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(71) Applicant: **Invivopower AB**
431 64 Mölndal (SE)

(72) Inventor: **BERN, Bengt**
431 64 MÖLNDAL (SE)

(74) Representative: **Kransell & Wennborg KB**
P.O. Box 2096
403 12 Göteborg (SE)

(54) **SKI POLE STRAP FOR IMPROVED POWER TRANSFER, AND SKI POLE**

(57) A ski pole strap (1) for transfer of power from a skier's hand (29) to a ski pole (27) when a pole stroke is performed in cross-country skiing, the ski pole strap (1) comprising an attachment portion (3) configured to attach the ski pole strap (1) to the ski pole (27); and a hand support portion (5) for supporting the hand (29) of the skier, the hand support portion (5) comprising at least 0.03 g/cm^2 of a thermoplastic material arranged at least in a region of the hand support portion configured to surround an ulnar border (31) of the skier's hand (29), when the ski pole strap (1) is in use, the thermoplastic material being plastically shapeable at a temperature below 100°C and having a flexural modulus of at least 50 MPa at 20°C.

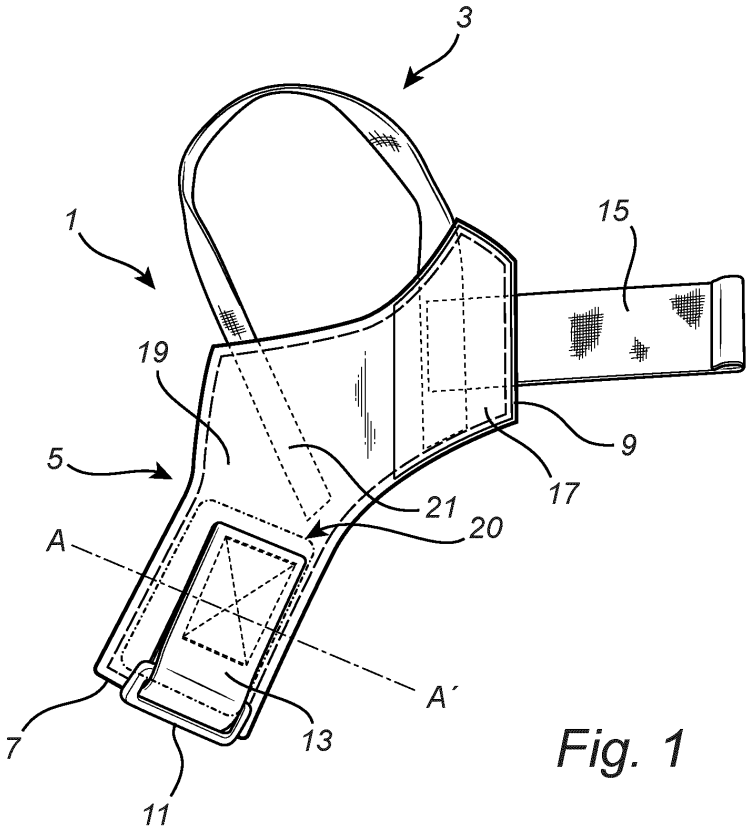

Fig. 1

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Description

Field of the Invention

[0001] The present invention relates to a ski pole strap for transfer of power from a skier's hand to a ski pole when a pole stroke is performed in cross-country skiing, and also relates to a ski pole comprising such a ski pole strap.

Background of the Invention

[0002] Like other sports, cross-country skiing is constantly evolving, and new techniques and equipment become predominant. At the top performing level, even a small gain in efficiency can be the difference between participating and winning.

[0003] In particular in races where the skating technique is prohibited, it has become increasingly popular to only use glide wax and exclusively rely on double poling for propulsion, including when going uphill.

[0004] To improve performance when double poling, new and stiffer ski poles have been developed.

[0005] It would be desirable to provide for further improved efficiency for a cross-country skier, in particular when double poling.

Summary

[0006] It is an object of the present invention to provide for further improved efficiency for a cross-country skier, in particular when double poling.

[0007] According to the present invention, it is therefore provided a ski pole strap for transfer of power from a skier's hand to a ski pole when a pole stroke is performed in cross-country skiing, the ski pole strap comprising: an attachment portion configured to attach the ski pole strap to the ski pole; and a hand support portion for supporting the hand of the skier, the hand support portion comprising at least 0.03 g/cm^2 of a thermoplastic material arranged at least in a region of the hand support portion configured to surround an ulnar border of the skier's hand, when the ski pole strap is in use, the thermoplastic material being plastically shapeable at a temperature below 100°C and having a flexural modulus of at least 50 MPa at 20°C.

[0008] Ski pole straps for advanced cross-country skiers are provided in different sizes to fit skiers with differently sized hands. Further, a ski pole strap in the correct size for a given hand has a predetermined region that will surround the ulnar border of the skier's hand when the ski pole strap is in use. In particular, this region will surround the hypothenar eminent group of muscles when the ski strap is used by the skier for poling.

[0009] At least 50% of the region of the hand support portion configured to surround the ulnar border of the skier's hand, when the ski pole strap is in use, may contain at least 0.03 g/cm^2 of the thermoplastic material. Advantageously an average surface density of the thermoplastic material across the entire region of the hand support portion configured to surround the ulnar border of the skier's hand, when the ski pole strap is in use may be at least 0.03 g/cm^2.

[0010] The hand support portion may be defined as the portion of the ski pole strap that is configured to be in contact with a part of the skier's hand, directly or via a glove, to transfer force from the hand to the ski pole, via the attachment portion of the ski pole strap. Accordingly, any portion of the ski pole strap that is not in contact with a part of the skier's hand (directly or via a glove), or is not directly involved in substantial transfer of force from the skier's hand to the ski pole is not included in the hand support portion. For instance, in a ski pole strap configured as a glove, portions of the ski pole strap surrounding the fingers are not included in the hand support portion.

[0011] The present invention is based on the realization that the existing cross-country skier power train, transmitting power from the skier to the ground via the ski poles, has a weak link at the power transfer from the skier's hands to the ski poles. In particular, the present inventor has realized that existing ski pole strap configurations allow power to be lost to deformation of soft tissue in the hands at each pole stroke, and that efficiency could be increased by reducing this deformation. The present inventor has further realized that this deformation can be reduced by arranging, in the hand support portion of the ski pole strap, a sufficient amount of thermoplastic material that is plastically shapeable at a temperature that allows the skier to mold at least a relevant subportion of the hand support portion to follow the individual shape of his/her hand.

[0012] It has been found that around 0.03 g/cm^2 of such a thermoplastic material arranged in a region of the hand support portion of the ski pole strap configured to surround an ulnar border of the skier's hand, when the ski pole strap is in use, is sufficient to provide a noticeable reduction of the deformation of the soft tissue in the hands at each pole stroke, resulting in a significant increase of the efficiency of the power transfer between hand and ski pole, on the average for a pole stroke.

[0013] I addition, it has been found that the ski pole strap according to example configurations of the present invention may significantly reduce the occurrence of blisters and calluses on the hands, thus improving the comfort for the skier.

[0014] Experiments have shown that it is feasible for the skier to heat the hand support portion of the ski pole strap using boiling water, and then shape the hand support portion to follow the individual shape of his/her hand without discomfort from the heat, when the skier wears a ski glove, and possibly a thin rubber glove outside the ski glove. To allow shaping to the hand without a ski glove, if conditions are such that the skier wishes to use the ski pole strap without a ski glove, it may be beneficial to use a thermoplastic material being plastically shapeable at a lower temperature, such as below 80°C.

[0015] Various suitable thermoplastic materials are provided by manufacturers of thermoplastic sheets for

use in orthotics and/or by makers of so-called hand-moldable polymers. As will be well-known to one of ordinary skill in the art, a thermoplastic material become plastically shapeable at temperatures lower than the melting temperature for the thermoplastic material. It would, furthermore, be straight-forward to one of ordinary skill in the relevant art to determine whether or not a certain thermoplastic material is plastically shapeable at a temperature below 100°C. If a person is able to shape the hand support portion of a ski pole strap heated using hot water to follow the individual shape of his/her hand, and that shape remains after the hand support portion has cooled down to room temperature, then the thermoplastic material in the hand support portion is plastically shapeable at a temperature below 100°C.

[0016] Before being molded to shape by the skier, the ski pole strap may be substantially flat, which may simplify distribution of ski pole straps to dealers or directly to skiers, or pre-molded to a shape that may be easier for the skier to start from when molding at least a relevant sub-portion of the hand support portion to follow the individual shape of his/her hand.

[0017] Although a ski strap with thermoplastic material limited to only the above-mentioned region configured to surround the ulnar border of the skier's hand, when the ski pole strap is in use, will provide a reduction of the deformation of the soft tissue in the hands at each pole stroke, a further reduction of the deformation can be achieved by arranging at least 0.03 g/cm^2 of thermoplastic material across a greater proportion of the hand support portion of the ski pole strap.

[0018] Advantageously, the thermoplastic material may thus be arranged in at least 50% of a total surface area of the hand support portion.

[0019] Even more advantageously, the thermoplastic material may be arranged in at least 70% of a total surface area of the hand support portion.

[0020] In embodiments, the hand support portion may be configured to at least partly wrap around the hand of the skier between a first end of the hand support portion and a second end of the hand support portion. The first end and the second end may be longitudinal ends of the hand support portion of the ski pole strap.

[0021] Advantageously, the thermoplastic material may be arranged along at least 60% of a distance between the first end and the second end of the hand support portion, for providing reduced deformation of the soft tissue in the skier's hand when performing a ski pole stroke.

[0022] To provide a further reduction in the deformation of the soft tissue in the skier's hand when performing a ski pole stroke, the thermoplastic material may be arranged along at least 80% of a distance between the first end and the second end of the hand support portion.

[0023] The ski pole strap may be configured in such a way that the first end of the hand support portion and the second end of the hand support portion are located on a dorsal side of the hand when the ski pole strap is in use. This configuration may also contribute to reduced deformation of the soft tissue in the skier's hand when performing a ski pole stroke, since there is much less soft tissue on the dorsal side of the hand than on the palmar side of the hand.

[0024] In embodiments, the hand support portion may comprise in the range of 0.03 - 0.5 g/cm^2 of the thermoplastic material across at least 30% of a total surface area of the hand support portion. This surface density range and coverage may provide a suitable trade-off between power efficiency and comfort for the user. It may be beneficial to provide the thermoplastic material within this surface density range across a larger proportion of the total surface area of the hand support portion, such as across at least 50% or at least 70% of the total surface area.

[0025] According to embodiments, the thermoplastic material may be sandwiched between a first textile layer arranged to face the hand of the skier and a second textile layer arranged to face away from the hand of the skier, when the ski pole strap is in use. This configuration may be beneficial for comfort, and may also provide for improved power transfer properties, since a composite structure including the first and second textile layers and the thermoplastic material may be formed when the ski pole strap is shaped to follow the shape of the skier's hand. The thermoplastic material may adhere to the first and second textile layers.

[0026] Furthermore, the attachment portion may be at least partly made of a textile material attached to the hand support portion. The attachment between the attachment portion and the hand support portion may be achieved using stitching.

[0027] According to an example configuration, the attachment portion may be attached to the hand support portion between the thermoplastic material and one of the first textile layer and the second textile layer. This configuration may provide for improved reliability and durability of the ski pole strap, since the attachment portion may be included in a composite structure including the first and second textile layers and the thermoplastic material. This may reduce wear on stitching, which may reduce the risk of the attachment portion being completely or partly detached from the hand support portion due to wear.

[0028] The thermoplastic material arranged at least in a region of the hand support portion configured to surround an ulnar border of the skier's hand, when the ski pole strap is in use may advantageously have a flexural modulus of at least 50 MPa at 20°C. Through the use of a thermoplastic material with a relatively high flexural modulus, in particular in relation to materials than can be found in conventional ski pole straps, deformation of the soft tissue in the hands at each pole stroke can be reduced using a relatively small amount of material. This provides for a relatively lightweight construction.

[0029] In an example configuration, the thermoplastic material may have a flexural modulus of at least 100 MPa

at 20°C, which allows for use of even less material.

[0030] To provide for a desirable combination of flexural and tensile properties, the thermoplastic material may exhibit a ratio between its flexural modulus and its Young's modulus in the range of 0.5 to 1.5.

[0031] In example configurations, the thermoplastic material may be provided as a layer of thermoplastic material that may be at least 0.3 mm thick. For example, a suitable thickness of such a layer may be in the range of 0.3 - 5 mm.

Brief Description of the Drawings

[0032] These and other aspects of the present invention will now be described in more detail, with reference to the appended drawings showing an example embodiment of the invention, wherein:

Fig 1 schematically shows a ski pole strap according to an example configuration of the invention;
Fig 2 is a schematic cross-section view of the ski pole strap in fig 1;
Figs 3A-B illustrate an exemplary method of individual shaping of the hand support portion of the ski pole strap;
Figs 4A-B are views of the ski pole strap according to an example of the invention after having been shaped;
Fig 5 illustrates deformation of soft tissue in the hand when a conventional ski pole strap is used; and
Fig 6 illustrates reduced deformation of soft tissue in the hand when a ski pole strap according to an example configuration of the present invention is used.

Detailed Description of Example Embodiment

[0033] Fig 1 schematically shows a ski pole strap 1 according to an example configuration of the invention. The ski pole strap 1 comprises an attachment portion 3 and a hand support portion 5. The attachment portion 3 is here illustrated in the form of a loop configured to be attached to a handle of a ski pole (not shown in fig 1). It should be noted that many other configurations of the attachment portion 3 are feasible. For instance, the attachment portion may comprise a snap-locking member for snapping into a receiving structure on the handle of the ski pole.

[0034] As is schematically indicated in fig 1, the hand support portion extends between a first longitudinal end 7 and a second longitudinal end 9. In the example configuration of fig 1, a buckle 11 is fixed to hand support portion 5, by webbing 13 stitched to the hand support portion 5 adjacent to the first longitudinal end of the hand support portion 5. In the example configuration of fig 1, a hook tape 15 is stitched to the hand support portion 5 adjacent to the second longitudinal end 9 of the hand support portion 5, and a patch of loop tape 17 is stitched to the hand support portion 5.

[0035] Thermoplastic material, here in the form of a layer 19 of thermoplastic material, is arranged at least in a region 20 (such an example region is indicated by the dash-dot line in fig 1) of the hand support portion 5 configured to surround an ulnar border of the skier's hand, when the ski pole strap 1 is in use. In the exemplary ski pole strap shown in fig 1, the thermoplastic material is arranged across more than approximately 90% of the total surface area of the hand support portion 5, as is schematically indicated by the dashed border line in fig 1. As was discussed quite extensively in the Summary section above, it should, however, be noted that many different configurations are possible within the scope of protection, as defined by the claims.

[0036] As is also schematically indicated in fig 1, the attachment portion 3 may be joined to the hand support portion 5 by overlapping portions 21 stitched together.

[0037] Fig 2 is a schematic cross-section view of the ski pole strap 1 in fig 1 of a section taken along the line A-A' in fig 1. The line A-A' passes through the region 20 of the hand support portion 5 configured to surround the ulnar border of the skier's hand, when the ski pole strap 1 is in use. Referring to fig 2, the layer 19 of thermoplastic material is, in the example configuration of fig 1 and fig 2, sandwiched between a first textile layer 23 arranged to face the hand of the skier and a second textile layer 25 arranged to face away from the hand of the skier, when the ski pole strap 1 is in use. The cross-section in fig 2 also includes the webbing 13 that secures the buckle 11 to the hand support portion 5 of the ski pole strap 1.

[0038] When the thermoplastic material is provided in the form of a layer 19 as is schematically indicated in fig 2, the layer 19 may be at least 0.3 mm thick to provide the desired flexural strength after having been shaped. The layer 19 may be less than about 5 mm thick, to keep the weight down and for comfort. In embodiments, the layer 19 may advantageously be in the range of 0.3 - 5 mm thick. It should be noted that the thermoplastic material need not be provided in the form of a distinct layer 19, but could be included in a composite structure. For instance, a textile, such as gauze may be embedded in thermoplastic material to form a reinforced structure. According to another option, thermoplastic material may be absorbed in a porous material.

[0039] Figs 3A-B illustrate an exemplary method of individual shaping of the hand support portion 5 of the ski pole strap 1. As is schematically indicated in fig 3A, the hand support portion 5 of the ski pole strap 1 is submerged in hot water, while the ski pole strap 1 is attached to a ski pole 27 by means of the attachment portion 3. When heated by the hot water, which may, of course, be up to about 100°C, the thermoplastic material that is embedded in at least a region of the hand support portion 5 goes from being stiff to being soft and plastically shapeable. As is well known to one of ordinary skill in the art, this transition is typically gradual.

[0040] When the thermoplastic material has been

heated sufficiently, the skier can insert his/her hand 29 in the ski pole strap 1 and adjust the fit by closing the ski pole strap 1 and plastically shaping the hand support portion 5 to closely conform to the shape of the hand 29 when the hand holds the ski pole 27 as is shown in fig 3B. For the correct fit, the skier should wear a ski glove, if a ski glove is intended to be worn when skiing. As is indicated in fig 3B, a thin rubber glove may be worn on top of the ski glove to avoid discomfort from the heat and prevent the ski glove from getting wet. When the ski pole strap 1, and thus the thermoplastic material comprised in the hand support portion 5 of the ski pole strap 1 has cooled down to a temperature when the thermoplastic material is no longer plastically shapeable, the skier can remove his/her hand 29 from the ski pole strap 1. The region 20 of the hand support portion 5 comprising at least 0.03 g/cm^2 of the thermoplastic material has then assumed the shape of the individual hand 29 of the skier. If the skier changes ski poles 27 or ski gloves, changes a setting of the attachment portion 3 of the ski pole strap, or is unsatisfied with the fit, the procedure described above and shown in figs 3A-B can simply be performed again.

[0041] Examples of thermoplastic materials suitable for being employed in the ski pole strap 1 according to examples of the present invention include Polyform™ and Aquaplast™ from the company CAMP Scandinavia, and the hand-moldable polymers by the company Thermoworx, for example, Whitemorph®. These are only a few examples of suitable low temperature thermoplastics. There are many other suitable options.

[0042] Figs 4A-B are views of the ski pole strap 1 according to an example of the invention after having been shaped. Fig 4A shows the palmar side of the hand 29, and fig 4B shows the dorsal side of the hand 29.

[0043] In the example configuration shown in figs 4A-B, substantially all of the hand support portion 5 of the ski pole strap 1 comprises in excess of 0.03 g/cm^2 of thermoplastic material. Accordingly, including the region of the hand support portion 5 surrounding the ulnar border 31 of the skier's hand 29. As is indicated in fig 4A, the hand support portion 5 additionally conforms to the shape of the palm of the hand 29, and encloses the volume of soft tissue at the root of the thumb.

[0044] In fig 4B can be seen that the hand support portion 5 at least partly wraps around the hand 29 between the first end 7 and the second end 9 of the hand support portion 5. The ski pole strap is configured in such a way that the first end 7 of the hand support portion 5 and the second end 9 of the hand support portion 5 are located on the dorsal side 33 of the hand 29 when the ski pole strap 1 is in use. As was mentioned further above, this configuration reduces deformation of soft tissue, since there is very little soft tissue on the dorsal side 33 of the hand 29.

[0045] As was explained in the Summary section, use of the ski pole strap 1 according to embodiments of the present invention provides for reduced deformation of soft tissue in the hands at each pole stroke. This can easily be understood by comparing the deformation resulting from use of a conventional ski pole strap, shown in fig 5, and the reduced deformation when a ski pole strap 1 according to an example configuration of the present invention is used, as shown in fig 6.

[0046] Both fig 5 and fig 6 are schematic cross-section views through the hand 29 when a ski pole strap is used.

[0047] In fig 5, a conventional ski pole strap 34 is shown, which does not include a relatively stiff material conforming to the individual shape of the hand 29. The conventional ski pole strap 34 is attached to the ski pole at an attachment point 35. When a pole stroke is performed, the ulnar region 31 of the hand 29 is pressed against the interior of the ski pole strap 34. Because the conventional ski pole strap 34 is soft, the soft tissue in the hand 29, including the hypothenar group of muscles in the ulnar region 31 is deformed and displaced towards the palm of the hand 29. A gap 37 is created at the palm. This deformation of the soft tissue in the hand results in loss of power, at every pole stroke. In addition, the movement of the skin in relation to the ski pole strap 34 results in discomfort, with the initial formation of blisters, before the skin has become calluses are formed.

[0048] In fig 6, it is illustrated how the shaped hand support portion 5 with relatively high flexural strength prevents the displacement of soft tissue inside the, *per se*, substantially incompressible skin. This effectively prevents, or at least reduces, deformation of the soft tissue in the hands at each pole stroke. The gain in efficiency can be easily understood by considering the portion 39 of each stroke being lost to compression of soft tissue in the hands 29 when a conventional ski pole strap 34 is used.

[0049] In the example configuration of the ski pole strap 1 schematically shown in fig 6, substantially the entire circumference of the hand 29 is surrounded by thermoplastic material with sufficient flexural strength to significantly reduce displacement of soft tissue. It should, however, be noticed that this is not necessary for achieving an advantage over conventional ski pole straps in terms of power efficiency. By arranging thermoplastic material that can be plastically shaped to the individual hand of the skier, by the skier, at least in a region of the hand support portion 5 surrounding the ulnar border 31 of the hand 29, a significant improvement can be achieved compared to the conventional ski pole strap.

[0050] The flexural modulus of the thermoplastic material that is necessary to achieve the desired reduction in deformation depends on the surface density of the thermoplastic material. For a higher surface density, a lower flexural modulus is sufficient. Experiments have shown that a surface density around at least 0.03 g/cm^2, at least in the region surrounding the ulnar region 31 of the hand 29, of plastically shapeable thermoplastic material, having a flexural modulus of at least 50 MPa at room temperature can provide a significant improvement in power efficiency, especially for double poling.

[0051] In the claims, the word "comprising" does not

exclude other elements or steps, and the indefinite article "a" or "an" does not exclude a plurality. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measured cannot be used to advantage.

Claims

1. A ski pole strap (1) for transfer of power from a skier's hand (29) to a ski pole (27) when a pole stroke is performed in cross-country skiing, the ski pole strap (1) comprising:

   an attachment portion (3) configured to attach the ski pole strap (1) to the ski pole (27); and
   a hand support portion (5) for supporting the hand (29) of the skier, the hand support portion (5) comprising a layer of thermoplastic material with at least 0.03 g/cm^2 of the thermoplastic material, the layer of thermoplastic material being arranged at least in a region of the hand support portion configured to surround an ulnar border (31) of the skier's hand (29), when the ski pole strap (1) is in use, the thermoplastic material being plastically shapeable at a temperature below 100°C and having a flexural modulus of at least 50 MPa at 20°C.

2. The ski pole strap (1) according to claim 1, the layer of thermoplastic material being arranged in at least 50% of a total surface area of the hand support portion (5).

3. The ski pole strap (1) according to claim 2, the layer of thermoplastic material being arranged in at least 70% of the total surface area of the hand support portion (5).

4. The ski pole strap (1) according to any one of the preceding claims, the hand support portion (5) being configured to at least partly wrap around the hand (29) of the skier between a first end (7) of the hand support portion (5) and a second end (9) of the hand support portion (5).

5. The ski pole strap (1) according to claim 4, the layer of thermoplastic material being arranged along at least 60% of a distance between the first end (7) and the second end (9) of the hand support portion (5).

6. The ski pole strap (1) according to claim 5, the layer of thermoplastic material being arranged along at least 80% of a distance between the first end (7) and the second end (9) of the hand support portion (5).

7. The ski pole strap (1) according to claim 5 or 6, the ski pole strap (1) being configured in such a way that the first end (7) of the hand support portion (5) and the second end (9) of the hand support portion (5) are located on a dorsal side (33) of the hand (29) when the ski pole strap (1) is in use.

8. The ski pole strap (1) according to any one of the preceding claims, the hand support portion (5) comprising in the range of 0.03 - 0.5 g/cm^2 of the thermoplastic material across at least 30% of a total surface area of the hand support portion (5).

9. The ski pole strap (1) according to any one of the preceding claims, the layer of thermoplastic material being sandwiched between a first textile layer (23) arranged to face the hand (29) of the skier and a second textile layer (25) arranged to face away from the hand (29) of the skier, when the ski pole strap (1) is in use.

10. The ski pole strap (1) according to claim 9, wherein the attachment portion (3) is at least partly made of a textile material attached to the hand support portion (5).

11. The ski pole strap (1) according to claim 10, wherein the attachment portion (3) is attached to the hand support portion (5) between the thermoplastic material and one of the first textile layer (23) and the second textile layer (25).

12. The ski pole strap (1) according to any one of the preceding claims, the thermoplastic material having a flexural modulus of at least 100 MPa at 20°C.

13. The ski pole strap (1) according to any one of the preceding claims, the thermoplastic material exhibiting a ratio between its flexural modulus and its Young's modulus in the range of 0.5 to 1.5.

14. A ski pole (27) comprising the ski pole strap (1) according to any one of the preceding claims.

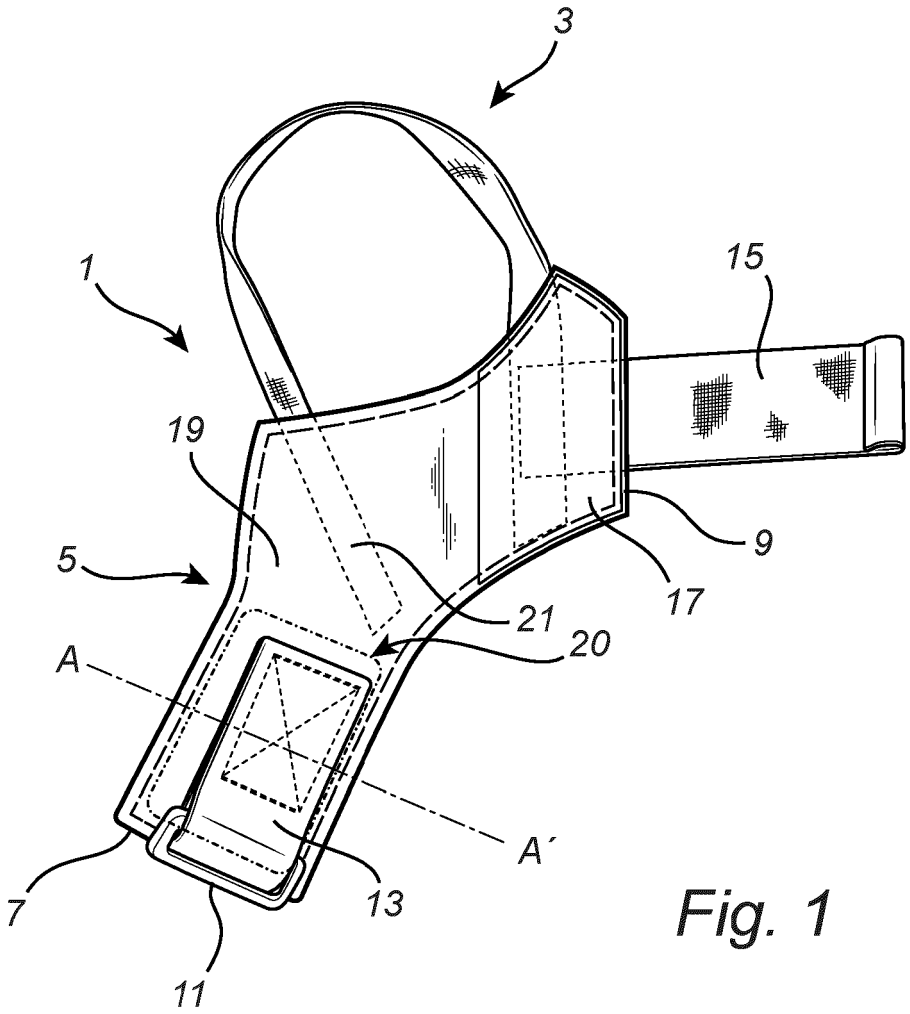


Fig. 1

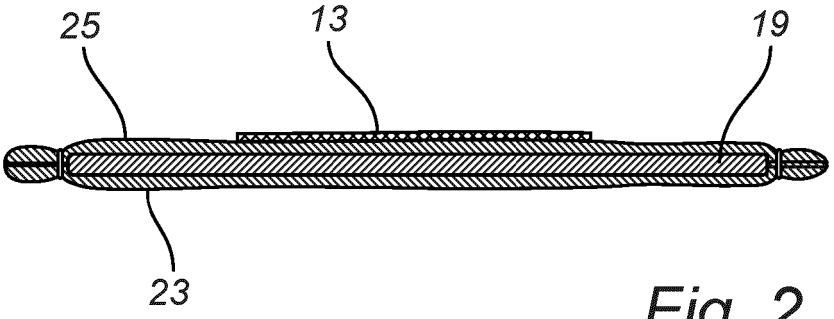


Fig. 2

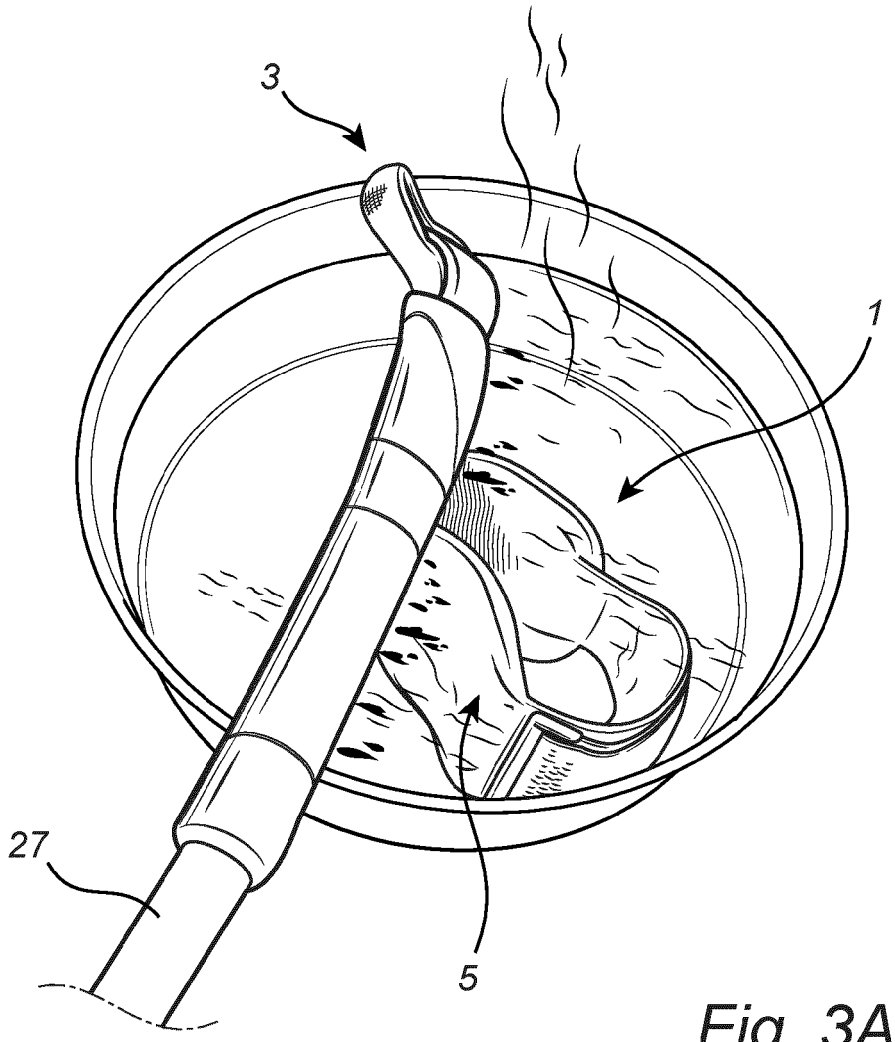


Fig. 3A

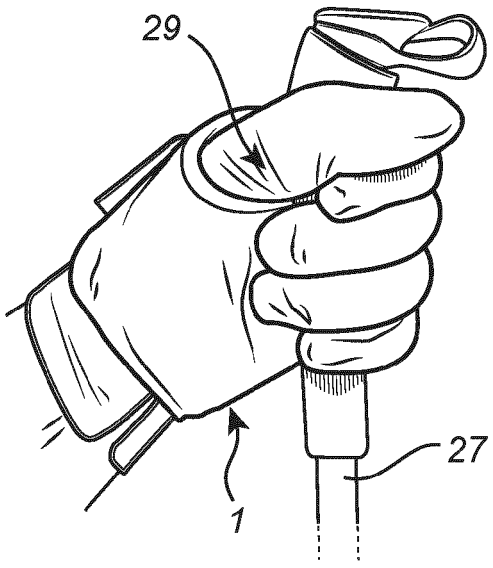


Fig. 3B

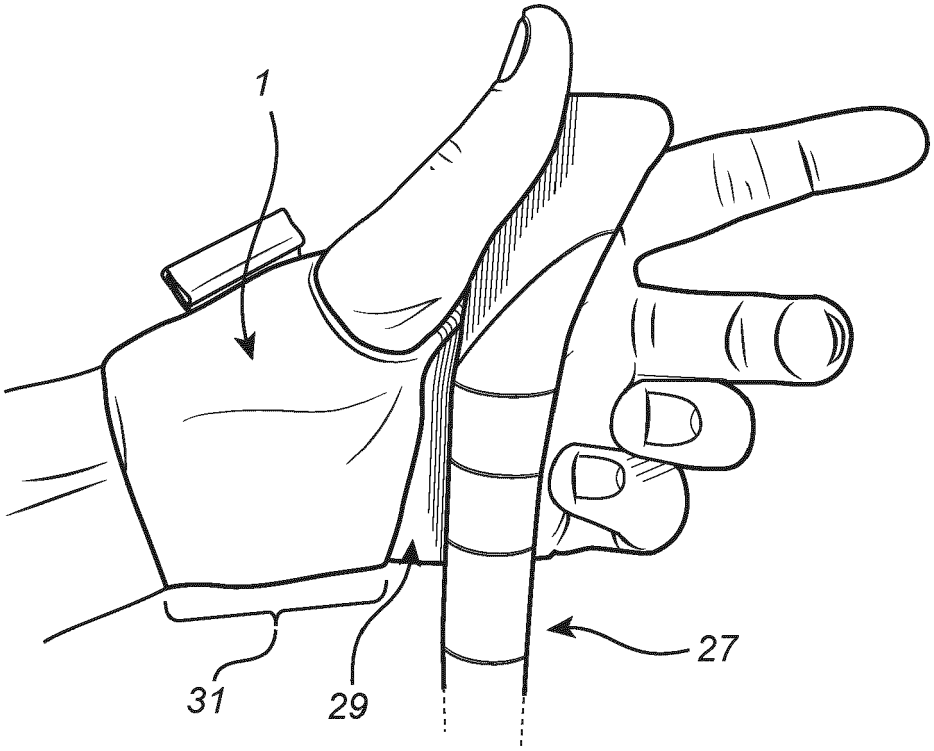


Fig. 4A

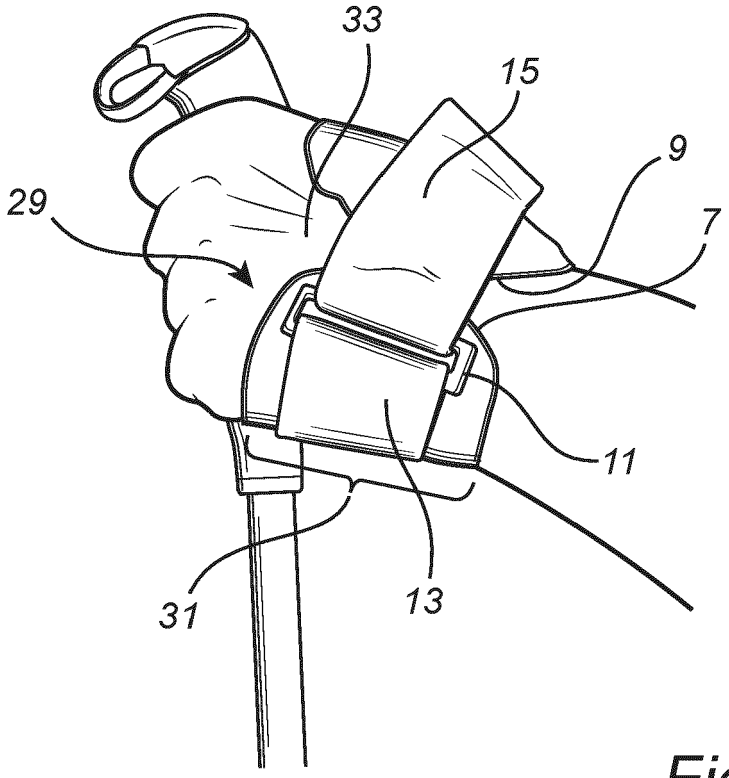


Fig. 4B

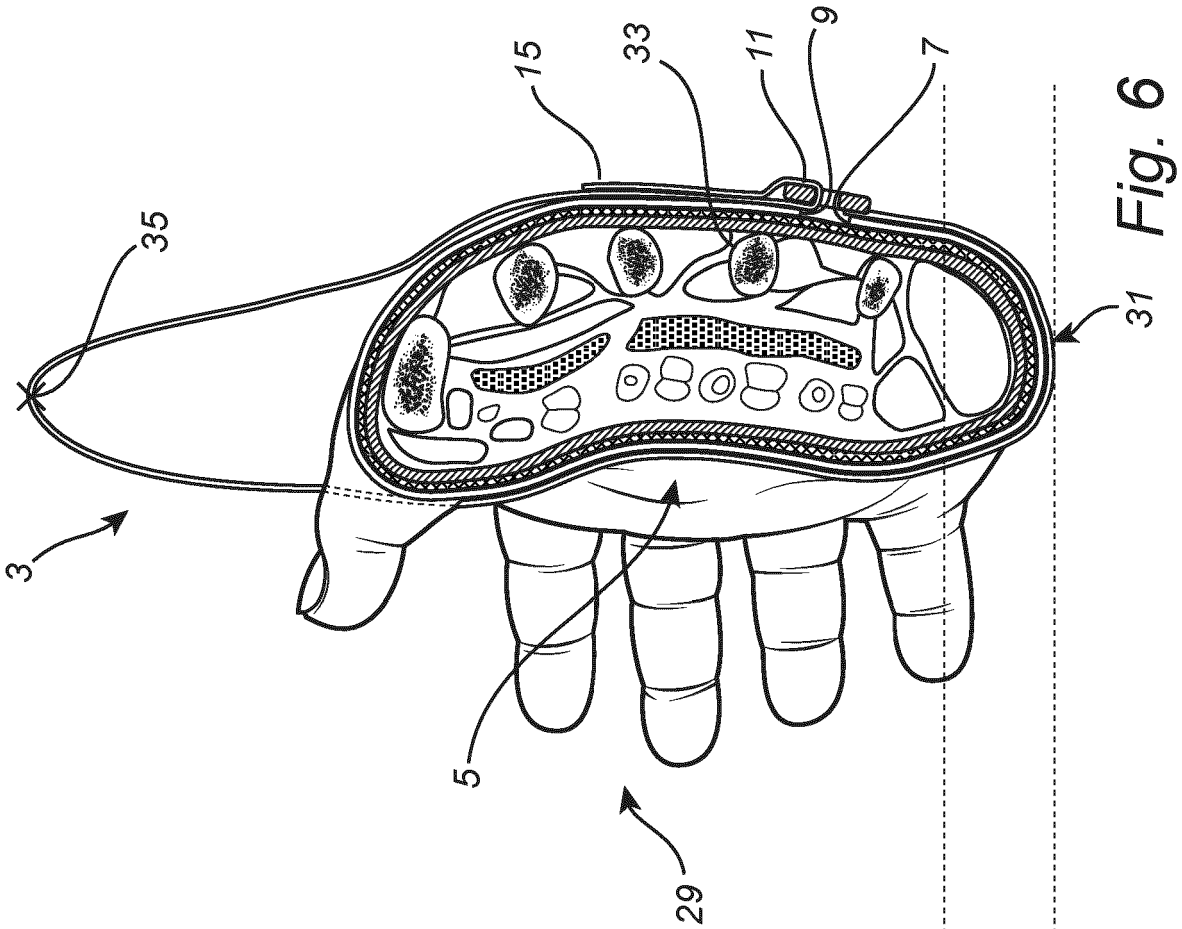
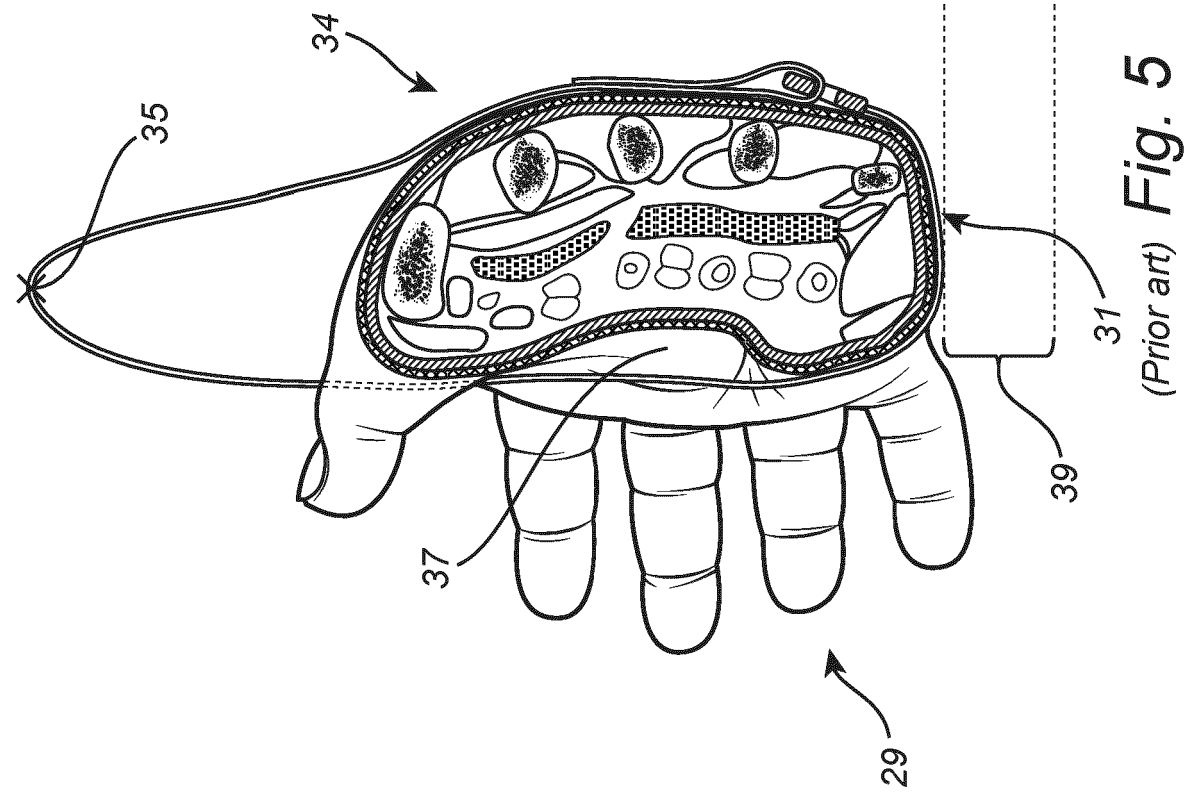


Fig. 6



(Prior art) Fig. 5

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 24 21 9347

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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