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(54) **Toe protection cap and footwear comprising toe protection cap**

(57) The invention relates to a toe cap (1) for shoes comprising an arcuate peripheral wall (3) capable of making up the front part (3a) and the two side parts (3b, 3c) of the toe cap (1), a top wall (5) and a bottom wall (7) capable of making up the top and bottom parts (5a, 7a), respectively, of the toe cap (1) and being connected to said arcuate peripheral wall (3), the rear edges of said walls (3, 5 and 7) defining a rear opening (8) for a user's

toes to be accommodated in the space defined by said walls (3, 5, 7), wherein at least said top wall (5) is provided with a number of holes (5c) regularly or irregularly distributed throughout its surface, and each hole (5c) is surrounded by a system of fillets (5d) strengthening the toe cap (1), wherein said system of fillets (5d) at least in said top wall (5) is existing as a closed network structure having said holes as void spaces between said fillets (5d).

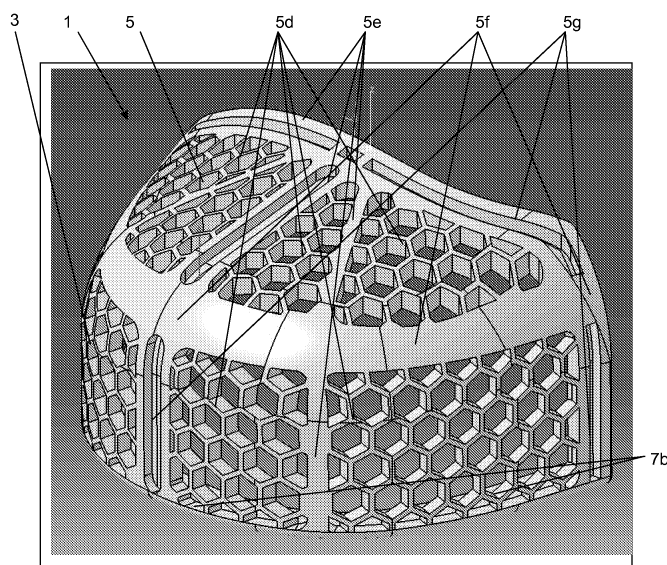


Figure 1

Description

[0001] The present invention relates to a toe protection cap. In particular, the invention relates to a toe protection cap providing improved ventilation to the forefoot including the toes of the wearer without a necessity of taking a loss of the toe protection cap in mechanical resistance to impacts or pushes. The invention also relates to footgear, e. g. safety shoes, protective shoes, occupation shoes, sports shoes, to name only a few without wanting to restrict the term, comprising such a toe protection cap as a means for preventing the forefoot of a wearer including the toes of said wearer from being hit by impacts or pushes by tools, constructional materials, debris, pieces of sports equipment etc..

[0002] The human foot, due to its adaptation to the erect movement of a human, is an anatomically and functionally highly complex part of the body. Even minor mechanical influences to the muscles or bones of the feet result into major discomfort or even pain, and a physical injury to the feet may even have the consequence that a person has to refrain from walking, and thereby loose the possibility of movement, for the time of completely healing the injury. Having these facts in view, the working environment always emphasized protecting the feet of workers reliably, for example by suitable shoes. Wearing safety shoes or safety boots is, hence, an obligatory requirement in many areas where a risk exists that the feet may be harmed, for example in the steel industry, building industry, in the gardening and landscaping fields, for firefighters and rescue service people as well as for soldiers.

[0003] Safety shoes usually are midheight footwear made of leather and/or rubber or other polymers as, for example, polyurethane or thermoplastic polyurethane. Safety boots reach a height sufficient for protecting the foot including a part of the lower leg; they are made, in most of the cases, either of leather or of rubber (where protection against water is needed). The sole of safety shoes/boots usually has an exposed profile for preventing the wearer from slipping and is often made of a high strength material in order to give the person wearing the shoe/boot a safe stand. In many cases, additional strengthening and puncture-preventing materials as, for example, steel plates or hard polymer parts made of, for example, Kevlar^R or ParaAmide^R are incorporated into the soles of safety shoes or safety boots.

[0004] From the safety point of view, the forefoot including the toes usually are the best protected parts of the foot: Safety shoes or safety boots are usually provided with a protective cap made of steel, aluminum or high-strength plastics at their forepart in order to protect the toes against injuries resulting from heavy objects falling down.

[0005] The document US-A 2005/0,144,809 discloses a composite-reinforced toe cap for a shoe, which includes multiple composite fiber reinforcement layers and a larger fiber layer laminated between and extending out from the composite fiber reinforcement layers. The fiber layer

is made of continuous strands. The composite fiber reinforcement layers are made of fiber-reinforced plastic composite materials, are laminated on the fiber layer to form a pre-product toe cap. A bonding coating is applied to the fiber layer that extends beyond the composite fiber reinforcement layer to form a binding. The pre-product is cured and has a binding that can be sewn to the sole, upper or tongue of a shoe.

[0006] The document US-A 2006/0,213,086 discloses a metal toe cap for safety shoes which includes an arcuate peripheral wall that tapers forward, a top wall, and a bottom wall defining a rear opening for receiving the toes of a user. The peripheral wall and the top wall are connected by an upper arcuate transition section having a thickness that increases toward the top wall such that the top wall has a thickness greater than that of the peripheral wall. The impact-resisting property of the top wall is thus improved.

[0007] As many other known toe caps, these to caps of the prior art have no ventilation in the front part of the toe cap, and hence, sweat or humidity cannot escape. This not only results into discomfort to the wearer of the shoe, but also creates ideal conditions for diseases and micro-organisms to develop.

[0008] A parallel European patent application covering an invention also assigned to the assignee/applicant of the present application and filed on 21 August 2009 and having the Official File No. 09 168 387.0 relates to a toe protection cap for shoes which comprises an arcuate peripheral wall capable of covering the front part and the two side parts of the toe cap, a top wall and a bottom wall capable of covering the top and bottom parts, respectively, of the toe cap and being connected to said arcuate peripheral wall, said walls defining a rear opening for a user's toes to be accommodated in the space defined by said walls, wherein said top wall has a rearside edge having the shape of a letter "S" thereby allowing a protection of all toes of a user.

[0009] Preferred embodiments of said prior toe protection cap relate to a toe protection cap specified as above, wherein said top wall of the toe protection cap is provided with a number of holes regularly or irregularly, preferably regularly, distributed throughout its surface. In even more preferred embodiments, said toe protection cap has some of said holes, preferably the majority of the said holes, more preferably each hole in the surface of the top wall surrounded by a system of fillets strengthening the structure of said toe protection cap.

[0010] Surprisingly, it was found in the present invention that, without giving up stability and safety features of the toe protection cap, the holes may be made larger than in the toe protection caps proposed earlier, if the structure and arrangement of the fillets is maintained. Even the toe protection cap top wall surface areas filling the space between the fillets may be omitted by creating voids, thereby generating a very much improved ventilation, without that the stability and strength of the toe protection cap is diminished and with the effect that a

safety of the forefoot and toes against falling tools/mat-
ters can be guaranteed. Even more surprisingly, it was
found that also the front and side parts of the toe protec-
tion cap may be provided with a similar ventilation by a
system of fillets and holes, or omitted toe protection cap
front and/or side wall surface areas, between said fillets,
without that a loss of the stability and strength of the toe
protection cap had to be observed.

[0011] Hence, it was an object of the present invention
to provide a toe cap for a shoe or boot or footgear which
allows sweat and humidity to escape from the inner space
of the toe cap, without giving up stability and safety fea-
tures of the toe cap.

[0012] Further, it was an object of the present invention
to provide a toe cap for a shoe allowing a reliable pro-
tection for the whole toe and forefoot area of the foot of
a wearer or user. Moreover, it was an object of the present
invention to provide a toe cap for a shoe allowing a greater
comfort to the wearer or user than with conventional toe
caps for shoes

[0013] Thus, the invention relates to a toe cap for shoes
or boots or footgear comprising an arcuate peripheral
wall capable of making up the front part and the two side
parts of the toe cap, a top wall and a bottom wall capable
of making up the top and bottom parts, respectively, of
the toe cap and being connected to said arcuate periph-
eral wall, the rear edges of said walls defining a rear
opening for a user's toes to be accommodated in the
space defined by said walls, wherein at least said top
wall is provided with a number of holes regularly or irreg-
ularly distributed throughout its surface, and each hole
is surrounded by a system of fillets strengthening the toe
cap, wherein said system of fillets at least in said top wall
is existing as a closed network structure having said holes
as void spaces between said fillets.

[0014] Preferred embodiments of the toe cap of the
invention are claimed in the dependent claims 2 to 11.

[0015] The invention also relates to shoes, boots and
footgear comprising a toe cap of the invention as de-
scribed below in detail. Such shoes/boots may be safety
shoes, protective shoes, occupation shoes, sports
shoes, or corresponding boots or footgear to name only
a few of shoes wherein the toe cap of the invention may
be used, without, however, restricting the invention to
those shoes.

[0016] The invention is now in detail described exem-
plarily by means of the Figures which show preferred
embodiments of the invention. The invention, however,
should not be construed to be limited to those preferred
embodiments described below and shown exemplarily
in the Figures.

In the Figures,

[0017]

Figure 1 shows a perspective view to a toe cap of
the invention having, in the embodiment shown in

the Figure, fillets at its top surface and at the surface
of the arcuate peripheral wall capable of making up
the front and side parts of the toe cap, said fillets
surrounding the holes, which holes are void spaces
between the fillets;

Figure 2 shows the toe cap of the invention as shown
in Figure 1, but viewed from another perspective;

Figure 3 shows a magnified view to the rear part
opening of the toe cap, said rear part being defined
by the rear edges of the top wall and the rear edges
of the side parts of the arcuate peripheral wall of the
toe cap of the invention; in this rear side view, also
the rim embodiment of the bottom wall of the toe cap
may be seen conveniently;

Figure 4 shows a magnified view, from the rear side,
into the inner space of the toe cap of the invention
defined by the rear edges of the peripheral and top
walls; also in this rear side view, the rim embodiment
of the bottom wall of the toe cap may be seen con-
veniently, too; and

Figure 5 shows a view to the toe cap of the present
invention from the front side; in the embodiment
shown in Figure 5, the fillets surrounding the void
spaces as well as the additional fillets having includ-
ed parallel grooves may be seen conveniently.

[0018] Referring now to Figure 1, there is shown a toe
cap 1 for shoes. Toe caps are usually made of plastics
or of a metal or metal alloy and are mounted in a front
end of a shoe, for example of a safety shoe, to withstand
external impact and thereby protect particularly the fore-
foot, i. e. the toes of a foot of a user of the shoe and the
consecutive part of the foot adjacent to the toes.

[0019] When addressing the position of, and the views
to, the toe cap of the present invention, all indications of
the position are defined, in the present specification and
in the claims, in the position of use of the toe cap in the
shoe. In accordance with such a definition, the "front"
side of the toe cap is that part of the cap which is posi-
tioned at the front side of the shoe, or close to the toe
tips of the user wearing the shoe with the toe cap. The
rear side of the toe cap is the side positioned, during use
of the toe cap, opposite to the front side and "showing"
to the middle part of the foot; the user enters into the toe
cap (when the toe cap is entered into, or fixed within, the
shoe) from the toe cap's rear side. In the same way, the
"lower" or "bottom" wall of the toe cap is the wall on which,
when in use, the foot of the user is positioned, while the
"upper" or "top" wall of the toe cap is the wall opposite to
the bottom wall of the toe cap; the upper side of the wear-
er's foot is adjacent to the toe cap's top wall.

[0020] As shown in Figure 1, the toe cap 1 of the in-
vention comprises a peripheral wall 3 which is formed
arcuate and which is capable of making up the front part

3a and the two side parts (left hand and right hand side parts) 3b, 3c of the toe cap 1. The toe cap further comprises a top wall 5 and a bottom wall 7 which are capable of making up the top part 5a and the bottom part 7a of the toe cap 1. The top and bottom walls 5, 7 are extending to, and are connected to, the arcuate peripheral wall 3 integrally along the front side and the left and right side of the toe cap 1 so as to form the toe cap 1.

[0021] The rear edges of the arcuate peripheral wall 3, of the top wall 5 and of the bottom wall 7 together define a rear opening 8 of the toe cap 1. This rear opening 8 opens a space for the accommodation of all the toes of one foot of the user, i.e. the toes of one foot of a user are accommodated in the inner space defined by said peripheral wall 3, top wall 5 and bottom wall 7. The user's or wearer's foot enters the inner space defined by said peripheral wall 3 and the top and bottom walls (5, 7) by passing the rear opening 8.

[0022] In a preferred embodiment of the invention, the rear side edge 5b of the top wall 5, and preferably also the rear side edge of the bottom wall, has the shape of a letter "S", which shape may be easily seen from Figures 1 and 2. The major advantage of such a shape similar to the letter "S" is the complete accommodation of all toes of one foot, and at least a part of the forefoot of the foot, of the user wearing the shoe with the toe cap 1 of the invention within the toe cap in a convenient and non-restricted manner. This is in contrast to the prior art, where mainly the large toes were sufficiently protected, while the small toes were not.

[0023] In accordance with the invention, the toe cap 1 is constructed as having a number of holes 5c distributed at least throughout the whole surface of the top wall 5 either regularly or irregularly. The term "regularly", as used in the description and claims is intended to mean that the holes have a substantially identical distance to the next-neighboring hole(s) throughout the top wall 5 of the toe cap 1. In contrast, a (partly or completely) irregular distribution of the holes means that the distances of one hole to the next-neighboring hole(s) may be more or less (or at least partly) different. A regular distribution of the holes 5c is preferred. Such hole or holes 5c may serve a ventilation of the toe and forefoot area of the foot of the user wearing the shoe including the toe cap 1. Such a ventilation not only improves the convenience of wearing such a shoe with a toe protection cap 1, but also prevents an accumulation of sweat and/or humidity in the inner space of the toe cap 1. The latter may prevent the generation of bad smells due to a growth of smell-generating bacteria and the occurrence of diseases at the foot or, specifically, at the toes.

[0024] In order not to lose strength of the toe cap 1 against impact, each hole 5c at least in the surface of the top wall 5 of the toe cap 1 is surrounded by a system of fillets 5d. By providing the fillets 5d around the hole(s) 5c, the toe cap material loss, by the holes 5c, is compensated, and a strengthening effect is obtained. Hence, the impact strength of the toe cap 1 is not deteriorated by

providing the ventilation holes 5c.

[0025] In accordance with the invention, said system of fillets 5d at least in said top wall 5 is existing as a closed network structure having said holes as void spaces between said fillets 5d. The term "closed network structure", as used in the present specification and claims, is defined to mean that the fillets 5d, at least in the top wall 5 of the toe cap of the invention, and preferably in the top wall 5 and in the arcuate peripheral wall 3 as well, are connected to each other in a structure-stabilizing manner and combined with each other so that, by establishing said "closed network structure", a continuous system of fillets around said holes, or even around void spaces, is established the stability and strength of which is at least not substantially deteriorated, preferably is not deteriorated, compared to a structure having no holes surrounded by fillets formed at the top wall and/or the peripheral front and/or side walls.

[0026] In accordance with the invention, such a closed network structure has said holes 5c as void spaces 5c between said fillets 5d. The term "void spaces", as used throughout the present specification and claims, is defined to mean that the surface area or surface areas between the fillets 5d, for example the surface area of the top wall 5 and/or the surface area of the arcuate peripheral wall 3 making up the front part 3a and/or the right and left side parts 3b, 3c of the toe cap 1, is/are a void space or void spaces, i.e. have the material of the top wall 5 and/or of the arcuate peripheral wall 3 omitted between the fillets 5d. This can best be seen from the present Figures 1, 2, 4 and 5. It is one particularly surprising result of the present invention that, despite the fact that the top wall material and/or arcuate peripheral wall material was omitted between the system of fillets making up the closed network structure of fillets 5d of the toe cap 1 of the present invention, no loss of strength of the overall toe cap 1 was observed, with the result that the toes and fore foot of a user wearing shoes with the included toe cap of the invention are not only ventilated in an excellent manner, but also are protected perfectly against impact by tools or falling debris.

[0027] In preferred embodiments of the invention, at least said top wall 5 of the toe cap 1 of the invention is provided with a number of holes 5c regularly distributed throughout its surface. In such preferred embodiments, said holes 5c are void spaces between said closed network structure of fillets 5d formed at least at the top wall 5 of said toe cap 1.

[0028] In accordance with the present invention, it is even more preferred that said top wall 5, i.e. the top wall 5 only, is provided with a number of holes 5c regularly distributed throughout its surface, said holes 5c being void spaces between said closed network structure of fillets 5d formed at the top wall 5 of said toe cap 1. Already with such an embodiment, a substantially improved ventilation of the user's toes and fore foot may be achieved, without decreasing the overall strength of the toe cap 1 against mechanical impact.

[0029] It is another preferred embodiment of the invention that said arcuate peripheral wall 3, i.e. the arcuate peripheral wall 3 only, is provided with a number of holes 5c regularly distributed throughout its surface, said holes 5c being void spaces between said closed network structure of fillets 5d formed at the arcuate peripheral wall 5 of said toe cap 1. Already with such an embodiment, a substantially improved ventilation of the user's toes and fore foot may be achieved, without decreasing the overall strength of the toe cap 1 against mechanical impact.

[0030] In an alternative, albeit also preferred embodiment of the invention, said top wall 5, and said arcuate peripheral wall 3 capable of making up the front part 3a and the two side parts 3b, 3c of the toe cap 1 as well, are provided with a number of holes 5c regularly distributed throughout their surface, said holes 5c being void spaces between said closed network structure of fillets 5d formed at the top wall 5 and at the arcuate peripheral wall 3 of said toe cap 1. In such an embodiment, the ventilation is even more improved. Surprisingly, the additional holes/void spaces 5c in the arcuate peripheral wall 3 do not deteriorate the stability and strength features of the overall toe cap 1 at all.

[0031] In an even more preferred embodiment of the invention, said fillets 5d around the holes or void spaces 5c in the toe cap's top wall surface and/or in the toe cap's arcuate peripheral wall surface form a hexagon around each of the holes / void spaces 5c. By arranging a larger number of hexagon arrangements of fillets 5d adjacent to each other, the above-mentioned closed network structure of fillets 5d formed at the top wall 5 and/or at the arcuate peripheral wall 3 of said toe cap 1 is achieved, whereby each of such hexagons surrounds a void space formed at the respective surface of the toe cap 1. In other words: The hexagon type system of fillets 5d surrounds areas of the top wall surface and/or arcuate peripheral wall surface, which areas are void spaces. In even more preferred embodiment of the invention, a larger number of adjacent hexagons of fillets 5d form a honeycomb structure at the top wall surface and/or at the arcuate peripheral wall surface of the toe cap 1. Such a honeycomb structure is capable of strengthening the toe cap against impacts despite the provision of ventilation holes 5c or void spaces 5d in the top wall surface and/or in the arcuate peripheral wall surface of the toe cap 1. Thus, the same strength as in conventional toe caps can be obtained by providing the honeycomb structure of fillets 5d around each ventilation hole(s) 5c / void spaces 5c for ventilation.

[0032] Furthermore, it is preferred in accordance with the present invention that said top wall surface and/or said arcuate peripheral wall surface has additional fillets 5e extending from one point at said rear side edge 5b of the top wall 5 and radially across the whole surface at least of the top wall 5. The term "radially extending", as used in the present specification and claims, is defined to mean that said point, at the rear side edge 5b of the top wall 5 of the toe cap 1, may be considered as being

the center of a (theoretical) circle, and said additional fillets 5e have the origin in said circle center and extend from said center throughout the top wall surface radially towards the rim of said (theoretical) circle. This can easily be seen from Figures 1, 2 and 5. By such additional fillets 5e, the toe cap structure may be additionally strengthened.

[0033] In a further preferred embodiment of the invention having additional benefits, there are additional fillets (5e) extending from one point at said rearside edge (5b) of the top wall surface radially across the whole surface of the top wall (5) and of the arcuate peripheral wall (3), thereby forming continuous additional fillets 5e extending from their "origin" at the rearside edge of the top wall 5 of the toe cap 1. By such a structure, a further strengthening the toe cap structure can be achieved.

[0034] In accordance with the invention, it is particularly preferred that the toe cap 1 has additional fillets 5e extending from one point located substantially in the middle, relative to said side parts 3b, 3c of the arcuate peripheral wall 3, at said rearside edge 5b radially across the whole surface of the top wall 5 and of the arcuate peripheral wall 3. By positioning the "origin" of the additional fillets 5e in the middle of the rearside edge 5b, relative to the side parts 3b, 3c of the arcuate peripheral wall 3, and allowing the additional fillets 5e to extend from said origin point, the toe cap structure can be additionally strengthened.

[0035] The number of such additionally strengthening fillets 5e is not particularly restricted, and a skilled person may select such number in accordance with the needs. It may be noted that an increasing number of such additional fillets 5e may contribute to an improvement of the strength, but may also adversely influence the ventilation properties, since the space available for voids for ventilation decreases. However, in further preferred embodiments of the invention, the number of such additional fillets (5e) extending across the whole surface of the top wall (5) and of the arcuate peripheral wall (3), and particularly preferably extending in equal angular distances to each other, is between three and five, as can best be seen in Figures 1, 2 and 5. By such additional fillets 5e arranged in equal angular distances to each other, the toe cap structure may be strengthened even further, and a good ventilation of the inner space of the toe cap according to the invention is nevertheless possible.

[0036] In an attempt to provide a toe cap 1 having less weight, material may be omitted at certain parts of the toe cap walls 3, 5, and 7. In order not to lose impact strength by omitting material, additional strengthening measures may be taken: In one optional (i.e. not necessary) embodiment of the invention, the arcuate peripheral wall 3 may be provided with strengthening fillets 3d on its inside, i. e. on the side directed to the inner space of the toe cap 1 directed to the toes of the wearer, in case that no hexagon fillet - void structure is provided at the arcuate peripheral wall 3 of the toe cap 1 of the invention, although this is not a preferred embodiment. When pro-

viding such additional fillets (which may extend in the direction between the top and bottom walls 5, 7, of the toe cap 1), the strength of the toe cap 1 may be improved. A toe cap 1 without such fillets 3d is preferred.

[0037] Omitting material, and thereby making the toe cap of the invention loose weight (which weight loss may be preferred for reasons of convenience of wearing the low weight toe cap 1), can be achieved, in accordance with another preferred embodiment of the invention, by an embodiment wherein said bottom wall 7 consists of a rim 7b extending from, and being connected to, the arcuate peripheral wall 3 along its front and two side parts 3a, 3b, 3c in a substantially perpendicular arrangement. Such an embodiment may best be seen in Figures 3 and 4, which clearly show that the "bottom wall" 7 is no longer a full area bottom wall 7 but is only a rim along the lower end of the arcuate peripheral wall 3 extending from said arcuate peripheral wall 3, along its front and side parts 3a, 3b, 3c, in an angle of more or less 90°, allowing a convenient placement of the front parts of the toes of the user and of the respective side parts of the outer (left and right) toes and of the fore foot on said rim 7b.

[0038] In a further preferred embodiment, said rim 7b is of a width allowing a convenient placement of the fore-foot sole and underside of the toes on it, and in an even more preferred embodiment, the rim 7b is of a width within a range of from 0.5 to 5 centimeters (cm), without restricting the invention to such a value or to any value in the above range. No loss of impact strength of the overall toe protection cap has to be taken by such an embodiment of the invention.

[0039] Advantageously, the impact strength of the toe cap 1 is improved further by a toe cap of the invention wherein additional fillets 5f are provided along the upper and lower peripheral edges connecting the top and bottom walls 5, 7 to the arcuate peripheral wall 3. Such a preferred embodiment may best be seen in Figures 1, 2 and 5. Such additional fillets 5f may include fillets 5f along the rear side edge of the top and bottom walls 5, 7 and/or along the rear side edge of the two side parts 3b, 3c of the arcuate peripheral wall 3, i.e. at the rear side edges forming the rear opening 8 of the toe cap 1. Such additional fillets 5f advantageously contribute to an improvement of the strength of the toe cap 1 as a whole.

[0040] It is further preferred in accordance with the present invention that the additional fillets 5e, 5f may comprise grooves 5g running within, and in parallel to, the additional fillets 5e, 5f. Such embodiments are shown in the Figures 1, 2 and 5. The grooves take away material from the additional fillets 5e, 5f, i.e. contribute to a reduction of the overall weight of the toe cap 1 of the invention, and they do not harm stability and strength properties of the toe cap 1.

[0041] The material for toe caps 1 of the present invention may be selected by a skilled person in accordance with material selections made in the prior art, and the material may be adapted to the specific requirements in each single case. In accordance with the skill, a ma-

terial may be used for manufacturing the toe caps 1 of the present invention which is selected from the group consisting of plastics, for example hard polymer materials like those used in the prior art, e. g. Kevlar^R or ParaA-mide^R (if a particular elasticity is required or desired, without giving up impact resistance / impact strength), reinforced plastics (e.g. fiber-reinforced plastics (glass fiber-reinforced or carbon fiber-reinforced or metal or metal oxide or metal boride or metal carbide or metal nitride whiskers-reinforced), metal powder-reinforced plastics), metal(s) or metal alloys. Particularly preferred are metals or metal alloys, e. g. aluminum or steel, or fiber-reinforced plastics. As reinforcing fibers for polymers of the plastics material, such fibers known from the prior art to achieve a plastics reinforcement may be used without restriction. Glass fibers, carbon fibers or whiskers made of metals, metal oxides, metal borides, metal carbides or metal nitrides or their mixtures are preferably used, and glass fibers and carbon fibers are particularly preferred. Even more preferably, in one exemplary and preferred embodiment of the invention, PA-6 (polyamide-6) may be used as the plastics material. Alternatively, steel (e. g. (without restriction) steel 8620 (e. g. of BASF AG) or steel 1050 SAE) may be used.

[0042] The process for manufacturing such embodiments of toe caps 1 as described above is not restricted, and a skilled person may select manufacturing processes in accordance with the requirements of each single case.

[0043] In an exemplary embodiment, a sheet of a metal or of a metal alloy, for example a steel sheet, may be punched from a larger piece of steel, and such a punched steel sheet is then deep-drawn or deep-pressed to obtain an integral body of the toe cap 1 of the invention. Such an integral body may then be subjected to further process steps, as for example polishing steps and steps of applying a surface coating, so as to obtain the final toe cap body.

[0044] In a preferred embodiment of the invention, the so-called MIM (metal injection molding) process is used for manufacturing the toe caps 1 of the invention. In the MIM process, a powder of the metal used as the material for the toe cap 1 is comminuted to a stage as fine as necessary (e. g. to metal particles having a size in the range of between 0.1 and 10 µm) and is admixed with suitable binders (e.g. waxes and/or polymers and/or cracking catalysts and/or solvents). In a preferred embodiment, a mixture containing 60 to 80 % by weight of metal (e. g. the above-mentioned steels, but this does not restrict the invention; also other metal or metal alloy powders may be used) and 20 to 40 % by weight of binder (s) is used. Such a mixture may be processed on conventional injection molding machines. A green body of the mixture used for injection molding is prepared. In a subsequent step, the green body is heated stepwise to temperatures in the range of, for example, 100 to 600 °C, so as to thermally crack the binders (wax(es), polymer (s), catalyst(s), solvent(s)). As a result, a body of metal powder is obtained (so-called "brown body"). The brown

body thus obtained is now sintered under controlled temperature/gas conditions (e. g. 600 to 1,400 °C; exemplary suitable gases: H₂, N₂, and/or Ar). A body now having, for example, > 96 % of the final density is obtained by such a sintering step. The surface of such a sintered body may be subjected to further processing steps as, for example, polishing steps and steps of applying a surface coating, so as to obtain the final toe cap body.

[0045] Toe caps of plastics materials, plastics materials comprising one type or several types of fibers (as defined above) may, for example, be manufactured by a usual injection molding process, as is well known to a person skilled in this technical field. Hence, the detailed description of the steps of such an injection molding process, its components and its conditions may be omitted here since they are known to a person in this technical field.

[0046] Of course, any other step conceivable to a skilled person for manufacturing such a toe cap body of the invention may be used.

[0047] In accordance with the invention, a toe cap 1 is inserted into a shoe in order to protect the shoe wearer's toes against impacts. Such impacts may be impacts due to the work of a tool used by the wearer or by anybody else in his/her environment, may be impacts by heavy things falling down, may be constructional materials, debris, pieces of sports equipment etc..

[0048] Hence, the invention also relates to shoes comprising a toe cap 1 as described above in detail. Such shoes may be safety shoes, protective shoes, occupation shoes, sports shoes, to name only a few of shoes wherein the toe cap of the invention may be used, without, however, restricting the invention to those shoes. In the European Union, such shoes are standardized, with respect to requirements they have to fulfill, in the industrial standards ISO EN 20345 (safety shoes), ISO EN 20346 (protective shoes) and ISO EN 20347 (occupation shoes).

[0049] Shoes provided with the toe caps 1 of the invention were tested first with respect to their strength to withstand to impacts by a heavy test object falling down on the shoe provided with the toe cap or to impacts by a tool swinging to the side of the toe cap, and were tested secondly with respect to the "foot climate" in the toe region due to a better ventilation of said region. The tests were conducted in accordance with standardized test methods.

[0050] It was found that the toe region, due to the presence of the toe cap 1 of the present invention, could be protected in an indentionally reliable manner as in cases of using conventional toe caps, so that the shoes passed the standardized tests.

[0051] On the other hand, the "foot climate" was found to be much better than in shoes having conventional toe caps, due to the fact that sweat and humidity could escape from the toe region and could not accumulate in that area. The results were even better than the results achieved with toe caps having holes mainly at the surface of the top wall. Hence, bad smells and diseases due to

the action of microorganisms in the toe area could be prevented from occurring.

[0052] The above description of the invention by its exemplary and preferred embodiments does not restrict the invention to these embodiments described. The scope of the invention is defined by the following claims.

Claims

1. A toe cap (1) for shoes comprising an arcuate peripheral wall (3) capable of making up the front part (3a) and the two side parts (3b, 3c) of the toe cap (1), a top wall (5) and a bottom wall (7) capable of making up the top and bottom parts (5a, 7a), respectively, of the toe cap (1) and being connected to said arcuate peripheral wall (3), the rear edges of said walls (3, 5 and 7) defining a rear opening (8) for a user's toes to be accommodated in the space defined by said walls (3, 5, 7), wherein at least said top wall (5) is provided with a number of holes (5c) regularly or irregularly distributed throughout its surface, and each hole (5c) is surrounded by a system of fillets (5d) strengthening the toe cap (1), wherein said system of fillets (5d) at least in said top wall (5) is existing as a closed network structure having said holes as void spaces (5c) between said fillets (5d).
2. The toe cap (1) for shoes as claimed in claim 1, wherein at least said top wall (5) is provided with a number of holes (5c) regularly distributed throughout its surface, said holes (5c) being void spaces between said closed network structure of fillets (5d) formed at least at the top wall (5) of said toe cap (1).
3. The toe cap (1) for shoes as claimed in claim 1 or claim 2, wherein said top wall (5) is provided with a number of holes (5c) regularly distributed throughout its surface, said holes (5c) being void spaces between said closed network structure of fillets (5d) formed at the top wall (5) of said toe cap (1); or wherein said top wall (5) and said arcuate peripheral wall (3) capable of making up the front part (3a) and the two side parts (3b, 3c) of the toe cap (1) are provided with a number of holes (5c) regularly distributed throughout their surface, said holes (5c) being void spaces between said closed network structure of fillets (5d) formed at the top wall (5) and at the arcuate peripheral wall (3) of said toe cap (1).
4. The toe cap (1) for shoes as claimed in any of claims 1 to 3, wherein said closed network structure of fillets (5d) forms hexagons around each of the void spaces (5c), preferably wherein said hexagons form a honeycomb-type closed network structure at least at the top wall surface of the toe cap (1), preferably at the top wall and/or arcuate peripheral wall surfaces, more preferably at the top wall surface and at the

arcuate peripheral wall surface of the toe cap (1).

5. The toe cap (1) for shoes as claimed in any of claims 1 to 4, wherein said top wall (5) has a rearside edge (5b) having the shape of a letter "S" thereby allowing a protection of all toes of a user.

6. The toe cap (1) for shoes as claimed in any of claims 1 to 4, wherein at least said top wall surface has additional fillets (5e) extending from one point at said rearside edge (5b) radially across the whole surface at least of the top wall (5), thereby additionally strengthening the toe cap structure; preferably has additional fillets (5e) extending from one point at said rearside edge (5b) radially across the whole surface of the top wall (5) and of the arcuate peripheral wall (3), thereby additionally strengthening the toe cap structure; more preferably has additional fillets (5e) extending from one point located substantially in the middle, relative to said side parts (3b, 3c) of the arcuate peripheral wall (3), at said rearside edge (5b) radially across the whole surface of the top wall (5) and of the arcuate peripheral wall (3), thereby additionally strengthening the toe cap structure; most preferably wherein the number of such additional fillets (5e) extending across the whole surface of the top wall (5) and of the arcuate peripheral wall (3) is between three and five.

7. The toe cap (1) for shoes as claimed in any of claims 1 to 6, additionally comprising additional fillets (5f) along the upper and lower peripheral edges connecting the top and bottom walls (5, 7) to the arcuate peripheral wall (3).

8. The toe cap (1) for shoes as claimed in claim 7, wherein the additional fillets (5e, 5f) may comprise grooves (5g) running within, and in parallel to, the additional fillets (5e, 5f).

9. The toe cap (1) for shoes as claimed in any of the claims 1 to 8, wherein the bottom wall (7) consists of a rim (7b) extending from, and being connected to, the arcuate peripheral wall (3) along its front and two side parts (3a, 3b, 3c) in a substantially perpendicular arrangement, said rim preferably being of a width allowing a convenient placement of the forefoot sole and underside of the toes on it, more preferably being of a width within a range of from 0.5 to 5 centimeters (cm).

10. The toe cap (1) for shoes as claimed in any of the claims 1 to 9, being made of a material selected from the group consisting of plastics, reinforced plastics, metals and alloys of metals, preferably made of steel or fiber-reinforced polyamide.

11. The toe cap (1) for shoes as claimed in any of the

claims 1 to 9, made as one upper half cap (1 a) and one lower half cap (1 b) and connected to the toe cap (1) before further use.

12. A footgear or shoe comprising a toe cap (1) as claimed in any of the claims 1 to 11.

13. The footgear or shoe as claimed in claim 12, being a safety shoe, a protective shoe, an occupation shoe, or a sports shoe.

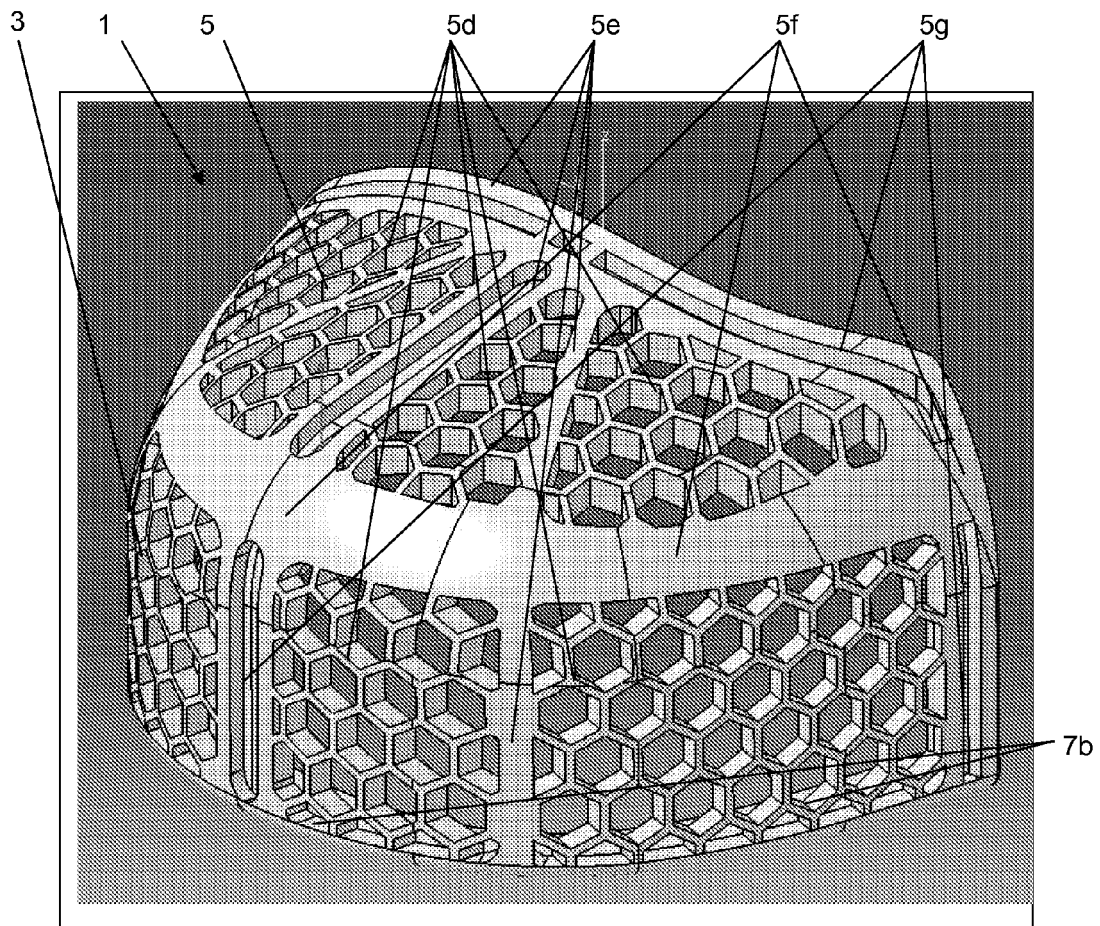


Figure 1

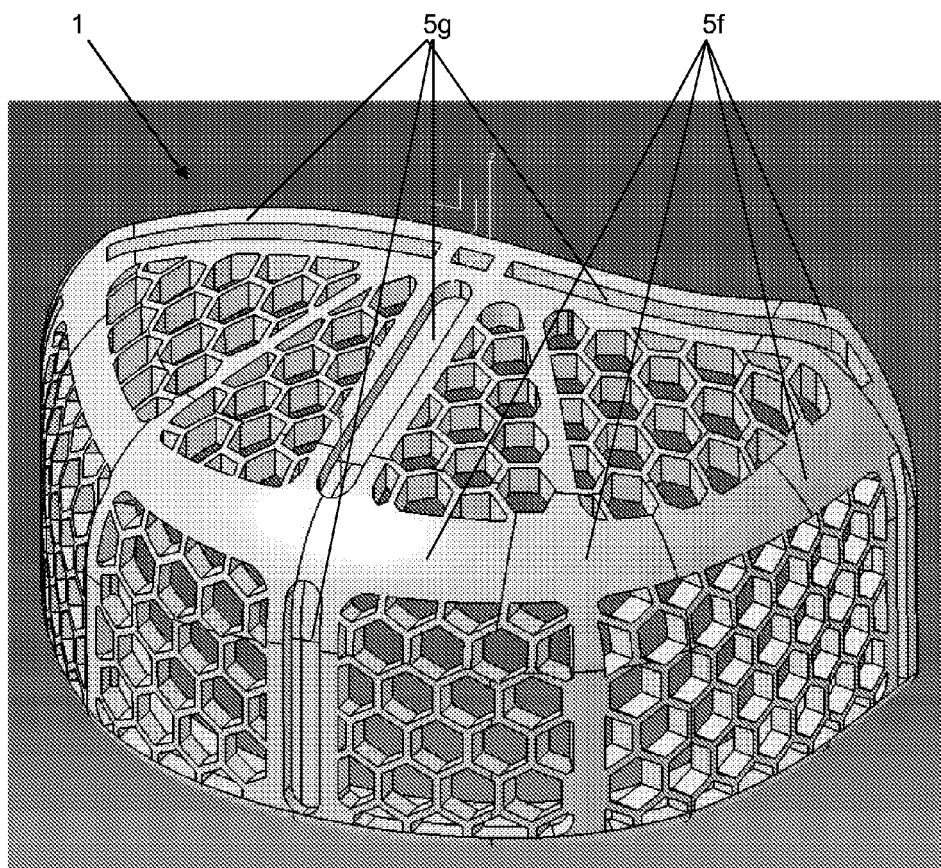


Figure 2

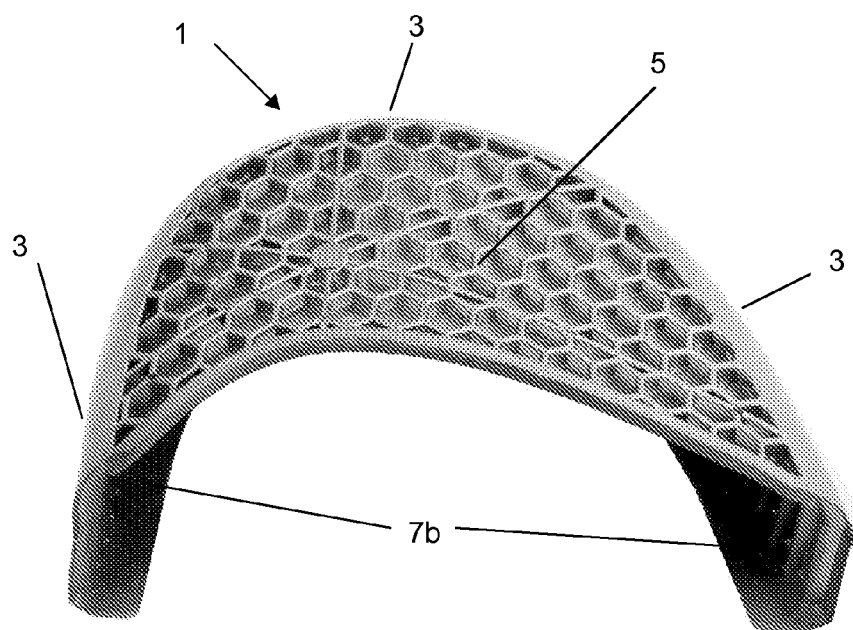


Figure 3

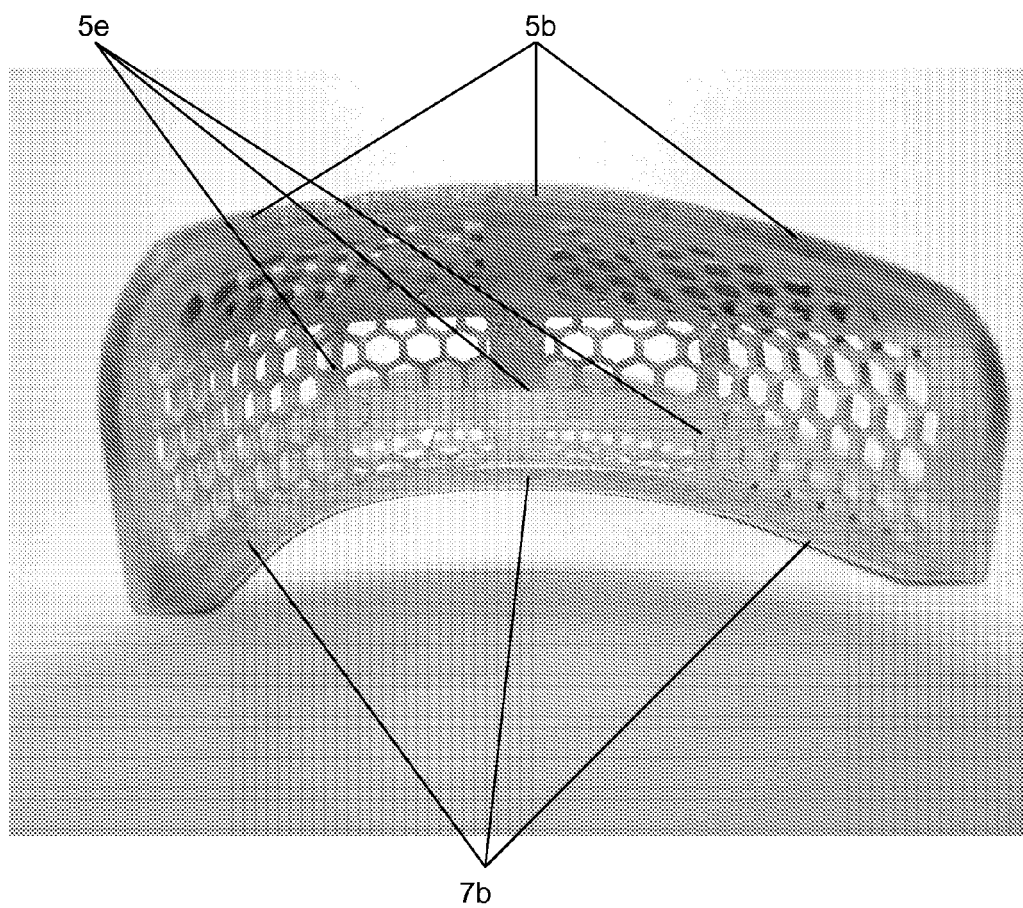


Figure 4

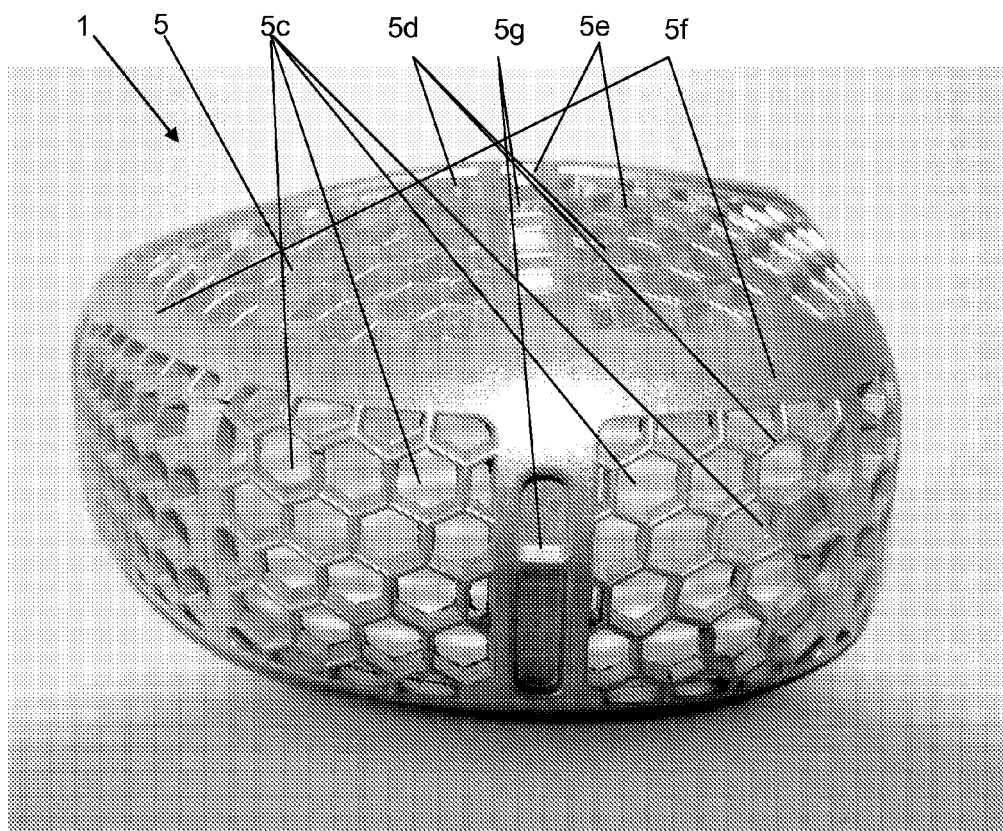


Figure 5



EUROPEAN SEARCH REPORT

Application Number
EP 09 17 4685

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 1 066 768 A1 (CALZATURIFICIO 5BI S R L [IT]) 10 January 2001 (2001-01-10) * paragraphs [0003], [0005], [0011]; claims; figures *	1-13	INV. A43B23/08
X	US 2008/115387 A1 (WALWORTH VAN T [US] ET AL) 22 May 2008 (2008-05-22) * paragraphs [0018], [110], [126], [128]; figures *	1-13	
			TECHNICAL FIELDS SEARCHED (IPC)
			A43B
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 30 November 2010	Examiner Claudel, Benoît
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 09 17 4685

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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30-11-2010

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EP 1066768	A1	10-01-2001	NONE

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REFERENCES CITED IN THE DESCRIPTION

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- US 20060213086 A [0006]
- EP 09168387 A [0008]