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(54) **A PROTECTIVE GLOVE**
SCHUTZHANDSCHUH
GANT DE PROTECTION

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Description

Field of the Invention

[0001] The invention relates to protective gloves used for protecting a wearer's hand and/or wrist when impacted against a surface and therefore may have particular applications in the field of motorcycles.

Background to the Invention

[0002] By definition gloves are protective in one way or another. The boxer's gloves will for example incorporate an outer padding to protect the user's hand when punching - naturally in such circumstances the user's hand would without protection undoubtedly be damaged. Other gloves are destined to protect the user's skin as he frequently repeats a movement under a given load. One example of such gloves would be those used in weight lifting.

[0003] Many prior art gloves are designed to have enhanced gripping capacities. An example of such a glove is shown in US patent number 6055669 which presents a bowling ball glove with improved grip to allow a pitcher of a ball to impose enhanced spin to a ball. Another example of non-slip gloves is presented in Japanese document 1216778.

[0004] Motorcycle gloves are generally designed to protect the wearer during a wide variety of travel situations. One of the requirements of gloves is that they be thermally insulating which becomes particularly important in harsh weather conditions or at elevated speeds. Such gloves are also customarily equipped with a water proofing layer which may take the form of a synthesised breathable material such as GORTEX (registered trade mark). The outer coating of many motorcycle gloves are still however often made out of leather, primarily because leather offers an ideal combination of natural protective and aesthetical properties. In certain areas of the motorcyclist's gear, there is sometimes proposed the incorporation of a highly abrasion-resistant material - for example located over the kneecaps or elbows or even over the outer portion of the glove which may come into contact with the road as the user manoeuvres a curve during say a race. An example of such a proposal is disclosed in GB 022627.5.

[0005] However, in this proposal the underside of the glove will primarily be designed to enhance the user's grip to facilitate difficult manoeuvres to be carried out.

[0006] One of the objectives of the invention is to present a radical departure from the conventional teaching of the above discussed prior art where the underside of the glove has the sole function of improving adhesion to objects during use.

[0007] A further objective of the present invention is to provide improvements to the protective characteristics of gloves when a user is impacted or propelled onto a surface.

[0008] Prior art gloves prove generally adequate in terms of thermal insulation and in being waterproof. However, in a motorcycle fall it is typical for the user of the glove to have the reflex of outstretching his arm in the vain attempt of protecting himself from the fall. As the user with his outstretched arms impacts on the road surface his hands and wrists are submitted to forces which often result in a fracture of a metacarpal or carpal bone. Statistically, the scaphoid bone is the most likely to fracture in these instances. There are typically one thousand of such accidents per day in the United Kingdom alone, a high percentage of which results in a fractured scaphoid bone.

[0009] The scaphoid bone is crucial to the intricate function of the wrist, it is the strong mechanical link between the proximal and distal carpal rows and can be regarded as an extension of the thumb ray into the wrist. It is subjected to shearing, rotational and compression forces from several surrounding structures. Therefore, any fracture of this bone is usually complex, often requiring prolonged immobilisation. The fracture is usually accompanied by a dull, deep pain in the wrist and throughout its treatment a pain may periodically be felt which may take weeks or even months to subside.

[0010] DE 35 19 633 is acknowledged but fails to disclose a reduction of friction on impact but only after the impact in case the outer leather material has been abraded and the intermediate PTFE layer is exposed.

[0011] A further objective of the present invention is therefore to offer specific protection to the bones in the hand and wrist and particularly to the scaphoid bone.

[0012] The solution to this problem presented hereafter also aims at retaining the flexibility and grip which the conventional glove user has been accustomed to.

Summary of the Invention

[0013] In its broadest independent aspect, the invention presents a glove for protection a wearer's wrist when impacted against a surface suitable for use on a motorcycle; said glove having a top side and an underside comprising:

- a finger region with an outermost surface of the underside of said glove having a first coefficient of friction relative to a road surface; said first coefficient of friction being of a level as achieved by leather which is typically used in motorcycling gloves;
- a palm region; and
- a wrist region;

characterised in that said glove incorporates a pad with a second coefficient of friction relative to a road surface; said second coefficient of friction being lower than said first coefficient of friction so as to reduce any force transmitted on impact to the user's wrist; the exposed surface area of said pad having said second coefficient of friction being located over the scaphoid

bone of the weaver.

[0014] The above configuration have the advantage of improving the distribution of forces when a wearer's hand and/or wrist is impacted against a surface. In addition, the wearer's dexterity is not in any way hampered which allows him to freely manoeuvre objects such as the controls of a motorcycle. These configurations will also reduce the seriousness of carpal fractures and will therefore allow its wearer should he suffer a fall of having a more rapid recovery. They will also in many instances prevent any fracture occurring altogether. These configurations will also be advantageous as the force may even be diverted to the forearm of the wearer which is constituted of bones which heal in a relatively straightforward manner should they themselves fracture.

[0015] In a subsidiary aspect, the surface area having a low coefficient of friction is located over the scaphoid bone of the user's wrist.

[0016] Simply by modifying the surface area over the scaphoid bone of a user's wrist, the likely damage to this bone can be reduced or even prevented.

[0017] Advantageously, the surface area with the low coefficient of friction may comprise fibrous material, the fibres generally extending in the direction of the forearm. This would allow the glove to be particularly ergonomic while advantageously diverting the force towards the forearm.

[0018] In a further aspect, the description covers a glove for protecting a wearer's hand and/or wrist when impacted against a surface comprising as part of its hand, wrist or forearm cover a single chamber or a series of chambers which contain fluid or are capable of containing fluid and are arranged so that any fluid flow remains during conventional use of the glove within the chamber or the series of chambers and which are located in a position to protect a section of the hand, wrist, forearm by absorbing at least in part the force of the impact.

[0019] This configuration is particularly beneficial in absorbing the force resulting from the impact and thus limits the occurrence of fractures in the bones beneath the chamber and may altogether prevent such fractures occurring in many instances.

[0020] In a subsidiary aspect, the chamber or the series of chambers cover an area corresponding essentially to the palm and/or underside of the wrist, the fingers being relatively unrestricted in movement as in a conventional glove.

[0021] This configuration offers a particularly practical solution to the incorporation of a chamber into a conventional gloves.

[0022] In a further subsidiary aspect, one chamber is located in use essentially over the underside of the scaphoid bone of the user's wrist. Covering this relatively small area dramatically reduces the extent of fractures and immobilisation which are often the result of when a wearer impacts against a surface for example during a fall from a motorcycle.

[0023] In a further subsidiary aspect any chamber in a

section of the glove above the wrist crease is primarily empty during conventional use of the glove and at least one adjacent chamber projects past any such chamber over the wrist crease so that on impact fluid flows from the adjacent chamber into the chamber in the section of the glove above the wrist crease.

[0024] This configuration is particularly advantageous as it combines in a particularly non-conventional fashion ergonomic and protective properties.

[0025] In a further subsidiary aspect, a chamber with pressurised fluid and control means adapted to release said pressurised fluid on impact so that the fluid fills a protective chamber.

[0026] This aspect allows a rapid expansion of protective area without hindering the wearer's movements in conventional use.

[0027] In a further subsidiary aspect, a single chamber protrudes from the glove over essentially the palm and/or wrist and is essentially triangular when viewed in cross-section.

[0028] This configuration will allow the area of protection to rapidly spread across a wide area and facilitate the transfer of impact force from the wrist and/or palm region towards the forearm of the user. Transferring the force from the wrist to the forearm region may stress the forearm or even fracture the forearm. However, any such fracture can relatively rapidly heal as opposed to the more complex recovery which would follow the fracture of say a carpal bone.

[0029] In a further subsidiary aspect, the walls of the or each chamber are sufficiently elastic so that the or each chamber stretches on impact over the area to be protected. This configuration allows the chambers to be relatively unobtrusive whilst during impact offering improved protection.

[0030] In a further subsidiary aspect, fluid is contained in conventional use primarily in the forearm region and upon outstretching the hand, circulation of fluid from the forearm to the palm and/or wrist regions of the glove is achieved. One of the advantages of this arrangement is that the forearm itself may be protected as well as protecting the critical palm and/or wrist regions of the glove when the hand is outstretched. Another advantage of this arrangement becomes apparent when the wearer grasps objects such as the handle bars of a motorcycle because in that mode of operation under the pressure of the grasp, the fluid is primarily retained in the forearm region so as to allow unrestricted precise grasping of objects.

[0031] In a further subsidiary aspect, the fluid circulates from each chamber to an adjacent chamber through restriction means. This allows a gradual absorption of force over the entire time of impact.

Brief Description of the Figures

[0032]

Figure 1 shows a schematic perspective view of the

underside of a right glove in accordance with a first embodiment of the present invention.

Figure 2 represents in perspective view the underside of the right glove in accordance with a second embodiment.

Figure 3 shows a schematic perspective view of the underside of the right glove according to a third embodiment.

Figure 4 represents a cross-sectional view across the low friction areas of the glove.

Figure 5 shows the underside of a left glove in perspective view in accordance with a fourth embodiment of the present invention.

Figure 6 shows the underside of a left glove in perspective view in accordance with a fifth embodiment.

Figure 7 represents a schematic perspective view of the underside of a left glove in accordance with a sixth embodiment.

Detailed Description of the Figures

[0033] Figure 1 shows a protective glove generally referenced 1 comprising a top side 2 (only partially visible in the drawing) and an underside 3, the glove has four separately displaceable finger and thumb covers such as that referenced 4.

[0034] The glove 1 can be approximately split into three general regions; the finger region 5, the palm region 6 and the wrist region 7. Over part of the palm region and the underside of the wrist region, there are provided two pads 8 and 9. The coefficient of friction of finger region 5 may for example be equivalent to that of the leather used typically in motorcycle gear. By contrast, the coefficient of friction of pads 8 and 9 will be selected by the person skilled in the art to be considerably lower than at least the coefficient of friction of finger region 5 so that when the user is propelled onto a surface with his arms outstretched, the impact's force usually primarily transmitted to the palm and wrist region of the glove may be diminished and even transferred in effect towards the forearm of the wearer.

[0035] Pads 8 and 9 are constituted of fibre materials which are orientated in the direction of the forearm. While this construction is particularly advantageous other materials are envisaged within the scope of the present invention and may be utilised by the person skilled in the art in the design of the glove. One particularly useful material is thought to be a rigid PVC or a nylon. Other low friction materials may be a metal such as titanium, silicon, silicon copolymers, silicon elastomers, polytetrafluorethylene, homopolymers, graphites, boron, polypropylene and/or polyethylene. It is also envisaged to utilize a ma-

terial which has similar low coefficient of friction as the above materials but is sufficiently bendable to allow the wearer to conventionally utilize the glove without noticeable restriction.

[0036] Returning to the specific description of figure 1, advantageously, the typical coefficient of friction of the pad's material with the average road surface is below 0.5.

[0037] The location of pads 8 and 9 and their shape is selected to improve the ergonomics of the glove. Pads 8 and 9 generally form a C shape with a gap 10 located between pads 8 and 9 so that movements about the wrist crease are in no way impeded.

[0038] The geometry of pad 8 is designed to generally cover the scaphoid and lunate bones of the carpus of the user. Pad 9 is destined to cover the lower region of the last metacarpal bone which may also be subjected to fracture in a conventional glove.

[0039] Figure 2 shows a glove 11 with an impact absorbing pad 12 which may be located beneath low friction pads 8 and 9 of glove 1. Pad 12 is constituted of two fluid containing chambers 13 and 14 which correspond in size to pads 8 and 9 of glove 1. The fluid contained in chambers 13 and 14 may have a high viscosity by being for example a silicon gel. The walls of chambers 13 and 14 may be generally elastic so as to stretch, preferably without rupturing in most load conditions on impact. A further chamber 15 may be located between chambers 13 and 14 and designed to be empty of fluid during normal use. Walls 16 and 17 may be adapted to allow the passage of fluid from chambers 13 and 14 to chamber 15 on impact whilst sufficiently sealed during conventional use of the glove to effectively prevent such passage of fluid. This latest characteristic of the glove allows it to be particularly ergonomic whilst being sufficiently protective.

[0040] Figure 3 presents glove 18 with a single low friction pad covering the carpal region and the lower portion of the metacarpal region of the user's hand when inserted in the glove. Pad 19 incorporates an array of fibres crossing each other to form a web like structure.

[0041] Pad 19 may be integral to the glove or may be constructed so as to be detachable from the glove should appropriate releasable attachable means be provided between the pad and the main body of the glove. These releasable attachment means may be selected by the person skilled in the art from known alternatives.

[0042] Figure 4 presents a cross-section 20 of a glove similar to the gloves presented in Figure 1 and Figure 2, the section line following essentially a line through low friction pads located over an absorption pad. There are provided two low friction pads 21 and 22 from which fibrous elements such as that referenced 23 project and are designed to achieve a low coefficient of friction on a typical road surface schematically illustrated and referenced 24. A waterproof layer 25 which may be selected to be of a breathable type by the person skilled in the art, wraps around the glove. Above friction pads 21 and 22, there is provided an absorption pad 26 within layer 25. Absorption pad 26 may incorporate a single chamber or

alternatively incorporate a number of chambers identical to that presented with reference to Figure 2 and in which the wrist crease gap may be filled by fluid following the impact on the road surface.

[0043] Further towards the hand receiving chamber 28 of the glove, there is provided a thermal layer 29 of standard kind.

[0044] Figure 4 also shows schematically within the glove the position of the scaphoid bone 30 as well as the lunate bone 31 and the lower region of a further wrist member 32.

[0045] Figure 5 represents a glove 33 with a single chamber 35 stretching from the glove's forearm region 34 up to the tips of the finger regions 36 of the glove.

[0046] The walls of chamber 35 and the properties of the fluid 38 combine so that when the user holds onto the handle bars of the motorcycle the fluid contained within the chamber 35 migrates under the gripping action towards the forearm region 34. When the grip is released from the handle bars such as when outstretching the arms during a fall the fluid tends to flow into the wrist and palm region of the glove as shown by arrow 37 so as to absorb at least in part the force of the impact.

[0047] Furthermore when low friction pads are provided over the palm or wrist of the user the force of impact will be reduced and will tend to be diverted towards the forearm which may also be protected by the lower region of chamber 35.

[0048] Figure 6 illustrates a further embodiment of the invention where a glove 39 incorporates a single chamber 40 protruding from the glove and of general triangular shape when viewed in cross-section. This configuration is particularly advantageous as it enhances the area over which the impact forces are spread and therefore will reduce the pressure exerted on a given bone.

[0049] Figure 7 presents a glove 41 incorporating in the forearm region a chamber 42 capable of containing a pressurised fluid. The fluid of chamber 42 may be released into channel 43 and into impact absorbing section 44 on impact, as appropriate control means (not illustrated in the figure) instruct the opening of chamber 42.

[0050] Chamber 42 may be provided with an inlet valve (not illustrated in the figure) through which air or any other appropriate fluid selected by the person skilled in the art may be pumped into the chamber by the user through conventional means and retained therein. This latest feature would render possible the chamber's properties to be individually set by the wearer of the glove.

[0051] The impact absorbing portion of the glove of any appropriate previously described embodiment may advantageously incorporate a portion of one or more chambers occupied by a first fluid operating in conjunction with a second portion of one or more chambers occupied by a second fluid, the second fluid being selected so that during impact when the first fluid is caused to displace in conjunction with the second fluid, the second fluid compresses so that when the impact force ceases to be applied the second fluid tends to return the first fluid

to its position before impact. This may be achieved for example by having the second fluid be air whilst the first fluid is relatively less compressible such as a gel.

Claims

1. A glove (1, 11, 20, 33, 39, 41) for protection of a wearer's wrist when impacted against a surface suitable for use on a motorcycle; said glove having a top side and an underside comprising:

- a finger region (5) with an outermost surface of the underside of said glove having a first coefficient of friction relative to a road surface; said first coefficient of friction being of a level as achieved by leather which is typically used in motorcycling gloves;
- a palm region (6); and
- a wrist region (7);

characterised in that said glove incorporates a first pad (8) having a second coefficient of friction relative to a road surface; said second coefficient of friction being lower than said first coefficient of friction so as to reduce any force transmitted on impact to the user's wrist; the exposed surface area of said first pad (8) having said second coefficient of friction being located over the scaphoid bone of the wearer.

2. A glove (1, 11, 20, 33, 39, 41) according to claim 1, wherein said glove incorporates a second pad (9) covering a distinct surface of the glove located over the lower region of the last metacarpal bone region of a wearer.

3. A glove (1, 11, 20, 33, 39, 41) according to either of the preceding claims, wherein said first pad (8) incorporates respectively said first and second pad (8,9) which incorporate fibrous material with fibres; the fibres generally extending in the direction of the forearm.

4. A glove (1, 11, 20, 33, 39, 41) according to either claim 1 or claim 2, wherein said first pad (8) incorporates respectively said first and second pad (8, 9) which incorporate polyethylene material.

5. A glove (1, 11, 20, 33, 39, 41) according to any of claims 1 and 2, wherein said first pad (8) is respectively said first and second pad (8,9) which are of rigid PVC material or nylon material.

6. A glove (1, 11, 20, 33, 39, 41) according to claim 2, comprising a gap (10) located between said first and second pads (8, 9) which corresponds to the wearer's wrist crease, wherein the pads (8, 9) generally

form a C shape.

7. A glove (1, 11, 20, 33, 39, 41) according to claim 1, wherein said first pad (8, 19) is C-shaped in plan view.
8. A glove (1, 11, 20, 33, 39, 41) according to any of the preceding claims, further comprising at least one fluid fillable chamber (13, 14, 26) corresponding to each pad and being located underneath said pads.
9. A glove (1, 11, 20, 33, 39, 41) according to claim 6, further comprising a chamber (15) in a section of the glove located above the wrist crease; and two adjacent chambers (13, 14) containing fluid; wherein said wrist crease chamber (15) is primarily empty whilst riding a motorbike and on impact fluid flows from said adjacent chambers (13, 14) into said wrist crease chamber (15).

Patentansprüche

1. Handschuh (1, 11, 20, 33, 39, 41) zum Schutz des Handgelenks eines Trägers beim Aufprall auf eine Fläche, der für die Verwendung an einem Motorrad geeignet ist; wobei der Handschuh eine Oberseite und eine Unterseite aufweist, umfassend:
- einen Fingerbereich (5) mit einer äußersten Fläche der Unterseite des Handschuhs, die einen ersten Reibungskoeffizienten relativ zu einer Straßendecke aufweist; wobei der erste Reibungskoeffizient eine Größe hat, die von Leder erreicht wird, das üblicherweise in Motorradhandschuhen verwendet wird;
 - einen Handflächenbereich (6); und
 - einen Handgelenkbereich (7);

dadurch gekennzeichnet, dass der Handschuh einen ersten Schützer (8) mit einem zweiten Reibungskoeffizienten relativ zu einer Straßendecke enthält; wobei der zweite Reibungskoeffizient kleiner ist als der erste Reibungskoeffizient, um jegliche auf das Handgelenk des Benutzers beim Aufprall übertragene Kraft zu verringern; wobei der freiliegende Flächenbereich des ersten Schützers (8) mit dem zweiten Reibungskoeffizienten sich über dem Kahnbein des Trägers befindet.

2. Handschuh (1, 11, 20, 33, 39, 41) nach Anspruch 1, wobei der Handschuh einen zweiten Schützer (9) enthält, der eine freiliegende Fläche des Handschuhs bedeckt, die sich über dem unteren Bereich des letzten Mittelhandknochens eines Trägers befindet.
3. Handschuh (1, 11, 20, 33, 39, 41) nach einem der

vorhergehenden Ansprüche, wobei der erste Schützer (8) jeweils den ersten und den zweiten Schützer (8, 9) enthält, die Fasermaterial mit Fasern enthalten; wobei die Fasern sich allgemein in Richtung des Unterarms erstrecken.

4. Handschuh (1, 11, 20, 33, 39, 41) nach entweder Anspruch 1 oder Anspruch 2, wobei der erste Schützer (8) jeweils den ersten und den zweiten Schützer (8, 9) enthält, die Polyethylenmaterial enthalten.
5. Handschuh (1, 11, 20, 33, 39, 41) nach einem der Ansprüche 1 und 2, wobei der erste Schützer (8) jeweils der erste und der zweite Schützer (8, 9) ist, die aus steifem PVC-Material oder Nylonmaterial sind.
6. Handschuh (1, 11, 20, 33, 39, 41) nach Anspruch 2, der eine zwischen dem ersten und dem zweiten Schützer (8, 9) befindliche Lücke (10) umfasst, die der Handgelenksfalte des Trägers entspricht, wobei die Schützer (8, 9) allgemein eine C-Form bilden.

7. Handschuh (1, 11, 20, 33, 39, 41) nach Anspruch 1, wobei der erste Schützer (8, 19) in der Draufsicht eine C-Form aufweist.
8. Handschuh (1, 11, 20, 33, 39, 41) nach Anspruch 2, der ferner eine mit Flüssigkeit befüllbare Kammer (13, 14, 26) umfasst, die jedem Schützer entspricht und sich unterhalb der Schützer befindet.
9. Handschuh (1, 11, 20, 33, 39, 41) nach Anspruch 6, der ferner eine Kammer (15) in einem Abschnitt des Handschuhs umfasst, der sich oberhalb der Handgelenksfalte befindet; und zwei nebeneinander angeordnete Kammern (13, 14), die Flüssigkeit enthalten; wobei die Handgelenksfaltenkammer (15) überwiegend leer ist, während ein Motorrad gefahren wird, und beim Aufprall Flüssigkeit aus den nebeneinander angeordneten Kammern (13, 14) in die Handgelenksfaltenkammer (15) strömt.

Revendications

1. Un gant (1, 11, 20, 33, 39, 41) destiné à protéger le poignet d'un porteur lors d'un impact contre une surface adapté à une utilisation sur une motocyclette, ledit gant possédant un côté dessus et un côté dessous comprenant :
- une zone de doigt (5) avec une surface la plus extérieure du côté dessous dudit gant possédant un premier coefficient de friction relatif à une surface de chaussée, ledit premier coefficient de friction étant d'un niveau atteint par un cuir qui est typiquement utilisé dans des gants

de motocyclisme,

- une zone de paume (6), et
- une zone de poignet (7),

caractérisé en ce que ledit gant est muni d'un premier élément de protection (8) possédant un deuxième coefficient de friction relatif à une surface de chaussée, ledit deuxième coefficient de friction étant inférieur audit premier coefficient de friction de façon à réduire toute force transmise lors d'un impact avec le poignet de l'utilisateur, la surface exposée dudit premier élément de protection (8) possédant ledit deuxième coefficient de friction étant située par-dessus l'os scaphoïde du porteur.

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2. Un gant (1, 11, 20, 33, 39, 41) selon la Revendication 1, où ledit gant est muni d'un deuxième élément de protection (9) couvrant une surface exposée du gant placée sur la zone inférieure de la zone du dernier os métacarpien d'un porteur. 20
3. Un gant (1, 11, 20, 33, 39, 41) selon l'une quelconque des Revendications précédentes où respectivement lesdits premier et deuxième éléments de protection (8, 9) contiennent un matériau fibreux avec des fibres, les fibres s'étendant généralement dans la direction de l'avant-bras. 25
4. Un gant (1, 11, 20, 33, 39, 41) selon la Revendication 1 ou 2, où respectivement lesdits premier et deuxième éléments de protection (8, 9) contiennent un matériau polyéthylène. 30
5. Un gant (1, 11, 20, 33, 39, 41) selon la Revendication 1 ou 2, où respectivement lesdits premier et deuxième éléments de protection (8, 9) sont d'un matériau PVC rigide ou d'un matériau nylon. 35
6. Un gant (1, 11, 20, 33, 39, 41) selon la Revendication 2, comprenant un espace (10) situé entre lesdits premier et deuxième éléments de protection (8, 9), qui correspond au pli du poignet du porteur, où les éléments de protection (8, 9) forment généralement une forme en C. 40
45
7. Un gant (1, 11, 20, 33, 39, 41) selon la Revendication 1, où ledit premier élément de protection (8, 19) est en forme de C dans une vue en plan. 50
8. Un gant (1, 11, 20, 33, 39, 41) selon la Revendication 2, comprenant en outre une cavité apte à être remplie de fluide (13, 14, 26) correspondant à chaque élément de protection et étant située sous lesdits éléments de protection. 55
9. Un gant (1, 11, 20, 33, 39, 41) selon la Revendication 6, comprenant en outre une cavité (15) dans une

partie du gant située au-dessus du pli du poignet, et deux cavités adjacentes (13, 14) contenant du fluide, où ladite cavité du pli du poignet (15) est essentiellement vide lorsque l'on roule en motocyclette et, en cas d'impact, du fluide s'écoule desdites cavités adjacentes (13, 14) dans ladite cavité du pli du poignet (15).

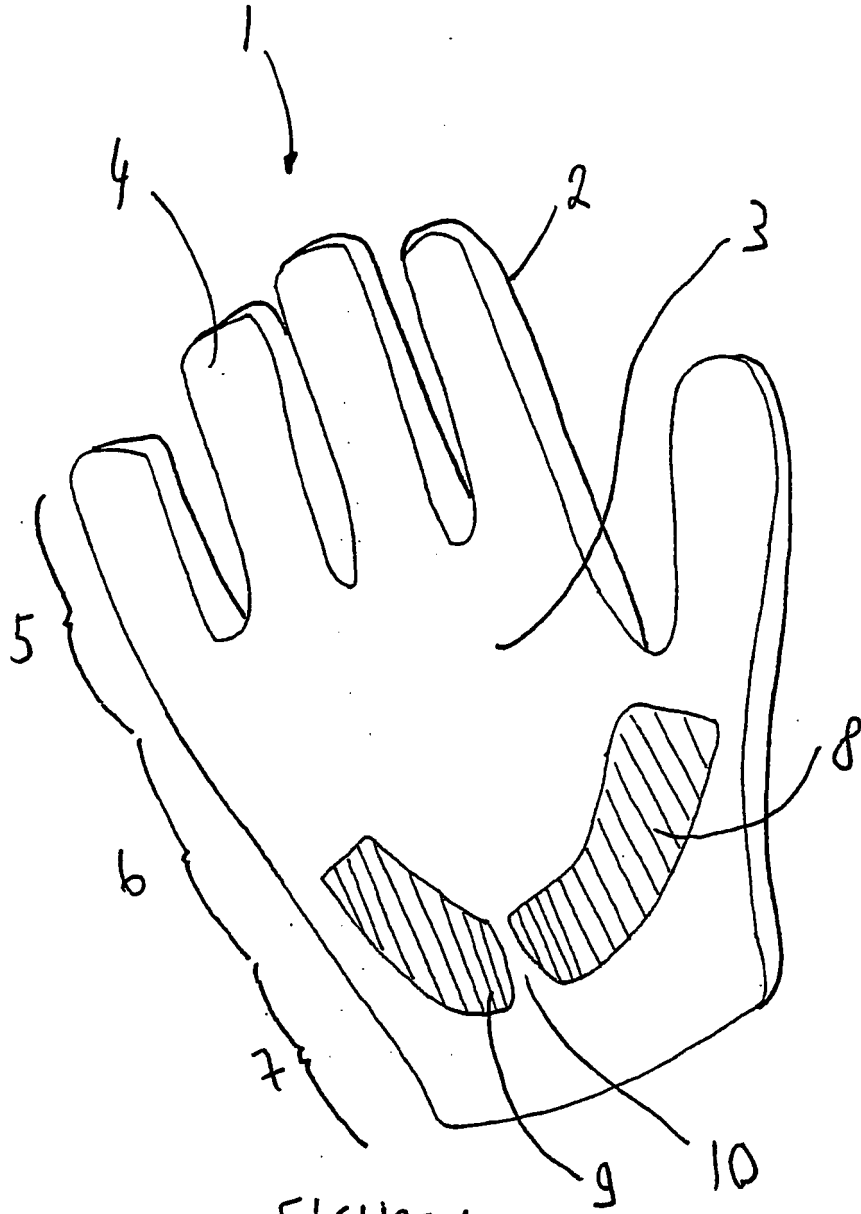
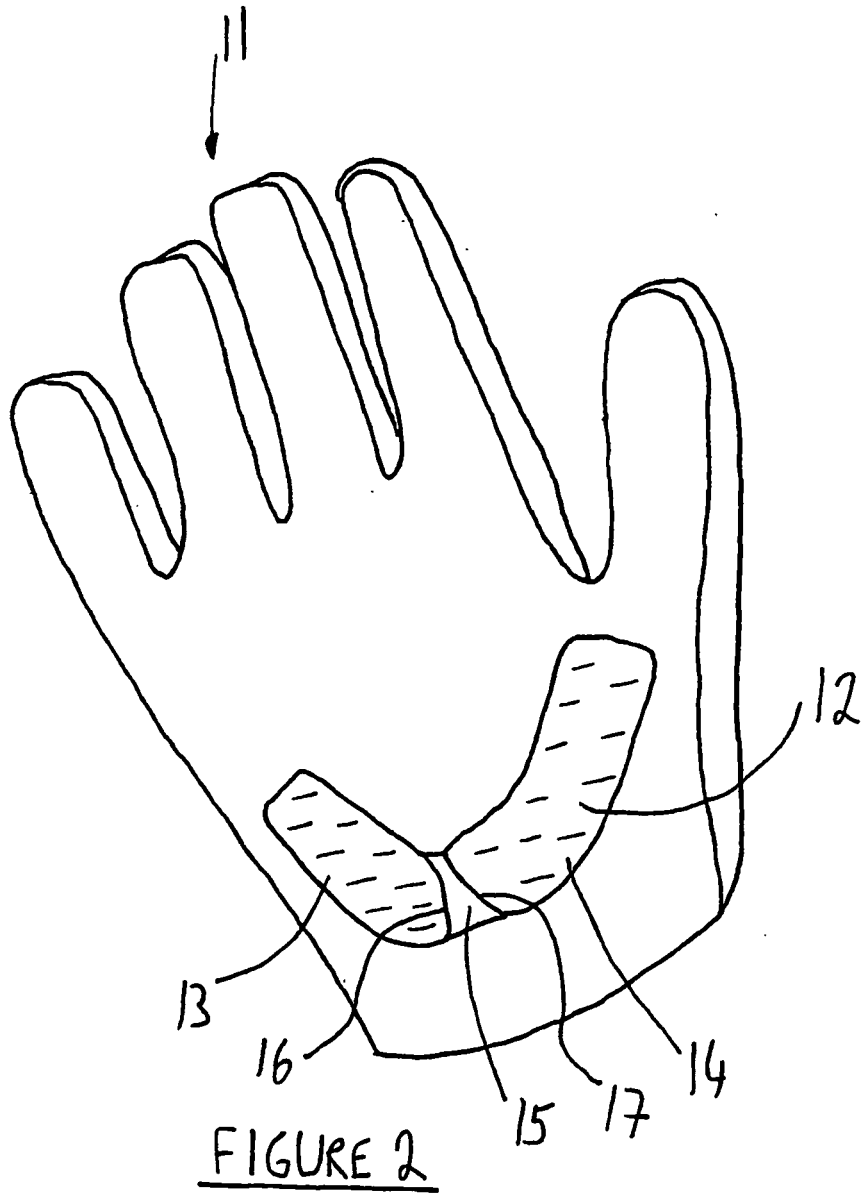


FIGURE 1



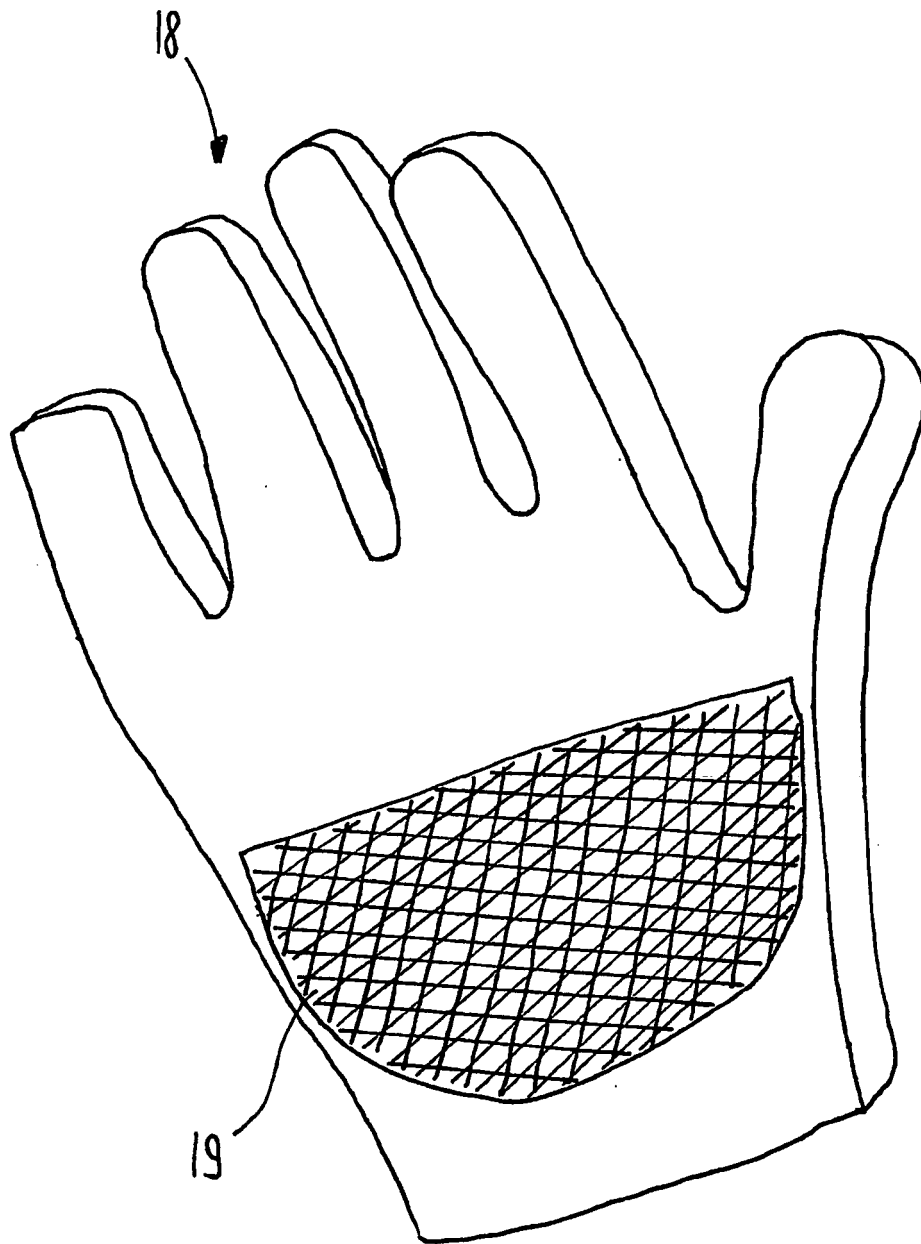
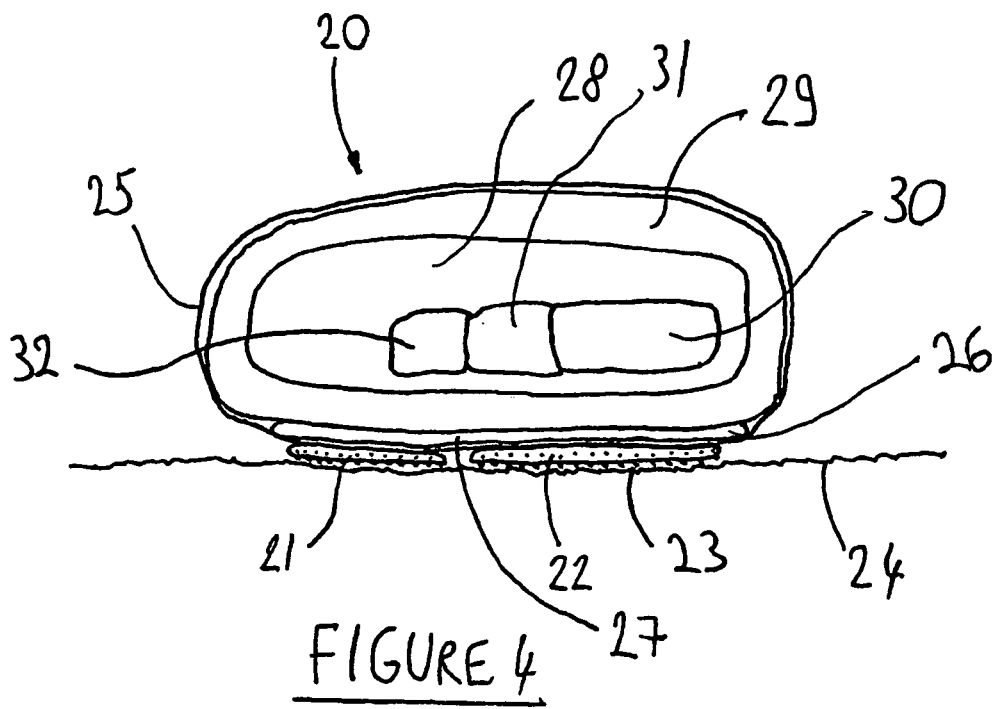


FIGURE 3



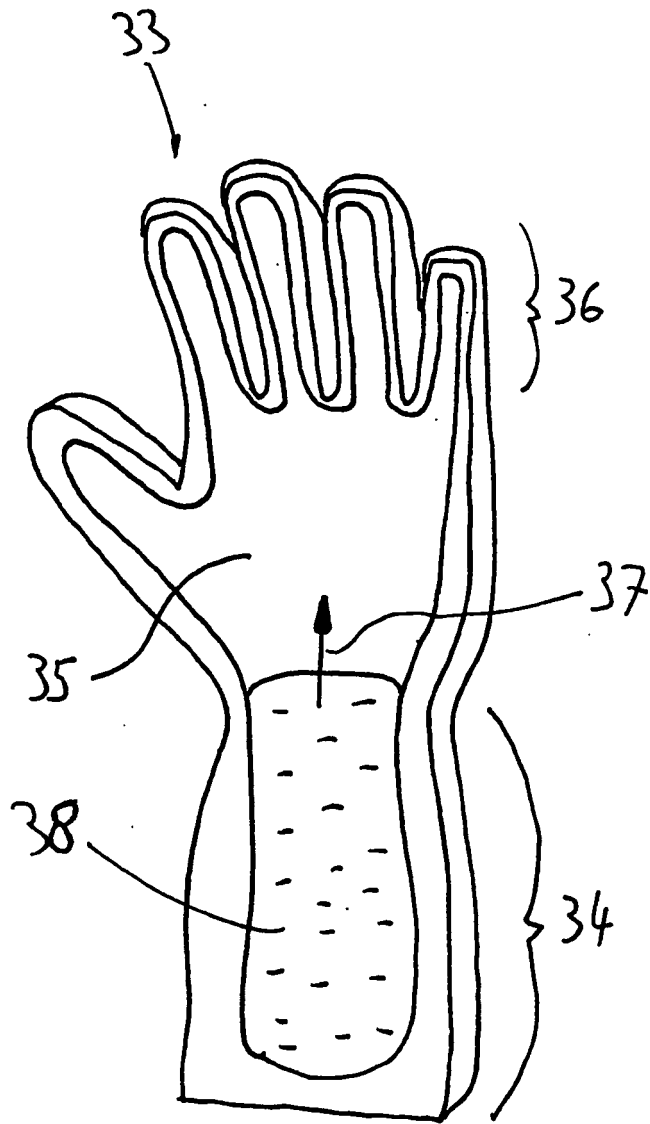


FIGURE 5

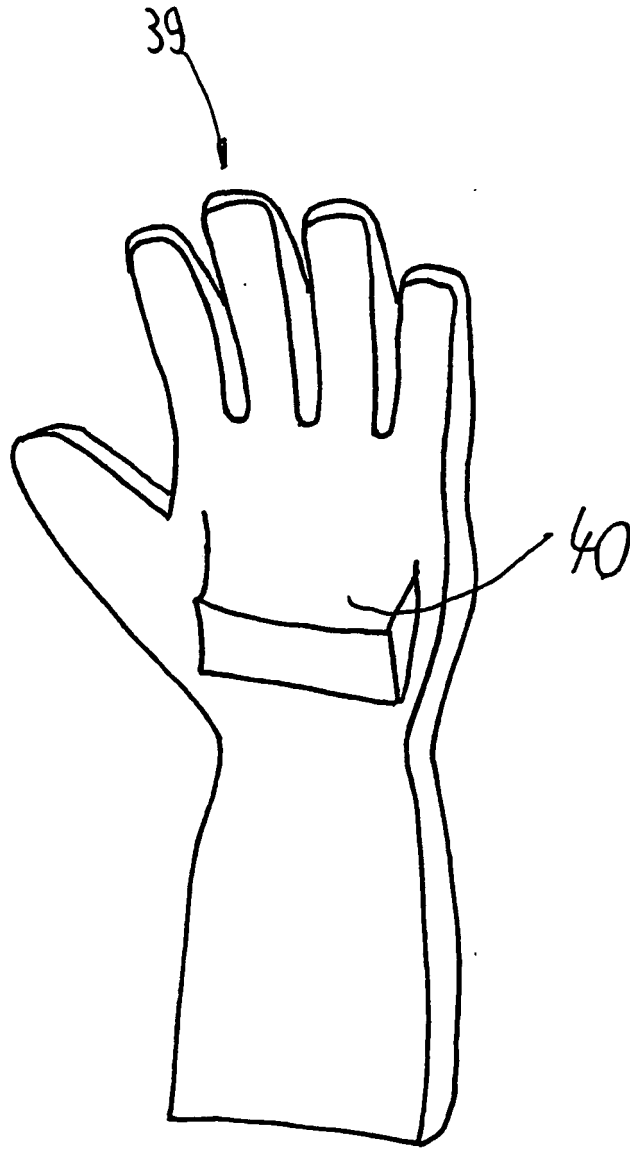


FIGURE 6

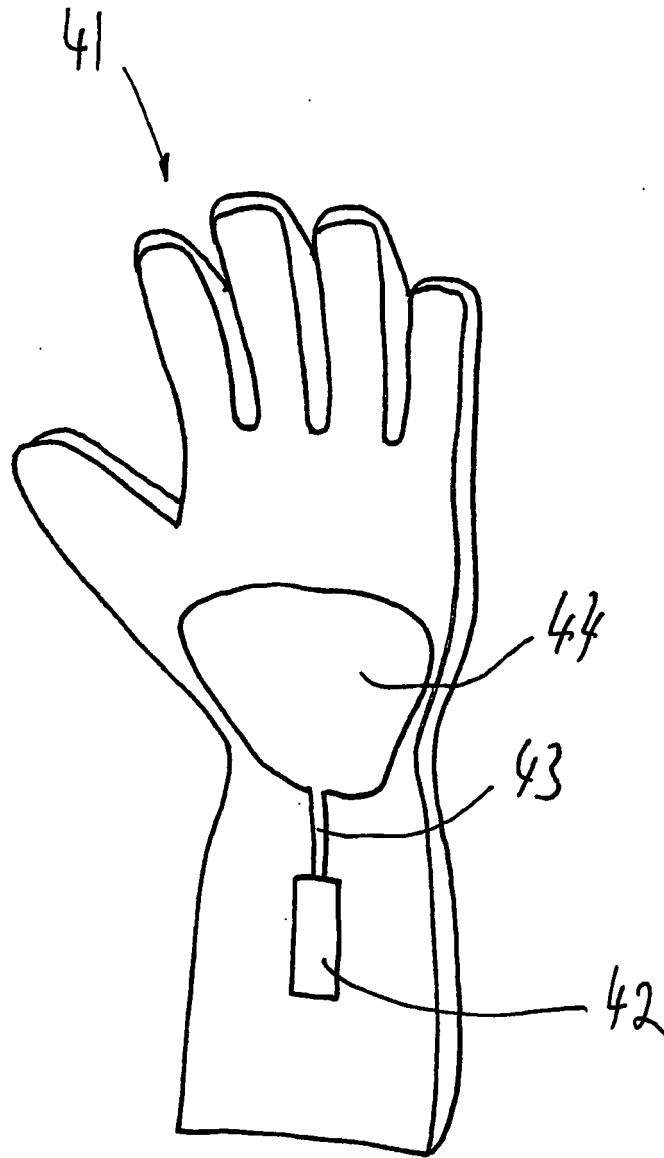


FIGURE 7

REFERENCES CITED IN THE DESCRIPTION

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