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(71) Applicant: **EXTINCTUS AS** [NO/NO]; Mostuveien 19,  
3226 Sandefjord (NO).

(72) Inventor: **GUNDERSEN, Nina**; Hellenen 31, 3280 Tjodal-  
lyng (NO).

(74) Agent: **TANDBERG INNOVATION AS**; Postboks 1570  
Vika, 0118 Oslo (NO).

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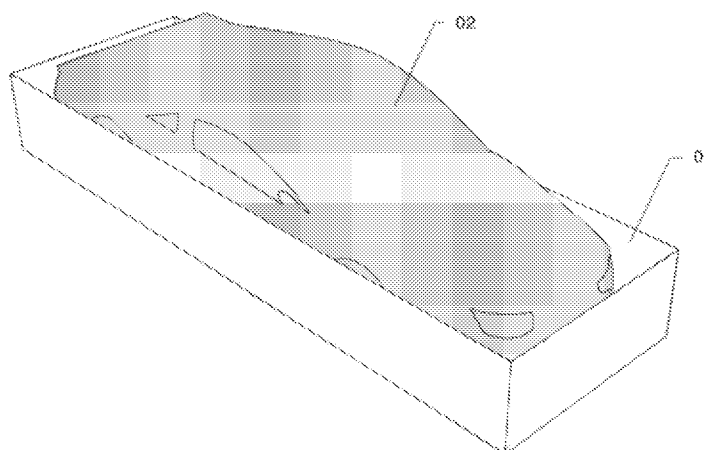
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(54) Title: DEVICE FOR FIRE EXTINGUISHING ENERGY STORAGE DEVICES OF VEHICLES WITH ELECTRICAL DRIVE

Fig. 1



(57) Abstract: The invention concerns a device for extinguishing fire in energy storage devices of vehicles with electrical drive, consisting of walls (01) to be mounted around the vehicle (02) to shape a pool that can be filled with water to cool down the temperature in the batteries, stop the thermal runaway and extinguish the fire. The device also keeps the waste extinguishing agent with toxic substances and electricity safely away from rescue responders during firefighting, and provides the opportunity to afterwards collect the waste water for correct disposal. The device can be mounted around a vehicle after a fire has occurred, or the device, or parts of it, can be pre-installed in exposed areas. The device can consist of one or several pieces, and can be mounted manually, partially automatic or fully automatic in any way that ensures appropriate waterproofness.



DEVICE FOR FIRE EXTINGUISHING ENERGY STORAGE DEVICES OF  
VEHICLES WITH ELECTRICAL DRIVE**BACKGROUND**

5 The invention concerns a device for extinguishing fire in energy storage devices of  
vehicles with electrical drive (subsequent often exemplified as batteries), consisting of  
walls to be mounted around the vehicle to shape a pool that can be filled with water to  
cool down the temperature in the batteries, stop the thermal runaway and extinguish the  
fire. The device also keeps the waste extinguishing agent with toxic substances and  
10 electricity safely away from rescue responders during firefighting, and provides the  
opportunity to afterwards collect the waste extinguishing agent for correct disposal.

Fire in energy storage devices of vehicles with electrical drive may occur during charging,  
in particular during fast charging, or after a collision or damage to the battery. This kind  
15 of fire is extremely challenging to extinguish due to "thermal runaway" that occurs in the  
batteries; When one battery cell is heated enough, a chain reaction occurs and the cells  
ignite each other, and in addition the battery cells themselves produce all four elements  
to keep the fire going - oxygen, combustible material, heat and chemical reaction.  
Cooling down the temperature is a way to extinguish such a fire, but with traditional  
20 extinguishing methods it is not possible to reach the batteries with enough water to cool  
them down. Large amounts of toxic gases are released to air by thermal runaway.  
Especially dangerous is the gas hydrogen fluoride, which has the ability to penetrate  
firefighter clothing, skin and muscles. Even smaller exposures can cause life-threatening  
systemic damage in addition to local etch damage. This affects cellular metabolism and  
25 leads to cell death or necrosis, as well as systemic damage related to hypocalcemia. The  
gas has a direct cardiovascular effect and may cause arrhythmias. 1/5 of the exposed  
amount remains in the body. Toxic emissions to air can also hurt other living creatures  
and the environment. Today the large amount of extinguishing agent that is used in the  
attempt to extinguish the fire brings many toxic substances from the batteries into the  
30 groundwater. This means that it is extremely important to extinguish such a fire as soon  
as possible, and to be able to collect the waste extinguishing agent for proper disposal.

**DISCLOSED AND KNOWN DEVICES**

CN202207410U discloses an automobile-used battery pack fire extinguisher. The fire  
35 extinguisher comprises a water spraying device, a human body protection tool and a  
movable coffer, wherein the water spraying device is used for spraying water onto an in-  
vehicle afire battery pack for fire extinguishing; the movable coffer stops and collects  
water sprayed by the water spraying device and prevents water from flowing all around  
to cause electric shocks. The device in CN202207410U uses the coffer to prevent the  
40 extinguishing water from flowing and cause electric shock, not to collect extinguishing

agent to cool down the temperature in the batteries as a method to extinguish the fire, or to collect the waste extinguishing agent for proper disposal, as the present invention discloses.

5 CN204050730U discloses a fire extinguishing system comprising a temperature detector and a water spraying fire extinguishing apparatus comprising a water storage tank. CN204050730U does not allow full drowning of the batteries to stop thermal runaway, as the present invention discloses. The device in CN204050730U is not portable in any way, and it would be necessary to have the complete device installed at every parking spot to  
10 ensure the intended function of it.

JP2013136266A and EP2624332A1 disclose extinction structures of an electric vehicle configured to supply extinguishing agent directly to the battery pack to immerse and cool down the temperature in the batteries. These solutions must be mounted during the  
15 production of the cars, and cannot be used to extinguish fire in cars without pre-installation, as the present invention discloses.

NO20161913 discloses a textile blanket to arrange with a car jack under a vehicle in fire, which should be attached by ropes, and filled with water to extinguish the fire. As this  
20 solution requires the vehicle to be jacked up with a car jack, the firefighters who are working to get this device in place will be heavily exposed to the extremely toxic substances released from the batteries during a fire, the extinguishing time becomes longer than necessary, and toxic emissions into the air and into extinguishing water will also be higher than necessary. It is also difficult to place underneath a vehicle where  
25 vehicles are tightly parked. The present invention overcomes these disadvantages by mounting the side walls of the device according to the invention around the vehicle without having to jack up the vehicle with a car jack. Also, the present invention is easy to use where vehicles are tightly parked. This means the extinguishing time will be heavily reduced, emergency responders do not have to stay close to the burning vehicle  
30 over time and be exposed to toxic substances, and health, life, environment and values can be saved.

## **DESCRIPTION OF THE INVENTION**

The present invention consists of walls 01 to be mounted around the vehicle 02 to shape  
35 a pool that can be filled with extinguishing agent to cool down the temperature in the batteries, stop the thermal runaway, and if a fire has occurred, extinguish the fire. The device also keeps the waste extinguishing agent with toxic substances and electricity safely away from rescue responders during firefighting, and provides the opportunity to afterwards collect the waste water for correct disposal.

To make sure the batteries can be completely submerged in water, the walls 01 are taller than the location of the batteries in the vehicle 02 the device is intended for. The device can be mounted around a vehicle 02 after a fire has occurred, or the device, or parts of it, can be pre-installed in exposed areas such as charging stations, auto repair shops, ferries and so on, to make the assembly of the device faster when it is needed. The device can consist of one or several portable or fixed pieces, and it can be mounted manually, semi- automatic, or fully automatic.

The walls 01 are waterproof, they resist high temperatures and exposure to flames, and can be chemical resistant and electrically non-conductive. The walls 01 can also comprise connecting devices 05 for firefighting equipment or/and waste disposal equipment, such as fire hoses and/or pumping hoses. In order to avoid leaking of extinguishing agent and other substances out of the device, all parts of the device can be sealed against each other and against the bottom with sealing-means. Such sealing-means are known to a person skilled in the art. Fixing means, connectors and all other materials used for the described application, including resistance to the extinguishing agent, expected chemicals, temperature and pressure are known and used by a person skilled in the art. Additional means, such as flaps and similar, may also help to avoid leaking. When the bottom frame 03 or the floor 11 is fixed, the bottom frame 03 or the floor 11 can comprise a drainage for dirt, as dirt may occur from the environment over time when pre-installed, and the drain openings can be closed by the walls 01 when the walls 01 are mounted, or by any other sealing methods. The device can consist of one single piece, like a flexible wall with fixing means included, or of multiple devices that together forms a pool. The device can be used to stop thermal runaway in all kind of batteries where thermal runaway may occur, not only in vehicle batteries.

figure 1 shows the device according to the invention, where the walls 01 are mounted around a vehicle 02 to shape a pool that can be filled with water to cool down the temperature in the batteries, stop thermal runaway and extinguish the fire.

Figure 2 shows an embodiment where portable or fixed walls 01 are mounted in guide profiles 04 on a portable or fixed bottom frame 03 or floor 11, or to the ground in any way that ensures appropriate waterproofness. The walls 01 can hold connecting devices 05 for firefighting equipment or/and waste disposal equipment, such as fire hoses and pumping hoses. If the bottom frame 03 is fixed, it may comprise drainage for dirt, and the drain openings are closed when the walls 01 are mounted, or by any other sealing methods.

Figure 3 shows an embodiment of a partially automatic or fully automatic device, which comprises a bottom frame 03, solid floor 11, sensors 10 for correct positioning of the vehicle, a top frame 09 which is positioned at the ground when not in use and pulls up the walls 01 with for example lifting units 12 when in use, smoke-, heat- or hydrogen fluoride sensors 08 with connected warning lights 07 and direct warning to the responsible personnel where the device is located, and a release- and/or reset button 06.

Figure 4 shows a fixed embodiment where one or several walls 01 are openable and closable for driving the vehicle in and/or out. The embodiment can hold smoke-, heat- or hydrogen fluoride detectors 08, and other technical sensors as described in figure 3. The walls 01 can be attached to a floor 11, but also to a bottom frame 03, or directly to the ground in any way that ensures appropriate waterproofness. This fixed embodiment can also be portable, if mounted on a car trailer or similar.

Figure 5 shows a fully portable embodiment with walls 01, bottom frame 03, inner flaps 13 to help keep the water in place, and loops 14 to help keep the walls up. This embodiment can be attached to the ground with fixing means such as weights, magnets, tar, glue, suction cups or any other fixing means that ensures appropriate waterproofness. It can be held up by ropes and loops 14, suction cups, poles, cranes, drones or any other stable support.

Figure 6 shows a fully portable embodiment with channels 15 that can be filled with air/gas or water. The channels 15 can also be located along the entire lower part of the embodiment, in order to be filled with water as a weight to keep the embodiment in place at the ground. Also, the entire wall can exist of channels 15 to be filled with air/gas to lift the walls 01 and keep them up.

Another embodiment has the possibility to cover the whole device with for example a cover or a roof to avoid escaping of gases and/or smoke and to isolate the fire. The cover can comprise gas filters, to vent out the built up gas pressure with reduced toxic emissions to air. With such an embodiment the vehicle can be parked under a protective atmosphere to isolate the fire as well as to protect the vehicle of aging process.

Other embodiments are where the whole device or parts of the device are mounted above parking places, with possibilities to lower it down and fasten it to the ground around the car.

Other embodiments have water mist/fog spraying systems mounted above or/and around the fixed bottom frame 03 or the floor 11, in order to reduce the amount of toxic

emissions to air in case of fire, and in this way, make the firefighting more health- and environment friendly. The spraying system mounted above is tall enough for the vehicle to fit underneath.

- 5 The device can be performed as a modular construction system, with side walls of different sizes to adjust the device effectively to different sizes and kinds of vehicles such lorries, buses, passenger cars, motorcycles, bicycles, airplanes and so on. Other embodiments make use of buildings and structures. For example, by using house walls, the garage, and similar. side walls respectively parts for the device according the invention.
- 10

**CLAIMS**

1. A device surrounding a vehicle (02) for extinguishing fire in energy storage devices of vehicles with electrical drive,

5

characterized in that

the device comprises one or more fixed and/or portable walls (01) which can be mounted as a pool around the vehicle (02) without the necessity to jack the vehicle up;

10

the device is designed to be filled with extinguishing agent to completely submerge the energy storage device to cool down the temperature in the batteries, stop the thermal runaway and in case of fire, extinguish the fire;

15

the design and choice of materials allows the opportunity to afterwards collect the waste extinguishing agent for correct disposal.

20

2. Device according claim 1, designed to mount the device around the vehicle before and/or after a fire has occurred, or to place the vehicle in the device before or after a fire has occurred.

25

3. Device according to claim 1, where the device can be manually, semi-automatically, or fully automatically manageable.

30

4. Device according claim 1, where portable or fixed walls (01) are mounted to a fixed bottom frame (03), floor (11) or to any other fixed fixing means, at places where vehicles can be parked and/or transported.

35

5. Device according claim 1, where portable walls (01) are mounted to a portable bottom frame (03), fixed to a channel (15) which can be filled with water as weight, attached to the ground by glue, tar, magnets, weights, suction cups, or mounted with any other portable fixing means directly to the ground/floor, in any way that ensures appropriate waterproofness.

6. Device according claim 1, where the device is made of materials that resists chemicals and are electrically non-conductive.

7. Device according to claim 1, where the device comprises electronic equipment like lifting units (12), sensors for correct parking (10), sensors for detecting smoke, heat and/or hydrogen fluoride (08), warning lights (07) and/or release/reset buttons (06).
- 5
8. Device according to claim 1, where the device comprises connecting devices (05) for firefighting equipment and/or waste disposal equipment, such as fire hoses and/or pumping hoses.
- 10
9. Device according to claim 1, where the walls are raised and/or held with channels (15) filled with air/gas.
10. Device according to claim 1, where the device is made of a single piece or of multiple pieces.
- 15
11. Device according to claim 1, where the device can cover the vehicle completely or almost completely with a cover or roof, and the cover comprises venting with gas filters.
12. Device according to claim 1, where the whole device or parts of the device are mounted above parking places, with possibilities to lower it down and fasten it to the ground around the car.
- 20
13. Device according to claim 1, when the bottom frame (03) or the floor (11) is fixed, the bottom frame (03) or the floor (11) comprise drainage for dirt.
- 25
14. Device according to claim 1, where water mist/fog spraying systems are mounted above or/and around the fixed bottom frame 03 or floor 11.
15. Device according to claim 1, where the device may be performed as a modular construction system, with side walls of different sizes to adjust the device effectively to different sizes and kinds of vehicles, and/or make use of buildings and structures.
- 30

Fig. 1

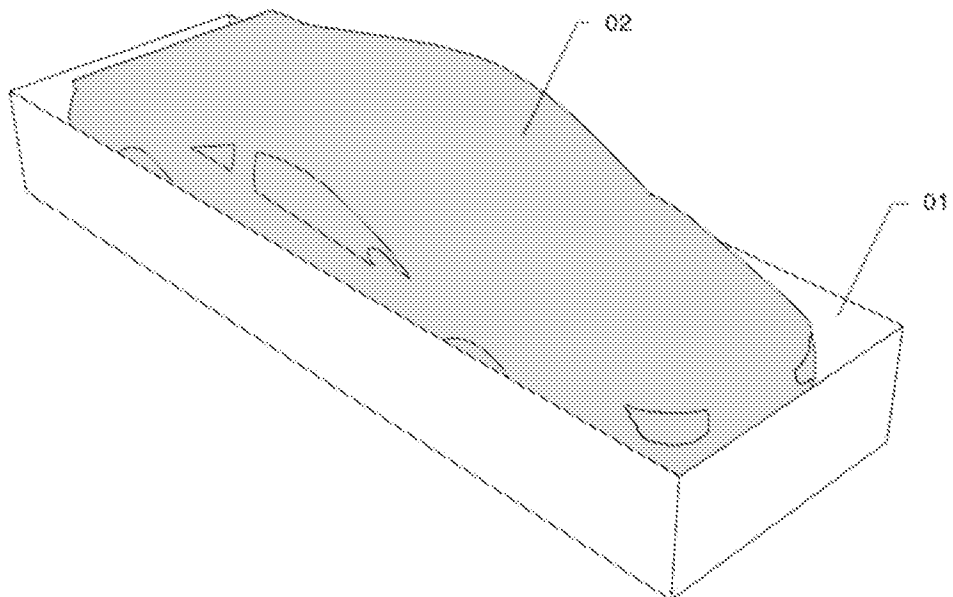


Fig. 2

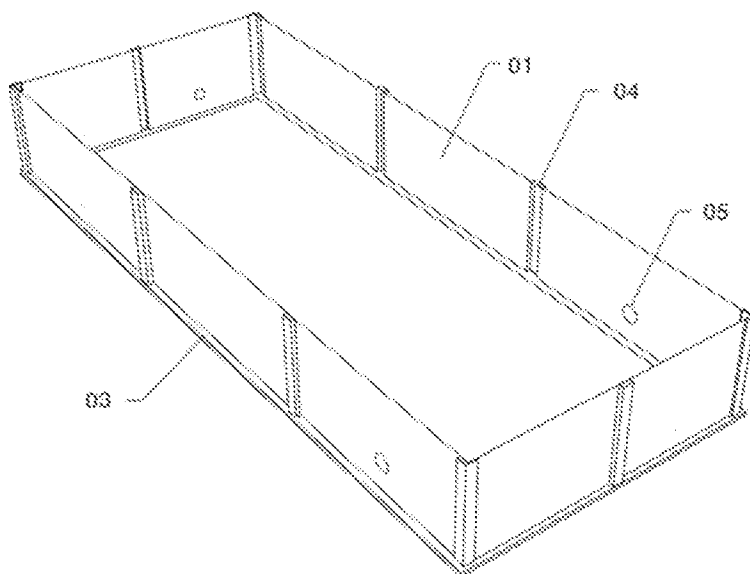


Fig. 3

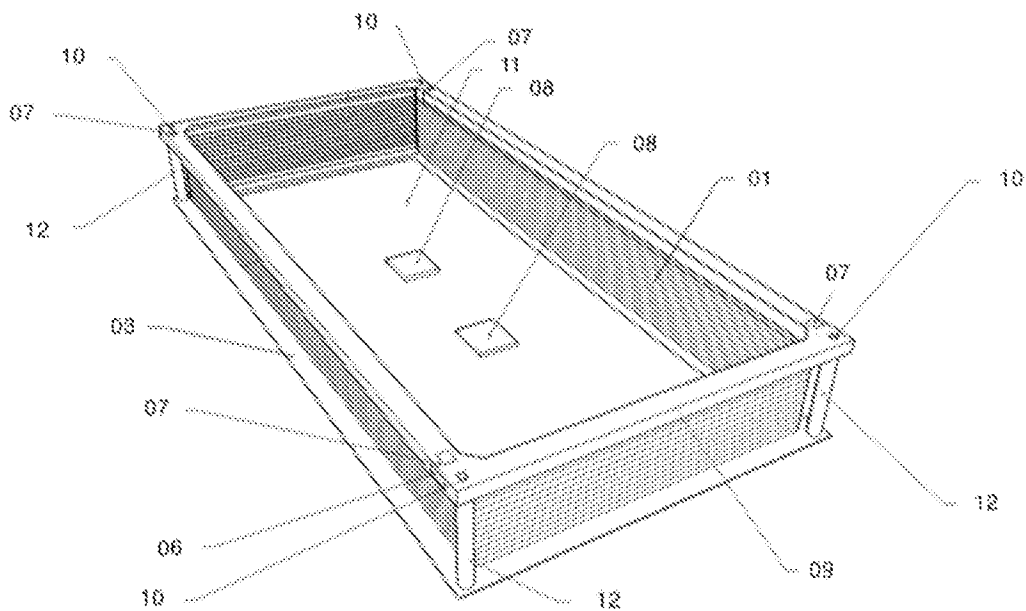


Fig. 4

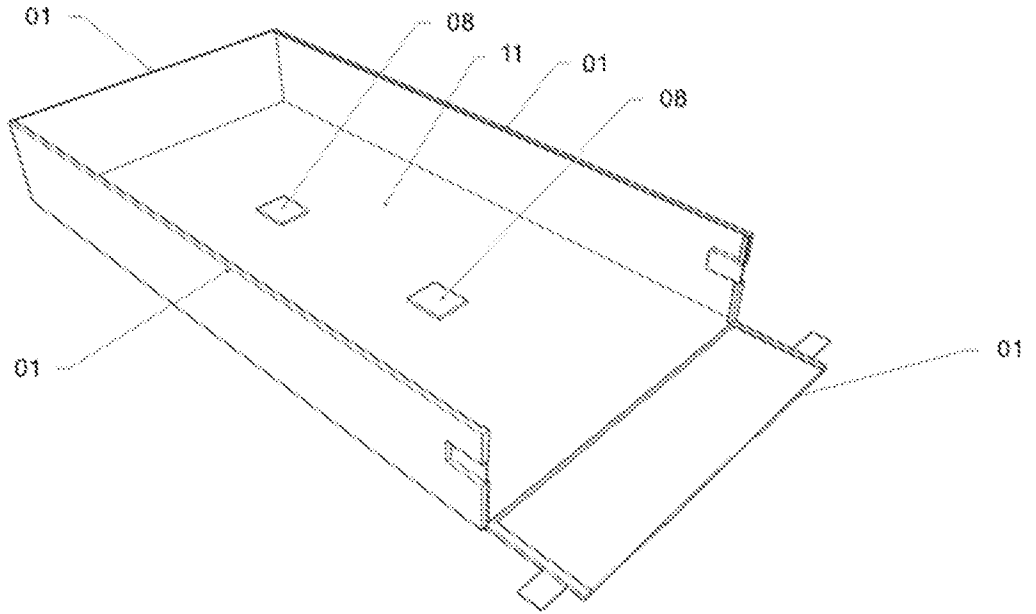


Fig. 5

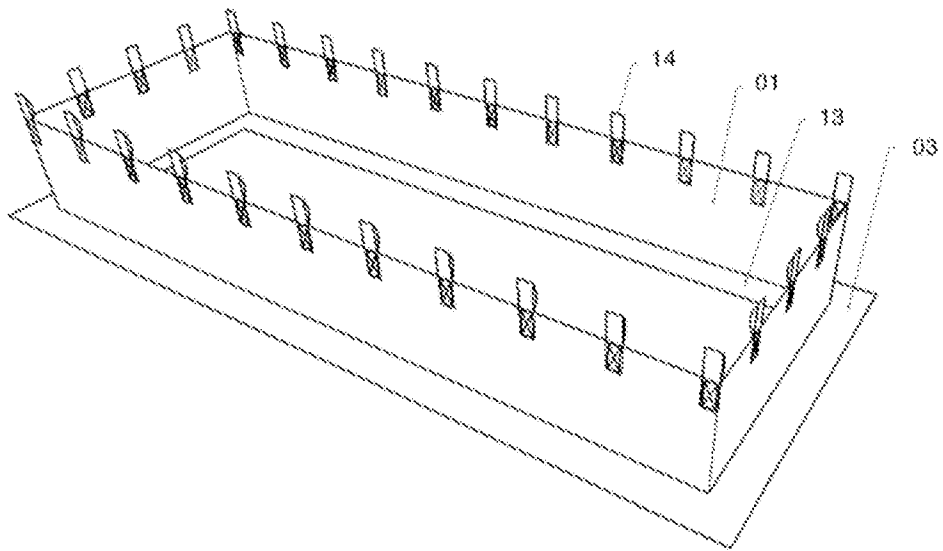
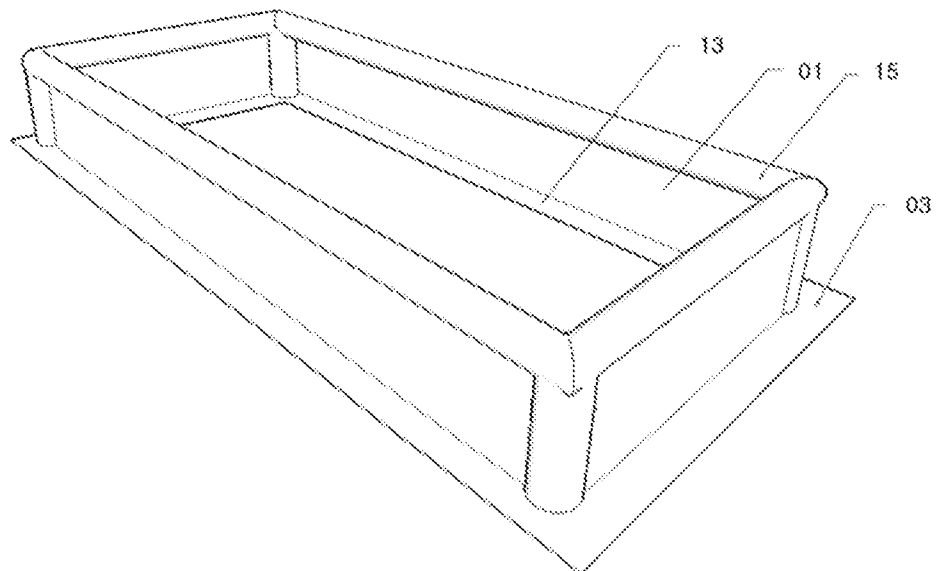


Fig. 6



INTERNATIONAL SEARCH REPORT

International application No  
PCT/N02018/000011

A. CLASSIFICATION OF SUBJECT MATTER  
INV. A62C3/07 A62C3/16  
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)  
A62C E04H

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 practicable, 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	CN 202 207 410 U (AMPEREX TECHNOLOGY LTD) 2 May 2012 (2012-05-02) cited in the application	1-8,10, 12-14
A	figure 1 paragraphs [0011], [0014] - [0015], [0017] - [0019], [0029], [0031] - [0036], [0038]	9,11,15
X	FR 2 569 668 A (TRABOUILLET ANDRE [FR]) 7 March 1986 (1986-03-07) figures 1-9 page 1, lines 1-3 page 2, lines 11-19 page 3, lines 18-27	1,3,5,9, 10,13
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Further documents are listed in the continuation of Box C.

See patent family annex.

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Date of the actual completion of the international search <b>26 September 2018</b>	Date of mailing of the international search report <b>09/10/2018</b>
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Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer  <b>Paul, Adeline</b>
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## INTERNATIONAL SEARCH REPORT

International application No  
PCT/N02018/000011

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2 766 462 A (NORMAN WILLIAM Z ET AL) 16 October 1956 (1956-10-16) figures 1-9 column 1, lines 15-18 column 2, lines 24-27, 30-34 -----	1-3,5,8, 10
X A	JP H06 79010 A (TAKENAKA KOMUTEN CO) 22 March 1994 (1994-03-22) figures 1-8 paragraphs [0023] - [0030] -----	1-8, 10-15 9

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/N02018/000011

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