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(54) **BIOMECHANICAL ARTICULATING SKATE**

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(57) **ABSTRACT**

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An ice skate in the form of a boot that surrounds a foot, ankle and preferably the lower leg of a user. The boot has a heel portion and toe portion and a metatarsal hinge facilitating rotational movement of the heel portion with respect to the toe portion about this hinge. The anterior and posterior blades have substantially linear edges for selectively contacting an ice surface, the blades being biased by use of a spring extending from the heel of the skate to the holder of the anterior blade.

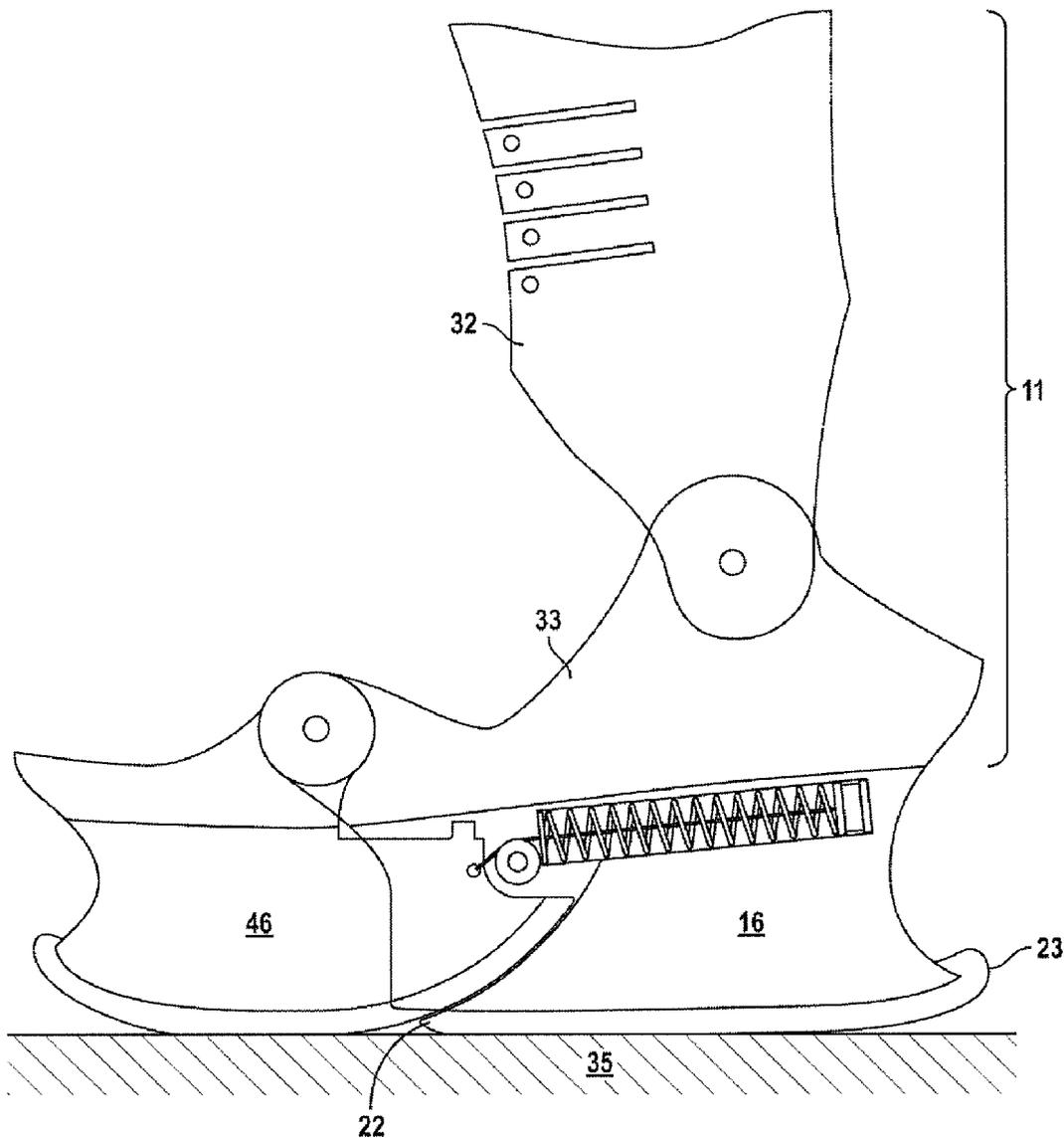
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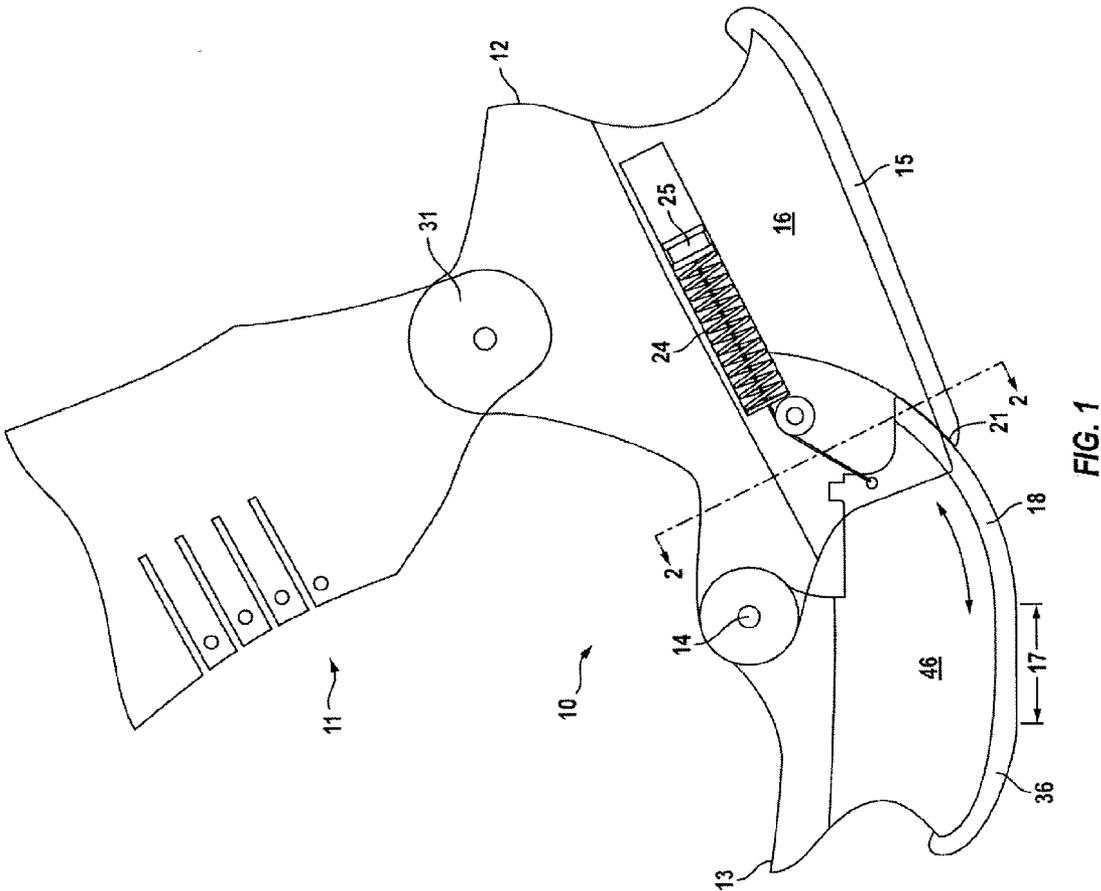


FIG. 1

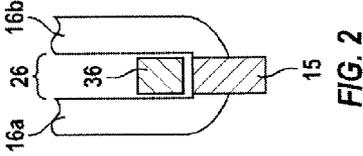


FIG. 2

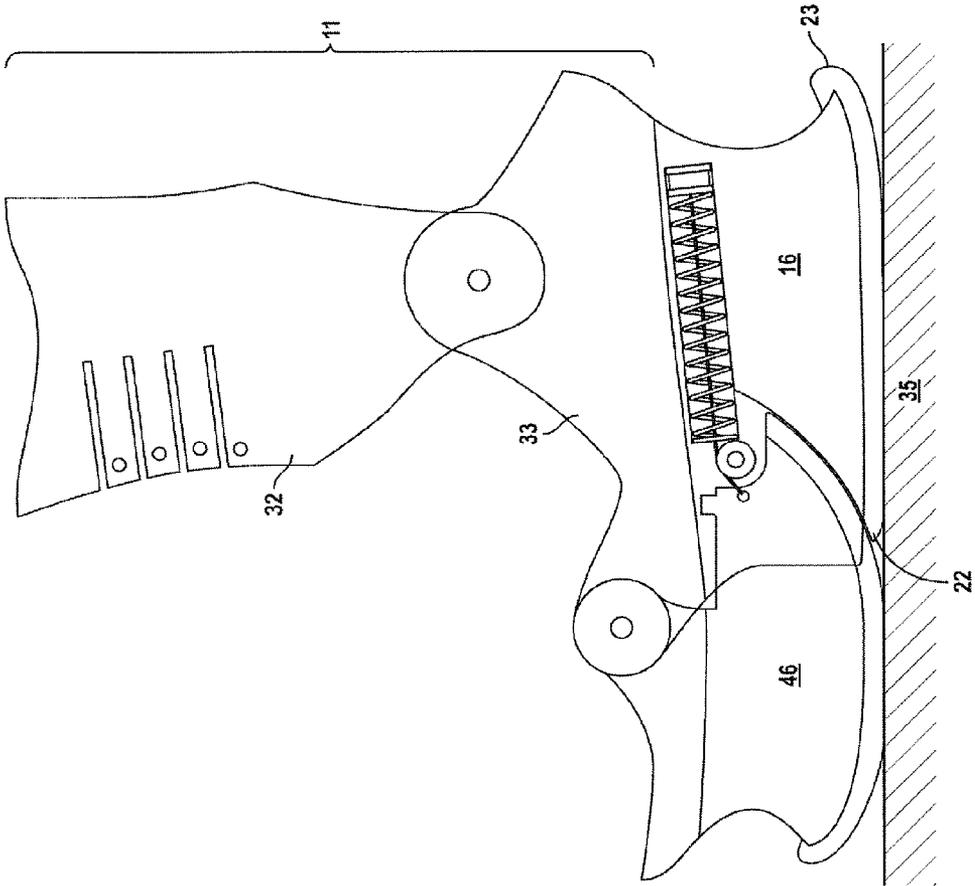


FIG. 3

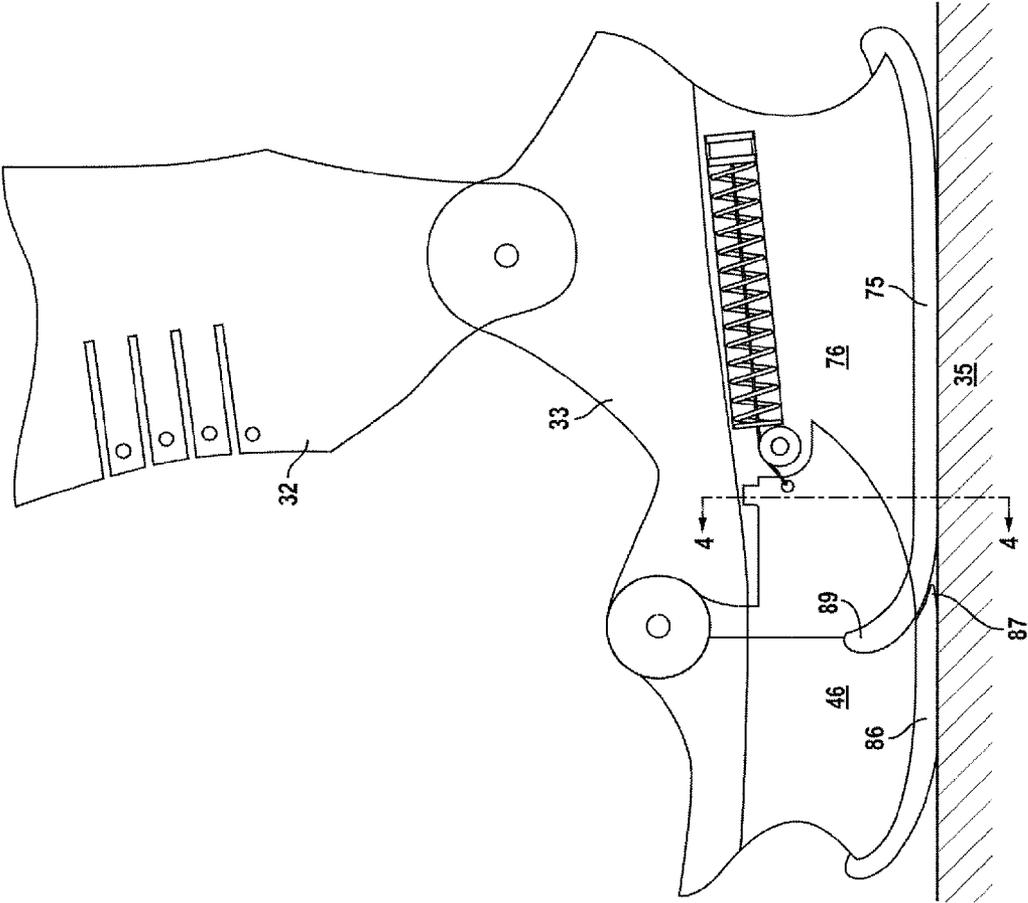


FIG. 5

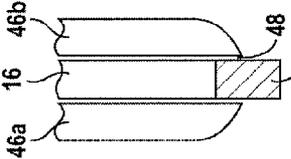


FIG. 4

BIOMECHANICAL ARTICULATING SKATE

TECHNICAL FIELD

[0001] The present invention relates to ice skates and particularly to ice skates having anterior and posterior blades which are capable of rotating with respect to one another about a metatarsal hinge. This provides a skate where there is simultaneous foot and blade articulation where the gap between the two blades remains small and constant during all phases of foot flexion and the back blade does not separate away from the skater's heel.

BACKGROUND OF THE INVENTION

[0002] Human motion depends on successful articulation of the joints in the lower limb which include the hip, knee, ankle and forefoot. The modern ice skate has a single blade attached to the front and the back of the boot that by design prevents articulation or locks-up the forefoot or metatarsal joints. Skating is thus accomplished by flexing the other lower limb 'unlocked' articulating joints and gliding along the ice. The fact that the metatarsal heads are locked-up has been a long recognized problem and led to the development of the clap skate and improvements in boot design flexibility. The clap skate allows plantar flexion at the forefoot while the blade simultaneously separates from the posterior region or heel of the boot. Plantar flexion is an essential biomechanical movement for walking, running, jumping and pivoting.

[0003] In conventional skates, the fulcrum for a skater's calf muscle extension moves from its usual point at the ball of the foot to the tip of the blade. This forces the heel to lift up higher and combined with the locked metatarsal heads limits the full range of calf muscle contraction.

[0004] It is thus an object of the present invention to provide ice skates which overcome the limitations as noted above. The present invention provides ice skates that facilitate the natural rotation of the metatarsal region of the foot which are more biomechanically efficient and enable the skater to maximize his or her potential power as would a sprinter wearing running shoes.

[0005] The invention will also allow the skater to be more stable in the athletic position, more agile in changing positional direction and less work will be required in the classic cross over turn. In essence, the skater's blade is now a dynamic rocker that allows for both speed when the foot is extended and easier pivoting when the forefoot is flexed.

[0006] These objects will be more readily appreciated when considering the following disclosure and appended claims.

SUMMARY OF THE INVENTION

[0007] The present invention relates to an ice skate having a boot, which when worn, surrounds a foot, ankle and preferably also the lower leg of a user. The boot further comprises a heel portion and a toe portion and a metatarsal hinge facilitating rotational movement of the heel portion with respect to the toe portion about the metatarsal hinge. A posterior blade is affixed to the heel portion characterized as having a substantial linear edge for selectively contacting an ice surface when used and having terminal front and rear ends defining a length of the posterior blade. In its first embodiment, the front end of the posterior blade is provided with a first arc of curvature. An anterior blade is affixed to the toe portion and to the metatarsal hinge through the toe portion, the anterior blade having a

substantially linear central portion and in its first embodiment, a rearwardly extending curve portion, the later having an arc of curvature substantially equal to the first arc of curvature of the posterior blade such that in use upon flexion, the posterior and anterior blades rotate with respect to one another about the metatarsal hinge while maintaining a relatively fixed spacing between the first edge of the posterior blade and the rearwardly extending curved portion of the anterior blade.

[0008] The present invention is also directed to an ice skate comprising a boot, which when worn, surrounds a foot, ankle and preferably the lower leg of a user, the boot further comprising a heel portion and toe portion and a metatarsal hinge facilitating rotational movement of the heel portion with respect to the toe portion about the metatarsal hinge. An anterior blade and a posterior blade are each affixed to blade holders. In one embodiment, the posterior blade is affixed to a heel blade holder comprising a pair of side walls and a gap between the side walls. An anterior blade is affixed to a toe blade holder whereupon during flexion, the posterior and anterior blades rotate with respect to one another about the metatarsal hinge, the anterior blade being stabilized by its selected passage within the gap. Alternatively, a gap is created by configuring the anterior or toe blade holder into a pair of side walls into which the posterior blade holder passes for stability.

BRIEF DESCRIPTION OF THE FIGURES

[0009] FIG. 1 is a partial cut away view of a first embodiment of the ice skate of the present invention in a first orientation.

[0010] FIG. 2 is cross sectional view taken along line 2-2 of FIG. 1.

[0011] FIG. 3 is a partial cut away view of the first embodiment of the ice skate of the present invention in a second orientation.

[0012] FIG. 4 is a cross sectional view taken along line 4-4 of FIG. 5.

[0013] FIG. 5 is a partial cut away view of a second embodiment of the ice skate of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0014] Novel features which are characteristic of the invention, as to organization and method of operation, together with further objects and advantages thereof will be better understood from the following description considered in connection with the accompanying drawings, in which preferred embodiments of the invention are illustrated by way of example. It is to be expressly understood, however, that the drawings are for illustration description only and are not intended as definitions of the limits of the invention. The various features of novelty which characterize the invention are recited with particularity in the claims.

[0015] There has been broadly outlined more important features of the invention in the summary above and in order that the detailed description which follows may be better understood, and in order that the present contribution to the art may be appreciated. There are, of course, additional features of the invention that will be described hereinafter and which will form additional subject matter of the claims appended hereto. Those skilled in the art will appreciate that the conception upon which this disclosure is based readily may be utilized as a basis for the designing of other structures,

methods and systems for carrying out the several purposes of the present invention. It is important therefore, that claims be regarded as including such equivalent constructions insofar as they do not depart from the spirit and scope of the present invention.

[0016] Certain terminology and the derivations thereof may be used in the following description for convenience and reference only, and will not be limiting. For example, words such as “upward,” “downward,” “left,” and “right” refer to directions in the drawings to which reference is made unless otherwise stated. Similar words such as “inward” and “outward” refer to directions toward and away from, respectively, the geometric center of a device or area and designated parts thereof. Reference in the singular tense include the plural and vice versa, unless otherwise noted.

[0017] In turning to FIG. 1, ice skate 10 is depicted comprising boot 11 which, when worn, surrounds the foot, ankle and lower leg of a user (not shown).

[0018] Boot 11 includes heel portion 12 for receiving the heel of a user and toe portion 13 for receiving the extended toes of a user, heel portion 12 and toe portion 13 being rotatable about metatarsal hinge 14.

[0019] Posterior blade 15 is removably affixed to posterior or heel blade holder 16 noting that posterior blade 15 is characterized as having a substantial linear edge for selectively contacting ice surface 35 when used. This can best be visualized in reference to FIG. 3 noting that in the FIG. 3 orientation where the user is not lifting heel portion 12 and is thus not stepping forward onto anterior blade 36, substantially linear central portion 17 of anterior blade 36 provides a substantially continuous substantially linear edge with posterior blade 15 riding upon ice surface 35. It should be noted that although central portion 17 of anterior blade 36 and posterior blade 15 are characterized as being “substantially linear”, it is contemplated that both blades could have some degree of curvature, while being embraced by the phrase “substantially linear”, although if curved, their respective arcs of curvature will be very shallow indicative of long radii of curvature and are certainly “substantially linear” as compared to curved portion 18 of anterior blade 36.

[0020] As more fully apparent from viewing FIG. 1, in its first embodiment anterior blade 36 includes, in addition to substantially linear central portion 17, rearwardly extending curved portion 18 having a substantially constant arc of curvature beginning rearwardly of linear central portion 17.

[0021] It should further be noted that posterior blade 15 is provided with front end 22 and rear end 23 which define the length of posterior blade 15. The front end 22 of posterior blade 15 is characterized as having first arc of curvature 21. In its first embodiment, an important feature of the present invention is that first arc of curvature 21 is substantially equal to the arc of curvature of rearwardly extending curved portion 18 of anterior blade 36 such that in use, upon flexion, posterior blade 15 rotates with respect to anterior blade 36 about metatarsal hinge 14 while ideally maintaining a relatively fixed spacing between the front edge of the posterior blade and the rearwardly extending curved portion of the anterior blade. Typically, such spacing is approximately one millimeter throughout the limits of rotation about metatarsal hinge 14 although a spacing of up to approximately 55 mm is considered within the scope of the present invention.

[0022] FIG. 1 depicts an orientation of skate 10 in which the skater is actively flexing, generally a movement to push off and generate forward motion. This is not the case as with the

orientation depicted in FIG. 3. As a preferred embodiment, skate 10 is provided with helical spring 24 ideally having dampener 25 in place as shown to draw blade 36 within posterior blade holder 16. To further illustrate a preferred feature of the present invention, reference is made to FIG. 2.

[0023] FIG. 2 is a cross sectional view taken along line 2-2 of FIG. 1. As illustrated, as a second preferred embodiment, posterior blade holder 16 is composed of side walls 16a and 16b creating gap 26 therebetween. When the foot of a user is not flexed and in which helical spring 24 causes anterior blade 36 to assume its FIG. 3 orientation, anterior blade 36 is stabilized by its selected passage within gap 26. As posterior blade 15 rotates about metatarsal hinge 14, rearwardly extending curved portion 18 of anterior blade 36 passes within and out of gap 26 formed between side walls 16a and 16b of heel blade holder 16.

[0024] As yet a third embodiment, reference is made to FIGS. 4 and 5 as an alternative to that depicted in FIG. 3. Specifically, anterior blade 86, terminating at end 87, is appended to anterior blade holder 46 composed of side walls 46a and 46b creating gap 48 therebetween. When the foot of a user is not flexed and in which helical spring 24 urges a FIG. 5 orientation, posterior blade 75 and particularly its curved forward end 89 and posterior blade holder 76 are stabilized by their passage within gap 48. As posterior blade 75 rotates about metatarsal hinge 14, posterior blade 75 and posterior blade holder 76 pass within and out of gap 48 formed between side walls 46a and 46b of anterior blade holder 46.

[0025] As a further preferred embodiment as a means of maximizing biomechanics, the present invention can include ankle hinge 31 enabling lower leg portion 32 of boot 11 to rotate with regard to ankle and foot portion 33.

[0026] It should be quite apparent that the present invention has provided a skate which adapts to the natural movement of the foot while improving the biomechanics of skating by enabling the skate to flex in regions accommodating natural foot flexure.

[0027] It should further be readily apparent that although the present invention was described in terms of an ice skate, it could equally be applied to an inline roller skate while taking advantage of the improvements provided thereby.

[0028] The above disclosure is sufficient to enable one of ordinary skill in the art to practice the invention, and provides the best mode of practicing the invention presently contemplated by the inventor. While there is provided herein a full and complete disclosure of the preferred embodiments of the invention, it is not desired to limit the invention to the exact construction, dimensions, relationships, or operations as described. Various modifications, alternative constructions, changes and equivalents will readily occur to those skilled in the art and may be employed as suitable without departing from the true spirit and scope of the invention. Such changes might involve alternative materials, components, structural arrangements, sizes, shapes, forms, functions, operational features or the like. Therefore, the above description and illustration should not be considered as limiting the scope of the invention, which is defined by the appended claims.

What is claimed is:

1. An ice skate comprising a boot, which when worn, surrounds a foot and ankle of a user, said boot further comprising a heel portion and a toe portion and a metatarsal hinge facilitating rotational movement of said heel portion with respect to said toe portion about said metatarsal hinge, a posterior blade affixed to said heel portion characterized as

having a substantially linear edge for selectively contacting an ice surface when used and having terminal front and rear ends defining the length of said posterior blade, said front end having a first arc of curvature, an anterior blade affixed to said toe portion, said anterior blade having a substantially linear central portion and rearwardly extending curved portion having an arc of curvature substantially equal to the first arc of curvature of said posterior blade such that in use, upon flexion, said posterior blade rotates with respect to said anterior blade about said metatarsal hinge while maintaining a relatively fixed spacing between said front edge of said posterior blade and said rearwardly extending curved portion of said anterior blade.

2. The ice skate of claim 1 wherein said posterior blade is biased such that its substantially linear edge is urged to be aligned with said central portion of said anterior blade.

3. The ice skate of claim 1 wherein said boot further comprises a lower leg portion and an ankle portion, said lower leg portion and said ankle portion hinged with respect to one another to facilitate their relative movement.

4. An ice skate comprising a boot, which when worn, surrounds a foot and ankle of a user, said boot further comprising a heel portion and a toe portion and a metatarsal hinge facilitating rotational movement of said heel portion with respect to said toe portion about said metatarsal hinge, a posterior blade affixed to a heel blade holder, said heel blade holder comprising a pair of side walls and a gap between said side walls and an anterior blade affixed to said toe portion whereupon flexion, said posterior and anterior blades rotate with respect to one another about said metatarsal hinge, said anterior blade being stabilized by its selected passage within said gap.

5. The ice skate of claim 4 wherein said posterior blade is biased such that said anterior blade is urged to pass within said gap.

6. The ice skate of claim 4 wherein said boot further comprises a lower leg portion and an ankle portion, said lower leg portion and said ankle portion hinged with respect to one another to facilitate their relative movement.

7. An ice skate comprising a boot, which when worn, surrounds a foot and ankle of a user, said boot further comprising a heel portion and a toe portion and a metatarsal hinge

facilitating rotational movement of said heel portion with respect to said toe portion about said metatarsal hinge, a posterior blade affixed to said heel portion characterized as having a substantially linear edge for selectively contacting an ice surface when used and having terminal front and rear ends defining the length of said posterior blade, said front end having a first arc of curvature, an anterior blade affixed to said toe portion, said anterior blade having a substantially linear central portion and rearwardly extending curved portion whereupon flexion, said posterior blade rotates with respect to said anterior blade about said metatarsal hinge while maintaining spacing between said front end of said posterior blade and said rearwardly extending curved portion of said anterior blade of less than approximately 55 mm.

8. The ice skate of claim 7 wherein said posterior blade is biased such that its substantially linear edge is urged to be aligned with said central portion of said anterior blade.

9. The ice skate of claim 7 wherein said boot further comprises a lower leg portion and an ankle portion, said lower leg portion and said ankle portion hinged with respect to one another to facilitate their relative movement.

10. An ice skate comprising a boot, which when worn, surrounds a foot and ankle of a user, said boot further comprising a heel portion and a toe portion and a metatarsal hinge facilitating rotational movement of said heel portion with respect to said toe portion about said metatarsal hinge, a posterior blade affixed to a posterior blade holder and an anterior blade affixed to an anterior blade holder, said anterior blade holder comprising a pair of side walls and a gap between said side walls whereupon flexion, said posterior and anterior blades rotate with respect to one another about said metatarsal hinge, said posterior blade being stabilized by its selected passage within said gap.

11. The ice skate of claim 10 wherein said posterior blade is biased such that said anterior blade is urged to pass within said gap.

12. The ice skate of claim 10 wherein said boot further comprises a lower leg portion and an ankle portion, said lower leg portion and said ankle portion hinged with respect to one another to facilitate their relative movement.

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