figure 2, an insert section 44 extends longitudinally from the distal end of the conical body 43, forming a bite block which supports the tube 2 against crushing or
puncturing by the patient's teeth. The insert section 44 can be described as a tube, flattened in
the dorsal to ventral direction and having two sections of wall removed leaving gaps 44e and
"amis" 44a which extend distally long the tube 2. The insert section 44 corresponds in shape
and dimension with the internal shape of the proximal end of the airway tube 2 such that it fits
snugly inside it, with curved arms 44a corresponding in profile to and thereby providing
support and rigidity to the sides of the airway tube. As a result of the removed wall sections
44e the support for the parts of the airway tube 2 adjacent the removed sections is reduced,
such that a relatively softer, deformable surface is provided, although overall support for the
tube 2 remains. In particular, it will be appreciated that supporting the sides of the airway tube
using correspondingly shaped arms 44a prevents crushing of the airway tube. A sleeve 45 of a
soft and compliant material is bonded in place around the outside of the airway tube 2,
covering the area into which the insert section 44 locates, and the thickness of the airway tube
wall at this point can be reduced to accommodate this such that the overall thickness at this
point 46 is not increased. Thus, it will be appreciated that this configuration provides a bite
block that not only supports the airway tube 2 at a point where the patient's teeth are normally
located when the device is in use, but also guards against damage to the teeth by virtue of the
less rigid parts. It will be appreciated that this form of connector can also be applied to airway
devices that do not include an oesophageal drain.

Turning now to the mask 3, the mask 3 consists of two parts, a body part 11 often referred to
as a back plate, and a peripheral cuff 6.

The back plate 11 is formed by moulding from a shore 50A Vythene PVC 4. PU. This
material is substantially softer and more deformable than the material of airway tube 2. The
back plate 11 comprises a generally oval moulding when viewed from the dorsal or ventral
directions, having a smooth dorsal surface 24, and a formed ventral surface 24a (Figure 5).
The dorsal surface 24 has a convex curvature from one side to the other, corresponding to the
curvature of the dorsal surface of the airway tube 2, and longitudinally, the dorsal surface 24
is also curved, having a curvature beginning at the joining portion 24b and extending with
constant rate of curvature toward the distal tip. As a result the tip is ventrally biased relative to
the distal end of the airway tube, in the assembled device 1, the extent of displacement of the
distal tip being approximately 20mm or 10 degrees, in order to produce a curvature in the
mask that is suited to the anatomy of the patient. On insertion, this displacement of the tip assists the mask in "turning the corner" in the insertion path.

Backplate 11 includes an integrally moulded cylindrical drain tube 20 that extends from its proximal to distal ends. At the proximal end, the drain tube 11 is dimensioned such that it can be joined to the drain tube of the airway tube. At its distal end, the wall of the drain tube 20 has a cut away portion 21, and a smooth, turned over edge.

The second part of the mask 3 is the peripheral cuff 6. The cuff 6 is in this embodiment blow moulded PVC and takes the form of a generally elliptical inflatable ring, a relatively deeper proximal end 37 with an inflation port 38 and a relatively shallower distal end tapering to a "wedge" profile 39. At the distal end the cuff is formed with a channel 22 in it is dorsal surface, the channel being of an open C shape that runs in a proximal to distal direction to the tip of the cuff. The cuff 6 is integrally formed in one piece. The wedge profile is provided such that the ratio of dorsal to ventral side surface areas favours the dorsal side. Thus, when deflated the distal end of the cuff 6 will curl with bias from dorsal to ventral side.

The cuff 6 is bonded to the backplate 11 such that the cut away section of the drain tube 20 extends over the channel 22 in the dorsal surface of the backplate 11, thereby forming a tube, part of the wall of which is formed by the backplate and part by the cuff 6. The tube terminates at or just before the distal extremity of the cuff, the smooth edge flaring to some extent in a dorsal direction.

In use, the deflated device 1 is inserted into a patient in the usual manner with devices of this type. As noted above, the relative rigidity of the airway tube 2 allows a user to grip it and use it to guide the device 1 into the patient, whilst the relatively softer, more compliant material of the back plate means that the mask will more readily deform to negotiate the insertion path without causing damage to the anatomy, and will return to its optimum shape to ensure that a good seal is achieved at the furthest extent of insertion. The ventral displacement of the distal tip relative to the join between the back plate 11 and airway tube 2 further enhances ease of insertion, because the distal tip is thereby presented at the optimum angle to negotiate the "bend" in the insertion path. In devices formed from relatively rigid materials such as PVC, as
opposed to the often used LSR these features are particularly important in easing insertion and providing for an enhanced seal. Once in place, the support 44 prevents crushing and puncturing of the airway tube 2 by the patient's teeth because the curved side walls of the airway tube 2 are supported by the correspondingly curved arms 44a of the support 44. However the tube 2 still guards against tooth damage because the cutaway gaps 44e allow some deformation of the surface of the tube 2.
Claims

1. An artificial airway device to facilitate lung ventilation of a patient, comprising an airway tube and a mask carried at one end of the airway tube, the mask having a distal end and a proximal end and a peripheral formation capable of forming a seal around the circumference of the laryngeal inlet, the peripheral formation surrounding a hollow interior space or lumen of the mask, the bore of the airway tube opening into the lumen of the mask, the airway tube including support means such that the cross sectional area of the bore is substantially maintained upon application of pressure by the patient's teeth whilst allowing local deformation of the tube at the point of tooth contact.

2. A device according to claim 1, the support means comprising an insert within the airway tube.

3. A device according to claim 2, the insert including a wall disposed to contact and support the airway tube the wall including a cut away portion disposed at a point that in use will be in line with the direction of biting of the patient's teeth.

4. A device according to claim 2, the insert including an external sleeve of the airway tube, the sleeve comprising a wall disposed to contact and support the airway tube, the wall including a cut away portion disposed at a point that in use will be in line with the direction of biting of the patient's teeth.

5. A device according to any preceding claim, the peripheral formation comprising an inflatable cuff.
### A. CLASSIFICATION OF SUBJECT MATTER

**INV. A61M16/04**

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)

A61M

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)

EPO-Internal

### C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>US 6 705 318 Bl (BRAIN ARCHIBALD I J [GB]) 16 March 2004 (2004-03-16)</td>
<td>1,2,5</td>
</tr>
<tr>
<td>Y</td>
<td>The whole document, especially paragraphs col umn 12, line 4 - col umn 13, line 17 and figures 9A-10B</td>
<td>3,4</td>
</tr>
<tr>
<td>X</td>
<td>GB 2 465 453 A (NASIR MUHAMMED ASLAM [GB]) 26 May 2010 (2010-05-26)</td>
<td>1,2,5</td>
</tr>
<tr>
<td>Y</td>
<td>The whole document, especially figures 1,2,8 and page 7, lines 19-34</td>
<td>3,4</td>
</tr>
<tr>
<td>Y</td>
<td>US 2008/276936 AI (COOK DANI EL J [US]) 13 November 2008 (2008-11-13) figures 1,2,4</td>
<td>3</td>
</tr>
<tr>
<td>Y</td>
<td>US 5 318 017 A (ELLISON LEE H [US]) 7 June 1994 (1994-06-07) col umn 3, lines 1-16; figure 3</td>
<td>3</td>
</tr>
</tbody>
</table>

Further documents are listed in the continuation of Box C.

See patent family annex.

### Date of the actual completion of the international search

8 December 2011

### Date of mailing of the international search report

16/12/2011

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040;
Fax: (+31-70) 340-3016

Authorized officer

Borowski, Aleksander
<table>
<thead>
<tr>
<th>Category*</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>US 4,166,467 A (ABRAMSON HARVEY J [US])&lt;br&gt;4 September 1979 (1979-09-04)&lt;br&gt;the whole document</td>
<td>4</td>
</tr>
</tbody>
</table>

**INTERNATIONAL SEARCH REPORT**

**International application No**

**PCT/GB2011/001421**

Form PCT/ISA/210 (continuation of second sheet) (April 2008)
<table>
<thead>
<tr>
<th>Patent document cited in search report</th>
<th>Publication date</th>
<th>Patent family member(s)</th>
<th>Publication date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>US 2004187872 Al</td>
<td>30-09-2004</td>
</tr>
<tr>
<td>GB 2465453 A</td>
<td>26-05-2010</td>
<td>AU 2009317011 Al</td>
<td>27-05-2010</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EP 2355883 A2</td>
<td>17-08-2011</td>
</tr>
<tr>
<td></td>
<td></td>
<td>GB 246545 A</td>
<td>26-05-2010</td>
</tr>
<tr>
<td></td>
<td></td>
<td>GB 2465455 A</td>
<td>26-05-2010</td>
</tr>
<tr>
<td></td>
<td></td>
<td>GB 2472359 A</td>
<td>02-02-2011</td>
</tr>
<tr>
<td></td>
<td></td>
<td>US 2011277772 Al</td>
<td>17-11-2011</td>
</tr>
<tr>
<td></td>
<td></td>
<td>WO 2010058219 A2</td>
<td>27-05-2010</td>
</tr>
<tr>
<td></td>
<td></td>
<td>WO 2010058220 Al</td>
<td>27-05-2010</td>
</tr>
<tr>
<td>US 2008276936 Al</td>
<td>13-11-2008</td>
<td>JP 2010526587 A</td>
<td>05-08-2010</td>
</tr>
<tr>
<td></td>
<td></td>
<td>US 2008276936 Al</td>
<td>13-11-2008</td>
</tr>
<tr>
<td></td>
<td></td>
<td>US 2011168183 Al</td>
<td>14-07-2011</td>
</tr>
<tr>
<td></td>
<td></td>
<td>WO 2008140885 Al</td>
<td>20-11-2008</td>
</tr>
<tr>
<td>US 5318017 A</td>
<td>07-06-1994</td>
<td>NONE</td>
<td></td>
</tr>
<tr>
<td>US 4166467 A</td>
<td>04-09-1979</td>
<td>NONE</td>
<td></td>
</tr>
</tbody>
</table>