



(51) International Patent Classification:

A62C 3/06 (2006.01) *A62C 2/06* (2006.01)
A62C 3/07 (2006.01) *F16L 5/04* (2006.01)
A62C 3/16 (2006.01) *H02G 3/04* (2006.01)

(21) International Application Number:

PCT/EP2018/059406

(22) International Filing Date:

12 April 2018 (12.04.2018)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

10 2017 107 904.1

12 April 2017 (12.04.2017) DE

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(81) Designated States (*unless otherwise indicated, for every
kind of national protection available*): AE, AG, AL, AM,
AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ,
CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO,
DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN,
HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP,
KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME,
MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ,
OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA,

SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN,
TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (*unless otherwise indicated, for every
kind of regional protection available*): ARIPO (BW, GH,
GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ,
UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ,
TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK,
EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV,
MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM,
TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,
KM, ML, MR, NE, SN, TD, TG).

Published:

— *without international search report and to be republished
upon receipt of that report (Rule 48.2(g))*

(54) Title: PROTECTIVE CONTAINER FOR HOLDING IGNITION-SENSITIVE OBJECTS AND PROTECTIVE SLEEVE,
SHELL OR BLOCK HAVING AT LEAST A FIRST SIDE AND A SECOND SIDE FOR PREVENTING HEAT PRESENT AT THE
FIRST SIDE FROM BEING TRANSFERRED TO THE SECOND SIDE

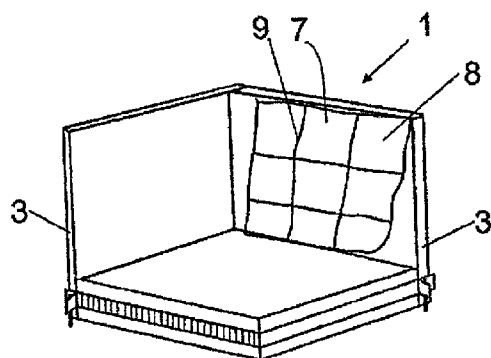


Fig. 2

(57) Abstract: A protective container for holding ignition-sensitive objects is claimed, which protective container consists of a base, side walls and optionally also an upper closing wall, the base being reinforced in order to improve the carrying capacity, and which is characterized in that the base consists of at least a plate made of expanded vermiculite, the upper side of which plate faces the container interior, and a supporting structure that reinforces the plate from below. With the protective container according to the invention it is possible to transport ignition-sensitive objects safely, the vermiculite material of the base is a plate made of expanded vermiculite so that this plate prevents sparks which occur during a possible self-igniting process, or also flames from passing out of the container and causing damage in the surrounding area.



Protective container for holding ignition-sensitive objects and protective sleeve, shell or block having at least a first side and a second side for preventing heat present at the first side from being transferred to the second side

The present invention relates to a protective container for holding ignition-sensitive objects consisting of a base, side walls and, if so required, an upper closing wall, the base being reinforced in order to improve the carrying capacity. The present invention also relates to a protective sleeve, shell or block having at least a first side and a second side for preventing heat at the first side from being transferred to the second side. The invention is further related to a use of a sleeve, shell or block for respectively around a pipe, an ignition-sensitive object, around a conduit, as at least a part of a passive fire-resistant sealing system or heat insulation.

The transportation of inflammable and combustible substances is subject to special regulations. Batteries for electric vehicles and tools are among the objects which are considered to be highly inflammable and are classified as hazardous goods according to the international transportation law. Lithium batteries in particular are subject to the hazardous materials regulations due to the risk of decomposition within the individual cell and complex burning and explosion behavior if damaged, e.g. in the event of a lithium ion battery incident, highly toxic HF is also released in gaseous form. Therefore, special regulations are to be observed for the commercial dispatch and transportation of lithium-ion batteries.

It is therefore necessary for the packages used for transportation to completely enclose the batteries, and for the batteries to be protected against short circuit. Another requirement is to protect the batteries against unintentional movement. The batteries should also be packaged or protected so that contact with conductive materials within the same packaging cannot lead to a short circuit.

When transporting inflammable and combustible substances it is desirable to arrange the transportation such that these goods are packaged so that the heat or flames that form under certain circumstances can already be checked or fully suppressed within the packaging so that no damage occurs outside of the packaging of these goods due to excessive heat or flames. In addition, any liquids passing out of the packaging material

should be collected and any gases passing out of the packaging material should be adsorbed.

Therefore, the object underlying the present invention is to make available a container in which inflammable or combustible goods can be packaged and transported, and in the event of combustion or ignition of these goods being transported, the surrounding area being shielded so that there is no damage to the surrounding area.

Accordingly, an object of the present invention is a protective container for holding ignition-sensitive objects consisting of a base, side walls and optionally also an upper closing wall, the base being reinforced in order to improve the carrying capacity, characterized in that the base comprises at least

- a vermiculite plate, the upper side of which faces the container interior,
- a supporting structure that reinforces the plate from below.

The protective container may also be referred to as a protective shell.

With the protective container according to the invention it is possible to safely transport ignition-sensitive objects. The vermiculite material of the base is a plate made of expanded vermiculite so that this plate prevents sparks which occur during a possible self-igniting process, or also flames, from passing out of the container and causing damage in the surrounding area. The supporting structure which reinforces the plate from below serves to improve the carrying capacity so that heavy objects and loads, e.g. batteries, can also be transported.

The base of the protective container according to the invention is a plate made of expanded vermiculite. Molds made of expanded vermiculite are known from the prior art. They are produced by a pressing process, water glass being used as the binding agent. Additional substances may also be contained, in particular those which have fire-retardant properties, also referred to as flame retardants or fire retardants in general language usage, and also absorptive properties with respect to liquids and gases that pass out and can bind and neutralize the latter.

The other walls of the container, in particular the side walls, are preferably also produced from a fire-retardant material, preferably also from expanded vermiculite. The upper closing wall can also be made of a different material, and can optionally also have a different

structure, preferably however, the upper closing wall also having fire-retardant properties, and particularly preferably being made of a vermiculite-based material.

The supporting structure which reinforces the plate from below is preferably a metal grate, a surface structure made of glass fiber-reinforced plastic or a surface structure with carbon fiber-reinforced plastic. The supporting structure preferably extends horizontally, at least over the majority of the base area of the plate. It has proven to be particularly preferred if the supporting structure is embedded into the material of the plate as reinforcement. This reinforcement can be incorporated into or be embedded in the material of the plates in a known manner during the production process for the plate made of expanded vermiculite. If the supporting structure is a metal grate, in an alternative embodiment the plate can sit on the metal grate.

In one possible embodiment of the present invention the supporting structure is provided on its outer edges with connection elements which serve to connect the base to the side walls. These connection elements can be, for example, straps formed on the supporting structure and protruding outwardly.

The protective container according to the invention also has, in addition to the base, side walls. These side walls are preferably in the form of side plates which are also made of expanded vermiculite material. The side plates can also have a reinforcing supporting structure to improve their strength. Generally, the thickness of the side plates is somewhat less than the thickness of the base. If a reinforcing supporting structure is incorporated into the side walls or adjoins the side walls, this supporting structure may have smaller dimensions than the supporting structure in the base.

The upper cover of the protective container can, for example, be formed in the same way as the side plates. In one possible embodiment the upper cover is formed by a surface element sub-divided like cassettes, as described below as a protective element, or by some other flexible material which is suitable as a cover.

In one particularly preferred embodiment the protective container according to the present invention has fire-active protective elements on one or more of the insides of the side walls facing the interior of the container and optionally of the base. This protective element is preferably a surface element sub-divided like cassettes, a fire-retardant material being located in each of the individual cassettes. The fire-retardant material which is contained in the protective element is preferably a fire-retardant filler, in particular raw vermiculite,

expanded graphite, an intumescent system or a combination of the above components, possibly also in combination with additional components. This protective element has additional fire-retardant properties.

If ignition or a fire occurs within the container, at high temperatures the raw vermiculite releases crystallization water and the volume of the raw vermiculite increases considerably, i.e. so-called expanded vermiculite forms. Due to the increase in volume the burning goods are enveloped by fire-protection material, and the fire-protection capacity of the container is further improved overall.

In its filling the protective element may contain up to 100 % raw vermiculite, preferably 20 to 80 % by weight in relation to the overall weight of the material contained in the surface element is raw vermiculite, and particularly preferably 40 to 60 % by weight. The raw vermiculite may have a grain size of 0, 1, 2, 3 or 4, grain sizes of 0, 1, 2 or 3 being preferred, and in particular the grain sizes 2 or 3 or mixtures thereof being used.

If a mixture of raw vermiculite and expanded vermiculite is contained in the protective element, the expanded vermiculite is preferably contained in an amount of up to 60 % by weight, particularly preferably in an amount of 5 to 50 % by weight, and in particular in an amount of 10 to 40 % by weight in relation to the amount of material that is contained. The expanded vermiculite preferably has a grain size of 0, 1, 2, 3 or 4, grain sizes of 0, 1, 2 or 3 are preferred, and grain sizes of 2 or 3 or mixtures thereof are particularly preferred.

The siliceous structure of the expanded vermiculite or raw vermiculite contributes to the binding and neutralization of liquids and gases passing out of the burning stored object. Since raw vermiculite expands when there is rapid heat propagation and so the volume of the protective element increases, rapid enclosure of the object can take place, and this may contribute to the source of fire being quenched.

Ceramization agents and propellants may be contained in the protective element as additional components. Appropriate ceramization agents are, for example, substances containing phosphor, such as phosphates, phosphinates, red phosphor, for example bonded in a PE masterbatch, phosphoric acid derivatives, as well as structures containing silicon, such as silicates, silanes and siloxanes or borate glass. The ceramization agent can be contained in an amount of up to 25 % by weight in relation to the overall weight of the material contained in the protective element, in particular in an amount of 5 to 20 % by weight, and in particular of 8 to 15 % by weight. If the raw vermiculite expands, the

ceramization agent may generate solidification of the free-flowing material contained in the protective element, and so bring about enclosure of the stored object.

The propellant may be any propellant, and may be selected, for example, from substances containing nitrogen, such as melamines, cyanurates, melamine cyanurates, melamine polyphosphates (MPP) or ammonium-based substances (APP). The propellant may bring about a further increase in volume, in particular when only small amounts of raw vermiculite are contained therein. The propellant may be contained in an amount of up to 15 % by weight, preferably from 3 to 10 % by weight, and particularly preferably in an amount of from 5 to 8 % by weight in relation to the overall weight of the material contained in the protective element.

If the protective element is in the form of a surface element sub-divided like cassettes, the basic structure of the surface element is preferably a textile surface material composed of two material layers which are connected to one another to form the cassettes along seam sections. The seams may be adhesive seams or sewn seams. The fire-retardant material is located between the seam sections.

In one possible embodiment the fire-retardant material in the protective element is in the form of free-flowing material. This type of filling offers the advantage that cushioning of the object to be stored or transported against e.g. impacts is additionally achieved.

The material from which the basic structure of the surface element is made should also be a fire-retardant material. Preferably, this is a fleece or a fabric made of a mineral fiber which is additionally permeable to gas and liquid.

The present disclosure is also directed to a protective sleeve, shell or block that can be used to facilitate that heat, which is due to a nearby fire, can be prevented from being easily transferred. Particularly where it is very important to ensure that a fire will not quickly spread throughout a construction, it is important to seal the remaining space in openings provided in walls, ceilings or decks for the extensions of pipe and/or cables from one compartment to another or from inside to outside and vice versa. For instance, a metal pipe that is extending from one compartment to another compartment on board of a metal construction such as a ship or an offshore oil platform will be extending through a hole in a metal wall. The remaining space in the hole needs to be sealed off such that fire cannot easily find its way through the hole. Furthermore, particularly when a metal pipe extends from one side of the wall to another side of the wall, it is important that heat transferred by

the metal of the pipe, can be insulated as much as possible, so that at the side that is not exposed to a nearby fire, the temperature will for as long as possible be kept relatively low. Similarly, where many cables are transported through a conduit, for instance of the size of a house door, it is important to have materials present in the conduit in the space that is not occupied by the cables, so that these materials equally can assist in preventing heat from being transferred through the conduit, be it directly, or via the heat transferred into the conduit via the cables.

Accordingly, the present disclosure provides a protective sleeve, shell or block having at least a first side and a second side for preventing heat present at the first side from being transferred to the second side, sleeve, shell or block comprising expanded vermiculite and a reinforcement structure for enhancing strength of the sleeve, shell, or block. Preferably the reinforcement structure is a coating applied at at least one of the first and second side, and preferably applied to all sides of the sleeve, shell or block. The coating may be an inorganic coating and/or of a heat insulating material. For such coating materials reference is made to for instance US 2014/0112861 and/or EP 1762588 A1. Preferably the coating is of a fire-retardant material. Even more preferably, the coating exhibits at atmospheric pressure during increasing ambient temperature a drop in its thermal conductivity.

Preferably, the coating has a porous structure or forms pores at elevated temperatures. Such pores may comprise pores having a diameter of less than 700 nm and preferably less than 70 nm. The porous structure may comprise clusterings of particles having a size within a range of 2 - 300 nm. Preferably, the coating is salt water resistant. The coating itself may be impermeable to gas when a pressure difference of 30 mBar is set between the first and the second side. The coating is preferably also impermeable to water. Reference is made to a coating material sold by the applicant under the trade name "Fissic".

Such a sleeve, shell or block may be very useful in marine environments. Due to the coating, tears formed in the expanded vermiculite material, may not result in fracture of the sleeve, shell or block.

In the attached figures possible embodiments of the present invention are illustrated. These show as follows:

Fig. 1: a perspective illustration of the claimed protective container;

Fig. 2: the protective container from Figure 1 with a protective element disposed on a side plate;

Fig. 3: a base plate;

Fig. 4: a metal grate.

Fig. 5: a perspective illustration of a sleeve of the present disclosure put around a pipe.

Fig. 6: Schematically a conduit 14 with protective blocks 15.

Figure 1 shows a protective container for holding ignition-sensitive objects having a base 2 and side walls 3, only two of the four possible side walls being represented in the illustration shown here. The upper closing wall is not shown here. The base 2 consists of a plate made of expanded vermiculite facing the interior of the container with its upper side and a supporting structure 5 that reinforces the plate from below. In the embodiment shown here the supporting structure 5 is embedded in the material of the plate as reinforcement, i.e. it is enclosed from above and from below by the expanded vermiculite. In the embodiment shown here the supporting structure extends over the majority of the base surface. On its outer edges the supporting structure 5 is provided with connection elements 6 which are configured such that the base can be connected to the side walls by these connection elements.

Figure 2 shows the protective container 1 from Figure 1, a fire-retardant protective element 7 being disposed on an inside of the side walls facing the interior of the container. In the embodiment that is shown here, the protective element 7 that is illustrated is a surface element sub-divided like cassettes, free-flowing material made of fire-retardant material being contained in the individual cassettes which form cavities. The basic structure of this surface element 7 is formed from a textile surface material composed of two material layers which are connected to one another to form the cassettes 8 exclusively along seam sections 9. The free-flowing fire-retardant material is located between the seam sections 9. In this way the protective element 7 serves as impact protection.

Figure 3 shows a base 2 of the protective container 1 according to the invention. This base 2 is preferably a plate made of vermiculite into which a supporting structure is incorporated. A possible embodiment of a supporting structure in the form of a metal grate is shown in Figure 4. The supporting structure generally extends over the base area of the base 2 and is

provided on its outer edges with connection elements 6 so that the base can be connected to the side walls in the manner of a push-together system. The upper cover (not shown here) may be configured in the same way as the side walls, but it can also be formed by the surface element 7 used as a protective element for the inner lining of the protective container 1 or by a different flexible material which is suitable as a cover.

Fig. 5 shows a protective sleeve 10 having an inner side (not visible) and an outer side 11, around a metal pipe 12 which penetrates a wall 13. The sleeve may be a two-part sleeve, held together for instance by metal straps 16.

Fig. 6 shows a front view of a rectangular conduit 14 with protective blocks 15 between sections. The conduit 14 may have the size of a door for an opening through which an adult can pass.

At the top of the opening there is a section visible with cables 17 held between strip-shaped insulating foam material 18. This section is kept in place by a block 15 according to the present disclosure. Straight under the top block 15, there is another section having cables 17 and strip-shaped insulating foam material 18. Further down below, another block 15 is positioned. The remaining sections through which cables 17 extend are filled with a different sealing system, for instance a system comprising sleeves made of rubber (expandable or non-expandable) clamped in tightly between the blocks and the inner wall of the conduit so that a backing-structure is provided for the application of a sealant 19. Such sealing systems are provided by the applicant under the tradenames RISE and NOFIRNO. Clearly, sections through which cables 17 extend can in such large conduits be separated by blocks in accordance with the present disclosure.

List of Reference Numbers

- 1 protective container
- 2 base
- 3 side walls
- 4 vermiculite plate
- 5 supporting structure
- 6 connection elements
- 7 protective element
- 8 cassette

- 9 seam section
- 10 sleeve
- 11 outer side
- 12 metal pipe
- 13 wall
- 14 conduit
- 15 protective block
- 16 metal straps
- 17 cables
- 18 insulation foam material
- 19 sealant

Claims

1. A protective sleeve, shell or block having at least a first side and a second side for preventing heat present at the first side from being transferred to the second side, the sleeve, shell or block comprising expanded vermiculite and a reinforcement structure for enhancing strength of the sleeve, shell or block.
2. The protective sleeve, shell or block, according to claim 1, wherein the reinforcement structure is a coating applied at at least one of the first and second side, preferably applied to all sides of the sleeve, shell or block.
3. The protective sleeve, shell or block, according to claim 2, wherein the coating is an inorganic coating.
4. The protective sleeve, shell or block, according to claim 2 or 3, wherein the coating is of a heat insulating material.
5. The protective sleeve, shell or block, according to any one of claims 2-4, wherein the coating is of fire-retardant material.
6. The protective sleeve, shell or block, according to any one of claims 2-5, wherein the coating exhibits at atmospheric pressure during an increase in ambient temperature a drop in its thermal conductivity.
7. The protective sleeve, shell or block, according to any one of claims 2-6, wherein the coating has a porous structure or forms pores at elevated temperatures.
8. The protective sleeve, shell or block, according to claim 7, wherein the pores comprise pores having a diameter of less than 700 nanometers, and preferably less than 70 nanometers.
9. The protective sleeve, shell or block, according to any one of claims 7 or 8, wherein the porous structure comprises clusterings of particles having a size within a range of 2 to 300 nanometers.
10. The protective sleeve, shell or block, according to any one of claims 2-9, wherein the coating is salt water resistant.

11. The protective sleeve, shell or block, according to any one of claims 2-10, wherein the coating itself is impermeable to gas when a pressure difference of 30 mBar is set between the first side and the second side.
12. The protective sleeve, shell or block, according to any one of claims 2-11, wherein the coating is impermeable to water.
13. A protective container for holding ignition-sensitive objects consisting of a base, side walls and optionally also an upper closing wall, the base being reinforced in order to improve the carrying capacity, **characterized in that** the base consists of at least a plate made of expanded vermiculite, the upper side of which plate faces the container interior, and a supporting structure that reinforces the plate from below.
14. The protective container according to Claim 13, characterized in that the supporting structure is a metal grate, a surface structure made of glass fiber-reinforced plastic or a surface structure with carbon fiber-reinforced plastic and extends horizontally, at least over the majority of the base area of the plate.
15. The protective container according to Claim 14, characterized in that the supporting structure is embedded into the material of the plate as reinforcement.
16. The protective container according to Claim 14, characterized in that the supporting structure is a metal grate and the plate sits on the metal grate.
17. The protective container according to any of Claims 13 to 16, characterized in that the supporting structure is provided on its outer edges with connection elements which connect the base to the side walls.
18. The protective container according to Claim 17, characterized by straps protruding outwardly on the supporting structure as connection elements.
19. The protective container according to any of Claims 13 to 18, characterized in that the side walls are side plates which are also made of vermiculite and optionally binding agents and other components which can also be reinforced by an embedded metal structure or a glass fiber-reinforced or a carbon fiber-reinforced structure.

20. The protective container according to any of Claims 13 to 19, characterized in that the base, the side walls and the upper closing wall are made of expanded vermiculite in combination with water glass.
21. The protective container according to Claim 20, characterized in that the expanded vermiculite has a grain size of 0, 1, 2, 3 or 4, preferably a mixture of grain sizes 2 or 3.
22. A protective container for holding ignition-sensitive objects consisting of a base, side walls and an upper closing wall, the base being reinforced in order to improve the carrying capacity, characterized in that fire-retardant protective elements are disposed on the insides of the side walls facing the interior of the container.
23. The protective container according to Claim 22, characterized in that each protective element is a surface element sub-divided like cassettes, free-flowing material made of fire-retardant material being contained in each of the individual cassettes.
24. The protective container according to Claim 22 or 23, characterized in that the basic structure of the surface element is a textile surface material composed of two material layers which are connected to one another to form the cassettes exclusively along seam sections, the free-flowing fire-retardant material being located between the seam sections.
25. The protective container according to either of Claims 23 or 24, characterized in that the fire-retardant material contained in the cassettes (cavities) is selected from vermiculite, organic fire-retardant materials, and/or one or more mineral-based fire-retardant materials different from vermiculite as well as ceramization agents and/or propellants is or are contained.
26. The protective container according to either of Claims 24 or 25, characterized in that the textile surface material is a fabric or fleece made of a mineral fiber.
27. Use of a sleeve, shell or block according to one of claims 1 - 12 for respectively around a pipe, an ignition-sensitive object, in a conduit as at least part of a passive fire-resistant sealing system or heat insulation.

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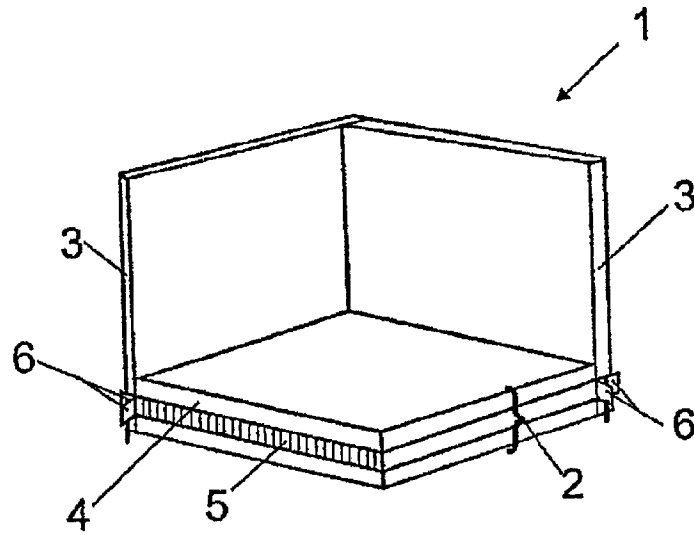


Fig. 1

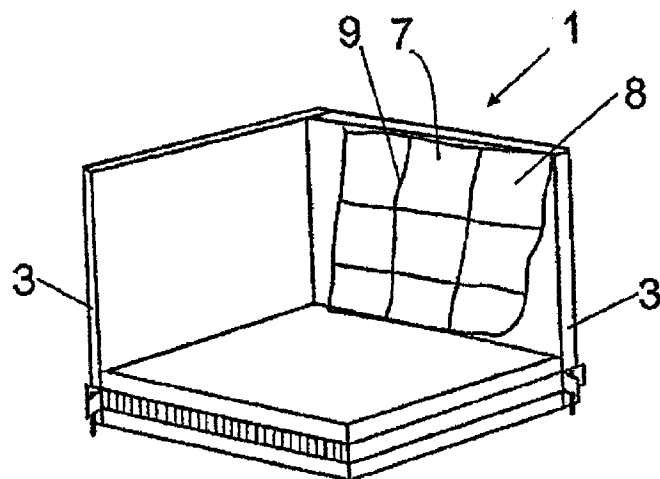


Fig. 2

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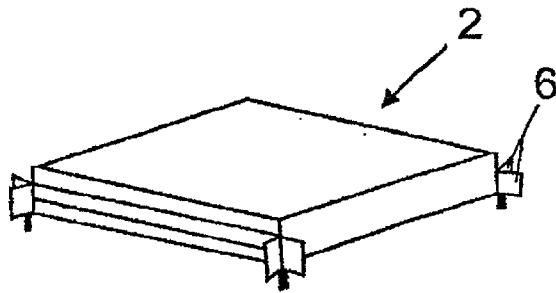


Fig. 3

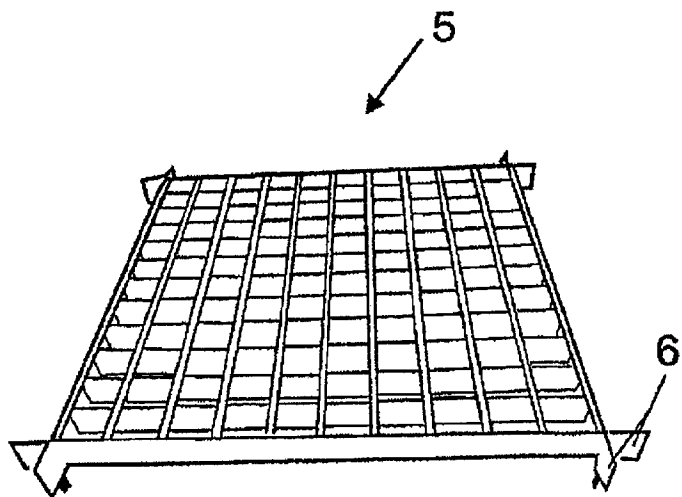


Fig. 4

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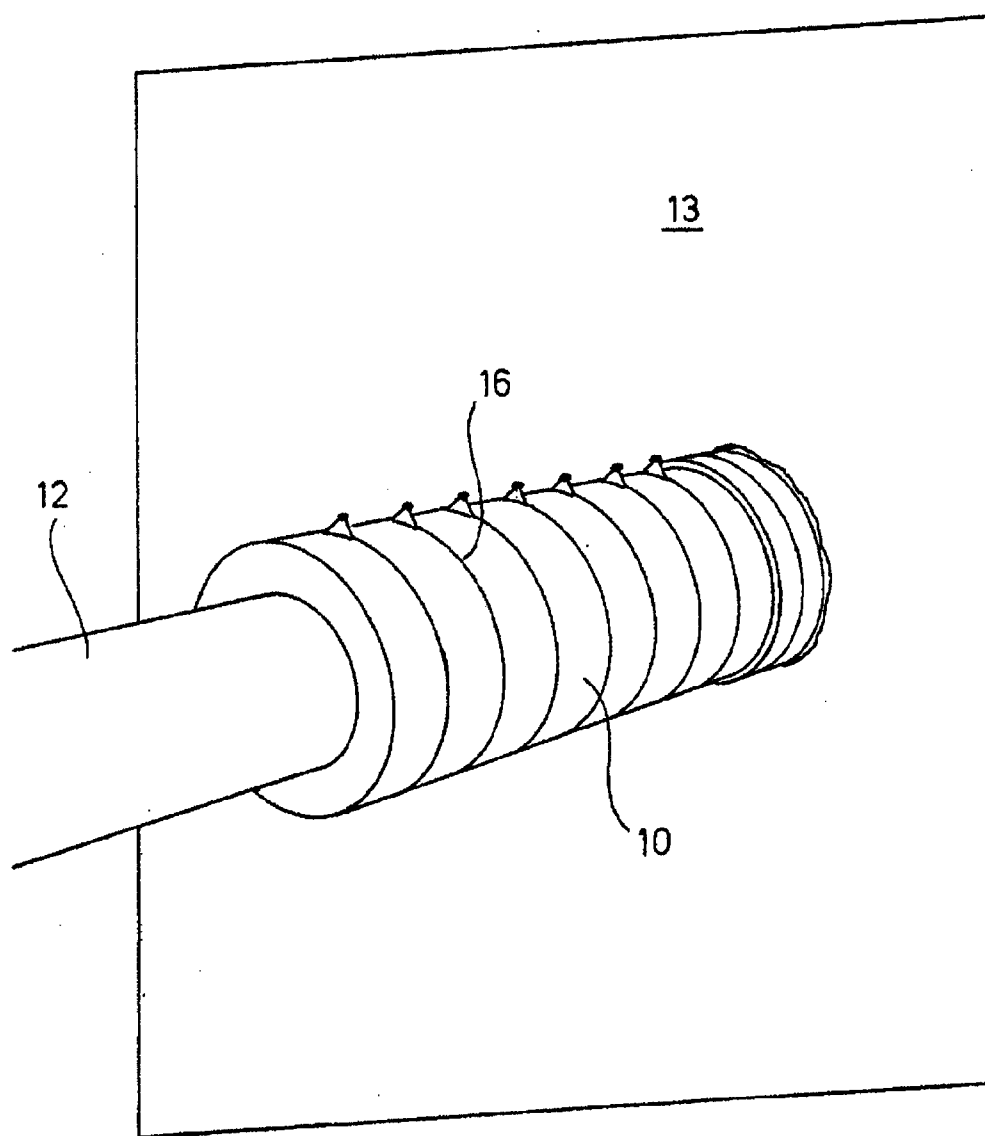


Fig. 5

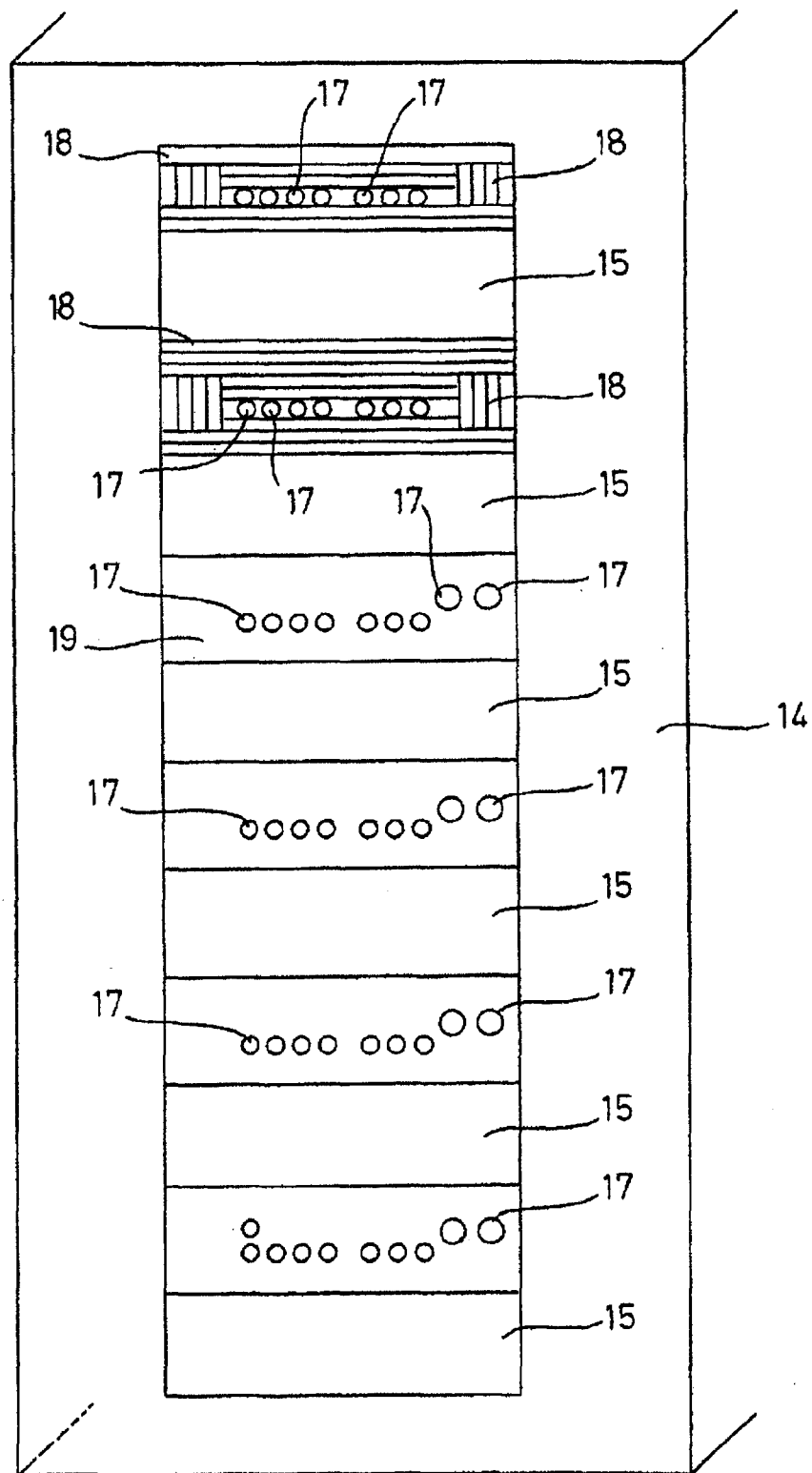


Fig. 6