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(71) Applicant: **Noise SRL**
**31046 Oderzo (TV) (IT)**

(72) Inventors:
- **Marton, Marco**
  **31046 Oderzo (T (IT)**
- **Da Rios, Antonio**
  **31046 Oderzo (T (IT)**
- **Comin, Alberto**
  **31046 Oderzo (T (IT)**
- **Sartor, Adriano**
  **31046 Oderzo (T (IT)**
- **Prevedello, Andrea**
  **31046 Oderzo (T (IT)**

(74) Representative: **Citron, Massimiliano et al**
**Via Primo Maggio, 6**
**31020 San Fior (TV) (IT)**

## (54) Modular, sound-absorbing panel

(57) A sound-absorbing modular panel (10) is described, comprising a tubular jacket (11), formed BY a single body in plastic material, that defines a compartment (12) for accommodating sound-absorbing material (13). Inside the tubular jacket (11) there are defined longitudinal (19, 20, 21, 22, 23, 24), angular (19, 20, 21, 22) and/or central (23, 24) reinforcement portions, which develop in the direction (X) transverse to the thickness of the panel (10) and comprise a plurality of longitudinal ribs (31, 32, 33, 34) defining a plurality of longitudinal cells (35, 36, 37, 38).

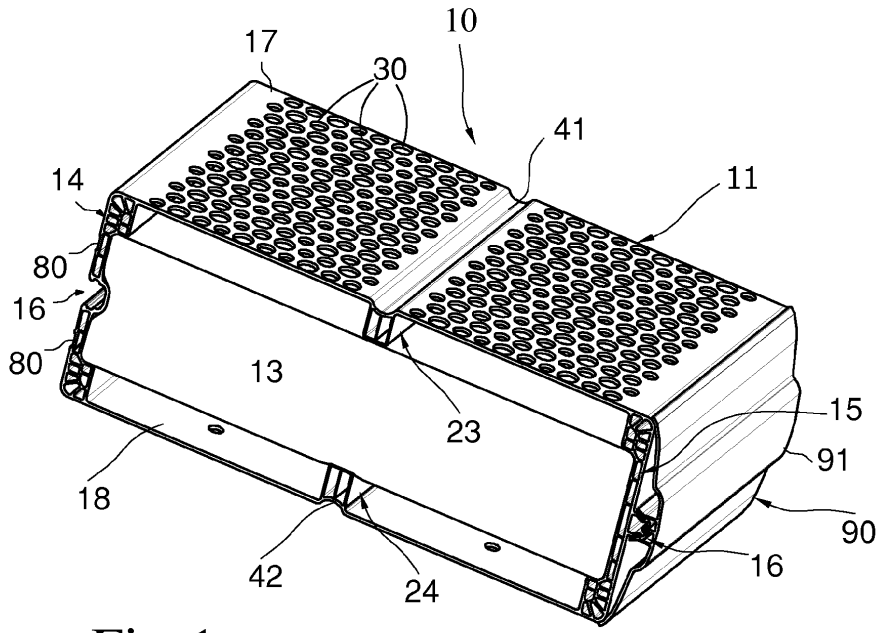


Fig. 1

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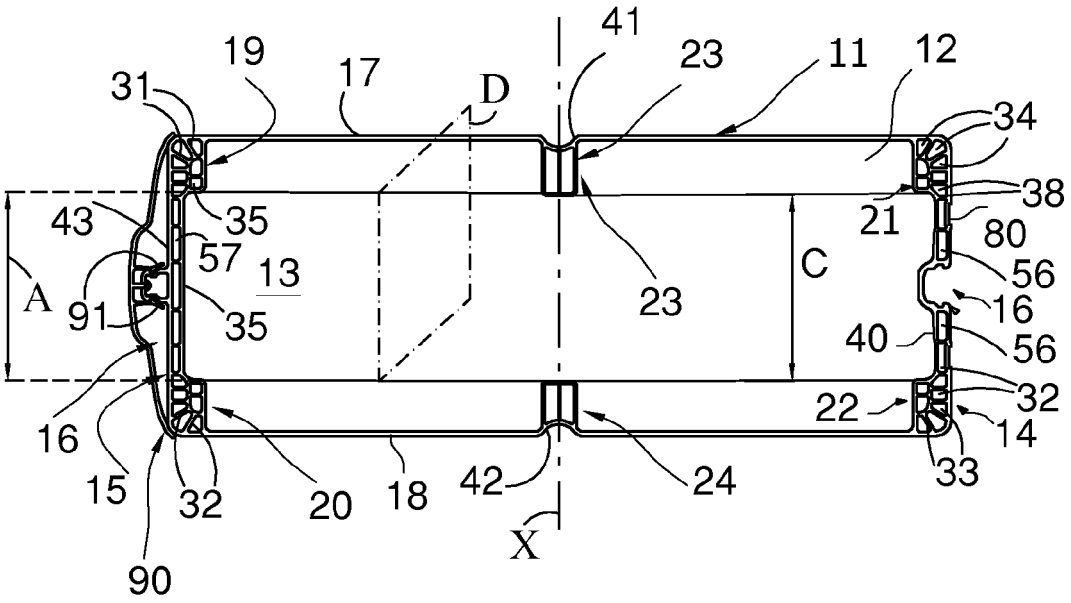
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Fig. 2

## Description

**[0001]** The present invention relates to an improved sound absorbing modular panel.

**[0002]** Barriers are known to shelter areas, usually residential, from for example traffic or rail noise. Certain types of noise barriers, structured to be more compact than embankments, are made of two walls with a cavity filled by earth. These barriers are so heavy that, to make them stable, they are step-structured, however having a significant bulk. Another known solution, to be of very limited dimensions in thickness and of small cost, has walls formed by panels consisting of a box-shaped body filled with sound-absorbing material. They owe their effectiveness of sound attenuation to the shape chosen for the surfaces of the panels and to the properties of the sound-absorbing material of the panels. The material that forms the box-shaped body of the panels is mostly aluminum, lightweight and suitable for producing panels structurally resistant. A drawback is that the aluminum box-shaped bodies contribute poorly to acoustic attenuation because they are rigid and good transmitters of vibrations, acoustical as well.

**[0003]** The noise barriers should be: inexpensive per unit area, of simple construction, capable of appreciable performance of acoustic attenuation and structural strength, and produced through the use of readily available and easily workable materials.

**[0004]** Furthermore, a need is to have a technique to obtain barriers of the color requested by the client, usually in order to allow environmental integration of barriers with the landscape in which they are placed.

**[0005]** There is also the need to obtain barriers in easily recyclable materials, in light of the substantial amount of material used for their realization.

**[0006]** The Italian patent application n. PD2010A000299 describes a sound absorbing modular panel which comprises two complementary half-shells of plastic material, united in correspondence of the lateral edges to define therebetween a housing space for sound-absorbing material, and the side edges are shaped to mate with each other. These half-shells have substantially equal cross-sectional profile, being obtained as pieces cut from a same substantially continuous section-bar.

**[0007]** The two half-shells are to be joined together by a special coupling operation, with the interposition of sealing in the joint areas, operation that requires time and manpower, and which then reflects on the cost for the final product. These panels, on the upper and lower walls, exhibit opposite mutually-complementary side walls, on which there are defined seats for coupling with an equal juxtaposed panel; these seats determine, though, a simple coupling by insertion of a male portion into a corresponding female seat. In the presence of strong wind stresses the panel tends to flex with the consequent risk of escape of the male portion from the female seat; this decoupling is not restored automatically, and two decoupled panels result in an undesirable discontinuity between them in terms of sound absorption. A further limitation is the fact of presenting internally longitudinal stiffening portions designed to serve also as supporting and centering means for the sound-absorbing material, shaped as a mat, positioned in it. These longitudinal stiffening portions are not, however, correctly positioned to oppose the panel inflexion in its median area, i.e. the area most subject to bending. Moreover, these longitudinal stiffening portions are given by corresponding relieves, that if internally determine support for the acoustic-insulation mat, determine at the same time a structural weakening to vertical loads, loads that are given by the overlapping of multiple sound-absorbing panels for the realization of a barrier.

**[0008]** There is the will to design a modular sound-absorbing panel capable of overcoming some limitations and drawbacks of the sound-absorbing panels of known type.

**[0009]** In particular, object of the invention is to devise a sound-absorbing panel being simpler and more rapid to assemble compared to known panels.

**[0010]** Another object is to devise a sound-absorbing panel more economical to produce than the known panels.

**[0011]** Another object is to devise a more robust sound-absorbing panel, able to withstand the vertical loads better and better oppose the transverse thrust of the wind and avoid mismatches.

**[0012]** Another object is to devise a more robust panel whose junction with another equal superimposed panel is able to withstand a transverse thrust of the wind.

**[0013]** Another object of the invention is to devise a sound-absorbing modular panel achievable with known systems and technologies.

**[0014]** This task and these and other objects that will become better apparent hereinafter, are achieved by a sound-absorbing modular panel as in the appended claims.

**[0015]** Features and advantages will become more apparent from the description of preferred, but not exclusive, embodiments of a sound-absorption panel according to the invention, illustrated by way of indicative and non-limitative example in the accompanying drawings, in which:

- Figure 1 shows a sectioned panel in a perspective view;
- Figure 2 shows a cross section of a panel;
- Figure 3 shows a detail of a junction between two superimposed equal panels;
- Figure 4 is a perspective view of two superimposed panels;
- Figures 5 and 6 represent two operating situations for the junction of Figures 3 and 4;
- Figures 7 and 8 show a detail of a panel, respectively exploded and assembled;
- Figures 9 and 10 each represent a perspective view

of an embodiment of the detail of Figures 7 and 8,
- Figure 11 is a perspective view of a complete panel;
- Figures 12 to 14 represent an embodiment of the particular of Figures 10 and 11;
- Figures 15, 17 show a variant of lid or end cap for the panel,
- Figure 16 shows an enlargement of the dotted circle in Fig. 16.

**[0016]** In the figures, given the symmetry in the pieces, sometimes for simplicity the numerical references are reported only for some elements.

**[0017]** With reference to the figures, a modular sound-absorbing panel is represented as a whole with the number 10. The panel 10 comprises a tubular jacket 11, given by a single body in plastic material, which defines a compartment 12 for accommodating sound-absorbing material, such as a mat 13. Two opposite walls of the tubular jacket 11, lower 14 and upper 15 when in use, have coupling means 16, described below, for the juxtaposition on a same reference plane, in the direction of the height when in use, of an improved sound-absorbing panel 10 with an equal panel 10a. The tubular jacket 11 is formed by a single body and not by two half-shells.

**[0018]** Such tubular jacket 11 is made by extrusion of a single piece of plastics, for example PVC, of a length, for example, between 3 meters and 5 meters. With this embodiment the cost of assembly of the two half-shells and sealing of the sealing lines are eliminated, and the numbers of pieces to extrude are halved, which from two, the half-shells, become only one, the tubular jacket 11. The tubular jacket 11 in one piece results in a greater resistance to flexing imposed by the lateral thrust of the wind. A side wall 17, of two side walls 17 and 18, is diffusely perforated with through-holes 30, to allow the passage of acoustic vibrations to the sound-absorbing material 13.

**[0019]** Boring is carried out after the extrusion process of the tubular jacket 11, and is performed with holes of different diameters for the purpose to optimize the distribution of the mechanical stresses on the panel without penalizing the performance of sound absorption. The sound-absorbing mat 13 is generally made of polyester fiber, but can be produced in other similar and equivalent materials; these mats are self-draining for water and therefore do not require protective surface treatments as it would be required in the case of rock-wool mats.

**[0020]** The sound-absorbing mat 13 is inserted into the tubular jacket 11. Inside the tubular jacket 11 are defined longitudinal reinforcement portions, angular 19, 20, 21, 22, and central 23 and 24. Such longitudinal reinforcement portions 19, 20, 21, 22, 23 and 24 develop in the transverse direction X of the thickness of the panel 10 so that the minimum distance A in the direction X between two opposite angular reinforcing portions 19 and 20, and 21 and 22, corresponds substantially to the thickness B of the sound-absorbing mat 13. This way the sound-absorbing mat 13 is positioned and held precisely in the correct position and at the correct distance from the side walls 17 and 18. Reinforcing angular portions 19, 20, 21 and 22, which are also those most stressed by the load of other panels above, comprise a plurality of longitudinal ribs 31, 32, 33 and 34 respectively, defining for each angular zone a plurality of longitudinal tubular cells 35, 36, 37, 38 with hollow section.

**[0021]** Note that the reinforcement portions are an integral part of the panel, and not added members.

**[0022]** Also the lower walls 14 and upper walls 15 are reinforced by reinforcement septa 39 and 40, which develop parallel to the lower walls 14 and upper walls 15 respectively and extend from the facing reinforcement angular portions 19, 20, 21 and 22. Reinforcement central portions 23 and 24 are defined on the median plane and each is given by a tubular hollow profile. These central reinforcement portions 23 and 24 develop towards the inside in the direction X to a height such that the minimum distance C between these two central portions 23 and 24 is similar, slightly higher or lower in terms of millimeters, than the thickness B of the sound-absorbing mat 13. Such reinforcement central portions 23 and 24 act, in addition to stiffening the panel 10, also as an abutment for the internal mat in case of bending of the panel by the wind thrust. In this way the side wall of the panel, in case of lateral thrust due to wind, finds in central area a support on the respective reinforcements 23 and 24 that, by leaning against the inner matt 13, reduce the cupping towards the inside of the side wall; this ensures greater resistance to bending for the panel to lateral wind forces as a result of improved control of its cross-section. In known aluminum panels, rather deep side channels are defined, because they extend from the side walls up to leaning on and center precisely the internal sound-absorbing mat; this excessive depth in transverse direction determines loss of stability of the side wall of the panel to vertical loads due to the weight of superimposed panels, so the sides under load tend to curve on the side.

**[0023]** Instead, externally to the side walls 17 and 18 in correspondence with the central longitudinal reinforcement portions 23 and 24, are defined corresponding horizontal channels 41 and 42, which are also cooperating to strengthen the tubular jacket 11; these horizontal channels are shallow in that the centering of the mat is obtained with the central internal reinforcement portions 23 and 24. The coupling means 16 for the juxtaposition, in the direction of the height when in use, of two equal sound-absorbing panels 10 and 10a are clearly visible in Figures 3, 5 and 6. Such coupling means 16, comprise, in the present embodiment, a longitudinal protuberance 43 extending from the upper wall 15, for example of a bottom improved panel 10a, and adapted to be inserted in a complementarily-shaped anchoring groove 44 formed on the bottom wall 14 of another equal improved panel 10 located above.

**[0024]** This longitudinal protuberance has a centering base 45, with walls protruding on converging planes, and a coupling head 46 having substantially T-shaped mush-

room-shaped section. This coupling head 46 defines two opposing undercuts 47 and 48 responsible for reversibly hooking with corresponding longitudinal anti-extraction edges 49 protruding toward the inside of said groove 44. In normal operation of the panels 10 and 10a, the anti-extraction edges 49 are adjacent to the centering base 45, while in case of strong lateral wind thrust the two panels flex and move apart, as exemplified in Figures 5 and 6, and the anti-extraction edges face the undercuts 47 and 48, available for reciprocal anchoring in an anti-slipping arrangement when relatively moving laterally between the two superimposed panels 10 and 10a.

**[0025]** The coupling head 46 and the anti-extraction edges 49 cooperate to prevent that under the lateral action of wind, as exemplified in Figures 5 and 6, two superimposed panels 10 and 10a may decouple one from another for the slipping of the longitudinal protuberance 43 out of the anchoring groove 44, slipping that occurs in the known art, and determines an undesired discontinuity in the sound-absorbing action of the barrier comprising the two panels.

**[0026]** The complete panel 10 is completed by inserting the ends of a sound absorbing mat 13 in the tubular jacket 11, then providing for the closure of the same end of the tubular jacket 11 with lids 50, having also a structural function. The lid 50, exemplified in Figures 7 and 8, comprises side centering flaps 51, 52 and 53 and inserts, upper 54 and lower 55, adapted to be inserted into the longitudinal channels 56 and 57 defined by the reinforcement septa 39 and 40 with the upper walls 15 and lower walls 14 respectively.

**[0027]** The lid 50 has automatic fastening means to the tubular jacket 11.

**[0028]** Such automatic fastening means are given by a series of fins 58 elastically deformable with snap-engagement teeth 59 protruding from the lid 50 in the inside of the panels and adapted to engage with corresponding holes 30 present on the side walls. The lid 50 has two vertical central reinforcement channels 60 and 61. In a variant of embodiment, the lid, indicated with 150 in Figures 9 and 10, exhibits two vertical reinforcement channels 160 and 161 whose end sections 162, 163, 164 and 165 diverge outwards up to resting at the longitudinal reinforcing angular portions 19, 20, 21 and 22 of the tubular jacket 11, so that the vertical load abuts on those most robust areas of the tubular jacket 11 itself.

**[0029]** In a second embodiment the lid, shown in Figures 12 to 14 with the number 250, exhibits integrated centering elastic elements for the panel 10 in the longitudinal direction with respect to the steel upright 270 (H-shaped) on which it is placed. These integrated elastic centering elements embodied, for example, in a plurality of elastic bridges 271, protrude cantilevered from the wall 272 of the lid 250, toward the central plate 273 of pillar 270. Such elastic bridges 271 are then connected at one end 274 to the wall 272, while the sides and the opposite end 275 of the same elastic bridge 271 are separated from the wall 272 itself.

**[0030]** These elastics bridges 271 are advantageously made as a one-piece body with the lid 250. The lid 50, 150 and 250 is made by injection molding of plastic material. For installation in the building yard, the panel is always a few inches shorter than the span between two internal uprights 270, therefore, the same panel could translate longitudinally and not be centered; these bridges 271 are used to compensate for this play and push the uprights ensuring the centering of the panel.

**[0031]** The "bridge" shape of such elastic elements ensures that during insertion of the panels between the uprights from above, they do not obstruct the sliding of the panel during the descent. The panels 10, like the known sound-absorbing panels, are mountable complete and can be superimposed on the fly.

**[0032]** On the outer face of the bottom wall 14 of the tubular jacket 11 are made containment grooves 80 for application of one or more sealing strips 81 between two superimposed panels. These sealing strips 81 can be made of soft and elastic elements (rubber, foam, etc..), with function also to compensate for the mechanical play between the panels and prevent the passage of acoustic vibrations between a panel and another superimposed. These sealing strips 81 can be applied through application of an adhesive tape made of rubber material and/or foam, or directly by co-extrusion during the continuous extrusion process of the tubular jacket 11.

**[0033]** As mentioned, preferably the plastic construction material for the tubular jacket 11 includes mainly polyvinyl chloride, abbreviated PVC. Moreover, the tubular jacket 11 is formed by two integral layers, of which

- a first layer, internal, thick, made of a base material composed of plastic for recycling, and
- a second layer, thin, for superficial coating called "skin", in virgin PVC, resistant to degradation by ultraviolet light and comprising a dye adapted to give it a color chosen for the final finish.

**[0034]** In particular, the dye is suitably made of chemically compatible with the plastic construction material of said second layer, mixed with it in powder form prior to the molding of the section from which to obtain the tubular jacket 11. The purpose of achieving the tubular jacket 11 by co-extrusion is to be able to employ internally recycled material with lower aesthetic features (uneven color) and outside a thin film of virgin material at a high cost, that offers the maximum aesthetic and high characteristics of resistance to weather. The material of the film is added anti "UV" for protection to the sun.

**[0035]** The improved panel 10 also includes a top protection 90 with the function of protection from direct sun and hail for the upper part of the panel, the most exposed to the aging of the plastic material by the action of UV rays. The top protection 90 is given by an extruded PVC profile, with central snap-engagement tongues 91 to the longitudinal relief 43 extending from the upper wall 15 of the tubular jacket 11.

**[0036]** All components of the improved panel 10, both the body of the panel and the end lids, and the internal sound-absorbing mats, are all made of 100% recyclable materials, this allows to have a complete recycling of the material of the product once it is disposed. The improved panel 10 according to the invention, with the tubular PVC jacket 11, offers the great advantage of not requiring a painting process: it is the same plastic material to obtain the coloring and required surface finish, while traditional panels made from sheet metal (steel, aluminum), must be forcedly painted, both to protect them from corrosion and to obtain an acceptable degree of reflectivity, not exceeding a certain level required by the regulations for road barriers. The absence of the painting process is an important advantage, because, given the large size of the object, it avoids a very expensive process: it would require large facilities, for both degreasing and cleaning of the sheets to prepare for painting, and for the coating plant itself (generally by deposition of powders), and for the large drying ovens required.

**[0037]** The painting process on traditional panels made of sheet metal has a significant impact on the cost, in addition to the plant, even because of the big amount of paint to be used to cover large areas. In the case instead of the PVC panel here described, the amount of dye for the plastic material, called "master", is already inserted in the plastic material in absolutely minimal doses and does not require additional processes. In addition, in the panel described here the "mastering" concerns only the thin outer layer of "skin" and not the internal thickness, and thus the "mastering" is limited only to a marginal part of the material equal to about 15% of the total weight of the panel.

**[0038]** The covering layer of the outer tubular jacket 11 may take a variety of colors, even special finishes, such as wood effect and nuanced finishes of various kinds in one or more colors, depending on the tastes and the needs of the buyer.

**[0039]** The use of the plastic material for the construction of the improved sound-absorbing panels, as in the invention, does not lead to galvanic corrosion phenomena due to possible contact of metals with different electrical potentials, as is the case for sheet metal panels with respect to the steel uprights, the various screws, etc.; the problem is also avoided of localized corrosion by friction and microgroove due to mechanical tensions where the protective passivating layer of the metal damages. The realization of the sound-absorbing panels in plastic material ensures lower maintenance costs of the barriers, precisely thanks to the characteristics of durability in time and absence of paint. The choice of plastic material in place of sheet and in particular the realization of the tubular jacket 11 by extrusion, allows to take advantage of complex sections for the extruded, while in the case of bent-sheet metal panels, the possible forms are only those achievable for bending of plates. The extrusion process also allows to varying and optimizing the thickness of the various parts, increasing it at the points of greater stress and reducing it in the less stressed points.

**[0040]** Figures 15 and 16 show a variant of the end lid or cap 300 for the panel, associable alone or in combination with those already described.

**[0041]** A lid 300 is equipped, at the sides or edges which are vertical in use, with sealing gaskets or fins 310, e.g. in elastic material (such as e.g. a flexible plastic). Their task is the mechanical compensation with respect to an H-shaped upright 350, within which they are placed (Fig. 17), and/or the acoustics sealing, to fill more the spaces between the panel and the upright 350.

**[0042]** The seals 310 may exhibit a convenient section (fig. 16) characterized by one or more lips 312 inclined relative to the major surface S of the lid 300, especially oriented to extend away radially in opposite direction to the panel. Preferably, the lips 312 are flexible.

**[0043]** In the case of longitudinal displacements of the panel between the uprights 350, the lips 312 prevent the slipping of the lid 300; they, thanks to their inclination, may also push the lid 300 in place inside the panel.

**[0044]** With or without the fins 310, the seals 310 can be equipped with appendices that protrude (e.g. orthogonally) from the surface S, to allow a mechanical compensation of the interspace between the lid 300 and an upright 350 in the space adjacent to the surface S. The effect is to reduce the possibility that the panels can translate longitudinally and/or to increase sound insulation.

**[0045]** The appendixes can be formed by a tubular body 314 which is hollow and preferably collapsible (flexible) and/or elastic, and from which there extend one or more flat lip-shaped gaskets or fins 316. The fins 316 preferably extend perpendicular to the surface S and/or are flexible.

**[0046]** The appendix is a compensating element that fits very well on the inner wall of the upright 350 in the case of abutment.

**[0047]** All of these flexible lips facilitate the guidance of the panel during the vertical insert operation from above inside the H-shaped uprights; the lips are arranged along the axis of vertical sliding of the panel.

**[0048]** It is found in practice that the invention achieves the intended task and intended objects by providing a modular sound-absorbing panel producible in a plastic material widely available and easily formable, as the polyvinyl chloride PVC, which also results in a panel more easily colorable, extremely easy and cheaper to paint than known panels today, and with low environmental impact, as its coloration is obtained by mixing with a compatible coloring material.

**[0049]** Especially, a sound-absorbing panel has been developed easier and quicker to compose compared to known panels, thanks to the tubular jacket in single piece instead of the two half-shells to be assembled with sealants.

**[0050]** Also, a sound-absorbing panel has been developed cheaper to achieve compared to the known panels. In addition, a sound-absorbing panel has been devel-

oped more robust than known panels, able to better bear vertical loads, thanks to the side lids described above, and to better oppose to the transverse thrust of the wind, thanks to the inner tubular stiffeners and coupling means with coupling head and anti-extraction edges. Furthermore, the sound-absorbing panel is made out of easily recyclable material at least for the production of further similar panels, and is also structurally at least as resistant as known aluminum-body panels, thanks to the provision of the integrated reinforcing elements which ensure the prevention of excessive flexural deformations, allow to maintain the stability of shape of the section and a significant resistance to lateral bulging of its walls.

**[0051]** The sound-absorbing panel also has sound attenuation performance better than the performance presented today by the panels with aluminum body, now known, thanks to the improved vibration damping implemented by the plastic material in which it is made, with respect to the aluminum of realization of the known panels. Also the panel is shock resistant and tough and durable and able to maintain lasting its mechanical performance and color quality. Not last, it has been developed a panel which can be manufactured with known systems and technologies.

**[0052]** The panel thus conceived is susceptible of numerous modifications and variants, all falling within the inventive concept; Moreover, all details may be replaced with other technically equivalent elements. In practice, the materials employed, provided they are compatible with the specific use, as well as the dimensions and contingent shapes, may be any according to the requirements and the state of the art.

## Claims

1. Sound-absorbing modular panel (10), **characterized by** comprising
   a tubular jacket (11), formed by a single body in plastic material, that defines a compartment (12) for accommodating sound-absorbing material (13),
   inside the tubular jacket (11) being defined longitudinal (19, 20, 21, 22, 23, 24), angular (19, 20, 21, 22) and/or central (23, 24) reinforcement portions, which
   develop in the direction (X) transverse to the thickness of the panel (10) and
   comprise a plurality of longitudinal ribs (31, 32, 33, 34) defining a plurality of longitudinal cells (35, 36, 37, 38).

2. Panel according to claim 1, comprising angular reinforcement portions (19, 20, 21, 22) in which the minimum distance (A) in said transverse direction (X) between two opposite angular reinforcing portions (19, 20, 21, 22) essentially corresponds to the thickness (B) of the sound-absorbing material (13).

3. Panel according to claim 1 or 2, wherein a side wall (17) of two lateral walls (17, 18) of the jacket is diffusely perforated with through-holes (30) to allow the passage of the acoustic vibrations to the sound-absorbing material (13).

4. Panel according to claim 2, wherein the jacket comprises a lower wall (14) and an upper wall (15) which are reinforced by reinforcement septa (39, 40).

5. Panel according to any one of the preceding claims, wherein the reinforcing portions comprise central reinforcement portions (23, 24) that are defined on the median plane of the jacket and each are given by a tubular rib.

6. Panel according to any one of the preceding claims, comprising coupling means (16) on two opposite walls (14, 15) for the juxtaposition on a same plane of reference of a sound-absorbing panel (10) with an equal additional panel (10a).

7. Panel according to claim 5, wherein said coupling means (16) for the juxtaposition, in the direction of the height in use, of two equal sound-absorbing panels (10, 10a) comprise a longitudinal relief (43) extending from the upper wall (15) and adapted to be inserted into a complementarily-shaper anchoring groove (44) defined on the lower wall (14) of another equal panel placed above, said longitudinal relief presenting a centering base (45) with walls developing on convergent planes, and a coupling head (46) having substantially T-section, said coupling head (46) defining two opposed undercuts (47, 48) arranged to reversible engage corresponding anti-extraction longitudinal edges (49) projecting towards the inside from said anchoring groove (44).

8. Panel according to any one of the preceding claims, wherein said tubular jacket (11) is closed with lids (50), having also structural function.

9. Panel according to claim 8, wherein each lid (50) has means for automatic fastening to the tubular jacket (11).

10. Panel according to claim 9, wherein said automatic fastening means comprise a series of elastically deformable fins (58) with snap-engagement tooth (59), which develop from the lid (50) on the part of the perforated side wall (17), with the snap-engagement teeth (59) adapted to engage in corresponding holes (30) present on the lateral bored wall (17).

11. Panel according to claims 7 or 8 or 9, wherein said lid (150) has two vertical stiffening channels (160, 161) whose end sections (162, 163, 164, 165) diverge outwards up to abutting in correspondence of

the longitudinal angular reinforcing portions (19, 20, 21, 22) of the tubular jacket (11), so that the vertical load goes to involve such more robust areas of the tubular jacket (11) itself.

**12.** Panel according to claims 7 or 8 or 9 or 10, wherein said lid (250) has integrated centering elastic elements for the panel (10) in longitudinal direction with respect to an H-shaped upright (270) on which it is inserted.

**13.** Panel according to claim 12, wherein said elastic centering integrated elements are given by a plurality of elastic bridges (271), extending in cantilevered manner from the wall (272) of the lid (250) toward the central plate (273) of the upright (270).

**14.** Panel according to any one of claims 7 to 13, wherein the lid (300) comprises one or more fins (312) that radially extend from the sides of the lid and are inclined from the major surface (S) of the lid.

**15.** Panel according to any one of claims 7 to 14, wherein the lid (300) comprises on its major surface (S) a flexible tubular body from which one or more tabs (312) extend perpendicular to the surface (S).

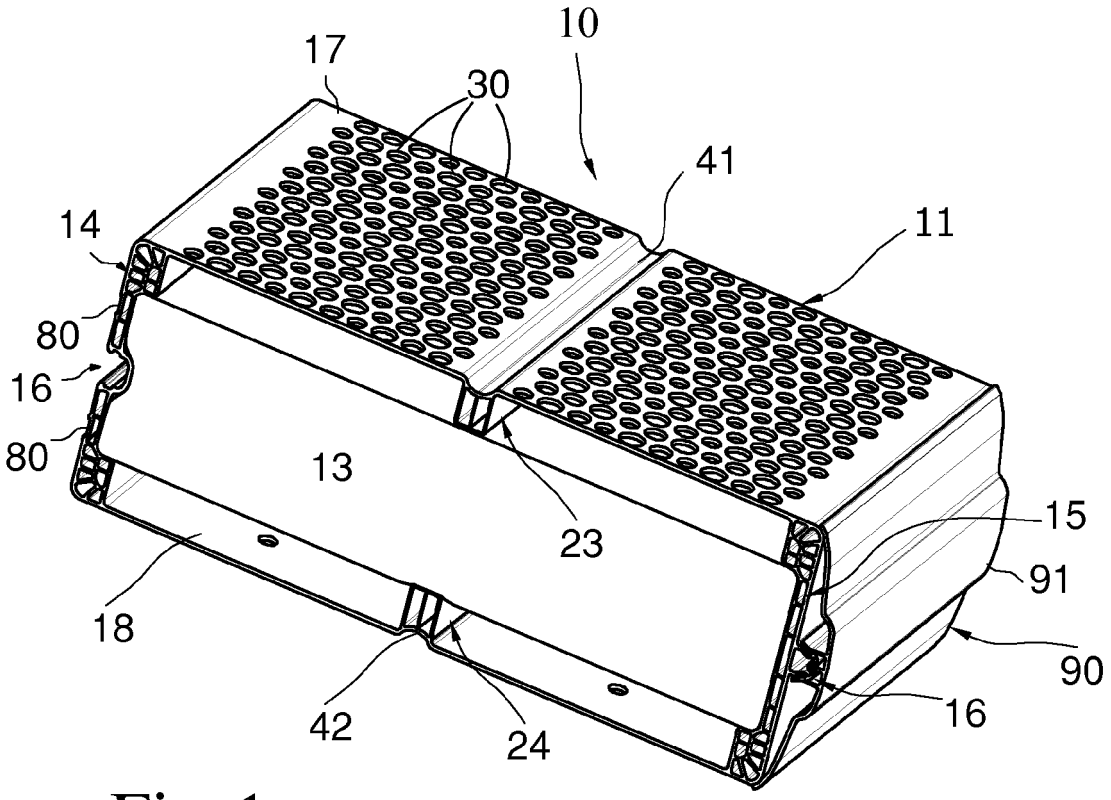
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Fig. 1

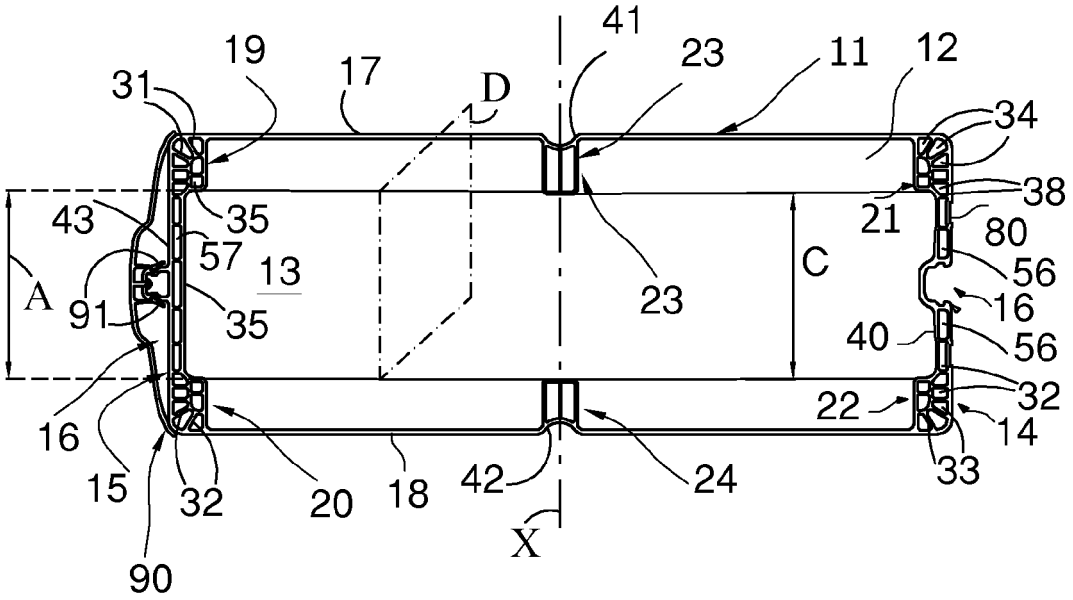
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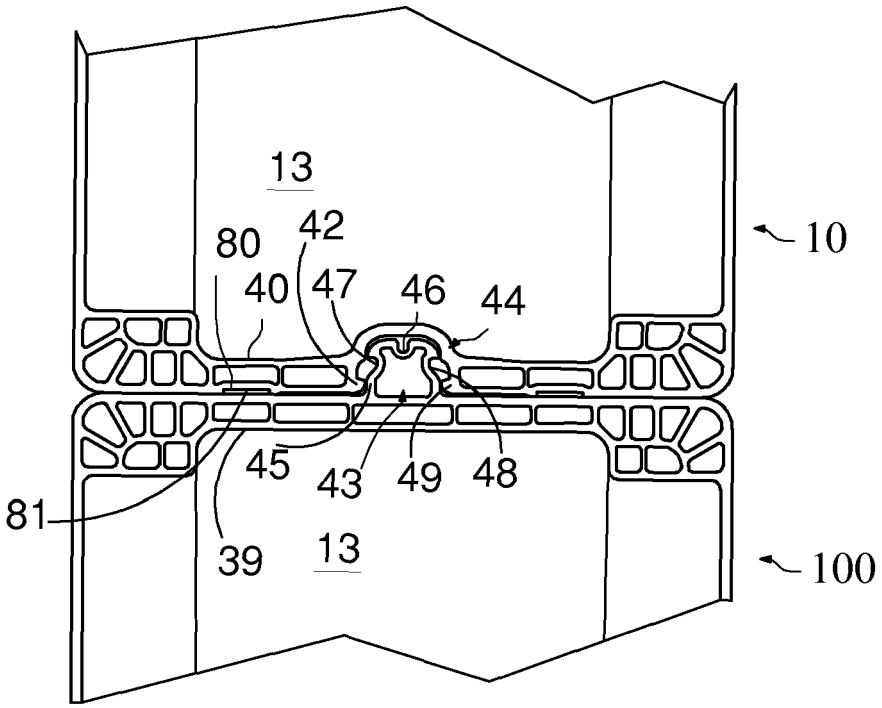
Fig. 2

Fig. 3



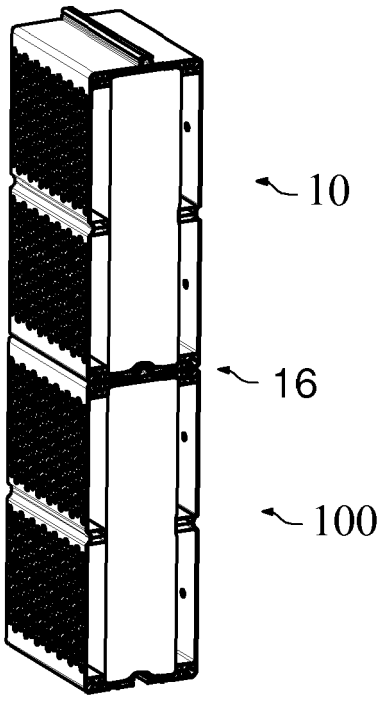
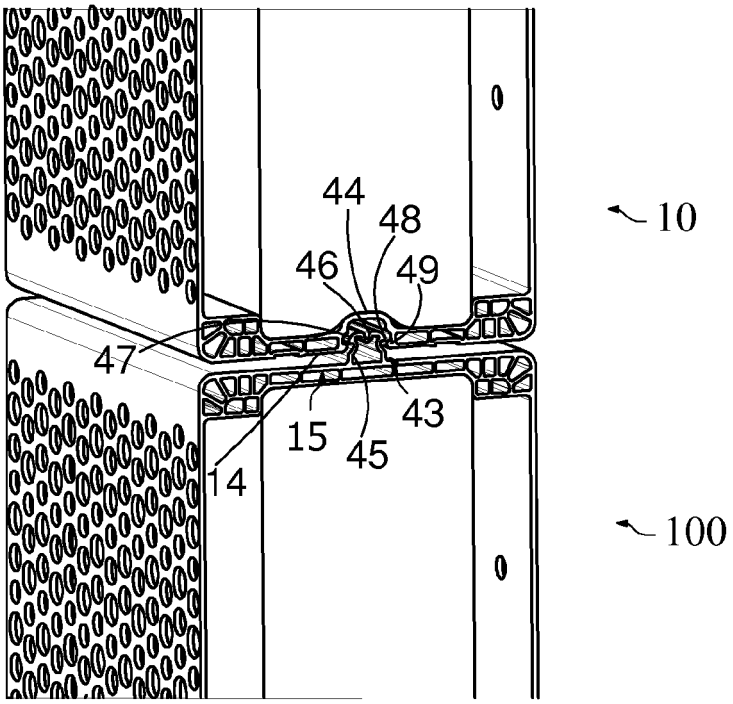




Fig. 4

Fig. 5



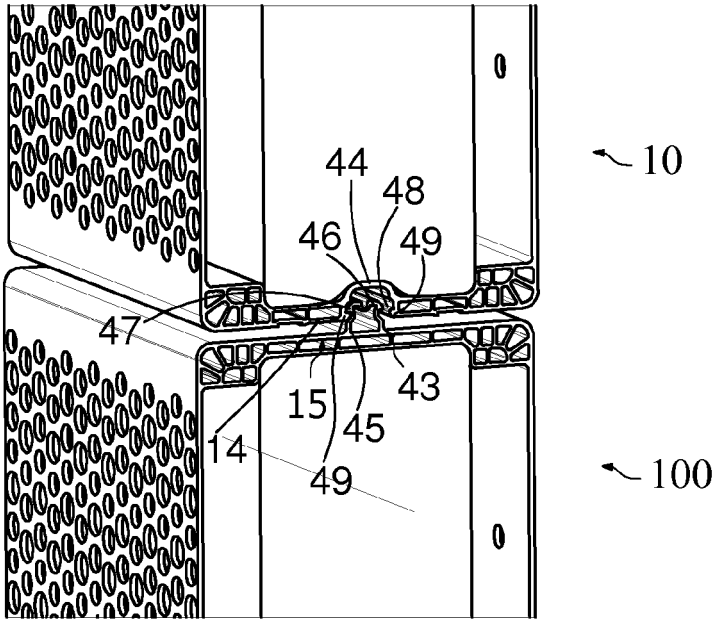




Fig. 6

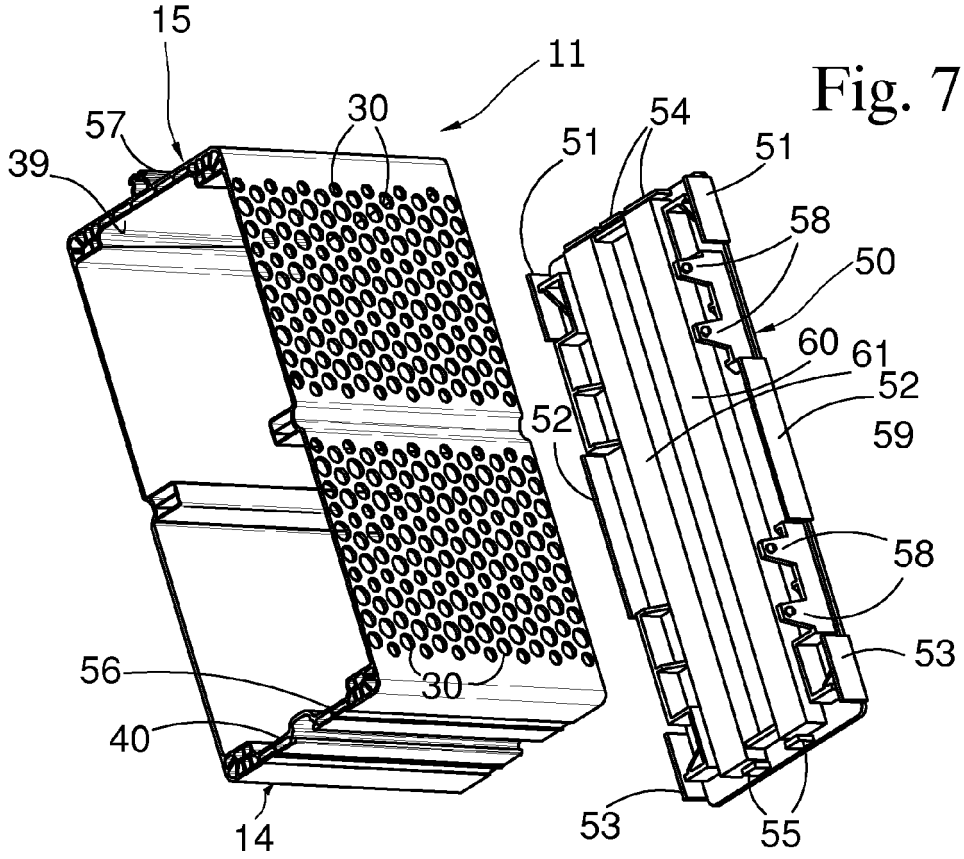

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Fig. 7

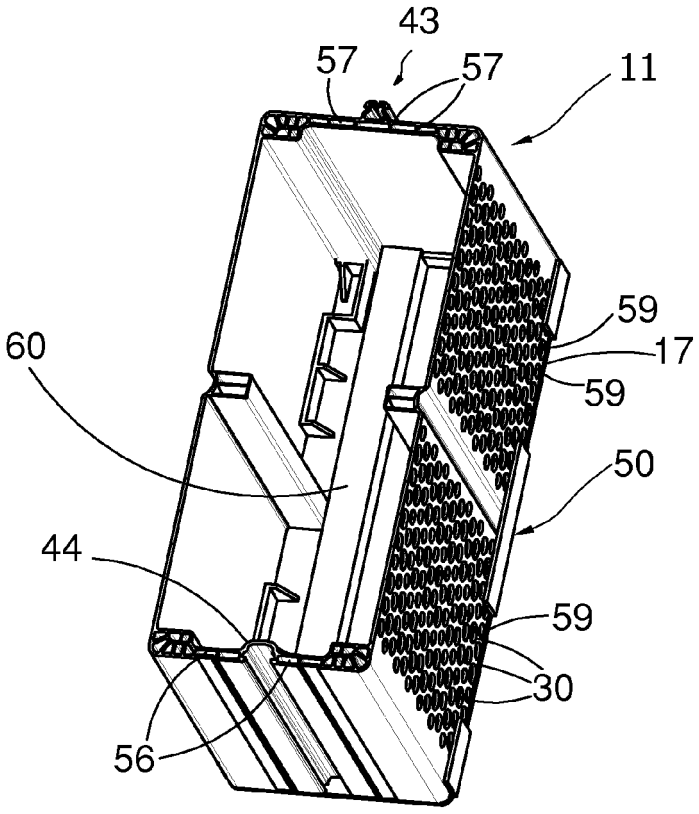
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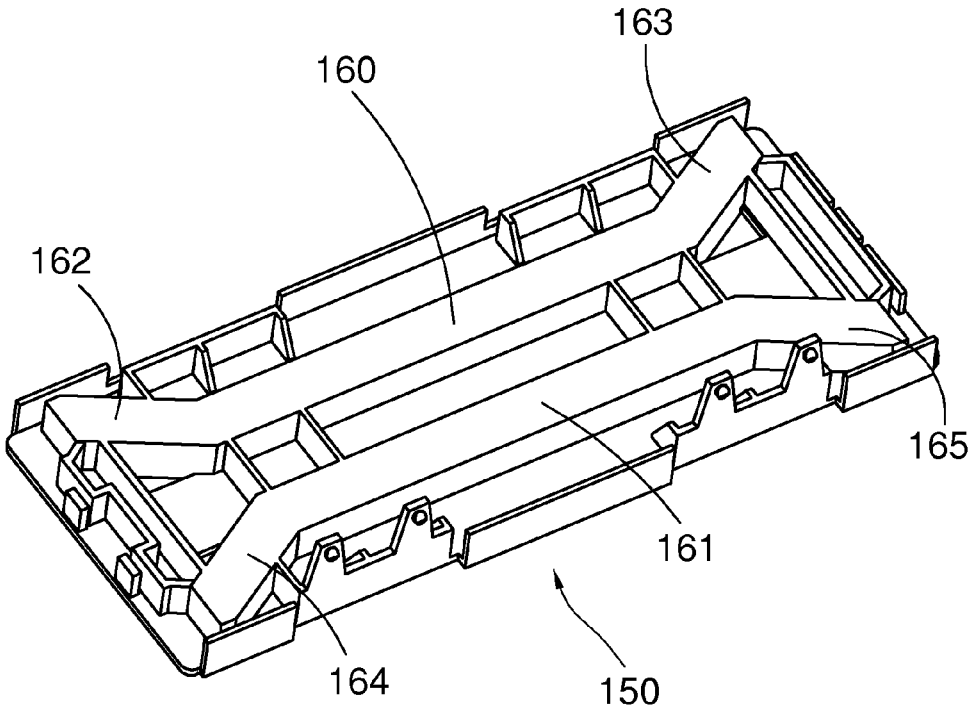
Fig. 8

Fig. 9



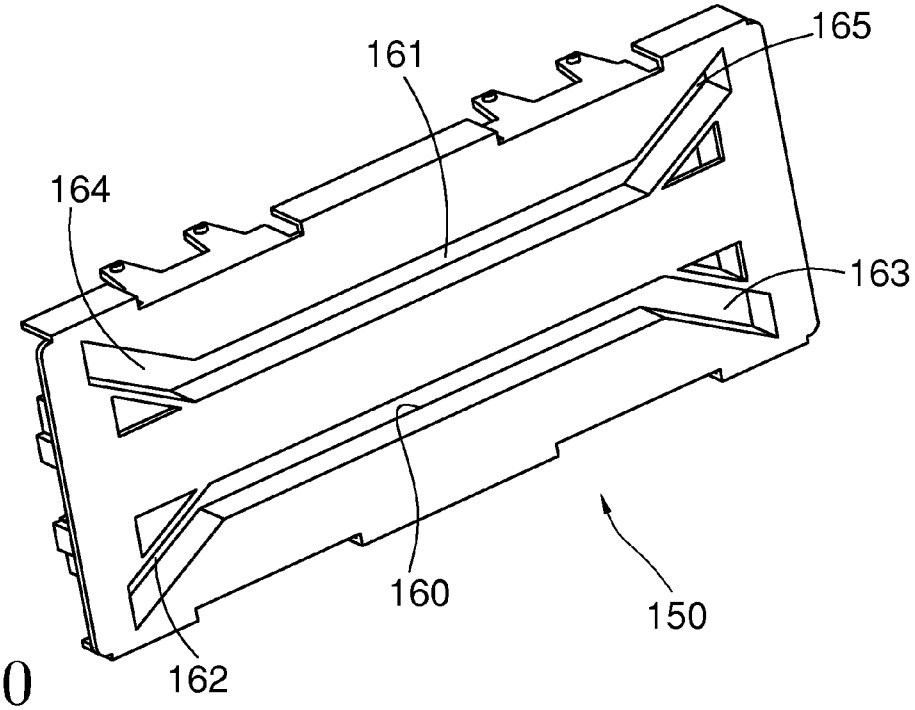
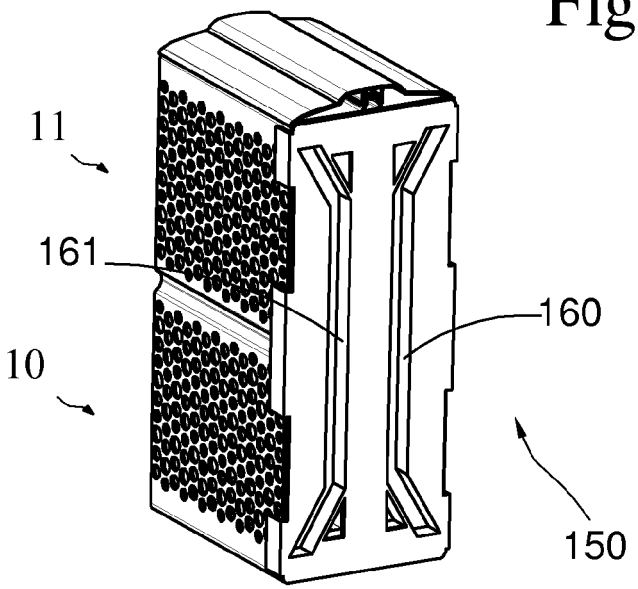




Fig. 10

Fig. 11



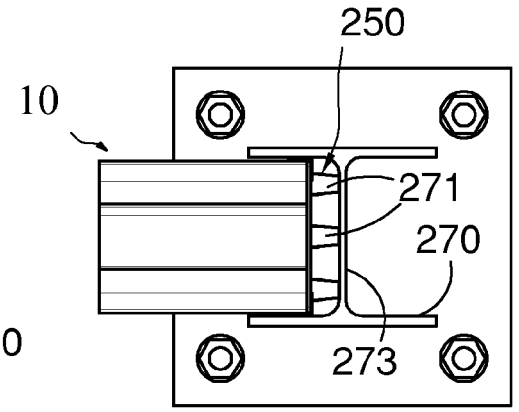




Fig. 13

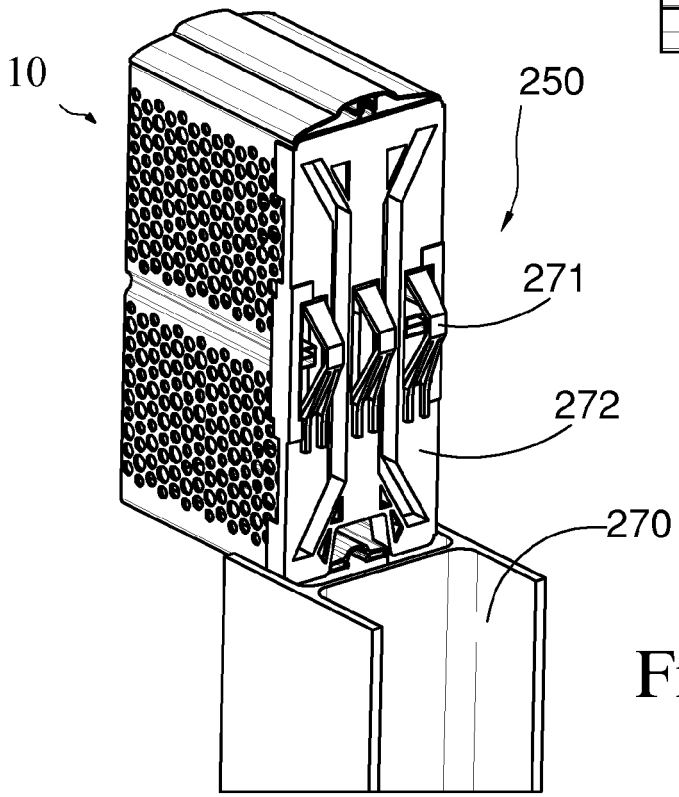
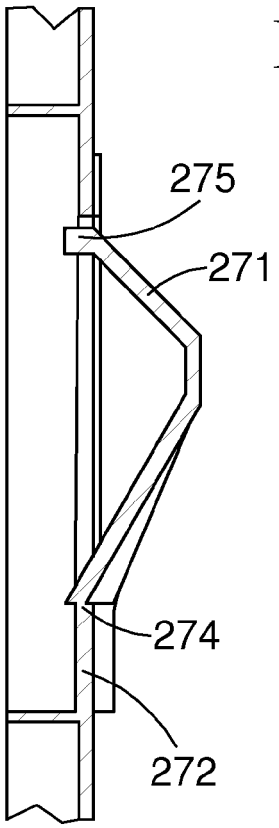



Fig. 12

Fig. 14



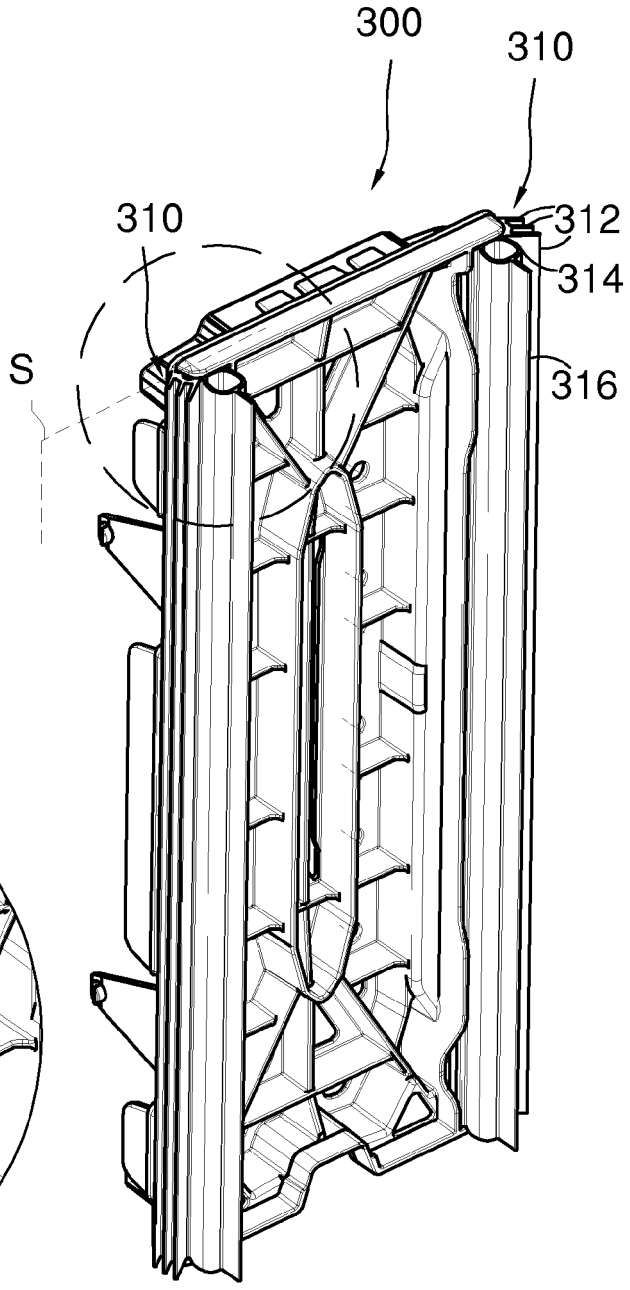
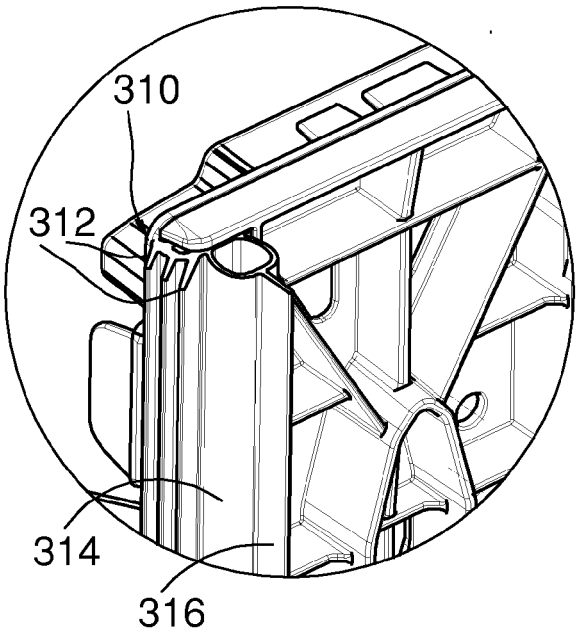




Fig. 15

Fig. 16



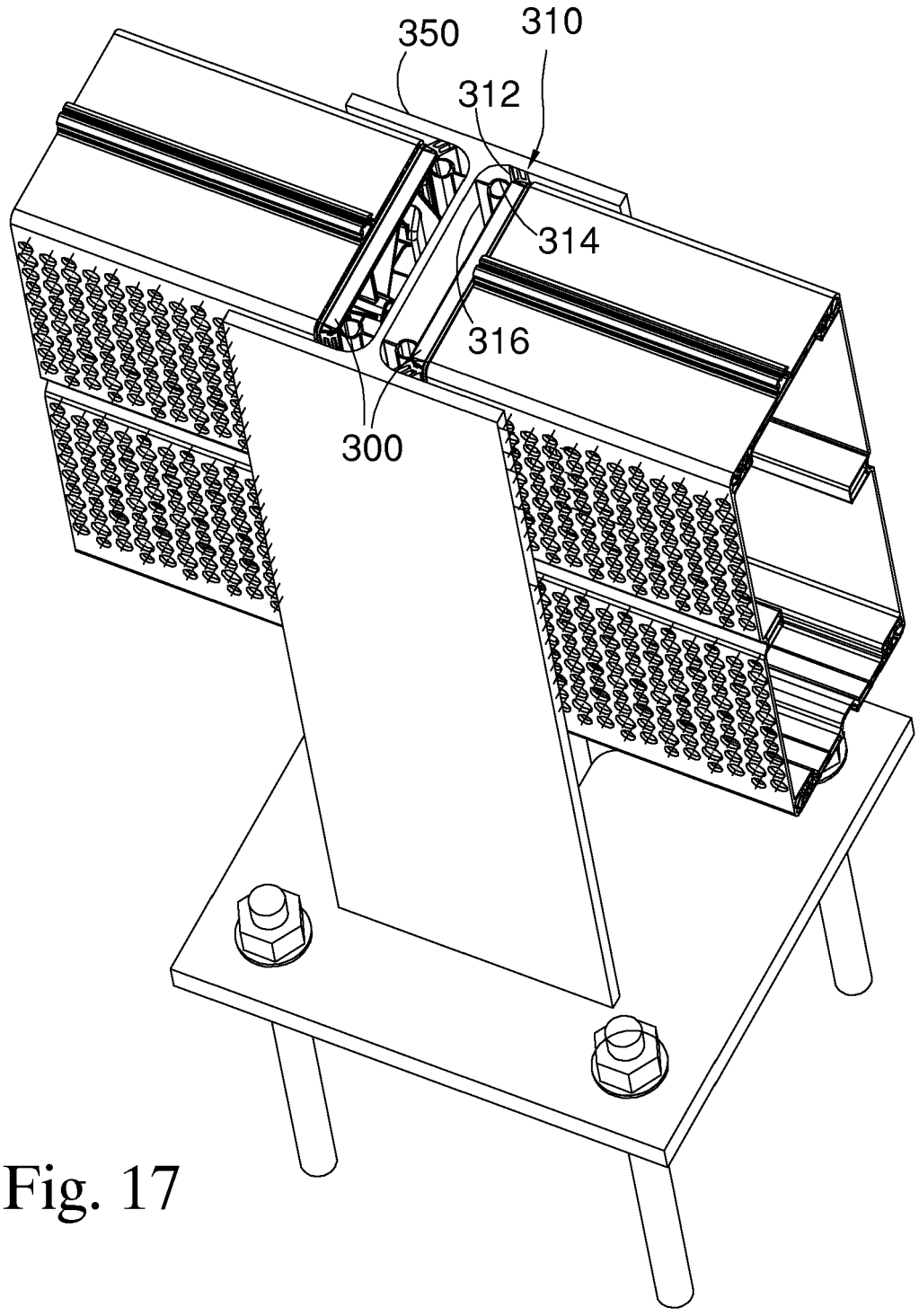



Fig. 17

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# EUROPEAN SEARCH REPORT

Application Number
EP 14 16 5906

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