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(54) Title: STRAP HAVING AT LEAST ONE CLIP

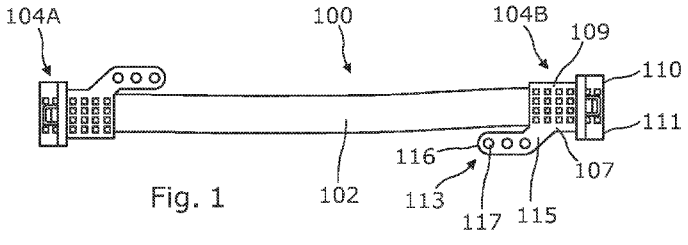


Fig. 1

(57) Abstract: A strap (100) includes an elongate flexible member (102) and at least one clip (104). The elongate flexible member is formed of first and second materials, the first material having a melting point corresponding to a melting point of a material at least partially forming the clip.

Strap Having At Least One Clip

The present invention relates to a strap having at least one clip.

Straps are used for various purposes, e.g. as carrying handles or closures on bags and the like. In many cases clips are used to connect the straps to another component or object. An important use for straps with clips is as safety helmet cradles, where they are used to comfortably fit the helmet on the head of a user. These straps include clips at their ends that fit into suitable slots arranged around the interior of the helmet. Typically, two or more straps are arranged in a criss-cross fashion.

The connection between the strap and its clips needs to be sufficiently strong to withstand impact to the helmet, otherwise there is a risk that a strap can become loose, causing the helmet to slip and allowing injury to the wearer's head. Conventionally, in order to attach the clip to the strap, the end of a strap is passed through a slot in a preformed clip and then looped round and fixed to an inner portion of the strap by stitching or ultrasonic welding.

However, such fixing is difficult to achieve in an automated manufacturing process and either needs to be done by hand, or requires a special robot to "fold over" the strap end and transfer of the strap and the clip between stations to perform the fixing operation. It is also known to form a clip on a strap by over-moulding a clip onto the end of a conventional strap made of a single type of material. However, with such conventional over-moulding there is no strong connection between the clip and the strap and so clip needs to be positioned so that the strap is not directly pulled when in situ in a safety helmet. A known way of addressing this issue is to add friction by turning the clip 180° and wrapping

the strap around it to align with the direction of pulling; however, this can cause automation hindrance in the assembly process. All these complications have time and cost implications for manufacturers.

Embodiments of the present invention are intended to address at least some of the abovementioned problems. Embodiments of the invention allow the clip to be formed directly onto a strap during a moulding process and do not require an end of the strap to be looped round and fixed to another portion of the strap.

According to a first aspect of the present invention there is provided a strap having at least one clip, the strap including:

an elongate flexible member, and

at least one clip,

wherein the elongate flexible member is formed of first and second materials, the first material having a melting point corresponding to a melting point of a material at least partially forming the clip.

The second material will normally have a melting point higher than the melting point of the first material (and the clip material). The second material and the clip material are chemically compatible so that they form a structure upon heating. Having the melting point the first material corresponding to the melting point of the material forming the clip (as well as the chemical compatibility of these materials) means that fusion between the clip and the elongate flexible member can occur during heating, such as during an over-moulding process. The melting point of the first material and the clip material may “correspond” by being within, say, around 5ºC of each other, or are both

lower than the melting point of the other strap material.

Typically, a melting point of the second material can be higher than that of the first material (and the clip material) so that no fusion between the second material and the clip material occurs during the heating.

The elongate flexible member may comprise a fabric formed of the first and the second materials. The first and the second materials may be weaved together, e.g. where threads of the first material are arranged in one direction and threads of the second material are weaved through/between the first material in a second direction. For example, the first material may comprise wefts of the fabric and the second material may comprise warps of the fabric. The weave may be a plain weave, or a V weave.

In one embodiment the clip material comprises mainly or exclusively of polypropylene. The first material of the flexible elongate member may comprise polypropylene and the second material may comprise polyester.

The clip may be fused at or adjacent at least one end of the flexible elongate material. A portion, typically an end, of the flexible elongate member may be encased within a body the clip. The end of the flexible elongate member may not pass out through the body of the clip. In use, the clip may engage with a clip inside a safety helmet. The strap may comprise a safety helmet cradle strap.

According to a further aspect of the present invention there is provided a safety helmet including at least one strap substantially as described herein.

According to yet another aspect of the present invention there is provided a strap having at least one clip, the strap including:

an elongate flexible member, and

at least one clip,

wherein the elongate flexible member is formed of first and second materials, the first material and a material at least partially forming the clip having melting points lower than a melting point of the second material.

According to a further aspect of the present invention there is provided a strap having at least one clip, the strap including:

an elongate flexible member, and

a clip,

wherein an end of the strap is located within a main body of the clip.

The end of the strap may not pass out of the main body and may not be looped round to be attached to another portion of the strap.

According to another aspect of the present invention there is provided a safety helmet cradle including at least one strap fitted with at least one clip substantially as described herein.

According to a further aspect of the present invention there is provided a method of forming a strap having at least one clip, the method including

placing an elongate flexible member formed of first and second materials into a mould tool;

heating a material for forming a clip of the strap to at least its melting point and transferring the heated clip material into the mould tool,

wherein the second material of the elongate flexible member has a melting point corresponding to the melting point of the clip material.

An end of the strap may be embedded within the formed clip.

Whilst the invention has been described above, it extends to any inventive combination of features set out above or in the following description. Although illustrative embodiments of the invention are described in detail herein with reference to the accompanying drawings, it is to be understood that the invention is not limited to these precise embodiments. As such, many modifications and variations will be apparent to practitioners skilled in the art. Furthermore, it is contemplated that a particular feature described either individually or as part of an embodiment can be combined with other individually described features, or parts of other embodiments, even if the other features and embodiments make no mention of the particular feature. Thus, the invention extends to such specific combinations not already described.

The invention may be performed in various ways, and, by way of example only, embodiments thereof will now be described, reference being made to the accompanying drawings in which:

Figure 1 shows a first example of a safety helmet cradle strap with clips fixed to each end;

Figure 2 shows a plan view of a schematic illustration of apparatus for manufacturing the strap, and

Figure 3 shows three straps fixed inside a safety helmet.

Referring to Figure 1, an example safety helmet cradle strap 100 comprises a flexible elongate member 102 having clips 104A, 104B fixed to each of its ends. The flexible elongate member typically comprises a fabric formed of at least two different materials. Typically, two different materials will be used, but in alternative embodiments more than that number may be used.

The fabric may be woven and the warps of the weave may be formed by one of the materials and the wefts by another of the material(s). The weave may be a plain weave, or a V weave, for instance. In one example, the material used for the wefts (26 in number) of the woven fabric comprises polypropylene and the material used for the warps (44 in number) comprises polyester. However, it will be understood that these are examples only and other materials, such as polyamide (nylon) could be used. In one example the strap has a length of around 270 – 305 mm, a width of about 15 – 25 mm.

Clip 104A has a rectangular main body 107 having square/rectangular apertures 109 in a generally grid-like arrangement, which can reduce the overall weight. The clip generally has a thickness of around 3 mm and the main body 107 has dimensions of approximately 25 mm x 25 mm. The clip also has an enlarged rectangular end portion 110 of around 38 mm x 15 mm.

The end portion also includes a grid-like arrangement of rectangular indentations/apertures 111. The end of the strap 102 extends to a point about 1 – 2 mm from the outer edge of the end portion 110. A dogleg type projection 113 extends outwardly from the side of the main body 107. The projection includes a first angled portion 115 extending at an angle of around 45º with respect to the side of the main body. Extending from that first portion is another elongate portion 116 that is parallel to the main length of the strap 104. The elongate portion includes a row of circular apertures 117, which, in use, attach to bulbous pin-like features on a strap component inside the helmet.

The clip 104B at the other end of the strap is substantially identical, except that it is arranged so that its dogleg portion is positioned on the opposite

side edge of the strap. In other embodiments there are no dogleg portions and it will be understood that the shape and dimensions of the clip can vary from the example shown and that different types of clips may be attached to different ends (or other portions) of the straps. In some cases only one end of the strap may be fitted with a clip.

Each clip is also mainly or exclusively formed of at least one material that has a melting point corresponding to a melting point of one of the strap materials. In one example the clip is also formed of polypropylene. Polypropylene has a melting point of around 230ºC, whilst polyester has a melting point of around 260ºC. Further, the materials used for the clip and in the strap are chemically compatible so that when a portion of the strap and the clip materials are in contact with each other and heated during a manufacturing process (as described below) to around 230ºC and then cooled, the polypropylene in the strap portion can fuse/meld/bond with the clip to form an integrated structure, whilst the polyester in the strap portion remains stable, retaining the integrity of the portion. Whilst in this example the strap wefts and the clip are formed of the same material, it will be appreciated that this need not be the case and that one of the strap materials and the clip can be formed of different materials, provided their melting points correspond (e.g. are within, say, around 5ºC of each other, or are both lower than the melting point of the other strap material). The present inventors have found that it is best to have fabric warps with a higher melting point than the fabric weft because this results in the strongest bond between the clip and the strap. Statistics for the strap used in the example are given below:

Polyester / polypropylene webbing

Width 20mm +0mm -0.5mm

Warp 44 ends of 550 decitex polyester

Weft 26 picks per inch of 440 decitex polypropylene

Weight 4.66 grams per metre

The inventors experimented with various combinations of strap materials (e.g. fabrics comprising various combinations of nylon, polyester and polypropylene) and clip materials (e.g. high density polyethylene, low density poly ethylene, polypropylene, polyamide (nylon), polyester and ABS), but found that the above combination of a polypropylene and polyester strap and polypropylene clip resulted having the best fusion, ideal stretch properties, low weight and low manufacturing costs. However, other combinations of materials can be used. For example, members of the polyolefin group other than polypropylene could be used.

Figure 2 illustrates schematically apparatus for manufacturing the safety helmet cradle straps. In use, a clip set mould tool is loaded into a press machine 202. One or more webbing lengths 204 (e.g. of mixed yarn Polyester/Polypropylene) is/are then placed into the Clip Set mould tool 206. This step can be automated by means of a robot arm 207 or performed manually. The tool cavities are then closed, clamping the webbing in place. The press machine is heated to at least the melting temperature of Polypropylene (but not as high as the melting temperature of polyester) and Polypropylene polymer is injected into the tool cavities, moulding over and encapsulating the ends of the webbing. The tool cavities are opened and the overmoulded

clip/webbing sets are removed from the mould tool. Again, this step can be automated by means of a robot arm or performed manually. The tool may mould clips on both ends of the strap substantially simultaneously, or a clip may be formed at one end first and then the other end of the strap is placed in the moulding toold. The overmoulded clip/webbing sets can be transferred to a helmet assembly location, e.g. manually or by robot arm. The overmoulded clip/webbing may be clipped onto a strap component to form the harness assembly. The clips of the harness assembly are then pushed into corresponding clip slots in a helmet shell moulding. Helmet finishing steps can include label attachment, potential printing requirements and packing operations. Thus, the clip is formed directly onto the strap during the moulding process and so there is no need to loop round part of the to attach it to another portion of the strap when fixing the clip. Further, the strap can be held in tension through the formation of the clip, which can help ensure that the fixing is secure.

Figure 3 shows an example set of three straps fixed inside a safety helmet 300 to form a cradle.

In contrast to forming clips on straps using over-moulding using a conventional single-material strap, embodiments of the present invention result in a chemical bond between one of the materials forming the strap material and the material forming the clip. Such a bond is not present when chemically incompatible materials are used. Having a bond between the strap and the clip in straps according to embodiments of the present invention means that the connection is sufficiently strong to withstand direct pulling, thereby eliminating the need to wrap the strap around the clip or the like for safety.

Although the main example application of the strap described above relates to safety helmet cradle straps, it will be understood that straps formed as described herein can be used for various purposes, including any product that uses webbing straps for a stress/performance critical purpose, such as fall arrest harnesses, parachute harnesses, sport harnesses, etc.

CLAIMS

1. A strap (100) having at least one clip, the strap including:

an elongate flexible member (102), and

at least one clip (104),

wherein the elongate flexible member is formed of first and second materials, the first material having a melting point corresponding to a melting point of a material at least partially forming the clip.

2. A strap according to claim 1, wherein the second material of the elongate flexible member (102) has a melting point higher than the melting point of the first material (and the melting point of the clip (104) material).

3. A strap according to claim 2, wherein the second material of the elongate flexible member (102) and the clip (104) material are chemically compatible so as to form a structure upon heating.

4. A strap according to claim 3, wherein the first material of the elongate flexible member (102) and the clip (104) are fused together during a heating process.

5. A strap according to claim 4, wherein the heating process comprises an over-moulding process.

6. A strap according to any one of the preceding claims, wherein the melting point of the first material of the elongate flexible member (102) and the melting point of the clip (104) material are within 5ºC of each other.

7. A strap according to any one of claims 1 to 5, wherein the melting point of the first material of the elongate flexible member (102) and the melting point of the clip (104) material are both lower than the melting point of the second

material of the elongate flexible member.

8. A strap according to claim 4 or 6, wherein the melting point of the second material of the elongate flexible member (102) is higher than the melting point of the first material (and the clip (104) material) so that no fusion between the second material and the clip material occurs during the heating.

9. A strap according to any one of the preceding claims, wherein the elongate flexible member (102) comprises a fabric formed of the first and the second materials.

10. A strap according to claim 9, wherein the first and the second materials are woven together.

11. A strap according to claim 10, wherein threads of the first material are arranged in one direction and threads of the second material are weaved through/between the first material in a second direction.

12. A strap according to claim 11, wherein wefts of the fabric comprise the first material and warps of the fabric comprise the second material.

13. A strap according to any one of claims 9 to 12, wherein the weave comprises a plain weave or a V weave.

14. A strap according to any one of the preceding claims, wherein the clip (104) material comprises mainly or exclusively of polypropylene.

15. A strap according to any one of the preceding claims, wherein the first material of the flexible elongate member (102) comprises polypropylene and the second material comprises polyester.

16. A strap according to any one of the preceding claims, wherein the clip (104) is fused at or adjacent at least one end of the flexible elongate material

(102).

17. A strap according to claim 16, wherein an end of the flexible elongate member (102) is encased within a body (107) of the clip (104).

18. A strap according to claim 17, wherein the end of the flexible elongate member (102) does not pass out through the body (107) of the clip (104).

19. A strap according to any one of the preceding claims, wherein the strap (100) comprises a safety helmet cradle strap.

20. A strap (100) having at least one clip, the strap including:

an elongate flexible member (102), and

at least one clip (104),

wherein the elongate flexible member is formed of first and second materials, the first material and a material at least partially forming the clip having melting points lower than a melting point of the second material.

21. A strap (100) having at least one clip, the strap including:

an elongate flexible member (102), and

a clip (104),

wherein an end of the strap is located within a main body (107) of the clip and does not pass out of the main body.

22. A safety helmet (300) including at least one strap (100) according to any one of the preceding claims.

23. A safety helmet cradle including at least one strap (100) according to any one of the preceding claims.

24. A method of forming a strap (100) having at least one clip, the method including

placing a portion of an elongate flexible member (102) formed of first and second materials into a mould tool (206);

heating a material for forming a clip (104) of the strap to at least its melting point and transferring the heated clip material into the mould tool to fuse around the portion of the elongate flexible member,

wherein the second material of the elongate flexible member has a melting point corresponding to the melting point of the clip material.

25. A method according to claim 24, wherein the portion of the elongate flexible member comprises an end of the strap.

26. A strap substantially as described herein and/or with reference to the accompanying drawings.

27. A safety helmet cradle substantially as described herein and/or with reference to the accompanying drawings.

28. A method of forming a strap substantially as described herein and/or with reference to the accompanying drawings.

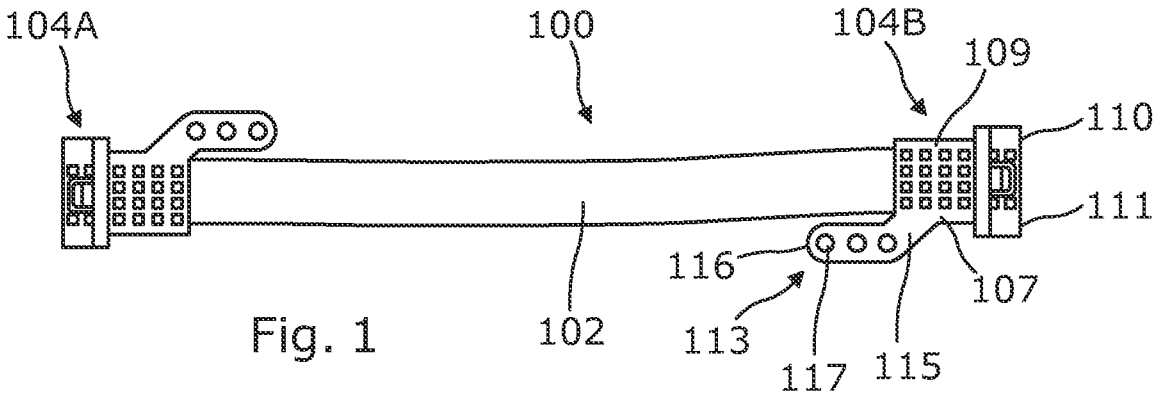


Fig. 1

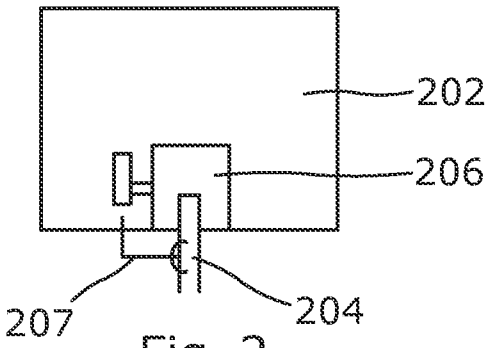


Fig. 2

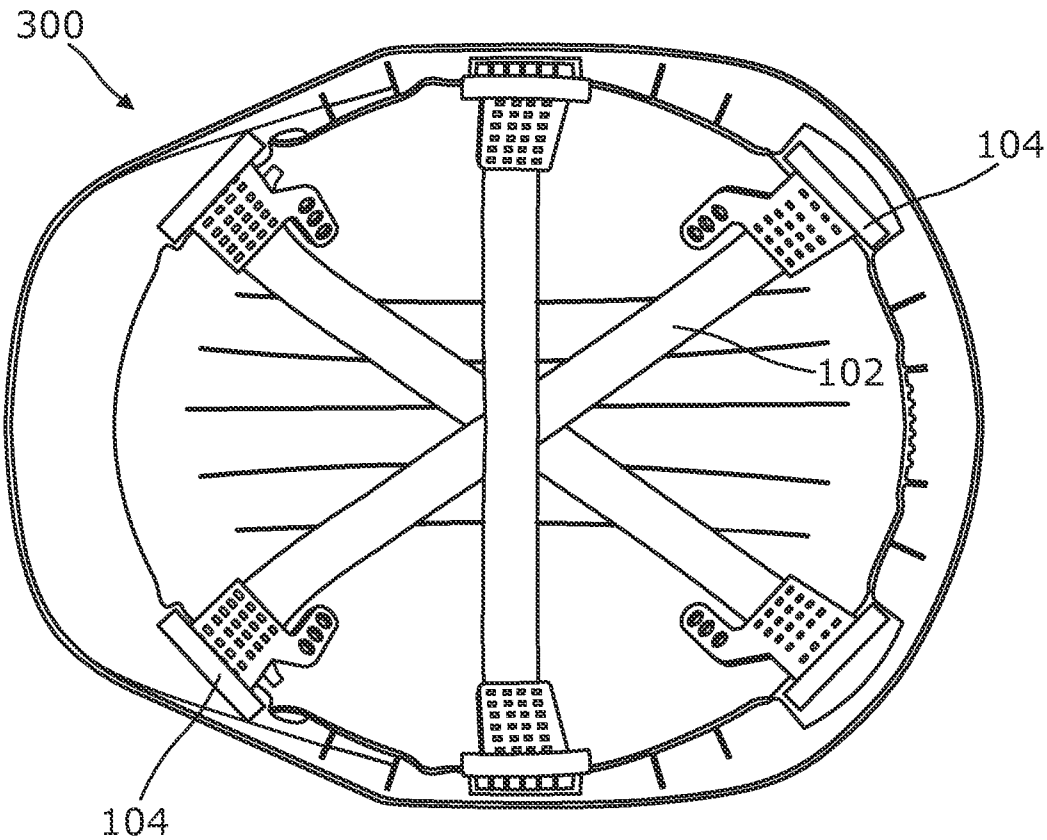


Fig. 3

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2011/052332

A. CLASSIFICATION OF SUBJECT MATTER
INV. A42B3/14 A42C2/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A42B A44B B29C A42C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2002/116749 A1 (BIELEFELD ERIC [US] ET AL) 29 August 2002 (2002-08-29)	21-23
A	paragraphs [0031], [0032], [0042] - [0045]; claims 1,13; figures 8,9,13	1,20,24
X	DE 299 14 894 U1 (ENHA KUNSTSTOFFVERARBEITUNGS G [DE]) 4 January 2001 (2001-01-04)	21-23
A	page 6, line 21 - page 7, line 18; figures 2,3	1,20,24
X	US 4 760 714 A (MOCK ELMAR [CH] ET AL) 2 August 1988 (1988-08-02)	21
A	claim 1; figure 1	1,24
X	FR 2 108 656 A5 (CINVA SA) 19 May 1972 (1972-05-19)	21
A	claim 1; figure 1	1,24

-/--

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
1 March 2012	08/03/2012

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	D'Souza, Jennifer

INTERNATIONAL SEARCH REPORT

International application No.
PCT/GB2011/052332

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☒ Claims Nos.: 26-28
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
see FURTHER INFORMATION sheet PCT/ISA/210

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box II.2

Claims Nos.: 26-28

The term "substantially as described herein and/or with reference to the accompanying drawings" used in claims 26 - 28 is vague and unclear and leave the reader in doubt as to the meaning of the technical features to which they refer, thereby rendering the definition of the subject-matter of said claims unclear, Article 6 PCT. As such a meaningful search of these claims is not possible.

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure. If the application proceeds into the regional phase before the EPO, the applicant is reminded that a search may be carried out during examination before the EPO (see EPO Guideline C-VI, 8.2), should the problems which led to the Article 17(2) declaration be overcome.

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2011/052332

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 1 775 110 A1 (ISE INTEX GMBH [DE]) 18 April 2007 (2007-04-18) claim 18 -----	24

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/GB2011/052332

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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