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(54) **Strip hinge composed of flexible strips of fiber reinforced synthetic material**

(57) The present invention relates to a hinge (10) for hingedly connecting a first and a second device (11, 12) along at least part of a length of a hinge axis (4) between them. The hinge (10) of the present invention comprises a first layer (1) of a first fibre reinforcing material and an opposite second layer (2) of a second fibre reinforcing material, the first layer (1) of the first fibre reinforcing material being connected to the second layer (2) of the second fibre reinforcing material over at least part of the length of the hinge axis (4), the connection defining on

opposite sides thereof a hingedly connected first and a second part (5, 6) comprising the opposite first and second layers of fibre reinforcing material (1, 2). The hinge of the present invention is suitable for use in a wide variety of applications, for example the hinged connection of a door to a container, the hinged connection of two or more panels, the hinged connection of a door to a wall of a building or an air plane, roller doors comprising a plurality of door panels hingedly connected to each other.

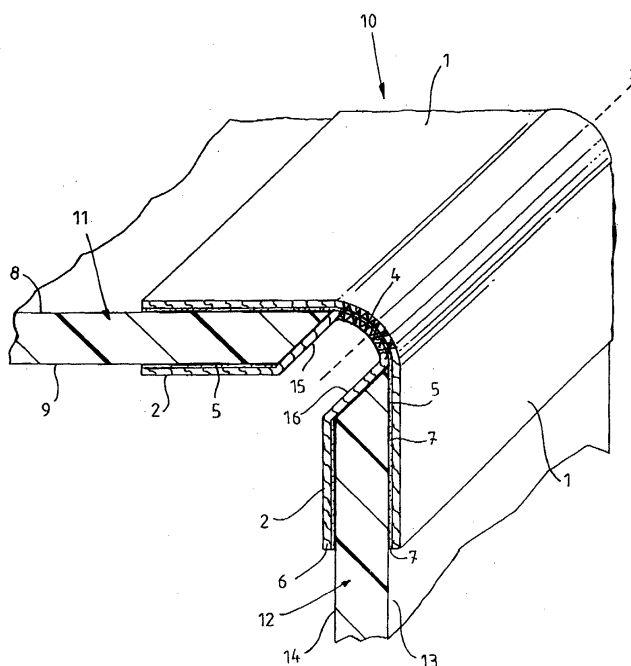


Fig. 1

Description

[0001] The present invention relates to a hinge for hingedly connecting a first and a second device along at least part of a length of a hinge axis between them, according to the preamble of the first claim.

[0002] The hinges known in the art consist of two parts rotatably mounted with respect to each other through a pin. Along the side of the first part that contacts a corresponding side of the second part, one or a plurality of cylindrical protrusions are provided, which are to be received in corresponding recesses on the second part. Likewise, along the side of the second part contacting the corresponding side of the first side, one or a plurality of annular protrusions are provided, which are to be received in corresponding recesses on the first part. The first and second part are connected by aligning the central hole of the annular protrusions on the first and second part and by passing a pin through the aligned central holes. In practice, usually the first hinge part is mounted to or provided on a first panel, the second part being mounted to or provided on a second panel.

[0003] These known hinges however present the disadvantage that the annular protrusions of the first and second part need to be well aligned to allow mounting the hinge. This has been found to be particularly laborious in case the annular protrusions of the hinge and the panel to which are provided, are made from one part.

[0004] It is the aim of the present invention to provide a new hinge, which may be produced in a simple manner and which is suitable for use with a large variety of materials and devices.

[0005] This is achieved according to the present invention with the technical features of the first claim.

[0006] The hinge of the present invention comprises

(a) a first layer or sheet of a first fibre reinforcing material and an opposite second layer of a second fibre reinforcing material. The first and second fibrous reinforcing material may be the same or different.

(b) the first layer of the first fibre reinforcing material is connected to the second layer of the second fibrous reinforcing material at the position of the hinge axis, over at least part of the length of the hinge axis.

(c) On opposite sides of the connection of the first layer of fibrous reinforcing material and the second layer of fibrous reinforcing material, hingedly connected first and a second parts are defined. The first part comprises a part of the opposite first and second layers of fibre reinforcing material on one side of the connection. The second part comprises a part of the opposite first and second layers of fibre reinforcing material on the opposite side of the connection.

[0007] The hinge of the present invention being made

of a composite material presents the advantages of being suitable for use with a large variety of devices, shapes and materials that need to be hingedly connected. The shape of the hinge, in particular the shape of the first and second part that are connected to respectively the first and second device, easily adapts itself to the shape of the devices to be connected. This in contrast to the state of the art hinges the shape of which has to be adapted to the devices to be connected already in the production stage thereof. This versatility of the composite material is combined with a reduced weight as compared to existing hinges, while providing improved resistance to wearing, combined with the property that the hinge may be rotated over an angle of more than 180°, often 270° or even 360° without necessitating any adaptation of the mechanical construction of the hinge or the use of dedicated parts. This is particularly advantageous when envisaging the use of the hinge of this invention for connecting a container door to a container.

[0008] In the hinge of this invention, the first and second layer comprise a sheet, a fabric or mat of a woven or non-woven, a stitched non-crimp fabric or a braided fabric of fibrous reinforcing material. The connection of both layers is facilitated when using a woven, braided or stitched non-crimp fabric or mat, the fibres extending under an angle of between 0 and 180° with respect to the hinge axis. Nevertheless, an angle between 30° and 60° and between 120° and 150° with respect to the hinge axis is preferred as in that way an optimum reinforcement at the position of the hinge axis is obtained. To improve the mechanical stability of the hinge it is preferred that the fibrous reinforcing material is built up of fibres that extend in various directions, in particular it is preferred that the fibrous material is built up of fibres extending in perpendicular directions. The man skilled in the art will be able to choose the appropriate fibrous reinforcing material depending on the intended use of the hinge and the loads to which the hinge is to be subjected.

[0009] The first and second layer of fibrous reinforcing material may be connected to each other by any means and in any way known to the man skilled in the art. For example the first and second layer may be chemically bonded to each other, be connected by means of an adhesive or be mechanically connected, the latter mechanical connection being preferred.

[0010] The mechanical connection may be achieved according to any method known to the man skilled in the art and will usually be adapted by the man skilled in the art to the nature of the fibrous reinforcing material of which the first and second layer are made. The mechanical connection may for example be achieved through welding, stapling, needling, braiding, knitting, tufting or flocking. The direction in which the connection is established is not critical to the invention and will usually be adapted by the man skilled in the art to the nature of the first and second fibrous reinforcing material. In order to

obtain an optimum connection and to minimise the risk to deformation of the connection and shifting of the connected panels with respect to each other in length direction of the hinge axis, the connection is preferably established in a zigzag manner. The zigzag preferably extends under an angle of between 30 and 60° with respect to the hinge axis.

[0011] The first and second layer may be made of the same or a different of fibrous reinforcing material. The first and second layer may comprise one single layer of fibrous reinforcing material or a plurality of superimposed layers, that may be connected to each other or not. Suitable fibrous reinforcing materials for use with the present invention comprise metal fibres, mineral fibres for example glass fibres, carbon fibres, wool, cotton, flax etc.; synthetic fibres for example polyester, polypropylene, polyethylene, polyamide or mixtures of two or more of these fibres. However, because of its high elongation to break ratio, the use of aramid fibres is preferred. It is however also possible to use twined or twisted fibres, even if the basic material of which they are made has a lower elongation to break ratio. The twisting and twining techniques have been found to improve the elongation to break ratio.

[0012] After having been connected to each other, the first and second layer are impregnated with a thermoplastic material or a mixture of two or more thermoplastic materials, a thermosetting resin or a mixture of two or more different thermosetting resins, an elastomeric material or a mixture of two or more elastomers, or a mixture of two or more thermoplastic materials, thermosetting resins and elastomers. However, elastomers and thermoplastic materials are preferred as they show a good flexibility at room temperature or bending strain, combined with a good bending strength. The thus impregnated fibrous reinforcing material offers the advantage of being a thermal insulator and of providing a good resistance to wearing. Moreover, although the fibrous reinforcing material is rather supple, after impregnation and mounting to the devices to be connected, it shows a sufficient strength combined with the flexibility needed to allow rotating the hingedly connected first and second devices with respect to each other. Furthermore, it may be easily built in a wide variety of plastic materials in such a way that the connection of the fibrous reinforcing sheets is hardly visible.

[0013] Within the scope of this invention, a wide variety of thermoplastic materials may be used, amorphous materials, crystalline as well as semi-crystalline materials. By selecting the appropriate material a more or less supple hinge or a hinge with a better strength and wearing resistance may be obtained. Examples of suitable thermoplastics include one or more materials selected from the group of polyurethane, polyethylene, polypropylene, ethylene-propylene copolymers, polybutadiene rubber or a mixture thereof. Within the scope of this invention, a wide variety of thermosetting resins may be used for impregnating the fibrous reinforcing material,

for example a material selected from the group of polyurethane, vinylester resins, unsaturated polyester resins, or a mixture of two or more of these materials. Examples of suitable elastomers include polyurethane, polypropylene, ethylene-propylene copolymers, polybutadiene rubber. These materials may be crystalline, semi crystalline or amorphous, depending on the envisaged flexibility and load bearing capacity.

[0014] The invention also relates to an assembly comprising a first and a second device that are hingedly connected to each other by means of the above described hinge.

[0015] In this assembly, the opposite layers of first and second fibre reinforcing material at a first side of the connection defining the first part, define between them a first free space for receiving a first device. Similarly, the opposite layers of first and second fibre reinforcing material of the second part define the second part with a second free space for receiving a second device.

[0016] It is however preferred to connect opposite first and second sides of the first device to respectively the first and second layer of the first part, and to connect opposite first and second sides of the second device to respectively the first and second layer of the second device.

[0017] The present invention also relates to a container comprising a container wall hingedly connected to a container door by means of the hinge of the present invention.

[0018] The invention is further elucidated in the appending figure and figure description.

[0019] Figure 1 shows a view to the hinge of the present invention.

[0020] The hinge 10 of the present invention comprises a first 1 and a second 2 layer of a fibrous reinforcing material, that are connected to each other along a hinge axis 3. The fibrous reinforcing material is impregnated with an elastomeric material, a thermoplastic material or a thermosetting resin or a combination of two or more of these materials.

[0021] The connection 4 may be continuous or may be interrupted, and may extend over the entire length of the hinge axis or over only part thereof, depending on the intended use of the hinge 1. The connection 4 will usually extend over a certain width, which will be adapted to the nature of the fibrous reinforcing material 1, 2, the technique with which the connection is achieved, the nature of the material used to effectuate the connection and the nature of the devices that need be connected.

[0022] As can be seen from figure 1, the first layer 1 extends substantially flat. At the position of the connection 4, on both sides thereof, the second layer 2 is bent 15, 16 towards the first layer 1 so as to contact the first layer 1 at the position of the connection 4. In that way on opposite sides of the connection 4 a first and second pocket 5, 6 are formed for receiving a first and second device 11, 12 that need to be hingedly connected. It is however preferred to use the hinge 10 of the present

invention for connecting a first and a second panel 11, 12.

[0023] To improve the functioning of the assembly, and to allow mounting the first and second panel 11, 12 at widely varying angles with respect to each other, the first and second panel 11, 12 will usually have in the vicinity of the connection 4, respectively a first and a second end part with a complementary shape.

[0024] Because of its nature, the hinge 1 of the present invention is suitable for hingedly connecting a wide variety of devices. Suitable examples include the hinged connection of a door to a container, the hinged connection of two or more panels, the hinged connection of a door to a wall of a building, an air plane, roller doors comprising a plurality of door panels hingedly connected to each other. When properly selecting the material of the door and the material of which the hinge is made, a fireproof door construction can be obtained.

[0025] To achieve a sturdy connection, opposite faces 8, 9 of the first panel 11 are connected to respectively the first and second layer of impregnated fibrous reinforcing material 1, 2.

[0026] The connection of both faces 8, 9 of the first panel may be effectuated using the same technique and the same material or in a different manner or using different materials. The connection may be established mechanically, for example through stapling, by means of screws, or through chemical bonding, for example by means of an adhesive or a compound which is capable of chemically reacting with both the material of the first panel 11 and the impregnation material for the first and/or second fibrous reinforcement 1, 2. Opposite faces 13, 14 of the second panel 12 are connected to respectively the first and second layer of impregnated fibrous reinforcing material 1, 2 in the same or a different manner as compared to the first panel 11.

[0027] For aesthetic reasons as well as for the sake of providing a sufficiently strong connection, the contact surface 7 between the first and second layer of impregnated fibrous reinforcing material 1, 2 and the first and second panel 11, 12 will be sufficiently large.

[0028] The assembly of the present invention may further comprise means for locking the first device to a further device or to a frame to which the first device is mounted. In practise, the assembly of the present invention may comprise locking means for locking the first or second panel or both to a frame or a further panel. Thereto, the side of the first or second panel 1, 2 facing the frame is provided with a protrusion and the frame or further panel are provided with a corresponding recesses for releasably receiving the protrusion. The releasable locking may be accomplished in any manner known to the man skilled in the art, for example in a mechanic manner, by means of co-operating magnets.

[0029] In a preferred embodiment, the frame is made of a composite material and comprises a hollow part. The hollow part is for example connected to a pressure device or contains mechanical means for expanding the

hollow part. The protrusion on the first panel 1 comprises means for engaging this recess. When locked into the recess, unlocking of the protrusion is achieved by applying a pressure to the hollow part of the frame or by mechanically expanding the hollow part.

Claims

1. A hinge (10) for hingedly connecting a first and a second device (11, 12) along at least part of a length of a hinge axis (4) between them, **characterised in that** the hinge (10) comprises a first layer (1) of a first fibre reinforcing material and an opposite second layer (2) of a second fibre reinforcing material, the first layer (1) of the first fibre reinforcing material being connected to the second layer (2) of the second fibre reinforcing material over at least part of the length of the hinge axis (4), the connection defining on opposite sides thereof a hingedly connected first and a second part (5, 6) comprising the opposite first and second layers of fibre reinforcing material (1, 2).
2. A hinge as claimed in claim 1, **characterised in that** the first and second layer (1, 2) comprise a fabric, a mat, a stitched non-crimp fabric or a braided fabric of a fibrous reinforcing material.
3. A hinge as claimed in claim 1 or 2, **characterised in that** at the position of the hinge axis (4), the fibres extend with respect to the hinge axis under an angle which varies between 0 and 180°, preferably between 30 and 150°.
4. A hinge as claimed in any one of claims 1-3, **characterised in that** the first and second layer are impregnated with a thermoplastic material or a mixture of two or more thermoplastic materials, a thermosetting resin or a mixture of two or more different thermosetting resins, an elastomer or a mixture of two or more elastomers, or a mixture of two or more thermoplastic materials, thermosetting resins and elastomers.
5. A hinge as claimed in claim 4, **characterised in that** as a thermoplastic material use is made of a material selected from the group of polyethylene, polypropylene, ethylene-propylene copolymers, polybutadiene rubber, polyurethane, or a mixture thereof, the thermoplastic material being amorphous, crystalline or semi-crystalline.
6. A hinge as claimed in claim 4, **characterised in that** as an elastomeric material use is made of a material selected from the group of polyurethane, polypropylene, ethylene-propylene copolymers, polybutadiene rubber, the elastomeric material being amor-

phous, crystalline or semi-crystalline.

7. A hinge as claimed in claim 4, **characterised in that**
as a thermosetting resin use is made of a material
selected from the group of polyurethane, vinyl ester
resins, unsaturated polyester resins, or a mixture of
two or more of these materials. 5

8. An hinge as claimed in any one of claims 1-7, **characterised in that** the first and second layer of fibrous reinforcing material are mechanically connected to each other. 10

9. A hinge as claimed in claim 8, **characterised in that**
the first and second layer are connected to each
other through stitching, needling, braiding, tufting or
flocking. 15

10. A hinge as claimed in any one of claims 1-9, **characterised in that** the first layer (1) extends substantially flat, and **in that** at the position of the connection (4), the first and second part of the second layer (2) bend towards the first layer. 20

11. An assembly comprising a first and a second device
hingedly connected to each other by means of a
hinge, **characterised in that** use is made of a hinge
(10) as claimed in any one of claims 1-9, the opposite
layers of first and second fibre reinforcing material (1, 2) of the first part defining a first free space (5) between them for receiving the first device (11). 25 30

12. An assembly as claimed in claim 11, **characterised in that** the opposite layers of first and second fibre reinforcing material (1, 2) of the second part define between them a second free space (6) for receiving the second device (12). 35

13. An assembly as claimed in claim 11 or 12, **characterised in that** opposite first and second sides (8, 9) of the first device (11) are connected to respectively the first and second layer (1, 2) of the fibrous reinforcing material of the first part (5). 40

14. An assembly as claimed in claim 12 or 13, **characterised in that** opposite first and second sides of the second device (12) are connected to respectively the first and second layer (1, 2) of the fibrous reinforcing material of the second part (6). 45

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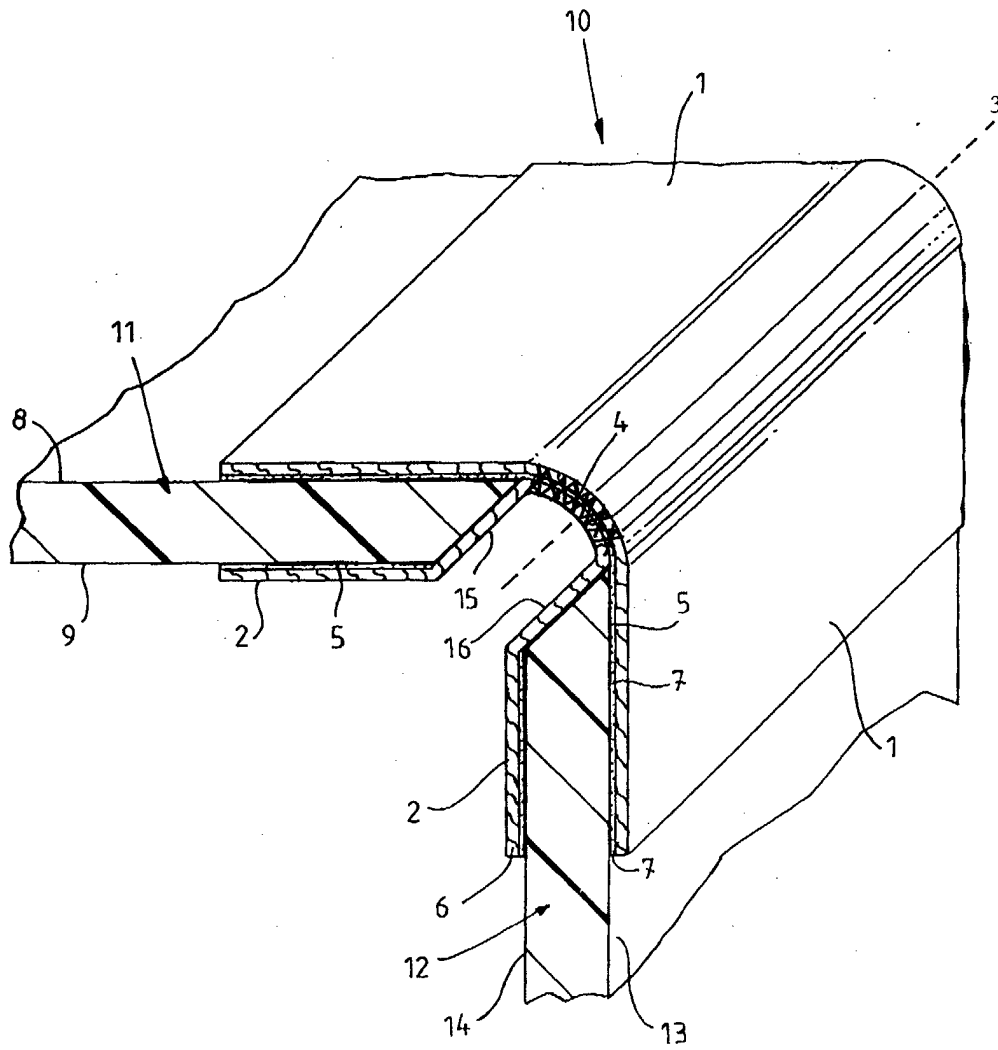


Fig. 1



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EUROPEAN SEARCH REPORT

Application Number
EP 03 44 7081

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The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 29 August 2003	Examiner Mund, A
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

EPO FORM 1503 03 82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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