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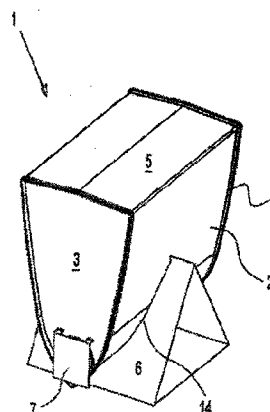
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54 Titre : Device for heating a container by solar power.

57 Abrégé :

The present invention relates to a device (1) for heating a container (12) and its content by solar power, which device (1) comprises at least one reflecting element (2), at least two end walls (3, 4) having means for fastening (10) said reflecting element (2) in between said at least two end walls, whereby said reflecting element (2) is forced to be formed in a shape which concentrates solar rays into a focusing area at a fixed point or fixed band irrespective of the sun's (13) position in the sky during the day, a transparent cover (5) arranged for providing an enclosure between said end walls (3, 4) and said reflecting element (2), and a placement unit (8) arranged to fix said container (12) into said focusing area, wherein said device (1) is collapsible, where said reflecting element (2) is flexible and foldable, where said end walls (3, 4) are removable and where said placement unit (8) is flexible and foldable. The present invention furthermore relates to a method for positioning a solar collector device (1) comprising a reflecting element (2) with opposite surfaces having a shared longitudinal axis, wherein said solar collector device (1) is placed on a surface with said longitudinal axis positioned preferably in an east/west direction.



Device for Heating a Container by Solar Power**Scope of the invention**

5 The present invention relates to a device for heating a container and its content by solar power, which device comprises at least one reflecting element, at least two end walls having means for fastening said reflecting element in between said at least two end walls, whereby said reflecting element is forced to be formed in a shape which concentrates solar rays into a focusing area at a fixed point or fixed band irrespective
10 of the sun's position in the sky during the day, a transparent cover arranged for providing an enclosure between said end walls and said reflecting element, and a placement unit arranged to fix said container into said focusing area.

Background of the invention

15 EP 1106188 describes a container for the disinfection of drinking water. The container comprises a body having a first and a second side and defining an interior for receiving a fluid, the first side being defined by a UV-transparent layer, and the second side being defined, at least in part, by a second layer that either reflects
20 sunlight or generates heat in response to solar energy.

In this type of container disinfection primarily occurs by using the UV light of the solar radiation. This is possible over a long time, but because most of the solar radiation takes place in the infrared part of the solar spectrum, this part of the light
25 passes through the drinking water with a very small heating effect. Heat absorption occurs after the infrared part of the spectrum has passed through the water and hits the back surface of the container. This leads to a quite low disinfection capacity in this type of container.

30 DK 2000 00 737 L describes a pasteurising device for disinfection of water. The device comprises two containers connected by a thermostatic shut-off valve and where a first container is placed in a solar collector. The thermostatic shut-off valve

allows water from running from the first container to the second container when the water in the first container has reached a certain temperature.

5 Due to the thermostatic shut-off valve the heated water runs into the second container as soon as the water reaches a certain temperature. This results in only partial disinfection of water because bacteria and viruses typically are only efficiently killed by maintaining a certain temperature over a certain period of time. Furthermore, the thermostatic shut-off valve is a bottleneck in the disinfection process because impurities/large particles in water from lakes, rivers, streams, or polluted wells could
10 clog the thermostatic shut-off valve, thereby reducing the efficiency of the pasteurising device.

DK 2001 00090 U3 describes a pasteurising device for disinfection of water. The device comprises boxlike cabinet in which a container and a reflecting element are
15 placed. The solar rays are reflected by the reflecting element into the container, thereby heating the content of the container.

The pasteurising device is built and assembled as a boxlike cabinet in the form of a stationary construction. The stationary construction of the cabinet reduces the
20 usefulness of the pasteurising device because it takes up much space during transport and storage. Furthermore the pasteurising device is shown as having optional extra equipment, e.g. a vertical rod for rotatable mounting of the device above the ground, and with further extensible reflecting elements which complicate the use of the pasteurising device.

25

Object of the invention

It is the object of the present invention to provide a simple, inexpensive, reusable and efficient device primarily for disinfection of water by using solar power.

30

This can be achieved with a device according to the preamble of claim 1 and wherein said device is collapsible, where said reflecting element is flexible and foldable,

where said end walls are removable and where said placement unit is flexible and foldable.

Description of the invention

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In this way it is possible to achieve simple and inexpensive disinfection of the content in a container if the device is placed in the sun with longitudinal axis of the reflecting element preferably in an east/west direction.

- 10 The efficiency of the device depends on the energy content of the solar radiation. In areas with sufficient solar energy available, the device may provide efficient disinfection of the content of a container in less than an hour, and may thus be used successfully in regions where water is contaminated by microorganisms.

- 15 The device according to the invention can disinfect water for at least 4-6 persons per day. In many tropical areas there is sufficient water, but the water is often infected at the source, and the actual distribution of the water often contributes to further microbiological contamination. By using the device according to the present invention a container can be filled with water which may or may not have been
20 filtered.

- The container is then closed so as to seal off the water from the environment during the disinfection process. The container may remain closed and used for storing the disinfected water without fear of recontamination. Thus no contamination can take
25 place during the disinfection process or subsequent storage.

- To obtain disinfection of the content of the container, the container is placed on a placement unit inside the enclosure provided between said end walls, said reflecting element, and said transparent cover.

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The solar rays are reflected by the reflecting element and concentrate into a focusing area at a fixed point or fixed band, irrespective of the sun's position in the sky during the day.

- 5 The placement unit is positioned inside the device in such manner that the container is placed at the focusing area, and the concentrated solar rays will heat the content of the container, whereby a temperature is reached that is sufficient for disinfecting the content of the container.
- 10 The fact that the end walls are enclosed around the reflecting element by said fastening means forces said reflecting element to be formed in a shape which concentrates solar rays into a focusing area at a fixed point or fixed band irrespective of the sun's position in the sky during the day.
- 15 To provide a simple, inexpensive and reusable device said device is collapsible, where said reflecting element is flexible and foldable, where said end walls are removable and where said placement unit is flexible and foldable.

Hereby a device can be formed that takes up very little space during storage and
20 transport, just as the weight of the device is very low. Devices can be packed ready for use, and a high number of devices can be transported in a container to places where a sudden demand arises, for example after a disaster.

A big problem after a disaster in an area is supply of drinking water because water
25 pipes and wells are damaged, and thus there is a high risk that people are infected by contaminated water.

With the device according to the present invention it is possible to disinfect
contaminated water in a very efficient way, even in areas with broken infrastructure,
30 as soon as big numbers of the device can be transported into the areas by e.g. helicopters.

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Furthermore can a device be disassembled into several parts and then either be transported to another area for immediate use, or be cleaned and stored away for later use.

5 In order to make it possible to place the device on e.g. the ground or suspended on an upright surface, said device furthermore comprises a collapsible and foldable support unit that either:

- 10 - has a recess with a form complementary to the outer form of the reflecting element, whereby the device will fit into the support unit, or
- is in the form of a number of fittings that can be attached to the reflecting element.

15 As the support unit is collapsible and foldable, it is easy to pack it together with the reflecting element and the end walls. Thus all devices are provided with a support unit.

20 Alternatively, the device is formed with a pointed or coned part or a protruding element which can be driven into the ground or into a surface, thereby keeping the device in a firm position during the disinfection of the content of a container.

To ensure that the solar rays are concentrated in a specific focusing area said fastening means of said end walls comprise recesses for receiving said reflecting
25 element, which recesses form said reflecting element in a Winston parabolic cusp form.

The geometry of a Winston parabolic cusp form is provided by taking two symmetrical half paraboloidal cylinders, which meet the following conditions:

- 30 - the focus of one cusp must be placed on the opposite cusp, and

- the cusp must be tilted inward until its top is parallel to the Winston axis, and thus parallel to the other cusp.

Alternatively said fastening means of said end walls comprise recesses for receiving
5 said reflecting element, which recesses form said reflecting element into a Trombe-Meinel form.

When the reflecting element is assembled, its form of can be other types than the Winston parabolic cusp or Trombe-Meinel form. The important thing is that the form
10 of the reflecting element ensures that the solar rays are concentrated in a specific focusing area at a fixed point or fixed band irrespective of the sun's position in the sky during the day.

In this way, the correct and stable shape of the solar collector is achieved by
15 mounting the reflecting element between the end walls. If a force presses the end walls against each other, the reflecting element is kept in the correct position in a simple manner. The fastening means have sufficient force to secure the reflecting element and may comprise bars suspended between and affixed to both end walls.

20 In one embodiment of the present invention said fastening means of said end walls comprise protrusions for support of the reflecting element, which protrusions are placed on both sides of said reflecting element.

The protrusions can be used for fixing a thin reflecting sheet that will gain strength
25 and stability when forming the curvature defined by the end walls and their protrusions. Thus a very thin flexible foil may be achieved in the correct form when suspended between at least two end walls that are kept apart by at least two spanners. Spanners may be foldable so as to allow for a device to be fully collapsed during storage and transportation.

30 In order to make it possible to assemble the device into a firm construction, said device furthermore comprises securing means for fastening said end walls to said

reflecting element. These securing means can be fastening clips which are mounted along the reflecting element and grab around the edge of each end wall, thereby keeping the end walls around the reflecting elements.

- 5 To ensure that the container is placed in the focusing area of the concentrated solar rays, the container is placed in a placement unit which constitutes an elastic and expandable sleeve, a pipe and/or a flexible and foldable mat.

The placement unit furthermore protects the reflecting element, end walls and/or
10 cover from melting/being damaged if the content of the container reaches high temperatures.

In a preferred embodiment of the invention the placement unit is a mat made of an insulating material which is placed at the bottom of the enclosure provided by the
15 reflecting element and the end walls.

When it is necessary to use the device for disinfecting e.g. water, a container is placed onto the mat and in the focusing area of the reflecting element.

- 20 In another embodiment of the invention, the placement unit is a sleeve, which can be elastic and be expanded by containers where the sleeve is in heat-conducting contact with at least one container. Hereby flexible securing of at least one container is achieved. Containers of different sizes should be placed in almost the same position so that the focusing band is inside the container for a range of container sizes.

25

The sleeve can be made of a heat-conducting material. In this way the part of the solar energy collected by the sleeve will be conducted to the surface of the container.

- The sleeve can be connected to a bar that is connected to both end walls and placed
30 over the focusing band of the reflecting element. This sleeve contains at least one container, which container is placed in the focusing band of the reflecting element.

In this way, a container is placed so that most of the solar energy reflected by the reflecting element is concentrated inside the container. Just using a sleeve is an inexpensive method for keeping the container in place.

- 5 In a third embodiment of the invention the placement unit is a tube, which forms a protective, flexible and transparent shield formed as a tube, attached to and suspended between two end walls. This tube may form an inner space, sealing off the solar collector from the outside environment. Foldable spanners may keep the shields fully suspended and in shape.

10

The tube is placed around the focusing band of the reflected solar radiation, and access to the tube is through at least one endplate. The use of a tube allows an efficient change of containers.

- 15 The tube can penetrate the end walls, and containers can be placed inside the tube without further access to the device. The tube may have covers at the openings in order to isolate it.

- 20 In one embodiment of the present invention said placement may unit furthermore comprise a foldable bar which is connected to both said end walls and placed over said focusing area of said reflecting element. During the use of the device, this foldable bar stretches the reflecting element by pressing the endplates away from each other.

- 25 Said placement unit can be made of a heat-conducting material, whereby heat from the enclosure of the device can be transported into the content of the container. This is especially important if the placement unit is a sleeve or a tube sealing off the container from direct contact with the air in the device.

- 30 The transparent cover arranged for providing an enclosure between said end wall and said reflecting element ensures that solar energy and heat do not dissipate from the device to the environment during use, thereby enhancing the heating efficiency of the

content in the container. The cover must be transparent in order to allow solar rays to enter the device.

5 The containers may be bottles that can be opened and closed, e.g. with a screw cap, which bottles are placed in the sleeve or the tube. Common soft drink bottles such as PET bottles are available at a very low price in almost all parts of the world, and they can be used as personal water containers. Each time a bottle is filled, it must be heated in the device for disinfection prior to use. A cooling period is necessary before drinking, because the water in the containers is heated to at least 65°C. PET
10 bottles can be used several times, but they will not last forever. However, as these bottles are inexpensive and available in large numbers, it is possible to easily obtain new bottles.

15 Alternatively, a flexible, foldable bag, made of heat conductive material may be inserted as a water container in areas where bottles are not available.

For use in non-tropical areas, the device can have at least one of said end walls made of a transparent material, and an inner side of at least one of said end walls is provided with a reflecting material.

20 Hereby the device becomes more efficient in non-tropical areas. Part of the light can penetrate one of the end walls and be reflected so as to heat the container. Light may also be reflected from the opposite end wall and further reflected to heat the container.

25 Alternatively at least one of said end walls is made as a one-way mirror allowing solar rays to enter the device, while reflecting and capturing solar rays inside the device.

30 The reflecting elements can be formed of a flexible surface having:

- a reflecting foil,
- a reflecting paper,

- a layer of reflecting paint, and/or
- a reflecting textile.

5 Instead of removing the transparent cover each time a container is placed into the device, one of the end walls can be provided with an opening through which it is possible to place a container on the placement unit.

10 To reduce the heat loss from the device through the opening, it is provided with a flap, arranged for allowing access to the opening during changing containers, or for barring the opening during the disinfection process.

15 The first step to reduce the risk of infection from contaminated water is to disinfect the water by e.g. using a device according to the present invention. The heating of water will kill a certain amount of bacteria or viruses, but it is necessary to keep the water at a high temperature over a period of time to further reduce the risk of infection.

20 Therefore every container could be provided with a thermometer with a memory unit, so that it is possible to check whether the water at some point during the disinfection process has reached the wanted temperature or not, while at the same time, the container is maintained in the device for a certain period of time.

25 The device could be used on a large scale or for industrial purposes by forming a device with a substantial length, and instead of using exchangeable containers, a pipe is placed on the placement unit. Hereby it is possible to disinfect large amounts of water, in batches or continuously.

30 For obtaining the optimum incident solar radiation of a solar collector device comprising a reflecting element with opposite surfaces having a shared longitudinal axis, said solar collector device is placed on a surface where said longitudinal axis is positioned preferably in an east/west direction.

According to the theoretical principles behind the use of solar collectors, the efficiency of the solar collector device during a whole day approximates its optimum when the shared longitudinal axis of the opposite surfaces of a reflecting element is positioned preferably in an east/west direction.

5

If the solar collector device is placed in an east/west direction, the incident solar radiation in the morning and afternoon will be allowed to pass through the end wall pointing towards the sun, whereby the total amount of solar rays available for the disinfection process is high.

10

If the solar collector device placed in a north/south direction, the incident solar radiation in the morning and afternoon will be partly blocked by the longitudinal surface of one of the reflecting elements, whereby the total amount of solar rays available for the disinfection process is reduced.

15

At noon there will be no or only minimum difference between the incident solar radiation into the solar collector device, regardless of the position.

20

In order to obtain the maximum solar input at winter and/or solstice, the device according to the invention has an acceptance angle of 30 degrees and/or may in one embodiment of the present invention be formed so that it is possible to tilt the device around the shared longitudinal axis of the reflecting element of the device.

Short description of the drawing

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The invention is described in more detail below with reference to the accompanying drawing in which:

30

Fig. 1 shows a device according to the invention,

Fig. 2 shows an exploded view of the device,

Fig. 3 shows an end view of the device,

Fig. 4 shows a device with a container according to the invention,,

5 Fig. 5 shows a plane view of the device in Fig. 4,

Fig. 6 shows a device positioned in two different positions proportionally to the corners of the world, and

10 Fig. 7 shows an alternative embodiment of the invention.

Detailed description of the invention

Fig. 1 shows a device 1 according to the invention, comprising a reflecting element
15 2, end walls 3, 4, a transparent cover 5, and a support unit 6.

The reflecting element 2 is placed between end walls 3, 4, and the device 1 is provided with an internal enclosure by attaching the transparent cover 5 to the end parts of the reflecting element 2 and the upper parts of end walls 3, 4.

20

The reflecting element 2 is forced by the end walls 3, 4 into a pointed form which is complementary to a recess 14 in the support unit 6, thereby allowing the device 1 to be placed in a stable manner.

25 To make it possible to position or change a container (not shown) in the device 1, without removing the cover 5, end wall 3 is provided with an opening (not shown).

The opening (not shown) is covered by a flap 7, arranged for allowing access to the opening (not shown) during exchange of containers (not shown) or for barring the opening (not shown) during the disinfection process. The flap 7 ensures that heat loss
30 from the device 1 through the opening (not shown) is minimal.

The support unit 6 is shown as a plate with an opening folded into a triangular support unit. When the plate is folded, the opening will form the recess 14 wherein the lower part of the reflecting element 2 is placed.

- 5 The end walls 3, 4 have a slightly pointed upper edge to force the cover 5 into a roof ridge form, thereby allowing any condensed water on the underside of the cover to run out against the reflecting element and down into the device.

Fig. 2 shows an exploded view of the device 1 and the various elements of which it consists. The device 1 comprises:

- a reflecting element 2,
- an end wall 3 with an opening 11 at the bottom part,
- 15 - an end wall 4; both end walls 3, 4 are provided with recesses 10 arranged for receiving an edge part of the reflecting element 2, thereby forming the reflecting element 2 into a Winston parabolic cusp form,
- 20 - a transparent cover 5, arranged for attachment to the end parts of the reflecting element 2 and upper parts of end walls 3, 4,
- a support unit 6 with a recess 14, where recess 14 has the same form as the bottom part of the reflecting element 2,
- 25 - an insulation mat 8 is arranged for being placing at the bottom of the reflecting element 2 so that it can protect the reflecting element 2 against excess heat from the heated content of the container (not shown), and
- 30 - a number of securing means in the form of fastening clips 9 having a hook part arranged for gripping around the edge part of each end wall 3, 4, thereby keeping the reflecting elements in place between the end walls 3, 4.

Fig. 3 shows the device 1 in a end view, where flap 7 covers the opening (not shown) provided at the bottom part of the end wall 3. The end wall 3 is shown as having a Winston parabolic cusp form and with a with an upper edge part having in a roof
 5 ridge form.

Fig. 4-5 show the device 1 with a container 12 in the form of a bottle placed inside. It is possible to remove or place a container 12 in the device through the opening 11. The container is placed on a mat (not shown) and in the focusing area of the
 10 concentrated solar rays.

Fig. 6 shows how the position of the device 1 affects the obtainable incident solar radiation.

15 When the solar collector device 1 is placed in an east/west direction and the sun 13 travels from east to west, the incident solar radiation in the morning and afternoon will be allowed to pass through the end wall pointing towards the sun, whereby it is possible to utilize the optimum amount of incident solar radiation.

20 Oppositely, when the solar collector device 1 is placed in a north/south direction, and the sun 13 travels from east to west, the incident solar radiation in the morning and afternoon will be partly blocked by the longitudinal surfaces of one of the reflecting elements. Thus the utilization of the incident solar radiation is lower.

25 Fig. 7 shows an alternative embodiment of the invention where device 20 comprises end walls 22, 23. Between these end walls 22, 23 a reflecting element 21 is placed which is formed as a cusp mirror.

Between the end walls 22, 23 and over the reflecting element 21, a bar 26 is placed,
 30 which bar 26 operates as an energy absorber support carrying a sleeve 25. The sleeve 25 is placed in the focusing area of the reflecting element 21, and the sleeve 25 comprises a container 24 for absorption of solar energy.

The device 20 is covered by a transparent top 29 which top 29 is positioned on the mechanical support 27 for the cusp mirror. The device 20 also comprises a mechanical support 28.

5

Device 20 may be disassembled for transport and storage whereby its height is reduced to only a few centimetres. The reflecting element 21 may be a single folded sheet that is only a few millimetres.

- 10 If the reflecting element 21 is foldable because it is formed of a flexible film, and the mechanical supports 27 and 28 are also foldable, only the bar 26 must be removed, or the bar 26 could also be a foldable bar.

- 15 In this case, it will be possible to remove the top 29 and fold all the mechanical support elements 27,28, and then, by also folding the sleeve 25 and the mirror 21, to compress the whole device 20 to a thickness of only a few centimetres.

- 20 The transparent top 29 can be formed in a way in which the end walls 22, 23 and the elements folded between these end walls 22, 23 can be placed in a depression that can be formed in the transparent top 29.

In this way, the top 29 becomes part of a container, thereby providing efficient storage and transport of the device 20.

- 25 One of end walls 22, 23 can be formed to fit into the depression in the transparent top 29 so that this end wall becomes the other part of the container which contains the entire device 20.

In this way efficient transport and storage at a low cost can be achieved.

30

The reflecting element 21 can be formed in the Trombe-Meinel curve for achieving a concentration band in the same area, independently of the sun's position in the sky.

CLAIMS

1. Device (1) for heating a container (12) and its content by solar power, which device (1) comprises at least one reflecting element (2), at least two end walls (3, 4) having means for fastening (10) said reflecting element (2) in between said at least two end walls, whereby said reflecting element (2) is forced to be formed in a shape which concentrates solar rays into a focusing area at a fixed point or fixed band irrespective of the sun's (13) position in the sky during the day, a transparent cover (5) arranged for providing an enclosure between said end walls (3, 4) and said reflecting element (2), and a placement unit (8) arranged to fix said container (12) into said focusing area, characterised device (1) is collapsible, where said reflecting element (2) is flexible and foldable, where said end walls (3, 4) are removable, and where said placement unit (8) is flexible and foldable.
2. Device (1) according to claim 1, characterised in that said device (1) furthermore comprises a collapsible and foldable support unit (6).
3. Device (1) according to claim 1, characterised in that said fastening means (10) of said end walls (3, 4) comprise recesses for receiving said reflecting element (2), which recesses form said reflecting element (2) in a Winston parabolic cusp form.
4. Device (1) according to claim 1, characterised in that said fastening means (10) of said end walls (3, 4) comprise recesses for receiving said reflecting element (2), which recesses form said reflecting element (2) into a Trombe-Meinel form.
5. Device (1) according to any of the claims 1-4, characterised in that said fastening means (10) of said end walls (3, 4) comprise protrusions for support of the reflecting element (2), which protrusions are placed on both sides of said reflecting element (2).

6. Device (1) according to claim 1, characterised in that said placement unit (8) constitutes an elastic and expandable sleeve, a pipe and/or a flexible and foldable mat.
- 5
7. Device (20) according to claim 6, characterised in that said placement unit (25) furthermore comprises a foldable bar (26), which is connected to both said end walls (22, 23), and which is placed over said focusing area of said reflecting element (21).
- 10
8. Device (1) according to any of the claims 6-7, characterised in that said placement unit (8) is made of a heat-conducting material.
9. Device (1) according to any of the claims 1-8, characterised in that at least one of said end walls (3, 4) is made of a transparent material, and an inner side of at least one of said end walls (3, 4) is provided with a reflecting material.
- 15
10. Device (1) according to any of the claims 1-9, characterised in that said device (1) furthermore comprises securing means (9) for fastening said end walls (3, 4) to said reflecting element (2).
- 20

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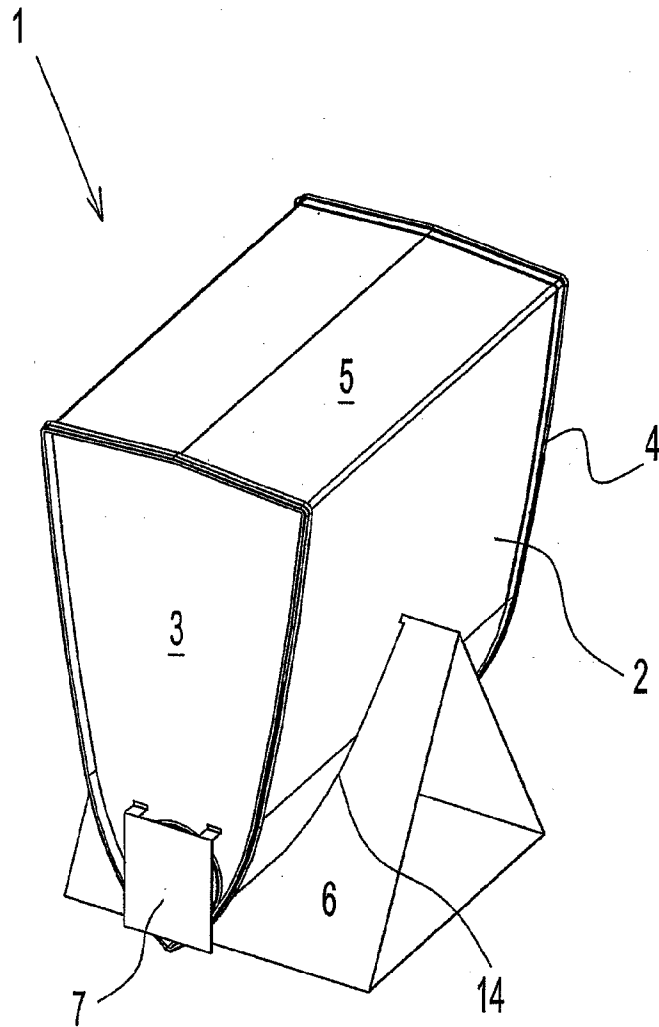


Fig. 1

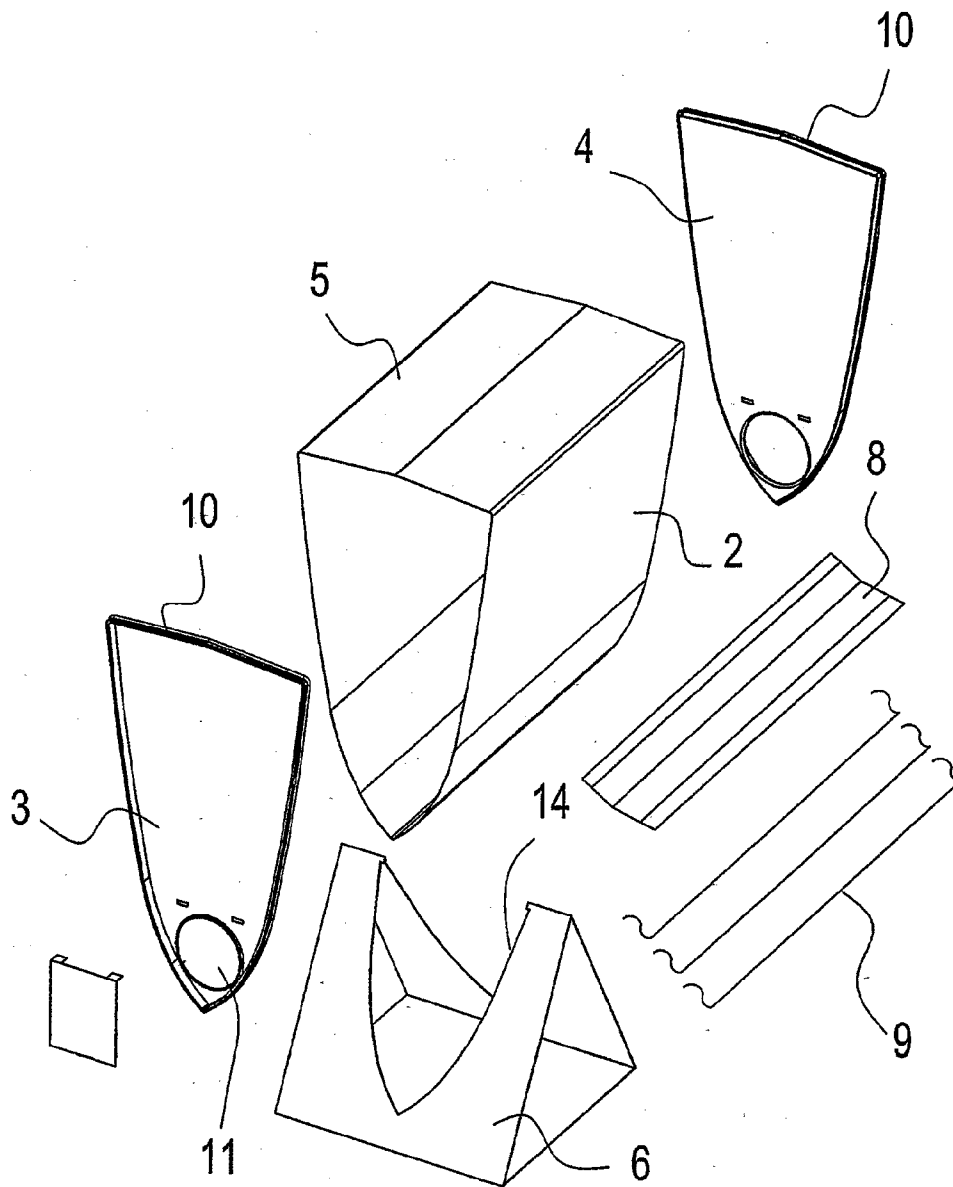


Fig. 2

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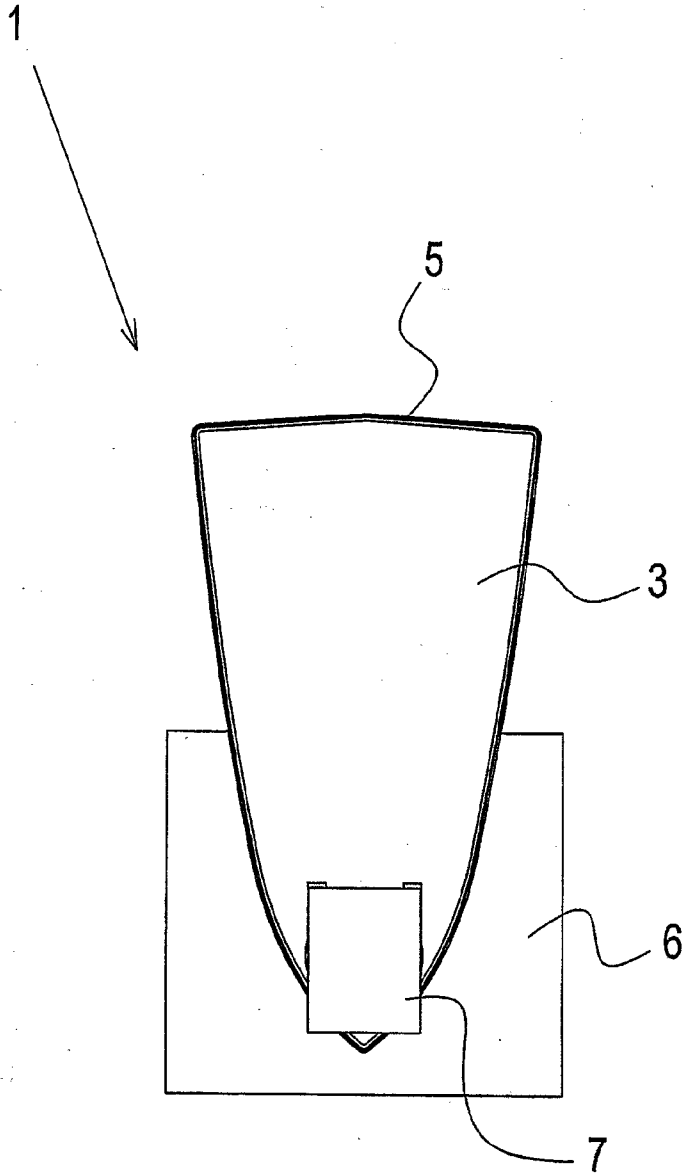


Fig. 3

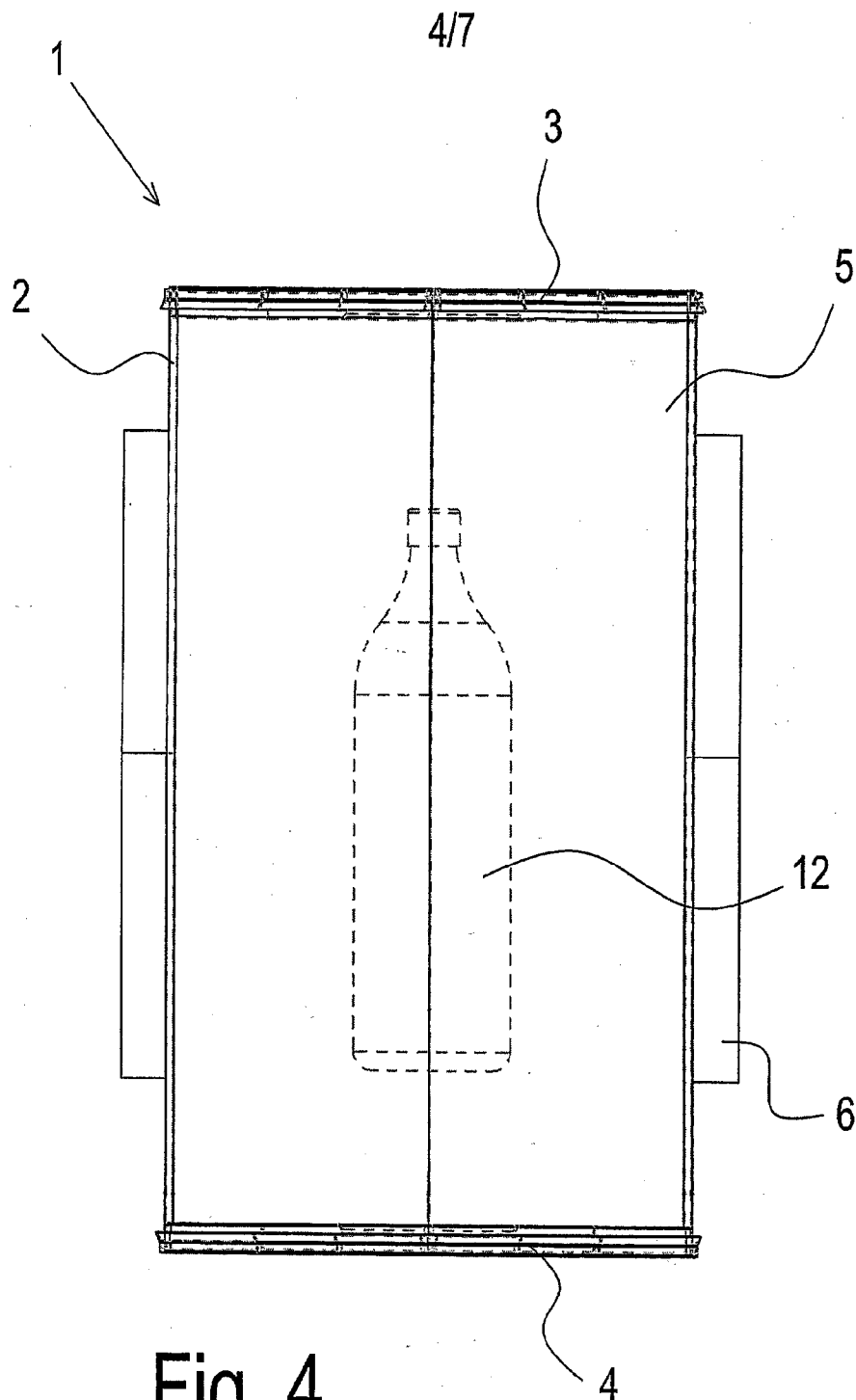


Fig. 4

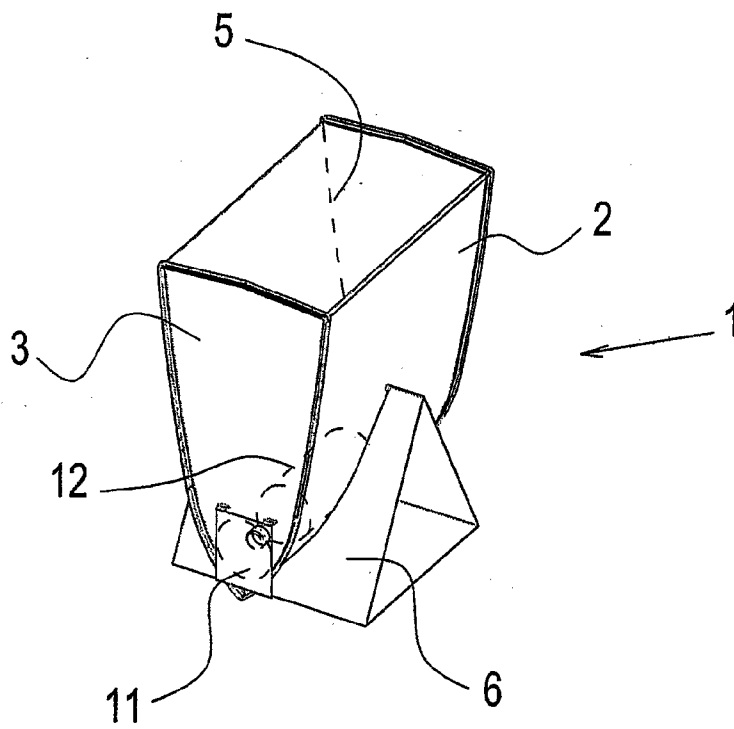


Fig. 5

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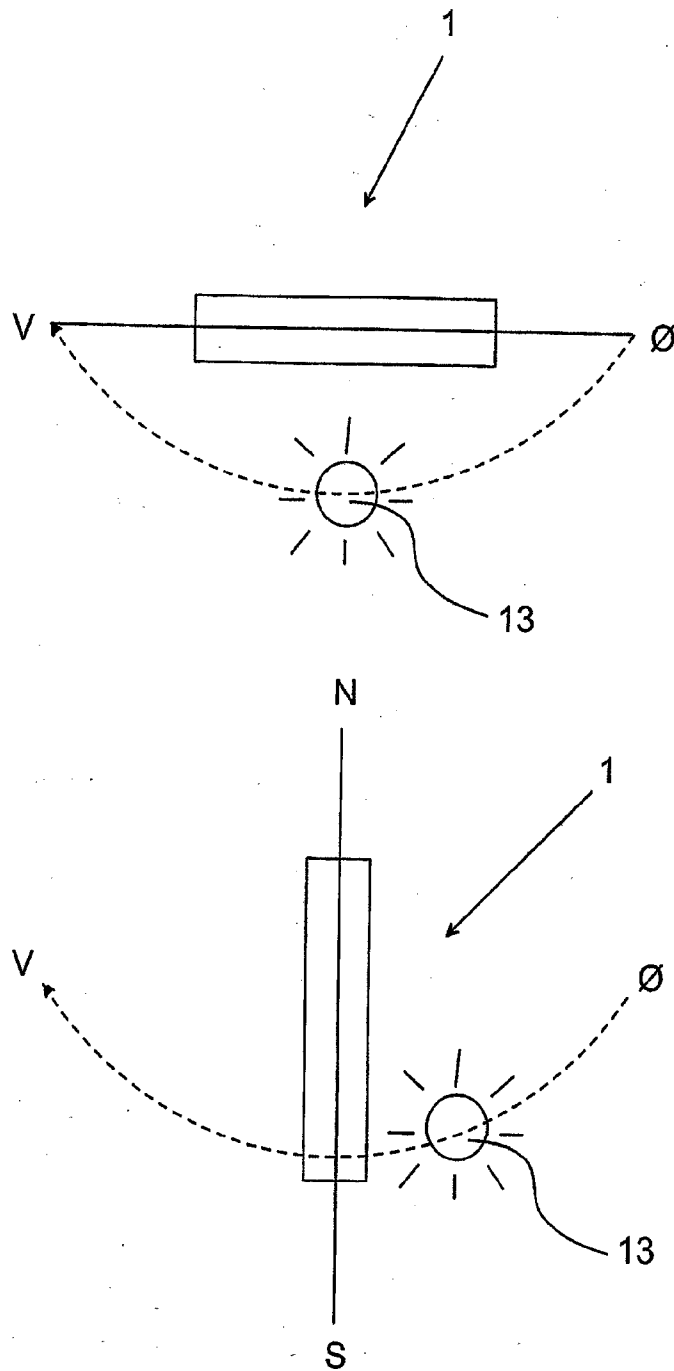


Fig. 6

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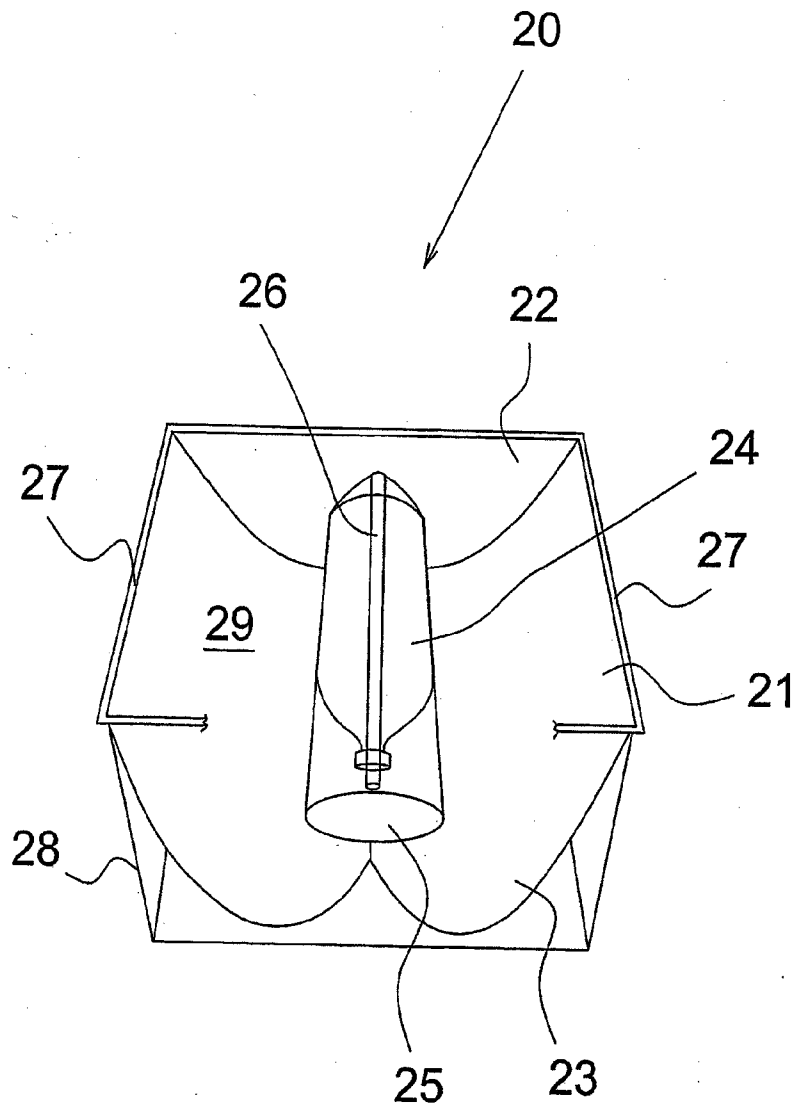


Fig. 7