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(54) **MODULAR BUILDING SYSTEM**

(57) Modular building system that comprises the coupling or superposition, horizontally or vertically, of prefabricated components made from reinforced concrete in order to create dwelling spaces, comprising, likewise, connections (200) between said components, and said components being selected from: - closed frames (2, 2a,

2b, 2c, 2d, 2e, 2') made from reinforced concrete; - vaults (34) made from reinforced concrete; - box structures made from reinforced concrete; the prefabricated components in reinforced concrete being incorporated into major prefabricated civil engineering works made from reinforced concrete.

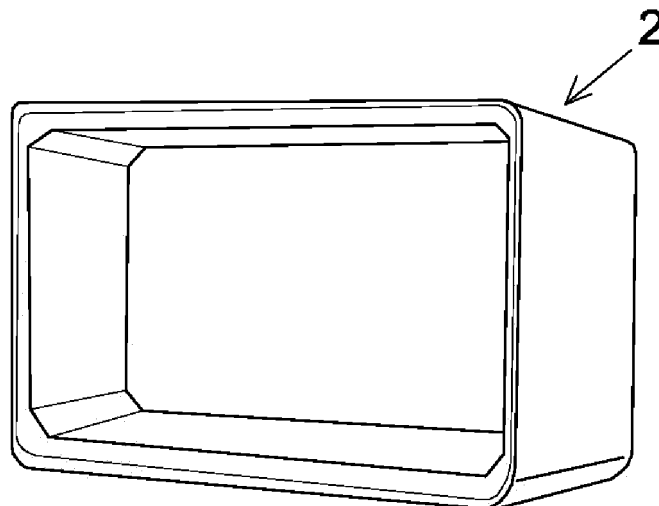


Fig 1

Description

OBJECT OF THE INVENTION

[0001] The present invention relates to a modular building system, building being understood to refer to dwelling-type construction with a wide range of uses, from housing, to administrative or industrial use, etc.

[0002] The technical field of the invention is the field of architecture, and more specifically the architecture of modular spaces, based on the principles of industrialized construction.

BACKGROUND OF THE INVENTION

[0003] Within the broad field of construction there is conventional construction, which is the most widely used, wherein the works are entirely carried out on site, employing a variety of materials, labor, energy, building techniques, etc., generating a large amount of waste.

[0004] Another system is that of manufactured homes. This type of home is characterized in that almost the entire space is manufactured in the factory, except for the final assembly. Its design and plan is repeatable, and is usually limited to small spaces. They have rigid designs, since in order to adopt a new one, one would have to adopt a new construction plan in the factory.

[0005] Another system is the prefab, half-way between the previous two, which is characterized in that major parts of the construction are factory-made, for subsequent incorporation into the rest of the construction on site. It is very widespread for the construction of industrial and agricultural units. It is a system wherein the dimensions and constituent components are not intended for a modular model.

[0006] The patent documents ES 2159212B1, ES 2094179, ES 2264391A1 and others propose modular structures for the construction of enclosures.

[0007] The applicant is not aware of the existence of any other modular construction models based on reinforced concrete prefabs having technical, structural and constituent characteristics similar to those of the invention.

DESCRIPTION OF THE INVENTION

[0008] The invented modular building system enables freedom of design, size and robustness in the construction of dwelling spaces (housing, administrative, industrial), extremely low building costs, due to the significant reduction in construction, materials, labor time and energy, etc., and a solid, environmentally friendly construction, since practically no waste is generated, and with zero maintenance of the construction. Moreover, the building may be buried, creating sustainable buildings that are very economical and integrated into the environment, due to the microclimate existing therein at approximately 18-21 °C, avoiding unnecessary energy consumption in the form of heating and cooling, avoiding CO2 emissions from energy consumption.

sumption in the form of heating and cooling, avoiding CO2 emissions from energy consumption.

[0009] Moreover, the projects are completed in a very short period of time.

5 [0010] The invented system makes it possible to create buildings whose spaces have broad freedom of design and dimensions, and allows for subsequent enlargements of the spaces, creating new ones or enlarging the existing ones at a low cost. Without construction work and without altering the aesthetics of the building.

10 [0011] According to the invention, the system comprises the easy coupling and/or superposition, horizontally and vertically, of prefabricated components made from reinforced concrete in order to create dwelling spaces, comprising, likewise, connections between said prefabricated components, which are selected from:

- closed frames made from reinforced concrete,
- open frames made from reinforced concrete,
- 20 - vaults made from reinforced concrete,
- box structures made from reinforced concrete;

[0012] Placing the components together, it is possible to make buildings with different floors or configurations, joining them horizontally or vertically - superposing them according to the project's needs.

[0013] For the creation of a building with the invented system, these components may be freely combined, since there is no specific shape that is preferred for its embodiment. Each design and project will require the most convenient shape to achieve its purpose: the possible combinations, horizontal, vertical or stacked, for an undefined number of these components, as well as the each component's dimensions.

35 [0014] Once the frames are placed, on a slab according to the project, and/or superimposed on the ones already placed, in the location of their final destination and coupled, we will then have a solid building that is structurally complete. With the exception being the wall designated to provide light and ventilation to the building's spaces, which will depend on the client's budget and preference for the definitive completion of the work.

40 [0015] The components or frames may be connected using tongue and groove joints, or in the case of flat joints, by placing components together to connect them. The frame placement can be horizontal, vertical or stacked, according to how many floors are needed.

[0016] The aforementioned frames or components made from reinforced concrete comprise the following:

- closed frames, in several different shapes, four-sided, rectangular, octagonal, tubular, vaulted, etc.
- open frames, in different "U" or "L" shapes, box structures with or without footings or which are semicircular, etc.

55 [0017] These prefabs are found in a wide variety of sizes, of 0.5 meters by 0.5 meters, in height, width and

length, and there is a broad range of different types on the market, or they may also be newly created in a specific form with specific measurements.

[0018] As an improvement, said prefabs are from civil engineering works, giving them a different use from that of civil engineering works (maritime infrastructure, highways, railroads, hydraulic works, airports) through the invention's system.

[0019] In addition to the description above, jointed frames, underpasses, overpasses, open C-shaped frames and retaining sidewalls may also be used. In general, all the frames or components may be with or without footings.

[0020] With the invented system, we can create buildings with many different functions, design options and robust structures. -Such as housing, for families, leisure, sports, hotels, etc.-, as well as administrative buildings, offices, schools, cultural buildings, etc., or for other uses: silos for storing grain, wine cellars, fish farms, for military use, barracks, ammunition depot, weapons storage, livestock use, etc., always apart from civil engineering works.

[0021] The projects are completed in a short time period because three constructive processes are reduced: the foundation, structural and enclosure processes are combined into one, cutting costs and time periods for completing the work, as well as the prices of the prefabricated units.

DESCRIPTION OF THE DRAWINGS

[0022]

Figure 1.- Shows a view of the generic closed frame of the invented system.

Figures 2 and 3.- Show each open frame which may be connected to form a closed frame.

Figures 4 to 6.- Show three examples of buildings made through the invented system.

Figures 7 and 8.- Show the layout of the components of a vault and that same vault assembled, respectively, usable in the inventioned system.

Figure 9.- Shows a view of another variant of a building made with the invented system.

Figure 10 and 11.- Show both views of two sides of an underpass prefabricated from civil engineering works, usable in the invented system, for example to set up gables.

Figure 12.- Shows a view of another variant of a building made with the invented system, in this case with a prefabricated underpass.

Figure 13.- Shows a detail view of a joint to reinforce a connection that is not tongue and groove between prefabricated pieces of the invented system.

Figure 14.- Shows a view of the variant of figure 9, where we can see the openings for the passage of the threaded bars connecting to the joints.

Figures 15 and 16.- Show each view of the generic frame of figure 1 with functional openings for pas-

sage or the implementation of holes.

PREFERRED EMBODIMENT OF THE INVENTION

[0023] Figure 1 shows a perspective view of a generic closed frame (2) made from reinforced concrete, according to the invention, which may be any measurement in width, height and depth, of the many that exist on the market that are already standardized, or may be a newly created component with specific measurements; while figure 2 shows a perspective view of an open U shaped frame (3), which can be complimented with another complementary U shaped frame (4) drawn in figure 3, which may be any measurement in height, width and depth of the many that exist on the market that are already standardized, or may be newly created components with specific measurements.

[0024] Figure 4 shows a specific configuration of a building (100) according to the invented system, of the many that can be configured by connecting, superimposing and combining these components or frames, forming a housing structure of 42 square meters comprising five first closed frames (2a) 4 meters wide, 3 meters high and 1.5 meters deep, making up a kitchen-living room (50), a bedroom (51) and an entrance (52), two second closed frames (2b) 2 meters wide, 3 meters high and 1.5 meters deep, together making up a bathroom (53), and other four second closed frames (2b) 2 meters wide, 3 meters high and 1.5 meters deep, making up a hallway (54) connecting the rooms, all of which is on the corresponding slab, not shown.

[0025] Figure 5 shows another specific configuration of a building (101) according to the invented system, of 93 square meters, comprising twelve first closed frames (2a) 4 meters wide, 3 meters high and 1.5 meters deep, making up a kitchen (60), three bedrooms (61) and an entrance (62), two second closed frames (2b) 2 meters wide, 3 meters high and 1.5 meters deep, together making up a bathroom (63), and four third closed frames (2c) 2 meters wide, 3 meters high and 1.5 meters deep, making up a bathroom in the adjacent bedrooms (61) or walk-in wardrobes.

[0026] Figure 6 shows another specific building configuration (102) designed for offices, for example, which would have a useful space of 52.2 square meters per floor, plus a patio or parking area of 27 square metres that comprises ten fourth closed frames (2d) 7 meters wide, 2.5 meters high and 1.5 meters deep in superimposed rows making up two floors (70, 71) or levels, three U shaped frames (3) 6 meters wide, 2.5 meters high and 1.5 meters deep, making up the patio (72) and two fifth closed frames (2e) 3 meters wide, 5 meters high and 1.5 meters deep for a stairwell (73) and entrance (74).

[0027] Figure 7 shows the perspective view of three components (8, 9) that make up a portion or frame of a vault (34)

[0028] Figure 8 shows a perspective view of the possible distribution of the components (8, 9) that will make

up the vault (34) to be created. In this figure, one can see that the sides (8) have footings (10). If they did not have footings, they could be put on the foundation. The space can be designated for multiple uses, depending on the dimensions.

[0029] As improvements added to the description above, jointed frames, underpasses, overpasses, open C shaped frames and retaining sidewalls, not shown, may also be used. In general, all the frames or components may be with or without footings.

[0030] Figure 9 shows another building (103), modification of the building (102) of figure 4 with 60 useful square meters that comprise five first closed frames (2a) 4 meters wide, 3 meters high and 1.5 meters deep, making up a kitchen-living room-dining room (90), a bedroom (91) and an entrance, five second closed frames (2b) 2 meters wide, 3 meters high and 1.5 meters deep, together making up a hallway (92) connecting the rooms, and two sixth closed frames (2f) 3 meters wide, 3 meters high and 1.5 meters deep, making up a bedroom (93) with a bathroom.

[0031] The enclosures of the open faces of the components made from reinforced concrete can be embodied through gables, also prefabricated from reinforced concrete, with footings (16), being able to be placed without footings and coupled to a foundation slab on the ground, not shown. These gables could be configured by the the sides (120) of an underpass prefabricated from civil engineering works, making use of these components. They are shown in figures 10 and 11

[0032] Figure 12 shows another building configuration (104), according to the invention, created from an underpass (33) from prefabricated from civil engineering works, with its sides (120) and lintels (121), with retaining sidewalls (122). Depending on the multiple measurements of the components that make up the building, bioclimatic spaces can be created for any use, with the possibility of burying said building, or any other building made according to the invented system, thanks to its robustness, with the exception of its accessible side or gable for access, achieving a housing structure or bioclimatic space, in the sense of a cave. Logically, the building does not have to be buried, and may remain on the surface, and other types of insulation or even a roof may be applied.

[0033] The connections (200) between components can be done by tongue and groove joints or by placing components together in the case of flat joints. The components will be taken to the location, predetermined in each design, and will be placed and connected to the building as established by the project.

[0034] To reinforce the connections (200) between the components, the invention comprises joints (201). These joints can materialize in different forms: for example through threaded bars (206) passing through openings (202) of the components to be connected and with support plates (203), interacting with the corresponding nuts (204) (see close-up in figure 13). In figure 14 we can see

the building of figure 9, showing the openings (202) for the passage of threaded bars, not shown in this figure, to connect the gables, or covers, also not shown.

[0035] Additionally, it has been provided in the invented system that the prefabricated components made from reinforced concrete can incorporate openings (300) in their manufacturing, which can serve to delimit inner through holes, windows, skylights, etc. These openings (300) are designed in the shapes of the prefabricated components made from reinforced concrete and may have many different shapes and the necessary dimensions in each case. Figures 15 and 16 show the embodiments of the generic closed frame (2), shown in figure 1, with said openings (300) in various positions.

Claims

1. A modular building system **characterized in that** it comprises the coupling or superposition, horizontally and vertically, of prefabricated components made from reinforced concrete in order to create dwelling spaces, comprising, likewise, connections (200) between said components, said components being selected from:

- closed frames (2, 2a, 2b, 2c, 2d, 2e, 2') made from reinforced concrete,
- open frames made from reinforced concrete,
- vaults (34) made from reinforced concrete,
- box structures made from reinforced concrete.

2. The modular building system according to claim 1 **characterized in that** the components made from reinforced concrete are found arranged on a slab.

3. The modular building system according to any of the preceding claims **characterized in that** it comprises walls designed to provide light and ventilation for the building's spaces that are created after the prefabricated components made from reinforced concrete are connected.

4. The modular building system according to any of the preceding claims **characterized in that** the closed frames (2, 2a, 2b, 2c, 2d, 2e, 2f, 2') made from reinforced concrete are selected from:

- four-sided frames,
- rectangular frames,
- octagonal frames,
- tubular frames.

5. The modular building system according to any of the preceding claims **characterized in that** the open frames made from reinforced concrete are selected from:

- U-shaped frames,
L-shaped frames,
semicircular frames.
6. The modular building system according to any of the preceding claims **characterized in that** the prefabricated components made from reinforced concrete comprise footings (10, 16a). 5
7. The modular building system according to any of the preceding claims **characterized in that** the connections (200) comprise connections through tongue and groove in the case of tongue and groove joints. 10
8. The modular building system according to any of the preceding claims **characterized in that** the connections (200) comprise connections by placing components together in the case of flat joints. 15
9. The modular building system according to any of the preceding claims **characterized in that** the prefabricated components made from reinforced concrete are selected from: 20
- jointed frames, 25
 - underpasses (33),
 - overpasses,
 - open C-shaped frames
 - retaining sidewalls (122).
10. The modular building system according to any of the preceding claims **characterized in that** the open faces of the components made from reinforced concrete are embodied through gables, prefabricated from reinforced concrete, with footings (16). 30
11. The modular building system according to any of the claims 1 to 9 **characterized in that** the open faces of the frames are embodied through gables, prefabricated from reinforced concrete, without footings, coupled to a foundation slab. 35
12. The modular building system according to either of the claims 10 or 11 **characterized in that** the gables comprise sides (120) of an underpass (33) prefabricated from civil engineering works. 40
13. The modular building system according to any of the preceding claims **characterized in that** the connections (200) comprise joints (201). 45
14. The modular building system according to claim 13 **characterized in that** the joints (201) comprise threaded bars (206) passing through openings (202) of the components made from reinforced concrete, and with support plates (203), interacting with the corresponding nuts (204). 50

15. The modular building system according to any of the preceding claims **characterized in that** the prefabricated components made from reinforced concrete incorporate openings (300) to delimit holes.
16. The modular building system according to any of the preceding claims **characterized in that** the prefabricated components made from reinforced concrete comprise large prefabs made from reinforced concrete from civil engineering works.
17. The modular building system according to any of the preceding claims **characterized in that** the building constructed (100, 101, 102, 103, 104) is buried.
18. The modular building system according to any of the claims 1 to 16 **characterized in that** the building constructed (100, 101, 102, 103, 104) is on the surface.
19. The modular building system according to claim 18 **characterized in that** the building constructed (100, 101, 102, 103, 104) on the surface comprises an insulation. 25

Amended claims under Art. 19.1 PCT

1. A modular building system that comprises the coupling or superposition, horizontally or vertically, of prefabricated components made from reinforced concrete in order to create dwelling spaces, comprising, likewise, connections (200) between said components, said components being selected from closed frames (2, 2a, 2b, 2c, 2d, 2e, 2') made from reinforced concrete, open frames made from reinforced concrete, vaults (34) made from reinforced concrete, and/or box structures made from reinforced concrete, said components made from reinforced concrete being found arranged on a slab **characterized in that** they comprise walls designed to provide light and ventilation for the building's spaces that are created after the prefabricated components made from reinforced concrete are connected. 30
2. The modular building system according to claim 1 **characterized in that** the closed frames (2, 2a, 2b, 2c, 2d, 2e, 2f) made from reinforced concrete are selected from: 35
- four-sided frames,
 - rectangular frames,
 - octagonal frames,
 - tubular frames.
3. The modular building system according to any of the preceding claims **characterized in that** the open frames made from reinforced concrete are selected 40

from:

U shaped frames,
L shaped frames,
semicircular frames.

4. The modular building system according to any of the preceding claims **characterized in that** the prefabricated components made from reinforced concrete comprise footings (10, 16). 5
5. The modular building system according to any of the preceding claims **characterized in that** the connections (200) comprise connections through tongue and groove in the case of tongue and groove joints. 10
6. The modular building system according to any of the preceding claims **characterized in that** the connections (200) comprise connections by placing components together in the case of flat joints. 15
7. The modular building system according to any of the preceding claims **characterized in that** the prefabricated components made from reinforced concrete are selected from: 20
 - jointed frames,
 - underpasses (33),
 - overpasses (33),
 - open C shaped frames 25
 - retaining sidewalls (122). 30
8. The modular building system according to any of the preceding claims **characterized in that** the open faces of the components made from reinforced concrete are embodied through gables, prefabricated from reinforced concrete, with footings (16). 35
9. The modular building system according to any of the claims 1 to 7 **characterized in that** the open faces of the frames are embodied through gables, prefabricated from reinforced concrete, without footings, coupled to a foundation slab. 40
10. The modular building system according to either of the claims 8 or 9 **characterized in that** the gables comprise sides (120) of an underpass (33) prefabricated from civil engineering works. 45
11. The modular building system according to any of the preceding claims **characterized in that** the connections (200) comprise joints (201). 50
12. The modular building system according to claim 11 **characterized in that** the joints (201) comprise threaded bars (206) passing through openings (202) of the components made from reinforced concrete, and with support plates (203), interacting with the 55

corresponding nuts (204)

13. The modular building system according to any of the preceding claims **characterized in that** the prefabricated components made from reinforced concrete incorporate openings (300) to delimit holes.
14. The modular building system according to any of the preceding claims **characterized in that** the prefabricated components made from reinforced concrete comprise large prefabs made from reinforced concrete from civil engineering works.
15. The modular building system according to any of the preceding claims **characterized in that** the building constructed (100, 101, 102, 103, 104) is buried.
16. The modular building system according to any of the claims 1 to 14 **characterized in that** the building constructed (100, 101, 102, 103, 104) is on the surface.
17. The modular building system according to claim 16 **characterized in that** the building constructed (100, 101, 102, 103, 104) on the surface comprises an insulation.

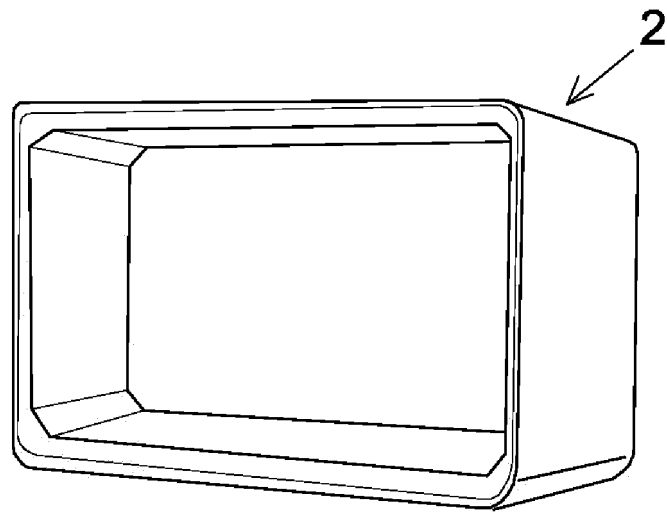


Fig 1

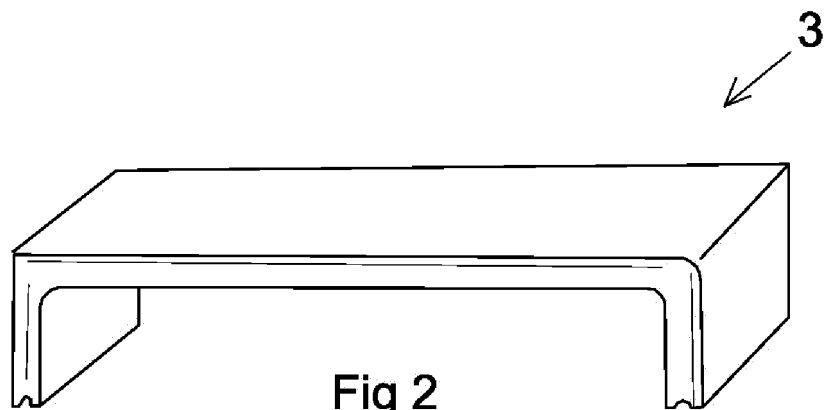


Fig 2

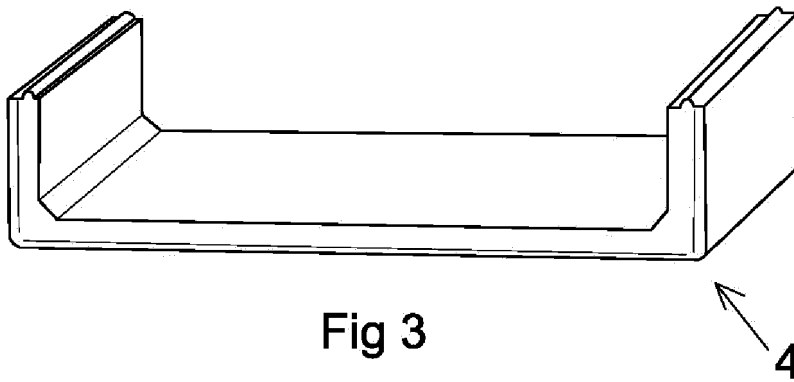
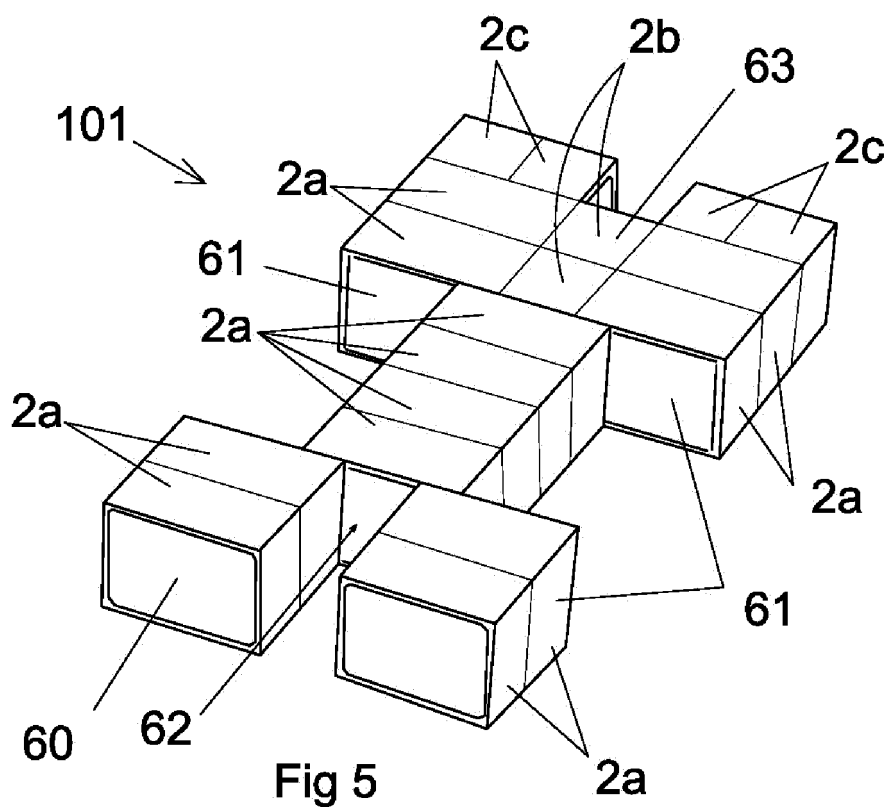
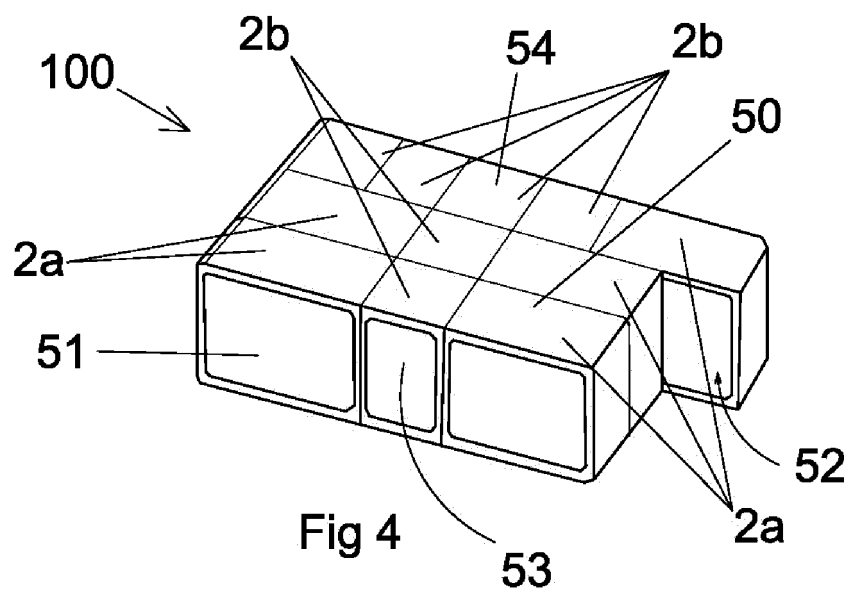


Fig 3



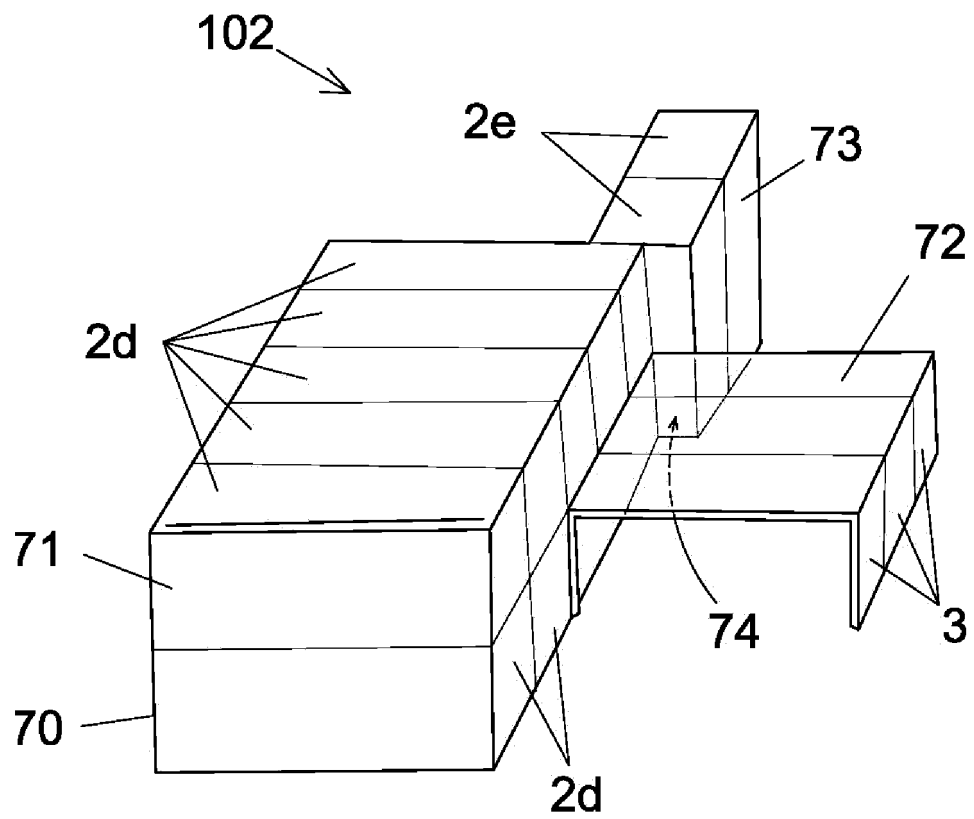
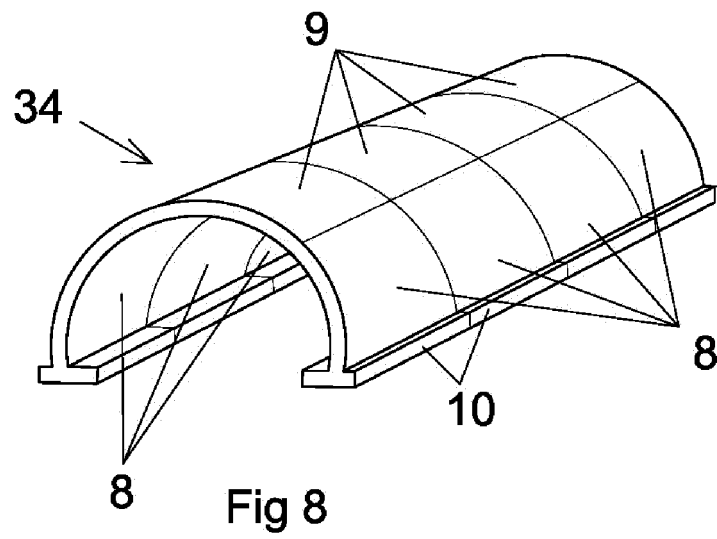
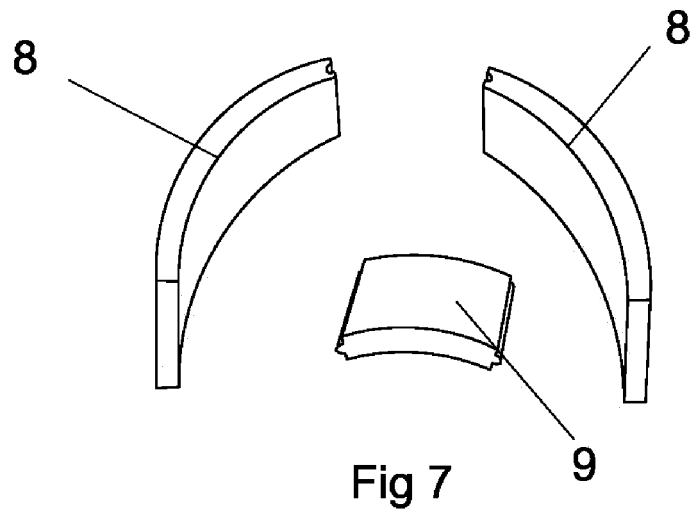
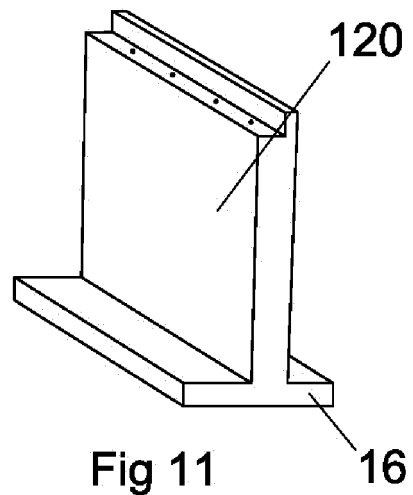
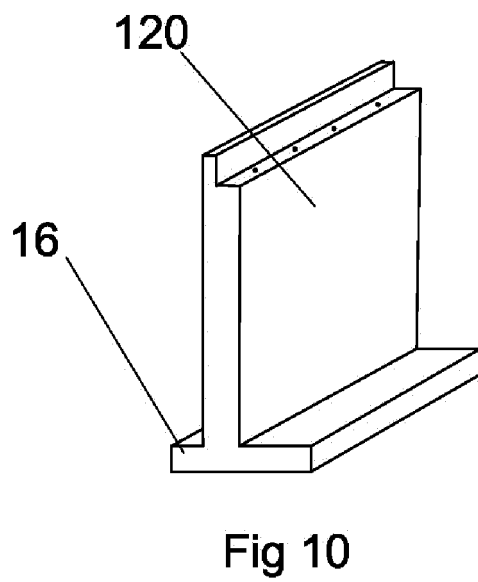
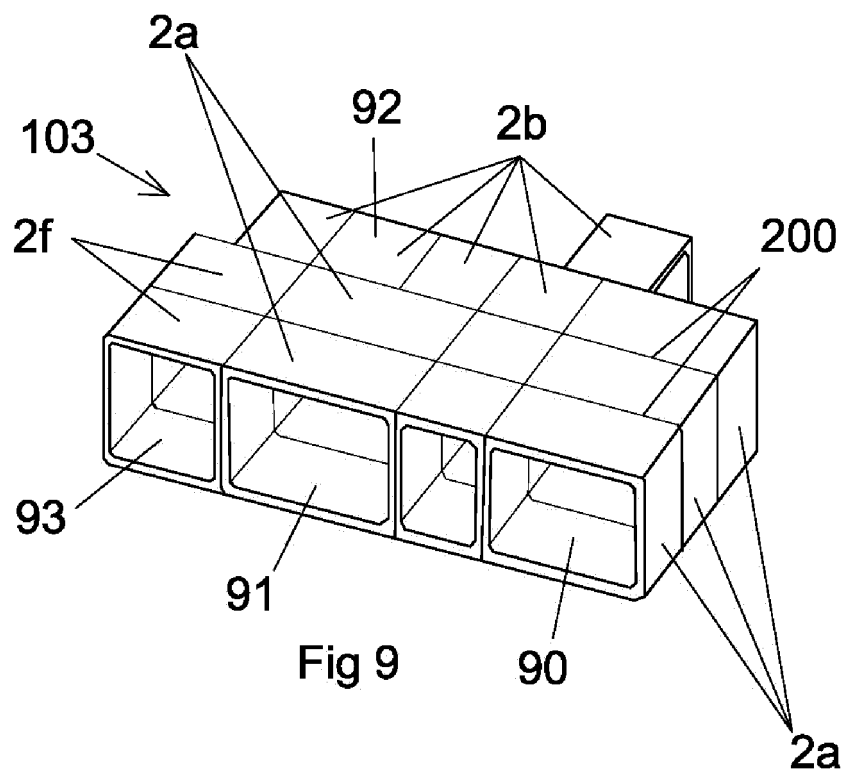
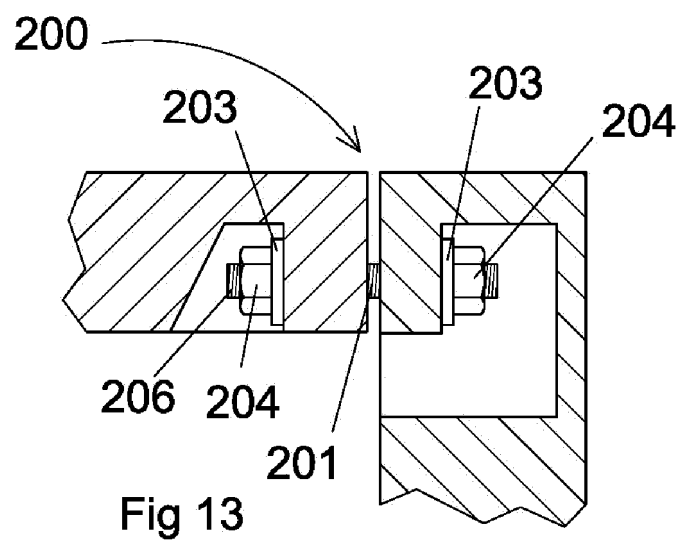
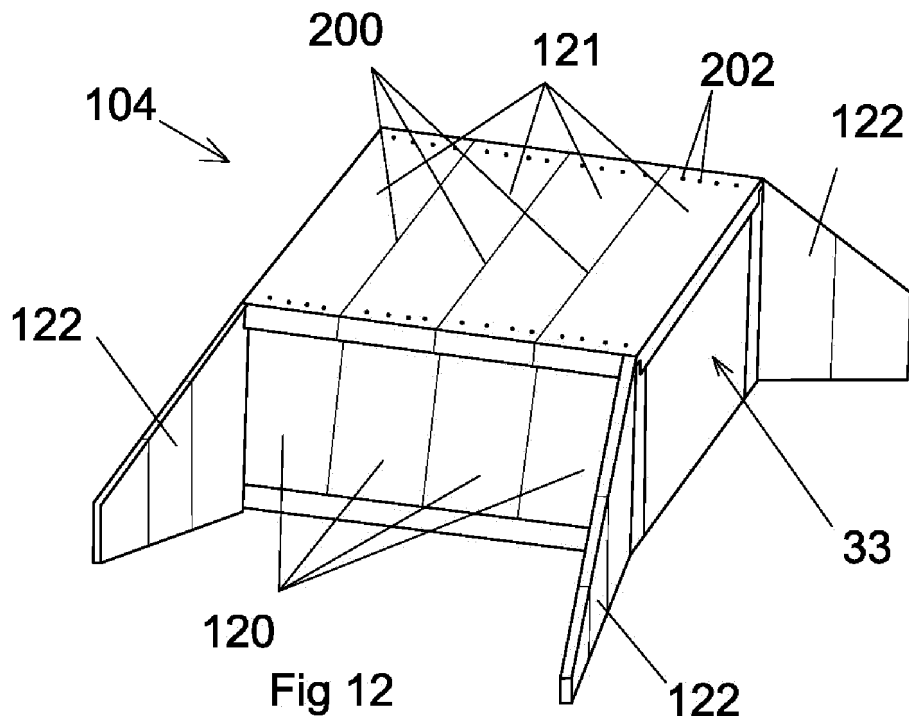


Fig 6







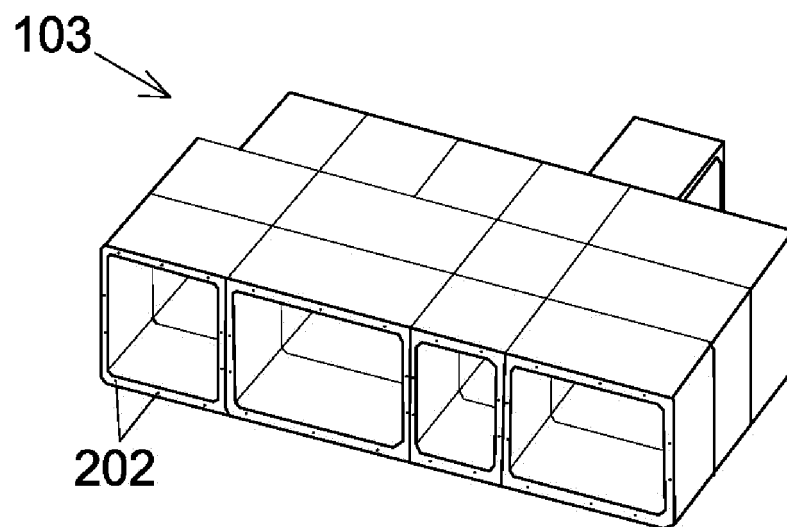


Fig 14

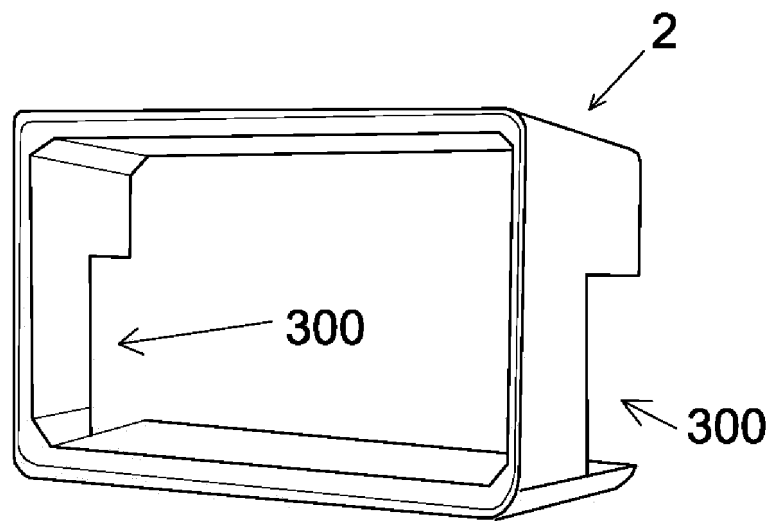


Fig 15

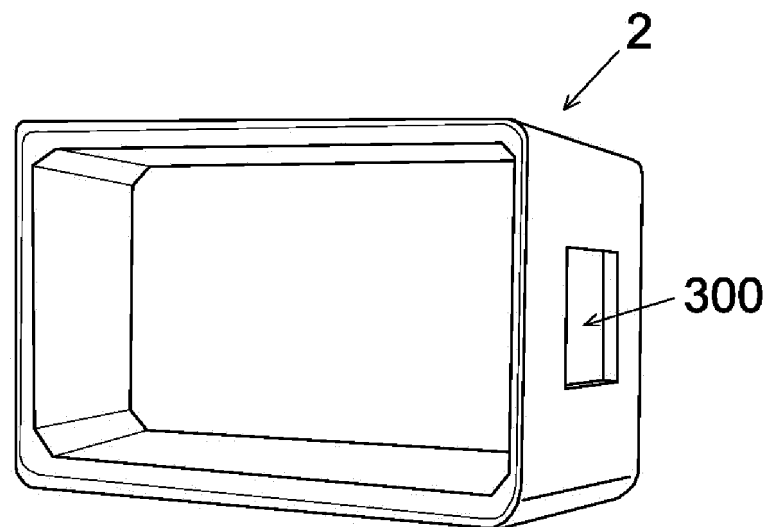


Fig 16

INTERNATIONAL SEARCH REPORT

International application No.
PCT/ES2014/070658

A. CLASSIFICATION OF SUBJECT MATTER

E04B1/348 (2006.01)

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)

E04B

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)

EPODOC, INVENES

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	ES 1120255U U (KILONEWTON CONSULTORES DE ENGENHARIA LDA) 01/09/2014, page 2, line 40- page 3, line 22; page 3, lines 45-50; página5, lines 50-54; claims; figures.	1-5,7,8,13-16,18,19
X	DE 3443938 A1 (HOERICH ROLF ET AL.) 05/06/1986, (abstract).[on line][retrieved on 03/12/2014]. Retrieved from:WPI/EPOQUE.; figures.	1,4, 10,11, 16-19
X	GB 1194372 A (M E L EQUIPMENT CO LTD) 10/06/1970, claims, figures.	1,5,7,13,14,16-18
X	EP 0373079 A1 (BERTRAND JEAN FRANCOIS) 13/06/1990, column 1, line 22- column 2, line 11; column 2, línea43--column 3, línea10; column 5, lines 6-9; claims 1-3; figures.	1,4,8,10,11,13-15, 19

☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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"A" document defining the general state of the art which is not considered to be of particular relevance.	
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"O" document referring to an oral disclosure use, exhibition, or other means.	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other documents , such combination being obvious to a person skilled in the art
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Date of the actual completion of the international search
05/12/2014

Date of mailing of the international search report
(16/12/2014)

Name and mailing address of the ISA/

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Telephone No. 91 3495431

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/ES2014/070658

C (continuation).		DOCUMENTS CONSIDERED TO BE RELEVANT
Category *	Citation of documents, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3564795 A (HENTON JESSE VERNON) 23/02/1971, column 1, line 64- column 2, line 59; claims 1-6; figures 1-10,14-16.	1,4,5,7
A	US 6161342 A (BARBIER LAURENT JEAN ET AL.) 19/12/2000, figure 1.	1,6
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