ICE SKATE BLADE

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Appl. No.: 13/286,353

Filed: Nov. 1, 2011

Related U.S. Application Data

Provisional application No. 61/409,142, filed on Nov. 2, 2010, provisional application No. 61/409,650, filed on Nov. 3, 2010.

Publication Classification

Int. Cl. A63C 1/30 (2006.01)

ABSTRACT

Ice skate blades represent the sole interface between a skater and the ice, a thin line of contact that must generate sufficient friction to melt the ice to allow gliding but not add drag under one state of usage and in another generate sufficient traction to support sharp turns and stopping. Today’s skate blades have a single hollow of predetermined profile across their width terminating in sharp edges at the outer limits of the skate blade. However, improved performance at both the competitive and recreational levels of skating and hockey in terms of the athletes and their sporting equipment has not followed through into the ice skate blade despite significant innovations in the skate boots. Accordingly it would be beneficial to provide increased design flexibility by allowing multiple hollows per blade such that the performance can be adjusted between inner and outer edges as well as across the entire width.
ICE SKATE BLADE

CROSS-REFERENCE TO RELATED APPLICATIONS


FIELD OF THE INVENTION

The present invention relates to the design of ice skate blades and methods of grinding such blades.

BACKGROUND OF THE INVENTION

In winter sports such as ice skating and hockey the blades of an ice skate are the point of contact for all of the forces generated in turns, spins, jumps, stops, gathering speed etc. Ice skates typically have a convex shape along a length of the skate blade and a concave shape across the width of the blade, defining two edges along the lengthwise edges of the blade. A skater can use either of these two edges in executing maneuvers on the ice surface.

With time the profiling of ice skates has evolved as former recreational sports such as skating evolved into Olympic sports with multiple disciplines including long-track speed skating, short-track speed skating, ice dance, ice etc and “shiny” hockey on frozen ponds, lakes, and rivers became a multi-billion dollar sporting franchise globally with individual players being remunerated in contracts of tens of millions of dollars. Alongside multiple equipment manufacturers jostle for an edge in the sports equipment market for the over 1.5 million registered hockey players globally and tens of millions of skaters globally who spend anything up to $1,000 on a pair of skates to keep up with their heroes, given the winning edge, etc.

As such ice skate blade profiles have evolved into a science with different profiles of blade between speed skating and ice dance, defender, goalie, attacker, short speed and long speed. Additionally atop these differences that science is establishing from research the individuality of the various players and the intuitive, difficult to quantify “feel” of their skates. However, despite this the overall fundamental design of an ice skate blade has remained essentially unchanged remaining as outlined above a single concave lateral profile on the bottom of the blade with an essentially longitudinally convex profile.

This design, despite significant research expenditure by the major equipment manufacturers of ice skates and ice skate sharpening equipment, is limiting as the single blade provides trade-off between a single hollow with a small surface area for gliding and two edges for providing friction in maneuvering. Speed skates, as opposed to hockey skates, for example have much longer blades and hollows for the express purpose of increasing the surface area in contact with the ice. Hence, after several hundred years ice skate blades have progressed more in recent years from refinements in materials and preparation, with grinding and now multiple polishing steps, with changes to profile occurring incrementally over the years allowing the skate to evolve to its current design and construction of a skate boot, a single skate blade holder, and a single skate blade with a single hollow which are, however, essentially the same as the original design.

Within the prior art several approaches to adapting the design of ice skates have been presented. These include K. Hall in U.S. Pat. No. 4,907,813 entitled “Ice Hockey Skate Blade” wherein there is taught a skate design comprising a top edge, a skating edge, and a toe portion. The skating edge has a gliding portion behind the toe portion which has a width less than the top edge of the blade and the toe portion of the blade. The front toe portion of the blade allows contact with the ice and has a width equivalent to standard hockey ice skate widths, while the gliding portion of the blade behind the toe section has a narrower width corresponding to ice skate racing blades. In contrast J. Swande in U.S. Pat. No. 5,826,890 entitled “Ice Skate Blade” teaches to a blade cross-section that varies between a central portion and the front and rear edges. Swande identifies a limitation in adapting the blade design to the requirements of defensive hockey players who favor shorter central gliding sections to obtain better turning ability unlike attacking hockey players who longer central sections for increased acceleration and gliding. Accordingly Swande teaches to introducing a main central runner and lateral side runners to reduce the surface pressure applied so as to limit the depth the blade bites into the ice wherein deep biting is undesirable. Accordingly Swande teaches to a three-section lateral profile that varies from having a central section with the result that four blade edges on a substantially common level to front and rear sections of the blade where the outer blade edges are set to a higher level than the central pair. The blade design of Swande being symmetric along the blade centre line at all points. The prior art of Swande is discussed below in respect of FIG. 3.

H. Redmond et al in U.S. Pat. No. 4,392,658 describes a similar structure to Swande in some embodiments with the concept of a central blade having two edge portions and a flat portion such that the central portion is in contact with the ice during gliding but the raised side portions are engaged during turning as they are disposed vertically away from the flat portion and thence are not in contact during gliding. As evident from FIG. 3 described below Redmond teaches to an essentially continuous series of designs between those addressing speed through to those for maneuverability.

However, these prior art designs suffered two drawbacks, first being that they do not address the fact that the current blade and hollow configuration was designed to create a turning and gliding surface with specific properties. Second, no corresponding method of sharpening them was developed which impacted their deployment as they are not compatible with the standard skate machining systems that operate with a profile grinding wheel. It has been determined that the current skate blade configuration generates friction between the blade and the ice, which creates a film of water between the blade and the ice, the film provides for the gliding properties of the blade. The proposed invention, by utilizing multiple hollows creates increased blade friction and thereby increases the water film for gliding and will therefore increase the gliding performance of the blade without compromising the turning capability which has already been designed into the current blade configuration whilst providing for both asymmetric variations of the blade and variations of the blade profile along the blade. Additionally the designs are compatible with a new grinding system that accommodates complex profiles which may be unique even to a specific pair of ice skates for an individual.

It is, therefore, desirable to provide increased ice skate performance by reducing drag and contact friction as
well as providing improved flexibility in varying the profile of the ice skate along its length between toe, middle and heel. It is also desirable to provide means of sharpening such skates which are incompatible to existing skate sharpening machines.

SUMMARY OF THE INVENTION

[0011] It is an object of the present invention to obviate or mitigate at least one disadvantage of the prior art.

[0012] In accordance with an embodiment of the invention there is provided an ice skate blade comprising:

[0013] a first profile formed longitudinally along a predetermined portion of the ice skate blade designed primarily for gliding upon an ice surface, the first profile having an edge at each end of the profile; and

[0014] a second profile formed longitudinally along a predetermined portion of the ice skate blade designed primarily for edging into the surface, the second profile having an edge at each end of the profile; wherein:

[0015] the first and second profiles share a common edge.

[0016] In accordance with an embodiment of the invention there is provided a method comprising:

[0017] providing an ice skate blade formed from a predetermined composition of materials;

[0018] forming a first profile longitudinally along a predetermined portion of the ice skate blade primarily for gliding upon an ice surface, the first profile having an edge at each end of the profile; and

[0019] forming a second profile longitudinally along a predetermined portion of the ice skate blade primarily for edging into the surface, the second profile having an edge at each end of the profile; wherein:

[0020] the first and second profiles share a common edge.

[0021] In accordance with an embodiment of the invention there is provided a method comprising:

[0022] providing an ice skate blade formed from a predetermined composition of materials;

[0023] grinding a first profile longitudinally along a predetermined portion of the ice skate blade primarily for gliding upon an ice surface, the first profile having an edge at each end of the profile and ground with a first tool having width substantially less than that of the lateral width of the first profile; and

[0024] forming a second profile formed longitudinally along a predetermined portion of the ice skate blade primarily for edging into the surface, the second profile having an edge at each end of the profile and ground with a second tool having width substantially less than that of the lateral width of the first profile; wherein:

[0025] the first and second profiles share a common edge.

[0026] Other aspects and features of the present invention will become apparent to those ordinarily skilled in the art upon review of the following description of specific embodiments of the invention in conjunction with the accompanying figures.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027] Embodiments of the present invention will now be described, by way of example only, with reference to the attached Figures, wherein:

[0028] FIG. 1 depicts ice skate blade profiles typically employed within sports and recreational environments and how these vary for different aspects of the same sport for professionals and serious amateurs;

[0029] FIG. 2 depicts ice skates and the sections now considered for a skate with varying profile for each according to the users sport;

[0030] FIG. 3 depicts ice skate blade profiles according to the prior art of Swande (U.S. Pat. No. 5,826,890) and Redmond (U.S. Pat. No. 4,392,658);

[0031] FIG. 4 depicts ice skate blade profiles according to embodiments of the invention;

[0032] FIG. 5 depicts a plan view of skate sharpening system according to an embodiment of the invention;

[0033] FIG. 6 depicts a side elevation view of the skate sharpening system according to an embodiment of the invention;

[0034] FIG. 7 depicts the prior art approach to dressing a grinding disc of the prior art as well as embodiments of the invention for grinding blades according to embodiments of the invention; and

[0035] FIG. 8 depicts a side elevation view of a skate sharpening system according to an embodiment of the invention for sharpening both blades simultaneously.

DETAILED DESCRIPTION

[0036] The present invention is directed to ice skate blades and methods of grinding such blades.

[0037] Reference may be made below to specific elements, numbered in accordance with the attached figures. The discussion below should be taken to be exemplary in nature, and not as limiting of the scope of the present invention. The scope of the present invention is defined in the claims, and should not be considered as limited by the implementation details described below, which as one skilled in the art will appreciate, can be modified by replacing elements with equivalent functional elements.

[0038] FIG. 1 depicts ice skate blade profiles, circular arc CA, flat bottom circular arc FBC, and flat bottom “V” FBV, typically employed within sports and recreational environments and how these vary for different aspects of the same sport for professionals and serious amateurs. Considering initially CA 110 then this represents the traditional profile of a skate. This is because the traditional method of shaping the grinding wheel that is used to sharpen the skate blade is to swing a single point diamond tool in an arc about the centerline of the grinding wheel. The variables in this CA 110 profile are the width of the skate blade w, the radius of the circular arc (r), the included angle at the edge of the blade (φ) and h_max, the maximum depth of the groove.

[0039] The geometry shown in CA 110 is with the circular arc centered with the blade, considered to be the best arrangement, and is known as “edges even condition”. The interrelation between the variables can be determined from Equations (1) and (2) below.

\[ h_{\text{max}} = r \left(1 - \cos \left(\alpha \sin (w/2r)\right)\right) \]  \hspace{1cm} (1)

\[ \phi = 90 - \alpha \left(\pi \sin (w/2r)\right) \]  \hspace{1cm} (2)

[0040] There are two variables that can be changed in the above equations; namely, the width of the skate blade, w, and the radius of the groove, r. The width of the blade, w, is dependent upon the type of skating being done, with the typical hockey blade being 0.110 inches (2.8 mm) wide. The typical radius, r, used by hockey players varies from 0.250 (6.35 mm), such as shown by profile 140B for sharper turns.
but making gaining speed harder, to 2.00 (50.8 mm) inches, such as shown profile 140A making turns difficult but gaining speed easier. A common radius being 0.50 (12.70 mm) inches to provide a trade-off between these demands from the skater. Typical values of groove radius, \( r \), when applied to hockey skates, 0.110 inches (2.8 mm) wide, will give the values of maximum depth, \( h_{max} \), and the edge angle as shown below in Table 1.

### TABLE 1

<table>
<thead>
<tr>
<th>Radius, ( r ) (in)</th>
<th>Depth, ( h ) (in)</th>
<th>Edge Angle, ( \phi ) (deg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.250</td>
<td>0.006613</td>
<td>77.29^\circ</td>
</tr>
<tr>
<td>0.500</td>
<td>0.00303</td>
<td>83.68^\circ</td>
</tr>
<tr>
<td>0.750</td>
<td>0.00202</td>
<td>85.79^\circ</td>
</tr>
<tr>
<td>1.000</td>
<td>0.00151</td>
<td>86.85^\circ</td>
</tr>
<tr>
<td>1.250</td>
<td>0.00121</td>
<td>87.48^\circ</td>
</tr>
<tr>
<td>1.500</td>
<td>0.00101</td>
<td>87.50^\circ</td>
</tr>
<tr>
<td>1.750</td>
<td>0.00086</td>
<td>88.12^\circ</td>
</tr>
<tr>
<td>2.000</td>
<td>0.00076</td>
<td>88.42^\circ</td>
</tr>
</tbody>
</table>

It is worth noting that the range of edge angles, \( \phi \), and depths, \( h \), is very limited. It is common knowledge in the ice skating world that a smaller radius provides better turning ability along with a slower glide speed, while a larger radius provides superior glide speeds along with poorer turning ability.

Now considering the FBC 120 then the cross-section through an ice skate blade is shown where a flat bottom has been added to the traditional circular arc profile, leaving the two interior circular arc profiles. In this case, the edge angle, \( \phi \), will remain the same as those calculated for circular arc profiles of various radii, \( r \), as shown in Table 1 above but the depth of the flat, \( h \), will be adjustable to any value less than the maximum depth, \( h_{max} \), under the blade as calculated for the circular arc. The depth of the flat, \( h \), is the distance between a line joining the two blade edges, and the flat bottom of the skate blade. The width of the flat bottom, \( d \), is given by Equation (3) below.

\[
d = 2\sqrt{r^2 - (r - h_{max} \cdot h)^2} \quad (3)
\]

The advantage of this profile over the traditional circular arc profile is that the edge angle, \( \phi \), can be maintained while the depth, \( h \), of the profile is reduced from \( h_{max} \), leading to a potentially faster skate with less drag. A nomenclature for FBC profiles used by some manufacturers is FBC-XXX-YY where XXX is the radius, \( r \), of the circular arc in thousandths of an inch and YY is the depth of the flat, \( h \), in thousandths of an inch.

Now referring to FBC 130 then this groove profile on an ice skate blade is an attempt to overcome the primary shortcoming of the traditional circular arc profile; the fact that the edge angle, \( \phi \), and the maximum depth of the groove, \( h_{max} \), are linked. This is a major constraint of the CA 110 profile. This profile is named flat bottom ‘v’ (FVB) as the two lower internal profile lines would intersect in a V if there were projected, and the bottom of the ice skate blade forms a flat bottom for the V shape resulting from that projection. There are a few geometric properties that define the shape of the FVB 130 ice skate blade profile; the blade width, \( w \), the width of the flat bottom, \( d \), and the depth of the flat bottom, \( h \). The height under the blade, \( h \), is the distance between a line joining the two blade edges and the flat bottom. The edge angle, \( \phi \), at the blade edge, in the case of a symmetrical (central to the blade width) location of the blade bottom is given by Equation (4) below.

\[
\phi = \arctan\left(\frac{w - d}{2h}\right) \quad (4)
\]

As can be seen from this formula; once a blade width, \( w \), is known, a value of blade bottom width, \( d \), can be chosen in conjunction with the depth of the flat, \( h \), to obtain a wide range of edge angles, \( \phi \), values. A similar nomenclature as that for FBC 120 is used by some manufacturers, being FVB-XXX-YY, where XXX represents the width of the flat bottom, in thousandths of an inch, and YY represents the flat depth, \( h \), in thousandths of an inch.

The ability to vary the blade profile being shown by profiles 150A through 150D whereby moving from first profile 150A to second profile 150B is variations for constant bottom width, \( d \), but varying depth of flat, \( h \), giving better turns. Moving from first profile 150A to third profile 150C is decreasing bottom width, \( d \), for constant depth of flat, \( h \), giving more speed. Moving diagonally from first profile 150A to fourth profile 150D is decreasing bottom width, \( d \), and increasing depth of flat, \( h \), trying to balance speed and turning.

Referring to FIG. 2 there are depicted hockey skate 210 and figure skate 220 showing the differences in design not only of the boot but the blade fitting to the boot and the construction of the blade. Historically a blade was a blade but now sharpening may consider the blade as having four zones, toe 212, front 214, middle 216 and heel 218 which are potentially profiled differently one zone from another but may also vary in profile between say a defenceman, an attacker, and a goalie for ice hockey. Balancing the designs of these zones results in improved balance, sharper turns, quicker turns, increased acceleration, reduced fatigue, increased power in strides and improved gliding, injury reduction, increased agility, increased lateral movement, increased speed, increased stability, and controlled leg extensions. However, providing such options to the general public as opposed to professional sportsmen and sports women has hitherto been unfeasible through the design of the blades supplied generally on commercial hockey skates, one design for all, and skate sharpening machines, and so forth.
position as the middle element. As such the ice skate 310 has symmetrically disposed side runners 305 that may be formed either in the same one piece as the middle 304 or formed by different elements.

[0050] Also shown in FIG. 3 are first to third schematic 350A to 350C respectively according to the prior art of Swande in U.S. Pat. No. 5,570,893 entitled “Blade of an Ice Skate” having a blade 321 with central portion 322 that has disposed on each side a first side runner 323 and second side runner 324. In first schematic 350A the blade 321 is shown in upright position such as during gliding wherein the central portion 322 is in contact with the ice. In second schematic 320B the blade 321 is shown leaning over to a first predetermined degree wherein the first side runner 323 is now in contact with the ice as opposed to just a single edge as with a typical prior art blade such as FCA 110 or FBV 130 in FIG. 1 supra. Now referring to third schematic 320C the blade 321 is shown leaning over to a second predetermined degree wherein the second side runner 324 is now in contact with the ice. As such Swande teaching to a blade offering enhanced gliding whilst the skater is turning, such as for example would be beneficial in speed skating.

[0051] In first profile 331 through sixth profile 336 blade geometries according to the prior art of Redmond in U.S. Pat. No. 4,392,658 entitled “Skate Blade” which have first and second longitudinal extending edges upwardly and inwardly rising from the outermost cutting edges together with longitudinal extending middle face centrally disposed between these edge faces. The progression of first profile 331 to sixth profile 336 evolving from essentially a FBV 130 design through to a design such as comparable to the front 301 of Swanke in ice skate 310 wherein the central portion is in contact with ice in the upright position and the side runners are not in contact.

[0052] Referring to FIG. 4 there are shown exemplary blade cross-sections according to embodiments of the invention. First blade cross-section 410 depicts a pair of circular arc profiles applied to the bottom of the skate providing increased friction allowing improved gliding performance. Second blade cross-section 420 comprises first circular section 420A, flat-bottomed V 420B, and second circular section 420C. Similarly third blade cross-section 430 comprises first circular section 430A, flat-bottomed V 430B, and second circular section 430C but differs from second blade cross-section 420 in that first and second circular sections 430A and 430C respectively are identical whereas they are different in second cross-section 420. Finally in fourth blade cross-section the blade profile comprises vee-groove 440A and circular groove 440B. Each of the blade cross-sections in FIG. 4 provides a balancing between gliding characteristics, e.g. by the vee-groove 440A in fourth blade cross-section 440, and maneuvering e.g. by the circular groove 440B.

[0053] It would be apparent to one of skill in the art that these profiles many be adapted according to the left or right skate of the user. Accordingly there is shown fifth blade cross-section 450 which is the mirror image of fourth blade cross-section 440, and hence representing for example the left skate of the user wherein fourth blade cross-section represents the right skate of the user. Depending upon the characteristics of the user in terms of weight, skating profile, position, etc then the left and right skate blades may not be mirror images of one another but different in terms of number of profile sections, depth of each profile section, type of profile section (e.g. FCA, FBV etc). Similarly the profile on different sections of the skate such as described above in respect of hockey skate 210 may be different, for example the front 214 and heel 218 may be designed primarily for biting into the snow for stopping, accelerating, and maneuvering. Middle 216 may be designed for gliding only or vary along its length according to the users balance etc for gliding weight to the front and maneuvering at the rear for example.

[0054] Accordingly a profile as taught provides for a first profile formed longitudinally along a predetermined portion of one side of a blade designed for gliding upon an ice surface with two edges, a second profile formed longitudinally on the opposite side of the blade in the same predetermined portion designed for edging into said ice surface with two edges, where the first and second profiles share a common edge. It would be evident to one skilled in the art that alternatively the blade may be formed from multiple discrete blades, each with one of the profile segments of the final blade. Optionauly such multiple discrete blades may be formed from different materials and the edges may be treated differently, for example different annals or surface finishes.

[0055] Whilst considering the design of an ice skate blade it is important to also consider how ice skate blade will be sharpened as with use the sharp edges become dulled and blunt so that optimum performance is only achieved after the blade is re-sharpened. At present commercial blade sharpening systems employ a pre-formed grinding wheel that has a predetermined profile. This profile is therefore applied to the entire length of the blade. Accordingly if a user wishes to have a different. The profile at the middle and heel of a skate blade that already presents a significant issue to the operator of the grinding machine. Now consider a profile that varies from say an FCA on the toe to a symmetric dual FBV at the middle to a dual FCA/RBV profile such as shown in third blade cross-section 430 of FIG. 4. Then the next pair of skates is asymmetric dual FCA/RBV such as shown in second blade cross-section 420 of FIG. 4.

[0056] Clearly such profiles are incompatible with prior art skate sharpening systems unless multiple grinding wheels with the different profiles are stocked and changed several times per skate blade sharpened. Accordingly such difficulties have limited the evolution of ice skate blade profiles as they cannot be re-sharpened such that perhaps high profile speed skaters, figure skaters, and hockey players may pay for a quantity of blades that are essentially use once and thrown away or skate sharpening machine manufacturers are willing to invest time supporting these high profile athletes as part of their marketing activities. But that is not representative of the vast majority of skaters who would benefit from enhanced ice skate profiles even if they were more limited to perhaps a small number for defense man, several for attackers, some for goaltenders etc as well as profiles that are tailored to novices as well as experts. As such it would be beneficial to provide a highly flexible ice skate blade sharpening system that allows complex geometries to be ground and polished as well as providing high flexibility to account for substantial variations between sequential skates being sharpened.

[0057] Now referring to FIG. 5 there is depicted a plan view of a skate sharpening system 500 according to an embodiment of the invention. A skate comprising skate body 510A and blade 510B is mounted to a holder 540 which is itself mounted to first stage 590 and therein to the base 530 of the skate sharpening system 500. The second portion of the skate sharpening system 500 being a grinding wheel 550 that is mounted to a frame 585 which includes a drive mechanism,
not shown for clarity, for the grinding wheel 550 which may be for example direct drive or differentially driven according to the degree of control/complexity of the skate sharpening system 500. This frame 585 is mounted to a second stage 580 and therein to the base 530 of the skate sharpening system 500. The frame 585 including adjustment screw 560 which is driven by drive 570. Adjustment screw 570 and corresponding drive 570 may be provided for example for multiple axes of the system including lateral, translational, vertical, yaw, pitch and roll.

[0058] According to one embodiment of the invention drive 570 may be manually adjusted, second stage 580 rigidly mounting the frame 585 to the base 530 and first stage 590 be manually controlled. According to another embodiment of the invention the first stage 590, second stage 580 and drive 570 may all be controlled through a central microprocessor to automate the process of grinding a desired profile thereby improving the reproducibility of the profile applied to the blade 5103. It would be evident to one skilled in the art that the program may be varied allowing an operator to simply key in an identity of a skater for example to retrieve their custom profile and reapply this to the skates.

[0059] It would also be evident to one of skill in the art that in both manual and automatic approaches that a measurement and indication of pressure between the blade 5103 and grinding wheel 550 may be made/displayed allowing increased control of the grinding process. Optionally if a conductive grinding wheel 550 is employed then an electrical contact may be made to both the grinding wheel 550 and blade 5103 such that initial contact of the blade 5103 to the grinding wheel 550 can be detected or monitored to detect errors in position as contact is lost for example.

[0060] Now referring to FIG. 6 there is shown a side view of a skate sharpening system 600 according to an embodiment of the invention, such as skate sharpening system 500 as described in FIG. 5 for example. The skate sharpening system 600 comprising a skate sub-system and grinding sub-system 6003. As shown a skate boot 630 is mounted into a holder 610 forming part of the skate sub-system, the holder 610 being mounted to a first stage 620. The skate boot 630 being clamped in the holder 610 through the action of a clamp engaged through operating lever 615. Attached to the skate boot 630 is skate blade 640.

[0061] Grinding sub-system 6003 comprises a grinding disc 685 that is mounted to a mounting plate 680 and thereby to spindle 670 which is driven by drive belt 660 from a motor, not shown for clarity. These elements being mounted to drive sub-frame 650 which is mounted to second stage 655. First stage 620 provides motion longitudinally with respect to the skate blade 640, i.e. along an axis perpendicular to the plane of the side view. Second stage 665 provides motion both in a linear axis perpendicular to the axis of motion of first stage 620, i.e. across the width of the skate blade 640, and rotational motion about a point “P” that is established as being at a point representing the expected interface between the grinding disc 685 and skate blade 640. As such the combined action of first stage 620 and second stage 665 is to provide four axis of movement between the skate blade 640 and grinding disc 685 allowing the grinding disc 685 to follow complex surfaces of movement such as those necessary to implement the profiles according to embodiments of the invention such as first to fifth blade cross-sections 410 through 450 respectively in FIG. 4.

[0062] Referring to FIG. 7 there is shown a first schematic 700A of a prior art approach to dressing a grinding disc and profiling a skate blade. A template 710 is initially provided that has a profile formed with a hard surface, e.g. CVD diamond that has in the middle a FBV profile. This template 710 is used to dress a grinding wheel 720 by grinding the grinding wheel 720 against the template 710. Once dressed the grinding wheel 720 can then be used to grind the FBV profile onto a blade 730. Accordingly in order to adjust a blade profile either the grinding wheel 720 should be replaced, and dressed with another template 710, or the same grinding wheel 720 redressed with the new template 710. As such changing the profile for each user and as such each sequential pair of skates is a time consuming process. Also adjusting the profile between the different parts of the blade 730, such as toe 212, front 214, middle 216, and heel 218 as shown in FIG. 2 above, would be extremely difficult even though it is beneficial for professional skaters and amateurs in competitions etc.

[0063] Second and third schematics 700B and 700C depict sharpening a skate blade according to embodiments of the invention. Second schematic 700B depicts a dual FBV profile 750 on a skate blade that is ground and/or polished with thin profile blade 740. Third schematic 700C depicts a FCA/FBV blade 790 along with first through third blades 760 to 780 respectively. These blades providing different grinding profiles which may be employed along with thin profile blade 740 alone or in combination with a skate sharpening system such as described seen in respect of skate sharpening systems 600 and 700 in FIGS. 6 and 7 respectively. It would be apparent to one skilled in the art that first and second stages 620 and 665 may be controlled through the use of a microprocessor to execute the complex sequence of movements required to control the blade in order to provide the profiles for ice skate blades according to embodiments of the invention. As such a skate sharpening system according to an embodiment of the invention allows for an operator of the system to program a new blade profile into the system and have it executed automatically. Hence, when a new pair of skates are loaded all the operator has to do is execute a new program or if the skates are for the same users as the previous pair repeat the currently loaded program. It would be evident to one of skill in the art that such a combination of thin grinding elements and automated skate sharpening system allows for a flexibility in profiling skate blades that cannot be achieved with the existing systems of the prior art.

[0064] It would also be evident to one of skill in the art that in skate sharpening systems 600 and 700 that a measurement and indication of pressure between the blade and grinding wheel may be made/displayed/utilized allowing increased control of the grinding process. Optionally if a conductive grinding wheel is employed then an electrical contact may be made to both the grinding wheel and blade such that initial contact of the blade to the grinding wheel can be detected or monitored to detect errors in position as contact is lost for example.

[0065] Now referring to FIG. 8 there is depicted a skate sharpening system 800 according to an embodiment of the invention wherein a pair of sharpening sub-systems, for example skate sharpening system 600 of FIG. 6 are assembled to a base, not shown for clarity. As such a skate mount 800A engages first and second grinders 800B and 800C. Each of the first and second grinders consists of a grinding wheel 830 that is driven through a belt system 845 from a motor, not shown for clarity, which provides the rota-
tional power for the grinding wheel 830. This drive and wheel sub-assembly is mounted to a body 820 that is in turn mounted to a stage 810.

[0066] The skate mount 800A provides for mounting of left skate 850A and right skate 850B with corresponding left blade 840A and right blade 840B with each being clamped via a levered mechanism engaged via first and second handles 860A and 860B respectively. Skate mount 800A further comprising skate stage 870. As with skate sharpening system 600 in FIG. 6 each stage 810 and skate stage 870 may be fixed or adjustable relative to the base and may be manually or mechanically positioned. It would therefore be evident to one skilled in the art that the profile applied from first grinder 800B to left blade 840A may be the same or different to that applied by second grinder 800C to right blade 840B.

[0067] It would be evident to one skilled in the art that whilst the simplest design is the stacking of a pair of skate sharpening systems 600 to form skate sharpening system 800 that under appropriate computer control the relative motions of first and second grinders 800B and 800C may be controlled such that they operate without requiring a minimum complete clear separation between them such that the vertical height of the skate sharpening system 800 may be reduced. Accordingly skate sharpening system 800 can provide complex blade profiles to each of the left and right skates of a user with accurate cross-referencing of the profile of one blade to the other.

[0068] It would be evident to one skilled in the art that the ice skate blade may be formed from a variety of materials according to the cost, strength, weight, rigidity, and performance tradeoffs that the skate manufacturer is working within. Such blades may for example be formed from carbon steel, high strength low alloy steel, low alloy steel, stainless steel, as well as metals such as titanium. Alternatively blades may be formed from a variety of composite materials which are engineered materials that comprise two or more components including for example polymer composites that combine reinforcing fibers such as carbon fiber, glass fiber, basalt fibers, or other reinforcing fibers with a thermosetting or thermoplastic polymer resin such as epoxy, nylon, polyurethane, polypropylene, or other resins wherein the reinforcing fibers provide stiffness and strength in the direction of the fiber length, and the resin provides shape and toughness and transfers load between and among the fibers. Optionally, the blades may be formed from one or more ceramic materials including for example oxides such as alumina, beryllia, ceria, and zirconia; non-oxides such as carbides, borides, nitrides, and silicides; as well as ceramic composite materials including for example particulate reinforced, fiber reinforced, and combinations of oxides and non-oxides.

[0069] The above-described embodiments of the present invention are intended to be examples only. Alterations, modifications and variations may be effected to the particular embodiments by those of skill in the art without departing from the scope of the invention, which is defined solely by the claims appended hereto.

What is claimed is:

1. An ice skate blade comprising:
   a first profile formed longitudinally along a predetermined portion of the ice skate blade designed primarily for edging into the surface, the second profile having an edge at each end of the profile; wherein the first and second profiles share a common edge.
   2. An ice skate blade according to claim 1 wherein, the lowermost points of the edges of the first and second profiles lie on a predetermined plane.
   3. An ice skate blade according to claim 1 wherein, at least one of the first and second profiles is selected from the group comprising circular arc, flat bottom circular arc and flat bottom vee (V).
   4. An ice skate blade according to claim 1 wherein, the ice skate blade is formed by mating a first blade with the first profile and a second blade with the second profile.
   5. An ice skate blade according to claim 1 further comprising:
      a third profile formed longitudinally along a predetermined portion of the ice skate blade designed primarily for edging into the surface, the third profile having an edge at each end of the profile and sharing a common edge with the first profile.
   6. An ice skate blade according to claim 5 wherein, the lowermost points of the edges of the first, second, and third profiles lie on a predetermined plane.
   7. An ice skate blade according to claim 1 further comprising:
      a third profile formed longitudinally along a predetermined portion of the ice skate blade designed primarily for edging into a surface, the third profile having an edge at each end of the profile and sharing a common edge with the second profile.
   8. An ice skate blade according to claim 7 wherein, the lowermost point of the non-common edge of the third profiles lies in a different place to the plane of the first and second profiles.
   9. An ice skate blade according to claim 1 wherein, the first profile is selected from the group comprising circular arc, flat bottom circular arc, and flat bottom vee (V); and
      the second profile is selected from the group comprising circular arc, flat bottom circular arc, and flat bottom vee (V) omitting the profile selected for the first profile.
   10. A method comprising:
       providing an ice skate blade formed from a predetermined composition of materials;
       forming a first profile longitudinally along a predetermined portion of the ice skate blade primarily for gliding upon an ice surface, the first profile having an edge at each end of the profile; and
       forming a second profile formed longitudinally along a predetermined portion of the ice skate blade primarily for edging into the surface, the second profile having an edge at each end of the profile; wherein the first and second profiles share a common edge.
   11. The method according to claim 10 wherein, the lowermost points of the edges of the first and second profiles lie on a predetermined plane.
   12. The method according to claim 11 wherein, at least one of the first and second profiles is selected from the group comprising circular arc, flat bottom circular arc, and flat bottom vee (V).
   13. The method according to claim 10 wherein, the ice skate blade is formed by mating a first blade with the first profile and a second blade with the second profile.
14. The method according to claim 10 further comprising; providing a third profile formed longitudinally along a predetermined portion of the ice skate blade primarily for edging into a surface, the third profile having an edge at each end of the profile and sharing a common edge with the first profile.

15. The method according to claim 14 wherein, the lowermost points of the edges of the first, second, and third profiles lie on a predetermined plane.

16. The method according to claim 10 further comprising; a third profile formed longitudinally along a predetermined portion of the ice skate blade designed primarily for edging into the surface, the third profile having an edge at each end of the profile and sharing a common edge with the second profile.

17. The method according to claim 16 wherein, the lowermost point of the non-common edge of the third profiles lies in a different place to the plane of the first and second profiles.

18. The method according to claim 10 wherein, the first profile is selected from the group comprising circular arc, flat bottom circular arc and flat bottom vee (V); and the second profile is selected from the group comprising circular arc, flat bottom circular arc and flat bottom vee (V) omitting the profile selected for the first profile.

19. A method comprising:
providing an ice skate blade formed from a predetermined composition of materials;
grinding a first profile longitudinally along a predetermined portion of the ice skate blade primarily for gliding upon an ice surface, the first profile having an edge at each end of the profile and ground with a first tool having width substantially less than that of the lateral width of the first profile; and
forming a second profile formed longitudinally along a predetermined portion of the ice skate blade primarily for edging into the surface, the second profile having an edge at each end of the profile and ground with a second tool having width substantially less than that of the lateral width of the first profile; wherein the first and second profiles share a common edge.

20. The method according to claim 19 wherein;
the first profile is selected from the group comprising circular arc, flat bottom circular arc and flat bottom vee (V); and
the second profile is selected from the group comprising circular arc, flat bottom circular arc and flat bottom vee (V) omitting the profile selected for the first profile.

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