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(71) Applicant: **HD Sports Ltd**
Sheffield S3 8DG (GB)

(72) Inventor: **Rudolph, Robert Keith**
Morton Grove, IL 60653 (US)

(74) Representative: **Stuttard, Garry Philip**
Urquhart-Dykes & Lord
Tower House
Merrion Way
Leeds LS2 8PA (GB)

(54) Skate

(57) The present invention relates to a unitary runner for an ice skate (such as a figure skate) and to a method for manufacturing the unitary runner including an extrusion step.

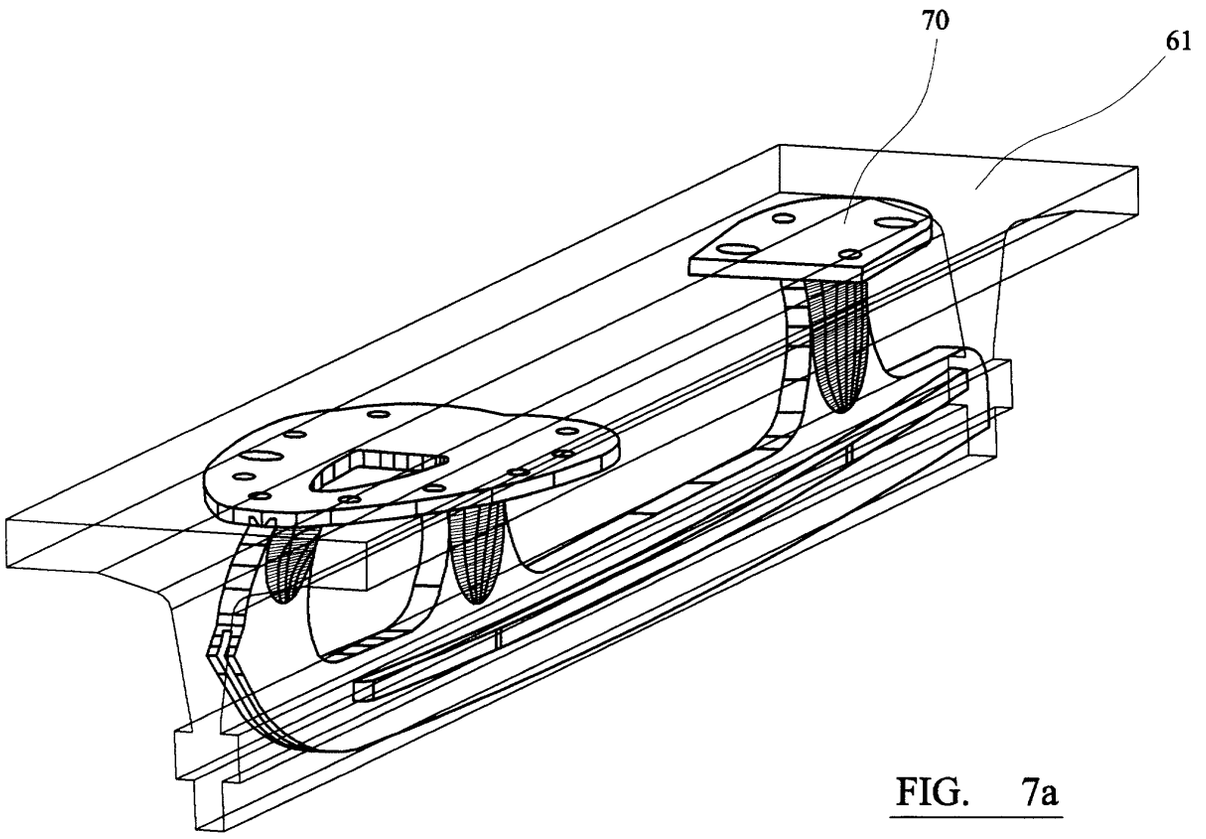

FIG. 7a

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Description

[0001] The present invention relates to a unitary runner for an ice skate (such as a figure skate) and to a method for manufacturing the unitary runner including an extrusion step.

[0002] Figure skates have properties different to those of hockey skates or speed skates. For example, speed skates are constructed for speed and not for very sharp turning and spinning as is the case in figure skating. Hockey skates are not constructed for the purpose of repeated jumps and landings.

[0003] The skating events in which figure skates are used include individual, pairs and ice dancing. These events require the runner of the ice skate to have certain properties so as to withstand the stresses and strains of repeated jumps and landings while still providing the level of control required for intricate footwork. For example, it is desirable for the runner to have a thin blade to assist the elegance of the skaters movements. In conventional figure skates, such a design is inefficient and may require support. This may be overcome by adding bracing (see for example US-A-4251086) or by thickening the base of the footwear (to which the runner is attached) and tapering the runner body down to the blade. However this approach is at the cost of the visual appearance of the skate.

[0004] The runner of the majority of hockey skates is conventionally made as a unitary item through injection moulding from plastic. Plastic fails to offer the requisite strength and stiffness and to compensate, the hockey skate is generally provided with bracing. Unfortunately, this renders the hockey skate large and unattractive.

[0005] US-A-5769434 discloses a skating appliance or vehicle with a composite, exchangeable runner blade embedded in a runner blade body by injection moulding.

[0006] It is known to exploit the favourable properties of aluminium (eg lightness) in the manufacture of skates. However these conventional skates are manufactured in a multiplicity of parts which require fastening together. Conventionally this may be done by brazing but sometimes this leads to weak, inflexible joints which are prone to fatigue and failure. An example is disclosed in US-A-6086084 where the multiplicity of parts include rods, tubes or beams extruded using a void-containing extrusion die of an appropriate profile.

[0007] US-A-5046746 discloses a method for manufacturing an in-line roller skate by extruding a substantially U-shaped aluminium section from which is machined a sophisticated framework to be attached to the boot.

[0008] The present invention seeks to improve the strength of a skate and its ability to withstand breakage by providing a runner for a skate in which the body of the runner, the heel plate and/or the toe plate are a unitary (joint-free) component.

[0009] According to one aspect the present invention provides a runner for a skate, the runner comprising:

a runner body;

a toe plate attachable to a fore part of an item of footwear; and

a heel plate attachable to a rear part of an item of footwear,

wherein the toe plate and/or heel plate are unitary with the runner body.

[0010] By providing toe and/or heel plates as a part of a single piece runner, weaknesses associated with joints between a runner body and plates are eliminated. For example, there is no requirement for fasteners such as bolts or screws which are unsightly and have a tendency to become dislodged and there is no reliance on (for example) dovetail joints which are less than ideal for machined regions of the runner (*eg* curved areas).

[0011] Preferably the runner is for a figure skate.

[0012] Preferably the runner is obtainable (eg obtained) by a manufacturing method including an extrusion step, particularly preferably is obtainable by a manufacturing method including an extrusion step using a substantially T-shaped extrusion die.

[0013] The heel plate and toe plate may be substantially planar. It is preferred for the heel and/or toe plate to curve upwardly to conform to the general shape of the boot (or other footwear) to which the runner is to be attached. The heel plate may slope downwardly from the rear to the front. The toe plate may slope upwardly from the rear to the front.

[0014] Preferably the runner comprises at least one toe support element towards a front end of the runner body which morphs into the toe plate. The same piece of material provides both the toe support element and toe plate and the toe support element simply changes shape to become the toe plate. This advantageously provides the runner body with the requisite support without compromising the attractiveness of the skate. Preferably the runner comprises a first toe support element which morphs into the toe plate and a second toe support element which morphs into the toe plate.

[0015] Preferably the runner comprises at least one heel support element towards a rear end of the runner body which morphs into the heel plate. The same piece of material provides both the heel support element and heel plate and the heel support element simply changes shape to become the heel plate. This advantageously provides the runner body with the requisite support without compromising the attractiveness of the skate.

[0016] The region where the runner body morphs into the plate can be thicker than the thickness of the runner body and/or plate adjacent the morphing region. Increasing the thickness of the region where the plates and supports merge increases the mechanical strength of that part of the runner in order to withstand deformation of the runner in use.

[0017] The morphing region may have a maximum thickness in a region substantially bisecting the angle defined by the planes of the plate and the runner body.

[0018] Preferably the (or each) toe and/or heel support element adopts a mushroom-like configuration.

[0019] The toe plate and heel plate may be separate components or may be joined (*ie* a single plate). The toe plate and/or heel plate may include an aperture or apertures to advantageously reduce their weight. The toe plate and/or heel plate may each comprise separate parts, each part having an associated support element.

[0020] The runner may include a reinforcing member extending partially or wholly along the longitudinal axis of the runner body. This helps to resist deformation of the runner under the action of transverse forces. The reinforcing member may be a single part or comprise a plurality of parts. The reinforcing member may have a substantially uniform shape along its length or it may vary in shape to provide differing degrees of reinforcement. A reinforcing member may be provided on one or each side of the runner body. The or each reinforcing member may be unitary with the runner body. The or each reinforcing member may be a reinforcing rib.

[0021] The runner body and plates may be composed of a lightweight, relatively high strength material. The runner body and plates may be composed of carbon fibre, ceramic or a metal. As used herein, the term metal (or reference to any specific metal) includes alloys and compounds thereof. Preferably the material is selected from the group of: aluminium, titanium and magnesium. A preferred magnesium alloy is ZK60 T-5 (Spectrulite Consortium, USA).

[0022] Preferably the material is aluminium which renders the skate lightweight without compromising the performance of the ice skate. Typically the aluminium has a tensile strength of 25,000lbs or more. Typically the aluminium has an elongation of 10% or more which helps to render the joint flexible and more able to withstand fatigue. Preferred is high grade aluminum such as aluminium 6061 T-6 (Kaiser Alm., USA) or higher.

[0023] The runner body and plates may have a weight of 0.3kg or less. Preferably the runner body and plates have a weight in the range 1.5 to 2.0 kg. This is lighter than any conventional runner.

[0024] Preferably the runner body is composed of a first material and has a contact edge extending along the lower edge of the runner body, wherein the contact edge is composed of a second material harder than the first material. By providing the runner body and contact edge of different materials, the overall weight of the runner can be reduced using a lightweight first material whilst still having an edge composed of a second material which provides the required skating performance. The contact edge may extend along the entire length of the runner body or along a part (or parts) of the entire length of the runner body.

[0025] Preferably the contact edge is a distinct component such as a blade.

[0026] Preferably the contact edge includes an integral toe pick at or (preferably) near to the front end of the contact edge *(eg* on a sharply curved portion of the contact edge). The toe pick assists spinning and jumping movements in figure skating. Preferably the toe pick comprises one or more (preferably a plurality of) teeth. For example, the plurality of teeth may adopt a sawtooth configuration. The sawtooth configuration is preferably non-uniform. For example, each tooth in the sawtooth configuration is of a different size. Preferably the teeth in the sawtooth configuration are of a diminishing size from rear to front.

[0027] The contact edge may be curved. The contact edge may be curved with a constant radius (*eg* a radius of 6, 7, 8 or 9 foot). The contact edge may be non-uniformly curved. For example, the contact edge may have a plurality of separately radiussed portions. The radiussed portions may be tailored to conform to the required performance of the skate. The portion of the contact edge at or near to the toe end may be sharply curved and generally this portion does not contact the ice in use (this portion is often referred to as the non-skating zone). The radius of the curve may increase progressively from the rear to the front (eg to the toe pick). For example, the radius may increase progressively (*eg* substantially linearly) between 6 and 9 feet (*eg* from 6 foot to 7 foot to 8 foot to 9 foot) from the rear to the toe pick. This embodiment advantageously permits the skater to make the requisite range of sharp turns (*eg* from dance to free-style).

[0028] The sides of the contact edge *(eg* blade) may be slightly tapered. The sides of the contact edge (*eg* blade) may be connected by a concave undersurface. The junctions of the undersurface and the sides provide two edges on which the skate can travel in use.

[0029] The contact edge may be a single piece. The contact edge may comprise more than one piece *(eg* separate pieces which may be contiguous or separated by intervening parts of the runner body). Different parts of the contact edge can be of different materials. For example a toe pick part may be of one material and the remainder of the contact edge may be of a different material or materials. In this way the hardness of the contact edge may be varied along its length to take into account the different performance requirements of the different parts of the contact edge.

[0030] The second material may be a high strength material with a low malleability and high wear resistance. The second material may be a metal. Preferably the second material is steel, particularly preferably a vanadium steel alloy, more preferably a vanadium steel alloy containing 3 to 9wt% of vanadium. Specific examples of suitable materials are Crusteel (Crucible Materials Corporation, USA) which has edge retaining properties ten times greater than conventional skates, 1-90 (Bowler - Germany), CPMS90V and (preferably) CPMS30V (Crucible Materials Corporation, USA). Alternatively preferably the second material is titanium such as the titanium compounds referred to in US-A-6318738. Preferred is titanium sintered with tungsten such as the alloy Creme Ti (Dynamet Technology, USA)

which is advantageously extrudable.

[0031] The contact edge and a lower edge of the runner body can provide between them an abutting formation. The abutting formation inhibits relative movement between the runner body and contact edge in a direction substantially perpendicular to a longitudinal axis of the runner.

[0032] The abutting formation may include parts that interlock. The abutting or interlocking formation may extend along a part or the entire length of the runner body. The interlocking formation may be a tongue and groove joint. Preferably the runner body provides a groove and the contact edge provides a tongue. Particularly preferably the contact edge has a shoulder on an instep side of the tongue and a shoulder on an opposite outstep side. The shoulder on the instep side preferably has a greater depth than the shoulder on the outstep side. This adds greater strength to the instep side.

[0033] Preferably the runner body and contact edge are fastened together. The runner body and contact edge may be fastened by a mechanical agent such as welding, braising or rivetting. The runner body and contact edge may be fastened by a chemical agent such as an adhesive or epoxy resin. The body and edge are typically joined by a high strength bonding adhesive such as a heat curing adhesive or a two part adhesive. Preferably the adhesive is flexible to accommodate relative movements during use. An elastic adhesive is preferred. A specifically preferred example of an adhesive is DP-190 (3M Corporation, USA) which has high tensile and peel strength, good elongation and may be heated to high temperatures (such as 149°C) so as to reduce curing time and assist adhesion.

[0034] By incorporating the runner of the invention in an ice skate, there is an improvement in the performance of the ice skate.

[0035] Thus according to a further aspect of the invention, there is provided an ice skate comprising a runner as hereinbefore defined.

[0036] Preferably the ice skate is a figure skate.

[0037] From a further patentable viewpoint, the present invention seeks to improve the manufacture of runners for ice skates (particularly figure skates) by including an extrusion step prior to machining. More particularly, the present invention relates to a method for manufacturing runners for ice skates using a substantially T-shaped extrusion which dispenses with additional fastening steps such as welding and whose versatility can be exploited to manufacture a wide range of designs with reduced waste material.

[0038] According to a yet further aspect of the invention, there is provided a method for manufacturing a runner for an ice skate comprising:

(A) extruding a heated extrudable material into an extrudate in a substantially T-shaped extrusion die.

[0039] The method of the invention is advantageously performed at low cost. For example, conventional machining (or forming) of a runner from an unshaped block of material will expend about five times as much material as is expended in machining an extrudate formed beforehand in step (A) of the present invention. It will be appreciated that this leads to significant cost savings.

[0040] Although the substantially T-shaped extrusion die may depart little from a precise T-shape, it is generally preferred that there are more detailed regions of the substantially T-shaped extrusion die which conform more closely to the ultimately desired shape of the runner. This advantageously minimises the amount of machining of the extrudate. Thus from at least one detailed region of the substantially T-shaped extrusion die may be obtained at least one portion of the profile of an extrudate corresponding to at least one part of the runner. For example, the portion of the profile of an extrudate may correspond to one of the group selected from the heel plate, the toe plate, the runner body, the reinforcing rib and the groove for inserting a blade. Preferably the substantially T-shaped extrusion comprises: four detailed regions from which are respectively obtained portions of the profile of an extrudate corresponding to the heel plate, the toe plate, the runner body and the groove for inserting a blade.

[0041] The extrudable material may be selected from the group consisting of magnesium alloy or aluminium. Preferably the extrudable material is aluminium. The method of the invention permits higher grade aluminium to be used whilst methods involving welding limit the effective material to lower grade aluminium.

[0042] The method of the invention may further comprise:

(B) cutting the extrudate into a plurality of extrudate lengths.

[0043] The method of the invention may further comprise:

(C) machining an extrudate length into a runner. Preferably the runner is as hereinbefore defined.

[0044] By performing a machining step after the extrusion step, there is a reduced machining time compared to conventional machining from large blocks and this further renders the method of the invention more efficient.

[0045] Machining may be carried out conventionally *(eg* using a CNC machine).

[0046] Preferably the method further comprises the steps of:

(D) forming a contact edge of a second material which is harder than the runner; and

(E) joining the contact edge *(eg* blade) to a lower edge of the runner body.

[0047] Step (D) may be carried out by cutting (*eg* laser cutting) from metal plate. Step (E) may further comprise heating the second material (where required such as for steel or steel alloys). The second material may be heated to yield a hardness of up to 58 Rockwell (or more) which improves longevity. Whether or not the second material is heated, it may also be necessary to straighten the contact edge prior to joining.

[0048] Step (E) may be mechanical. For example, the contact edge may be joined to the lower edge of the runner body interlockably.

[0049] Step (E) may be chemical. Preferably step (E) is carried out using an adhesive. Typically the adhesive is a high strength bonding adhesive such as a heat curing adhesive or a two part adhesive. Preferably the adhesive is flexible to accommodate relative movements during use. An elastic adhesive is preferred. A specifically preferred example of an adhesive is DP-190 (3M Corporation, USA) which has high tensile and peel strength, good elongation and may be heated to 149°C to hasten the curing process.

[0050] Preferably step (E) is mechanical and chemical. The combined strength of (for example) an interlocking tongue and groove and an adhesive gives excellent tensile and peel strength.

[0051] Preferably step (C) of the method further comprises the step of:

(C1) polishing the runner (*eg* to a mirror finish).

[0052] Step (C1) may be carried out manually or mechanically (*eg* by electro-polishing or vibratory de-burring).

[0053] Preferably step (C) of the method further comprises the step of:

(C2) coating the surface of the runner.

[0054] The coating is provided to protect the surface of the runner. Preferably step (C2) is carried out by anodising which advantageously permits different coloured finishes to be applied to aluminium.

[0055] The method of the invention may further comprise:

attaching the runner to an item of footwear or a part of an item of footwear. Suitable footwear includes boots and shoes.

[0056] An embodiment of the invention will now be described, by way of example only, and with reference to the accompanying drawings, in which:

Figure 1 shows a side view of a runner according to the present invention;
Figure 2 shows a plan view of the runner of figure 1;
Figure 3 shows an expanded end view of a rear part of the runner of figures 1 and 2;
Figure 4 shows an end view of the front of the runner of figures 1 to 3;
Figures 5a-d shows cross-sectional views of four substantially T-shaped extrusion dies for carrying out an embodiment of the method of the invention;
Figure 6 is a perspective view of a T-shaped extrusion die for carrying out an embodiment of the method of the invention;
Figures 7a and b illustrate in perspective and side view respectively a substantially T-shaped extrusion die superimposed with an embodiment of a unitary runner of the invention;
Figures 8a and b illustrate in perspective and side view respectively a substantially T-shaped extrusion die superimposed with an embodiment of a unitary runner of the invention;
Figure 9 illustrates a disassembled view of a unitary runner of the invention; and
Figure 10 illustrates a perspective view of the unitary runner of the invention (and of Figure 9) fully assembled.

[0057] Similar components in different Figures share common reference numerals unless indicated otherwise. Figures 1 to 4 show a runner for a right footed ice skate. A runner for a left footed ice skate will be a mirror image of that shown in these Figures. In use, the runner is fastened to the sole of an ice skating boot, or other suitable item of footwear, for use by a figure skater.

[0058] With reference to Figures 1 to 4 there is shown a runner for a figure skate designated generally by reference numeral 100. The runner 100 has a runner body 102 and a blade 104 which extends along the entire length of a lower edge of the runner body 102 and along its longitudinal axis. A heel support element 106 is provided toward a rear end of the runner body 102 and upwardly depending from an upper edge of the runner body 102. An upper, free end of the heel support element 106 includes a heel plate 108 having two countersunk apertures 108b and 108d for receiving fixing screws by which the heel plate 108 can be fastened to a heel part of a boot. Two further apertures 108a and 108c are elongated to permit minor adjustment when the boot is being secured to the runner 100.

[0059] A first toe support element 110 and a second toe support element 112 are provided towards a front end of the runner body 102, upwardly depending from the upper edge of the runner body 102. The first toe support element 110 is located at the front end of the runner body 102 and the second toe support element 112 is provided between the first toe support element 110 and the heel support element 106. Support elements 110 and 112 include a toe plate 114 joining them and including eight countersunk apertures (one shown as 114a) for receiving fixing screws by which a forward part of the sole of a boot can be fastened to the runner 100. Two further apertures 114a and 114b are elongated to permit minor adjustment when the boot is being secured to the

runner 100.

[0060] A reinforcing rib 120, 122 is provided on each side of the runner body 102 and each runs along a significant portion of the length of the runner body 102 (from its heel towards its toe) and along its longitudinal axis. The reinforcing ribs 120, 122 increase the rigidity of the runner body 102 with respect to bending moments in directions perpendicular to the plane of the runner body 102.

[0061] The runner body, supports, heel and foot plates and reinforcing ribs are provided as a unitary, joint-free piece of machined aluminium whose manufacture will be described in greater detail below. The heel support element 106 smoothly changes shape into the heel plate 108 rather than the heel plate 108 being a separate member joined to the support element 106. Similarly, both the first toe support element 110 and second toe support element 112 smoothly change shape into the toe plate 114, rather than the toe plate 114 being provided as a separate element joined to the support elements 110 and 112. The support elements 106, 110, 112 have a generally mushroom shape as can best be seen in the view of the toe end of the runner 100 in Figure 4.

[0062] A blade 104 is provided as a separate part to the runner body 102 and extends along the entire length of the runner body 102 from the heel end to the toe end. A front end of the blade 104 includes a toe pick 124 and the shape of the blade 104 substantially matches the shape of the lower edge of the runner body 102. The blade 104 is made from high strength vanadium steel.

[0063] The blade 104 is sufficiently hard so as to be able to retain a sharp edge during use and also to provide a sufficiently sharp and strong toe pick 124 so as to provide the required skating performance. The aluminium runner body 102 of the runner reduces the overall weight of the runner thereby providing a runner (and therefore a skate) having a reduced weight compared to prior art skates, without reducing the skating performance of the skate. The aluminium body and steel blade 104 represent a composite runner which provides the optimum performance characteristics of lightweight with sufficiently hard running edges and toe pick.

[0064] The blade 104 is connected to the runner body 102 by a tongue and groove joint as shown particularly in Figure 3. The lower edge of the runner body 102 has a groove extending along its entire length. An upper edge of the blade 104 has a tongue 126 also extending along the entire length of the runner body 102, as illustrated schematically in Figure 1 by dashed line 128. Blade 104 is attached to the runner body 102 by inserting the tongue 126 into the groove and using an elastic adhesive to fasten them together.

[0065] In use, significant forces are exerted in a direction perpendicular to the plane of the body 102 (illustrated by arrows A and B in Figure 3), particularly during take off and landing. The tongue and groove joint helps to prevent the blade 104 from disengaging the runner body 102 under the actions of such transverse forces owing to its mechanical configuration. The tongue and groove joint shown is a preferred means of securely connecting the blade 104 and runner body 102, and providing a robust joint along the entire length of the runner. Alternative joints could be used that provide some abutting parts of the runner body 102 and blade 104 which resist relative motion therebetween transverse to the runner 100.

[0066] As illustrated in Figure 3, blade 104 has a shoulder 130 on an instep side and a shoulder 132 on an opposite outstep side. The shoulder 130 on the instep side has a greater depth than the shoulder 132 on the outstep side. The sides of the blade 104 are slightly tapered and are connected by a concave undersurface 134. The junctions of the undersurface and the sides provide two edges 135, 136 on which the skate can travel in use as is well understood in the art.

[0067] Broken lines 140, 142 and 144 show the "footprint" of the upper parts of the supports 110, 112, 106 where they merge with the substantially planar toe and heel plates 114, 108. The heel and toe plates 114, 108 are in fact slightly curved to match the slightly curved shape of the sole of a skate boot. The runner body 102 has a substantially flat planar configuration which is substantially perpendicular to the planes of the heel and toe plates 114, 108. The support elements 110, 112, 106 include regions 146, 148, 150 on each side of increased thickness with respect to the remainder of the runner body 102. The parts of the support of the same thickness as the remainder of the runner body smoothly change shape and increase in thickness as they morph into their respective plates 114, 108.

[0068] As illustrated in Figure 4, there is an area of maximal thickness 152, 154, 156 for each of the increased thickness regions 146, 148, 150 which occurs in an area generally bisecting the angle defined by the planes of the plates and the runner body.

[0069] Figures 5a-d shows in cross-section four substantially T-shaped extrusion dies for carrying out an embodiment of the method of the invention. The profile of the extrudate obtainable from each substantially T-shaped extrusion die is largely the same. Thus in the extrusion die illustrated in Figure 5(d), there are regions 1 to 5 from which are obtained portions of the profile of an extrudate corresponding to a heel plate (1), a toe plate (2), a runner body (3), a reinforcing rib (4) and a slot (5) for inserting a blade. A simpler extrusion die is shown in Figure 2(c) from regions 1 and 2 of which there is obtained portions of the profile of an extrudate corresponding to a toe plate (2) and heel plate (1). An even simpler extrusion die is shown in Figure 2(b) in which there is no region from which is obtained a portion of a profile of an extrudate corresponding to a slot for inserting a blade. The extrusion die shown in Figure 2(a) has regions corresponding to those shown in Figure 2(d) but with an additional region 6 from which is obtained a portion of a profile of an extrudate corresponding to a void.

[0070] Figure 6 is a perspective view of a substantially T-shaped extrusion die 61 of the type illustrated in Figure 2(c). In the substantially T-shaped extrusion die 61, there are regions 1 to 4 from which are obtained portions of a profile of an extrudate corresponding to a heel plate (1), a toe plate (2), a runner body (3) and a reinforcing rib (4).

[0071] In the manufacture of a unitary runner of the invention, a large ingot of aluminium is heated, melted and pressed through the substantially T-shaped extrusion die 61. The resulting aluminium extrudate is cut into lengths and fed into a CNC machine where the detailed profile of the runner is machined. After machining, the runner is polished and anodised.

[0072] Figures 7a and 7b illustrate (in perspective and side view respectively) the substantially T-shaped extrusion die 61 of Figure 6 superimposed with an embodiment of the unitary runner 70 of the invention largely of the type illustrated in Figures 1 to 4. From this illustration, the small amount of material which needs to be machined from the extrudate to obtain the unitary runner 70 will be appreciated. From Figure 7b, it will be seen that the radius of the curved blade 74 increases progressively from the rear to the front (in fact from 6 foot to 7 foot to 8 foot to 9 foot) and extends into a steep curve at the front portion 77.

[0073] Figures 8a and 8b illustrate (in perspective and side view respectively) a substantially T-shaped extrusion die 81 of the type illustrated in Figure 2(b) superimposed with an embodiment of the unitary runner 80 of the invention having a heel plate 83, a toe plate 82, a runner body 84, a reinforcing rib 85 (on each face) and a connecting bridge section 87 (on each face). The connecting bridge section 87 provides added support to the toe plate 82.

[0074] Figure 9 illustrates the unitary runner 80 of Figure 8a and 8b prior to insertion of a vanadium-containing steel blade 90. The vanadium-containing steel blade 90 is laser cut from vanadium-containing steel plate and comprises an elongate tongue 91 which inserts into an elongate slot 86 of the runner body 84. At the edge of the elongate tongue 91 are elongate shoulders 92 on which the lower edge 88 of the runner body 84 is seated. The vanadium-containing steel blade 90 is fastened by a high strength, elastic adhesive. Figure 10 illustrates the unitary runner 80 of Figure 8a and 8b after insertion of the steel blade 90.

Claims

1. A runner for a skate comprising:

a runner body;
a toe plate attachable to a fore part of an item of footwear; and
a heel plate attachable to a rear part of an item of footwear, wherein the toe plate and/or heel plate are unitary with the runner body.

2. A runner as claimed in claim 1 for a figure skate.

3. A runner as claimed in claim 1 or 2 obtained by a manufacturing method including an extrusion step.

4. A runner as claimed in claim 3 obtained by a manufacturing method including an extrusion step using a substantially T-shaped extrusion die.

5. A runner as claimed in any preceding claim wherein the heel and/or toe plate curve upwardly to conform to the general shape of the footwear to which the runner is to be attached.

6. A runner as claimed in any preceding claim wherein the heel plate slopes downwardly from the rear to the front.

7. A runner as claimed in any preceding claim wherein the toe plate slopes upwardly from the rear to the front.

8. A runner as claimed in any preceding claim comprising at least one toe support element towards a front end of the runner body which morphs into the toe plate.

9. A runner as claimed in claim 8 comprising a first toe support element which morphs into the toe plate and a second toe support element which morphs into the toe plate.

10. A runner as claimed in any preceding claim comprising at least one heel support element towards a rear end of the runner body which morphs into the heel plate.

11. A runner as claimed in any of claims 8 to 10 wherein the morphing region where the runner body morphs into the plate can be thicker than the thickness of the runner body and/or plate adjacent the morphing region.

12. A runner as claimed in claim 11 wherein the morphing region has a maximum thickness in a region substantially bisecting the angle defined by the planes of the plate and the runner body.

13. A runner as claimed in any of claims 8 to 12 wherein the (or each) toe and/or heel support element adopts a mushroom-like configuration.

14. A runner as claimed in any preceding claim including a reinforcing member extending partially or wholly along the longitudinal axis of the runner body.

15. A runner as claimed in any preceding claim wherein the runner body and plates are composed of a lightweight, relatively high strength material selected from the group consisting of: aluminium, titanium and magnesium or an alloy thereof.

16. A runner as claimed in claim 15 wherein the runner body and plates are composed of aluminium or an alloy thereof.

17. A runner as claimed in any preceding claim wherein the runner body is composed of a first material and has a contact edge extending along its lower edge, wherein the contact edge is composed of a second material harder than the first material.

18. A runner as claimed in claim 17 wherein the contact edge is a blade.

19. A runner as claimed in claim 17 or 18 wherein the contact edge includes an integral toe pick at or near to the front end of the contact edge.

20. A runner as claimed in claim 19 wherein the toe pick comprises a plurality of teeth in a non-uniform sawtooth configuration, wherein the teeth in the non-uniform sawtooth configuration are of a diminishing size from rear to front.

21. A runner as claimed in any of claims 17 to 20 wherein the contact edge is non-uniformly curved and the radius of the curve increases progressively from the rear to the front.

22. A method for manufacturing a runner for an ice skate comprising:

(A) extruding a heated extrudable material into an extrudate in a substantially T-shaped extrusion die.

23. A method as claimed in claim 22 wherein from at least one detailed region of the substantially T-shaped extrusion die is obtained at least one portion of the profile of an extrudate corresponding to at least one part of the runner.

24. A method as claimed in claim 22 wherein the portion of the profile of the extrudate corresponds to one of the group selected from the heel plate, the toe plate, the runner body, the reinforcing rib and the groove for inserting a blade.

25. A method as claimed in claim 24 wherein the substantially T-shaped extrusion die comprises: four detailed regions from which are respectively obtained portions of the profile of an extrudate corresponding to the heel plate, the toe plate, the runner body and the groove for inserting a blade.

26. A method as claimed in any of claims 22 to 25 further comprising the steps of:

(B) cutting the extrudate into a plurality of extrudate lengths; and
(C) machining an extrudate length into a runner.

27. A method as claimed in claim 26 further comprising the steps of:

(D) forming a contact edge of a second material which is harder than the runner; and
(E) joining the contact edge to a lower edge of the runner body.

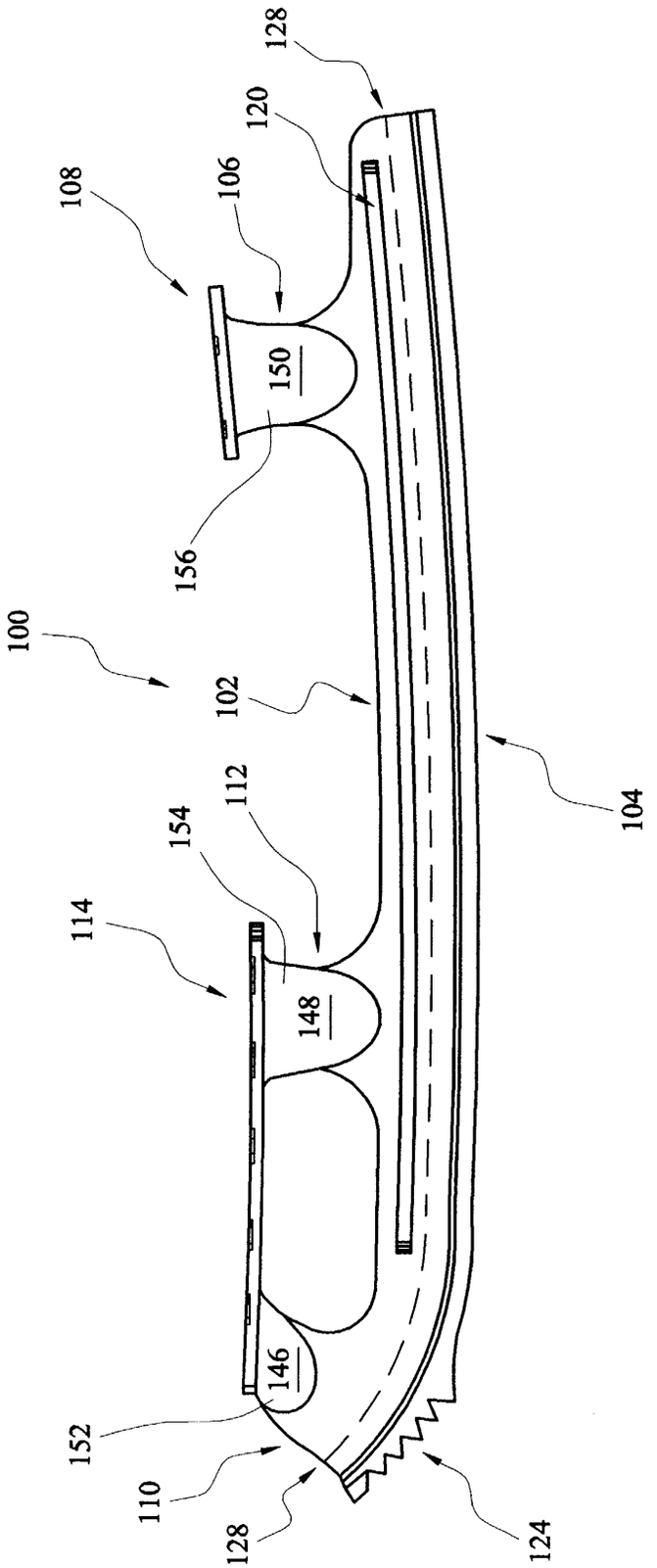
128
120
108
106
150
156
100
102
104
112
154
114
148
146
152
110
128
124

FIG. 1

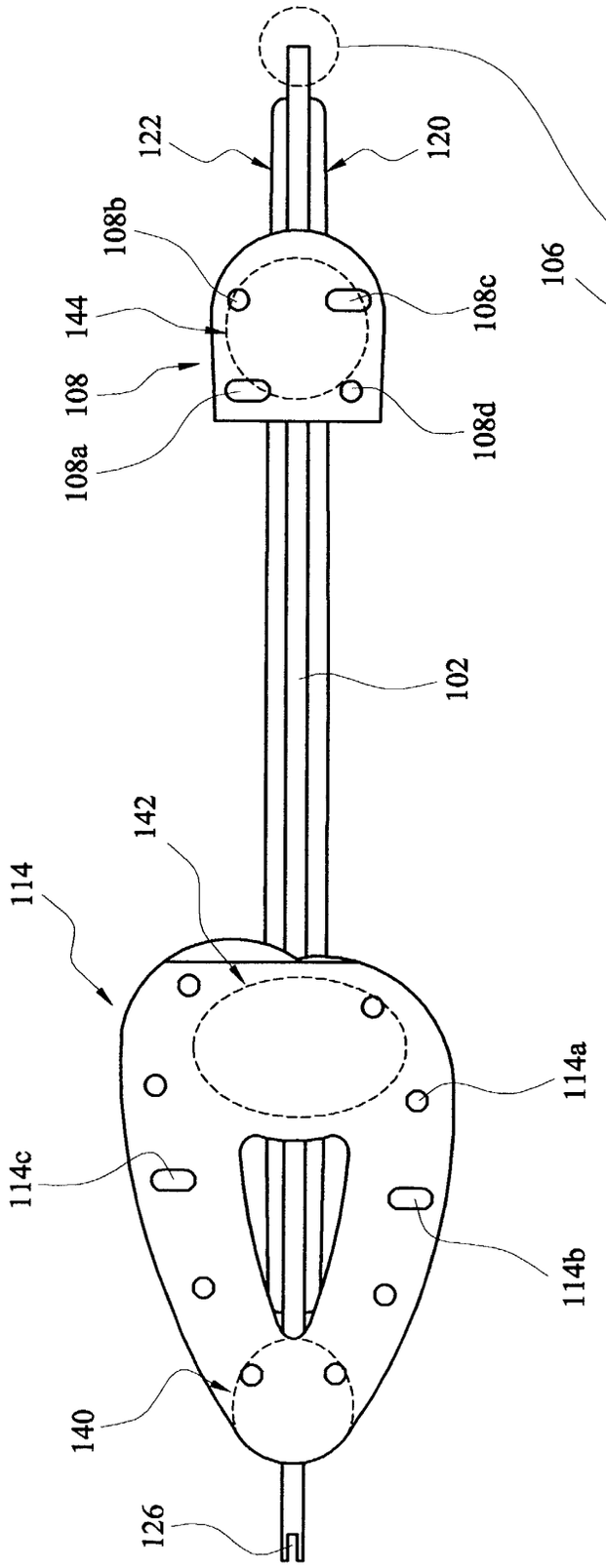
122
120
108b
108c
144
108
108a
108d
102
142
114
114a
114c
114b
140
126

FIG. 2

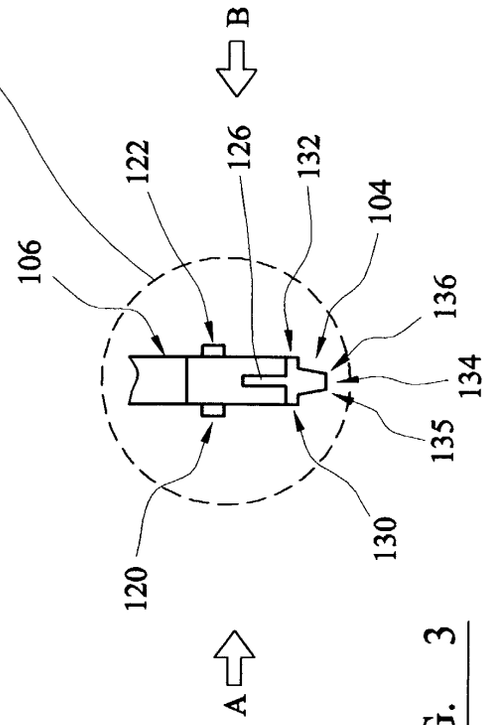
B
A
122
126
132
104
106
136
134
135
130
120

FIG. 3

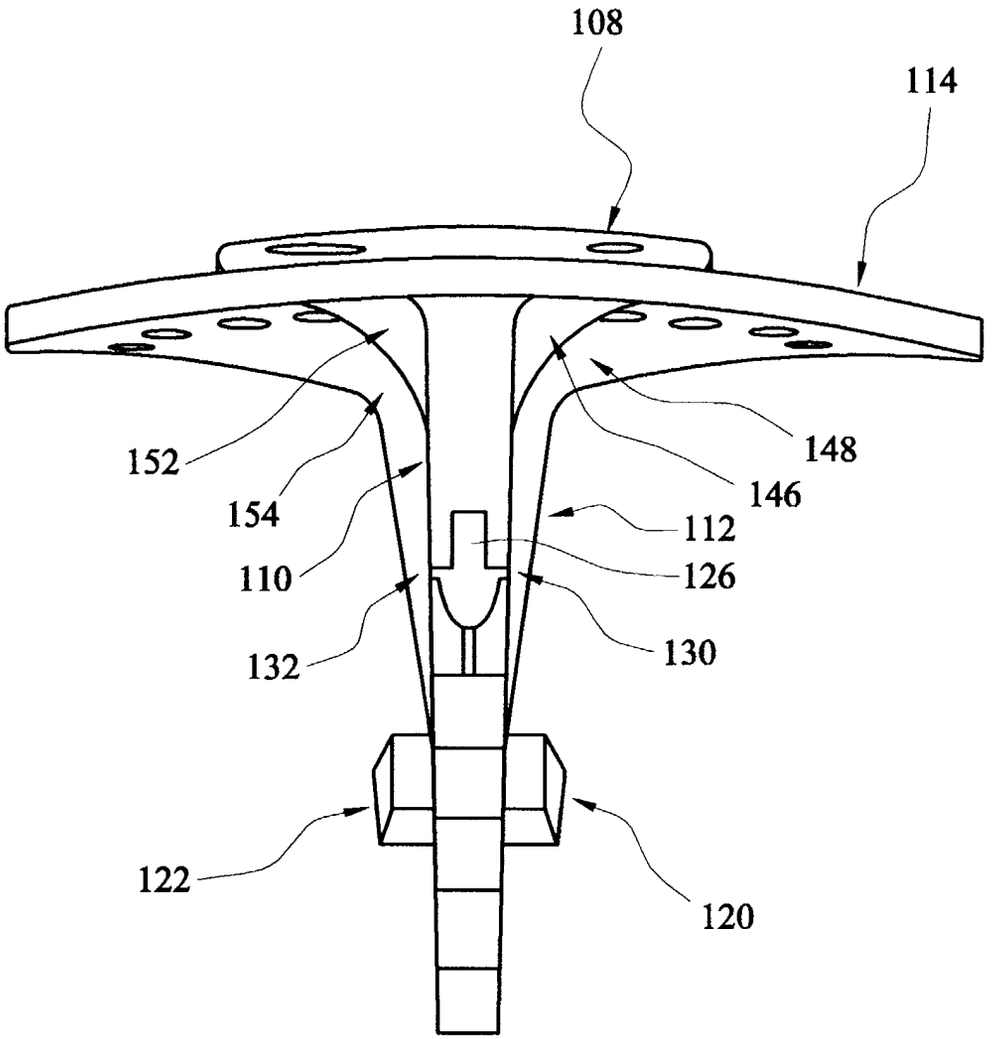

FIG. 4

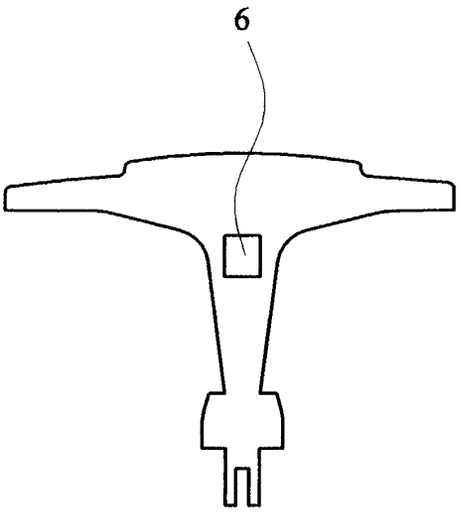

FIG. 5(a)

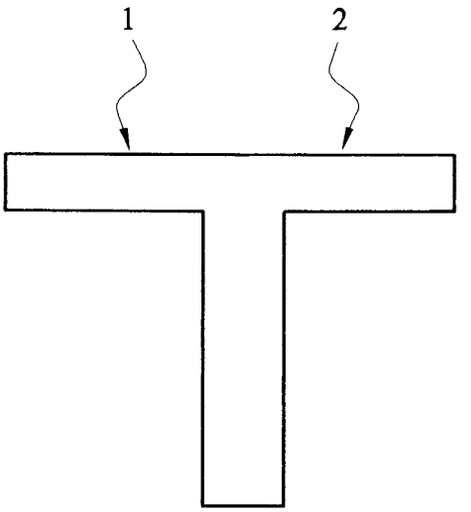

FIG. 5(b)

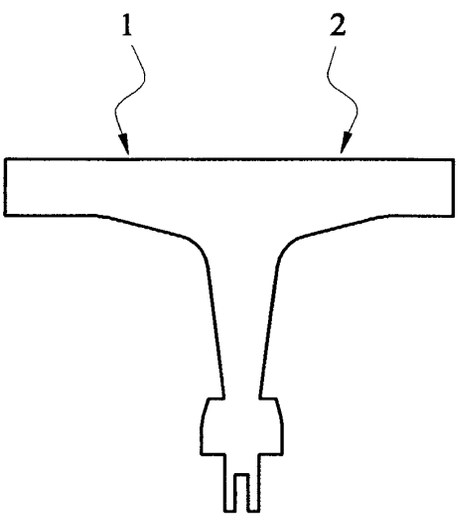

FIG. 5(c)

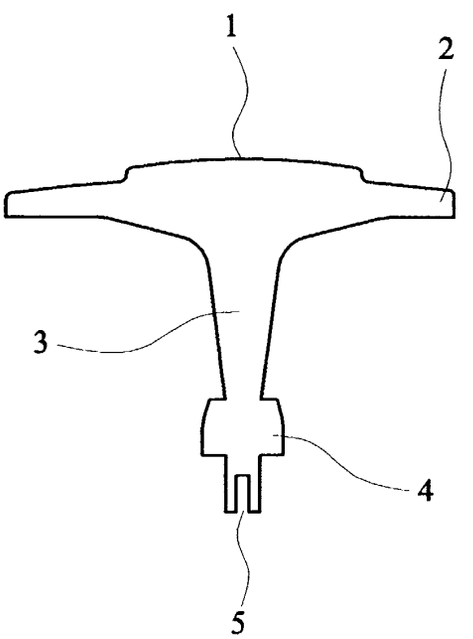

FIG. 5(d)

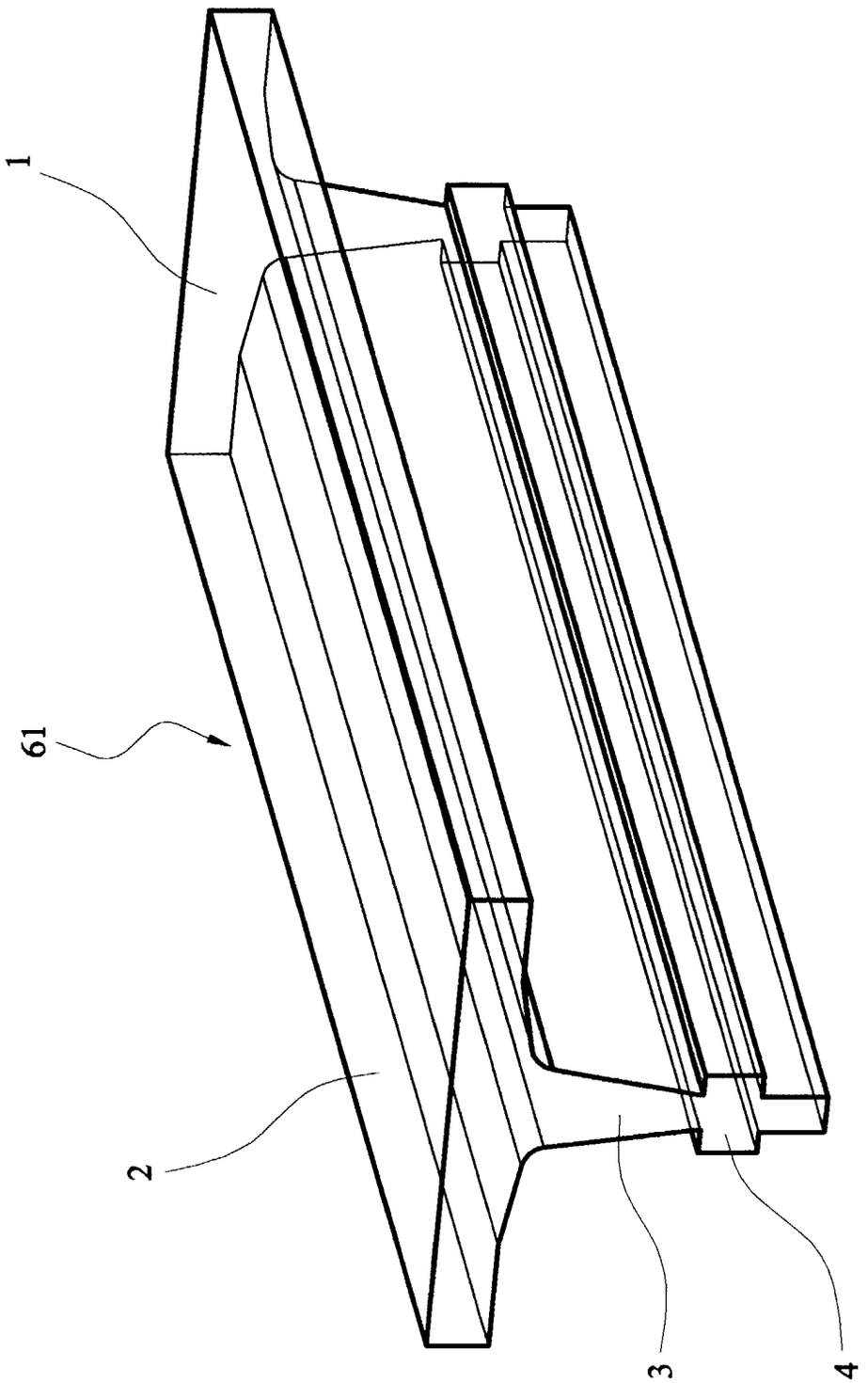

FIG. 6

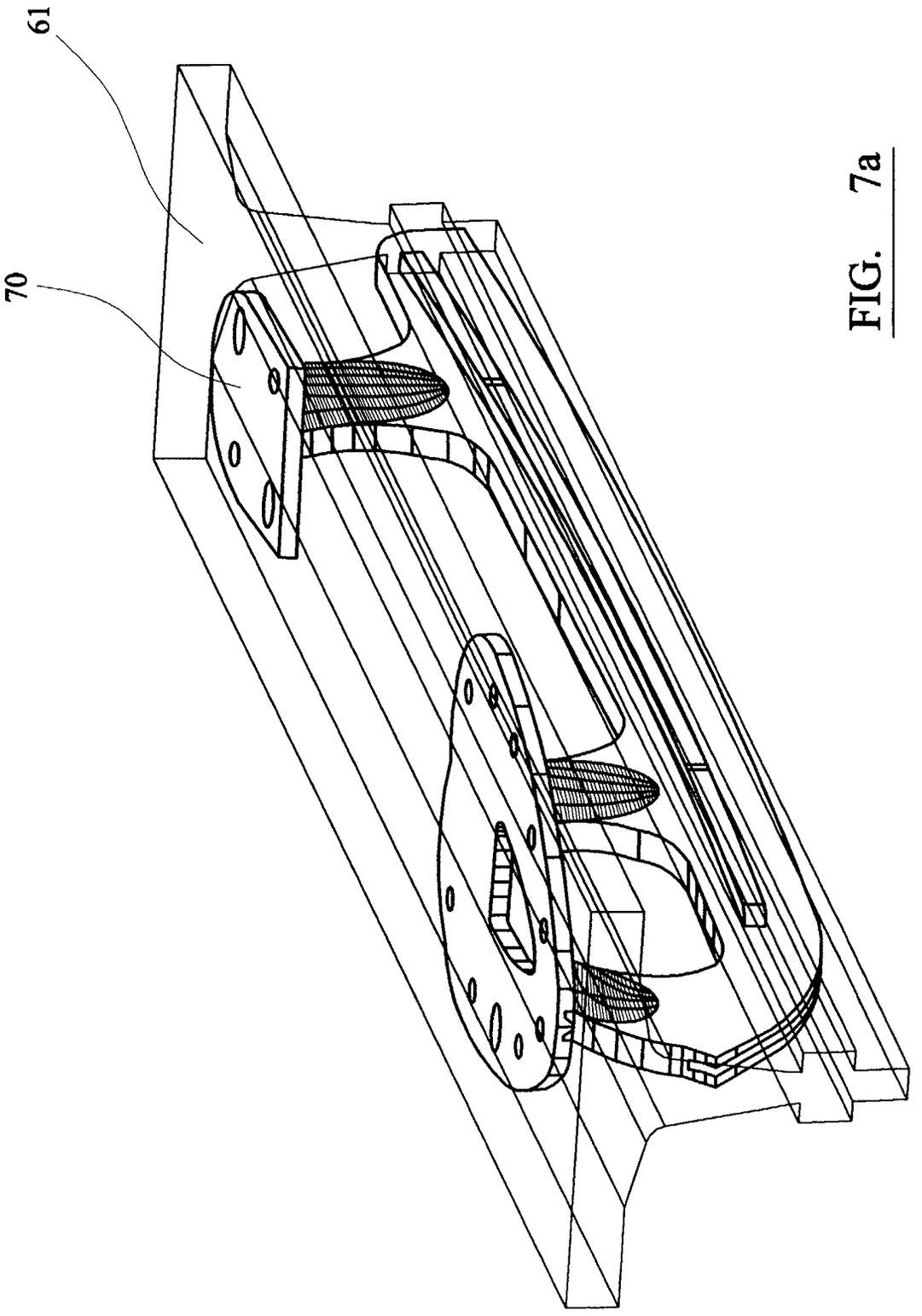

FIG. 7a

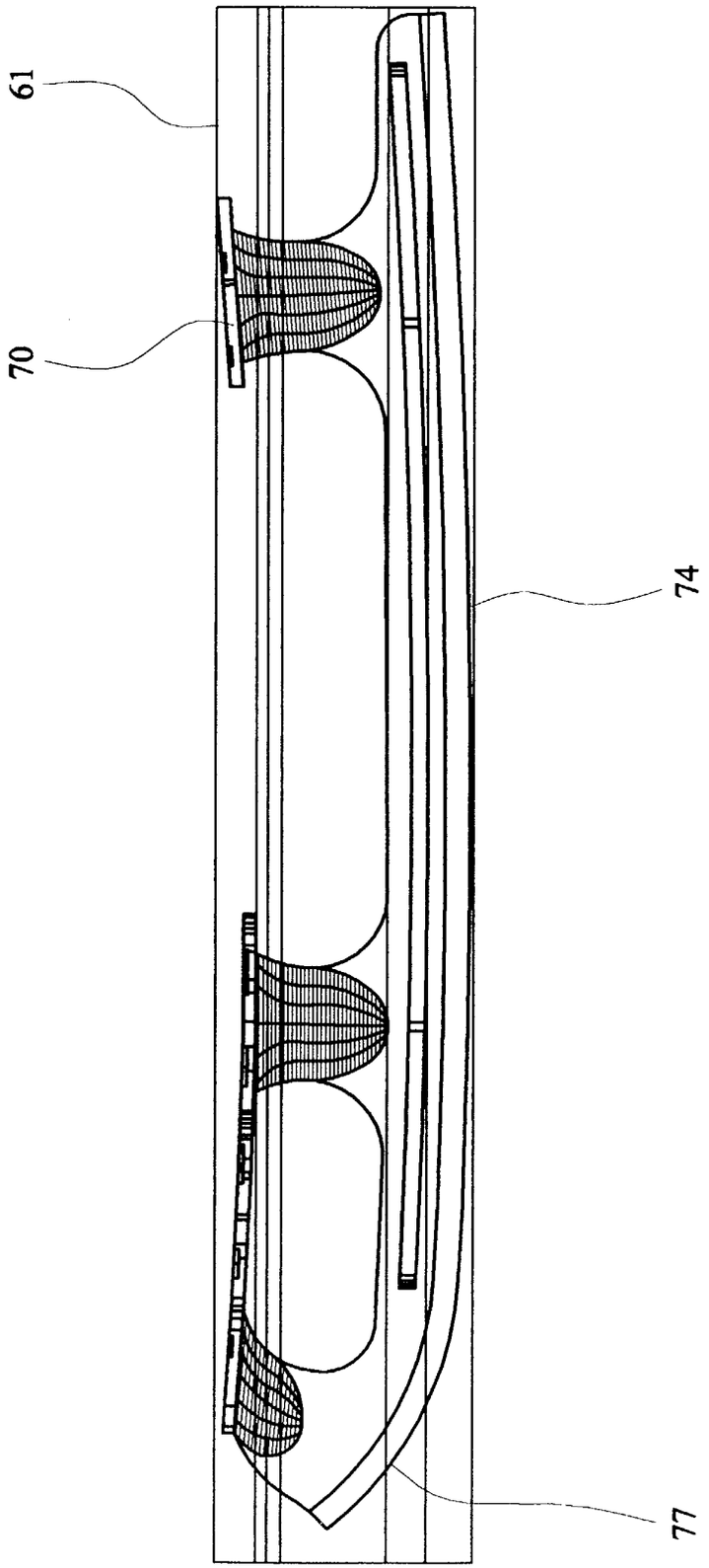

FIG. 7b

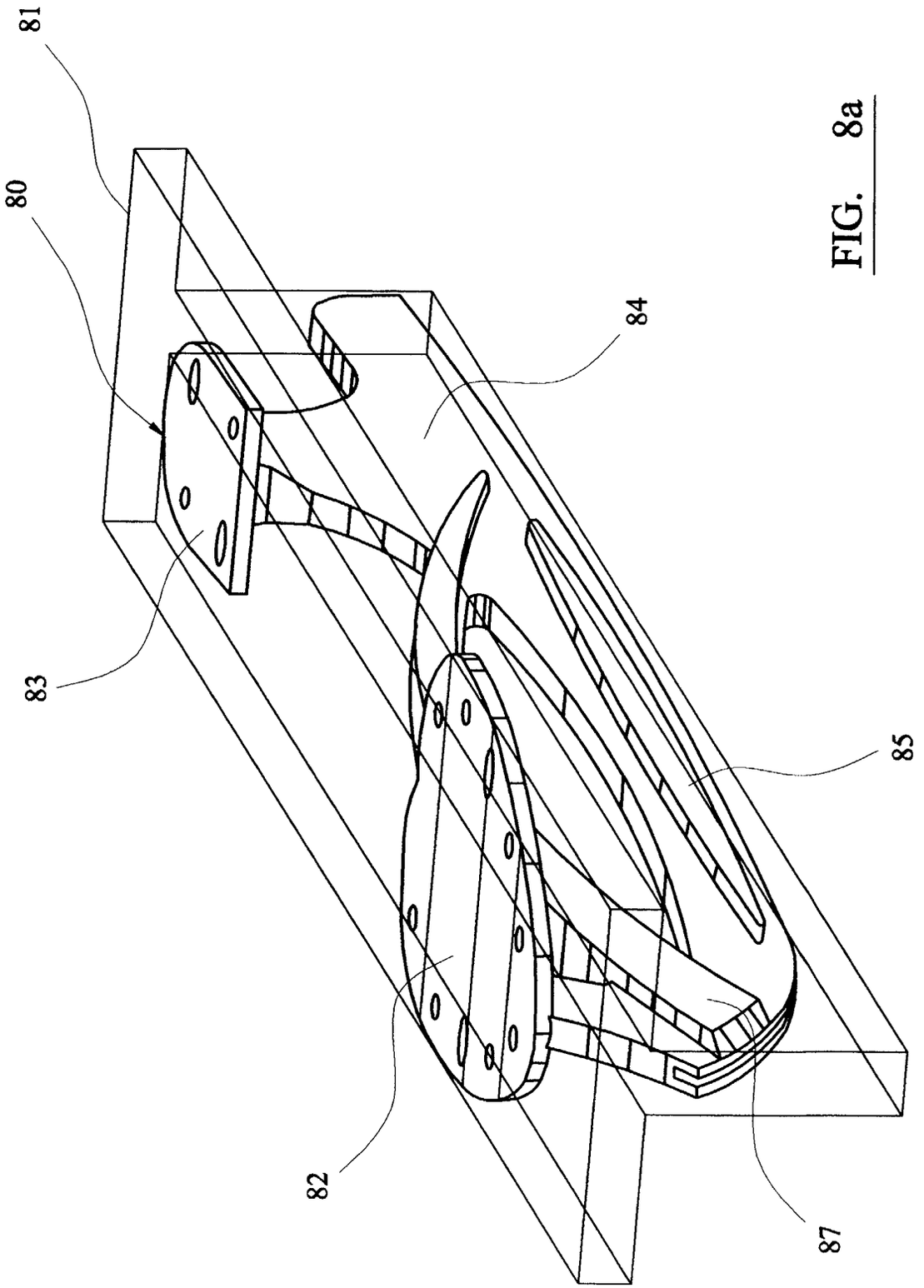

FIG. 8a

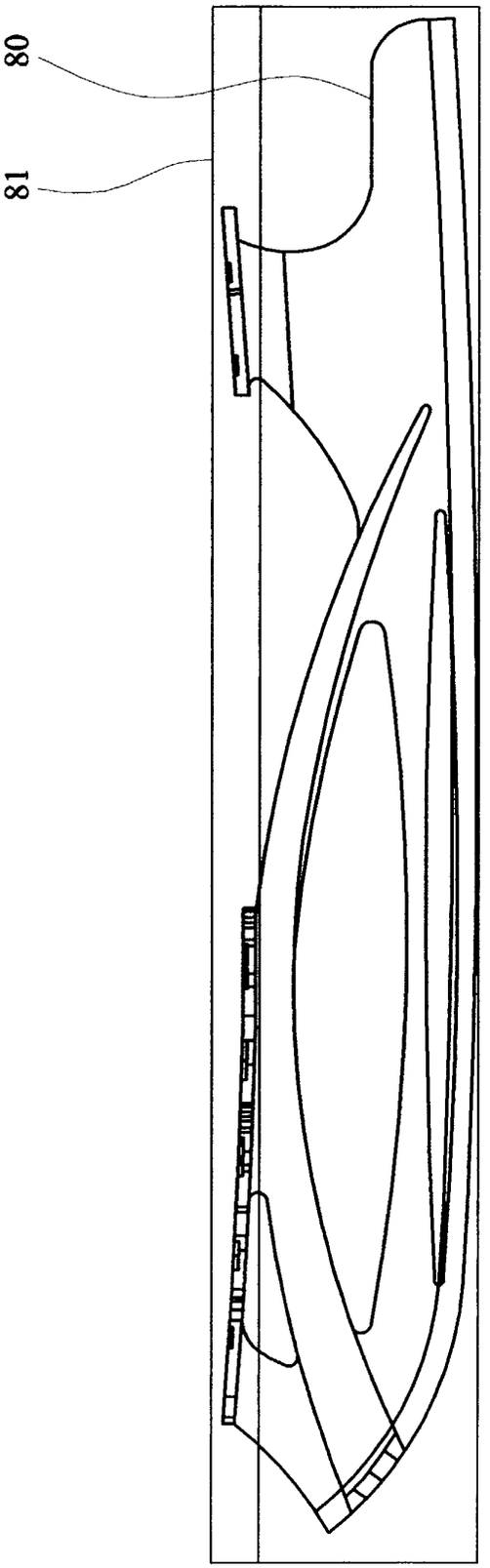

FIG. 8b

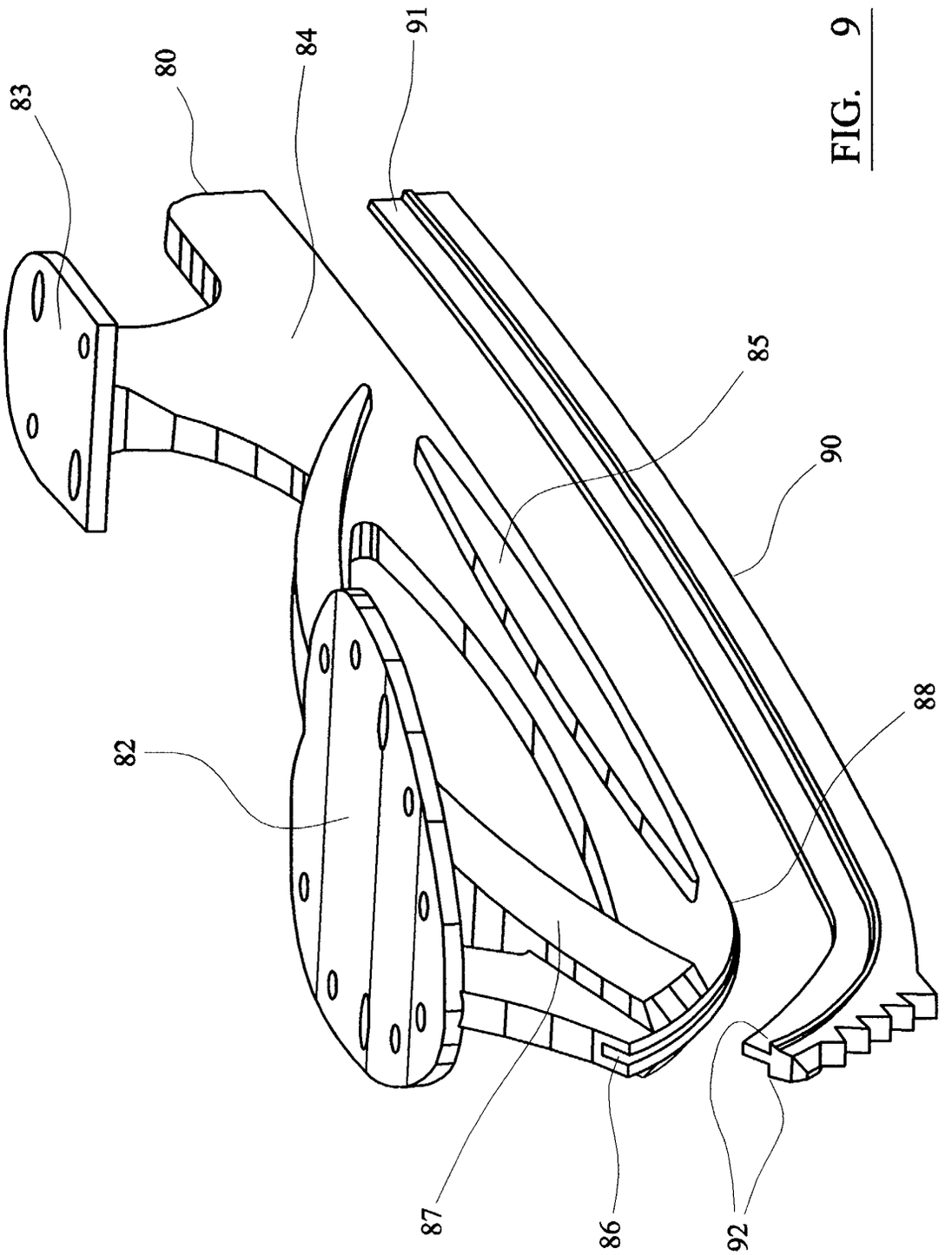

FIG. 9

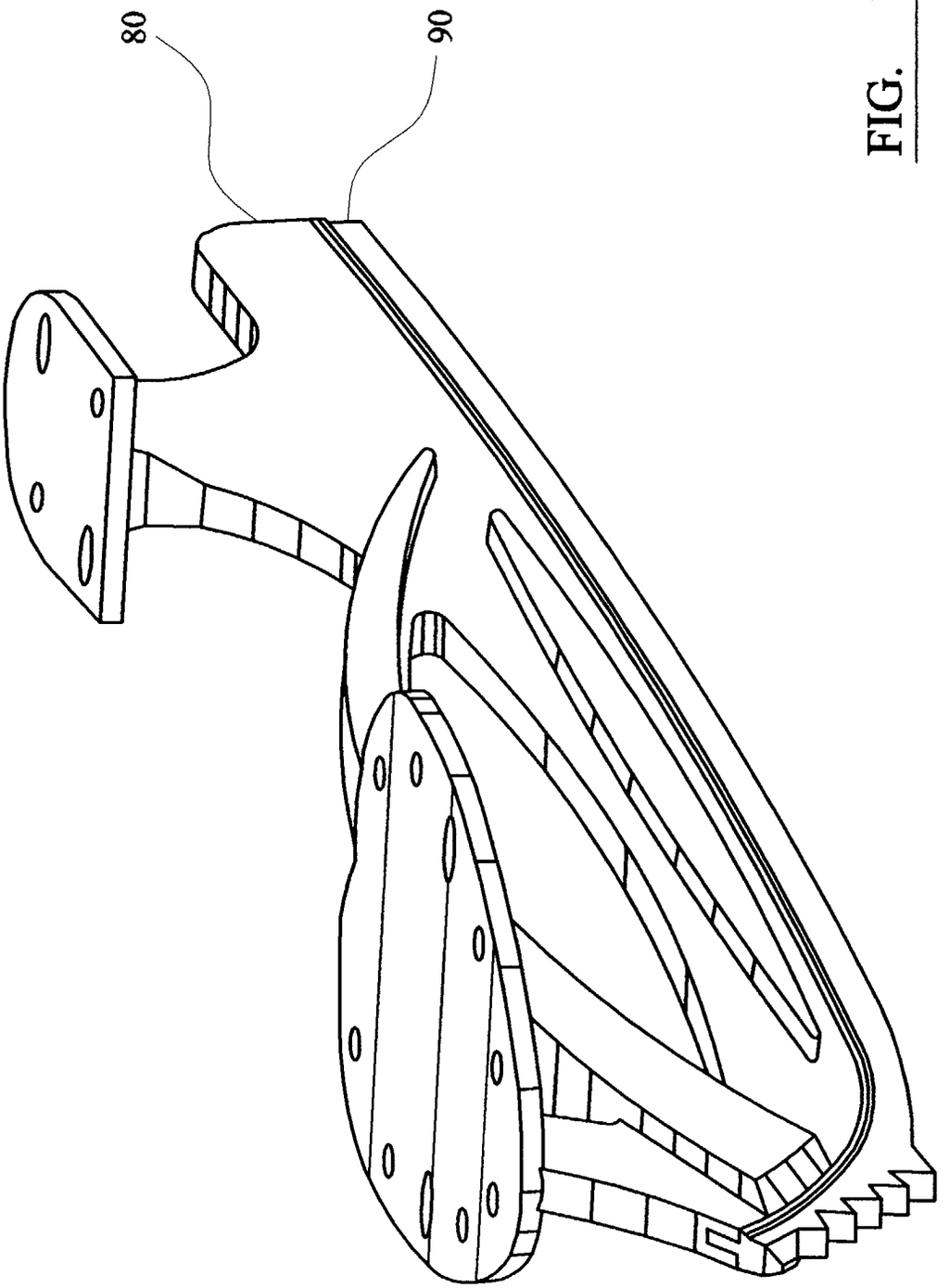

FIG. 10

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 03 25 3878

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	3 October 2003	Verelst, P

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