

(19) Ministère de l'Economie
Office de la propriété intellectuelle

(11) Numéro du brevet d'invention : **92129**

(12) **BREVET D'INVENTION**

(45) Date de délivrance du brevet d'invention : **10.07.2014**

(51) Int. Cl.: **H01M10/12**
H01M2/02

(22) Date de dépôt : **09.01.2013**

(54) **PRESSURE AND HEAT RESILIENT BATTERY CONTAINER BOX**

(30) Priorité :

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PRESSURE AND HEAT RESILIENT BATTERY CONTAINER BOX

Technical field

- 5 The present invention relates to a container for a Valve Regulated Lead Acid Battery, and more specifically to a battery container box that provides high resilience to internal pressure and external heat during operation of the battery.

Background of the invention

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A Valve Regulated Lead Acid (VRLA) is generally made of several electrolyte cells, which are located in a single battery container box. Unlike in flooded lead-acid batteries, the hydrogen and oxygen produced in the cells of a VRLA battery is largely recombined back into water. In order to function properly, the interior of the battery cells needs to be

15 pressurized. Containers for VRLA batteries typically contain a valve regulated degassing system that allows a surplus of gas to be evacuated from the interior of the container.

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The electrolyte inside the cells of a VRLA battery may be in the form of a liquid or a gel substance. Use of a gelified electrolyte, which presents a higher inertia to movement than liquid, allows the installation of the battery in a multitude of positions, without risking spillage of the electrolyte. In Absorbed Glass Mat (AGM) VRLA batteries, the liquid electrolyte inside a battery cell is contained in a mat of fine glass fibres. This allows for the design of batteries which may be put at tilted angles without spilling the liquid electrolyte.

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VRLA batteries, and in particular AGM batteries, are used for a wide range of applications, such as for example starter batteries for cars, or power supplies on boats. An AGM battery is typically housed in a polypropylene (PP) moulded box, which is formed by a container having six equally large compartments, and a lid or cover, which is typically welded to the container. Each compartment in the container box contains a battery cell.

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Starter batteries are put to use in a multitude of environments, for example on a boat, or near the motor block of an automobile, where they are exposed to a multitude of external conditions. Known VRLA battery container boxes moulded from PP could suffer important and permanent deformations when they are exposed to temperatures of 90°C or higher. The

35 outer sidewalls of the battery container box, which are parallel to the internal baffles separating the compartments, tend to curve towards the outside, or bulge, with increasing

heat. Depending on the positioning of a starter battery beneath the hood of an automobile, the battery container box may well be exposed to temperatures higher than 90°C if the heat generating motor block is nearby. In such a configuration, the temperatures could subject the battery container box to permanent structural damage leading to a reduction of the battery's lifespan. A standard known battery container box is moulded integrally from PP. Exposing such a box to a temperature of 90°C and to an internal pressure of 200 mbar for a prolonged timespan results in important and permanent deformations at the center of the battery container box's sidewall faces. When exposed to high temperatures, PP softens and permanent deformations are likely to ensue. VRLA containers that are produced integrally from PP with talc could be an alternative solution to reduce bulging at higher temperatures, but this advantage is annihilated due to new disadvantages. As this material is more fragile, material breaks may arise at lower temperatures, and it could be problematic to heat-seal a lid to a container made of PP and talc during production.

The dimensions of battery container boxes should conform to the European Standard EN 50342-2. As a result of applying the standard, which dictates the end-to-end dimensions of a container box, the typical resulting outer wall thickness of VRLA container boxes is of about 5 mm. Increasing the thickness of the outer walls significantly will either increase the end-to-end dimensions of the box, which would no longer comply with the standard, or it would decrease the size of the battery compartments inside the container.

A known container, described in EP 1 041 655 B1, presents ribbings on the outer surfaces of two lateral walls of the container, which aim to increase the structural rigidity of the walls, in order to decrease their tendency to bulge. The document does not disclose moulding techniques for such a design. However, such a design will inevitably discard some of the benefits inherent to the VRLA and AGM technologies. Indeed, such batteries have the benefit of being mountable at tilted angles, which is not the case with flooded lead-acid batteries. The suggested ribbings form a series of pockets on two of the container's lateral walls. If such a battery container is mounted at a tilted angle, substances such as oil, which may be spilled on the battery during its normal operation, may become trapped in these pockets. The pockets do not allow the spilled substances to be evacuated by flowing along the outside surfaces of the container. Moreover, the pockets formed by the suggested outer ribbings may gather dust and dirt. Such externally ribbed container boxes therefore present some drawbacks for their use as VRLA/AGM battery housing containers, which is why the automotive industry does in general not accept externally ribbed containers for use in cars.

Technical problem to be solved

It is an objective of the present invention to provide a container for VRLA and AGM batteries, which overcomes at least some of the disadvantages of the prior art.

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Summary of the invention

According to a first aspect of the invention, a battery container box is provided. The battery container box comprises at least one compartmenting wall that is arranged in parallel to two
10 opposing sidewalls of the box. At least one of said two sidewalls comprises a strengthening panel that has a surface area substantially matching the surface area of the sidewall. The strengthening panel is fixed to the internal face of said sidewall by welding.

The battery container box and the strengthening panel may preferably be made of plastic
15 material, and the panel may be fixed to said sidewall by ultrasonic welding.

Preferably, the strengthening panel may comprise a flat face which is directed towards the interior of the container box.

20 The strengthening panel may further comprise a protruding ribbing pattern on the face that is in contact with the internal face of said sidewall. Preferably, ribbing pattern may define welding contours or line.

The ribbing pattern may further comprise a parallel lines pattern.

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Each rib of the ribbing pattern may preferably have a spiked profile in cross-section.

The thickness of the strengthened container sidewall including the thickness of the strengthening panel may preferably be generally equal to 5 mm. Thickness of the
30 strengthening panel may be generally equal or greater than 2.5 mm.

Preferably, the strengthening panel may be made of a plastic material having structural strengthening properties. The material may further have isolating properties. Preferably, the material may be polypropylene comprising a filler, which may be talc.

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According to a second aspect of the invention, there is provided a method for producing a strengthened battery container box as described by the invention. A container box and at least one strengthening panel are provided, and the method comprises the steps of

- releasably fastening the strengthening panel to an interior surface of a sidewall of the container box,
- welding the strengthening panel to said interior surface.

The welding step may preferably comprise ultrasonic welding. Ultrasonic welding of the strengthening panel to the sidewall of the container box may preferably comprise the steps of:

- pressing said strengthening panel and said container sidewall together;
- applying an acoustic vibration having a frequency between 15 kHz and 70 kHz from the outside surface of said sidewall, at positions corresponding to a ribbing pattern on said strengthening panel.

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A battery container box according to the present invention presents smooth inside and outside surfaces, yet it incorporates a structural reinforcement of the container's sidewalls, without increasing the battery dimensions.

The container box according to the present invention increases the rigidity of the battery box, as it is less prone to bulging when it is exposed to high temperatures. This allows it to be used in a number of new applications, wherein high temperatures prevail. The material of the strengthening panel may be adapted to fit the strength requirements of any application for which the battery box container is manufactured.

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Brief description of the drawings

Several embodiments of the present invention are illustrated by way of figures, which do not limit the scope of the invention, wherein:

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Fig. 1 shows an isometric view of an embodiment of a device according to the present invention.

Fig. 2a and Fig. 2b show isometric views of a strengthening panel according to an embodiment of the present invention.

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Fig. 3 shows a schematic cross-section of a strengthening panel according to an embodiment of the present invention.

Fig. 4 shows a detail of a schematic cross-section of a container sidewall and strengthening panel according to an embodiment of the present invention.

Detailed description of the invention

This section describes the invention in further detail based on preferred embodiments and on the figures.

As shown in Fig 1, the battery container box 02 according to the present invention comprises four outside walls and a bottom floor, as well as an opening at the top. During the assembly of a VRLA battery, electrolyte cells are inserted into the box, which is then closed by a battery box cover. The electrolyte cells and battery box cover do not as such form part of the present invention. The container box comprises two, but preferably six battery compartments that are separated by separation walls or baffles 08. The baffles are substantially parallel to two of the container's sidewalls 04, 05. Each of these sidewalls has an external face oriented toward the outside of the container box, and an internal face oriented toward the interior of the container box. The container is preferably moulded from polypropylene (PP).

At least one of the sidewalls 04, 05, but preferably both, is structurally reinforced by a strengthening panel 10, which is arranged in parallel to and in contact with the sidewall 05, and in parallel to the baffles 08. The surface area of the strengthening panel 10 substantially matches the surface area of the sidewall 05. The face 12 of the panel 10, which is directed towards the interior of the container box, is generally flat and devoid of ribbings or protrusions. The panel 10 may be made of any material. It is advantageous to use a material with thermal insulation, acoustic insulation, and structurally strengthening properties. In a preferred embodiment, the strengthening panel 10 is made of PP with a filler such as talc or glass fibres. The panel 10 is fixed to the container sidewall by using a welding method. As both the container box and the strengthening panel are preferably made of a plastic material, it is particularly advantageous to use an ultrasonic welding technique to permanently join the two parts.

The preferred strengthening panel 10, as illustrated in isolation by Fig 2a, presents a first face 14 which contacts the interior face of the sidewall of the container box. The face 14

preferably comprises a ribbing pattern 16 which defines welding contours. Each rib 16 protrudes from the face 14 and presents a spiked cross-section, preferably in the shape of a pointy triangle having its base aligned with the face 14. The height of the ribbing is preferably small as compared to the thickness of the panel 10. The ribbing pattern 16 may preferably
 5 comprise a set of parallel lines, but any other shape or pattern of contours that facilitate the welding of the panel 10 to the battery container box is suitable and lies within the scope of the present invention.

As shown in Fig 2b, the opposite face 12 of the strengthening panel 10 is generally smooth
 10 and devoid of ribbings and protrusions. After joining the strengthening panel to the battery container box, the face 12 is oriented towards the interior of the box. One of the edges of the panel 10, which is oriented towards the opening of the container box preferably has a tapered shape 18 in order to facilitate the provision of a battery cover onto the battery container box. Fig 3 illustrates both faces 12, 14 of a preferred strengthening panel 10,
 15 including a cross-sectional representation of a rib 16.

The strengthening panel may be made of a polypropylene base compound with a filler, such as for example talc or glass fibres.

20 During production of the container box, the strengthening panel is arranged so that one of its faces 14 contacts the interior face of a sidewall 05 of the container 02. In a most preferred embodiment, a similar arrangement comprising a second panel is provided at an opposing sidewall 04.

25 The panel is permanently fastened to the sidewall using a welding technique, preferably an ultrasonic welding technique. Both parts are preferably pressed together by fastening means, and an ultrasonic wave having a frequency in the range between 15 kHz and 70 kHz is applied from the outside surface of said sidewall 05, at positions corresponding to the ribbing pattern 16 on said strengthening panel 10. Devices for generating such soundwaves are
 30 known in the art and will not be detailed any further in this description. The spiked shape of the ribbing 16 on the face 14 is especially designed to concentrate the melting process. The spiked rib 16 of the panel part acts as an energy director which contacts the plastic part 05. The ultrasonic energy melts the point of contact between the two parts, creating a joint as illustrated in Fig 4. The ribs 16 on the face 14 of the panel 02 engage with the flat surface of
 35 the sidewall 05 in order to form the strengthened container box 02.

While any other panel thickness may be used in accordance with the present invention, it is preferred that the strengthening panel has a thickness of at least 2.5 mm. The total container wall thickness of the reinforced wall, as shown in Fig 4, is equal to 5 mm. This is comparable with the thickness of a standard container sidewall, while the stiffness of the container according to the present invention is increased.

In an alternative embodiment, both of the strengthening panel's faces are devoid of any ribs and protrusions. They are both generally flat. However, an internal surface of the sidewall of the container box comprises the spiked ribbing pattern that defines the welding contour. The welding process is similar as described above, but the ribs on the internal face of the sidewall engage with the flat surface of the panel in order to form the strengthened container box.

In yet another alternative embodiment, both the strengthening panel and the container box's sidewall comprise ribbing patterns, each of which defines welding contours. The ribbings on both pieces are arranged so that a rib on one piece faces a flat surface on the other piece. The welding process is similar as described above. The first set of ribs on the face of the panel engages with the facing flat surface of the sidewall, whereas the second set of ribs on the internal face of the sidewall engages with the facing flat surface of the panel, in order to form the strengthened container box.

Both the container and the strengthening panel may be moulded by known moulding techniques using moulds adapted to the desired shapes. Moulding techniques are known in the art and will not be explained in further detail in the context of the present invention.

Tests have shown that a preferred container according to the present invention, strengthening panels made from a polypropylene base compound comprising 30% of talc, allow to increase the stiffness of the shorter side walls as compared to similar containers made of PP. At the same time, the advantages of standard PP containers are maintained and it remains possible to heat-seal a lid to the container box. The battery container box according to the present invention presents flat outside surfaces. The dimensions of the box are similar to that of a standard PP container box, while the mechanical properties are improved and adaptable to specific application needs.

It should be understood that the detailed description of specific preferred embodiments is given by way of illustration only, since various changes and modifications within the scope of

the invention will be apparent to the skilled man. The scope of protection is defined by the following set of claims.

CLAIMS

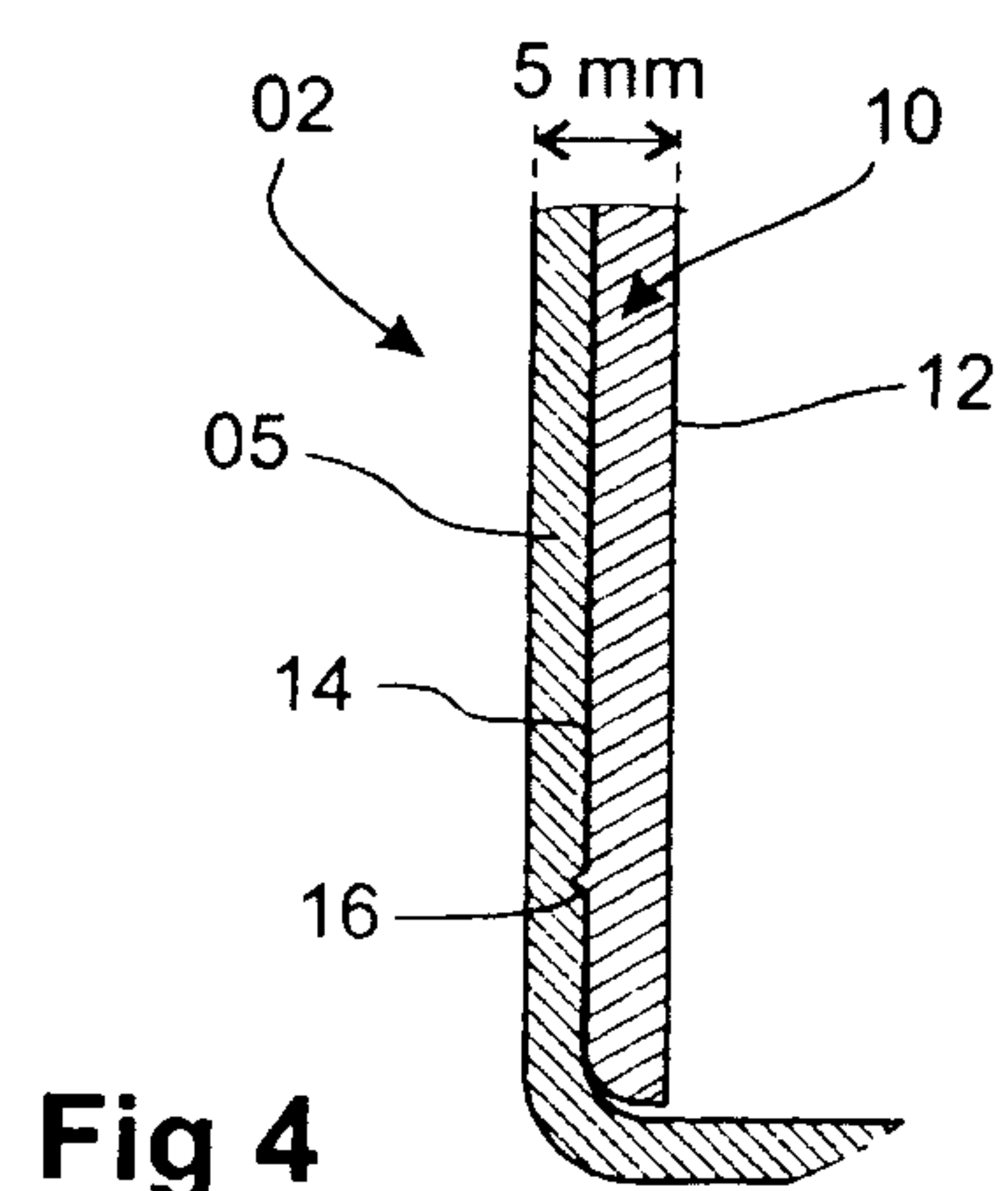
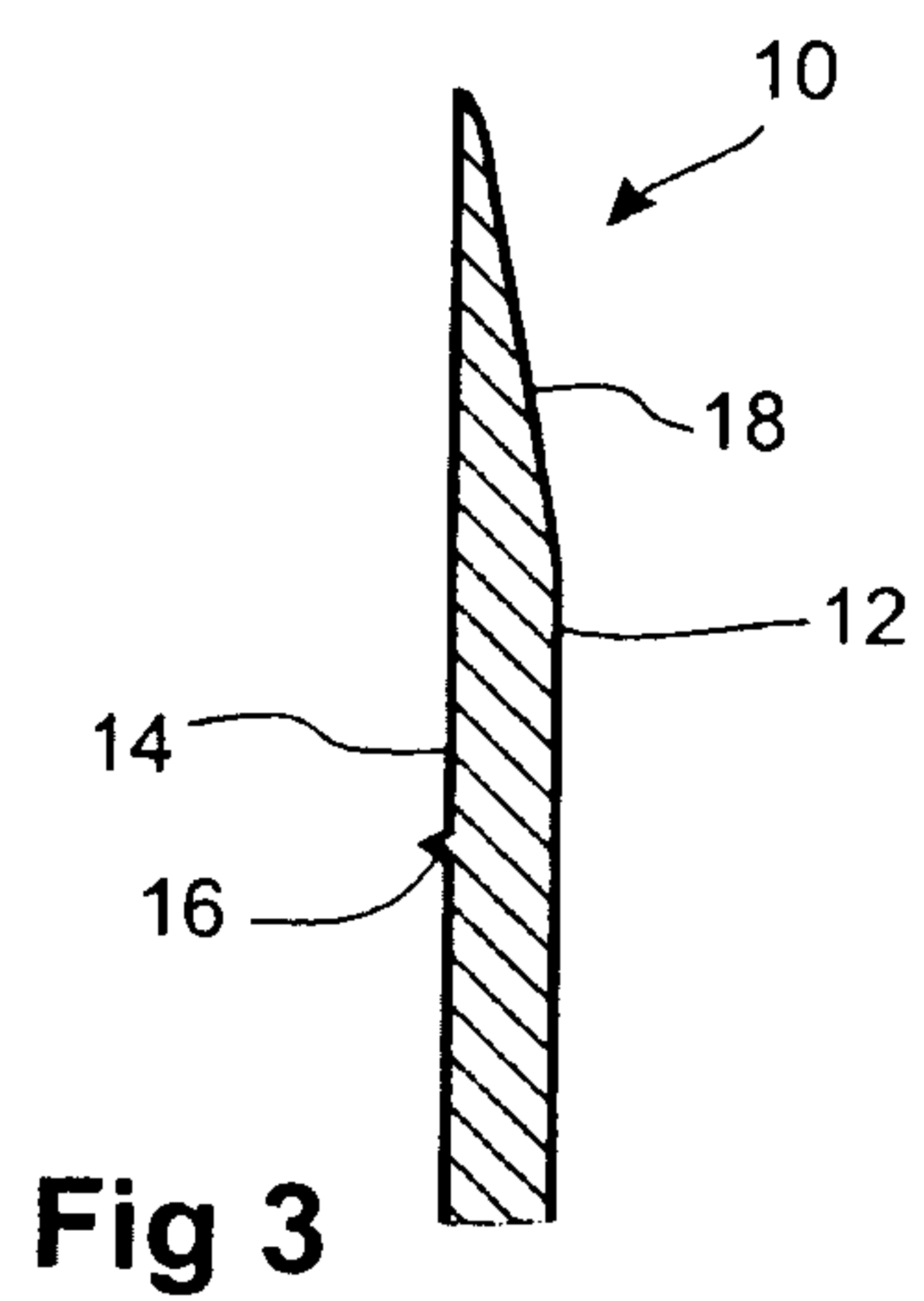
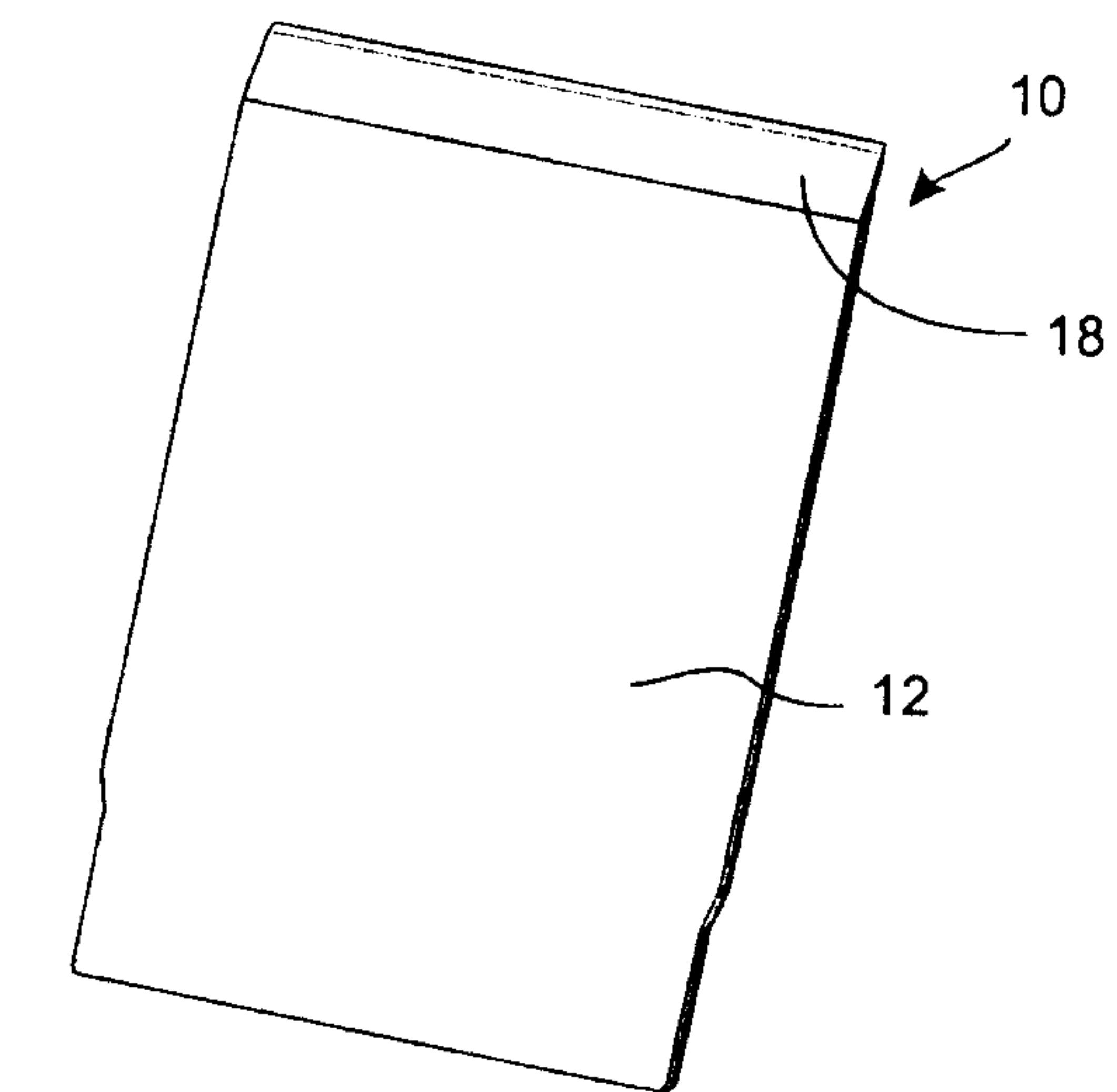
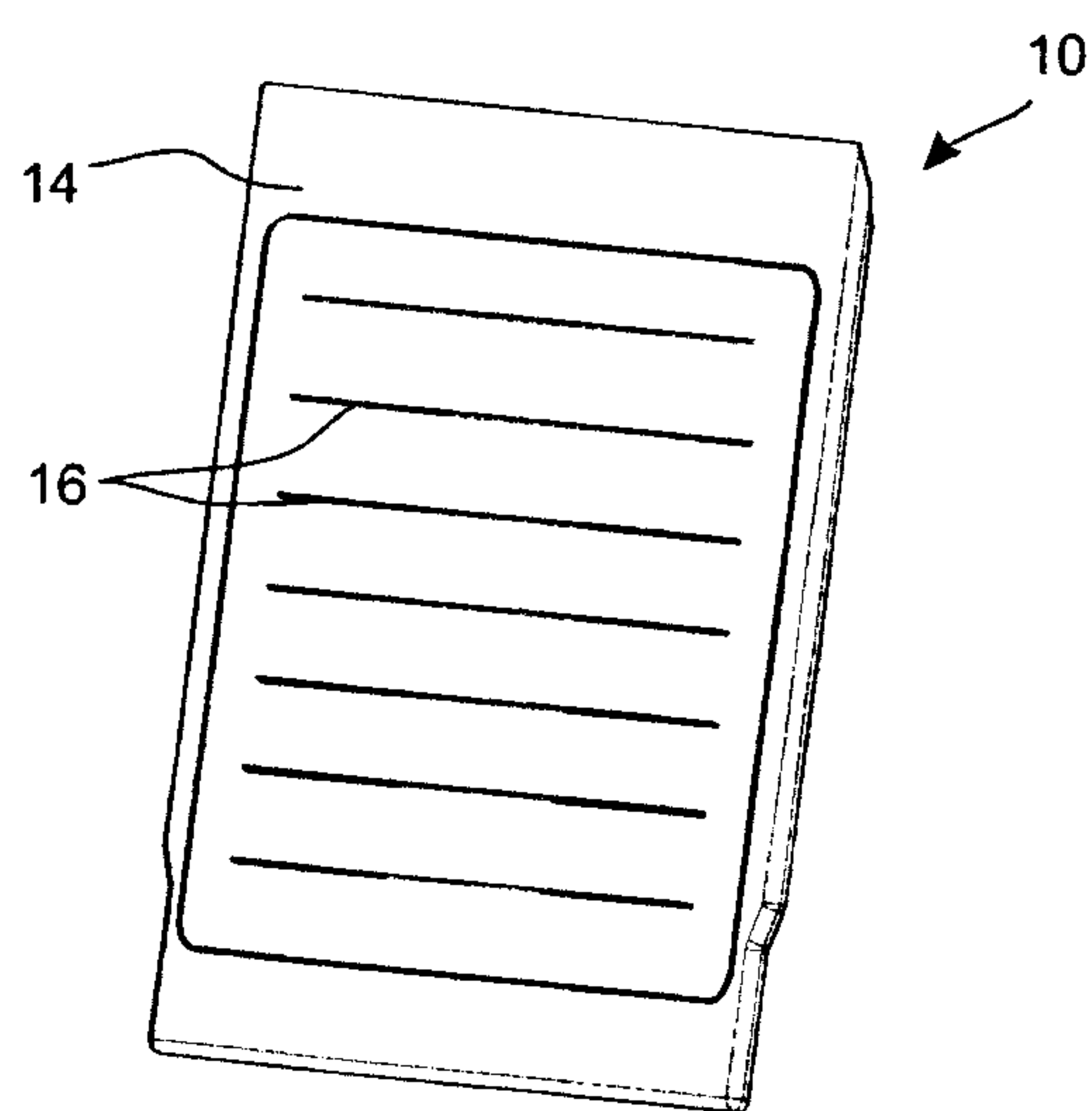
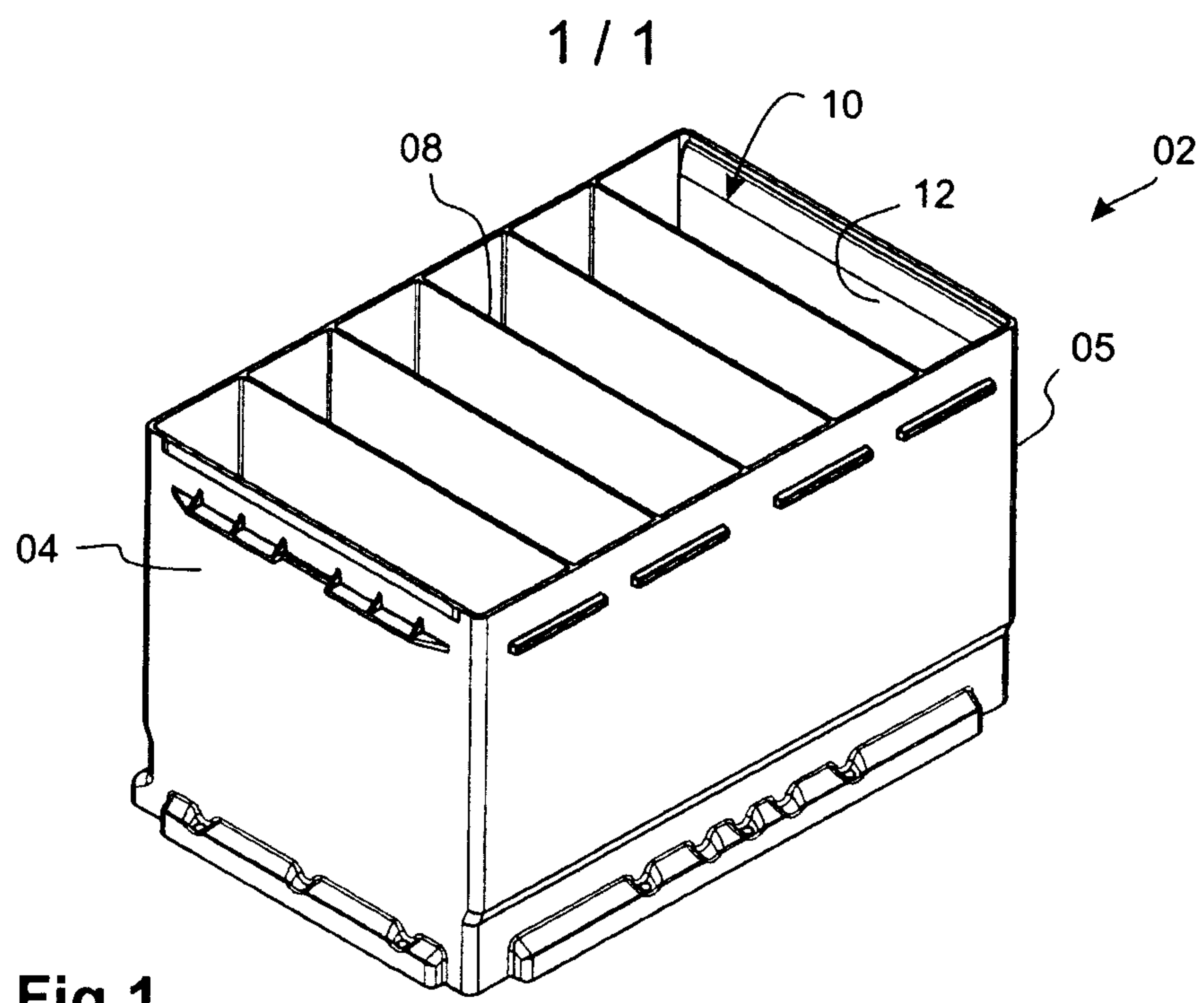
1. A battery container box (02) comprising at least one compartmenting wall (08) being arranged in parallel to two opposing sidewalls (04; 05) of the box, wherein at least one of said two sidewalls (05) comprises a strengthening panel (10) having a surface area that substantially matches the surface area of said sidewall, and wherein said strengthening panel (10) is fixed to the internal face of said sidewall (05) by welding.
2. The container box according to claim 1, wherein said container box and said strengthening panel are made of a plastic material, and wherein said strengthening panel is fixed to said sidewall by ultrasonic welding.
3. The container box according to any of claims 1 to 2, wherein the strengthening panel (10) comprises a flat face (12) which is directed towards the interior of the container box (02).
4. The container box according to any of the previous claims, wherein the strengthening panel (10) comprises a protruding ribbing pattern (16) on the face (14) that is in contact with the internal face of said sidewall (05), and wherein the ribbing pattern defines welding contours.
5. The container box according to claims 4, wherein the ribbing pattern (16) comprises a parallel lines pattern.
6. The container box according to any of claims 4 or 5, wherein each rib of the ribbing pattern (16) has a spiked profile.
7. The container box according to any of the previous claims, wherein the thickness of the strengthened container sidewall including the thickness of the strengthening panel is equal to 5 mm.
8. The container box according to claim 6, wherein the thickness of the strengthening panel (10) is equal or greater than 2.5 mm.

9. The container box according to any of the previous claims, wherein the strengthening panel (10) is made of a plastic material having structural strengthening properties.
- 5 10. The container box according to any of the previous claims, wherein the strengthening panel (10) is made of a material having isolating properties.
11. The container box according to any of claims 9 or 10, wherein the material is polypropylene comprising a filler.
- 10 12. The container box according to claim 11, wherein the filler is talc.
13. A method of producing a strengthened battery container box according to any of the preceding claims, wherein one container box and at least one strengthening panel are provided, the method comprising the steps of
- 15 - releasably fastening said strengthening panel to an interior surface of a sidewall of said container box,
- welding said strengthening panel to said interior surface.
14. The method according to claim 13, wherein the welding step comprises,
- 20 - pressing said strengthening panel and said container sidewall together;
- applying an acoustic vibration having a frequency between 15 kHz and 70 kHz from the outside surface of said sidewall, at positions corresponding to a ribbing pattern on said strengthening panel.

ABSTRACT**PRESSURE AND HEAT RESILIENT BATTERY CONTAINER BOX**

According to the present invention, a battery container comprising four sidewalls and a floor
5 is provided. The container comprises at least two battery compartment separated by baffles.
At least one sidewall that is parallel to said baffles has a substantially smooth outside face,
and comprises strengthening means.

(Fig. 1)





SEARCH REPORT

in accordance with Article 35.1 a)
of the Luxembourg law on patents
dated 20 July 1992

LO 784
LU 92129

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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			

**ANNEX TO THE SEARCH REPORT
ON LUXEMBOURG PATENT APPLICATION NO.**

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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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