The invention relates to a pneumatic tire wherein the crown has a ply comprised of substantially circumferentially oriented cords which are spirally wound. The winding pitch p of said cords is greater than 2.5 times the cord diameter D. The tread compound is applied directly on said cords. This arrangement facilitates tire fabrication and assures good adherence between the tread compound and the rest of the crown of the tire.
Pneumatic Tire With Improved Endurance

The invention relates to a pneumatic tire for vehicles, in particular a tire the architecture of which is optimized to facilitate fabrication while retaining high reliability and endurance.

It is common practice in the art, particularly for tires for passenger cars which must be capable of rolling at high speeds, to use a tire ply comprised of substantially circumferentially oriented cords for the purpose of reinforcing the stiffening hoop effect of the tire crown. This ply may be disposed radially outwardly of the other reinforcing plies customarily used in the crown. Such a tire ply is generally called a « zero-degree ply ».

For use in typical passenger cars, the cords in the ply are generally based on nylon. Because nylon cord has a relatively low modulus of elasticity, it is usually laid at a high laying density, that is to say with a winding pitch the magnitude of which is close to the diameter of the cord itself.

In such classical configurations, the gap left between two adjacent cords, called the « inter-cord space, i », is small, often less than 0.4 Φ, where Φ is the diameter of the cord. Most often,

\[ i < 0.25 \Phi. \]

Thus, for a cord of diameter 0.7 mm, the inter-cord space is typically on the order of 0.175 mm.

Accordingly, in order to obtain good bonding of the zero degree ply within the crown of the tire, it is necessary to apply around its cords an optimized layer of cushion compound. This layer of cushion compound must present high adherence to the cords and high strength, to enable said layer to resist shear stresses between adjacent cords. The composition of this layer of cushion compound must also be such as to enable good adherence with the tread compounds, which latter are disposed radially outward of this layer of cushion compound.

It has been found that it is difficult to achieve good adherence of the tread compounds with the zero degree ply comprised of substantially circumferentially oriented cords.
In the following, « cord » is understood to mean both monofilaments and multifilaments, or assemblies such as cables, plied yarns or any other type of equivalent assemblies, and this, regardless of the material or treatment of these cords, for example, surface treatment or coating or dipping to promote adhesion to the rubber.

« Compound » means a rubber mix having one or more base elastomers and additives selected in accordance with the properties of the compound desired for the zone of the tire it is used.

« Layer of cushion compound » for a given reinforcing ply is understood to mean the rubber compound in contact with the reinforcing cords of the ply, adhering to these and filling the gaps between adjacent cords.

« Contact » between a cord and a layer of cushion compound is understood to mean that at least part of the outer circumference of the cord is in intimate contact with the rubber compound constituting the cushion compound.

« Linear density » applied to a cord is the weight in grams per 1000 meters of the cord, stated in units of « tex ». The units used for the stress on a cord, or the modulus of elasticity of a cord are centi-newton per tex (cN/tex).

« Winding pitch, p », applied to a substantially circumferentially oriented cord which is spirally wound particularly in a large-diameter spiral having as its main axis the main axis of the tire, is the transverse distance between the cord axes of the cords of two adjacent loops in the spiral. « Laying density, d », is the reciprocal of the winding pitch and thus corresponds to the number of loops of a spirally wound cord per unit axial length (along the main axis of the winding). Customarily, d is stated as the number of cords per decimeter (units of 1/dm), and p is stated in units of millimeters.

Thus \( p = 100/d \).

The fill density of reinforcing cords in a ply is characterized by the « fill coefficient, FC », defined as the ratio of the diameter of the cord to the laying distance:

\[ FC = \Phi/p, \]

where \( \Phi \) is the diameter of the cord; and

\( p \) is the winding pitch of the cord.

Typically, this ratio is \( > 0.6 \), and often it is \( > 0.75 \).
The principal claimed matter of the invention relates to a tire, comprising a crown extended by two respective sidewalls and two respective beads, and a carcass which is anchored in said beads, said crown having the following components, disposed in the following order with progression radially from the interior to the exterior with respect to the main axis of the tire:

-- at least one reinforcing belt comprised of parallel cords disposed at an angle \( \alpha \) in the range 10-75° with respect to the circumferential direction;
-- at least one ply, comprised of cords which are spirally wound, wherewith the cords themselves are substantially oriented in the said circumferential direction; and
-- a tread;

wherein said tread is in direct contact with said substantially circumferentially oriented cords; and in that, in at least one particular zone of the crown,  

\[ FC < 0.4 , \]

where \( FC \) is the fill coefficient, defined as  

\[ FC = \Phi/p , \]

where \( \Phi \) is the cord diameter of said cords, and \( p \) is the winding pitch between the cord axes of neighboring said cords comprising the spiral winding.

It follows that the inter-cord space must be at least \( 1.5\Phi \); thus for a cord of diameter 0.7 mm the inter-cord space must be at least 1.05 mm.

The direct application of the tread compound on the substantially circumferentially oriented cords facilitates the tire fabrication by limiting the number of components to be assembled. The wide winding pitch of these cords ensures excellent reliability and endurance of the adhesion between the tread and the rest of the crown, in that said adhesion is attributable principally to direct bonding between rubber compounds which are in mutual contact.

Preferably, the fill coefficient of the ply comprised of substantially circumferentially oriented cords is \( < 0.4 \) over the entire width of the crown.

According to an advantageous variant embodiment, the fill coefficient of said ply is lower in the central zone of the crown than in the lateral zones; thus the winding
pitch of said circumferentially oriented cords is greater in the central zone of the crown. This provides a higher density of reinforcing components in the lateral regions (shoulder regions), which increases the resistance of the tire to high speed conditions.

According to a second variant embodiment, the fill coefficient of the ply comprised of substantially circumferentially oriented cords is higher in the central zone of the crown than in the lateral zones; thus the density of reinforcing components is higher in said central region, which provides a flatter transverse profile of the tire, thereby improving tire performance in vehicle handling.

According to another embodiment, the tread comprises two compounds, a tread compound intended to come into contact with the road and an underlayer compound, different from the tread compound, disposed radially inwardly of said tread compound. In this embodiment, the underlayer compound is in direct contact with the said substantially circumferentially oriented cords.

Such underlayers are known in the art. Compositions of such underlayers are intended to improve various aspects of performance, such as tire wear or the cornering stiffness of the tire. However, the optimization tends to come at the cost of inferior adherence to a cord structure and/or lower strength parameters, when compared to classical tread compositions applied by calendering.

Thus the invention offers the possibility of products with improved performance.

The substantially circumferentially oriented cords which are spirally wound develop a stress at 3% deformation greater than 12 cN/tex, and preferably greater than 20 cN/tex. Thus, they offer a high modulus of elasticity at appreciable deformations, thereby allowing the ply of which they are comprised to perform its functions well, and in particular, the conferring of strength to the crown during operation at high speed.

The circumferentially oriented cords may also have an initial modulus of elasticity less than 900 cN/tex, and preferably less than 800 cN/tex. The advantage of the low initial modulus is a more comfortable ride and lower tire coast-by noise, during operation at low speed.

Such a cord may be a hybrid cord or yarn comprised of at least one nylon cord or yarn and at least one aramid cord or yarn.
Various embodiments of the invention will be described hereinbelow, with reference to the accompanying drawings, in which:

Fig. 1 is a partial transverse cross section of a pneumatic tire 1 according to the invention;

Fig. 2 is a partial transverse cross section of a second embodiment of an inventive tire;

Fig. 3 is a partial transverse cross section of a variant embodiment of the tire according to Fig. 1;

Fig. 4 is a partial transverse cross section of a second variant embodiment of the tire according to Fig. 1; and

Fig. 5 is a plot of stress versus elongation for three types of cords described hereinbelow.

Fig. 1 is a partial transverse cross section of a pneumatic tire 1 according to the invention, which tire is comprised of a crown 2 extending to two sidewalls 3, which sidewalls have two respective beads (not shown). The crown has:

-- a carcass ply 4, which is anchored in known fashion in the two beads;

-- two reinforcing belts 5, 6 each of which is formed from parallel cords and is disposed at a bias angle (α, β respectively, in particular on the order of +30° and -30° respectively) with respect to the circumferential rolling direction, wherewith the cords of ply 5 are at an appreciable crossing angle to those of ply 6; and

-- an outer ply 7 comprised of cords which are substantially circumferentially oriented.

The carcass ply 4 is substantially oriented radially, i.e. at 90° to the circumferential direction. The tread surface of the crown 2 has grooves 8.

The ply 7 of cords oriented substantially circumferentially is comprised of textile cords which are spirally wound in order to ensure good stiffening hoop effect of the crown 2. In the exemplary embodiment illustrated in Fig. 1, these cords are dipped cords which have a linear density of 521 tex. They are made from two identical aramid yarns of 167 tex individually twisted at 280 t/m (turns per meter) in a first direction and
from one Nylon yarn of 140 tex twisted at 280 t/m in the same direction, these three yarns being further simultaneously twisted at 280 t/m in the opposite direction. The initial modulus of elasticity of this cord is 740 cN/tex, and the stress developed at a 3% elongation is 30 cN/tex. The diameter of the cord is 0.8 mm.

The diameter $\Phi$ of a textile cord is determined as follows: with the cord under tension, a parallel light beam is interrupted by the cord, creating a shadow which is measured instantaneously by an array of photoreceptors. A measurement sequence at 900 points along 50 cm of the cord yields the value of the mean width of the cord. The diameter $\Phi$ is calculated by averaging 4 such measurement sequences.

Fig. 5 shows a curve of stress versus elongation for this cord (curve c) as well as for two other commonly used cords:

-- curve a: nylon cord (2 yarns of Nylon);
-- curve b: aramid cord (2 aramid yarns);
-- curve c: aramid-Nylon cord.

The nylon cord (curve a) is a dipped cord of 441 tex made from two identical nylon yarns of 210 tex individually twisted at 200 t/m in a first direction then simultaneously twisted at 200 t/m in the opposite direction. The initial modulus of elasticity of this cord is 530 cN/tex, the stress at a 3% elongation is 9 cN/tex. Thus, the modulus of elasticity of this cord is low at low deformations as well as at appreciable deformations.

The aramid cord (curve b) is a dipped cord of 376 tex made from two identical aramid yarns of 167 tex individually twisted at 440 t/m in a first direction then simultaneously twisted at 440 t/m in the opposite direction. The initial modulus of elasticity of this cord is 2030 cN/tex, the stress at a 3% deformation is 68 cN/tex. This cord is thus characterized by a high modulus of elasticity.

In the embodiment of the tire 1 according to Fig. 1, the tread compound 2 is in direct contact with the outer tire ply 7. This configuration facilitates the fabrication of the tire by reducing the number of different components to be installed and the time needed for this fabrication.
The high modulus of elasticity of the cords of the tire ply 7 allows said cords to be disposed externally of tire plies 5 and 6 at a high winding pitch, namely greater than 2 mm, and thereby with a fill coefficient (FC) less than 0.4. If cords comprised solely of nylon were used, this would require a relatively high laying density, whereby the fill coefficient FC would be relatively high, with an inter-cord space very small and therefore would result in weaker binding of the tread compound over the cords of the tire ply 7.

One may employ hybrid nylon-aramid cords such as illustrated in Fig. 5c. Compared to aramid cords, these hybrid cords have a lower modulus of elasticity at low deformations, which makes it possible to reduce the tire coast-by noise. This choice also results in a more comfortable ride.

Fig. 2 is a partial transverse cross section of a pneumatic tire 10 according to the invention, the crown of which tire has an underlayer 12 between the tread region 11 and the outer ply 17. The ply 17 as shown is comprised of cords which are substantially circumferentially oriented. The underlayer 12 is applied directly onto the cords of the ply 17.

Fig. 3 illustrates a variant embodiment 20 of the tire according to Fig. 1. In this variant tire 20 the outer ply 27 of substantially circumferentially oriented cords are applied:

-- at a first winding pitch \(p_1\) in the axial zone A disposed generally in the center of the crown; and

-- at a second winding pitch \(p_2\) in the axial zone B located laterally of zone A.

Both \(p_1\) and \(p_2\) are chosen such that the fill coefficient FC of the ply 27 is less than 0.4, and such that \(p_1 > p_2\). The magnitude of \(p_1\) may be in the range 5-10 mm, and that of \(p_2\) in the range 2-4 mm.

This change in the winding pitch allows increased cord density of the circumferentially oriented cords in the lateral regions of the crown to provide increased strength at high rotational speeds. The use of cords having a high modulus of elasticity at higher deformations (curves b and c in Fig. 5) enables higher winding pitches. The proportion of the width of the crown occupied by zone B may vary in different tire designs.
Fig. 4 illustrates another variant embodiment of the tire according to Fig. 1. In this variant tire 30, the outer ply 37 of substantially oriented cords has a first winding pitch \( p_1 \) in the axial zone C at the center of the crown, and a second winding pitch \( p_2 \) in the axial zone D located laterally of zone C. Both \( p_1 \) and \( p_2 \) are chosen such that the fill coefficient FC of the ply 37 is less than 0.4, and such that \( p_1 < p_2 \). The magnitude of \( p_1 \) may be in the range of 2-4 mm, and that of \( p_2 \) in the range 4-8 mm.

This change in the winding pitch allows increased cord density of the circumferentially oriented cords in the central zone of the crown, to provide a flatter transverse profile of the tire, thereby improving tire performance in vehicle handling. As with the preceding embodiment of Fig. 3, the width of the zone C in the axial direction admits of substantial variation.

According to a first embodiment of a method of fabrication, the inventive tire may be advantageously fabricated on a rigid core which imparts the form to the interior cavity of the tire, as described in patents EP 0,242,840 or EP 0,822,047. All the components of the tire are applied over said core, as required by the final architecture. The components are thus applied directly in their final dispositions, without subjecting them to externally applied forming stress at any time during the fabrication. Then the vulcanization process takes place. The core is removed when the vulcanizing process is complete. To lay the reinforcing cords in the carcass, one may particularly employ the apparatuses described in EP 0,243,851. To lay the cords in the crown, one may particularly employ the apparatuses described in EP 0,248,301, and to apply the rubber materials one may particularly employ the apparatuses described in EP 0,264,600.

The above-described method of fabrication has the advantage of greatly reducing or eliminating pre-stressing of the cords, particularly those oriented at \( 0^\circ \) (with respect to the circumferential direction around the main axis of the tire), during the traditional forming operations.

One may also partially cool the tire while on the core, so as to maintain the cords in the state of deformation imposed during their laying.
It is also possible to fabricate the tire or a drum of the type described in WO 97/47,463, or EP 0,718,090, wherewith one accomplishes the rough-shaping of the tire before laying the substantially circumferentially oriented cords.

One may then lay said circumferentially oriented cords on an underlying form means which has a geometry identical to that intended in the vulcanizing mold. The crown is then assembled using a rough-formed piece which is complementary to the tire, employing transfer techniques known to a person skilled in the art. Then, again according to methods which are per se known, the tire is loaded into a press and the tire is subjected to pressure via a membrane disposed in the interior of the tire.

This fabrication method also serves to minimize or eliminate pre-stressing which can result from the forming processes which take place in the vulcanization press.

All of the described methods enable the substantially circumferentially oriented cords to be spirally, wherewith the diameters of the laid cords differ by less than 0.5% from the final diameters of said cords in the tire after vulcanization. This low deviation between the pre- and post-vulcanization diameter can be achieved over the entire width of the crown 2.
Claims:

1. A tire, comprising a crown extended by two respective sidewalls and two respective beads, and a carcass which is anchored in said beads, said crown having the following components, disposed in the following order with progression radially from the interior to the exterior with respect to the main axis of the tire:
   -- at least one reinforcing ply comprised of parallel cords disposed at an angle $\alpha$ in the range 10-75° with respect to the circumferential direction;
   -- at least one ply comprised of cords which are spirally wound wherewith the cords themselves are substantially oriented in the said circumferential direction;
   and
   -- a tread;

wherein said tread is in direct contact with said substantially circumferentially oriented cords, and, in at least one particular zone of the crown,

$$\text{FC} \leq 0.4,$$

where FC is the fill coefficient, defined as

$$\text{FC} = \Phi/p,$$

where $\Phi$ is the cord diameter of said cords and p is the winding pitch between the cord axes of neighboring said cords comprising the spiral winding.

2. A tire according to claim 1, wherein the fill coefficient FC of the ply comprising substantially circumferentially oriented cords is less than or equal to 0.4 over the entire width of the crown.

3. A tire according to claim 1 or 2, wherein the fill coefficient FC of the ply comprised of substantially circumferentially oriented cords has a lower value in the central zone of the crown than in the lateral zones.
4. A tire according to claim 1 or 2, wherein the fill coefficient FC of the ply comprised of substantially circumferentially oriented cords has a higher value in the central zone of the crown than in the lateral zones.

5. A tire according to one of claims 1-4, wherein the tread comprising
-- a tread compound intended to come into contact with the road, and
-- an underlayer compound different from the tread compound disposed radially inwardly of said tread compound, wherewith said underlayer compound is in direct contact with said substantially circumferentially oriented cords.

6. A tire according to one of claims 1-5, wherein the substantially circumferentially oriented cords develop a stress at 3% deformation greater than 12 cN/tex.

7. A tire according to claim 6, wherein the substantially circumferentially oriented cords develop a stress at 3% deformation greater than 20 cN/tex.

8. A tire according to claim 6 or 7, wherein the substantially circumferentially oriented cords have an initial modulus of elasticity less than 900 cN/tex.

9. A tire according to claim 8; wherein the substantially circumferentially oriented cords have an initial modulus of elasticity less than 800 cN/tex.

10. A tire according to one of claims 1-9; wherein the substantially circumferentially oriented cords comprise at least one Nylon yarn associated with at least one aramid yarn.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 B60C9/22 B60C9/20 B60C11/00

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)

IPC 7 B60C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic database consulted during the international search (name of database and, where practical, search terms used)

EPO-Internal, PAJ, WPI Data

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 5 385 188 A (KOGURE TOMOHIKO ET AL)</td>
<td>1,2</td>
</tr>
<tr>
<td>Y</td>
<td>column 2, line 23 - line 30</td>
<td>3-5, 10</td>
</tr>
<tr>
<td></td>
<td>column 2, line 50 - column 3, line 9</td>
<td></td>
</tr>
<tr>
<td></td>
<td>claims 2, 3, figure 1</td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>PATENT ABSTRACTS OF JAPAN</td>
<td>1, 4</td>
</tr>
<tr>
<td></td>
<td>vol. 018, no. 245 (M-1603), 11 May 1994 (1994-05-11)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&amp; JP 06 032111 A (BRIDGESTONE CORP), 8 February 1994 (1994-02-08)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>abstract</td>
<td></td>
</tr>
<tr>
<td></td>
<td>the whole document</td>
<td></td>
</tr>
</tbody>
</table>

-/--

X Further documents are listed in the continuation of box C.

X Patent family members are listed in annex.

* 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 document 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 novel or 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

"S" document member of the same patent family

Date of the actual completion of the international search

19 July 2000

Date of mailing of the international search report

28/07/2000

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel: (+31-70) 340-2040, Tx: 31 651 epo nl
Fax: (+31-70) 340-3018

Authorized officer

Bibollet-Ruche, D
<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></td>
<td>page 3, line 15 - line 29 page 5, line 4 - line 13 figures</td>
<td>1,2,10</td>
</tr>
<tr>
<td>Y</td>
<td>GB 2 033 852 A (CONTINENTAL GUMMI WERKE AG) 29 May 1980 (1980-05-29) page 1, line 94 - page 2, line 12 figures</td>
<td>5</td>
</tr>
<tr>
<td>A</td>
<td>page 1, line 94 - page 2, line 12 figures</td>
<td>1</td>
</tr>
<tr>
<td>Y</td>
<td>US 4 293 019 A (MAIOCCI LUIGI) 6 October 1981 (1981-10-06) column 4, line 20 - line 42</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>column 5, line 1 - line 10 figures 1,2</td>
<td>1</td>
</tr>
<tr>
<td>Y</td>
<td>EP 0 661 179 A (SUMITOMO RUBBER IND) 5 July 1995 (1995-07-05) page 4, line 6 - line 33 table 1</td>
<td>10</td>
</tr>
<tr>
<td>A</td>
<td>page 4, line 6 - line 33 table 1 figures 1,4-7</td>
<td>1</td>
</tr>
<tr>
<td>A</td>
<td>US 4 216 813 A (KERSKER THEODORE M ET AL) 12 August 1980 (1980-08-12) column 1, line 54 - column 2, line 54 figures 1-3</td>
<td>1,9,10</td>
</tr>
<tr>
<td>Patent document cited in search report</td>
<td>Publication date</td>
<td>Patent family member(s)</td>
</tr>
<tr>
<td>---------------------------------------</td>
<td>-----------------</td>
<td>-------------------------</td>
</tr>
<tr>
<td>US 5385188 A</td>
<td>31-01-1995</td>
<td>NONE</td>
</tr>
<tr>
<td>JP 06032111 A</td>
<td>08-02-1994</td>
<td>NONE</td>
</tr>
<tr>
<td>FR 2429678 A</td>
<td>25-01-1980</td>
<td>NONE</td>
</tr>
<tr>
<td>GB 2033852 A</td>
<td>29-05-1980</td>
<td>DE 2838464 A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>FR 2434700 A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IT 1122382 B</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AR 220172 A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AT 362245 B</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AT 179279 A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BE 874324 A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CA 1089341 A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DE 2909086 A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DK 494378 A,B</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ES 478547 A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>FI 790651 A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>FR 2419187 A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>GB 2015937 A,B</td>
</tr>
<tr>
<td></td>
<td></td>
<td>GR 74916 A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IE 48017 B</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IN 150528 A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>JP 54126305 A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LU 80957 A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NL 7810897 A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NO 790776 A,B</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SE 7812263 A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TR 20674 A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ZA 7900805 A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DE 69403315 T</td>
</tr>
<tr>
<td></td>
<td></td>
<td>JP 7232511 A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>US 5558144 A</td>
</tr>
<tr>
<td>JP 06071781 A</td>
<td>15-03-1994</td>
<td>NONE</td>
</tr>
<tr>
<td>US 4216813 A</td>
<td>12-08-1980</td>
<td>NONE</td>
</tr>
</tbody>
</table>